United States Patent [19]

Johnson

[11] **3,766,348**

[45] **Oct. 16, 1973**

[54] **TWO PART CASING FOR TRIGGER SWITCH WITH ONE PART MOUNTING ALL SWITCH CONTACT MEMBERS**

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[73] Assignee: **Arrow-Hart, Inc.,** Hartford, Conn.

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[52] **U.S. Cl.**..... **200/157,** 200/16 D, 200/76, 200/166 CT

[51] **Int. Cl.**... **H01h 13/08,** H01h 1/58, H01h 13/30

[58] **Field of Search**..... 200/157, 76, 16 C, 200/16 D, 166 BH, 166 CT

[56] **References Cited**

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Assistant Examiner—Robert A. Vanderhye
Attorney—William F. Sonnekalb, Jr.

[57] **ABSTRACT**

The parts of an electric switch are contained within a two-part insulating casing in which a trigger member slides and operates an over-center mechanism to impart a snap action movement to a yoke which causes a movable contact carrier to operate bridging contacts. Sets of fixed contacts are engaged and disengaged by different bridging contacts with one bridging contact always remaining in contact with one fixed contact of its set. The fixed contacts are stamped from sheet metal and are mounted edgewise in separate slots in the casing. All of said fixed and bridging contact members are mounted in one of said casing parts.

7 Claims, 9 Drawing Figures

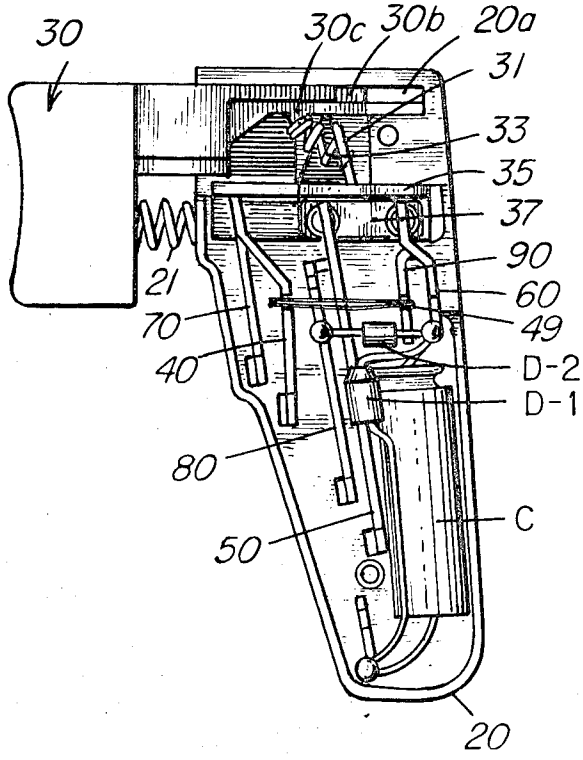


FIG. 1

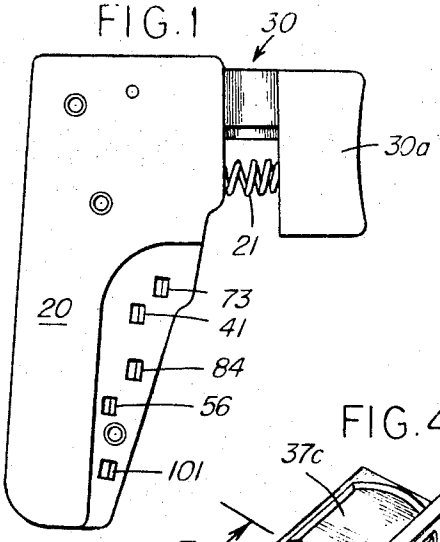


FIG. 2

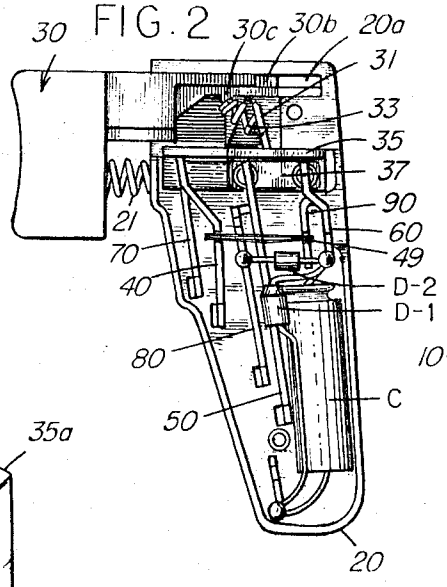


FIG. 3

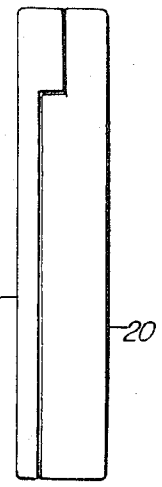


FIG. 4

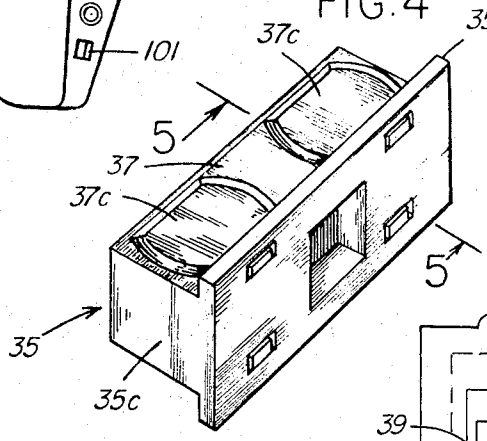


FIG. 9

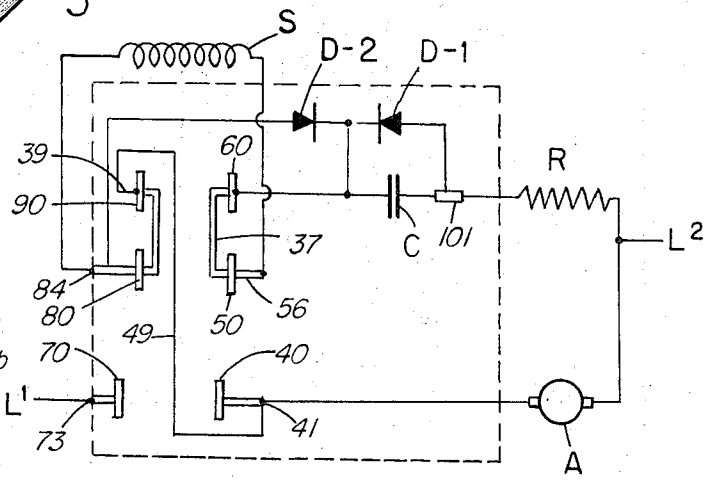


FIG. 5

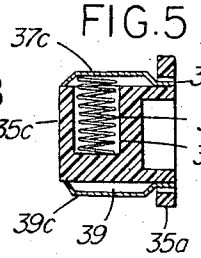


FIG. 8

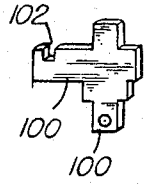


FIG. 6

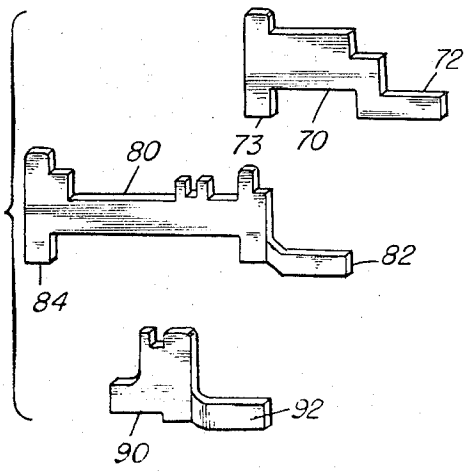
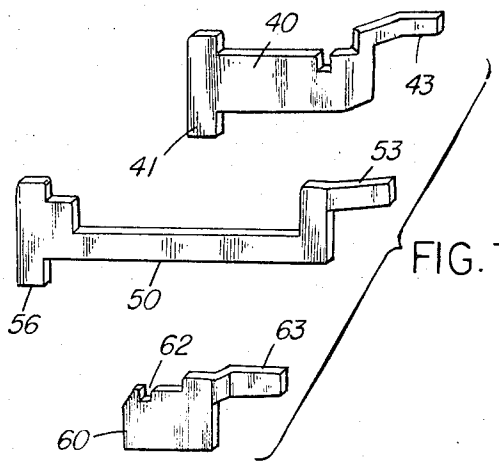


FIG. 7



TWO PART CASING FOR TRIGGER SWITCH WITH ONE PART MOUNTING ALL SWITCH CONTACT MEMBERS

This invention relates to electric switches for controlling the operation of portable electric power-operated hand tools and more particularly relates to a snap action electric switch having a trigger as an operating member for movable contacts and having fixed contacts which are engaged and disengaged by movement of the trigger member and movable contacts to cause encircuiting connections to an electric motor for operating it at full power or dynamically braking the motor immediately upon disconnecting it from the power lines.

BACKGROUND OF THE INVENTION

The patent of T.A.O. Gross U.S. Pat. No. 3,548,276 issued Dec. 15, 1970, discloses a circuit suitable for use in connection with electric power operated portable hand tools for dynamically braking the motor when the circuit to it from the source of power is broken. This circuit contemplates use of a conventional double pole double throw switch to connect a universal or a series wound motor directly in series circuit with the power lines in the on position of the switch and to brake the connection of the motor to the power lines in off position, while concomitantly connecting the motor winding with the dynamic braking circuitry.

BRIEF DESCRIPTION OF THE INVENTION

According to the invention, the parts of the switch are mounted within a two-part insulating casing containing two sets of contacts which are connectable to an electric motor and the power line by movement of a movable contact in in one position of the switch. In another position of the switch, the contacts are connected to electronic circuit components including diodes and a small size capacitor which are also contained within the insulating casing and to the motor to cause dynamic braking of the motor. An insulating movable contact carrier carries two bridging contacts each of which bridges either a common and one or the other of two other contacts of the set as a slidable trigger is moved in and outwardly of the casing and operates a snap action over-center yoke which causes movement of the movable contact carrier.

It is an object of the invention to provide a novel compact trigger-operated switch for use in a portable electric power operated tool utilizing the circuit of said patent or of any other suitable dynamic braking circuit.

Other objects and advantages of the invention will appear as it is described in connection with the accompanying drawing.

Another object is to provide a novel construction of a snap action double-pole double throw, trigger-operated switch, which may be economically assembled from economically manufactured parts, and including electronic circuit components within a compact casing, for use in a dynamic braking circuit.

In the drawing, FIG. 1 is a side elevation view of a switch embodying the invention.

FIG. 2 is a side elevation view with the cover removed and viewed from the opposite side from FIG. 1.

FIG. 3 is an end elevation view.

FIG. 4 is a perspective view partly broken away of the contact carrier and one movable contact used in the invention.

FIG. 5 is a section view along line 5—5 of FIG. 4.

FIG. 6 is an exploded perspective view of the upper contact and terminal members.

FIG. 7 is an exploded perspective view of the lower contacts and terminal members.

FIG. 8 is a detailed view showing in side elevation the end terminal member.

FIG. 9 is a schematic view of the switch contacts and terminals when used in a dynamic braking circuit.

Referring to the drawing, two mating casing halves **10** and **20** are molded of insulating material into convenient elongated tapered rectangular shape with hollowed-out and recessed interiors to accommodate the parts of the switch mechanism when the halves are put together.

At one end of the casing guideways **21** are provided for a rectilinearly slidable trigger member **30** which has a finger engaging portion **30*a*** of common shape exterior to the casing, and a portion **30*b*** extending into the casing and slidable in the guideways of the casing halves.

A coiled compressed biasing spring **21** seats at one end in a recess in the finger portion **30** of the trigger while its opposite end presses against the casing to bias the trigger to off position.

To operate the movable parts of the switch an over-center coiled compression spring **33** engages at one end with a nub **30*c*** on the inner end of the trigger and seats at its other end on the transverse portion of a U-shaped sheet metal yoke **31**. The yoke is pivotally mounted by outwardly extending trunnions seated in aligned bearing recesses in the casing halves. The transverse portion of the yoke engages a longitudinally slidable contact carrier **35** made of molded insulating material which is T-shaped in cross-section and extends parallel to the travel of the trigger and adjacent the inner portion **30*b*** of the trigger. The contact carrier **35** is guided in its sliding movement by engagement with the casing and the fixed contacts hereinafter described.

The contact carrier has a guide part **35*a*** and a contact carrying part **35*c*** perpendicular to the guide part, the carrier part **35*c*** having oppositely facing parallel surfaces facing the cover part **10** and the base part **20** of the casing. Seated on each of these surfaces is a stamped metal movable bridging contact **37, 39,** respectively, of flattened dumbbell shape having domed contact buttons **37*c*, 39*c*** at each end. The contact buttons are adapted to engage different fixed contacts (as hereinafter described) as the carrier **35** is moved by the yoke **31** as the yoke swings between off and on positions when the trigger is finger pressed in and returns outwardly when released. In order that the movable contacts may resiliently engage the various fixed contacts and be biased toward them, two coiled compression springs **38** are provided in two spaced cylindrical bores **35*b*** or recesses beneath the contact buttons **35*c***.

The fixed contacts for engagement and disengagement by the movable bridging contacts are mounted in the base half **20** of the casing in spaced positions as will now be described.

The fixed contacts are located in two levels in parallel planes. Only for convenience in reference, the contacts in these levels will be referred to as upper and lower contacts simply to identify them, it being obvious

that the invention is not limited to higher or lower location of the contacts with respect to each other or to the casing parts.

The contact members **40, 50, 60, 70, 80** and **90** are all stamped from sheet metal into the various shapes illustrated in FIGS. **6** and **7** and are mounted edgewise in separate slots molded in the base half **20** of the casing. The contour of each slot is complementary to the edgewise contour of the member which it receives. Some of the members have flat terminal extensions which project through apertures in the flat floor of the base half **20** as described below.

Viewing FIG. **2**, the second, fourth and sixth members **40, 50** and **60** each have flat central body portions as may be seen in detail in FIG. **7**. From each, a finger extends towards the movable contact carrier **35** thus providing upper contacts **43, 53, 63** which have flat under edge surfaces lying in the same plane and adapted to be engaged by the bridging contact **37** as it is slid to and fro by movement of the carrier **35** under influence of the yoke **30**.

Members **40** and **50** on the edges opposite the contact fingers each have a terminal lug, **41** and **56** respectively, extending from its inner edge through apertures in the base half **20**.

The first, third and fifth members **70, 80** and **90**, each have flat central body portions as may be seen in detail in FIG. **6**. From each, a finger extends toward the movable contact carrier thus providing lower contacts **72,82** and **92**, which have flat upper edge surfaces lying in the same plane and adapted to be engaged by the bridging contact **39** as it is slid to and fro by movement of the carrier **35** under the influence of yoke **30**. Members **70** and **80** on the opposite contact fingers each have terminal lugs, **73** and **84** respectively, extending from its inner edge through apertures in the base half **20**.

The members **60** and **90** may have terminal portions but do not require them in the usage for which the disclosed embodiment is intended.

The movable contact members **37** and **39** are of such length that their dome-shaped contact portions **37***c* and **39***c*, respectively, are spaced apart a distance equal to the spacing of the contact fingers. Specifically and for example, the upper movable contact **37** has its contact buttons spaced apart the same distance as the upper fixed contacts **43** and **53**; and this distance is the same as the distance between the contact fingers **53** and **63**. Thus, when the switch is in the off position as illustrated in FIG. **2**, contact **37** bridges the upper contact fingers **63** and **53**. When the switch is moved into the on position, the movable contacts will slide into position where it will engage and bridge the contact fingers **43** and **53**.

Likewise, the lower contact **39** in the off position of FIG. **2** will bridge the lower contact fingers **92** and **82**; and when moved into the on position the lower contact **39** will bridge the lower contact fingers **82** and **72**.

From the foregoing, it will be clear that the switch can occupy only two positions even though the trigger may be in transit between its fully depressed or fully released positions. Movement of the trigger will not become effective to change the position of the movable contact members **37,39** unitl the over-center spring **33** is moved through an over-center position in respect to the yoke **31** as the trigger is actuated. As the over-center position is passed through, the yoke will move the contact carrier and bridging contacts with a snap action.

As will now be described, the fixed contacts **53, 63** and **82, 92** have circuit connections to electronic circuit components for dynamic braking of a motor which may be connected to the switch terminals, whilst the fixed contacts **72, 73** are connected respectively to one power line and to one side of the motor A armature. In the off position contact **72** is not engaged by the bridging contact **39**, in consequence of which the power to the motor is cut off and only the braking circuitry is connected operatively. On the other hand, while the braking circuitry is connected operatively (in the off position) it is ineffective after the motor armature has stopped turning.

One use of the invention is in connection with the circuit of the above mentioned Gross U.S. Pat. No. 3,548,276. When so used, a capacitor C is mounted within the casing near the lower end and is connected at its negative end to a terminal **100** made of stamped sheet metal and mounted in the end of the base **20** of the casing in a slot similarly to the other terminal and contact members. The terminal member **100** has a terminal lug **101** extending through an aperture in the casing wall for external connection thereto of an external resistor (not shown) in accordance with said U.S. Pat. No. 3,548,276.

Also connected to the terminal **100** is the anode of a diode D-**1** whose cathode is connected to the cathode of another diode D-**2** and to the positive side of the capacitor C and to the contact member **60** by wires which are soldered into a notch **62** formed in the upper edge of the member **60**.

The anode of the diode D-**2** is connected to the contact **80**. To the terminal **84** of the contact **80** is also connected one end of the field or stator winding S of the motor, while the other end of that winding is connected to terminal **56** of the contact **50**.

A shunt connection **49** consisting of flexible highly conductive bowed metallic strips positioned face to face with their ends in notches in the contacts **40** and **90** connects those contacts electrically.

From the foregoing, it will be observed that by the edgewise mounting of the contact and terminal members in slots in base portion **20** of the casing, a considerable number of contact and terminal members can be compactly arranged in insulated relation. Also by having the contact fingers in two levels a single bridging contact carrier can be conveniently positioned with bridging contacts mounted thereon in the different planes in which each contact member must move to bridge its set of fixed contacts. In addition to the foregoing, the compact arrangements of the fixed and movable contact members permits the use of an over-center type of action in a unit. It is particularly important, when the invention is applied to a circuit such as that of U.S. Pat. No. 3,548,276, that the movable contacts disconnect the power line from the motor prior to the encircuiting of the braking circuitry and also that the switch and its contained components be small enough to be readily and conveniently mounted within the handle of a portable power-operated tool such as a saw.

Many modifications within the scope of the invention will occur to those skilled in the art. Therefore, the invention is not limited to the precise form herein described.

I claim:

1. An electric switch comprising an insulating casing made of two cooperating parts recessed to cooperatively receive and position conductive switch and circuit elements, a trigger member slidable in a cavity at one end of said casing, a yoke member pivotally mounted in said casing and operable between two positions, an over-center spring connecting said trigger member and said yoke imparting snap action movement to said yoke incident to movement of said trigger member, a movable contact carrier operated to and fro by said yoke member in the same direction as said trigger member, a plurality of bridging contact members mounted on said carrier in insulated relation, a plurality of sets of fixed contacts engageable and disengageable by different bridging contact members, all said fixed and bridging contact members being mounted in one of said casing parts, said fixed contacts being stamped from sheet metal and mounted edgewise in separate slots in said casing in generally parallel relationship to one another and in a direction transverse to the direction of movement of said movable contact members, said bridging contact members each remaining in engagement with one of the fixed contacts of its set in both positions of said yoke.

2. A switch as claimed in claim 1 in which said sets of fixed contacts have the contact surfaces of the sets in spaced planes.

3. A switch as claimed in claim 2 in which said contact carrier has oppositely facing contact surfaces on which said bridging contact members are supported, spring means supported in said carrier resiliently supporting at least one of said bridging contacts.

4. An electric switch adapted for dynamically braking an electric motor, comprising an insulating casing made of two cooperating parts recessed to cooperatively receive and position conductive switch and circuit elements, a trigger member slidable in a cavity at one end of said casing, a yoke member pivotally mounted in said casing and operable between two positions, an over-center spring connecting said trigger member and said yoke imparting snap action movement to said yoke incident to movement of said trigger member, a movable contact carrier operated to and fro by said yoke member in the same direction as said trigger member, a plurality of bridging contact members mounted on said carrier in insulated relation, a plurality of sets of fixed contacts engageable and disengageable by different bridging contact members, all said fixed and bridging contact members being mounted in one of said casing parts, said other casing part having recesses to guide the movement of said trigger member, said fixed contacts being stamped from sheet metal and mounted edgewise in separate slots in said casing in generally parallel relationship to one another and in a direction transverse to the direction of movement of said movable contact members, said bridging contact members each remaining in engagement with one of the fixed contacts of its set in both positions of said yoke, and a separate terminal member mounted in a separate slot in said casing and extending through a wall thereof, a capacitor in said casing connected to said separate terminal and to one of said contacts, and two diodes in said casing having opposite ends thereof connected to said one contact, one of said diodes being also connected to said separate terminal, and the other diode being connected also to one of said contact and terminal members.

5. A switch as claimed in claim 4 in which said sets of fixed contacts have the contact surfaces of the sets in spaced planes.

6. An electric switch comprising an insulating casing made of two cooperating parts recessed to cooperatively receive and position conductive switch and circuit elements, a trigger member slidable in a cavity at one end of said casing, a yoke member pivotally mounted in said casing and operable between two positions, an over-center spring connecting said trigger member and said yoke imparting snap action movement to said yoke incident to movement of said trigger member, a movable contact carrier operated to and fro by said yoke member in the same direction as said trigger member, a plurality of bridging contact members mounted on said carrier in insulated relation, said contact carrier having oppositely facing contact surfaces on which said bridging contact members are supported, and spring means supported in said carrier resiliently supporting at least one of said bridging contacts, a plurality of sets of fixed contacts engageable and disengageable by different bridging contact members, all said fixed and bridging contact members being mounted in one of said casing part, said other casing part having recesses to guide the movement of said trigger member and said yoke member; said fixed contacts being stamped from sheet metal and mounted edgewise in separate slots in said one casing part in generally parallel relationship to one another and in a direction transverse to the direction of movement of said movable contact members, said bridging contact members each remaining in engagement with one of the fixed contacts of its set in both positions of said yoke.

7. A switch as claimed in claim 6 in which a plurality of said fixed contacts have terminal portions extending through apertures in the wall of said casing.

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