Sept. 13, 1966 J. F. SULLIVAN 3,272,941

OVERLOAD PROTECTED ELECTRIC SWITCH

Filed Oct. 2, 1964 2 Sheets-Sheet 1

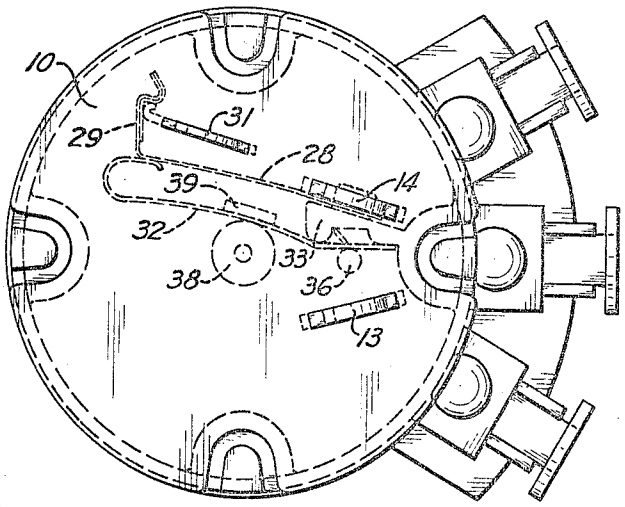


Fig. 1

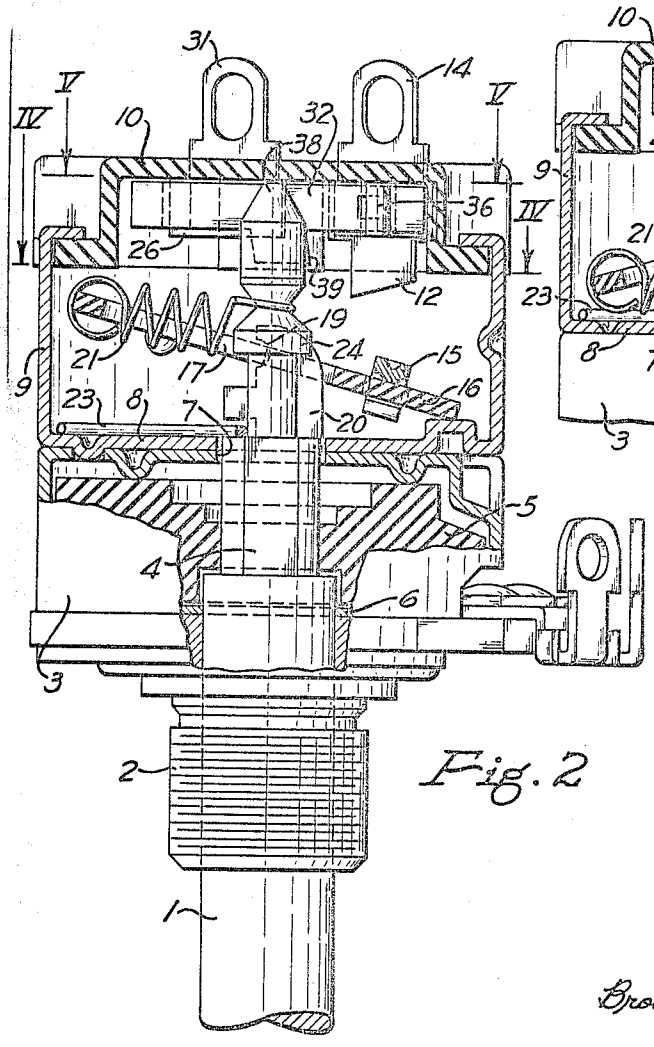


Fig. 2

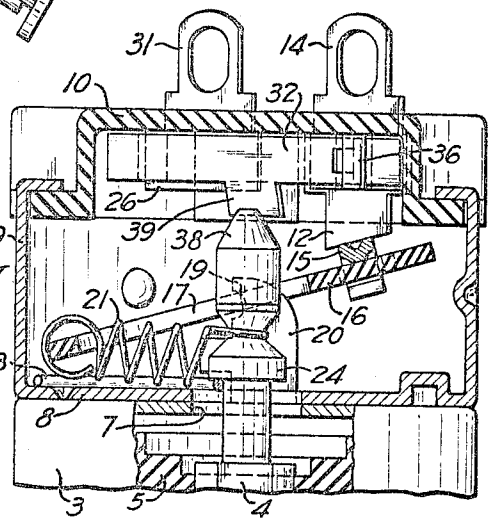


Fig. 7

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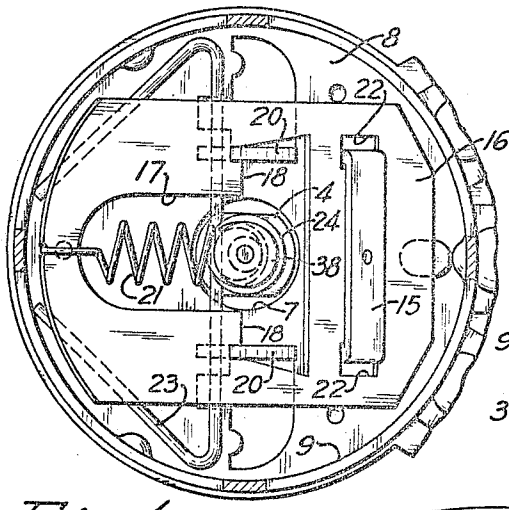


Fig. 4

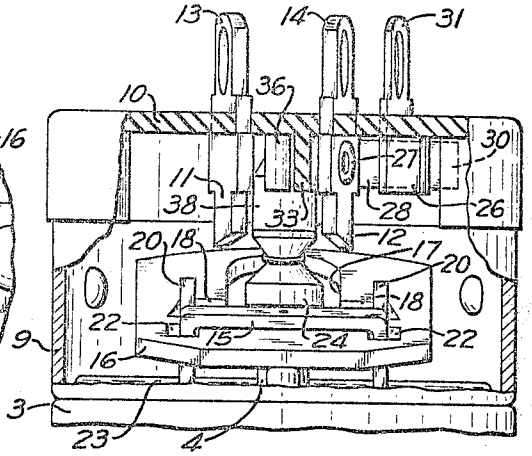


Fig. 3

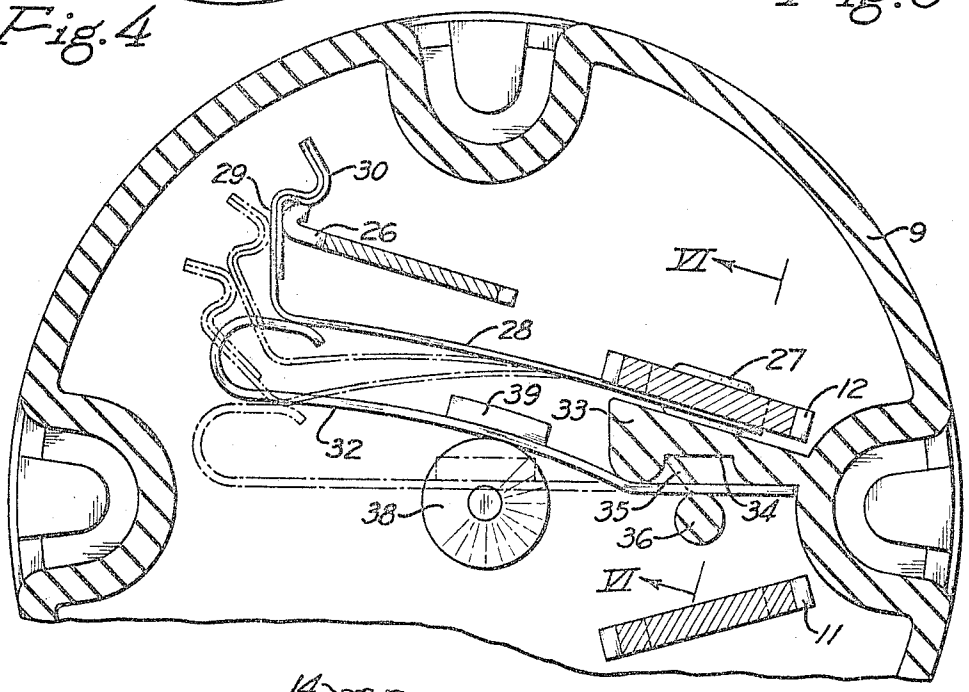


Fig. 5

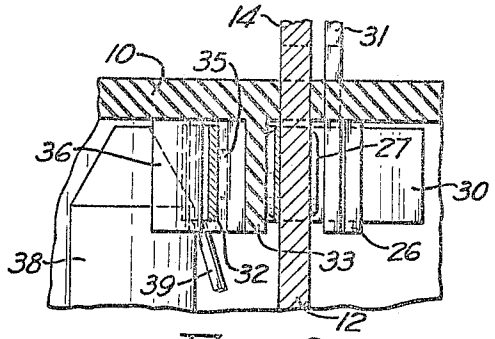


Fig. 6

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OVERLOAD PROTECTED ELECTRIC SWITCH

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6 Claims. (Cl. 200—116)

This invention relates to electric switches, and more particularly to switches provided with means for opening the circuit in case of excessive flow of electric current therethrough.

As is well known, it is common practice to place a a thermally operated circuit breaker in an electric circuit in order to open the circuit in case it is subjected to an overload. Circuit breakers have to be reset after they have opened, and of course they occupy space that may be at a premium in a given instrument or appliance. It has therefore been proposed to incorporate the circuit breaker in the switch housing and to reset the breaker by means of the control shaft of the switch. It has been found, however, that resetting such a circuit breaker has adversely affected the sensitivity and accuracy of response of the bimetal thermal element of the breaker, that excessive arcing may occur when the circuit breaker opens, and that the circuit breaker may not reclose satisfactorily.

It is among the objects of this invention to provide an electric switch containing a circuit breaker, in which the circuit breaker occupies very little space, in which the circuit breaker is automatically reset when the switch is opened by its control shaft, in which arcing is minimized on opening, in which arcing cannot occur when the breaker is reset, in which the sensitivity of the breaker is not impaired by frequent resetting, and in which the circuit breaker can always be reset or closed satisfactorily.

In accordance with this invention, electric contacts are mounted inside a switch housing, where they can be opened and closed by a control shaft. A bimetallic conductor strip is secured at one end in fixed position to one of the contacts. Besides the other end of the strip there is a circuit breaker contact. The strip has a laterally projecting contact end normally latched onto this breaker contact, from which the strip is adapted to bend and spring away when overheated by excessive electric current flowing therethrough. Extending lengthwise of the conductor strip along the side thereof opposite its contact end is a resilient reset strip, one end of which is anchored in the housing adjacent the fixed end of the other strip. The reset strip is spaced from the conductor strip while the latter's contact end is latched onto the breaker contact. The control shaft actuates means for bending the reset strip to force its free end toward the adjacent end of the conductor strip when the shaft is operated to open the switch. Therefore, if the conductor strip has become unlatched from the breaker contact, the free end of the reset strip will push the contact end of the conductor strip back into latching engagement with the breaker contact. If desired, one of the switch contacts can also serve as the circuit breaker contact, in which case the stationary end of the conductor strip is secured to the contact previously referred to as the breaker contact.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is a rear view of my switch;

FIG. 2 is a horizontal central section through the

switch and part of a volume control secured to the front of the switch;

FIG. 3 is a side view of the switch, with its side wall broken away to show the interior;

FIG. 4 is a vertical section taken on the line IV—IV of FIG. 2;

FIG. 5 is an enlarged fragmentary vertical section taken on the line V—V of FIG. 2, showing only the circuit breaker;

FIG. 6 is a fragmentary section taken on the line VI—VI of FIG. 5; and

FIG. 7 is a fragmentary view similar to FIG. 2, but showing the switch closed.

Referring to the first six figures of the drawings, in which the switch is shown open, the switch that is illustrated is similar to the push-pull switch shown in Dressel Patent 2,947,832. As in that patent, a control shaft **1** is rotatably and slidably mounted in a bushing **2** secured to the front of the suitable volume control unit **3** when the switch is to be combined with a volume control. The bushing is threaded and adapted to extend through a hole in a panel and receive a nut for rigidly mounting the bushing in place. The shaft has a non-circular central portion **4** that is splined in a head **5** of insulating material rotatably mounted in the volume control housing. The head carries the usual contact (not shown) that slidably engages a resistance element **6** in the front of the control housing. The rear end of the shaft extends back through a central opening **7** in the back of the volume control and on through a similar opening in the metal front wall **8** of a switch housing that has a cylindrical side wall **9** integral with its front wall. The front of the switch housing is welded or otherwise rigidly attached to the back of the volume control housing.

The control shaft extends back into the switch housing and, in its rear position, is spaced a short distance from the rearwall **10** of the housing. This wall is made of insulating material, such as molded plastic, and supports a pair of fixed electric lug-like contacts **11** and **12** that are disposed quite close together between the center of the wall and one side of the housing. The contacts extend through the back wall of the housing and project behind it to form electric terminals **13** and **14**.

In order to engage and electrically connect the fixed contacts, a bridging contact **15** can be used. This bridging contact is carried by one end of an arm **16** that is formed from a plate of insulating material. The arm is inclined to the shaft and is provided with an opening **17**, through which the shaft extends. The opening is considerably larger than the shaft so that the arm will not engage it. As shown in FIG. 4, the opening preferably is formed from two slots intersecting each other to form a T, with the cross bar of the T parallel to the bridging contact and close to it. The stem of the T extends from the opposite side of its cross bar toward the end of the arm remote from the contacts. Shoulders **18** (FIG. 4) are thus provided by the sides of the cross bar that connect with the stem of the opening. These shoulders are set in semicircular notches **19** (FIG. 2) in the edges of a pair of tongues **20** cut from the front wall of the switch housing and bent backwardly into parallel relation on opposite sides of the control shaft. The positions of the tongues in the ends of the cross bar of opening **17** prevent arm **16** from moving sideways. To hold arm shoulders **18** in the tongue notches, a coil spring **21** is disposed in the stem of opening **17** and has

one end hooked around the adjacent end of the arm and the opposite end hooked onto the grooved rear end portion of the shaft behind the arm. In this position the spring also holds the adjoining end of the arm in its rear position and its free end in its forward position, as shown in FIG. 2, with the bridging contact spaced from the fixed contacts.

It will be seen that with this construction, pulling the control shaft forward to the position shown in FIG. 7 will likewise pull the inner end of the spring forward to a location in front of notches **19** and thereby cause the opposite end of the spring to snap the adjoining end of the arm forward and swing the bridging contact back against fixed contacts **11** and **12** to close the switch as shown in FIG. 7. During this movement of the arm, it swings on an axis passing through its shoulders in the tongue notches, the tongues **20** thereby serving as bearing members for oscillation of the arm. When the bridging contact strikes the fixed contacts it will align itself with them because it is formed from a bar that has forwardly bent ends extending loosely through oversized openings **22** (FIG. 4) in the arm and then bent toward each other. When the shaft is pushed in again, the coil spring will snap the arm in the opposite direction to swing the bridging contact away from the fixed contacts to open the switch. Coil spring **21** does not create side thrust on the shaft that might cause it to bind, because the side thrust is balanced or nearly counteracted by means of a compression spring **23** that is located in front of the coil spring and compressed between the side wall of the switch housing and the side of the control shaft. By pushing laterally against the shaft in one direction, this spring prevents the coil spring from pulling the shaft off center in the opposite direction.

The compression spring also provides a very good electrical connection between the control shaft and the switch housing and thereby insures good grounding of the shaft. Another advantage of compression spring **23** is that it can serve to limit forward movement of the control shaft in the switch. This is done by providing the rear end portion of the shaft with an integral enlargement **24** that will strike the compression spring when the control shaft has been pulled forward a predetermined distance.

It is a feature of this invention that a thermally operated circuit breaker is combined with this switch in series with it. Accordingly, a third fixed contact **26** is mounted in the switch housing on the back wall **10** at the end of switch arm **16** opposite to the bridging contact. This third contact is at the same side of the control shaft as one of the other fixed contacts, such as contact **12**, and preferably is in a place more or less parallel to it. One of the contacts **12** or **26**, preferably contact **26**, serves as a circuit breaker contact. The edge of the circuit breaker contact away from contact **12** is rolled outwardly to form a curved surface as shown in FIG. 5. Suitably fastened to the other contact, in this case contact **13** by means of a rivet **27**, is one end of a bimetallic electrical conductor strip **28**. This strip is positioned on edge relative to the back wall of the housing and extends across the shaft and the side of the breaker contact facing the shaft. The free end of the strip has a laterally projecting contact end **29** that resembles a hook and that normally is latched onto the curved edge of the breaker contact. The contact end of the strip is bent at an angle to the rest of the strip and may be provided with a reversely curved end portion. Also, it is desirable to secure a facing **30** of good contact material to the inner surface of this bent portion of the strip for engagement with the breaker contact. The breaker contact extends through the back wall of the housing and becomes a projecting electric terminal **31**. Terminals **13** and **31** are connected into an electric circuit so that current will flow through the switch as long as it is closed and the conductor strip is latched onto breaker contact **26**. The strip is so constructed that if it is overheated by excessive electric current flowing through it, its bent contact end **29** will tend to straighten and release itself from the breaker contact, whereupon the strip will spring away from that contact and swing toward the shaft to break the circuit like a blown fuse. Even when the strip cools and returns from its far dotted line position in FIG. 5 to its intermediate dotted line position, it will not engage the breaker contact, but will remain spaced from it.

In order to reset the circuit breaker, a resilient reset strip **32** is provided, which extends lengthwise of the conductor strip in the space between it and the shaft, as shown in FIG. 5. One end of the reset strip is anchored in the switch housing adjacent the riveted end of the conductor strip. One convenient way of doing this is to provide the front of the back wall with an integral projection **33** provided with a laterally opening recess **34**, and punch a tongue **35** out of the reset strip for projection into this recess. The tongue is held in the recess by a boss **36** projecting from the back wall and engaging the reset strip on the side opposite its tongue. The free end of the reset strip may be doubled upon itself adjacent the contact end of the conductor strip to add to its resiliency but, as shown by dotted lines in FIG. 5, they do not touch as long as the switch is closed and the conductor strip is latched onto the breaker contact.

After the conductor strip has sprung away from circuit breaker contact **26**, due to overheating, the control shaft of the switch is pushed in to separate the bridging contact from the adjoining fixed contacts. This movement of the shaft pushes an actuator **38**, attached to its inner end, against the adjoining side of the reset strip and thereby bends that strip away from the axis of the shaft as shown in full lines in FIG. 5 to force its free end toward the breaker contact. If both the control shaft and the reset strip are made of metal, actuator **38** should be an insulating material. Preferably, the front edge of the reset strip is provided centrally with an inclined lug **39** that is engaged by an inclined surface on the actuator to bend the strip outwardly. The actuator presumably has a conical end for engaging the inclined lug. As the free end of the reset strip is swung outwardly, it engages the free end of the conductor strip and bends that strip outwardly until the contact end snaps over the breaker contact as shown in full lines in FIG. 5.

As long as the conductor strip is engaging the breaker contact, the reset strip performs no work when it is swung back and forth by the movements of the control shaft. When the switch is overheated and the conductor switch swings away from the breaker contact, it will lightly strike the free end of the reset strip, which will dampen the vibrations that would otherwise occur and possibly cause arcing between the breaker contact and the conductor strip.

It will be seen that the open circuit breaker cannot be reclosed until the switch has been opened, because the inward movement of the shaft performs the two operations in sequence, with the bridging contact moving away from the fixed contacts first. Therefore, the circuit breaker is never reset on a live circuit, but when the switch is closed again the circuit is ready to operate.

The reset strip, by transmitting a force from the central control shaft to the free end of the conductor strip, does not distort or stretch the bimetallic element, so the sensitivity and accuracy of response of that element is not impaired by frequent resetting. The resetting force is applied to the end, not the center, of the thermal element. Also, the reset strip, by its resiliency, is able to compensate for any accumulation of tolerances in the switch, thereby assuring reengagement of the circuit breaker strip with the circuit breaker contact.

According to the provisions of the patent statutes, I have explained the principle of my invention and have

illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. An overload protected electric switch comprising a housing, a pair of fixed electric contacts inside the housing, one of said contacts being a circuit breaker contact, a thermally responsive bimetallic conductor strip secured at one end to the other contact, the strip having a laterally projecting contact end normally hooked onto said breaker contact, said strip being adapted to bend and spring away from the breaker contact when overheated by excessive electric current flowing therethrough, a third fixed contact beside one of said pair of fixed contacts, a movable bridging contact in the housing, a control shaft for moving the movable contact into and out of engagement with said third contact and the fixed contact beside it, a resilient reset strip extending lengthwise of the conductor strip along the side thereof remote from said circuit breaker contact, means in the housing anchoring one end of the reset strip adjacent said other fixed contact, the reset strip being spaced from the other strip while said contact end is hooked onto the breaker contact, and means actuated by the control shaft for bending the reset strip to force its free end toward the adjacent end of the conductor strip when the shaft is operated to open the switch, whereby if the conductor strip has become unhooked from the breaker contact the free end of the reset strip will push said contact end back into hooked-on engagement with the breaker contact.

2. An overload protected electric switch comprising a housing, a pair of fixed electric contacts inside the housing, one of said contacts being a circuit breaker contact, a thermally responsive bimetallic conductor strip secured at one end to the other contact, the strip having a laterally projecting contact end normally hooked onto said breaker contact, said strip being adapted to bend and spring away from the breaker contact when overheated by excessive electric current flowing therethrough, a movable contact in the housing, a control shaft for moving the movable contact into and out of engagement with one of the fixed contacts, a resilient reset strip extending lengthwise of the conductor strip along the side thereof remote from said circuit breaker contact, means in the housing anchoring one end of the reset strip adjacent said other fixed contact, the reset strip being spaced from the other strip while said contact end is hooked onto the breaker contact, and means mounted on the rear end of the control shaft and engageable with the central portion of the reset strip for bending the reset strip to force its free end toward the adjacent end of the conductor strip when the shaft is operated to open the switch, whereby if the conductor strip has become unhooked from the breaker contact the free end of the reset strip will push said contact end back into hooked-on engagement with the breaker contact.

3. An overload protected electric switch comprising a housing, a pair of fixed electric contacts inside the housing, one of said contacts being a circuit breaker contact, a thermally responsive bimetallic conductor strip secured at one end to the other contact, the strip having a laterally projecting contact end normally hooked onto said breaker contact, said strip being adapted to bend and spring away from the breaker contact when overheated by excessive electric current flowing therethrough, a movable contact in the housing, an axially movable control shaft for moving the movable contact into and out of engagement with one of the fixed contacts, a resilient reset strip extending lengthwise of the conductor strip along the side thereof remote from said circuit breaker contact, means in the housing anchoring one end of the reset strip adjacent said other fixed contact, the reset strip being spaced from the other strip while said contact end is hooked onto the breaker contact, said strips being disposed beside the shaft and extending across it, and means actuated by the control shaft for bending the reset strip to force its free end toward the adjacent end of the conductor strip when the shaft is operated to open the switch, whereby if the conductor strip has become unhooked from the breaker contact the free end of the reset strip will push said contact end back into hooked-on engagement with the breaker contact.

4. An overload protected electric switch comprising a housing having front and back walls connected by a side wall, a bushing rigidly mounted in front of the front wall, two fixed electric contacts in the housing mounted on its back wall, a bimetallic conductor strip secured at one end to one of said fixed contacts in a position edgewise to the back wall and extending across one side of the other fixed contact, the strip having a laterally projecting contact end normally latched onto said other contact, said strip being adapted to bend and spring away from said other fixed contact when overheated by excessive electric current flowing therethrough, a resilient reset strip extending lengthwise of the conductor strip along the side thereof opposite said contact end, means in the housing anchoring one end of the reset strip adjacent said one fixed contact, the reset strip being spaced from the other strip while said contact end is latched onto the other fixed contact, a third fixed contact mounted beside one of said two fixed contacts, a switch arm movably mounted inside the housing, an electric bridging contact carried by said arm, a control shaft mounted in said bushing and operatively connected with said arm to move said bridging contact into and out of engagement with said third fixed contact and the fixed contact beside it, and means actuated by the control shaft for bending the reset strip to force its free end toward the conductor strip when the shaft is operated to open the switch, whereby if the conductor strip has become unlatched from the adjoining fixed contact the free end of the reset strip will push said contact end back into latching engagement with that adjoining contact.

5. An overload protected push-pull electric switch comprising a housing having front and back walls connected by a side wall, the front wall having a central opening through it, a bushing rigidly mounted in front of the front wall in line with said opening, a control shaft slidably mounted in the bushing and extending back into the housing, a switch arm inside the housing inclined to the shaft and provided with an opening loosely receiving the shaft extending therethrough, means rockably mounting the arm on an axis extending across the shaft, means operatively connecting the shaft and arm for rocking the arm on said axis as the shaft is pulled and pushed, an electric bridging contact carried by the back of the end of the arm normally nearest said front wall, a pair of fixed electric contacts in the housing mounted on its back wall at one end of the arm in position to be engaged by the bridging contact when it is swung back toward them by pulling the shaft, a third fixed contact in the housing mounted on its back wall behind the opposite end of the arm, one of said fixed contacts being a circuit breaker contact, a bimetallic conductor strip secured at one end to a fixed contact at the end of said arm opposite to the end adjacent said breaker contact, said strip being positioned edgewise to the back wall and extending across the axis of said shaft and the shaft side of the breaker contact, the strip having a laterally projecting contact end normally latched onto the breaker contact, said strip being adapted to bend and spring away from the breaker contact when overheated by excessive electric current flowing therethrough, a resilient reset strip extending lengthwise of the conductor strip between it and said shaft, means in the housing anchoring one end of the reset strip adjacent the secured end of the conductor strip, the reset strip being spaced from the other strip while said

contact end is latched onto the breaker contact, and means actuated by the shaft for bending the reset strip to force its free end toward said breaker contact when the shaft is pushed to open the switch, whereby if the conductor strip has become unlatched from the breaker contact the free end of the reset strip will push said contact end back into latching engagement with the breaker contact.

6. An overload protected electric switch according to claim **5**, in which said last-mentioned means has a forwardly and inwardly inclined surface, and said reset strip is provided with a central inclined lug at its front edge

for engagement by said inclined surface to move that strip toward the conductor strip.

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Disclaimer

3,272,941.—*James F. Sullivan*, St. Marys, Pa. OVERLOAD PROTECTED ELECTRIC SWITCH. Patent dated Sept. 13, 1966. Disclaimer filed Jan. 13, 1969, by the assignee, *Stackpole Carbon Company*.

Hereby enters this disclaimer to claims 1, 2 and 3 of said patent.

[*Official Gazette April 29, 1969.*]