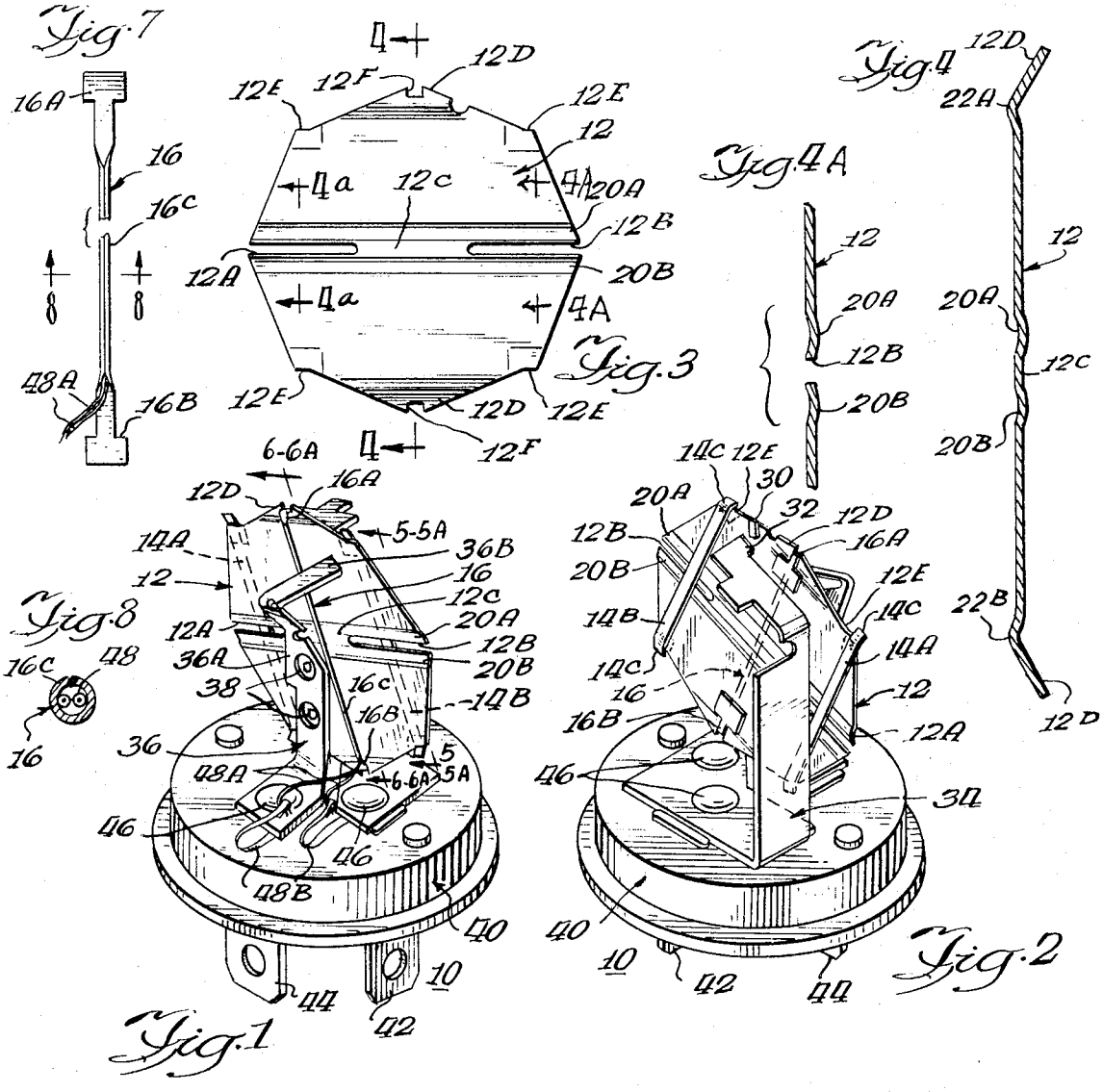
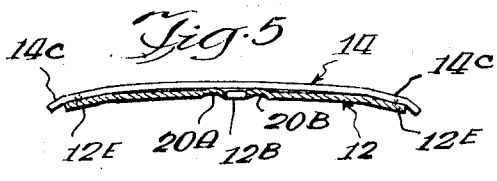
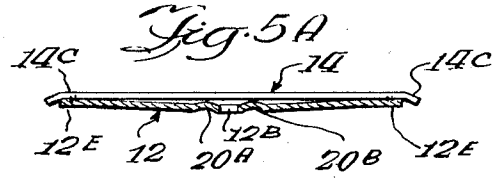
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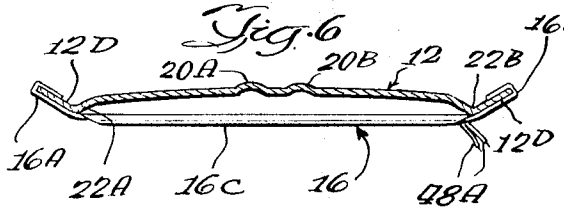
SNAP ACTION ELECTRIC SWITCH

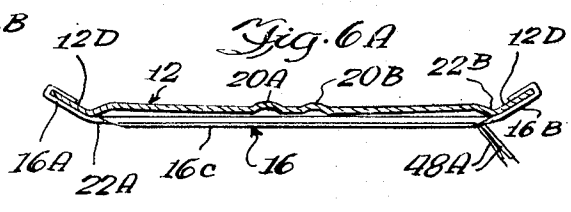
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SNAP ACTION ELECTRIC SWITCH

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Int. Cl. H01h 61/06

U.S. Cl. 337—135 6 Claims

ABSTRACT OF THE DISCLOSURE

A snap action electric switch comprising a flexible snap acting metallic contact carrying vane with vane biasing means and longitudinally expansible pull wire means overlying the opposite surfaces of the vane and tensioned to flex the contact carrying portion of the vane in opposite directions between two positions in response to alternate heating and cooling of the pull wire.

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation-in-part of applicant's copending application Ser. No. 597,045, filed Nov. 25, 1966, and assigned to the assignee of this application.

FIELD OF INVENTION

The invention pertains to snap action electric switches operated by the alternate heating and cooling and the resultant expansion and contraction of an element generally called pull means or a pull wire. Most often the switches are used to control the flashing of automotive signal lights, such as turn signals.

DESCRIPTION OF THE PRIOR ART

Snap action switches of the character set forth immediately above are well known and of various constructions. Many include a flexible vane that is creased and thus biased into one position by inherent or intrinsic stresses in the vane. The device disclosed and claimed in the above referred to copending application utilizes a substantially flat unstressed flexible vane with separate biasing means and pull wire so arranged that alternate heating and cooling of the pull wire results in snap action movement of the vane and a contact carried by it between two positions. Greater reliability of operation, life expectancy and simplicity of construction are desired.

SUMMARY

Greater reliability of operation and life expectancy of the snap switches are obtained by constructing the vane with two sets of ribs or projections that extend in opposite directions from the plane of the vane. One set of ribs projects in a first direction toward and cooperates with the central region of the biasing means to limit movement of the vane toward the biasing means in the cold contracted condition of the pull wire, thereby to provide an angular relationship between the two better to insure return operation of the vane by the biasing means when the pull wire is heated and expanded. The second set of ribs extends in the opposite direction from the first toward the pull wire for cooperation with the end portions of the pull wire to space the latter from the vane so that the pull wire (which is of the indirectly heated type, i.e., with a heater element carried by the pull wire) will not be engaged and undesirably bent by the vane when the vane moves toward the pull wire in the expanded condition of the pull wire. The arrangement contributes to the longevity of the pull wire and thus of the device.

Other objects and advantages of the present invention will become apparent from the ensuing description of an illustrative embodiment thereof, in the course of which reference is had to the accompanying drawing, in which:

FIG. 1 is a perspective view of the snap action switch of the present invention, viewed from the pull wire side;

FIG. 2 is a perspective view of the device of FIG. 1, viewed from the opposite or biasing means side;

FIG. 3 is a plan view of a movable vane utilized in the device, the vane being shown prior to attachment of the associated biasing and pull wire means which are shown in FIGS. 1 and 2;

FIG. 4 is a sectional view of the vane taken along the line **4**—**4** of FIG. 3;

FIG. 4A is a fragmentary sectional view of the vane taken along line 4A—4A of FIG. 3;

FIGS. 5 and 6 are sectional views taken along the lines **5**—**5** and **6**—**6** of FIGS. 1 and 2 and illustrating the position of the vane with respect to the biasing and pull wire means, respectively, when the pull wire means is in its cold unexpanded or contracted position;

FIGS. 5A and 6A are views corresponding to FIGS 5 and 6, but illustrating the position of the vane with respect to the biasing and pull wire means, respectively, when the pull wire means is in its heated expanded condition;

FIG. 7 is a plan view of the pull wire means; and

FIG. 8 is a cross sectional view along the line **8**—**8** of FIG. 7.

FIGS. 5 and 6 are dimensionally enlarged in order better to illustrate the construction and operation of the vane with relation to its associated biasing and pull wire means.

Referring now to the drawing, the snap action switch device of the present invention is generally designated by the reference character **10**. In large measure the device is like the one illustrated and claimed in my earlier referred to copending application. It includes, in the main, a flexible and resilient metallic vane **12** of generally octagonal shape, biasing means **14** comprising a pair of straps **14A** and **14B** overlying one surface of and attached to opposite edges of the vane at the ends of the vane, and pull wire means **16** comprising a longitudinally expansible pull wire attached at its ends **16A** and **16B** to opposite ends of the vane and positioned substantially centrally of the straps **14A** and **14B**. The vane **12** is substantially flat and inherently unstressed and provided with opposite extending transverse slots **12A** and **12B** as disclosed in my copending application.

As will be described in greater detail hereinafter, the biasing straps are tensioned and flex the vane in one direction away from the straps, as best illustrated in FIGS. 5A and 6A. The length of the pull wire is such that in its cold unexpanded or contracted position it is tensioned and flexes the vane in the opposite direction, i.e., toward the straps, see FIGS. 5 and 6. The biasing straps and pull wire are effective in response to alternate heating and cooling and resultant expansion and contraction of the pull wire to move the vane between its alternate flexed positions. Movement of the vane is utilized to move one or more contacts mounted on the vane relative to a stationary contact or contacts associated therewith thereby to provide desired circuit controlling functions.

In accordance with the present invention, the vane is provided with first and second sets of projecting ribs **20** and **22** extending transversely of the pull wire and biasing straps. The ribs cooperate with the pull wire and biasing straps to improve operation and extend the operating life of the device.

The first set of ribs **20**, including the individual ribs **20A** and **20B**, are located substantially centrally of and

extend across the vane transversely of the biasing straps and pull wire fairly closely adjacent and parallel to the slots **12A** and **12B**. They project toward and cooperate with the biasing straps which they engage when the pull wire is cold and contracted, as shown in FIG. 5, with respect to strap **14B**, to limit the relative movement of the vane and straps toward each other. This limitation of movement results in a small angle between the halves of the straps at the sides of the ribs and the vanes to space them so as better to insure return of the vane by the biasing straps when the pull wire is heated and expands. This angular relation has been found to facilitate movement of the vane in response to alternate heating and cooling of the pull wire **16** and the resulting movement of the vane between the positions shown in FIGS. 5 and 6 and in FIGS. 5A and 6A.

FIG. 5 illustrates the relative positions of the vane and biasing straps when the pull wire is heated—as well as illustrating the bias initially applied to the vane by the straps. This bias is such as to flex the vane away from the straps, the vane bending in a hingelike manner at a central area **12***c* between the slots **12***a* and **12***b* and the ribs **20***a* and **20***b*, thereby to produce considerable movement of the upper end of the vane as shown in FIGS. 1 and 2. The ribs also contribute rigidity to the vane at its central region, thus serving additionally to concentrate the alternate flexing or bending of the vane to the central region **12C**.

The pull wire **16** is spaced from the vane **12** by the second set of ribs **22**, which includes the two ribs **22A** and **22B**, located at opposite ends of the vane. These ribs also run transversely of the biasing straps and pull wire and project from the plane of the vane at the pull wire side. The ends of the vane beyond the ribs **22A** and **22B** have small triangular portions **12D** that are bent slightly in the same direction as the projection of the ribs **20** to which the opposite ends **16A** and **16B** of the pull wire are secured. The ribs **22A** and **22B** project but slightly, but enough to prevent any substantial contact and undesired bending of the pull wire by the vane.

As illustrated and earlier indicated, the vane **12** is of octagonal shape. It is stamped with the previously referred to opposed slots **12A** and **12B** extending inwardly from opposite edges of the vane toward the center. The slots have a length about one-third the width of the vane, leaving the central flat vane area **12C** between the ribs **20A** and **20B** and the slots. The ribs **20** are thus located at each side of the slots and disposed parallel to the slots and both the slots and ribs are disposed transversely of the biasing straps and pull wires. The ribs **20A** and **20B** may be of uniform height, although the central portions thereof which do not engage the tensioning straps **14** may be somewhat higher in order to provide additional stiffening of the vane, thereby better to insure the overcenter snap action of the vane between the positions illustrated in FIGS. 5 and 6.

As is the case with the vane of my copending application, the vane **12** can be formed by a stamping operation or operations in which the vane is initially cut into the slotted octagonal configuration. The ribs and outer triangular portions **12D** can be formed on the vane at the same time. The ribs, however, do not disturb the substantially flat construction of the vane nor do they provide any inherent or intrinsic stresses in the vane which need to be relieved by heat treatment or otherwise.

The biasing straps **14** are attached to spaced alternate flats **12E** of the vane and extend parallel to one another and overlie one surface of the vane. The straps comprise strips of material, preferably metallic, having a length somewhat longer than the distance between points **12E**. The ends **14C** of each biasing strap are spot welded in place at the region of the flats. The effective lengths of the biasing straps **14** are such as to flex the vane away from the biasing straps and transversely of the direction of the bias, to a position substantially as illustrated in FIGS. 5A and 6A. Thus, when the pull wire is hot and in its expanded condition the biasing straps effect snap movement of the vane to the position of FIGS. 5A and 6A. Adjustment of the magnitude of the bias can be conveniently and easily adjusted by bending the flats **12E** of the vane and such adjustment of the straps may be effected independently of each other, as well as independently of the pull wire.

In the cold condition of the pull wire the central regions of the straps **14** are engaged by the ribs **20A** and **20B** with the result that the opposite halves of the straps and vane are at a slight angle to each other, even though the vane is biased toward the straps by the pull wire. In the heated and expanded condition of the pull wire the vane is flexed away from the bias straps and the ribs may be spaced and generally at least one of the straps is spaced from the ribs. The aforementioned angular spacing between the straps and vane better insures movement of the vane from the position of FIGS. 5 and 6 to the position of FIGS. 5A and 6A.

The pull wire **16** overlies the other surface of the vane and is attached to and extends between opposed points **12D** of the vane, which are provided with locating slots **12F** receiving flat end portions of the pull wire. The pull wire comprises a strip of material, preferably metallic and heat expansible in a longitudinal direction, having a length slightly in excess between the points **12D**. The pull wire is attached at its ends to the vane by means of crimping and welding and the ribs **22A** and **22B** space the pull wire slightly from the adjacent surface of the vane **12**. In the heated condition of the pull wire the latter approaches the surface of the vane somewhat but has no substantial engagement with it, so that, as earlier noted, there is no substantial engagement or undesired bending of the pull wire by the vane and the pull wire remains substantially straight over its length.

The vane **12** moves with snap action between two positions. In what may be termed a first position in which the pull wire **16** is cold but ready to be heated, a contact **30** at the upper or outer and substantially free end and biasing strap side of the vane is spaced from an associated fixed contact **32** mounted upon a conductive bracket **34** of suitable shape. The opposite end portion of the vane is fixedly secured to a bracket type support **36**, the mounting being effected by longitudinally spaced spot welds **38** at an off center portion of the vane, to an intermediate portion **36A** of the bracket. The bracket is provided with a somewhat transversely extending end portion **36B** which extends toward the vane and against which the vane may abut in the aforesaid normal position. It should be noted that in the illustrated arrangement the contact **30** is also at the bias wire side of the vane.

Referring particularly to FIGS. 1 and 2, it may be noted that the device **10** includes a base **40** preferably formed of non-conductive material, such as molded plastic. The device generally includes a cover (not shown) engageable with the base and associated element. Extending downwardly from the base are a plurality of plug-in type terminal members, of which two, indicated by the reference characters **42** and **44**, are illustrated. These terminals are connected to the supports **34** and **36**, respectively, by conductive rivets **46**.

Alternate heating and cooling of the pull wire **16** to effect alternate expansion and contraction of the pull wire may be accomplished in any desired manner. In the illustrated device the pull wire **16** is heated indirectly by means of a resistance heating wire or element **48** disposed within and in intimate heat transfer relation with a substantial length of the pull wire **16**.

In accordance with a feature of the invention, the pull wire is provided with a tubular central portion **16C** formed as a circular tube, as best illustrated in FIGS. 7 and 8. The heating element **48** of insulated resistance wire is formed in what might be considered a hairpin shape and inserted

into the tubular portion whereby the closed end or bight portion of the wire is disposed within the tubular portion. The heating element may take other shapes or be of a straight through type mounted within the tubular portion. The result is a readily made indirectly heated pull wire in which the heating element is protected by and in intimate heat transfer relationship with an enclosing portion of the pull wire.

The projecting ends **48A** of the heating wire extend and are electrically connected to the terminals **42** and **44** as by flexible conductors **48B**. The circuit arrangement is such that the heating element is energized in the indicated position of the vane in which contacts **30** and **32** are disengaged, assuming that a source of electricity is connected to the terminals. When the pull wire expands and the vane moves to its other position to effect engagement of contacts **30** and **32** the heating element is short circuited. Signal lights may be in circuit with one of the terminals so that when the heating element is short circuited (and thus cooling) the lights are energized sufficiently to be lighted; when the heating element is not short circuited (and being heated) and in series with the lamps, the lamps are not lighted.

In operation, the vane **12** is normally in the condition illustrated in FIGS. 1 and 2 wherein the pull wire **16** is in its contracted or unexpanded condition. In this condition the vane is flexed by the pull wire in the direction toward the biasing straps **14** to a position in which the contacts **30** and **32** are out of engagement and the heating element is connected in non-shorted manner across the terminals **42** and **44**. At this time the associated signal lights are not lighted. This condition and position of the vane is also shown in FIGS. 5 and 6.

After the pull wire **16** is heated for a period of time, it expands so that the vane **12** is snapped by the biasing straps **14** to its alternate position, as shown in FIGS. 5A and 6A. This movement causes the outer end of the vane abruptly to move with snap action, to effect engagement of contacts **30** and **32** and short circuiting of the heating element **48**. As a result, the pull wire **16** begins to cool, and after a period of time contraction of the pull wire **16** snaps the vane to its original position. The foregoing operations are continued resulting in alternating operation of the vane and signal lamps until such time as a circuit controlling switch is opened.

While the present invention has been described in connection with the details of particular illustrated embodiments thereof, it should be understood that the present invention is not limited to these details, except insofar as set forth in the accompanying claims.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Apparatus of the type described comprising a substantially flat and unstressed resilient vane, means supporting the vane, flexible vane biasing strap means and heat expansible pull wire means attached to the vane at opposite sides of the latter for effecting snap action of the vane between two positions in response to alternate heating and cooling of the pull wire means, and the improvement comprising a pair of ribs located near the center of the vane and extending transversely of the vane and the biasing strap means, said ribs projecting away from the vane toward and engaging the biasing strap means at spaced regions centrally of the latter in one position of the vane to space biasing strap means from the vane.

2. Apparatus as claimed in claim **1**, additionally comprising spaced ribs on the vane near the points of attachment of the pull wire means to the vane, the ribs projecting away from the vane toward and engaging the pull wire near its ends to space the latter from the vane.

3. In apparatus of the type described in claim **2**, wherein the vane is a substantially flat unstressed metallic vane, the vane biasing means comprises a pair of spaced apart generally parallel straps at one side of the vane and each attached to opposite ends of the vane to flex the vane in one direction transversely of and away from the biasing means, the expansible pull means has its ends attached to the opposite ends of the vane between and generally parallel to the biasing straps, said vane has slots extending transversely of the direction of the straps from the edges toward the center of the vane, said slots being located substantially midway between said opposite ends of the vane, a conductive mount for the vane, a contact mounted on a free end of the vane and movable therewith, a stationary contact engageable by the movable contact in one of its positions, a supporting base, a conductive mount for the stationary contact, said mounts being supported on the base, and terminals on said base connected respectively to said mounts, and wherein the rib means comprises spaced ribs extending transversely of the vane near the sides of the slots and parallel thereto and projecting a short distance toward the biasing straps, the vane mount being attached to the vane between one of the latter ribs and the adjacent end of the vane at a region between the pull means and one of the biasing straps, said pull means having a length such that in its unexpanded and contracted condition it flexes the vane in a direction toward the biasing straps so that the latter engage the ribs to provide a limit angular relation between the vane and the straps.

4. In apparatus as claimed in claim **3**, wherein the pull means has a tubular portion between its points of attachment to the vane and a reversely bent insulated resistance type heater wire has its closed end portion within said tubular portion.

5. In apparatus as claimed in claim **4**, wherein the pull means has flat end portions and the vane has slots at its ends for receiving and locating the flat end portions.

6. Apparatus of the type described including a snap acting resilient vane movable between two positions, means supporting the vane, and heat expansible pull wire means attached at its ends to the vane for effecting snap action of the vane between its two positions in response to alternate heating and cooling of the pull wire means, said pull wire means including a strip of material having a central tubular portion of substantially closed circular cross section between its points of attachment to the vane, said strip having substantially flat single-thickness portions adjacent its ends for attachment to the vane, and an insulated resistance type heater wire mounted within said tubular portion.

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