

Jan. 20, 1959

J. W. WELSH
SNAP ACTION DEVICE

2,870,291

Filed June 6, 1957

2 Sheets-Sheet 1

FIG. 1

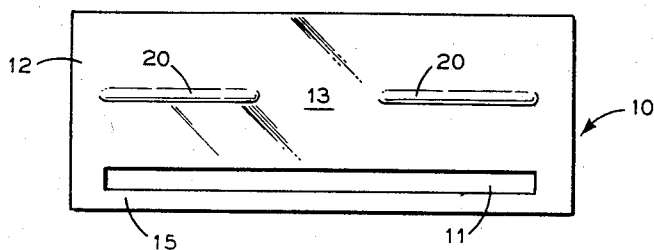


FIG. 2

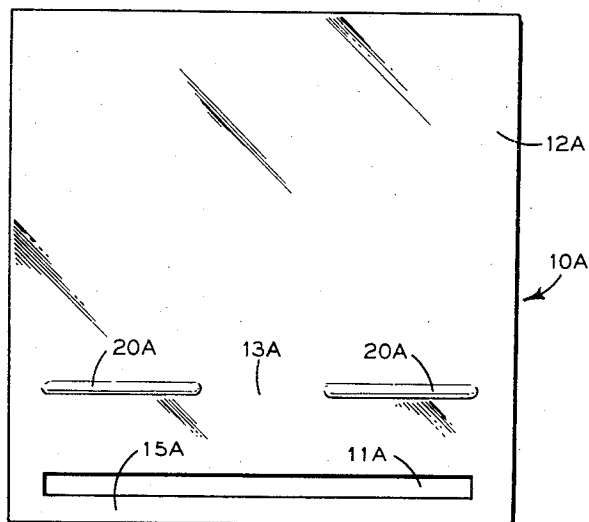
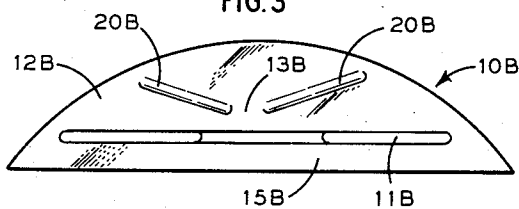


FIG. 3



INVENTOR.
J. W. Welsh
BY *[Signature]*
ATTORNEY

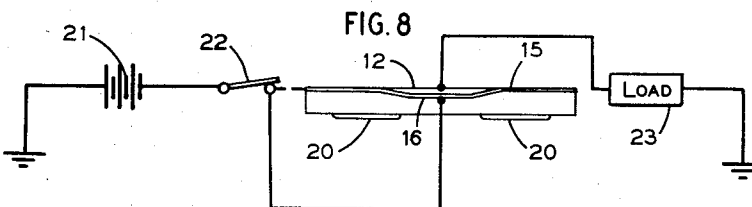
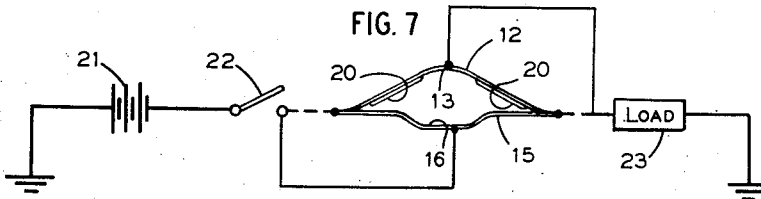
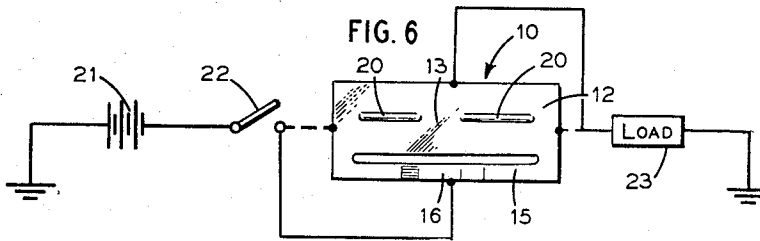
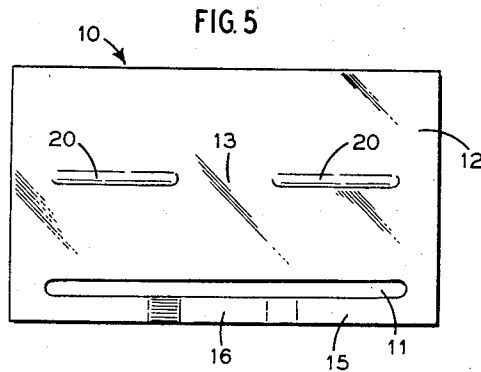
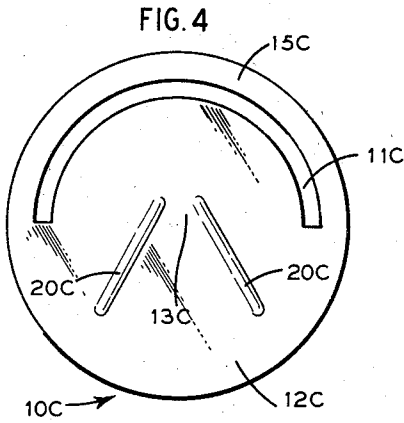
Jan. 20, 1959

J. W. WELSH
SNAP ACTION DEVICE

2,870,291

Filed June 6, 1957

2 Sheets-Sheet 2



INVENTOR.
J. W. Welsh
BY *D. J. Welsh*
ATTORNEY

1

2,870,291

SNAP ACTION DEVICE

James W. Welsh, Summit, N. J., assignor, by mesne assignments, to Hoda Corporation, Great Neck, N. Y., a corporation of New York

Application June 6, 1957, Serial No. 663,925

8 Claims. (Cl. 200—113)

This invention relates to snap action vanes for use in thermostatically or thermodynamically operated electric circuit controllers, such as for the type of circuit breaking and/or reversing switch, one form of which is known as a flasher. More particularly, the invention is directed to such vanes having a thermostatic operator integral therewith, such as the type forming the subject matter of my copending application Serial No. 664,034, filed June 6, 1957, for "Snap Action Device."

In my U. S. Patent No. 2,756,304 of July 24, 1956, I have illustrated and described a novel type of snap action vane, and a switch or flasher incorporating the same, in which a vane of relatively stiff spring metal is given an initial set by providing a pair of aligned and longitudinally spaced deformations extending from diagonally opposite corners of the vane toward the center thereof, the central area of the vane being left undeformed. This gives the vane an initial bend about a first diagonal extending along the deformation.

The vane is pre-stressed to bend about the other diagonal by attaching a thermostatic wire or ribbon to the corners at the ends of the first diagonal, the wire or ribbon being attached in the cold, contracted condition with the vane bent about the second diagonal. When the wire or ribbon is heated and expands, the vane snaps to its initial bent condition about the first diagonal. When the wire or ribbon cools and contracts, the vane snaps back to its condition of being bent about the second diagonal.

It has been found that, if such a vane is supported in a certain zone adjacent its center, there is a considerable amplitude of movement of the vane about such mounting point during the snapping action, particularly at the corners of the vane. This characteristic has been advantageously utilized in providing vane operated switch controlling circuits preferably including electric heating circuits for the thermostatic operator, and flashers or other snap action switches incorporating such a vane have gone into extensive commercial use.

As described in my said copending application, it has been found that the manufacture of such snap action vane switches can be greatly simplified and reduced in cost by making the thermostatic operator integral with the vane in a single vane forming operation. This eliminates the time and labor hitherto necessary in pre-stressing the vane and holding it pre-stressed while the pull ribbon or wire is attached to the vane by spot welding or brazing. Even more importantly, the contact making and breaking operation of the vane is greatly improved, as the contact pressure is maintained fully or even increased during a contact opening cycle right up to the instant when the contacts snap open. This characteristic greatly increases the contact life by minimizing arcing or burning of the contacts.

In making the vane, a piece of preferably electrically conductive spring metal is used, the metal being selected for high elasticity and resistance to creep under static or dynamic stresses. Other factors important in the selec-

2

tion of the metal are its specific temperature resistance, coefficient of resistance, and coefficient of expansion, all of which factors must be considered with particular reference to external or ambient operating conditions.

The metal piece is formed with a closed-end slot extending along and parallel to an edge so as to provide a narrow strip of metal along such edge integral at each end with the much larger body section of the vane. This narrow strip forms the thermostatic strip or wire for snapping the vane between two conformations. Due to its smaller cross-section as compared with that of the main body of the vane, the strip heats and expands at a faster rate than does the main body when there is a flow of electric current through the vane.

In accordance with the present invention, the vane is so designed as to form an automatic breaking or storage point to build up kinetic energy. In order to obtain this general characteristic, the vane is so formed as to provide controllable pressure points or areas within the vane.

This is effected by thinning the vane metal along a pair of rectilinear zones to form a pair of ridges or embossed sections which are rectilinear and extend inwardly toward each other but have their inner ends separated. This embossing accomplishes several purposes. In the first instance, the thinning of the vane material sets up substantial external pressures along the general line of the embossments. In the second instance, the spacing of the inner ends of the embossments creates a focal point or area toward the center of the vane so that the vane, when operating, will break down at a predetermined point or area.

The central area between the inner ends of the embossments is kept unmarred as most of the flexing will occur in this area. The bending stresses are also kept away from this central area. It has been found that keeping this central area free of stresses results in stable operation of the vane being effectively maintained over a long period of time. The depth of the embossments and the consequent thinning of the vane material is dependent upon the desired operating parameters of the vane.

The deformation of the main body section results in an initial set being imparted to the vane along a bending line determined by the direction of the deformations. The "thermostatic strip" is then foreshortened by forming an offset therein at or adjacent its center. This foreshortening of the strip, which latter is integral at each end with the main body section, results in stressing the main body section to bend about a line normal to the strip and at an angle to the initial bending line of the body section.

If the vane is now heated, as by an electric current flowing therethrough, the strip heats and expands much faster than the main body section. The differential expansion of the strip relative to the main body section progressively decreases the stress holding the main body section bent about a line normal to the strip, and the main body section flattens to a point where it snaps to a position bent about its initial bending line as determined by the direction of the deformations therein.

As the vane cools, the differential contracting of the strip again stresses the main body section to bend about the line normal to the strip and, after an equilibrium of forces is reached and just passed, at which time the vane snaps back to its V-shape bent about the line normal to the strip.

The snapping of the main body section between positions bent about a pair of different axes or lines results in there being a substantial amplitude of relative movement between selected points or areas of the main body section and selected points or areas of the strip.

For an understanding of the invention principles, reference is made to the following description of typical

embodiments thereof as illustrated in the accompanying drawings.

In the drawings:

Figs. 1 through 4 are plan views of various forms which the vane may assume in practice;

Fig. 5 is a plan view of the vane of Fig. 1 after deformation of the "strip";

Fig. 6 is a schematic wiring diagram of the vane of Fig. 5 as incorporated in an electric heating circuit; and

Fig. 7 is a side elevation view of the vane of Fig. 5 in the unheated condition; and

Fig. 8 is a side elevation view of the vane of Fig. 5 after snapping to its stressed position due to heating by the circuit of Fig. 6.

Referring to Fig. 1, a vane 10, of suitable high electrical resistance material which is resilient in nature, such as thin spring steel is formed with an elongated slot or cutout 11 extending along and parallel to one edge. Slot 11 divides vane 10 into a main body section 12 and a much narrower strip 15 integral at each end with body section 12. Due to the difference in cross-sectional area between body section 12 and strip 15, when an electric current is caused to flow through vane 10, strip 15 will heat and expand at a much greater rate than will body section 12. Thus, strip 15 will expand differentially relative to body section 12 causing relative bending of the body section 12 and strip 15.

In accordance with the invention, the bending stresses are directed toward a relatively central area 13 of body section 12 by thinning or otherwise deforming the metal of section 12 along a pair of rectilinear lines, extending inwardly toward each other, to form bosses, ridges, or depressions 20. It will be noted that the inner ends of the deformations 20 are spaced from each other, leaving the central area 13 therebetween substantially undeformed. Deformation of body section 12 causes the vane to have an initial set or bend about a bending line or axis aligned with deformations 20.

Fig. 1 shows a vane 10 of rectangular form, and this shape is preferred in many practical applications of the invention. However, this vane may take other configurations, in plan, without effect on its operation. Thus, in Fig. 2, vane 10A is shown as substantially square, with slot 11A extending in closely spaced parallel relation to one edge to define body section 12A and strip 15A, bosses or ridges 20A being formed in section 12A, in the same manner as in Fig. 1, to leave unmarred central area 13A.

In Fig. 3, vane 10B is generally semi-circular, with slot 11B extending parallel to a diameter. Deformations 20B converge toward central unmarred area 13B of body section 12B.

In some cases, a circular shape vane 10C is desired, as shown in Fig. 4. In this case, slot 11C extends parallel to the circumference of the vane. Ridges 20C are formed in section 12C and are spaced from and diverge outwardly from slot 11C.

Fig. 5 shows the vane 10 of Fig. 1 as further deformed by imposing an offset bend 16 in strip 15. As best seen in Fig. 7, the consequent shortening of the distance between the ends of strip 15 results in a bend being imparted to body section 12 about an axis perpendicular to deformations 20.

Fig. 6 schematically illustrates a typical electric circuit incorporating vane 10. As shown, the ungrounded terminal of a grounded battery 21 is connected through a switch 22 to one side of vane 10, such as to the center of strip 15. The other side of vane 10 is connected to ground through a lead 23. Alternative connections are shown in broken lines.

When switch 22 is closed, as shown in Fig. 8, an electric current flows through vane 10 and flows over parallel paths comprising body section 12 and strip 15. Strip 15 heats more rapidly than section 12 and thus expands relative to the body section. The resultant outward force at the ends of strip 15 effect a flattening of sec-

tion 12 and, when the forces in section 12 reach a certain point, the body section snaps to the position of Fig. 8 in which it is bent about its initial bend line along deformations 20. This flattening and subsequent snapping "lifts" the bend 16 of strip 15 relative to the unmarred area 13 of main body section 12.

If switch 22 is now opened, strip 15 contracts and, when the contracting force attains a pre-set value, vane 10 is snapped back to the position of Fig. 7 wherein it is bent about a line normal to deformations 20. By alternate opening and closing of switch 22, vane 10 may thus be cyclically snapped between the "stress-deformed" position of Figs. 6 and 7 and the "restored" position of Fig. 8; the positions of the respective sections of the vane being exaggerated for illustrative purposes.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the invention principles it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A snap action vane comprising a substantially flat piece of a single resilient metal having a relatively elongated closed-end slot extending along and adjacent an edge thereof to divide the vane into a main body section and a strip separated from said body section by said slot and integral with the body section at each end, with the strip having a cross-sectional area only a fraction of that of the body section; said body section having a pair of substantially rectilinear deformations therein extending toward a central area of the body section; the inner ends of the deformations terminating short of each other to leave said central area free of deformation; whereby, upon heating of said vane, the strip will expand relative to the body section to induce bending stresses in the body section with the bending stresses directed by said deformations.

2. A snap action vane comprising a substantially flat piece of a single resilient metal having a relatively elongated closed-end slot extending along and adjacent an edge thereof to divide the vane into a main body section and a strip separated from said body section by said slot and integral with the body section at each end, with the strip having a cross-sectional area only a fraction of that of the body section; said body section having a pair of substantially rectilinear deformations therein extending toward a central area of the body section; the inner ends of the deformations terminating short of each other to leave said central area free of deformation; said strip having an offset bend intermediate its ends to bend said body section to a stress-deformed position bent about a zone perpendicular to said strip; whereby, upon heating of said vane, the strip will expand relative to the body section to flatten said body section and to induce bending stresses in the body section to snap said vane to a restored position with the bending stresses directed by said deformations.

3. A snap action vane for use in an electrothermally actuated switch comprising a substantially flat piece of a single resilient metal of relatively high electrical resistance having a relatively elongated closed-end slot extending along and adjacent an edge thereof to divide the vane into a main body section and a strip separated from said body section by said slot and integral with the body section at each end, with the strip having a cross-sectional area only a fraction of that of the body section; said body section having a pair of substantially rectilinear deformations therein extending toward a central area of the body section; the inner ends of the deformations terminating short of each other to leave said central area free of deformation; whereby, upon flow of electric current through the vane, the strip will heat and expand relative to the body section to induce bending stresses in the body section with the bending stresses directed by said deformations.

5

4. A snap action vane for use in an electrothermically actuated switch comprising a substantially flat piece of a single resilient metal of relatively high electrical resistance having a relatively elongated closed-end slot extending along and adjacent an edge thereof to divide the vane into a main body section and a strip separated from said body section by said slot and integral with the body section at each end, with the strip having a cross-sectional area only a fraction of that of the body section; said body section having a pair of substantially rectilinear deformations therein extending toward a central area of the body section; the inner ends of the deformations terminating short of each other to leave said central area free of deformation; said strip having an offset bend intermediate its ends to bend said body section to a stress-deformed position bent about a zone perpendicular to said strip; whereby, upon flow of electric current through the vane, the strip will heat and expand relative to the body section to flatten said body section and to induce bending stresses in the body section to

5

10

15

20

6

snap said vane to a restored position with the bending stresses directed by said deformations.

5. A snap action vane as claimed in claim 2 in which said deformations comprise embossments thinning the material of the body section.

6. A snap action vane as claimed in claim 4 in which said deformations comprise embossments thinning the metal of the body section.

7. A snap action vane as claimed in claim 6 in which said embossments are aligned.

8. A snap action vane as claimed in claim 6 in which said embossments converge.

References Cited in the file of this patent

UNITED STATES PATENTS

2,363,280	Arnold	Nov. 21, 1944
2,533,274	Matulaitis et al.	Dec. 12, 1950
2,708,697	Welsh	May 17, 1955
2,716,682	Franklin	Aug. 30, 1955
2,720,568	Bletz	Oct. 11, 1955