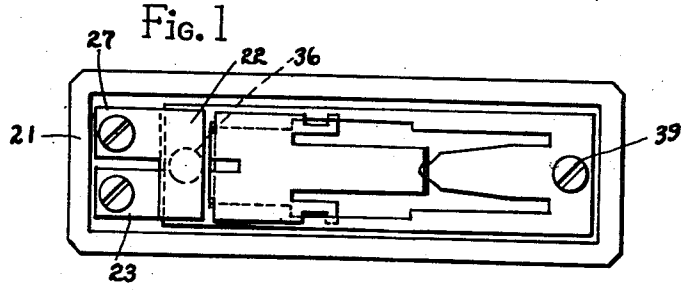
Aug. 22, 1950 R. D. ARBOGAST 2,519,334

SNAP ACTING MECHANISM

Filed Aug. 2, 1946

Fig. 1



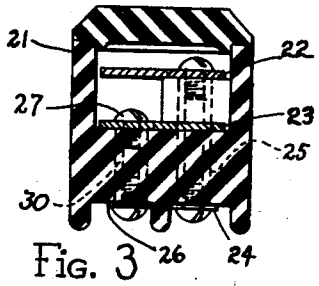
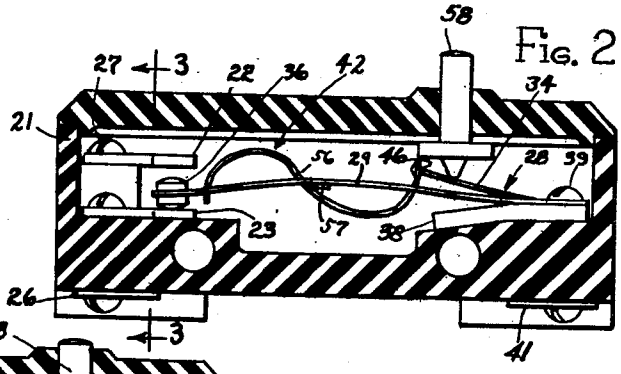


Fig. 3

Fig. 2



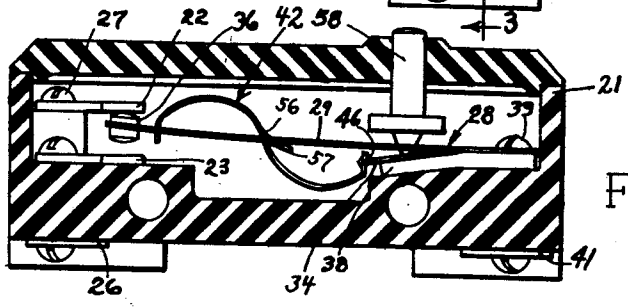


Fig. 4

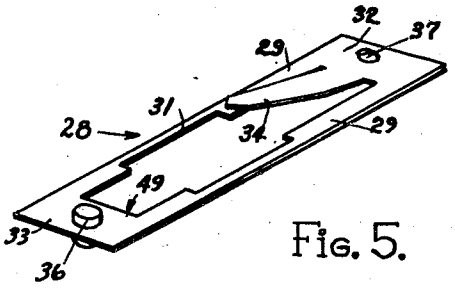


Fig. 5.

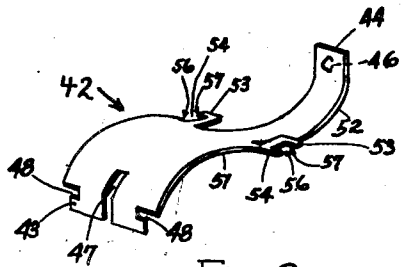


Fig. 6

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SNAP ACTING MECHANISM

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10 Claims. (Cl. 200—67)

1

This invention relates generally to an improved snap acting mechanism of the character used in pneumatic control valves, compact precision type electric switches and the like and has particular reference to a construction which operates with a minimum amount of vibration.

To illustrate the problem, certain snap acting mechanisms have an elongated carrying member made of flat stock, usually spring material. Where the mechanism is employed to operate a valve, the carrying member carries a valve disc; where it is employed in an electric switch, it carries a movable contact. The carrier is mounted in cantilever fashion or pivotally at one end and the other end carries the valve disc or electrical contact which is arcuately movable between stops, at least one of which may be a valve seat or, in the case of a switch, a stationary contact. One or more compression members are associated with the carrier member in such a way that the compression member normally maintains the free end of the carrier member pressed against one or the other of the stops, but when deflected as by a conventional operating plunger the compression member is moved through an axis of maximum stress to snap the carrier member quickly to the opposite stop. At this point in the operation, the problem dealt with by the present invention arises for as soon as the carrier member strikes one of the stops the elongated spring comprising the carrier member will vibrate, which may cause the valve disc or mobile contact to chatter open and closed. While this effect is momentary, the wire-drawing or arcing resulting from this chattering condition, where multiplied by thousands of operations, substantially reduces the service life of the parts.

On the basis of high speed camera studies and other tests, I have found that this vibration of the elongated carrier member is in the nature of a series of standing waves, that is, in alternate nodes and loops, and that it may be dampened or effectively minimized by depressing one of the loops, thereby breaking up the whole series of standing waves. In the example illustrated here, I have employed two pairs of transverse spaced shoulders formed on an intermediate portion of the compression spring. When the carrier is snapped against one stop, one pair of these shoulders engage the carrier at a position where the tendency to vibrate is greatest (this exact position will usually be determined experimentally for a particular carrier and method of mounting); and when the carrier is snapped

2

against the opposite stop, it will be engaged by the other pair of shoulders at approximately the same location.

Hence, it is broadly the purpose of this invention to provide a snap acting mechanism in which the tendency of the carrier member to vibrate in a standing wave is dampened out by means engaging the carrier at a position where a loop of a standing wave tends to occur at the instant that the mobile members are snapped from one position to another.

I have also found a beneficial vibration dampening effect is brought about at the instant of snap acting operation by a construction that pivots the compression element about an intermediate portion of the carrier at a position where a loop of a standing wave would form if the member were free to vibrate, whereby snap-action movement from one preselected position to the other is characterized by the compression element snapping from one pivotal position to another about the member in order to press the intermediate portion of the carrier in a direction opposite that to which the valve-or-contact-carrying end portion is pressed.

Other objects and attendant advantages will become apparent from the following description and the drawings in which—

Figure 1 is a view of a single pole double throw switch illustrating the principles of the present invention, with the cover plate removed to show the interior parts;

Fig. 2 is a longitudinal sectional side view of the switch of Figure 1 with the cover plate and operating plunger in place and showing the parts in their free or normal positions;

Fig. 3 is a transverse sectional view of Fig. 2 taken on the line 3—3;

Fig. 4 is a view similar to Fig. 2 but showing the plunger depressed and the parts in their operated or abnormal positions, and

Figs. 5 and 6 are perspective views, respectively, of the contact carrier and the compression spring member shown in the previous views.

Like parts are designated by like reference characters throughout the figures.

While the present invention is applicable generally to many types of snap acting mechanisms, it will be illustrated here in connection with a snap-acting spring mechanism for an electric switch.

In the drawings, the switch has the housing 21 with upper and lower contacts 22 and 23 connected, respectively, to outside terminals 24 and 26 by screws 27 and threaded bushings 25 and

30. A contact carrier, generally designated 28, is formed from a punching of spring material and has a pair of longitudinally extending arms 29 which are recessed as at 31, end portions 32 and 33 joining the arms 29, and an inwardly extending upwardly biased, pointed tongue 34. The end portion 33 carries a double-headed mobile contact 36 and the other end portion 32 is apertured, as at 37, for mounting on the plate 38 by the bolt 39 which connects with the outside terminal 41. The inner end of the plate 38 is bent downwardly a suitable amount to limit the downward deflection of the tongue or compression element 34. The compression spring, generally designated 42, may likewise be formed from a punching of spring strip material. As shown in the side views of Figs. 2 and 4, it is formed in an S-shape having flattened, substantially parallel end portions 43 and 44, the latter being indented, as at 46, to engage the pointed end of the tongue 34. The opposite end portion 43 is split centrally at 47 for ease of assembly and has the transversely extending side recesses 48 for engagement with the tension elements or arms 29 of the contact carrier and to maintain the end of the S-shaped member in pivotal abutment with the inner edge 49 of the carrier end portion 33. That part of the compression element intermediate the ends 43 and 44 comprises a downwardly concave portion 51 and a relatively narrow upwardly concave portion 52. Extensions 53 from the downwardly concave portion 51 are exteriorly recessed, as at 54, for pivotal engagement with the carrier arms 29. These extensions 53 are bent slightly upward to adjust the gap between the shoulders 56 and 57. The preferred position along the carrier, for engagement of the shoulders 56 and 57, will be the center of a loop of one of the standing waves produced by the carrier arms 29 when vibrating without restraint. This may be determined experimentally in any suitable manner as by high speed camera studies, or in some cases by visual observation. A plunger 58 will be provided to move the tongue 34 from the Fig. 2 to the Fig. 4 positions; and in the self-returning type of switch illustrated specifically herein, the tongue 34 will be upwardly biased sufficiently that when the plunger is released the stresses stored up on the tongue will overcome the compression of the S-shaped element 42 and move the parts back to the position shown in Fig. 2.

In the normal or plunger non-depressed position, as shown in Fig. 2, the upward bias of the tongue 34 will maintain the mobile contact 36 in engagement with the lower stationary contact 23. The shoulders 57 on the compression element 42 will bear upwardly against the bottom of the carrier arms 29. The unstressed distance between the compression element end portions 43 and 44 will be greater than that when assembled in the switch and consequently it will be under compression and in turn will place the tongue 34 under compression and the arms 29 under tension. As the plunger is depressed, the tongue 34 will be deflected downwardly accompanied by an increase in stress in it, the arms 29, and the S-shaped compression element 42. These stresses will reach a maximum when the pivot point on the end of the tongue is in coplanar alignment with the carrier arms 29. Slight further depression of the plunger past this axis of maximum stress will cause the compression element 42 to expand under its stored up stresses and snap the mobile contact 36 upward against

the upper stationary contact 22. At the same time and before the arms 29 can begin vibrating under the closing impact, the compression element shoulders 56 are moved down into engagement with the top of the carrier arms, as shown in Fig. 4, to prevent the vibration from starting. As the plunger 58 is released, the mobile contact will be snapped back to the Fig. 2 position by a reversal of the above-described operations and in this case the shoulders 57 will engage the bottom of the carrier arms to similarly dampen out any tendency to vibrate.

While a particular form of the present invention has been shown, it will be apparent that minor changes therein will readily suggest themselves to others skilled in the art without departing from the spirit and scope of the invention. For example, I have shown the contact carrier as comprising a rectangular frame with an inwardly extending tongue portion, but there will obviously be many variations of this specific construction.

Having thus described the invention, what is claimed as new is:

1. In a snap acting mechanism, the combination of a carrier member having a long arm and a short arm mounted on common mounting means, said long arm being movable between preselected limit positions defined by stops, a resilient compression member compressibly interposed between the free ends of said long and short arms, intermediate portions of said compression member and said long arm being mutually engageable in at least one of said preselected limit positions, the portion of said long arm engageable with said compression member being located at a position where a vibration loop would occur in said long arm if the latter were free to vibrate, actuating means for effecting the movement of said compression member through an axis of maximum stress to move said long arm between said preselected positions accompanied by movement of said intermediate portion of said compression member into engagement with said intermediate portion of said long arm to minimize vibration of the entire carrier member.

2. In a snap acting mechanism, the combination of a carrier having long and short arm members each having one end mounted on a common support, said long arm being movable between preselected positions defined by stops, a resilient member having opposed portions thereof engaged for compression respectively with the free ends of said long and short arms and having an intermediate portion thereof forcibly engageable with said long arm in each of said preselected positions to minimize vibration of said long arm when snapped between said preselected positions, and actuating means effective to move said resilient member through an axis of maximum stress to move said long arm between said preselected positions by snap action.

3. The combination recited in claim 2 where the resilient member and the long arm member are engageable at intermediate portions of each by means including a pair of spaced shoulders formed on one of said members for engaging the other member therebetween.

4. In a snap acting mechanism the combination of a spring system formed of spring strip material having a generally rectangular shape with a pair of spaced side members connected by end portions and having a tongue extending inwardly from one of said end portions, the end of said system carrying said tongue being mount-

ed on a support, the end of said system opposite said tongue being movable by snap action between preselected positions defined by stops, a resilient member compressed between said tongue and the movable end of said system, said resilient member having an intermediate portion engageable with said side members at particular intermediate portions of the latter where loops of standing waves would form if they were free to vibrate when said spring system is moved to strike either of said stops, and actuating means effective to move said resilient member through an axis of maximum stress to move the movable end of said spring system by snap action between said preselected positions.

5. A snap acting mechanism comprising a member operatively mounted at one end, a second member operatively mounted at one end, a link connecting free ends of said members in such a way as to form a snap acting system, one of said members being movable to tilt said link to move the other of said members with snap action between preselected positions, and means acting between said link and said other member in an area intermediate the connections between the link and said members in at least one of said preselected positions to apply a force in opposition to the contact force and thereby restrain said other member from vibrating at a portion thereof where a loop of a standing wave would otherwise form if said member were free to vibrate.

6. In an electric snap switch, the combination of a contact carrier formed of spring strip material having generally rectangular shape and having an inwardly extending tongue, the end of said carrier carrying said tongue being mounted in cantilever fashion, the end of said carrier opposite said tongue having a mobile contact movable between preselected positions defined by stops, at least one of said stops being a stationary contact, an S-shaped compression element compressibly interposed between said contact end and the end of said tongue, said S-shaped element having an intermediate portion positioned and dimensioned for engagement with a portion of said carrier connecting the ends thereof in either of said preselected positions, actuating means applied to the tongue intermediate its ends to deflect said S-shaped element to move said carrier by snap-action between said preselected positions.

7. In an electric snap switch, the combination of a contact carrier having a long member and a short member mounted in a cantilever fashion on a common stationary means, said long member having a mobile contact thereon movable between preselected positions defined by stops, at least one of said stops comprising a stationary contact, an S-shaped resilient member having its ends engaged for compression respectively with the free ends of said long and short members and having an intermediate portion thereof crossing and engaging said long member at each of said preselected positions to minimize vibration of said mobile contact when snapped against either

of said stops, actuating means operably associated with said short member to deflect said S-shaped member to move said mobile contact between said preselected positions by snap action.

8. A snap acting mechanism comprising, spaced stops, a flexible member having an end free to move between said stops with a snap action, said member being of such resilient construction that standing vibration waves form thereon upon engagement of said free end with the stops, and means engageable with said flexible member at a portion thereof intermediate its ends where a standing vibration wave occurs for dampening the vibrations of said member when said free end engages said stops, said means being operative to press said portion in a direction opposite to the stop with which the free end is engaged.

9. In a snap acting mechanism the combination comprising spaced fixed contacts, a flexible member mounted in a cantilever manner and having a contact mounted on an end free to move between said fixed contacts with a snap action, said member being of such resilient construction that standing vibration waves form thereon upon engagement of the movable contact with the fixed contacts, and means engageable with said flexible member at a portion remote from the movable contact where a standing vibration wave occurs for dampening the vibrations of said member when the movable contact engages one of said fixed contacts, said means being operative to press said portion in a direction opposite to the fixed contact with which the movable contact is engaged.

10. In a snap acting mechanism, the combination of first and second flexible resilient arms, said first arm being movable between preselected limit positions defined by stops, a compression member interposed between said arms to form a snap spring system having an axis of maximum stress, said compression member having an intermediate portion that engages said first arm in at least one of said preselected limit positions, the portion of said first arm being engaged by said compression member being located at a position where a vibration would occur in said first arm if the latter were free to vibrate, and actuating means for effecting movement of said compression member through the axis of maximum stress to move said first arm between preselected positions accompanied by movement of said intermediate portion of said compression member into engagement with said intermediate portion of said first arm to minimize vibration thereof.

RAYMOND D. ARBOGAST.

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