United States Patent

John

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[54] ELECTRIC SWITCH WITH A SNAP-ACTION SYSTEM

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[51] **Int. Cl.** **H01h 37/18,** H01h 37/52, H01h 37/62

[58] **Field of Search** ..... 200/67 D, 166.1; 337/337, 340, 337/342, 343, 345, 346, 347, 349, 365, 59, 89, 361; 73/378.3

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Assistant Examiner—Dewitt M. Morgan
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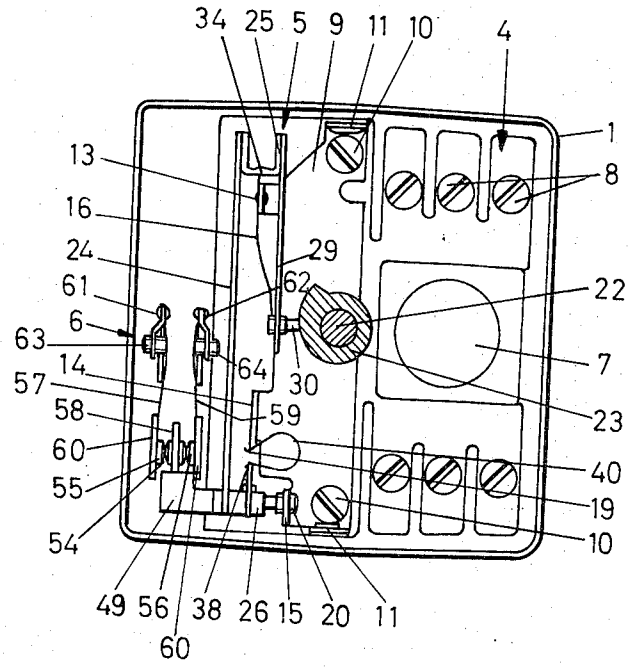
[57] **ABSTRACT**

A snap action thermostatic switch assembly of the type having a bimetal arm and an omega spring. The assembly has a fixed contact and a pair of resiliently mounted movable contacts on opposite sides of the fixed contact. The movable contacts have lugs and the bimetal arm has an actuating element which engages these lugs to move one contact or the other away from the fixed contact. The bimetal arm has a displacement range so that the actuating element thereof separates from the contact lug of a movable contact that is brought into engagement with the fixed contact. With this construction the tendency of a movable contact to rebound is minimized by reason of the mass associated with a movable contact being reduced the instant the movable contact touches the fixed contact.

1 Claims, 3 Drawing Figures



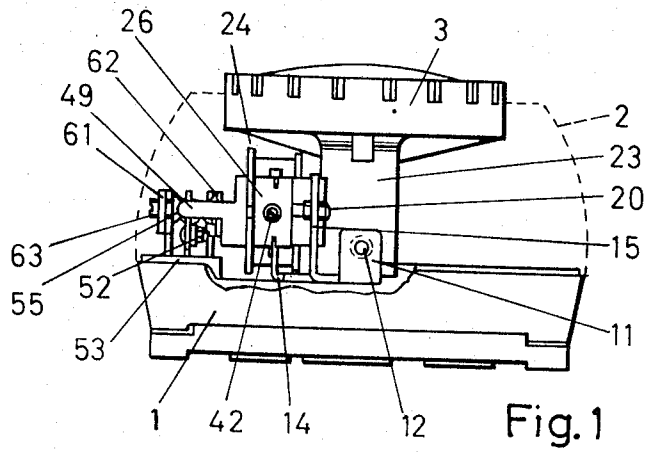

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Fig. 1

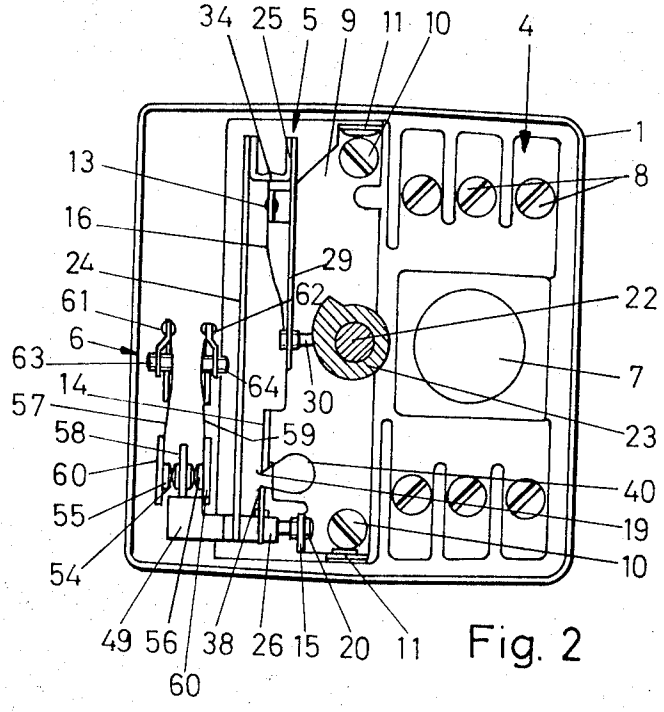
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Fig. 2

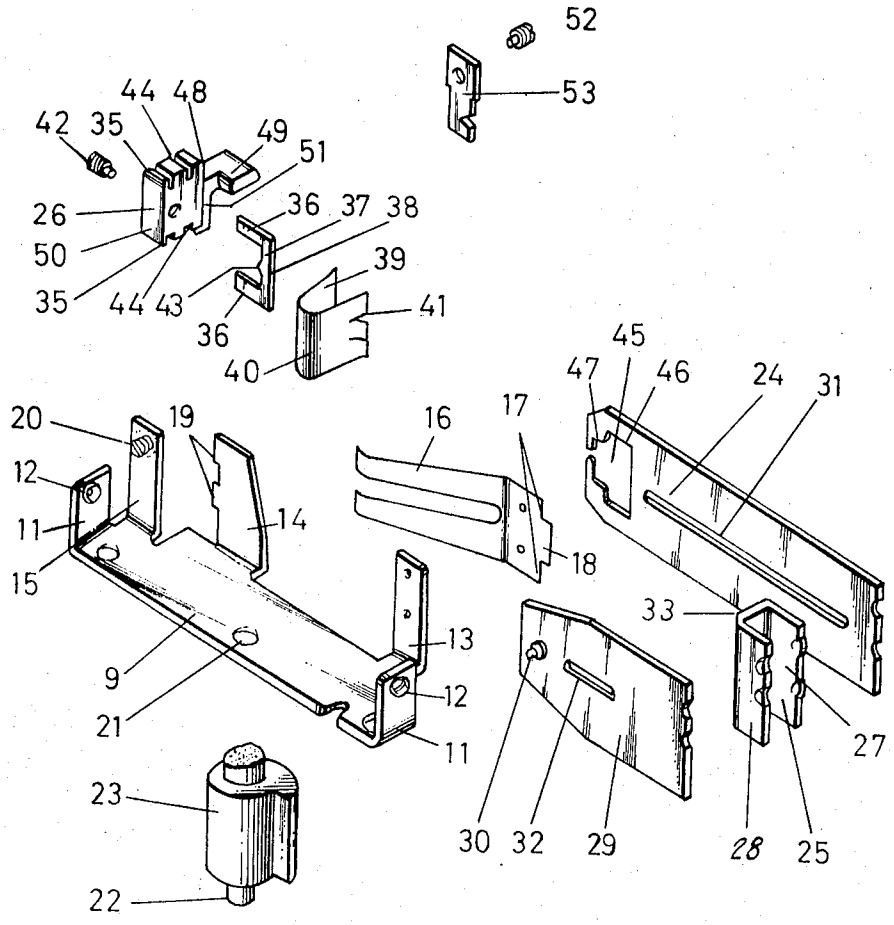
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Fig. 3

ELECTRIC SWITCH WITH A SNAP-ACTION SYSTEM

The invention relates to an electric switch with an electric contact system and a two-part snap-action system comprising a main arm and an omega spring.

An evaporator thermostat having a two-part snap-action system comprising a main arm and an omega spring is known, which snaps over on one side of the dead-center plane between positions defined by stops. The contact system comprises a fixed contact and a moving contact which is pressed against the fixed contact by a closing spring. The main arm carries an actuating element by which the moving contact is either raised or moved towards the fixed contact during the snap-over action. For the purpose of adjusting the difference, i.e. the change in pressure in the working element of the evaporator thermostat, necessary for effecting the snap-over action, it is possible to change the tension in the omega spring, for which purpose the fixed bearing of this spring takes the form of an adjusting screw. Considerable rebound times have been observed when closing takes place in the case of the contact system of an evaporator thermostat of this kind.

Similar or still more marked rebound phenomena occur in another electric switch in which the moving contact is fitted directly on the main arm of the snap-action system.

Also known are snap-action systems comprising more than two elements e.g. two rigid arms and a snap-action spring, which move through the dead-center plane during the snap-over movement, the two end positions being defined by stops, at least one of which is adjustable so as to vary the distance in the snap-action system.

The object of the invention is to provide an electric snap-action switch of the simplest possible construction, in which the tendency to rebound can be kept at a minimum.

Based on an electric switch having an electric contact system and a two-part snap-action system comprising a main arm and an omega spring, the invention solves this problem by a combination of the following features:

a. The contact system comprises a movable contact, which is pressed by a closing spring against a fixed contact and can be lifted from the fixed contact by an actuating element on the main arm, the movable mass of the snap-action system being separated from the mass of the movable contact at the moment of closing.

b. The difference in the snap-action system is determined by two stops which determine the displacement of the main arm during the snap-over action and one at least of which is adjustable.

c. The distance between the two points at which the omega spring is supported is adjustable in order to set a minimum for rebound when contact occurs.

The invention is based upon the consideration that the mass striking the fixed contact on the one hand and the velocity of this mass on the other are responsible for rebound. The impinging mass is reduced by lifting the actuating element from the moving contact at the moment of closing so that only the small mass of the moving contact is effective. The velocity is so adjusted by relating the strength of the closing spring to the strength of the omega spring, that the rebound effect becomes small or is even entirely suppressed. This matching of the springs is possible because the difference can be adjusted with the help of the stops, so that the omega spring is available for these matching purposes.

In practice, the procedure is preferably such that the omega spring is rated beforehand relatively to the closing spring in such manner that a short rebound period results. In this procedure however, very large tolerances such as are unavoidable in the case of omega springs can be accepted, since adjustment in the sense of obtaining minimum rebound is possible. Once the adjustment has been made, it is generally possible to maintain it by adjusting the difference; however there is no difficulty in making a subsequent adjustment in cases where this should be necessary.

In some cases it may also be expedient instead of or in addition to applying feature c, to make the bias of the contact-closing spring adjustable.

In an electric switch of this kind, the contact system can also include two movable contacts one of which is lifted from the associated fixed contact in each of the two positions of the snap-action system. If this contact system is arranged in a completely symmetrical manner, a satisfactory adjustment to suit the two closing springs can be achieved by appropriately setting the omega spring. If however there is a danger of the closing springs also exhibiting some differences as regards tolerances, it is advantageous to be able to effect an adjustment in this case too.

It is particularly advantageous to position the stops on both sides of the dead-centre position of the snap-action system. This means that the snap-action system passes through the dead-centre position during the snap-over action. Here, it is possible to operate in the straight portion of the characteristic curve of the omega spring. Completely symmetrical conditions can be obtained; considerable freedom is available in the setting of the difference. In particular, both stops can be adjustable symmetrically with respect to each other, so that the mean temperature is maintained upon altering the difference. The symmetrical construction is of considerable advantage particularly when use is made of a contact system employing two movable contacts.

In accordance with a further aspect of the invention, the actuating element can occupy an at-rest position such that in travelling to the movable contact it covers a greater lost-motion distance than is necessary for separating the masses. Thus, the actuating element will have developed considerable velocity before striking the moving contact, so that the switch opens very rapidly.

The main arm can itself be constituted by an operating element. In a preferred example, the main arm is constituted by a bimetal strip. This results in a room thermostat of extremely simple construction.

In many cases it is expedient to make the movable, rather than the fixed, support for the omega spring displaceable in the direction of the dead-centre line of the snap-action system. This measure often renders the adjusting means more readily accessible.

A contact-closing spring in the form of a leaf spring can be loaded by an adjustable screw. In this way the strength of the omega spring can be suited in a simple manner.

The invention will now be described in more detail by reference to an embodiment illustrated in the drawing, in which:

FIG. 1 is a side view of the switch of the invention, constituting a room thermostat incorporating a bimetal actuation means,

FIG. 2 is a plan view with a section through the spindle of the adjusting device, and

FIG. 3 is an exploded view of those parts of the snap-action system important to its operation.

The room thermostat is accommodated in a casing **1**, having a cover **2** shown in broken lines. A knob **3** for setting the working points passes through the cover. A connection system **4**, a snap-action system **5** and a contact system **6** are accommodated side by side in the casing.

The connection system **4** comprises an inlet **7** in the base and a row of connecting screws **8** on each side of the inlet.

The snap-action system **5** is mounted on a base plate **9** which is secured to the base of the casing by means of screws **10**. At opposite end-faces, the base plate carries bent-up tabs **11** containing tapped holes **12** for securing the cover **2**. Tabs **13**, **14** and **15** are bent up at one side. The tab **13** carries a leaf spring **16** which constitutes both blades **17** and a guide tab **18** for a first fixed support. The tab **14** carries blades **19** forming a second fixed support. The tab **15** is tapped to accommodate a set-screw **20** forming a stop. The base-plate also contains a fixing hole **21** for receiving a spindle **22** of the adjusting device which takes the form of a cam disc **23** and is firmly connected to the setting knob **3**.

A bimetal main arm **24** is provided at one end with a first attachment **25**, in the form of a U-shaped stirrup and, at the other end, with a second attachment constituted by a block **26**

of insulating material. Whilst the main arm 24 is secured to the limb 27 of the stirrup 25, the opposite limb 28 of the stirrup carries a second bimetal strip 29 which bends in the opposite direction to the main arm 24. The second bimetal strip 29 acts as an adjusting lever and, under the action of the leaf spring 16, bears against the cam disc 23 of the adjusting means, by way of a set-screw 30. The main arm 24 and the bimetal strip 29 contain slots 31 and 32 through which air can pass. The slot 31 also enables the screw 30 to be actuated. The central web 33 of the stirrup 25 contains an elongate recess 34, in which are accommodated the blades 17. At its middle, the recess contains an orifice which receives the guide tab 18.

The block 26 contains a first pair of lateral grooves 35 into which extend the limbs 36 of a U-shaped sheet-metal stamping 37. The end edge of this constitutes a knife-edge support 38 for flexible connection to one end 39 of an omega spring 40, the other end 41 of which is held in the blade 19 of the second fixed support. A screw 42, driven into the block 26, acts on the inner edge 43 of the sheet-metal stamping 37, which is pressed by the omega spring 40 against the end of the screw. A second pair of lateral grooves 44 in the block 26 is used for securing it to the main arm 24. For this purpose, this main arm contains an orifice 45 having a stepped edge. The first portion 46 is of such cross-section that the block 26 can be pushed through it. The second stepped portion 47 however forms guides along which the block 26 can be pushed by its lateral grooves 44 under the effect of the omega spring 40. Also, on an extension 48, the block 26 carries an actuating element 49 for displacing the contact system. The set-screw stop 20 can engage the surface 50 of the block 26, and a set-screw stop 52, guided in a retaining means 53, can engage the opposite surface 51.

The contact system incorporates a fixed middle double contact 54 and two outer movable contacts 55 and 56. Each contact is mounted on a carrier 57, 58 and 59, the central one 58 of which is substantially rigid, whereas the two outer carriers 57 and 59 take the form of leaf springs and are rendered rigid at their outer parts by tabs 60 bent up at the side. These leaf springs are held at their other ends in fixed clamping means 61 and 62, which are fitted with set-screws 63 and 64 with the help of which the bias of these leaf springs can be adjusted. These leaf springs are closing springs which resiliently press the movable contacts 55 and 56 in their at-rest positions against the fixed contact 54. The outer carriers 57 and 59 extend so far beyond the associated contacts that the actuating element 49 can engage them and can lift the contacts from the fixed contact, thereby overcoming the spring force of their support.

The result of this arrangement that when the snap-action system moves over from the position illustrated in FIG. 2, the actuating element 49 executes a leftward movement, the movable contact 56 following this movement under the action of its closing spring 59. When the contact 56 lies on the fixed contact 54, the movable masses of the snap-action system become separated from the moving contact 56, so that only the mass of this latter contact is then effective.

At the same time or just before or just after, the moving contact 55 is lifted from the fixed contact 54, the snap-action system having already reached a considerable velocity so as to cause a rapid opening of the set of contacts.

A minimum rebound time is obtained if the movable contact 56 strikes the fixed contact 54 at a predetermined velocity. This velocity can be influenced by adjusting the screw 42, i.e. the moving support for the omega spring 40, since the steepness of the characteristic curve of the omega spring is altered by this adjustment. Additional phasing can be achieved with the help of the set-screws 63 and 64, by means of which the bias of the closing springs 57 and 59 can be altered. By these measures it is possible to keep rebound extraordinarily small or even to suppress it entirely.

The difference in the room thermostat can be set with the help of the set-screw stops 20 and 52. In the present embodiment the two end points of the snap-action movement are positioned symmetrically on both sides of the dead-centre line of the snap-action system. By adjusting the two screws 20 and 52 each time, it is possible to maintain this symmetrical mode of operation, which, on the one hand, keeps the mean value of the set temperature unchanged and, on the other, is advantageous on account of the symmetrical contact system.

The required room temperature is set with the help of the setting knob 3, which when rotated causes the main arm 24 to swing, through the agency of the cam disc 23. The scale on the setting knob 3 can be accurately calibrated with the help of the screw 30.

When assembling the switch, all the parts of the snap-action system can be mounted beforehand on the base-plate 9. This base plate is then fitted in the casing alongside the connecting system 4 and, finally, the cover 2 is fitted over the entire assembly and screwed tightly on to the tabs 11.

Instead of the bimetal main arm 24, use can also be made of a rigid main arm which, for example, is acted on by a thermostatic or pressure-influenced working element and a spring having a nominal rating.

What is claimed is:

1. A thermostatic switch assembly comprising, a frame, a bimetal strip secured to said frame and forming a main arm, a fixed contact, a movable contact, a leaf type contact spring attached to said frame and said movable contact for biasing said movable contact in the direction of said fixed contact, lug means attached adjacent said movable contact, an actuating element on said main arm for engaging said lug means to move said movable contact away from said fixed contact, said actuating element having a displacement range so as to be separated from said lug means when said fixed and movable contacts are in abutting engagement, an omega spring supported on said frame and operatively connected to adjustable means on said actuating element, said adjustable means movable relative to said actuating element to vary the characteristics of said omega spring and hence the velocity of said actuating element, said adjustable means and set screw means for making the bias of said contact spring adjustable cooperating to control the rebound characteristics of said contact spring.

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