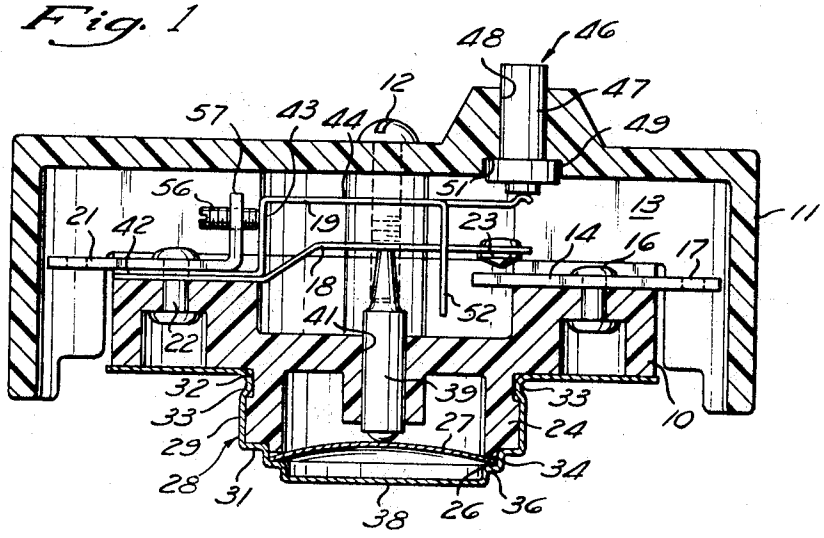
March 10, 1970 E. G. THEM 3,500,278

THERMOSTAT

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Fig. 1



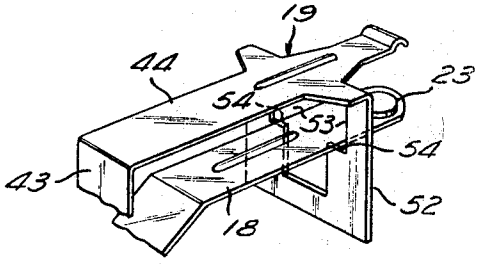




Fig. 2

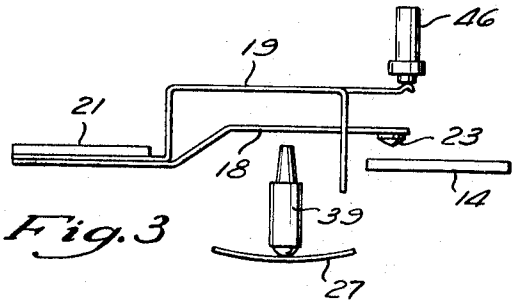



Fig. 3

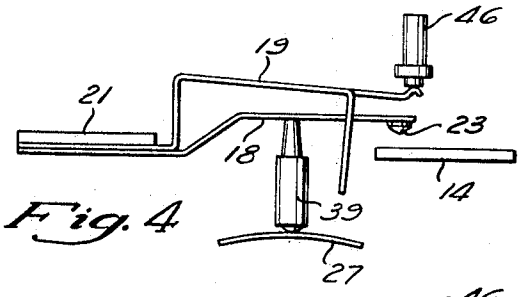



Fig. 4

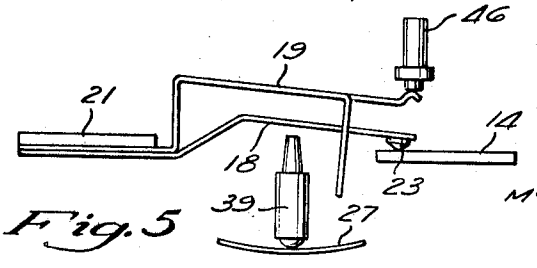



Fig. 5

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# THERMOSTAT

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Int. Cl. H01b 37/52
U.S. Cl. 337—354 9 Claims

## ABSTRACT OF THE DISCLOSURE

A thermostatic switching device is disclosed which includes a bimetallic disc operable to hold the switch open until a predetermined temperature condition is reached and is then operable to permit the switch to close. A non-thermal condition responsive mechanism is also provided to hold the switch open when it is in one condition and to allow the switch to close when it is in an operated condition. Consequently the switch actually closes only when the snap disc is in the operating condition at the same time the non-thermal responsive mechanism is in the operated condition. The structure is arranged so that the non-thermal responsive mechanism does not affect the thermostatic operation of the switch when such operation is controlled by the bimetallic snap disc.

## Background of invention

This invention relates generally to thermostatic switching devices and more particularly to a novel and improved thermostatic switching device which includes two separate operating means which are provided to control the operation of a single switch, wherein only one such operating means is thermal responsive.

## Prior art

In some instances in the past switching devices have been provided which include thermal responsive switch operating means in combination with non-thermal switch operating means. For example, the patent to Seely et al. 2,844,778 provides a starter switch incorporating thermal responsive means to render the switch inoperative after a period of time of switch closed condition in order to provide means to protect the motor intended to be operated by the switch. Examples of other types of switches of this general category are contained in the United States patents to Swingle 2,293,179 and to Epstein 2,743,333. Such devices generally have not been arranged to provide accurate temperature control since their primary function has been that of protecting against excessive heat or excessive overloading. Therefore, such devices have not generally been constructed in such a way so as to combine accurate thermostatic functions with separate non-thermal condition response.

## Summary of invention

The present invention is directed to a novel and improved structure arranged to provide accurate thermostatic response in combination with response to other non-thermal conditions. For example, a thermostat incorporating this invention may be used in ice-making machines wherein automatic operation requires accurate temperature response to be combined with a separate relatively low force level non-thermal condition response.

In the illustrated embodiment of this invention a body assembly is provided with a switch including a fixed contact and a mobile contact mounted on a mobile contact support. The mobile contact support is arranged to bias the mobile contact toward engagement with the fixed contact. The bimetallic snap disc is mounted on the body assembly and is connected to the mobile contact by means of a bumper. The various elements are arranged so that



the bimetallic disc maintains the switch open when the disc is in one position of stability and allows the switch to close when the disc is in the opposite position of stability.

The illustrated embodiment also includes a spring arm arranged to transmit a contact opening force to the mobile contact support. The spring arm in one condition maintains the switch open and another condition allows the switch to close. An operator is provided to move the spring arm between its switch open holding condition and the condition in which it allows the switch to close. The operator is adapted to operate in response to a non-thermally induced force. The spring arm is arranged so that it cannot exert a force on the mobile contact urging it toward the closed condition so it does not affect the thermostatic functioning of the device when it is in its operated position. The switch remains open unless both the snap disc and the spring arm move to the position to allow switch closing. If either the snap disc or the non-thermal condition responsive means is in position to hold the switch open, the switch remains open.

In the illustrated embodiment the spring arm is provided with an adjustment means to adjust the force necessary to move the spring arm to the position in which it allows the switch to close. With this adjustment, the mechanism can be adjusted for operation by non-thermally induced forces of a very low order. In instances where relatively large forces are available, the adjustment need not be provided.

## Description of the drawings

FIGURE 1 is a side elevation, in cross section, illustrating the structural detail of a preferred embodiment of this invention;

FIGURE 2 is a fragmentary perspective view of the mobile contact arm and spring arm, illustrating the operational connection therebetween;

FIGURE 3 is a schematic illustration of the operating mechanism illustrating positions of the various elements of the mechanism when the snap disc is moved to the position in which it allows the switch to close while the non-thermal condition responsive spring arm maintains the switch open;

FIGURE 4 is a schematic illustration similar to FIGURE 3 illustrating the mechanism when the snap disc is in position to maintain the switch open and the spring arm is in position to allow the switch to close; and

FIGURE 5 is a schematic illustration similar to FIGURES 3 and 4 illustrating the mechanism when the snap disc and the spring arm are both in position to allow the switch to close. This is the only condition in which the switch actually closes.

Referring to FIGURE 1, the switching device includes a body assembly including a main body element **10** and a cover element **11**. These elements are normally formed of a thermosetting plastic resin such as a phenolic material which is electrically insulating in character. The cover element **11** is removably secured to the main body **10** by a fastener **12** which may be a screw or the like. The elements **10** and **11** cooperate to provide a switch chamber **13** in which the switching mechanism is mounted.

The switching mechanism includes a fixed contact **14** mounted on the body element **10** by a rivet **16** and provided with a terminal portion **17**. Mounted on the opposite side of the body element **10** are a mobile contact support arm **18**, a spring member **19**, and an L-shaped terminal element **21**. A single rivet **22** mounts all of these elements in place. The mobile contact support arm extends in cantilever fashion to a position adjacent to the fixed contact **14** and is provided with a mobile contact **23** positioned to engage the fixed contact **14** to provide electrical connection between the terminal portion **17** and terminal

member 21. Lead wires (not illustrated) are connected to the terminals 17 and 21 to provide the connection with the external circuit.

The main body member 10 is formed with a cylindrical projection 24 providing an axially facing end wall 26 which is adapted to engage one side of a bimetallic snap disc 27. A disc retaining cup 28 is provided with a cylindrical section 29 which fits around the projection 24 and a radial section 31 which fits against a mating end face on the projection 24 to axially locate the retainer 28. The body is provided with recesses 32 into which the retainer 28 is deformed at 33 to permanently mount the retainer on the body.

The retainer 28 is formed with a step section including an axial portion 34 to radially locate the disc and a radial section 36 which cooperates with the end wall 26 to axially locate the disc. In the illustrated embodiment the retainer 28 is provided with a closed end wall 38 which is recessed to allow the disc to snap to its lower position of stability without interference.

An elongated bumper 39 is axially guided in a bore 41 in the body element 10 and extends between the disc 27 and the mobile contact arm 18. The various elements are proportioned so that the bumper 39 holds the mobile contact 23 spaced from the fixed contact 14 to maintain the switch open when the disc 27 is in the upward position of stability illustrated in FIGURE 1. However, when the disc snaps through to its opposite or downward position of stability, as illustrated in FIGURES 3 or 5, the bumper 39 can move under the influence of the spring force of the arm 18 to allow the arm to carry the mobile contact 23 into engagement with the fixed contact 14 thereby closing the switch. The closing of the switch, however, can only occur if the non-conditioned responsive mechanism is also in a condition to allow switch closure.

The spring arm 19 is provided with a base portion 42 sandwiched between the end of the mobile contact support arm 18 and the terminal member 21. At the end of the base portion 42 the spring 19 is provided with a lateral portion 43 which extends between the base portion and a longitudinal section 44. Located at the free end of the longitudinal section 44 is a plunger operator 46 provided with a cylindrical portion 47 guided within a bore 48 in the cover element 11. The plunger operator 46 is provided with a flange 49 which cooperates with a recess 51 in the cover member 11 to limit outward movement thereof.

The longitudinal section 44 is provided with a lateral connecting section 52 best illustrated in FIGURE 2. This lateral section 52 is formed with an opening 53 through which the mobile contact support arm 18 projects. The opening 53 is provided with inwardly extending shoulders 54 adapted to engage the underside of the mobile contact support arm 18 to prevent the mobile contact 23 from moving into engagement with a fixed contact 14 when the spring arm 19 is in the position illustrated in FIGURES 1 and 3. However, when the plunger operator 46 is pushed downward, the shoulders 54 move out of contact with the mobile contact support arm 18 so the spring arm 19 is disconnected from the mobile contact support arm and the support arm is then controlled by the snap disc 27.

An adjusting screw 56 is threaded through the upstanding portion 57 of the terminal 21 and is positioned to engage the lateral portion 43 to provide adjustment of the spring arm 19. The adjustment screw 56 may be threaded inwardly to reduce the amount of force necessary to depress the plunger 46 or may be backed off to increase the force. If the non-thermal operation provides sufficient force to operate a relatively stiff spring, the adjustment screw 56 need not be used and the spring arm 19 is then merely sized to overcome the force of the contact support 44 and to maintain the plunger flange 49 against the radial surface of the recess 51. The various elements are proportioned so that the flange 49 engages the mating surface of the recess 51, to limit the upward movement of the spring arm 19 before the mobile contact support 18 is stressed beyond its elastic limit. Preferably the elements are proportioned so that the bumper 39 engages the mobile contact support 18 and lifts it out of contact with the shoulders 54 when the elements are in the position of FIGURE 1. With such an arrangement the spring arm 19 maintains the plunger 46 firmly seated in the recess 51 and the bumper 39 is held in contact with the disc 27 by the contact support 18.

The mobile contact support arm 18 is sized so that its force urging the mobile contact 23 toward the fixed contact, and switch closed position, is relatively small so that the switch may be operated by the snap disc without excessively changing the calibration of the snap disc. The force of the spring arm 19 must be sufficiently strong, when it holds the contacts open, to overcome the force of the mobile contact support arm 18 to maintain the contact open.

There are four different conditions of operation which may exist. In FIGURE 1 a first of four conditions is illustrated. In this condition the snap disc is in its upward position of stability so the bumper 39 operates to hold the switch open. At the same time the plunger 46 is not depressed so the spring arm 19 is also in position to hold the switch open. As mentioned above, it is preferable to arrange the proportions so that the shoulders 54 of the spring arm 19 are out of contact with the mobile contact support 18 in this condition.

In FIGURE 3 a second operating condition is illustrated. In this condition the disc 27 has snapped from the position illustrated in FIGURE 1 to its opposite position of stability and the bumper 39, therefore, does not maintain the mobile contact 23 in the switch open condition. However, the plunger operator 46 is not depressed so the switch is held in the switch open position by virtue of the action of the spring 19 alone since the shoulders 54 of the spring (see FIGURE 2) engages the underside of the mobile contact support arm 18 and hold the contacts apart. When the elements are proportioned, as described above, so that the snap disc positions the mobile contact, in the condition of FIGURE 1, a slight movement toward contact closed condition will occur when the disc snaps. This movement, however, stops when the shoulders are engaged and the spring arm 19 is proportioned so that the shoulders 54 are engaged before the switch closes as illustrated in FIGURE 3.

FIGURE 4 illustrates a third condition which may exist wherein the switch is also maintained in the open condition. In this instance the plunger operator 46 is depressed to bend down the spring arm 19. This moves the shoulders 54 (see FIGURE 2) down and completely clear of the mobile contact support 18. In this condition the mobile contact support arm 18 is completely free of effect by the non-thermal condition responsive mechanism. In FIGURE 4, however, the disc 27 is in its upward position of stability so the bumper 39 maintains the mobile contact 23 in its switch open position. The plunger 46 and the spring arm 19 are arranged so that movement of the plunger until its end face is flush with the adjacent surface of the cover element 11 does not cause engagement of the upper side of the mobile contact 23 or its support 18 by the spring arm 19. Therefore, the non-thermal condition responsive mechanism is functionally disconnected from the mobile contact arm and does not in any way effect the operation of the thermostat in response to thermal conditions when this condition exists.

The switching device may be mounted by any suitable means. For example, the disc retainer 28 may be provided with lateral extensions formed with apertures to provide for the mounting. Such projections are not illustrated, but would normally extend laterally with respect to the plane of the section of FIGURE 1. When mounted in position, the plunger operator 46 should be positioned to

be engaged by the mechanism producing the non-thermal responsive movement. For example, if the thermostatic switching device is used to control an icemaking mechanism, a link or operator which senses the presence or absence of ice in the system is positioned to engage the end of the plunger **46** and operate it between its depressed and extended position. Similarly the disc **27** is located to sense the temperature condition to be controlled.

Although a preferred embodiment of this invention is illustrated, it is to be understood that various modifications and rearrangements of parts may be resorted to without departing from the scope of the invention as defined herein.

What is claimed is:

**1.** A thermostatic switching device comprising a body assembly, a switch in said body assembly including a fixed contact and a mobile contact assembly, said mobile contact assembly including a mobile contact carried by a resilient contact support which resiliently urges said mobile contact toward a switch closed position in engagement with said fixed contact, thermal responsive means connected to said mobile contact assembly being operable to maintain said switch open until a predetermined temperature condition is reached and then allowing said switch to close, and a separate non-thermal condition-responsive operating means connected to said mobile contact assembly operable in a first condition to hold said switch open and operable in a second condition to allow said switch to close, whereby said switch closes only when said separate operating means is in said second condition and said predetermined temperature condition exists.

**2.** A thermostatic switching device as set forth in claim **1** wherein said resilient contact support is a cantilever arm supported on said body assembly at a location remote from said mobile contact.

**3.** A thermostatic switching device as set forth in claim **2** wherein said separate operating means are arranged so that it is disconnected from said mobile contact and does not affect the operation thereof when in said second condition.

**4.** A thermostatic switching device as set forth in claim **3** wherein said second operating means includes a resilient arm cantilever mounted on said body and providing sufficient spring force to overcome the resilient force of said resilient contact support when said separate operating means are in said first condition.



**5.** A thermostat as set forth in claim **4** wherein adjustment means are provided to adjust the force of said resilient arm.

**6.** A thermostatic switching device as set forth in claim **4** wherein said separate operating means includes an operator member projecting to the exterior of said body assembly adapted to be actuated by external means to operate said separate operating means between said first and second conditions.

**7.** A thermostatic switching device as set forth in claim **6** wherein said operator member is limited in its movement in the direction of its projection from said body assembly and does not project from said body assembly when said separate operating means is in said second condition.

**8.** A thermostatic switching device as set forth in claim **1** wherein said thermal responsive means is a bimetallic snap disc having two positions of stability, and bumper means is positioned between said disc and resilient contact support to allow said switch to close only when it is in one of said positions of stability.

**9.** A thermostatic switch device as set forth in claim **8** wherein said snap disc is operatively connected to said mobile contact assembly so that it can only produce forces thereon urging said mobile contact assembly toward its switch open position, and said separate operating means is operatively connected to said mobile contact assembly so that it can only produce forces thereon urging said mobile contact assembly toward its switch open position.

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U.S. Cl. X.R.

337—66, 91, 367