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COMBINED PRESSURE AND SAFETY SWITCH

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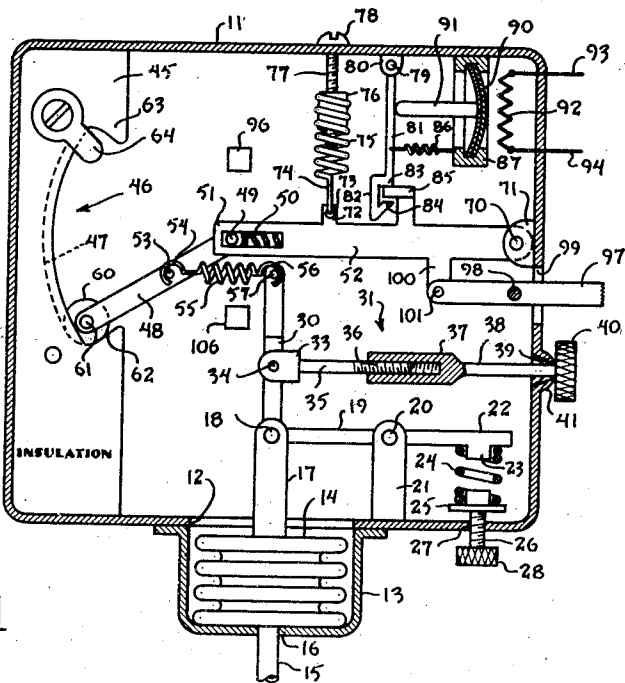


Fig. 1

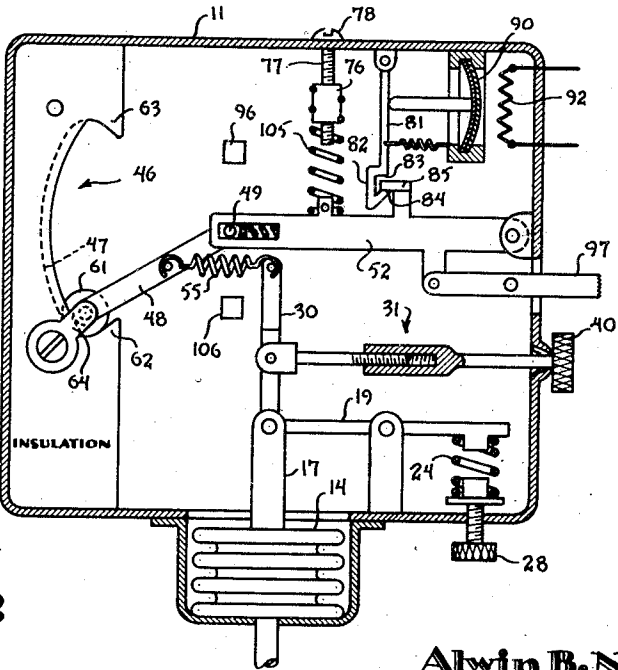


Fig. 2

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COMBINED PRESSURE AND SAFETY SWITCH

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This invention relates broadly to the field of switches, and more specifically to that type of switch which is operated by more than one responsive mechanism.

In many cases it is desirable to place a switch under the normal control of a device responding to a certain condition, and to associate a second device with the switch to operate it independently of the first device when a second condition reaches a predetermined value.

In the field of refrigeration for example, it would be desirable to provide a device responding to the pressure on the suction side of the compressor for operating a switch to energize the compressor motor when the suction pressure exceeded a given value and to deenergize the compressor motor when the pressure dropped below a second lower value. It would also be desirable to provide a safety device for independently opening the switch in case the compressor motor should become overloaded. The pressure responsive device might also be made to respond to the pressure on the high pressure side of the compressor instead of the suction side in order to deenergize the compressor motor if the pressure reached too high a value. The safety device in this case also would open the switch in case of an overload on the compressor motor.

It is therefore an object of this invention to provide a switch which will perform the functions as stated above.

A further object is to provide a pressure responsive device for operating a snap action mechanism and a differential adjustment which comprises varying the distance which the pressure responsive device must move in order to operate the snap action mechanism.

A further object is to provide a differential adjustment which comprises a link connecting a condition responsive device and an over center snap action mechanism and a means for manually selecting the path along which the link is moved by the condition responsive device.

Another object of the invention is to provide a snap acting lever having a roller at its free end, a track for said roller, and stationary contacts on said track with which said roller is adapted to contact.

Still another object of this invention is to provide a switch which is operated by a pivoted lever through the medium of an over center spring and a bellows, in combination with a safety device for moving the pivot for the lever so the switch can be opened independently of the bellows.

Another object is to provide a switching mech-

anism which, by a few simple substitutions, can be changed from one which will open on high pressure and close on low pressure to one which will close on high pressure and open on low pressure, and a safety device which will open the switch independently of the pressure responsive device in both cases.

Although this device has been described in connection with a refrigeration system, it will be clear that it has many other applications.

These and other objects will become readily apparent to those skilled in the art as the following specification is read in the light of the accompanying drawing in which:

Figure 1 is a more or less diagrammatic showing of my invention as applied to a low pressure cut-out, and

Figure 2 is a showing of my invention as applied to a high pressure cut-out.

Referring first to Figure 1, the reference numeral 11 designates a casing in which the switch mechanism of the present invention is contained. In the bottom of the casing 11 is a hole 12 and a housing 13 is secured around the hole 12 on the outside of the casing. Located within the housing 13 is a bellows 14 which is connected by means of a capillary tube 15 extending through hole 16 in the housing 13 to a source of variable pressure which is to be controlled. It will be understood, however, that if it is desired to control a variable temperature, the tube 15 will be connected to a thermal bulb which will respond to the variations in the temperature to be controlled.

The movable end of the bellows 14 carries a post 17 to which is freely pivoted by means of a pin 18 the lever 19. Lever 19 is also pivoted by means of pin 20 to a support 21 suitably mounted on the casing 11. The end 22 of the lever 19 has an extension 23 about which is located one end of a compression spring 24, the other end being seated on a flanged member 25 which is carried by a screw 26 adjustably positioned in a hole 27 in the bottom of the casing 11. The screw 26 is provided with a knurled head 28 located outside of the casing 11 so that the screw may be manually adjusted in the casing to vary the position of the flanged member 25 which in turn will vary the force exerted by the spring 24 on the lever 19. This acts as the main adjustment for the bellows 14 to determine the pressure or temperature at which it will operate the post 17.

Also freely pivoted on pin 18 is a link 30 which is guided in its movement by the bellows 14 by means of a guide arm generally indicated at 31.

The guide arm 31 is formed by two members, one of which comprises a saddle 33 which is freely pivoted to the link 30 by means of the pin 34, the saddle 33 having an extending rod 35 which is screw-threaded at its end as shown at 36. The other member is in the form of a nut 37 which is screwed onto the screw threads 36, the nut having an extension 38 which passes through hole 39 in the side of the casing 11 and terminates in a knurled head 40. It will be seen that the casing about the hole 39 is struck outwardly in a rounded form as shown at 41 to provide a bearing surface about which the head 40 may roll as the saddle 33 is moved by the bellows 14. Manual rotation of the head 40 will lengthen or shorten the guide arm 31 to vary the path taken by the link 30 as it is moved under the influence of the bellows 14. The purpose of this adjustment will be described more in detail later on.

On the inside of the casing 11 is located a block of insulating material 45 which has a cut-away portion generally indicated at 46 at the bottom of which is located a narrow groove 47. A contact arm 48 is pivoted by means of a pin 49 in a slot 50 located in the end 51 of a lever 52. The contact arm 48 is provided with a pin 53 about which is looped one end 54 of a tension spring 55, the other end 56 of which is looped about pin 57 carried by the upper end of the link 30. The free end of the contact arm 48 carries a rolling contact or wheel 60 by means of an axle 61, the wheel fitting in the groove 47 and rolling along its length as the contact arm 48 is moved back and forth in a manner to be described. The ends 62 and 63 of the cut-away portion 46 serve as stops for the wheel 60. Located in the upper end of the cut-away portion 46 is a pair of resilient contact members, one of which is shown at 64, the other being located immediately behind it. As the contact arm is moved to its upper position, it will close the circuit between the contacts 64.

In considering the operation of that part of the device which has just been described, it will at first be assumed that the parts are in the position shown in Figure 1. The pressure within the bellows 14 is at a low value which has caused the contact arm 48 to move to switch open position. As the pressure increases within the bellows 14, it will expand and raise the post 17 causing the link 30 to move in an upwardly direction under the guidance of the arm 31 which will rotate about the raised portion 41 in the side of the casing 11. Upward movement of the link 30 raises end 56 of the tension spring 55 and until this end passes over center with respect to the pivot 49, the contact arm 48 will remain in the position shown in Figure 1 due to the fact that the spring 55 is tending to rotate this arm in a counter-clockwise direction. However, as the end 56 passes over center with respect to the pin 49, the spring 55 will exert a rotative force on the arm 48 in a clockwise direction and cause it to snap to its upper position where it will close the circuit between the contacts 64. The closure of this circuit will cause a reduction in the pressure which expanded the bellows 14 and which will then contract and again move the end of spring 56 over center with respect to the pin 49, and this spring will then snap the contact arm 48 back to its original position as shown in Figure 1.

Due to the fact that the bellows must overcome the force exerted by the spring 55 before it can actuate the contact arm 48, and also due to the fact that the pin 57 must be above the pin 49 to snap the contact arm to its upper position

and below the pin 49 to snap the contact arm 48 to its lower position, the instrument will have a certain differential. The purpose of the rotative adjustment of the knurled head 40 is to vary the length of the guide arm 31 for the purpose of varying this differential. Assume that the head 40 is rotated in a direction to lengthen the arm 31, it will be seen that in the first place the pin 57 will be moved toward the left which will reduce the tension of the spring 55 which will tend to reduce the differential of the instrument due to the fact that there will be less spring force which the bellows 14 must overcome before it can operate the contact arm 48. In the second place, movement of the pin 57 toward the left will mean that the bellows will not have to move the link 30 as great a distance in order that the pin 57 pass over center with respect to the pin 49. This will also reduce the differential of the instrument and in fact will have a greater effect on the reduction than the effect of reducing the tension of the spring 55. If the head 40 is rotated in the opposite direction, the length of the guide arm 31 is shortened which means that the spring 55 will be put under greater tension and that the bellows 14 must move the link 30 a greater distance before the pin 57 will move over center with respect to the pin 49.

It will be seen, therefore, that this device has two adjustments, first, rotation of the head 28 varies the force exerted by spring 24 which will adjust the pressure or temperature at which the bellows will start to operate. This is the main adjustment for the device. Adjustment of the head 40 merely acts to adjust the difference in pressure or temperature at which the bellows will cause the contact arm to rotate in one direction and the pressure or temperature at which the bellows will cause the contact arm to rotate in the opposite direction.

The lever 52 is pivoted by means of pin 70 to a support 71 suitably fastened to the side of casing 11. The lever 52 is provided with an upstanding ear 72 having a hole 73 therein in which is looped one end 74 of a tension spring 75, the other end of which is suitably fastened to a non-rotatable nut 76. A screw 77 depends loosely through a hole in the top of the casing 11 and is adjustably threaded in a hole extending longitudinally through the nut 76. The screw 77 is supported by and also adjusted by a head 78 which engages the casing 11. Rotation of the head 78 causes a vertical adjustment of the non-rotatable nut 76 and hence a variation in the tension of spring 75. The function of the spring 75 is to bias the lever 52 for rotation in a clockwise direction about its pivot 70.

Pivoted by means of pin 79 in a support 80 suitably connected to the casing 11 is a latch member 81 having a generally U shaped end 82 forming two latching surfaces 83 and 84. The lever 52 has an extension 85 which normally extends between the two latching surfaces 83 and 84 and engages one of them depending upon which way the lever 52 is biased. In Figure 1, the lever 52 is biased for rotation in a clockwise direction and hence the extension 85 engages the latching surface 83. A tension spring 86 is connected between the latch 81 and a block of insulating material 87 suitably connected to the casing 11 to bias the latch to move into engagement with the extension 85. Thus it will be seen that the lever 52 is normally latched and maintained stationary so as to provide a fixed position for the pin 49 about which the contact arm

48 rotates. Suitably mounted in the insulating block 87 is a thermostat of the bimetallic snap disc type indicated at 90. A connecting rod 91 extends from the center of the disc 90 and is adapted under certain circumstances to engage the rotatable latch 81. An electric heating element is diagrammatically shown at 92 and connected by means of conductors 93 and 94 to a load circuit which may be controlled by the switch contacts 64. Under normal conditions of the load circuit, the heater 92 develops a relatively small amount of heat and the snap disc 90 remains in the position shown in Figure 1. However, upon an overload the heater 92 will develop an additional amount of heat which will heat the disc 90 to the point where it will snap toward the left and the connecting rod 91 will rotate the latch 81 in a clockwise direction where the latching surface 83 will move out of engagement with extension 85 on the lever 52.

In considering the operation of the device as a whole, it will be assumed that the parts are in the position shown in Figure 1. On an increase in pressure in the bellows 14, the contact arm 48 will be moved to its upper position where it closes the circuit between the contacts 64 as described above. Under normal load conditions, the bellows 14 will control the contact arm 48 in accordance with the pressure or temperature to be controlled. However, if the pressure is high and the circuit between the contacts 64 closed, and an overload occurs it is desirable to open the circuit. Under such conditions, the heater 92 will develop a sufficient amount of heat to cause the bimetallic disc 90 to snap to the left causing the connecting rod 91 to rotate the latch arm 81 out of engagement with the extension 85. This permits the tension spring 75 to rotate the lever 52 in a clockwise direction until it engages the stop 96. This will cause the pin 49 about which the contact arm 48 rotates to move over center with respect to the spring 55 and the result is that the contact arm 48 will be rotated in a counter-clockwise direction to disengage the contacts 64 and open the load circuit. It is seen that this action is entirely independent of any pressure which may exist within the bellows 14.

When the heater 92 cools, the disc 90 will snap back to its original position but the lever 52 must be manually returned by means of a reset lever 97 which is pivoted at 98 and extends through the hole 99 in the side of the casing 11. The lever 97 is connected to an extension 100 on the lever 52 by means of the pin 101. By raising the outer end of the lever 97, the lever 52 will be rotated in a counter-clockwise direction and if the disc 90 has snapped back to its original position at this time, the rotation of the lever 52 to its original position will cause the latch 81 to reengage the extension 85 and the device will then have been reset. The disc 90 must be given time to cool before the device is reset because otherwise the latch 81 would be prevented from moving into engagement with the extension 85 when the lever 52 was manually rotated.

The device disclosed in Figure 1 is a device which will open the circuit on low pressure and close it on high pressure and open the circuit on an overload. The device disclosed in Figure 2 is one which will open the circuit on high pressure, close the circuit on low pressure, and open the circuit on overload. In order to change the device of Figure 1 to the device of Figure 2, only a few simple changes are needed. In the first

place, the stationary contacts 64 must be moved to the lower end of the groove 47 so that a decreased pressure within the bellows 14 will close the circuit between the contacts. In order that the overload device shall operate to move the contact arm 48 to its upper position when the latch 81 is released, it is necessary to bias the lever 52 for rotation in a counter-clockwise direction instead of a clockwise direction as in Figure 1. In order to accomplish this, a compression spring 105 is substituted for the tension spring 75 of Figure 1. The compression spring 105 will now cause the extension 85 on the lever 52 to engage the latching surface 84 instead of the surface 83 as in Figure 1, and when the latch 81 is released on overload the compression spring 105 will rotate the lever 52 in a counter-clockwise direction until it engages the stop 106. This will cause the pin 49 to pass over center with respect to the spring 55 when the parts are in the position shown in Figure 2 which will cause the contact arm 48 to move to its upper position and break the circuit between the stationary contacts 64.

The main adjustment feature and the differential adjustment of the two devices are identical as are all of the other parts which have not been specifically mentioned in connection with Figure 2. It is, therefore, believed unnecessary to further describe this figure or its operation.

It will, therefore, be seen that a very simple mechanism has been provided for opening a switch on a predetermined low pressure and close it on a predetermined higher pressure and for opening the switch on an overload regardless of the existing pressure. The overload cut-out is of such a nature that it must be manually reset, at which time the trouble producing the overload may be located and corrected. It is also seen that this device by a few simple changes may be made to open the switch on a high pressure and close it again on a predetermined lower pressure, the overload cut-out again working to open the switch independently of the existing pressure.

As certain changes and modifications in this invention may occur to those who are skilled in the art, it is to be understood that I intend to be limited only by the scope of the appended claims and not by the specific embodiment disclosed.

I claim as my invention:

1. In a switch, a pivoted lever, a roller carried by a free end of said lever, a block of insulation, a groove in said block in which said roller is adapted to travel, a pair of stationary contacts connected to said groove, a tension spring connected to said lever, a pressure responsive device and said spring, said device moving said spring back and forth over center with respect to said lever to snap said roller into and out of engagement with respect to said stationary contacts, a pivoted arm for guiding said link as it is moved by said pressure responsive device, and manual means for varying the length of said arm between its pivot and said link.

2. In a switch, a pivoted lever, a roller carried by a free end of said lever, a block of insulation, a groove in said block in which said roller is adapted to travel, a pair of stationary contacts connected to said groove, a tension spring connected to said lever, a pressure responsive device, a link connecting said pressure responsive device and said spring, said device moving said spring back and forth over center with respect

to said lever to snap said roller into and out of engagement with respect to said stationary contacts, and means for varying the tension of said said spring.

3. A snap action mechanism comprising a lever, a pivot for said lever, an over center spring, means for moving said spring to cause said lever to snap from one position to another, and means for moving said pivot to cause said lever to snap to one position under the influence of said spring independently of said first mentioned means.

4. A snap action mechanism comprising a lever, a pivot for said lever, said pivot being biased for movement in one direction, means normally preventing movement of said pivot, an over center spring, a condition responsive device for moving said spring to operate said lever from one position to another, and means responsive to a second condition for actuating said first mentioned means to permit said pivot to move under the influence of its bias to cause said lever to be operated to one position by said spring independently of said condition responsive device.

5. In a device of the character described comprising in combination, a first lever, a pivot for said lever, a second lever, one end of said second lever being pivotally supported on a free end of said first lever, a spring biasing said first lever for rotation, a latch for preventing such rotation, an over center spring connected to said second lever, a switch controlled by said second lever, a pressure responsive bellows, connecting means between said bellows and said over center spring whereby upon an increase in pressure said bellows will move said spring to rotate said second lever about its pivot in one direction and close said switch, and upon a decrease in pressure said bellows will move said spring to rotate said second lever in the other direction about its pivot and open said switch, and a thermostat for tripping said latch at a predetermined temperature to permit said first lever to rotate under the influence of its bias and cause said second lever to rotate in said other direction and open said switch independently of said bellows.

6. In a device of the character described, a pivoted control lever, an over center spring connected at one end to said lever, first means to move the other end of said spring in a definite path, said movement carrying said spring over center with respect to said lever whereby the latter is moved with a snap action, and a second means for moving said other end of said spring in a direction transverse to said path whereby movement of said first means causes movement of said other end of said spring in a different path.

7. In a device of the character described, a first pivoted lever, a second lever pivoted on said first lever, an over center spring connected to said second lever, a condition responsive device for moving said spring to cause said second lever to be snapped back and forth between two positions, a latch for normally preventing movement of said first lever, a second condition responsive device for tripping said latch, said first lever being rotatable in one direction to cause said second lever to be snapped to one of its positions and rotatable in the other direction to cause said second lever to be snapped to its other position, both movements being independent of said first condition responsive device, and means for biasing said first lever for rotation in a direction dependent upon the position it is desired the second lever assume when said latch is tripped by said second condition responsive device.

8. A device of the character described comprising in combination, a pivoted control lever, an over center spring connected at one end to said lever, a condition responsive device, a link joining said condition responsive device and the other end of said spring, guide means cooperating with a mid point on said link for determining the path along which the said other end of the spring is moved by said condition responsive device and link, and means for adjusting said guide means.

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