Jan. 23, 1962 G. W. GUSTAFSON 3,018,345

SWITCH APPARATUS

Filed Dec. 15, 1960

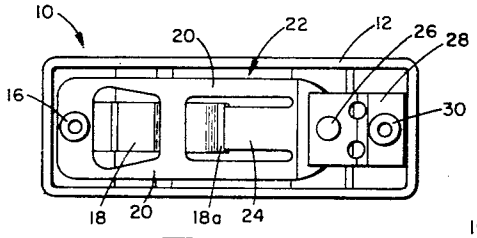

Fig 2

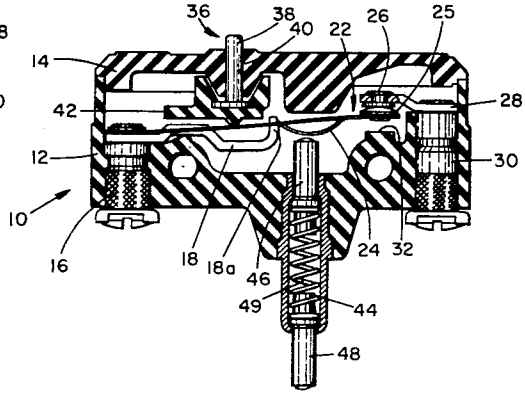

Fig 1

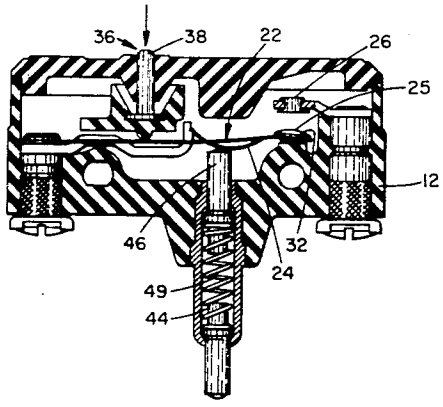

Fig 3

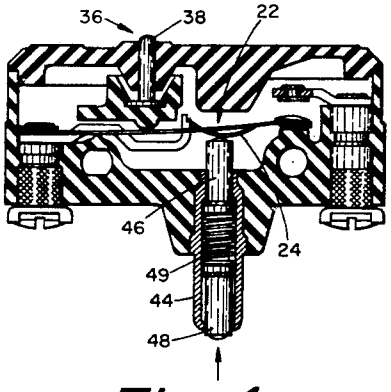

Fig 4

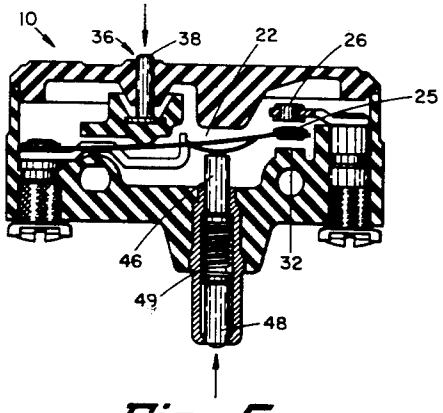

Fig 5

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SWITCH APPARATUS

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This invention is directed to an improved trip-free reset arrangement for utilization with a precision snap acting mechanism.

In many condition control systems, it is necessary that the system be made inoperative upon a particular condition being attained in the system. For example, in automatically controlled forced air home heating arrangements, it is imperative that the temperature in the bonnet of the furnace be maintained below a pre-determined level if damage to the furnace and the home it serves is to be averted. Consequently, the arrangement must be designed to become inoperative or be shut down if the temperature in the bonnet of the furnace exceeds the predetermined level. To bring about an inoperative condition in the arrangement upon the pre-determined level being attained, it is common to cause a precision snap acting switch to be actuated by means sensitive to the temperature in the bonnet of the furnace. It is also the usual custom to utilize reset snap acting switches, that is, switches which upon being actuated are "tripped out" so that a manual resetting action is required to return the switch to its initial condition to thereby allow the arrangement to again become operative if in fact the temperature in the bonnet of the furnace is below the predetermined level and/or if the fault which caused the excessive temperature has been corrected. However, most such reset snap acting switches can be "blocked in," that is, placed in such a condition that upon the temperature in the bonnet of the furnace dropping below the pre-determined level, the switch is reset automatically to allow the furnace again to become operative. Of course, under such a set of circumstances, if something is faulty in the arrangement, it does not become immediately apparent inasmuch as no indication of the fault is given as would be the case if the switch were not "blocked in." Ultimately of course, if something is faulty in the arrangement, complete breakdown occurs with the possibility of personal injury and extensive damage to the system and the home it serves.

To overcome the shortcomings of ordinary reset snap acting switches which can be "blocked in," so-called trip-free reset snap acting switches are utilized in condition control systems of the type under consideration. Such switches include a reset arrangement which requires a positive actuation thereof each time it is necessary to reset the switch with which it is associated.

Trip-free reset snap acting switches as such are known in the prior art. However, the reset portions of such switches are relatively complex in operating movement and structure requiring cams, cam surfaces, drop offs and the like and are relatively large in size and costly to build because of the foregoing.

In the present invention a trip-free reset snap acting switch is disclosed, the reset portion of which is extremely simple in operation and structure and which is comprised of a few straightforward components and which is relatively small in size resulting in a mechanism which is inexpensive to build.

Therefore, it is an object of the present invention to provide a trip-free reset mechanism for a snap acting mechanism which is extremely simple in its operation and relatively small in size.

Another object of the present invention is to provide a trip-free reset arrangement for a snap acting mechanism which is extremely simple in structure and which is comprised of elements which are inexpensive to produce and assemble.

These and other objects will become more apparent from a reading of the following specification and appended claims in which:

FIGURE 1 is a cross-sectional view of a snap acting switch in a normal unactuated condition which switch includes an improved trip-free reset arrangement in its free position;

FIGURE 2 is a plan view of FIGURE 1 with the cover removed;

FIGURE 3 is a view of the arrangement of FIGURE 1 with the switch in an actuated condition and the trip-free reset arrangement in its free position;

FIGURE 4 is a view of the arrangement of FIGURE 1 with the switch in the actuated condition and with the trip-free reset arrangement in a condition just prior to the switch being reset to the condition of FIGURE 1; and

FIGURE 5 is a view of the arrangement of FIGURE 1 with the switch in an actuated condition and the trip-free reset arrangement in a "blocked in" condition.

In FIGURES 1 and 2, a reset precision snap acting switch **10** includes a base **12** and a cover **14** appropriately secured thereto. A first terminal member **16** is molded in the base **12** and supports an anchor member **18** having an upstanding leg **18***a* at an extremity thereof. Also supported from the terminal member **16**, in a cantilever fashion, are a pair of interconnected tension members **20** of a snap spring **22**. The snap spring **22** includes a compression member **24** which is supported from the upstanding leg **18***a* of the anchor member **18**, also in cantilever fashion. A contact **25** is disposed on the movable extremity of the snap ring **22** and is arranged to normally engage a fixed contact **26** supported from a contact support member **28** which in turn is supported from a second terminal member **30** molded in the base **12**. A stop **32** is provided on the base **12** for engagement by the movable contact **24** upon actuation of the switch **10** and snap movement of the snap spring **22**. Actuation of the switch **10** is brought about by inward movement of a plunger **36** which is supported in the cover **14**. The plunger **36** is comprised of an upset metal pin **38** which is disposed in opening **40** of the cover **14** and a plastic shoe **42** which is molded about the upset portion of the metal pin **38** and which engages a portion of the snap spring **22**. A bushing **44** is also molded in the base **12** and has a pair of oppositely disposed plungers **46** and **48** with a coil spring **49** disposed therebetween located therein.

As shown in FIGURE 1, the switch **10** is in its normal unactuated condition and the reset arrangement comprised of the bushing **44**, plungers **46** and **48** and coil spring **49** is in its free position.

Referring now to FIGURE 3, upon an actuating force being applied to the metal pin **38** of the plunger **36**, movement is imparted to a portion of the snap spring **22** until

the snap over point or neutral plane thereof is attained whereupon the movable contact **25** of the snap spring **22** travels with a snap movement from the fixed contact **26** to the stop portion **32** provided on the base **12**. As the snap spring **22** passes through its neutral plane in its movement toward its actuated condition, the compression member **24** engages the outer extremity of the plunger **46** causing an inward movement thereof into the bushing **44** against the bias of the spring **49**.

It should be noted that the supports for the snap spring **22** and the stop portion **32** are so located that the snap spring **22** is not self-returning from its actuated to its unactuated condition.

Upon the actuating force being removed from the metallic pin **38** of the plunger **36**, the reset arrangement can be actuated to cause the snap spring **22** to assume the position shown in FIGURE 1. Thus, referring to FIGURE 4, by moving the plunger **48** inwardly into the bushing **44**, a constantly increasing force is built up in the spring **49**. During initial movement of the plunger **48**, nothing occurs insofar as movement of the plunger **46** and the snap spring **22** are concerned inasmuch as the bias supplied by the snap spring **22** is in excess of that supplied by the spring **49**. However, a point is ultimately reached wherein the force of the spring **49** is sufficient to overcome the bias of the snap spring **22**. Upon this occurring, the plunger **46** moves outwardly from the bushing **44** under the bias of spring **49** causing movement of the snap spring **22** towards the position shown in FIGURE 1. Thereupon the force stored in the spring **49** accelerates the movement of the plunger **46** and the snap spring **22**. The plunger **46** is limited in its movement so that it is not and can not be physically in contact with the compression member **24** of the snap spring **22** as the snap spring **22** passes through its neutral plane. However, due to the momentum imparted to the snap spring **22**, it is caused to be driven to, through and past its neutral plane so as to assume the position shown in FIGURE 1.

Thus the trip-free reset arrangement as disclosed herein is based on a principle of force storage with consequent force dispersal to cause movement and acceleration to be imparted to an overcenter mechanism but without any portion of the reset arrangement physically in contact with the overcenter mechanism as it passes or enters into the neutral plane of the overcenter mechanism.

In FIGURE 5, with the switch **10** in an actuated condition, an actuating force is applied to the metallic pin **38** of the plunger **36** and a reset force is applied to the plunger **48**. It can be seen that the movable contact **25** has been moved from the stop **32** but is not in engagement with the fixed contact **26**. In other words, the switch **10** is in a condition as would cause the system with which it is associated to be inoperative and further the reset mechanism is "blocked in." Now should the actuating force be removed from the metal pin **38** of the plunger **36**, the reset arrangement is incapable of driving the snap spring to the condition shown in FIGURE 1. This is because the plunger **46** has already attained its ultimate outward position, and therefore, the force stored in the spring **49** is not effective to cause movement of the plunger **46** and consequently of the snap spring **22**. Again, since the plunger **46** is incapable of being in engagement with the snap spring **22** as it enters the neutral plane, it can not cause the snap spring **22** to assume the condition shown in FIGURE 1 once it has attained its ultimate position without having first imparted momentum to the snap spring **22**.

Thus, with a trip-free reset arrangement of the type described above, a snap acting mechanism can not be "blocked in" so as to cause automatic de-actuation thereof after first being subjected to an excessive condition and then a normal condition. Each time it is desired to reset the snap acting mechanism, it is necessary for the plunger **48** to be moved inwardly subsequent to the actuation of the snap acting mechanism. With this function, true trip-free reset is provided.

The trip-free reset arrangement utilizes a simple operating procedure and is comprised of but a few straightforward elements. Further, all of the elements of the trip-free reset arrangement are simple to fabricate and assemble resulting in a low cost structure.

With all of the innumerated advantages in mind, it is apparent that there are modifications of the invention possible. Therefore, the scope of the invention should be determined from the following claims.

I claim.

1. A trip-free reset arrangement for a non-self return snap switch including a snap acting system having a neutral plane and having cantilever supported compression and tension members disposed on a support member, an operating plunger for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of the unsupported interconnected extremities of said compression and tension members from a first stop portion to a second stop portion provided on said support member, the combination comprising: a bushing fixed in said support member; a reset plunger supported in and partially disposed beyond said bushing in a first direction; a driven member supported in and partially disposed beyond said bushing in a second direction and limited in movement in said second direction; and a coil spring disposed in said bushing and between said reset plunger and said driven member; a portion of said snap acting system arranged to engage the extremity of said driven member beyond said bushing upon said snap acting system being driven past its neutral plane and toward said second stop portion thereby causing movement of said driven member against the bias of said coil spring; subsequent movement of said reset plunger against the bias of said coil spring and the bias of said snap acting system ultimately resulting in the energy stored in said coil spring being sufficient to overcome the force of said snap acting system thereby causing movement of said driven member and said snap acting system towards said first stop portion, the energy stored in said coil spring imparting momentum to said snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof, with said operating plunger in its actuated position and said reset plunger in its ultimate reset position, said driven member being located in its ultimate position in said second direction with the extremity thereof a finite distance removed from the neutral plane of said snap acting system and said snap acting system being located to the second side of its neutral plane so that further movement of said snap acting system does not arise upon said operating plunger assuming its unactuated position.

2. A trip-free reset arrangement for a non-self return snap switch including a snap acting system having a neutral plane disposed on a support member, an actuator for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of a portion thereof from a first stop portion to a second stop portion, the combination comprising: a bushing fixed with respect to said support member; a reset plunger supported in and partially disposed beyond said bushing in a first direction; a driven member supported in and partially disposed beyond said bushing in a second direction and limited in movement in said second direction; and spirng means disposed in said bushing and between said reset plunger and said driven member; a portion of said snap acting system arranged to engage the extremity of said driven member beyond said bushing upon said snap acting system being driven past its neutral plane and toward said second stop portion thereby causing movement of said driven member against the bias of said spring means; subsequent movement of said reset plunger against the bias of said

spring means and the bias of said snap acting system ultimately resulting in the energy stored in said spring means being sufficient to overcome the force of said snap acting system thereby causing movement of said driven member and said snap acting system towards said first stop portion, the energy stored in said spring means imparting momentum to said snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof; with said actuator in its actuated position and said reset plunger in its ultimate reset position, said driven member being located in its ultimate position in said second direction with the extremity thereof a finite distance removed from the neutral plane of said snap acting system and said snap acting system being located to the second side of its neutral plane so that further movement of said snap acting system does not arise upon said actuator assuming its unactuated position.

3. A trip-free reset arrangement for a non-self return snap switch including a snap acting system having a neutral plane disposed on a support member, operating means for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of a portion thereof from a first stop portion to a second stop portion, the combination comprising: a reset member appropriately supported by said support member; a driven member appropriately supported by said support member and limited in movement in a given direction; and a spring means disposed between said reset member and said driven member; a portion of said snap acting system arranged to engage an extremity of said driven member upon said snap acting system being driven past its neutral plane and toward said second stop portion thereby causing movement of said driven member against the bias of said spring means; subsequent movement of said reset plunger against the bias of said spring means and the bias of said snap acting system ultimately resulting in the energy stored in said spring means being sufficient to overcome the force of said snap acting system thereby causing movement of said driven member and said snap acting system towards said first stop portion, the energy stored in said spring means imparting momentum to said snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof; with said operating means in its actuated position and said reset member in its ultimate reset position, said driven member being located in its ultimate position in said given direction with the extremity thereof a finite distance removed from the neutral plane of said snap acting system and said snap acting system being located to the second side of its neutral plane so that further movement of said snap acting system does not arise upon said operating means assuming its normal position.

4. A trip-free reset arrangement for a non-self return snap switch including a snap acting system having a neutral plane disposed on a support member, operating means for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of a portion thereof from a first stop portion to a second stop portion, the combination comprising: a reset member appropriately supported by said support member; a driven member appropriately supported by said support member and limited in movement in a given direction; and a compressible resilient medium disposed between said reset member and said driven member; a portion of said snap acting system arranged to engage an extremity of said driven member upon said snap acting system being driven past its neutral plane and toward said second stop portion thereby causing movement of said driven member against the bias of said compressible resilient medium; subsequent movement of said reset plunger against the bias of said compressible resilient medium and the bias of said snap acting system ultimately resulting in the energy stored in said compressible resilient medium being sufficient to overcome the force of said snap acting system thereby causing movement of said driven member and said snap acting system towards said stop portion, the energy stored in said compressible resilient medium imparting momentum to said snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof; with said operating means in its actuated position and said reset member in its ultimate reset position, said driven member being located in its ultimate position in said given direction with the extremity thereof a finite distance removed from the neutral plane of said snap acting system and said snap acting system being located to the second side of its neutral plane so that further movement of said snap acting system does not arise upon said operating means assuming its normal position.

5. A trip-free reset arrangement for a non-self return snap mechanism including a snap acting system having a neutral plane disposed on a support member, operating means for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of a portion thereof from a first position to a second position, the combination comprising: a driven member appropriately supported by said support member and limited in movement in a given direction; and spring means appropriately supported by said support member; a portion of said snap acting system arranged to engage an extremity of said driven member upon said snap acting system being driven past its neutral plane and toward said second stop position thereby causing movement of said driven member against the bias of said spring means; subsequent movement of said spring means against the bias of said snap acting system resulting in energy being stored in said spring means and ultimately resulting in the energy stored in said spring means being sufficient to overcome the force of said snap acting system thereby causing movement of said driven member and said snap acting system towards said first stop position, the energy stored in said spring means imparting momentum to said snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof; with said operating means in its actuated position and said driven member in its ultimate reset position, said driven member being located in its ultimate position in said given direction the extremity thereof a finite distance removed from the neutral plane of said snap acting system so that further movement of said snap acting system and said snap acting system being located to the second side of its neutral plane does not arise upon said operating means assuming its normal position.

6. A trip-free reset arrangement for a non-self return snap mechanism including a snap acting system having a neutral plane disposed on a support member, operating means for driving said snap acting system through its neutral plane from a first side thereof to the second side thereof so as to cause snap movement of a portion thereof from a first position to a second position, the arrangement comprising: resilient means supported by said support member and having a first extremity limited in movement in a given direction and a second extremity; a portion of said snap acting system arranged to engage the first extremity of said resilient means upon said snap acting system being driven past its neutral plane and toward said second stop position thereby causing movement of the first extremity of said resilient means against the inherent bias thereof; subsequent movement of the second extremity of said resilient means against the bias of said snap acting system ultimately resulting in the energy stored in said resilient means being sufficient to overcome the force of said snap acting system thereby causing movement of the first extremity of said resilient means and said snap acting system towards said first stop position, the energy stored in said resilient means imparting momentum to said

snap acting system to cause movement thereof through its neutral plane from the second side thereof to the first side thereof; with said operating means in its actuated position and the second extremity of said resilient means in its ultimate reset position, the first extremity of said resilient means being located in its ultimate position in said given direction a finite distance removed from the neutral plane of said snap acting system and said snap acting system being located to the second side of its neutral plane so that further movement of said snap acting system does not arise upon said operating means assuming its normal position.

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