Jan. 15, 1957 C. W. WOOD 2,777,638

THERMOSTATIC CONTROL VALVE

Filed May 28, 1953

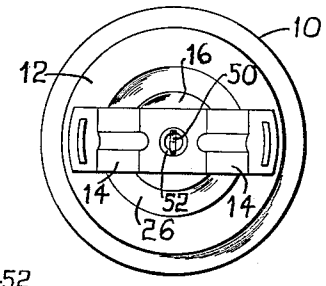


FIG. 3

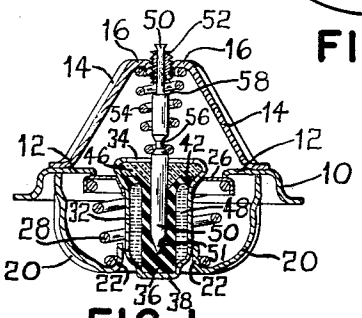


FIG. 1

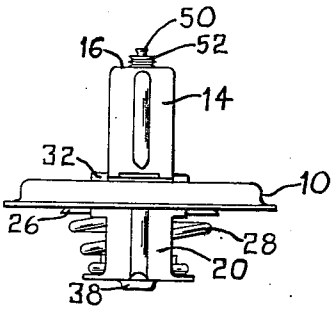


FIG. 2

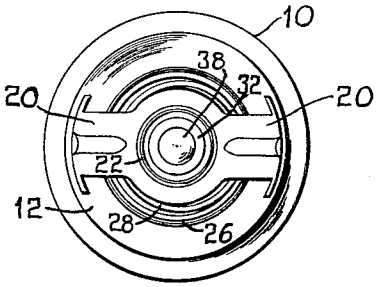


FIG. 4

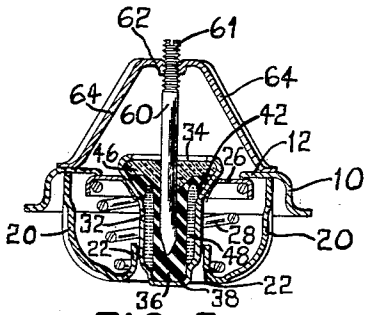


FIG. 5

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THERMOSTATIC CONTROL VALVE

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Application May 28, 1953, Serial No. 358,059

6 Claims. (Cl. 236—34)

This invention relates to a thermostatic fluid control valve. It relates particularly to a thermostatic fluid control valve for the cooling system of an internal combustion engine; but the invention is not so limited, in that it may be applied to other types of fluid systems.

An object of this invention is to provide a fluid control device which is small in size and compact.

Another object of this invention is to provide a thermostatic control device which has durability and long life.

Another object of the invention is to provide a fluid control device which is simple in construction and has a minimum number of moving parts.

Other objects and advantages reside in the construction of parts, the combination thereof and the mode of operation, as will become more apparent from the following description.

In the drawing,

Figure 1 is a side sectional view of the valve of this invention.

Figure 2 is a side view of the fluid control valve of this invention.

Figure 3 is a top plan view of the fluid control valve.

Figure 4 is a bottom view of the invention.

Figure 5 is a side sectional view disclosing a preferred modification of the invention.

Referring to the drawing in detail, the valve comprises an annular ring-shaped body 10 having an inwardly extending flange portion 12 forming a fluid port through the body 10. Attached to the body 10 and extending upwardly therefrom are a plurality of arms 14, each attached to a supporting plate 16 at the upper ends thereof. Attached to the lower side of the body 10 are a plurality of arcuate legs 20, at the ends of which is attached a guide cylinder 22. A movable valve member 26 is urged to closed position within the fluid passage in the body 10 by means of a spring 28 which surrounds a cylindrical casing 32, which is attached to the movable valve member 26. The ends of the spring 28 resiliently abut the legs 20 and the movable valve member 26. The construction of the casing 32 with the contents therein is similar to the thermal responsive device disclosed in my copending application Serial No. 333,707, filed January 28, 1953.

The casing 32 is an enclosed container having an orifice 34 in the upper surface thereof. Within the casing 32 is an elastic cylinder 36. The lower portion of the cylinder 36 is seated within a cup section 38 at the lower part of the casing 32. The cup section 38 retains the lower portion of the elastic cylinder 36 from radial movement. At the upper end of the elastic cylinder 36 is a flange 42 which extends radially from the elastic cylinder 36 and abuts the inner walls of the casing 32. The flange 42 is restricted from longitudinal movement, due to the fact that it is pressed downwardly by a disc 46 which is retained within the casing 32 at the upper end thereof.

Surrounding the cylinder 36 and filling the remaining space in the casing 32 is an expansive material 48. The elastic cylinder 36 is provided with a centrally located

longitudinal opening throughout a portion of the length of the spool. Positioned within the longitudinal opening in the elastic cylinder 36 is a pin or rod 50 having a tapered end 51. The pin 50 extends upwardly and protrudes from the casing 32 through an orifice in the disc 46 and through the aligned orifice 34 in the upper surface of the casing 32. The upper end of the pin 50 is slidably retained within a screw member 52 which is threadedly attached to the supporting plate 16 at the upper ends of the legs 14. A comparatively small helical spring 54 abuts the lower surface of the supporting plate 16, encircles the pin 50 and engages the pin within a notch 56. The spring 54 is a repositioning actuator, the function of which will be described below.

Under normal temperature conditions, the elements disclosed in Figure 1 will appear very much as they do in that figure. However, under conditions of increasing temperature, the expansive material 48 expands. This expansion results in a distortion of the elastic cylinder 36. Due to the fact that the elastic cylinder 36 is composed of a material which is non-compressible, the walls of the cylinder move inwardly in a direction to close the longitudinal opening in the spool. This results in forcing the pin 50 in a direction from the body of the cylinder 36 and from the casing 32. Under conditions of increased temperatures, the expansive material 48 will expand to such an extent that the pin 50 is actuated from the casing 32 such a distance that a shoulder 58 toward the upper part of the pin 50 is forced into abutting contact with the lower end of the screw member 52, which prohibits further movement of the pin 50. The distance which the pin 50 is moved by the expansion of the expansive material before the shoulder 58 abuts the end of the screw member 52 is called a pre-travel distance. Further expansion of the expansive material 48 results in further closing of the longitudinal opening within the cylinder 36. However, due to the fact that the pin or rod 50 is restricted from further movement, the casing 32 is caused to move downwardly, guided by the inner walls of the guide cylinder 22. As the casing 32 moves downwardly, it carries with it the movable valve member 26, which is attached to the casing 32. Therefore, this downward movement of the casing 32 results in the opening of the port through the body 10.

The thermostatic valve of this invention is ordinarily located in a fluid system, so that the fluid surrounds the casing 32. As the movable valve member moves to open the passage, fluid is allowed to move upwardly through the port in the body 10. When sufficient fluid has flowed through the passage or port in the body 10 and has circulated in the system, its temperature is reduced. The temperature of the expansive material is also reduced and gradually decreases in volume, allowing the helical spring 28, aided by the pressure of the fluid circulating through the port in the body 10, to force the movable valve member toward closed position. This movement toward closed position of the movable valve member is possible following the decrease in volume of the expansive material and the resulting decrease in total pressure of the expansive material against the walls of the elastic cylinder 36. Therefore, the longitudinal opening in the cylinder 36 is opened to a greater extent, allowing the pin or rod 50 to be inserted more deeply into the opening in the cylinder 36. When the temperature of the fluid surrounding the casing 32 has decreased sufficiently to allow the valve member to close the port in the body 10, the comparatively small helical spring 54, which is attached to the notch 56 of the pin 50, re-positions the pin 50 to its normal depth within the cylinder 36. The position of the screw member 52 may be threadedly adjusted in the supporting plate 16, thereby adjusting the normal distance between the shoulder 58 of the pin or rod

50 and the lower end of the screw member 52. Adjustment of this distance changes the travel distance of the pin 50, which thereby changes the temperature at which the shoulder 58 will engage the lower surface of the screw member 52, which results in changing the temperature at which the casing 32 begins to move downwardly, consequently changing the temperature at which the movable valve member 26 begins to open.

A preferred modification of the device of this invention is disclosed in Figure 5. The operation of the valve shown in Figure 5 is similar to the operation of the valve disclosed in Figure 1. However, the preferred modification employs the use of a pin 60, rather than the pin 50. An upper end 61 of the pin 60 is threadedly attached to a support plate 62 at the upper ends of the arms 64. Therefore, it may be understood that the pin 60 is not movable longitudinally as the walls of the elastic cylinder 36 are forced inwardly. Therefore, as the expansive material expands to such an extent that it forces the walls of the elastic cylinder inwardly in a direction closing the longitudinal opening through the cylinder, movement of the casing 32 immediately results and opening of the movable valve member 26 immediately begins. In other words, there is no pre-travel distance of the pin 60 before the movable valve member 26 starts to open. Hence, the valve 26 starts to open when the expanding pressure of the expansive material against the walls of the elastic cylinder 36 begins. Due to the fact that the pin 60 does not move, a re-positioning actuator, such as spring 54, is not necessary.

Both the preferred embodiment, as shown in Figures 1 and 2, and the preferred modification, as shown in Figure 5, may be calibrated and set to open and close at identical temperatures.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. In a fluid control valve, a body member having a flow passage therethrough, a support member extending from one side of the body member and attached thereto, a guide member attached to the body member and extending from the opposite side of the body member, a movable valve member operable to close the flow passage, comprising a casing having a solid end wall provided with an aperture therein, the casing being attached to the valve member and encircled by the guide member, resilient means abutting the guide member and the movable valve member urging the valve member to closed position, an elastic cylinder retained within the casing and having the ends thereof abutting opposite end walls of the casing, the elastic cylinder having a cavity therein extending a portion of the length thereof, a thermal responsive material surrounding the elastic cylinder, and a pin attached to the support member and extending into the elastic cylinder through the aperture in the casing.

2. In a thermostatic control valve having a valve seat forming a fluid port, a support member attached to the valve seat, comprising a casing having a solid end wall, the solid end wall having an aperture therein, an elongate body of elastic material having a cavity therein extending a portion of the length thereof, the elongate body being retained within the casing and extending the length thereof, expansive material within the casing partially surrounding the body of elastic material, annular guide means attached to the valve seat and encircling the casing for guiding the movement of the casing, a movable valve member attached to the casing adjacent said solid end wall and resiliently urged against the valve seat, and a rod attached to the support member and extending into the casing through the aperture in said solid end wall, the rod also extending into the cavity of the body of elastic material.

3. In a thermal responsive fluid control valve comprising a body member having a flow passage therethrough, a support member attached to one side of the body member, a guide member attached to the other side of the body member, a screw member having an abutment end and threadedly attached to the support member, an enclosed casing having a solid end wall provided with an orifice therein, the casing being slidably retained by the guide member, a valve member attached to the casing, the valve member having spring means urging it to closed position, an elastic cylinder extending substantially the length of the casing and positioned within the casing, the elastic cylinder having a longitudinal hole therein at substantially the center thereof extending a portion of the length of the cylinder, an expansive material contained in the casing and engaging the elastic cylinder, a pin positioned within the longitudinal hole in the elastic cylinder and extending from the casing through the orifice in the solid end wall of the casing, the pin being slidably attached to the screw member, the pin having an abutment shoulder adapted to contact the abutment end of the screw member, the pin also having a peripheral notch therein, and a spring having one end within the notch and the other end engaging the support member, initial movement of the casing and the valve member occurring when the abutment shoulder of the pin engages the abutment end of the screw member, the temperature at which initial movement begins being determined by the adjusted position of the screw member, the spring engaging the support member resiliently biasing movement of the pin.

4. In a fluid control valve comprising a ring-shaped body member provided with a valve seat having a flow passage therethrough, a support member attached to one side of the body member, a hollow screw member provided with an abutment surface and adjustably attached to the support member, an annular guide member attached to the other side of the body member and concentric with the flow passage of the body member, an enclosed casing having a solid end wall provided with an orifice therein, the casing being slidably retained by the guide member, a valve member attached to the casing adjacent said solid end wall, the valve member having resilient means urging it to closed position, an elastic cylinder extending substantially the length of the casing and positioned within the casing, the elastic cylinder having a longitudinal hole therein at substantially the center thereof extending a portion of the length of the cylinder, an expansive material contained in the casing and engaging the elastic cylinder, a pin positioned within the longitudinal hole in the elastic cylinder and extending from the casing through the orifice in the solid end wall of the casing, the pin being slidably movable within the hollow screw member, the pin having an abutment shoulder adapted to contact the abutment surface of the hollow screw member to limit the movement of the pin, the pin also having an annular notch therein, and a spring having one end within the notch and the other end abutting the support member, the spring urging the pin toward the end of the longitudinal hole in the elastic cylinder, the pin being extruded from the casing by the expansion of the expansive material until the abutment shoulder of the pin engages the abutment surface of the screw member, further expansion of the expansive material causing movement of the casing carrying with it the movable valve member.

5. A thermal responsive fluid control valve of the type having a valve seat forming a fluid port therethrough, a support member attached to the valve seat, a closure member movable toward and away from the valve seat, comprising a container attached to the closure member, the container having solid end walls, one of said solid

end walls having an aperture therein, an elastic body within the container and extending between said end walls, the elastic body having walls forming a cavity therein extending a portion of the length thereof and in alignment with the aperture, the walls forming the cavity being less in thickness than the length of the remaining portion of the elastic body which does not have the cavity therein, thermal expansive material within the container encompassing the elastic body, and a rod attached to the support member and slidably extending within the cavity of the elastic body within the container through said aperture in one of the end walls of the container.

6. In combination with a fluid valve device having a valve seat member forming a flow passage therethrough, support structure attached to the valve seat and extending therefrom, a closure member movable toward and away from the valve seat to close the flow passage, resilient means engaging the support structure and the closure member urging the closure member into engagement with the valve seat member, an actuator assembly comprising a container attached to the closure member, the container having solid end walls, an elastic body within the container and extending between the end walls thereof, the elastic body having a cavity therein extending a portion of the length thereof, a rod attached to the support structure and extending into the cavity of the elastic body through one of the end walls of the container, and a body of thermal responsive expansible-contractible material encompassing the elastic body within the container, movement of the container and the closure member being caused by expansion of the expansible-contractible material within the container, thus causing inward movement of the walls of the cavity while the position of the elastic body remains fixed, causing an extrusion action upon the rod and causing relative movement between the rod and the elastic body.

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