Oct. 5, 1954 J. L. STUBBLEFIELD 2,690,874

DUAL ACTION SAFETY THERMOSTAT FOR LIQUID COOLING SYSTEMS

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FIG. 1.

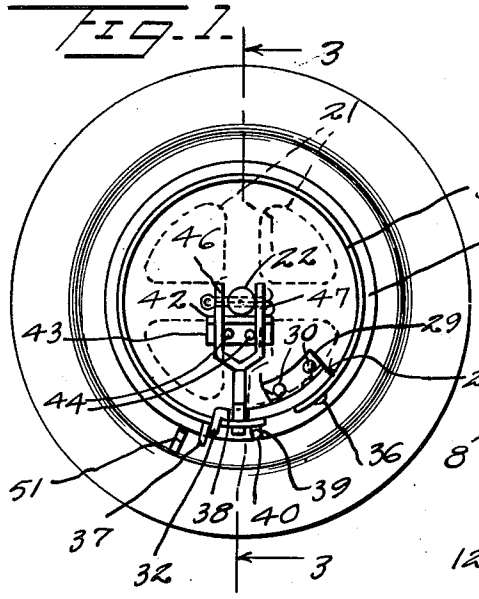


FIG. 2.

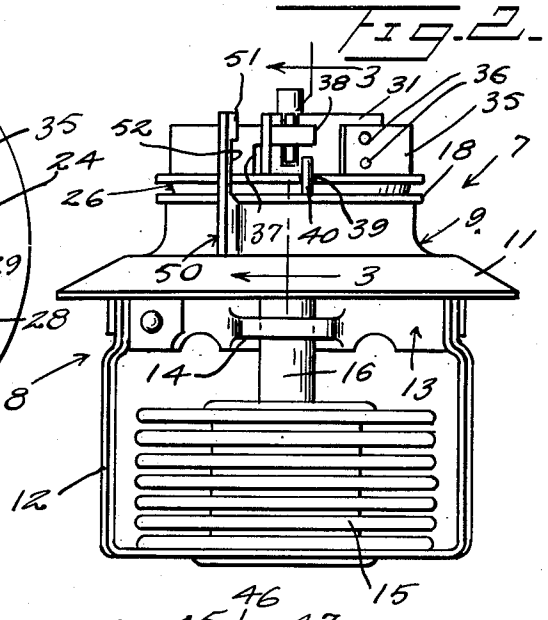


FIG. 3.

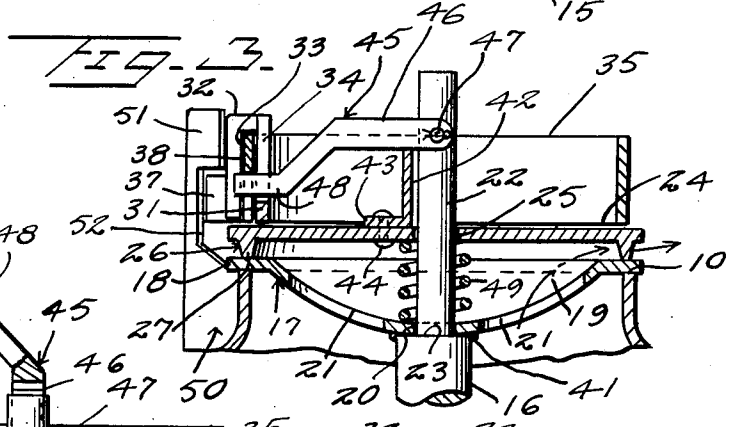


FIG. 4.

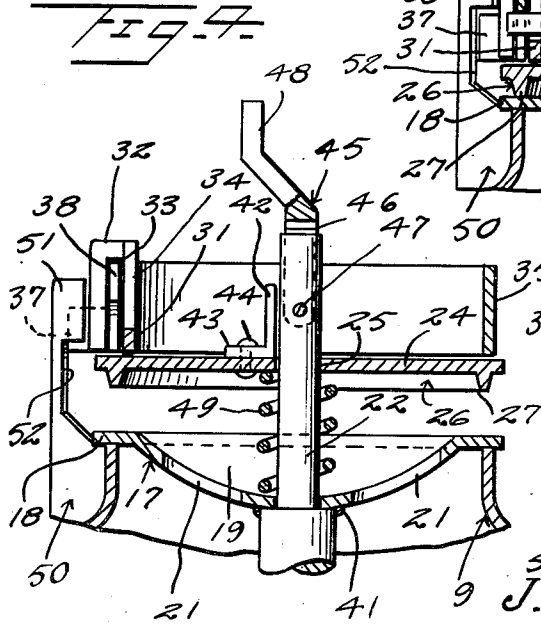
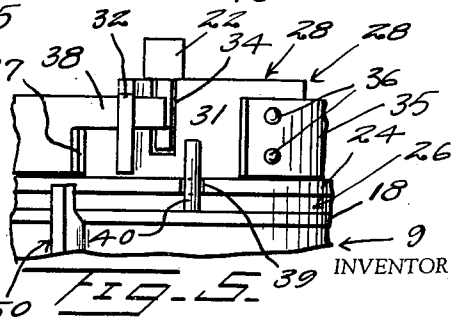


FIG. 5.



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DUAL ACTION SAFETY THERMOSTAT FOR LIQUID COOLING SYSTEMS

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8 Claims. (Cl. 236—34)

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This invention relates to an improved thermostat for controlling the flow of a liquid coolant through a cooling system and is primarily adapted for use in the cooling system of an internal-combustion engine to prevent the flow of the liquid coolant through the system until a predetermined temperature of the coolant has been reached, to thereby effect a more rapid heating of the engine to a proper operating temperature.

More particularly, it is an aim of the present invention to provide a thermostat for the aforedescribed purpose having two separately operated valves including a secondary safety valve capable of opening to permit the free flow of the liquid coolant in the event that the primary valve fails to open when the coolant has reached a predetermined temperature, to thereby provide a dual action thermostat which will positively prevent overheating of an engine due to failure of the thermostat to operate and which frequently occurs with conventional thermostats.

Still a further object of the invention is to provide a dual thermostat of extremely simple construction including a secondary valve and valve control means which is maintained inoperative except upon failure of the primary valve and its actuating means to function.

Still another object of the invention is to provide a dual action safety thermostat of relatively simple construction and which will occupy substantially the same space as conventional thermostats now in use, enabling it to be readily substituted for a conventional single action thermostat.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawing, illustrating a presently preferred embodiment thereof, and wherein:

Figure 1 is a top plan view of a dual action thermostat constructed in accordance with the invention;

Figure 2 is a side elevational view thereof;

Figure 3 is an enlarged fragmentary sectional view, partly in elevation, taken substantially along a plane as indicated by the line 3—3 of Figures 1 and 2;

Figure 4 is a view similar to Figure 3 illustrating the secondary valve in an open position, and

Figure 5 is a fragmentary elevational view looking from left to right of Figure 3 and showing certain of the parts as they will appear immediately before release of the secondary valve.

Referring more specifically to the drawing, the improved dual action thermostat in its entirety and comprising the invention is designated generally 7 and includes a frame, designated generally 8. The frame 8 has an upper annular part

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9 the upper edge of which forms a valve seat 10. Said annular upper part 9 includes a flared lower portion or skirt 11. The frame 8 also includes a substantially U-shaped bellows support 12, the upper ends of the legs of which are suitably secured to the underside of the apron 11. A guide strip 13, forming a part of the frame 8, is secured at its ends to the upper portions of the legs of the U-shaped member 12 and has struck-out oppositely bowed intermediate portions forming a valve stem guide 14. The frame 8 as illustrated in Figure 2 and as previously described is of substantially conventional construction in thermostats. A conventional temperature responsive thermostat bellows 15 is supported by the U-shaped member 12 and has a lower end resting on the intermediate portion of the member 12. A valve stem 16 is fixed to and extends upwardly from the upper end of the bellows 15 and slidably through the guide 14.

A primary valve 17 includes a substantially flat peripheral portion 18 which surrounds a dished central portion 19 of said valve. A portion of the underside of the flat peripheral portion 18 of the valve 17 normally rests upon the valve seat 10. The dished portion 19 is provided with a central opening 20 and a plurality of relatively large openings 21 surrounding and spaced from the opening 20. The valve stem 16 has an upper portion 22 of restricted diameter which extends upwardly through the central opening 20 and which combines with the enlarged lower portion of the stem 16 to form an annular upwardly facing shoulder 23 which bears against the underside of the dished valve portion 19 around its opening 20, and which may be suitably secured thereto.

The dual action thermostat 7 also includes a secondary valve 24 which is disk shaped and which has a central opening 25 through which the restricted valve stem portion 22 loosely extends. The valve 24 includes an integral annular depending rib 26 which tapers in width toward its relatively narrow bottom edge 27, which edge is adapted to rest upon the upper surface of the substantially flat valve portion 18.

A bracket, designated generally 28, includes a base flange 29 which is secured by fastenings 30 to a portion of the upper side of the valve 24. The bracket 28 has an upstanding longitudinally arced wall 31 which extends upwardly from the flange 29 and the valve 24 and which is disposed inwardly of and near a portion of the periphery of said valve and substantially concentric thereto. The base 29 is disposed adjacent one end of said wall 31. The other end of said wall, remote from the base 29, terminates in an outturned flange 32 having a slot 33 which opens outwardly of the bottom thereof and which extends upwardly to near the upper edge

of said wall and flange. The wall 28, near the flange 32 is provided with a slot 34 which opens outwardly of the upper edge of said wall and which extends to adjacent the bottom edge thereof.

One end of a temperature responsive strip 35 is secured by fastenings 36 against the wall 31, adjacent the base 29 and remote from the flange 32. The other end of the temperature responsive strip 35 is split longitudinally and has a cutoff bottom portion projecting outwardly to form a relatively short lip 37 and a top portion forming a continuation of the strip 35 and constituting a relatively narrow elongated tongue 38. The strip 35 is disposed with its plane substantially perpendicular to the plane of the valve 24 and extends from the wall 31 in a direction away from the flange 32 to form a ring segment and a substantially complete ring with the wall 31. The tongue 38 extends inwardly through the upper portion of the slot 33 across the outer side of a portion of the slot 34, and the lip or abutment 37 bears against the outer side of the lower portion of the flange 32. The strip 35 may be formed of a bimetallic material which will cause said strip to tend to straighten from its arcuate shape as illustrated in Figure 1 when subjected to heat.

A portion of the valve 24, located adjacent the wall 31, is provided with an outwardly opening notch 39 to slidably receive a stud or pin 40 which is fixed to and rises from a part of the valve portion 18, to permit the valve 24 to slide toward and away from the valve 17 but to prevent rotation of the valve 24 on the stem portion 22 relatively to the valve 17. As will hereinafter become apparent, it is likewise desirable that neither valve 17 or 24 turns relatively to the stem 16, 22 and accordingly the shoulder portion 23 is preferably secured, as by soldering or welding, as indicated at 41 to the valve 17.

An upstanding abutment member 42 rises from the valve 24 adjacent a portion of its opening 25 and has an angular bottom flange 43 which rests upon a portion of the upper surface of the valve 24 and is secured thereto by fastenings 44. A lever 45 has a bifurcated end 46, the furcations of which straddle a part of the valve stem portion 22 and are pivotally connected thereto by a suitable pivot element 47, such as a cotter pin, which extends loosely through distal portions of said furcations and diametrically through the valve stem portion 22. The lever 45 is swingably mounted by the pivot element 47 for swinging movement in a plane parallel to the axis of the valve stem 16 and has a free end 48 disposed for swinging movement into and out of the slot 34 which is offset downwardly or toward the valve 24, relatively to the bifurcated end 46. An expansion coil spring 49 is disposed loosely around the valve stem part 22, between the secondary valve 24 and the dished part 19 of the primary valve 17 for urging the secondary valve 24 upwardly to an open position, as illustrated, in Figure 4.

A bar 50 has a lower part suitably secured to a portion of the outer side of the upper frame portion 9 and extends upwardly therefrom and has an upper part 51 which is spaced outwardly from a portion of the strip 35 and which is disposed to extend substantially radially of the valve 24. The bar 50 has a recessed inner portion 52 disposed beneath its upper portion 51 which accommodates movement of the valves 17 and 24, relatively to the upper frame portion 9 and which additionally accommodates movement of the abutment 37, as will hereinafter be described. The upper portion of the bar 50 is circumferentially spaced from the flange 32 and the lip or abutment 37 is normally disposed between said flange 32 and a part of the bar 50, as best illustrated in Figures 1 and 2.

Assuming that the bellows 15 is retracted, as illustrated in Figure 2, before permitting the tongue 38 to pass inwardly through the slot 33, the lever 45 is swung downwardly about its pivot 47 in a counterclockwise direction from its upright position of Figure 4 to its position of Figure 3. As the lever 45 swings downwardly, a portion of its bifurcated end 46 will bear on the upper edge of the abutment member 42 for displacing the valve 24 downwardly to cause the annular surface 27 of the rib 26 to seat flush on the flat valve portion 18 and to compress the spring 49. When this has been accomplished, the free end 48 of the lever 45 will be disposed to extend through the bottom portion of the slot 34, so that the tongue 38 may pass inwardly of the slot 33 and across the upper edge of the lever end 48. At the same time, the abutment 37 passes through the recessed portion 52 toward and into engagement with the flange 32. The tongue 38 thus locks the lever 45 in its position of Figures 1 to 3 for maintaining the valve 24 in a closed position in engagement with the primary valve 17.

Assuming that the thermostat 7 is mounted in a conduit portion of a liquid cooling system, not shown, in a conventional manner so that the liquid cannot pass through said conduit portion around the apron 11, it will be readily apparent that with the valves 17 and 24 positioned as illustrated in Figure 3 that the liquid coolant cannot pass upwardly through the thermostat but may merely enter through the openings 21 to fill the space between the valves 17 and 24. If the bellows 15 is operating properly and if the stem 16 does not stick in the guide 14 and the valve portion 18 does not stick to the valve seat 10, as the temperature of the liquid coolant rises the bellows 15 will be expanded and extended upwardly to displace the valve stem 16 upwardly to cause the valves 17 and 24 to move upwardly as a unit with the valve stem to allow the liquid coolant to pass through the thermostat upwardly between the valve seat 10 and valve 17. When the thermostat opens in this manner, the valve 24 and the parts supported thereby and by the valve stem portion 22 will be maintained in their positions of Figure 3.

However, it frequently happens that the thermostat will not function as previously described due to a breakage in the bellows 15 or because the stem 16 sticks in the guide 14 or the valve 17 sticks to the seat 10. Should the valve 17 fail to open for any of these reasons, after the liquid coolant has been heated to a temperature higher than normally required to open the valve 17 but before a temperature has been reached sufficient to damage an engine cooled by the coolant, the heat of the coolant will act upon the temperature responsive strip 35 by induction through the valve 24 to cause said strip to move toward a straight position and so that the tongue 38 will slide from right to left as seen in Figure 2 outwardly through the slot 33. As soon as the tongue 38 moves sufficiently to the left to clear the lever end 48, the tensioned spring 49 will force the valve 24 upwardly, causing the lever 45 to be swung upwardly and the valve 24 and parts carried thereby to be displaced upwardly relatively

to the valve 17, as illustrated in Figure 4, so that the thermostat 7 will thus be opened to allow the coolant to pass upwardly through the openings 21 of the valve 17 and outwardly between the valves 17 and 24.

The bar 50 may be omitted but if provided performs a very definite and desirable function. If the valve 17 opens normally, the valve 24 will be displaced upwardly therewith to substantially the position of Figure 4 and the abutment 37 will then be disposed between the flange 32 and the upper bar portion 51. Said bar portion 51 will function as a stop to prevent the abutment 37 from moving sufficiently from right to left, as seen in Figures 1 and 2, away from the flange 32, so that the tongue 38 can clear the lever end 46. Consequently, irrespective of how much the strip 35 is heated after opening of the valve 17, said strip cannot move to a position to release the lever 45 so that the valve 24 will be maintained in engagement with the valve 17. Additionally, when the valve 24 is in an open postion out of engagement with the valve 17, the strip 35 may not retract sufficiently to permit the tongue 38 to pass across the slot 34, since the abutment or lip 37 will then move into engagement with the side of the bar portion 51 located remote from the flange 32. Accordingly, the valve 24 must be returned to a seated position on the valve 17 before the parts 37 and 38 can be returned to their positions of Figure 2, after release of the valve 24.

The narrow edge 27 of the valve 24 which contacts the primary valve portion 18 will not afford sufficient surface area to cause sticking of the valve 24 to the valve 17 as a result of rust or corrosion carried by the coolant. Accordingly, when the lever 45 which forms a latch is released, the spring 49 will positively move the valve 24 to its open position relatively to the valve 17.

Various modifications and changes are contemplated and obviously may be resorted to, without departing from the spirit or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A dual action safety thermostat valve comprising a frame including an annular head portion forming a passage therethrough for a coolant and having an outer end defining the outlet end of said passage, a primary valve, a valve stem extending through said primary valve and having an intermediate portion fixed thereto for normally supporting said valve in a closed position against said outlet end, a secondary valve slidably mounted on the stem outwardly of the primary valve, a latching lever pivotally mounted on said stem outwardly with respect to said secondary valve, detent means mounted on said secondary valve for engaging a free end of the latching lever in one position of the latching lever to retain said secondary valve in a closed position in engagement with the primary valve, said primary valve having openings therein providing communication between portions of adjacent sides of the valves, a first temperature responsive element connected to said stem for displacing the valves as a unit away from the outlet end of the annular head portion to an open position when said first temperature responsive element is actuated in response to a temperature increase, and said detent forming a part of a second temperature responsive element adapted to be actuated by a higher temperature than the first temperature responsive element for moving the detent to a position to disengage said latch lever to release said secondary valve for movement away from the primary valve to an open position.

2. A dual action safety thermostat valve as in claim 1, said primary valve having a dished portion extending away from the secondary valve and in which the openings thereof are formed, an expansion spring means interposed between said valves and urging the secondary valve away from the primary valve.

3. A dual action safety thermostat valve as in claim 2, said primary valve having a substantially flat peripheral portion surrounding said dished portion and engaging said outlet end, and said secondary valve having an annular rib defining a relatively narrow surface engaging the flat portion of said primary valve when the secondary valve is latched in a closed position.

4. A dual action safety thermostat valve as in claim 3, said detent having an outwardly extending abutment, and means supported by said frame and disposed to be engaged by said abutment when the primary valve is in an open postion to prevent movement of the detent to a position for releasing the latching lever.

5. A dual action safety thermostat valve as in claim 4, and means slidably and nonrotatably connecting the secondary valve to the primary valve.

6. A dual action safety thermostat valve of the character described comprising a frame including an annular portion defining a passageway therethrough for a liquid coolant and having an outer end constituting the outlet end of said passage, valve means for closing said outlet end including a primary valve seating against said outlet end and a secondary valve disposed outwardly of and seating against the primary valve, a stem fixed to the primary valve and extending slidably through the secondary valve, a latch element swingably supported on said stem, temperature responsive detent means supported by said secondary valve and retaining the latch element in a position for holding said secondary valve in a closed position against the primary valve, said primary valve having openings communicating with a space between said valves, a temperature responsive element connected to said stem and actuated by a rise in temperature for moving the valves as a unit with the stem to an open position, said temperature responsive detent means being actuated in response to a higher temperature for releasing said latch element for opening of the secondary valve by movement away from the primary valve upon failure of the primary valve to open.

7. A dual action safety thermostat valve as in claim 6, and spring means interposed between said valves for moving the secondary valve to an open position away from the primary valve when said latch element is released.

8. A dual action safety thermostat valve as in claim 6, and means preventing movement of said temperature responsive detent means to a latch element releasing position when the primary valve is in an open position.

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