Aug. 9, 1966 L. H. SELWAY 3,265,300

RADIATOR SHUTTER MECHANISMS

Filed July 27, 1964 5 Sheets-Sheet 1

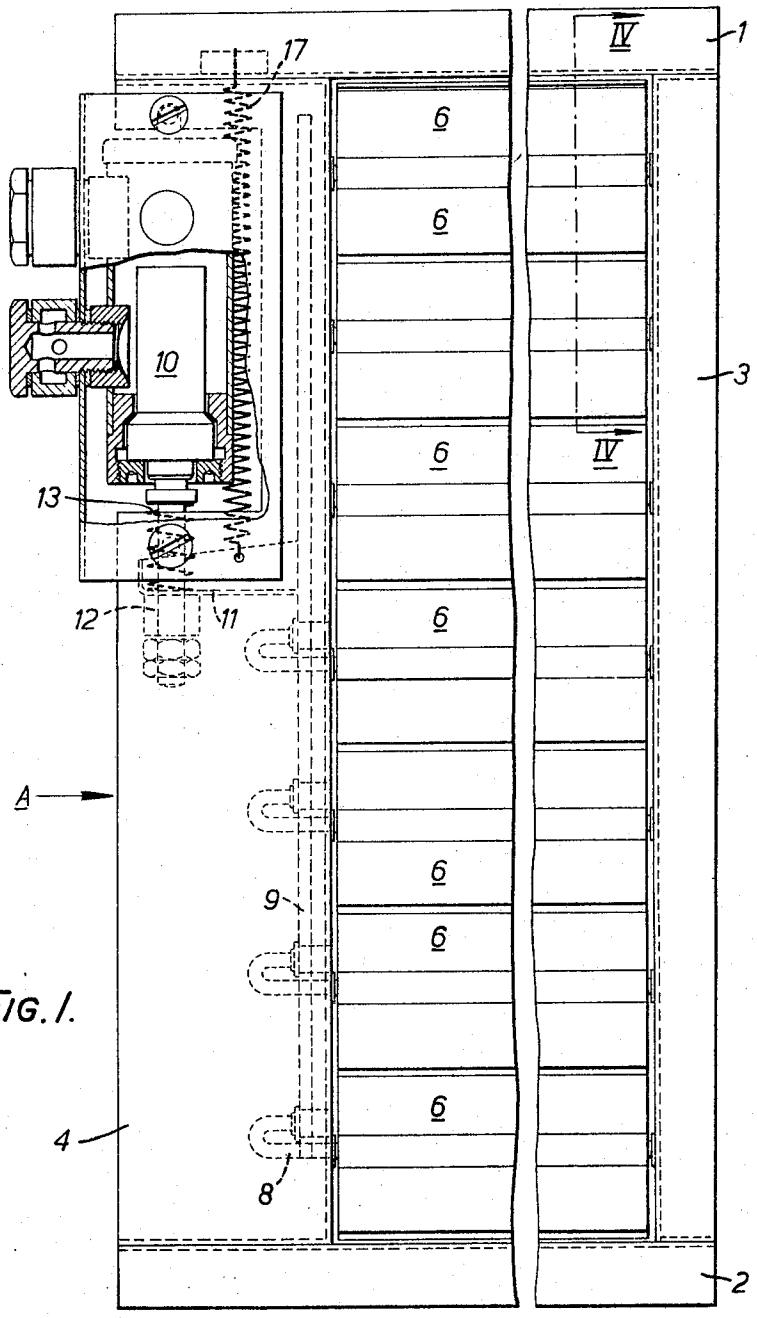


FIG. 1.

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RADIATOR SHUTTER MECHANISMS

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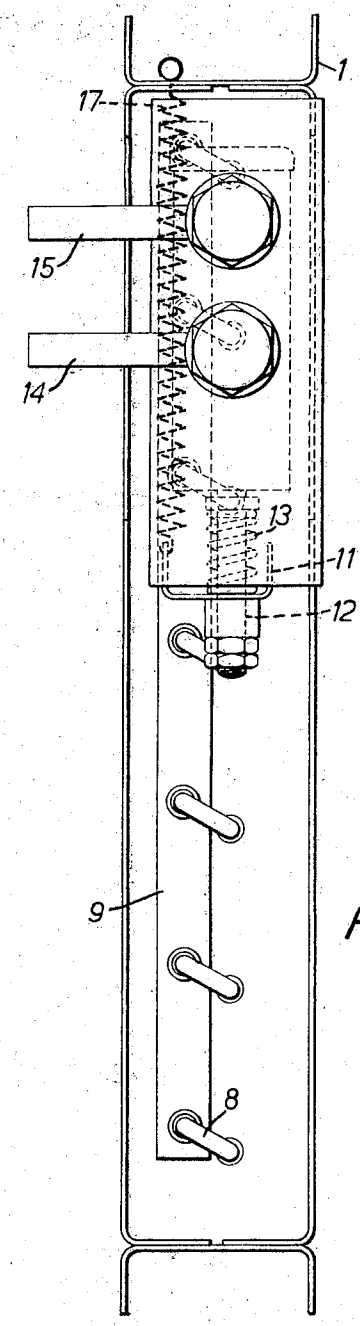


FIG. 2.

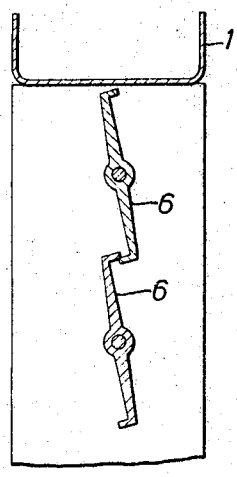


FIG. 4.

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RADIATOR SHUTTER MECHANISMS

Filed July 27, 1964 5 Sheets-Sheet 3

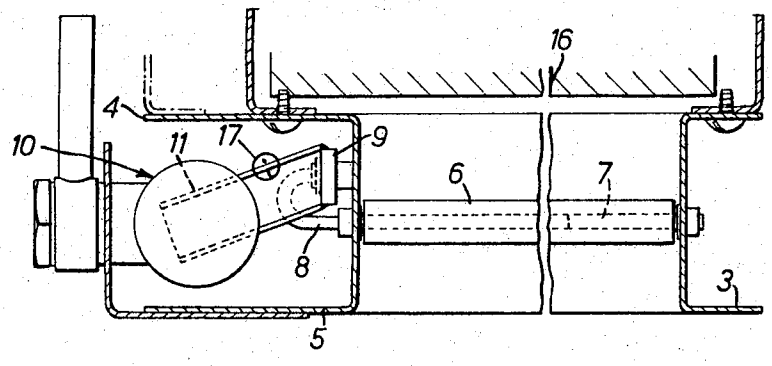


FIG. 3.

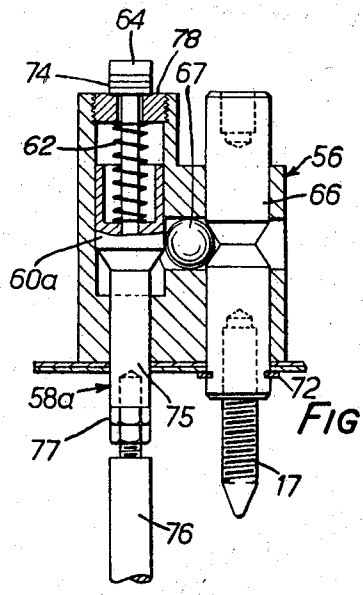


FIG 8

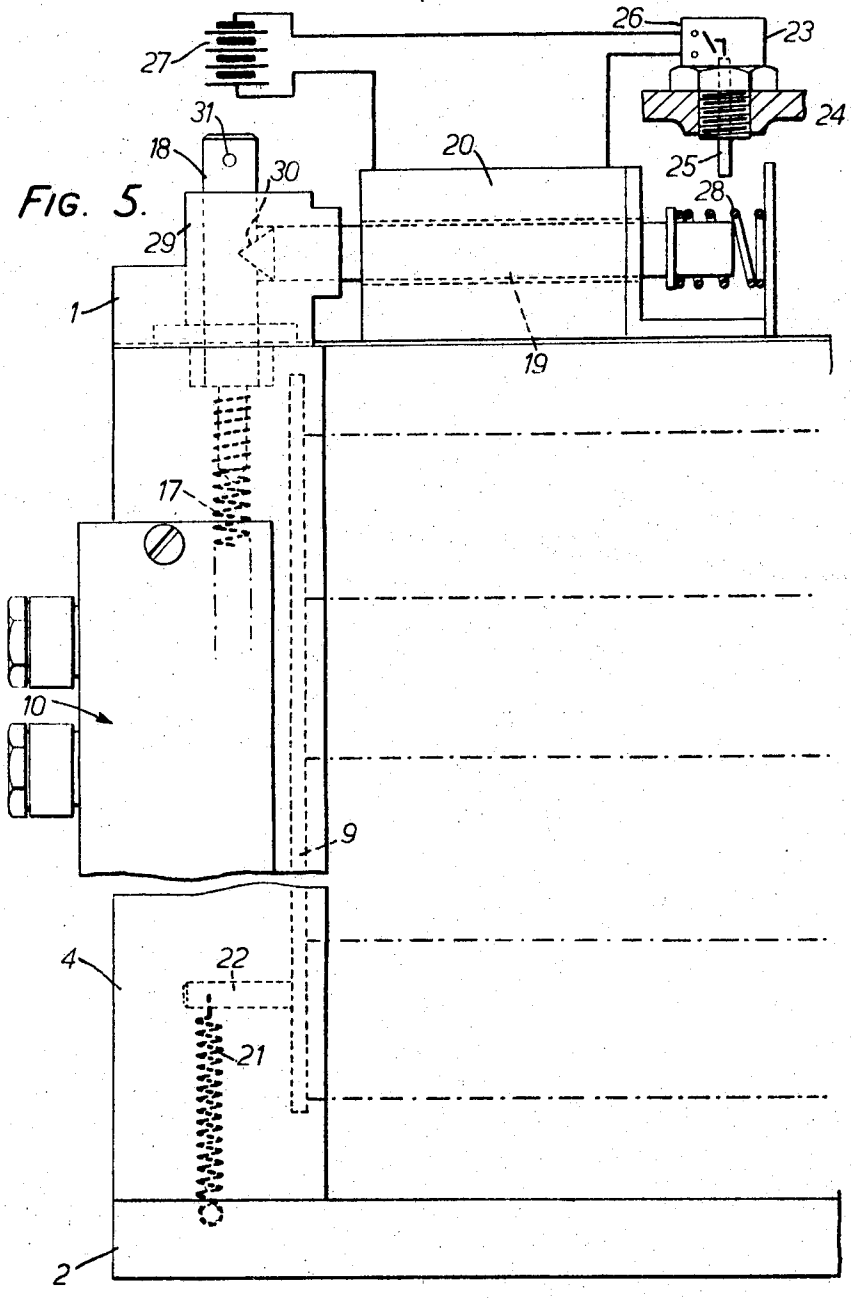
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RADIATOR SHUTTER MECHANISMS

Filed July 27, 1964 5 Sheets-Sheet 4

FIG. 5.



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RADIATOR SHUTTER MECHANISMS

Filed July 27, 1964 5 Sheets-Sheet 5

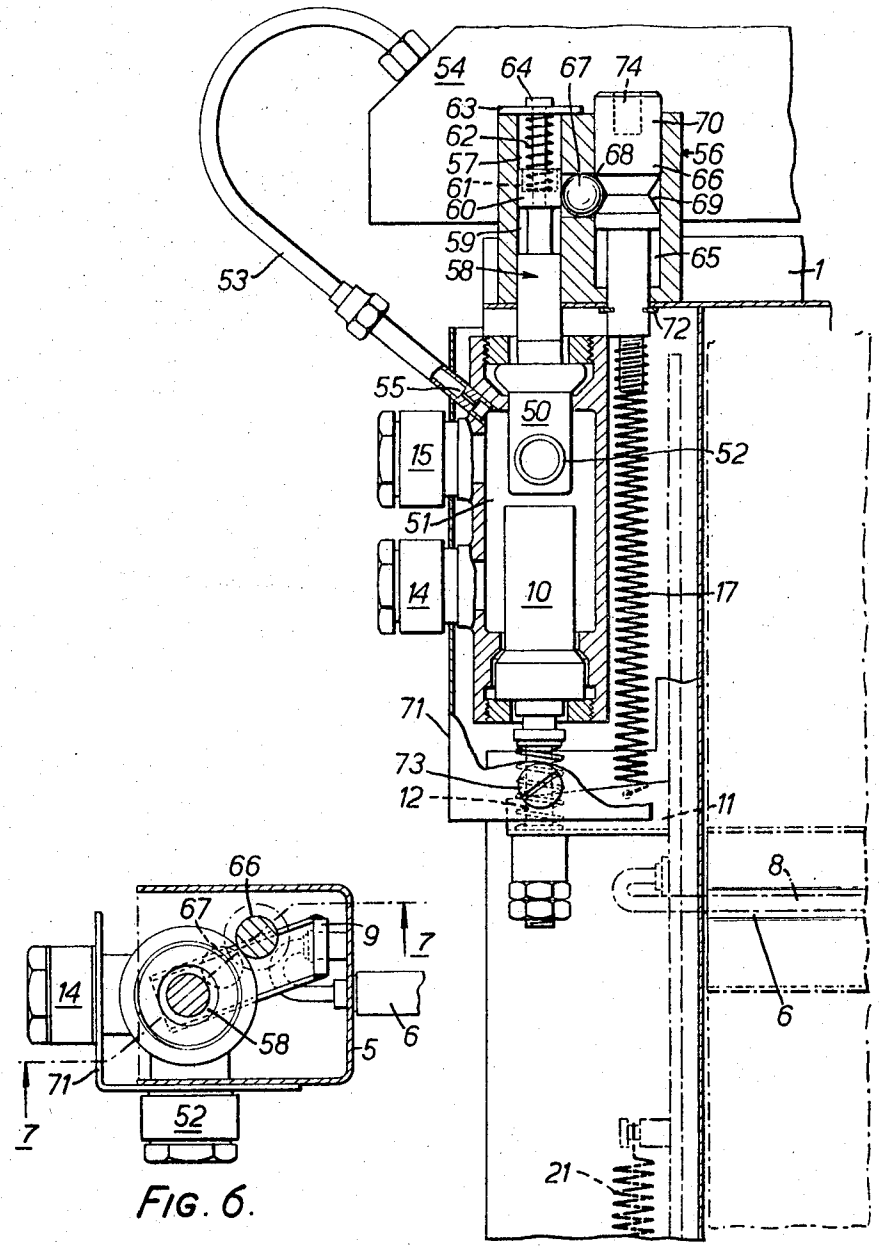


FIG. 6.

FIG. 7.

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United States Patent Office 3,265,300 Patented August 9, 1966

3,265,300

RADIATOR SHUTTER MECHANISMS

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Claims priority, application Great Britain, July 26, 1963, 29,695/63; Nov. 25, 1963, 46,417/63
10 Claims. (Cl. 236—35.2)

This invention relates to a radiator shutter mechanism having pivotal shutters which are automatically moved under the control of a thermostat to regulate air flow to the radiator matrix as a function of engine cooling liquid temperature.

The invention provides means by which, in the event of a failure in the thermostat control, the mechanism fails safe with the shutters open.

According to the present invention there is provided a temperature responsive actuator including an actuating member, first biasing means coupled to the actuating member to urge the actuating member in one sense, a first temperature responsive means for moving said actuating member in opposition to said biasing means, a release mechanism operative to reduce the effect of said first biasing means, a second temperature responsive means operable at a given temperature to actuate said release mechanism, a second biasing means operable in the same sense as the first temperature responsive control element to move said actuating member in the opposite sense to said first biasing means, and means for controlling the temperature at which said release means operates.

Features and advantages of the present invention will appear from the following description of certain preferred embodiments thereof, given by way of example only, reference being had to the accompanying drawings in which:

FIGURE 1 is a front elevation, partly in section, of a radiator shutter mechanism;

FIGURE 2 is an end elevation of the same mechanism looking in the direction of arrow A of FIGURE 1;

FIGURE 3 is a plan view of said mechanism fitted to a vehicle radiator, the top member of the mechanism frame being removed to show operating parts of the mechanism;

FIGURE 4 is a section along the line IV—IV of FIGURE 1; and

FIGURE 5 diagrammatically illustrates a fail-safe arrangement for incorporation in the mechanism of the previous figures.

FIGURE 6 is a diagrammatic end elevation of one end of a second embodiment of a radiator shutter mechanism showing a fail-safe controlling mechanism;

FIGURE 7 is a section view along the line 7—7 of FIGURE 6; and

FIGURE 8 is a section view through a modified fail-safe controlling mechanism.

In the various figures like parts are indicated by like reference numerals.

Referring first to FIGURES 1 to 4, the radiator shutter mechanism includes a frame which is constituted by top and bottom members 1 and 2 respectively, a vertical member 3 suitably secured to one end of the top and bottom members, and a pair of vertical members 4 and 5 suitably secured to the other end of the top and bottom members.

Mounted for pivotal movement in the frame are a plurality of shutters 6 which are each pivotally supported at one end by a pivot rod 7 in the vertical member 3 and at the other end by a pivot rod 8 in a housing defined by registering semi-circular recesses in the vertical members 4 and 5.

Each pivot rod 8 is cranked and a link 9 is mounted

on the pivot rods at the free end of their cranked parts to provide an operating connection between the shutters and a thermostat 10. An inclined member 11 is secured to the link 9 and carries a plunger 12 which is directly engaged by the piston element of the thermostat. An overload spring 13 is mounted about the plunger.

The thermostat has inlet and return ports 14 and 15, respectively, and preferably is of a wax capsule type.

The pivot rods preferably run in nylon bushes housed in the vertical members, and the cranked ends of the pivot rods 8 engage in nylon bushes housed in the link 9.

The radiator shutter mechanism would be mounted in front of a radiator matrix diagrammatically shown at 16, and the inlet and return ports 14 and 15, respectively, of the thermostat would be connected into the cooling water system of the engine.

In operation, a rise in temperature of the cooling water causes the piston element of the thermostat to move outwardly thereby to move the plunger 12, and hence the inclined member 11 and link 9, downwardly as viewed in FIGURES 1 and 2. Such movement pivots the shutters open so that they allow an increased flow of air to the matrix.

There is also provided a return spring 17 which serves, upon retraction of the piston element under a fall in the cooling water temperature, to return the link 9 upwardly and so move the shutters towards their closed position, the result being a decrease in air flow past the shutters to the radiator matrix.

In the construction illustrated in FIGURES 1 to 4, the return spring is anchored at one end to the inclined member 11 and at the other end to the top member 1.

Whilst the arrangement as so far described functions satisfactorily it has the disadvantage that should for some reason the thermostat cease to function then the return spring will fully close the shutters. Accordingly air flow to the radiator matrix would be cut off with the result that eventual overheating of the engine would occur.

Turning now to FIGURE 5 there is shown an arrangement which overcomes the described disadvantage.

In this arrangement the return spring is not anchored to the top member 1 but instead is secured to an anchor pin 18. This anchor pin, until such time as the cooling water reaches an undesirably high temperature, for example 100° C., which would be indicative of a failure of the thermostat control, is held in the position shown by a solenoid plunger 19. In this position, the return spring 17 is operative to bias the shutters towards their closed position. When, however, the cooling water attains said temperature the solenoid coil 20 is energized by which the solenoid plunger is withdrawn from engagement with the anchor pin. The return spring is thereby rendered inoperative and a fail-safe spring 21, which is anchored at one end to a peg 22 fast with the link 9, and at its other end to the bottom frame member 2, acts to urge the link downwardly and so positively move the shutters to their fully open position. Thus the mechanism fails safe allowing maximum air flow to the radiator matrix.

It should be mentioned that the pull of the fail-safe spring 21 is considerably less than that of the return spring 17 so that during normal operation the latter spring predominates.

The solenoid is energized and de-energized under the control of a thermostat 23. This thermostat is mounted on the engine block 24 and includes a heat sensing element 25 projecting into a water jacket of the block. The thermostat also incorporates a heat switch 26 which operates to make and break an electrical circuit from the vehicle battery 27 to the solenoid coil 20. The arrangement is such that during normal operation of the radiator shutter mechanism the heat switch, under the control of

the heat sensing element, breaks said electrical circuit so that the solenoid plunger engages the anchor pin in the illustrated position, and upon the temperature of the cooling water in the jacket reaching a dangerous level, the heat sensing element causes the heat switch to make said circuit and thereby initiate retraction movement of the solenoid plunger.

In order to urge the solenoid plunger against the anchor pin when the solenoid is de-energized there is provided a spring 28. The forward end of the solenoid plunger is slidably mounted in a housing 29 in which is also supported the anchor pin. The housing is secured to the top frame member 1. The anchor pin is recessed at 30 and the solenoid plunger is pointed for securing engagement in the recess. The lower end of the anchor pin is threaded and makes screwed engagement with the return spring.

To warn the driver of the vehicle that the radiator shutter mechanism has failed safe, a warning light may be incorporated on the dashboard of the vehicle which would be arranged to be illuminated upon the solenoid circuit being completed.

A cocking pin 31 is secured to the anchor pin and serves to facilitate manually raising the latter pin to reset the return spring when the fault in the thermostat control has been corrected, the pointed end of the solenoid plunger automatically re-engaging the anchor pin recess 30 when in register therewith.

It is to be understood that the invention is not restricted to the herein particularly described construction which is given purely for illustration purposes. For example, the heat sensing element could be located in any of a number of positions in the cooling system such as the top of the radiator, the hot water hose pipe from the engine to top radiator tank, the radiator thermostat, the thermostat 10, or the hot water pipe which would connect the engine block/heater hose to the inlet port 14 of the thermostat 10.

Referring now to FIGURES 6 to 8 of the drawings, an embodiment is shown in which the shutters 6 are failed to safe by means of a mechanical arrangement rather than the electrical arrangement described above.

The thermostat incorporates, as well as the wax capsule 10 for normally effecting pivotal movement of the shutters 6 in accord with the cooling liquid temperature of the engine through the plunger 12, inclined member 11 and link 9 which latter is operable on the pivot rods 8 secured in the shutters, a fail-safe wax capsule 50. This additional capsule is set to operate when the cooling liquid acting on it in the chamber 51 of the thermostat attains a predetermined temperature which would be that temperature at which the liquid boils or slightly below that temperature. In the case of water, therefore, the operating temperature would be say 100° C., assuming the radiator system was not pressurized, and appropriately higher than this figure with a pressurized system.

In addition to the normal inlet and return ports 14 and 15, respectively, to the chamber 51 connected in the cooling circuit which is either connected directly to the engine block or indirectly through the heater circuit, there is provided a further inlet port 52 which is also connected into that cooling circuit. All the ports are defined in banjo joints. The chamber 51 is also connected via an air bleed line 53 to the top tank 54 of the radiator. A restrictor 55 is incorporated in the air bleed line.

Mounted on the top member 1 of the radiator shutter mechanism frame and secured to that member in any suitable fashion is a block 56. Slidably mounted in an aperture 57 in this block is a plunger, generally denoted at 58, whose lower end makes contact with the piston element of the wax capsule 50. The plunger includes a peripheral recess 59 and above that recess a head 60. The head is itself recessed at 61 and a return spring 62 for the plunger seats at its lower end in the recess and bears at its upper end against a plate 63 which is suitably attached to the block 56. A locking pin 64 is secured into the plunger head 60 and is slidable through the plate, the lowest position of the pin and hence the plunger being determined by the engagement of the pin head with the upper surface of the plate.

The block 56 also has a counter bored aperture 65 whose axis is parallel to that of its aperture 57. An anchor pin, generally denoted at 66, is mounted in the aperture 65 and at its lower end is screwed into the upper end of the return spring 17 for the shutters 6. The anchor is normally held in the position shown when the spring serves, upon a decrease in the cooling liquid temperature and consequent retracting of the piston element of the wax capsule 10, to return the link 9 upwardly and so effect appropriate closure of the shutters 6. The means holding the anchor pin comprises a ball 67 which is mounted in a channel 68 in the block 56 merging with the apertures 57 and 65. The diameter of the ball is greater than the length of the channel so that when the plunger head 60 is opposite the channel, which occurs when the fail-safe capsule 50 is effectively inoperative, the ball projects into the aperture 65 and into a tapered sided recess 69 in the head 70 of the anchor pin 66. The anchor pin is, of course, subjected to a downward bias by the return spring 17, and accordingly imparts by way of the upper tapered face of its recess 69 a sideways force to the ball 67. The ball, however, since it is engaging the plunger head 60 cannot move, and the result is that the ball firmly engages in the recess 69 and thereby restrains the anchor pin from moving downwardly. Thus the upper edge of the return spring 17 is firmly anchored and the spring operates on the shutters as described. However should the plunger 58 be moved upwardly by the fail-safe capsule 50 an amount sufficient to bring its recess 59 into alignment with the ball 67, as occurs when the temperature of the cooling liquid assumes dangerous proportions, then the ball is able to move sideways in the channel 68 and will, in fact, under the influence of the upper tapered face of the anchor pin recess 69, do so, thus leaving free the anchor pin 66 to move downwardly under the bias of the return spring 17. The anchor pin in executing this movement renders the return spring 17 slack and thereby inoperative on the shutters. At that time, the fail-safe spring 21 acts to urge the shutters fully open. Downward movement of the anchor pin is halted when its head 70 engages the base of the body counter bore 65.

The fail-safe mechanism is recocked, upon the fault leading to the temperature of the cooling water rising dangerously being rectified, by removing the thermostat which is done by removing it and the angle bracket 71 on which it is mounted as one unit, and pulling the anchor pin 66 upwardly until a circlip 72 on the pin engages the upper member 1 of the frame. The spring 62 should then return the plunger 58 so that again the plunger head 60 is aligned with and contacts the ball 67. If the plunger should stick then it can be moved by pushing down the cocking pin 64. Lastly, the thermostat and angle bracket 71 are refitted when the shutter mechanism is again ready for use. The angle bracket is held at its ends by screws 73 to the vertical member 5 of the shutter frame and is released therefrom by removing these screws.

The anchor pin head 70 is provided with a threaded hole 74 into which can be screwed a suitable tool for enabling the pin to be readily recocked. Alternatively the head could have a bayonet type socket.

It is believed that operation of the fail-safe mechanism is self evident from the foregoing description. However, briefly and to reiterate, when the temperature of the cooling water acting on the thermostat attains boiling point or possibly just below, the fail-safe capsule 50 operates to urge the plunger 58 upwardly and so bring the plunger recess 59 into register with the ball 67, the ball then, under the influence of the sideways force constantly exerted on it by the tapered recess 69 in the anchor pin 66, entering the plunger recess and leaving the anchor pin recess, so that the anchor pin is no longer held against

the biasing action of the return spring **17** and is forced downwardly thereby by which the spring eventually becomes slack and the fail-safe spring **21** becomes the dominant spring and positively moves the shutters to the fully open position.

With the fail-safe control, the radiator shutter mechanism will fail to safe upon the following conditions obtaining:

(a) The capsule **10** failing.
(b) The normal inlet becoming blocked.
(b) The normal return becoming blocked.
(b) The normal inlet and return becoming blocked.
(e) An airlock occurring in the cooling circuit.

In connection with the last condition, airlocks within the system would be greatly minimised due to the air-bleed pipe **53** connected to the tank top **54**.

In a modified arrangement of the described embodiment, a fail-safe thermostat separate from the normal operating thermostat capsule **10** is provided. This thermostat would be suitably mounted on the shutter frame top member **1** with its piston element operating along a line perpendicular to the axis of movement of the anchor pin. The plunger **58** with its biasing spring and cocking pin would be as before but also turned round through a right angle with the plunger lying above the anchor pin head **66** and in alignment with the recess **69** with the ball **67** again being positioned in a suitable channel between the head **66** and the plunger head **60**. Thus, the plunger would work at right angles to and across the anchor pin. With this arrangement there would be a single inlet connection to the fail-safe thermostat from the cooling circuit and a bleed line back to the top tank of the radiator. The bleed line could, of course, be replaced with a normal return line back to the engine block directly or indirectly through the heater circuit.

It will be appreciated that in the described constructions the actuating element of the fail-safe capsule must move through a certain distance before the plunger head is clear of the ball and that therefore the temperature at which the anchor pin will be released is higher than that which first initiates movement of the actuating element. The difference between these temperatures can be varied if the plunger setting with the system "cold" can be adjusted in relation to the ball and the fail-safe capsule. By providing such an adjustment a range of anchor pin "release" temperatures can be obtained with a standard capsule and a maximum release temperature obtained which is considerably higher than the temperature at which the capsule first operates.

FIGURE 8 shows an arrangement of plunger, ball, anchor pin and associated parts wherein the plunger setting is adjustable. Purely for example and to provide a clear explanation, it will be assumed that the actuator element of the fail-safe capsule first makes an operating movement when the temperature of the cooling water to which it is subjected is 195° F., that the maximum stroke of the actuator element is 7/16 inch, that the element moves 1/16 inch for each 2° F. rise after 195° F., so that if the actuator element moves through a full stroke before the anchor pin is released the release temperature is 14° F. above the initial actuating temperature, that the ball is of 3/8-inch diameter. If the end of the straight cylindrical face of the plunger head **60***a* was in line with the ball center line with the fail-safe mechanism inoperative, then due to the geometrical layout, the plunger **58***a* would need to move 3/16 inch to release the ball **67** and thus the anchor pin **66** which would occur at a rise in temperature of 6° above the initial operating temperature i.e. an effective operating temperature of 201° F. Similarly if the plunger end face was to be set 1/16 inch below the ball centre line, a rise in temperature of 8° F. above 195° F. would be required to release an anchor pin. Since the plunger stroke is limited to a maximum of 7/16 inch, the maximum temperature rise would be 14° F. above 195° F., thus giving a fail to safe release at 209° F. In fact, this temperature is about the desired figure as heat losses in hose and thermostat could contribute a further 8 to 10° F. which would bring the total up to 217 to 219° F., and pressurised systems would operate at a slightly higher temperature than 219° F. before boiling occurred.

Adjustment of the plunger setting is obtained by varying the effective length of the plunger. The plunger differs from that illustrated in FIGURE 2 in that it does not have a recess below its head but instead has a shank of reduced diameter which, of course, serves the same purpose. The shank is in two parts, the upper one **75** of which having a threaded hole in its end and the lower one **76** having a portion of recessed diameter which is screwed into that hole. A pair of adjusting and locking nuts **77** are mounted on the screwed portion by means of which the lower part can be screwed into and out of the threaded hole and locked in the selected position appropriate to the effective length required of the plunger. As will be seen the spring **62** which biases the locking pin **64** and hence the plunger downwardly bears at its upper end against a disc **78** screwed into the block **56**. When the plunger is set at its maximum length then the head of the locking pin will project above the disc **78** and upon removal of the thermostat the plunger will be urged downwardly by the spring **62** until the locking pin head engages the disc **78**. In order to reduce this degree of movement of the plunger one or more washers **74** may be provided between the locking pin head and the disc; the overall washer thickness would be decreased as the length of the plunger was decreased. The lower end of the plunger shank may rest in a dimple in the fail-safe capsule thereby to be steadied.

The described constructions employ what may be termed a direct coupling between the fail-safe thermostat and the return spring **17**. Alternatively, remote control could be obtained through links, levers, or push rods; also by utilizing links, levers or cables (plastic or metallic), chains or other suitable connecting means.

The fail-safe thermostat could be made to operate by pulling instead of pushing, as described, using the same type of positive lock and releasing mechanism i.e. using a ball for locking and the movement of a rod with a recess for releasing.

The basic control mechanism for effecting movement of the anchor pin has many applications and the invention is not intended to be limited to its use with the described radiator shutter mechanism. Fundamentally, the control mechanism of the present embodiment may be summarized as comprising a control member which in one position holds a locking element in engagement with an actuable member and which can be urged from that position into one in which to allow the locking element to be disengaged from the actuable member, the latter member then being free to make an operating movement, possibly under a spring bias. The control member can move automatically in response to a signal, in the present case the signal coming as an urging force from a thermostat.

Examples of other applications for the control mechanism are use with hydraulic controls, central heating, flue restrictions and automotive industry.

I claim:

1. A temperature responsive actuator including an actuating member, first biasing means coupled to the actuating member to urge the actuating member in one sense, a first temperature responsive means for moving said actuating member in opposition to said biasing means, a release mechanism operative to reduce the effect of said first biasing means, a second temperature responsive means operable at a given temperature to actuate said release mechanism, a second biasing means operable in the same sense as the first temperature responsive means to move said actuating member in the opposite

sense to said first biasing means, and means for adjusting the temperature at which said release means operates.

2. An actuator for operating between open and closed positions at least one radiator shutter pivotally mounted in a frame, comprising

an axially shiftable shutter actuating member **9**;

first (**17**) and second (**21**) biasing means biasing said actuating member in opposite directions, respectively;

first temperature responsive means **10** for axially and progressively displacing said actuating member as a function of temperature in one direction against the force of said first biasing means;

releasable means, **19**, **67**, operable to at least partially reduce the biasing force of said first biasing means **17**;

and second temperature responsive means, **23**, **50**, for operating said releasable means, whereby said actuating member is shifted in said one direction by said second biasing means.

3. An actuator according to claim **2** wherein said first biasing means comprises a tension spring connected at one end to said actuating member.

4. An actuator according to claim **3**, and further including a spring tension control element connected with the other end of said tension spring and adapted for movement relative to said frame, said releasable means normally preventing movement of said control element relative to said frame.

5. An actuator according to claim **4** in which said spring tension control element comprises an axially displaceable plunger containing intermediate its ends a recess.

6. An actuator according to claim **5** in which said release mechanism comprises a locking ball adapted for locking engagement with the recess in said spring tension control plunger, and a ball control member moveable by said second temperature responsive means from a position in which said ball is held in locking engagement with said recess to a position in which said ball can move out of engagement with said recess to release said plunger.

7. An actuator according to claim **6**, in which said ball control member comprises an axially moveable plunger having a recess for receiving said ball, and adapted to be moved by said second temperature responsive means from a position in which said ball is held in said locking engagement with the recess in said spring tension control plunger to a position in which the ball can move into the recess in said ball control plunger to release said spring tension control plunger.

8. An actuator according to claim **5**, in which said release mechanism comprises a locking plunger having an end adapted for locking engagement with the recess in said spring tension control plunger and moveable by said second temperature responsive means out of said locking engagement to a position in which said spring tension control plunger is released.

9. An actuator according to claim **5**, in which said second temperature responsive control means comprises a thermostat having an actuating plunger adapted to move said release mechanism plunger at a given temperature.

10. An actuator according to claim **5**, in which said second temperature responsive control means comprises a thermally responsive switch controlling a solenoid adapted to move said release mechanism plunger at a given temperature.

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