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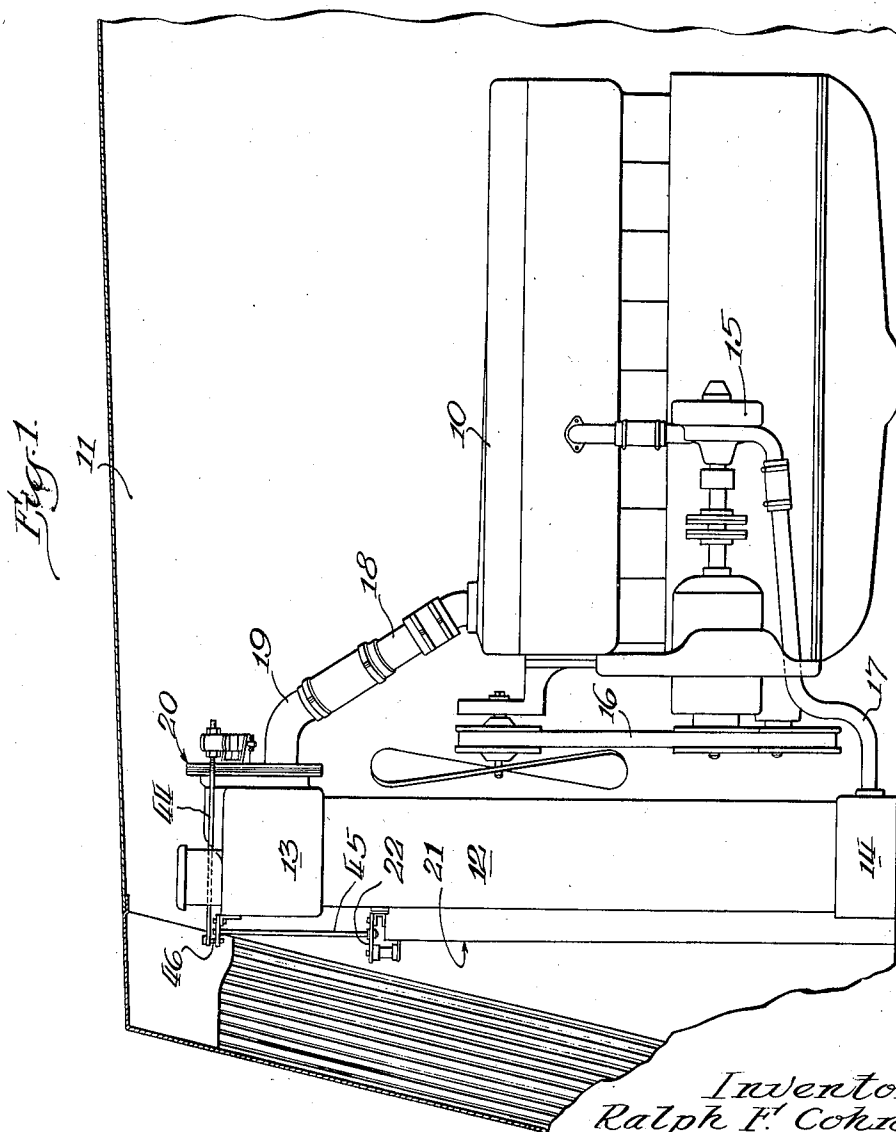
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THERMOSTATICALLY ACTUATED SHUTTER UNIT

Filed Oct. 20, 1938

3 Sheets-Sheet 1



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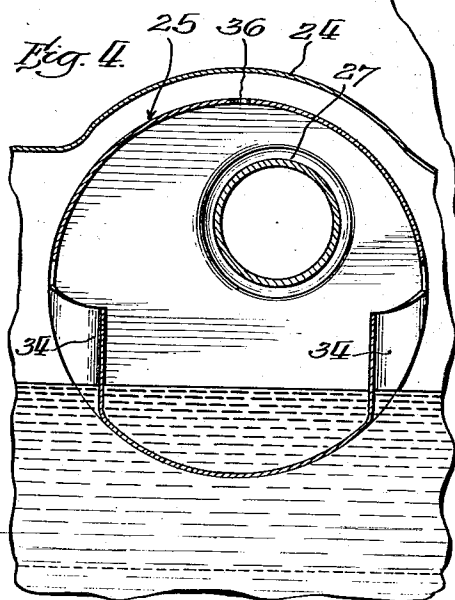
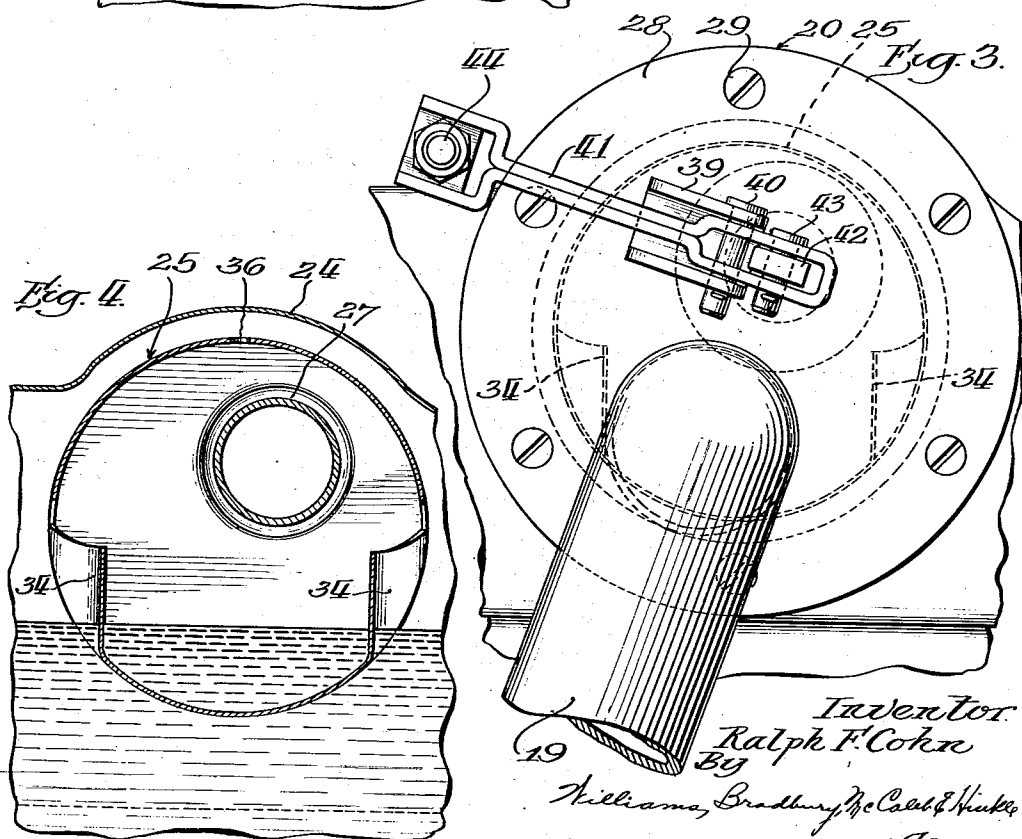
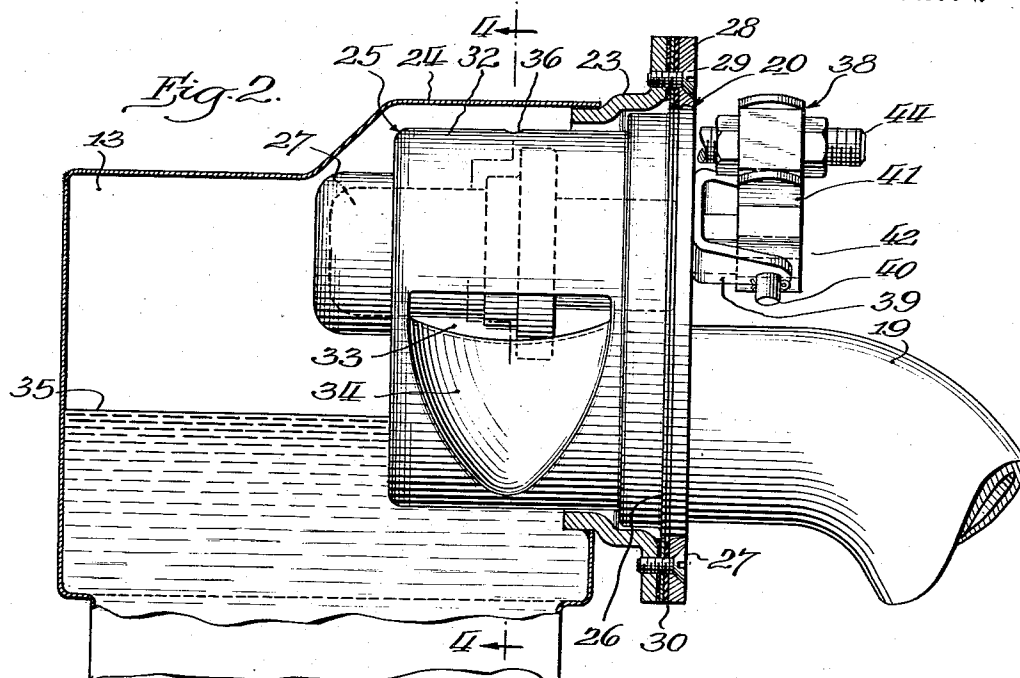
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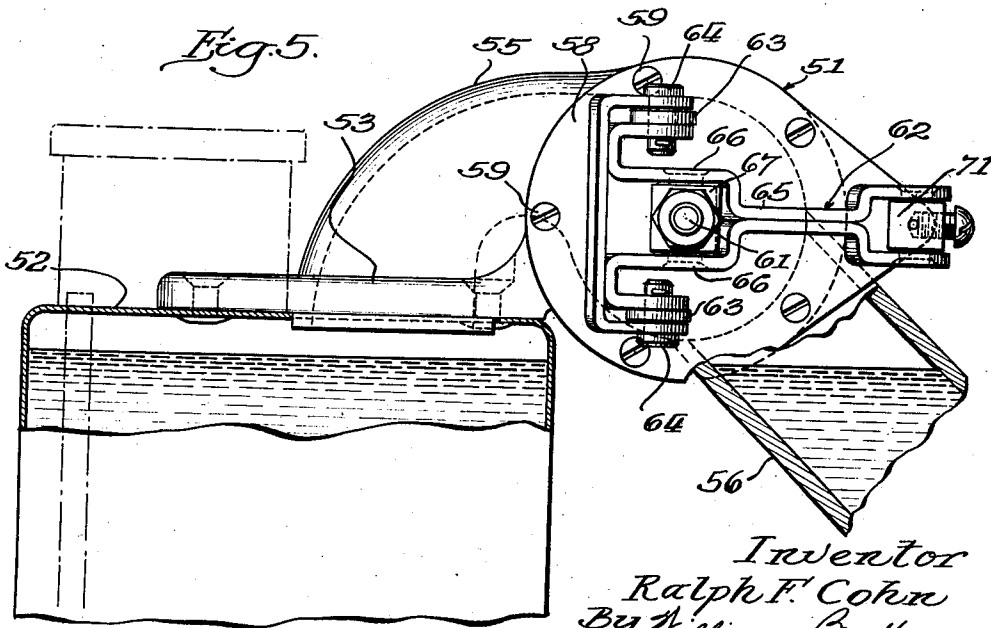
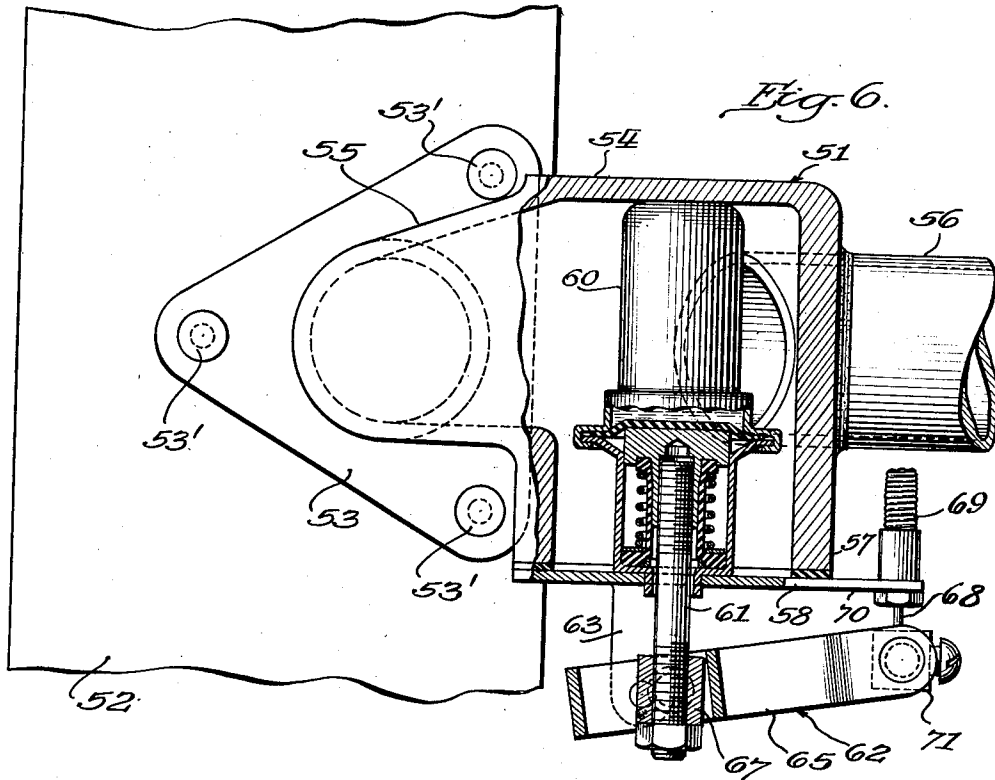
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THERMOSTATICALLY ACTUATED SHUTTER UNIT

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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THERMOSTATICALLY ACTUATED SHUTTER
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Application October 20, 1938, Serial No. 235,977

14 Claims. (Cl. 123—178)

The present invention relates to apparatus for regulating the temperature of the heat exchange medium used in cooling a prime mover of the type generating heat when operated, and more particularly to apparatus for regulating the temperature of the water used in cooling the internal combustion engine of an automotive vehicle.

The regulating apparatus heretofore used has comprised shutters operable from closed to open positions, and vice versa, for varying the effectiveness of a radiator through which the coolant is circulated by any suitable means, such as a pump operating simultaneously with the engine, and thermal responsive means adapted to vary the position of the shutters in response to variations in the temperature of the coolant. One of the drawbacks of apparatus of this type is that the shutters are not quickly returned to their closed position when the engine is stopped, because of the relatively slow rate of decrease in the temperature of the coolant. The open shutters permit cold air to enter under the hood covering the engine with the result that the latter is cooled considerably before the shutters are closed to conserve the heat stored in the engine and coolant.

It is a primary object of the present invention to provide a new and improved coolant temperature regulating system in which the shutters are quickly operated to a closed position when the engine stops.

A more specific object of the present invention is to provide a new and improved temperature regulating system for a circulating coolant in which the shutters are quickly operated to a closed position when the engine stops by thermal responsive means located above the level of the coolant obtaining in the system when the coolant is not circulating, whereby the thermal responsive means is subjected to the action of a medium, ordinarily air, having a temperature lower than the coolant.

Another object of the invention is to provide a new and improved shutter actuating thermal responsive unit which may be installed with ease in existing apparatus, or just as easily made part of new apparatus.

A further object of my invention is to provide a new and improved thermal responsive actuating means for the shutters of the cooling system of an automobile engine which is compact, simple, and economical of manufacture.

Another object of my invention is to provide a novel coolant temperature regulating means for a cooling system in which the coolant is circulated

whenever the apparatus to be cooled is operated, comprising a coolant circuit having a part located above the level of coolant obtaining when the coolant is not being circulated, whereby thermosiphon circulation of the coolant is prevented to conserve the heat stored in the coolant when the apparatus is inoperative.

Another object of my invention is to provide a new and improved shutter actuating thermal responsive means for a circulating coolant temperature regulating system which may be installed with ease in existing apparatus or made part of new apparatus, and which is surrounded by a housing that forms a part of the coolant conduit and has a coolant inlet and an outlet, of which the latter is at a level above the level of the coolant obtaining when it is not being circulated.

Other objects and advantages of the invention will become apparent from the ensuing description in the course of which reference is had to the accompanying drawings, in which:

Fig. 1 is a diagrammatic elevational view of an internal combustion engine equipped with a regulating system according to the present invention;

Fig. 2 is a partial longitudinal sectional view through the upper radiator tank of the apparatus illustrated in Fig. 1 in which the novel thermal responsive shutter actuating unit of the present invention is illustrated in elevation;

Fig. 3 is an end elevation of the unit illustrated in Fig. 2;

Fig. 4 is a vertical transverse cross sectional view through the unit taken along the line 4—4 in Fig. 2;

Fig. 5 is a side elevation of a modified form of the thermal responsive shutter actuating unit showing the same attached to the upper radiator tank; and

Fig. 6 is a top plan view, partly in section, of the unit shown in Fig. 5.

The embodiment which has been selected to illustrate the invention includes a prime mover 10 of the type generating heat when operated, preferably an internal combustion engine, which is enclosed in the usual hood 11 and provided with a closed coolant circulating system including a heat exchanger. The latter is the usual radiator 12 having upper and lower tank portions 13 and 14, respectively. The coolant circulating system includes also a jacket about the engine 10 enabling the coolant, ordinarily water, to come into heat exchange relationship with the engine and a pump 15 operated simultaneously

with the engine through suitable driving connections including a fan belt 16. The coolant circuit includes also a conduit 17 connecting the lower radiator tank 14 to the inlet of the pump and a conduit 16 connecting the water jacket to an elbow 19 forming an integral part of the novel shutter actuating thermal responsive unit 20 of the present invention. The pump 15 may be actuated from the internal combustion engine 10 by means other than that illustrated, or it may be driven by an independent prime mover, the only prerequisite being that it operate whenever the engine is operated.

The effectiveness of the radiator 12 is controlled by shutters 21 which control the effective area of the radiator. The shutters may be of conventional form, and while not illustrated in detail, it is assumed they are of the type comprising a plurality of vertically disposed shutter elements adapted to be operated from a normally closed position, into which they are biased by resilient means (not shown) to an open position by means of an actuating mechanism including a pivotally mounted operating lever 22 effecting simultaneous operation of all the shutter elements.

It should be understood that the specific details or construction of the engine or of the shutters may be varied infinitely without affecting the merits of the invention, and the present invention is equally applicable to all types of shutters whether they be detachable or built-in shutters. Furthermore, it is contemplated that the effectiveness of the radiator may be controlled by controlling the flow of air thereby, which, as a matter of fact, the shutters may be thought of doing.

The thermal responsive shutter actuating unit of the present invention is illustrated in detail in Figs. 2, 3, and 4. Referring now to these figures, which typify the construction when the unit is installed in a radiator tank designed to receive it, it may be seen that the unit 20 is supported in the upper portion of the upper radiator tank 13 by an outwardly flanged adapter ring 23 welded, or otherwise secured, in fluid-tight manner to an enlarged portion 24 of the tank. The enlarged portion is preferably, but not necessarily, located somewhat nearer one side of the tank to render the unit more accessible.

The adapter ring supports a reservoir defining housing 25 of cup-like shape provided with an outwardly extending peripheral flange 26 welded, or otherwise secured, to the flange of the adapter ring.

The thermal responsive element 27 of the shutter actuating unit, which is not illustrated in detail as it may take one of many forms presently available, is attached, as by spinning, welding, or soldering, to a circular closure plate 28 in turn removably attached to the flange 26 of the adapter ring, by a plurality of screws 29. Leakage of coolant from within the housing is prevented by a sealing gasket 30 interposed between the closure plate and flange.

When the above-described unit is to be installed in existing apparatus, the unit may be assembled complete and then welded, or otherwise secured, to the upper radiator tank in an opening configured to receive the adapter ring. This opening will ordinarily have to be made in the tank and the existing opening plugged because the existing openings are located below the water level obtaining in the system when the engine is inoperative.

The central portion 32 of the housing 25 constitutes a coolant reservoir into the lower portion of which the coolant flows through the inlet elbow 19. The coolant entering the reservoir is adapted to contact the thermal responsive element 27 whenever the coolant circulates because outlet passages 33 leading from the reservoir to the interior of the upper radiator tank are located substantially at the level of the thermal responsive unit. The outlets are preferably formed by slotting the housing horizontally and then depressing the portions 34 underneath the slots inwardly, as illustrated best in Fig. 4.

In order that the shutters be quickly returned to their closed positions when the engine stops, provided of course they have been previously operated to an open or partially open position, the unit 20 is so located that the thermal responsive element 27 is above the level of the coolant obtaining in the system when the engine stops, which level is indicated by the reference character 35 in Fig. 2. Consequently, when the engine stops, the thermal responsive element is no longer subject to the temperature of the coolant as it is entirely free thereof, but is, on the other hand, subject to the temperature of another medium, in this case air, having a lower temperature than the coolant, whereby the thermal responsive element is quickly cooled to effect closure of the shutters.

In order that the coolant recede to the same level inside the upper radiator tank and the reservoir, the coolant circuit must provide a path for the coolant, i. e., the pump must not completely block the flow of the coolant when it stops. Centrifugal pumps are ordinarily used in automotive vehicles and they do not completely block the flow of coolant when stopped. If it is desirable to use a pump that does block the flow when stopped, then a small opening could be provided on the lower side of the reservoir to insure an equal level of the coolant within the reservoir and the radiator.

Another of the advantages of the above-described unit results from the fact that the inlets 33 are located to prevent thermosiphon circulation of the coolant when the engine stops. This advantage results from locating the inlets above the water level obtaining in the system when the engine is stopped. Prevention of thermosiphon circulation allows the water in the radiator to cool without any surge and hot water is trapped around the cylinders permitting it to absorb heat from the cylinder walls after the engine has stopped without losing this heat in the radiator.

In order to prevent the formation of an air trap within the thermostat housing and consequent improper functioning of the thermal responsive element, the upper part thereof is provided with an aperture 36. This insures the free flow of the coolant into the reservoir 25, around the thermal responsive element 27 out through the passage 33 into the radiator 13 due to the fact that, as the level of the coolant rises above the outlet passage 33 in the reservoir, the air in the upper part of the reservoir is forced out through the aperture 36. The aperture 36 also has the additional and important advantage that when the engine stops there is no possibility of a vacuum being formed in the upper part of the housing. If a vacuum was formed in the upper part of the housing, coolant would remain therein, making it impossible to subject the thermostat to the temperature of the air within the upper

part of the radiator whenever the engine stops. Likewise, if the coolant remained in the upper part of the housing, the thermosiphon circulation would continue.

5 The effectiveness of the shutters is controlled by the thermal responsive element 27 through suitable linkage mechanism. In the present embodiment the linkage mechanism, indicated generally by reference character 38, is supported in
10 part part upon a U-shaped bracket 39 secured, as by welding, to the exterior surface of the closure plate 28. A pin 40 is mounted in the bracket and it, in turn, pivotally supports a lever 41 adapted to be actuated by operating stem 42 of
15 the thermal responsive element. The element 42 is operatively connected to the lever by a pin 43 passing through both the stem and the lever and permitting relative pivotal movement of the two. The movement of the lever is transmitted
20 to the shutter actuating lever 22 by adjustable operating rods 44 and 45 interconnected by a link 46. It should be understood that the specific linkage mechanism described immediately above has been described solely for the purpose
25 of illustrating the invention and that any other suitable linkage mechanism may be utilized.

The construction of the thermal responsive element has not been described in detail for the reason it may be of any of the well-known types
30 used in actuating shutters.

When the engine is at rest and cold, the shutters 21 are maintained in closed position by suitable resilient biasing means (not shown). As soon as the engine starts, the water in the circulating system is heated by the combustion of
35 fuel in the engine and the water is circulated by the pump 15. The water flows from the pump into heat exchange relationship with the engine 10 and thence through conduit 12 and elbow 19 into the reservoir 32 of the thermostatic shutter
40 actuating unit. The water pressure is sufficient to cause most of the water to contact the thermostatic element 27 and the latter operates the shutters into positions dependent upon the temperature of the water, through the linkage mechanism heretofore described. The water escapes
45 from the reservoir 32 into the upper radiator tank through the openings 33, is cooled in the radiator, and again circulated through the above-described path by the pump 15. Thus, during
50 all the time that the engine is in operation, the water temperature is maintained within predetermined desired limits by the controlling action of the thermostat upon the shutters. When the
55 engine stops the water ceases to circulate, and the water drops to a level below the thermostat and likewise below the inlet openings 33. As pointed out above, this results in first, the preventing of any thermosiphon circulation of the
60 water, and second, the subjection of the thermostat to the action of the air in the upper part of the radiator tank, which has a lower temperature than the water.

It has been found that when the thermal responsive shutter actuating means is adjusted to maintain the temperature of the coolant within a range of about 155 to 160 degrees F., the temperature of the air in the upper radiator tank is in the neighborhood of 15 to 20 degrees F. lower
70 when the outside air temperature is 75 to 80 degrees F. Therefore, immediately the engine stops, the thermal responsive element is cooled more rapidly than the coolant, and will more quickly close the shutters. Experiments indicate the
75 shutter-closing time of the system of the present

invention is considerably less than the time required in systems in which the thermal responsive element is immersed in the coolant at all times. The quick operation of the shutters to their closed positions and prevention of thermosiphon circulation conserve the heat stored in the coolant and engine to permit more prolonged stops before starting difficulties due to low engine and coolant temperature are encountered.

The temperature of the air within the upper
10 part of the radiator tank is dependent upon the temperature of the coolant and also upon the temperature of the outside air. Since the temperature of the air within the tank is dependent upon the temperature of the outside air and the
15 temperature differential between the air and coolant is greater in winter than in summer, the shutter unit is actuated to its closed position more rapidly in the winter than in the summer. Consequently, there is effected a greater conservation of heat in the coolant and engine in winter, when such is desirable, and the coolant and engine are adapted to be cooled by the outside
20 air for a longer time in summer.

In the modified form of the invention illustrated in Figs. 5 and 6, the thermostatic shutter
25 actuating unit is constructed as an integral part of an elbow connection between the water jacket and the upper radiator tank of the engine. An advantage of this construction is that all the coolant contacts the thermostatic element when it circulates thereby.

Referring now to Figs. 5 and 6, it may be seen that the unit, indicated in its entirety by reference character 51, is mounted upon the flat upper
35 surface of a radiator tank 52 by a substantially triangular base plate 53 forming an integral part of the unit. The plate 53 may be attached to the upper surface by any suitable means, such as the rivets 53'. The plate is connected to the
40 reservoir 54 of the unit by a right angled elbow 55 forming the outlet from the reservoir into the upper radiator tank. Water is conducted to the reservoir from the water jacket of the engine through a conduit 56 also forming an integral
45 part of the unit.

The reservoir 54 is constructed with a cylindrical open front portion 57 which is closed by a closure plate 58 attached thereto by a plurality of screws 59. The thermal responsive element
50 60, which may be of conventional construction, and which, therefore, has been illustrated somewhat diagrammatically and is not described in detail herein, is supported by the closure plate and provided with an operating stem 61 whereby
55 movement of the thermal responsive unit is transmitted to the shutters through a linkage mechanism, indicated generally by reference character 62. The linkage mechanism is supported in part by a pair of spaced apart brackets 63 extending
60 outward from the closure plate and apertured to receive pins 64. The pins pivotally support an operating lever 65 operatively connected to the stem 61 by a pair of pins 66 permitting pivotal movement between the lever and a block 67 in
65 threaded engagement with the stem. The movement of the lever 65 is transmitted to the shutters through a flexible wire 68 slidably mounted within a flexible conduit 69 supported at one end upon a lug 70 forming an integral part of the closure
70 plate 58. The wire 68 is adjustably secured to a block 71 pivotally mounted in the forked end of the operating lever 65.

The operation of the modification just described corresponds substantially with that of the pre-
75

viously described modification. When the engine is operating the temperature of the coolant is regulated by the thermal responsive element 60 which controls the position of the shutters 5 through the actuating mechanism hereinbefore described. Inasmuch as this element is located directly in the path of the coolant flowing through the elbow-like unit, it is acted upon by substantially all the coolant. When the engine stops 10 and circulation of the coolant stops therewith, the water recedes to a level below the lowermost point of the turn in the elbow so that the element 60 is above the level and thermosiphon circulation of the coolant is prevented. The element 15 60 is subjected to the temperature of the air above the water, and since this temperature is lower than that of the water, the shutters are quickly operated to a closed position, whereby the heat stored in the water and engine is conserved. 20

The specific embodiments of my invention described above are simple and rugged in construction so that they may be manufactured economically and installed in existing or new apparatus 25 with a minimum of expense and difficulty.

It should be understood that the specific embodiments described above are merely illustrative of my invention and that they are susceptible of various modifications. My invention, in its broader 30 aspects, may be seen to comprise a heat exchange system in which the effectiveness of a heat exchanger is controlled by thermal responsive means in contact with a circulating heat exchange medium whenever the latter is circulated, 35 and in contact with a medium having a temperature different from that of the heat exchange medium related to outside air when the circulation of the latter ceases. In a more specific aspect, the circulating heat exchange medium is not 40 only in contact with a medium having a temperature different from the heat exchange medium, but it is in contact with a medium the temperature of which is related to the outside air in such manner that the effectiveness of the heat exchanger is controlled in a very desirable manner. 45

Since my invention, in its more specific application, may be used not only with automotive vehicles, but with prime movers of the type adapted to generate heat when operated, I do not wish 50 to be limited to the precise details of construction set forth above in the description of preferred embodiments of my invention, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention what I claim is new and desire to secure by Letters Patent of the United States is:

1. In combination with a prime mover generating heat when operated, and a cooling system 60 therefor comprising a radiator, coolant circulating means operative whenever the prime mover is operated and means for varying the effectiveness of the radiator, a single closed coolant conduit connecting the engine and radiator having a portion 65 above the coolant level obtaining when the engine is inoperative, and thermal responsive means positioned in said portion adapted to contact coolant circulating therethrough for controlling the radiator effectiveness controlling means.

2. In an automotive vehicle of the type including an engine generating heat when operated, and a cooling system comprising a radiator, coolant circulating means operative whenever the engine is operated, and shutters for varying the effective area of the radiator, the combination includ- 75

ing, a single closed coolant conduit connecting the engine and radiator having a portion above the coolant level obtaining when the engine is inoperative, and thermal responsive means positioned in said portion for contact with coolant 5 circulating therethrough for controlling the position of the shutters.

3. In combination, a prime mover of the type generating heat when operated, a closed coolant circulating system for cooling said prime mover 10 including a heat exchanger, means for circulating a coolant through said heat exchanger during operation of the prime mover, and means for controlling the effectiveness of said heat exchanger, said circulating system having a portion 15 through which substantially all the coolant flows and so constructed and located with respect to the remainder that it is free of the coolant when the prime mover is inoperative, and thermal responsive means located in said portion for contact 20 by circulating coolant for controlling the heat exchanger effectiveness controlling means.

4. In an automotive vehicle, the combination including, a cooling system for the vehicle engine comprising a radiator and a pump operated 25 by the engine for circulating a coolant in heat exchange relationship to the engine and through the radiator, a conduit through which substantially all the coolant flows having a portion above the level of coolant obtaining when the pump is 30 inoperative connecting said engine and radiator, shutters for controlling the effective area of the radiator, and a thermostat in said portion of the conduit for controlling the shutters.

5. In an automotive vehicle, the combination 35 including, a cooling system for the vehicle engine comprising a radiator, a pump operated by the engine for circulating a coolant in heat exchange relationship to the engine and through the radiator, a conduit through which substantially 40 all the coolant flows connecting said engine and radiator, shutters for controlling the effective area of the radiator, and thermal responsive means for controlling the shutters, said conduit comprising a portion readily detachable from the 45 remainder and supporting the thermal responsive means therein for contact with coolant flowing therethrough, and said portion being so located with respect to the remainder of the cooling system that the thermal responsive means is above 50 the level of the coolant obtaining when the pump is inoperative.

6. In an automotive vehicle, the combination including, a cooling system for the vehicle engine comprising a radiator and a pump operated 55 by the engine for circulating a coolant in heat exchange relationship to the engine and through the radiator, said radiator having a portion located above the level of the coolant obtaining when the pump is inoperative, shutters for controlling the effective area of the radiator, and 60 thermal responsive means mounted in said portion of the radiator and in the path of the coolant flowing to the radiator for controlling the shutters.

7. In an automotive vehicle, the combination including, a cooling system for the vehicle engine comprising a radiator and a pump operated 65 by the engine for circulating a coolant in heat exchange relationship to the engine and through the radiator, said radiator having a portion located above the level of the coolant obtaining when the pump is inoperative, shutters for controlling the effective area of the radiator, and thermal responsive means mounted in said por- 75

tion of the radiator and in the path of the coolant flowing to the radiator for controlling the shutters, said thermal responsive means comprising a unitary structure adapted to be inserted into and attached to the upper tank of the radiator.

8. In an automotive vehicle, the combination including, a cooling system for the vehicle engine comprising a radiator and a pump operated by the engine for circulating a coolant in heat exchange relationship to the engine and through the radiator, said radiator having a portion located above the level of the coolant obtaining when the pump is inoperative, shutters for controlling the effective area of the radiator, and thermal responsive means mounted in said portion of the radiator and in the path of the coolant flowing to the radiator for controlling the shutters, said thermal responsive means comprising a unitary structure adapted to be inserted into and attached to the upper tank of the radiator, and said structure including, a cup-like housing extending into the radiator tank, a closure member therefor apertured to provide a coolant inlet and to receive the thermal responsive element of the shutter controlling means, passageways in said housing leading into the interior of the tank so arranged that circulating coolant contacts the thermal responsive element, and a passageway for air from the upper region of the housing to the interior of the radiator tank.

9. In an automotive vehicle, the combination including, an engine, a cooling system for said engine comprising a radiator, a coolant circulating pump operated by the engine and a coolant conduit through which substantially all the coolant flows connecting the engine and radiator having a portion above the level of coolant obtaining when the engine is inoperative.

10. A cooling system for prime movers of the type generating heat when operated, including in combination, a radiator, means including a closed circuit for circulating a coolant in heat exchange relationship with the prime mover and through said radiator, and means operated simultaneously with the prime mover for effecting circulation of the coolant, said circuit extending above the level of the coolant to prevent thermosiphon circulation of the coolant when said circulating means is inoperative.

11. In combination, a thermal responsive element, a housing therefor provided with an inlet

and an outlet, said inlet and outlet being so located with respect to the thermostat that a fluid medium flowing through the housing contacts the thermostat, and an air passage at the upper end of said housing.

12. In a cooling system for a prime mover comprising a heat exchanger, coolant circulating means effective during operation of the prime mover and a conduit for the coolant leading from the prime mover to the heat exchanger, the combination including thermal responsive means, and a housing therefor comprising a portion of said conduit readily detachable from the remainder of said conduit, said portion being so located with respect to the remainder of the cooling system that the thermal responsive means is above the level of the coolant obtaining when the circulating means is inoperative.

13. In a cooling system for a prime mover comprising a radiator type heat exchanger, coolant circulating means and a coolant conduit interconnecting the radiator and prime mover, said radiator having a portion above the level of the coolant obtaining when the circulating means is inoperative, the combination including, thermal responsive means, a unitary housing for said thermal responsive means forming a portion of said conduit and readily attachable to said radiator with the thermal responsive means above the said level of the coolant, and a coolant outlet in said housing so located that when the circulating means is effective the coolant contacts the thermal responsive means.

14. In a cooling system for a prime mover comprising a radiator type heat exchanger, coolant circulating means and a coolant conduit interconnecting the radiator and prime mover, said radiator having a portion above the level of the coolant obtaining when the circulating means is inoperative, the combination including, thermal responsive means, a unitary housing for said thermal responsive means forming a portion of said conduit and readily attachable to said radiator with the thermal responsive means above the said level of the coolant, a coolant outlet in said housing so located that when the circulating means is effective the coolant contacts the thermal responsive means, and a passageway for air from the upper region of said housing to the interior of the radiator.

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