Feb. 15, 1944. J. E. JUSTUS 2,341,789

COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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FIG. 1.

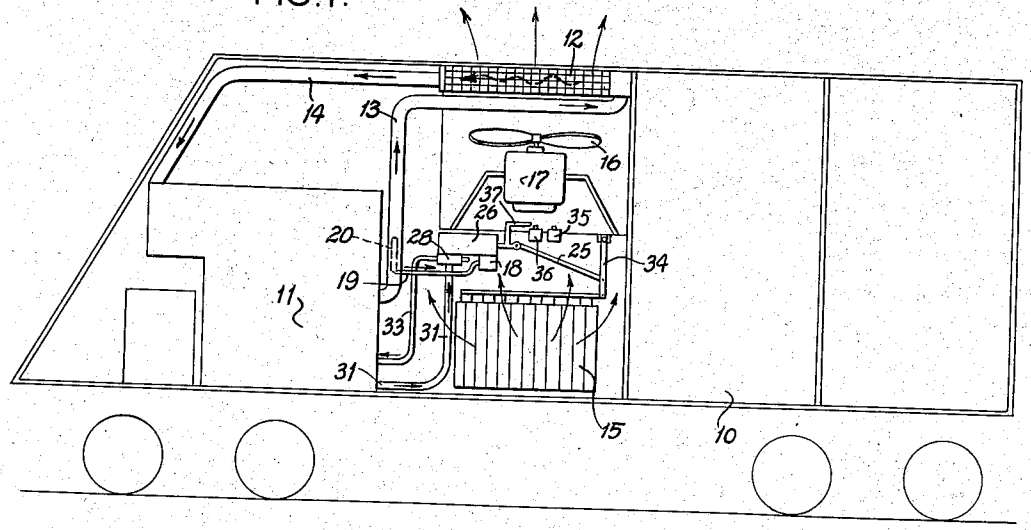


FIG. 2.

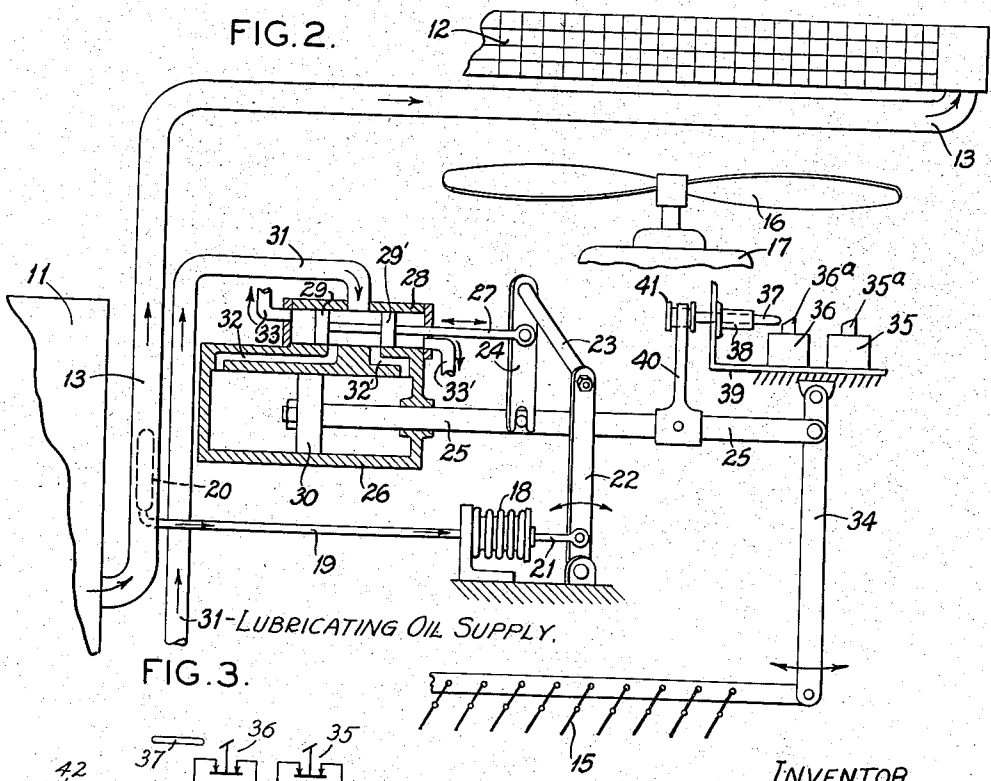
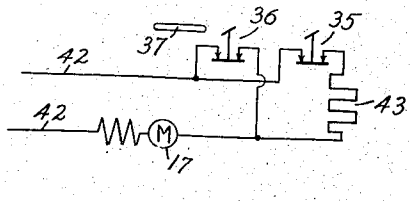


FIG. 3.



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COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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3 Claims. (Cl. 123—174)

This invention relates to cooling systems for internal combustion engines and particularly to improved means for controlling engine temperature.

The principal object of the invention resides in the provision of improved means for controlling and maintaining within a limited range the temperature of internal combustion engines employed for vehicle propulsion, especially railway locomotives, under varying conditions of loading, speed and ambient air temperature. More particularly an object of the invention is attained in the provision of improved means for controlling the rate of air flow through the radiator of a fluid cooled engine, in accordance with the temperature of the cooling fluid, and involves the joint control of an air impeller and a system of adjustable vanes or louvers associated with the engine radiator.

Other objects and advantages will appear from the following description and accompanying drawing setting forth the invention.

In the drawing, Fig. 1 is a diagrammatic side elevational view of a railway locomotive powered by an oil or gas engine utilizing the cooling air temperature control system of my invention;

Fig. 2 illustrates, diagrammatically, the means employed for controlling the flow of air through the radiator, and

Fig. 3 is a wiring diagram for the motor that drives the air impeller.

Referring now by characters of reference to the drawing, Fig. 1 illustrates a railway locomotive 10 which has for its prime source of power a Diesel engine 11. The engine 11 is provided with conventional cooling equipment, including cylinder water jackets and a heat exchanger or radiator 12 suitably connected to the jackets by forward and return pipes 13 and 14. In the present installation the radiator 12 is mounted horizontally, subjacent an opening in the roof of the locomotive cab, at the discharge end of a conduit that takes in air through openings in the opposite sides of the cab near the floor level. These intake openings are provided with shutter or damper devices, each comprising an assemblage of vertically disposed, adjustable louvers or vanes indicated generally at 15, arranged to be opened coordinately and to varying degrees between full-open and -closed positions.

The louvers 15 are adapted to pick up air from the slip stream and as will be understood, the volume of air inducted for passage through the radiator is proportional to the degree to which the louvers 15 are opened. The flow of air through the radiator is adapted to be augmented by an impeller 16 suitably mounted within the conduit between the louvers 15 and radiator 12, such impeller being driven by an electric motor 17 of variable speed type.

The operation of the louvers 15 and control of fan speed is effected through the operation of a hydraulic servo-motor under the control of a temperature responsive device influenced by the temperature of the jacket water. Such a temperature responsive device is an expandible chamber or bellows 18 which is connected by pipe 19 to a bulb 20, located in the hot water line 13, containing a suitable, readily vaporizable gas or fluid which expands pursuant to rising water temperatures, such expansion being transmitted through pipe 19 to effect, in proportional degree, elongation of the bellows element 18. The bellows is connected by a rod 21 to a lever 22 which in turn is connected by a laterally extending tie bar to the upper end of a lever 24. Lever 24 is fulcrumed at its lower end on the piston rod 25 of the servo-motor, designated generally at 26, and is connected at an intermediate point to the valve control rod 27 of the servo-motor. Rod 27 extends into a valve chest 28 and by means of a pair of spaced, piston-like valve members 29, 29' controls the flow of fluid under pressure to the cylinder space on the opposite sides of the double acting piston 30. A connection with the pressure side of the lubricating oil system is made by pipe 31 which communicates with the interior of the valve chest 28 at a point between the valves 29, and thence with the cylinder at opposite sides of the piston through passages 32 and 32'. Pipes 33 and 33' connect the ends of the valve chest 28 to the low pressure or return side of the oil circulating system. The piston rod 25 of the servo-motor is operatively connected by suitable linkage, including a lever 34, to the louvers 15.

The operation and speed of fan 16 is coordinated with the operation of louvers 15 in the following manner. The fan motor 17, in the present example of two speed type, is under the control of two switches, a low speed switch 35 and a high speed switch 36. These switches have

actuating plungers 35a and 36a adapted to be depressed sequentially by a rod member 37 mounted for endwise movement in a guide sleeve 38 carried by a bracket 39. As will be understood from the drawing, depression of the actuating plungers to open their associated switches is accomplished through a camming action of the rod 37 as it moves toward the right across the ends of the plungers. The rod 37 is connected to the piston rod 25 so as to move therewith, there being provided an arm member 40 secured to the piston rod 25 and having a lost-motion connection 41 with rod 37. Such lost motion connection desirably prevents the switches from responding to insignificant movements of rod 25. Fig. 3 illustrates the electrical circuit connection for the fan motor 17. In this figure the power supply lines are designated 42. The low speed switch 35 connects the motor 17 to the supply lines through a suitable resistance unit 43, and the high speed switch, when closed, connects the motor directly to the supply lines.

The manner in which the described mechanism operates to control engine temperature is as follows. First, it will be understood that during those periods wherein the temperature of the jacket water at the bulb 20 is constant, that is, neither rising nor falling, the positions of valves 29 and 29' are as shown in Fig. 2, the ports for both passages 32 and 32' being open and in communication with the high pressure line 31. Under these conditions equal pressure is exerted on the opposite sides of piston 30 and consequently it remains stationary. Now, if the temperature of the jacket water in pipe 13 rises, the bellows 18 will expand and move the levers 22 and 24, and thereby the valve piston, to the right. The valve 29 is thus caused to move across the port 32 relieving the pressure from that passage by placing it in communication with the low pressure or return line 33. During this transition period passage 32' continues to be in communication with the high pressure line 31. The now unbalanced pressures on the opposite sides of the main piston 30 causes that member to shift toward the left, and in so doing moves the valve piston back to its former, normal position wherein both of the passages 32 and 32' communicate with the high pressure line 31. Equal pressure on the opposite sides of the main piston 30 is accordingly restored and the main piston comes to rest in a new position to the left of its former position, its movement in such direction having opened the louvers 15 to a greater extent.

The control of fan speed through switches 35 and 36 is coordinated with the louver control above described. With the louvers in full open position the switch operating rod 37 is disengaged from the plunger 36a of the high speed switch 36 which, under this circumstance, is closed (Fig. 3). The fan motor then operates at high speed under full line voltage. As the temperature of the jacket water drops, switch rod 37 moves to the right and opens switch 36 so that the fan motor is energized at reduced voltage, and hence reduced speed, through switch 35' and resistance unit 43. With continued lowering of the engine jacket temperature rod 37 moves into engagement with and depresses plunger 35a to open the low speed switch 35, and since switch 36 is also being held open by rod 37 the fan motor becomes completely deenergized and ceases to operate. The operation of the fan as coordinated with that of the louvers in a temperature control system of the described character, where engine jacket temperatures are desired to be maintained at about 160 degrees F. will be understood from the following table of exemplary figures.

Increased temperatures

	Degrees
Louvers closed	155
Louvers 50% open	160
Louvers 60% open, and low speed fan starts	161
Louvers 95% open, and high speed fan starts	164½
Louvers 100% open, and high speed fan running	165

Decreased temperatures

	Degrees
Louvers 100% open, and high speed fan running	165
Louvers 90% open, and high speed fan stopped, and low speed running	164
Louvers 55% open, and low speed fan stopped	160½
Louvers closed	155

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In combination in an engine cooling system including a radiator, a variable speed, motor-driven fan and a shutter device for varying the flow of air through said radiator, control means for said fan and shutter device, said means including a shaft arranged for endwise movement to open and close said shutter device, a plurality of fan speed control switches and an operating member common to said switches, said member being connected for movement with said shaft and adapted to close said switches sequentially to increase the fan speed when said shaft is moved in one direction.

2. In combination in an engine cooling system including a radiator, a variable speed motor-driven fan and a shutter device for varying the flow of air through said radiator, control means for said fan and shutter device, comprising a plurality of fan speed control switches having individual, aligned actuating fingers, a member movable along the line of said switch fingers adapted sequentially to engage and operate the same, an operating member for said shutter device, and means connecting said switch operating member for movement by said shutter operating member, said means including a lost-motion device for permitting limited movement of said shutter operating member independently of said switch operating member.

3. In combination in an engine cooling system including a radiator, means for varying the flow of air through said radiator, comprising a shutter device and a variable speed motor-driven fan, power means of cylinder and piston type connected to said shutter device to open and close the same, a thermal-responsive device subject to engine temperature for controlling said power means, a plurality of fan speed control switches having actuating fingers disposed in alignment, an operating member movable along the line of said switches and adapted by cams to engage and operate said fingers sequentially to effect staged variations of fan speed, and means connecting said switch operating member for movement by the piston of said power means, including a lost-motion device for permitting limited movement of said piston independently of said switch operating member.

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