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INTERNAL-COMBUSTION ENGINE COOLING SYSTEM

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FIG. 1

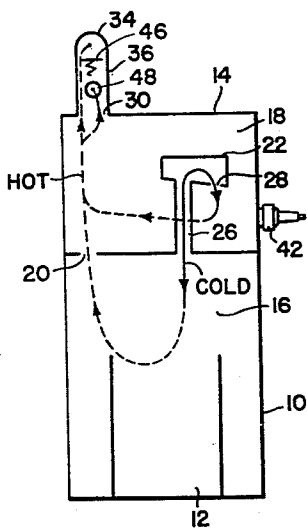
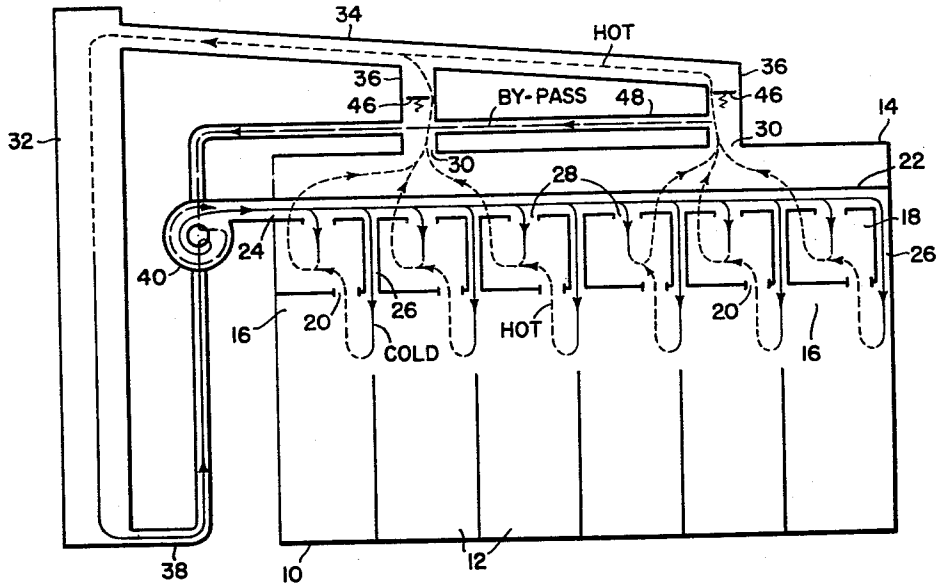


FIG. 2

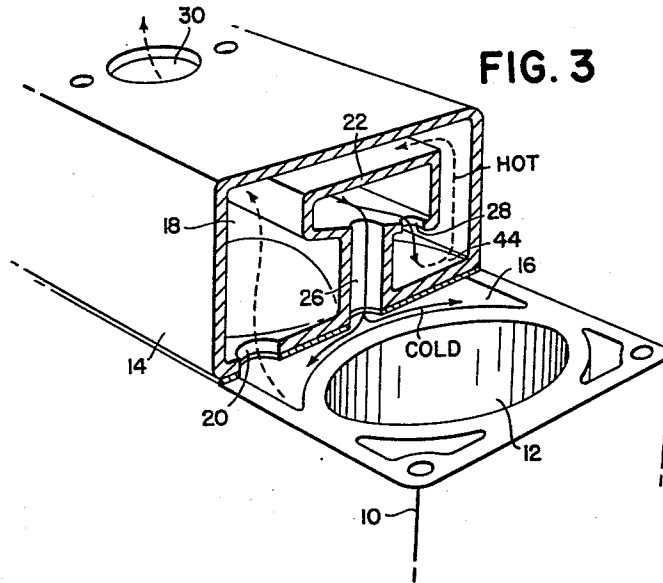


FIG. 3

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INTERNAL-COMBUSTION ENGINE COOLING SYSTEM

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5 Claims. (Cl. 123—41.08)

This invention relates to an internal-combustion engine and more particularly to an improved cooling system therefor.

The invention has for its principal object the provision of a cooling system having a plurality of thermostats or temperature-responsive valves for assuring uniform coolant temperatures throughout the engine, especially in engines of substantial length, such as those having several cylinders in line. The invention has for another object an improved cooling system having a bypass circuit controlled by the two or more temperature-responsive valves whereby the radiator or heat-exchanger may be by-passed under certain operating conditions. Another object of the invention resides in the connection of the by-pass circuit directly to the intake side of the coolant pump. A still further object resides in the provision of a coolant-distributing means in the form of a tube preferably embodied in the engine head and having coolant outlets, some of them leading to a coolant chamber in the head and others leading to the coolant jacket means for the several cylinders. The advantage of the distributing tube is that coolant is distributed directly to the hottest portions of the engine, such as combustion chambers, spark plug and/or injection nozzle seats and the tops of the cylinders. The discharge side of the water pump is connected directly to the inlet of the heat distributing tube, which makes it mechanically simpler to mount the water pump.

The foregoing and other important objects and desirable features inherent in and encompassed by the invention will become apparent as a preferred embodiment thereof is disclosed by way of example in the ensuing description and accompanying sheet of drawings, the figures of which are described below.

Fig. 1 is a schematic view illustrating the overall cooling system as seen in elevation.

Fig. 2 is an end view of the structure shown in Fig. 1.

Fig. 3 is fragmentary view, partly in section and drawn to an enlarged scale, showing the relationship of the heat distributing tube to the head and related components.

The engine, as is typical, includes a cylinder block and head structure comprising a block 10 having a series of upright cylinders 12 arranged in line. In the present case, there are six cylinders, which gives the engine structure substantial fore-and-aft length. The expression "fore-and-aft" is used as a term of convenience and not as a term of limitation. Likewise, the cylinders may be arranged otherwise than in upright positions.

The block is supplemented by a head 14, secured to the top of the block over the tops of the cylinders as is conventional in this respect. Coolant jacket means 16 may be associated in typical fashion with the cylinders 12, and the head 14 has therein a coolant chamber 18 which has a plurality of first passages or openings 20 in coolant-transfer communication with the jacket means 16.

It is a feature of the invention that the head 14 is provided lengthwise thereof with heat-distributing means,

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herein the form of a cast-in distributing tube 22. In the present case, the forward end of the tube 22 opens forwardly as an inlet 24, and the tube is provided lengthwise thereof with a plurality of vertical passages 26 which open downwardly to the jacket means 16. Since the jacket means includes portions between the several cylinders, and since the passages 26 are spaced lengthwise of the block structure, it will be seen that there is a passage 26 for the jacket portion between each pair of cylinders. Stated otherwise, the passages 26 are equal in number to and spaced apart on the order of the jacket means portions between the several cylinders 12. In addition to the passage portions 26, the tube 22 has a plurality of openings which open downwardly directly to the coolant chamber 18 in the head. Consequently, coolant introduced at the tube inlet 24 flows through the tube and exits at 26 to the jacket means 16 and at 28 to the chamber 18 in the head. The coolant continues its circulation upwardly through the passages 20 back to the head chamber 18 and outwardly through a pair of fore-and-aft spaced apart outlets 30.

In normal operation, the coolant is circulated back to a radiator or heat-exchanger 32, to the top of which is connected conduit means 34 having front and rear branches 36 connected respectively to the head outlets 30. The lower end of the radiator 32 is connected by an intake conduit 38 to the intake side of a fluid-circulating means such as a conventional coolant pump 40, and the discharge side of the pump is connected to the distributing tube inlet 24. For the purposes of explaining the normal coolant circulation, full lines are used to illustrate the path of cold water from the lower part of the radiator 32 through the pump 40 to the inlet 24 of the distributing tube 22. The cold coolant passes to the cylinder jacket means 16 and head chamber 18 as indicated. Fig. 2 illustrates a spark plug at 42 as being located in the vicinity of the openings 28 in the tube 22. Since the water pump supplies coolant under pressure, the coolant in the tube 22 will be at a relatively high pressure and thus will be discharged through the openings 28 not only in the vicinity of the spark plugs 42 but in the vicinity of combustion chambers 44 for the several cylinders as shown in Fig. 3, as well as in the zone of the tops of the cylinders 12. If fuel injectors are used in place of the spark plugs 42, they will occupy generally the same location and accordingly the coolant-transfer benefits will be obtained.

In view of the relatively substantial length of the engine structure, coolant temperatures may vary from front to rear thereof. Consequently, the engine structure may be regarded as having front and rear ends to which the head outlets 30 are respectively proximate. As already stated, as the coolant is circulated and picks up heat, it will exit through the outlets 30 to the conduit means branches 36 and thence through the conduit means 34 to the top of the radiator, where it will be cooled for flow downwardly to the intake line 38 for the pump 40.

For the purposes of enabling warming up of the engine, it is conventional practice to use a temperature-responsive valve. The present invention departs from this practice to the extent that a plurality of temperature-responsive valves is used. In the present case, since there are two branches 36, two temperature-responsive valves will be used, which are here illustrated schematically at 46, one in each branch 36. These, per se, may be of any type and are therefore shown only schematically. Suffice it to note that each valve is of the type which closes its branch in response to relatively low coolant temperatures and which opens its branch when the temperature increases above a pre-determined value. These valves are used in conjunction with a by-pass conduit 48 which in-

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terconnects the branches 36 and which leads to the intake side of the pump 40. Each valve 46 is located downstream of the junction between the conduit 48 and the branches 36. Consequently, when the valves 46 are closed, the branches 36 are cut off from communication with the conduit means 34 but retain communication with the by-pass line 48. Therefore, the closed valves and the by-pass conduit are effective to establish a by-pass circuit illustrated in dot-dash lines as to coolant flow. When the coolant temperature rises to a sufficient value, the valves 46 open, reestablishing communication between the branches 36 and the conduit means 34, whereby the coolant can flow through the conduit means 34 as well as through the by-pass line 48. Obviously, when both valves are closed, as when the engine is cold, the coolant circulates only in the by-pass circuit and the engine is warmed up quickly and evenly. Should one of the valves open before the other, it would provide a path for not only warm coolant at the opened valve but for colder coolant from the vicinity of the other valve. The colder coolant would then react against the open valve, causing it to close, thus assuring functioning in the manner required, that is, to secure even distribution of heat so that engine temperatures from front to rear are substantially uniform.

As expressed above, one of the features of the invention is the mounting of the water pump 40 directly to the front end of the head 14. This is made possible as a mechanical feature facilitating design and assembly, since the inlet 24 for the distributing tube 22 opens at the forward end of the head. The feature of having the tube 22 cast in the head eliminates at least one external conduit means, plus the advantage of leading passages such as those at 26 and 20 directly to the jacket means 16 without external connections.

Features and advantages in addition to those outlined will readily occur to those versed in the art, as will modifications and alterations in the preferred embodiment disclosed, all of which may be achieved without departure from the spirit and scope of the invention.

What is claimed is:

1. In an internal-combustion engine: an elongated cylinder block and head structure having coolant jacket means running lengthwise thereof and provided with a coolant inlet and a pair of coolant outlets spaced apart lengthwise thereof; a coolant heat exchanger; an inlet conduit connecting one side of the exchanger to the inlet; an outlet conduit connected to the other side of the exchanger and having a pair of branches, one connected to each outlet, for normal circulation of coolant from said one side of the exchanger to the jacket means via

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said inlet and from the jacket means to the other side of the exchanger via said outlets and outlet conduit; by-pass means interconnecting the branches upstream of the outlet conduit and connected to the jacket means inlet in by-passing relation to the exchanger; and a pair of temperature-responsive valves, one in each branch downstream of the connection of said branch to the by-pass means and upstream of the connection of said branch to the outlet conduit, and operative in response to high coolant temperatures to open the respective branches to both the by-pass means and outlet conduit and responsive to low coolant temperature to cut off said branches from the outlet conduit while leaving said branches in communication with the by-pass means.

2. The invention defined in claim 1, in which: the cylinder block and head are separate elements secured together; said head has a coolant chamber therein in communication with the jacket means; and said head contains the inlet and the two outlets.

3. The invention defined in claim 2, in which: the head includes a coolant distributor passage means having openings leading to the chamber and to the jacket means, and said inlet leads directly to said distributor passage means.

4. The invention defined in claim 3, including a pump disposed in the inlet conduit and having intake and discharge sides respectively toward the exchanger and the inlet; and said by-pass means leads to the inlet conduit at the intake side of the pump.

5. In an internal-combustion engine: an elongated cylinder block and head structure having coolant jacket means running lengthwise thereof and provided with a coolant inlet and a pair of coolant outlets spaced apart lengthwise thereof; a coolant heat exchanger; an inlet conduit connecting one side of the exchanger to the inlet; an outlet conduit connected to the other side of the exchanger and having a pair of branches, one connected to each outlet, for normal circulation of coolant from said one side of the exchanger to the jacket means via said inlet and from the jacket means to the other side of the exchanger via said outlets and outlet conduit; and temperature-responsive by-pass means operative in response to low coolant temperatures to connect both outlets to the jacket means inlet in by-passing relation to both the exchanger and the outlet conduit.

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