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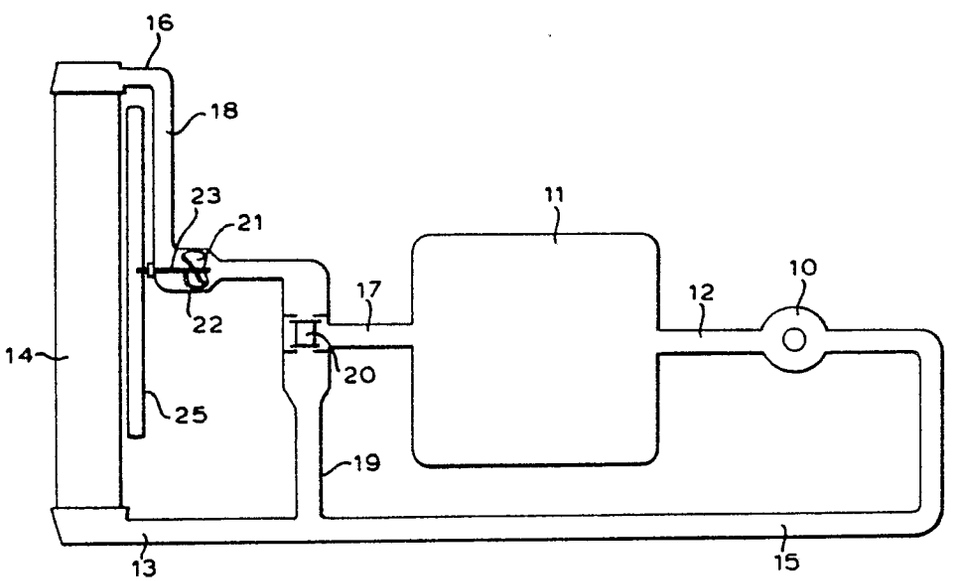
(54) Cooling systems.

(57) A cooling system for an internal combustion engine in which coolant is circulated through an engine cooling jacket (11) and a radiator (14) by means of an engine driven pump (10), a turbine (21, 22, 23) being disposed in the return (18) between the radiator (14) and cooling jacket (11), said turbine (21, 22, 23) driving a fan (25) to force air through the radiator (14).



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COOLING SYSTEMS

The present invention relates to cooling systems and in particular to cooling systems for internal combustion engines.

In conventional internal combustion engine cooling systems an engine driven pump circulates coolant from the cooling jacket of the engine, through a radiator and back to the cooling jacket. A thermostatically controlled bypass is provided so that all or part of the flow of coolant may be circulated through the cooling jacket without passing through the radiator. Consequently, from start-up while the engine is still cold, the thermostat will prevent coolant flowing through the radiator and as the engine gradually warms up, flow of coolant through the thermostat from the radiator will increase.

A fan is provided to cause air to flow through the radiator to assist heat exchange. This fan may be driven directly from the engine and may be driven continuously or may be arranged to cut-in at some temperature, under for example the control of a viscous clutch or similar means. Alternatively, the fan may be driven electrically under suitable control. Whether driven directly by the engine or electrically, the fan imposes a significant power loss on the engine output. Controlling the fan so that it only operates at higher temperatures requires sophisticated control means which adds significantly to the cost of the system.

According to one aspect of the present invention, a cooling system for an internal combustion engine having an engine driven pump for circulating coolant around a circuit including a cooling jacket and a radiator, a bypass in parallel with the radiator and thermostatic means for controlling flow through the bypass and radiator; and a fan for forcing air through the radiator, characterised in that said fan is driven by means of a turbine, said turbine being disposed in the return between the radiator and cooling jacket.

In this manner, the flow of coolant in the cooling system is used to drive the fan. This may be achieved with minimal additional power consumption and the thermostat which controls the rate of flow of coolant through the radiator will also control the speed of the fan.

An embodiment of the invention is now described, by way of example only, with reference to the accompanying drawing which illustrates schematically a cooling system in accordance with the present invention.

In the system illustrated, an engine driven pump 10 circulates coolant from a water jacket 11 via outlet 12, to the inlet 13 of a radiator 14 via line 15. The outlet 16 from the radiator 14 is connected to the inlet 17 of water jacket 11 by return line 18. A bypass 19 interconnects lines 15 and 18, a thermostatic valve 20 being provided at the junction between return line 18 and bypass 19 to control the relative rates of flow of coolant from return line 18 and bypass 19 to the inlet 17.

A turbine 21 is located in a housing 22 which forms part of the return line 18. The turbine 21 is mounted on a shaft 23 which is located in suitable bearings and extends through the wall of housing 22, sealing means being provided to prevent leakage of coolant. A fan 25 is attached to the end of shaft 23 which extends from the housing 22, said fan 25 upon rotation of the shaft 23 due to flow of coolant over the turbine 21 from the outlet 16 of radiator 14 to the inlet 17 of cooling jacket 11, being arranged to draw air through the radiator 14.

In operation, when the engine and coolant are cold, the thermostatic valve 20 will close connection between the return line 18 and inlet 17 and will fully open the connection between bypass 19 and inlet 17. The engine driven pump 10 will consequently recirculate coolant from the water jacket 11, via line 15 and bypass 19 back into the coolant jacket via inlet 17. Under these conditions, there will be no flow of coolant through the radiator 14 or past the turbine 21 and consequently the fan 25 will remain stationary.

As the temperature of the coolant increases, the connection between return line 18 and inlet 17 is gradually opened so that coolant will begin to flow through the radiator 14. As this coolant flows past the turbine 21, it will rotate the fan 25. The speed of the fan 25 and hence the amount of air drawn through the radiator 14 will depend upon the rate of flow of coolant through the radiator 14 which in turn is controlled by the thermostatic valve 20 as a function of the temperature of the coolant.

The system described above thus provides a cooling system in which the speed of the fan 25 will be automatically adjusted so that it will be stationary or slow when the coolant temperature is low and the radiator is only required to remove a small amount of heat and will be fast when the coolant temperature is high and the radiator is required to remove large amounts of heat.

Various modifications may be made without departing from the invention. For example, while in the above embodiment the fan is driven directly by the turbine, the turbine may alternatively be arranged to drive the fan through suitable drive means, for example a belt and pulley system. Such drive means may also include means for increasing or reducing the drive ratio. Also the thermostatic valve may be located in any suitable position in

which it will control the rate of flow through the radiator and the bypass.

If required, a low powered electric motor may be provided to assist the turbine at low engine speeds. This motor may be mounted directly on the turbine shaft. Switching means responsive to engine speed and coolant temperature will energise the motor when the speed of the engine is below a predetermined value and the coolant is at or above its normal operating temperature.

Claims

1. A cooling system for an internal combustion engine having an engine driven pump (10) for circulating coolant around a circuit including a cooling jacket (11) and a radiator (14), a bypass (19) in parallel with the radiator (14) and thermostatic means (20) for controlling flow through the bypass (19) and radiator (14); and a fan (25) for forcing air through the radiator (14), characterised in that said fan (25) is driven by means of a turbine (21, 22, 23), said turbine (21, 22, 23) being disposed in the return (18) between the radiator (14) and cooling jacket (11).

2. A cooling system according to Claim 1 characterised in that the thermostat (20) will prevent flow of coolant through the turbine (21, 22, 23), when the coolant is below a predetermined temperature.

3. A cooling system according to Claim 1 or 2 characterised in that a thermostatic valve (20) is situated between the outlet (16) from the radiator (14) and inlet (17) to the water jacket (11), and between the bypass (19) and the inlet (17) to the water jacket (11).

4. A cooling system according to Claim 3 characterised in that the turbine (21, 22, 23) is disposed between the outlet (16) from the radiator (14) and the thermostatic valve (20).

5. A cooling system according to any one of Claims 1 to 4 characterised in that the fan (25) is driven directly by the turbine (21, 22, 23).

6. A cooling system according to any one of Claims 1 to 4 characterised in that the fan (25) is driven by the turbine (21, 22, 23) via means which will increase or reduce the drive ratio.