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(54) REGULATING TRANSMISSION FLUID AND ENGINE COOLANT TEMPERATURES IN A MOTOR VEHICLE

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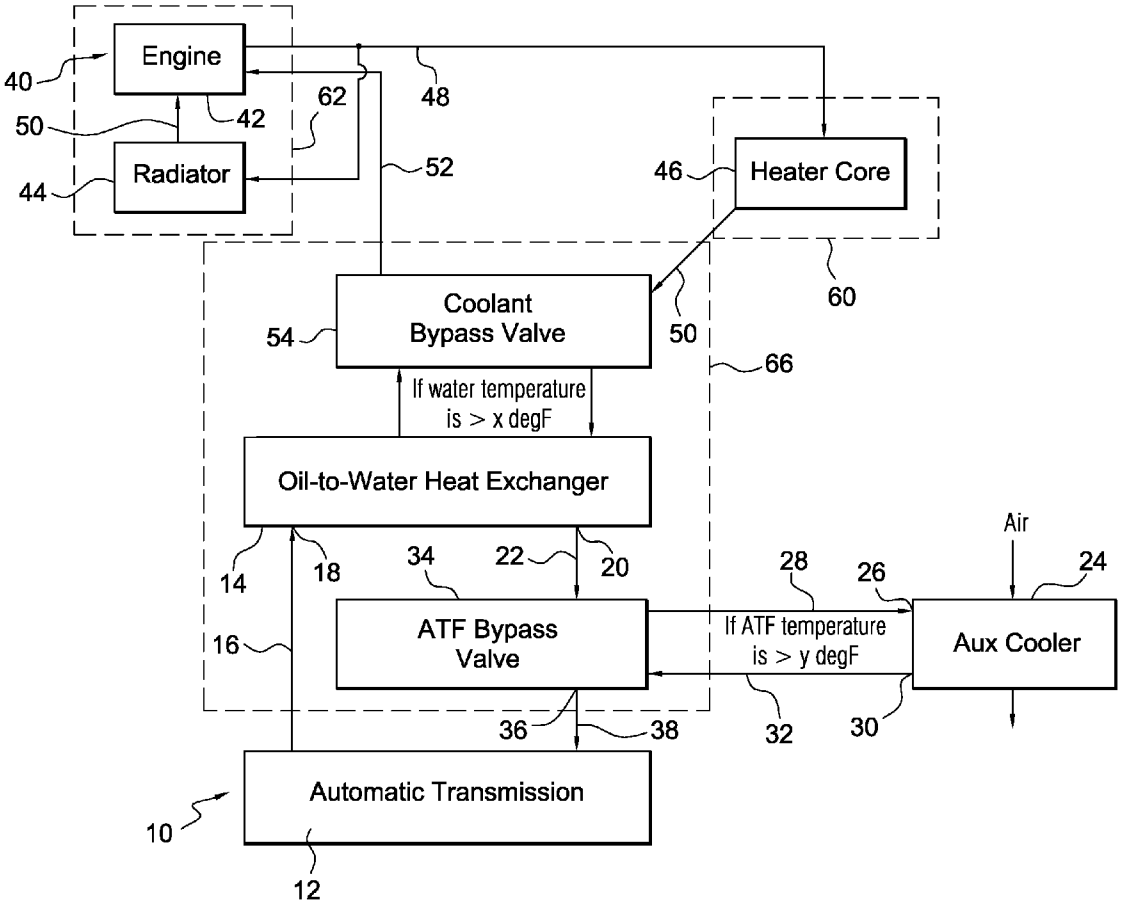
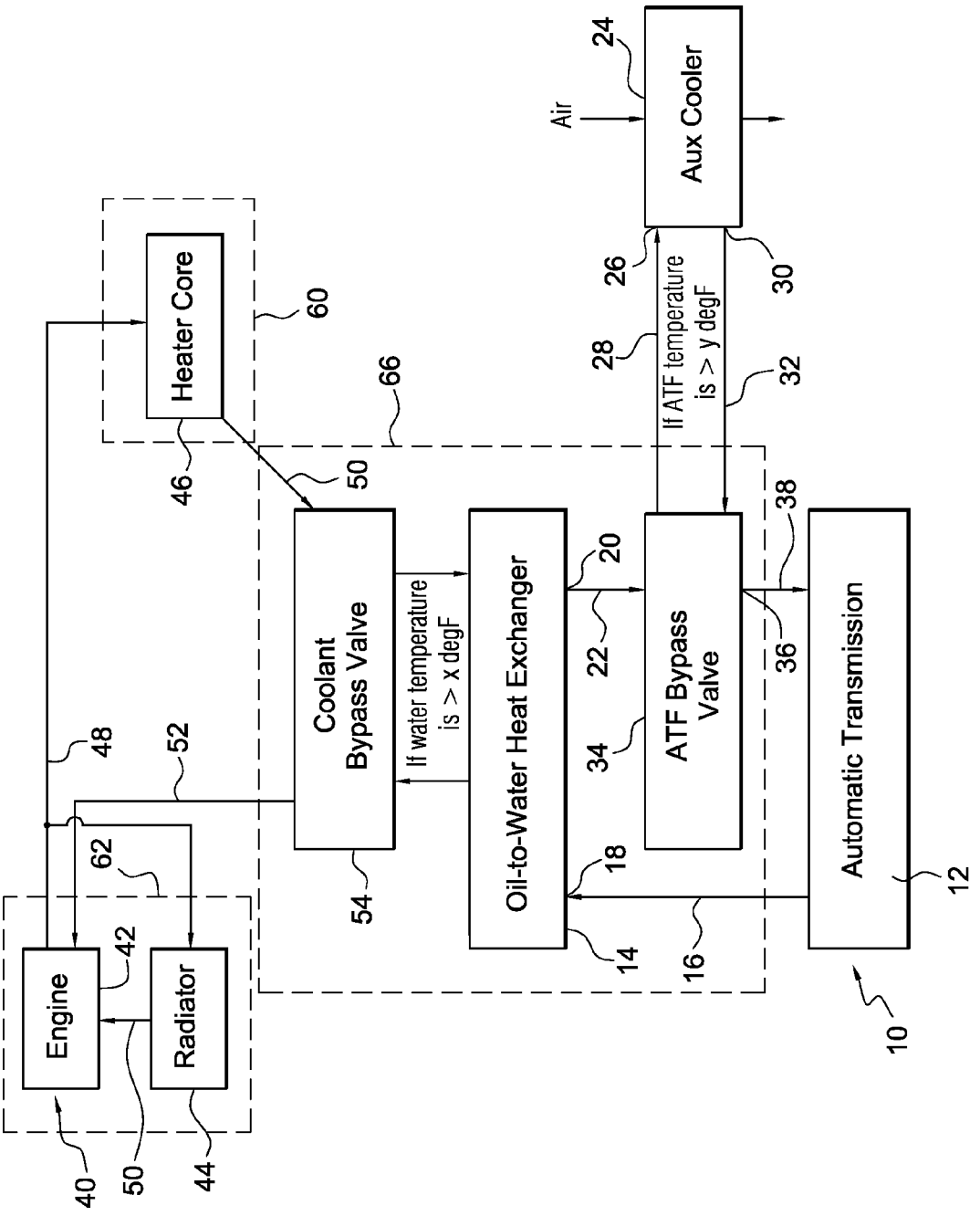
(57) **ABSTRACT**

A system for controlling the temperature of a transmission fluid includes a first heat exchanger communicating with a source of engine coolant for transferring heat between the engine coolant and the transmission fluid and including a first outlet through which transmission fluid exits the first heat exchanger, a second heat exchanger through which air may flow for transferring heat between the transmission fluid and the air and including a second inlet through which transmission fluid enters the second heat exchanger, and second outlet through which transmission fluid exits the second heat exchanger, and a first bypass valve for alternately opening and closing the second inlet and the second outlet when a temperature of transmission fluid exiting the first outlet is greater than a first reference temperature, and for bypassing the second heat exchanger when the temperature of transmission fluid exiting the first outlet is less than the second reference temperature.




Air
Aux Cooler
Heater Core
Coolant Bypass Valve
If water temperature is > x degF
Oil-to-Water Heat Exchanger
ATF Bypass Valve
If ATF temperature is > y degF
Automatic Transmission
Engine
Radiator
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REGULATING TRANSMISSION FLUID AND ENGINE COOLANT TEMPERATURES IN A MOTOR VEHICLE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to apparatus for regulating the temperature of transmission fluid and engine coolant in a motor vehicle.

[0003] 2. Description of the Prior Art

[0004] A transmission cooling system may include an oil-to-water cooler or an oil-to-air cooler, or both of these, which remove heat contained in the transmission oil and are sized to accommodate a heat load produced when the transmission is operating under severe duty conditions. To reduce transmission friction, it is desirable to run the transmission at a relatively high temperature. The higher temperature reduces oil viscosity, which is one of the larger contributors to internal friction.

[0005] A cooler bypass valve may be used to reduce heat transfer from the transmission oil when cooling is not desired, so that internal friction can warm the transmission oil to the desired operating temperature. But cooler bypass valves have limited effect on warm up rates after a cold start.

[0006] An oil-to-water cooler located in the heater loop uses engine coolant to heat the transmission, especially after cold starts. This cooler has an advantage over an oil-to-water cooler installed in the radiator, in which no coolant flows until the engine reaches its desired operating temperature due to a closed thermostat. Although the oil-to-water cooler located in the engine coolant loop provides a solution for light duty vehicles, it is not capable of cooling heavier duty applications, such heavy duty trucks and other towing vehicles, due to their high coolant temperatures and a need for the transmission to run at temperatures close to the maximum engine coolant temperature.

[0007] Furthermore, performance of the passenger compartment heater is compromised when engine coolant is used to heat the transmission. Warming the transmission causes a lower coolant temperature, which reduces heater performance and slows delivery of heat to the passenger compartment.

SUMMARY OF THE INVENTION

[0008] A system for controlling the temperature of a transmission fluid includes a first heat exchanger communicating with a source of engine coolant for transferring heat between the engine coolant and the transmission fluid (sometimes called oil or ATF) and including a first outlet through which transmission fluid exits the first heat exchanger, a second heat exchanger through which air may flow for transferring heat between the transmission fluid and the air and including a second inlet through which transmission fluid enters the second heat exchanger, and second outlet through which transmission fluid exits the second heat exchanger, and a first bypass valve for alternately opening and closing the second inlet and the second outlet when a temperature of transmission fluid exiting the first outlet is greater than a first reference temperature, and for bypassing the second heat exchanger when the temperature of transmission fluid exiting the first outlet is less than the second reference temperature.

[0009] The engine coolant side bypass valve bypasses the ATF heat exchanger whenever the heat core discharge temperature is below a desired threshold. Then the first heat exchanger can be nearly any size without compromising the rate at which temperature of the heater core increases below that threshold. Above that temperature threshold, the bypass valve will open, thereby admitting coolant into the first heat exchanger.

[0010] ATF always flows through the heat exchanger. The second bypass valve senses the return oil temperature and, that temperature is below a reference temperature, e.g. 200° F., it will return to the transmission, which is a bypass to any auxiliary cooler in the ATF cooling loop. If the oil temperature is greater than the reference temperature, the ATF bypass valve opens, thereby admitting oil to flow to the auxiliary cooler, then return to the transmission.

[0011] The system provides additional packaging advantages when including both the water-side bypass, ATF-bypass and first heat exchanger as one assembly.

[0012] The scope of applicability of the preferred embodiment will become apparent from the following detailed description, claims and drawings. It should be understood, that the description and specific examples, although indicating preferred embodiments of the invention, are given by way of illustration only. Various changes and modifications to the described embodiments and examples will become apparent to those skilled in the art.

DESCRIPTION OF THE DRAWINGS

[0013] The invention will be more readily understood by reference to the following description, taken with the accompanying drawing, in which:

[0014] The FIGURE is a schematic diagram of a system for controlling the temperature of automatic transmission fluid.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] A automatic transmission **10** includes a oil sump **12**, which is a source of transmission fluid, from which transmission fluid is supplied to the intake side of a transmission pump (not shown) and into which fluid is delivered from the hydraulic circuit of the transmission after the fluid lubricates and carries heat from the clutches, bearings, shafts, gears and other components of the transmission.

[0016] A first heat exchanger **14**, which communicates with the source of transmission fluid **12** through an oil line **16**, is adapted to carry engine coolant and to transfer heat between the engine coolant and the transmission fluid. Heat exchanger **14** includes a first inlet **18** through which transmission fluid enters heat exchanger **14** from line **16**, and a first outlet **20** through which transmission fluid exits the heat exchanger and enters a line **22**.

[0017] A second heat exchanger **24** includes a passageway through which ambient air may flow, transfers heat between the transmission fluid and the air. Heat exchanger **24** includes a second inlet **26**, through which transmission fluid enters the second heat exchanger through an oil line **28**, and second outlet **30**, through which transmission fluid exits the second heat exchanger through an oil line **32**.

[0018] A first bypass valve **34** is supplied through line **22** with transmission fluid exiting heat exchanger **14** at outlet **20** and includes an outlet **36**, through which transmission fluid is carried in oil line **38** to the fluid source **12**. Oil lines **28**, **32** communicated bypass valve **34** and heat exchanger **24**.

[0019] Bypass valve **34** opens communication through the second inlet **26** and second outlet **30** when the temperature of transmission fluid exiting the first outlet **20** is greater than a first reference temperature. Bypass valve **34** causes transmission fluid to bypass second heat exchanger **24** and to flow directly into fluid source **12** when the temperature of transmission fluid exiting the first outlet **20** is lower than the second reference temperature. This bypass valve **34** closes communication through the second inlet **26** and second outlet **30** when the temperature of transmission fluid exiting the first outlet **20** is greater than a first reference temperature.

[0020] Preferably the first reference temperature is about 200° F., and the second reference temperature is about 190° F. Preferably bypass valve **34** is a bypass valve of the wax motor type that is used in automatic transmission cooler loops by various automotive manufacturers.

[0021] As engine **40** includes a chamber **42**, i.e., a source of engine coolant, in which engine coolant circulates around the combustion chambers of the engine and from which engine coolant is supplied to a third heat exchanger, which may include a radiator **44**, or a heater core **46**, or both the radiator and heater core. An engine coolant circuit includes coolant line **48**, which carries coolant from the coolant source **42** to heater core **46**; a coolant line **50**, which carries coolant from the heater core **46**; and coolant line **52**, which carries coolant to the engine **42**.

[0022] Coolant lines **50**, **52** carry coolant to and from a second bypass valve **54**. The second bypass valve **54** opens and closes communication between heater core **46** and engine **42** when the temperature of engine coolant entering bypass valve **54** is less than a third reference temperature, which results in the coolant bypassing heat exchanger **14**. Bypass valve **54** closes communication between heater core **46** and engine **42** when the temperature of the engine coolant entering valve **54** is greater than the third reference temperature.

[0023] Preferably the third reference temperature is about 30° F. Preferably bypass valve **34** is a bimetal bypass valve used frequently to bypass the radiator.

[0024] Preferably heater core **46** is located in a passenger compartment **60**, engine **40** and radiator **44** are located in an engine compartment **62**, and coolant bypass valve **34**, ATF bypass valve **54** and heat exchanger **14** are incorporated in a subassembly **64**, which is attached to the transmission **10** and located in the engine compartment. Alternatively, coolant bypass valve **54** and heat exchanger **14** are incorporated in a subassembly, which is attached to the transmission **10** and located in the engine compartment, but the ATF bypass valve **34** is located in either heat exchanger **24**, i.e., the auxiliary cooler, or in lines **28**, **32**.

[0025] In accordance with the provisions of the patent statutes, the preferred embodiment has been described. However, it should be noted that the alternate embodiments can be practiced otherwise than as specifically illustrated and described.

What is claimed is:

1. In a motor vehicle having an internal combustion engine and automatic transmission, a system for regulating the temperature of transmission fluid and engine coolant comprising:

a source of engine coolant;

a source of transmission fluid;

a first heat exchanger communicating with the source of engine coolant, including a first inlet through which transmission fluid enters the first heat exchanger from the source of transmission fluid, and a first outlet through which transmission fluid exits the first heat exchanger, for transferring heat between the engine coolant and the transmission fluid;

a second heat exchanger through which air may flow, including a second inlet through which transmission fluid enters the second heat exchanger, and second outlet through which transmission fluid exits the second heat exchanger, for transferring heat between the transmission fluid and the air;

a first bypass valve for opening communication through the second inlet and the second outlet when a temperature of transmission fluid exiting the first outlet is greater than a first reference temperature, and for closing communication through the second inlet and the second outlet when the temperature of transmission fluid exiting the first outlet is less than the second reference temperature.

2. The system of claim **1** wherein the first heat exchanger and the first bypass valve are connected to the transmission.

3. The system of claim **1** further comprising:

a third heat exchanger communicating with the source of engine coolant; and

a second bypass valve for opening communication between the engine coolant in the third heat exchanger and the engine coolant in the first heat exchanger when a temperature of engine coolant entering the second bypass valve is greater than a third reference temperature, and closing communication between the engine coolant in the third heat exchanger and the engine coolant in the first heat exchanger when the temperature of said engine coolant entering the second bypass valve is less than the third reference temperature.

4. The system of claim **1** wherein the first heat exchanger, the first bypass valve and the second bypass valve are connected to the transmission.

5. The system of claim **1** wherein the third heat exchanger further comprises a heater core for transferring heat from the engine coolant to air in a passenger compartment of the vehicle.

6. The system of claim **1** wherein the third heat exchanger further comprises a radiator for transferring heat from the engine coolant to ambient air.

7. The system of claim **1** wherein the third heat exchanger further comprises:

a heater core for transferring heat from the engine coolant to air in a passenger compartment of the vehicle; and

a radiator communicating with the heater core, for transferring heat from the engine coolant to ambient air.

8. The system of claim **1** further comprising a connection between the first outlet and the source of transmission fluid.

9. The system of claim **1** wherein the first bypass valve further includes a connection between the first outlet and the source of transmission fluid.

10. A method for regulating the temperature of transmission fluid and engine coolant in a motor vehicle having a source of engine coolant and a source of transmission fluid, the method comprising the steps of:

providing a first heat exchanger communicating with the source of engine coolant and including a first inlet through which transmission fluid enters the first heat exchanger from the source of transmission fluid and a first outlet through which transmission fluid exits the first heat exchanger;

using the first heat exchanger to transfer heat between the engine coolant and the transmission fluid;

providing a second heat exchanger that includes a second inlet through which transmission fluid enters the second heat exchanger, and second outlet through which transmission fluid exits the second heat exchanger;

using the second heat exchanger to transfer heat between the transmission fluid and ambient air;

opening communication through the second inlet and the second outlet when a temperature of transmission fluid exiting the first outlet is greater than a first reference temperature; and

closing communication through the second inlet and the second outlet when the temperature of transmission fluid exiting the first outlet is less than the first reference temperature.

11. The method of claim **10** further comprising the steps of:

providing a third heat exchanger communicating with the source of engine coolant;

opening communication between the engine coolant in the third heat exchanger and the engine coolant in the first heat exchanger when a temperature of engine coolant exiting the third heat exchanger is greater than a third reference temperature; and

closing communication between the engine coolant in the third heat exchanger and the engine coolant in the first heat exchanger when the temperature of engine coolant exiting the third heat exchanger is less than the third reference temperature.

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