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(54) Total cooling assembly for a vehicle having an internal combustion engine

Totaler Kühlungszusammenbau für Kraftfahrzeuge, die mit Brennkraftmaschinen angetrieben werden

Système de refroidissement global pour véhicules possédant un moteur à combustion interne

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- **PATENT ABSTRACTS OF JAPAN vol. 095, no. 010, 30 November 1995 & JP 07 180554 A (AISIN SEIKI CO LTD), 18 July 1995**

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Description

Field of the Invention

[0001] This invention relates to a cooling assembly and more particularly to a total cooling system that includes various pump and valve configurations to provide efficient fluid circulation and heat rejection in an engine compartment of an internal combustion engine of a vehicle.

Background of the Invention

[0002] An internal combustion engine requires heat rejection generally either by air or liquid. In conventional vehicles, liquid cooled engines are most common. Liquid engine cooling is accomplished by an engine-driven coolant pump (commonly referred to as a water pump) mounted on the engine block and operated directly by the engine. The pump forces coolant through passages in the engine, where the coolant absorbs engine heat, then the coolant passes through a radiator where heat is rejected, and finally coolant is returned to the pump inlet to complete the fluid circuit. A fan, driven either directly from the engine or by an electric motor, is used in many cases to draw ambient air across the radiator so that heat is rejected at the radiator by transferring heat from the coolant to the ambient air, thus cooling the engine.

[0003] A conventional thermostat controls the flow of pumped coolant through the radiator in relation to coolant temperature. The thermostat controls flow through the radiator until the coolant reaches a sufficiently hot temperature to cause the thermostat to allow flow through the radiator such that the radiator may effectively limit engine temperature. In this way, the thermostat performs a form of coolant temperature regulation that establishes a desired operating temperature for the engine once the engine has fully warmed up while inherently allowing the coolant to heat more rapidly when the engine is started from a cooler condition.

[0004] Although the above described cooling system is effective in operation, to improve fuel economy, it is preferable to operate the cooling fan and water pump motor based on cooling requirements, rather than on the rpm of the engine.

[0005] Japanese patents JP 58,162,716 and JP 7,180,554 describes a cooling device for an engine having a by-pass circuit and includes a thermostat operated 3-way valve.

[0006] US-A-5,660,145 describes a cooling assembly for an engine.

[0007] A need exists to provide a total cooling system incorporating at least one electric coolant pump-motor and an electric fan motor which operate independent of engine rpm and wherein cooling is optimised based on current draw of the coolant pump-motor.

SUMMARY OF THE INVENTION

[0008] The invention comprises a total cooling assembly adapted for installation in an engine compartment of an automotive vehicle and defining an air flow path, the vehicle having an internal combustion engine, the assembly comprising: a heat exchanger module constructed and arranged to transfer heat from fluid coolant to air entering the air flow path and comprising front and rear faces such that air can pass in heat exchange relation across said heat exchanger module to absorb heat from fluid coolant flowing through said heat exchanger module, said heat exchanger module including an inlet and an outlet; a cooling fan module carrying said heat exchanger module and comprising fan and an electric fan motor for drawing air across said heat exchanger module from said front face to said rear face of said heat exchanger module; pump structure carried by said cooling fan module to circulate fluid coolant, said pump structure having at least one pump and an electric motor driving said pump; a cooling circuit in which fluid coolant is circulated by the action of said pump structure, said cooling circuit permitting the fluid coolant to move from said pump structure to the engine, an outlet of said engine being constructed and arranged to communicate fluid coolant with the inlet to said heat exchanger module, the outlet of said heat exchanger module being fluidly connected with an inlet to said pump structure to return the fluid coolant to said pump structure, said cooling circuit including bypass structure fluidly constructed and arranged to connect an outlet of the engine with an inlet to said pump structure; valve structure in said cooling circuit to regulate flow therethrough such that during a warm-up operating condition of the engine, said valve structure is controlled to permit fluid coolant allow from the outlet of the engine through said bypass structure and to the inlet of the pump structure, while substantially preventing fluid coolant to flow through said heat exchanger module; and a controller to control operation of said at least one electric motor of said pump structure, said electric fan motor, and said valve structure, and characterised by the features according to claim 1, second port.

[0009] Other objects of the present invention, as well as methods of operation and functions of related elements of the structure, and the combination of the parts and economics of manufacture, will become more apparent upon consideration of the detailed description and appended claims with reference to the accompanying drawings, all of which form a part of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 is an exploded perspective view of a first exemplary embodiment of a total cooling assembly provided in accordance with the principles of the present invention;

FIG. 2 is a schematic fluid circuit of the total cooling assembly of FIG. 1; according to the invention

FIG. 3 is a schematic fluid circuit of a second embodiment of a total cooling assembly not according to the invention; and

FIG. 4 is yet another embodiment of a fluid circuit of a total cooling assembly not according to the invention.

Detailed Description of the Preferred Embodiments

[0011] With reference to FIG. 1 a total engine cooling assembly, generally indicated 10, for an internal combustion engine is shown, provided in accordance with the principles of the present invention. The internal combustion engine is schematically illustrated and designated by the letter E. In an exploded perspective view from the upper left rear, the cooling assembly 10 comprises a cooling fan module, generally indicated at 12, an electric coolant pump structure, generally indicated at 14, an electronic systems control module 16, and a heat exchanger module, generally indicated at 18. As shown in FIG. 1, the pump structure 14 and the electronic systems control module 16 are carried by the cooling fan module 12. In addition, when assembled for employment in a front engine compartment of an automotive vehicle powered by the engine E, the heat exchanger module 18 is joined with the cooling fan module 12 by suitable joining means, such as fasteners, to form the total cooling assembly 10.

[0012] The heat exchanger module 18 comprises a radiator 20 and, when air conditioning is provided, an air conditioning condenser 22 is disposed adjacent to the radiator 20. Radiator 20 is conventional, comprising right and left side inlet header tanks 24R and 24L, and a core 25 disposed between the two header tanks 24R, 24L. The right side header tank 24R is an inlet tank and includes an inlet tube 26 at an upper end thereof. The inlet tube 26 is fluidly coupled with a T-type connector 28 of the pump structure 14, the function of which will become apparent below. The left side header tank 24L is an outlet tank and includes an outlet tube 30 near lower end thereof which is fluidly connected to an inlet (not shown) of the pump structure 14.

[0013] In the embodiment of FIG. 1, the pump structure 14 comprises first and second pump-motors P1 and P2, respectively, each having a pump being driven by an associated electric motor. Pump-motor P2 has an inlet 29 (FIG. 2) fluidly connected to the outlet tube 30 of the heat exchanger module 18. The pump-motor P2 is fluidly connected to pump-motor P1 and pump-motor P1 includes an outlet 40 fluidly coupled with the internal combustion engine E at inlet 62, and fluidly connected to a heater core 44. In accordance with the principles of the present invention, bypass structure, generally indicated at 43, is provided which includes a hose 45 coupled to a return inlet 47 of the pump-motor P1, and the T-type connector 28. Valve structure 74 is provided in the bypass structure for controlling flow therethrough. As noted above, inlet 26 of the radiator 20 is fluidly connected to one end of the T-type connector 28. The other end of the T-type connector 28 is fluidly coupled to the engine E, the function of which will be explained below.

[0014] The cooling fan module 12 comprises a panel structure 32 having a size corresponding generally to the size of the heat exchanger module 18. The pump structure 14 and the electronic systems control module 16 are coupled to the panel structure 32. In the illustrated embodiment, an axial flow fan structure is provided and comprises a fan 46 and an electric motor 48 coupled to the fan 46 to operate the fan 46. Fan 46 is disposed concentrically with a surrounding circular-walled through opening 50 in the panel structure 32. An expansion tank 52 is mounted on the cooling fan module 12 to receive, from connector 33 of the right header tank and via tube 35, coolant during certain operating conditions.

[0015] Radiator 20 and condenser 22 each define a heat exchanger serving to reject heat to ambient air. Engine coolant, in the case of the engine cooling system, and refrigerant, in the case of the air conditioning system, flow through passageways and their respective heat exchangers while ambient air flows across the passageways from the front face to the rear face of the heat exchanger module 18, in a direction of arrows A in FIG. 1. The air passes successively through the condenser 22 and the radiator 20. Each heat exchanger (condenser 22 and radiator 20) typically is constructed with fins, corrugations, or other means to increase the effective heat transfer surface area of the passageways for increasing heat transfer efficiency. The flow of ambient air across the heat exchanger module 18 forms an effluent stream, with such flow being caused either by the operation of the fan 46 by motor 48 to draw air across the heat exchanger module 18 or by a ram air effect when the vehicle is in forward motion, or a combination of both.

[0016] The electronic systems control module 16 receives electric power from the vehicle electrical system and also various signals from various sources. Module 16 comprises electronic control circuitry that acts upon the signals to control the operation of electric motors of the pump-motors P1 and P2, fan motor 48 and to control the operation of the valve structure 74 and heater valve 68. Since control module 16 operates the fan 46 and pump structure 14 at speeds based on cooling requirements rather than engine r.p.m., engine power is used more efficiently and thus, fuel economy is improved. Examples of other signal sources controlled by the control module 16 include temperature and/or pressure sensors located at predetermined locations in the respective cooling and air conditioning systems, and/or data from an engine management computer, and/or data from an electronic data bus of the vehicle's electrical system. The control module 16 includes a controller or microprocessor which processes signals and/or data from the various sources to operate the pump-motors and fan such that the temperature of coolant, in the case of the engine cooling system, and the pressure of refrigerant, in the case of the air conditioning system, are regulated to the desired temperature and pressures, respectively.

[0017] FIG. 2 is a schematic illustration of the total cooling system 10 of FIG. 1. As shown, the pump structure 14 comprises the two pump-motors, P1 and P2. An outlet 40 of the pump of the pump-motor P1 fluidly communicates with an inlet 62 of the engine E. In addition, an outlet 40 of the pump of pump-motor P1 communicates with an inlet 64 of the heater core 44. An outlet 66 of heater core 44 is in communication with a heater valve 68 which communicates via connecting line 70 with fluid exiting the engine via flow path 72. Connecting line 70 is in fluid communication with the bypass structure 43. The T-type connector 28 permits coolant to flow through to the radiator inlet 26 and also to valve 74 disposed in the bypass structure 43 and return to the pump-motor P1. Valve 74 is preferably a two-way variable flow control valve movable between open and closed positions at any point in between so as to open or close the bypass structure 43. The outlet 30 of the radiator 20 is directed to the second pump-motor P2 and the second pump-motor P2 is in fluid communication with the pump of pump-motor P1. The pump-motors P1 and P2 are conventional and are provided so that a single high power pump-motor generally of higher cost need not be provided. Further, flow of coolant can be controlled easier with two smaller pump-motors than with one large pump-motor.

[0018] Another advantage of employing the two-pump-motors P1 and P2 of the embodiment of FIG. 2, is that the total cooling assembly may include a built-in "limp-home" fail safe feature. Thus, in the two pump-motor design, if one pump-motor fails, the other pump-motor will ensure that fluid may pass around the failed pump-motor via a pump bypass circuit having a pressure relief valve. The pressure relief valve will ensure that the coolant passes to the engine to protect the engine. The controller of the control module 16 will have logic built-in to control this feature and to alert the driver of the vehicle to bring the vehicle to a service center.

[0019] If the valve associated with the bypass structure fails, a default , closed valve condition is established such that all coolant passes through the radiator circuit.

[0020] In a first option of the embodiment of FIG. 2, pump-motors P1 and P2 each has a two-speed brush motor. Pump-motor P1 preferably operates at 300 W and 120W while pump-motor P2 preferably operates at 450 W and 150 W. In a second option, the pump-motors P1 and P2 each has a brushless motor, with pump-motor P1 operating at 300 W, while pump-motor P2 operates at 450 W. Finally, in a third option, pump-motor P1 has a two-speed brush motor operating at 300 W and 120 W while pump-motor P2 has a brushless motor operating at 450 W.

[0021] TABLE 1 shows flow rates through the radiator 20, heater core 44 and bypass structure 46 at operating conditions for option 1, wherein pump-motors P1 and P2 each have a two speed brush motor. As shown, at warm-up, valve 74 in the bypass structure 43 is open and generally no flow is permitted through the radiator 20 since flow is restricted at pump-motor P2 which is not in operation. During operating conditions other than warm-up, both pump-motors P1 and P2 are in operation. The current draw is shown in the table for each operating condition. It is noted that only 0.3 l/s is required through the radiator 20 at idle and at 70 Kph for heat balance, but the low speed of the pump motors forces 2.0 l/s.

TABLE 1

Operating Condition	Q (Kw)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kpa)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Rad.	Bypass	Htr		P1	P2	P1	P2	P1	P2	
Warm Up 0 Kph		0.0	1.6	0.0	1.6	31	0	1.6	0.0	120	0	9.2
Idle 0 Kph	8.0	2.0	0.0	0.0	2.0	48	32	2.0	2.0	120	150	20.8

TABLE 1 (continued)

Operating Condition	Q (Kw)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kpa)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Rad.	Bypass	Htr		P1	P2	P1	P2	P1	P2	
70 Kph	25.0	2.0	0.6	0.0	2.6	75	32	2.6	2.0	120	150	20.8
Trailer + grade 90 Kph	35.0	2.0	0.2	0.0	2.2	58	32	2.2	2.0	300	150	34.6
H. Speed 24 0 Kph	50.0	2.5	0.0	0.0	2.5	50	75	2.5	2.5	300	450	57.7

[0022] TABLE 2 shows flow rates through the radiator 20, heater core 44 and bypass structure 46 at operating conditions for option 2, wherein pump-motors P1 and P2 each have a brushless motor. Again, at warm-up, valve 74 in the bypass structure 43 is open and generally no flow is permitted through the radiator 20 since flow is restricted at pump-motor P2 which is not in operation. During operating conditions other than warm-up, both pump-motors P1 and P2 are in operation. The current draw is shown in the table for each operating condition.

TABLE 2

Opening Condition	Q (K^w)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kps)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Rad.	Bypass	Htr		P1	P2	P1	P2	P1	P2	
Warm Up 0 Kph		0.0	0.5	0.0	0.5	3	0	0.5	0.0	4	0	0.3
Idle 0 Kph	8.0	0.3	0.5	0.0	0.8	8	1	0.8	0.3	16	1	1.3
70 Kph	25.0	1.0	0.5	0.0	1.5	27	8	1.5	1.0	100	20	9.2
Trailer + grade 90 Kph	35.0	1.5	0.5	0.0	2.0	48	18	2.0	1.5	235	66	23.2
A. Speed 240 Kph	50.0	2.5	0.0	0.0	2.5	75	50	2.5	2.5	450	305	58.0

[0023] TABLE 3 shows flow rates through the radiator 20, heater core 44 and bypass structure 46 at operating conditions for option 3, wherein pump-motor P1 has a two-speed brush motor and pump-motor P2 has a brushless motor. At warm-up, valve 74 in the bypass structure 43 is open and generally no flow is permitted through the radiator 20 since flow is restricted at pump-motor P2 which is not in operation. During operating conditions other than warm-up, both pump-motors P1 and P2 are in operation.

TABLE 3

Operating Condition	Q (Kw)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kpa)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Rad.	Bypass	Her		P1	P2	P1	P2	P1	P2	
Warm Up 0 Kph		0.0	1.6	0.0	1.6	31	0	1.6	0.0	120	0	9.2

TABLE 3 (continued)

Operating Condition	Q (Kw)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kpa)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Rad.	Bypass	Her		P1	P2	P1	P2	P1	P2	
Idle 0 Kph	8.0	0.3	1.3	0.0	1.6	31	1	1.6	0.3	120	1	9.3
70 Kph	25.0	1.0	0.6	0.0	1.6	31	8	1.6	1.0	120	20	10.8
Trailer + grade 90 Kph	35.0	2.0	0.2	0.0	2.2	58	32	2.2	2.0	315	156	36.2
H. Speed 240 Kph	50.0	2.5	0.0	0.0	2.5	50	75	2.5	2.5	315	450	58.8

[0024] FIG. 3 is a schematic illustration of a total cooling system 10' not according to the invention. As shown, pump outlet 40 fluidly communicates with an inlet to the engine E and outlet 78 of the engine E communicates via a line 80 with the inlet 26 of the radiator 20. Outlet 78 also communicates with the bypass structure 43. Coolant flow through the bypass structure 43 is controlled by a three-way variable flow control valve 82. An outlet 30 of the radiator 20 communicates with the three-way valve 82 which in turn communicates with the inlet of the pump-motor P1. A heater core 44 communicates with an inlet 84 of the pump-motor P1 via line 86 and a heater valve 68 is disposed between the heater core and the engine E. In this embodiment, the pump-motor P1 preferably has a brushless motor which operates generally at 760 W. FIG. 3 represents a 36 volt system.

[0025] TABLE 4 shows flow rates through the radiator 20, heater core 44 and bypass structure 46 at operating conditions for the embodiment of FIG. 3, wherein the pump-motor P1 has a brushless motor and a three-way valve 82 is employed in the fluid circuit. As shown, at warm-up, the three- way valve 82 permits flow from the bypass to the pump-motor P1, but prevents flow through the radiator 20. Note that the current draw is much less than the two pump-motor embodiments in TABLES 1-3 since only one motor is need.

TABLE 4

Operating Condition	Q (Kw)	Circuit Flow (l/s)			Tot Eng Flow (l/s)	Delta P (Kpa)		Flow (l/s)		Inp Power (W)		Current Draw (A)
		Red.	Bypass	Htr		P1	P2	P1	P2	P1	P2	
Warm Up 0 Kph		0.0	0.5	0.0	0.5	4		0.5		5		0.1
Idle 0 Kph	8.0	0.3	0.5	0.0	0.8	18		0.5		35		1.0
70 Kph	25.0	1.0	0.5	0.0	1.5	37		1.5		135		4.0
Trailer + grade 90 Kph	35.0	2.0	0.5	0.0	2.0	71		2.0		345		10.0
H. Speed 240 Kph	50.0	2.5	0.0	0.0	2.5	138		2.5		840		23.0

[0026] FIG. 4 is a schematic illustration of a total cooling system 10' not according to the invention. As shown, an outlet 40 of pump-motor P1 is in fluid communication with an inlet to engine E. In addition, an outlet of the pump of the pump-motor P1 is in fluid communication with the inlet 26 of radiator 20. A two-way variable flow control valve 88 is disposed between the pump-motor P1 and the radiator 20. An outlet of the engine E is fluidly connected to the bypass structure 43 via line 90, which is also connected to the outlet 30 of the radiator 20. As shown, the bypass structure 43 communicates with the pump-motor P1. Further, an outlet of the pump-motor P1 is in fluid communication with an inlet to the heater core 44. A heater valve 68 is disposed downstream of the heater core 44 and the outlet of the heater core 44 communicates with the pump-motor P1. Pump-motor P1 preferably has a brushless motor which operates at 640 W. FIG. 4 represents a 36 volt system.

[0027] TABLE 5 shows flow rates through the radiator 20, heater core 44 and bypass structure 46 at operating conditions for the embodiment of FIG. 4, wherein the pump-motor P1 has a brushless motor and a two-way valve 88 is provided in the fluid circuit. Again, at warm-up, valve 88 is closed such that no flow is permitted though the radiator.

TABLE 5

Operating Condition	Q (Kw)	Circuit Flow (l/s)		
		Radiator	Bypass	Heater
Warm Up 40 Kph		0.0	0.5	0.0
Idle 40 Kph	8.0	0.3	0.5	0.0
70 Kph	25.0	1.0	0.5	0.0
Trailer + grade 490 Kph	35.0	2.0	0.5	0.0
A. Speed 240 Kph	50.0	2.5	0.0	0.0

[0028] For each embodiment as represented by TABLES 1-5, it is assumed that the pump of the pump structure 14 is approximately 60% efficient, and the motor which operates the pump of the pump structure 14 is approximately 68 % efficient.

[0029] It can be appreciated that in the one pump-motor design, in the case of pump or motor failure, no coolant will be circulating and there is no "limp-home" feature. However, to protect the engine, the controller of control module 16 will alert the driver to shut-off the engine immediately to prevent permanent engine damage.

[0030] Motors of the pump-motors P1 and P2, and the motor 48 to operate the fan 46 are typically DC motors compatible with the typical DC vehicle electrical system. The electrical current flowing to each motor is controlled by respective switches, solid-state or electromechanical, which are operated by control module 16, and may be internal to that module. Figure 1 shows electric wing 51 leading from control module 16 to the respective electric motors.

[0031] The total cooling system 10 is installed in vehicle by "dropping" it into the vehicle engine compartment and securing it in place. Various connections are then made such as connecting the fluid hoses and connecting the module 16 with the vehicle electrical system and with various signal sources mentioned above.

[0032] It can be seen that the total cooling system of the invention provides cooling based on cooling requirements and not based on engine rpm. Cooling is optimized based on the current draw of the coolant pump-motor selected.

Claims

1. A total cooling assembly (10) adapted for installation in an engine compartment of an automotive vehicle and defining an air flow path, the vehicle having an internal combustion engine, the assembly comprising:

a heat exchanger module (18) constructed and arranged to transfer heat from fluid coolant to air entering the air flow path and comprising front and rear faces such that air can pass in heat exchange relation across said heat exchanger module to absorb heat from fluid coolant flowing through said heat exchanger module, said heat exchanger module including an inlet and an outlet;

a cooling fan module (12) carrying said heat exchanger module and comprising fan (46) and an electric fan motor (48) for drawing air across said heat exchanger module from said front face to said rear face of said heat exchanger module;

pump structure (14) carried by said cooling fan module to circulate fluid coolant, said pump structure having at least one pump and an electric motor driving said pump;

a cooling circuit in which fluid coolant is circulated by the action of said pump structure, said cooling circuit permitting the fluid coolant to move from said pump structure to the engine, an outlet of said engine being constructed and arranged to communicate fluid coolant with the inlet to said heat exchanger module, the outlet of said heat exchanger module being fluidly connected with an inlet to said pump structure to return the fluid coolant to said pump structure, said cooling circuit including bypass structure fluidly constructed and arranged to connect an outlet of the engine with an inlet to said pump structure;

a valve structure (74) in said cooling circuit to regulate flow therethrough such that during a warm-up operating condition of the engine, said valve structure is controlled to permit fluid coolant allow from the outlet of the engine through said bypass structure and to the inlet of the pump structure, while substantially preventing fluid coolant to flow through said heat exchanger module; and

a controller (16) to control operation of said at least one electric motor of said pump structure, said electric fan motor, and said valve structure, and **characterised in that** said valve structure (74) is a two-way variable flow control valve (74) disposed in bypass structure bewteen an outlet of the engine and an inlet to said pump stucture so as to control flow between the outlet of the engine and said inlet to said pump structure.

2. The assembly according to claim 1, further comprising a heater core (44) and a valve (66) associated with said heater core, said heater core being constructed and arranged to receive the fluid coolant and to return the fluid coolant to said pump structure.

3. The assembly according to claims 1 or 2, wherein said pump structure comprises first and second pump-motors (P1, P2), said first pump-motor being disposed upstream of said two position valve and downstream of an inlet to the engine, and said second pump-motor being disposed upstream of an outlet of said heat exchanger module and downstream of said first pump-motor.

4. The assembly according to claim 3, wherein a motor of each of said first and second pump-motors is a two-speed brush motor.

5. The assembly according to claim 4, wherein a motor of each of said first and second pump-motors is a brushless motor.

6. The assembly according to claim 4, wherein a motor of said first pump-motor is a brush motor and a motor of said second pump-motor is a brushless motor.

7. The assembly according to any preceeding claim, wherein said controller is an electronics control module (16) carried by said cooling fan module.

8. The assembly according to any preceeding claim, wherein said heat exchanger module comprises a radiator (20) and a condenser (22).

9. The assembly according to any preceeding claim, wherein said cooling fan module includes panel structure, said panel structure having an opening therethrough, said fan being mounted within said opening, said pump structure and said controller being mounted on said panel structure.

10. The assembly according to any preceeding claim, wherein if one of said pump-motor fails, said controller is constructured and arranged to control operation of the other pump-motor to ensure that coolant is directed to the engine.

Patentansprüche

1. Gesamt-Kühlbaugruppe (10), die für den Einbau in den Motorraum eines Kraftfahrzeugs geeignet ist und einen Luftdurchflussweg definiert, wobei das Fahrzeug einen Verbrennungsmotor aufweist und wobei die Baugruppe umfasst:

eine Wärmeaustauschereinheit (18), die so konstruiert und angeordnet ist, dass sie Wärme vom Kühlmittel auf die in den Luftdurchflussweg einströmende Luft überträgt, und die eine Vorderseite und eine Rückseite umfasst, so dass Luft durch die besagte Wärmeaustauschereinheit strömen und dabei mit ihr in eine Beziehung des Wärmeaustausches eintreten kann, um Wärme von dem durch die besagte Wärmeaustauschereinheit strömenden Kühlmittel zu absorbieren, wobei die besagte Wärmeaustauschereinheit einen Einlass und einen Auslass umfasst;

eine Kühlgebläseeinheit (12), welche die besagte Wärmeaustauschereinheit trägt und ein Gebläse (46) und einen elektrischen Gebläsemotor (48) zum Ansaugen von Luft durch die besagte Wärmeaustauschereinheit von der besagten Vorderseite zu der besagten Rückseite der besagten Wärmeaustauschereinheit umfasst;

eine Pumpenkonstruktion (14), die von der besagten Kühlgebläseeinheit getragen wird, um die Zirkulation

des Kühlmittels zu bewirken, wobei die besagte Pumpenkonstruktion wenigstens eine Pumpe und einen die besagte Pumpe antreibenden Elektromotor aufweist;
einen Kühlkreislauf, in welchem durch die Funktion der besagten Pumpenkonstruktion eine Zirkulation von Kühlmittel bewirkt wird, wobei der besagte Kühlkreislauf eine Bewegung des Kühlmittels von der besagten Pumpenkonstruktion zum Motor ermöglicht, wobei ein Auslass des besagten Motors so konstruiert und angeordnet ist, dass von ihm Kühlmittel zum Einlass der besagten Wärmeaustauschereinheit strömen kann, wobei der Auslass der besagten Wärmeaustauschereinheit auf eine den Durchfluss eines Fluids ermöglichende Weise mit einem Einlass der besagten Pumpenkonstruktion verbunden ist, damit das Kühlmittel zu der besagten Pumpenkonstruktion zurückströmen kann, wobei der besagte Kühlkreislauf eine Kurzschlusskonstruktion umfasst, die so konstruiert und angeordnet ist, dass sie auf eine den Durchfluss eines Fluids ermöglichende Weise einen Auslass des Motors mit einem Einlass der besagten Pumpenkonstruktion verbindet;
eine Ventilkonstruktion (74) in dem besagten Kühlkreislauf, um den Durchfluss durch diesen hindurch auf eine solche Weise zu regeln, dass während eines Warmlauf-Betriebszustandes des Motors die besagte Ventilkonstruktion so gesteuert wird, dass sie ein Fließen des Kühlmittels vom Auslass des Motors durch die besagte Kurzschlusskonstruktion zum Einlass der Pumpenkonstruktion ermöglicht, während sie ein Fließen von Kühlmittel durch die besagte Wärmeaustauschereinheit im Wesentlichen verhindert; und
ein Steuergerät (16) zum Steuern der Funktion des besagten wenigstens einen Elektromotors der besagten Pumpenkonstruktion, des besagten elektrischen Gebläsemotors und der besagten Ventilkonstruktion; **dadurch gekennzeichnet, dass** die besagte Ventilkonstruktion (74) ein Zweiwege-Durchflussregelventil (74) ist, das in der Kurzschlusskonstruktion zwischen einem Auslass des Motors und einem Einlass der besagten Pumpenkonstruktion angeordnet ist, so dass es den Durchfluss zwischen dem Auslass des Motors und dem besagten Einlass der besagten Pumpenkonstruktion regelt.

2. Baugruppe nach Anspruch 1, welche ferner einen Heizungswärmetauscher (44) und ein mit dem besagten Heizungswärmetauscher in Zusammenhang stehendes Ventil (66) umfasst, wobei der besagte Heizungswärmetauscher so konstruiert und angeordnet ist, dass er das Kühlmittel aufnimmt und das Kühlmittel zu der besagten Pumpenkonstruktion zurückführt.

3. Baugruppe nach Anspruch 1 oder 2, wobei die besagte Pumpenkonstruktion eine erste und eine zweite Pumpen-Motor-Einheit (P1, P2) umfasst, wobei die besagte erste Pumpen-Motor-Einheit in Strömungsrichtung gesehen vor dem besagten Zweipositionsventil und nach einem Einlass des Motors angeordnet ist und die besagte zweite Pumpen-Motor-Einheit in Strömungsrichtung gesehen vor einem Auslass der besagten Wärmeaustauschereinheit und nach der besagten ersten Pumpen-Motor-Einheit angeordnet ist.

4. Baugruppe nach Anspruch 3, wobei jeweils ein Motor der besagten ersten und zweiten Pumpen-Motor-Einheit ein Bürstenmotor mit zwei Drehzahlstufen ist.

5. Baugruppe nach Anspruch 3, wobei jeweils ein Motor der besagten ersten und zweiten Pumpen-Motor-Einheit ein bürstenloser Motor ist.

6. Baugruppe nach Anspruch 3, wobei ein Motor der besagten ersten Pumpen-Motor-Einheit ein Bürstenmotor und ein Motor der besagten zweiten Pumpen-Motor-Einheit ein bürstenloser Motor ist.

7. Baugruppe nach einem der vorhergehenden Ansprüche, wobei das besagte Steuergerät eine elektronische Steuereinheit (16) ist, die von der besagten Kühlgebläseeinheit getragen wird.

8. Baugruppe nach einem der vorhergehenden Ansprüche, wobei die besagte Wärmeaustauschereinheit einen Kühler (20) und einen Kondensator (22) umfasst.

9. Baugruppe nach einem der vorhergehenden Ansprüche, wobei die besagte Kühlgebläseeinheit eine Plattenkonstruktion umfasst, wobei die besagte Plattenkonstruktion eine durch sie hindurchgehende Öffnung aufweist, wobei das besagte Gebläse in der besagten Öffnung angebracht ist und die besagte Pumpenkonstruktion und das besagte Steuergerät auf der besagten Plattenkonstruktion montiert sind.

10. Baugruppe nach einem der vorhergehenden Ansprüche, wobei das besagte Steuergerät so konstruiert und angeordnet ist, dass es, falls eine der besagten Pumpen-Motor-Einheiten ausfällt, den Betrieb der anderen Pumpen-Motor-Einheit so steuert, dass gewährleistet ist, dass dem Motor Kühlmittel zugeführt wird.

Revendications

1. Système de refroidissement global (10) prévu pour être installé dans un compartiment moteur d'un véhicule automobile et définissant un trajet d'écoulement d'air, le véhicule ayant un moteur à combustion interne, le système comprenant :

   un module d'échangeur de chaleur (18) construit et prévu pour transférer de la chaleur provenant du réfrigérant fluide à l'air entrant dans le trajet d'écoulement d'air et comprenant des faces avant et arrière de sorte que l'air puisse passer en relation d'échange de chaleur à travers ledit module d'échangeur de chaleur pour absorber la chaleur provenant du réfrigérant fluide s'écoulant à travers ledit module d'échangeur de chaleur, ledit module d'échangeur de chaleur comportant une entrée et une sortie ;
   un module de ventilateur de refroidissement (12) portant ledit module d'échangeur de chaleur et comprenant un ventilateur (46) et un moteur électrique de ventilateur (48) pour aspirer l'air en travers dudit module d'échangeur de chaleur depuis ladite face avant vers ladite face arrière dudit module d'échangeur de chaleur ;
   une structure de pompe (14) portée par ledit module de ventilateur de refroidissement pour faire circuler du réfrigérant fluide, ladite structure de pompe ayant au moins une pompe et un moteur électrique entraînant ladite pompe ;
   un circuit de refroidissement dans lequel du réfrigérant fluide circule sous l'effet de ladite structure de pompe, ledit circuit de refroidissement permettant au réfrigérant fluide de se déplacer depuis ladite structure de pompe vers le moteur, une sortie dudit moteur étant construite et agencée pour faire communiquer le réfrigérant fluide avec l'entrée dudit module d'échangeur de chaleur, la sortie dudit module d'échangeur de chaleur étant raccordée fluidiquement à une entrée de ladite structure de pompe pour ramener le réfrigérant fluide à ladite structure de pompe, ledit circuit de réfrigérant comportant une structure de dérivation construite et agencée fluidiquement pour raccorder une sortie du moteur à une entrée de ladite structure de pompe ;
   une structure de soupape (74) dans ledit circuit de refroidissement pour réguler l'écoulement à travers celui-ci de sorte qu'au cours d'un état de fonctionnement de chauffage initial du moteur, ladite structure de soupape soit commandée pour permettre un écoulement de réfrigérant fluide depuis la sortie du moteur à travers ladite structure de dérivation et vers l'entrée de la structure de pompe, tout en empêchant substantiellement le réfrigérant fluide de s'écouler à travers ledit module d'échangeur de chaleur ;
   et une unité de commande (16) destinée à commander le fonctionnement dudit au moins un moteur électrique de ladite structure de pompe, dudit moteur électrique de ventilateur, et de ladite structure de soupape, et **caractérisé en ce que** ladite structure de soupape (74) est une soupape à deux voies à commande d'écoulement variable disposée dans la structure de dérivation entre une sortie du moteur et une entrée de ladite structure de pompe de manière à réguler l'écoulement entre la sortie du moteur et ladite entrée de ladite structure de pompe.

2. Système selon la revendication 1, comprenant en outre un noyau de chauffage (44) et une soupape (66) associée audit noyau de chauffage, ledit noyau de chauffage étant construit et agencé de manière à recevoir le réfrigérant fluide et à ramener le réfrigérant fluide vers ladite structure de pompe.

3. Système selon les revendications 1 ou 2, dans lequel ladite structure de pompe comprend des premier et deuxième moteurs-pompes (P1, P2), ledit premier moteur-pompe étant disposé en amont de ladite soupape à deux voies et en aval d'une entrée du moteur, et ledit deuxième moteur-pompe étant disposé en amont d'une sortie dudit module d'échangeur de chaleur et en aval dudit premier moteur-pompe.

4. Système selon la revendication 3, dans lequel un moteur de chacun desdits premier et deuxième moteurs-pompes est un moteur à balais à deux vitesses.

5. Système selon la revendication 4, dans lequel un moteur de chacun desdits premier et deuxième moteurs-pompes est un moteur sans balais.

6. Système selon la revendication 4, dans lequel un moteur dudit premier moteur-pompe est un moteur à balais et un moteur dudit deuxième moteur-pompe est un moteur sans balais.

7. Système selon l'une quelconque des revendications précédentes, dans lequel ladite unité de commande est un module de commande d'électronique (16) porté par ledit module de ventilateur de refroidissement.

8. Système selon l'une quelconque des revendications précédentes, dans lequel ledit module d'échangeur de chaleur

comprend un radiateur (20) et un condenseur (22).

9. Système selon l'une quelconque des revendications précédentes, dans lequel ledit module de ventilateur de refroidissement comporte une structure de panneau, ladite structure de panneau ayant une ouverture la traversant, ledit ventilateur étant monté dans ladite ouverture, ladite structure de pompe et ladite unité de commande étant montées sur ladite structure de panneau.

10. Système selon l'une quelconque des revendications précédentes, dans lequel si l'un desdits moteurs-pompes tombe en panne, ladite unité de commande est construite et agencée pour commander le fonctionnement de l'autre moteur-pompe pour garantir que du réfrigérant soit dirigé vers le moteur.

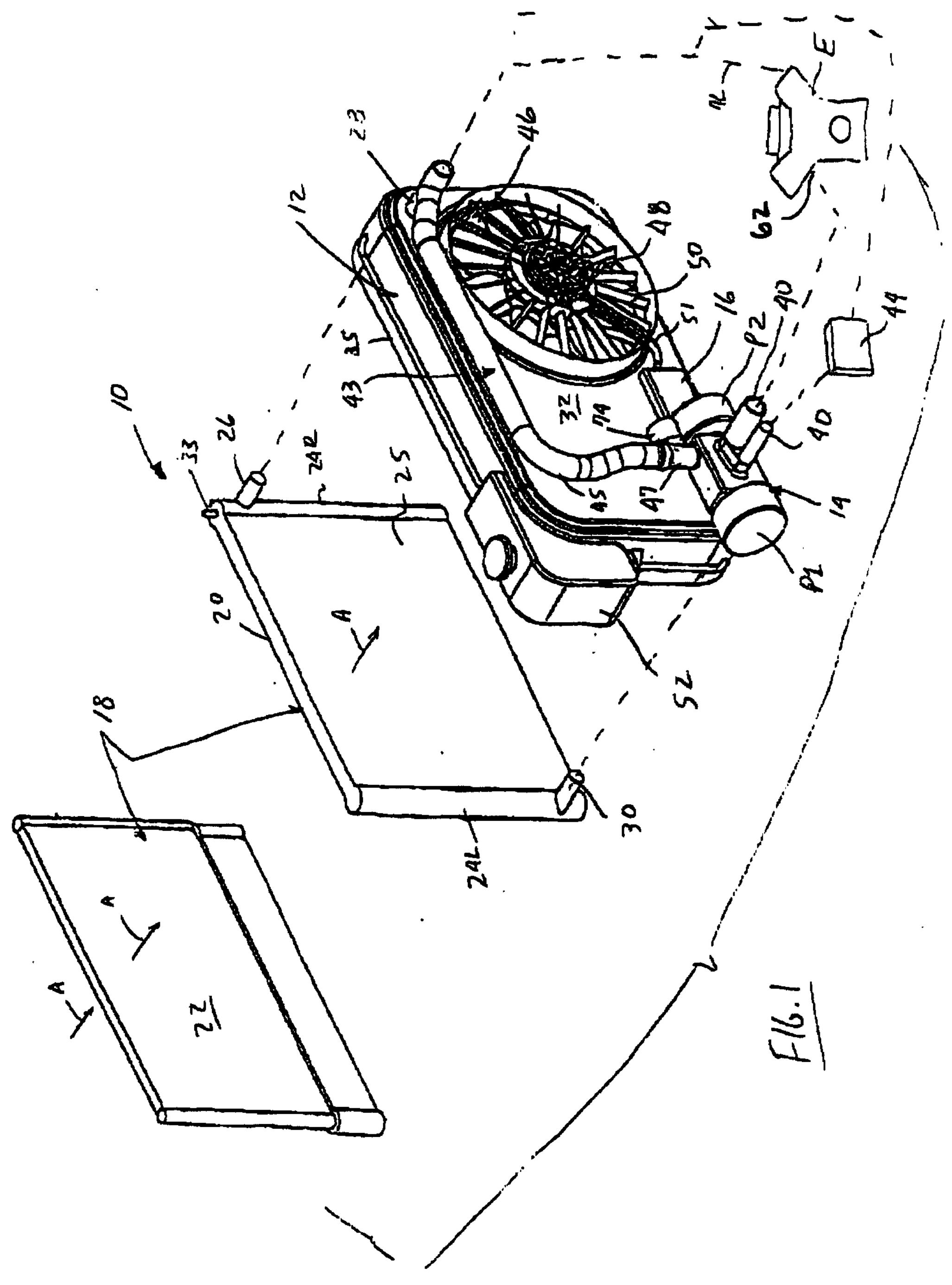


FIG. 1

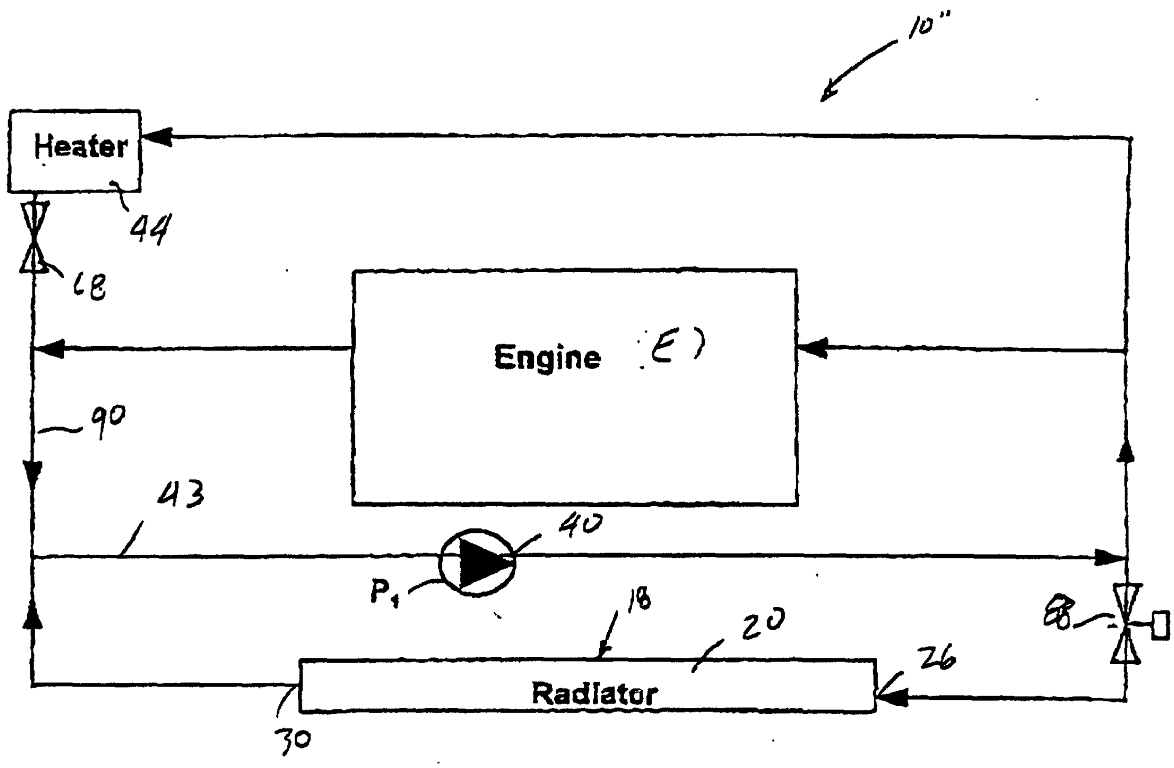
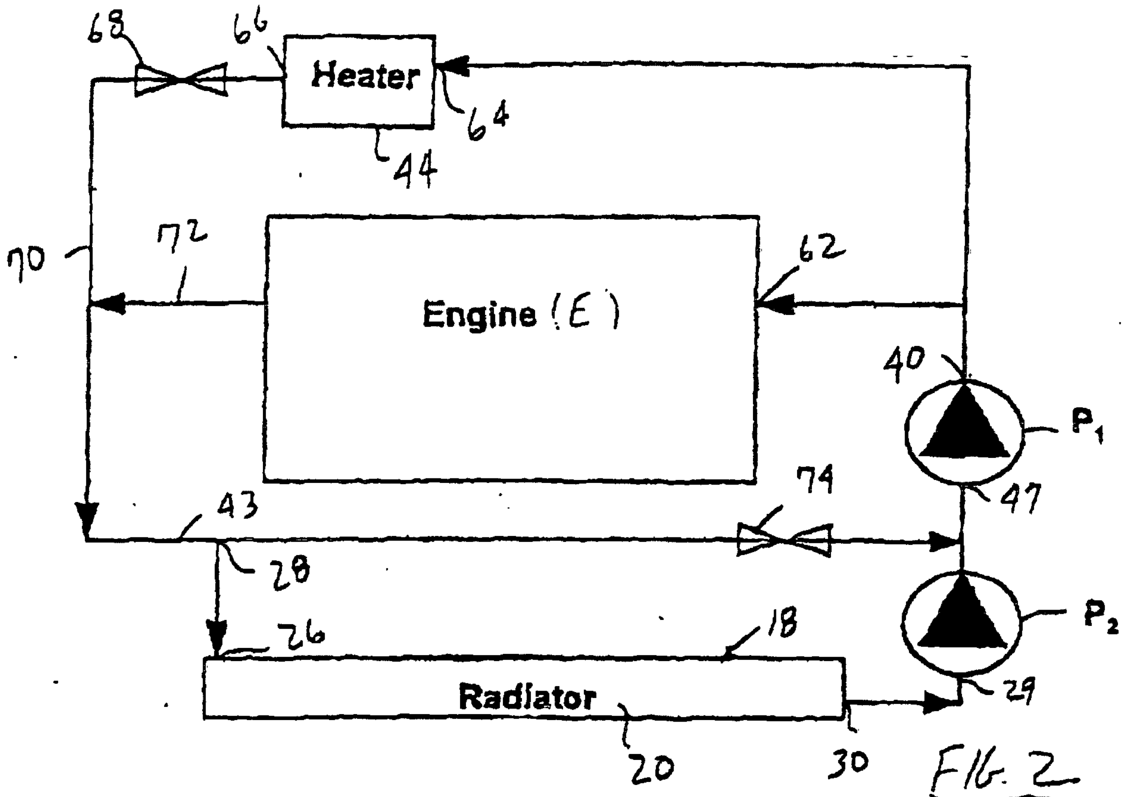
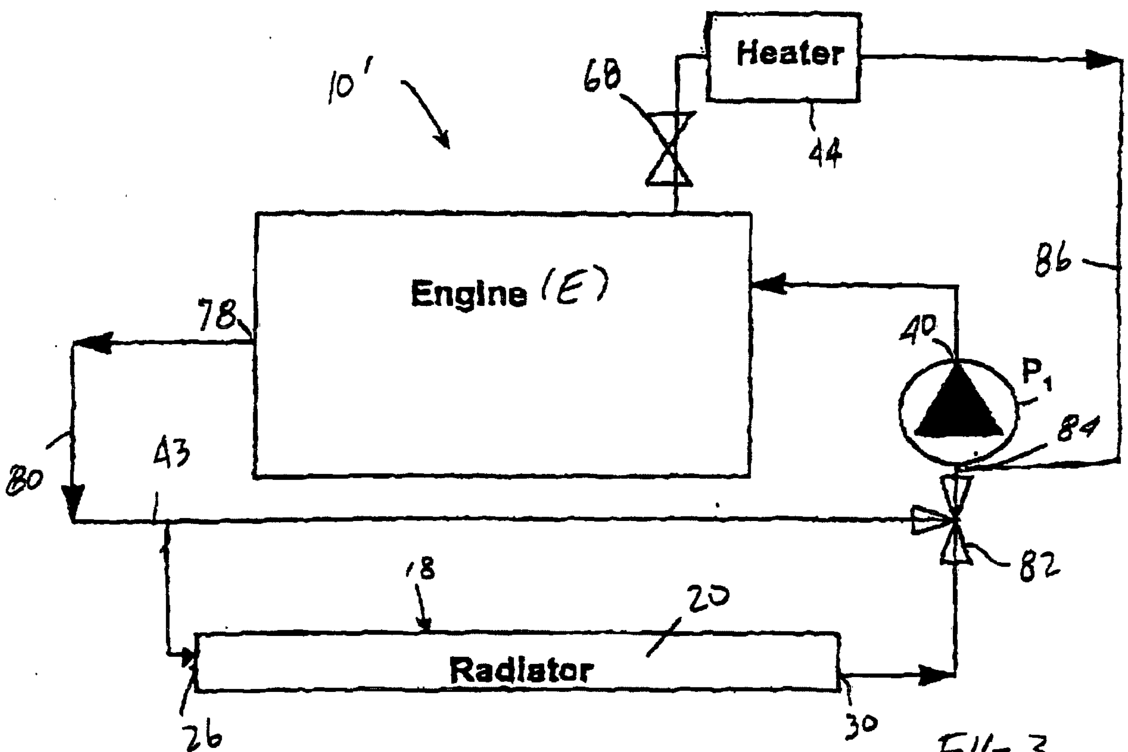


FIG. 4



68
66
Heater
64
44
70
72
Engine (E)
62
40
P1
47
74
43
28
P2
26
18
Radiator
29
20
30

FIG. 2



10'
68
Heater
44
86
Engine (E)
78
40
P1
84
80
43
82
18
20
Radiator
26
30

FIG 3