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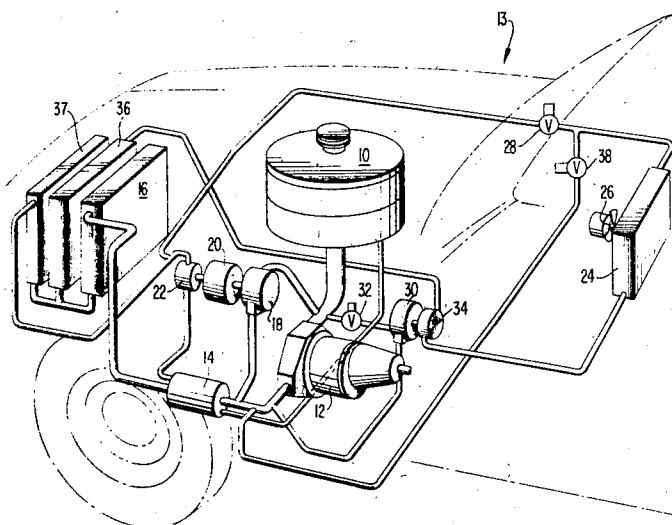
[56] **References Cited**
UNITED STATES PATENTS
 3,519,065 7/1970 Kitrilakis 165/26
 3,153,442 10/1964 Silvern 165/50
 3,339,663 9/1967 Anderson 60/36

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[54] **VEHICULAR AIR-CONDITIONING AND HEATING SYSTEM**
 9 Claims, 2 Drawing Figs.

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 165/43, 60/36, 62/467
 [51] Int. Cl. **B60h 3/04**
 [50] Field of Search 165/42-
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ABSTRACT: A vehicular heating and cooling system is disclosed for use with a power plant of the vapor turbine cycle type. The system uses the fluid from the power plant itself as a working fluid.



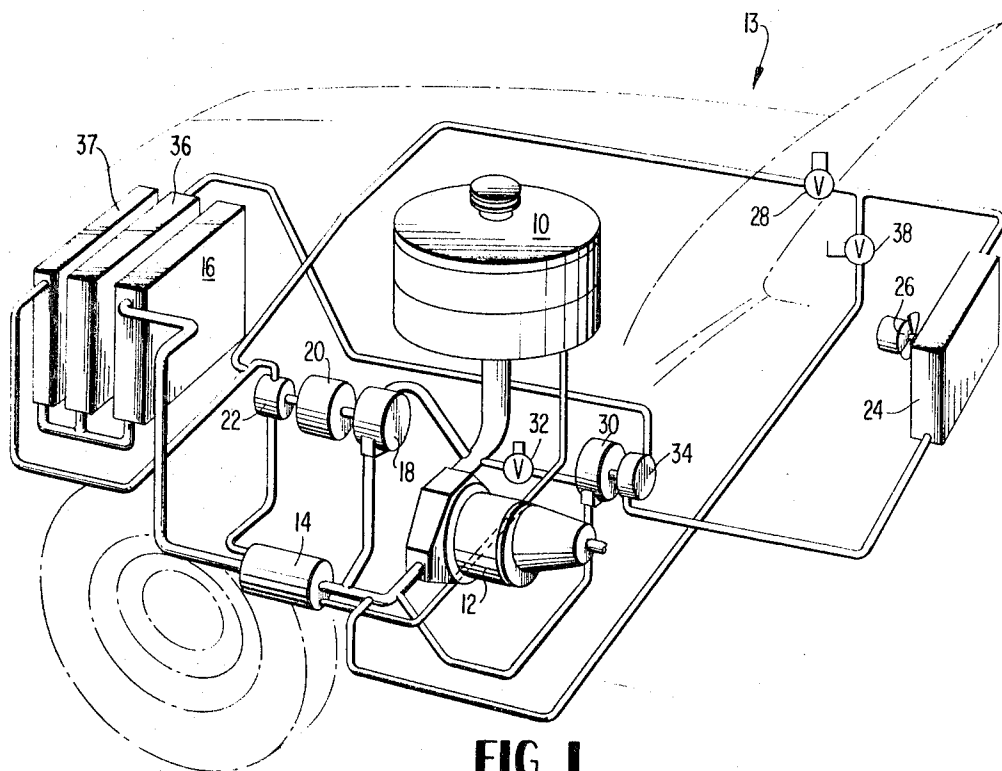


FIG. 1

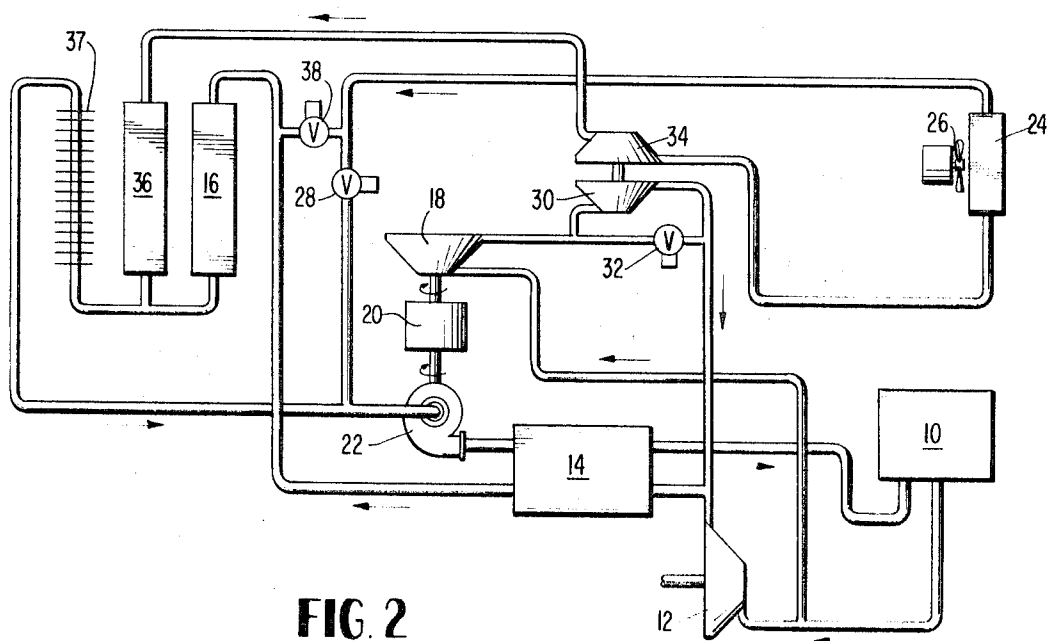


FIG. 2

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VEHICULAR AIR-CONDITIONING AND HEATING SYSTEM

BACKGROUND OF THE INVENTION

Automobiles using turbines as prime movers and in which the turbine operates on a vapor turbine cycle are known and examples may be found in my prior U.S. Pat. Nos. 3,315,466, 3,339,663, and 3,359,731. While it would be possible to use the alternator as a source of electricity for driving a motor-driven compressor-powered refrigeration system for cooling such automobiles, this would not be as efficient as a system sharing the same working fluid employed in the vapor turbine cycle.

BRIEF SUMMARY OF THE INVENTION

A heat exchange coil placed at a convenient location within the vehicle and having a fan means for establishing a positive circulation of air over the coil is connected so as to be either heated or cooled by the working fluid from the turbine cycle. For heating, hot vapor is supplied to the coil from the exhaust of the power turbine either before or after passing through a recuperator in heat exchange relation to the return line to the boiler. For cooling purposes, liquid from the condenser is expanded through a conventional expansion valve into the heat exchange coil and the vapor or mixed vapor and liquid is withdrawn from the coil by a compressor driven by an auxiliary turbine and returned thereby to the condenser. Appropriate valving either manually or thermostatically controlled, determines the heating or cooling functions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric piping diagram of one embodiment of a vehicular air-conditioning system in accordance with the present invention, and

FIG. 2 is a modification of the arrangement shown in FIG. 1 but in schematic flow diagram form.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring first to FIG. 1, the prime mover vapor-cycle turbine system includes a boiler 10 supplying hot fluid to a power turbine 12 which through appropriate gearing, not shown, is mechanically connected to the driving wheels of the vehicle 13 in which it is mounted. The exhaust from the power turbine 12 goes first through a heat recuperator 14 and then to a condenser 16. The boiler 10 also supplies hot vapor to an auxiliary turbine 18 which drives an alternator 20 providing a source of electrical power for the vehicle lighting and the like and also drives a boiler feed pump 22. Preferably the mechanical arrangement of the turbine 18, the alternator 20 and the pump 22 is such that all are on a common shaft as shown in my prior U.S. Pat. No. 3,359,731. The pump 22 is connected to return liquid from the condenser 16 back to the boiler 10 through the recuperator 14.

The heating and cooling system in accordance with one embodiment of the present invention includes a heating and cooling coil 24 placed at an appropriate location within the vehicle. A fan 26 establishes a positive flow of air over the coil during either heating or cooling functions. In the embodiment of FIG. 1, the cooling function is achieved by opening the valve 28 in order to admit liquid from the condenser and permit it to expand in the heating and cooling coil 24. A second auxiliary turbine 30 is connected in parallel with the power turbine 12 whenever the valve 32 is opened. The turbine 30 drives a compressor 34 to take the vapor and/or liquid and vapor mixture from the coil 24 and return it to a second condenser 36. Since it is desirable that the vapor output from the compressor 34 should go to a condenser which is as cool as possible, a second condenser 36 is employed and positioned upstream of the condenser 16 which is the main condenser for the power plant.

A finned coil 37 positioned in front of both condensers 16 and 36, serves as a liquid subcooler as described in more detail in my prior U.S. Pat. No. 3,315,466.

The return line from the condenser 36 is connected to the return line from the condenser 16 which leads to the inlet of the feed pump 22 which returns the liquid to the boiler 10.

The valve 28 should be a typical refrigeration system expansion valve of the type which automatically maintains either a given temperature of vapor pressure in the coil 24. The valve 32 could conveniently be a solenoid-operated valve which opens automatically whenever the valve 28 is opened. The valve 28 could be either manually or thermostatically controlled.

Whenever heating rather than cooling is desired for the vehicle interior, the valve 38 is opened which permits flow of hot vapor from the exhaust of the power and auxiliary turbines 12 and 18 to flow through the coil 24. This vapor returns to the system through the idling compressor 34 and the condenser 36. Here again, the control of the valve 38 could be manual or thermostatic.

Turning now to FIG. 2 of the attached drawings, an alternative arrangement of parts is shown and one which may be more efficient than the embodiment of FIG. 1 under certain circumstances. The same components are employed and consequently the reference numerals are the same as for the apparatus in FIG. 1. The basic difference between the two systems is that in FIG. 2 the valve 38 for the heating cycle connects the input of the coil 24 to the downstream side of the recuperator 14 rather than directly to the output of the power turbine exhaust. Obviously the temperature of the vapor downstream of the recuperator will be somewhat less than the power turbine exhaust temperature but it should nevertheless be sufficient to provide adequate heating under most circumstances.

The second difference between the apparatus of this Figure and that shown in FIG. 1 lies in the connection of the auxiliary turbines 18 and 30. In this embodiment these turbines are in series with each other rather than in parallel, as is the case with FIG. 1. Obviously with the connections as shown in this Figure, the valve 32 must be closed during the cooling cycle because it is in effect a bypass valve for the turbine 30.

It is believed that the arrangement of FIG. 2 will be more efficient than the arrangement of FIG. 1 but the auxiliary turbines may have to be a little larger in size.

In lieu of the turbine driven compressor disclosed in FIGS. 1 and 2, either vortex or jet compression could be employed.

From the foregoing description, it will be apparent to those skilled in this art that there is herein shown and disclosed a new and useful heating and cooling arrangement for vehicles which are powered with turbines of the vapor cycle type.

I claim:

1. In combination with a vehicle propelled by a prime mover power plant of the boiler-turbine-condenser type, a system for heating or cooling the interior of the vehicle comprising:
 - a heat exchange coil positioned within said vehicle;
 - means for establishing a forced circulation of air over said coil;
 - first selectively operable means for conducting hot fluid from the exhaust of said turbine to said coil whenever heating is desired;
 - second selectively operable means for expanding liquid from said condenser through said coil;
 - means for returning fluid from said coil to said condenser;
 - first and second auxiliary turbines;
 - a compressor driven by said first auxiliary turbine and connected between the outlet of said coil and said condenser; and
 - a pump driven by said second auxiliary turbine and connected between said condenser and said boiler.
2. The combination defined by claim 1 in which said auxiliary turbines are connected in parallel with each other and with the power turbine.
3. The combination defined by claim 1 in which said auxiliary turbines are connected in series with each other and in parallel with the power turbine.
4. In combination, a vehicular propulsion unit power plant of the vapor cycle type and an air-conditioning system, said plant and system using the same working fluid, comprising:

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- a. a boiler for supplying hot vapor;
- b. a power turbine for driving the vehicle connected to said boiler;
- c. a first condenser connected to the exhaust of said power turbine;
- d. a boiler feed pump connected between said condenser and said boiler;
- e. a first auxiliary turbine also connected to said boiler and said condenser and arranged to drive said boiler feed pump;
- f. a heat exchange coil;
- g. means establishing an airflow over said coil;
- h. a second auxiliary turbine connected between said boiler and said condenser;
- i. a compressor arranged to be driven by said second auxiliary turbine;
- j. a second condenser having its outlet connected to the outlet of said first condenser;
- k. means connecting said compressor between the outlet of said heat exchange coil and the inlet of said second condenser;
- l. and valve means selectively operable to admit hot vapor from said power turbine exhaust to the inlet of said heat

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exchange coil whenever heating is desired and for expanding liquid from the outlet of said condenser into the inlet of said heat exchange coil whenever cooling is desired.

5 5. The combination defined by claim 4 including a recuperator heat exchanger having a fluid path connected between said boiler feed pump and said boiler, and a second fluid path connected between the exhaust of said power turbine and the inlet of said first condenser.

10 6. The combination defined by claim 5 in which said valve means connects the inlet of said heat exchange coil to a point between said recuperator and said first condenser when heating is desired.

15 7. The combination defined by claim 5 in which said valve means connects the inlet of said heat exchange coil directly to the exhaust of said power turbine when heating is desired.

8. The combination defined by claim 4 in which said auxiliary turbines are connected in parallel with each other and with said power turbine.

20 9. The combination defined by claim 4 in which said auxiliary turbines are connected in series with each other and in parallel with said power turbine.

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