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A. B. REAVIS

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ENGINE COOLING

Filed July 27, 1929

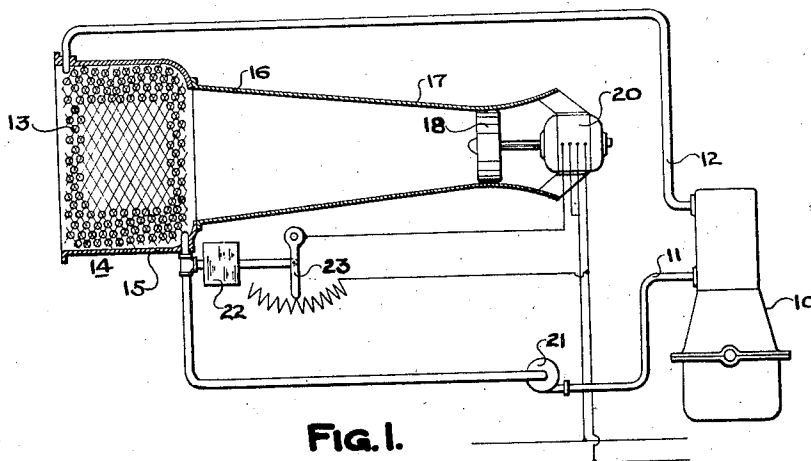


Fig. 1.

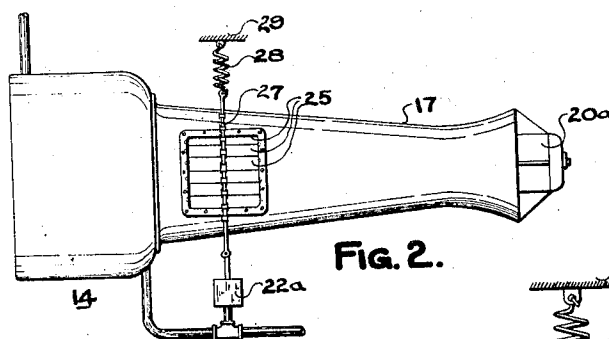


Fig. 2.

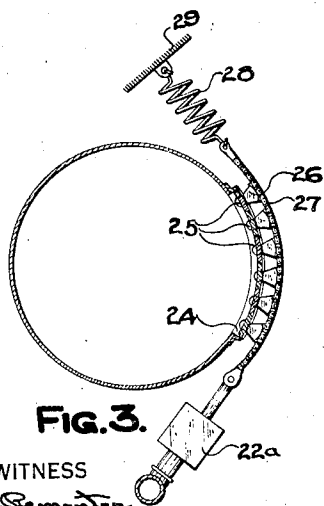


Fig. 3.

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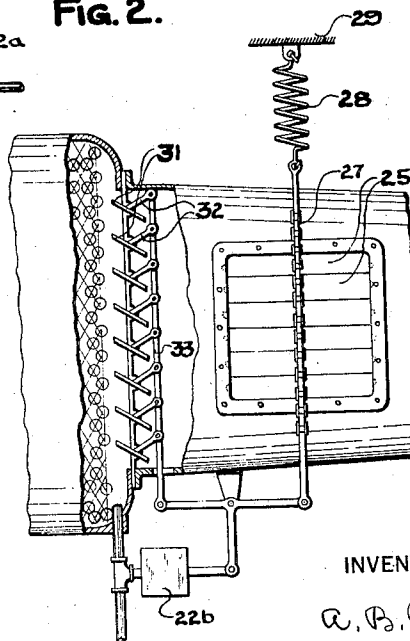


Fig. 4.

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ENGINE COOLING

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My invention relates to cooling systems for internal combustion engines and it has for an object to provide improved means for cooling the jacket liquid.

5 In accordance with my invention, I provide what may be termed a cooling unit for the circulating or jacket liquid of an internal combustion engine, the unit consisting essentially of a heat exchanger or radiator, embodying a casing with tubular or cellular elements therein, the tubular elements being adapted to have the cooling or circulating liquid pass therethrough, and propeller blower means for forcing air to pass through the heat exchanger and about the tubular elements thereof, the blower means comprising a casing having its discharge end arranged to discharge air through the heat exchanger and a motor-operated propeller arranged in the casing. With apparatus of this character, it is desirable that the cooling unit shall be so arranged that cooling liquid returning to the engine jacket space shall be at as nearly uniform a temperature as possible; and a more particular object of my invention is to provide a unit of the character referred to having this capability.

It is, of course, well known to employ thermostatic control of shutter means for automobile radiators in order to control the temperature of jacket water returning to the engine jacket space. In an arrangement of this character, the shutter means merely operates to control the quantity of air admitted to or entering the radiator. My improved cooling system is different in that a propeller blower is used to force air through the heat exchanger, the discharge end of such blower being connected to the latter, and in that I provide, with a combined blower and heat exchanger unit, thermostatic means responsive to temperature of the liquid returning to the engine for varying the capacity of the blower means to deliver air to the heat exchanger. This variation in delivery capacity may be effected either by varying the propeller motor speed or by spilling a portion of the air.

These and other objects are effected by my invention, as will be apparent from the following description and claims, taken in con-

nection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a diagrammatic view showing my improved cooling means with thermostatic control of the propeller motor;

Fig. 2 is a view, similar to Fig. 1, but showing thermostatic control of spilling means associated with the blower device;

Fig. 3 is a detail view of the shutter and the operating means therefor of Fig. 2; and,

Fig. 4 is a view, similar to Fig. 2, but showing, in addition, shutter means for controlling communication between the blower casing and the heat exchanger.

In Fig. 1, I show an internal combustion engine 10 having inlet and outlet cooling liquid passages 11 and 12 for the jacket space or spaces of the engine, the passages 11 and 12 being connected by tubular or cellular elements 13 of the heat exchanger, at 14, the latter embodying a suitable casing 15, which has connected thereto the diverging end 16 of the converging-diverging casing 17 of blower means for causing air to be discharged from the casing through the heat exchanger and about the tubular elements 13 thereof.

The blower means includes a propeller 18 arranged substantially at the throat portion of the converging-diverging casing 17, the propeller being operated by a suitable motor 20. It will be obvious that the propeller causes air to be translated through the converging-diverging casing and then through the heat exchanger, such air absorbing heat from the tubular or cellular elements 13 forming a part of the fluid circuit including the passages 11 and 12 and the pump 21 for enforcing circulation of liquid through such circuit. If desired, as shown in the drawings, the flow area of the heat exchanger and the discharge area of the casing 17 may be coordinated to secure the best operation. On account of the space occupied by the tubular or cellular elements of the heat exchanger, it is obvious that the over-all flow area of the latter, including the space occupied by the tubular or cellular elements should be relatively larger than the flow area of the discharge end of the casing 17 in order to reduce the resistance to flow of air there-

through. To this end, I show the heat exchanger casing larger than the diverging end 16 of the converging-diverging casing 17.

With internal combustion engines, and more particularly Diesel engines as the heat of compression of the latter is relied upon for ignition, it is desirable that means shall be employed to maintain the returning cooling liquid at a substantially uniform temperature. To this end, in Fig. 1, I show a thermostat 22 associated with the return passage 11 and serving to adjust the movable arm 23 of a rheostat arranged in the field circuit of the shunt motor 20. With this arrangement, an increase in temperature of the returning liquid causes an increase in the field circuit resistance, which results in an increase in speed of the motor 20. A decrease in the returning cooling liquid temperature results in a decrease in the speed of the motor. Therefore, the motor speed is made dependent upon the temperature of the cooling liquid and the speed may be so controlled that the blower means serves to deliver sufficient quantity of air to the heat exchanger to maintain a substantially uniform returning cooling liquid temperature.

In Fig. 2, I show apparatus somewhat similar to that shown in Fig. 1 except that the motor 20a for the propeller 18 may be of the constant speed type and air is spilled from the converging-diverging casing 17 in order to control the quantity of air delivered from the latter casing to the heat exchanger, at 14. To this end, I show the converging-diverging casing 17 provided with an opening 24 closed by a series of shutters 25 having pivots at their ends supported by the casing 17. The shutters may be turned simultaneously in the same direction to open the opening 24 to a desired extent, or they may be turned in the other direction to close such opening. Any suitable operating mechanism may be associated with the shutters 25 to secure simultaneous opening and closing movements thereof. In Fig. 3, I show the shutter elements 25 provided with segmental sprocket elements 26 engaging a sprocket chain 27, the latter having one end connected to a spring 28 supported from a stationary support 29. The other end of the sprocket chain is operatively connected to the thermostat 22a. In operation, if the temperature of the returning cooling liquid should become too high, the thermostat 22a is effective to move the shutters 25 in a closing direction; and, if the temperature declines below a predetermined point, the spring 28 is effective to move the shutters 25 in an opening direction, whereby the quantity of air delivered to the heat exchanger may be varied in order to carry off sufficient heat to maintain a substantially constant temperature of returning cooling liquid.

In Fig. 4, I show the converging-diverging

casing 17 equipped with shutter means as shown in Figs. 2 and 3 together with additional shutter means arranged between the heat exchanger and the discharge end of the converging-diverging casing 17. The latter shutter means embodies cooperating shutter elements 31 having arms 32 connected to an operating link 33, the latter being moved in one direction or the other by the thermostat 22b. The thermostat is also connected to a sprocket chain 27 engaging sprocket elements 26, as shown in Fig. 3, and having its upper end connected to a spring 28. The relationship of the operating means for the shutters 25 and 31 is such that as the shutters 25 open the shutters 31 close and vice-versa.

From the foregoing, it will be apparent that I have devised a propeller blower cooling unit suitable for use with the cooling circuit of an internal combustion engine such that the propeller blower is controlled or regulated in order to deliver to the heat exchanger sufficient air to maintain a substantially constant returning cooling liquid temperature. In the form shown in Fig. 1, the required quantity of air passing from the propeller blower to the heat exchanger to give a desired returning liquid temperature is secured by adjustment of the motor speed. In Figs. 2 and 3, variation in delivery of air from the blower to the heat exchanger is secured by adjustably spilling a portion of the air. A propeller type blower having a suitably designed housing is highly efficient and the power consumption corresponds to the demand in all forms shown. Where the motor speed is varied, the power consumed depends on the speed; and, where there is spilling, the power required for operating the propeller diminishes.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a cooling system for jacket liquid of an internal combustion engine, the combination of a liquid circuit including the engine jacket space, inlet and outlet passages connected to the jacket space, and a heat exchanger connecting the inlet and outlet passages; and means for furnishing cooling air to the heat exchanger including a casing having a divergent portion with its discharge end arranged to discharge air through the heat exchanger, a propeller in the casing at the entrant end of the divergent portion, and means responsive to temperature of liquid leaving the heat exchanger for con-

trolling the quantity of air delivered from the casing to the heat exchanger.

2. In a cooling system for jacket liquid of an internal combustion engine, the combination of a liquid circuit including the engine jacket space, inlet and outlet passages connected to the jacket space, a heat exchanger connecting the inlet and outlet passages, and a pump for enforcing circulation of liquid in the circuit; and propeller blower means for furnishing cooling air to the heat exchanger including a converging-diverging casing having its diverging end arranged to discharge air through the heat exchanger, a propeller in the region of the casing where the converging and diverging portions thereof join, and means responsive to temperature of liquid leaving the heat exchanger for controlling the capacity of the blower means to deliver air to the heat exchanger.

3. In a cooling system for jacket liquid of an internal combustion engine, the combination of a liquid circuit including the engine jacket space, inlet and outlet passages connected to the jacket space, a heat exchanger embodying a casing and tubular elements and the tubular elements affording communication between the inlet and outlet passages, and a pump for enforcing circulation of liquid in the circuit; and propeller blower means for furnishing cooling air to the heat exchanger including a converging-diverging casing having its diverging end connected to the heat exchanger casing and arranged to discharge air through the heat exchanger and about the tubular element thereof, a propeller in the region of the casing where the converging and diverging portions thereof join, and means responsive to temperature of liquid leaving the heat exchanger for controlling the capacity of the blower means to deliver air to the heat exchanger.

4. In a cooling system for jacket liquid, of an internal combustion engine, the combination of a liquid circuit including the engine jacket space, inlet and outlet passages connected to the jacket space, a heat exchanger connecting the inlet and outlet passages, and a pump for enforcing circulation of liquid in the circuit; and propeller blower means for furnishing cooling air to the heat exchanger including a converging-diverging casing having its diverging end arranged to discharge air through the heat exchanger, a propeller arranged substantially in the throat portion of said casing, an electric motor arranged at the up-stream side of the propeller for driving the latter, and means responsive to temperature of liquid leaving the heat exchanger for controlling the speed of said motor.

5. In apparatus for cooling internal combustion engine jacket liquid, the combination of a heat exchanger including a casing and tubular elements, the jacket liquid being ar-

ranged to pass through the tubular elements, and propeller blower means for furnishing cooling air to the heat exchanger, said propeller blower means including a converging-diverging casing having its diverging end connected to one end of the heat exchanger casing and arranged to discharge air through the heat exchanger and about the tubular elements thereof, a propeller in the region of said casing where the converging and diverging portions thereof join, a motor for driving the propeller, and means responsive to the temperature of liquid leaving the heat exchanger for controlling the speed of said motor.

In testimony whereof, I have hereunto subscribed my name this 23rd day of July, 1929.

ANDREW B. REAVIS.