Aug. 15, 1950 R. R. HULL ET AL 2,518,621

PUMP

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Fig. 1

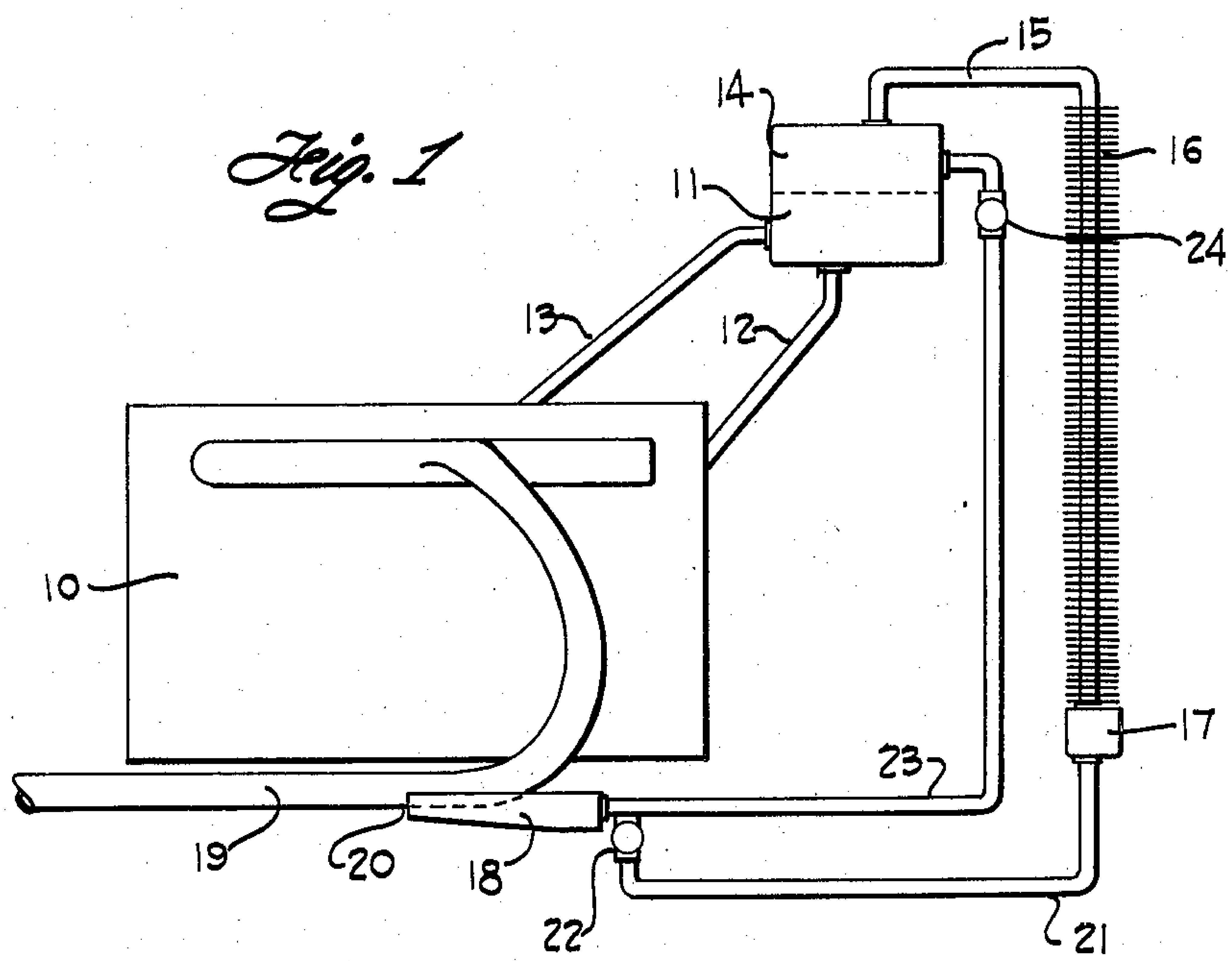
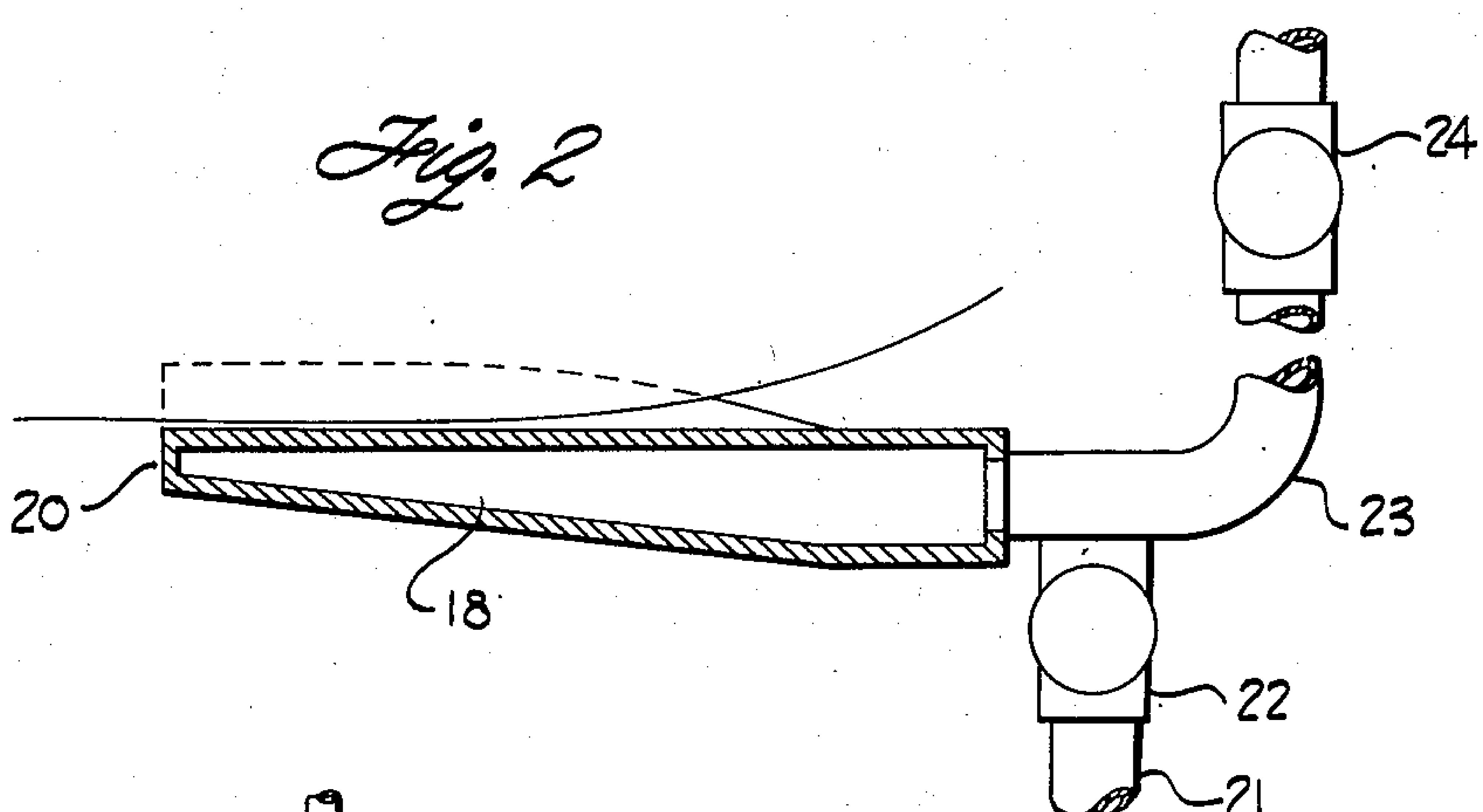


Fig. 2



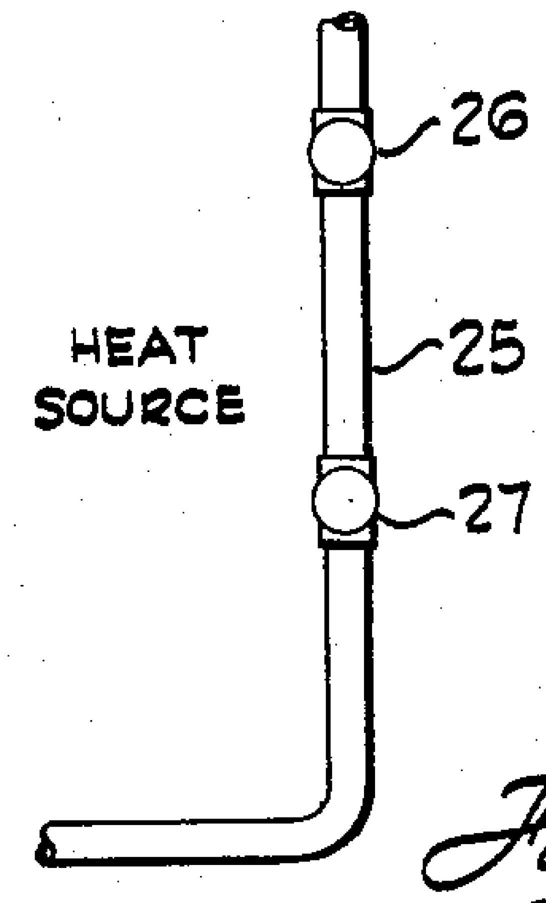


Fig. 3

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6 Claims. (Cl. 123—175)

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This invention relates to improvements in pumps and particularly to that class of pumps utilized to return condensate from a condenser to the cooling system of an internal combustion engine.

Heretofore the advantages of "vapor phase" in cooling of internal combustion engines have been recognized wherein the temperature of the cooling water in the water jackets of the engine is maintained at substantially its boiling point. In such systems the water jackets of the engine are connected to a suitable water supply tank in the top of which there is normally a steam space for steam rising from the heated water. A condenser or radiator is usually connected to this steam space so that when the engine is operating under heavy loads and a considerable amount of steam is being generated this steam may be condensed in the condenser or radiator and the condensate returned to the cooling system. Heretofore, pumps of various types have been used for returning the condensate from the condenser to the cooling system. Generally, however, these pumps have proven unsatisfactory. When the engine is operating under light loads little, if any, steam is passed into the condenser and there are frequent situations when there is no condensate in the condenser. Consequently the pump under such circumstances can receive no condensate and operates dry. When the pump operates in this manner packing difficulties immediately arise and the pump may lose its prime. Usually it is but a question of a relatively short time before the pump requires a repair or replacement when it is subjected to these conditions.

It has been proposed to utilize as a pump for these peculiar conditions a flash vaporizing chamber to flash vaporize a portion of the condensate received from the condenser and use this portion to expel condensate into the cooling system of the engine. However, in experiments heretofore conducted the flash vaporizing chamber was merely a lateral extension at the top of a well to which the condensate from the condenser was admitted. When the condensate entered the flash vaporizing chamber at the top of the well it was quickly converted into steam and would expel the condensate in the well up through an induction tube immersed therein which led back to the cooling system of the engine.

Such experiments have not proven satisfactory due to the fact that such pump would quickly discontinue its operation.

We have determined that the reason that such

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experimental flash vaporization pumps have discontinued operation is due to the fact that noncondensable gases are introduced into the water of the cooling system. These gases may enter the water past leaky gaskets or may slowly pass through the pores of the metal between the cylinder walls and the water jackets. Regardless of how such noncondensable gases are introduced into the water of the cooling system or into the condensate in the condenser these gases tend to collect in the top of the well and to fill the flash vaporizing chamber with the result that the experimental pumps quickly became gas locked with noncondensable vapors and discontinued operation.

It is an object of the present invention to provide an improved pump wherein a flash vaporization chamber is utilized which receives condensate from the condenser when condensate is available and flash vaporizes a portion of this condensate utilizing it as an expelling medium for expelling unvaporized condensate and returning it to the cooling system. In such a pump there are no moving parts with the exception of one or more anti-reverse flow check valves and if the engine is operating under such conditions that there is no condensate available in the condenser no harm to the pump is done. The loss of prime of the pump is immaterial for when there is a return of conditions and condensate is available in the condenser this condensate on being supplied to the vaporization chamber causes the pump to resume normal operations.

More specifically, an object of the invention is to provide a pump having the above-mentioned characteristics wherein the outlet is arranged at substantially the highest point of the vaporization chamber so that if noncondensable gases are admitted thereto these gases will not collect and vapor lock the pump but will be carried along with the pumped condensate to ultimately find egress through the vent for these gases that is located elsewhere in the system.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawing for an illustrative embodiment of the invention, wherein:

Figure 1 is a diagrammatic view of an engine employing "vapor phase" cooling and illustrating the pump embodying the present invention as having been installed in its cooling system; and

Fig. 2 is an enlarged sectional view through the pump; and

Fig. 3 is a view illustrating a simplified modification.

Referring to the accompanying drawing wherein similar reference characters designate similar parts throughout, 10 indicates an internal combustion engine the cooling system of which has a water supply tank 11. An outlet from this tank indicated at 12 serves to conduct water therefrom to the water jackets in any conventional or preferred manner and the inlet thereto indicated at 13 serves to return water from the water jackets to the tank. The upper portion of the tank 11 may be regarded as having a steam space 14 which is connected as at 15 to the top of a radiator or condenser 16. The condensate in the radiator or condenser collects in a tank 17 at the bottom thereof and it is desired to return this condensate when available to the cooling system.

The pump embodying the present invention that is utilized to return the condensate to the cooling system or to the tank 11 consists of a flash vaporizing chamber 18 that is preferably mounted or secured to the exhaust pipe 19 of the engine. This chamber is preferably tapered toward a closed end 20 and is so mounted on the exhaust pipe as to receive heat therefrom at its top. In other words heat from the exhaust pipe preferably passes downwardly through the top of the tapered flash vaporization chamber 18. A conduit 21 that is preferably equipped with a check valve 22 leads from the tank 17 and provides an inlet to the flash vaporization chamber that is disposed laterally with respect to the longitudinal axis of the chamber. A conduit 23 which may or may not be provided with a check valve 24 provides the outlet from the chamber 18 that is arranged opposite the closed end 20 and axially with relation to the length of the chamber. The conduit 23 leads back to the cooling system and may enter it in the tank 11.

If the engine is operating under light loads the steam generated in the tank 11 may be so small that it will condense in the steam space 14 without delivering any steam to the condenser 16. Under such circumstances there is no condensate available in the tank 17 to be pumped and returned to the system. Under these circumstances the chamber 18 is merely heated by the exhaust pipe 19 without any harm being done to it. However, when load conditions increase and steam is passed into the condenser 16 the condensate in the tank 17 flows by gravity through the conduit 21 past the check valve 22 and enters the chamber 18. A portion of the water entering this chamber is quickly vaporized and the steam thus quickly generated serves to expel the remainder of the water admitted to the chamber 18 and to force it past the check valve 24 through conduit 23 into tank 11. As soon as one charge of water is thus expelled additional condensate from tank 17 may enter the chamber 18 and the operation repeated. The cycle of these operations usually takes place very fast but is somewhat dependent upon the temperature to which the chamber 18 is heated by the exhaust pipe 19. The cycles of operation may follow each other with such great rapidity that the discharge of water back into the tank 11 may appear to be almost continuous.

It is preferable that the flash chamber taper toward the closed end 20 so that steam will more quickly be developed in this narrow closed end to expel the remainder of the charge of condensate that is admitted near the large end of the chamber.

If noncondensable vapors or gases are present in the condensate to be pumped these vapors or gases will not collect in the chamber 18 and thus vapor lock the pump inasmuch as the outlet 23 is located approximately even with the uppermost point of the chamber 18. Thus if these gases are taken into the chamber 18 they are quickly expelled therefrom by the steam along with the returning condensate. Usually systems of this character have vents provided at suitable points such as for example at the top of the condenser 16 and these noncondensable gases may find egress from the system therethrough.

It will be appreciated that with this arrangement the noncondensable gases will not vapor lock the pump and that if the engine should return to low load conditions wherein there is no condensate available in tank 17 that the pump merely discontinues its operation and becomes heated by the exhaust pipe 19 without damaging any of its parts.

While the chamber 18 is shown as being substantially horizontal in position it may be slightly inclined with respect thereto. The closed end 20 may be slightly higher than the outlet 23 but if raised materially above the outlet the upper end of the chamber will ultimately collect noncondensable gases and the pump then becomes vapor locked. It is, therefore, preferable that the chamber be so arranged as to avoid the possibility of collecting noncondensable vapors such as in the horizontal position illustrated.

It will, of course, be appreciated that any other heating means may be used to heat the chamber 18 in lieu of the exhaust pipe 19. The exhaust pipe 19 is merely utilized as it is readily available on the engine and has heat available that would otherwise normally be wasted.

While the pump is illustrated as having two check valves 22 and 24 a single check valve in many instances will suffice and there have been occasions where both check valves can be dispensed with. As the inlet to the chamber is disposed laterally the tendency of the expelled condensate to flow reversely through the inlet is normally quite small even though the check valve 22 is omitted. During the operation of the pump apparently a substantial part of the pumping action is due to the kinetic energy in the water that is quickly accelerated through the outlet and there may be conditions wherein this water traveling through the outlet at a relatively high speed tends to draw and carry with it water that may be available in the inlet.

In the construction illustrated in Fig. 3 there is merely a vertically disposed pipe or conduit indicated at 25 in which there are two spaced upwardly opening and downwardly closing check valves indicated at 26 and 27. The conduit 25 may be subjected to any suitable heat source between these check valves that is capable of quickly vaporizing the liquid in the conduit. Such heat source may be the exhaust pipe or the exhaust manifold from the engine. The check valves 26 and 27 may be so arranged that the hydrostatic head on the liquid will elevate some of it past the check valve 27 where it then becomes quickly vaporized and the expansion of the steam forces the liquid to be suddenly expelled upwardly past the check valve 26. The sudden expansion of the steam will force the liquid in the conduit above the check valve 26 upwardly so that there is sufficient upward inertia to decrease the pressure in the conduit between the check valves. Consequently additional liquid may then enter the conduit space between the check valves past the check valve **27** and be suddenly vaporized and the cycle thus repeated. In this construction likewise due to the arrangement of the conduit noncondensable vapors will not collect between the check valves to cause the pump to discontinue operation. On the contrary these noncondensable gases will be carried upwardly along with the liquid and steam past the check valve **26**.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the append claims.

We claim:

1. A pump comprising an approximately horizontally arranged flash chamber tapering toward the closed end thereof, means for admitting liquid to be pumped to said chamber, means for heating the chamber to flash vaporize the liquid admitted thereto, the outlet from the chamber being substantially as high as the chamber whereby noncondensable gases will not collect in the chamber to vapor lock the pump.

2. A pump comprising an approximately horizontally arranged flash chamber tapering toward the closed end thereof, means for admitting liquid to be pumped to said chamber, means for heating the chamber to flash vaporize the liquid admitted thereto, the outlet from the chamber being substantially as high as the chamber whereby noncondensable gases will not collect in the chamber to vapor lock the pump, the heating being applied to the top of the chamber.

3. A pump comprising an approximately horizontally arranged flash chamber tapering toward the closed end thereof, means for admitting liquid to be pumped to said chamber, means for heating the chamber to flash vaporize the liquid admitted thereto, the outlet from the chamber being substantially as high as the chamber whereby noncondensable gases will not collect in the chamber to vapor lock the pump, the inlet being arranged laterally with respect to the chamber and the outlet being arranged opposite the closed end thereof.

4. In a cooling system for internal combustion engines wherein there is a condenser adapted to receive steam from the system and condense it therein, means for returning the condensate to the cooling system comprising a flash vaporizing chamber, means for heating the chamber, said chamber having its outlet arranged substantially as high as the highest point of the chamber so that noncondensable vapors will not collect therein, means for admitting condensate from the condenser to said chamber, and means connecting the outlet with the cooling system for admission of the condensate thereto.

5. In a cooling system for internal combustion engines wherein there is a condenser adapted to receive steam from the system and condense it therein, means for returning the condensate to the cooling system comprising a flash vaporizing chamber, means for heating the chamber, said chamber having its outlet arranged substantially as high as the highest point of the chamber so that noncondensable vapors will not collect therein, means for admitting condensate from the condenser to said chamber, and means connecting the outlet with the cooling system for admission of the condensate thereto, an anti-reverse flow check valve in the inlet and outlet to and from said chamber.

6. A pump comprising an approximately horizontally arranged elongated flash chamber having a closed end and an open end and being otherwise imperforate, means for admitting liquid to be pumped to said chamber through the open end thereof, and means for heating the chamber to flash vaporize the liquid admitted thereto, the outlet from the chamber being substantially as high as the chamber whereby noncondensable gases will not collect in the chamber to vapor lock the pump.

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