W. W. MUIR.

COOLING SYSTEM.

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1,311,529.

Patented July 29, 1919.

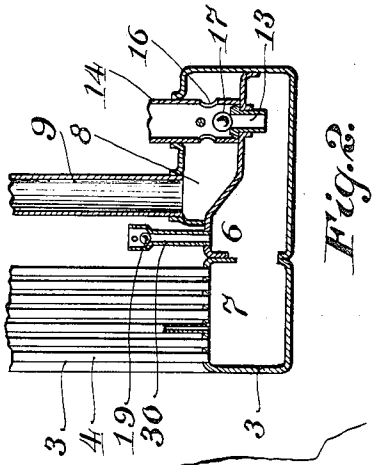


Fig. 2.

Fig. 1.

Witnesses,

Inventor

Willington W. Muir

By Edwin F. Lemcke

Attorney

UNITED STATES PATENT OFFICE.

WELLINGTON W. MUIR, OF BALTIMORE, MARYLAND.

COOLING SYSTEM.

1,311,529. Specification of Letters Patent. Patented July 29, 1919.

Application filed June 14, 1918. Serial No. 239,991.

To all whom it may concern:

Be it known that I, WELLINGTON W. MUIR, a citizen of the United States of America, residing in the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Cooling Systems, of which the following is a specification.

This invention relates to a cooling system for internal combustion engines, particularly where the supply of cooling water is limited so that it must be used over and over again, the excess heat being discharged into the atmosphere, the water merely acting as a carrier for the waste heat from the cylinders to the discharging means. This includes the various power plants, as those in automobiles, trucks, tractors, aeroplanes, boats and the like.

This cooling system is of the type described in my Patent No. 1,252,927 in which the water is normally, *i. e.*, after the engine has had time to warm up, at boiling temperature, the principal means for abstracting heat from the water being a condenser from which the liquid is substantially excluded, the latter having a continuous circulation which includes the engine, jacket and a separator. The vapor is passed into the condenser where it is reduced to a liquid, giving up as excess or waste heat the latent heat of vaporization only, the liquid being returned to the circulator. With such a system as that described in my Patent No. 1,252,927, it is perfectly feasible and convenient to run without overheating or excess pressure in the cooling system, provided the pump is of sufficient capacity to handle the vaporization under all conditions, but economy can be exercised by the use of a smaller and cheaper pump as compared to what is found necessary with the system thus described. In the absence of the improvements which are the subject of this application, insufficient capacity in the pump causes excess pressure over the condensed liquid in and beneath the condenser. Such pressure is objectionable in that it may result in interference with the separation and passage of vapor to and through the condenser and hence with the efficiency of the system.

The device described in my prior patent consists of a cooling system for internal combustion engines having a circuit for the cooling liquid, including a jacket, means for separating the vapor from the liquid in the circuit, a condenser for the vapor, means for passing the liquid through the circuit and returning the condensed liquid to the circuit, the liquid being excluded from the condenser. The present invention relates to the provision, in combination with the elements of such a system, of means for relieving the pressure in the condenser or over the condensed liquid whenever the capacity of the pump proves insufficient to keep down the pressure in the condenser.

In the preferred form of the invention, the circuit includes a separator at a higher level than the water jacket, the same being shown in the form of a tank in which there is considerable exposed surface of liquid from which the vapor escapes freely. From this air or vapor space above the liquid, the vapor is carried to the condenser which in the road vehicle type corresponds to the core of the radiator, the before-mentioned tank taking the place of the top tank of the radiator. The condensed liquid then flows from the condensing core to a suitable receptacle whence it is taken back into the circulation. In the form shown, there is a suitable circulating pump which returns the condensed liquid to the circuit and serves to pass the liquid through the water jacket and circuit. It may sometimes happen that vapor is formed in excess of the capacity of the pump. Under such circumstances, pressure is generated over the condensed liquid also in the condenser and separator, resulting in the formation of steam pockets, imperfect circulation and insufficient cooling of the walls of the combustion chamber. Pressure constitutes an obstacle to the free separation of vapor and the passage of the same to the condenser resulting in failure of the system to discharge the excess heat generated which is represented by the latent heat of vaporization.

To correct these difficulties, I have balanced the system by means of a vent preferably connected to the side of the condenser remote from the separator so as to have the effect, in case pressure is generated, of reducing the pressure at the point in the condenser toward which the vapor is to circulate, and thus assisting circulation. As the pump, which is a feature of my system in its preferred form, and the action of the condenser itself tend to produce a sub-atmospheric pressure or vacuum in the con-

denser, which condition is favorable to circulation, I provide means in the vent for preventing the entrance of outside air which would destroy the vacuum and in most instances interfere with the circulation.

Other important features consist in the arrangement of the system as hereinafter described and claimed.

In the accompanying drawings I have illustrated a cooling system embodying the features of my invention in the preferred form.

Figure 1 is a side elevation with certain parts, *i. e.*, the condenser, separator, etc., shown in section; and

Fig. 2 illustrates a modified form of the invention.

Referring to the drawing by numerals, the illustration includes a cylinder casting 1 with a water jacket 2 inclosing the combustion chambers and a radiator 3 with suitable connections. The term radiator in the present instance is applied in a general way as including the usual core 4 which operates as a condenser, a top tank 5 which acts as a separator, and a bottom chamber 6 which is divided into a condenser chamber 7 and a return water passage 8. The separator 5 is connected to the suction or return passage 8 by a pipe 9, by-passing or paralleling the condenser or radiator core 4. The space 10 above the liquid in the separator is connected to the condenser or radiator core 4 by a suitable passage 11 and a distributer 12 which leads the vapor to the various tubes of the condenser. The bottom chamber 6 of the condenser is shown as connected by a nozzle or valve seat 13 to the suction 14 of the pump 15 and the suction 14 is connected to the return passage 8 in any suitable and convenient manner as by lateral perforations 16 surrounding the valve seat or nozzle 13. The nozzle 13 is preferably supplied with means shown in the form of a non-return ball valve 17 for substantially excluding the back-flow of water from the circuit 8, 9, 14, etc., to the condenser and condenser chamber.

To prevent the generation in the condenser and condenser chamber of pressure in excess of that of the atmosphere, the latter is provided with a suitable vent 18 leading to the outside air; in the present instance it is placed inside the by-pass 9 and it leads upward through the chamber 5 opening through the top of the tank to the outside air where there is a valve 19 to prevent influx of air to the system while serving to balance the system and provide for the free escape of any excess pressure from the condenser and condenser chamber.

With the arrangement shown, there is practically no tendency of the liquid to escape through the vent as the condenser and condenser chamber never contain any accumulation of liquid, the same being removed as fast as it is formed while the engine is running and excluded by the valve 16 when the engine is idle, so that the vent may be at any desired height.

Fig. 2 illustrates a modified form showing the discharge end of the vent well down in the system. The reference characters correspond to those already explained in connection with Fig. 1 except that the vent is indicated by reference character 30.

It is regarded as essential to the success of the system that the water should be substantially excluded from the condenser and condenser chamber, the normal water level being as illustrated by the line 20 in Fig. 1. To prevent filling of the system above the desired level, it is found expedient to seal or eliminate the usual cap 21 at the top of the tank and provide a filler opening 22 which may be placed under the hood, this filler opening closed by a suitable filler cap 26 being at the desired water level.

In operation, the cooling liquid is drawn from the return passage 8 through the suction pipe 14 by the pump 15 and delivered into the jacket 2. The lift of the pump causes the liquid to rise to the top tank or separator 5. From the separator, the unvaporized liquid passes through the by-pass 9 to the return passage 8. Thus, the jacket 2, the separator 5, the by-pass 9, the return passage 8, and the return connections leading to the jacket, make up a circuit through which the liquid is passed continuously during the operation of the engine. Separation of the vapor from the liquid takes place at the surface 20 of the liquid in the tank or separator 5, the vapor from the air or vapor space 10 above the liquid being led downward through the passage 11 which has its upper end well above the surface of the liquid, and preferably protected from the entrance of the liquid by any suitable means as a turret or dome 25 which may take the place of the usual filler pipe and cap. The vapor entering this pipe passes to the distributer 12 and then through the condenser 4, which, as shown, may correspond to the core in an ordinary radiator. The condensed water enters the condenser chamber 6 where it collects in the bottom of the chamber until removed by the suction of the pump acting through the nozzle 13 arranged to prevent back-flow of water to the condenser and condenser chamber by any suitable means or relation of the parts, in the present instance a ball valve 17 being employed. One end of the pump suction 14, in the form of the invention shown, incloses the nozzle 13, the pipe being perforated at 16 to admit a continuous supply of water to the suction of the pump.

In the operation of the apparatus, the normal temperature of the system is the

boiling point of the cooling liquid used and this invention contemplates the control of the temperature of the system by varying the volatility of the liquid, for example, mixing alcohol with water in different proportions or using various liquids or solutions.

As has been pointed out, it may happen that the condenser and pump are at times of insufficient capacity to handle all the vapor generated so that pressure would be set up in the condenser and condenser chamber 6 opposing the flow of vapor to the condenser and the separation of the vapor from the liquid, resulting in the formation of steam pockets which interfere with the complete circulation and free passage of the heat from the cylinder walls to the cooling liquid. To avoid this, the vent 18 has been supplied in direct communication with the remote side of the condenser, *i. e.*, the point toward which the vapor to be condensed is to be drawn or led in passing through the condenser. This serves to balance the system and eliminate any tendency to the generation of pressure and when there is sufficient pressure to cause discharge, it assists in drawing the vapor through the condenser and prevents the formation of steam pockets due to insufficient separation and condensation of vapor from the liquid.

It is apparent in connection with Fig. 2 that there is normally a vacuum in the condenser chamber and the liquid is withdrawn as fast as it is formed so that the vent may be at any convenient height, an important feature of the vent being means for preventing the influx of outside air which would form air locks and interfere with the condenser vacuum and with the circulation. In the present instance, such means is shown in the form of a non-return valve 19.

I have thus described apparatus embodying my invention specifically and in detail in order that it may be made and used by those skilled in the art. However, the specific description herein is not intended to limit the scope of the invention which is defined in the claims.

What I claim and desire to secure by Letters Patent is:

1. In a cooling system for internal combustion engines, a continuous circuit for the liquid, including a jacket and means for separating the vapor from the liquid, a condenser associated with the circuit to receive the vapor and return the condensed liquid to the circuit, and a vent to the atmosphere in direct communication with the condensed liquid.

2. In a cooling system for internal combustion engines, a continuous circuit for the liquid, including a jacket and means for separating the vapor from the liquid, a condenser associated with the circuit to receive the vapor and return the condensed liquid to the circuit, a vent in direct communication with the portion of the system containing the condensed liquid, and means for passing the liquid through the circuit, withdrawing liquid from the condenser and returning it to this circuit.

3. In a cooling system for internal combustion engines, a continuous circuit for the liquid, including a jacket and means for separating the vapor from the liquid, a condenser associated with the circuit to receive the vapor and return the condensed liquid to the circuit, a vent to the atmosphere in direct communication with the condensed liquid, means for preventing the influx of air through the vent, and means for passing the liquid through the circuit, withdrawing liquid from the condenser and returning it to the circuit.

4. In a cooling system for internal combustion engines, a radiator having a top chamber acting as a separator, a bottom chamber, and an intermediate core to act as a condenser, means for leading vapor from the top chamber to the condenser substantially excluding the water therefrom, the condensed liquid passing into the lower chamber, a jacket, connecting means from the jacket to the separator, means for passing the liquid by the condenser, means for maintaining continuous circulation through the jacket, separator and by-pass, and a connection to the suction side of the circulating means for drawing the condensed liquid from the bottom chamber of the rediator.

5. In a cooling system for internal combustion engines, a radiator having a top chamber acting as a separator, a bottom chamber, and an intermediate core to act as a condenser, means for preventing the water level from rising above a certain predetermined point in the top chamber, means for leading vapor from the top chamber to the condenser and substantially excluding the water therefrom, the condensed liquid passing into the lower chamber, a jacket, means for passing the liquid by the condenser, means for maintaining the liquid in continuous circulation through the jacket, separator and by-pass, and a connection to the suction side of the circulating means for drawing the condensed liquid from the bottom chamber of the radiator.

6. In a cooling system for internal combustion engines, a radiator having a top chamber acting as a separator, a bottom chamber, and an intermediate core to act as a condenser, means for preventing the water level from rising above a certain predetermined point in the top chamber, means for leading vapor from the top chamber to the condenser and substantially excluding the water therefrom, the condensed liquid pass-

ing into the lower chamber, a jacket, connecting means from the jacket to the separator, means for leading the liquid by the condenser and a connection for drawing the condensed liquid from the bottom chamber of the radiator.

7. In a cooling system for internal combustion engines, a radiator having a top chamber, a bottom chamber and an intermediate core to act as a condenser, means for leading vapor from the space above the water in the top chamber to the condenser and excluding the water therefrom, the condensed liquid passing into the lower chamber, a jacket, connections from the jacket to the separator, a by-pass leading the liquid by the condenser, the jacket, the separator, the by-pass and the connections forming a continuous circuit for the liquid, and means for drawing the condensed liquid from the bottom chamber of the radiator and returning it to the circuit.

8. In a cooling system for internal combustion engines, a radiator having a top chamber, a bottom chamber and an intermediate core to act as a condenser, means for leading vapor from the space above the water in the top chamber to the upper part of the condenser and excluding the water therefrom, the condensed liquid passing into the lower chamber, a jacket, connections from the jacket to the separator, a by-pass leading the liquid by the condenser, the jacket, the separator, the by-pass and the connections forming a continuous circuit for the liquid, means for drawing the condensed liquid from the bottom chamber of the radiator and returning it to the circuit, and a vent to the atmosphere to relieve the pressure on the condensed liquid.

9. In a cooling system for internal combustion engines, including a radiator, a water jacket, top and bottom connections, the radiator including a bottom tank and a vent leading from the bottom tank to a point above the level of the water in the system.

10. In a cooling system for internal combustion engines, a circuit for cooling fluid including a jacket and means for separating the vapor from the fluid, means for maintaining positive circulation of cooling liquid through the circuit, a condenser and connections associated with the circuit and condenser whereby the vapor is passed to the condenser and the condensed fluid returned to the circuit, the liquid being substantially excluded from the condenser, and a vent to prevent back pressure, air locks, steam locks and the like, the same being connected to the system on the suction side of and near to the circulating means.

11. In a cooling system for internal combustion engines, a continuous circuit for the fluid, including a jacket and means for separating the vapor from the fluid, a condenser and connections associated with the condenser and separator for leading the vapor to the condenser, means for positively circulating the fluid through the circuit, connections associated with said means for returning the liquid formed by condensation of vapor in the condenser to the circuit, normally excluding substantially all the unvaporized fluid from the condenser, means for venting the pressure on said condensed vapor prior to its reëntrance into the circuit, and means for preventing the influx of outside air through the vent.

12. In a cooling system for internal combustion engines, a continuous circuit for the fluid including a jacket and means for separating the vapor from the fluid, a condenser with connections associated with the condenser and circuit for leading the vapor to the condenser and returning the condensed liquid to the circuit, and a vent in direct communication with the condensed liquid.

Signed by me at Baltimore, Maryland, this 3 day of June, 1918.

WELLINGTON W. MUIR.

Witnesses:
ZELLA KUHN,
EMMA WEHMEYER.