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E. J. MANNING

INTERNAL COMBUSTION ENGINE COOLING SYSTEM

Filed Dec. 29, 1922

FIG. 1

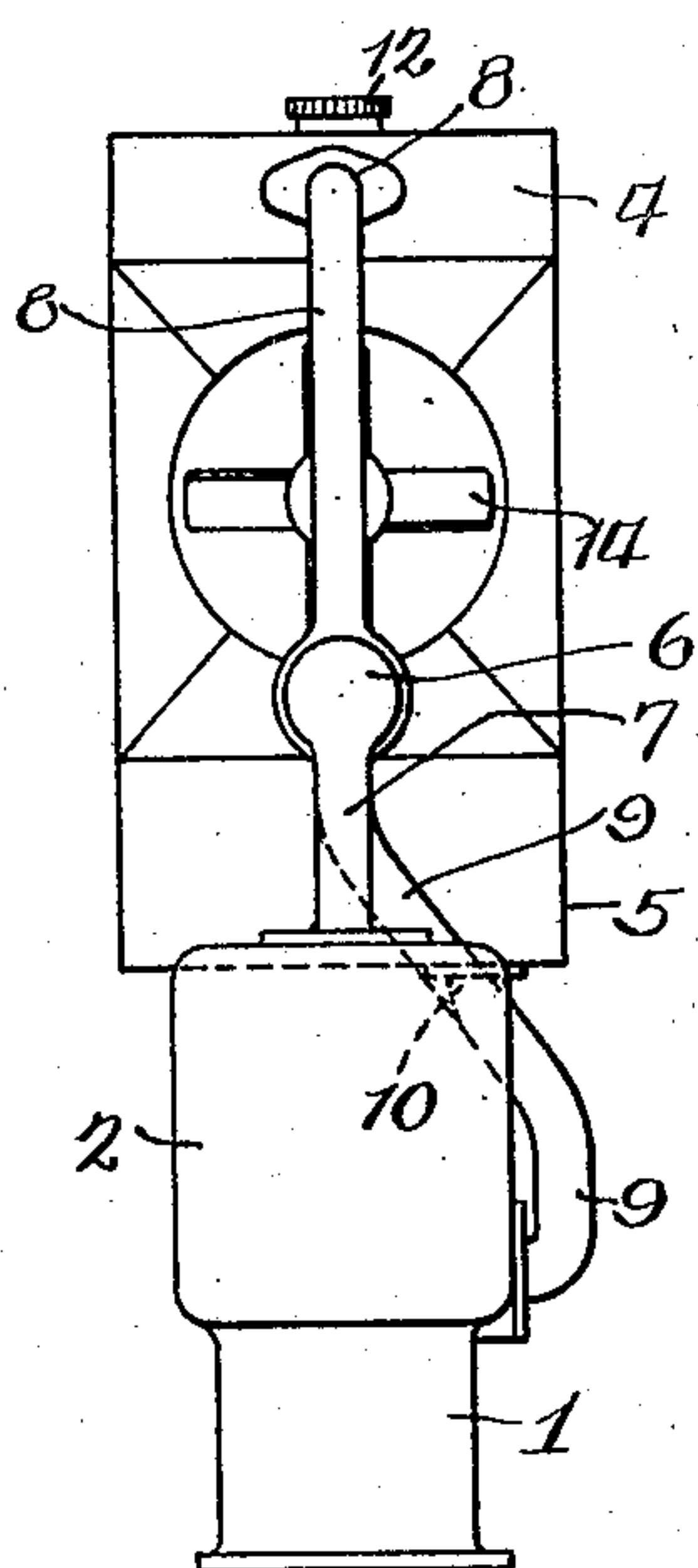


FIG. 2

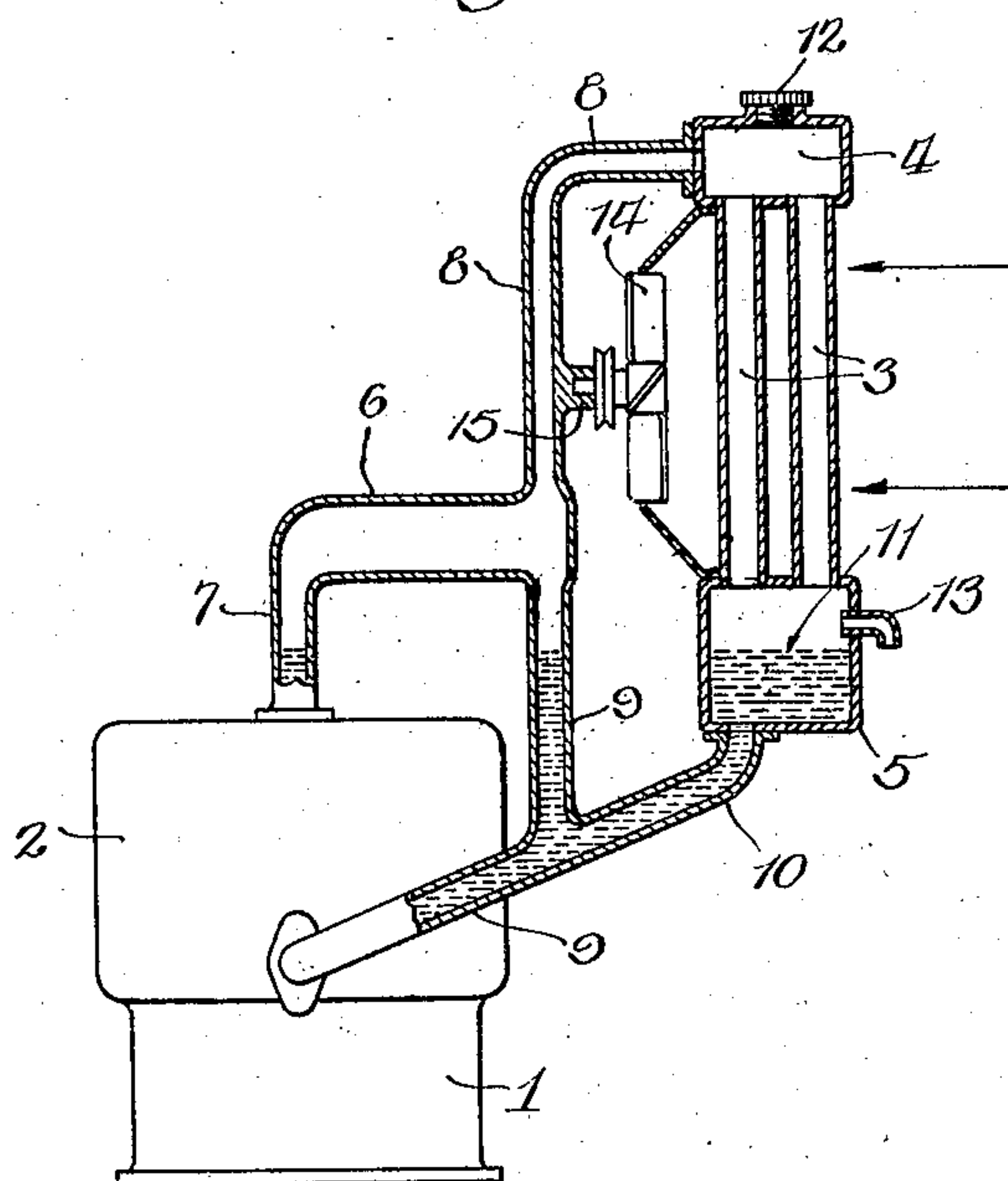


FIG. 3

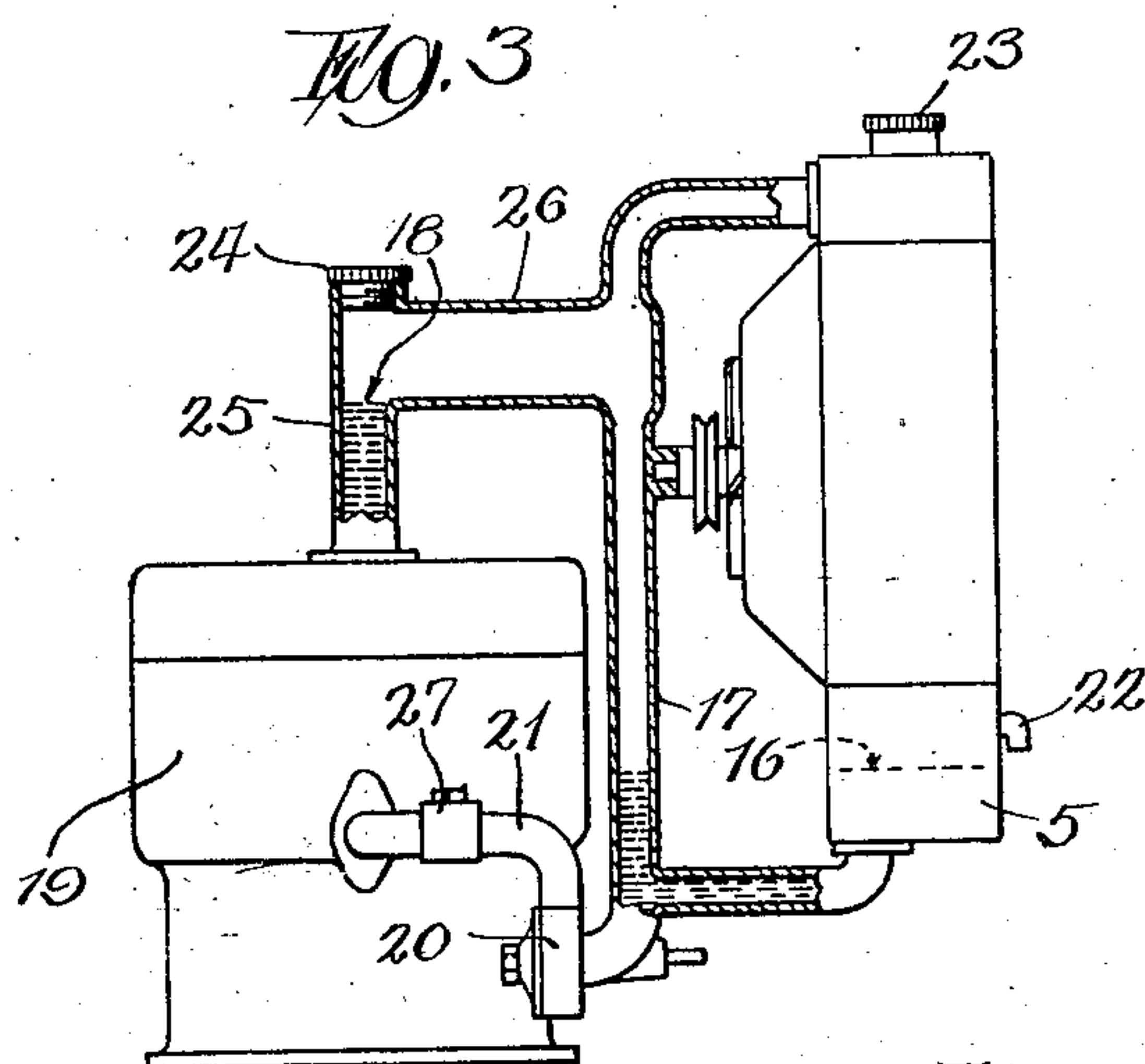
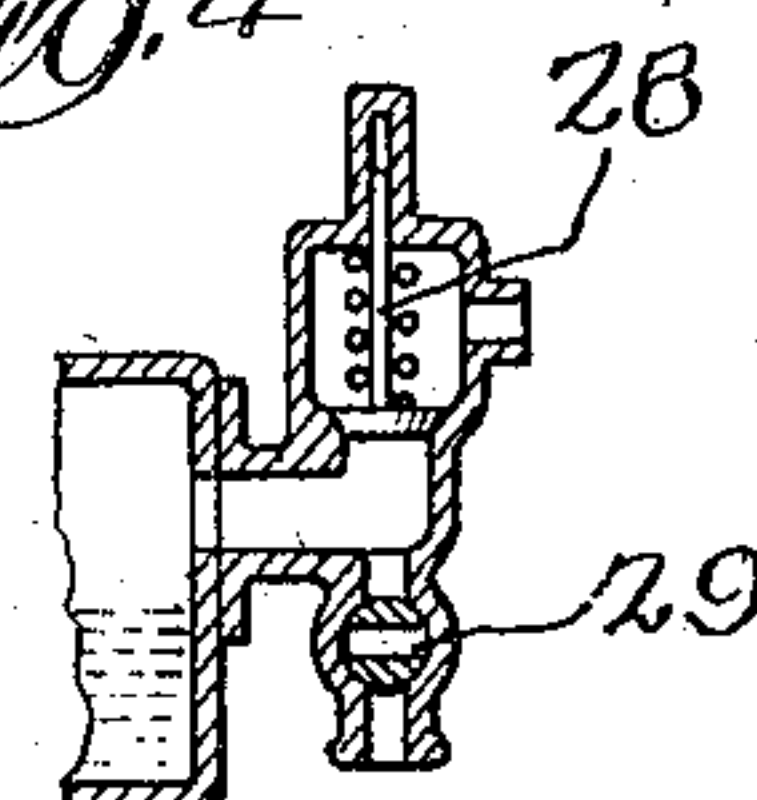


FIG. 4



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INTERNAL-COMBUSTION-ENGINE COOLING SYSTEM.

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This invention relates to internal combustion engine cooling systems, in which a radiator is employed for the condensation of steam, instead of for the cooling of the water, and in which the radiator is, therefore, normally free of water.

Generally stated, the object of the invention is to provide an improved construction and arrangement whereby, in a cooling system of the foregoing general character, a tank is provided at the bottom of the radiator, for the accumulation of the water of condensation, in combination with a steam separator, and connections whereby the water level in the tank is always the same as that in the return water connection from the separator, and so that the radiator is normally free of water, as will hereinafter more fully appear.

It is also an object to provide certain details and features of construction and novel combinations tending to increase the general efficiency and the desirability of an internal combustion engine water cooling system of this particular construction.

To these and other useful ends the invention consists in matters hereinafter set forth and claimed and shown in the accompanying drawings in which—

Figure 1 is a rear end elevation of an internal combustion engine having a cooling system embodying the principles of the invention.

Figure 2 is a side elevation of the same, showing the water cooling system in section.

Figure 3 is a view similar to Figure 2, showing another form of the invention.

Figure 4 is a detail view showing a check valve for the vent of the tank at the bottom of the radiator.

As thus illustrated, the internal combustion engine 1 may be of any suitable known or approved character. As shown, the engine has a water jacket 2 of the usual or any suitable character. The radiator 3 for the condensation of steam may be of any suitable character, but as shown is composed of vertical tubes having a header 4 at their upper ends, and the bottom of the radiator thus provided is provided with a tank 5 for the accumulation therein of the water of condensation. A steam separator 6 is provided, in the form of a horizontally disposed hollow element, and a steam and water connection 7 leads from the top of said water

jacket to the separator. A steam connection 8 leads from the top of the separator to the header 4 which is the top of the radiator. A return water connection 9 leads from the lower end of the separator to the bottom of the water jacket. Also, as shown, an outlet water connection 10 leads from the bottom of the tank 5 to the return water connection 9, so that the normal water level 11 in the tank 5 is always the same as that in the connection 9, when the system is working under normal conditions. As shown in Figure 2 the header 4 has a closure 12 which can be removed for the introduction of water into the system, so that in this case the system is filled through the radiator, until the water rises to the level 11 as previously explained. To assist in the maintaining of the water level at the proper height, an overflow outlet 13 is provided for the upper portion of the tank 5, and as shown in Figure 2 the same water level will be maintained in the water and steam connection 7 leading from the top of the jacket. A fan 14 is provided for cooling the radiator, and means 15 are provided on the separator to support said fan, so that the air is drawn through the radiator, as indicated by the arrows.

In operation, the water boils over through the connection 7, into the separator 6, and the steam escapes through the connection 8 into the top of the radiator, while the unvaporized water drops down and into the return water connection 9, and then flows to the bottom of the jacket. The steam thus entering the radiator will be condensed therein, and the water of condensation will fall into the tank 5, and this water of condensation will flow through the connection 10 to the water jacket of the engine, but the water in the connection 9 and in the tank 5 is balanced, so to speak, and will preserve an even level at a point somewhere below the overflow outlet 13, for should the water in filling the system rise above this level it will overflow through this outlet and thereby ensure or maintain the desired conditions, for in a system of this kind it is desirable to keep the radiator free of water so that the steam may freely condense therein and fall into the tank below.

In Figure 3 the cooling system is substantially the same as that previously described, but in this case the radiator and its tank 5 are arranged at a lower level, so that the

water level 16 maintained in the tank and in the return water connection 17 is below the water level 18 which is permissible in the water and steam outlet leading from the top of the water jacket 19 of the engine. Also, as shown in Figure 3, a pump 20 is located in the return water connection 21 which leads to the bottom of the water jacket, so that all water in the system must pass through this pump before returning to the bottom of the water jacket. In this case, also, an overflow 22 is provided for the tank 5, so that in filling the system the water in this tank and in the connection 17 will assume the desired level, if too much water is introduced into the system. The top of the radiator, in Figure 3, has a screw cap 23, like the ordinary radiator, but with this arrangement it is also desirable to provide a screw cap 24 on the connection 25 which may be removed for the introduction of water into said jacket, and when this is done the water will rise in the connection 25 leading from the top of the water jacket until it overflows into the separator 26, and the water will then rise from the latter and in the tank 5 until it assumes the level 16 previously mentioned. This level 16 is maintained when the pump 20 is operating substantially at normal speed, or under proper conditions, but no matter how fast the pump may operate the water will not flood the radiator, and the latter will be kept substantially free of water and in condition to rapidly condense any steam which enters at the top thereof from the separator. A check valve 27 may be interposed in the connection 21 to prevent back flow through the pump and to maintain the water level 18 when the pump stops.

With the provision of the overflow outlet (13 or 22) atmospheric pressure will be maintained in the radiator and tank at the base thereof. Cold air can enter and chill the steam, and should the pressure rise too high the steam may escape from said overflow outlet. Air can enter and pass through the radiator into the steam separator. The general scheme serves to reduce the amount of radiator surface necessary, as compared with that of an ordinary system in which the water is circulated through the radiator.

Steam enters the top of the radiator and gradually forces the air down and out of the outlet (13 or 22), as the temperature of the engine rises, and will blow off through said outlet if the engine overheats until the steam enters the tank 5 at the bottom of the radiator. The water circulation is maintained independently of the radiator. In Figure 2, the water circulation does not start until the water boils over from the connection 7 into the separator 6, but in Figure 3 the circulation starts as soon as the pump 20 begins to run. Of course,

this pump may be operated by the engine in the ordinary or any suitable manner. With the open vent shown at 13 or 22 air will enter freely to maintain atmospheric pressure, and will flow in and out as the load on the engine changes. Of course, steam will only blow off through this vent in case of a very heavy load, as in very hot weather this might occur. On the other hand, with a very light load, the steam may not move downward more than two or three inches in the top of the radiator, but if the load were suddenly increased it might be forced half way down or more through the condenser tubes. If the load is suddenly reduced, or if the engine is stopped, the steam, of course, will rise in the radiator, and will be condensed in the condenser tubes and the air in the base portion of the radiator will automatically flow in or out to maintain atmospheric pressure within the system.

In Figure 4 the vent is provided with a check valve 28 which permits steam and water to escape, but prevents air from entering, so that in such case condensation of the steam in the radiator will leave a vacuum therein, or a partial vacuum, and the steam generated when the engine starts up again will come quickly into the radiator without having to first push the air out of the radiator. A hand valve 29 is provided below the check valve 28, which can be left open for the escape of water, in filling the system, so that an indication will be given when the proper water level is reached in the tank below the radiator and the return water connection from the separator.

One of the distinguishing features, it will be seen, of the invention shown and described as per Fig. 3, is that the construction involves a steam separator having a steam and water connection 7 to the bottom of the water jacket and a drain connection 9 to the bottom of the water jacket and a steam connection 8 to the top of the condenser, in a structure in which the water level is equalized in the tank or reservoir 5 and in the drain connection 9 of the circulating system, and in a system in which all water must pass through the pump 20 from the drain connection 9 and from the tank 5 in which the condensate is accumulated from the condenser.

Of course, in either form of the invention, the water can circulate without passing through the tank, and without passing through any part of the condenser. The steam separator in each case is above the normal water level in the tank or reservoir at the bottom of the condenser, which tank serves as a reservoir for a varying quantity of water. In each case the filling means for filling the system with water are above the chamber of the steam separator, so that

the system can be filled until the water overflows from the outlet provided for the tank at the bottom of the condenser, thus indicating that the system is sufficiently filled.

5 If the outlet is of the character shown in Fig. 4, then the valve 29 will be left open while the system is being filled. The outlet serves in any event to discharge steam and air, automatically, when the pressure rises, or when such is necessary or desirable.

Thus, in the form of the invention shown in Fig. 3, means are provided to maintain the water level in the return connection and the tank, including the elements 13 and 22, and whereby said tank and condenser and said jacket and return tube form independent units, one for condensing the vapor and holding the condensate and extra supply of cooling liquid and the other providing circulating means for the cooling liquid in the jacket, and whereby steam only can pass into the condenser, and cooling liquid to compensate for evaporation can only pass into the jacket from said tank. In other words, each unit performs its function complete and independent of the other unit. The steam separator placed in the top of the circulating system simply separates the steam and passes it into the condenser. When the engine is first started only the liquid in the jacket is heated and this being in circulation the temperature would rise quickly and evenly, during which time the other unit is not in operation, and it only begins to operate when steam flows into the condenser, and to compensate for the loss of liquid (because of evaporation) liquid will flow from the tank into the jacket. As a matter of fact, the separator forms an overflow level for the jacket, and this level never changes. If water in the form of steam passes into the condenser the overflow level not being permitted to change means that the amount must be supplied by the level in the return tube which did not receive the amount supplied the jacket, and this tube level dropping will receive enough from the tank to equalize the two levels, and the water supplied will of course be at a much lower temperature, but the small quantity joining the rapidly circulating large volume will not reduce the temperature more than a degree or so.

What I claim as my invention is:—

55 1. In an internal combustion engine, a cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a water jacket for cooling the engine, a condenser having a header forming a tank at the bottom thereof to serve as a reservoir for a varying quantity of water and to keep the condenser normally free of condensate, a steam separator having a steam and water connection to the top of said jacket, in which

connection the normal water level is below the chamber of the separator, said separator having a drain connection to the bottom of the jacket and a steam connection to the top of said condenser, said tank having means to keep the water level therein below the condenser, and a water connection from the bottom of said reservoir to said drain connection, whereby to equalize the water level in said drain connection and in said tank.

2. A structure as specified in claim 1, having an outlet in said tank whereby steam and air and water can escape to the atmosphere from said condenser.

3. A structure as specified in claim 1, comprising a pump in said drain and water connection, whereby all water and condensate in the system must pass through said pump and flow into said jacket from said separator and tank, while all steam must pass into the top of said condenser, and an outlet in said tank whereby air or steam can escape.

4. In an internal combustion engine, a cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a water jacket for cooling the engine, a condenser having a water connection from the bottom thereof to the bottom of said jacket, a steam separator attached to the top of said jacket and having a steam connection to the top of said condenser and a drain connection to the bottom of said jacket, a pump in said water connection, a tank in the system to serve as a reservoir for a varying quantity of water and condensate, so that a water level is maintained by gravity above said pump but below the said separator and said condenser, and whereby steam must pass into the top of said condenser, while the water must circulate through said jacket and overflow into said drain connection, and whereby condensate will return to said jacket.

5. A structure as specified in claim 4, having an outlet at said condenser whereby steam and air can pass therefrom.

6. In an internal combustion engine, a cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a water jacket for cooling the engine, a condenser having a header forming a tank at the bottom thereof to serve as a reservoir for a varying quantity of water and condensate, a steam separator connected to the top of said jacket and having a steam connection to the top of said condenser and a drain connection to the bottom of said jacket, a water connection from the bottom of said tank to the bottom of said jacket, said tank disposed in position whereby its water level is maintained by gravity in said drain connection, and a pump in said water

connection, whereby water is forced into said separator and overflows into said drain connection, and so that steam flows into the top of said condenser and condensate drains by gravity into said tank and returns through said pump to said jacket.

7. A structure as specified in claim 6, having an outlet at said condenser whereby steam or air can escape.

8. An internal combustion engine cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a water jacket for the engine, a radiator for the cooling and condensation of steam only, having its bottom provided with a tank for the water of condensation, thereby to keep the radiator normally free of water, a steam separator above the normal water level in said tank, a steam and water connection from the top of said jacket to the separator, in which connection the normal water level is below the chamber of the separator, a steam connection from the separator to the top of said radiator, a return water connection from the separator to the bottom of said jacket, so that water can circulate without passing through the tank, a connection from the bottom of the tank to said return water connection, so that the water level in said return connection and in the tank will always be the same, means to maintain this water level, and means for introducing water into the system.

9. An internal combustion engine cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a radiator for the condensation of steam, a tank forming a base for said radiator, serving as a reservoir for the accumulation of the water of condensation, a water jacket having its bottom connected to the bottom of said tank, a steam and water separator for the top of said jacket, filling means above the chamber of the separator, and an overflow outlet for the upper portion of said tank, adapted to permit air or steam or water to escape to the atmosphere, and so that in filling the water is prevented from rising above the separator or into the radiator.

10. An internal combustion engine cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a water jacket for the engine, a radiator for the cooling and condensation of steam only, having

its bottom provided with a tank for the water of condensation, thereby to keep the radiator normally free of water, whereby said tank and condenser and said jacket and return tube form independent units, one for condensing the vapor and holding the condensate and extra supply of cooling liquid and the other providing circulating means for the cooling liquid in the jacket, and whereby steam only can pass into the condenser, and cooling liquid to compensate for evaporation can only pass into the jacket from said tank, a steam separator above the normal water level in said tank, a steam and water connection from the top of said jacket to the separator, in which connection the normal water level is between the separator and the top of the jacket, a steam connection from the separator to the top of said radiator, a return water connection from the separator to the bottom of said jacket, so that water can circulate without passing through the tank, a connection from the bottom of the tank to said return water connection, so that the water level in said return connection and in the tank will always be the same, means to maintain this water level, and means for introducing water into the system.

11. An internal combustion engine cooling system the predetermined working temperature of which is the boiling point of the liquid employed therein, comprising a radiator for the condensation of steam, a tank forming a base for said radiator, serving as a reservoir for the accumulation of the water of condensation, whereby said tank and condenser and said jacket and return tube form independent units, one for condensing the vapor and holding the condensate and extra supply of cooling liquid and the other providing circulating means for the cooling liquid in the jacket, and whereby steam only can pass into the condenser, and cooling liquid to compensate for evaporation can only pass into the jacket from said tank, a water jacket having its bottom connected to the bottom of said tank, a steam and water separator for the top of said jacket, filling means above the chamber of the separator, and an overflow outlet for the upper portion of said tank, adapted to permit air or steam or water to escape to the atmosphere, and so that in filling the water is prevented from rising above the separator or into the radiator.

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