Dec. 14, 1965 L. P. BARLOW 3,223,075

EBULLIENT COOLING SYSTEM

Filed May 13, 1964 3 Sheets-Sheet 1

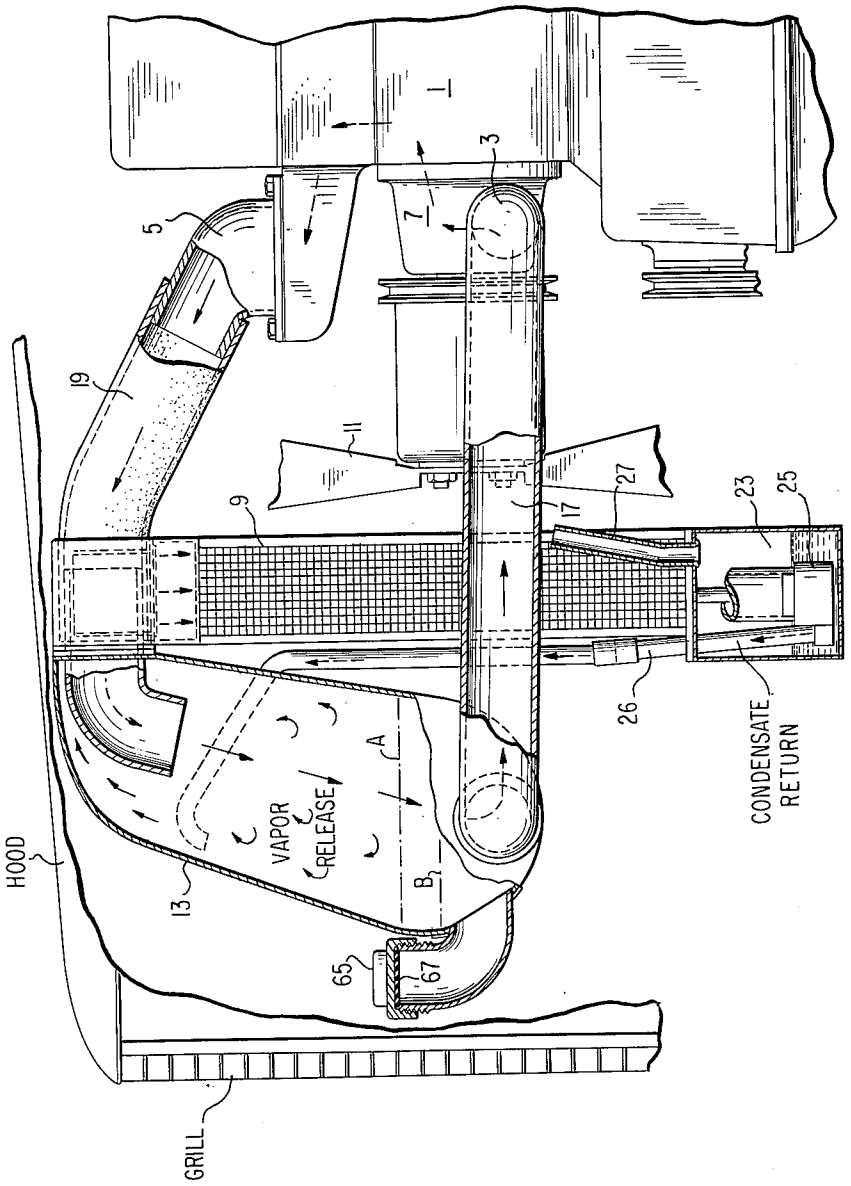

FIG. 1

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Filed May 13, 1964 3 Sheets-Sheet 2

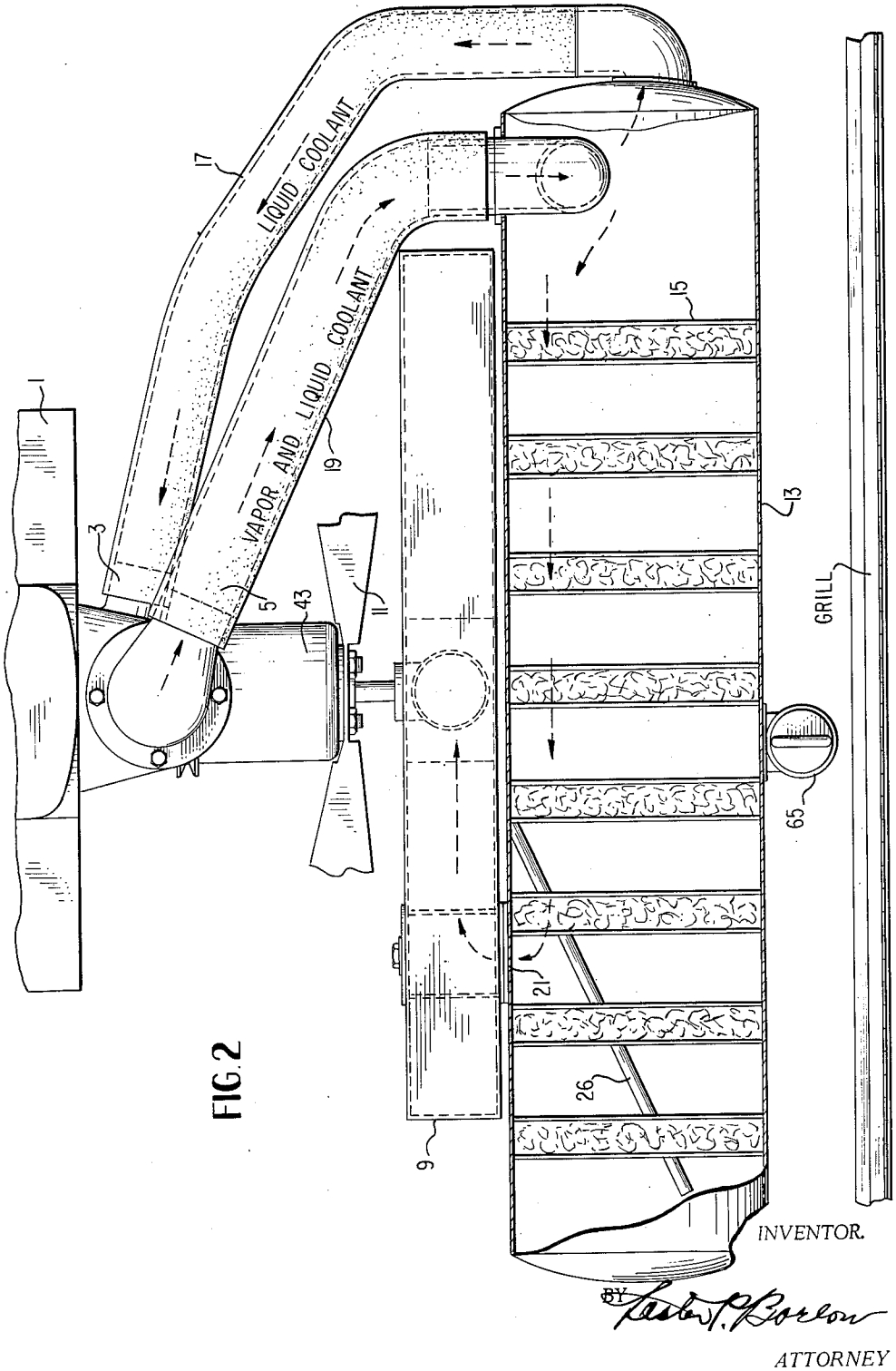

FIG. 2

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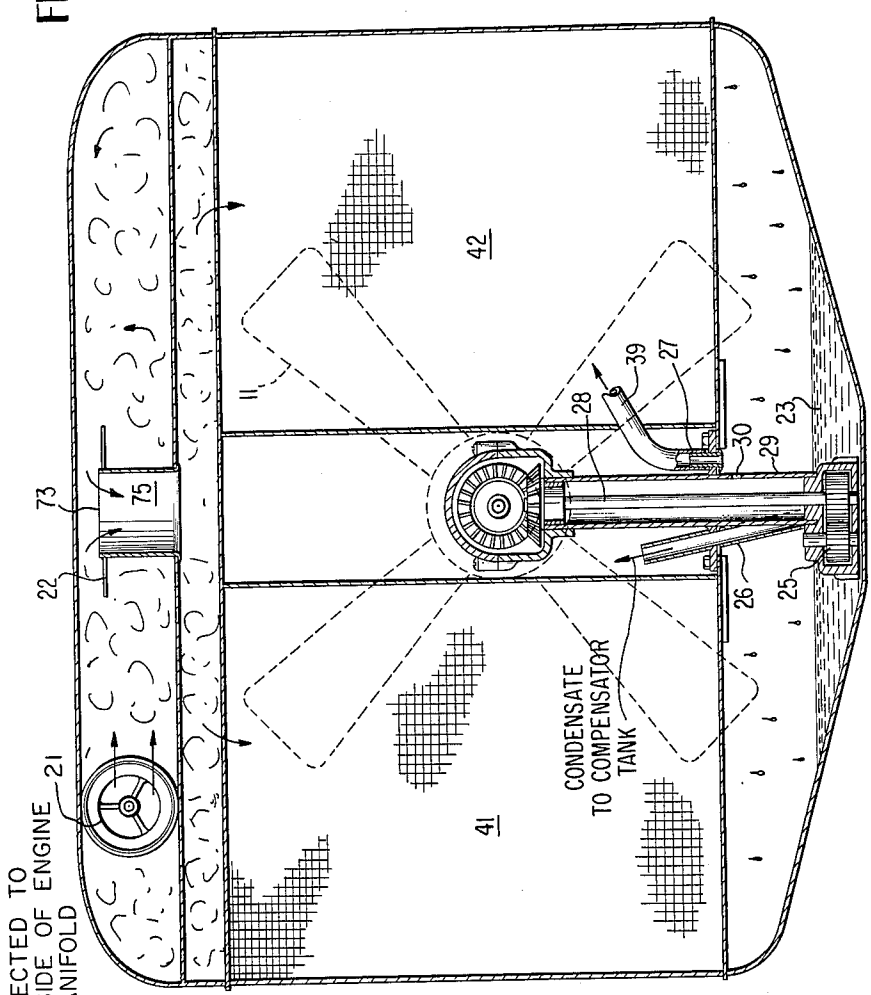
EBULLIENT COOLING SYSTEM

Filed May 13, 1964 3 Sheets-Sheet 3

FIG. 3



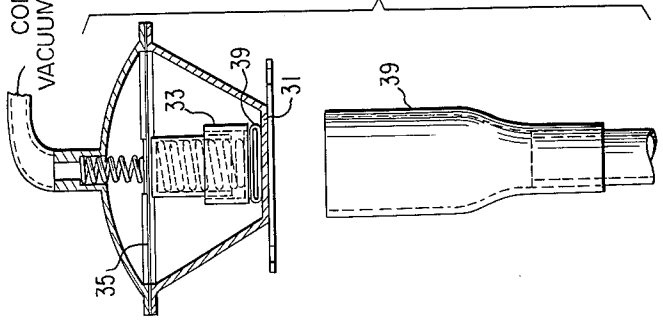


FIG. 4

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3,223,075

EBULLIENT COOLING SYSTEM

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Filed May 13, 1964, Ser. No. 367,188
30 Claims. (Cl. 123—41.24)

The present invention relates to an improved cooling system for internal combustion engines and more particularly to an ebullient cooling system which is readily adaptable to the modern motor vehicle.

The conventional cooling system generally used for automobile engines consists essentially of a pump to circulate a heat transfer medium through the engine and a radiator to dissipate the engine heat.

In such systems the coolant from the radiator is pumped into the cylinder jacket near the bottom of the block, absorbs heat as it rises through the cylinder jacket and dissipates the heat as it descends through the radiator. It is obvious that with such a system the top of the cylinder lining becomes hotter than the bottom. Due to this uneven temperature the top of the cylinder liner expands to a higher degree than the bottom distorting the shape of the liner. This distortion results in poor ring fit, and hence, increased blow-by, greater oil consumption, metal stresses, friction and engine wear.

With efficient ebullient cooling, however, these difficulties are no longer present, since little or no temperature rise occurs in the coolant during operation of the system.

Such a cooling system takes advantage of the latent heat of vaporization—the heat necessary to change liquid to vapor without a change in temperature. Since the coolant throughout the cylinder jacket is at its boiling point the heat which it absorbs merely transforms the coolant to its vapor stage, the vapor being lighter than liquid boils off the top and the coolant in the cylinder walls remains at a uniform temperature from top to bottom.

In view of the higher operating temperatures with this system the fuel gases are less likely to condense and bring about an accumulation of acid in the crankcase. The uniform cylinder wall temperature also brings about better controlled combustion and greater engine thermal efficiency. Thus, through ebullient cooling, engine corrosion is greatly reduced, lubricant contamination is lessened, the use of fuels of widely varying composition becomes practicable, and the engine in general operates more efficiently.

One of the major problems confronting our cities today is smog caused in large measure by exhausts containing unburned gases emitted by inefficient running automobile engines. A high percentage of these unburned gases which are emitted to the atmosphere from automobile engines are due to the inadequacies of the conventional cooling systems now in use. In fact, in order to prevent knocking due to hot spots in the engine caused by inadequate cooling lead additives have been added to the fuels which tend to further contaminate the air. With efficient ebullient cooling systems this problem would be greatly alleviated for the higher temperatures which occur within the firing chamber of the engine produce cleaner burning of the fuel, resulting in a marked decrease in the amount of unburned hydrocarbons and gases and the uniform temperatures produced eliminate engine hot spots and the need for lead additives in the fuel.

The application of ebullient cooling to internal combustion engines for powering automobiles, however, is not new, by any means. I, myself, starting with my first system in 1912, have developed numerous cooling systems for automobile engines utilizing ebullition, for many of which I have received U.S. Letters Patent. One of the major drawbacks to the widespread use of such systems

until recently, however, was the unavailability of a suitable coolant.

Traditionally, three materials, water, ethylene glycol and methanol, separately or in various combinations, have been widely employed as ebullient coolants. But all carry with them serious disadvantages.

Water, perhaps the most popular, poses the threat of freezing during shutdown. When weather is especially cold, condensate may even freeze during continuous operation. Ethylene glycol prevents freezing in the engine block or boiler. However, it does not azeotrope with water and consequently, freezing still remains a problem in separators, condensers, and related piping. Methanol on occasion has been mixed with water and glycol. However, methanol has a high vapor pressure, giving high vapor losses and causing poor heat-transfer efficiency in the system.

The foregoing disadvantages placed severe seasonal and geographical restrictions on the use of ebullient cooling systems. Therefore, while such systems were used with tremendous success in specific instances their acceptance remained limited.

In recent years, thanks to the development of a new permanent coolant, Dowtherm 209, these seasonal and geographic disadvantages can now be eliminated. Dowtherm, having a property of forming an azeotrope with 47 weight percent water, has an atmospheric boiling point of 209° F. Also, mere azeotropic conditions exist with solutions containing from 30–60 weight percent of Dowtherm, hence, maintaining exact concentration in the ebullient cooling system is not critical. Weather conditions, likewise, present no problem for Dowtherm pour points range from −18° F. for a 40 weight percent solution to −80° F. for one of 60 percent.

The advent of this new coolant has injected renewed interest in developing cooling systems which take into account the formidable advantages of ebullition. As a result, many more stationary engines are now being equipped with ebullient cooling systems.

But attempts to utilize ebullient cooling in engines powering modern automobile vehicles and the like are now confronted by obstacles not present in stationary engines.

In a normal stationary engine installation as in the old model automobiles there is room for steam domes over the engine and ample room for condensers and reservoir tanks. With the modern automobile this is not the case. As a result of incorporating aerodynamic features in the design of automobiles the hood of the modern automobile has a low silhouette. This low silhouette hood completely eliminates the possibility of positioning a steam dome on top of the engine as had been done in previous cooling system designs. Not only is there the low silhouette hood to contend with in the modern automobile but in most installations there is an air cleaner above the engine and accessories such as power steering, power brakes, air conditioning units and batteries under the automobile hood which leave very little additional room available for a cooling system.

The higher horsepower, rapid load changes, and acceleration rates also provide problems in the design of ebullient cooling systems for the modern automobile. Not only is there no room for position a steam dome over the engine under a low silhouette hood in a modern automobile, there is now a need in ebullient cooling systems for the modern automobile for increased head room due to the surges in ebullition caused by higher horsepower and rapid changes in acceleration rates.

In automobile designs of recent years there has been provided a space between the so-called front grill and the radiator. This is about the only space available under the hood of the modern automobile capable of meeting

the space requirements of an ebullient cooling system for the powerful internal combustion engines of passenger vehicles. Yet, none of the known vapor cooling systems or combinations thereof will work in this space due to the lack of head room.

Another serious obstacle in providing an ebullient cooling system for the modern automobile is to provide a system which eliminates the constant need of replenishing the coolant supply. In previous systems appreciable amounts of coolant were lost through the air vent to the atmosphere. Replacing the lost coolant not only proves expensive due to cost of chemical coolants but when operating in remote areas desired chemical coolants are often not available. While in most systems water if available can be added to the chemical coolants, the addition of water to the coolant changes the freezing point and in cold climates the difficulties of freezing may be encountered.

Therefore despite the desirability of providing the modern automobile with ebullient cooling, previous attempts to meet this need have all proven unsatisfactory.

It is a primary object of this invention to provide an ebullient cooling system readily adaptable to the modern automobile which eliminates the need for a steam dome located above the engine.

It is another object of this invention to provide an ebullient cooling system for internal combustion engines which will fit under the low silhouette hood of the modern automobile.

It is another object of the present invention to provide an ebullient cooling system which utilizes the space which has come into existence in recent years and is almost universally available between the radiator and the grill of the modern automobile.

It is an object of the present invention to provide a cooling system including a compensating chamber in which the liquid in the compensating chamber can be evacuated to a level below the coolant level in the engine, resulting in an effective increase in head room in the compensating chamber.

It is an object of the present invention to provide an improved cooling system in which a coolant circulates through an engine at or near its boiling point and the principal area of heat transfer is in a state of ebullition, the cooling of the heated surfaces of the engine taking place by ebullition.

It is an object of the present invention to provide an engine cooling system that operates in such a manner that the temperature of the coolant circulating to the engine and the temperature of coolant circulating from the engine are the same.

It is an object of the present invention to provide a cooling system by which a thermal balance will be maintained in all cylinders of a multi-cylinder engine, thus providing a smoother running engine.

It is an object of the present invention to provide a cooling system for an internal combustion engine which will maintain all the cylinders at a constant temperature, thus preventing the condensation of products of combustion on cylinder walls resulting in corrosion, sludging and excessive wear.

It is an object of the present invention to provide a cooling system for an internal combustion engine which will maintain the engine at a constant higher temperature resulting in more efficient combustion of fuels, the elimination of hot spots in the engine and the need for lead additives in the fuel.

It is another object of the present invention to provide an ebullient cooling system wherein coolant losses are eliminated.

It is an object of the present invention to provide a cooling system for an internal combustion engine including a compensating chamber and a condenser located between said compensating chamber and said engine for receiving vapor from said chamber and having

a pump for returning condensate formed therein back to the compensating chamber.

It is an object of the present invention to provide in an ebullient cooling system a compensating chamber for separating the vapor and liquid coolant and means therein for forming a reservoir of coolant for the system.

It is still another object of the present invention to provide in an ebullient cooling system a condenser including a top section for restricting the intake of liquids entrained in the vapor entering therein, coils for the condensation of the vapor, a well for collecting condensate and a pump for eliminating the condensate.

Other details, objects and advantages of the present invention will become apparent from the following description of the present embodiment thereof, taken in conjunction with the drawings which accompany and form part of the specification.

In the drawings:

FIGURE 1 is a side view, partly in section, of the present invention as adapted to a modern automobile.

FIGURE 2 is a top view, partly in section, of the present invention.

FIGURE 3 is a front view, partly in section, of the condenser which forms a part of the invention.

FIGURE 4 is an illustration of a vacuum-controlled spring plug for preventing loss of the coolant embodied in the present invention.

Referring to the drawings, the engine **1** represents a typical internal combustion engine, having a cooling jacket surrounding the cylinders, a water inlet **3**, water outlet **5** and water pump **7**. A condenser **9** somewhat similar in size to a conventional radiator is shown in association with the engine occupying the same location as would a radiator in a conventional water cooled engine. The vapor flowing therethrough, being cooled by air circulation induced by the customary mobility of the installation and/or the fan **11** as shown.

The heart of the invention is a compensating chamber **13** containing a multitude of vertical barriers **15** of metal grids or of non-woven heat-stabilized fiber filters or the like (see FIG. 2), connected by suitable conduits **17** and **19** with inlet **3** and outlet **5** of the engine **1** and located directly in front of the condenser **9** in the normal air flow space which is located between the radiator and grill of an automobile equipped with a water cooling system.

The conduit **19** connected at the top of one end of the compensating chamber **13** is curved and directed downward toward the bottom of the compensating chamber. The conduit **17** is connected to the bottom of the compensating chamber directly below the conduit **19** thus forming a short circuit of coolant flow through the chamber between the conduits.

Near the top of the compensating chamber **13** but at a point remote from the conduit **17** an opening **21** is provided connecting chamber **13** and the condenser **9** in order to allow vapor to pass from the chamber into the condenser.

The top of the condenser **9** is so segregated that in order for the vapor to travel down into the coils of the condenser it must first rise around baffle **22** to an opening **73** at the end of a short vertical pipe **75**. Any vapor heavy with liquid not so rising eventually returns with said liquid into the compensating chamber **13**.

At the bottom of the condenser in the center there is a well **23** for collecting condensate. Inserted in this well is a pump **25**, which may be a small conventional pump, electrically driven, or driven from the fan hub through conventional gearing with an angle compensating connector, for pumping the condensate through a conduit **26** to a point near the top of the compensating chamber **13** but remote from conduits **17** and **19** and outlet **21**. The well at the bottom of the condenser insures the collection and return of the condensate to the compensating chamber **13** regardless of the incline which the condenser may be shifted due to the grade of the road on which the auto-

mobile may be traveling. When the pump **25** is driven by a vertical shaft **28** coupled by conventional gearing and an angle compensating connector to the fan hub, the housing **29** surrounding the shaft **28** is provided with an opening or drain **30** preventing liquid coolant from building up to too high a level within the housing and leaking out around the packing glands at the top of the vertical shaft.

As shown in FIGURE 3, the coil section of the condenser **9** may be split into two sections **41** and **42** in order to provide room down the middle of the condenser for gearing connected to the fan hub through an angle compensating connector for driving the condensate pump **25**.

An air vent **27** with a one-way valve **39** located in the condenser at the highest point of the well **23** remote from the condensing surfaces is provided in order to prevent pressure from building up within the cooling system to too high a degree and also to prevent air in the atmosphere from entering the system. In order to reduce to a minimum loss of coolant through the air vent **27** during the momentary rise in pressure in the cooling system due to the latent heat remaining in the system after the engine has been shut down there is provided a combination vacuum controlled spring plug by which the rubber valve **39** at the end of the air vent allows pressure to build up to one-half a pound of pressure when the engine is running and to two pounds of pressure when the engine is shut down.

The rubber valve **39** at the end of the air vent **27** is inserted between two members **31** and **33**, the bottom member **31** being stationary and the top member **33** being a plug connected to one side of a spring biased diaphragm **35**. On the other side of the diaphragm **35** there is a connection to the vacuum side of the engine manifold so that when the engine is operating the vacuum acts to draw the diaphragm **35** to relieve the pressure exerted against the rubber valve **39**, at which time the valve is set for a pressure of approximately one-half pound. When the engine stops and the vacuum is cut off the diaphragm is no longer drawn and the valve is set for a pressure of two pounds.

The compensating chamber **13** is located in front of the condenser **9** which takes the same position as does a radiator used in water cooled systems, the top of the compensating chamber **13** and the condenser **9** being no higher than the top of the radiator would be.

The outer surface of the chamber **13** is shaped like an airfoil to allow air to flow past it and up behind it when circulating about the coils in the condenser **9** insuring adequate condensation of the vapor.

A filler cap **65** is located on the side of the chamber **13** and is so positioned that no more than the recommended quantity of liquid coolant can be poured into the system. In conjunction with the filler cap **65** is a gasket **67** which insures against leakage of coolant past the cap.

While it is recommended that for year round use a permanent azeotropic coolant such as Dowtherm 209 be used in the system having a boiling point in the neighborhood of 209° and a low freezing point, other coolants such as water and the like may be used under suitable climatic conditions.

When the engine **1** is not running the liquid coolant in the compensating chamber **13** and the cylinder jacket of the engine **1** are at a common level indicated by the numeral A in FIGURE 1. When the engine starts, however, the liquid coolant is pumped up into and out of the cylinder jacket decreasing the liquid level in the compensating chamber **13** to a level indicated by the letter B.

By lowering the liquid level in the compensating chamber an upper level or section is formed in the compensating chamber providing head room for the separation of the liquid and vapor and room for expansion of the coolant without the necessity of positioning the compensating chamber **13** at a higher elevation than the engine.

While the elevation of the compensating chamber **13** is limited by the low silhouette hood of the automobile by providing a compensating chamber which is approximately 8 to 9 inches high, 7 or 8 inches from front to rear, and 36 inches across, there is ample head room provided to meet the needs of the largest automobile engines now in use.

The vertical barriers **15**, made of metal grids or nonwoven heat-stabilized fiber filters or the like, not only tend to break down the surges of vapor and liquid coolant delivered into the compensating chamber but also restrain the flow of liquid coolant from the far end of the compensating chamber **13** to the connecting conduit **17** so that there is in effect a substantially closed circuit with regard to liquid flow created connecting conduits **17** and **19**, the engine cylinder jacket and one end of the compensating chamber **13**, the liquid in the far end of the compensating chamber effectively providing a reservoir for the system and merely providing liquid to take the place of coolant removed from the circuit in vapor form. By effectively providing this closed circuit of circulating liquid coolant the system is able to furnish liquid coolant back into the cylinder jackets at or very close to its boiling point, thus, increasing the efficiency of the system.

In referring to the coolant as being a liquid it is recognized that there will often be a small amount of vapor which remains entrained in the liquid carried back to the cylinder jacket, however this vapor is negligible in comparison to the amount of vapor removed in the compensating chamber and actually is somewhat of an advantage in that it insures the liquid coolant entering the cylinder jacket is at its boiling point.

When starting up an engine equipped with my improved cooling system filled to the recommended level with liquid coolant, the pump **7** pumps the liquid coolant from the compensating chamber **13** through the connecting conduit **17** and into the cylinder jacket of the engine **1**, thus lowering the level of the liquid in the compensating chamber **13** and forming an upper section in the chamber for separating the liquid and vaporized coolant flowing out from the cylinder jacket of the engine **1** through the conduit **19**. While previous systems have utilized thermosyphoning for circulating the coolant through the cylinder block the pump **7** not only establishes the differential liquid coolant level between the compensating chamber **13** and the cylinder jacket of the engine **1** but also by increasing turbulence in the cylinder jacket breaks up the vapor pockets caused by ebullition and prevents the building up of super heated steam forming hot spots in the engine. Thus, there is maintained a thermal balance of all the cylinders in a multi-cylinder engine and a smooth runing engine is provided. The liquid coolant deposited to the compensating chamber **13** through the conduit **19** is immediately returned at a temperature at or near its boiling point to the engine. The vapor, while working its way through the barriers in the compensating chamber **13** to the condenser **9** deposits entrained liquid in the compensating chamber **13**, condenses in the condenser **9**, collects in the well **23** at the bottom of the condenser and is then pumped through conduit **26** to the far end of the compensating chamber **13** a reservoir of coolant for the system. While some previous systems claim to effectively syphon the condensate from the condenser, with an automobile engine which operates at various speeds it has been found that syphoning is very ineffective at low speeds. This is overcome in my system by providing an electric powered pump or a pump powered through conventional gearing from the fan hub for returning the condensate to the compensating chamber.

Vapor in the compensating chamber **13** is normally prevented from flowing down through conduit **26** to the bottom of the condenser **9** by the flow of condensate from the well **23** being pumped up by the pump **25** to the compensating chamber **13**. Whenever the condensate is

completely evacuated from the well 23, then air remaining in the system is pumped through the conduit 26 and accomplishes the same result. This air is then entrained with vapor passing over to the condenser through opening 21 and returns to the bottom of the condenser and collects as static air over the condensate in the well 23. When the engine and pump 25 are shut down condensate collects in the well 23 sealing off the conduit 26 and preventing vapor from descending down it.

Were it not for the valve 39 which I have provided at the air vent 27, pressure would build up in the system under heavy loads and emit through the air vent 27 not only static air collected in the well 23 of the condenser 9 but coolant as well. A similar momentary build-up of pressure and resultant loss of coolant would occur when the engine was shut down due to the latent heat remaining in the system. In order to prevent this loss of coolant the one-way valve 39 which will not permit atmospheric air to enter the system allows the pressure to build up to a predetermined amount before it opens. I have found that with the capacity for expansion present in this system allowing a pressure of a half pound is normally sufficient to insure against the loss of coolant caused by surges of pressure during operation of the engine. In order to prevent loss of coolant due to the momentary build-up of pressure from latent heat when the engine is shut down, the valve 39 is acted upon by a vacuum-controlled spring plug to withstand a greater build-up of pressure in the system. A pressure resistance of two pounds is normally sufficient to prevent loss of coolant due to this momentary surge.

With my present invention I thus provide an ebullient cooling system which may be readily adapted to the modern automobile without any change in present automobile design. The modern automobile even with its low silhouette hood can be converted from a water cooled system to an ebullient cooling system merely by removing the radiator and replacing it with my present invention, thus providing for more efficient engine operation and a resultant decrease in the smog now affecting our cities.

I also provide an ebullient cooling system in which there is no loss of coolant to the atmosphere and thus no longer the need for the motorist to be annoyed nor burdened by the expense of replenishing the coolant supply.

While I have shown the preferred method and means of practicing the present invention it is to be understood that various changes in the steps of the method and the parts of the apparatus may be made by those skilled in the art without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. An ebullient cooling system comprising in combination with an engine having a cooling jacket with a coolant circulating therethrough and inlet and outlet circulating conduits for said coolant, a compensating chamber connected to receive coolant from the outlet conduit including an upper level receptive of vapors released from the coolant entering the compensating chamber and a lower level in which collects the non-vaporized coolant connected to the inlet circulating conduit, means in said system for maintaining the operating level of said non-vaporized coolant in the chamber substantially below the level of the coolant in the cooling jacket of said engine and a condenser connected to said compensating chamber for condensing said vapor coolant.

2. An ebullient cooling system comprising the combination described in claim 1 wherein said means for maintaining the operating level of the non-vaporized coolant in said compensating chamber includes a pump connected to said inlet circulating conduit.

3. An ebullient cooling system comprising the combination described in claim 2 wherein the reception of the coolant from said outlet conduit and the non-vaporized coolant connection to said inlet circulating conduit are at one end of said chamber.

4. An ebullient cooling system comprising the combination described in claim 3 wherein said compensating chamber is horizontally elongated and has therein a multitude of vertically positioned barriers for breaking down the surges of vapor and liquid coolant and forming a reservoir of relatively static liquid coolant.

5. An ebullient cooling system which will fit under the low silhouette hood of the modern automobile comprising the combination with an engine having a cooling jacket with a coolant circulating therethrough, inlet and outlet circulating conduits with said coolant and a pump for circulating said coolant in conjunction with said inlet circulating conduit, of a compensating chamber located in front of said engine connected to receive coolant from the outlet conduit including an upper level receptive of vapors released from the coolant entering the compensating chamber and a lower level in which collects the non-vaporized coolant connected to the inlet circulating conduit, means for maintaining the operating level of the non-vaporized coolant at a level below the level of the coolant in the cooling jacket of said engine, a condenser for condensing said vapor coolant, a connection between said upper level of said compensating chamber and said condenser remote from the outlet circulating conduit of said engine for transmitting vapor coolant to said condenser for condensation, a well at the bottom of said condenser for collecting said condensate and means for returning said condensate to said compensating chamber.

6. An ebullient cooling system as defined in claim 5 wherein the means for returning said condensate to said compensating chamber includes a pump and a conduit connecting the well in the condenser to the interior of said chamber.

7. An ebullient cooling system as defined in claim 6 including a one-way air vent located near the bottom of said condenser for passing air therefrom having means to regulate the amount of pressure build-up in the system.

8. An ebullient cooling system as defined in claim 7 wherein said regulating means for said air vent is so designed as to allow a greater build-up of pressure in the system when said engine is shut down than when it is operating.

9. A method of cooling an internal combustion engine comprising circulating a vaporizable coolant in a sealed cooling system, filling the cooling jacket of the internal combustion engine from a compensating chamber thereby lowering the level of liquid coolant in said compensating chamber below the coolant level in the cooling jacket, transferring heat from said engine and vaporizing a portion of said coolant, separating the resultant vapor and liquid coolant in the portion of said chamber above the liquid coolant level, returning the separated liquid coolant back to the cylinder jacket of the engine and condensing the separated vapor coolant and returning it to said compensating chamber.

10. A method of cooling an internal combustion engine comprising circulating a vaporizable coolant in a sealed cooling system, filling the cooling jacket of the internal combustion engine from a compensating chamber thereby lowering the level of coolant in said compensating chamber below the level of coolant in said cooling jacket, transferring heat from said engine and vaporizing a portion of said coolant, pumping said vapor and liquid coolant out of said cylinder jacket, redirecting the flow of said vapor and liquid coolant down into said compensating chamber separating said vapor and liquid coolant in the portion of said compensating chamber above the liquid coolant level, returning the separated liquid coolant back to the cylinder jacket of the engine, condensing the separated vapor coolant, and pumping the condensate to said compensating chamber.

11. A method of cooling an internal combustion engine

comprising circulating a vaporizable coolant in a sealed cooling system, filling the cooling jacket of the internal combustion engine from a compensating chamber thereby lowering the level of coolant in said chamber below the level of coolant in the cooling jacket, transferring heat from said engine and vaporizing a portion of said coolant, separating the resultant vapor and liquid coolant in the portion of said chamber above the liquid coolant level, returning the separated liquid coolant back to the cylinder jacket of the engine, condensing the separated vapor coolant and returning it to said chamber.

12. A method of cooling an internal combustion engine as defined in claim 11 including the actuating of a valve to allow for the momentary build-up of pressure caused by latent heat remaining in the system when the system is shut down.

13. In an ebullient cooling system, an airfoil shaped horizontally elongated compensating chamber closed to the ambient atmosphere, including an outlet located at the bottom and at one end thereof, an inlet located near the top of said compensating chamber and at the same end as said outlet for directing liquid coolant down toward said outlet, a number of spaced barriers extending vertically from top to bottom in said chamber for providing an effective reservoir of liquid coolant in said chamber and breaking down surges of mixed vapor and liquid coolant entering said chamber, an opening located at the top of said chamber remote from said inlet and said outlet for passing vapor from said chamber to a condenser, and a conduit opening located near the top of said chamber remote from said inlet and said opening for passing vapor from said chamber to a condenser, said conduit opening returning condensate to said chamber.

14. In an ebullient cooling system, an airfoil shaped horizontally elongated compensating chamber as defined in claim 13 wherein said spaced barriers extending vertically from top to bottom in said chamber are made of non-woven heat-stabilized fiber.

15. In an ebullient cooling system, an air foil shaped horizontally elongated compensating chamber, including an outlet located at the bottom and at one end thereof, an inlet located near the top of said compensating chamber and at the same end as said outlet for directing liquid coolant down toward said outlet, a number of spaced barriers extending vertically from top to bottom in said chamber for providing an effective reservoir of liquid coolant in said chamber and breaking down surges of mixed vapor and liquid coolant entering said chamber, and an opening at the top of said chamber remote from said inlet and said outlet for passing vapor therethrough.

16. An ebullient cooling system comprising in combination with an engine having a cooling jacket with a coolant circulating therethrough and inlet and outlet circulating conduits for said coolant, a compensating chamber connected to receive coolant from the outlet conduit including an upper level receptive of vapors released from the coolant entering the chamber and a lower level in which collects the non-vaporized coolant connected to the inlet circulating conduit, a number of spaced barriers extending vertically from top to bottom in said chamber for providing an effective reservoir of liquid coolant and breaking down surges of mixed vapor and liquid coolant entering said chamber, a condenser, an opening located at the top of said chamber remote from said inlet and said outlet for passing vapor to said condenser, and means in said condenser for returning condensate to said chamber.

17. In an ebullient cooling system a combination with an internal combustion engine having a cooling jacket with a vaporizable coolant circulating therethrough and outlet and inlet circulating conduits, of a compensating chamber connected to said inlet and outlet conduits located in front of said engine, a condenser connected to said compensating chamber located between said engine and said compensating chamber, an air vent located near the bottom of said condenser, a one-way air valve located at the end of said air vent preventing atmospheric air from entering the system, and means associated with said valve allowing pressure to build up in the system to one predetermined amount while said engine is operating and a second predetermined amount of pressure when said engine is shut down insuring against loss of coolant in the system.

18. In an ebullient cooling system for an internal combustion engine, a condenser comprising a well at the bottom of said condenser for collecting condensate, a pump located in said well for removing condensate from said condenser, an air vent located at the top of said well, a one-way valve connected to the end of said air vent for preventing the admission of air from the atmosphere into the system and means associated with said valve for allowing one predetermined amount of pressure to build up in said system while the engine is operating and another predetermined amount of pressure to build up in the system when the engine is shut down insuring the prevention of coolant loss from the system.

19. In an ebullient cooling system a condenser as defined in claim 18 wherein said means associated with said valve for controlling the pressure in the system includes a vacuum-controlled spring plug which exerts pressure on said valve.

20. An ebullient cooling system comprising a combination with an engine having a cooling jacket with a coolant circulating therethrough and inlet and outlet circulating conduits for said coolant, of an airfoil shaped horizontally elongated compensating chamber located in front of said engine, said chamber connected to receive coolant from said outlet conduit and including an upper level receptive of vapors released from the coolant entering the compensating chamber and a lower level in which collects the non-vaporized coolant connected to the inlet circulating conduit, means connected in said system for maintaining the operating level of said non-vaporized coolant in the chamber substantially below the level of the coolant in said engine, and a condenser connected to said compensating chamber located between said chamber and said engine for receiving vapor from said chamber and returning condensate to said chamber, said compensating chamber positioned so as to form an air duct between it and upper coils of said condenser.

21. A method of increasing the efficiency of an internal combustion engine so as to reduce smog normally caused by the emission of hydrocarbons and blowby comprising circulating through the cooling jacket of an internal combustion engine a vaporizable liquid coolant maintained at a constant temperature coinciding with its boiling point, vaporizing a portion of said liquid coolant by transferring heat from said engine to said coolant, separating the resultant vapor and liquid coolant, and returning the separated liquid coolant at its boiling point back through the engine.

22. A method of increasing the efficiency of an internal combustion engine as defined in claim 21 wherein the constant maintained temperature of said vaporizable liquid coolant is between 200° and 215°.

23. A method of increasing the efficiency of an internal combustion engine as defined in claim 21 wherein said separated vapor coolant is condensed and transferred to an effective coolant reservoir.

24. In an ebullient cooling system for increasing the efficiency of an internal combustion engine a compensating chamber comprising an outlet located at the bottom and at one end thereof, inlet means located near the top of said compensating chamber and at the same end as said outlet utilizing the energy derived from the ebullition of the coolant to direct liquid directly down toward said outlet, and a number of spaced barrier means extending vertically from top to bottom in said chamber providing an effective direct passageway for the flow of liquid coolant from said inlet means to said outlet.

25. In an ebullient cooling system, a compensating chamber closed to the ambient atmosphere, including an outlet located at the bottom and at one end thereof, an inlet located near the top of said compensating chamber and at the same end as said outlet for directing liquid coolant down toward said outlet, a number of spaced barriers extending vertically from top to bottom in said chamber for providing an effective reservoir of liquid coolant in said chamber and breaking down surges of mixed vapor and liquid coolant entering said chamber, an opening located at the top of said chamber remote from said inlet and said outlet for passing vapor from said chamber to a condenser, and a conduit opening located in said chamber at a point remote from said inlet and said opening for passing vapor from said chamber to a condenser, said conduit opening returning condensate to said chamber.

26. In an ebullient cooling system, a compensating chamber, including an outlet located at the bottom and at one end thereof, an inlet located near the top of said compensating chamber and at the same end as said outlet for directing liquid coolant down toward said outlet, a number of spaced barriers extending vertically from top to bottom in said chamber for providing an effective reservoir of liquid coolant in said chamber and breaking down surges of mixed vapor and liquid coolant entering said chamber, and an opening at the top of said chamber remote from said inlet and said outlet for passing vapor therethrough.

27. An ebullient cooling system comprising an internal combustion engine having a cooling jacket with a vaporizable coolant circulating therethrough and outlet and inlet circulating conduits, a compensating chamber connected to said inlet and outlet conduits, a condenser connected to said compensating chamber, an air vent located near the bottom of said condenser, a one-way air valve located at the end of said air vent preventing atmospheric air from entering the system, and means associated with said valve allowing pressure to build up in the system to one predetermined amount while said engine is operating and a second predetermined amount of pressure when said engine is shut down insuring against loss of coolant in the system.

28. An ebullient cooling system as defined in claim 27 wherein said compensating chamber contains therein a multitude of vertically positioned barriers for breaking down the surges of vapor and liquid coolant and forming a reservoir of relatively static liquid coolant.

29. A method of increasing the efficiency of an internal combustion engine so as to reduce smog normally caused by the emission of hydrocarbons and blowby comprising circulating into the cooling jacket of the internal combustion engine a vaporizable liquid coolant having a temperature coinciding with its boiling point, circulating said coolant through the cylinder jacket of said internal combustion engine at a constant temperature, vaporizing a portion of said liquid coolant by transferring heat from said engine to said coolant, redirecting the flow of said vapor and liquid coolant down into a compensating chamber, separating said vapor and liquid, returning the separated liquid coolant back to the cylinder jacket of the engine, condensing the separated vapor coolant in a condenser, and pumping the condensate to said compensating chamber.

30. A method of increasing the efficiency of an internal combustion engine comprising circulating through the cooling jacket of an internal combustion engine a vaporizable liquid coolant maintained at a constant temperature coinciding with its boiling point, vaporizing a portion of said liquid coolant by transferring heat from said engine to said coolant, separating the greater portion of the resultant vapor from the liquid coolant and returning the separated liquid coolant at its boiling point back through the cooling jacket of said engine, a sufficient amount of vapor remaining entrained in the liquid coolant during its return to the cooling jacket of said engine so as to maintain the liquid coolant at its boiling point.

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