Dec. 15, 1925. 1,565,284

H. C. MALLORY

COOLING SYSTEM

Original Filed May 28, 1921

Fig. 1.

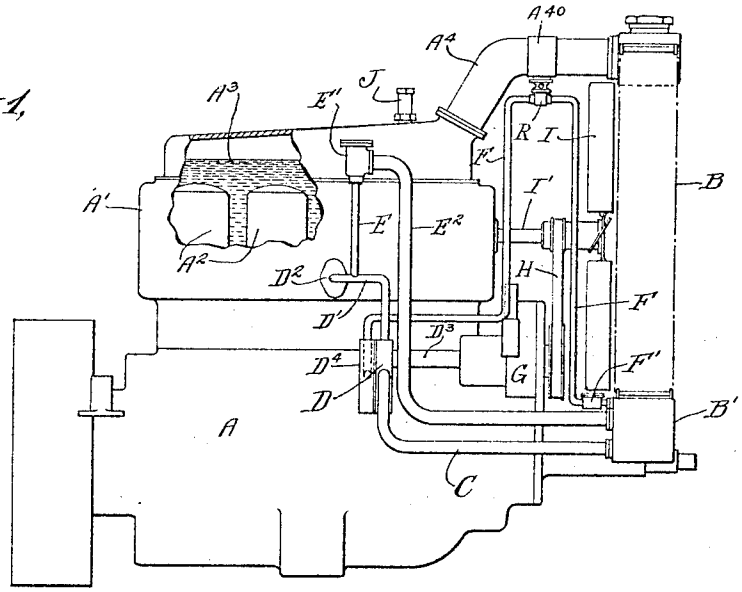



Fig. 2.

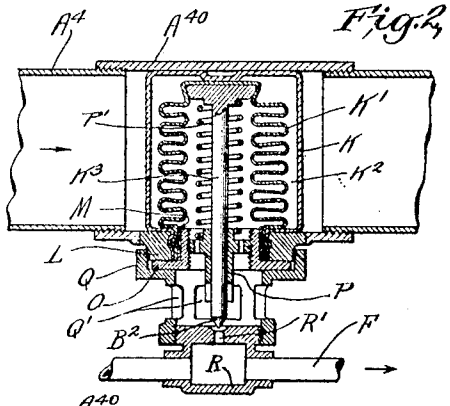



Fig. 3.

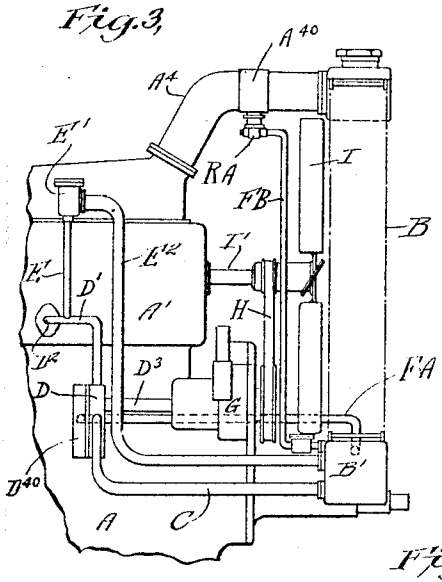
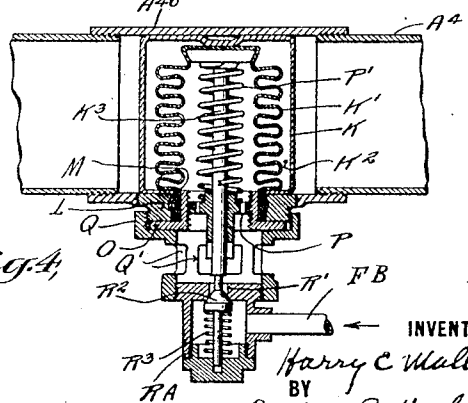



Fig. 4.




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Patented Dec. 15, 1925. 1,565,284

# UNITED STATES PATENT OFFICE.

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## COOLING SYSTEM.

Application filed May 28, 1921, Serial No. 473,439. Renewed April 17, 1925.

*To all whom it may concern:*

Be it known that I, HARRY C. MALLORY, citizen of the United States, and resident of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Cooling Systems, of which the following is a specification.

My present invention relates to that type of cooling system suitable for use in cooling the cylinder walls of an internal combustion engine in which a liquid containing cooling jacket is connected in a closed circulating system with a condenser which receives and condenses vapors formed by the evaporation of the cooling liquid in the jacket and from which liquid of condensation is returned to the jacket, and the general object of my invention is to provide improved means for regulating the capacity of the condenser as required to maintain a desired temperature of the liquid in the cooling jacket. The capacity of the condenser depends upon several factors which are more or less readily susceptible of adjustment; for example, it is usually feasible to vary the capacity of a condenser by varying the temperature or volume of the cooling fluid used or the amount of condenser surface swept by the cooling fluid, but in the practical use of my present invention I ordinarily prefer to adjust the condenser capacity by maintaining a regulable accumulation of air in the condensing space. This regulation I effect in accordance with the present invention by means of a thermostatic device which is responsive to the temperature in the cooling jacket and may conveniently be located in the vapor path leading from the cooling jacket to the condenser, and I utilize this device to actuate a valve directly controlling the accumulation of air in the condenser. Where, as is generally the case with internal combustion engines of present design, the temperature which it is desired to maintain in the cooling jacket is less than the temperature at which the water or other cooling liquid employed boils at atmospheric pressure, my thermostatic regulating device is employed to regulate the vacuum or minus pressure in the system. My improved regulating means is well adapted, however, for use under conditions where it is desirable to maintain the vapor pressure in the system above that of the atmosphere.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and its advantages, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is an elevation with parts broken away and in section of an internal combustion engine and cooling system;

Fig. 2 is a section of the thermostatically controlled valve mechanism employed in Fig. 1;

Fig. 3 is a partial elevation taken similarly to Fig. 1 of a modified form of cooling system; and

Fig. 4 is a view taken similarly to Fig. 2 illustrating the thermostatically controlled valve mechanism used in Fig. 3.

In the drawings, and referring first to the construction shown in Figs. 1 and 2, A represents an internal combustion engine of the type employed on automobiles having a cooling jacket A′ surrounding the engine cylinders $A^2$. This jacket is normally partially filled with a cooling liquid, and the vapor space above the liquid level $A^3$ in the upper portion of the jacket is connected by a vapor conduit $A^4$ to the top of a condenser B which, for automobile use, is advantageously air cooled, and may be similar in general construction and arrangement to the radiator employed in an ordinary water circulation engine cooling system employed on automobiles. Liquid of condensation formed in the condenser is returned to the jacket A′ by a return line C leading from the lower header B′ of the condenser to the inlet of a pump D having its outlet D′ connected to the jacket at $D^2$. E, E′ and $E^2$ represent an overflow return line to the header B′ by which the height of the water level in the jacket is normally maintained approximately constant at the level indicated by the line $A^3$. As shown the pump D which may be of the gear type or may be of any other suitable type, has its shaft $D^3$ driven from the main engine shaft through

the reduction gear and connected by the belt H to the engine driven shaft I' carrying the fan I for drawing air over the condenser.

The apparatus shown in Figs. 1 and 2 is intended for operation with a vacuum or minus pressure in the condenser, and for this purpose the circulating system must be connected to a suitable vacuum creating device for drawing air out of the system. The means shown for the apparatus comprises a conduit F running to a vacuum pump $D^4$ arranged alongside the water pump D and driven from the shaft $D^3$ through it will be understood that in lieu of connecting the conduit F to a special pump $D^4$ this conduit may in some cases, at least, be connected to the suction intake manifold of the engine 1. In addition to providing means for withdrawing air from the system it is also necessary to provide means for permitting air to enter the system when conditions require this. Conveniently as in the construction shown the means for admitting air to the system includes a regulating valve R located in the conduit F and comprising a casing having its interior connected to the atmosphere by a valve seated port R'. The flow through the port R' is controlled by a valve member $B^2$ actuated by a thermostatic device which includes a container K and an expansible bellows K' mounted in the container with a closed liquid and vapor containing space $K^2$ between them. As shown the container K and bellows K' are mechanically connected together at their lower ends and the joint between them sealed by compressing them in a known manner between a collar L and internal ring M. As shown the member L which is externally threaded is screwed into a threaded opening in a casing element $A^{10}$ forming a part of the vapor pipe $A^4$. The casing of the valve R is mechanically connected to the casing $A^{10}$ by a threaded coupling member Q and the latter also holds in place an annular internally threaded member O in which is screwed a part P which forms a guide for a rod or post $K^3$ having its upper end secured to the top of the bellows member K' and having the valve member $B^2$ formed on its lower end. The member P also forms an abutment or follower for the lower end of a spring P' acting against the upper end of the rod $K^3$ and tending to hold the latter in its elevated position. The tension of the spring P' may be adjusted by screwing the member P up and down in the member O. The member Q is formed with apertures Q' in its tubular body portion whereby free communication is provided between the atmosphere and the port R', and through which an adjustment of the spring abutment member P may be secured, though in general, factory rather than field adjustment of the member P is desirable. J represents a safety valve provided for limiting the maximum pressure possible in the cooling system.

In the contemplated mode of use of the apparatus shown in Figs. 1 and 2, the thermostatic device K is so designed and adjusted that when the temperature in the vapor conduit $A^4$ is less than the temperature intended to be maintained in normal operation, the bellows member K' will be expanded and the valve member $B^2$ will be lifted above its seat, thus permitting an influx of air into the valve casing R and thence into the condenser B. The air thus entering the condenser reduces the condensing capacity of the latter and thereby tends to increase the vapor temperature in the system to the desired value. When on the other hand the temperature in the vapor pipe $A^4$ exceeds that which it is desired to maintain, the consequent expansion of the fluid in the space $K^2$ compresses the bellows K' until the valve member $B^2$ closes the port R' whereupon the air is rapidly sucked out of the condenser and the capacity of the latter increases until the temperature in the system is reduced to the desired value. In ordinary practice, during periods in which the engine load is not fluctuating, the valve member $B^2$ will be cracked and admit just enough air to prevent the vacuum pump from withdrawing any air from the system except such air as may leak into the latter, as through joints in the piping. When the temperature to which the thermostatic device is subjected increases or decreases the valve $B^2$ will close or open more widely and thereby vary the condensing capacity as required to restore the desired temperature in the system. With the arrangement specified the temperature of the vapor to which the thermostatic device is subjected is the same as that of the liquid in the cooling jacket and the thermostatic valve mechanism operates to maintain the cooling liquid constantly at the desired temperature for which the apparatus is designed.

While in general, at least with internal combustion engines as at present designed, it is desirable to maintain a temperature of the cooling liquid which corresponds to a vapor pressure in the cooling system less than that of the atmosphere, it is, or may be, desirable under some conditions to operate with a pressure in the system above that of the atmosphere and in Figs. 3 and 4 I have illustrated a modification for this purpose. The essential difference between the apparatus shown in Figs. 1 and 2 arises in the fact that the pump $D^{10}$ replacing the pump $D^2$ of the construction first described is a compressor, instead of an exhauster, which delivers compressed air to the condenser through the conduit FA and is adapted to maintain a delivery pressure in excess of the maximum normally required in the vapor

system. The valve RA in this construction is adapted to open and permit the escape of air from the system through a separate conduit FB when the temperature in the system rises above the desired value, and to close and prevent the escape of air when the pressure in the system is less than that which it is desired to maintain. The thermostatic device employed in Figs. 3 and 4 may be identical with that employed in Figs. 1 and 2, though it should be adjusted to operate at the higher range of temperatures, but the valve member RA is provided with an internal valve member $R^2$ which is acted on by a spring $R^4$ tending to hold the valve member $R^2$ in the position in which it closes the port R'. The thermostatic valve actuator $K^3$ engages the valve member $R^2$ and depresses the latter, thus opening the port R' when the temperature in the conduit $A^4$ rises above the desired value and the bellows K' collapses, and the bellows expands and permits the valve member $R^2$ to seat and close the port R' when the temperature in the conduit $A^4$ falls below the predetermined value.

It will be apparent of course that if the valve RA were placed in the conduit FA and the conduit FB dispensed with the operation of the apparatus of Figs. 3 and 4 would not be altered, and that if the valve R of Figs. 1 and 2 were taken out of the conduit F and connected to the condenser by a separate conduit no real operative change would result.

The present invention is an improvement on the cooling system disclosed and claimed in my Patent No. 1,424,664, granted August 1, 1922, wherein the provisions specifically disclosed for admitting air to and withdrawing it from the cooling system operate in direct response to the pressure in the cooling system. The provisions disclosed but not claimed herein for regulating the height of water level in the liquid cooling jacket are claimed in my earlier application, No. 290,257, filed April 15, 1919.

Features of construction and arrangement employed in the thermostatic valve mechanism disclosed but not claimed herein, are claimed in an application filed November 13, 1925, Ser. No. 68830, as a division of this application.

While in accordance with the provisions of the statutes I have illustrated and described the best form of my present invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of my invention without departing from the spirit of my invention as set forth in the appended claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

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

1. In an engine cooling system comprising an engine cooling space and a condenser connected to said space, and adapted to condense vapors formed by the absorption of heat by a cooling liquid contained in said space, the improvement which consists in means for adjusting the capacity of said condenser as required to maintain said liquid at an approximately constant temperature, comprising a thermostatic device responsive to the cooling liquid temperature.

2. In an engine cooling system comprising an engine cooling space and a condenser connected to said space, and adapted to condense vapors formed by the absorption of heat by a cooling liquid contained in said space, the improvement which consists in a thermostatic device responsive to the cooling liquid temperature for regulating the accumulation of air in said condenser as required to maintain said liquid at an approximately constant temperature.

3. In an engine cooling system comprising an engine cooling space and a condenser connected to said space, and adapted to condense vapors formed by the absorption of heat by a cooling liquid contained in said space, the improvement which consists in means comprising a source of air under a pressure exceeding that of the atmosphere connected to said system and an air outlet from said system for regulating the capacity of the condenser.

4. In an engine cooling system comprising an engine cooling space and a condenser connected to said space, and adapted to condense vapors formed by the absorption of heat by a cooling liquid contained in said space, the improvement which consists in means comprising an outlet from a source of air under a pressure exceeding that of the atmosphere to said system and an air outlet from said system and means responsive to the temperature of the cooling liquid for regulating the flow through one of said outlets.

5. In an engine cooling system comprising an engine cooling space and a condenser connected to said space, and adapted to condense vapors formed by the absorption of heat by a cooling liquid contained in said space, the improvement which consists in means for automatically adjusting the capacity of the condenser as required to maintain a substantially constant pressure therein exceeding that of the atmosphere with varying rates of vapor generation in said receptacle.

Signed at New York, in the county of New York and State of New York, this 27th day of May A. D. 1921.

HARRY C. MALLORY.