May 22, 1923. 1,456,072

S. A. MOSS

COOLING SYSTEM FOR INTERNAL COMBUSTION ENGINES OR THE LIKE

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Fig. 1.

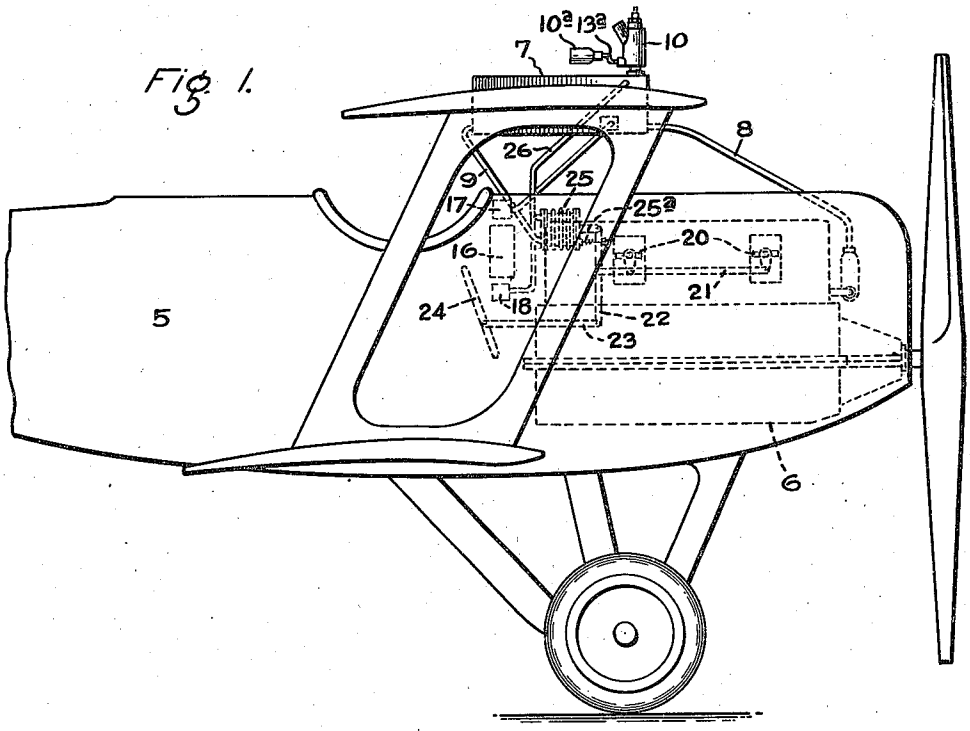
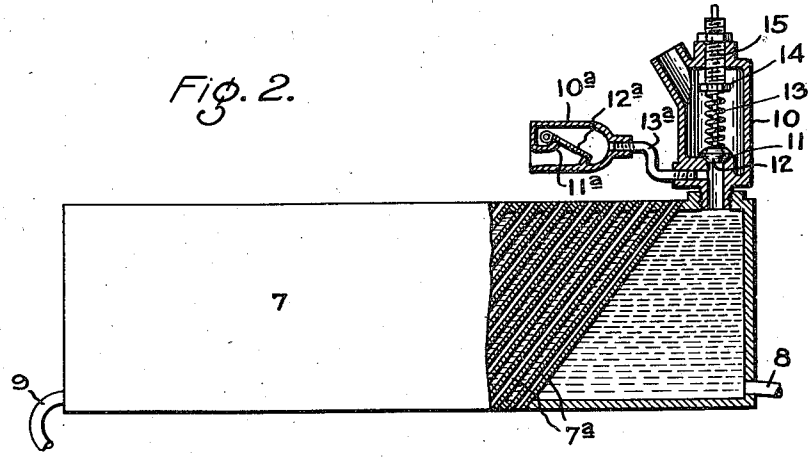


Fig. 2.



Inventor,
Sanford A. Moss.
by Albert G. Davis
His Attorney.

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UNITED STATES PATENT OFFICE.

SANFORD A. MOSS, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

COOLING SYSTEM FOR INTERNAL-COMBUSTION ENGINES OR THE LIKE.

Application filed October 15, 1920. Serial No. 417,179.

To all whom it may concern:

Be it known that I, SANFORD A. Moss, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Cooling Systems for Internal-Combustion Engines or the like, of which the following is a specification.

The present application is a continuation in part of my application, Serial No. 301,105, filed May 31, 1919.

The present invention relates to radiators for gasolene engines or the like and more particularly to radiators which are subjected to varying outside pressures as is met with for example in connection with the radiators of aeroplanes which operate at various altitudes. As is well known, the boiling temperature of a liquid depends on the pressure, and at high altitudes where the atmospheric pressure is low, the cooling liquid (usually water) in the radiator of an aeroplane motor may easily reach a temperature where it will boil and soon exhaust itself.

On the other hand, if a hermetically sealed radiator is used the difference in pressure between the inside and outside may become so great at high altitudes as to cause the radiator to burst and in any event, would be a continuous source of danger.

The object of the present invention is to provide an improved structure and arrangement which will overcome the above difficulty and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, Fig. 1 is an outline of a part of an aeroplane equipped with a radiator embodying my invention, and Fig. 2 is a detail partly in section of the radiator.

Referring to the drawing, 5 indicates an aeroplane, 6 its engine, and 7 the radiator which is connected to the cooling jackets of the engine by pipes 8 and 9. The radiator may be of any suitable structure and has cooling tubes 7^a through which air passes to cool the liquid in the radiator.

Now, according to my invention, I form the cooling system so it is entirely closed to the outside atmosphere and so construct the radiator and other parts that their walls will withstand a certain desired difference in pressure between the inside and outside thereof. I then provide in the system, for example, in connection with the radiator, a suitable outwardly opening relief valve which will open to relieve the pressure in the system in case the difference in pressure between the inside and outside of the system approaches too closely the pressure which the system is designed to withstand.

In addition to and in combination with the outwardly opening relief valve, I provide also an inwardly opening check valve adapted to admit air to the radiator when the pressure on the outside of the radiator exceeds that on the inside.

The two valves above referred to may be built into a common valve structure or they may be separate valves as found desirable. In the present instance, I have shown a relief valve comprising a casing 10 attached to the top of radiator 7 and provided with a seat 11 upon which seats a valve 12. Surrounding the stem of valve 12 is a suitable spring 13 for biasing the valve toward closed position. One end of spring 13 rests on valve 12 and the other end engages an adjustable abutment 14, having a portion 15 in threaded engagement with casing 10. By adjusting abutment 14 the tension of spring 13 may be made such that valve 12 will open when the pressure inside the radiator exceeds that on the outside by a predetermined amount.

Connected with the radiator, for example, with casing 10 at a point below valve 12 is an inwardly opening valve comprising a casing 10^a having a seat 11^a against which rests a non-return valve 12^a. Valve 12^a is shown as being a simple form of clapper valve biased by its weight to closed position. Valve casing 10^a is connected to and supported on casing 10 by a short pipe 13^a.

When my improved arrangement is used in connection with an aeroplane it will be clear that as the aeroplane rises in the air, the pressure on the outside of the radiator, i. e., the atmospheric pressure, decreases. However, the pressure in the radiator will be maintained the same until the difference in pressure is reached at which the relief valve is set to open. This, of course, is at a pressure lower than that considered safe for the weakest part of the cooling system. The relief valve will then open and permit the pressure within the cooling system to lower

to a safe value when it will automatically close again. By this means a safe pressure difference between the inside and outside of the system will be maintained always. At the same time, however, the highest safe pressure will be maintained in the system so as to keep the boiling temperature of the cooling liquid as high as possible thus maintaining a higher temperature at which the engine may operate which adds to its power and efficiency.

In the case of an aeroplane, there is always provided an altimeter for indicating the aeroplane altitude, such an instrument being indicated at 16, and according to my invention, it may be provided, in addition to the regular scale, with an additional scale indicating corresponding values of safe temperatures of cooling water. These temperatures would be boiling temperatures corresponding to the altitudes, plus an amount corresponding to the pressure differences for which the relief valve is set. In connection with the radiator is a thermometer 17, for example, a thermometer of the vapor-pressure type, for indicating the temperature of the cooling water and a pressure gauge 18. By observing these instruments the aviator can regulate the power of his engine in any well known or suitable manner so as to keep the actual temperature of the cooling water within the safe temperature indicated by the scale on the altimeter.

When the aeroplane is operating at high altitudes more or less of the water may be boiled out of the radiator through the relief valve 12. As a result when the radiator cools as for example by shutting off the engine more or less or by the machine approaching the ground the pressure on the outside of the radiator has a tendency to become greater than that on the inside. This is overcome, however, by the inwardly opening valve 12ª which under such circumstances opens to admit air to the radiator. By this means the pressure inside the radiator cannot decrease lower than that upon the outside so that the boiling temperature of the water in the radiator will always equal at least that which corresponds to the surrounding atmospheric pressure.

As will be clear, if a valve such as valve 12ª were not provided there is a likelihood that the pressure within the radiator might become sufficiently low to cause the radiator to collapse upon the aeroplane approaching the ground after having flown to a high altitude.

If desired, I may provide in connection with the radiator a suitable means which will automatically regulate or cut down the power of the engine in case the difference in pressure between the inside and the outside of the radiator reaches an unsafe value and I have indicated such an arrangement diagrammatically in Fig. 1. Associated with the engine are suitable regulating throttle valves 20 which are connected by a rod 21 to the central portion of a floating lever 22. One end of floating lever 22 is connected by a link 23 to a hand lever 24. The other end of floating lever 22 is pivotally connected to a sealed diaphragm chamber 25 of suitable structure which is subjected on its inside to the pressure in the radiator through a pressure pipe 26. Diaphragm chamber 25 is thus subjected on its inside to the radiator pressure and on its outside to the surrounding atmospheric pressure, and hence will be expanded and collapsed in accordance with the difference between such pressures. As is obvious hand lever 24 may be operated in the ordinary manner to regulate the setting of valves 20, floating lever 22 at such times pivoting on its pivotal connection with diaphragm chamber 35. Diaphragm chamber 25 will be so adjusted that for safe differences in pressure between the inside and outside of the radiator it will not be affected. This may be accomplished in any suitable manner as by means of an adjustable spring as indicated at 25ª. In case such pressure differences become so great as to be unsafe, however, then the diaphragm chamber will be expanded thus moving valves 20 toward closed position to cut down the power of the engine.

In accordance with the provisions of the Patent Statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with an aeroplane having an internal combustion engine, and a hermetically sealed liquid cooling system therefor comprising a radiator through which cooling liquid circulates and conduits connecting the radiator to the engine, of means for preventing the occurrence of abnormal operating conditions in the radiator due to high altitudes comprising valve means associated with the system and adapted to open outwardly whenever the altitude atmospheric pressure falls below the pressure in the radiator by more than a predetermined amount, and to open inwardly to prevent the formation at any altitude of a vacuum in the radiator.

2. The combination with an aeroplane having an internal combustion engine, a hermetically sealed liquid cooling system therefor comprising a radiator through which cooling liquid circulates and conduits connecting the radiator to the engine, of means for preventing the occurrence of abnormal

operating conditions in the radiator due to high altitudes comprising an outwardly opening valve biased to closed position and adapted to open whenever the altitude atmospheric pressure falls below the pressure in the radiator by more than a predetermined amount, and an inwardly opening valve which opens to admit air to the radiator to prevent the formation at any altitude of a vacuum in the radiator.

3. The combination with an internal combustion engine having a closed cooling system, of means for automatically diminishing the power of the engine when the pressure on the outside of the cooling system reaches a value a predetermined amount lower than that on the inside.

4. The combination with an internal combustion engine having a cooling jacket, of a radiator connected to the jacket to form a closed liquid cooling system, an automatic pressure relief valve connected to said system, and means for automatically diminishing the power of the engine in case the difference in pressure between the inside and outside of the radiator passes beyond a predetermined value.

5. The combination with an internal combustion engine having a cooling jacket, of a radiator connected thereto to form an entirely closed circulating system, means for indicating to the aviator the operative condition of the liquid in the cooling system whereby he can regulate his engine in accordance therewith, and automatic means for diminishing the power of the engine in case the difference in pressure between the inside and the outside of the radiator becomes greater than a prdetermined amount.

6. The combination with an internal combustion engine having a cooling jacket, of a radiator connected thereto to form an entirely closed circulating system, means for indicating to the aviator the operative condition of the liquid in the cooling system whereby he can regulate his engine in accordance therewith, and automatic means controlled by the difference in pressure between the inside and outside of the radiator for diminishing the power of the engine when such pressure difference reaches a predetermined amount.

In witness whereof, I have hereunto set my hand this 13th day of October, 1920.

SANFORD A. MOSS.