April 12, 1938. H. A. RABATEL 2,114,238

COOLING SYSTEM

Filed April 18, 1936

Fig. 1.

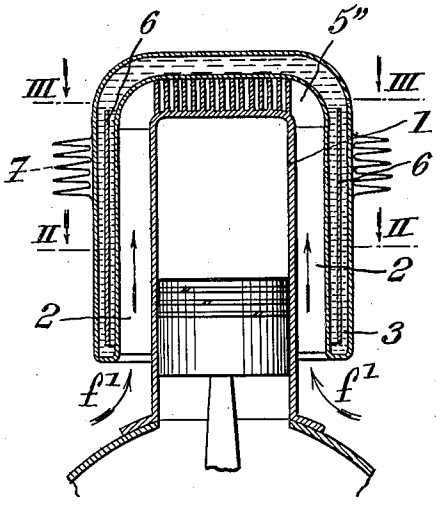


Fig. 2.

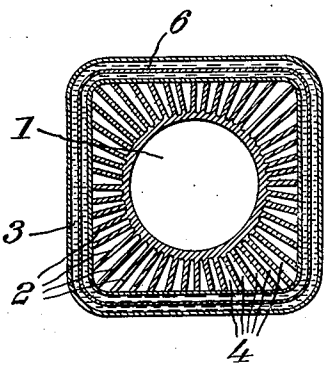


Fig. 3.

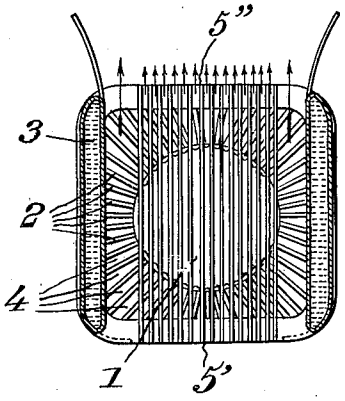
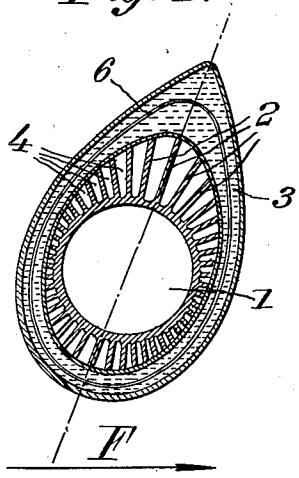


Fig. 4.



INVENTOR:
HENRI AUGUSTIN RABATEL
ATTORNEYS:

Bailey & Parsons

Patented Apr. 12, 1938 2,114,238

UNITED STATES PATENT OFFICE

2,114,238

COOLING SYSTEM

Henri Augustin Rabatel, Paris, France

Application April 18, 1936, Serial No. 75,172
In Belgium April 29, 1935

15 Claims. (Cl. 123—173)

The present invention relates to engines which are to be provided with cooling means and it is more especially, although not exclusively, concerned with engines of this kind in which the walls to be cooled have regions at different temperatures, which is the case with internal combustion engines the cylinders of which are at a higher temperature at the top (cylinder head) than at the base.

The object of the present invention is to provide an engine of the kind above referred to with cooling means which are better adapted to meet the requirements of practice.

The essential feature of the present invention consists in combining means for cooling certain portions of the engine, said means consisting of radiating elements, such as cooling fins or ribs, with a device for equalizing the temperatures of said radiating elements at different points of said walls, such a device consisting advantageously of a jacket or envelope through which a fluid such as a liquid is caused to flow.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawing, given merely by way of example, and in which:

Fig. 1 is a vertical axial sectional view of a cylinder of a star-shaped internal combustion engine according to the present invention;

Fig. 2 is a sectional view on the line II—II of Fig. 1;

Fig. 3 is a sectional view on the line III—III of Fig. 1;

Fig. 4 shows a modification of Figs. 1 and 2 in horizontal section.

The invention will now be specifically described as applied to the cylinder 1 of an internal combustion engine of the radial type.

The whole of the engine, with the exception of the cooling means is devised in any conventional or other suitable manner.

The external wall of cylinder 1 is provided with radiating means 2 projecting from said external wall.

The ends of at least some of these radiating elements are connected together through means capable of equalizing, at least to a certain degree, the temperatures of said radiating elements at various points of the walls of the cylinder. Advantageously this result is obtained by providing an enveloping jacket adapted to be filled with a liquid, for instance glyco-ethyl. There is thus left, between cylinder 1 and jacket 3, a free space through which it is possible to produce a circulation of air flowing along the surface of the radiating elements, this space communicating with inlet and outlet orifices, preferably provided at the ends of the cylinder, respectively.

Advantageously, these radiating elements consist of fins which are designed to distribute the heat radiating from cylinder 1 over their entire surface, and to transmit the heat of the hotter portion of the cylinder, that is, of the cylinder head, to those parts of the fins adjacent the cooler portion of the cylinder, that is, near its base. For instance the radiating fins in question are disposed along radial planes of the cylinder, the cylinder head being itself provided with cooling fins disposed in any suitable manner, for instance parallel to one another and to the axis of the cylinder.

It will be readily understood that, with such an arrangement, radiating elements 2 separate the space existing between cylinder 1 and jacket 3 into a plurality of channels 4, preferably fluid-tight, and parallel to the generatrices of the cylinder. The cooling air will thus be able to flow through these channels parallel to the axis of the cylinder, advantageously entering said channels on the side corresponding to the base of the cylinder.

If the air circulation takes place in the direction above indicated, that is to say in the direction of arrows f^1 (Fig. 1), it is clear that the fresh air first flows along the radiating elements carried by the base of the cylinder. Inasmuch as these radiating elements transmit or distribute the heat of the upper portion of the cylinder also toward the cooler base portion thereof adjacent the channel openings, the cooling effect of the radiating elements is considerable.

In any case, I provide means for ensuring the circulation of air between cylinder 1 and jacket 3. This circulation may be produced either by the head wind of the machine carrying the internal combustion engine, or through a fan, blower or the equivalent.

Concerning now the radiating elements, they may be constructed in any suitable manner.

For instance they are cast integral either with cylinder 1 or with jacket 3, or the whole of cylinder 1, jacket 3, and elements 2 may be made as a single unit.

The elements may also be made separately and assembled in any suitable manner, for instance by encasing the ends of the radiating ele-

ments in said cylinder and said jacket during the moulding operation.

Said radiating elements may differ in height corresponding to the different parts of the cylinder, for instance their dimensions may be increased or reduced according to the available space, or some of them may be eliminated entirely.

Finally, each cylinder of the engine is preferably provided with an individual jacket 3, and the radiating elements or fins 2 and the enclosing jackets 3 may be constructed of such size and shape that the various jackets together form an envelope which surrounds as fully as possible the whole of the radiating elements.

Each element or jacket 3 of the envelope therefore constitutes a kind of hood surrounding the upper part of the cylinder, apertures 5', 5'' being however provided at the level of the cylinder head so as to permit an air stream to flow through said envelope, transversely to the cylinder axis, and to cool the radiating elements carried by the cylinder head.

Envelope 3 shall for instance be given a rectangular section as shown by Fig. 2 or a streamlined section as shown by Fig. 4, the axis of which is in the general direction of the air stream flowing around the cylinder, that is to say slightly inclined with respect to the fore and aft axis of the airplane in the case of an engine the cylinders of which are partly disposed in direct contact with the atmosphere, so as to take into account the rotary movement of the air behind the propeller, which is supposed to turn in the direction of arrow F.

Although the circulation of the liquid present in jacket 3 can be ensured in many different ways, it is preferable to provide means whereby the hot liquid coming from the region around the cylinder head flows down to the level of the radiating elements carried by the lower part of the cylinder, is cooled through contact therewith, thus giving off its heat to said lower parts (which heat is subsequently reduced by the cooling air entering channels 4 at the level of the lower part of the cylinder) and then flows upwardly so as to be again heated by the radiating elements carried by the upper part of the cylinder.

In order to obtain such a circulation, I may make use of a pump, or, more simply, and as it will be supposed hereinafter, take advantage of a thermo-siphon effect, by providing baffles 6 suitably arranged for compelling the liquid to flow along the desired circuit.

Finally, I may, if so desired, ensure the cooling of the liquid present in jacket 3 by causing it to flow through a radiator, or again, when this is made possible by the conditions of use of the engine, by providing the outer face of jacket 3 with cooling fins 7.

An engine provided with a cooling system such as above described works in the following manner:

The circulation of the liquid in the envelope has the following effects:

On the one hand it equalizes the temperature of the radiating elements and in particular it lowers the temperature of the parts located at the lower part of the cylinders at the expense of those located close to the cylinder heads, whereby the stream of air circulating between said radiating elements exerts a very efficient cooling action by absorbing heat even from the radiating elements located below the lowest point uncovered by the piston.

On the other hand the liquid circulation improves the general cooling of the engine, due to the fact that the absorption of heat takes place through the radiator or through fins 7.

Anyway, these cooling means have the following chief advantages:

They make it possible to increase the radiating surface of a cylinder the external surface of which is given and they permit the provision of a suitable system of cooling fins extending as far as the base of the cylinder and all the parts of which have an efficient cooling action although parts of the corresponding wall of the cylinder are never uncovered by the piston at the end of its downward stroke;

The cooling system according to the invention makes it also possible to increase the height or length of the radiating elements without increasing their thickness since they are heated from both sides, that is from the cylinder wall 1 and the jacket 3, near the base of the cylinder through the heat transmission of their own body and of jacket 3. An undue cooling of the base portion of the cylinder as compared with the cooling of the cylinder head is hereby avoided;

The cooling system permits an increase of the mean temperature of the system of fins with respect to the usual arrangement, owing to the fact that it equalizes the temperatures of the radiating elements;

The cooling system maintains the liquid at a moderate temperature without lowering the temperature of the system of fins, whereby certain liquids (ethyl-glycol for instance) can be kept below their flash point;

It enables the engine to work with a reduced power in case of breakdown of the liquid circulation, cooling being then ensured in a sufficient manner by the action of air on the system of fins;

The cooling system further makes it possible to reduce the thickness of the cylinder head and of the lateral walls of the cylinder owing to the mechanical reinforcement ensured by the system of fins and jacket 3, which produces a reduction of the weight of the engine and of the difference of temperature between the inner and outer walls, this effect being especially important in the case of engines having cylinders of large bore and of high rates of compression, and more specifically, in the case of injection engines;

Finally, the cooling system according to the invention permits the elimination, either wholly or partly, of the oil radiator owing to the fact that the fins at the bottom part of the cylinder efficiently cool the lubricating oil.

Of course, instead of making use of fins for connecting the outer wall of the cylinder with the inner wall of jacket 3, I might employ any other radiating elements, such for instance as rods of a section of several square millimeters, preferably not in line in the direction of the air stream that flows along them.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. A cooling system for an internal combustion engine having at least one cylinder, comprising a plurality of channels extending along the outer surface of said cylinder parallel to the axis thereof, said channels having openings for passing cooling air therethrough, a jacket enclosing said channels, and a liquid in said jacket, said channels being in heat exchange relation with said outer surface and said jacket.

2. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins secured to the outer surface of said cylinder, a jacket surrounding said fins, a liquid in said jacket, said surface, said fins and the inner wall of said jacket forming a plurality of channels for the passage of cooling air therethrough.

3. A cooling system according to claim 2, said fins extending parallel to the axis of said cylinder.

4. A cooling system according to claim 1 further including means for cooling the outer wall of said jacket.

5. A cooling system according to claim 1, further including cooling fins secured to the outer surface of said jacket for cooling said liquid.

6. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins radially extending from and secured to the outer wall of said cylinder, a jacket surrounding said fins, a liquid in said jacket, said wall, said fins and the inner wall of said jacket forming a plurality of channels, said channels having inlet openings near the bottom and outlet openings near the head of said cylinder, for passing cooling air therethrough.

7. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins secured to the outer surface of said cylinder, a hood-like jacket surrounding said fins, a liquid in said jacket, said outer surface, said fins and the inner wall of said jacket forming a plurality of channels extending along the lateral side of said cylinder and parallel to the axis thereof, and a plurality of channels extending transverse to said axis along the cylinder head, said channels having openings at the opposite ends for the passage of cooling air therethrough.

8. A cooling system according to claim 2 further including means for cooling the outer wall of said jacket.

9. A cooling system according to claim 2 further including cooling fins secured to the outer surface of said jacket for cooling said liquid.

10. A cooling system for an internal combustion engine having at least one cylinder arranged to work in an air stream at right angles to the axis of said cylinder, which comprises, in combination, a plurality of cooling fins parallel to the axis of said cylinder carried by the lateral walls thereof, a plurality of cooling fins parallel to the direction of the air stream carried by the cylinder head, and a jacket disposed around said cylinder in contact with said cooling fins, a liquid in said jacket, and means for causing said liquid to circulate through said jacket in such manner as to equalize the temperatures of all the points of said fins.

11. A cooling system according to claim 10 in which said jacket forms a hood surrounding said cylinder, the part of said hood of the level at the cylinder head being provided with at least one aperture through which the air stream can flow along the cooling fins carried by the cylinder head.

12. A cooling system for an internal combustion engine having at least one cylinder, comprising a plurality of channels extending along the outer surface of said cylinder parallel to the axis thereof, said channels having openings for passing cooling air therethrough, a jacket enclosing said channels, and a liquid having a high boiling point in said jacket, said channels being in heat exchange relation with said outer surface and said jacket.

13. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins secured to the outer surface of said cylinder, a jacket surrounding said fins, a liquid having a high boiling point in said jacket, said surface, said fins and the inner wall of said jacket forming a plurality of channels for the passage of cooling air therethrough.

14. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins radially extending from and secured to the outer wall of said cylinder, a jacket surrounding said fins, a liquid having a high boiling point in said jacket, said wall, said fins and the inner wall of said jacket forming a plurality of channels, said channels having inlet openings near the bottom and outlet openings near the head of said cylinder, for passing cooling air therethrough.

15. A cooling system for an internal combustion engine having at least one cylinder, comprising cooling fins secured to the outer surface of said cylinder, a hood-like jacket surrounding said fins, a liquid having a high boiling point in said jacket, said outer surface, said fins and the inner wall of said jacket forming a plurality of channels extending along the lateral side of said cylinder and parallel to the axis thereof, and a plurality of channels extending transverse to said axis along the cylinder head, said channels having openings at the opposite ends for the passage of cooling air therethrough.

HENRI AUGUSTIN RABATEL.