July 18, 1939. E. WAEBER 2,166,331

APPARATUS FOR COOLING FUEL-VALVES FOR INTERNAL COMBUSTION ENGINES

Filed Jan. 15, 1937

Fig. 1.

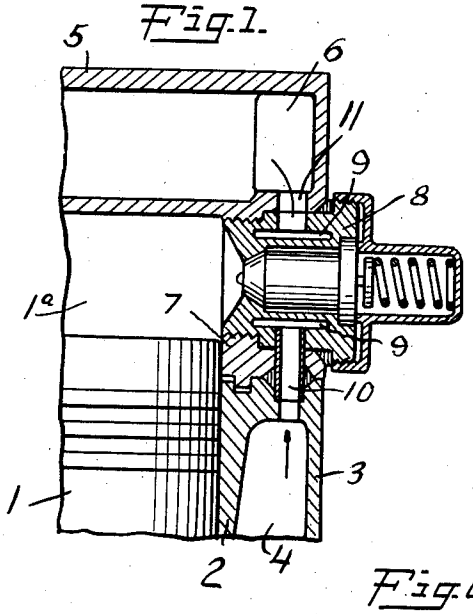


Fig. 3.

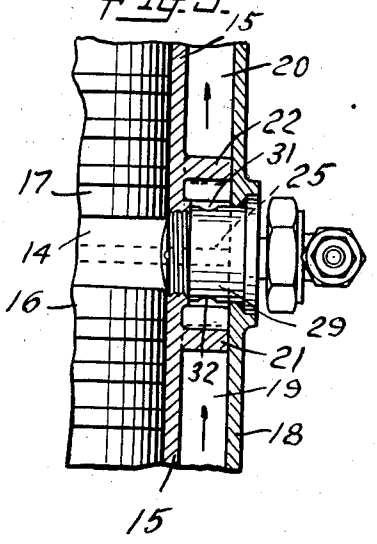


Fig. 2.

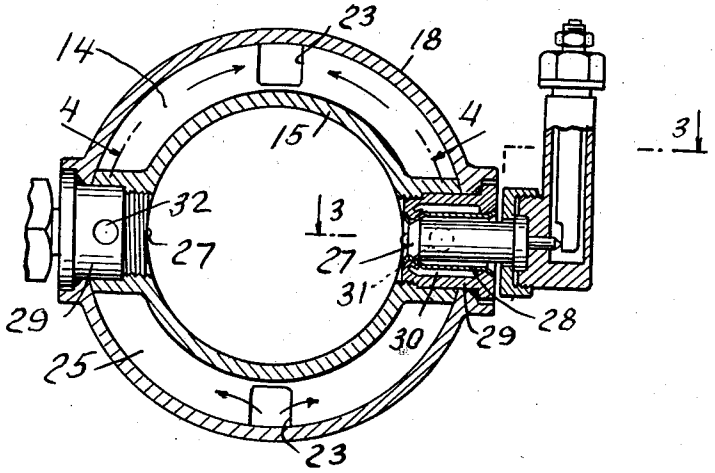
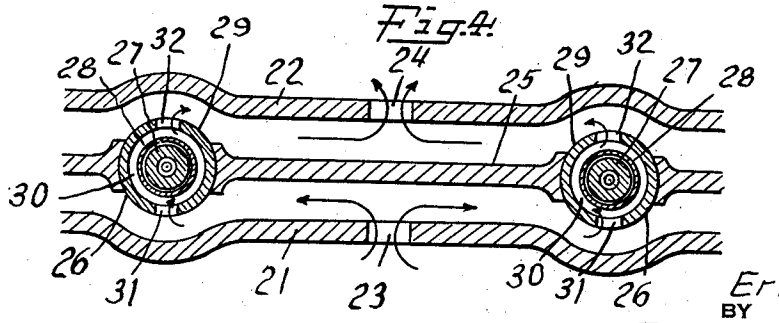


Fig. 4.



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Patented July 18, 1939 2,166,331

UNITED STATES PATENT OFFICE

2,166,331

APPARATUS FOR COOLING FUEL-VALVES FOR INTERNAL COMBUSTION ENGINES

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Application January 15, 1937, Serial No. 120,667
In Switzerland July 27, 1936

6 Claims. (Cl. 123—177)

This invention relates to internal combustion engines of the type in which fuel is injected into the engine cylinder by means of a fuel-valve and has for its object the provision of means for cooling the fuel-valve. It is an object of the invention to provide means for circulating the cooling medium used in cooling the engine cylinders in contact with the fuel-valve.

The apparatus of the invention comprises a cylinder liner and a cylinder jacket which form a cylinder-cooling space for the circulation of a cylinder cooling medium, one or more fuel-valves projecting through the liner and the jacket, adapted to inject fuel into the cylinder and a duct or passageway in contact with the fuel-valve for the circulation of the cooling medium therethrough. It is a particular object of the invention to provide partition means in association with the liner and jacket for controlling the passage of the cooling medium from the cylinder-cooling space through the duct or passageway. In engines having a cylinder head, the cooling medium is passed from the cylinder-cooling space through the fuel-valve duct and then into a space or chamber for cooling the cylinder head. In engines of the opposed-piston type, the cylinder-cooling space is divided by suitable walls adjacent the fuel-valves, and the cooling medium is forced to pass from one side of the walls to the other through the duct or passageway in contact with the fuel-valve.

The invention will be better understood from the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 is a fragmentary view, with parts shown in section, of one form of apparatus in accordance with the invention;

Fig. 2 is a cross-sectional view of a working cylinder illustrating another form of apparatus in accordance with the invention;

Fig. 3 is a view, partly in section, taken along the line 3—3 of Fig. 2, and

Fig. 4 is a development of a section taken substantially along line 4—4 of Fig. 3.

That modification of apparatus in accordance with the invention illustrated in Fig. 1, is especially adapted to internal combustion engines having a cooled cylinder head. The apparatus comprises a piston 1, a cylinder 1a, a cylinder liner 2, a jacket 3, and a cylinder-cooling space 4 for the circulation of a cylinder cooling medium, for example, water. The cylinder head 5 has a chamber 6 therein for the circulation of a cooling medium and is mounted upon the cylinder in any suitable manner. The under portion of the cylinder head preferably comprises a base 7 which serves as a partition or wall separating the cooling space of the cylinder 1a from the chamber in the cylinder head.

The fuel-valve 8 of the injection type is appropriately mounted adjacent the union of the cylinder head and liner, and comprises a surrounding duct or passageway 9, which communicates with passageway 10 leading into the cylinder-cooling space 4 and with a passageway 11 leading into the chamber 6 in the cylinder head 5. The apparatus illustrated in Fig. 1 is so constructed and arranged that the cooling medium cannot be passed from the cylinder-cooling space 4 to the cylinder head chamber 6 without passing through the duct 9. In other words the only passageway for the flow of the liquid-cooling medium from space 4 to the chamber 6 is as indicated by the arrows, through passageways 10, 9 and 11.

The apparatus illustrated in Figs. 2, 3 and 4 comprises a cylinder 14, a cylinder liner 15 and opposed-pistons 16 and 17 which are preferably arranged in a horizontal position and, as shown, are in their dead center positions. A cylinder jacket 18 is mounted in spaced relation to the liner 15 thereby forming cylinder-cooling spaces 19 and 20 which are separated from each other by the transverse walls 21 and 22. The transverse walls 21 and 22 have openings 23 and 24, respectively (Figs. 2 and 4), for the passage of the cooling medium. An intermediate transverse wall 25 is located equi-distant from the piston ends and has two diametrically opposite openings 26. In an especially advantageous construction, each fuel-valve 27 has a rolled sleeve 28 mounted thereover and a valve-jacket 29 fitted over the sleeve. The jacket has a surrounding recess which is walled off from the fuel-valve by the sleeve, thereby forming a surrounding duct or passageway 30 for the circulation of a cooling medium to cool the valve. The assembly of elements comprising the fuel-valves 27, the sleeve 28 and the jacket 29 is inserted through suitable openings in the cylinder wall and jacket and closely fitted into the openings 26. Valve-jacket 29 has diametrically opposite openings 31 and 32 therein which open a communicating pasageway from the cylinder-cooling space 19 through the duct 30 and into the cylinder-cooling space 20. In this construction of apparatus the cooling medium flows as indicated by the arrows from the cylinder-cooling space 19 through the opening 23, between walls 21 and 25, through opening 31, around the fuel-valve in the duct 30, out the opening 32, into the space between walls 22 and

25, through the opening 24 and into the cylinder-cooling space 20. The apparatus is so constructed that all of the cooling medium supplied to the cylinder-cooling spaces must flow through the ducts surrounding the fuel-valves. It is to be understood that the foregoing description of one valve applies to each fuel-valve since they are each constructed in the same way and function similarly.

The engine constructed in accordance with this invention may be provided with any suitable pump means (not shown) for circulating the cooling medium or thermo-syphonic action may be employed for this purpose.

The apparatus of the invention enables the fuel-valve cooling to be controlled in a very simple manner by controlling the cylinder cooling. Apparatus in accordance with the invention is especially advantageous in multi-cylinder engines of the opposed-piston type in which the fuel-valve must be arranged in the middle of the cylinder jackets, in the plane of the cylinder axis, that is, at the narrowest place between the working cylinders.

I claim:

1. Internal combustion engine apparatus comprising a cylinder liner, a cylinder jacket, said liner and jacket being mounted in spaced relation thereby forming a cylinder-cooling space for a cooling medium, an injection fuel-valve operatively associated therewith, a duct for the circulation therein of a cooling medium embracing the exterior part of the valve, a cylinder head having a chamber therein for the circulation of a cooling medium and means for passing the cooling medium from the cylinder-cooling space through the duct and into the chamber.

2. Internal combustion engine apparatus comprising two opposed-pistons in a cylinder, a cylinder liner, a cylinder jacket, a plurality of transverse walls between the liner and jacket dividing the space between the liner and jacket into two separate cylinder-cooling spaces one adjacent each of the pistons, a fuel valve mounted in an opening in the liner and jacket and between the walls, said valve having a duct in its exterior portion, and means for passing a cooling medium from one of the cylinder-cooling spaces through the duct and into the other cooling space.

3. A combination with an internal combustion engine of the fuel injection type comprising a cylinder, a cylinder liner, a cylinder jacket, at least two cooling spaces in heat exchanging contact with the cylinder, a wall in engagement with the liner and the jacket separating the two cooling spaces, a fuel valve adapted to inject fuel into the engine inserted through the liner and adjacent the two cooling spaces, said valve being provided with a duct in its exterior portion in which a cooling medium may be circulated, and conduit means for passing the cooling medium from one cooling space through the duct to the other cooling space.

4. In internal combustion engine apparatus having a cylinder, at least two cooling spaces in heat-exchange contact with the cylinder and an injection fuel-valve located at approximately the junction point of said spaces, and having a duct in the exterior portion of said fuel-valve for the circulation of a cooling medium, a passageway connecting said duct with each of said cooling spaces respectively for passing all of the cooling medium from one space through the duct to the other space.

5. An internal combustion engine of the opposed-piston type comprising a cylinder liner, a jacket mounted in spaced relation over the liner, wall means between the liner and the jacket dividing the space between the liner and the jacket into two cylinder-cooling spaces, a fuel-valve projecting through the liner at approximately the junction point of said cooling spaces and midway between the dead-end positions of the pistons, said fuel-valve having a duct in its exterior wall, and a passageway connecting each cooling-space with the duct, whereby the cooling medium for cooling the liner may be circulated from one cooling-space to the other through the duct.

6. Apparatus according to claim 5 in which the wall means comprises two walls spaced apart, each wall having at least one hole therein, and an intermediate wall between the said two walls, said intermediate wall having an opening therein in which the fuel-valve is mounted.

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