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COMPRESSION IGNITION INTERNAL COMBUSTION ENGINE

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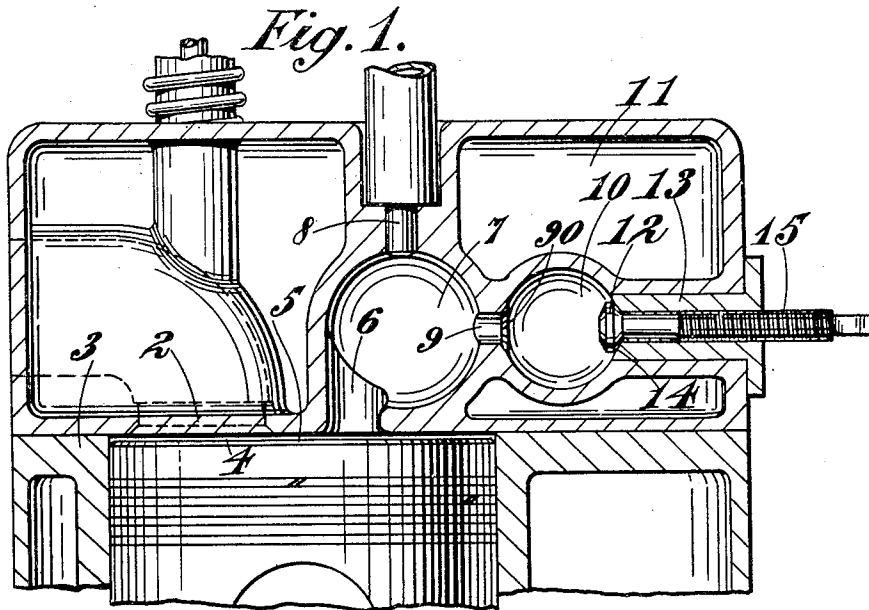
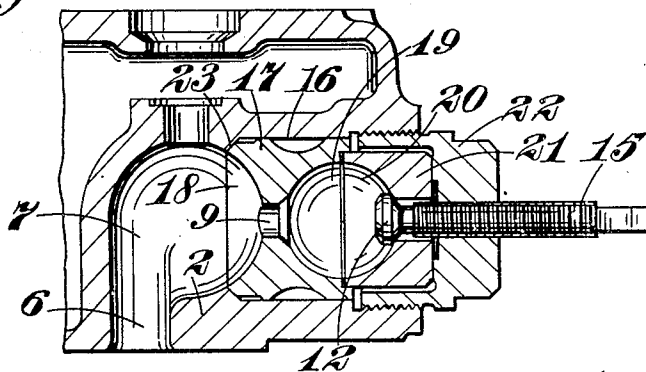
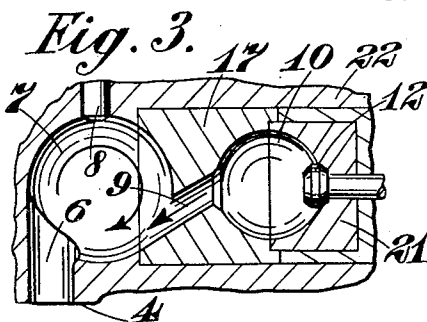
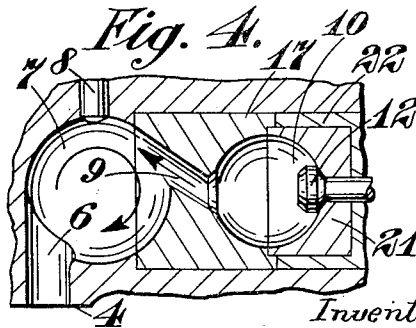


Fig. 2.



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COMPRESSION-IGNITION INTERNAL-COMBUSTION ENGINE

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This invention relates to compression ignition internal-combustion engines, and it has for its chief object to provide an engine with an operative clearance volume of such shape that turbulence and mixing of the fuel spray with the air will be improved, so that very complete combustion of the fuel will be obtained.

A further object of the invention is to provide improved means whereby an operative clearance volume suitable for normal running may be reduced in size, in a known manner, so as to increase the compression pressure and hence ensure compression ignition when the engine is cold.

A further object is to arrange for the clearance volume or the shape thereof to be altered without the cylinder head being removed.

According to this invention, the operative clearance volume is wholly within the cylinder head and comprises first and second compression chambers, and relatively narrow passages connecting the first chamber with the cylinder and with the second chamber.

In the accompanying drawings,

Figure 1 is a central vertical section of part of an internal combustion engine cylinder constructed in accordance with this invention.

Figure 2 is a similar view of a part of a modified construction, and

Figures 3 and 4 are diagrams, in plan, showing other modifications.

Like numerals indicate like parts throughout the drawings.

In the construction illustrated in Figure 1, the cylinder head 2 is attached to the cylinder barrel 3 leaving only sufficient clearance at 4 between it and the piston head 5 for mechanical reasons. In the flat face of the cylinder head are arranged (but not shown) the air inlet and the exhaust valves as usual, and in the face is also formed a small port or passage 6 of a bore which may be of about the diameter of the air valve port. This passage leads tangentially into a relatively large spherical chamber 7, hereinafter termed the "first compression chamber". This chamber is water-jacketed and in one wall, preferably that most remote from the

cylinder, is arranged a fuel valve 8, whereby fuel under pressure can be discharged into the chamber 7 in the form of a spray. In another face of the first compression chamber is formed a second relatively small port 9 which communicates with another compression chamber 10, hereinafter referred to as the "second compression chamber", and this also is preferably spherical and is water-jacketed. The joint volume of the chambers 7 and 10 and the passages 6 and 9 therefore constitutes the entire operative clearance volume, which is wholly within the cylinder head. The cylinder head jacket is shown at 11.

A valve 12 is provided whereby the port 9 between the two chambers can be closed. For example, at a point opposite the communicating port 9 between the two chambers there may be arranged in the wall of the second chamber a sleeve 13 terminating at the chamber end with a conical valve seating 14. Screwing through this sleeve is a stem 15 carrying the valve 12 which is coned on both faces. The back face is adapted to co-operate with the seating 14 on the sleeve when the stem is screwed fully outwards in order to prevent any leakage past the stem, as is shown in Figure 1. When the stem is screwed fully inwards across the chamber 10, the conical outer face of the valve engages a seating 16 in the mouth of the port 9 between the two chambers, thus closing the connection between them.

The joint volume of the chambers and the passages 6 and 9 is such as to ensure satisfactory compression ignition when the engine is warm without involving unduly high running pressures. Such a clearance volume is, however, insufficient to ensure sufficient temperature for compression ignition when the engine is cold, but this is overcome by closing the communicating port 9 between the two chambers. This isolates the second compression chamber 10 and reduces the operative clearance volume, so that the compression ratio is then very much higher. The size of the second chamber is so determined that this higher compression ratio will ensure compression ignition when the engine is cold

without the use of a cartridge or other similar aid to ignition.

If desired, the second compression chamber may be formed in a body which is separate from the cylinder head so that by removing this body secondary compression chambers of different sizes can be easily fitted and the compression space of the engine varied.

In the arrangement shown in Figure 2, the cylinder head is bored out at 16 radially to the first chamber 7 and of a diameter about that of that chamber. Into this is fitted the body 17 which is recessed at 18 on its outer face, the recess forming part of the first chamber 7 and having in it the communicating port 9. The body is also recessed at 19 on the other face, so as to form part of the second compression chamber, the other part of which is formed at 20 in a recessed plug 21 which is clamped against the body 17 by a cap 22 which screws into the end of the bore 16 and bears against the back face of the plug 21, pressing it against the body 17 and the body against a coned seating 23 at the end of the bore.

The valve stem 15 screws through the cap and passes freely through the plug 21.

Thus, by removing the cap 22, the plug and body can be easily withdrawn and others with recesses 19 and 20 of different sizes can then easily be fitted. In this way the compression ratio can easily be altered without removal of the cylinder head.

It is not essential that the chambers should be spherical, but preferably the first chamber 7 is of circular section, and the passage 6 between it and the cylinder is tangential thereto so that, on the compression stroke, the air revolves rapidly in the first chamber.

The communicating passage 9 between the two chambers is preferably tangential to the first chamber and its direction may be such that the flow from the second chamber into the first either is in the direction of, or is opposite to, the rotary flow of the air in the first compression chamber, as is shown in the diagrams 3 and 4.

In Figures 1 and 2 the passage 9 is shown as being radial to the first chamber.

By means of the tangential arrangement of the passage 6 with regard to the first compression chamber the air is caused to whirl therein during fuel injection, thus ensuring good combustion, this turbulence being enhanced or modified according to the direction adopted for the passage 9.

An important feature of the invention is that the size of the passage 9 is so determined as to provide the requisite turbulence for normal running, when both chambers are in use.

It is well-known that for a given rate and setting of fuel injection, the maximum pressure in the cylinder is proportional to the

compression pressure and also to the degree of turbulence provided.

Thus when the second chamber 10 is isolated for starting, the compression pressure is higher than when both chambers are in use, but the turbulence is so much reduced that the maximum pressure developed is little greater than the normal running pressure, and if, for any reason, the passage 9 is left closed, no ill-effects can result.

The invention, therefore, provides an engine wherein the operative clearance volume is of a shape adapted to promote turbulence and improved mixing of the fuel spray and air, having improved means whereby this clearance volume may be reduced for starting from cold, and also means whereby the size and shape of the clearance volume may be altered without removal of the cylinder head.

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

1. In an internal-combustion engine, a cylinder, a cylinder head having a water jacket and an interior flat surface, and a piston operable in said cylinder with a minimum of clearance between the piston and said flat surface, said cylinder head having therein spaced cavities lying within the water jacket for receiving an operative clearance volume and with one cavity opening directly into the cylinder and having a narrow passage extending between and intercommunicating the cavities.

2. A cylinder head for internal-combustion engines adapted to receive an operative clearance volume wholly within the head, comprising a head body having a pair of chambers therein with a constricted passage between the chambers and a second passage extending from one of the chambers through the cylinder closure wall of the head, and valve means within the head for controlling intercommunication through the passage between the chambers.

3. A cylinder head for internal-combustion engines, comprising a body portion having a cylinder closure wall and provided within the body portion with two separate chambers and a restricted passage between the chambers, the body portion also having a restricted passage leading at a tangent from one of said chambers and opening through said cylinder closure wall, said other chamber and passage therefrom being disposed on an axis at an angle to the axis of the cylinder.

4. A cylinder head for internal-combustion engines, having two separate and spaced apart spherical clearance volume chambers therein and having a passage between the chambers of a width less than the radius of the chambers and having a second passage leading from one of the chambers through the cylinder closure wall of the head, both of said

passages being disposed substantially tangentially to their respective chambers.

5. A cylinder head for internal-combustion engines, having two separate and spaced apart spherical clearance volume chambers therein and having a passage disposed diagonally between the chambers and opening at opposite ends substantially at a tangent into the respective chambers, the head also having a second passage leading at a tangent from one of said chambers and at an acute angle to the first passage and from the remote side of the chamber from said first passage outwardly through the cylinder closure wall of the head.

6. A head for internal-combustion engines, having a cavity therein open at one side and having a restricted passage leading from the cavity through the cylinder closure wall of the head, and a removable portion mounted in the head closing the open side of said cavity and having a second cavity therein and a restricted passage leading from the second cavity into the first cavity.

7. A head for internal-combustion engines, having a cavity therein open at one side and having a restricted passage leading from the cavity through the cylinder closure wall of the head, and a removable portion mounted in the head and comprising a pair of inter-fitting parts, one of said parts having a depression therein corresponding in curvature to said cavity and said part adapted to close the open side of said cavity, said part also having a depression therein providing a portion of a second cavity and having a restricted passage leading from the depressed portion to the first cavity, said second part of the removable portion having a depression therein providing a portion of the second cavity to provide the second cavity between said parts, and a removable cap mounted upon the head for holding said parts together and in position for closing said first cavity.

8. A head for internal-combustion engines, having a cavity therein with a restricted passage leading from the cavity through the cylinder closure wall of the head and with one side of the cavity open, a removable portion mounted in the head and closing said open side of the cavity and having a second cavity therein with a restricted passage leading between the cavities, and a valve carried by said removable portion and operable through the outer end of the same for controlling inter-communication between the cavities through said restricted passage in the removable portion.

In testimony whereof I affix my signature.
ARTHUR FREEMAN SANDERS.