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COMBUSTION CHAMBER

Filed Aug. 30, 1928

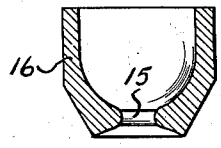


FIG. 2

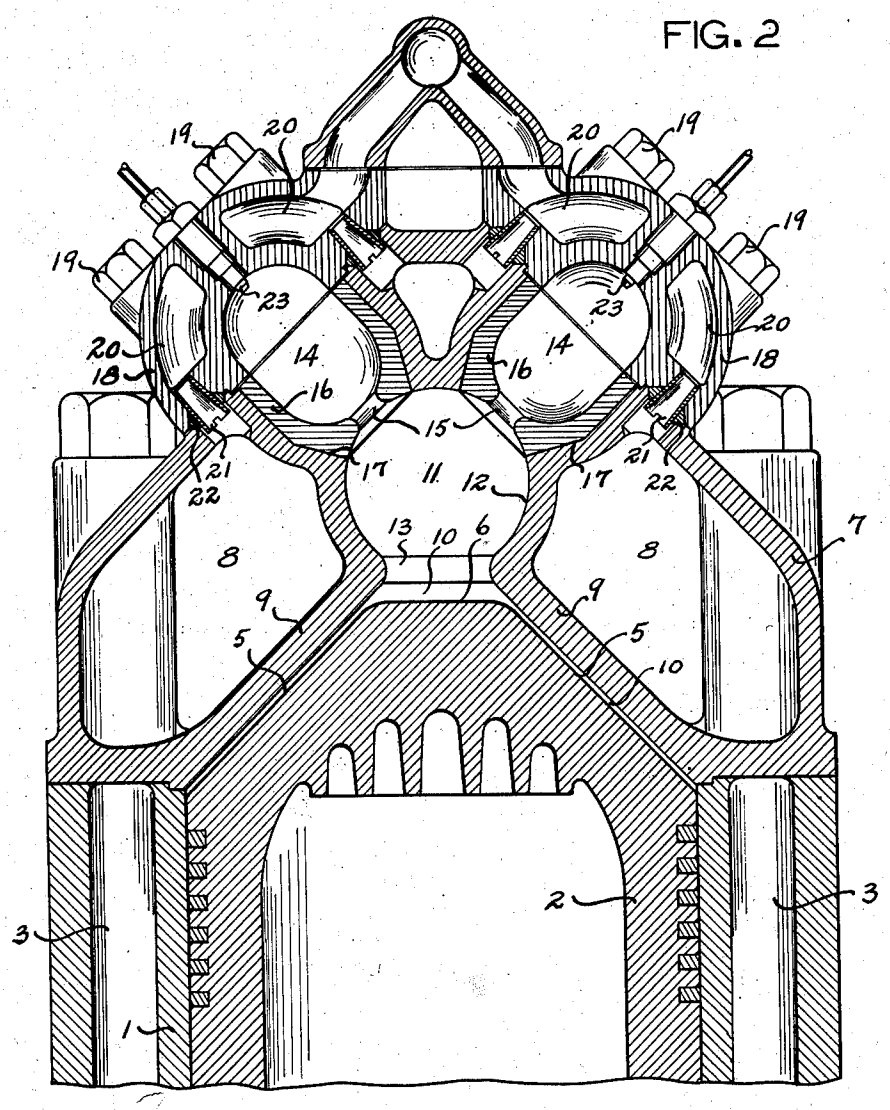


FIG. 1

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COMBUSTION CHAMBER

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This invention relates to improvements in combustion chambers and especially to an improved construction and arrangement of preliminary and main combustion chambers in internal combustion engines of the solid injection type.

An object of this invention is to construct and dispose a plurality of precombustion chambers about the main combustion space or clearance, in such a manner as to provide a cleaner burning mixture, free from residual deposits of unburned fuel.

Another object is so to construct and dispose the precombustion chambers in relation to a main combustion chamber, that the delivery of the fuel from these precombustion chambers will create a region of greater heat concentration in the main chamber remote from the piston top, thereby eliminating the well known tendency toward burning of the piston top.

Further objects include an improved shape of precombustion chamber; an improved construction of cooling jacket around the chambers and piston; novel features of construction to effect desirable relative volumes and locations of the several chambers with regard to the proper delivery of fuel and the necessary volumes of combining air; and an improved arrangement and construction of passages between the several chambers and the clearance space.

Further objects and advantages will appear from the following detailed description of the parts and the accompanying drawing, in which Fig. 1 is a sectional elevation along a vertical center line of an internal combustion engine to which a preferred form of my invention is applied; Fig. 2 is a sectional elevation of a preferred form of replaceable liner used in the precombustion chambers.

It will, of course, be understood that the present disclosure relates to a single executional embodiment of the invention, and that substantial variations in the arrangement and construction of the several parts may be made without departing from the spirit and full scope of this invention, as defined by the claims.

Referring by numerals to the drawing, the cylinder 1, of any suitable type, is provided with a corresponding form of piston 2. A water jacket 3 provides cooling means for the piston, cylinder and related parts. As seen from Fig. 1, the piston 2 may be formed with an outer or upper end of frusto-conical form, the sides 5 of which terminate in a flat portion 6 to form a piston top. The slope of the sides 5 of the piston is, in the present example, about 45 degrees, although any slope may be utilized which will present a relative large surface to the cooling jacket formed in the cylinder head 7. It will be seen that the cylinder head is provided with a relatively large water-jacket 8, and that the inner wall 9, of the head, conforms to the slope of the sides 5 of the piston, being in close contact therewith, except for a necessary mechanical clearance 10 therebetween. This arrangement provides an effective cooling surface for the main combustion space or clearance, and greatly reduces the troublesome burning of piston tops.

Centrally located within the cylinder head, and directly above the piston top 6, is a combustion chamber 11 which is preferably defined by a spherical wall 12, and around which a part of the water-jacket of the head is disposed. Although other forms of chamber may function satisfactorily, the preferred form shown has the advantage of creating a region of high temperature at the center of the sphere, which is situated farthest from the cooling effect of the jackets. A short, restricted passage 13 provides means for travel of the burning fuel from the chamber 11 into the clearance 10, and the interior of the cylinder. The passage 13 is related to the sphere in cross sectional area so as to provide a proper exit velocity, and burning of the fuel, as it proceeds therethrough.

Preferably, two precombustion chambers 14 are formed within the head and in communication with the main chamber 11 by restricted passages 15. Each of the precombustion chambers 14 is provided with a replaceable wall-portion or liner 16, which fits into a recess 17 in the head 8, and with a cap member 18, serves to enclose the chambers. Each of the chambers 14 is, in the preferred

construction, of the general shape of an oblate spheroid. The cap member 18 is adapted to be secured to the cylinder head by means of bolts 19 or the like.

The precombustion chambers 14 are disposed at an angle to each other in the head, the preferred angular relation therebetween being approximately 90 degrees, and by preference the center lines, or axes, of the chambers 14 intersect at or near the center of the spherical chamber 11. This arrangement assures a delivery from each passage 15, directly to the center of the sphere. A region of higher temperature is maintained adjacent the passage 15, due to the fact that this point is situated further from the cooling effect of the head jacket 7, and further because the cooling must take place by convection through a double thickness of metal, viz., the wall and the liner. The cap member is maintained relatively cool by a water-jacket 20 formed therein, which is connected to the head packet 7 by replaceable tube members 21 around which are inserted gaskets 22 to prevent leakage of compression and combustion pressure, and water. The fuel is adapted to be sprayed, preferably simultaneously, into each precombustion chamber by means of separate injection nozzles 23, situated in the cap members 18. Each fuel nozzle is preferably disposed coaxially with one of the chambers 14.

I prefer to construct the various chambers and main combustion space of substantially the relative volumes shown, as this arrangement has been found to provide for clean uniform burning, without objectionable deposits of solids, and without burning the piston face. In the example described, the total volumes of the two precombustion chambers 14 is approximately 70 per cent of the volume of the main combustion clearance 10, added to that in the spherical chamber 11. The relative volumes and shape of the chambers may be altered by the insertion of a replaceable liner of greater or less thickness, as may be found necessary with different fuels, different operating speeds, etc.

It will, of course, be understood that the example described is but a single preferred embodiment of the present invention, and that alterations in the construction, location and angular arrangement of the precombustion chambers, may be made without departing from the spirit and full intendment of the invention.

In operation, the oil is sprayed, simultaneously, into each of the precombustion chambers 14, during the upward stroke of the piston or at a point in the stroke corresponding to the greatest compression. During this time the compressed air will have circulated thoroughly through the several chambers. The oil entering the precombustion chambers 14 is ignited in a hot zone existing in each chamber, due to the air therein having been compressed to ignition temperature. In consequence of the fact that the air contained in the chambers 14 is not sufficient for the complete combustion of the fuel, the ignition produces only a partial combustion, which nevertheless, causes a sudden increase in pressure and expulsion of the unignited fuel portion into the chamber 11 without giving the fuel an opportunity to precipitate upon the walls of the chambers 14, 11, etc. Upon being impelled through the restricted passages 15, the fuel is more completely broken up.

The unignited fuel, along with the ignited part thereof, is impelled by its own pressure, from the passages 15, directly into the center of the chamber 11 which, by the arrangement and angular relation of the chambers 14, is the meeting point of the two passages. The separate streams of fuel from each chamber 14 impinge upon each other at this meeting point in the chamber 11, where the unignited fuel encounters a region of great heat concentration, as above described, and all the fuel becomes ignited. In consequence of the fact that a relatively larger volume of air is present in this chamber, a further rise in pressure drives the burning fuel through the passage 13 into the clearance space, wherein the remainder of the fuel is burned to completion.

The preferred arrangement of the precombustion chambers 14 and 15 is such as to provide an improved flow and concentration of the fuel delivered into the combustion chamber 11. A better mixture and control of the fuel is obtainable in the smaller precombustion chambers than would be possible in a single larger chamber. The described location and disposition of the chambers assures an intersection of the paths of the fuel streams delivered therefrom, in the chamber 11, with a resulting mutual impinging effect, and thus eliminates the splash or wall wetting action, which often occurs where only a single injector and precombustion chamber is used.

Obviously, separate grades of fuel may be injected at the same or different times through nozzles 23, so as to effect combustion of a variety of fuel mixtures, with or without altering the relative volumes of the precombustion chambers within narrow limits, by means of the described replaceable liners. I prefer, however, when a single uniform grade of fuel is used, to supply fuel simultaneously to each of the injection nozzles, and to maintain the precombustion chamber volumes substantially equal.

I claim as my invention:

1. In an internal combustion engine, a cylinder, a piston and means therewith forming a combustion space including a main clearance adjacent the piston, and a plurality of chambers in communication with the clearance, one of said chambers constituting

an expansion space adapted to receive and combine the fuel charges from a plurality of other of said chambers, and having an opening for delivery of such fuel charges to the main clearance.

2. In an internal combustion engine, a cylinder including means forming a main combustion clearance, means for receiving and initially firing separate charges of fuel and a chamber distinct from said clearance, coacting with said last means to combine the separate fuel charges, said chamber provided with a discharge passage into said clearance, adapted for delivery thereto, of the combined fuel charges.

3. In an internal combustion engine, a cylinder, means for independently injecting and means for receiving and initially firing separate charges of fuel, means forming a chamber adapted to combine the separate charges of fuel, and a passage adapted to deliver the combined fuel charges from the chamber to the cylinder.

4. In an internal combustion engine, a piston, a cylinder, means forming a combustion clearance, and means therewith forming a plurality of communicating combustion chambers, each distinct from said clearance, a pair of said chambers being of substantially equal volume, and another of said chambers arranged to combine the fuel charges from said paired chambers.

5. In an internal combustion engine, means forming a combustion space including a piston clearance, a pair of distinct preliminary combustion chambers, and passages arranged for combining the fuel discharge from said chambers, in advance of its delivery to said clearance.

6. In an internal combustion engine, means forming a combustion space, including a piston clearance, a pair of distinct preliminary combustion chambers, and an accumulating chamber, disposed between said preliminary chambers and said clearance.

7. In an internal combustion engine, means forming a combustion space including a main clearance and a pair of distinct precombustion chambers, arranged for projecting a liquid fuel charge as mutually impinging streams, and means for delivering the fuel charge to the main clearance, said means having a trend tending to avoid wetting contact of the fuel with the walls of said combustion space.

8. In an internal combustion engine, a cylinder, means cooperating therewith to form a combustion space including a main combustion clearance, a pair of distinct precombustion chambers and a combustion chamber between the first named chambers and clearance, and having a restricted delivery opening into the clearance; said precombustion chambers being substantially symmetrically disposed about said combustion chamber.

9. In an internal combustion engine, a cylinder, a compression and combustion space formed thereby with the cylinder head; said space including a pair of distinct precombustion chambers, a substantially spherical receiving chamber and the main clearance space, all of said chambers being substantially symmetrically disposed with respect to a common axis, and each thereof having the greater part of its surface fluid cooled.

10. In an internal combustion engine, a cylinder, a cylinder head, a piston, and means constituted by the cylinder head forming a pair of divergently disposed precombustion chambers, and a separate combustion space distinct from a main clearance, said chambers adapted to divide an initial fuel charge, and said combustion space, arranged thereafter to concentrate the fuel charge, before delivery thereof to the main clearance.

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