

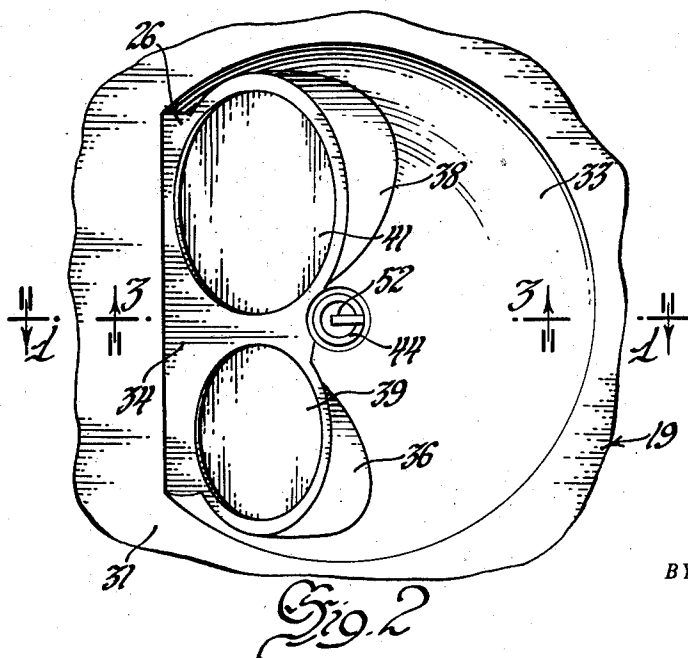
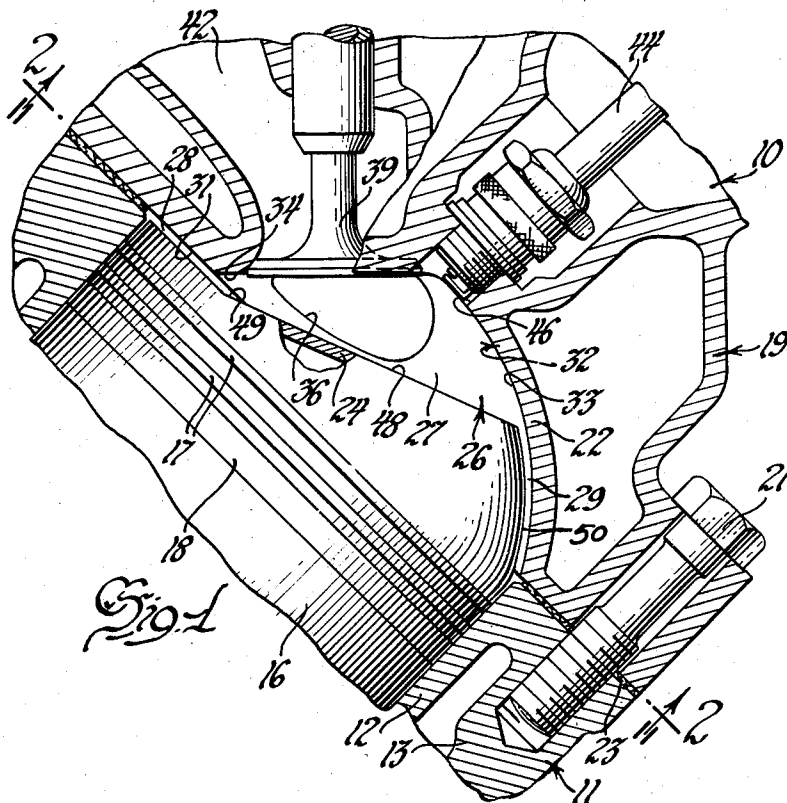
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COMBUSTION CHAMBER

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2 Sheets-Sheet 1



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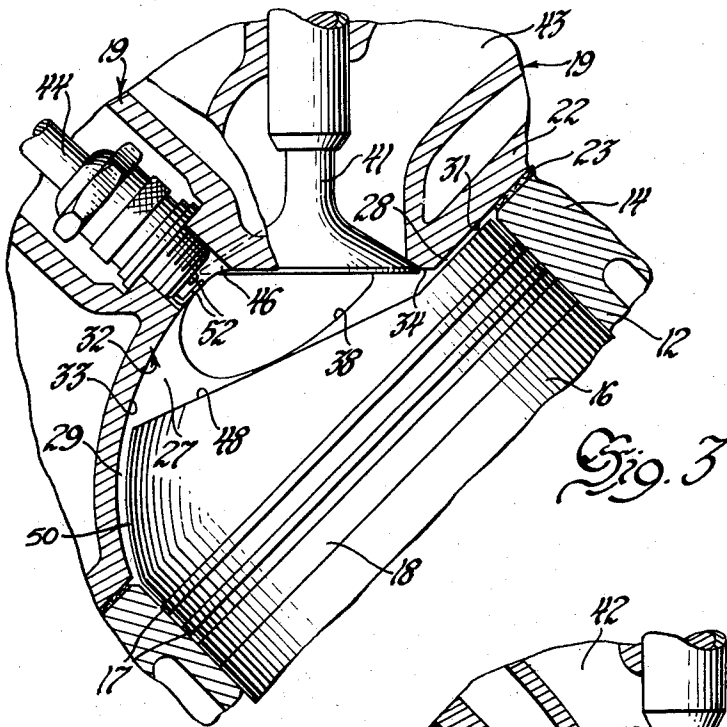


Fig. 3

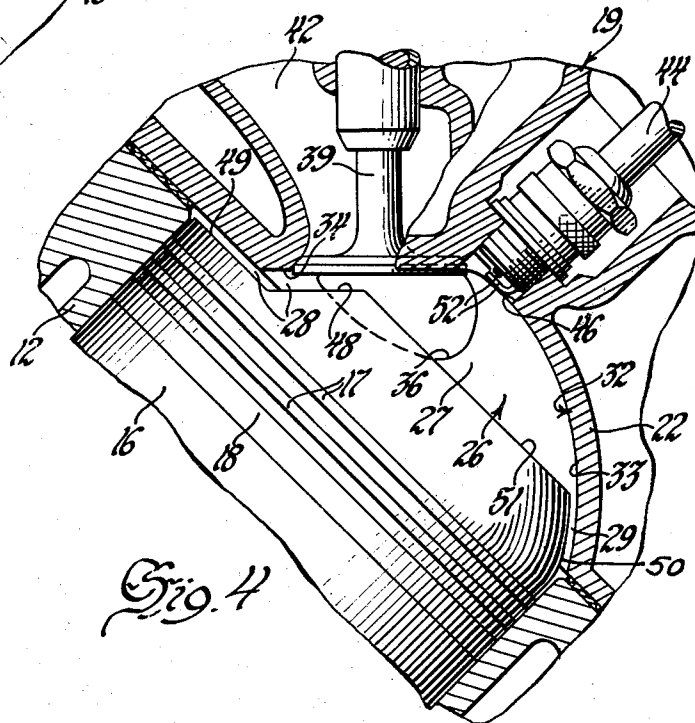


Fig. 4

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COMBUSTION CHAMBER

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8 Claims. (Cl. 123—191)

This invention relates to combustion chambers for internal combustion engines and has particular relation to combustion chambers especially applicable for use in 4-stroke cycle, spark ignited, internal combustion engines for automotive and other purposes.

As compression ratios become higher it becomes more difficult to control the maximum pressure that occurs in a cylinder of a multi-cylinder internal combustion engine. If the combustion chambers are not substantially of identical volume when the charge is compressed the maximum compression pressures in the cylinders may vary to a considerable extent. If there is such variation in maximum compression pressures it will be impossible to employ the maximum compression ratio that might otherwise be employed in such an engine. In order to obtain a maximum compression ratio in any engine, it is desirable to employ machine finished surfaces on the surfaces of the head that are directly opposed to the end surfaces on the pistons in the cylinders. This invention is concerned with making an efficient combustion chamber in an engine head having combustion chamber surfaces that may be difficult to machine.

The invention also is concerned with obtaining a highly turbulent condition in the charges compressed in the combustion chambers of the cylinders of such engines. It is proposed to provide a combustion chamber in which a plurality of oppositely directed clearance spaces are employed to create a rotating couple in the charge compressed in the firing chamber part of the combustion chamber. Such highly turbulent charges in the combustion chamber of an engine will burn faster than less turbulent charges and will permit a higher compression ratio in an engine without increasing the octane rating of the fuel employed.

It is further proposed to provide a high compression ratio combustion chamber in which hydrocarbon fuel may be more completely burned at low engine speeds. This result may be accomplished by providing a rapidly rotating mass in the charge compressed in the firing chamber and by positioning the spark plug radially outwardly with respect to the axis of the rotating mass. With such a spark plug location fuel will be separated from the rotating mass and directed adjacent the terminals of the spark plug in each cylinder. This will make it possible to ignite a relatively rich mixture at each spark plug of the engine and this initially ignited fuel will thereafter burn a leaner mixture throughout the remainder of the combustion chamber of the engine.

In the drawings:

Figure 1 is a fragmentary cross-sectional view of an internal combustion engine having a combustion chamber embracing the invention. Figure 1 illustrates the exhaust valve side of a cylinder of the engine substantially in the plane of line 1—1 on Figure 2.

Figure 2 is a fragmentary view of the head of the engine illustrated by Figure 1. Figure 2 is taken substantially in the plane of 2—2 on Figure 1, looking in the direction of the arrows thereon.

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Figure 3 is a view similar to Figure 1 except that Figure 3 illustrates the inlet valve side of a cylinder on the other side of the engine.

Figure 4 is a view similar to Figure 1 illustrating the exhaust valve side of a similar engine cylinder with a modified form of piston therein.

The engine 10 embracing the invention includes an engine block 11 in which a plurality of cylinders 12 may be formed in rows indicated at 13 in Figure 1 and at 14 in Figure 3. The cylinders are adapted to receive pistons 16 which reciprocate therein to provide compression, expansion, exhaust and intake or other strokes for a spark or otherwise ignited internal combustion engine operating on a 4-stroke or other suitable cycle of operations. The pistons may have compression rings indicated at 17, and oil rings indicated at 18, if this is considered desirable. The ends of the cylinders 12 are adapted to be closed by heads 19 secured by bolts 21 to the block 11 on the banks of cylinders 13 and 14. The heads 19 have inner walls 22 sealed around the cylinders 12 by gaskets 23. The parts of the walls 22 closing the ends of the cylinders 12 and the oppositely disposed walls 24 forming the ends of the pistons 16 have spaced surfaces forming the combustion chambers 26 for the cylinders of the engine. The combustion chambers 26 are formed to provide centrally disposed firing chambers 27 and oppositely disposed mechanical clearance spaces 28 and 29. Inlet valves 41 and exhaust valves 39 open into the firing chambers 27 through parts formed in the walls 22.

The inner surfaces of the heads 19 are formed by plane surfaces 31 extending entirely across the heads and inwardly depressed surfaces of revolution indicated at 32. The surfaces of revolution preferably include spherical or other suitably curved side surfaces 33 and obliquely disposed plane end surfaces 34 intersecting the plane surfaces 31. The plane surfaces 34 are disposed obliquely with respect to the axes of the cylinders 12. The surfaces of revolutions 33 and 34 may be formed by a tool having a plane end surface and a spherical or other suitably curved side surface and rotating about axes normal to the surfaces 34. The head surfaces of the combustion chambers 26 other than those formed by the plane surfaces 31 may be machined by projecting the tool into cavities cast in the inner walls 22 of the heads 19. The size of the tool employed in making the side surfaces 33 is such that the edges of the side surfaces 33 intersecting the plane surfaces 31 will be concentrically disposed with respect to and substantially the same diameter as the ends of the cylinders 12. The surfaces 31 may be machined by any suitable tool capable of forming a plane surface. The plane surfaces 34 may be enlarged to provide room for seating inlet and exhaust valves for each cylinder of the engine by making plunge cuts into the walls 22 on the axes of the valves. The tools employed may have plane end surfaces normal to the axes of rotation thereof and suitably formed cylindrical side surfaces. The cavities cut by operation of such tools on the axes of the inlet valves 41 and the exhaust valves 39 are indicated at 36 and 38. The cavities 36 are larger than the exhaust valves 39 and the cavities 38 larger than the inlet valves 41 to provide good breathing for each cylinder of the engine. The inlet and exhaust valves 41 and 39 respectively are adapted to open through the walls 22 into the combustion chambers 26 through the obliquely disposed plane surfaces 34. The exhaust valves 39 are adapted to open exhaust passages 42 and the inlet valves 41 are adapted to open inlet passages 43 for exhausting and supplying the cylinders 12. The heads 19 are provided with spark plugs 44 for each of the cylinders 12 of the engine. The spark plugs may be threaded into openings 46 extending through the walls 22 between

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the valves 39 and 41 and as near as possible to the axes of the cylinders 12. The inner extremities of the openings 46 may form cylindrical or other suitable ignition chambers or pockets adjacent the firing chambers 27 and substantially at the intersections between the plane surfaces 34 and the side surfaces 33. It may be desirable to have the ignition terminals 52 for the spark plugs 44 terminate somewhat outwardly beyond the main part of the firing chambers 27 and in the ignition pockets or chambers 46 forming the inner ends of the openings into which the spark plugs project.

The end walls 24 of the pistons 16 may be formed to provide obliquely disposed plane surfaces 48, transversely disposed plane surfaces 49 and spherical or other suitably curved side surfaces 50, similar to the side surfaces 33 in the head 19. In the structure disclosed by Figures 1 and 3 the obliquely disposed plane surfaces 48 form an acute angle with respect to the plane surfaces 34. The surfaces 34 and adjacent parts of the side surfaces 33 form the firing chambers 27. In the structure disclosed by Figure 4 the obliquely disposed surfaces 48 are substantially parallel to the plane surfaces 34, the firing chambers 27 being formed to a large extent between plane end surfaces 51 formed on the ends of the pistons 16 and the surfaces 33 and 34 of the heads. Also in the structure disclosed by Figure 4 the spaces between the surfaces 34 and 48 become a part of the mechanical clearance spaces indicated at 28.

In the structure disclosed by Figures 1 and 3 it will be apparent that on the compression stroke of the pistons 16 the charges previously admitted to the cylinders by the inlet valves 41 will be compressed into the combustion chambers 26. This compression of the charges will result in rapidly rotating masses of the charge being finally compressed in the firing chambers 27. Such rotating masses in the firing chambers 27 will result from the oppositely directed blasts of charge compressed in the oppositely directed clearance spaces 28 and 29. For example, the charge compressed between the oppositely disposed surfaces forming the clearance spaces 28 will be projected into the firing chambers 27 along the obliquely disposed end surfaces of the piston indicated at 48. The blasts of charge compressed between the oppositely disposed surfaces forming the clearance spaces 29 will be directed into the firing chambers 27 along the outer parts of the side surfaces 33. The discharge of such blasts of compressed charge from the clearance spaces 28 and 29 will rotate the compressed charges in the firing chamber 27 disclosed by Figure 1 in a counterclockwise direction and in the firing chamber disclosed by Fig. 3 in a clockwise direction. The rapidly rotating charges in the firing chambers will tend to throw fuel radially outwardly of the compressed charges and into the vicinity of the spark plug terminals 52 in the ignition pockets 46. This will cause a rich mixture to be collected in the pockets 42 and in the vicinity of the spark plug terminals 52. Such stratified charges of a rich mixture can be ignited in the pockets 46 and will burn the remaining leaner parts of the charges compressed in the firing chambers 27. This stratification of fuel will permit the use of a generally leaner mixture in an engine during the slow speed operation of the engine where the mixture now must be excessively rich.

Also, the oppositely directed blasts from the clearance spaces 28 and 29 will rotate the charges compressed in the firing chambers 27 at tremendous speeds and on transversely disposed axes with respect to the axes of the cylinders 12. These rapidly rotating charges in the firing chambers 27 will burn much more rapidly than without such rotation of the charges.

In the structure disclosed by Fig. 4 the blasts of mixture discharged by the clearance spaces 28 and 29 are along the surfaces 34 and 32 of the walls of the combustion chambers. These blasts will meet near the places where the surfaces 32 and 34 join in the firing

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chambers 27. This meeting of the blasts from the clearance spaces 28 and 29 will cause oppositely rotating masses of charge in the firing chambers 27 and will cause fuel also to be collected in the ignition pockets 46 adjacent the terminals 52 of the spark plugs 44.

In either event the charges in the firing chambers will be violently turbulent charges which will be readily ignited and rapidly burned by the operation of the ignition system of the engine.

I claim:

1. A combustion chamber for an internal combustion engine having a head and a cylinder and a piston operable in said cylinder and comprising a curved side surface and a plane end surface, said surfaces being formed on said head in opposed relation to the end of said cylinder, said plane end surface being formed on said head to intersect said curved side surface throughout the entire extent of said plane end surface and within the cylinder engaging surface of said head and being disposed obliquely with respect to the axis of said cylinder, said curved side surface being a surface of revolution having an axis normal to said plane end surface, a pair of inlet and exhaust valves in said head and opening into said cylinder through said plane end surface, and means for igniting a charge compressed in said cylinder between said head surfaces and the end of said piston.

2. A combustion chamber for an internal combustion engine as defined by claim 1 and in which said curved side surface is a spherical surface having a radius of curvature greater than the radius of said cylinder.

3. A combustion chamber for an internal combustion engine as defined by claim 1 and in which said end of said piston is formed to provide a curved side surface substantially concentrically disposed with respect to a part of said curved side surface on said head.

4. A combustion chamber for an internal combustion engine as defined by claim 1 and in which said end of said piston is formed to provide a plane surface disposed obliquely with respect to said axis of said cylinder and said plane end surface of said head and opposite said plane end surface of said head.

5. A combustion chamber for an internal combustion engine as defined by claim 1 and in which said end of said piston and said head are formed to provide plane and closely spaced and opposed surfaces disposed normally with respect to said axis of said cylinder and parallel to and closely spaced and oppositely disposed from a plane surface of said head intersecting said plane end surface.

6. A combustion chamber for an internal combustion engine as defined by claim 1 and in which said head is formed to provide a plane surface disposed normally with respect to the axis of said cylinder and in opposed relation to one side of said cylinder and intersecting said plane end surface of said head.

7. A combustion chamber for an internal combustion engine having a head and a cylinder and a piston operable in said cylinder and comprising an elongated firing chamber formed by opposed walls on said head and said piston and a pair of oppositely disposed clearance spaces communicating with said firing chamber and formed by opposed walls of said head and said piston, said opposed walls being substantially parallel to one another and directed at the ends of said clearance spaces adjacent said firing chamber toward said firing chamber and in opposite and laterally spaced relation, one of said clearance spaces being positioned to direct a blast of compressed charge along one of said opposed walls forming said firing chamber, the other of said clearance spaces being positioned to direct a blast of compressed charge along the other of said opposed walls forming said firing chamber, said blasts along said firing chamber walls being oppositely directed and laterally spaced and forming a rotating couple in the charge compressed in said firing chamber, inlet and exhaust valves disposed in said opposed wall of said head forming said firing chamber

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with one of said valves adjacent one and the other adjacent the other end of said firing chamber, and a spark plug positioned in said head with the ignition terminals thereof disposed in said firing chamber and between said valves and radially outwardly with respect to the rotating mass forming said charge compressed in said firing chamber.

8. A combustion chamber for an internal combustion engine having a head and a cylinder and a piston operable in said cylinder and comprising a firing chamber formed by opposed walls on said head and said piston and a pair of oppositely disposed clearance spaces communicating with said firing chamber and formed on opposed walls of said head and said piston, said opposed walls being substantially parallel to one another and directed at the ends of said clearance spaces adjacent said firing chamber toward said firing chamber and in opposite and laterally spaced relation, one of said clearance spaces being positioned to direct a blast of compressed charge along one of said opposed walls forming said firing chamber, the other of said clearance spaces being positioned to direct a blast of compressed charge along the other of said opposed walls forming said firing chamber, said blasts along said firing chamber walls being oppositely directed and laterally spaced and forming a rotating couple in the

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charge compressed in said firing chamber, a spark plug positioned in said head with the ignition terminals thereof disposed in said firing chamber and radially outwardly with respect to the rotating mass forming said charge compressed in said firing chamber, and an ignition chamber formed in said head around said terminals of said spark plug and outwardly of said firing chamber and in a position to collect separated fuel from said rotating mass forming said charge compressed in said firing chamber.

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