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COMBUSTION CHAMBER

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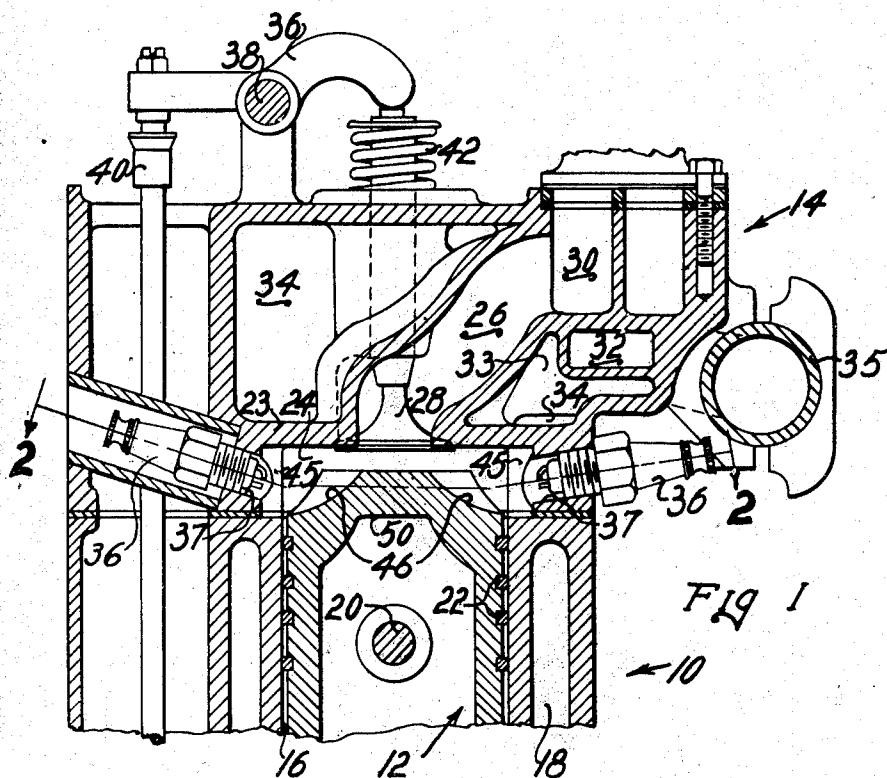


Fig 1

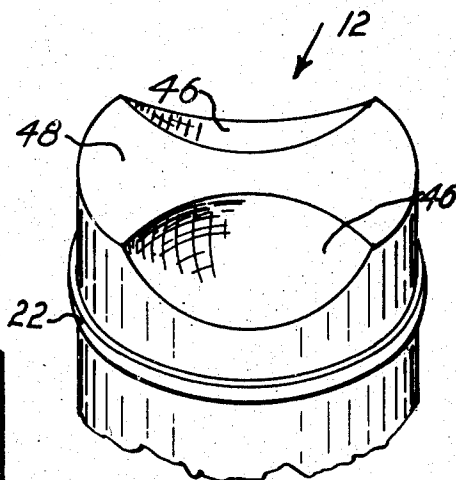


Fig 3

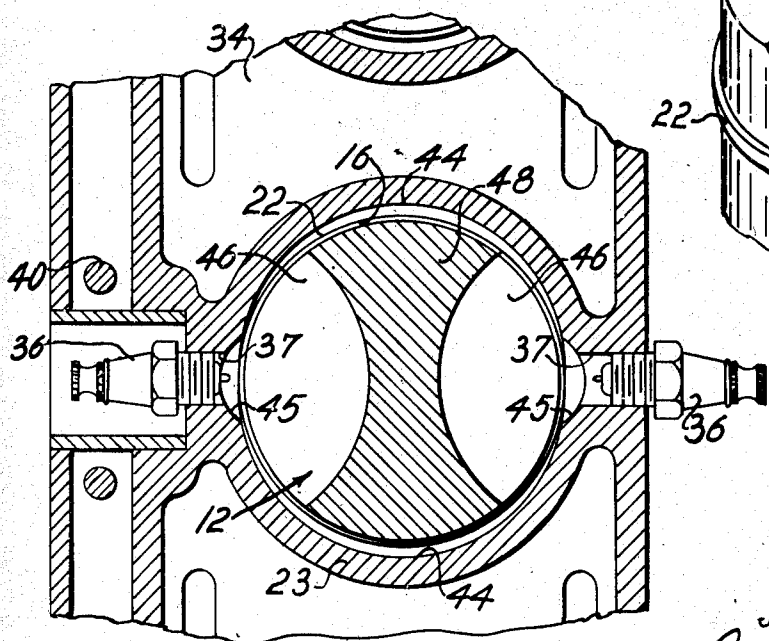


Fig 2

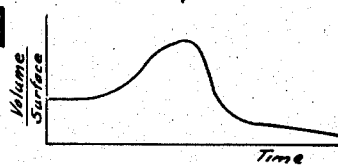


Fig 4

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COMBUSTION CHAMBER

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3 Claims. (Cl. 123—191)

This invention relates to combustion chambers of internal combustion engines and has particular reference to the shape of a combustion chamber of a valve-in-head engine.

It is an object of this invention to provide a combustion chamber for more perfectly controlling combustion in a valve-in-head engine.

It is another object of this invention to provide a combustion chamber in which the fuel mixture is less liable to detonate, causing the engine to knock.

It is another object of this invention to provide a combustion chamber which will function smoothly in a dual ignition engine.

It is another object of this invention to provide a piston which is co-operable with the head of a valve-in-head engine to form a novel combustion chamber.

Other objects and advantages of this invention will be apparent from a consideration of the following description and claims and the attached drawings of which there is one sheet and in which—

Figure 1 represents a vertical, transverse, sectional view through a cylinder of an internal combustion engine of the valve-in-head type;

Figure 2 represents a sectional view taken along planes indicated by the broken lines 2—2 in Figure 1 and looking in the direction of the arrows;

Figure 3 represents a perspective view of the top of the piston illustrated in Figures 1 and 2;

Figure 4 represents a graph in which the ratio of the volume of unburned fuel to the surface surrounding that volume is plotted against the time of burning in the combustion chamber.

It is generally understood that the fuel charge in an internal combustion engine does not normally explode all at once, but burns along a generally spherical flame front, the center of which is located at the spark plug. In dual combustion engines, two flame fronts are started concurrently and are propagated at approximately equal rates through the fuel charge. These spherical flame fronts first intersect in the center of the chamber leaving pockets of unburned fuel toward the sides of the cylinder, which charges are liable to detonate due to the increased pressure in the chamber. This results in a knock in the engine. This invention deals with means for overcoming this undesirable feature. The spark plugs of the engine have been moved as far apart as possible so that the flame fronts are more nearly flat when they intersect, thus leaving smaller pockets of unburned fuel. The piston has been so shaped on its upper surface

as to increase the area of piston and head surface surrounding the final unburned charge so that as the heat within the combustion chamber increases due to the compression of the partially burned fuel charge, the increased surface will absorb more heat from the unburned charge, thus preventing it from reaching its detonation temperature.

Figure 1 shows an internal combustion engine having a cylinder block generally indicated at 10, a piston generally indicated at 12, and a head generally indicated at 14. Within the block 10 are formed the usual cylinders 16 surrounded by cooling water jackets 18. The piston 12 is provided with the usual piston pin 20, and piston rings 22. The lower wall 23 of the head 14 is recessed on the underside thereof to form the combustion chamber 24 into which a fuel mixture is led by the intake passage 26 controlled by the valve 28. The intake passage 26 opens from the side of an intake manifold 30 cast along the upper surface of the head 14. Positioned underneath the intake manifold 30 is a heater chamber 32 connected to the exhaust passage 33 which discharges into the exhaust manifold 35. The intake passage, heater chamber and exhaust passage are surrounded by cooling water space 34. Spark plugs 36 extend through apertures 37 in the side walls of the block 10 and project into the sides of the combustion chamber 24. The usual type of valve actuating mechanism including the rocker arms 36, rocker arm shaft 38 and push rods 40 are carried on top of the block 14 so as to open the valves 28 against the force of the valve springs 42.

Specifically, the combustion chamber 24 is generally oval-shaped in plan view, having semi-circular ends 44 (see Figure 2). This increases the length of the combustion chamber along the line of the valves so that larger valve ports may be used. The sides of the chamber 24 between the semi-circular ends 44 are curved outwardly by cutting away the lower wall 23 in semi-cylindrical pockets 45 which intersect the apertures 37 in which the spark plugs 36 are positioned with the electrodes positioned at or near the center of the spherical recesses 46 when the piston 12 is in its top dead center position.

Attention is called to the fact that by providing the pockets 45, the spark plugs 36 may be moved further out in the apertures 37, thus increasing the distance between the plugs and lengthening the radius of the flame fronts. Moving the plugs out without providing the pockets 45 is ineffective beyond a limit because a point

is soon reached where the small aperture 37 will not be scavenged of burned gases after each charge is fired and the efficiency of the plug is cut down. The pockets 45 also retain small initial charges which may be ignited by the plugs to start broad flame fronts in the main charge.

The piston 12, which operates in the cylinder 16, has its upper face cut away in a pair of cup-shaped surfaces 46 on opposite sides of the piston and adjacent to the spark plugs 36. Between these cut away portions 46 is left a flat land portion 48 which is shaped somewhat like an hour-glass. The inside of the piston is hollowed out under the land 48 as at 50 (see Figure 1) to lighten the piston.

The piston 12 is arranged to project upwardly into the combustion chamber 24 with the land portion 48 spaced slightly from the valve 28 when the piston is at top dead center.

In operation, with a charge of fuel compressed in the combustion chamber, the spark plugs 36 will ignite the small initial charges in the cut away pockets 45 on the sides of the combustion chamber from where the flame front will pass through the major portion of the charge which is retained between the combustion chamber walls and the cup-shaped surfaces 46 of the piston. When the main charge has been burned, a relatively small final charge will remain between the land portions 48 and the top of the combustion chamber. This final portion will have been raised in temperature due to the increased pressure in the chamber. However, the area of the land 48 on the piston and the area of the valves and the top of the combustion chamber surrounding the final charge is relatively large and sufficient heat will be conducted away from the final charge through the piston to the water cooling jacket 18 and through the top of the combustion chamber to the cooling jacket 34 in the head to prevent the final charge from rising to a temperature at which it will detonate.

As indicated in Figure 4, in which the ratio of the volume of unburned fuel to the surface of the chamber surrounding that volume is plotted against the time of burning of the entire charge, at the time of ignition the volume to surface ratio represents the total volume and total surface. As the small initial charge in pockets 45 is burned, a small volume surrounded by a relatively large surface is burned so that the volume to surface ratio is increased. After the main charge is burned, a small volume remains between large surfaces so the volume to surface ratio drops rapidly to a very low value indicating a chamber which will extract more heat from the charge and prevent it from detonating as has been explained above. The relationship between the initial, main and final charges in the chamber and the surfaces surrounding those charges will not be the same in all engines to get maximum power and smoothness from the engine. For instance, different engines with different size pistons and compression ratios will operate most efficiently with different volume to surface ratio curves. Thus while the shape of the combustion chamber could be determined by using a flat top

piston and shaping the top wall of the chamber under the cylinder head, it is much cheaper to use a flat top chamber and obtain the desired shape of chamber by cutting away the piston. This makes it easier to design the intake and exhaust ports and valves for a flat top chamber, while the correct chamber shape may be determined by experiment with pistons cut in different shapes.

While I have described by invention in some detail, I intend this description to be an example only and not as a limitation of my invention in which I make the following claims:

1. In an internal combustion engine, a cylinder block having cylinders formed therein, a cylinder head having combustion chambers formed on the underside thereof, having a flat top surface and co-operable with said cylinders, ignition devices for said combustion chambers, valve mechanism carried in said head and projecting through said top surface, pistons carried in said cylinders and arranged to project into said combustion chambers in their uppermost positions, each of said pistons being provided with a flat central upper portion projecting into adjacency with said flat top surface of the combustion chamber and said valves and extending parallel thereto, each of said pistons being provided with oppositely-facing, and spherical-surfaced recesses in each side, the center of which is approximately at said ignition device, the recesses being disposed in the projecting portion of each piston in its uppermost position, said ignition devices being carried by said cylinder head opposite the recesses in said pistons, the walls of said combustion chambers being partially recessed in the vicinity of said ignition devices, to provide vertical, partially cylindrical surfaces.

2. A combustion chamber for a valve-in-head engine comprising a pair of oppositely facing lateral recesses having their principal surface formed as a segment of a cylinder, a spark plug mounted in each of said recesses with the electrodes thereof adjacent said cylindrical surface, a pair of principal chambers, each of said recesses opening into one of said chambers, each of said chambers having its major surface remote from said recesses formed as a portion of the surface of a sphere, said electrodes being located at the approximate centers of said spheres.

3. A combustion chamber for a valve-in-head engine comprising a pair of oppositely facing lateral recesses having their principal surface formed as a segment of a cylinder, a spark plug mounted in each of said recesses with the electrodes thereof adjacent said cylindrical surface, a pair of principal chambers, each of said recesses opening into one of said chambers, each of said chambers having its major surface remote from said recesses formed as a portion of the surface of a sphere, said electrodes being located at the approximate center of said sphere, said principal chambers being joined by a thin flat chamber uniform in depth throughout and having an outline in plan generally similar to that of an hour-glass.

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