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FIRING CHAMBER FOR INTERNAL COMBUSTION ENGINE

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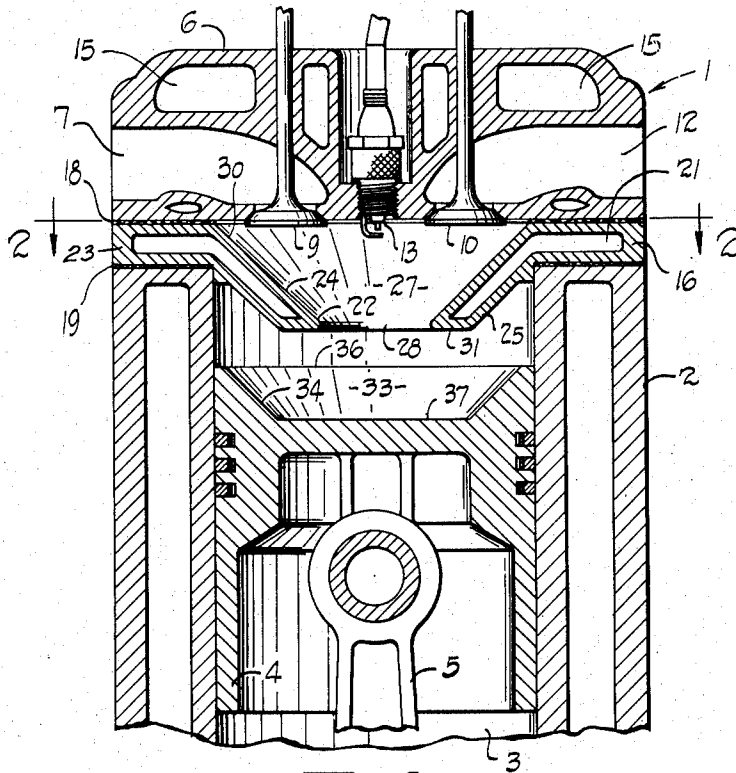


FIG. 1

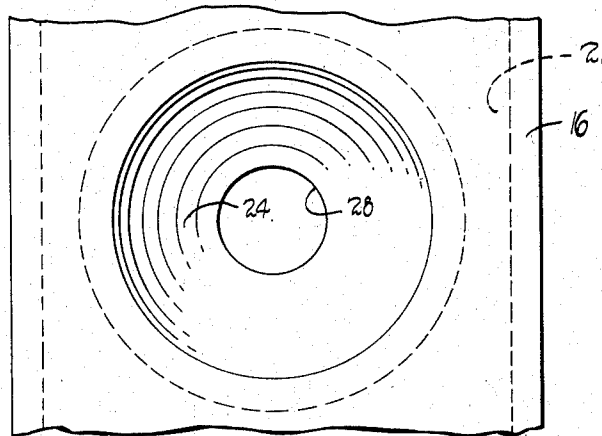


FIG. 2

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FIRING CHAMBER FOR INTERNAL COMBUSTION ENGINE

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15 Claims. (Cl. 123—191)

This invention relates to internal combustion engines and more particularly to firing chambers for internal combustion engines.

A general object of this invention is to provide an improved, more efficient internal combustion engine and an improved more efficient firing chamber for internal combustion engines whereby to increase the operating efficiency, economy and/or work output of the engine over that obtained by conventional internal combustion engines under the same operating conditions.

Another object of this invention is to provide an improved, more efficient and economical firing chamber for internal combustion engines which may be an integral part of the engine or a part thereof or may be a separate member adapted to be mounted between the cylinder block and head of an internal combustion engine without requiring modification of the block and/or head.

Other objects of this invention include the provision of an improved internal combustion engine and firing chamber therefor which increases the turbulence of the fuel-air mixture within the cylinder and firing chamber and which mixes the fuel-air mixture more intimately and efficiently; which increases generally the overall thermal efficiency of the engine; which improves fuel vaporization and combustion; which reduces fuel consumption; which causes the combusted gases to act upon the piston with a jet action and extracts work from the combusted gases both during the vertical jet flow thereof and the subsequent horizontal flow; and/or which permits the use of higher compression ratios than is ordinarily possible for a fuel having a given octane rating.

A still further object of this invention is to provide a firing chamber for internal combustion engines which extends into the adjacent cylinder and a piston shaped complementarily to the said firing chamber and adapted to cooperate with said firing chamber to obtain the aforesaid objects and advantages.

These and other objects and advantages of this invention will become apparent from the following description of a preferred form thereof, reference being had to the accompanying drawings, in which:

Figure 1 is a broken vertical section of a single cylinder of an internal combustion engine, showing a preferred form of this invention; and

Figure 2 is a horizontal section viewed along the line 2—2 of Figure 1.

Briefly this invention comprises the provision of an improved firing chamber, for internal combustion engines, which is adapted to modify the structure and function of the engine and more particularly of the cylinder and piston so as to increase the efficiency of the engine by improved fuel combustion and utilization of the forces released thereby. Accordingly the invention includes a firing chamber having an orifice of less diameter than the firing chamber and cylinder and conical exterior and interior surfaces slanting upwardly therefrom, and a piston, recessed complementarily to the exterior surface of said firing chamber. The orifice provides a restricted passage

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through which the fuel mixture is compressed or forced on both the intake and compression strokes of the engine whereby to increase the turbulence in the fuel mixture and thereby mix the same more thoroughly, minutely and homogeneously, as well as directing the combustion gases against the central portion of the piston, with a jet-like action. The conical surfaces of the firing chamber and the piston recess provide direction and ease of flow to and for the flow of gases within the cylinder and firing chamber and ensure the realization of increased thermal efficiency by properly relating the respective parts and portions of the engine to each other. Further the conical surface of the piston recess utilizes and extracts work from both the vertical and horizontal flow of the combustion gases as they jet through the orifice and spread outwardly after initial engagement with the piston.

Internal combustion engines and firing chambers embodying the preferred form of this invention use up to 30 percent less fuel in obtaining the same power and performance as ordinary engines, or conversely, extract more power and performance from a like amount of like fuel as well as permitting the use of higher compression ratios for a fuel having a given octane rating than is possible with ordinary internal combustion engines. For ease of understanding, this invention is herein described as applied to a single cylinder of an internal combustion engine. However, it is to be understood that the invention may be used with an engine having a plurality of cylinders, six or eight, for example, and that the structure with respect to each such cylinder would be similar.

More specifically, as best seen in Figure 1 my invention is adapted for use with an internal combustion engine indicated generally at 1, comprising a cylinder block 2 with a bore or cylinder 3 in which piston 4 reciprocates. Piston 4 is connected to the drive shaft, not shown, by piston rod 5 in the usual manner. The engine 1 also includes a head 6, having a fuel intake passage 7, intake valve 9, exhaust valve 10, exhaust passage 12, and spark plug 13. Both the block 2 and the head 6 are provided with a plurality of interconnected voids or passages 15 through which coolant, usually water, is circulated. All of the above elements, except the piston as will hereinafter more fully appear, are old and well-known in the art and per se form no part of the present invention.

Interposed between the cylinder block 2 and the head 6 is a firing chamber 16 which is preferably a separate member adapted to be mounted between the block and head of a conventional internal combustion engine but which may be formed integrally with the head, for example, if desired. When, as preferred, firing chamber 16 is formed separately from the block and head, gaskets 18 and 19 are disposed between the firing chamber and the block and head respectively in order to prevent leakage of fuel mixture, combusted gases or coolant.

Firing chamber 16 preferably has cooling means, and is therefore conveniently provided with a double walled construction defining voids or passages 21, which are interconnected with the passages 15 in the block and head by means of appropriate apertures formed in the firing chamber, the gaskets 18 and 19, the block and the head to the end that the coolant is circulated within the firing chamber as well as within the block and head.

In order to obtain the advantages of this invention and ensure the proper and desired flow of gases within the cylinder and firing chamber, the firing chamber and piston have a male and female relationship respectively. To this end the firing chamber has a central portion indicated generally at 22 which depends or extends downwardly, as viewed, into the cylinder 3. Central portion 22 comprises internal and external walls 24 and 25 re-

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spectively which define, in part, passage 21 and slope downwardly and inwardly from the horizontal portion 23 of firing chamber 16. Internal wall 24 defines and provides an internal open-ended, frusto-conical shaped combustion chamber 27 having a relatively narrow, preferably flat, horizontal throat opening 28 in communication with the cylinder 3 and a top opening 30 which is adapted to be covered by head 6. Top opening 30 of combustion chamber 27 is of considerably larger diameter than throat opening 28, and the valves 9 and 10 and spark plug 13 are mounted within the head 6 so as to be disposed over and within the top opening 30 of chamber 27 to the end that chamber 27 has selective communication with intake and exhaust passages 7 and 12. Wall 25 has a frusto-conical shape extending into the cylinder 3 and adapted to cooperate with piston 4 to ensure that proper compression and gas flow are obtained and also preferably includes a flat horizontal portion 31 adjacent and surrounding throat opening 28 in order to provide for internal passage 21 and to permit wall 24 and the sloping portion of wall 25 to be parallel as is preferred. It is preferred, for maximum performance results, that walls 24 and 25 slope at an angle of 42 degrees with the horizontal. Naturally when a firing chamber embodying this invention is adapted for use with an engine having a plurality of cylinders, the firing chamber preferably is made as a single integral unit with a large horizontal portion 23 conforming to the general shape of the juncture of the head and block and a plurality of spaced depending portions 22 equal in number to the number of cylinders.

Piston 4 is recessed or dished as at 33 complementary to the external wall 25 of the firing chamber 16 to the end that when the piston is at the highest point of its upward stroke, the piston mates with the firing chamber, and there is a minimum tolerance or gap therebetween. Recess 33 is therefore also frusto-conical in shape having side wall 34, which is parallel to the sloping portion of wall 25, a horizontal open top 36 and a horizontal lower surface 37 (top of piston 4) which is parallel with throat opening 28 and the horizontal portion 31 of wall 25. Surface 37 and wall 34 are so related to throat 28 that the combustion gases passing jet-like through the throat first impinge vertically on surface 37 and then spread horizontally striking side wall 34 which extracts further work therefrom.

In using a firing chamber embodying this invention causes the inflowing fuel-air mixture (on the intake stroke) to pass through the throat 28 and into the cylinder 3, and the contraction and expansion of the incoming fuel mixture as it passes through the throat and into the cylinder increases the turbulence thereof and effects a more efficient mixture. Correspondingly, as the piston rises on the compression stroke, the fuel-air mixture is again forced back through the throat into the combustion chamber 27. This induces further turbulence and mixing to create a more uniform mixture, and because of the complementary shape of the exterior of the firing chamber 16 (wall 25) and the recess 33 (wall 34) of the piston 4, all of the fuel-air mixture is forced into the firing chamber so as to obtain maximum compression and mixing. The shape of the external wall 25 of firing chamber 16 and side wall 34 of recess 33 assures that the fuel-air mixture flows easily into the combustion chamber 27 without being entrapped within that portion of the cylinder surrounding the external wall of the firing chamber.

Once compression is completed, the mixture is ignited, and, of course, upon burning, expands and rushes jet-like through the throat 28 impinging against the central portion of the surface 37 of the piston 4, thereby producing an even smooth thrust upon the piston. The combustion gases then expand and flow horizontally and work, a second time, upon the piston by acting upon the sloping side wall 34 of recess 33.

Upon completion of the power stroke and initiation of the exhaust stroke, a firing chamber embodying my in-

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vention is further advantageous in that the shape of the external wall 25 of the chamber and the complementary shape of side wall 34 of the recess 33 facilitate the evacuation of the cylinder and chamber in the same manner as on the compression stroke so as to ensure a maximum advantage from the invention.

Modifications, changes, and improvements to the preferred form of the invention herein described may occur to those skilled in the art, who come to understand the precepts and principles thereof. Therefore, it is wished that the patent has a scope consistent with the advance by which the invention has promoted the art and not to be limited to the form of the invention herein particularly illustrated and described.

I claim:

1. In an internal combustion engine, the combination of a cylinder block having a cylinder therein, a piston adapted for reciprocal movement within the cylinder, a firing chamber overlying said block and cylinder and a head overlying said firing chamber, said firing chamber having spaced internal and external walls projecting into said cylinder and defining an internal passage for the circulation of coolant, said interior wall defining a frusto-conical shaped open-ended combustion chamber having a relatively large top opening adjacent said head and a relatively narrow central horizontal throat opening in communication with said cylinder, said external wall being frusto-conical in shape and having a flat horizontal portion adjacent said throat and a sloping portion extending upwardly and outwardly from said flat portion and parallel with said internal wall and being disposed at an angle of substantially 42 degrees with the horizontal, said head including intake and exhaust passages, intake and exhaust valves controlling said intake and exhaust passages respectively and a spark plug, said intake and exhaust valves and said spark plug being disposed over and within said top opening of said combustion chamber, said piston having a recess, said recess being of frusto-conical cross-section and having side walls complementary to said sloping portion of said external wall of said firing chamber and a flat, horizontal lower surface complementary to said throat opening and said flat portion of said external wall and being adapted to be disposed closely adjacent said external wall and throat opening when said piston is reciprocated adjacent said firing chamber and passages in said head and block in respective communication with said internal passages in said firing chamber.

2. In an internal combustion engine, the combination of a cylinder block having a cylinder therein, a piston adapted for reciprocal movement within the cylinder, a firing chamber overlying said block and cylinder and a head overlying said firing chamber, said firing chamber having spaced internal and external walls projecting into said cylinder and defining an internal passage for coolant, said interior wall defining a frusto-conical shaped, open-ended combustion chamber having a relatively large top opening adjacent said head and a relatively narrow central throat opening in communication with said cylinder, said external wall having a sloping portion of frusto-conical shape and extending upwardly and outwardly from adjacent said throat opening at an angle of substantially 42 degrees with the horizontal, said head including intake and exhaust passages and a spark plug having communication with said combustion chamber and intake and exhaust valves for controlling said intake and exhaust passage respectively, and said piston having a recess of frusto-conical cross-section complementary to said external wall and throat opening and adapted to be disposed closely adjacent thereto when said piston is reciprocated adjacent said firing chamber.

3. In an internal combustion engine, the combination of a cylinder block having a cylinder therein, a piston adapted for reciprocal movement within the cylinder, a firing chamber overlying said block and cylinder and a head overlying said firing chamber, said firing chamber

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having spaced internal and external walls projecting into said cylinder and defining an internal passage for coolant, said interior wall defining a frusto-conical shaped, open-ended combustion chamber having a relatively large top opening adjacent said head and a relatively narrow central throat opening in communication with said cylinder, said external wall having a sloping portion of frusto-conical shape and extending upwardly and outwardly from adjacent said throat opening, said head including intake and exhaust passages and a spark plug having communication with said combustion chamber and intake and exhaust valves for controlling said intake and exhaust passage respectively, and said piston having a recess of frusto-conical cross-section complementary to said external wall and throat opening and adapted to be disposed closely adjacent thereto when said piston is reciprocated adjacent said firing chamber.

4. The combination according to claim 3 in which said throat opening is flat and horizontal and said external wall has a horizontal portion surrounding said throat opening.

5. The combination according to claim 4 in which said internal wall is parallel with said sloping portion of said external wall.

6. In an internal combustion engine, the combination of a cylinder block having a cylinder therein, a piston adapted for reciprocal movement within the cylinder, a firing chamber overlying said block and cylinder and a head overlying said firing chamber, said firing chamber having a central portion projecting into said cylinder and a central portion of said firing chamber defining a frusto-conical shaped, open-ended combustion chamber having a relatively large top opening adjacent said head and a relatively narrow central throat opening in communication with said cylinder and an outer wall sloping upwardly and outwardly from adjacent said throat opening and being disposed at an angle of 42 degrees with the horizontal, means for selectively conducting fuel to and exhaust gases from said combustion chamber, said piston having a recess having bottom and side walls complementary to said outer wall and throat opening and adapted to be disposed closely adjacent said outer wall and throat opening when said piston is reciprocated adjacent said firing chamber.

7. In an internal combustion engine, the combination of a cylinder block having a cylinder therein, a piston adapted for reciprocal movement within the cylinder, a firing chamber overlying said block and cylinder, a head overlying said firing chamber, said firing chamber having a central portion projecting into said cylinder and defin-

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ing an open-ended combustion chamber having a relatively large upper opening adjacent said head and a relatively narrow throat opening in communication with said cylinder and a sloping inner wall therebetween and an outer wall sloping upwardly and outwardly from adjacent said throat opening, and means for selectively conducting fuel to and exhausting gases from said combustion chamber, said piston having a recess complementary to said outer wall and throat opening and adapted to be disposed closely adjacent said outer wall and throat opening when said piston is reciprocated adjacent said firing chamber.

8. The combination according to claim 7 in which said inner and outer walls are spaced from each other and define an internal passage for coolant.

9. The combination according to claim 8 in which said inner and outer walls are parallel.

10. The combination according to claim 7 in which said throat opening is flat and horizontal and said outer wall has a flat horizontal portion surrounding said throat opening.

11. The combination according to claim 7 in which said outer wall is frusto-conical in shape.

12. The combination according to claim 11 in which said outer wall is disposed at an angle of substantially 42 degrees with the horizontal.

13. A firing chamber for an internal combustion engine having a cylinder block with a cylinder therein, said firing chamber being adapted to overlie said cylinder and having a downwardly projecting central portion extending into said cylinder, said downwardly projecting central portion having an inner wall defining a frusto-conical shaped open-ended combustion chamber having a relatively large upper opening and a relatively narrow throat opening adapted to be in communication with said cylinder and an external wall having a frusto-conical shape sloping upwardly and outwardly from adjacent said throat opening.

14. The firing chamber according to claim 13 in which said external and inner walls are spaced apart and define a passage for coolant.

15. The firing chamber according to claim 13 in which said external wall slopes at an angle of substantially 42 degrees with the horizontal.

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