Sept. 11, 1962 G. BURRELL 3,052,960

FRUSTO CONICAL COMBUSTION CHAMBER AND METHOD OF MAKING SAME

Original Filed Dec. 31, 1954 2 Sheets-Sheet 1

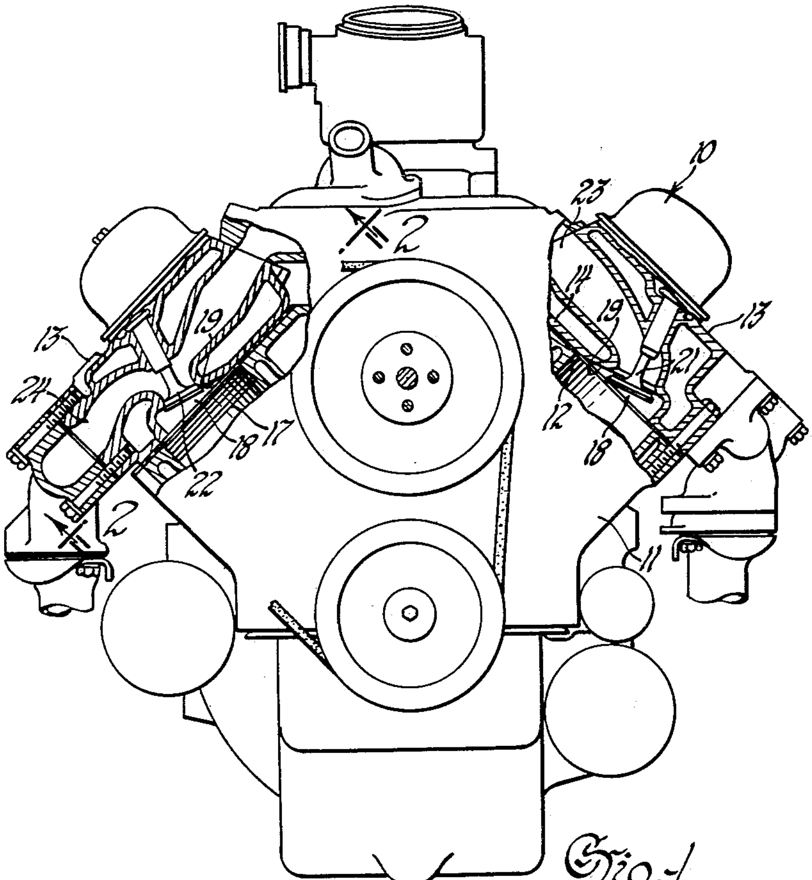

Fig. 1

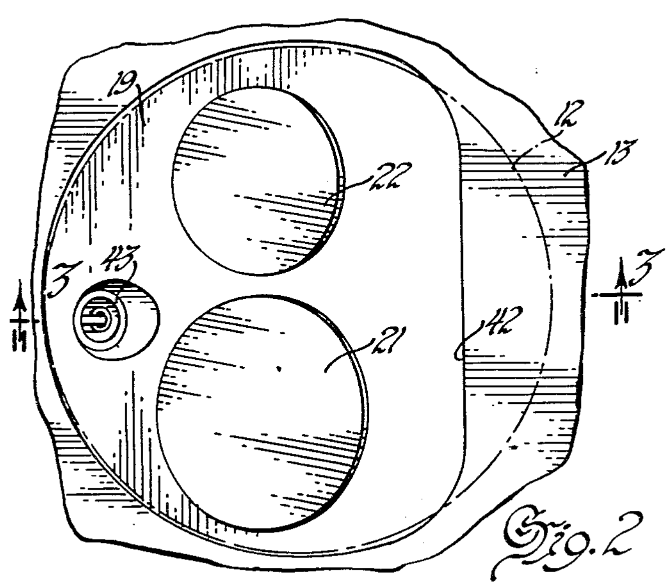

Fig. 2

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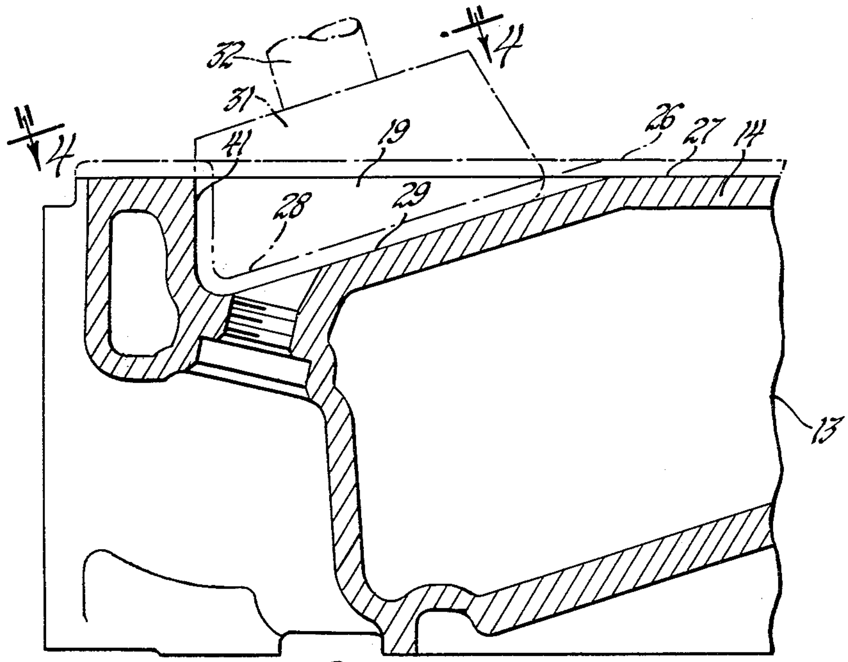

Fig. 3

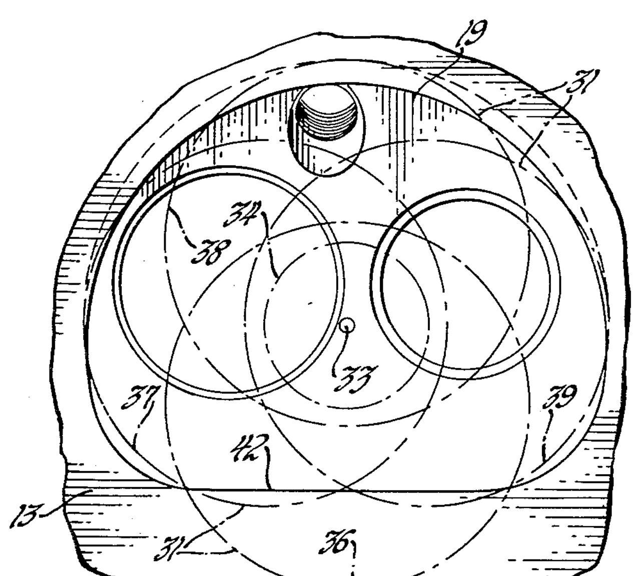

Fig. 4

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FRUSTO CONICAL COMBUSTION CHAMBER AND METHOD OF MAKING SAME

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Original application Dec. 31, 1954, Ser. No. 479,142, now Patent No. 2,878,800, dated Mar. 24, 1959. Divided and this application Aug. 4, 1958, Ser. No. 752,795

1 Claim. (Cl. 29—156.4)

This application is a division of S.N. 479,142 filed in the name of Gilbert Burrell, December 31, 1954 now Patent No. 2,878,800.

This invention relates to combustion chambers and to methods of forming combustion chambers for high speed, high compression ratio, internal combustion engines for automotive and other uses.

Heretofore it has been the practice to form wedge shape combustion chambers for valve in head internal combustion engines by molding cavities in the heads and then finishing the cavities by performing metal finishing operations on the surfaces forming the cavities. In high speed, high compression ratio engines for automotive and other uses it has been found that cavities formed by casting and without finishing the surfaces of the cavities are likely to vary in size, thereby making the operation of the engines unsatisfactory. When these wedge shaped chambers are made so that it is possible to position the spark plugs near the volumetric center of the chambers, it is difficult not only to cast but to finish the chambers, unless the chambers are made in a shape that does not quite fit the ends of the cylinders with which the cavities must cooperate in forming the combustion chambers for an engine. It has been the practice heretofore to make these cavities somewhat wider than the cylinders at the thin edges of the cavities, thereby providing relatively deep pockets projecting radially beyond the cylinders. These pockets tend to cause preignition and to result in unsatisfactory operation of the engine.

It is now proposed to form wedge shape cavities that are frusto conical in formation and that substantially fit the ends of the cylinders of the engine, particularly at the thin edges of the cavities where the preignition pockets have been previously formed. It is also proposed to provide a method of finishing that does not form excessive pockets at the thin edges of the cavities.

In the drawing:

FIGURE 1 is an end elevational view of an engine with parts thereof broken away to illustrate frusto conical cavities formed in the heads of the engine and which cooperate with the pistons and cylinders to provide the combustion chambers for the engine.

FIGURE 2 is a fragmentary plan view of one of the engine heads and illustrating one of the frusto conical cavities formed in the head and the relation of this cavity to a cylinder of the engine indicated by the broken circular line thereon.

FIGURE 3 is a fragmentary cross-sectional view of one of the engine heads and illustrating the operation of a tool employed in finishing one of the combustion chamber cavities in the head.

FIGURE 4 is a fragmentary plan view of the head illustrated by FIGURE 3 and showing the progress of the tool in its movement throughout the series of steps involved in the finishing of one of the combustion chamber cavities therein.

The engine 10 embracing the invention comprises an engine block 11 in which rows of cylinders 12 are formed and to which heads 13 are secured over the ends of the

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cylinders 12. The block 11 has normally disposed and finished plane surfaces thereon at the ends of the cylinders 12 and to which finished plane surfaces on the inner walls 14 of the heads 13 are secured by bolts 16 projecting through the heads. Pistons 17 are reciprocably mounted in the cylinders 12 in such a way that at the outer dead center positions of the pistons the outer end surfaces of the pistons are substantially flush with the plane end surfaces of the block 11 to which the heads 13 are secured. Combustion chambers 18 are formed by the cavities 19, the cylinders 12 and the pistons 17. Inlet valves 21 and exhaust valves 22 for each cylinder of the engine open into the combustion chambers 18 by operation of the valve actuating mechanism of the engine and for controlling inlet passages 23 and exhaust passages 24 respectively. The passages 23 and 24 terminate in aligned ports opening into the cavities 19.

The cavities 19 may be cast or otherwise formed in the inner walls 14 of the heads 13. If the heads are made by casting, it is considered desirable to finish the outer surfaces of the inner walls 14 by removing the metal between the dot and dash line 26 and the finish line 27 to provide the plane surfaces to be secured to the plane surfaces on the block 11 surrounding the cylinders 12. The cavities 19 are preferably cast in the inner walls 14 by employing cores or molds or frusto conical formation and which project into the heads in oblique relation to the finished surfaces 27 and the axes of the cylinders 12. The dot and dash line 28 indicates the unfinished configuration of one of the cavities 19 as formed by the cores or molds employed in the casting process.

In order to provide combustion chambers for the engine that do not vary materially in size, it is considered desirable to finish the cavities 19 by removing the metal between the dot and dash line 28 and the line 29. It is proposed to do this by employing a frusto conical metal cutting and finishing tool such as that indicated at 31 and with the larger end of the tool forming the inner part of the cavity. The tool 31 may be rotated upon the axis of the shaft 32 and may be rotated about an axis of rotation 33 at the center of the frusto conical surface represented by the line 29 and illustrating the finished surface of the cavity 19. When so rotated the axis of rotation of the shaft 32 will follow the dot and dash line indicated at 34. FIGURE 4 illustrates the line of the tool 31 at positions 36, 37, 38 and 39, which the tool may occupy during the finishing of the cavities 19. It will be noted that in position 36 the tool may be rotated upon the axis of the shaft 32 without engaging any part of the side wall 41 of the cavity 19. However, the large end of the tool 31 will be in a position to remove metal from the inner end surface of the cavity between the lines 28 and 29. As the tool 31 is rotated upon the axis of the shaft 32 and about the point 33 the tool will move from position 36 to positions 37, 38 and 39 and will return to position 36 at the end of one revolution about the axis through the point 33. As the tool moves from position 36 to position 37 it will be apparent that the side of the tool will commence to cut the side wall 41 of the cavity and will continue to cut the side wall of the cavity until the tool again approaches position 36. At position 36 it will be apparent that the tool 32 can be moved axially inwardly and outwardly of the head 13 without destroying the overhanging side wall surface 41 which is formed by the frusto conical configuration of the cavity 19. When the cavity 19 is formed by rotation of the tool 31 about the axis of the tool and about an axis spaced from the axis of the tool, it will be apparent that the side wall 41 will be of frusto conical configuration throughout the entire extent thereof.

In the present instance, it is proposed to project the tool 31 into the head 13 in such manner that the thin edge of the cavity **19** will intersect the plane surface **27** on a chord **42** which spans less than 180° of the configuration of the cavity. The side wall **41**, therefore, will extend from the opposite ends of the chord **42** throughout more than 180° of the arcuate extent of the side wall **41**.

It is proposed to position the heads **13** on the cylinders **12** in such manner that the chords **42** at the thin edges of the cavities **19** will intersect the ends of the cylinders **12** adjacent one side of the cylinders **12**. Then it is proposed to position the cavities so that the outer extremities of the side walls **41** of the cavities will substantially follow the curvature of the outer ends of the cylinders **12**. Since the tool **31** is smaller than the diameter of the cavity **19** the cavity will not be widened at the thin end thereof by movement of the tool inwardly and outwardly along the surface **39**. Hence the pockets heretofore formed at the thin ends of the cavities and outwardly beyond the peripheral limits of the ends of the cylinders **12** will not be formed.

It is considered preferable to locate the spark plugs **43** in the cavities **19** between the vales **21** and **22** and a considerable distance from the larger ends of the cavities **19** so that the charges that are compressed in the combustion chamber of the engine will commence to burn as near as possible to the center mass of the charge in cavities.

I claim:

A process of forming a combustion chamber cavity in a head for a cylinder of an internal combustion engine comprising the steps of positioning a rotating obliquely mounted frusto conical metal cutter adapted to also be rotated about an axis of a supporting machine tool and having a work engaging end surface of less diameter than that of the cavity, engaging said end surface of said frusto conical tool with said cylinder head thereby machining a portion of a wall of said cavity so as to produce a finished oblique surface having a chord of intersection between said oblique cavity wall and a horizontal surface of said cylinder head that spans substantially less than 180° of the finished cavity, and removing said cutter at its precise place of insertion whereby a combustion chamber cavity that is not widened by initial and terminating movements of the cutter is produced, thereby substantially reducing overlap between the cylinder head cavity and a mating engine block cylinder cavity so as to prevent engine preignition which occurs when such an overlap exists.

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