July 11, 1961 W. V. BRIEN 2,991,780

COMBUSTION CHAMBERS FOR INTERNAL COMBUSTION ENGINES

Filed Dec. 9, 1959

2 Sheets-Sheet 1

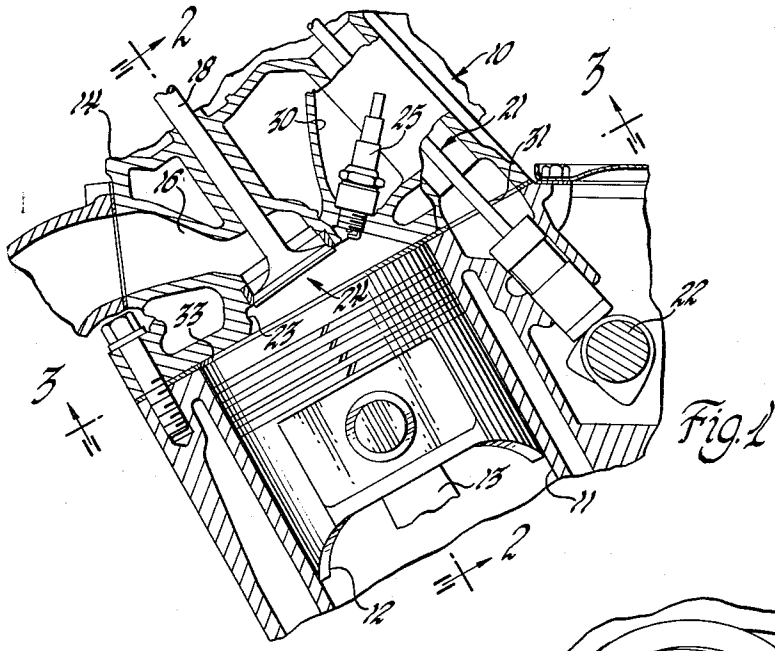

Fig. 1

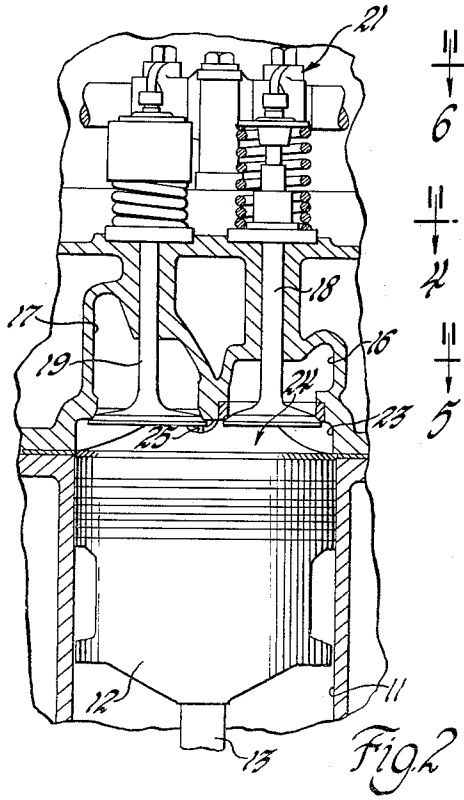

Fig. 2

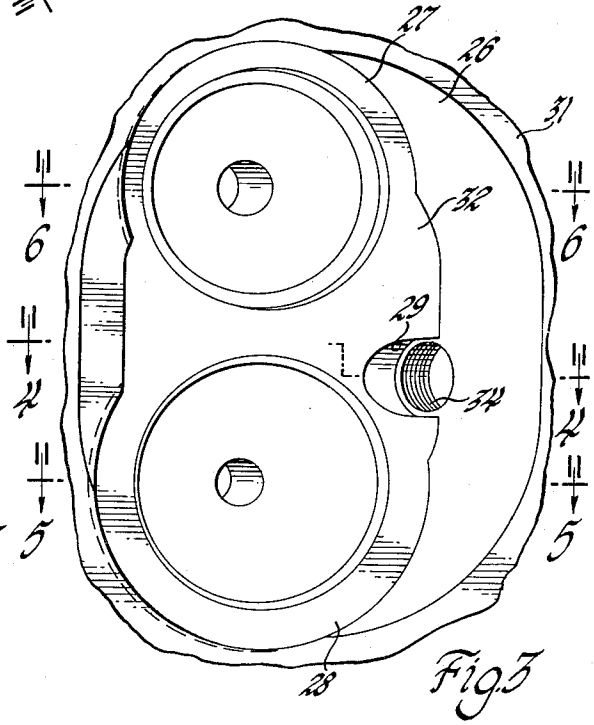

Fig. 3

INVENTOR.
Wayne V. Brien
BY
L. D. Burch
ATTORNEY.

July 11, 1961 W. V. BRIEN 2,991,780

COMBUSTION CHAMBERS FOR INTERNAL COMBUSTION ENGINES

Filed Dec. 9, 1959 2 Sheets-Sheet 2

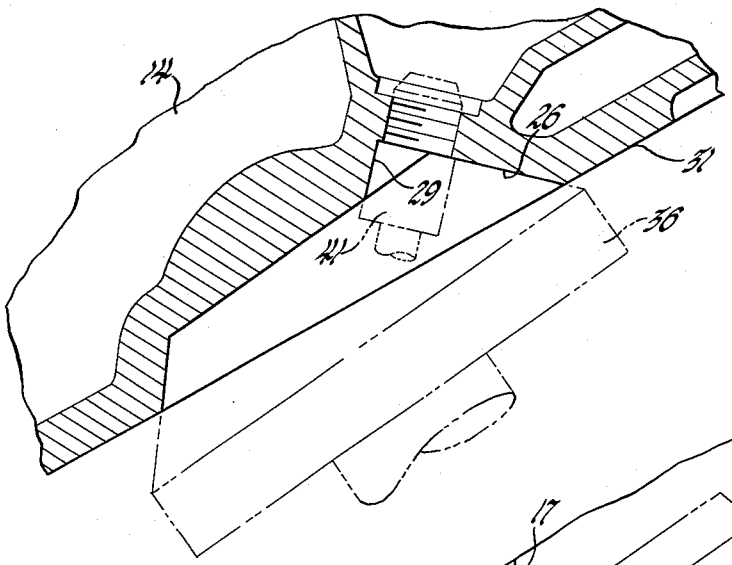

Fig 4

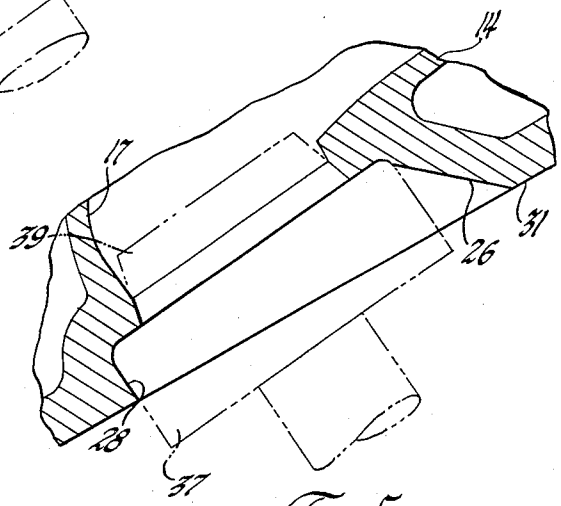

Fig 5

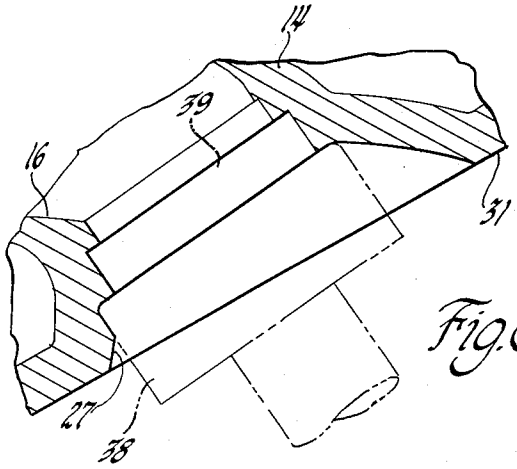

Fig 6

INVENTOR.
Wayne V Brien
BY
L. A. Burck
ATTORNEY

United States Patent Office 2,991,780 Patented July 11, 1961

2,991,780

COMBUSTION CHAMBERS FOR INTERNAL COMBUSTION ENGINES

Wayne V. Brien, Pontiac, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Filed Dec. 9, 1959, Ser. No. 858,409
4 Claims. (Cl. 123—191)

This invention relates to combustion chambers for internal combustion engines, particularly to combustion chambers formed by intersecting surfaces of revolution.

It is desirable to provide combustion chambers in which the surfaces either are machined or die cast from tools that may be easily machined. This provides a closer control of combustion chamber volume, particularly in multiple cylinder internal combustion engines that are made of cast iron, aluminum or other materials. It is also desirable to provide combustion chambers that can be made in different sizes on the same production equipment merely by changing the cutting tools employed, but without changing the distances through which the tools operate. Squish or quench areas are also desirable in combustion chambers but these should be located to promote the efficient combusion of fuel. This is sometimes difficult in combustion chambers that are machined or otherwise produced. Squish areas which force the charge into the firing chamber as the piston travels upwardly should create a turbulence that will promote a rapid flame travel and should be positioned to cool the last part of the charge to burn, thereby reducing the tendency of this part of the charge to spontaneously ignite. The mass of the charge should also be concentrated as near as possible to the spark plug so that as the flame travel progresses the area of the flame front will decrease. It is also desirable to machine or otherwise form the surfaces of a combustion chamber so that there will be no sharp corners between the intersecting surfaces, it being preferable that all such corners should be formed by surfaces disposed in obtuse angular relation.

The foregoing desirable features are thought to be embodied in the combustion chamber embracing the invention herein disclosed.

In the drawings:

FIGURE 1 is a fragmentary cross-sectional view of a multiple cylinder V-type internal combustion engine for automotive and other uses.

FIGURE 2 is a fragmentary longitudinal sectional view illustrating one cylinder of the engine disclosed by FIGURE 1. FIGURE 2 is taken substantially in the plane of line 2—2 on FIGURE 1, looking in the direction of the arrows.

FIGURE 3 is a fragmentary view of a cavity in one of the heads of the engine disclosed by FIGURES 1 and 2 and particularly illustrating the machined or otherwise formed surfaces of revolution that form the cavity. FIGURE 3 illustrates the head structure before the valves and spark plugs are assembled in the head and substantially as it would appear in the plane of line 3—3 on FIGURE 1, looking in the direction of the arrows.

FIGURES 4, 5 and 6 are fragmentary views that are taken substantially in the planes of lines 4—4, 5—5 and 6—6 on FIGURE 3, looking in the direction of the arrows on these lines. FIGURES 4, 5 and 6 illustrate in outline certain tools that may be employed in forming the surfaces defining the cavity illustrated by FIGURE 3.

The engine 10 is a six-cylinder 60° V-type internal combustion engine that is especially adaptable for use in driving trucks and busses, although such an engine might be used for any other purpose.

The engine 10 has cylinders 11 containing reciprocating pistons 12 that are connected by connecting rods 13 to the rotatable crankshaft of the engine. The outer ends of the cylinders 11 are closed by heads 14 in which exhaust passages 16 and inlet passages 17 are formed and which are adapted to exhaust the products of combustion from and supply combustible charges to each of the cylinders 11 of the engine 10. The exhausting and charging of the cylinders is controlled by exhaust valves 18 and inlet valves 19, there being a pair of these valves for each of the cylinders 11. The valves 18 and 19 are actuated by valve actuating mechanism 21 that are driven by the camshaft 22 in timed relation to the operation of the crankshaft of the engine.

The exhaust and inlet passages in the heads 14 open into firing chambers 23 that extend into the heads 14 and that include the greater part of the spaces between the cylinders and the pistons and the heads and that form the combustion chambers 24 for the cylinders of the engine. The combustion chambers have spark plugs 25 which are secured in the heads 14 and with the terminals projecting into the combustion chambers 24. The heads are formed to provide cavities 30 on the inside of each head and one of which is provided for each cylinder 11 of the engine. The firing chambers 23 are provided by forming cavities in the heads of the engine, there being one of the cavities or firing chambers 23 for each of the cylinders 11 of the engine. It is proposed to form the cavities 23 by employing surfaces of revolution which intersect one another and which provide proper communication with the exhaust and inlet passages 16 and 17 and with the spark plugs 25. Each of the cavities or firing chambers 23 may be formed by surfaces of revolution indicated at 26, 27, 28 and 29. It is proposed to form the surfaces of revolution 26 as an elongated right frusto conical surface of revolution, the axes of which are in a plane coincident with or parallel to the axes of the valves 18 and 19 for each cylinder 11 of the engine. The inner end of each of the surfaces of revolution 26 is a plane surface 32 that is normal to the axes of the valves 18 and 19. It is proposed to form the surfaces of revolution 26 in such a way that the ends of the surfaces will be disposed obliquely to the plane surfaces 31 on which the heads 14 and the cylinders 11 are secured together. The outer ends of the frusto conical surfaces 26 intersect and terminate in the plane surfaces 31 of the heads 14. The surfaces of revolution 27 and 28 may have outer cylindrical surfaces that intersect the sides of the frusto conical surfaces 26 and include plane end surfaces that form a continuation of the plane surfaces 32 forming the inner ends of the frusto conical surfaces 26. The surfaces 27 and 28 are formed concentrically relative to the axes of the valves 18 and 19 and are large enough to provide suitable clearances around the valve so that the charging and exhausting gases can flow freely inwardly or outwardly around the valves. The surfaces of revolution 29 may also include cylindrical surfaces which intersect the inner ends 32 of the frusto conical surfaces 26 and which terminate at the ends in plane surfaces substantially coincident with the side surfaces of the frusto conical surfaces 26 and in the plane parts of the side surfaces between the arcuate ends thereof. It will be noted that all of the surfaces 26, 27, 28 and 29 forming the cavities 23 intersect in obtuse angular relation to provide corners that are not sharp corners.

It is proposed to form the cavities 23 in the heads 14 in such a way that the larger ends of the cavities will be on the spark plug sides of the cylinders and that the cavities will be closer to the edges of the spark plug sides of the cylinders than to the opposite edges of the cylinders. This will provide relatively large squish or quench areas 33 on the sides of the cylinders opposite the spark plugs. The spark plugs 25 are located in the heads in such a way that the threads of the spark plugs

will engage threaded openings 34 in the heads that are axially aligned with the cylindrical sides of the surfaces 29 so that when the spark plugs are secured in the heads the terminals of the spark plugs will be within the cavities 23 and partly within the surfaces 29. The valves 18 and 19 are disposed in the heads 14 so that the inner surfaces of the valves will be substantially within or parallel to the end surfaces 32 of the frusto conical surfaces 26 and from which the ends of the surfaces 27 and 28 extend.

It will be apparent that when the pistons 12 compress explosive charges in the combustion chambers 24 the squish areas 33 will cause turbulence in the combustion chambers by discharging blasts of compressed charges toward the spark plugs 23. This will cause a rotation of the charges in the firing chambers 23 toward the spark plugs on the sides of the combustion chambers adjacent the pistons and away from the spark plugs on the sides of the firing chambers adjacent the valves. This rotation of the charges will cause a proper explosive mixture to be available for ignition adjacent the spark plugs. Then when the charges are ignited the flame fronts will advance from the spark plugs across the firing chambers toward the quench areas 33 which will cause the last part of the charge to burn to be cooled by the quench areas 33. Also, since the spark plugs are on the sides of the firing chambers having the greatest volume it will be apparent that the charges will burn across the firing chamber toward the shallower sides of the firing chamber and this will decrease the areas of the flame fronts as they progress across the firing chambers. It will be further noted that all of the surfaces of the firing chambers intersect one another and the surfaces 31 on the heads 14 to provide obtuse angular corners.

FIGURES 4, 5 and 6 illustrate tools that may be employed to finish the cavities 23 in the heads 14. FIGURE 4 illustrates a rotating tool 36 that may be employed in forming the frusto conical surface 26. The tool may be projected into the head at either end of any cavity and may be moved across the head with the axes of the tool in a plane parallel to or coincident with the axes of the valves 18 and 19. This will form the elongated parts of the surfaces of the cavities 23. It will be noted that the tool 36 is a frustum of a right circular cone, that the inner end of the tool is disposed obliquely to the surface 31 of the head 14 and that the side surfaces of the tool intersect the surfaces 31. The intersection of the sides of the elongated frusto conical surfaces 26 and the surfaces 31 provide large base areas for the frusto conical surfaces 26 and the end of the tool 36 forms the surfaces 32 which are the smaller base surfaces of the frusto conical surfaces 26. A rotating tool such as that indicated at 37 may be employed for forming the surfaces 28 of the cavities 23. This tool may be projected into the heads with the axis of the tool in alignment with the axes of the valve guides for the inlet valves 19 and until the end of the tool is in the plane of the inner ends 32 of the frusto conical surfaces 26. A rotating tool 38 may be similarly projected into the head with the axis thereof in alignment with the axes of the valve guides for the exhaust valves of the cylinders and until the end of the tool is in the plane of the surfaces 32. The tools 37 and 38 also may have end parts 39 which will finish the valve seats and the parts of the passages 16 and 17 adjacent the valve seats. A rotating tool such as that indicated at 41 may also be projected into the heads with the axis thereof in alignment with the axes of the openings 34 receiving the spark plugs 25. The tool 41 will cut the surfaces 29 that intersect the end surfaces 31 and will terminate in the sides of the frusto conical surface 26. FIGURE 3 illustrates how one of the cavities 23 will appear before the spark plug and valves are installed and after the surfaces 26, 27, 28 and 29 are finished.

I claim:

1. A combustion chamber for an internal combustion engine having a cylinder and a head, said cylinder and said head having plane mating surfaces on which said cylinder and said head are secured together and said head having inlet and exhaust passages opening into said combustion chamber through inlet and exhaust valves in said head and said head having a spark plug having terminals projecting into said combustion chamber, and comprising, an elongated cavity formed in said head and extending through said plane surface of said head and into which said inlet and exhaust passages open through said valves, said cavity being formed by intersecting surfaces of revolution, one of said surfaces of revolution being a laterally elongated frusto conical surface of revolution having laterally spaced and parallel axes and having the smaller base thereof formed as a plane surface terminating within said head in spaced relation to said plane surface of said head and having the larger base thereof terminating in said plane surface of said head and having said spaced axes in a plane extending across said head substantially in parallel relation to a plane through the axes of said valves, the other of said surfaces of revolution being surfaces of revolution formed coaxially with the axes of said valves and extending within and forming the seats for said valves and forming valve opening clearances around said seats substantially in the plane of said smaller base of said frusto conical surface of revolution.

2. A combustion chamber for an internal combustion engine having a cylinder and a head, said cylinder and said head having plane mating surfaces on which said cylinder and said head are secured together and said head having inlet and exhaust passages opening into said combustion chamber through inlet and exhaust valves in said head and said head having a spark plug having terminals projecting into said combustion chamber, and comprising, an elongated cavity formed in said head and extending through said plane surface of said head and into which said inlet and exhaust passages open through said valves, said cavity being formed by intersecting surfaces of revolution, one of said surfaces of revolution being a laterally elongated frusto conical surface of revolution having laterally spaced and parallel axes and having the smaller base surface thereof formed as a plane surface terminating within said head in spaced relation to said plane surface of said head and having the larger base surface thereof terminating in said plane surface of said head and having said spaced axes in a plane extending across said head substantially in parallel relation to a plane through hte axes of said valves, the other of said surfaces of revolution being surfaces of revolution formed coaxially with the axes of said valves and extending within and forming the seats for said valves and forming valve opening clearances around said seats substantially in the plane of said smaller base of said frusto conical surface of revolution, said intersecting cavity surfaces of revolution forming obtuse angles between said cavity surfaces of revolution throughout said cavity, said laterally elongated frusto conical surface of revolution and said plane surface of said head also forming obtuse angles between the intersecting surfaces thereof.

3. A combustion chamber for an internal combustion engine having a cylinder and a head, said cylinder and said head having plane mating surfaces on which said cylinder and said head are secured together and said head having inlet and exhaust passages opening into said combustion chamber through inlet and exhaust valves in said head and said head having a spark plug having terminals projecting into said combustion chamber, and comprising, an elongated cavity formed in said head and extending through said plane surface of said head and into which said inlet and exhaust passages open through said valves, said cavity being formed by intersecting surfaces of revolution, one of said surfaces of revolution being a laterally elongated frusto conical surface of

revolution having laterally spaced and parallel axes and having the smaller base thereof formed as a plane surface disposed obliquely to said plane surface of said head and terminating within said head in spaced relation to said plane surface of said head and having the larger base thereof terminating in said plane surface of said head and having said spaced axes in a plane extending across said head substantially in parallel relation to a plane through the axes of said valves, other of said surfaces of revolution being surfaces of revolution formed coaxially with the axes of said valves and extending within and forming the seats for said valves and forming valve opening clearances around said seats substantially in the plane of said smaller base of said frusto conical surface of revolution, another of said surfaces of revolution being a surface of revolution formed coaxially with the axis of said spark plug, said another surface of revolution being formed between the ends of said cavity and on the side of said cavity where said smaller base is the greatest distance from said plane surface of said head.

4. A combustion chamber for an internal combustion engine having a cylinder and a head, said cylinder and said head having plane mating surfaces on which said cylinder and said head are secured together and said head having inlet and exhaust passages opening into said combustion chamber through inlet and exhaust valves in said head and said head having a spark plug having terminals projecting into said combustion chamber, and comprising, an elongated cavity formed in said head and extending through said plane surface of said head and into which said inlet and exhaust passages open through said valves, said cavity being formed by intersecting surfaces of revolution, one of said surfaces of revolution being a laterally elongated frusto conical surface of revolution having laterally spaced and parallel axes and having the smaller base thereof formed as a plane surface disposed obliquely to said plane surface of said head and terminating within said head in spaced relation to said plane surface of said head and having the larger base thereof terminating in said plane surface of said head and having said spaced axes in a plane extending across said head substantially in parallel relation to a plane through the axes of said valves, other of said surfaces of revolution being surfaces of revolution formed coaxially with the axes of said valves and extending within and forming the seats for said valves and forming valve opening clearances around said seats substantially in the plane of said smaller base of said frusto conical surface of revolution, another of said surfaces of revolution being a surface of revolution formed coaxially with the axis of said spark plug, said another surface of revolution being formed between the ends of said cavity and on the side of said cavity where said smaller base is the greatest distance from said plane surface of said head, said plane surface of said head forming a quench area over said cylinder on opposite sides of said cavity, said squish area on the side of said cylinder opposite said spark plug being substantially greater than said squish area on the side of said cylinder adjacent said spark plug.

References Cited in the file of this patent

UNITED STATES PATENTS

2,347,097	Ginn et al.	Apr. 18, 1944
2,617,400	Weaving	Nov. 11, 1952
2,718,221	Leach	Sept. 20, 1955
2,736,306	McDuffie	Feb. 28, 1956
2,800,123	Fisher	July 23, 1957
2,803,228	Sorensen	Aug. 20, 1957

FOREIGN PATENTS

301,797	Italy	Oct. 12, 1932