June 12, 1956 B. J. MITCHELL 2,749,899

COMBUSTION CHAMBER

Filed April 16, 1952 2 Sheets-Sheet 1

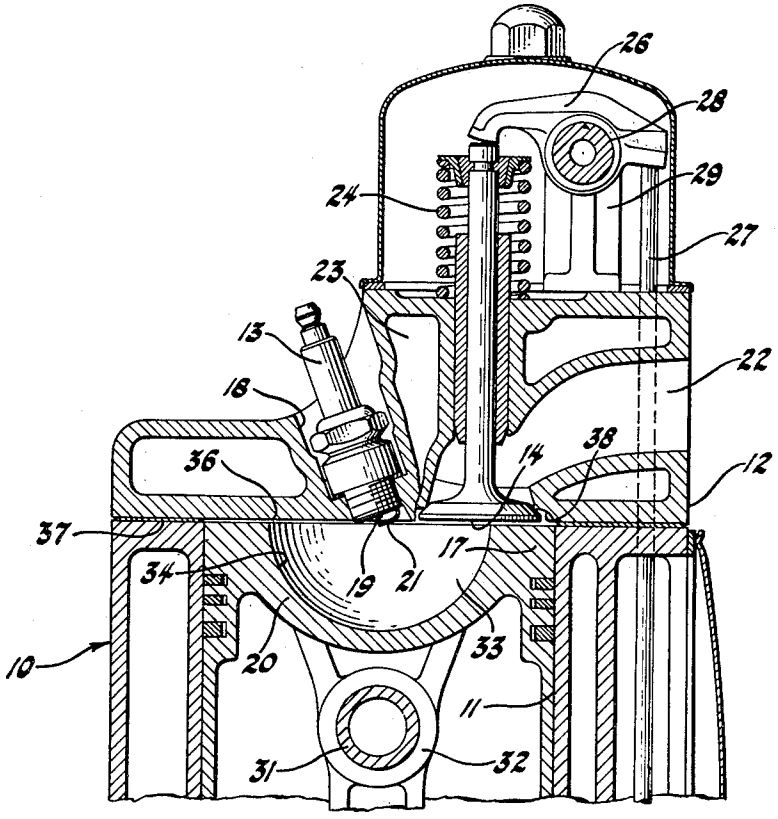


Fig. 1

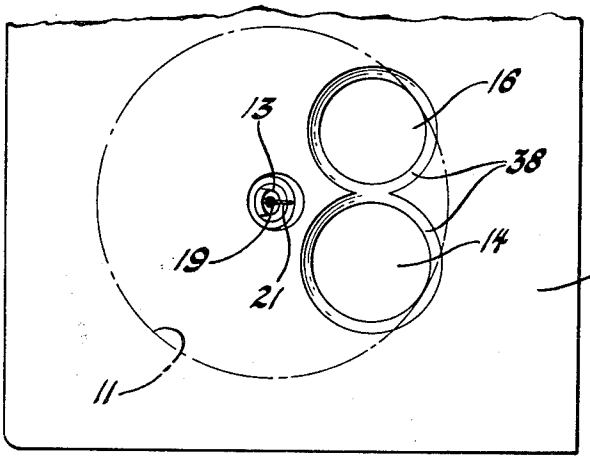


Fig. 2

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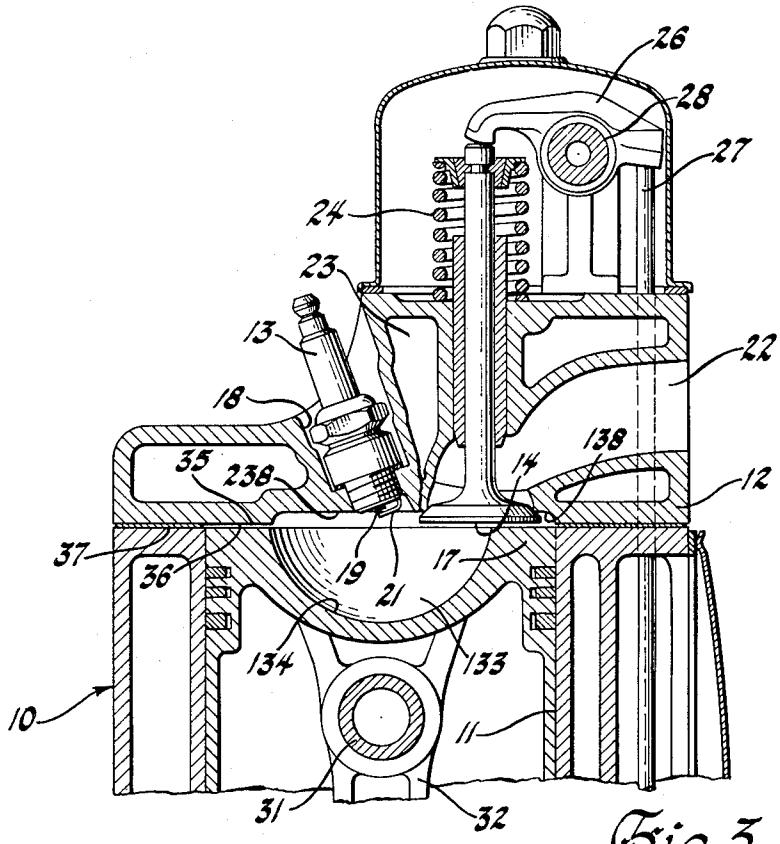


Fig. 3

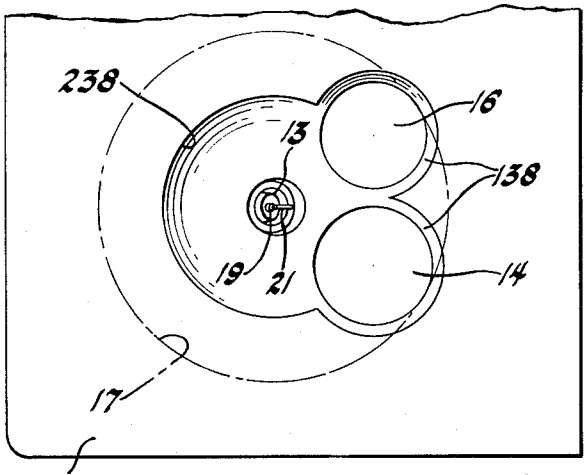


Fig. 4

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COMBUSTION CHAMBER

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3 Claims. (Cl. 123—191)

The invention relates to combustion chambers for internal combustion engines and has particular relation to combustion chambers especially suitable for spark-ignited, poppet valve, four stroke cycle, piston and cylinder, internal combustion engines for automotive use.

It is customary to construct the combustion chambers of poppet valve type internal combustion engines largely to meet the requirements of the valves. Large inlet valves are required to provide good volumetric efficiency, and while it is customary to employ smaller exhaust valves than inlet valves, it is still necessary to provide exhaust valves of considerable size to prevent excessive losses in exhausting the cylinders of the engine. In small bore long stroke engines or in engines where the bore does not exceed the stroke, it is difficult particularly in valve in head engines to design a proper combustion chamber that will operate at high compression ratios with low octane fuel, when valves capable of meeting the above requirements are employed.

It is now proposed to design the engine and the combustion chamber around the requirements for good combustion. It is proposed to increase the bore and to decrease the stroke until a large enough cylinder is provided that the spark gap of the spark plug can be located at the center of the major part of the combustion chamber and the valves can be located in the space between the spark plug and the periphery of the cylinder wall. Such an expedient will not only improve the octane rating of the engine but will decrease the length of the cylinders, the connecting rods and the throw of the crankshaft, etc., thereby providing a more compact, efficient and a less expensive engine.

In the drawings:

Figure 1 is a fragmentary transverse sectional view of an engine having a combustion chamber embracing the principles of the invention.

Figure 2 is a bottom plan view of the engine head, valves and spark plug assembly employed in the structure disclosed by Figure 1.

Figure 3 is a transverse sectional view of an engine having a combustion chamber constructed according to another form which the invention may assume.

Figure 4 is a bottom plan view of the engine head assembly structure illustrated by Figure 3.

In the structure disclosed by Figures 1 and 2, there is disclosed a four stroke cycle, internal combustion engine indicated by the numeral **10**. The engine **10** comprises a cylinder **11**, head **12**, a spark plug **13**, inlet and exhaust valves **14** and **16** respectively, and a piston **17**.

The spark plug **13** is secured in an opening **18** in the head **12** with the spark gap **19** between the terminals **21** thereof approximately on the axis of the cylinder **11**. The inlet valve **14** is somewhat larger than the exhaust valve **16**, each being of proper sizes to provide good breathing and exhaust for the piston displacement in the cylinder. The inlet valve **14** is located between the spark plug **13** and the edge of the cylinder **11** and supplies a combustible mixture to the engine through inlet passage

22. The exhaust valve **16** is also located between the spark plug **13** and the inner surface of cylinder **11** for exhausting the cylinder through the exhaust passage controlled by the valve. It will be noted from Figure 2 that the inlet valve **14** and exhaust valve **16** are located as far away from the spark plug **13** as is possible to remain within the cylinder **11**. This is done so that cooling water within the cooling cavity **23** in the head **12** can circulate between the spark plug **13** and the valves **14** and **16**. The valves **14** and **16** may be closed by springs **24** and opened in properly timed relation to one another and to the crankshaft of the engine by rocker arms **26** actuated by push rods **27** or by other suitable means. The rocker arms **26** may be mounted for rotation on a shaft **28** supported upon the head of the engine by supports indicated at **29**. The piston **17** has a piston pin **31** engaged by a connecting rod **32** operated by the crankshaft of the engine. The relation between the throw of the crankshaft and the diameter of the cylinder **11** is such that the engine **10** will operate as a large bore short stroke engine. An example of such an engine would be any engine in which the diameter of the cylinder exceeds the axial movement of the piston in the cylinder. The diameter of the cylinder **11** and consequently of the piston **17** is in the present instance great enough to permit the spark gap of the spark plug **13** to be on the axis of the cylinder **11** and yet to provide room for the use of inlet and exhaust valves of normal size in the head of the cylinder.

An example of the relation between the size of the valves **14** and **16** and the size of the cylinder **11** might be given as follows: An engine as constructed heretofore might have a displacement in each cylinder based on the movement of a three inch piston throughout the four inch stroke. In order to provide for proper breathing and exhaust in such an engine, it has been found necessary to provide inlet and exhaust valves of sizes X and Y respectively. Also it has been found necessary to locate the spark plug with the terminals thereof in such position that the spark gap between the terminals was not upon the axis of a cylinder or at the center of the combustion chamber of the engine.

In the present instance the cylinder **11** might be four inches in diameter and the stroke of the piston two and a quarter inches. This would provide the same displacement as the engine previously referred to and it would provide room enough in the head end of the engine and within the walls of the cylinder **11** to provide valves of a size X and Y as previously used and to locate the spark gap between the terminals of the spark plug **13** upon the axis of the cylinder **11**.

The combustion chamber in any cylinder of the engine **10** includes a substantially hemispherical firing chamber **33** formed between a concave wall **34** forming a part of the head end of the piston **17** and the head of the engine. The hemispherical outer surface of the wall **34** forming the chamber **33** terminates in a clearance space **36** of shallow annular formation between the head end of the piston **17** and the lower plane surface **35** of the cylinder head **12**. The clearance space **36** is of minimum depth to provide a relatively small part of the total combustion chamber space. A minimum clearance space may be equal to or less than the thickness of the cylinder gasket **37** which is employed between the head **12** and the cylinder **11**. Such gaskets are generally about .070 of an inch in thickness although gaskets much thinner than this may be employed. It is possible to make the clearance space **36** no more than .010 or .020 of an inch in thickness and this may be desirable as a minimum clearance in certain instances.

It may also be desirable to provide annular valve clearances indicated at **38** and formed in the surface **35** around

both the inlet and exhaust valves 14 and 16. The valve clearances 38 may overlap the edge of the hemispherical combustion chamber space indicated at 33 as is shown by Figures 1 and 2 of the drawing. It is then possible to have good breathing and exhaust notwithstanding the fact that the valves 14 and 16 to a large extent overlie the shallow clearance space 36. The valves 14 and 16 when closed form substantially a continuation of the lower plane surface 35 of the head 12 thereby continuing the clearance space 36 at substantially the same depth throughout the annular extent thereof.

It will be apparent that the combustion chamber space comprises the hemispherical chamber or opening in the piston 17, the annular space 36 between the piston and the head, the annular clearance spaces 38 around the valves, and whatever space there may be at the end of the spark plug 13 and around the spark plug terminals 21; that the spark gap 19 is substantially equidistant in all directions from the hemispherical outer surface of the wall 34 of the chamber 33 and from the outer peripheral edge of the annular clearance space 36, and that the annular clearance spaces 38 around the engine valves also are in communication with the main part of the combustion chamber which consists of a hemispherical chamber 33. When the spark at the spark gap 19 ignites the mixture in the combustion chamber, the flame will travel at practically a uniform rate throughout the chamber 33 and will reach all parts of the hemispherical surface of the wall of the chamber 33 at the same time. Under such circumstances there will be no unburned pockets of fuel in the chamber 33 which do not ignite until after the main parts of the charge have ignited. With respect to the relatively small part of the charge that may be contained within the annular clearance space 36, it will be apparent that the flame will reach all parts of the inner periphery of the annular clearance space at practically the same time. As the clearance space 36 is relatively shallow substantially and of uniform depth the charge will burn in this clearance space on a flame front that is relatively long and narrow and that is exposed to practically the same extent at the opposite edges thereof to the radiant heat absorbing surfaces of the piston 17 and the head 12. The flame therefore will tend to burn the charge in the clearance space 36 at a relatively slower rate than within the chamber 33 and the flame will approach the outer periphery of the annular clearance space 36 at a relatively uniform rate in all directions. There will therefore be no unburned pockets of the charge in annular clearance space 36 that do not burn until after the main part of the charge in the annular clearance space 36 has burned. The part of the charge contained in the clearance spaces 38 around the valves 14 and 16 may burn at a somewhat more rapid rate than the charge in the annular clearance space 36 but will be burned by the time the burning of the charge in the annular clearance space 36 is completed. There will therefore be no unburned pockets of fuel remaining in the annular clearance spaces 38 after the greater part of the charge in the remaining parts of the combustion chamber of the engine has been burned.

The structure disclosed by Figures 3 and 4 has elements of engine construction that are the same as the corresponding elements of engine construction disclosed by Figures 1 and 2. The same reference numerals therefore are applied to these elements in Figures 3 and 4 as have been applied thereto in Figures 1 and 2. Also the characteristics of engine operation and combustion as described with respect to Figures 1 and 2 also are applicable to the structure disclosed by Figures 3 and 4. The principal difference between the structures lies in the fact that the annular clearance spaces 138 surrounding the valves 14 and 16 in Figures 3 and 4 extend at 238 throughout the central part of the cylinder 11 and overlaps and

forms a part of the hemispherical chamber 133. The spark plugs 13 therefore are positioned in the head 12 in such a way that the spark gap 19 between the terminals 21 thereof remain substantially equidistant from all parts of the wall 134 of the piston 17. The extension 238 of the annular clearance spaces 138 therefore forms a part of the hemispherical chamber 133 and the flame which starts at the spark gap 19 therefore will reach all parts of the surface of the wall 134 at approximately the same time. It will also be apparent that the flame will reach all parts of the annular clearance space 36 at approximately the same time and the burning of the charge in the clearance space 36 and in the clearance spaces 138 will occur in the same manner as has previously been described.

I claim:

1. A large bore short stroke engine comprising a cylinder having an inner wall surface, a head and a piston with said piston being reciprocably mounted in said cylinder, said head having an inner wall formed to provide substantially a plane inner wall surface closing the end of said cylinder, said piston having an end wall formed to provide a concentrically disposed hemispherical wall surface extending therein and a concentrically disposed annular wall surface surrounding said hemispherical surface and terminating at the inner wall surface of said cylinder, said inner wall surfaces of said piston and said head and said cylinder forming a combustion chamber for said engine and including a firing chamber formed between said inner wall surface of said head and said hemispherical wall surface of said piston and communicating with the inner edge of a minimum mechanical clearance space formed between said inner wall surface of said head and said annular wall surface of said piston, a spark plug secured in said head and having the spark gap terminals thereof extending through said head and disposed substantially at the center of said hemispherical and annular surfaces forming said firing chamber and said minimum mechanical clearance space, a pair of inlet and exhaust valves disposed in said head and opening inwardly through said inner wall surface of said head and extending throughout the greater part of said inner wall surface between said spark plug and the inner wall surface of said cylinder on one side of said spark plug and having the inner surfaces thereof extending substantially in the plane of said inner wall surface of said head, said inlet and exhaust valves being positioned in said head to overlap said annular clearance space and said firing chamber.

2. A large bore short stroke engine as defined by claim 1 and having annular clearance spaces formed in said inner wall surface of said head and surrounding said valves.

3. A large bore short stroke engine as defined by claim 1 and having annular clearance spaces recessed in the inner wall surface of said head and surrounding said valves and extending to the edges of said firing chamber and terminating in said inner wall surface of said head at the periphery of said hemispherical depression.

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