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COMBUSTION CHAMBER

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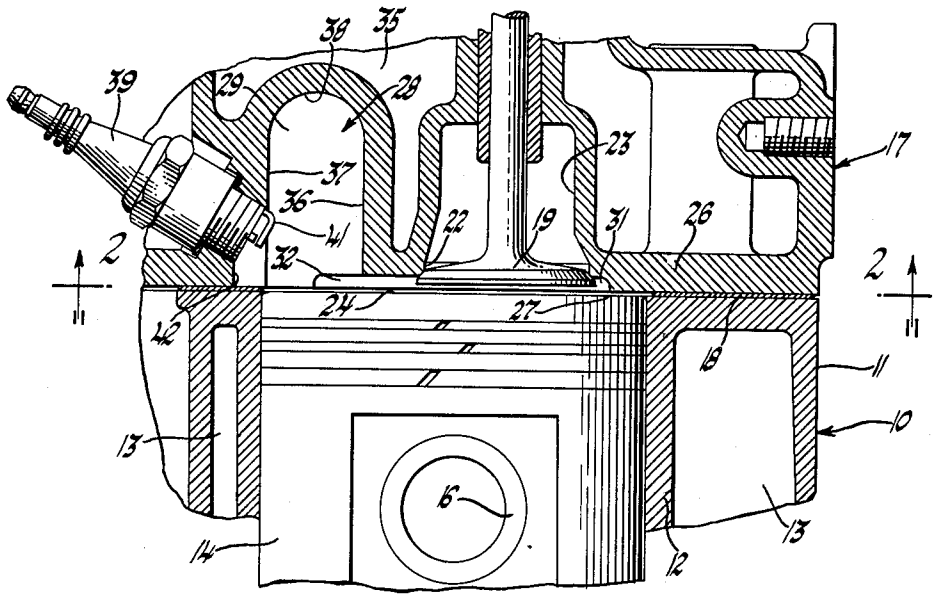

Fig. 1

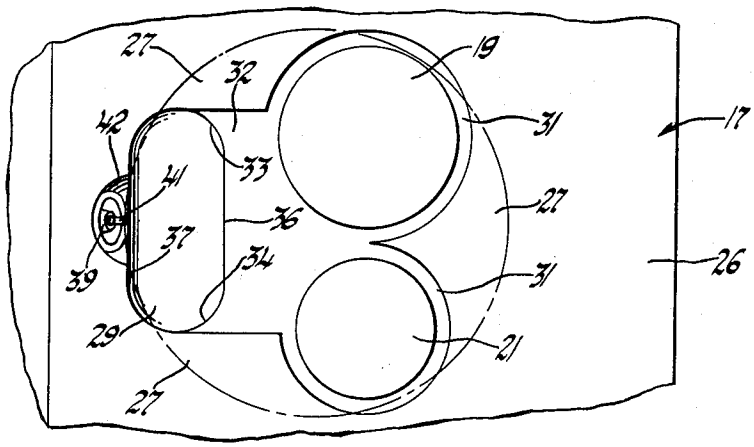

Fig. 2

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COMBUSTION CHAMBER

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4 Claims. (Cl. 123—191)

This invention relates to spark ignited, piston and cylinder type internal combustion engines adapted to operate without objectionable detonation on commercial grades of hydro-carbon fuels.

The combustion chamber is especially applicable to valve-in-head engines in which one or more of the inlet and exhaust valves opens into a mechanical clearance space between the end of the piston and the head. The firing chamber forming part of the combustion chamber is located in the head at one side of the valves and communicates with the mechanical clearance space and the cylinder in directly opposed relation to the piston. The firing chamber is elongated transversely and axially of the cylinder and has an outlet which is as large in cross-sectional area as any other part of the firing chamber. The ignition terminals of a spark plug are disposed in the outlet so that the burning will start in the outlet and will progress across the outlet to the clearance space between the piston and the head before a large part of the charge is burned in the ends of the firing chamber remote from the outlet.

In the drawing:

Figure 1 represents a fragmentary cross-sectional view of an engine, partly through the axis of a cylinder and partly through the axis of one of the valves.

Figure 2 is a fragmentary upside down plan view of the head of the engine, taken substantially in the plane of line 2—2 on Figure 1.

The engine **10** comprising the invention includes an engine block **11** having one or more cylinders **12** formed therein. The block **11** is provided with cavities **13** for cooling fluid for cooling the cylinders **12**. The cylinders **12** contain reciprocal piston **14** adapted to drive the connecting rods of a crankshaft through piston pins indicated at **16**. The cylinders **12** of the block **11** have a head **17** adapted to be bolted or otherwise secured to the block **11** upon a cylinder gasket indicated at **18**. The head **17** has inlet and exhaust valves **19** and **21** respectively adapted to control ports communicating with the interior of the cylinder **12** and through which fluid is supplied to and exhausted from the engine through inlet and exhaust passages also formed in the head **17**. One of the inlet passages and one of the inlet ports are indicated respectively by the numerals **22** and **23**. The valves **19** and **21** may be operated in any conventional manner as by being resiliently closed by springs and opened by rocker arms and push rods actuated by a cam shaft driven by the crankshaft of the engine **10**. The inlet passages leading to the ports **22** controlled by the valves **19** may be supplied with a combustible mixture of hydro-carbon fuel and air by any suitable charge forming device for the engine **10**. The exhaust passages leading from the exhaust ports controlled by the exhaust valves **21** may be connected to any suitable exhaust system for exhausting the products of combustion from the engine **10**.

The piston **14** may be formed in such a way as to provide a plane end wall adjacent the head **17**, which is

uniformly spaced from the adjacent plane surface of the lower wall **26** of the head **17**. The space **27** between the walls **24** and **26** of the piston **14** and head **17** respectively provides a minimum mechanical clearance for operating the piston **14**. The space **27** also provides a quench space forming a part of the combustion chamber of the engine. The thickness of the mechanical clearance or quench space **27** ordinarily is of gasket thickness, this being generally in the neighborhood of about .070 of an inch. However, such mechanical clearance or quench space may vary considerably, from a few thousandths of an inch to perhaps a hundred thousandths of an inch or more. The combustion chamber **28** of the engine comprises a firing chamber **29**, the mechanical clearance or quench space **27** and valve clearance spaces **31** which are formed part of the way around the valves **19** and **21** and which merge with a passage **32** extending across the head **17** to the outlet end of the firing chamber **29**. The firing chamber **29** is formed in the head **17** at one side of and relatively close to the valves **19** and **21**. However, it is desirable to cool the head **17** and the various passages and engine elements therein. For this purpose a cooling fluid cavity **35** is formed in the head **17** in such manner that a part of the cavity extends between the firing chamber **29** and the inlet and exhaust passages controlled by the valves **19** and **21**.

It is also desirable to construct the head **17** in such a way that the outlet end of the firing chamber **29** and the valves **19** and **21** are substantially directly opposed to the open end of the cylinder **12**. In order to insure ease of manufacture and an unrestricted outlet between the firing chamber **29** and the interior of the cylinder **12** the firing chamber is formed in such a way as to include oppositely disposed semi-cylindrical walls **33** and **34** which project into the head **17** in parallel relation. It is preferable to connect the edges of the semi-cylindrical walls **33** and **34** by plane side walls **36** and **37** and that the axes of the semi-cylindrical end walls **33** and **34** project into the head **17** in parallel relation to the axis of the cylinder **12**. The inner end wall **38** of the firing chamber **29** may be formed of arcuate shape or in any suitable manner so long as it does not contain pockets or other enlargements making the inner end of the firing chmber **29** larger than the various parts thereof extending toward the firing chamber outlet. The engine **10** is provided with a spark plug **39** which is secured in a threaded opening formed in the head **17** in such a manner that the ignition terminals **41** of the spark plug are directly within the outlet by which the firing chamber **29** communicates with the interior of the cylinder **12**. In the present instance the outlet end of the firing chamber **29** is enlarged adjacent the terminals **41** by an arcuate formed recess **42** which projects into the lower extremity of the side wall **37** of the chamber **29**. The recess **42** is wide enough and the terminals **41** are so near being within the wall **37**, that the walls of the recess **42** do not materially affect the initial rapid burning of the charge around the terminals **41**. The firing chamber **29** extends in length in parallel relation to a line between the axes of the valves **19** and **21**. Also, the spark plug **39** is located approximately at the mid-point between the opposite ends of the firing chamber **29**. It is preferred that the axis of the spark plug should be directed obliquely across the middle of the firing chamber **29** and toward a point immediately below the lower edge of the side wall **36** of the firing chamber **29**. Hence, the progress of the flame from the terminals **41** will be directly across the outlet from the firing chamber and toward the middle of the various clearance spaces beneath the wall **36** of the head **17**. In addition, it is preferred to have the firing chamber also elongated in a direction parallel to the axis of the cylinder **12** so that the terminals **41** of the spark plug **39** are closer to the adjacent edges of the clearance

spaces 32 and 27 than to the various parts of the firing chamber 29 which are remote from the outlet by which the firing chamber communicates with the interior of the cylinder 12.

The burning in the combustion chamber 28 will start at the ignition terminals 41 of the spark plug 39 and since the ignition terminals are in the enlarged outlet by which the firing chamber 29 communicates with the interior of the cylinder 12 the burning will expand rapidly in the outlet and will progress directly across the outlet to the various narrow spaces where the firing chamber 29 communicates with the clearance spaces 32, 31 and 27. Thereafter the burning will continue toward the more remote parts of the firing chamber 29 and of the clearance spaces 32, 31 and 27. It will be apparent that some parts of the clearance spaces 27 are somewhat remote from the firing chamber 38. However, since the clearance spaces 27 are very shallow and contain very little of the charge in proportion to the area of the piston and the head to which such small portions of the charge are exposed the rate of burning in the clearance spaces 27 will be relatively slow. The clearance spaces 32 and 31 which surround the valves 19 and 21 are relatively not so shallow as the clearance spaces 27 and consequently the burning will be somewhat more rapid in the clearance spaces 32 and 31. However, the clearances spaces 32 and 31 are exposed to a relatively large amount of surface area of the head 17 and the piston 14 and consequently the burning in these spaces is not so rapid as it would be in an unrestricted space. In addition to this, the clearance spaces 32 and 31 communicate directly with the outlet part of the firing chamber 29 which is directly opposite the ignition terminals 41 of the spark plug 39. The edge of the space 32 therefore is nearer the ignition terminals 41 than are the remote parts of the firing chamber 29. The burning in the clearance spaces 32 and 31, therefore, will start considerably before the final part of the charge is burned in the remote parts of the firing chamber 29 and before the pressure and temperature rise in the charge in the combustion chamber has become excessive. The charge in the clearance spaces 32 and 31 therefore will commence to burn fairly quickly but will burn somewhat slowly across the clearance spaces until the final part of the charge in these clearance spaces is burned.

In the claims:

1. An engine comprising a cylinder having a reciprocal piston therein and inlet and exhaust valves in the head of said cylinder, a firing chamber for said cylinder and projecting into said head at one side of said valves, said firing chamber being formed by spaced semi-cylindrical end walls having the axes thereof disposed in parallel relation to the axis of said cylinder and being tangently connected to one another by parallel and plane side walls, and a spark plug having the ignition terminals thereof projecting into a part of said firing chamber adjacent the outlet of said firing chamber.

2. An engine comprising a cylinder having a reciprocal piston therein and inlet and exhaust valves in the head of said cylinder, a combustion chamber formed in said cylinder and comprising a firing chamber formed in said head at one side of said valves and a minimum mechanical space between the end of said piston and the head of said cylinder and said valves, said combustion chamber also including a valve clearance space extending around each of said valves and between said valves and the outlet leading from said firing chamber, said firing chamber being formed to provide an elongated outlet leading to said cylinder and extending in parallel relation to a line connecting the axes of said valves, said outlet having a cross-sectional area as great as any other part of said firing chamber and communicating with said valve clearance space throughout the length of the elongated outlet from said firing chamber, and a spark plug secured in said head, said spark plug having the ignition terminals thereof projecting into said outlet with the axis of said spark plug directed transversely across said outlet to said firing chamber and toward the middle of the part of said valve clearance space communicating with said firing chamber outlet.

3. An engine comprising a cylinder having a reciprocable piston therein and inlet and exhaust valves in the head of said cylinder and in opposed relation to the end of said piston, a combustion chamber including a firing chamber formed in said head at one side of said valves and a minimum mechanical clearance space formed between the end of said piston and the head of said cylinder and said valves, said firing chamber being elongated in length and height and with the length and height thereof extending in parallel relation to the stems of said valves and with the width thereof extending normally with respect to the stems of said valves, said firing chamber having an elongated outlet having a cross sectional area as great as that of any other inwardly disposed part of said firing chamber and communicating with said minimum mechanical clearance space throughout the length of said elongated outlet, and a spark plug secured in said head, said spark plug having the ignition terminals thereof projecting into said firing chamber adjacent said outlet and with the axis of said spark plug directed transversely across said firing chamber and toward the middle of the opposite wall of said firing chamber, said ignition terminals being positioned in said firing chamber with the spark gap therebetween in position to burn an ignitable charge compressed in said firing chamber directly across said firing chamber and toward said opposite wall thereof and throughout an arc of substantially 180°.

4. An engine comprising a cylinder having a reciprocable piston therein and inlet and exhaust valves in the head of said cylinder and in opposed relation to the end of said piston, a combustion chamber including a firing chamber formed in said head at one side of said valves and a minimum mechanical clearance space formed between the end of said piston and the head of said cylinder and said valves, said firing chamber being elongated in parallel relation to the stems of said valves and having an outlet with a cross sectional area as great as that of any other part of said firing chamber and communicating with said minimum mechanical clearance space, and a spark plug secured in said head, said spark plug having the ignition terminals thereof projecting into said firing chamber adjacent said outlet with the axis of said spark plug being directed transversely across said firing chamber and toward the middle of the opposite end of said firing chamber and toward said outlet, said ignition terminals being positioned in said firing chamber with the spark gap therebetween in position to burn an ignitable charge compressed in said firing chamber directly across said firing chamber and toward said opposite end thereof and toward the adjacent edge of said minimum mechanical clearance space and throughout an arc of substantially 180°.

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