Sept. 7, 1954

W. CZARNOCKI

PISTON AND CYLINDER CONSTRUCTION FOR INTERNAL-COMBUSTION ENGINES

2,688,320

Filed Oct. 23, 1951

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Fig. 1

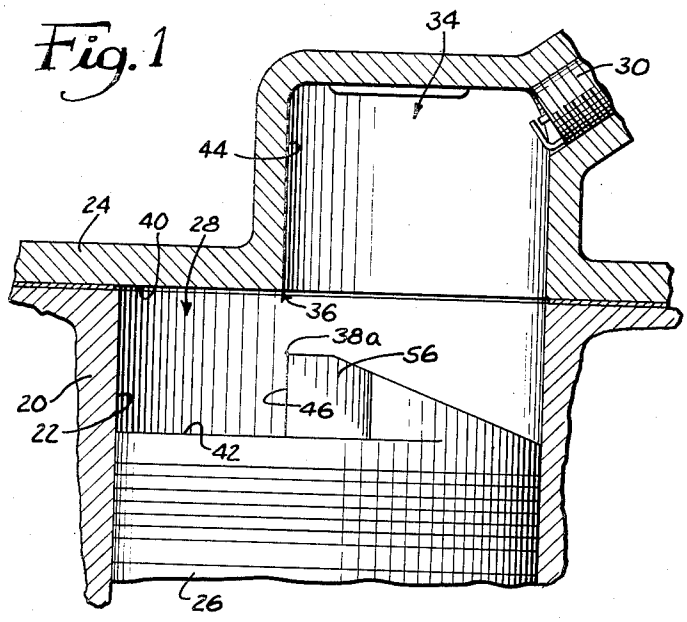
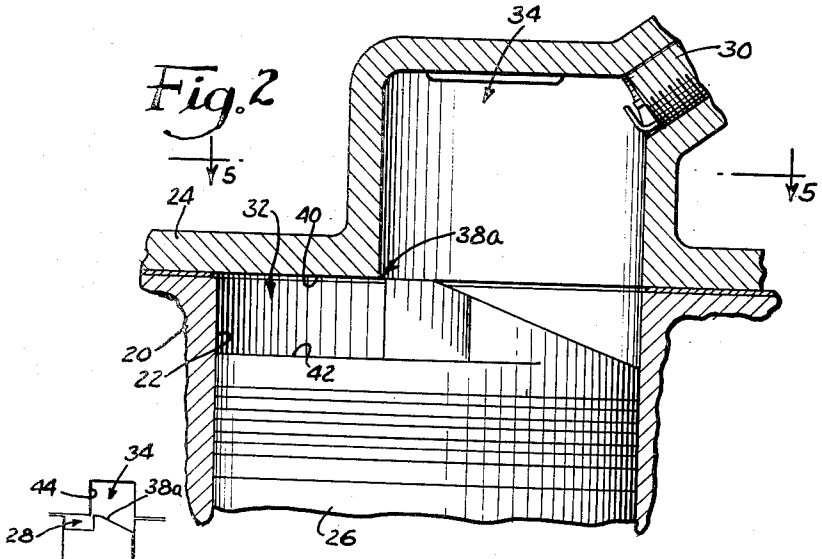


Fig. 2



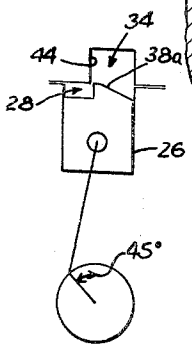


Fig. 3

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Fig. 4

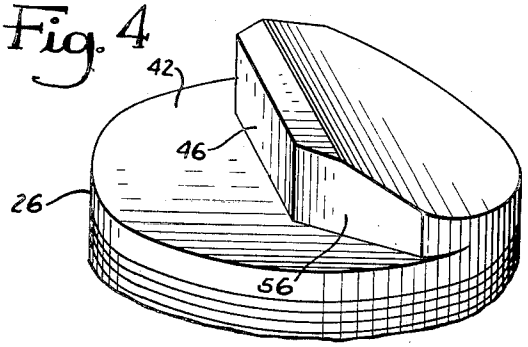


Fig. 5

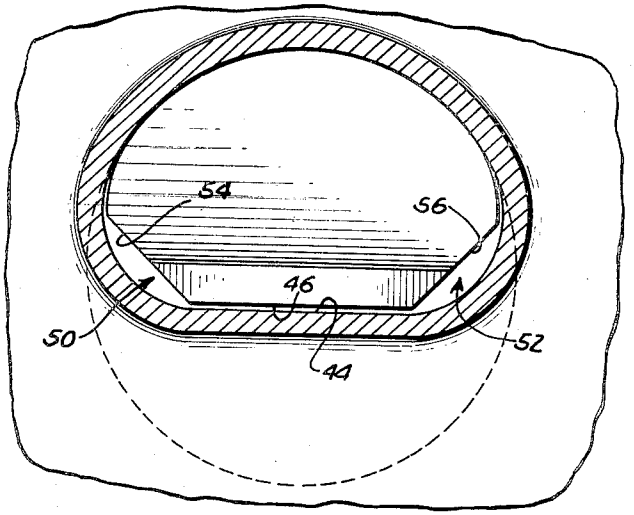
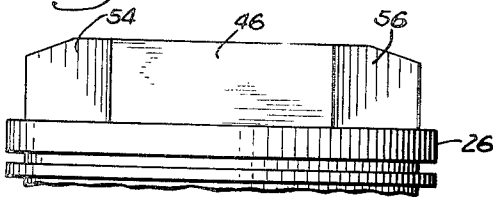


Fig. 6



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PISTON AND CYLINDER CONSTRUCTION FOR INTERNAL-COMBUSTION ENGINES

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Application October 23, 1951, Serial No. 252,712

Claims priority, application Great Britain January 17, 1951

2 Claims. (Cl. 123—191)

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The present invention relates generally to internal combustion engines and more particularly to the construction of pistons and cylinders for such engines. The invention represents further developments in the improvements in piston and cylinder constructions as disclosed in the copending application of Henry George Ferguson, Alexander Senkowski and William Henry Harrow, Serial No. 248,674, filed September 28, 1951.

As disclosed in the aforesaid copending application, engine performance is enhanced as compared to that theretofore possible through the utilization of piston and cylinder constructions wherein, as the piston approaches its top dead center position in its compression stroke, the compartment defined by the piston and cylinder is effectually divided into two chambers, a pump chamber and a combustion chamber, having restricted communication therebetween. As the compression stroke of the piston continues, the portion of the charge in the pump chamber is compressed therein and is forced into the combustion chamber for deflection by the walls thereof in a manner to impart a swirling motion to the charge in the latter chamber.

It is an object of the present invention to provide a novel piston and cylinder construction for producing improved engine performance and more efficient fuel utilization wherein extremely severe turbulence is effected within the combustion chamber thereof for a substantial portion of the compression stroke of the piston as a result of collision of different portions of the charge of fuel vapor and air mixture introduced into the combustion chamber to the end that mixing of the charge and flame propagation is enhanced.

The object of the invention thus generally set forth together with other objects and ancillary advantages are shown by way of illustration in the accompanying drawings, in which:

Figure 1 illustrates in fragmentary vertical section a cylinder construction with a piston therein shown in fragmentary side elevation embodying the features of the present invention.

Fig. 2 is similar to Fig. 1 but illustrates different relative positions of the piston and cylinder.

Fig. 3 is a diagrammatic representation of the piston and cylinder construction shown in the preceding figures and illustrates crankshaft position for the piston disposition relative to the cylinder as illustrated in Fig. 2.

Fig. 4 is a fragmentary perspective view of the crown portion of the piston shown in Figs. 1 and 2.

Fig. 5 is a fragmentary transverse section taken substantially in the plane of line 5—5 in Fig. 2.

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Fig. 6 is a fragmentary front elevation of the piston crown portion shown in Fig. 4.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawings and will herein be described in detail the preferred embodiment, but it is to be understood that it is not thereby intended to limit the invention to the form disclosed, but it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring more particularly to the drawings, there is shown a portion of an engine block 20 having a cylindrical bore 22 therein which is closed at one end by a head 24. The portion of the block 20 defining the cylindrical bore 22 and the portion of the head 24 closing the upper end of the bore are conventionally termed a cylinder. Reciprocable within the cylinder is a piston 26. The piston together with the cylindrical wall of the bore 22 and the overlying portion of the head 24 define a compartment, generally designated 28, into which a combustible charge comprising a mixture of fuel vapor and air is introduced. After compression by upward movement of the piston 26, the charge is ignited by means of an electric spark from a spark plug 30. Thus the charge is burned, and the resulting expansion drives the piston downwardly thereby converting the energy of the charge into useful work.

The cylinder and piston are especially constructed so that as the piston approaches the upper end of its stroke (Fig. 2), the compartment 28 is effectually divided into two chambers, a pump chamber 32 and a combustion chamber 34, with restricted communication being provided between the two. As a result, and upon further movement of the piston 26 toward a top dead center position, a portion of the charge introduced into the compartment 28 is compressed in each of the two chambers 32 and 34. That portion of the charge compressed in the pump chamber 32 is forced therefrom at high velocity into the combustion chamber 34.

As shown, the cylinder head 24 and the crown portion of the piston 26 are formed with substantially complementary projections or steps, generally designated 36 and 38 respectively, which interfit toward the top of the stroke of the piston to define the two chambers 32 and 34. These steps include parallel faces 40 and 42 on the cylinder head 24 and piston 26, respectively, which lie substantially perpendicular to the axis of the piston and cylinder. Additionally, the steps include contiguous faces 44 and 46, respec-

tively, lying substantially parallel to the axis of the piston and cylinder and, as shown, are laterally offset therefrom. The latter faces extend transversely of the cylinder and piston and have a minimum working clearance therebetween which may, for example, be on the order of .040''. As indicated in Figs. 2 and 4, the height of the piston step **38** is such that the upper edge **38***a* thereof is oppositely disposed with respect to the lower edge of the cylinder head step when there is approximately 45° of angular crankshaft travel left before the piston reaches top dead center position in its compression stroke. It is at this point that the piston and cylinder head steps cooperate to divide the compartment **28** into the two chambers **32** and **34**. Continued upward movement of the piston **26** toward its top dead center position increases the overlap of the vertical faces **44** and **46** of the cylinder head and piston steps **36** and **38** and traps a portion of the charge of fuel vapor and air mixture in the pump chamber **32** as well as continuing to compress that portion of the charge in the combustion chamber **34**.

In carrying out the present invention, the restricted communication provided between the two chambers **32** and **34** is such that the portion of the charge trapped in the pump chamber **32** is forced therefrom into the combustion chamber **34** in a plurality of streams which are of such velocity and are so directed as to collide in the combustion chamber and create severe turbulence therein. More particularly, spaced ducts are provided to afford communication between the pump and combustion chambers **32** and **34** so that charge trapped in the former chamber during the remaining part of the compression stroke of the piston is forced through the ducts in the form of streams directed so as to collide within the combustion chamber, the resulting intermingling thereof enhancing mixing of the fuel vapor and air of the charge prior to ignition by operation of the spark plug **30** and thereafter enhancing flame propagation.

In the illustrative embodiment, communication between the pump chamber **32** and the combustion chamber **34** is provided by a pair of spaced ducts **50** and **52** disposed at the ends of the overlapped faces **44** and **46** of the cylinder head and piston steps **36** and **38**. The ducts **50** and **52** are defined by chamfered vertical faces **54** and **56** disposed in angular relation to the face **46** of the piston step **38** and the oppositely disposed portions of the side wall of the cylinder head step adjacent the ends of the face **44** thereof.

In view of the relatively close spacing between the faces **44** and **46** of the head step and the piston crown step, substantially all of the charge compressed in the pump chamber **32** is forced therefrom into the combustion chamber **34** by way of the ducts **50** and **52**. This portion of the charge therefore is directed in two streams upwardly and at opposite sides of the combustion chamber **34** toward the top wall thereof. Upon impingement of the two charge streams on the top wall of the combustion chamber, each stream is deflected inwardly toward the other and generally toward the spark plug **30**. It is apparent therefore that the two streams collide and intermingle and because of their velocity, severe turbulence is produced within the combustion chamber **34**.

It has been found that experimental engines

equipped with pistons and cylinders constructed in accordance with the present invention have improved engine performance through more efficient fuel utilization as compared to similar engines employing conventional piston and cylinder constructions. Additionally, it has been found that the instant construction affords a better ignition range, that is, ignition can be further advanced with less or without detonation as compared to conventional constructions and as compared to those described in the aforesaid copending application.

I claim as my invention:

1. In an internal combustion engine, the combination comprising a cylinder, a piston reciprocable within said cylinder, and a head closing one end of said cylinder having a step including a side wall having a face lying generally in the direction of travel of said piston, said piston having a step formed on its crown portion including a face lying generally in the direction of travel thereof, said steps interfitting with said faces overlapping and having minimum working clearance therebetween as said piston approaches a top dead center position to define pump and combustion chambers, said piston step being relieved at the ends of said piston face to define faces disposed in angular relation to said piston face and lying generally in the direction of travel of said piston, and the portions of the side wall of said head step opposite said angularly disposed faces of said piston step cooperating with said angularly disposed piston step faces to define a pair of spaced ducts interconnecting said chambers.

2. For use in an internal combustion engine having a cylinder and a head closing one end of said cylinder having a step including a side wall having a face lying generally in the direction of travel of said piston, a piston adapted to be received in the cylinder and having a step formed on its crown portion including a face lying generally in the direction of travel thereof, said piston step being adapted to interfit with the head step with said piston step face overlapping the corresponding face of the head step with minimum working clearance therebetween as said piston approaches a top dead center position so as to define pump and combustion chambers, said piston step being relieved at the ends of said piston step face to define other faces disposed in angular relation to said piston step face, said other faces also lying generally in the direction of travel of said piston and being adapted to define with the portions of the side wall of the head step opposite thereto a pair of spaced ducts disposed in the direction of piston travel for interconnecting said chambers.

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