March 11, 1941. C. N. MITCHELL 2,234,844

INTERNAL COMBUSTION ENGINE

Original Filed April 30, 1928

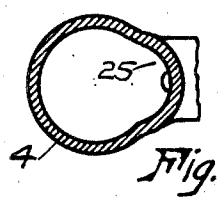


Fig. 4

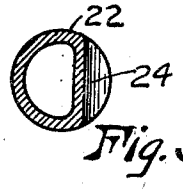


Fig. 3

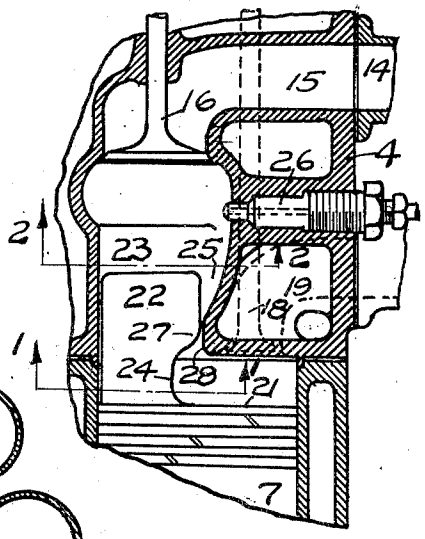


Fig. 2

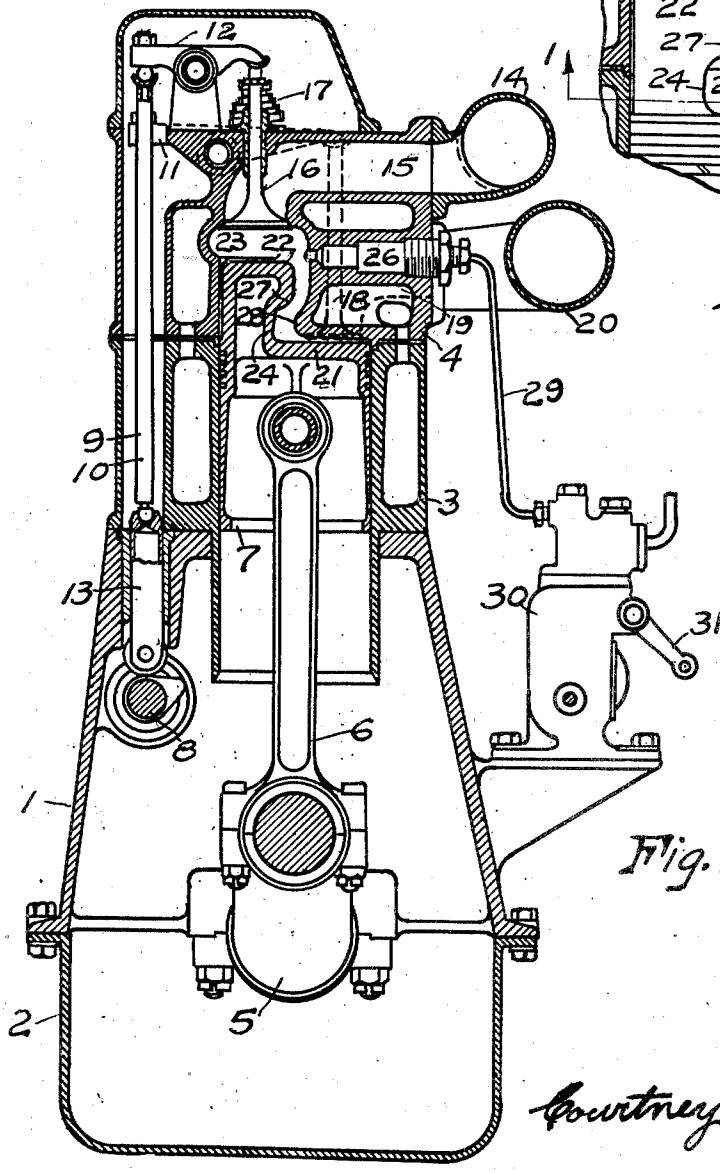


Fig. 1

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INTERNAL COMBUSTION ENGINE

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Original application April 30, 1928, Serial No. 274,133. Divided and this application June 25, 1938, Serial No. 215,750

3 Claims. (Cl. 123—32)

This invention relates to an internal combustion engine and this application is a division of my application Serial No. 274,133, filed April 30, 1928, and renewed December 2, 1932. Its particular features are those shown in Figs. 4 and 5 of the original drawings of that application.

In order that an internal combustion engine of the compression ignition type operate efficiently, means must be provided to completely pulverize the fuel and mix it with the air at the time of injection. Due to air under the high pressures existing in the cylinder at the time of injection being very resistant to penetration by fuel as delivered by an injector, means must be provided to effect this penetration by causing the air to pass the nozzle of the injector in a stream of limited thickness. Failure to obtain penetration results in incomplete combustion causing smoky exhaust and loss of fuel due to over-rich mixtures; or, if all the fuel is to be burned completely, an excess of air must be present to effect this which results in low mean effective pressures and low power out-put. These conditions are emphasized by the results obtained when attempts are made to operate an engine of this kind at high speeds.

The principal object of this invention is to provide means for obtaining penetration of the air by the fuel stream. A further object is to provide an arrangement whereby this penetration is independent of the operating speed of the engine. Another object is to provide an engine which will deliver a high power out-put for each unit of piston displacement volume. Another object is to provide an engine which will be free from smoke, odors and other obnoxious conditions resulting from incomplete combustion. A still further object is to provide an internal combustion engine which can be manufactured at a relatively low cost and from a limited weight of material, and one which will require a minimum amount of repair and service expense.

In attaining these objects, this invention contemplates a combustion chamber construction in which a material portion of the air of compression itself is directed past the injector nozzle in a thin, penetrable stream in order to secure the desired uniform and finely divided mixture of fuel and air within the working cylinder and with the most simple arrangement of parts.

Fig. 1 is a transverse section through the engine showing the general arrangement of parts related to the improved combustion chamber. Fig. 2 is an enlarged fragmentary section of the combustion chamber and related parts. Fig. 3 is a section on line 1—1 of a portion of the piston as indicated in Fig. 2. Fig. 4 is a fragmentary section on line 2—2 of Fig. 2 and for purpose of greater clearness has been added to the drawing.

As this invention is concerned primarily with the elements of the combustion chamber, only a brief mention will be made of the other elements entering into the engine illustrated in the drawing. The crank case 1 is closed at its lower side with the engine pan 2 and is provided at its upper side with cylinder block 3 upon which is arranged cylinder head 4. The crank shaft 5 is mounted in bearings carried by crank case 1 and is joined by connecting rod 6 to piston 7 which is of special construction. The cam shaft 8 is driven from the crank shaft 5 by means of the usual train of gears or by chain and sprockets. The push rods 9 and 10 are actuated by cam shaft 8 through the medium of tappets 13. The push rod 9, which is concealed by push rod 10, actuates rocker arm 11 and push rod 10 actuates rocker arm 12.

An air supply pipe 14 communicates with port 15 and air inlet valve 16. The valve 16 is actuated against the tension of spring 17 by rocker arm 12. The valve 18, which is actuated by rocker arm 11, permits the exhaust gases to pass out through port 19 into exhaust manifold 20. The piston 7 which is provided with the usual rings and piston pin, is of the trunk type and has integrally formed on a part of its head 21 a hollow boss 22 adapted to extend into space 23 provided therefor in the cylinder head 4. This hollow boss, which is of a general cylindrical form, is provided with an under-cut and somewhat flattened part 24 which provides a passage for the gases at one period of the cycle. The lower part or throat leading to the space 23 is of circular section and of suitable size to provide working clearance for the upper part of boss 22. On one side of space 23 somewhat above the circular throat, a cutout portion 25 is provided. This cut out portion 25 is located opposite to and in operating relation with the cut out section 24 of the boss 22. The wall of this cut out portion 25 is curved to form a smooth passage for the gases entering the space 23. An injector 26 is arranged with its nozzle extending slightly through the curved wall of the cut out portion 25.

In the operation of the engine it will be noted that when the piston rises in the cylinder compressing the gases contained therein, the upper

part of boss 22 enters the throat of chamber 23 restricting the flow of the gases into this chamber and causing pressure to build up faster above head 21 than above the boss 22 in space 23. As the piston continues to rise and the pressure difference has increased to an appreciable amount the curved edge 27 of the piston boss 22 passes the curved edge 28 in the wall of chamber 23, and from the space over the piston head 21, the gases, now heated to a high temperature by adiabatic compression, are suddenly released into chamber 23. These gases sweep along the wall of the cut out space 25 and over the nozzle of injector 26 just at the time of injection, the fuel being supplied to the injector through tube 29 by fuel pump 30. As the fuel is thus injected into a rapidly moving stream of hot gases it is thoroughly atomized and burned completely without the usual requirement of excess air.

It is to be noted that the fuel discharged from the injector 26 does not impinge directly against any wall of the combustion chamber if it should pass entirely through the stream of gases, but is directed across a space of considerable magnitude, and the particles of fuel can come in contact with the walls of the chamber 23 only after they have been picked up and at least partly burned by the air contained in the gas stream.

By modifications in the form of the cut out portion 24 of the boss 22 as well as by changes in the contour of the wall of chamber 23 a wide variety of changes can be made in the combustion characteristics of the engine. For variations in the speed and load conditions the timing of the injection is modified. This is accomplished by the manipulation of control lever 31 on the fuel pump 30.

Numerous modifications may be made in the embodiments of my invention such as changing the angle and position of the injector to vary the relation of the fuel stream to the air or gas stream; the provision of two or more steps in the piston boss instead of only one as shown; the direct connection of the fuel pump to the rocker arm or cam shaft to eliminate the use of a separate exterior pump as shown on the present drawing, and numerous other modifications which come within the scope of the following claims.

I, therefore, particularly point out and distinctly claim as my invention:

1. In an engine of the type described, a cylinder, a piston operating in said cylinder, a large combustion chamber, and a small combustion chamber, the piston having a projection adapted to enter the small combustion chamber to substantially isolate said chamber from the large combustion chamber during a part of the stroke of the piston to provide a substantial difference in pressure of gases in the two chambers, a valve controlling a flow of the gases, said valve being substantially coaxial with the aforesaid projection, means for establishing a passage between the combustion chambers before the completion of the aforesaid stroke to equalize the pressures in the two chambers by a sudden flow of a stream of the gases through the passage, and an injector disposed to inject fuel into said stream substantially at the time of maximum velocity of gases through the passage, the fuel being directed across the space between the projection of the piston and the aforesaid valve.

2. In an engine of the type described, a cylinder, a piston operating in said cylinder, a large combustion chamber and a small combustion chamber, the piston having a projection adapted to enter the small combustion chamber to substantially isolate said chamber from the large combustion chamber during a part of the stroke of the piston to provide a greater pressure in the large combustion chamber than in the small combustion chamber, means to establish a passage between the two chambers before the completion of the aforesaid stroke to equalize the pressures in the two chambers by a sudden flow of a stream of gases thru the passage into the small combustion chamber, said passage being provided by an undercut portion of said projection cooperating with a recess in the small chamber, and an injector disposed to inject fuel into the stream flowing in the recess substantially, at the beginning of flow thru the passage.

3. In an engine of the type described, a cylinder, a piston operating in said cylinder, a large combustion chamber and a small combustion chamber, the piston having a projection adapted to enter the small combustion chamber to substantially isolate said chamber from the large combustion chamber during a part of the stroke of the piston to provide a greater pressure in the large combustion chamber than in the small combustion chamber, means to establish a passage between the two chambers before the completion of the aforesaid stroke to equalize the pressures in the two chambers by a sudden flow of a stream of gases thru the passage into the small combustion chamber, said passage being provided by an undercut portion of said projection cooperating with a recess in the small chamber, and an injector extending thru a wall of the recess to inject fuel into the stream flowing therein.

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