Jan. 8, 1946. B. C. FISHER 2,392,371

HIGH COMPRESSION ENGINE FOR LOW TEST FUEL

Filed June 6, 1942 2 Sheets-Sheet 1

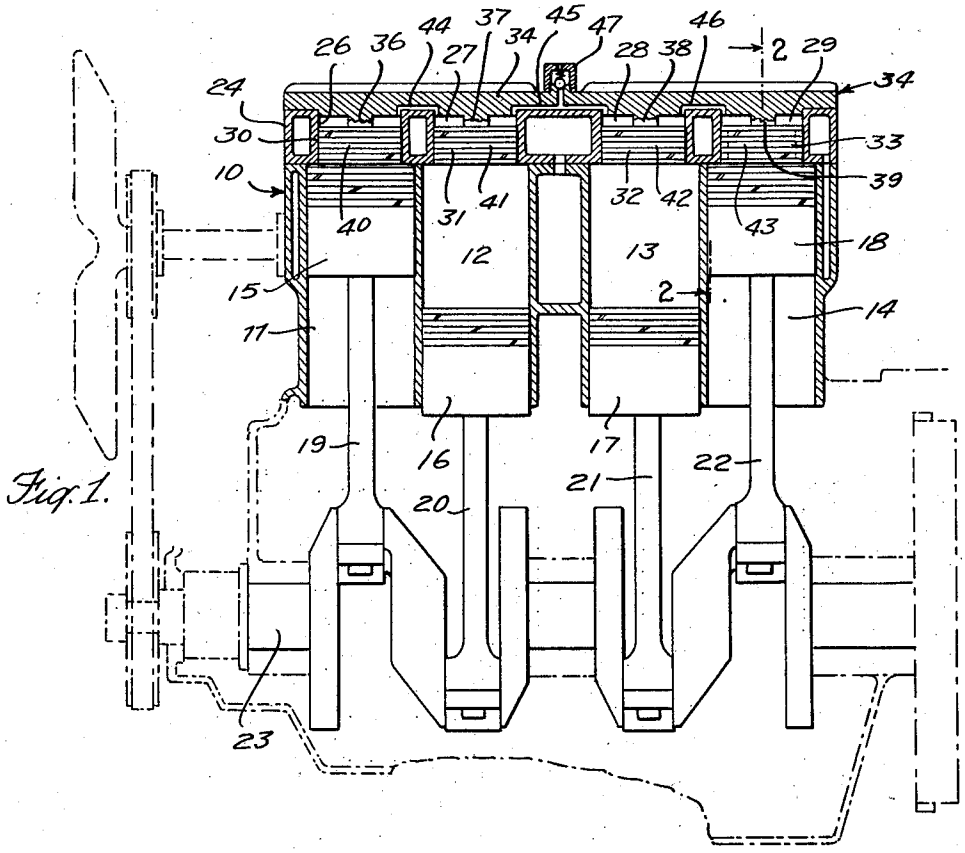


Fig. 1.

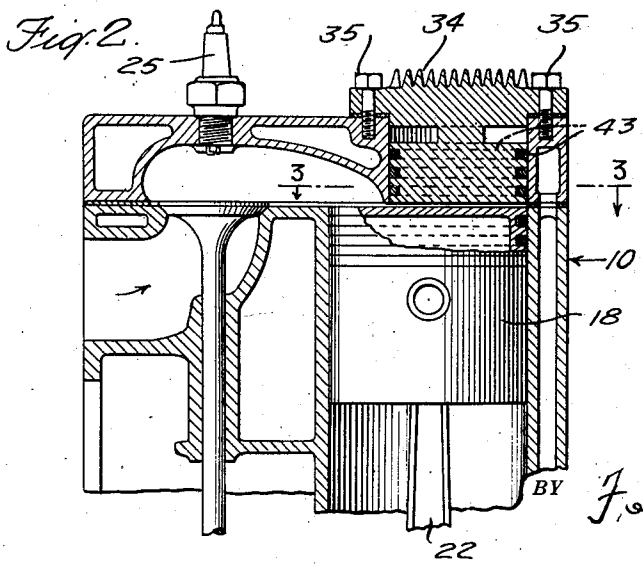


Fig. 2.

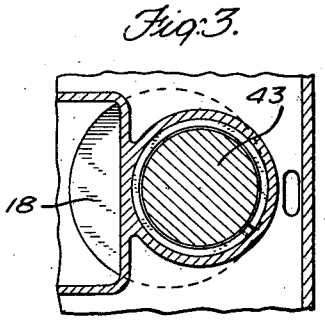


Fig. 3.

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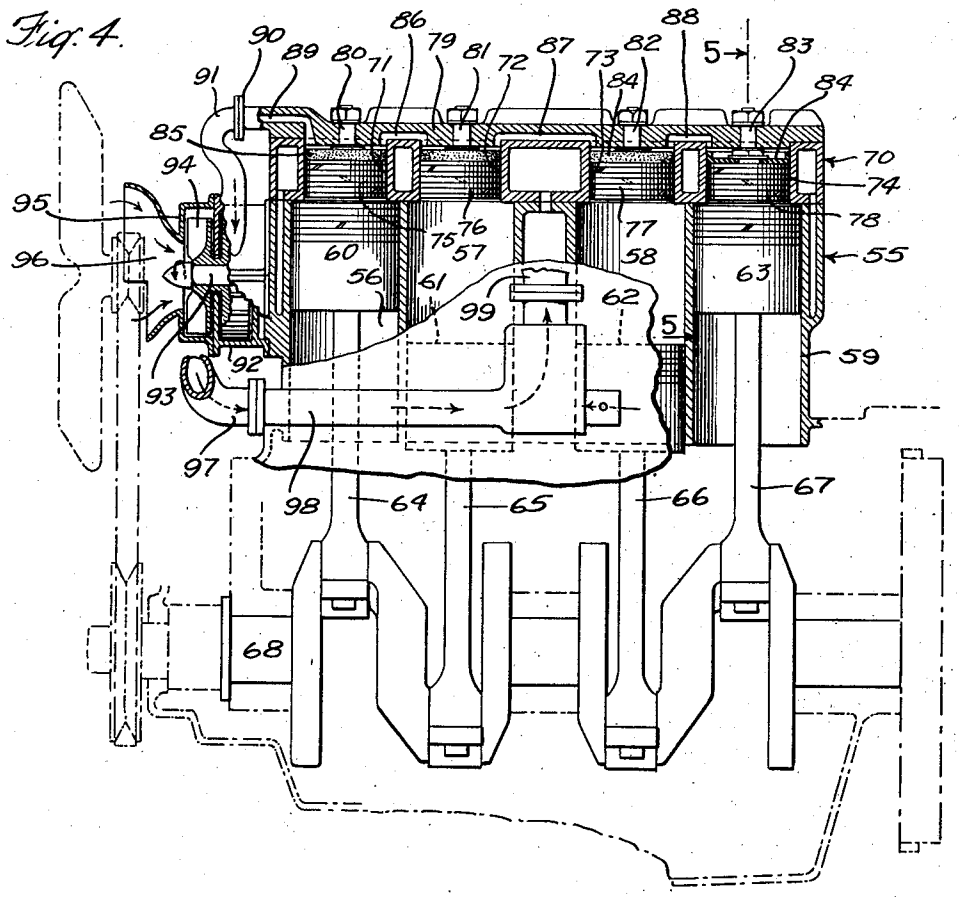
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Fig. 4.



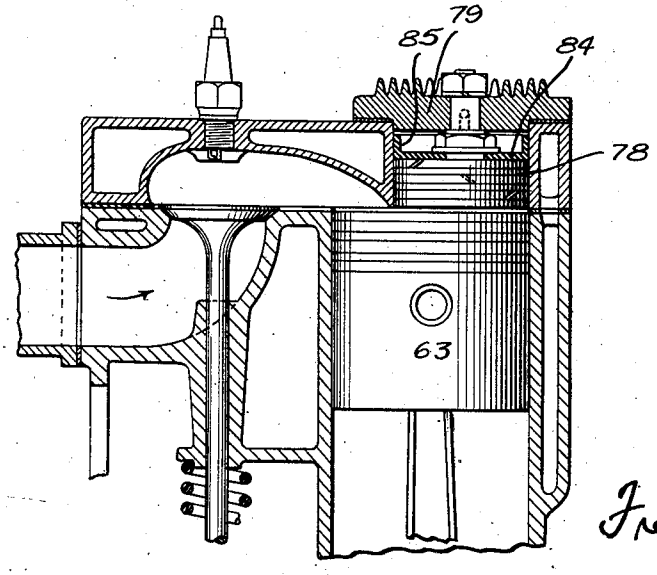


Fig. 5.

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2,392,371

HIGH-COMPRESSION ENGINE FOR LOW-TEST FUEL

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Application June 6, 1942, Serial No. 446,014

8 Claims. (Cl. 123—182)

This invention relates to internal combustion engines and particularly to such engines which are designed to have high compression.

One of the objects of the invention is to provide a high compression internal combustion engine which can utilize low test fuels without detonation.

Another object of the invention is to provide a high compression internal combustion engine with means to relieve the high pressures developed by full load conditions so that detonation is prevented.

Still another object of the invention is to provide a high compression internal combustion engine with means to utilize for a useful purpose in connection with the operation of the engine that part of the explosive pressures which are produced in the cylinders under full load conditions and would normally cause detonation.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts, which will be exemplified in the constructions hereinafter set forth, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a side sectional elevational view of a cylinder block and crank shaft showing my improved invention with additional parts of the engine shown in dot-and-dash lines;

Fig. 2 is an enlarged sectional front view through one of the cylinders of the engine of Fig. 1;

Fig. 3 is an enlarged sectional plan view through the engine head and taken on the line 3—3 of Fig. 2;

Fig. 4 is a sectional side elevational view of an engine block and crank shaft assembly showing a modified form of the invention; and

Fig. 5 is an enlarged sectional front view taken on the line 5—4 of Fig. 4.

Referring now to Fig. 1 of the drawings, a four cylinder engine is shown having an engine block 10 provided with the cylinders 11, 12, 13, and 14 in which operate the working pistons 15, 16, 17, and 18. The pistons are connected respectively by connecting rods 19, 20, 21 and 22 to the usual crank shaft 23.

A head 24 is provided for the engine block 10 and carries the spark plugs 25 in the usual manner. This head, unlike the usual head is provided with openings 26, 27, 28, and 29 which are located directly above the working pistons and are a little over half as large in diameter. These openings are provided with closing plugs 30, 31, 32, and 33 which may be integrally connected with a cover plate 34 held in place by suitable stud bolts 35. The plugs 30, 31, 32, and 33 are made to conform to the openings 26, 27, 28, and 29, which are preferably circular, and the plugs are spaced from the plate 34 by integral portions 36, 37, 38, and 39 of reduced diameter, so that a space is provided between each plug and the plate 34. The plugs 30, 31, 32, and 33 are provided with piston rings 40, 41, 42, and 43 which make a close fit with the interior of the openings, these being bored out similarly to a cylinder for the purpose.

The plugs 30, 31, 32, and 33 do not move in the openings in the cylinder head, but the close fit of the piston rings which are provided on them permit leakage from the combustion space of the main cylinder into the spaces above the plugs 30, 31, 32, and 33. The head 34 is provided with longitudinal grooves 44, 45, and 46 which connect the openings 26 and 27, 27 and 28, and 28 and 29, so that all of these openings are connected together above the plugs 30, 31, 32, and 33. At the center of the engine I provide a relief valve 47 which may be of any desired type and is shown in the drawing as a spring pressed ball seated upon an aperture leading from the groove 45 to the atmosphere.

In the operation of the engine, the piston rings 40, 41, 42 and 43 are tight enough to prevent any leakage into the space above the plugs during the compression stroke. When the explosion takes places, there may be slight leakage past these rings into the spaces above the plugs, but the pressure will soon build up in these spaces, since the relief valve 47 is held closed by the spring, until the pressure will be sufficient to prevent substantial leakage past the piston rings under ordinary reduced load operation of the engine.

However, as soon as full load is applied to the engine and the throttle is wide open, the explosion pressures increase enormously in the combustion chamber, caused by an increased amount of fuel in the combustion space and therefore increased compression. As the explosion takes place some of the gases are forced upwardly past the piston rings 40, 41, 42, and 43 into the spaces above the plugs 30, 31, 32, and 33. Enough of the gases leak up into these spaces at this time to prevent detonation. If the full load and full

throttle conditions are maintained, then the pressures in these spaces begin to build up so much, that, if it were not for the relief valve 47, gases could no longer be forced past the piston rings. This relief valve, however, is adjusted to permit these gases to escape, so that at all times when full load conditions obtain there can be a leakage past the rings which will eliminate detonation.

The effectiveness of the leakage path will be determined by the number, size, and tightness of the rings 40, 41, 42, and 43. These rings should preferably have overlapping joints, as indicated, to cut down the leakage to a minimum. The number required may be determined by a cut-and-try method. By leaving the relief valve open, rings may be added until the leakage is small enough so that it will not interfere with the normal operation of the engine at reduced loads. When this condition is obtained the number of rings will be sufficient. The relief valve 47 may then be adjusted by adjusting the pressure of the spring, so that it will open under full load conditions just sufficiently to prevent detonation. This adjustment may be made by tightening the compression of the spring until detonation occurs and then releasing it slightly.

I have discovered that in order to eliminate detonation and still maintain the efficiency of the engine by providing a leakage path for excess pressures developed at the time of the explosion, it is necessary to have a leakage path of extremely small cross-section and at the same time to have a leakage path which will open into the combustion space through a relatively long distance and adjacent that portion of the combustion space where the flame propagation, which causes detonation, occurs. The arrangement illustrated complies with these requirements. The surfaces of the plugs 30, 31, 32, and 33 are flush with the underside of the head and the lowermost one of the rings 40, 41, 42, and 43, in each case, is closely spaced from these lower surfaces. Thus, the opening of the leakage path is a circle which is positioned slightly off center of the cylinder, as shown in Fig. 3, but which acts in effect like a relatively long crack in the head and extends across a substantial distance of the upper end of the combustion space.

While I have found the arrangement disclosed in Figs. 1 to 3 to be effective in eliminating detonation in high compression engines, I may also utilize the pressures developed in the spaces above the plugs for operating some device which cooperates in the running of the engine. Thus, in Figs. 4 and 5 I have disclosed a modified form of the invention in which the principle of the leakage path is much the same. Here a four cylinder engine is shown with a cylinder block 55, having cylinders 56, 57, 58, and 59 provided with working pistons 60, 61, 62, and 63 connected by connecting rods 64, 65, 66, and 67 to a crank shaft 68.

A head 70 is similar to the head 24 of Fig. 1 and is provided with openings 71, 72, 73, and 74 into which are fitted the plugs 75, 76, 77, and 78. These plugs are held in position by a cover plate 79 which is secured upon the head 70 by bolts, not shown, similar to the bolts of Fig. 2. The plugs 75, 76, 77, and 78 are mounted upon the plate 79 by means of posts 80, 81, 82, and 83 which extend up from the plugs and are secured against the upper and lower surfaces of the plate, 79 by suitable securing nuts which space the plugs from the plate, as indicated.

The plugs differ from those described in connection with Fig. 1 in that each is provided on the top surface with a flexible gasket 84 which is secured against the upper surface of the plug by means of securing nuts. The gaskets may be made of leather, fiber, or other suitable material which will withstand the conditions of use. The gasket 84 is larger in diameter than the top of the plug and the outer edge thereof is turned up as indicated at 85 in Fig. 5, to form a one-way seal for the leakage path, which acts similarly to the leather washer on a plunger pump. Gases can pass up past the piston rings into the space between the plug and the plate 79, but when they try to pass in the other direction the edges of the gasket 84 are crowded into the space so as to prevent the return passage. This maintains a pressure in the space above the plug because any leakage past the rings caused by an explosion will tend to build up this pressure.

The openings 71, 72, 73, and 74 are connected together by means of longitudinal grooves 86, 87, and 88 cut in the under surface of the plate 79, as indicated, but in this case there is no relief valve. However, the duct 89 communicates with the space 71 at the forward end of the engine and this duct leads to a flanged fitting 90 to which the intake connection 91 of a turbine 92 is connected. The turbine 92 is positioned in front of the engine adjacent the fan and is provided with a shaft 93 upon which is mounted the blades 94 of an air supercharger 95 having an inlet manifold 96 which may open just behind the fan to receive air from it. The outlet 97 of the supercharger 95 may be connected to an air inlet manifold 98 leading directly to the carburetor 99 which supplies the air and fuel mixture to the engine.

In the operation of this arrangement pressure is developed in the spaces between the plate 79 and the plugs 75, 76, 77, and 78 as the engine operates. These gases under pressure are forced out through the duct 89 into the turbine inlet 91 and drive the turbine 92, which in turn drives the super-charger 95 causing air to be drawn through the intake 96 and forcing it under pressure into the air intake of the carburetor.

When the engine is operating under idling or low-load conditions, the pressure may not be high enough to operate the turbine, but at these times additional air under pressure is not necessary. However, at full load with wide open throttle the supercharger will operate. Thus, detonation is prevented and at the same time the extra pressures developed by the explosion, which would otherwise be wasted, are utilized to drive the supercharger.

It will thus be seen that I have provided a simple head for an engine which has no moving parts in it but which will eliminate detonation. By means of my invention, therefore, it is possible to operate a high compression engine on low-test fuels which would ordinarily cause terrific detonation in such an engine with resultant loss of power and deterioration of the various parts of the engine. I am able to eliminate this detonation by providing a very small leakage path for the excess pressures to escape and in the modification of Figs. 4 and 5 I provide a means to utilize these excess pressures to aid in the operation of the engine.

While the excess pressures have been shown in Figs. 4 and 5 as operating a supercharger, it will be evident that any small piece of engine equipment may be driven in this manner. Also, where such a piece of equipment is driven by these

excess pressures, it is not as important to maintain the leakage at a minimum, because the loss of efficiency in the explosion chambers is given back to the engine by the operation of the accessory.

Since certain changes may be made in the above article and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which as a matter of language might be said to fall therebetween.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a high compression internal combustion engine a cylinder, a working piston in said cylinder, a head for said cylinder, and means in said head to provide a leakage path of such small cross-section that explosive gases will leak into said path when pressures develop which would otherwise cause detonation, but said leakage path will not interfere with the normal operation of said engine.

2. In a high compression internal combustion engine a cylinder, a working piston in said cylinder, a head for said cylinder, means in said head to provide a leakage path from said cylinder of such small cross-section that leakage along said path will occur when pressures develop which would otherwise cause detonation, but said leakage path will not interfere with the normal operation of said engine, said path having an extended opening into said cylinder.

3. In a high pressure internal combustion engine a cylinder, a working piston in said cylinder, a head for said cylinder, a separate chamber in said head, means to provide a leakage path from said cylinder into said chamber of such small cross-sectional area as substantially to prevent explosive gases from passing into said chamber except when said pressures are sufficient otherwise to cause detonation.

4. In a high pressure internal combustion engine a cylinder, a working piston in said cylinder, a head for said cylinder, a separate chamber in said head, means to provide a leakage path from said cylinder into said chamber of such small cross-sectional area as substantially to prevent explosive gases from passing into said chamber except when said pressures are sufficient otherwise to cause detonation, the opening of said leakage path into said cylinder extending for a relatively long distance.

5. In a high pressure internal combustion engine, a cylinder, a working piston in said cylinder, a head on said cylinder, means providing a leakage path through said head, said means comprising a plug fixed into an opening in said head and having a groove around the circumference thereof and a piston ring in said groove, the clearance between said ring and the opening in said head being sufficient to provide a very small leakage path through said head.

6. In a high pressure internal combustion engine, a cylinder, a working piston in said cylinder, a head on said cylinder, a chamber in said head, there being a circular opening between said chamber and cylinder through said head, a plug fixed in said opening and conforming to the walls thereof, a groove around the circumference of said plug, and a piston ring in said groove, the clearance between said piston ring and the walls of said opening being such that a leakage path is formed between said cylinder and said chamber such that explosive gases will pass into said chamber only when said pressures are sufficiently high so that detonation would otherwise be caused.

7. In a high pressure internal combustion engine, a cylinder, a working piston in said cylinder, a head for said cylinder, a separate chamber in said head, means to provide a leakage path from said cylinder into said chamber of such small cross-sectional area as substantially to prevent explosive gases from passing into said chamber except when said pressures are sufficient otherwise to cause detonation, and means to relieve the pressure in said chamber when it rises above a predetermined value.

8. In a high pressure internal combustion engine, a cylinder, a working piston in said cylinder, a head on said cylinder, a chamber in said head, there being a circular opening between said chamber and cylinder through said head, a plug fixed in said opening and conforming to the walls thereof, a groove around the circumference of said plug, and a piston ring in said groove, the clearance between said piston ring and the walls of said opening being such that a leakage path is formed between said cylinder and said chamber such that explosive gases will pass into said chamber only when said pressures are sufficiently high so that detonation would otherwise be caused, and means to relieve the pressure in said chamber when it rises above a predetermined value.

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