March 25, 1930. W. G. GERNANDT 1,751,989

MEANS FOR FEEDING FUEL TO AN INTERNAL COMBUSTION ENGINE OF THE HIGH COMPRESSION TYPE

Filed Oct. 29, 1924 2 Sheets-Sheet 1

FIG. 1

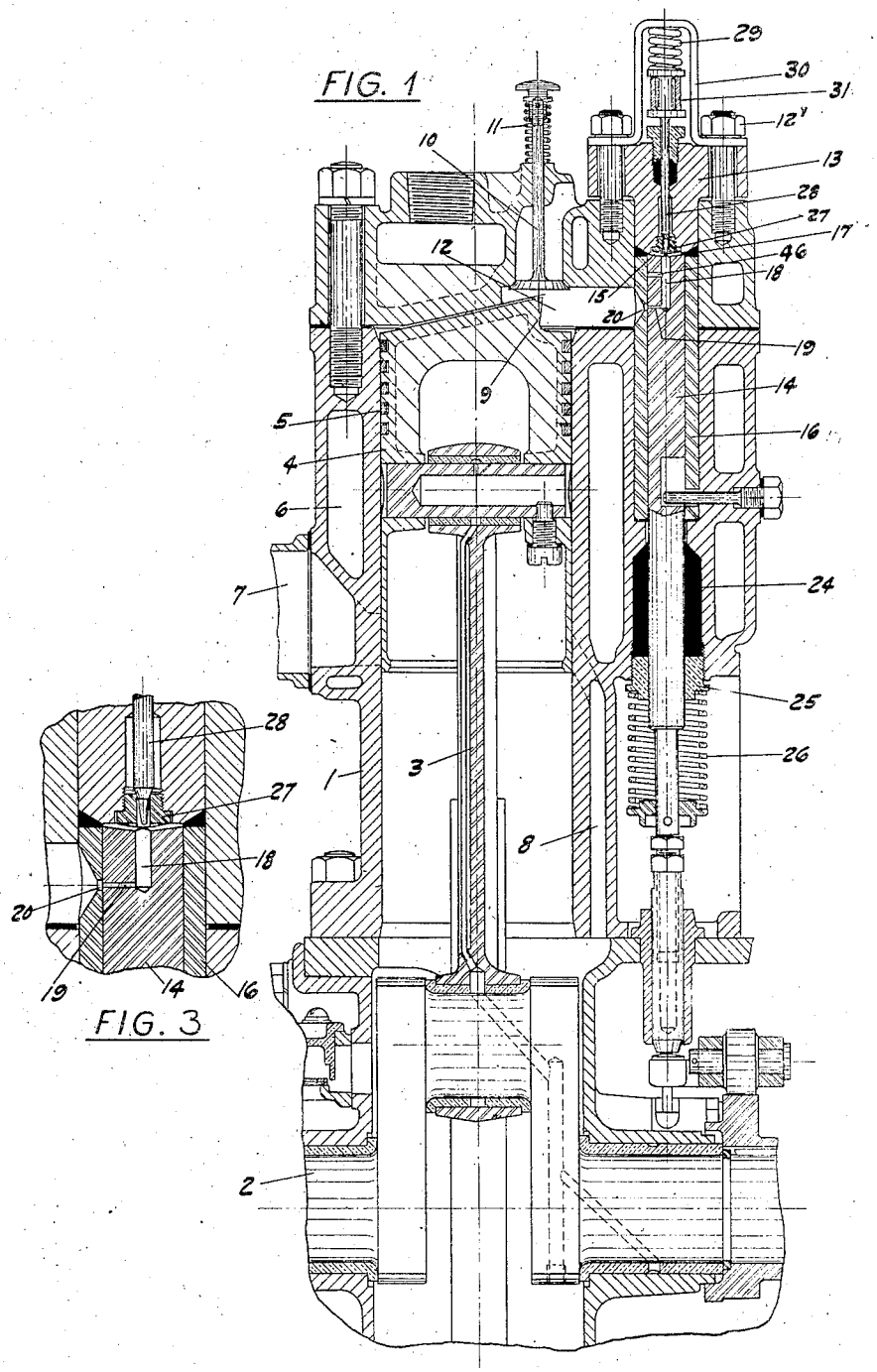


FIG. 3

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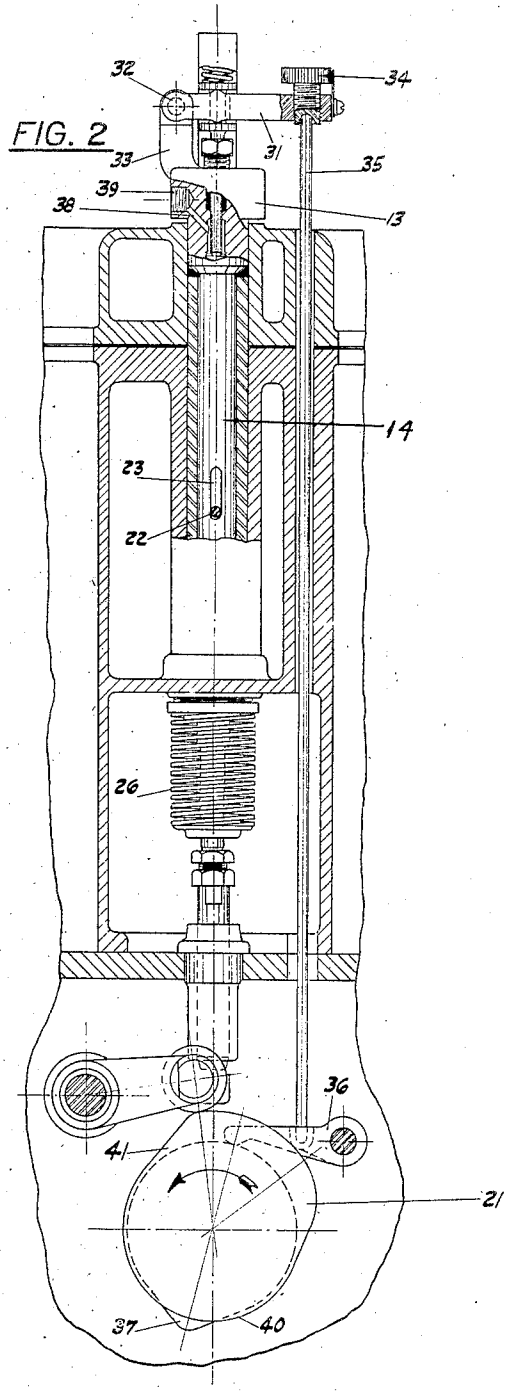
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FIG. 2



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Patented Mar. 25, 1930

1,751,989

UNITED STATES PATENT OFFICE

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MEANS FOR FEEDING FUEL TO AN INTERNAL-COMBUSTION ENGINE OF THE HIGH-COMPRESSION TYPE

Application filed October 29, 1924. Serial No. 746,545.

This invention relates to means for feeding fuel to an internal combustion engine of the high compression type, that is to say, an engine in which air is taken into the working cylinder and compressed by the piston therein so that the high temperature developed is sufficient to ignite the fuel which is injected at the proper time from a compression chamber in which fluid products of combustion are trapped and then compressed for the purpose of injecting the fuel that is passed into the compression chamber or a fuel depository therein.

The objects of this invention include means for obtaining a high compression engine of great flexibility, that is to say, one that is responsive to adjustments arranged to vary the speed and power of the engine.

Another object is to obtain an engine which is adapted to use fuel having a low specific gravity such as kerosene, or distillate, although, it is to be understood that it is not limited to one particular type of fuel.

Another object of my invention is to provide an engine which is relatively easy to start, yet positive in its starting operations.

Other objects will be apparent to one skilled in this art.

In order to carry out the objects of my invention, I utilize the fundamental idea of trapping some of the fluid products of combustion in a compression chamber, preferably closely adjacent the main cylinder and then after passing the fuel to the compression chamber, or a fuel depository therein, to compress the products of combustion, and at the proper time, in the cycle to connect the compression chamber with the main cylinder whereby the fuel is injected into the said main cylinder.

In my application 739,249 filed September 23, 1924, I have disclosed a specific arrangement for trapping fluid products of combustion and compressing this for the purpose of injecting fuel into the engine cylinder. My present application is directed to a modified form by which similar results may be accomplished.

My present invention will be best understood by reference to the attached drawings, wherein

Figure 1 is a part sectional view through the engine showing my improvement.

Figure 2 is a part sectional view at right angles to Fig. 1, the section being taken through the fuel plug and compression chamber also showing the cam arrangement and

Figure 3 is a modified form of the end of the plunger as shown in Fig. 1.

Referring now to details wherein like numbers refer to corresponding parts in the various views, 1 is an engine cylinder having a piston 4 therein. The piston 4 is connected by a connecting rod 3 to a crank shaft 2 which carries the usual fly wheel not shown. The piston 4 has the usual piston rings 5 and the cylinder 1 a water jacket 6. The engine illustrated is of the two cycle type having an exhaust port 7, the air intake not being shown, although, a by-pass 8 is indicated for passing the air, which is compressed in the crank case to the cylinder when the piston is at substantially the lowest part of the stroke. The piston 4 has a part 9 cut away to deflect air from the exhaust port as the air comes from the by-pass 8. The pocket 12 is formed in the upper part of the cylinder when the piston is in its position of the highest compression. The valve 10 held in position by a spring 11 is used in the head of the cylinder for the purpose of relieving compression at the time of starting the engine. Attached to the end of the cylinder, and in any satisfactory manner, as by bolts 12′ is a fuel plug 13, and arranged preferably tandem with the plug 13 is a compression plunger 14, the upper end of which is shaped at 15 to form a fuel depository. It will be seen that between the end of the plug 13 and the end of the plunger, or fuel depository 15, there is formed a compression chamber. As indicated in the drawings, the plunger 14, preferably works in a sleeve 16 constructed of suitable material and a gasket 17 is placed between the end of the plug 13 and the sleeve 16. Extending longitudinally of the plunger 14 from the depository 15, is a passage-way 18, and from the passage-way 18, and substantially near the bottom thereof is a cross bore 19. When the

plunger is in the position shown in Fig. 1, the cross hole or bore 19 is then in alignment with an opening 20 in the engine or the sleeve 16 which establishes communication between the compression chamber and the pocket 12. The plunger 14 also is provided with a cross bore 46 leading from the longitudinal passage-way 18 to the periphery of the plunger and is adapted to be brought into alignment with the hole 20 when the plunger 14 is substantially near the end of its non-compression stroke. The purpose of this will be later described.

By reference to Fig. 2, the relative position between the cam 21 and the compression plunger 14, will be seen. The compression plunger 14 is held in proper position through the medium of the aligning pin or screw 22, the end of which operates in a slot 23, so that the alignment of the passages 19 and 20 will be assured. The lower end of the plunger 14 is surrounded with packing 24, held in position by a gland 25. A spring 26 is used to return the plunger 14, after the compression stroke has been completed, through the medium of the cam 21. The end of the fuel plug 13 is preferably provided with a bushing 27 in which is seated a control valve 28 which is held by a spring 29 so as to normally close the opening into the compression chamber.

Mounted on the upper end of the plug 13 is a member 30 which acts as an abutment for the spring 29. Valve 28 is opened at the proper time in the cycle of operation by the lever 31 which is pivoted at 32 to a support arm 33. Attached to the upper end of the lever 31 preferably by an adjusting member 34 is a push rod 35 which is operated by a lever 36 which in turn is actuated by the cam 37. As the valve 28 is lifted, the fuel is injected through the passage-way 38 into the compression chamber, it being understood that a fuel pipe is adapted to be fitted to plug 13 at the point 39. The manner of feeding the fuel to the passage-way 38 forms no part of my present invention and therefore will not be further described, it being obvious that various means of feeding fuel to the passage-way 38 may be utilized.

In operation, the position of the main working piston and the compression plunger are shown at about the time when the fuel is being injected into the engine cylinder. Of course, it is to be understood, that the plunger 14 may be timed with respect to the main working piston so that the fuel is injected into the cylinder to give the maximum power from the engine. Assuming that the parts shown in Fig. 1, are in the position as stated fluid products of combustion, which are compressed in the compression chamber, forces the fuel from the depository 15, formed in the upper end of the compression plunger 14 through the bore 19 and the opening 20 into pocket 12 where fuel is ignited by the highly compressed air therein. As the cycle of operation continues, and the cam 21 reaches the point 40, the plunger 14 moves downward until the port 46 is brought into registration with the port 20 which ports are thus held in registration until approximately the point 41, on the cam is reached when the cam moves the plunger 14 upward shutting off the compression chamber from the pocket 12. In the case of Fig. 3 when the point 40 of the cam is reached the end of the plunger 14 uncovers the port or hole 20 and when the point 41 of the cam is reached the plunger moves upward and closes off the connection to the pocket 12. During the interval of time, the cam is moving from the point 40 to 41, the fluid products of combustion at a relatively low pressure, as compared with the pressure directly after the ignition takes place, is passed into the compression chamber. Since it is impossible to scavenge all the products of combustion from the pocket 12 as the piston 4 moves upward, these gases are forced into the compression chamber and before any substantial amount of air can enter the compression chamber, the plunger 14 moves upward shutting off communication with the pocket 12 as has been described. During the interval of time the products of combustion are being trapped into the compression chamber, it will be seen by referring to Fig. 2 that the cam 37 produces an injection of fuel into the compression chamber which fuel is received by the fuel depository formed at the end of the compression plunger 14. As will be seen in Fig. 2 the control valve 28 can be adjusted to meter a definite quantity of fuel into the compression chamber. After the fuel has been injected into the fuel depository, the valve 28 closes, and shortly thereafter, the compression cycle starts. When the plunger 14 reaches the position shown in Fig. 1 then the fuel with the products of combustion which have been compressed, are forced into the pocket 12, and ignition takes place. By this arrangement he pocket 12 is substantially cleared of products of combustion as has been described and highly compressed undiluted air takes its place thereby insuring proper ignition of the fuel on injection and the products of combustion transferred and utilized in the compression chamber for fuel injection purposes.

It will be obvious that various changes may be made in the details for carrying my invention into practice; for example, the sleeve 16 may have more than one hole 20 in cooperation with a corresponding number of radially extending holes in the plunger 14, it being understood that these holes are all in the same horizontal plane and the section through the engine shows but one pair of openings. Consequently, I do not wish to be limited to the specific forms herein shown and described.

Having thus described my invention what I claim is:

1. In an internal combustion engine having a main cylinder and a piston therein, means for feeding fuel to said cylinder including a compression chamber having a plunger therein with means for actuating said plunger in proper time with respect to said piston, said plunger having a longitudinal passage and a cross bore leading from said passage to the periphery of said plunger, said engine having a single passage-way which is in alignment with said cross bore in the plunger when the plunger is at the end of its compression stroke, and means including said single passage-way in the engine for trapping products of combustion in the compression chamber when the plunger is at substantially the end of its non-compression stroke, and means leading into the compression chamber from the end opposite the plunger for passing fuel into the upper end of said compression chamber at the proper time.

2. In an internal combustion engine of the class described, means for feeding fuel to the engine cylinder including an injection plug fitting in a bore in the end of the engine head, a sleeve fitting in said bore, a compression plunger movably carried in said sleeve so as to form a compression chamber between the end of the plug and the plunger, said plunger end being formed to act as a fuel depository, said plug having means for passing a regulated quantity of fuel to the depository, and means for trapping products of combustion in said compression chamber comprising a longitudinal bore in the plunger leading from the end thereof, a passage-way through the wall of the sleeve into the engine cylinder and a cross bore in the plunger leading from the longitudinal bore and brought into alignment with said passage-way when the plunger is near the end of its non-compression stroke and further means for injecting the fuel after compression of the products of combustion including a second cross bore, from the longitudinal bore in the plunger, brought into alignment with the passageway in the sleeve when the plunger is substantially near the end of its compression stroke.

3. In an internal combustion engine having a cylinder and piston therein, a gas pocket formed at the upper end of the cylinder, a sleeve forming a part of the wall of said pocket, a plunger in said sleeve carrying a fuel depository, a fuel plug positioned in the engine and forming with the plunger a compression chamber with means carried by the plug for passing fuel to said depository, means for passing products of combustion from said pocket to said chamber, when the plunger is near the end of its non-compression stroke, including a hole through the sleeve, and means for injecting the fuel and products of combustion into said pocket including a longitudinal bore in the plunger and a cross bore leading from the longitudinal bore and brought into alignment with said hole in the sleeve when the plunger is near the end of its compression stroke.

4. An engine comprising, in combination with a combustion chamber, a fuel compression chamber communicating therewith through a single port, a plunger operable to compress fuel in the compression chamber, said plunger having a longitudinal fuel passageway leading from its head and a pair of spaced apart cross bores leading therefrom and each adapted to register with the bore leading into the combustion chamber, one of said cross bores being adapted to register with the bore in the combustion chamber when the plunger is in the compression position to admit fuel into the combustion chamber and the other cross bore adapted to register with the bore into the combustion chamber when the plunger is in the noncompression position to admit products of combustion into the compression chamber.

In testimony whereof, I affix my signature.

WALDO G. GERNANDT.