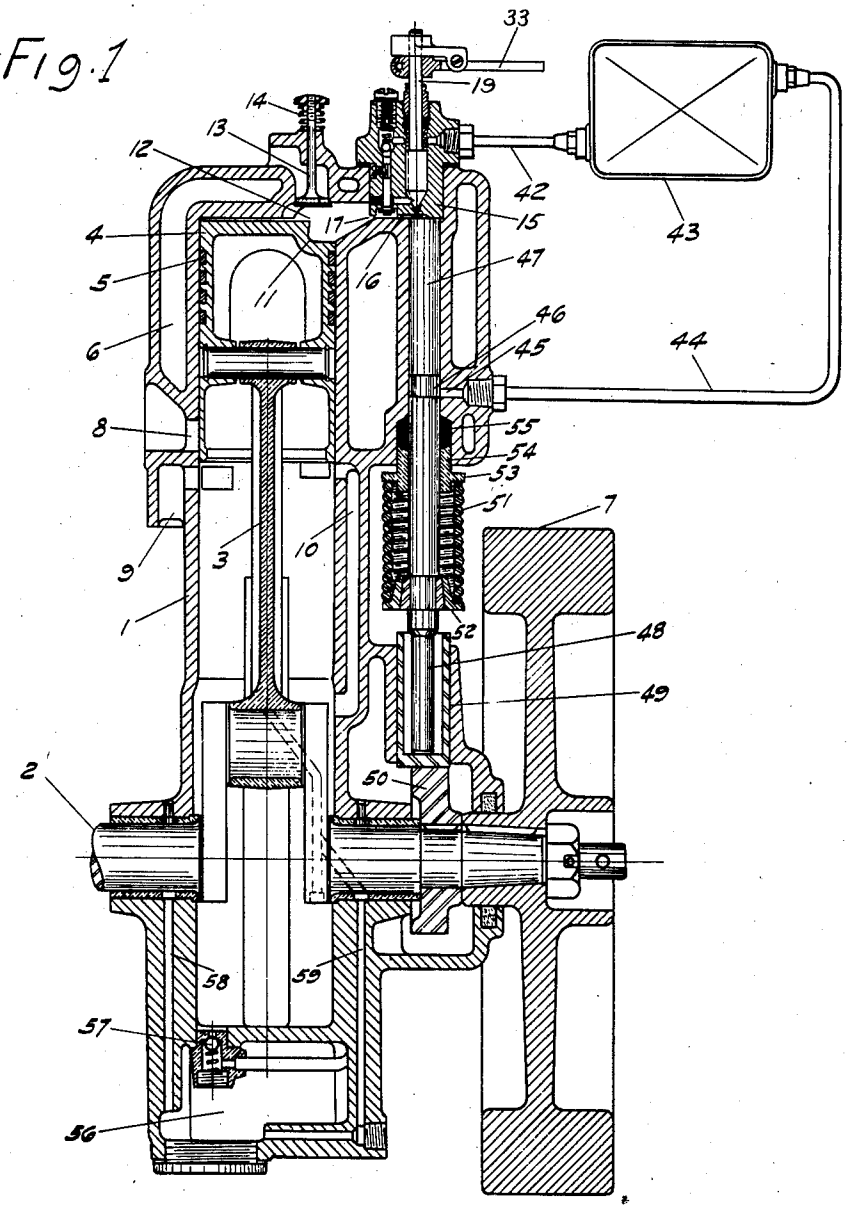
May 5, 1931. W. G. GERNANDT 1,803,326

MEANS FOR FEEDING FUEL TO HIGH COMPRESSION INTERNAL COMBUSTION ENGINES

Original Filed April 20, 1923 2 Sheets-Sheet 1

Fig. 1



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MEANS FOR FEEDING FUEL TO HIGH COMPRESSION INTERNAL COMBUSTION ENGINES

Original Filed April 20, 1923 2 Sheets-Sheet 2

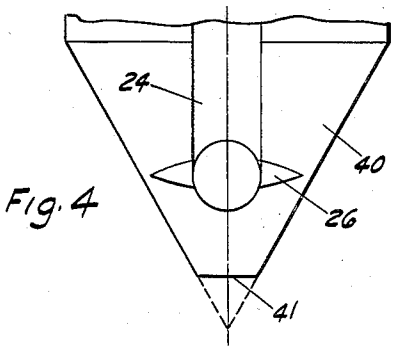


Fig. 4

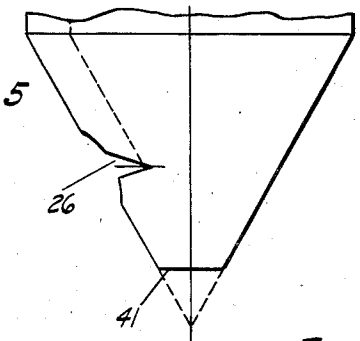


Fig. 5

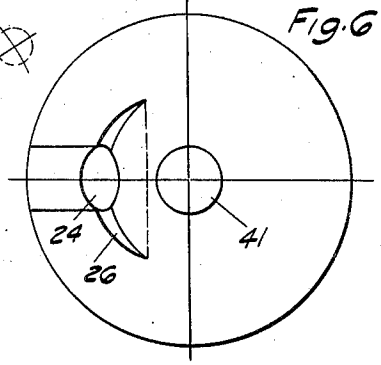


Fig. 6

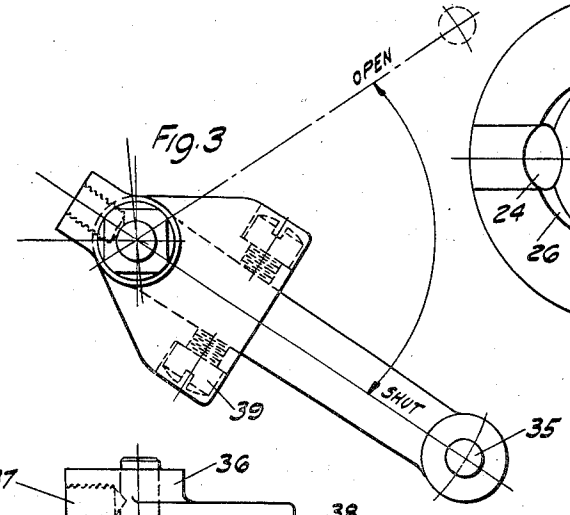


Fig. 3

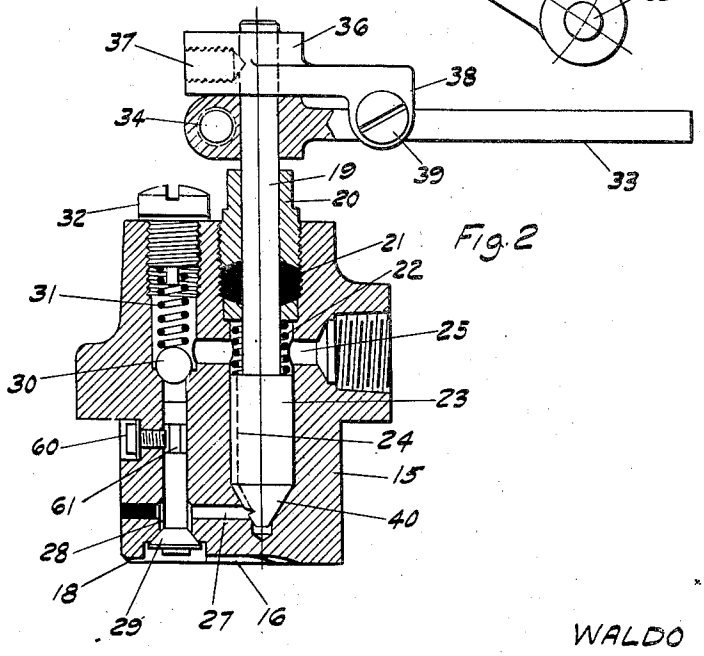


Fig. 2

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UNITED STATES PATENT OFFICE

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MEANS FOR FEEDING FUEL TO HIGH-COMPRESSION INTERNAL-COMBUSTION ENGINES

Application filed April 20, 1923, Serial No. 633,544. Renewed August 25, 1928.

This invention relates to means for feeding fuel to a high compression internal combustion engine, particularly of the general type described in my Patent 1,359,498 issued November 23, 1920, wherein, in the present instance, through the design of the engine cylinder and its piston taken with other details, fluid products of combustion are trapped in a compression chamber adjacent to and communicating with a fuel depository which in turn is in restricted communication with the engine cylinder. The products of combustion after being compressed in the compression chamber are then utilized for forcing fuel from the fuel depository, into the engine cylinder at the proper time to get the maximum effect on the engine piston. Engines of this type may be operated on different grades of fuel, for example, gasoline, kerosene, distillate fuel oil, etc., it being more economical to operate the engine from the lower grades of fuel, but when such low grade fuels are used, great difficulty is experienced in feeding these fuels to the engine cylinder, particularly where it is desired to operate the engine at variable speeds and under conditions of widely varying temperatures.

It is, therefore, the principal object of my present invention to provide a relatively simple and inexpensive, yet highly efficient means for feeding fuel to the engine.

In order to illustrate the application of my present invention, I have chosen to illustrate the same in combination with an engine which utilizes other of my improvements, one or two of which will be referred to merely for the purpose of making my present invention better understood.

Other and further objects will be apparent from a reading of the specification taken in connection with the annexed drawings, wherein:

Figure 1 is a reduced sectional view through an engine of my design, showing the fuel feeding means attached thereto.

Figure 2 is a view of the fuel injector per se, but on an enlarged scale from that shown in Fig. 1.

Figure 3 is a top view of the control lever shown in Fig. 2, while

Figure 4 is an enlarged view of the inner end of the fuel valve.

Figure 5 is a side view of Fig. 4, while

Figure 6 is an end view of Fig. 5.

It is to be understood that the drawings are merely illustrative and are not to be taken as showing exact proportions.

Referring now to the details, wherein like numbers refer to corresponding parts in the various views, 1 represents an engine cylinder and 2 a crank shaft having a flywheel 7 and a connecting rod 3, connecting the shaft to piston 4 in the usual wellknown manner. Piston 4 is provided with the usual rings 5. The cylinder 1 is also provided with the usual water jacket 6. The engine shown is of the two-cycle type having an exhaust port 8, an air intake 9 and a bypass 10 for passing the air which is compressed in the crank case through to the cylinder when the piston is at substantially the lowest position of its stroke. The piston 4 has a portion 11 cut out to serve to deflect the air away from the exhaust port when it comes from the bypass 10. The pocket 12 is formed in the upper part of the cylinder when the piston is in its position of highest compression. A valve 13 held in position by spring 14, is provided in the head of the engine cylinder for the purpose of relieving compression at the time of starting the engine. Mounted in any suitable manner, as by bolts (not shown), adjacent the upper end of the cylinder, is an injector plug 15. The lower portion of the plug 15 is cut away or relieved to form a depository 16 for the fuel and the depository 16 is in communication with the pocket 12 through a restricted passage 17, which may be formed by relieving the end of the plug 15 at the point 18. The plug 15 carries a fuel valve 19, through the medium of a bushing 20, suitable packing 21 being used to prevent the escape of fuel by the valve 19, which is held in working position by the spring 22. The valve 19 has an enlarged head 23 on which the spring 22 rests. The head 23 also has a longitudinal channel 24 leading from the chamber 25 to a V-slot 26 which is cut across the face of the

tapered end 40 of the valve member at a point adjacent the opening to passage 27. As indicated in Figs. 4 to 6, inclusive the V-slot is wider at the central portion and tapers on either side of a vertical plane through the center of the valve. The lower end of the taper 40 is preferably cut off as indicated at 41 in order to insure that the valve seats on the taper 40. The passage 27 leads into a small bore 28 within which valve 29 is positioned, it being noted that the valve 29 provides an opening into the fuel depository 16, from the passageway 27. In the upper end of the passageway 28 is seated a ball check valve 30 which is held in place by spring 31 and screw 32. To the upper end of the valve 19 is attached a lever 33, the outer end of the lever preferably being split to take a set screw fitting the hole 34 which when set up causes the lever to grip the stem of the valve.

In order to get accurate positioning of the lever 19 with respect to any control rod that may be attached thereto through the medium of the hole 35, I provide an adjusting clamp 36 which may be fastened to the outer end of the valve 19 by a set screw fitting in the hole 37. One end of the clamp 36 has downwardly turned ears 38 and set screws 39, from which it will be seen by loosening the screw in hole 34 and one of the screws 39, on actuation of the other screw 39, the position of the lever 33 will be shifted with respect to the valve 19 to any required position when the screws 39 are set up against the sides of the lever 33 and screw 34 tightened. This provides a very rigid and accurate control attachment for the valve 19.

As indicated in Fig. 1, the chamber 25 in the injector plug is connected by conduit 42 with fuel tank 43 which in turn is connected by pipe 44 with a passageway 45 that cooperates with a recess 46 in compression plunger 47, it being understood that plunger 47 is lubricated by the fuel and that a slight pressure is maintained on the tank 43 by virtue of the fact that there is actually a pressure leakage past the plunger 47 due to the necessary mechanical clearance around the plunger, to the recess 46, which thus acts as a medium through which the leakage pressure is applied to the fuel in the tank 43. The plunger 47 has its lower end 48 seated in a hardened steel cup 49 that has its bearing in the crank case and which cup is actuated by the cam 50 carried on the crank shaft. The plunger 47 is normally held against its seat in the cup 49 by spring 51 positioned between the collar 52 and flange 53 on the bushing 54, which serves to hold packing 55 in place around the plunger 47. An oil reservoir 56 is located directly below the crank case and pressure is applied to same by allowing a small portion of the air which is compressed in the crank case at each revolution to pass through a ball check valve 57 and oil is carried from the chamber 56 by means of the passageway 58 and 59 to the main bearings of the engine.

Since the operation of a two-cycle engine, per se, is generally understood no extended description of this will be made, but rather it will be pointed out how fuel is fed to the engine cylinder. As has been indicated, fuel under slight pressure is fed through the conduit 42 to the chamber 25 surrounding the valve stem 19. Fuel passes through the groove 24 to the V-slot 26, passageway 27, chamber 28, from which it is carried into the fuel depository 16 by the check valve 29 at a time when the piston 4 is near the end of its expansion stroke, when there is the minimum pressure in the combustion chamber of the engine and in the fuel depository. Furthermore the cam 50 produces a sudden final descent of plunger 47 which acts to lessen the pressure in the fuel depository and the suction thereby produced aids in opening the valve 29. The extent of opening of valve 29 is controlled by the pin or screw 60 which enters a recess 61 in the upper end of the stem of valve 29. On the compression stroke, more of the products of combustion, which have not been scavenged from the pocket 12, are forced through the restricted passage 17 into the fuel depository and into the compression space above the plunger 47 which action produces a certain turbulence within the depository and acts to finely divide the fuel preparatory to its injection into the engine cylinder, which act takes place by a rapid movement of the plunger 47 at substantially the time when piston 4 reaches the point of maximum compression. This rise in pressure in the fuel depository closes the valve 29 and causes the fuel to be injected into the engine ahead of or mixed with the products of combustion that have been trapped in the fuel depository and compression space above the plunger 47.

Due to the pressure maintained in the tank 43, there might be pressure enough applied to the valve 29 in the chamber 28 to interfere with its proper function and in order to overcome this, the ball check valve 30 actuated by spring 31, serves to equalize the pressure on the valve 29 so that it can function properly. It will be observed that the amount of fuel fed to the engine is controlled by the turning of the valve 19 through the medium of the lever 33 and on account of the particular design of the fuel valve, the amount of fuel metered may be varied with accuracy, with the result that the engine has a great flexibility with a wide speed range with no misfire at either high or low speeds.

It will be observed that since the fuel is atomized by gas having little or no oxygen therein, there can be no burning before the actual injection takes place, it being understood that in a high compression engine of

this type ignition takes place when the fuel hits the highly compressed air within the engine cylinder. It will also be seen that the injection or rate of injection is mechanically timed so that with an increase of crank shaft speed there is a corresponding increase in the rate of fuel injection, hence the fuel must enter the engine cylinder during a certain angular travel of the crankshaft and not during a "fixed" time.

While it is apparent that changes may be made in certain of the details, I do not wish to be limited in the application of my invention, except as limited by the scope of the appended claims.

Having thus described my invention what I claim is:

1. Means for feeding fuel to an engine cylinder having a working piston therein comprising an injector plug, said plug provided with a fuel passage having a valve controlling one end of said passage, a valve for controlling the other end of said passage comprising a member having a tapered end fitting in a tapered seat, said tapered end having a V-slot across that part of its face adjacent the passage end, a fuel chamber intermediate the ends of said member and a groove leading from said chamber to the V slot.

2. Means for feeding fuel to an engine cylinder having a working piston therein comprising a plug having a bore therein and a cut away portion providing a depository, the lower end of which is conical, a metering valve having a conical end positioned in said bore and provided with means for holding it on its seat on the conical end thereof, a second bore with a passage leading to the first bore adjacent the conical end of the valve, a valve seated in said second bore and controlling its opening into the fuel depository, a fuel chamber associated with the first mentioned bore, said conical ended valve having a transverse V-slot in its conical face with a groove extending from the V-solt to said fuel chamber.

3. Means for feeding fuel to an engine cylinder having a working piston therein comprising a plug having a bore extending from one end to a point near the other end where it terminates in a conical seat and a cut away portion providing a depository, a metering valve having a conical end positioned in said bore and provided with means for holding it on said seat, a second bore extending all the way through the plug with a passage leading to the first bore adjacent the conical end of the valve, a valve seated in the inner end of said second bore and controlling its opening into the fuel depository, a fuel chamber associated with the first bore, said fuel chamber opening into the second bore, movable means for separating that part of the second bore below the fuel chamber from the rest of the bore, said conical ended valve having a transverse V slot in its conical face with a groove extending from the V slot to said fuel chamber.

4. Means for feeding fuel to an engine cylinder having a working piston therein, including an injector plug provided with a fuel passage having a valve controlling one end of said passage; a valve for controlling the other end of said passage comprising a member having a tapered end fitting in a tapered seat, said tapered end having a V slot across that part of its face adjacent the passage end, a fuel chamber intermediate the ends of said member, a groove leading from said chamber to the V slot, said V slot being wider at the point where said groove intersects it.

5. Means for feeding fuel to an engine cylinder having a working piston therein, comprising an injector plug having a fuel passage therein, a valve controlling one end of said passage with means for limiting the amount of opening of said valve; a valve for controlling the other end of said passage comprising a member having a tapered end fitting in a tapered seat, said tapered end having a V slot across that part of its face adjacent the passage end, a fuel chamber intermediate the ends of said member, a groove leading from said chamber to the V slot, said V slot being wider at the point where said groove intersects it.

6. A fuel injector for a high compression engine, consisting of: a plug having two bores, the lower end of one bore being conical and having a passage leading from the conical portion into the second bore, an automatic check valve positioned in said second bore and a valve having a conical seat fitting on the conical surface of its bore, a fuel chamber associated with the bore having the conically shaped end, said second mechanical valve having a transverse V slot in its tapered face with a groove extending upward to said chamber.

7. A fuel injector for a high compression engine, consisting of: a plug having two bores, one extending all the way through the plug and the other terminating in a conical seat near the engine end of the plug, said plug having one end formed so that when positioned over a part of the engine adjacent thereto there is formed a fuel depository and a compression chamber, a passage leading from the conical seat of said bore into the second bore near the engine end of the plug, an automatic check valve positioned in the engine end of the second bore, a fuel chamber connecting said bores, a metering valve in the first bore having a conical end to fit said conical seat, said valve having a transverse V slot in its conical face with a groove extending upward to said chamber, an equalizing valve positioned in the second bore

below the entrance of the fuel chamber therewith, and means for closing the outer end of said second bore.

8. A fuel injector for a high compression engine, consisting of: a plug having two bores, one extending all the way through the plug and the other terminating in a conical seat near the engine end of the plug, said plug having one end formed so that when positioned over a part of the engine, there is formed a fuel depository and a compression chamber, a passage leading from the conical seat of said bore into the second bore near the engine end of the plug, an automatic check valve positioned in the engine end of the second bore and means for limiting the amount of opening of said valve, a fuel chamber connecting said bores, a metering valve in the first bore having a conical end to fit said conical seat, said valve having a transverse V slot in its conical face with a groove extending upward to said chamber, an equalizing valve positioned in the second bore below the entrance of the fuel chamber therewith, and means for closing the outer end of said second bore.

9. An injector plug for internal combustion engines having two bores, one of which opens into a recessed portion in the engine end of the plug and the other terminates in a conical seat near the same end of the plug, a fuel chamber associated with the second bore, a check valve for controlling the opening of the first bore into said recessed portion, a passageway leading, from the first bore above the seat of said check valve to the second bore at the conical seat, a fuel metering valve in the second bore and having a conical end to fit said conical seat with means for holding the valve on its seat, said metering valve having a V slot in its conical face and a duct leading upward to said fuel chamber, and means attached to said metering valve for actuating the same for the purpose described.

10. An injector plug for high compression engines having two bores one of which opens into a recessed portion therein and the other terminates in a conical seat near the engine end of the plug, a fuel chamber connecting said bores, a check valve having a limited opening for controlling the opening of the first bore into said recess, a passageway leading, from the first bore above the seat of said check valve to the second bore at the conical seat, a metering valve in the second bore having a conical end to fit said conical seat, with means for holding the valve on its seat, said metering valve having a V slot in its conical face and a duct leading upward to said fuel chamber, an equalizing valve positioned in the first bore below the entrance of the fuel chamber thereto, and means attached to said metering valve for actuating the same.

11. An injector plug for high compression engines having its end constructed to fit into the engine and form a portion of a compression chamber and a fuel depository, said plug having a fuel chamber with a metering valve passing therethrough and terminating in a conical end fitting a conical seat, said conical end having a transverse V slot of variable cross-sectional area, and a longitudinal groove leading from the V slot to said fuel chamber, a bore in the plug opening into the fuel depository portion, a check valve positioned in said opening, a passageway leading from the bore above the valve seat to a point adjacent the conical seat, the metering valve so constructed as to bring different sectional areas of the V slot over the end of said passageway upon rotation of said valve.

12. An injector plug for high compression engines having its end constructed to fit into and form a portion of a compression chamber and a fuel depository, said plug having a fuel chamber with a metering valve passing therethrough and terminating in a conical end fitting a conical seat, said conical end having a transverse V slot of variable cross-sectional area and a longitudinal groove leading from the V slot to said fuel chamber, a bore in the plug opening into the fuel depository portion, a check valve positioned in the depository end of the bore with means for limiting the opening of the valve, an equalizing valve in the bore below the entrance of the fuel chamber, a passageway leading from the bore above the depository valve seat to a point adjacent the conical seat, the metering valve so constructed as to bring different sectional areas of the V slot over the end of said passageway upon rotation of said valve.

In testimony whereof, I affix my signature.

WALDO G. GERNANDT.