May 3, 1932. C. E. BATHRICK 1,856,066

MEANS FOR FEEDING FUEL TO AN INTERNAL COMBUSTION ENGINE

Filed June 16, 1923 2 Sheets-Sheet 1

Fig. 1

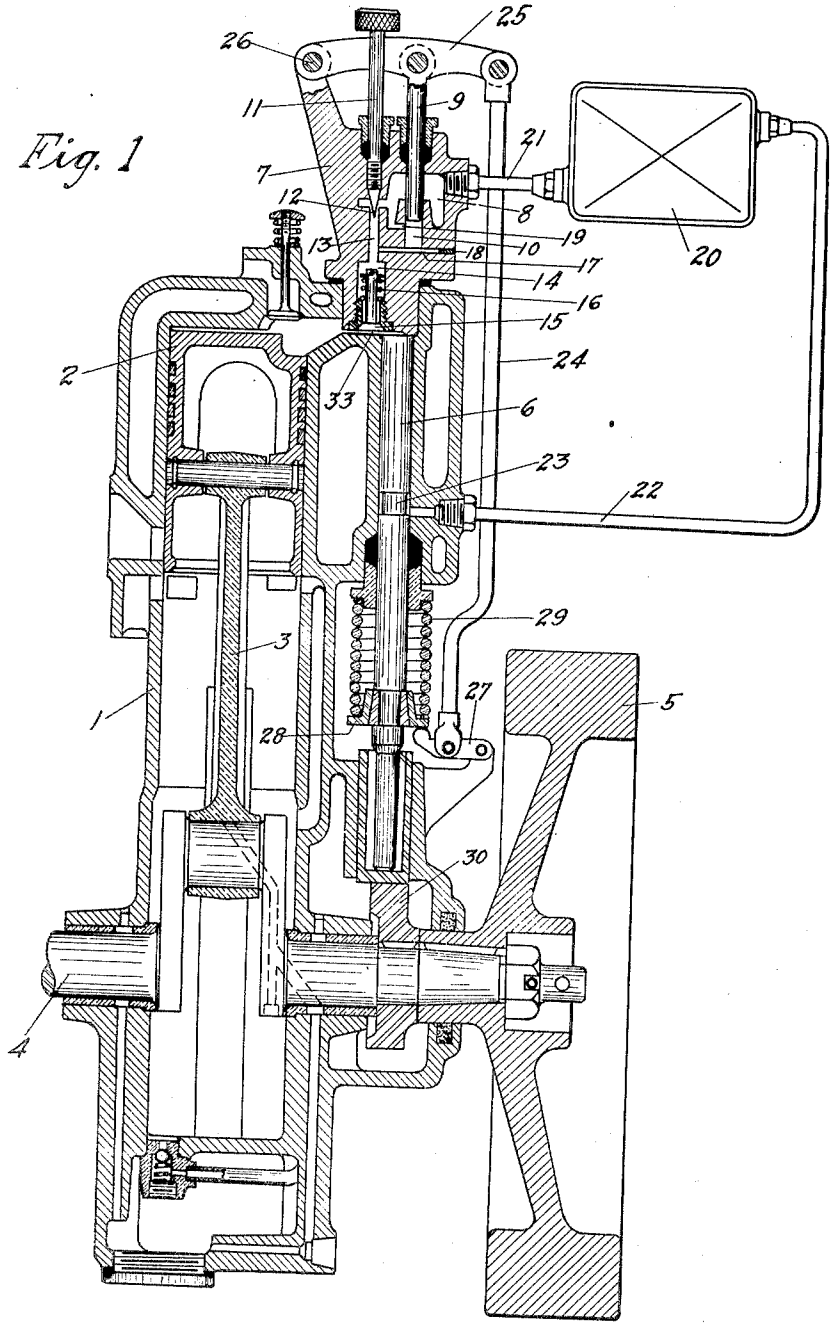

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Fig. 2

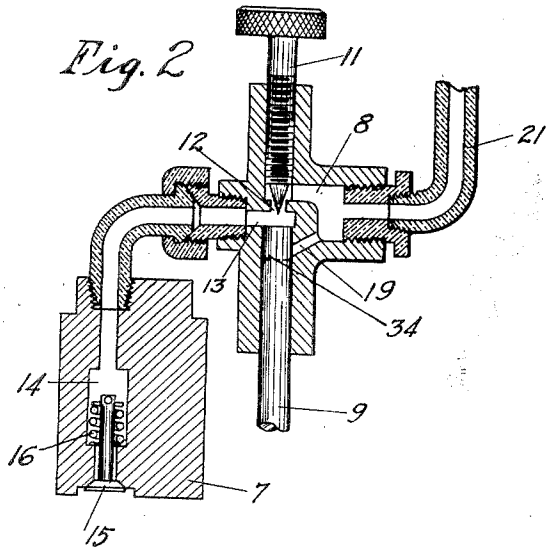


Fig. 3

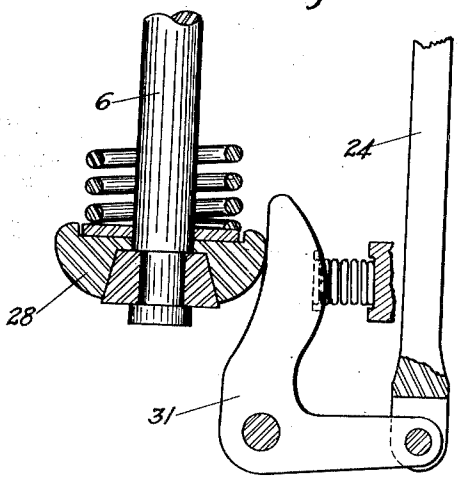


Fig. 4

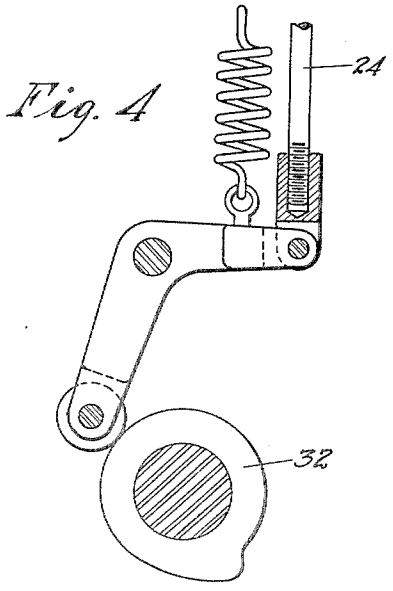
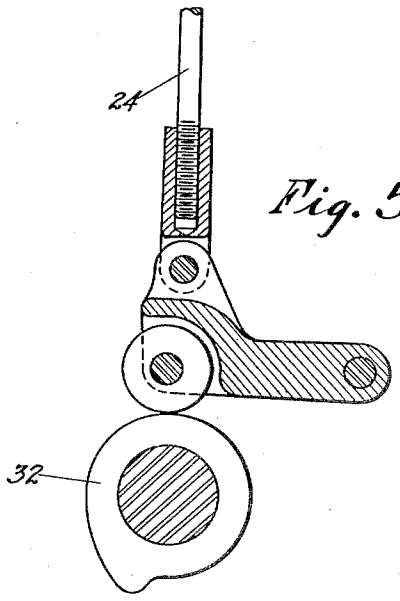


Fig. 5



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UNITED STATES PATENT OFFICE

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MEANS FOR FEEDING FUEL TO AN INTERNAL COMBUSTION ENGINE

Application filed June 16, 1923. Serial No. 645,778.

This invention relates to improved means for feeding fuel to an internal combustion engine, particularly of the high compression type which may be operated on different grades of fuel, such as gasolene, kerosene, distillate, fuel oil, etc., it being more advantageous to operate the engine on the lower grades of fuel provided this can be fed to the engine in a suitable manner.

It is, therefore, the principal object of my invention to provide a simple means for efficiently feeding or metering definite quantities of any kind of liquid fuel to an internal combustion engine.

In order to illustrate the application of my invention, I have shown the same in combination with an engine such as shown and described in Gernandt application 633,544 filed April 20, 1923, but it is to be clearly understood that the fuel metering device or devices described herein can be used in various combinations, and the application is, therefore, not limited to an engine of the Gernandt type wherein, through the design of the engine cylinder and its piston, taken with other details, products of combustion are trapped in the fuel depository and the compression chamber adjacent the engine cylinder, after which the fuel is injected into the depository and then the trapped products of combustion are compressed, forcing the fuel from the depository into the engine cylinder at the proper time.

My invention will be clearly understood by reference to the attached drawings in which:

Figure 1 is a reduced sectional view through an engine of the Gernandt type heretofore referred to, showing the fuel feeding means attached thereto.

Figure 2 shows a modified form of a fuel injector or metering device.

Figures 3, 4 and 5 indicate various constructions or means for actuating the injector plunger.

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

In the drawings like numbers refer to corresponding parts in the various views, 1 representing an engine cylinder having a piston 2, connecting rod 3, crank shaft 4 and fly-wheel 5. Adjacent the engine cylinder 1 is a compression chamber having a plunger 6 therein. Fitting within the end of the cylinder is a fuel plug 7 which, as per Fig. 1, carries the injector mechanism per se. This mechanism consists of: a fuel chamber 8, a fuel pump plunger 9, the free end of which is positioned in a bore 10, and a fuel feed control needle 11, the lower end of which is positioned in an orifice 12 that opens from the fuel chamber 8 into fuel passageway 13, which in turn opens into a valve chamber 14, the lower end of which is closed by a fuel feed check valve 15, the same being held in closed position by a spring 16. A duct 17 leads from the plunger cavity or bore 10 to the passage 13 and valve chamber 14, the outer end of the duct 17 being closed by a plug 18. A port 19 leads from the fuel chamber 8 to the cavity or bore 10.

A fuel tank 20 is connected by a pipe 21 to the fuel chamber 8. In the combination shown in Fig. 1 a slight pressure is placed in the tank 20 through the medium of a pipe 22 and the recess 23 in the plunger 6, all as described in the said Gernandt application heretofore referred to, but it will be understood that fuel may be fed to the chamber 8 by gravity or any other suitable means.

The plunger 9 as shown in Fig. 1 is actuated by a pull rod 24 and lever 25, the same being pivoted at 26. The rod 24 can be actuated in any number of ways, for example in Fig. 1, it is shown connected to a lever 27 that is pivoted to a part of the engine frame, the lever 27 being actuated by the collar 28 carried on the compression plunger 6, said plunger being returned to normal position by spring 29, after its actuation by cam 30 carried on the crankshaft. Another way of operating the rod 24 is indicated in Fig. 3 in which the bushing 28 actuates lever 31 in a somewhat different manner from the way lever 27 is actuated in Fig. 1. Still other ways are indicated in Figs. 4 and 5, in which the rod 24 is actuated by a cam 32, suitably formed and positioned on an operating part of the engine. So much depends

on the general design of the engine on which the fuel feeding means is to be used that the ways for actuating the fuel plunger may be varied over wide limits, but when used with the Gernandt type of engine, the fuel plunger 9 is actuated at a time when the engine piston is near the end of its working stroke or approximately 180 degrees from the position shown in Fig. 1.

Considering now the operation of my fuel feeding and metering system, fuel is supplied to the chamber 8 under slight pressure or other means as indicated and when the plunger 9 is in the position shown in Fig. 1 fuel will flow through the port 19 into the plunger cavity or bore 10, fuel duct 17, into the valve chamber 14, also through the orifice 12 and passage 13, filling the entire space from the check valve 15 back to and including the fuel chamber 8. On the compression stroke of the plunger 9, port 19 is closed and a pressure is built up in the fuel duct 17 and chamber 14 against the check valve 15. At the proper time, due to the position of the engine piston and pressure on the valve 15, the same will open and a definite amount of fuel is metered or sprayed into the fuel depository 33, thus the spring loaded check valve 15 acts as a nozzle for spraying fuel into the fuel depository. At the same time that pressure is applied to the chamber 14, as above described, a certain amount of the fuel is passed through the orifice 12, depending on the position of the valve 11, back to the fuel chamber 8. Consequently the amount of fuel metered to the fuel depository 33 is controlled by the tension of spring 16 and the size of the by-pass orifice 12; the greater the opening of the by-pass orifice 12, the greater the amount of fuel leaking back to the fuel chamber 8 and the less amount of fuel is forced past the check valve 15 into the fuel depository. Conversely, the smaller the by-pass orifice 12, the greater will be the amount of fuel that will be forced into the fuel depository on the opening of the valve 15. This arrangement has another decided advantage, and that is a time element in the by-passing of surplus fuel past the needle valve, which is of considerable advantage when a governor is used in connection therewith. For example, at a given number of engine revolutions per minute a certain definite quantity of fuel would be by-passed through the orifice 12. Should a load be applied that is sufficient to reduce the speed, a longer time is thereby allowed for by-passing and consequently a smaller portion of fuel would be injected into the fuel depository.

In the form of fuel injector shown in Fig. 2, the principle of operation is exactly the same as that shown in Fig. 1, the lower position of fuel plunger 9 being indicated by dotted line 34.

It is evident that the detail construction of the fuel plug and its associated mechanism and the manner of actuating certain parts of said mechanism is susceptible of many changes, a number of which have already been indicated, for it will be apparent by referring to Fig. 2 that the fuel plunger and needle valve with the associated parts may be mounted even down close to the crankshaft and the plug 7 carry only the valve 15. Furthermore the port 19 may be controlled by a suitable check valve so that when pressure is set up in the plunger chamber 10 by the plunger 9 this check valve will close the port 19 and prevent any return of fuel back through this passage to the fuel chamber 8; consequently I do not wish to be limited to the exact details shown and described herein.

Having thus described my invention, what I claim is:

1. Means for feeding fuel to an internal combustion engine, comprising: a plug having a valve chamber with one end opening in the direction of the engine cylinder with a valve normally closing the cylinder end of said chamber; a fuel chamber, a passage extending from the valve chamber and having an orifice opening into the fuel chamber, a bore having a plunger positioned therein, said bore having a duct communicating with the passage, a port leading from said fuel chamber to said bore at a point ahead of said plunger when in its retracted position, means for controlling the size of said orifice and means for actuating said plunger for applying pressure to the fuel in the valve chamber for the purpose described.

2. Means for feeding fuel to an internal combustion engine, comprising: a plug having a valve chamber with one end opening in the direction of the engine cylinder with a valve normally closing the cylinder end of said chamber; a fuel chamber, a bore having a plunger positioned therein, a port leading from said fuel chamber to said bore whereby the bore is filled with fuel when the said plunger is in its retracted position, a duct leading from said valve chamber into said bore, means for actuating said plunger at the proper time to apply pressure to the fuel in the valve chamber, a by-pass orifice, and means for controlling its size for determining the amount of pressure applied to the fuel in the valve chamber.

3. Means for feeding fuel to an internal combustion engine, comprising: a plug having a valve chamber with one end opening in the direction of the engine cylinder, a spring loaded check valve for closing the said opening and further acting as a nozzle for spraying fuel that is to feed said engine cylinder, a fuel chamber, a bore having a plunger positioned therein, a port leading from said fuel chamber to said bore whereby the bore is filled with fuel when the said plunger is in its retracted position, a duct leading from

said valve chamber and communicating with said bore, means for actuating said plunger at the proper time to apply pressure to the fuel in the valve chamber, and means for determining the amount of pressure applied to the fuel and valve in the valve chamber.

4. Means for feeding fuel to an internal combustion engine, comprising: a plug having a valve chamber with one end opening in the direction of the engine cylinder, a spring loaded check valve for closing the said opening and further acting as a nozzle for spraying fuel that is to feed said engine cylinder, a fuel chamber, a bore having a plunger positioned therein, a port leading from said fuel chamber to said bore whereby the bore is filled with fuel when the said plunger is in its retracted position, a duct leading from said valve chamber and communicating with said bore, means for actuating said plunger at the proper time to apply pressure to the fuel in the valve chamber, a by-pass to determine the pressure applied to the fuel and valve in the valve chamber, and a needle valve for controlling the by-pass.

5. Means for feeding fuel to an internal combustion engine, comprising: a plug for fitting into the head of the engine cylinder, said plug carrying within itself, a valve chamber with one end opening into a fuel depository adjacent the engine cylinder, a valve normally closing the depository end of said chamber, a fuel chamber, a bore having a plunger positioned therein, a port leading from said fuel chamber to said bore whereby the bore is filled with fuel when the said plunger is in its retracted position, a duct leading from said valve chamber into communication with said bore, a by-pass orifice between the fuel chamber and valve chamber, and a load regulating valve for controlling said by-pass orifice; and means for actuating said plunger at the proper time to apply pressure to the fuel and valve in the valve chamber.

6. Means for feeding fuel to an internal combustion engine comprising: a plug having a valve chamber with one end opening in the direction of the engine cylinder with a valve normally closing the engine end of said chamber; a fuel chamber, a bore having a plunger positioned therein, a port leading from said fuel chamber to said bore, a duct leading from said valve chamber into communication with said bore, means for actuating said plunger at the proper time to apply pressure to the fuel in the valve chamber, and means for controlling the amount of fuel passed by said valve toward the engine cylinder consisting of; a spring on said valve and a by-pass orifice between the fuel chamber and the valve chamber with means for controlling the size of said orifice.

7. Means for feeding fuel to an internal combustion engine comprising, a fuel feeding chamber, a valve chamber and a plurality of passages connecting the chambers, a member for applying pressure to fuel in the valve chamber, said member being movable into a position to obstruct one of the passages and means positioned in another of said passages for metering fuel from the valve chamber back to the fuel chamber when pressure is applied to the fuel in the valve chamber.

8. Means for feeding fuel to an internal combustion engine comprising, a fuel feeding chamber, a valve chamber, two passageways connecting the chambers, a valve in the valve chamber, a yielding means for closing the valve, a member designed to apply pressure to fuel in the valve chamber and movable into a position to obstruct one of the passages, means in the other passage for metering and regulating the flow of a portion of the fuel from the valve chamber to the feeding chamber when pressure is applied to the fuel in the valve chamber.

9. Means for feeding fuel to an internal combustion engine comprising, a fuel feeding chamber, a valve chamber having dual connections with said fuel feeding chamber, a passageway from said valve chamber to the engine, a member arranged to obstruct one of said connections and to simultaneously apply pressure to the fuel in the fuel chamber, and means restricting the opening in the other connection between the valve chamber and fuel chamber for controlling the amount of fuel leaking back to the fuel chamber through said other connection when pressure is applied to fuel in the valve chamber and thereby controlling the amount of fuel fed to the engine.

10. Fuel feeding means including, in combination, two pumps having oppositely arranged pistons moved in timed relation and communicating with a common outlet, one pump being arranged to compress a fuel-injecting gas and the other to supply liquid fuel to said gas, and a by-pass from a point between the fuel compressing piston and the common outlet for returning a portion of the liquid fuel to a point back of the fuel pump, whereby the amount of fuel supplied to the gas is regulated.

In testimony whereof, I affix my signature.

CHARLES E. BATHRICK.