Jan. 29, 1935. I. W. CORY 1,989,549

INTERNAL COMBUSTION ENGINE

Filed Aug. 11, 1933

Fig. 1

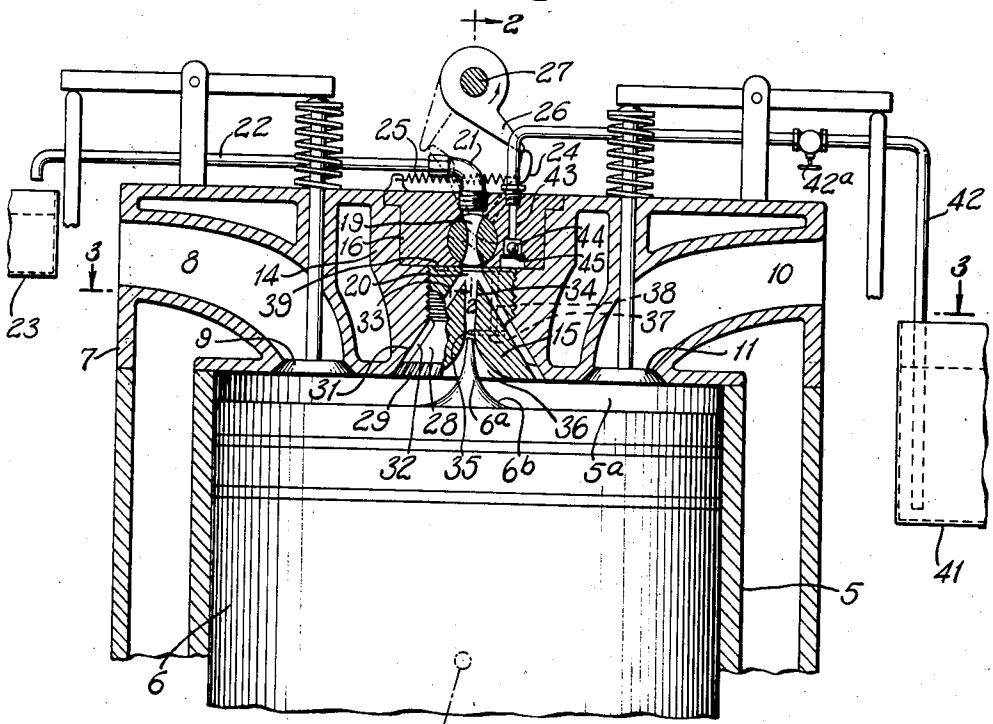



Fig. 2

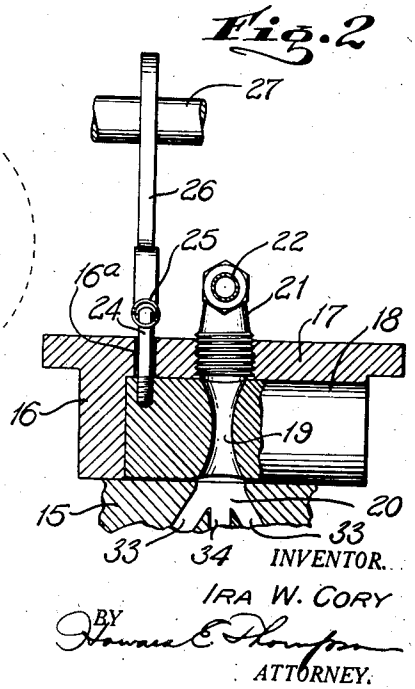
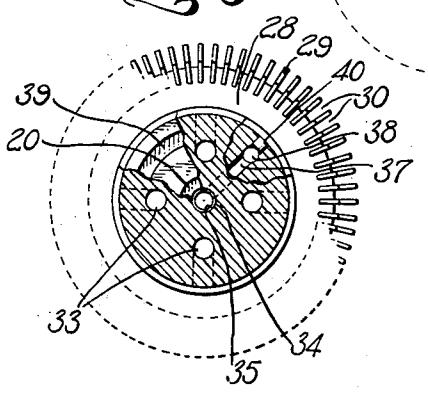



Fig. 3




INVENTOR.
IRA W. CORY
BY Howard E. Thompson
ATTORNEY.

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## INTERNAL COMBUSTION ENGINE

Ira W. Cory, New York, N. Y., assignor to Katherine F. Cory, New York, N. Y.

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6 Claims. (Cl. 123—33)

This invention relates to internal combustion engines and particularly to what are known as fuel oil engines; and the object of the invention is to provide improved fuel injecting means for engines of this class wherein the air under pressure in the cylinder is utilized to introduce and spray fuel into the cylinder at the end of the compression stroke of the piston of the cylinder; a further object being to provide a fuel supply means of the class described having a nozzle with means for creating a suction therein for drawing fuel from a supply tank into a chamber in said nozzle, and further to the provision of a valve for causing the flow of air under pressure through the nozzle to create said suction and to introduce the fuel into the nozzle chamber and still further, to discharging the fuel so drawn into the nozzle into the cylinder through a plurality of circumferentially arranged discharges; a still further object being to provide means on the piston of the cylinder cooperating with the nozzle to aid in building up pressure within the fuel chamber of the nozzle to cause the discharge of the fuel into the cylinder against the air under pressure therein; a further object being to provide a cam shaft for actuating the control valve of the fuel supply with means for quickly moving the valve into closed position when released by said cam; and with these and other objects in view, the invention consists in an automatic fuel supply and injector device of the class and for the purpose specified, which is simple in construction, efficient in use, and which is constructed as hereinafter described and claimed.

The invention is fully disclosed in the following specification, of which the accompanying drawing forms a part, in which the separate parts of my improvement are designated by suitable reference characters in each of the views, and in which:

Fig. 1 is a diagrammatic sectional view through the upper end portion of the cylinder of an engine showing one of my improved oil feed and injector devices therein.

Fig. 2 is a partial section on the line 2—2 of Fig. 1; and,

Fig. 3 is a partial section on the line 3—3 of Fig. 1.

For the purpose of diagrammatically illustrating one assemblage and use of my invention, I have indicated at 5 in Fig. 1 of the drawing the cylinder of a fuel oil engine, at 6 the piston in said cylinder, at 7 the cylinder head containing intake ports 8 controlled by valves 9 and exhaust ports 10 controlled by valves 11. At 12, I have indicated in dotted lines the crank shaft of the engine and at 13 a connecting rod coupling the piston 6 with one of the cranks of the shaft 12 in accordance with conventional practice. In this connection, it will be understood that my invention is not necessarily limited to any particular design of engine and the present illustration is simply to show one possible adaptation of my invention.

In the construction shown, the head 7 includes a central stock or body 14 with which is detachably coupled a nozzle 15 and a valve casing 16, the latter being in the form of a flange block having an elongated bore 17 in which a valve cylinder 18 is mounted, the latter having a transverse port 19 adapted to register with a fuel chamber 20 centrally of the upper end of the nozzle 15 and also with an elbow coupling 21 of a discharge pipe 22, the free end of which opens into a receiving tank or container 23. The cylinder valve 18 includes a projecting cam arm 24 with which is coupled a spring 25 which serves to normally support the valve 18 with the passage 19 thereof out of registering alinement with the chamber 20 and the elbow 21. A cam 26 on a cam shaft 27 is adapted to engage the cam arm 24 when in normal position and to move the same causing rotation of the valve 18 to bring the port 19 thereof in registering alinement with the chamber 20 and elbow 21 as seen in Fig. 1 of the drawing so as to permit the transmission of air under pressure therethrough, and when the cam arm is released from the cam 26, said arm will automatically return to normal position by the spring 25. The cam shaft 27 is in operative engagement with the shaft 12 as in other engines.

The nozzle plug 15 is externally threaded at its inner end to engage the stock or body 14 and the outer end 28 is conical in form and terminates in a peripheral nurled ring 29 which forms a multiplicity of circumferential discharges 30 between the conical bore 31 of the body 14 and said plug and an annular chamber 32 between the conical portion 28 and said bore 31.

The chamber 32 is placed in communication with the chamber 20 by a plurality of passages 33 which are drilled or otherwise formed in the threaded end of the plug. The plug is also provided with a central passage 34 contracted to form a Venturi throat 35 centrally of the plug. Beyond said throat, the bore or passage 34 flares outwardly as seen at 36. A horizontal bore or passage 37 opens into the bore 34 at the Venturi throat 35 and communicating with the passage 37 is another passage 38 arranged intermediate

two of the passages 33, and the passage 38 opens into an annular groove 39 formed in the upper surface of the plug 15. The outer end of the bore or passage 37 is closed by a cork or plug 40 to prevent any escape of fuel oil through said end of the passage.

At 41 I have indicated part of a fuel oil supply tank into which extends a fuel oil supply pipe 42 which is coupled with the valve casing 16 and is in communication with a vertical passage 43 formed therein at one side of the valve 18. The passage 43 is enlarged at its lower end and contains therein a ball check valve 44 and a screen 45 for supporting the ball against accidental displacement. The enlarged end of the passage 43 communicates with the annular groove 39 of the plug 16 so as to place the fuel oil of the tank 41 in direct communication with the discharge passage or bore 37 of the nozzle 15 through the passage 38, the bore 43 and pipe 42 as will be apparent.

It will be understood that in the operation of the cam arm 24 to rotate or oscillate the valve 18, the same will move through an elongated slot 16*a* formed in the casing 16, and one end wall of this slot or aperture may serve as a stop for limiting the movement of the valve by the spring 25.

I also preferably employ centrally of the top of the piston 6 a plunger 6*a* which is adapted to enter the bore 34 and the plunger 6*a* joins the piston in a flared wall 6*b* which cooperates with the flared lower end 36 of the bore 34 and the plunger will aid in discharging the fuel from the chamber 20 into the annular chamber 32 and out through the discharges 30, as will be apparent.

In the operation of my improved fuel injecting means for engines of the class under consideration, it will be understood that the valve 18 is in closed position at the beginning of the compression stroke of the piston 6 and remains closed until said piston is about to reach the end of the compression stroke, at which time, the valve is opened by means of the cam arm 24 and cam 26, causing the air under pressure from the combustion chamber 5*a* of the cylinder to pass upwardly through the bore or passage 34 of the nozzle and out through the bore 19 of the valve and the pipe 22. This rush of air through the bore 34 will create a suction in the passage 37 and cause fuel oil to be drawn from the tank 41 into the bore 34. By proper timing of the cam shaft and the method of actuating the valve 18, said valve may be released instantly upon the injection of fuel into the bore 34, causing the fuel to be pocketed in the chamber 20 beneath the valve 18, and building up at such time an excessive pressure in the chamber 20, causing the fuel to be discharged under pressure through the nozzle discharges 30 into the combustion chamber 5*a* when the piston reaches substantially its uppermost position in the cylinder, and during this operation, any oil that may pass into the pipe 22 will collect in the tank 23.

In the above operation, it will be understood that the plunger 6*a* will aid in discharging the fuel from the chamber 20 through the discharges 30 of the nozzle. In some instances and with some designs of engines of the class under consideration, it may be found desirable to so construct the chamber 20 as to provide for a precombustion or burning of the fuel in the chamber prior to the discharge thereof into the combustion chamber 5*a* of the cylinder and this, in such cases, would produce better firing operations of the engine and largely remove smoke from the exhaust by virtue of more complete and perfect combustion.

In some instances, it may be desirable to include a needle valve 42*a* in the supply pipe 42, so as to control and regulate the volume of fuel transmitted through said pipe. In this connection, it will be understood that the check valve 44 is employed to prevent any back pressure through the pipe 42 when the explosion or combustion takes place in the cylinder or in the chamber 20.

It will be apparent that an automatic fuel supply system of the class under consideration will materially simplify the fuel supply to engines of the class under consideration and will eliminate objectionable features to the present type of fuel injection employed in engines of the class under consideration and eliminate the use of compressors or the like employed for introducing fuel in what is known as the solid fuel injection.

It will be understood that while I have shown one method of accomplishing the desired result, my invention is not necessarily limited to the specific structure of the nozzle herein disclosed, nor to the type of the valve 18 herein set forth nor to the manner of its operation, and various other changes in and modifications of the construction herein shown and described may be made within the scope of the appended claims without departing from the spirit of my invention or sacrificing its advantages.

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

1. In an engine of the class described, a fuel injecting nozzle disposed in the head of the cylinder, means including a valve for causing discharge of the compressed air of the cylinder through a bore in said nozzle, a fuel supply passage opening into the bore of said nozzle whereby the passage of air through said bore will create a vacuum in said passage to draw fuel from a fuel supply into said bore, and said nozzle having discharge ports through which fuel introduced into said bore is discharged into the cylinder of the engine when said valve is in closed position.

2. In an engine of the class described, a fuel injecting nozzle disposed in the head of the cylinder, means including a valve for causing discharge of the compressed air of the cylinder through a bore in said nozzle, a fuel supply passage opening into the bore of said nozzle whereby the passage of air through said bore will create a vacuum in said passage to draw fuel from a fuel supply into said bore, said nozzle having discharge ports through which fuel introduced into said bore is discharged into the cylinder of the engine when said valve is in closed position, and said first named means including valve actuating means in operative engagement with the engine shaft.

3. In an engine of the class described, a fuel injecting nozzle disposed in the head of the cylinder, means including a valve for causing discharge of the compressed air of the cylinder through a bore in said nozzle, a fuel supply passage opening into the bore of said nozzle whereby the passage of air through said bore will create a vacuum in said passage to draw fuel from a fuel supply into said bore, said nozzle having discharge ports through which fuel introduced into said bore is discharged into the cylinder of the engine when said valve is in closed position, said first named means including valve actu-

ating means in operative engagement with the engine shaft for moving said valve in one direction, and a spring for moving the valve in the opposite direction.

4. In an engine of the class described, a fuel injecting nozzle disposed in the head of the cylinder, means including a valve for causing discharge of the compressed air of the cylinder through a bore in said nozzle, a fuel supply passage opening into the bore of said nozzle whereby the passage of air through said bore will create a vacuum in said passage to draw fuel from a fuel supply into said bore, said nozzle having discharge ports through which fuel introduced into said bore is discharged into the cylinder of the engine when said valve is in closed position, and the discharge ports of said nozzle consisting of a plurality of circumferentially arranged ports disposed around the bore of said nozzle.

5. In a fuel oil engine of the class described, a cylinder, a piston in the cylinder, a cylinder head, a fuel injection nozzle detachably coupled with the cylinder head centrally thereof and of said piston, said nozzle having a bore opening into the cylinder and extending through said nozzle, the bore having a contracted Venturi throat, the nozzle including a fuel admission passage opening into the bore at said throat, a valve in said nozzle and in communication with the bore thereof controlling the passage of compressed air from said cylinder through said bore to create a vacuum in the fuel admission passage to cause fuel to be drawn into the bore of said nozzle, means controlling said valve to instantly stop the discharge of compressed air through the bore and the admission of fuel therein, and said nozzle having discharge ports through which fuel introduced into the bore of said nozzle may be discharged into the cylinder above the piston at the end of the compression stroke.

6. In a fuel oil engine of the class described, a cylinder, a piston in the cylinder, a cylinder head, a fuel injection nozzle detachably coupled with the cylinder head centrally thereof and of said piston, said nozzle having a bore opening into the cylinder and extending through said nozzle, the bore having a contracted Venturi throat, the nozzle including a fuel admission passage opening into the bore at said throat, a valve in said nozzle and in communication with the bore thereof controlling the passage of compressed air from said cylinder through said bore to create a vacuum in the fuel admission passage to cause fuel to be drawn into the bore of said nozzle, means controlling said valve to instantly stop the discharge of compressed air through the bore and the admission of fuel therein, said nozzle having discharge ports through which fuel introduced into the bore of said nozzle may be discharged into the cylinder above the piston at the end of the compression stroke, and the piston including a plunger extending into the bore of said nozzle to assist in the discharge of the fuel into the cylinder.

IRA W. CORY.