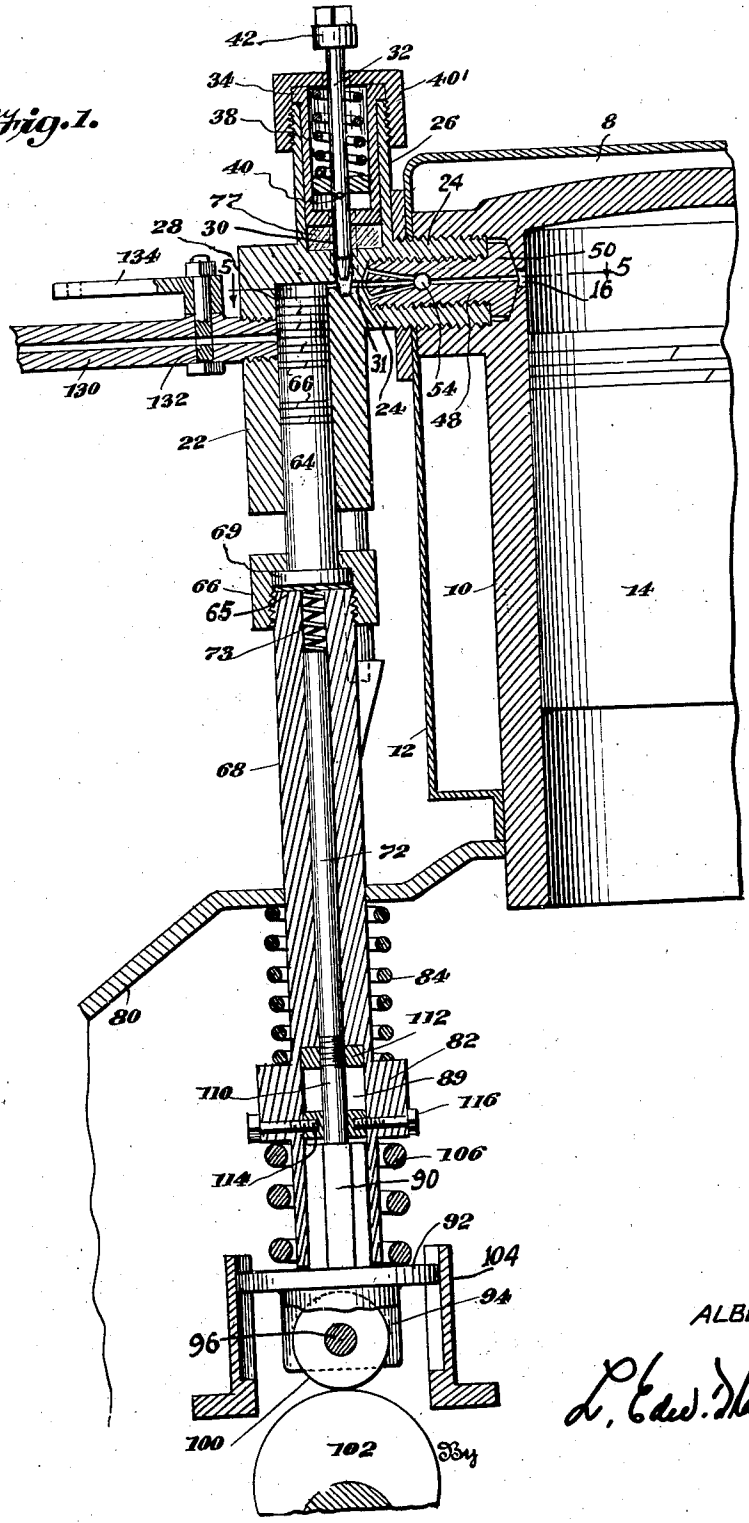
Dec. 24, 1940. A. PERRINE 2,225,796

FUEL INJECTOR FOR DIESEL MOTORS

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Fig. 1.




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Fig. 2.

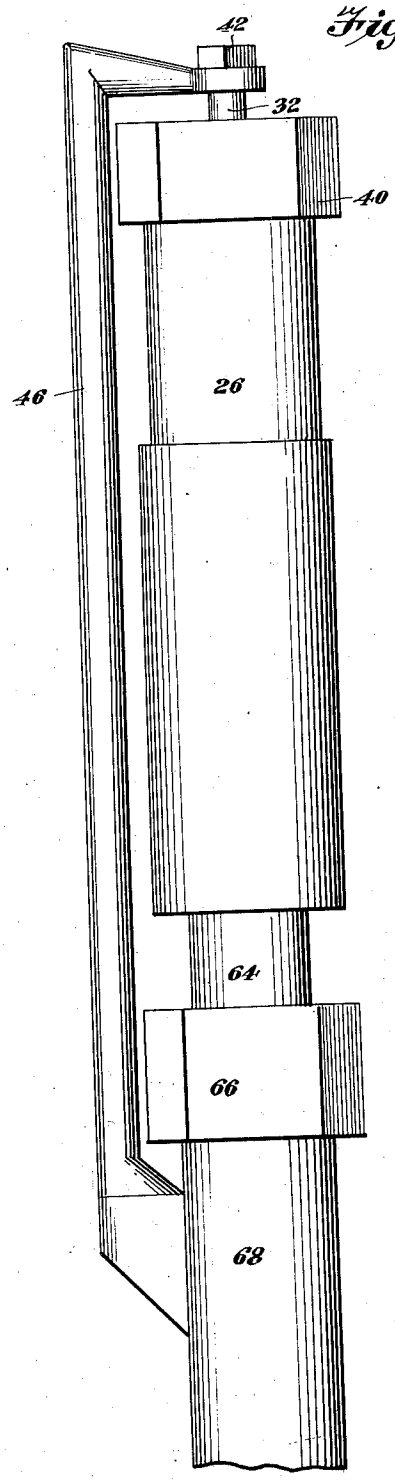
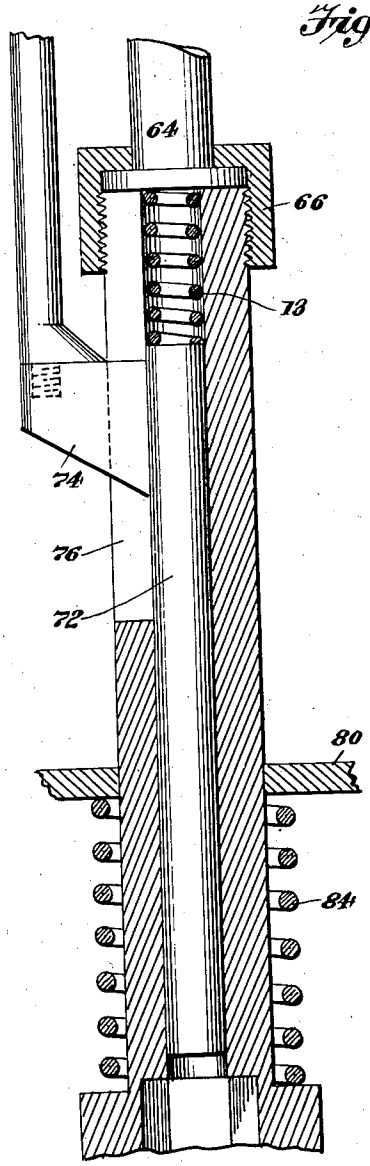



Fig. 6.




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Fig. 3.

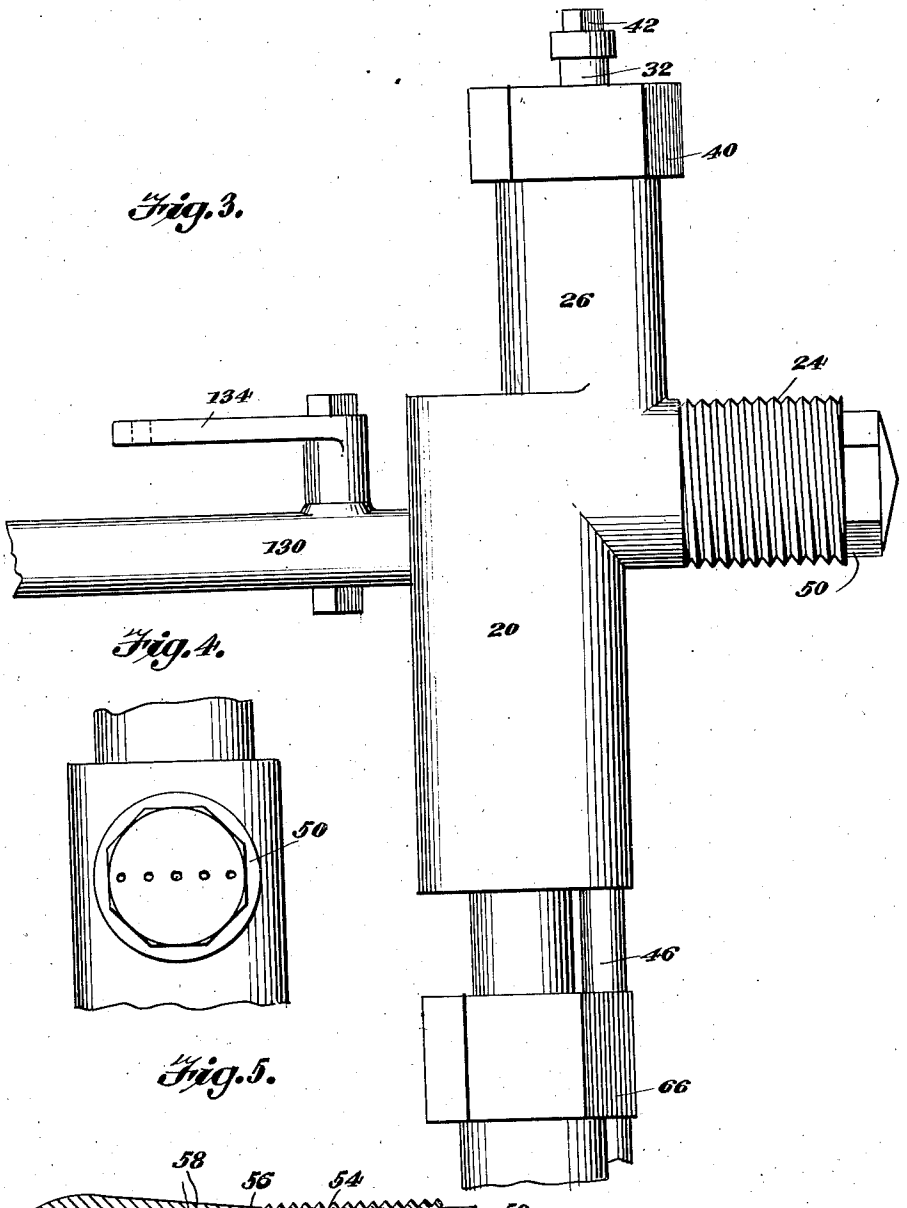
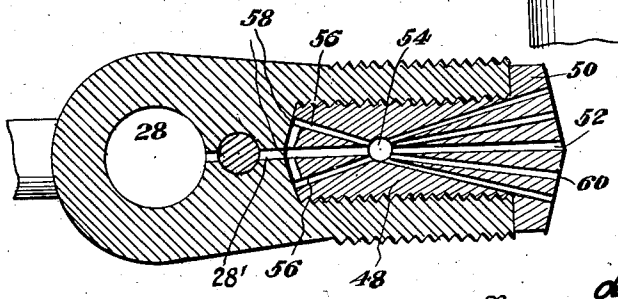



Fig. 4.




Fig. 5.




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# UNITED STATES PATENT OFFICE

2,225,796

## FUEL INJECTOR FOR DIESEL MOTORS

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Application June 5, 1937, Serial No. 146,670

6 Claims. (Cl. 123—139)

The present invention relates to a fuel injector and more particularly to an injector of this character which is especially adapted for use in connection with supplying fuel to Diesel motors.

One of the objects of the present invention is to provide a fuel injector which will eliminate in the plunger type of injector the stoppage of the injection when air bubbles get ahead of the plunger.

A still further important object of the invention is to provide a novel means for periodically actuating the needle valve after a predetermined pressure has been obtained.

A still further important object of the invention is to provide a novelly constructed nozzle.

Other important objects of the invention including simplicity of construction and low cost of manufacturing will become apparent from a study of the description when considered in connection with the accompanying drawings, wherein:

Figure 1 is a vertical sectional view of the injector illustrating the manner in which the same is secured to the cylinder of an internal combustion engine.

Figure 2 is a partial side elevational view of the injector.

Figure 3 is a fragmentary side elevational view of the upper portion of the injector.

Figure 4 is a fragmentary rear elevational view showing the arrangement of the outlet port of the nozzle.

Figure 5 is a horizontal sectional view of Figure 1 taken on the line 5—5 thereof showing the construction of the nozzle, and

Figure 6 is a fragmentary vertical sectional view illustrating the manner in which the push rod functions to open the needle valve at a predetermined time.

In the accompanying drawings wherein for the purpose of illustration there is shown a preferred embodiment of the invention, the reference numeral 8 generally designates the cylinder block which includes the usual cylinder wall 10 having a surrounding spaced water jacket 12, the cylinder in the usual manner having a reciprocating piston 14 therein. Adjacent the upper portion of the cylinder wall 10 the same is provided with a fuel inlet port 16 for supplying fuel to the upper portion of the cylinder above the piston 14 in the usual manner.

The fuel injector forming the subject matter of the present application comprises a body portion generally designated by the reference numeral 20 which includes a depending cylindrical portion 22, an integral nozzle receiving extension 24 and an integral upstanding valve receiving cylinder 26. The cylinder 22 is provided with a piston receiving bore 28 which communicates with the interior of the nozzle receiving extension 24 by means of the passageway 31. It will be seen that the passageway 30 extends transversely of the body and has extending longitudinally thereof a substantially conical-shaped bore defining a valve seat for the valve member 32 which is operable in the bore clearly illustrated in the drawings. The valve 32 has a valve seat on the free end thereof corresponding to the conical-shaped valve receiving seat and is longitudinally movable for controlling the fluid passage from the bore 28 to the nozzle in the extension 24.

The valve 32 is slidable in the sleeve 34 and is received in the extension 26 and is normally urged in its closed downward position by means of the coil spring 38 which abuts the transversely extending pin 40 through the valve 32. The upper end of the coil spring 38 abuts the cap 40' which is screw-threaded on the member 26, the valve 32 projecting through an aperture therein and being provided with a screw-threaded end for receiving a nut 42 which securely holds the valve lifting arm 46 thereon. Thus, the valve 32 is normally maintained by means of the coil spring 38 in its seated closed position preventing the passage of fluid from the bore 28 to the nozzle 48.

As clearly illustrated the nozzle receiving extension 24 is screw-threaded on its outer periphery and is receivable in the laterally extending extension 50 of the cylinder the nozzle communicating with the bore 16 for introducing the fuel as will be more fully hereinafter described within the upper portion of the cylinder.

Referring now to Figure 5 it will be observed that the nozzle 48 is screw-threaded in its receptacle 24 and is provided with a substantially hexagonal-shaped head 50 facilitating the introduction within the member 24 and the removal therefrom. The nozzle is provided with a centrally disposed longitudinally extending bore 52 therein having arranged centrally of the nozzle therein an aperture defining what may be called an eddy pool 54. A pair or more of diverging bores 56 extend inwardly from the eddy pool 54 and merge with angularly inwardly extending bores 58 which communicate the bores 56 with the longitudinally extending bore 52. A plurality of spacedly disposed diverging bores 60 extend outwardly from the eddy pool 54 in a fan-like manner. These bores 60 and the longitudinally

extending bore 52 all lie in the same horizontal plane as clearly illustrated in Figure 4 resulting in the apertures defined thereby in the head 50 lying on a straight line. In this connection it is to be noted that the outer side of the head 50 inclines from the central portion thereof rearwardly so that the fluid is sprayed in the upper portion of the cylinder over a wide area.

The outer side of the head of the injector, as it will be observed, inclines from the central portion rearwardly providing a stronger and thicker seat of cylinder wall metal, allowing the slope of the outer side of the head to more nearly approach 90° crossing orifices. This permits an instantaneous explosion of each separate jet of spray and, consequently, more even combustion. From this construction, it will be observed that a portion of the injector head is, in effect, moved away from the heat of combustion and nearer to the cooling medium thereby helping prevent carbonization of the orifices.

A piston 64 provided with a plurality of spaced piston rings 66 is freely slidable in the bore 28 and the lower end of the piston 64 is provided with an integral head 69. As will be observed the head or cap 66 is screw-threaded onto the upper end of the compressor rod 68 causing the flanged head 69 of the piston 64 to be united or held in position with respect to the compressor rod. It will be observed that a shim 65 is disposed between the head 69 and the upper end of the rod 68.

The compressor rod 68 has a centrally disposed longitudinally extending bore therein in which there is received the slidable push rod 72, the upper end of the push rod 72 having a spring 73 thereon, which abuts the bottom of the shim 65.

As clearly illustrated in Figure 6 the push rod 72 has a laterally extending integral arm 74 thereon which projects through a longitudinally extending slot 76 in the compressor rod 68. The lower portion of the valve lifting rod or arm 46 as clearly shown is connected to the upper portion of the lateral extension 74, to the end that vertical longitudinal movement of the push rod 72 within its bore affects a corresponding raising and lowering of the valve 32. Obviously, the coil spring 73 normally urges the push rod 72 to its normal position.

As clearly illustrated the compressor rod 68 depends downwardly through an aperture in the pan 80 of the motor and on its lowermost end is provided with an integral head 82. A coil spring 84 encircles the compressor rod 68 and is interposed between the underneath side of the pan 80 and the upper portion of the head 82 normally urging the compressor rod 68 in a downward direction. The head 82 is provided with a longitudinally extending guideway 89 of substantially hexagonal shape in horizontal cross section which merges with the bore receiving the push rod 72. The head or enlargement 82 as will be observed is integral with the lower free end of the compressor rod 68 that portion of the compressor rod 68 depending from the head or enlargement 82 having a longitudinally extending bore therein of substantially the same cross sectional area as the hexagonal shaped guideway 89 in which the compressor base 90 is freely movable. The compressor base is provided with an outwardly extending flange 92 which is adapted to abut the lower free end of the compressor rod and has a depending integral pair of spaced ears 94 which have a transversely extending shaft 96 therein on which there is freely rotatable a roller 100 which rides on the cam 102 of the motor. It will thus be observed that upon rotation of the cam 102 in the usual manner, the eccentric mounting of the same thereon effects an upward and downward movement of the compressor base, the flange portion 92 thereof being vertically ridable or slidable in the guideway 104. As clearly shown, the base 90 is normally urged in a downward position by means of the coil spring 84 encircling the lower portion of the compressor rod 68 above head 82 and having its upper end abutting the lower portion of the crankcase 80 and the upper side of the enlargement 82 of the rod 68 thus urging the base and rod in a downward direction, and keeping the roller 100 firmly seated on cam 102.

As clearly shown, the compression of the heavy spring 106 by the upward movement of base 90 forces in turn compressor rod 68 to move longitudinally upward and thus drive the piston 64 upward against the fuel and in this manner create the predetermined pressure, equal to the force necessary to compress spring 106, on the fuel before injection occurs. Also the spring 106 allows the piston 64 to adjust itself to any amount of fuel entering chamber 28 and inject small amounts efficiently as well as large amounts.

The upper end of the compressor base 90 as clearly illustrated in Figure 1 has an upwardly extending integral extension 110 the upper end of which is adapted to contact the lower end of the push rod 72. Adjacent the upper end of the extension 110 there is screw-threaded thereon a cap 112 which is freely slidable upon longitudinal movement of the compressor base 90 in the guideway in the enlargement 82. The downward travel of the base 90 is limited or controlled by the feet 114 secured within the enlargement by means of the screw bolt 116.

As will be observed from a study of Figure 1, it will be seen, that the fuel is introduced within the bore 28 through the medium of the conduit 130 which is screw-threaded in the wall of the cylindrical member 22 and has provided therein a transversely extending valve 132 actuated by means of a lever 134 for controlling the flow of fuel through the conduit 130 into the bore 28.

In operation, the entrance of the fuel in the bore 28 is controlled by means of the throttle valve 132 and upon actuation thereof the fuel is introduced in the bore 28 upon the upper end of the piston 64. As hereinbefore described the needle valve 32 in the lowermost position of the push rod 72 is normally closed and upon rotation of the cam 102 in the usual manner, the compressor rod through the medium of the compressor base is moved upwardly placing the fluid in the bore 28 by means of the piston 64 under pressure, the valve 32 remaining closed during this upward movement of the piston 64 preventing the fuel from going through the passageway 30 to the nozzle. It is to be noted that during this upward travel and movement of the compressor rod 68 the extension 110 has not as yet engaged the lower end of the push rod 72. Just before the piston 64 reaches the top of its stroke the upper end of the extension 110 contacts the lower end of the push rod 72 effecting a lifting of the needle valve 32 releasing the fuel which is under full injection pressure, the highly compressed oil shooting through the passageway 30 through the converging bore 56 into the eddy pool 54 where it is broken into a fine mist and then passes through the diverging conduits 52

and 60 shooting out of the apertures in the head across the cylinder in a fan-like spray. It is to be observed in this connection that a packing 7 is disposed around the needle valve 32 below the sleeve 34 preventing the back flow of oil or fuel along the needle valve when under pressure. Thus the fuel is placed under pressure at the proper time by means of the piston and upon the upper stroke of the piston the upper end thereof closes the entrance of the inlet passage of the conduit 130 in the bore 26 throwing the full pressure of the spring 106 on the piston so that even one drop of oil receives the entire pressure. Thus, there is no vacant space so that air in the fuel injector would not prevent the injection of fuel by being compressed and expanded. By this construction the needle valve cannot be lifted until the oil is under full injection pressure and each time the injection takes place the piston or plunger 66 fully completes its stroke there being no vacant space for the accumulation of air and the consequent rise of trouble due to air in the fuel injection chamber.

While there is shown for the purpose of illustration a preferred embodiment of the invention it is to be understood that it is capable of various changes and modifications without departing from the spirit and scope thereof and it is intended, therefore, that only such limitations shall be imposed thereon, as are indicated in the prior art or in the appended claims.

What is claimed is:

1. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle casing communicating with said cylinder, a nozzle in said casing, a normally closed valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source of fluid to said cylinder, a compressor rod connected to said piston and adapted to be actuated by the cam shaft of an engine, a push rod slidable in said compressor rod, a lifter rod connected to said valve and to the push rod, means controlled by the cam shaft for actuating the push rod independently of the compressor rod to open said valve at a predetermined position of said cam shaft controlled means and resilient means between the cam shaft controlled means and the compressor rod whereby the fuel is injected from the cylinder into the nozzle at a predetermined pressure.

2. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle communicating with said cylinder, a valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source of fluid to said cylinder, a compressor rod for actuating said piston, a push rod slidable in the compressor rod, a lifter rod connected to said valve and to the push rod, said compressor rod having a guideway in the lower portion thereof, a compressor base slidable in said compressor rod guideway having outwardly extending flanges on the lower end thereof for abutting engagement with the lower end of the compressor rod, an extension on the upper end of the compressor base for actuating said push rod, a roller for engagement with the cam shaft rotatably mounted on said compressor base, a guideway in which the compressor base is slidable, said compressor rod having an outwardly extending flange inwardly of the free end thereof, a coiled spring encircling the end of the compressor rod with one end thereof abutting the flange of the compressor rod and the other end the flange of the compressor base, whereby upon operation of the cam shaft, the push rod is actuated independently of the compressor rod to open the valve for injecting fuel from the cylinder into the nozzle at a predetermined pressure.

3. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle communicating with said cylinder, a valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source of fluid to said cylinder, a compressor rod for actuating said piston, a push rod slidable in the compressor rod, a lifter rod connected to said valve and to the push rod, said compressor rod having a guideway in the lower portion thereof, a compressor base slidable in said compressor rod guideway having outwardly extending flanges on the lower end thereof for abutting engagement with the lower end of the compressor rod, an extension on the upper end of the compressor base for actuating said push rod, means in the compressor rod guideway for limiting the downward movement of said compressor base, a roller for engagement with the cam shaft rotatably mounted on said compressor base, a guideway in which the compressor base is slidable, said compressor rod having an outwardly extending flange inwardly of the free end thereof, a coiled spring encircling the end of the compressor rod with one end thereof abutting the flange of the compressor rod and the other end the flange of the compressor base, whereby upon operation of the cam shaft, the push rod is actuated independently of the compressor rod to open the valve for injecting fuel from the cylinder into the nozzle at a predetermined pressure.

4. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle communicating with said cylinder, a valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source of fluid to said cylinder, a compressor rod for actuating said piston, resilient means for normally urging said compressor rod in a downward position, a push rod slidable in the compressor rod, a lifter rod connected to said valve and to the push rod, resilient means for normally urging said push rod in a downward position, said compressor rod having a guideway in the lower portion thereof, a compressor base slidable in said compressor rod guideway having outwardly extending flanges on the lower end thereof for abutting engagement with the lower end of the compressor rod, an extension on the upper end of the compressor base for actuating said push rod, a roller for engagement with the cam shaft rotatably mounted on said compressor base, a guideway in which the compressor base is slidable, said compressor rod having an outwardly extending flange inwardly of the free end thereof, a coiled spring encircling the end of the compressor rod with one end thereof abutting the flange of the compressor rod and the other end thereof abutting the flange of the compressor base, whereby upon operation of the cam shaft, the push rod is actuated independently of the compressor rod to open the valve for injecting fuel from the cylinder into the nozzle at a predetermined pressure.

5. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle communicating with said cylinder, a valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source

of fluid to said cylinder, a compressor rod connected to said piston and adapted to be actuated by the cam shaft of an engine, a push rod slidable in said compressor rod, a lifter rod connected to said valve and to the push rod, resilient means normally urging said push rod in its lowermost position, means controlled by the cam shaft for actuating the push rod independently of the compressor rod to open said valve at a predetermined position of said cam shaft controlled means, and resilient means between the cam shaft and the compressor rod whereby the fuel is injected from the cylinder into the nozzle at a predetermined pressure.

6. A fuel injector comprising a body including a cylinder, a piston slidable in said cylinder, a nozzle communicating with said cylinder, a valve for controlling the flow of fluid from said cylinder to said nozzle, means for supplying a source of fluid to said cylinder, a compressor rod connected to said piston and adapted to be actuated by the cam shaft of an engine, a push rod slidable in said compressor rod, a lifter rod connected to said valve and to the push rod, means controlled by the cam shaft including a spring for actuating the compressor rod and the piston to place the fuel in the cylinder under pressure and to subsequently actuate the push rod independently thereof at a predetermined position of the cam shaft controlled means for opening said valve.

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