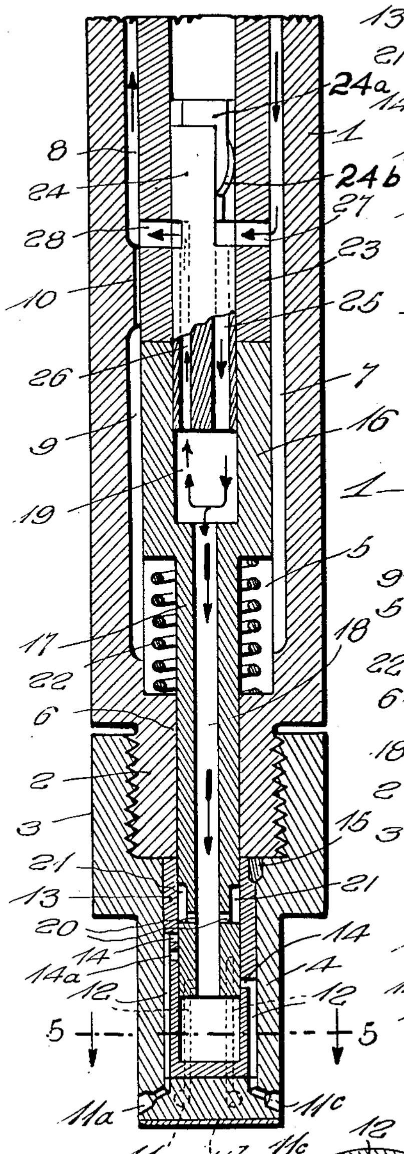
April 27, 1943. F. R. KING 2,317,618

FUEL INJECTOR

Filed Dec. 23, 1940

FIG. 1



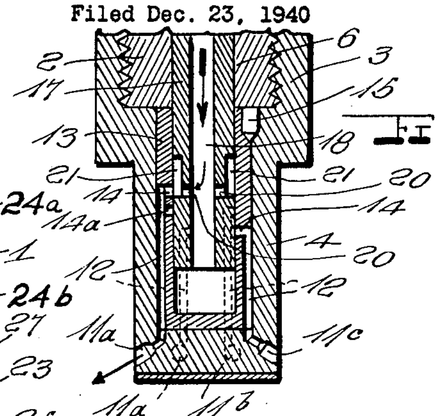


FIG. 2

FIG. 3

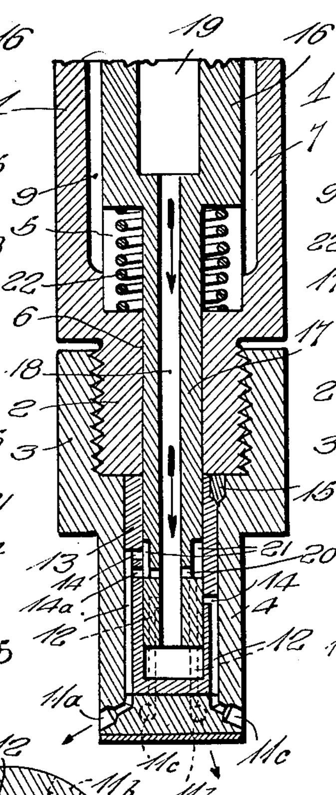


FIG. 4

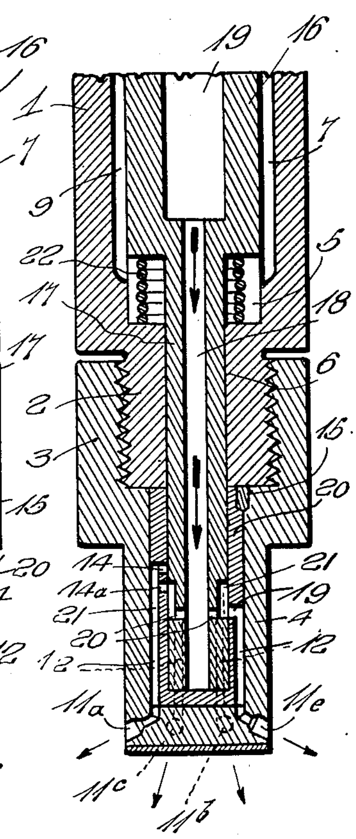
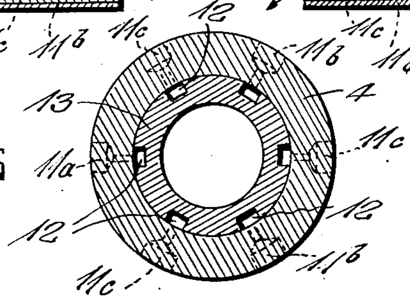


FIG. 5



INVENTOR.

Franklin R. King,

BY

[signature]

Attorney

Patented Apr. 27, 1943 2,317,618

UNITED STATES PATENT OFFICE

2,317,618

FUEL INJECTOR

Franklin R. King, Yelm, Wash.

Application December 23, 1940, Serial No. 371,452

2 Claims. (Cl. 299—107.2)

This invention relates to a fuel injector and more particularly to a cylindrical valve fuel injector for Diesel engines, it being one object of the invention to provide a fuel injector which is automatically adjusted in response to variations in engine speed and resulting pressures, thus causing flow of fuel to the engine to be automatically increased as engine speed increases and the proper quantity of fuel delivered in accordance with the speed of the engine.

Another object of the invention is to provide a fuel injector wherein the fuel is delivered to the nozzle of the injector through a hollow valve which is yieldably held against sliding movement in one direction and urged in this direction by pressure of the fuel oil so that as engine speed increases and pressure on the fuel also increases, ports of the valve will be progressively and successively moved into registry with discharge ports of the injector to permit progressive increase in the quantity of fuel discharged from the injector.

Another object of the invention is to provide a fuel injector of such construction that under certain conditions fuel under pressure may return to the place of origin by movement through a bypass formed in the injector.

Another object of the invention is to provide a fuel injector which is simple in construction and capable of being easily taken apart and reassembled when cleaning or repair is necessary.

In the accompanying drawing:

Fig. 1 is a sectional view taken longitudinally through the improved fuel injector, the upper portion of the injector being broken off and the valve being in its initial position.

Fig. 2 is a sectional view taken longitudinally through the lower portion of the injector with the valve shifted to low speed position.

Fig. 3 is a view similar to Fig. 2, with the valve in position for second speed.

Fig. 4 is a view similar to Fig. 3, with the valve set for high speed.

Fig. 5 is a sectional view taken transversely through the nozzle of the injector, on the line 5—5 of Fig. 1.

This improved fuel injector has a cylindrical body 1 which may be of any desired length and leads from a suitable source of fuel under pressure, the pressure being supplied in a conventional manner by the Diesel engine to which the fuel is delivered. The lower end of the body 1 is reduced to form a shank 2 which is externally threaded and engages in the internally threaded socket 3 of a nozzle 4. The main chamber 5 of the body 1 extends to adjacent the lower end thereof and the shank 2 is formed with a bore 6 leading from the front end of the chamber 5. A channel 7 extends longitudinally of the chamber 5 at one side thereof and, at the opposite side of the chamber from the channel 7 are channels 8 and 9 which terminate in spaced relation to each other and are connected by a shallow groove or air vent 10.

The nozzle 4 is closed at its lower end and about its circumference is formed with spaced orifices or outlet ports which become active in a certain order to be hereinafter explained and which, for convenience, have been designated as 11*a*, 11*b*, and 11*c*. These orifices or ports constitute terminals for lower ends of conduits 12 formed in a liner 13 longitudinally thereof, and attention is called to the fact that the conduits leading to the ports 11*b* are longer than those leading to the ports 11*c* but shorter than the conduit leading to the port 11*a*. It is also to be noted that the conduits have inlet openings 14 leading from their upper ends, the conduit leading from the port 11*a* being provided with a second opening 14*a* spaced downwardly from its inlet 14. A key 15, which is driven into registering notches, holds the liner stationary and prevents it from turning in the nozzle.

A pressure controlled valve 16 operates in the body and the nozzle and has a cylindrical upper portion from which extends a tube 17 of a diameter adapting it to fit snugly in the bore 6 and the liner 13. The bore 18 of this tube leads from the lower end of the chamber 19 defined by the cylindrical upper portion of the valve and in spaced relation to its lower end the tube is formed with outlet openings 20 communicating with external recesses 21 of such dimensions that they may register with the inlet openings of the conduits 12 in a manner to be hereinafter set forth.

A spring 22 which is seated in the lower end of chamber 5, urges the valve upwardly and normally holds it in the position shown in Fig. 1, with its upper end abutting the lower end of a sleeve 23 which fits snugly in the body 1. This sleeve is plugged by a core or plunger 24 having passages 25 and 26 formed longitudinally therein from its lower end and having their upper ends registering with openings 27 and 28 formed through opposite side portions of the sleeve and communicating with the oil passages 7 and 8. The core 24 is a vertically disposed pump plunger or piston of the type shown in Patents Nos. 2,082,808; 2,096,711; and 2,144,862, and is driven by conventional driving means of the type shown in the prior patents mentioned. Said driving means, which has been omitted from the drawing, is timed with the engine and is equipped with conventional means for rotating the plunger to vary the capacity of the pump. When the plunger is in the raised position shown in Fig. 1, the ports 27 and 28 communicate with each other through the groove 24a formed in the plunger and, during downward movement of the plunger, the ports are gradually cut off by covering portions of the plunger. Injection delivery then takes place until the port 27 is again uncovered by the portion 24b of the groove moving into registry with the port. Since the portion 24b of the groove 24a has a curved side wall, turning of the plunger to adjusted positions will regulate the time required for uncovering of the port 27 during downward movement of the plunger. The passage 25 is of greater diameter than the passage 26 and, referring to Fig. 1, it will be seen that the lower portion of the core engages in the chamber 19 of the valve 16 so that during operation of the injector, the fuel may flow from passage 7 downwardly through passage 25 into the chamber 19 and a portion of this fuel flows through the bore 18 of tube 17 while surplus fuel enters passage 26 and flows upwardly through the same and through the passage 8 back to the source of supply. The vent 10, which establishes communication between the passages 8 and 9, allows air to escape and thus prevent the formation of an air cushion or the accumulation of oil under pressure in the lower portion of chamber 5, which would prevent proper reciprocating movement of the valve.

When this fuel injector is in use, it is mounted in a conventional manner with its nozzle within the cylinder or casing of a Diesel engine. In the initial position of the valve, the side ports 21 of the stem are located above the side ports 14 of the liner and fuel cannot enter the conduits 12. If the fuel is under pressure, it will enter the chamber 19 from passage 25 and then leave by way of passage 26 and return to the source of supply. When the engine is in operation and pressure forces the valve downwardly to the position shown in Fig. 2, the recess registers with the port 14 of the conduit leading to the outlet 11a, and fuel will be discharged from this outlet for operation of the motor at low speed. When the throttle is opened wider the increased pressure again forces the valve downward and the recess will register with the side port 14a and, at the same time, register with the inlets of the conduits leading to the outlets 11b and fuel will be discharged from these outlets as well as from the outlet 11a. This is shown in Fig. 3. The pressure is again increased when the throttle is fully opened for high speed operation of the motor, and the valve will then be shifted downwardly to the position shown in Fig. 4. The recess will then register with the inlets of all of the conduits and fuel will be discharged from the outlets 11c in addition to the outlets 11a and 11b. It will thus be seen that the valve will be successively moved into position to deliver fuel to first the outlet 11a, then to the outlets 11a and 11b, and then to the outlets 11a, 11b and 11c, and the quantity of fuel delivered will be progressively increased and sufficient fuel delivered to the engine at all times. When the engine is shut off, the spring 22 returns the valve to its initial position and the flow of fuel will be stopped, it being understood that if the throttle is actuated to merely reduce the speed of the engine, instead of shutting it off entirely, the quantity of fuel will be reduced proportionately. At all times, surplus fuel will be returned to the source of supply through the passage 26.

Having thus described the invention, what is claimed is:

1. A pressure controlled fuel injector comprising a tubular body having a main chamber and a bore leading from the chamber through the discharge end of the body, a nozzle carried by and extending from the discharge end of said body and having a head at its outer end and discharge ports spaced from each other circumferentially of the nozzle, a liner for the nozzle formed with external grooves extending longitudinally thereof and constituting conduits having their forward ends registering with the ports of the nozzle and their rear ends communicating with inlet openings extending through the walls of the liner, a pressure actuated valve having a hollow cylinder slidable longitudinally in the body and a tubular stem extending forwardly from the cylinder and slidably passing through the bore of the body into the liner, said stem having side ports for registering with the inlet openings of the conduits as the valve is shifted forwardly, and spring means yieldably resisting forward movement of the valve.

2. A pressure controlled fuel injector comprising a tubular body having a main chamber and a bore leading from the chamber through the discharge end of the body, a nozzle carried by and extending from the discharge end of said body and having a head at its outer end and discharge ports spaced from each other circumferentially of the nozzle, a liner for the nozzle formed with external grooves extending longitudinally thereof and constituting conduits having their forward ends registering with the ports of the nozzle and their rear ends communicating with inlet openings extending through the walls of the liner, certain of said conduits extending rearwardly along the liner beyond rear ends of other conduits and one of the elongated conduits having its rear end portion communicating with front and rear inlet openings spaced from each other longitudinally of the liner, a tubular pressure actuated valve slidable longitudinally in the body and including a tubular stem slidable longitudinally in the liner and formed with outlet openings through its sides terminating in grooves extending longitudinally of the stem externally thereof in position to successively register with the inlet openings of the conduits as the valve is shifted forwardly, and spring means for yieldably resisting forward movement of the valve.

FRANKLIN R. KING.