April 3, 1956 R. SEIFERT 2,740,669

FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

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Fig. 2.

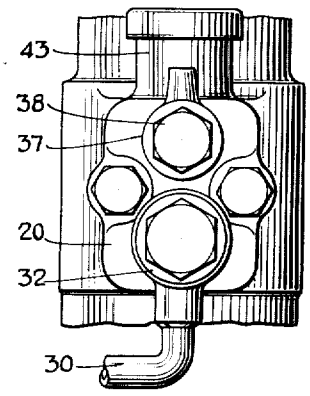


Fig. 1.

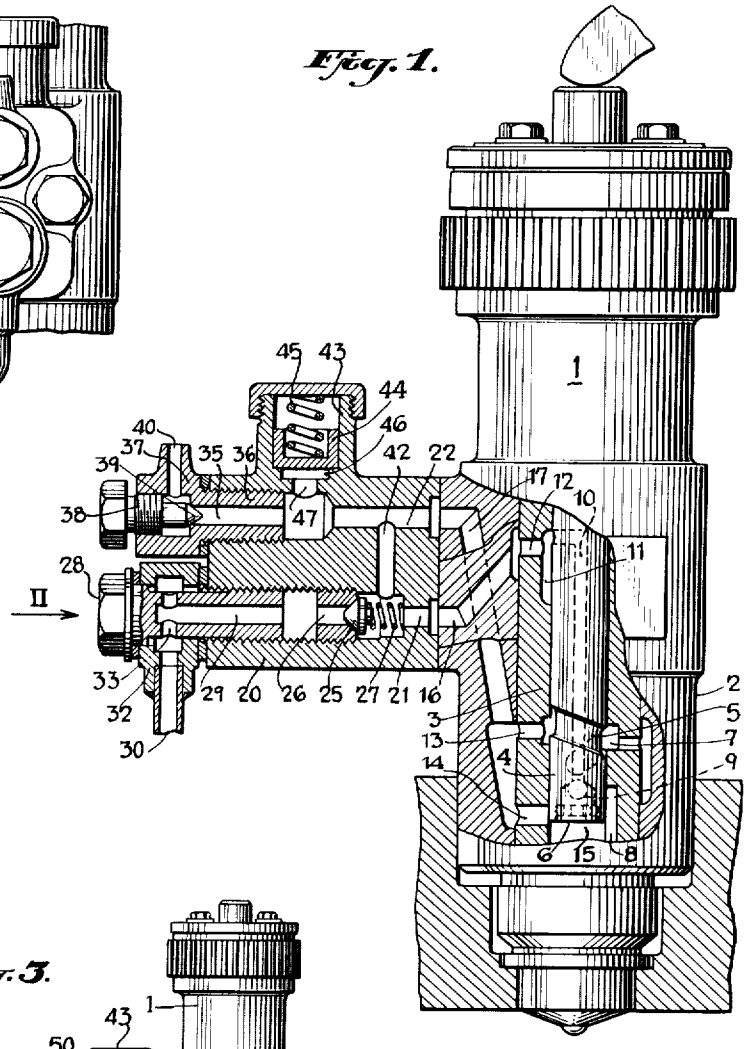
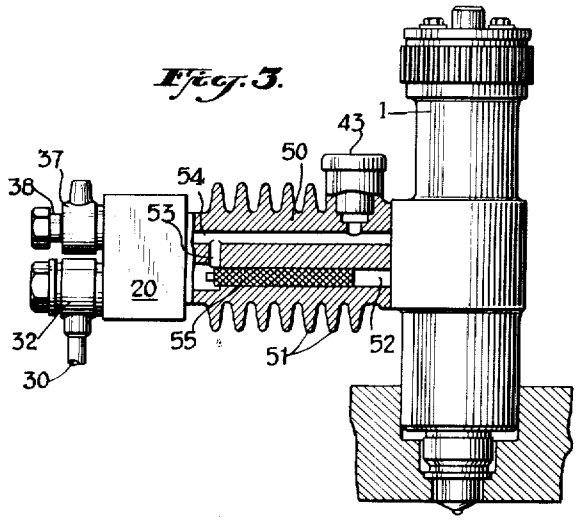


Fig. 3.



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FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

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6 Claims. (Cl. 299—107.2)

The invention relates to a fuel injection device for internal combustion engines, particularly for vehicles, in which the fuel pump and the injection nozzle form a unit.

In such devices a plurality of connections and conduits are required, which is undesirable: one connection for the supply of the fuel and one connection for the return of unused fuel which may be used for scavenging and cooling. Provision of a plurality of conduits for each device is cumbersome and requires pipes, screw connections, packings and other fittings which frequently cause leakage. Fuel return conduits connected with a plurality of devices transmit irregularities in one device to the other devices, necessitating a check valve in each conduit. The fuel pump must have excessive capacity in order to maintain circulation of the unused fuel which is heated and frequently contains air causing additional difficulties.

In order to avoid the aforedescribed disadvantages, the device according to the invention is provided with only one pipe connection through which the fuel is supplied, a conduit being provided within the device for returning the unused fuel into the supply conduit. The returned fuel forms a circuit within the device with the supplied fuel so that the returned fuel need not be conducted away from the device as in conventional arrangements.

In order to prevent pumping of fuel from a device, whose injection nozzle is out of order, back into the fuel supply line, adversely affecting operation of the other devices connected with the same supply line, a check valve is provided within the device according to the invention, preventing transmission of high pressure from the circuit within the device into the fuel supply line.

According to the invention a pressure accumulator is connected with the conduits within the device between the pump chamber of the injection device and the check valve, preventing excessive pressures in the fuel admission and fuel return conduits.

Means are provided in the device according to the invention for removing air from the fuel admission and fuel return channels which are interconnected within the device; these means afford reliable removal of the air before starting and during operation of the engine. The air removal means are preferably connected with the fuel return conduit so that no air enters the fuel admission conduit. The air relief means also permit testing of proper functioning of the fuel injection device during operation of the internal combustion engine.

A fitting is preferably provided comprising a connection for the supply of fuel, the fuel admission and fuel return channels, a channel interconnecting the admission and return channels, a check valve, and a fuel filter, if desired. This facilitates supervision of the device and its connections. The fuel channels and the interior of the pump can be conveniently cooled by providing the fitting with cooling means, for example, with cooling ribs.

The novel features which I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of two embodiments thereof when read in connection with the accompanying drawing in which

Fig. 1 is a part sectional side view of the device according to the invention;

Fig. 2 is a side view of the device shown in Fig. 1 taken at a right angle to the view of Fig. 1;

Fig. 3 is a part sectional side view of a modified device according to the invention.

Like parts are designated by like numerals in all figures of the drawing.

Referring more particularly to Figs. 1 and 2 of the drawing, numeral 1 designates a fuel injection device having a casing 2 containing a sleeve 3, the latter guiding a pump plunger 4. The plunger is provided with a control groove 5 cooperating with an annular recess 7 and with a longitudinal groove 8 in the sleeve 3 for regulating the injection periods. The edge of the bottom surface 6 of the plunger 4 controls beginning of the fuel injection. A check valve 9 is provided in the plunger 4. Channel 10 admits fuel through the pump plunger and the valve 9 into a pressure chamber 15. A longitudinal groove 11 at the inside of the sleeve 3 communicates with a transverse bore 12 in the sleeve, which is provided with two additional transverse bores 13 and 14.

Numeral 16 designates a channel in casing 1 through which fuel is conducted into the bore 12. A return channel 17 communicates with bores 13 and 14. The channels 16 and 17 are shown in two different sections in Fig. 1 because they are located behind one another in two different planes.

A fitting 20 is attached to the casing 2 of the device 1. It is provided with a bore 21 for admitting fuel and a bore 22 for returning fuel. Bore 21 has a widened portion containing a check valve 25, 26 which opens against the action of a spring 27 due to the pressure of the fuel in the supply line 30. The latter terminates in an annular member 32 which is pressed to the body of the fitting 20 by means of a plug 28 having a longitudinal bore 29 and a transverse bore 33 effecting communication of conduit 30 through an internal recess in member 32 with the bore 29. The fuel passing through the valve 25 flows through conduit or channel 16 into the injection device 1. The excess fuel flows through channel 17 into the bore 22 of the fitting 20. Bore 22 communicates with a bore 35 in a threaded extension 36 of a nipple 37. Bore 35 is normally closed by an air relieve plug 38 which is screwed into the nipple and which has a conical end 39 adapted to close the bore 35 which, otherwise, communicates with an outlet bore 40.

The fuel admission bore 21 and the fuel return bore 22 are interconnected by means of a transverse bore 42.

Fitting 20 is provided with a pressure accumulator chamber 43 containing a piston 44 which is movable against a spring 45. The space 46 facing the piston communicates through a bore 47 with the return channel 22.

Fig. 2 is a view of the fitting 20 in the direction of the arrow 1 in Fig. 1, showing the front of the annular member 32, to which the fuel supply conduit 30 is connected, and showing the front of the air relieve screw 38.

The parts of the injection device are shown in the position before beginning of the fuel injection into the combustion chamber of the internal combustion engine. The injection begins as soon as the edge of the face 6 of the pump plunger 4 passes the lower edge of the bore 14. The injection ends when the pressure chamber 15 is connected with the return channel 17 through the

groove 8, the control groove 5, the annular recess 7, and the bore 13.

When a certain pressure has been built up in chamber 15 at the downstroke of plunger 4, valve 9 closes, so that no fuel can escape through the valve during the injection period. Since all conduits and channels are filled with fuel, additionally admitted fuel, which may cause a sudden increase of pressure in the channels 16, 21 and 17, 22, is received in the pressure accumulator 43. The piston 44 is thereby moved against the pressure of spring 45 so that the pressure in the system is limited to a corresponding measure. Upon the suction stroke of plunger 4, the tensioned spring 45 effects supply of accumulated fuel to the chamber 15 through the transverse connection 42, the channels 21, 16, and the bores 12 and 10. When spring 45 is released, the check valve 25 is opened by the suction effected by the plunger 4, so that fuel is admitted to the chamber 15 from conduit 30 through the conduits 33, 29, 26, 21, 16, 12, 11, 10 and through the valve 9.

The system according to the invention makes it unnecessary to return excess fuel to the fuel reservoir. No return conduit and connections are needed and circulation of excessive amounts of fuel is avoided, so that the fuel supply pump can be made much smaller than in conventional systems.

Valve 25 remains closed at irregularities in the nozzle of the injection device, i. e. if no or not enough fuel passes through the nozzle during the injection period. Therefore, the pressure shocks developed in the pump circuit cannot be transmitted into the supply line 30 and to the injection devices of the other cylinders.

Air can be removed through the air valve 39 from each injection device at the start and during operation of the engine. This valve also affords checking of the operation of the injection devices during operation of the internal combustion engine. The air removal device 37, 39 can also be used for draining leakage oil which may be present in the injection device.

Fig. 3 illustrates an embodiment of the invention in which the fitting 20 is provided with a collar 50 in which the oil circulating through channels 54, 53, and 52 is cooled by the provision of cooling ribs 51, whereby also the injection device 1 is cooled. Channel 54 is connected with channel 22 in the fitting 20, the channel 42 of the latter being replaced by channel 53 in the collar 50. Channel 52 communicates with channel 21 of the fitting 20. The collar 50 and the channel 52 may be made so long that a rod shaped filter 55 can be inserted for cleaning the fuel oil admitted to the device 1. The collar 50 may have any desired configuration; its longitudinal axis may be, for example, parallel to the longitudinal axis of the device 1 or it may be inclined thereto.

The aforedescribed arrangements considerably simplify the piping for the fuel supply to the internal combustion engine. The new system can be easier supervised and increases safety of operation.

While I have shown and described specific embodiments of my invention, it will be apparent to those skilled in the art that various changes, modifications, substitutions, additions and omissions may be made therein without departing from the spirit and scope of my invention as set forth in the appended claims.

What is claimed is:

1. A fuel injection device for internal combustion engines particularly for motor vehicles comprising an injection pump and an injection nozzle forming a unit with said pump, a fuel supply conduit connected with the device, a fuel admission channel communicating with said conduit and with said pump, a fuel return channel interconnecting said pump and said fuel admission channel within the device for returning excess fuel from said pump into said fuel admission channel within the device, and a check valve in said fuel admission channel between the connection of said admission channel with said supply conduit and the connection of said return channel with said admission channel for preventing transmission of excess fuel pressure from said return channel to said supply conduit.

2. A fuel injection device as set forth in claim 1 comprising an air relief means connected with said return channel.

3. A fuel injection device according to claim 1 comprising a pressure accumulating device connected with said return channel.

4. A fuel injection device for internal combustion engines particularly for motor vehicles comprising a fuel injection pump and a fuel injection nozzle forming a unit with said pump, a fuel admission channel and a fuel return channel disposed in said unit and connected with said pump, a fitting connected with said unit, a first bore in said fitting communicating with said admission channel, a second bore in said fitting communicating with said return channel, a third bore in said fitting interconnecting said first and said second bore, a hollow plug member inserted in said fitting for closing said first channel against the outside, an annular member arranged around said plug member and having an internal recess communicating with the interior of said plug member, a fuel supply conduit connected with said annular member for supplying fuel into said recess, a check valve in said first bore between said plug member and the connection of said first bore with said third bore, and an air relief valve connected with said fitting for relieving air from said bores.

5. A fuel injection device as set forth in claim 4 comprising a fuel filter inserted in said first bore.

6. A fuel injection device as set forth in claim 4 comprising cooling ribs connected with the outside of said fitting.

References Cited in the file of this patent

UNITED STATES PATENTS

1,811,731	Petty	June 23, 1931
2,055,580	Larsson	Sept. 29, 1936
2,496,804	Meitzler	Feb. 7, 1950

FOREIGN PATENTS

526,666	Great Britain	Sept. 23, 1940