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EXTERNAL SPRING NEEDLE VALVE FUEL INJECTOR

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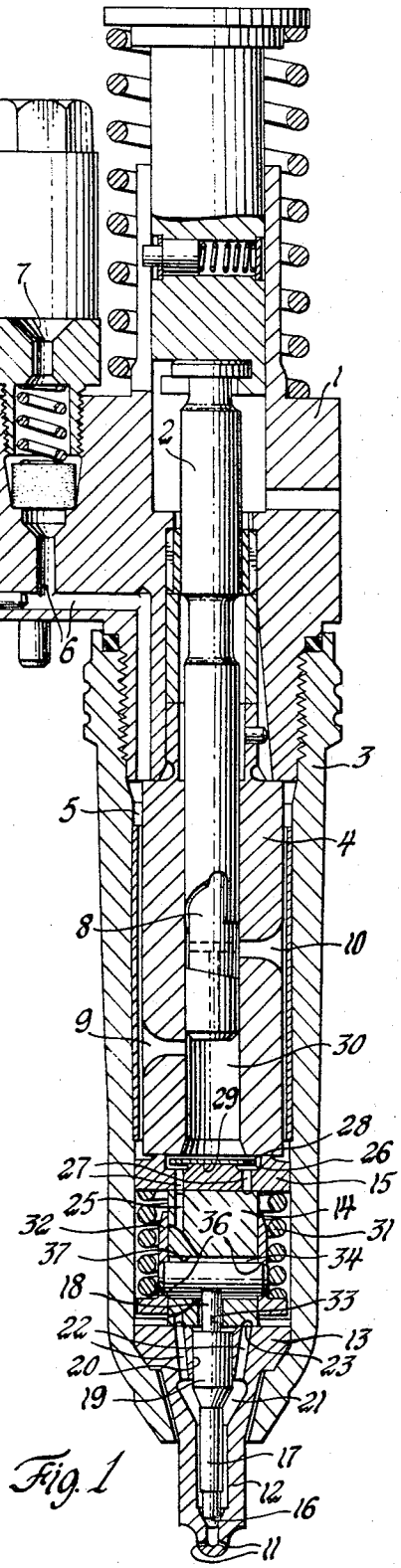


Fig. 1

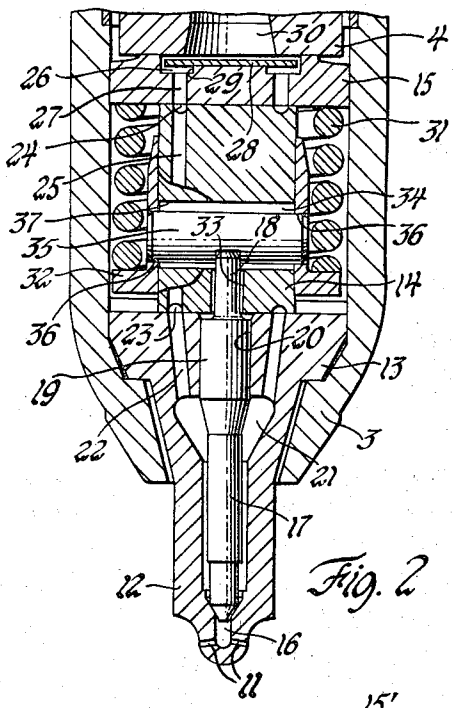


Fig. 2

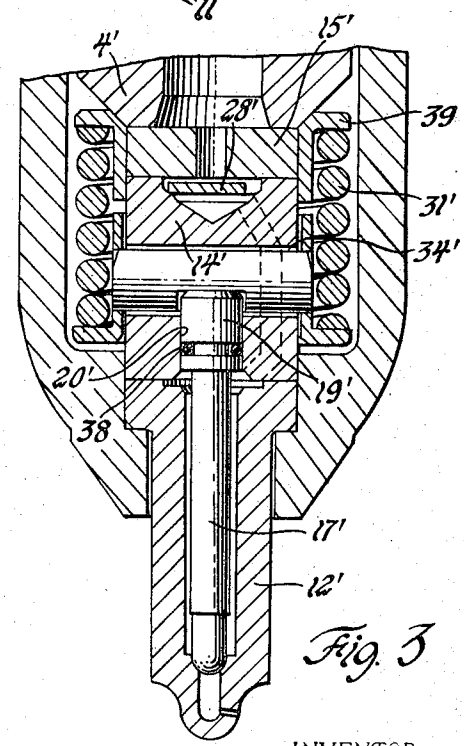


Fig. 3

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EXTERNAL SPRING NEEDLE VALVE FUEL INJECTOR

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ABSTRACT OF THE DISCLOSURE

A unit type fuel-injector pump having a needle-type injection valve openable oppositely of the direction of fuel flow and biased closed by a spring surrounding the spacer block in which the valve is slidably guided, the spring force being transmitted to the valve by a cross pin extending through a transverse slot in the spacer block.

Background of the invention

This invention relates to fuel injection apparatus and particularly to unit type fuel injector-pumps for diesel engines.

Devices of this type are well known, including those wherein the normally closed injection valve is of the needle type which opens oppositely of the direction of fuel flow during injection. The construction disclosed in U.S. Patent No. 3,006,556 to Shade et al. is typical thereof. In such previous injector-pumps, the spring which biases the needle valve to its closed position has been centrally located in a relatively small diameter spring chamber where it directly acts against the needle valve. In such arrangements, the "tip" passage through which the injection fuel is delivered from the pump chamber to the spray tip outlet is formed by a series of connecting drilled passages through the spacer elements outboard of this central spring chamber. As a result, the limited space available in the spring chamber has placed severe limitations on the size and consequent strength of the injection valve spring, adversely affecting its cost and durability because of the high stressing of the spring in operation.

Summary of the invention

In accordance with the invention, I have overcome the above-mentioned problems and disadvantages of such needle type unit injector-pumps by an arrangement which enables use of a much larger than conventional valve spring, and which also enables shortening and thereby reducing the volume required for the tip passage for better volumetric efficiency of injection. By substituting a spring which "externally" surrounds the spacer parts of the nozzle, heavier and stiffer material can be employed for the spring, and its biasing action on the needle valve can be very simply effected by means of a transfer pin loosely disposed within a cross slot in the spacer.

These and other objects and advantages of the invention will be better understood from the following description, having reference to the attached drawing.

Brief description of the drawing

FIGURE 1 is a longitudinal sectional view through a unit injector-pump constructed in accordance with the invention.

FIGURE 2 is an enlarged view of the lower portion of the unit shown in FIGURE 1.

FIGURE 3 is a further enlarged view, similar to FIGURE 2 but showing a slight modification of the invention.

Description of the preferred embodiment

Referring now in detail to the drawing, and first to FIGURES 1 and 2, the upper portion of the unit is conventional and comprises a housing **1** in which a plunger **2** is reciprocable. Forming an extension of and threaded to the lower end of the housing **1** is a nut **3** enclosing a bushing **4** which forms the pump cylinder for the plunger. An annular reservoir space **5**, surrounding the bushing within the nut, is supplied with fuel via passages **6** in the housing from an external fuel connection **7**. The plunger has the usual external metering groove **8** adjacent its lower end by which opening and closing of ports **9** and **10** in the bushing are controlled during each downward stroke of the plunger to handle a predetermined volume of fuel via the spray orifices **11** in the lower end of the spray tip **12**. Other details of the upper or pump part of the unit are also conventional and require no description for present purposes.

As will be seen best in FIGURE 2, the flanged upper end **13** of the spray tip seats in the lower end of the nut **3**, being clamped thereagainst by spacer means comprising a lower spacer block **14** and an upper spacer block **15**, which latter abuts against the lower end of the bushing **4**. The spray tip has its outlet **16** normally closed by a needle type injection valve **17** whose upper end terminates in a shaft portion **18** above the upward end of the spray tip. Intermediate its ends the needle valve has an enlarged or piston portion **19** which has a close sliding fit in the upper bore **20** of the spray tip. Surrounding this piston portion of the valve within the spray tip is a fuel chamber **21** which extends down to the spray tip outlet **16** and is connected through the upper end of the spray tip via one or more drilled passages **22**. These latter passages communicate, in turn with an annular groove **23**, in the bottom face of the lower spacer block **14**. A similar groove **24** is shown in the upper end face of this spacer **14**, and is connected with the groove **23** by one or more drilled passages **25** through this spacer. The upper spacer **15** is shown provided with a fuel cavity **26** which is connected with the groove by one or more drilled passages **27**. Disposed within the cavity **26** is a check valve **28** in the form of a flat plate, which normally rests in its open position (shown) on a central protuberance **29** in the bottom of the cavity, but which is raisable in response to fuel pressure to close against the lower end of the bushing **4**. It will be appreciated that the passages **27**, **25** and **22** provide for flow of fuel from the pump chamber **30** in the bushing to the spray tip outlet **16**, and that the check valve **28** serves to block any reverse flow of fuel as might be induced by engine combustion gases entering these fuel passages in the event the needle valve **17** failed to close after an injection.

The injection valve is biased to its closed position by spring means shown in the form of a coil compression spring **31** surrounding the spacer **14**. This spring reacts upwardly, through its seat formed by the upper spacer **15**, against the lower end of the bushing **4**. The lower end of the spring is provided with a retainer **32** which slidably embraces the lower spacer **14**. An opening **33** is provided in the lower end of the spacer **14** to loosely receive the shaft portion **18** of the needle valve, and intersecting this opening is a cross slot **34** in which a pin **35** is loosely disposed. Intermediate its ends, this pin abuts the upper end of the needle valve shaft portion **18**, and the opposite ends of the pin extend into close fitting openings **36** in the retainer **32**. The upper wall **37** of the cross slot serves as a stop to limit opening movement of the needle valve.

During operation, as fuel pressure is built up in the pumping chamber **30** by the plunger **2** moving downward to close the bushing ports **9** and **10**, corresponding fuel pressure builds up in the fuel chamber **21** below the piston portion **19** of the valve sufficient to raise it to open the outlet **16** for injection of fuel through the spray tip ori-

fices **11**. Such upward movement of the needle valve is transmitted by the pin **35** to the spring retainer **32** and against the underside of the spring **31**. The spring force thus opposes such opening movement of the needle valve in accordance with the amount of fuel pressure developed in the pump chamber **30** and fuel chamber **21**, and when this pressure is relieved by the plunger metering groove **8** uncovering the bushing port **9** at the end of the injection stroke the needle valve again returns to its closed position.

The modification shown in FIGURE 3 differs principally from that previously described in that the needle valve **17'** has its piston portion **19'** slidably guided within a bore **20'** in the lower spacer member **14'**, instead of in the spray tip **12'**. An O-ring type of seal **38** is carried by this piston portion of the needle valve to effect a good seal against leakage of fuel into the cross slot **34'**. Also, the needle valve return spring **31'** seats at its upper end against a retainer **39** instead of against the upper spacer **15'**, and the anti-blow back valve **28'** is arranged to close against this upper spacer instead of against the lower end of the pump bushing **4'**. The operation of this form of the invention is, however, substantially identical with that of FIGURES 1 and 2.

While the invention has been shown and described with reference to only two embodiments, it is appreciated that various minor changes in the parts and their relationship may be made without departing from the spirit and scope of the invention as hereinafter defined.

I claim:

1. In a unit fuel injector-pump, a plunger, a member defining a pumping chamber for said plunger, a spray tip having an outlet for fuel displaced from the chamber by the plunger, spacer means between said member and spray tip, said spacer means having a passage there-

through for fuel flow from the chamber to the spray tip, an injection valve normally closing said outlet but movable toward said member to open the outlet in response to a predetermined fuel pressure in the passage, said spacer means having a cross-slot extending transversely therethrough, spring means disposed externally of the spacer means and reacting against said member, and a pin loosely disposed in said cross-slot and interconnecting the spring and injection valve for biasing said valve closed.

2. The invention of claim **1**, wherein said injection valve includes a shaft portion extending into said cross-slot and the pin overlies the extended end of said shaft portion.

3. The invention of claim **2**, including a retainer for said spring means, said retainer having a slidable fit on the spacer means and openings closely receiving the respective ends of the pin.

4. The invention of claim **3**, wherein said cross-slot has a wall abuttable by the pin to limit opening movement of the injection valve.

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