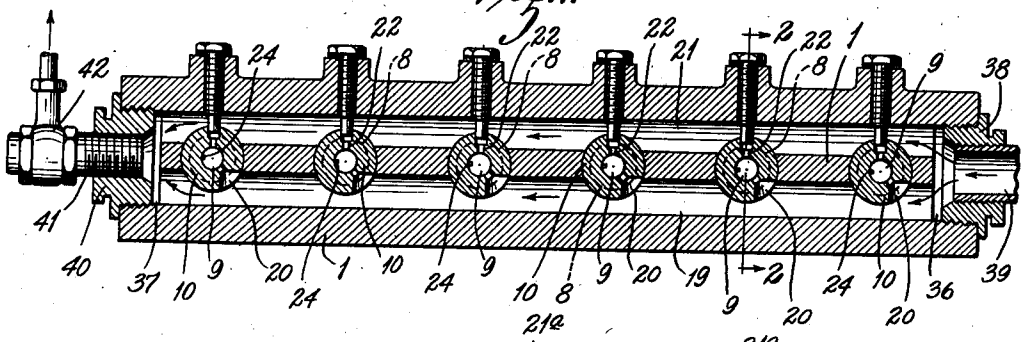
March 5, 1940. T. V. BUCKWALTER 2,192,372

FUEL INJECTION PUMP

Filed Nov. 18, 1937

Fig. 1.



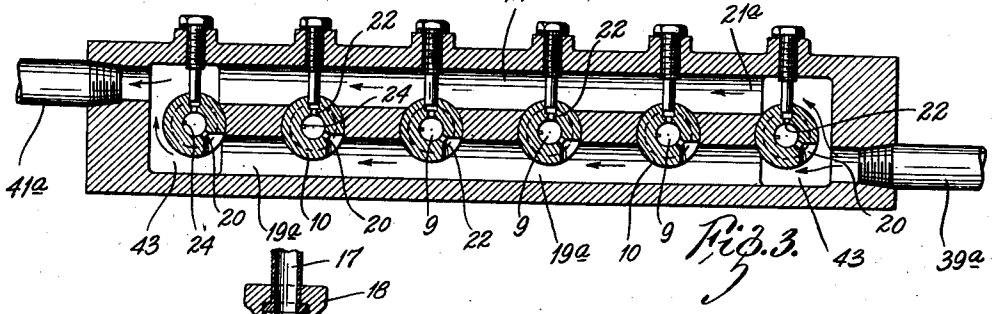


Fig. 3.

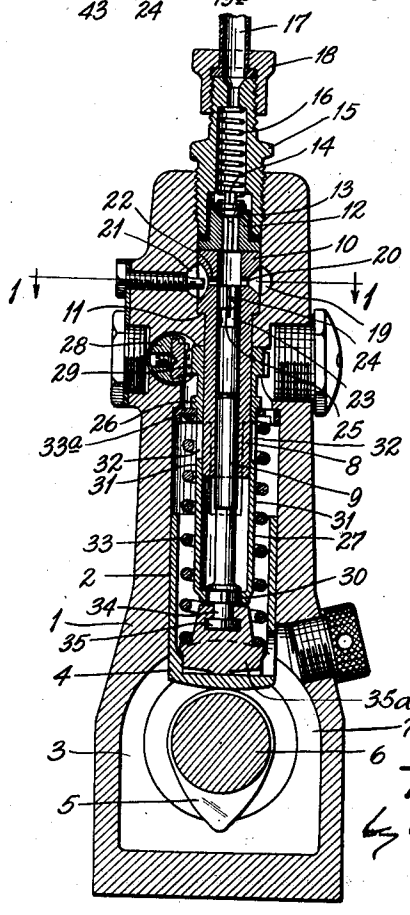


Fig. 2.

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Patented Mar. 5, 1940 2,192,372

UNITED STATES PATENT OFFICE

2,192,372

FUEL INJECTION PUMP

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Application November 18, 1937, Serial No. 175,234

5 Claims. (Cl. 103—41)

This invention relates to fuel injection pumps of the type wherein the pump plunger is provided with inlet and overflow ports that are located adjacent to each other and communicate with a common fuel supply passageway and the pump plunger, at a predetermined point of its pressure stroke, by-passes fuel from the pressure space in the pump cylinder to said fuel supply passageway through said overflow port, thereby relieving the pressure in said pressure space and terminating the fuel delivery.

In the above type of pump, the by-passed fuel enters the fuel supply passageway under considerable pressure and thus places the fuel therein adjacent to the inlet and overflow ports in a violent state of commotion or turbulence, thereby interfering with the flow of fuel into the pressure space of the cylinder on the following suction stroke of the plunger and thus causing the pump to deliver an insufficient quantity of fuel. The principal object of the present invention is to provide improved means for preventing such interference with the filling of the pressure space of the cylinder on the suction stroke of the plunger. Other objects are cheapness and simplicity of construction and compact of design. The invention consists in the fuel injection pump and the parts and combinations and arrangements of parts hereinafter described and claimed.

In the accompanying drawing, which forms part of this specification and wherein like symbols refer to like parts wherever they occur,

Fig. 1 is a horizontal section through a fuel injection pump embodying my invention, the section being taken on the line 1—1 of Fig. 2,

Fig. 2 is a vertical transverse section through said pump at one of the cylinders on the line 2—2 in Fig. 1,

Fig. 3 is a view similar to Fig. 1 illustrating a modified form of the invention.

Referring to the accompanying drawing, my invention is illustrated in connection with a multi-cylinder fuel injection pump for a multi-cylinder internal combustion engine of the compression ignition type. Said pump comprises a suitable housing 1 having a plurality of vertical bores 2 therein that are spaced apart longitudinally thereof and have enlarged lower end portions 3 adapted to receive tappet cups 4 that are engaged at their lower ends by cams or tappets 5 on a cam shaft 6 located in a longitudinal chamber 7 provided therefor in the bottom of said housing.

Mounted in each of the vertical bores 2 of the pump housing 1 is a pump cylinder 8, which contains a piston or plunger 9 and has an enlarged upper end portion 10 that rests on an annular seat 11 provided therefor in the upper portion of said bore. A tubular member 12 rests on the upper end of the pump cylinder 8 and is provided at its upper end with a seat 13 for a suitable fuel discharge valve 14. Threaded into the upper end of the bore 2 is a tubular fitting or shell 15, which holds the valve seat member 12 down on the upper end of the pump cylinder and the latter down on its seat in said bore and is provided at its upper end with a space for a coil spring 16 that normally holds the fuel discharge valve 14 against the seat 13 provided therefor at the upper end of said member. A suitable fuel discharge pipe 17 is connected to the upper end of the tubular fitting or shell 15 by means of a cap 18 threaded on the upper end thereof.

The pump housing 1 is provided on one side of the pump cylinders with a longitudinal fuel passageway 19 which opens into all of said cylinders through inlet ports 20 in that side thereof. Said housing is likewise provided on the opposite sides of the pump cylinders with a longitudinal fuel passageway 21 that also opens in all of said cylinders through overflow ports 22 in that side thereof. As shown in the drawing, the two spaced parallel fuel passageways 19 and 21 and the ports communicating therewith are preferably located at the same level.

Each plunger 9 is preferably provided with an annular groove 23 that communicates through a longitudinal groove 24 with the pressure space of the cylinder and has an inclined or helical edge 25, whereby the delivery stroke of the plunger may be regulated by turning it in its cylinder to vary the point in the pressure stroke of the plunger in which the overflow port 22 is placed in communication with said pressure space through the grooves 23 and 24 to relieve the pressure in said space and thereby permit the delivery valve 14 to seat and terminate the fuel delivery. By this arrangement, delivery of the fuel begins as soon as the plunger stroke covers the ports 20 and 22 and ends as soon as the helical upper edge 25 of the groove 23 in the plunger opens the overflow port 22 and relieves the pressure in the space above said plunger.

The mechanism for turning the plungers on their axes to vary the amount of fuel delivered thereby preferably comprises axially alined upper and lower driving and driven sleeves 26 and

27 mounted on the lower end portions of the cylinders and plungers, respectively, and a rack rod 28 mounted for axial sliding movement in a horizontal bore that extends longitudinally of the pump from end to end thereof on one side of the cylinders and cooperates with gears 29 on the upper ends of the respective driving sleeves. The upper or driving sleeve 26 for each plunger is rotatably mounted on the lower end of the cylinder therefor; and the lower or driven sleeve 27 has a non-rotary connection with said plunger comprising a flatsided portion 30 thereof that fits a similarly shaped opening in the lower end of said lower sleeve. The driving connection between the driving sleeve 26 and the driven sleeve 27 preferably comprises upwardly extending oppositely disposed tongues 31 on the driven sleeve that fits within downwardly opening diametrically opposed notches 32 fitted therefor in the driving sleeve, thereby permitting relative axial movement of the two sleeves but preventing relative rotary movement thereof.

Surrounding the driving and driven sleeves for each plunger is a helical compression spring 33 that serves to retract said plunger and to hold the driven sleeve 27 upwardly in the tappet receiving portion of the vertical bore 2 in the pump housing. The tappet cup 4 is spaced outwardly from the driven sleeve 27 so as to accommodate the piston retracting spring 33. A washer 33*a* supports the driving sleeve 26 below the gear 29 thereon and is held against an annular shoulder provided therefor in the vertical housing bore 2 by means of the spring 33. The plunger is provided below the bottom of the lower portion of the driven sleeve 27 with an annular groove 34 and terminates below said groove in a flat-sided head portion 35. The lower end of the piston retracting spring 33 is supported upon an annular seat provided therefor on a circular block 35*a* having an opening therein whose upper portion snugly receives the grooved portion 34 of the plunger and whose lower portion is widened to receive the head 35 at the lower end of the plunger. This block seats on the bottom of the tappet cup 4 and is held against axial movement relative to the plunger but may be rotated relative thereto.

As shown in Fig. 1 of the drawing, the pump housing has a threaded circular opening or recess 36 in one end thereof that communicates with the adjacent ends of both longitudinal fuel passageways 19 and 21; and said housing has a similar opening 37 in the other end thereof that communicates with opposite ends of the two longitudinal fuel passageways. The threaded opening 36 at one end of the pump housing has a sleeve 38 threaded therein that is adapted to receive and support the threaded end of a fuel inlet or supply pipe or conduit 39 which leads from a suitable fuel supply pump or other source of fuel supply (not shown). The threaded opening 37 at the opposite end of said housing also has a sleeve 40 threaded therein that is adapted to receive and support the threaded end of a pipe or conduit 41 which is preferably provided with a check or relief valve 42 and is adapted to return to the fuel pump or supply fuel in excess of that discharged through the delivery valves 14.

By the arrangement described, the fuel flows from the single supply pipe 39 into the adjacent ends of the two longitudinal fuel passageways 19 and 21 where it is separated into two separate streams that are joined together upon leaving the ends of said passageways and enter the return pipe 41 in the form of a single stream. With this arrangement of fuel feed, any violent commotion or disturbance created in the fuel stream in the fuel passageway 21 by the fuel by-passed or discharged into said stream from the overflow ports 22 is segregated from the inlet ports 20 and thus does not interfere with the flow of the fuel into the inlet ports. The continuous flow of fresh fuel through the fuel passageway 21 which communicates with the overflow ports 22 also tends to smooth away or diminish any turbulence of fuel in said passageway and thereby minimize the effect of such disturbance on the fuel drawn into the cylinder through said overflow ports; this continuous flow of fresh fuel also serves to carry away and break up any bubbles created by the return flow of the surplus or by-passed fuel.

In the modified construction shown in Fig. 3, the spaced parallel fuel passageways 19*a* and 21*a* terminate at the endmost pump cylinders and the pump housing is provided with fuel chambers 43 that communicate with both of said passageways. A fuel supply conduit 39*a* opens into one of said fuel chambers preferably substantially in line with the longitudinal fuel passageway on the inlet port sides of the pump cylinders; and a fuel return conduit 41*a* leads from the other fuel chamber preferably substantially in line with the longitudinal fuel passageway that communicates with the overflow or by-pass ports in said cylinders. This construction operates in substantially the same manner as the construction shown in Fig. 1 to prevent the disturbance created in the fuel stream by the by-passed fuel from interfering with the filling of the pressure spaces in the pump cylinders.

What I claim is:

1. A fuel injection pump comprising a plurality of cylinders spaced apart lengthwise of said pump, plungers reciprocating in the respective cylinders, said pump having two longitudinal fuel passageways spaced apart on opposite sides of said cylinders, said cylinders having inlet ports therein communicating with one of said fuel passageways and overflow ports communicating with the other of said passageways, a single fuel supply conduit opening into both of said passageways at one end thereof, and a single fuel outlet conduit leading from both of said passageways at the other end thereof.

2. A fuel injection pump comprising a plurality of cylinders spaced apart lengthwise of said pump, plungers reciprocating in the respective cylinders, said pump having two longitudinal fuel passageways spaced apart on opposite sides of said cylinders, said cylinders having inlet ports therein communicating with one of said fuel passageways and overflow ports communicating with the other of said passageways, a single fuel supply conduit opening into both of said passageways at one end thereof, a single fuel return conduit leading from both of said passageways at the other end thereof, and a pressure control valve in said return conduit.

3. A fuel injection pump comprising a plurality of cylinders spaced apart lengthwise of said pump, plungers reciprocating in the respective cylinders, said pump having single openings in its opposite ends and two longitudinal fuel passageways spaced apart on opposite sides of said cylinders and both communicating at one end with one of said openings and at the other end with the other of said openings, said cylinders having inlet ports therein communicating with one of said fuel passageways and overflow ports communicating with the other of

said fuel passageways, a single fuel supply conduit opening into the single opening at one end of said pump, and a single fuel return conduit leading from the single opening at the other end of said pump.

4. A fuel injection pump comprising a plurality of pump cylinders spaced apart lengthwise of said pump, said pump having a fuel inlet chamber partially surrounding the cylinder at one end thereof, a fuel outlet chamber partially surrounding the cylinder at the opposite end thereof and two spaced longitudinal passageways extending from chamber to chamber on opposite sides of the remaining cylinders, said endmost cylinders having fuel inlet and overflow ports communicating with the chambers adjacent thereto, and said remaining cylinders having fuel inlet and overflow ports communicating with the respective fuel passageways, a fuel supply conduit leading to said fuel inlet chamber, and a fuel return outlet conduit leading from said fuel outlet chamber.

5. A fuel injection pump comprising a plurality of pump cylinders spaced apart lengthwise of said pump, said pump having a fuel inlet chamber partially surrounding the cylinder at one end thereof, a fuel outlet chamber partially surrounding the cylinder at the opposite end thereof and two spaced longitudinal fuel passageways extending from chamber to chamber on opposite sides of the intermediate cylinders, said endmost cylinders having fuel inlet and overflow ports communicating with the fuel chambers adjacent thereto, and said intermediate cylinders having fuel inlet and overflow ports communicating with the respective fuel passageways, a fuel supply conduit leading to said fuel inlet chamber and a fuel return conduit leading from said fuel outlet chamber, said fuel inlet conduit opening into said fuel inlet chamber substantially in line with the fuel passageway that communicates with said fuel inlet ports and said fuel return conduit opening into said fuel outlet chamber substantially in line with the fuel passageway that communicates with said fuel overflow ports.

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