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W. J. COLE

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DIESEL ENGINE FUEL PUMP

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Fig. 1.

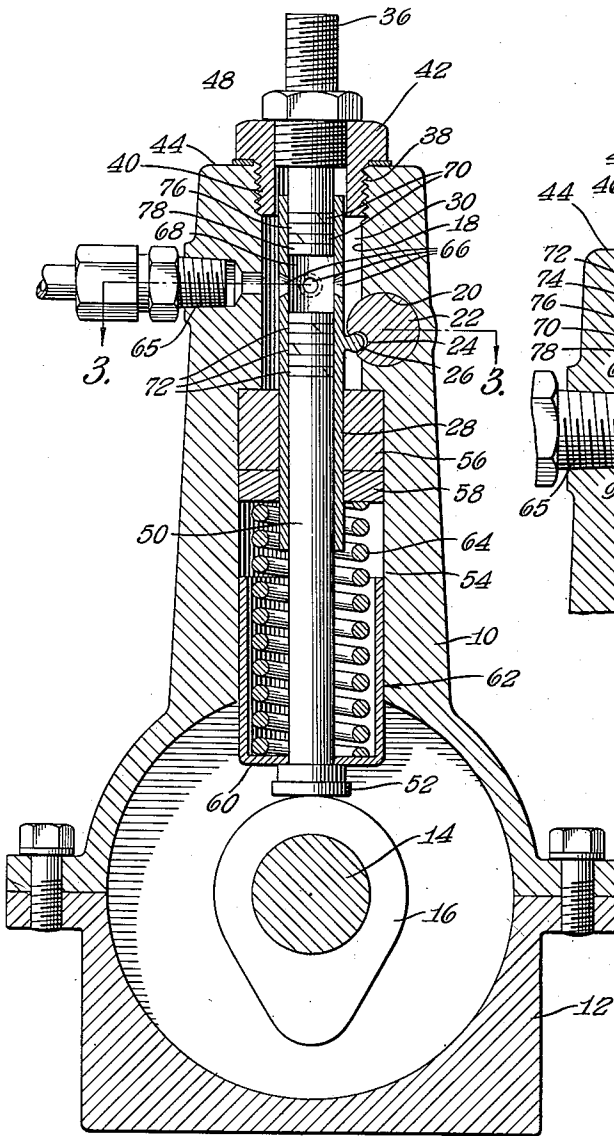


Fig. 2.

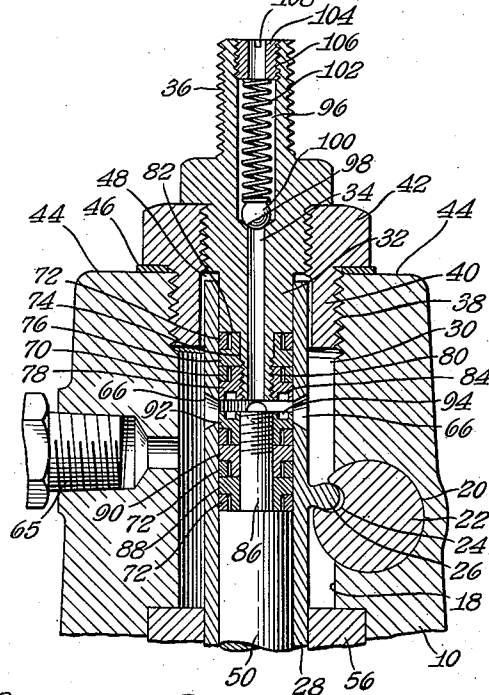
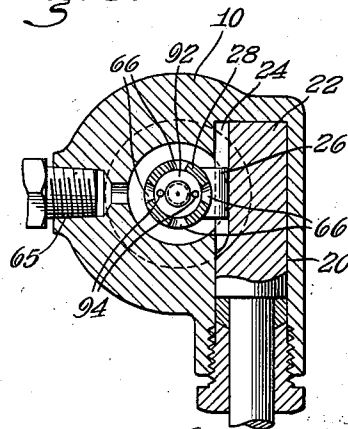


Fig. 3.



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WITNESS

UNITED STATES PATENT OFFICE

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DIESEL ENGINE FUEL PUMP

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7 Claims. (Cl. 103—41)

My invention relates to internal combustion engines of the Diesel type, and has among its objects and advantages the provision of an improved fuel injection pump.

Fuel injection pumps such as are employed in Diesel engines, for example, are subjected to enormous pressures. Because of high pressures required in such pumps, considerable difficulty has been heretofore encountered in precisely shaping the plungers, barrels, etc., to required specifications. It is common practice to hand lap such parts to their correct relative sizes, and such work entails considerable time and expense.

Accordingly, an object of my invention is to provide a fuel injection pump embodying novel means designed to effectively hold the high pressures to which such pumps are subjected. More specifically, I make use of a plunger and barrel construction provided with sealing rings capable of holding the necessary high pressures, thus permitting the plunger and barrel parts to be constructed with machine tolerances, thereby eliminating the time and cost elements incident to hand lapping common in the art. I provide novel means for retaining the sealing rings and in which said means are so devised as to permit assembly of the rings without enlarging their diameters preparatory to being slipped into position, thereby eliminating any danger of breakage.

A further object is to provide a fuel injection pump embodying a novel fuel metering feature so that the amount of fuel delivered to the engine may be varied from maximum to minimum in accordance with variations in engine speed. The metering device is designed so as to be operable through the medium of an engine driven governor.

In the accompanying drawing:

Figure 1 is a sectional view of a fuel injection pump in accordance with my invention;

Figure 2 is an enlarged sectional view of a portion of the structure of Figure 1; and

Figure 3 is a sectional view along the line 3—3 of Figure 1.

In the embodiment selected to illustrate my invention, I make use of a casing 10 having a base 12 within which is journaled the usual engine-driven shaft 14 upon which I mount a cam 16. Casing 10 includes a bore 18 provided with an intersecting bore 20 within which I rotatably mount a shaft 22 operatively connected with a governor (not shown) to be rotated in accordance with the speed of the engine. Such governors are well known in the art and need not be described in detail.

Shaft 22 includes a longitudinal recess 24 for the reception of a lug 26 carried by a fuel metering sleeve 28 adapted to be reciprocated longitudinally of the bore 18 through rotary motion of the governor rotated shaft 22. Sleeve 28 is of considerably less outside diameter than the bore 18 to provide a reservoir 30 for fuel. The upper end of the metering sleeve 28 slidably embraces an upper plunger 32 which is bored at 34 for the passage of fuel to the engine, and is provided with a threaded extension 36 for connection with an injection or delivery pipe (not shown).

Bore 18 is provided with internal threads 38 for connection with a threaded sleeve 40 having a nut 42 positioned adjacent the end 44 of the casing 10. Between the nut 42 and the end 44 I place a sealing gasket 46. The inner bore 48 of the sleeve 40 is slightly larger in diameter than the outside diameter of the sleeve 28 to permit free relative movement of the latter.

Fig. 1 illustrates the lower end of the metering sleeve 28 as embracing the upper end of the lower plunger 50, which has its lower end provided with a head 52 arranged in operative relation with the cam 16. Thus, the plunger 50 will be reciprocated through rotary motion of the cam 16. Bore 18 communicates with a larger axial bore 54 through which the greater part of the lower plunger extends, and in which I position a sealing ring 56 which embraces the outer face of the metering sleeve 28. Adjacent the sealing ring 56 I position a sealing gland 58 which also embraces the metering sleeve. Between the sealing gland 58 and the bottom 60 of a cup 62 I interpose a compression spring 64. Cup 62 is slidable in the bore 54, and the bottom 60 of the cup is urged against the head 52 on the plunger 50 by reason of the compression spring 64.

The reservoir 30 is supplied with fuel from a pipe 65 leading to a fuel supply (not shown), and the metering sleeve 28 is provided with a plurality of ports 66 which place the reservoir 30 in communication with the bore 68 of the metering sleeve. Movement of the metering sleeve 28 is controlled through rotation of the shaft 22. Thus, the position of the ports 66 is determined by the speed of the governor, which in turn is controlled by the engine. Fig. 1 illustrates the metering sleeve 28 in a lowered position, and the plunger 50 is in its retracted position, with the ports 66 at this time located above the upper end of the plunger 50. Fig. 2 illustrates the position of the metering sleeve 28 in its

upper extreme position and with the plunger 50 correspondingly elevated.

According to the illustration of Fig. 1, upward movement of the plunger 50 by the cam 16 will cover the ports 66 so that the fuel trapped inside the metering sleeve between the plungers 32 and 50 will be forced to the engine through the bore 34. Elevation of the metering sleeve 28, in response to increased engine speed, brings the ports 66 closer to the plunger 32 so that the plunger 50 must travel upwardly a greater distance before it will cover the ports 66. In other words, elevation of the metering sleeve 28 increases the distance of the ports 66 from the end of the plunger 50 when in its maximum lowered position so that the plunger 50 will deliver a smaller quantity of fuel to the engine after it closes the ports 66. Thus, the amount of fuel delivered to the engine is effectively controlled through the medium of the metering sleeve 28 which is responsive to engine speed.

The governor will, of course, be equipped with the usual manual control so that the engine may be stopped through rotation of the shaft 22 for shifting the sleeve 28 to the position of Fig. 2, at which time fuel will flow through the ports 66 rather than through the bore 34.

Plunger 32 is provided with a series of sealing rings 70, while the plunger 50 is provided with a series of sealing rings 72. Referring to Fig. 2, plunger 32 is fashioned with a shank 74 upon which flanged sleeves 76 and 78 are mounted, with the sleeve 78 having threaded connection with the shank 74, as at 80. One of the sealing rings 70 is housed between the flange of the sleeve 76 and the shoulder 82 of the plunger 32, while the other sealing ring 70 is housed between the two flanges of the flanged sleeves 76 and 78. Sleeve 78 may be provided with bores 84 for connection with a tool such as a spanner wrench to facilitate tightening of the parts. While the flanged sleeves 76 and 78 may be turned down tightly to have relative fixed connection with the shank 74, the flanges of the sleeves and the shoulder 82 are so spaced as to loosely support the sealing rings in the necessary degree so that the rings may have proper sealing relation with the wall of the bore 68.

Plunger 50 includes a threaded shank 86 upon which I mount flanged sleeves 88, 90 and 92. Sealing rings 72 are assembled with the flanged sleeves 88, 90 and 92 in the same manner as the sealing rings 72 are assembled with the flanged sleeves 76 and 78. Flanged sleeve 92 has threaded connection with the shank 86 and the sleeve is provided with bores 94 for connection with a spanner wrench.

Bore 34 communicates with a larger diameter bore 96 terminating in a valve seat 98. Bore 34 is normally closed by a ball valve 100 biased against the seat 98 by a compression spring 102 with a pressure somewhat in excess of the supply pressure of the fuel. A sleeve 104 has threaded connection at 106 with the extension 36 to constitute an abutment for the compression spring 102, and the sleeve includes a fuel passage 108. Compression spring 102 maintains the ball valve 100 upon its seat 98 until the pressure exerted by the fuel trapped in the metering sleeve 28 increases substantially above that at which the fuel is supplied to the metering sleeve.

The sealing rings associated with the two plungers cooperate with the metering sleeve 28 in such manner as to effectively hold the working pressure. The sealing rings are easily assem-

bled with their retaining parts, and these parts are so fashioned as to permit assembly of the rings without enlarging their diameters. Thus, the sealing rings permit the use of a metering sleeve and associated plungers having machine tolerances so as to completely eliminate the necessity of hand lapping, thus greatly reducing the manufacturing cost of such parts, in addition to providing a plunger and barrel structure capable of holding the high pressures necessary in fuel injection pumps of this type.

While I have illustrated a single plunger unit, it will be understood that my invention is equally well adapted to multiple plunger units.

Having thus described certain embodiments of my invention in detail, it is, of course, understood that I do not desire to limit the scope thereof to the exact details set forth except insofar as those details may be defined in the appended claims.

I claim:

1. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; a sealing means extending circumferentially about said sleeve and comprising a wall portion of said fuel chamber; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; and means for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve.

2. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; a sealing means extending circumferentially about said sleeve and comprising a wall portion of said fuel chamber; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; and a rotary means journaled in said casing and operatively connected with said sleeve for shifting the sleeve relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve.

3. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; a sealing means extending circumferentially about said sleeve and comprising a wall portion of said fuel chamber; said fixed and reciprocatory plungers

being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; a rotatable control shaft journaled in said casing; and an operating connection between said shaft and the sleeve for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers through rotation of the shaft to vary the amount of fuel trapped in said sleeve.

4. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; a sealing means extending circumferentially about said sleeve and comprising a wall portion of said fuel chamber; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; a rotatable control shaft journaled in said casing and having a recess; and a projection on said sleeve fitting in the recess for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers through rotation of the shaft to vary the amount of fuel trapped in said sleeve.

5. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; means for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve; said reciprocatory plunger being guided by said

sleeve; and sealing means defining in part said fuel chamber for guiding said sleeve.

6. A fuel injection pump comprising a casing having a fuel chamber; a fixed plunger having a fuel outlet passage; a reciprocatory fuel injection plunger arranged coaxially with the fixed plunger; an adjustable fuel metering sleeve slidable axially on said first plunger and slidably receiving said reciprocatory plunger; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said chamber; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel relatively to the sleeve to force fuel trapped in the sleeve through said fuel outlet passage; means for shifting said sleeve relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve; said reciprocatory plunger being guided by said sleeve; a shoulder in said casing; and a sealing means pressed against said shoulder for guiding said sleeve and defining in part said chamber.

7. A fuel injection pump comprising a casing having a first bore and a coaxial second bore of larger diameter providing a shoulder at the meeting ends of the first and second bores; said first bore comprising a fuel reservoir; a fuel metering sleeve arranged axially of the first and second bores; a closure means for one end of said first bore and having a fixed plunger provided with an axial fuel outlet; said sleeve having one end slidably embracing said fixed plunger; a reciprocatory fuel injection plunger slidable in said sleeve; a sealing means inside said second bore adjacent said shoulder and embracing said metering sleeve to guide the latter and to close the other end of said first bore; said fixed and reciprocatory plungers being axially spaced and said sleeve having a port placing the interior of the sleeve between the fixed and reciprocatory plungers in communication with said reservoir; said fuel injection plunger being provided with a cup opening in the direction of said sealing means and slidably guided inside said second bore; resilient means acting on said cup and said sealing means for pressing the latter against said shoulder; said reciprocatory plunger closing said port upon a predetermined fuel injection stroke travel to force fuel trapped in the sleeve through said fuel outlet passage; and rotary means operatively connected with said sleeve for adjusting the latter relatively and axially of said fixed and reciprocatory plungers to vary the amount of fuel trapped in said sleeve.

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