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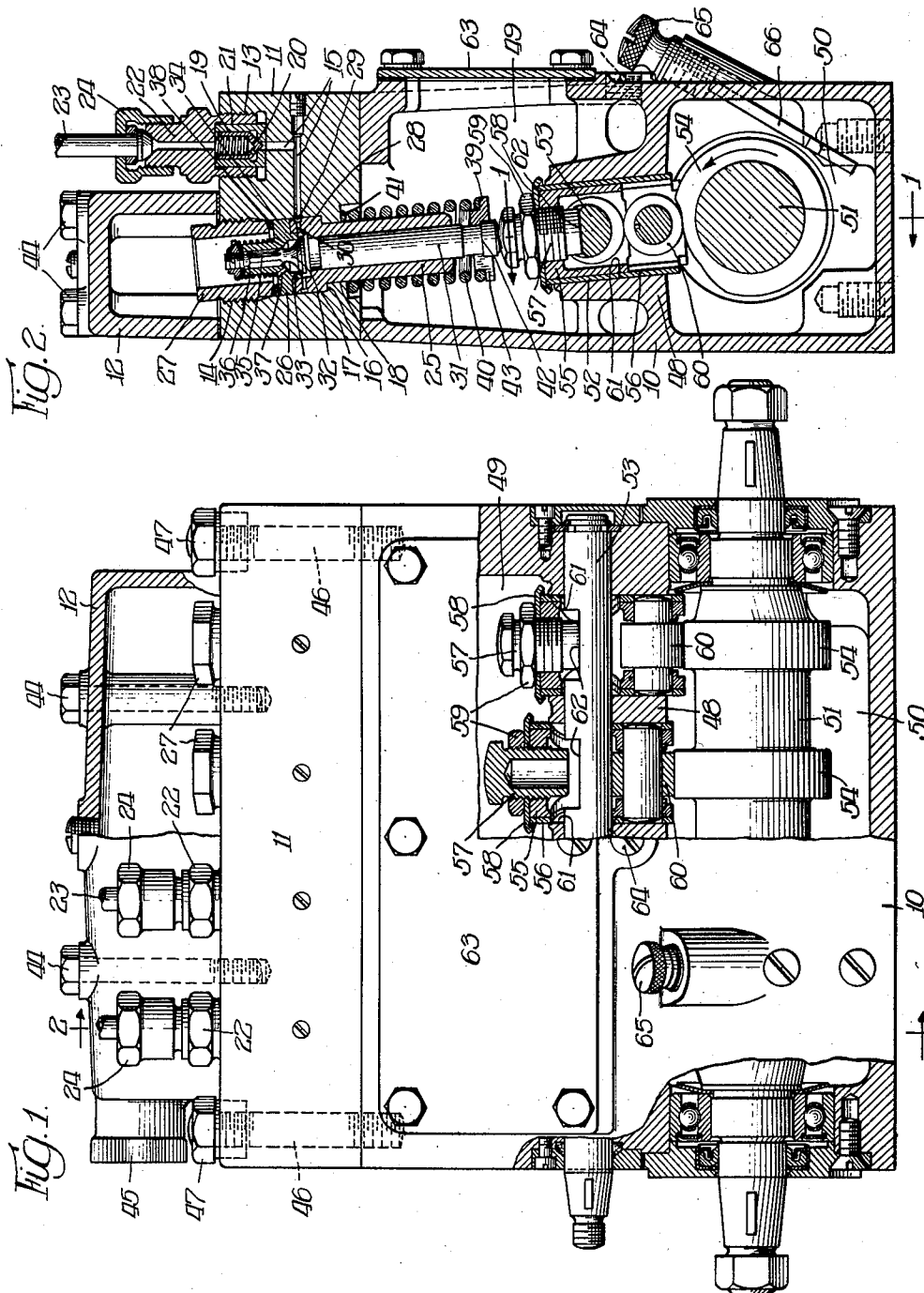
W. E. BUTTLE

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FUEL INJECTION PUMP

Filed Oct. 29, 1936

2 Sheets-Sheet 1



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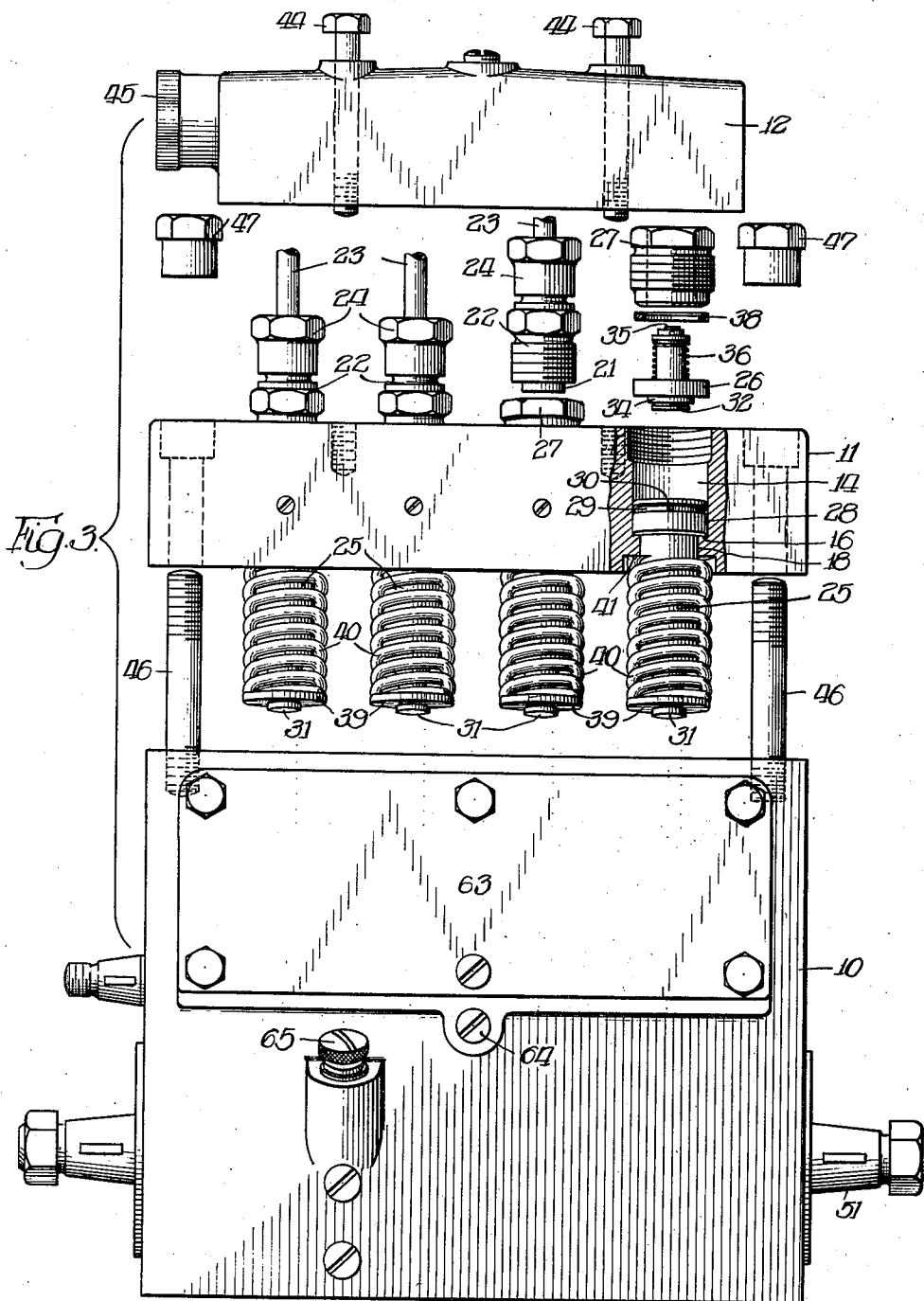
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UNITED STATES PATENT OFFICE

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FUEL INJECTION PUMP

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2 Claims. (Cl. 103—38)

This invention has to do with fuel injection pumps of the type used on Diesel engines.

The object of the invention is to provide a pump unit of improved design, which will deliver extremely small yet accurately metered quantities of solid fuel to the cylinders of the engine, quickly producing the requisite injection pressure at the nozzle in each cylinder and as quickly reducing the pressure at the end of the injection period, which is dependable in operation, giving trouble free service over long periods of time under severe operating conditions, and which is above all characterized by its simplicity and accessibility, the design requiring but comparatively few parts, which parts can be made and fitted together with great accuracy, and the relative arrangement of the parts enabling the same to be easily taken apart and reassembled for purposes of cleaning and repairing.

While the foregoing statement is indicative in a general way of the nature of the invention, other more specific objects and advantages will be apparent to those skilled in the art upon a full understanding of the construction, arrangement and operation of the parts combined to form this improved pump unit.

A preferred embodiment of the invention is presented herein for the purpose of exemplification, but it will of course be appreciated that the invention is susceptible of embodiment in other structurally modified forms coming equally within the scope of the appended claims.

In the accompanying drawings:

Fig. 1 is a partially sectional side view of the pump unit, sectioned on the line 1—1 of Fig. 2;

Fig. 2 is a vertical transverse section through the unit, taken on the line 2—2 of Fig. 1; and

Fig. 3 is a side view of the unit, with certain of the main parts shown separated from each other in order to illustrate the simplicity and accessibility of the plungers, barrels and valves.

Pumps of much the same general character have been manufactured and used before, but their cost of manufacture has been objectionably high because of the complicity of the design employed, and their use has been limited not only because of their cost but because of the difficulties and inconveniences encountered in quickly getting at certain of the parts for the purpose of cleaning or repairing the same. The present invention resides in an improved design which is distinguished by the simplicity and accessibility of its few parts.

The device shown in the drawings is a four-pump unit for application to a four-cylinder en-

gine, but it will of course be understood that the device can be made up with any desired number of individual pumps in the unit. The casing of the unit is composed of three readily separable parts—namely, a housing 10 which forms the base, a body 11 which rests on top of the housing, and a fuel inlet manifold 12 which rests on top of the body.

The body 11 is a solid horizontally elongated block of rather flat rectangular cross section. It contains a row of four upright cylindrical bores 13 in the top near the front edge and a row of four inclined cylindrical bores 14 in the top near the rear edge, which inclined bores 14 extend downwardly and forwardly through the bottom and are connected with the corresponding upright bores 13 by means of L-shaped fuel passages 15. The passages 15 lead from the front sides of the bores 14 forwardly and upwardly into the bottoms of the bores 13. Just below the level of the passages 15 the bores 14 are provided with annular shoulders 16 which divide the same into upper large diameter portions 17 and lower small diameter portions 18.

Each of the upright bores 13 contains a downwardly spring-pressed discharge valve 19 which coacts with a seat 20 formed in the bottom of a cup-shaped cage 21. The seat 20 in the cage registers with the upper end of the passage 15 in the bore. The cage 21 is positioned in the hollowed out lower end of a retaining nipple 22, which nipple is screwed down into the bore and clamps the cage tightly in position. The nipple 22 is connected at its upper end to one of the fuel lines 23 of the associated engine by means of a coupling nut 24.

Each of the inclined bores 14 contains a plunger barrel 25, a valve cage 26 and a sleeve nut 27, in the order named. The barrel 25 is positioned in the lower small diameter portion 18 of the bore and projects downwardly and forwardly from the bottom of the body for some distance. It is held against downward movement by an annular rib 28 at its upper end which occupies the lower end of the enlarged portion 17 of the bore and rests upon the shoulder 16. The barrel 25 is counter-bored at its upper end for a short distance, and the annular rib 28 on the outside of the barrel is provided with a groove 29 which registers with the end of the passage 15 in the side of the bore 14 and is connected with the counterbored portion of the barrel by means of several small radial ports 30. The barrel 25 contains an accurately fitted reciprocating plunger 31, which plunger extends the greater part of the length of the barrel

and projects a short distance from the lower end of the same.

The valve cage 26 in each of the bores 14 is positioned on top of the barrel 25 in that bore and contains an upwardly spring-pressed inlet valve 32. The valve 32 acts against a seat 33 which is formed on the lower edge of a hollow boss 34 on the bottom of the cage 26. The boss 34 projects down into the counterbored upper end of the barrel 25. The stem 35 of the valve 32 is mounted in another boss 36 of smaller diameter on the top of the cage. The space surrounding the upper boss 36 is connected to the chamber in the lower boss 34 by means of several small ducts 37.

The sleeve nut 27 in each of the bores 14 is screwed into the upper end of the bore, into tightly clamped engagement with a small packing ring 38 on the top of the cage 26 in that bore, with the inner wall of the nut in radially spaced relation to the boss 36 on the top of the cage. The nut 27 holds both the barrel 25 and the cage 26 in place, and projects just far enough from the top of the body 11 to be engaged conveniently by a wrench.

The plunger 31 in the barrel in each of the bores 14 is provided at its lower end with a collar 39, and a coil spring 40 is compressed between the collar 39 and a seat 41 which is formed in the bottom of the body about the lower end of the bore. The barrel 25 is encircled by the spring and serves as a guide for the same. The collar is held against axial movement on the plunger by engagement with a small shoulder 42 on the latter, and is provided with a radial slot 43 which permits its ready removal.

The fuel inlet manifold 12 is U-shaped in cross section and is cupped over all of the inlet valve retaining sleeve nuts 27 on the top of the body behind the discharge valve retaining nipples 32. The manifold 12 is clamped to the top of the body in fluid tight association with the latter by means of a plurality of cap screws 44 and is provided at one end with an opening 45 which is adapted to be connected with the main fuel line.

The body 11 is clamped to the top of the housing 10 by means of two studs 46 which project upwardly from the ends of the housing through holes in the ends of the body and are engaged at their upper ends by nuts 47. The housing 10 is hollow and is divided by a horizontal partition 48 into an upper section 49 and a lower section 50. The upper section 49 is occupied by those parts of the pump mechanisms which project downwardly from the body; the lower section 50 contains a horizontally disposed cam shaft 51 and forms a chamber for the oil used in lubricating the cam shaft; and the partition 48 provides a support for a row of cam actuated tappet mechanisms 52 and also a support for a horizontally disposed control shaft 53. The cam shaft 51 is adapted to be connected in any suitable manner with the crank shaft of the associated engine, and is located with its axis intersecting the inclined axes of the plungers 31. The tappet mechanisms 52 are located in axial alignment with the plungers 31 above cams 54 formed on the cam shaft 51.

Each of the tappet mechanisms 52 consists of a solid cylindrical body 55, a sleeve 56 about the body, a hollow tappet rod 57 screwed into the upper end of the body, an oil shield 58 cupped over the body and sleeve, a jam nut 59 screwed on the rod 57 above the shield, and a cam following roller 60 journaled in the lower end of the body in vertically spaced relation to the lower end of

the rod 57. Each of these tappet mechanisms slides up and down in a guideway 61 which is formed in the partition 48 beneath each of the pump assemblies. The control shaft 53 extends through vertically elongated openings in the sides of all of the tappet mechanisms, in the spaces present between the rods 57 and the roller 60. The shaft 53 is provided at the locations of each tappet rod 57 with a flattened cam face 62 which engages the rod during the downstroke of the latter and determines its lowermost position. The line contact resulting from the hollow character of the lower end of the rod 57 enables a fine adjustment to be obtained.

The control shaft 53 can be operated by hand or can be connected with a governor of any suitable character, such as one which is responsive to variations in the vacuum present in the inlet manifold of the associated engine, to permit the supply of fuel to the engine to be accurately regulated by the control shaft in accordance with the engine requirements. The control shaft is shown in its full load position in Fig. 2. In this position the four pumps in the unit will deliver their maximum charges of fuel to the injector nozzles in the cylinders of the engine. By turning the control shaft in either direction the working strokes of the plungers will be progressively shortened until a point is reached at about 90° where the plungers will not move at all and no fuel will be delivered.

The upper section 49 of the housing 10 is provided with a removable cover plate 63, for access to the tappet rods 57 in adjusting the same, and is also provided with a removable screw plug 64 or other connection for draining out any fuel oil which may accumulate in time on the partition 48. The lower section 50 of the housing, which is adapted to contain lubricating oil for the cam shaft 51, is provided with an inlet for the oil into which a screw plug 65 equipped with a gauge blade 66 is screwed.

It will be observed in Fig. 2 that the low parts of the cams 54 are quite short with respect to the high parts of the same, with the result that the control shaft 53 is relieved from the spring pressure of all the pumps with the exception of the one actually pumping at any particular instant, thereby reducing and equalizing the force required to operate the control shaft.

In operation, the plungers 31 are moved up and down in the barrels 25 by means of the cam shaft 51, the interposed tappet rods 57 and the springs 40. The fuel oil which enters the inlet manifold 12 is drawn down past the inlet valves 32 by the plungers 31 during their spring-actuated downstrokes and is forced out past the discharge valves 19 into the fuel lines 23 by the plungers 31 during their cam-actuated upstrokes.

The pump of this invention is a substantial improvement over earlier pumps in the simple arrangement of the bores 13 and 14 in the body 11, the inclined positioning of the bores 14 which makes this arrangement possible, the shouldered support for the plunger barrels 25 in the bores 14, and the stacked arrangement of the barrels 25, inlet valve cages 26 and sleeve nuts 27 in the bores 14 beneath the fuel inlet manifold 12 in fixedly clamped but readily removable association.

With the construction described a positive control is had over the fuel fed to the engine, an equal quantity of fuel being injected into each cylinder, and such delivery being maintained uniform without the need of any adjustment other

than the initial clearance adjustment between the tappets and the control shaft. This construction eliminates any need for the heretofore commonly used spill valve or by-pass valve openings, most of which have required a periodical readjustment due to the seemingly unavoidable uneven wear in the spill valve holes and other passages.

I claim:

1. In a pump of the character described, a body containing a cylindrical bore, which bore is provided intermediate its ends with an annular shoulder dividing the bore into an upper large diameter portion and a lower small diameter portion, a plunger barrel in the small diameter portion of the bore projecting from the bottom of the body and having an annular rib in clamped engagement with the shoulder, a self-contained inlet valve unit in the large diameter portion of the bore in clamped engagement with the barrel, and a sleeve nut threaded into the large diameter portion of the bore in axially clamped engagement with but radially spaced relation to the valve unit, whereby to provide an annular fuel passage therebetween, said unit and barrel being withdrawable from the top of the body upon removal of the sleeve nut.
2. In a pump of the character described, a body containing a cylindrical bore, which bore is provided intermediate its ends with an annular shoulder dividing the bore into an upper large

diameter portion and a lower small diameter portion, a plunger barrel in the small diameter portion of the bore projecting from the bottom of the body and having an annular rib in clamped engagement with the shoulder, a self-contained inlet valve unit in the large diameter portion of the bore in clamped engagement with the barrel, and a sleeve nut threaded into the large diameter portion of the bore in clamped engagement with the valve unit, said unit including a cage which projects downwardly into the barrel and upwardly into the sleeve nut and is characterized intermediate its ends by a relatively thin annular clamping rib which overlies the top of the barrel and underlies the bottom of the sleeve nut, said unit also including a vertically reciprocating valve which seats against the bottom of the cage within the top of the barrel and is provided with a stem which extends upwardly through the cage to a point beyond the top of the latter, and a coil spring which surrounds the aforesaid upwardly projecting portion of the cage and is compressed between the top of the stem and the aforesaid clamping rib, in inwardly spaced relation to the inside of the sleeve nut, whereby to provide an annular fuel passage therebetween, and said unit and barrel being withdrawable from the top of the body upon removal of the sleeve nut.

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