Oct. 22, 1940. L. BEEH 2,219,002

FUEL PUMP

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Fig. 1.

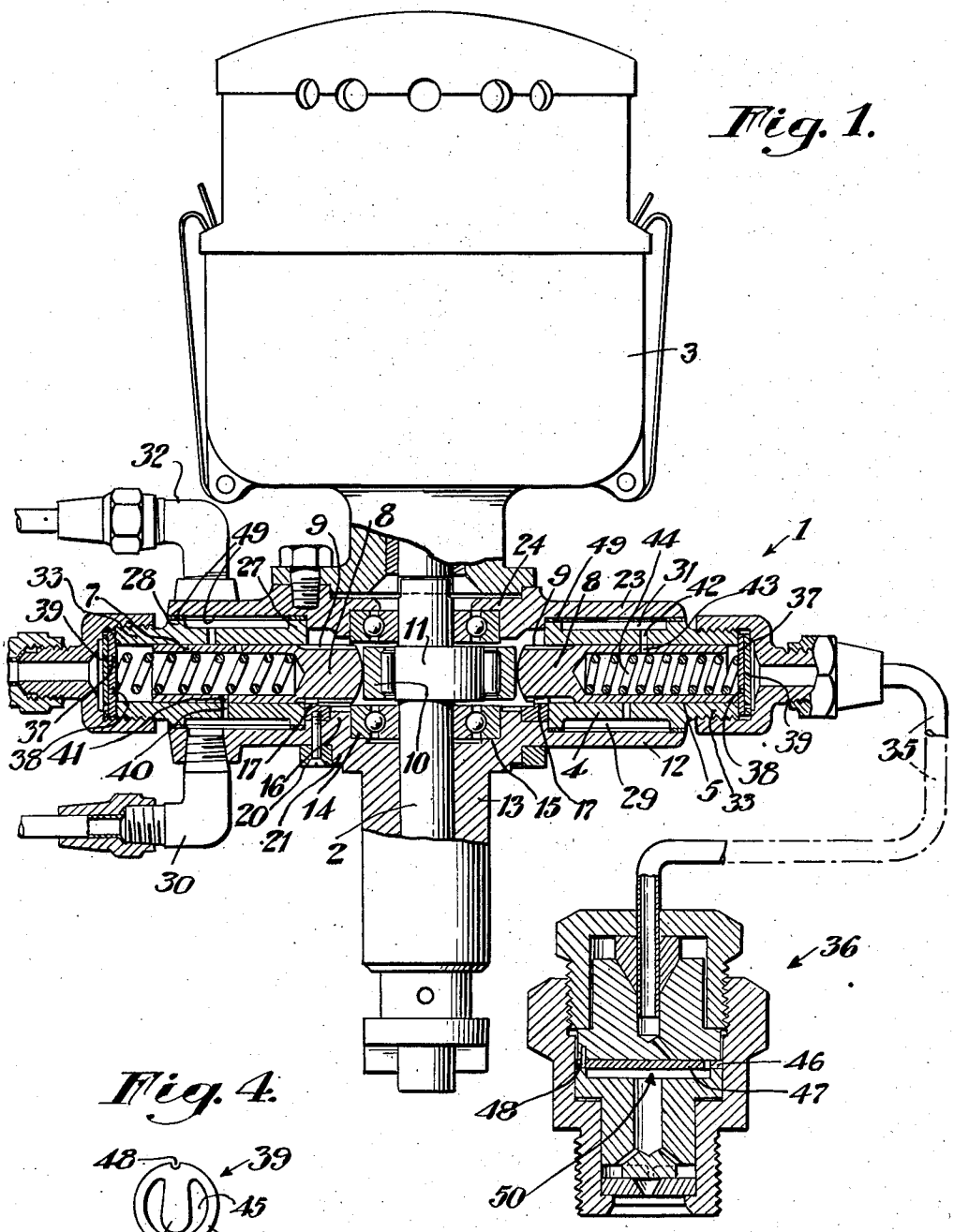

Fig. 4.

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Fig. 2.

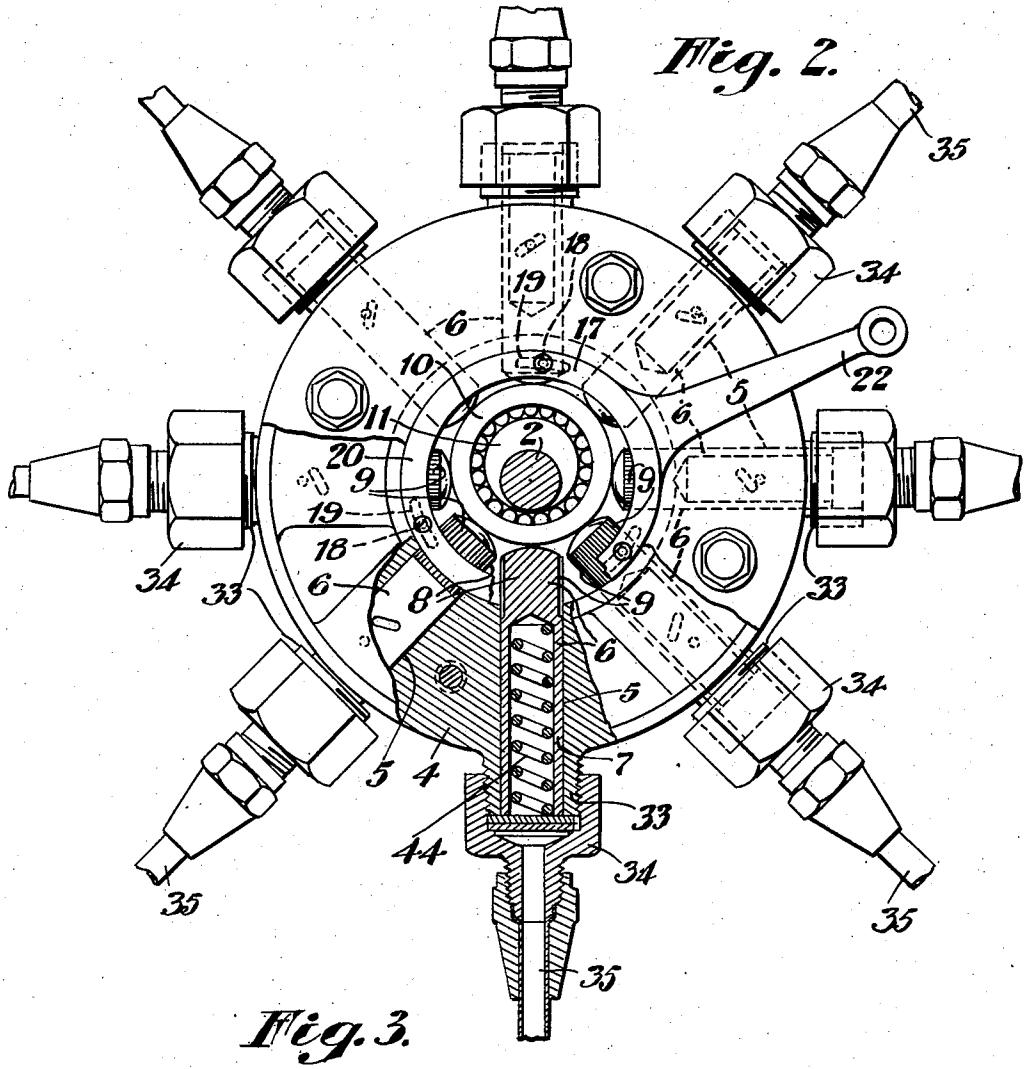
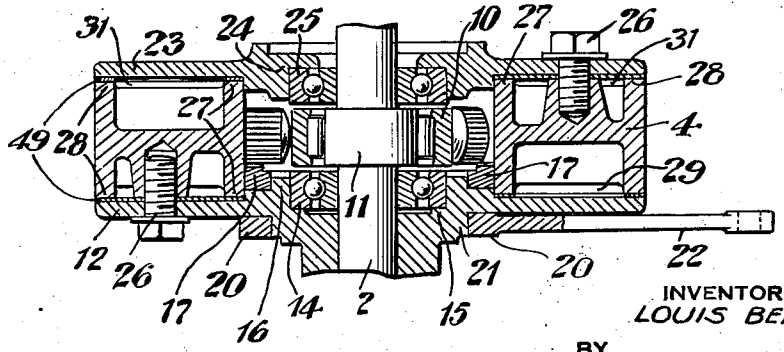


Fig. 3.



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FUEL PUMP

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7 Claims. (Cl. 103—174)

This invention relates to fuel pumps for internal combustion engines of the type in which fuel is injected into the engine cylinder or into the air inlet during each suction stroke of the engine pistons. Engines of this type are well known but are not in commercial competition with automotive engines of the carburetter type due to the greater cost of the fuel pump as heretofore constructed in comparison with the cost of a carburetter and also due to the difficulty of accurately measuring the small quantities of fuel required by such engines per working stroke.

It is a primary object of the present invention to provide a fuel pump for engines of this type which is of simple construction and which can be easily and cheaply manufactured and assembled.

It is among the objects of this invention to provide a fuel pump which is so compactly arranged that it is suitable for automotive purposes and may be mounted in the relatively small space available for the auxiliary equipment of such engines.

It is a further object of the invention to provide a pump of the type described which is readily accessible for servicing of all parts and in which all parts subject to wear may be readily removed for replacement or repair.

A further object of the invention resides in the provision of a simple structure for simultaneously varying the quantity of fuel supplied to each of the cylinders of a multi-cylinder engine.

The invention further resides in novel structural features the nature and advantages of which will in part be apparent and in part more particularly pointed out in the following detailed description.

Referring to the accompanying drawings, Figure 1 illustrates partly in section and partly in side elevation, a fuel pump and one of the cooperating fuel nozzles constructed in accordance with the invention.

Figure 2 is a bottom plan view with parts broken away to show internal construction.

Figure 3 is a vertical section through the pump body.

Figure 4 is a detail showing the structure of the discharge valve of the pump.

In the drawings the fuel pump, which is indicated generally at 1, is mounted upon a shaft 2, immediately below an ignition distributor 3. A pump body 4, formed of a single annular casting, is provided with a plurality of radial bores 5, forming the cylinders of the pump. A plurality plungers 6, are reciprocatively mounted in the bores 5, each plunger being formed of a sleeve like portion 7, at one end, and a solid portion 8 forming the opposite end. The solid end portions 8 of the plungers are provided with longitudinally extending grooves 9 on the exterior surface thereof forming sliding gears, the function of which will later appear. The end portions 8 of the plungers 6 project inwardly of the pump body to contact an outer ring 10 of a roller bearing assembly mounted upon an eccentric 11 of the shaft 2.

The pump body 4, is supported by a lower end plate 12, which end plate is integral with a sleeve 13 surrounding the shaft 2. Ball bearings 14, supported within the end plate 12 by a shouldered portion 15, provides a bearing for the shaft 2 at a point immediately below the eccentric 11. An annular boss 16, surrounding the bearing 14, centers the ball bearing 14 in its inner circumference, and also centers, on its outer circumference, a crown gear 17 the teeth of which are adapted to mesh with the teeth formed on the end portions 8 of the plungers 6 by the grooves 9. A plurality of pins 18 are attached to the crown gear 17 and extend through curved slots 19 in the end plate 12 to connect with an actuating ring 20 mounted upon the exterior of the end plate 12. An enlarged portion 21 of the sleeve 13 serves to center the actuating ring 20, and a lever 22, integral with or rigidly attached to the ring 20 is provided for angularly adjusting the actuating ring 20 and correspondingly rotating the crown gear 17.

An upper end plate 23 is provided with an internal shoulder 24 which centers a ball bearing 25 for the shaft 2 at a point immediately above the eccentric 11. Machine screws 26, extend through the end plates 12 and 23 and are screwed into threaded bores in the body portion 4 to secure the end plates to the body portion and gaskets 49 insure a fluid tight seal at the joints so formed. Concentric annular bosses 27 and 28 on each side of the body 4 space the end plates from the body to provide two annular chambers therebetween. The lower of these chambers indicated at 29, provides a suction chamber and is in communication with a supply tank (not shown) by way of a supply pipe 30. The other chamber, indicated at 31, provides a by-pass chamber which is in communication with the supply tank by way of a return pipe 32.

A plurality of externally threaded annular bosses 33 formed integral with the body portion 4, and forming extensions of each of the bores 5, project radially from the body 4 for some dis-

tance beyond the outer circumference of the body and of the end plates 12 and 23. Reduction nipples 34 on the bosses 33 form connections between the pump cylinders and the discharge passages 35 which lead to suitable fuel nozzles 36 which discharge either into the engine cylinders or adjacent the inlet valves thereof. The reduction nipples 34 also serve to hold closing disks 37 on the end of the bosses 33 to effectively close the open end of the pump cylinders formed by bores 5 except for the discharge openings 38 provided in each disk 37. A discharge valve 39 formed in a manner hereinafter more particularly described, is adapted to close the opening 38. Passages 40 extend from the annular suction chamber 29 to each of the pump cylinders 5 and passages 41 through the sleeve like portion 7 of each plunger are adapted to register with the passage 40 when the pump plungers 6 are in their innermost position. A plurality of passages 42 are likewise provided between each pump cylinder and the by-pass chamber 31, while oblique slots 43 forming passages through the sleeve like portion of the plungers are adapted to register with the passages 42 during the later portion of the discharge stroke of the plungers. Springs 44, within the sleeve like portions 7 of the plungers and bearing against the closing disks 37, maintain the inner ends of the plungers in contact with the bearing ring 10 of the eccentric 11.

Referring to Figure 4, it will be seen that each of the discharge valves 39 is formed from a thin disk of spring metal, a portion of which is cut out, as indicated at 45, leaving an outer peripheral rim 46 and a central tongue 47 which tongue is adapted to cover the discharge opening 38 in the disk 37. In order to prevent relative rotation of the disk 37 and the valve 39, the valve has a notch 48 adapted to register with a raised portion on the disk and thus maintain the two members in such registry that the tongue 47 will always cover the opening 38.

The fuel nozzle indicated generally at 36 in Figure 1 is of simple construction and, when the pump is used to supply fuel to the air inlet of an engine, it may be of the type commonly known as an open nozzle. Where the fuel is to be injected directly into the engine cylinder, I prefer to use the form shown having a check valve 50, similar in construction to the discharge valve 39 of the fuel pump. This check valve 50 is desirable to prevent the compression and explosion pressures in the engine cylinder from reacting upon the fuel line and pump connections.

In operation, the plungers 6 are driven outwardly through a fixed stroke by the eccentric 10 and returned inwardly by the springs 44 in the usual manner. During the inward or return stroke of a plunger a partial vacuum is created in the corresponding pump cylinder and upon reaching its innermost position, the passage 41 moves into register with the passage 40 and fuel from the suction chamber 29 is drawn into the pump cylinder. Upon the outward movement of the plunger fuel is forced through opening 38 in the disk 37 against the action of the valve 39 and thence through the discharge passage 35 and the nozzle 36 which opens either into the working cylinder of the engine or at a point adjacent the intake valve thereof. This action continues until the oblique slot 43 registers with the opening 42 at which point the supply of fuel to the engine terminates abruptly and during the remainder of the outward stroke of the piston fuel from the pump cylinder passes into the annular by-pass chamber 31 from which it is returned to the supply tank by way of the passage 32.

Angular adjustment of the lever 22 and the attached actuating ring 20 produces a corresponding movement in the crown gear 17 which being in mesh with the gear formed by the grooves 9 upon the solid end portions 8 of the plungers rotates the latter so that the angular grooves 43 will register with passages 42 sooner or later during the discharge stroke of the plunger and accordingly reduce or increase the amount of fuel which is supplied through the discharge pipes 35 to the engine cylinders.

From the above description it will be seen that in the event of failure of any one of the pump members, the defect may be remedied by removing the reduction nipple 38 which will permit the insertion of a new discharge valve, or a new plunger as necessary without removing the pump from the engine to which it is attached.

It will also be seen that the structural features described result in a simple pump structure which occupies but a small space and which may readily be applied to existing engine structures without material alteration thereof.

Simplicity of construction and ease of manufacture will be particularly apparent in the structure of the pump body 4 which comprises a single casting forming an annular web having no internal cavities which would be likely to involve difficulty or expense in the casting thereof. The provision of the suction and by-pass sumps between the body portion and the end plates is a material factor in the simplicity of the design inasmuch as this helps to avoid internal cavities in the casting and also permits access to passages 41 and 42 should one of them become clogged.

Although there is herein described but a single preferred embodiment of the invention, other embodiments within the scope of the appended claims will be obvious to those skilled in the art from a consideration of the form shown.

The invention has been described in conjunction with a fuel pump of the type commonly known as a radial cylinder pump. It will be obvious to those skilled in the art that certain of the features of the invention are not limited to pumps of this type but are applicable to pumps generally, and other aspects are applicable to pumps of the general type in which the capacity thereof is altered by a relative rotation between the pump piston and the pump cylinder.

Having thus described the invention, I claim:

1. A fuel pump comprising an annular web having a plurality of bores extending radially therethrough, plungers reciprocative in said bores, a shaft extending through the central opening of said annular web and having an eccentric adapted to actuate said plungers, end plates removably fastened to each side of said annular web and having internally shouldered portions, and ball bearings centered in each of said shouldered portions providing journals for said shaft upon each side of said eccentric.

2. A fuel pump of the type having a plurality of pistons extending radially from a central shaft, a pump body having radial bores forming pump cylinders, integral annular bosses projecting outwardly from the outer circumference of said body and forming a prolongation of each bore, a reduction nipple on each boss having internal threads

coacting with external threads upon said boss, and a pair of disks secured on the end of each boss by the corresponding nipple, one of said disks forming a closure for said pump cylinder and the other forming a discharge valve covering an opening in said closure.

3. A fuel pump comprising an annular web having a plurality of bores extending therethrough, plungers reciprocative in said bores, lateral passages extending from each of said bores to each side of said annular web, end plates attached to each side of said web and forming therewith annular channels on each side thereof, each of said lateral passages extending to one of said chambers.

4. A fuel pump comprising an annular web having a plurality of bores extending therethrough, plungers reciprocative in said bores, said web also having lateral passages extending from each of said bores to each side thereof, plates attached to each side of said web and forming therewith a pair of annular channels, said lateral passages opening into said channels, annular bosses projecting from the circumference of said web and forming extensions of said bores, a discharge connection threaded upon each boss, a discharge valve clamped between each connection and the end of each boss.

5. A fuel pump comprising an annular web having a plurality of cylinder bores extending radially therethrough, plungers reciprocative in said bores, a plate fastened to one side of said web forming therewith an annular suction chamber and a plate fastened to the opposite side of said web forming therewith an annular by-pass chamber.

6. A fuel pump comprising an annular web having a plurality of cylinder bores extending radially therethrough, plungers reciprocative in said bores, plates fastened to each side of said web and forming therewith annular suction and by-pass chambers, a crown gear supported on the inner face of one of said plates, said pistons having end portions coacting with said gear and means extending through said last mentioned plate for rotating said gear.

7. A fuel pump comprising an annular web having a plurality of cylinder bores extending radially therethrough, plungers reciprocative in said bores, a plate detachably secured to one side of said web forming therewith a suction chamber and a plate detachably secured to the opposite side of said web forming therewith a by-pass chamber.

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