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W. E. LEIBING
METERING FUEL PUMP
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FIG 2

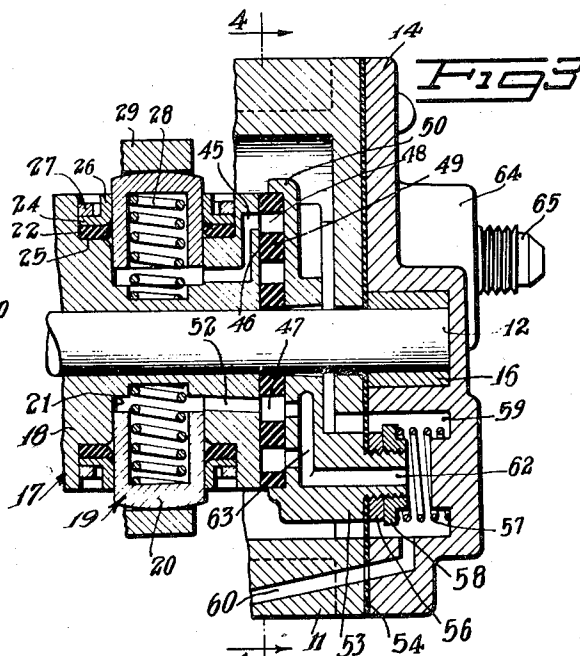
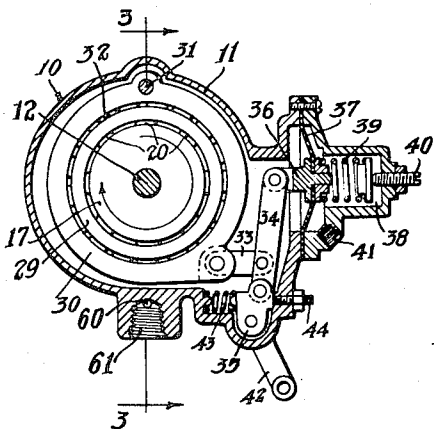


FIG 4

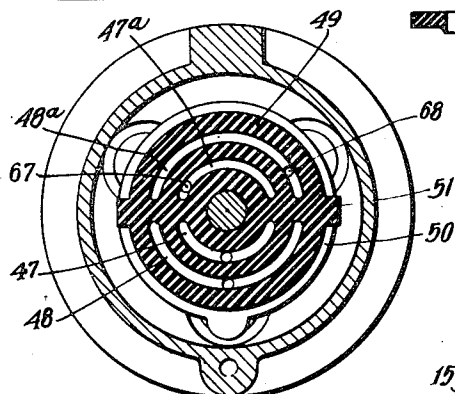


FIG 6

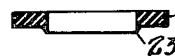


FIG 5

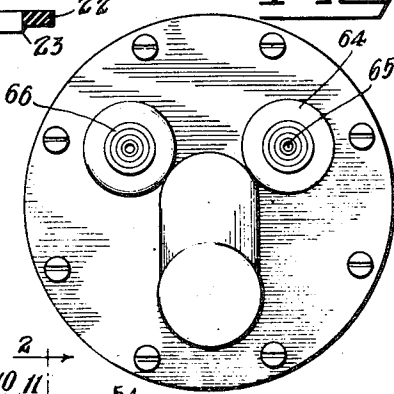
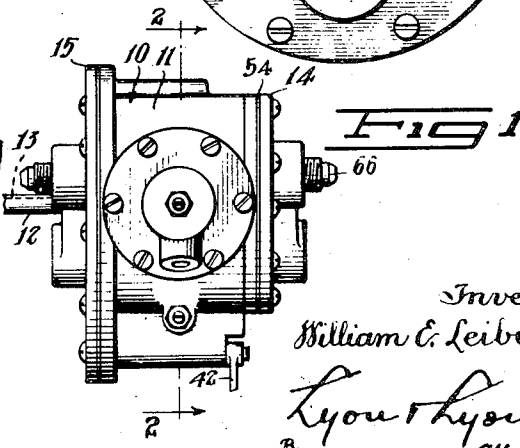
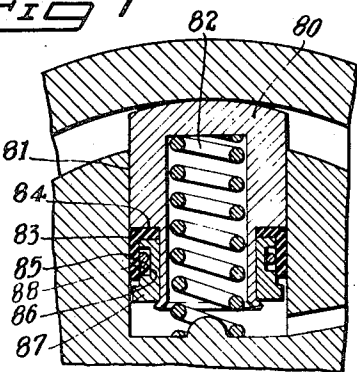


FIG 7



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UNITED STATES PATENT OFFICE

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METERING FUEL PUMP

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2 Claims. (Cl. 103—2)

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This invention relates to a metering fuel pump and is particularly directed to improvements over the device shown in my copending application, Serial No. 789,106, filed December 1, 1947.

Standard practice in the construction of internal combustion engines of the manifold induction type is to position the intake valves of adjacent cylinders of the engine in relatively close relationship in order that they may be fed from a common branch or "leg" of the intake manifold. Thus, a conventional eight cylinder engine has four legs or branches in its intake manifold, a six cylinder engine has three branches, a four cylinder engine has two, etc.

A large proportion of conventional automobile engines and truck engines employ either six or eight cylinders. Therefore, it is highly desirable to separate the overall fuel requirements of the engine into as many divisions as there are branches in the intake manifold. By this arrangement it is possible to obtain much more uniform distribution of fuel in the intake manifold than is possible with the conventional system employing a single carburetor. The single duct from the carburetor ordinarily supplies the total amount of fuel to the intake manifold, and it has been found extremely difficult in practice to divert an equal amount of fuel into the separate manifold branches, especially under the conditions of pulsating and reversal of flow which has been found to exist at times in conventional intake manifolds.

The principal object of the present invention is to separate the total amount of fuel delivered to an internal combustion engine of the manifold induction type into as many divisions as there are branches in the intake manifold, and in this way to supply each of the branches with exactly the same amount of fuel.

Another object is to provide a metering fuel pump having more than two separate discharges, each delivering the same amount of fuel at any given instant.

Another object is to provide improved forms of sealing means for the positive displacement pumping elements employed in connection with my fuel pump device.

Another object is to provide a novel form of ported sealing washer adapted to be positioned between a stationary support and the pump carrying rotor.

Other objects and advantages will appear hereinafter.

In the drawings:

Figure 1 is a side elevation showing a preferred embodiment of my invention.

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Figure 2 is a sectional elevation taken substantially on the lines 2—2 as shown in Figure 1.

Figure 3 is a fragmentary sectional view taken substantially on the lines 3—3 as shown in Figure 2.

Figure 4 is a sectional view taken substantially on the lines 4—4 as shown in Figure 3.

Figure 5 is an end elevation.

Figure 6 is a transverse sectional view of one of the sealing rings shown in Figure 3.

Figure 7 shows a modified form of sealing device.

Referring to the drawings, a metering pump assembly generally designated 10 is provided with a relatively stationary housing 11 in which a shaft 12 is rotatably mounted. A projecting end of the shaft is provided with a keyway 13 for connection to a driving member (not shown). Any suitable or desirable driving member such as, for example, a flexible drive shaft, a pulley, a sprocket or a gear may be employed for turning the shaft at a speed proportional to the speed of an internal combustion engine. The purpose of the metering fuel pump 10 is to deliver fuel to the engine in accordance with engine requirements. A preferred form of driving connection for the shaft 12 may include a flexible shaft (not shown) driven from the cam shaft of the internal combustion engine.

As described in my copending application referred to above, the housing 11 may be provided with removable end members 14 and 15, each of which carries a bearing 16 for the shaft 12. Fixed on the shaft 12 is a rotor assembly generally designated 17. This assembly includes a rotor 18 and a plurality of positive displacement pump elements 19. The pump elements are substantially duplicates and may be mounted in a double row on the rotor 18. Each of these units 19 may include a hollow piston 20 reciprocable on the rotor 18 within a radially extending bore 21. Sealing means may be provided to prevent leakage between the piston and bore, and as shown in Figure 3 of the drawings this sealing means may include an annular resilient sealing ring 22 of molded construction and provided with a lip 23 extending radially inwardly. The free inner diameter of the ring 22 is slightly smaller than the outside diameter of the piston 20 so that the ring 22 is initially deformed when it is assembled over the piston 20. A nonresilient follower 24 acts to confine the resilient ring 22 between the follower and the annular shoulder 25. The follower 24 may be provided with a cylindrically extending guide 26 for the piston 20. The

follower 24 may be maintained in operative position by means of a deformable ring element 27.

A compression spring 28 within the hollow piston acts to move the piston radially outwardly. Outward movement of the piston is limited by the encircling sleeve 29 which rotates with the rotor assembly 17. A ring 30 pivotally mounted on the housing 11 at 31 encircles the sleeve 29, and a bearing 32 is interposed between the sleeve 29 and the encircling ring 30. It will be understood that the sleeve 29 extends over both of the rows of pumping elements, and that a single ring 30 encircles the sleeve 29.

Means are provided for shifting the position of the ring 30 within the housing 11 in order to shift the rotary sleeve 29 to an eccentric position with respect to the rotor assembly 17. As shown in the drawings this means includes a link 33 pivotally connected to the ring and to a lever 34. The lever 34 has one end pivotally attached to a fitting 35 and the other end pivotally connected to a central movable member 36 secured to a flexible diaphragm 37. A vacuum chamber 38 is provided on one side of the diaphragm 37, and a coil spring 39 is mounted within the chamber 38 and adapted to move the diaphragm toward the left as viewed in Figure 2. The force of the spring may be varied by means of the adjustable set screw 40. A port 41 is provided leading to the chamber 38, and a conduit (not shown) is provided to connect this port 41 with the suction manifold of the internal combustion engine. From the above description it will be understood that when the manifold suction is relatively high, atmospheric pressure on the left side of the diaphragm 37 acts to compress the spring and to move the ring 30 to reduce the eccentricity with respect to the rotor assembly 17. When the manifold suction pressure is relatively low the spring 39 moves the diaphragm 37 to the left and thereby increases the eccentricity of the ring 30 and sleeve 29, with the result that the individual pumping units 19 on the rotor assembly 17 operate with a longer stroke.

As shown and described in my prior application above identified, the fitting 35 may be pivotally mounted on the housing 11 and may be provided with an actuating lever 42 extending exteriorly of the housing. A compression spring 43 within the housing normally acts to hold the fitting 35 against the inner end of an adjustable set screw 44. Under cold starting conditions when it is desirable to increase the proportion of fuel in the fuel air mixture leading to the internal combustion engine the actuating lever 42 is turned in a counterclockwise direction, as viewed in Figure 2, and thereby moves the lower end of the lever 34 in a direction to increase the eccentricity of the sleeve 29.

Each of the positive displacement pumping elements 19 is provided with a single port for both inlet and discharge. As the piston 20 of each unit reciprocates with respect to the bore 21, fuel in liquid form is alternately drawn into the inner end of the bore 21 and expelled therefrom through a single port 45 formed in the rotor 18. Each of the ports 45 terminate at the plane end face 46 on the rotor 18. The ports 45 do not all emerge at the end face 46 at the same distance from the axis of the shaft 12, but on the contrary some of the ports terminate on the end face 46 in a position to align with the inner arcuate slots 47, and other ports terminate at a position to

align with the outer arcuate slots 48. The arcuate slots 47 and 48 are provided in a resilient sealing washer 49 carried by a non-rotatable support member 50. As shown in Figure 4 the outer slots 48 and inner slots 47 are concentric about the shaft axis, and each extends around the washer 49 for an angular distance approximating 180°. The portions of the resilient washer 49 between adjacent ends of the inner slots 47 and between adjacent ends of the outer slots 48 act as dam sections to prevent communication between the slots. Laterally extending ears 51 may be provided on the resilient washer 49 and received by the support member 50 to prevent relative rotation between the washer and the support member 50. Furthermore, the washer 49 may be advantageously secured to the support member 50 by cementing or bonding it thereto.

From the above description it will be understood that the port 45 leading from one of the pumping units 19 alternately registers with slots 48 and 48a, while the port 52 communicating with another of the pumping units 19 alternately registers with the slots 47 and 47a. It will also be understood that although only two of the pumping units 19 are shown in Figure 3 additional units may be positioned at 90° from the units illustrated, and that another row of pumping units may be placed on the rotor to the left of those illustrated. Thus in Figure 2 eight pistons 20 are shown, and these are equally spaced around the circumference of the rotor with one row staggered 45° behind the other. Accordingly, a duplicate porting assembly including the rotor face, washer 49 and support member 50 is provided at the other end of the rotor 18.

The support member 50 is provided with circumferentially spaced axially extending projections 53, each of which extends through the flexible diaphragm 54 which is confined between the housing 11 and the end cap 14. A nut 56 threaded on the end of the extension 53 clamps each of the extensions with respect to the diaphragm 54. A coil spring 57 is provided which presses against a follower 58 on each of the extensions 53 to apply sealing pressure against the resilient washer 49. Furthermore, this mounting of the support member 50 on the diaphragm 54 allows the support member and washer 49 to oscillate slightly to absorb any wobble of the end surface 46 of the rotor. One of the extensions 53 extends into a chamber 59 which communicates with a fuel inlet conduit 60. This conduit extends from a central threaded opening 61, to which fuel is delivered for both ends of the rotor 18. A conduit 62 is provided within the lower extension 53 communicating with the chamber 59 and with ports 63 positioned in the support member and aligned with the lower arcuate slots 47 and 48.

In a similar manner the other two extensions on the support member are fixed to the diaphragm 54 and extend into chambers provided within the cap 14. One of these chambers 64 leads to the first fuel discharge fitting 65, and the other chamber connects with the second fuel discharge fitting 66. Suitable passageways are provided in the upper extensions 53 which connect the first discharge fitting 65 with the port 67 on the support member and aligned with the upper arcuate slot 47a, and connect the second fuel discharge fitting 66 with the port 68 registering with the upper arcuate slot 48a. Fuel in liquid form, therefore, is constantly admitted

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into the arcuate slots 47 and 48 and is pumped by the pumping elements 19 outwardly through the arcuate slots 47a and 48a to the individual discharge fittings 65 and 66. Two discharge fittings are thus provided on each end of the device 10, and accordingly the pumped fuel may be led individually to each of the four branches of the inlet manifold of the internal combustion engine.

When the device is to be used with a six cylinder engine one end of the rotor 18 may be provided with four pumping units 19 and the other end of the rotor provided with only two pumping units. As an alternate arrangement three pumps in each end of the rotor may be provided, two with outlets at one end and one with an outlet at the other end of the rotor. Thus by cross-drilling of the rotor 18 some of the pumps deliver to the opposite end of the rotor, and it is thereby possible to have equal delivery in three outlets with equal intervals of time between pulsations.

In the modification shown in Figure 7, I have illustrated a modified form of sealing means for each of the pistons 80 operating within cylinder bores 81. The piston is formed hollow to receive a coil spring 82 and carries a sealing device mounted thereon. This sealing device comprises a resilient cup 83 having a radial flange 84 and a skirt 85. The skirt encircles a groove 86 formed in the follower 87 secured on the piston 80. The follower 87 may be secured in any preferred manner as, for example, by swaging the lower portion of the piston 80. A coil spring 88 is mounted in the groove 86. The spring contains approximately one and one-half turns of wire, and the normal free outer diameter of the spring is slightly larger than the free inner diameter of the skirt 85. The spring, therefore, exerts a light pressure outwardly on the skirt of the cup 83. I found that this type of sealing device for the reciprocable pistons provides an exceptionally efficient seal, yet which gives long service without appreciable wear.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. In a fuel pump for an internal combustion engine of the manifold induction type the combination of a rotor driven in accordance with engine speed; a plurality of positive displacement pumps on the rotor, the rotor having a plane end face provided with ports communicating with said pumps; valve means including a non-rotatable washer adapted to contact said end face in sealing relation, the washer having a plurality of inner and outer concentric arcuate slots extending directly therethrough and adapted to register with the rotor ports; a support member for said washer, said member being provided with a supply conduit and a plurality of circumferentially spaced discharge passageways, the supply conduit communicating with a plurality of said arcuate slots, the discharge passageways each communicating with a single arcuate slot; a plurality of circumferentially spaced springs encircling the supply conduit and discharge passageways and adapted to provide a flexible support for said member and washer and further acting to maintain sealing pressure between the washer and the rotor end surface.

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2. In a fuel pump for an internal combustion engine of the manifold induction type, the combination of: a rotor driven in accordance with engine speed; a plurality of positive displacement pumps on the rotor, the rotor having a plane end face provided with ports communicating with said pumps; valve means including a non-rotatable washer adapted to contact said end face in sealing relation, the washer having a plurality of inner and outer concentric arcuate slots extending directly therethrough and adapted to register with the rotor ports; a support member for said washer, said member having a plurality of circumferentially spaced projections, a plurality of springs each encircling one of said projections and adapted to provide a flexible support for said member, one of the projections having a fuel supply conduit therein and each of the other projections having a fuel discharge passageway therein, the supply conduit communicating with a plurality of arcuate slots and the discharge passageways each communicating with a single arcuate slot.

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