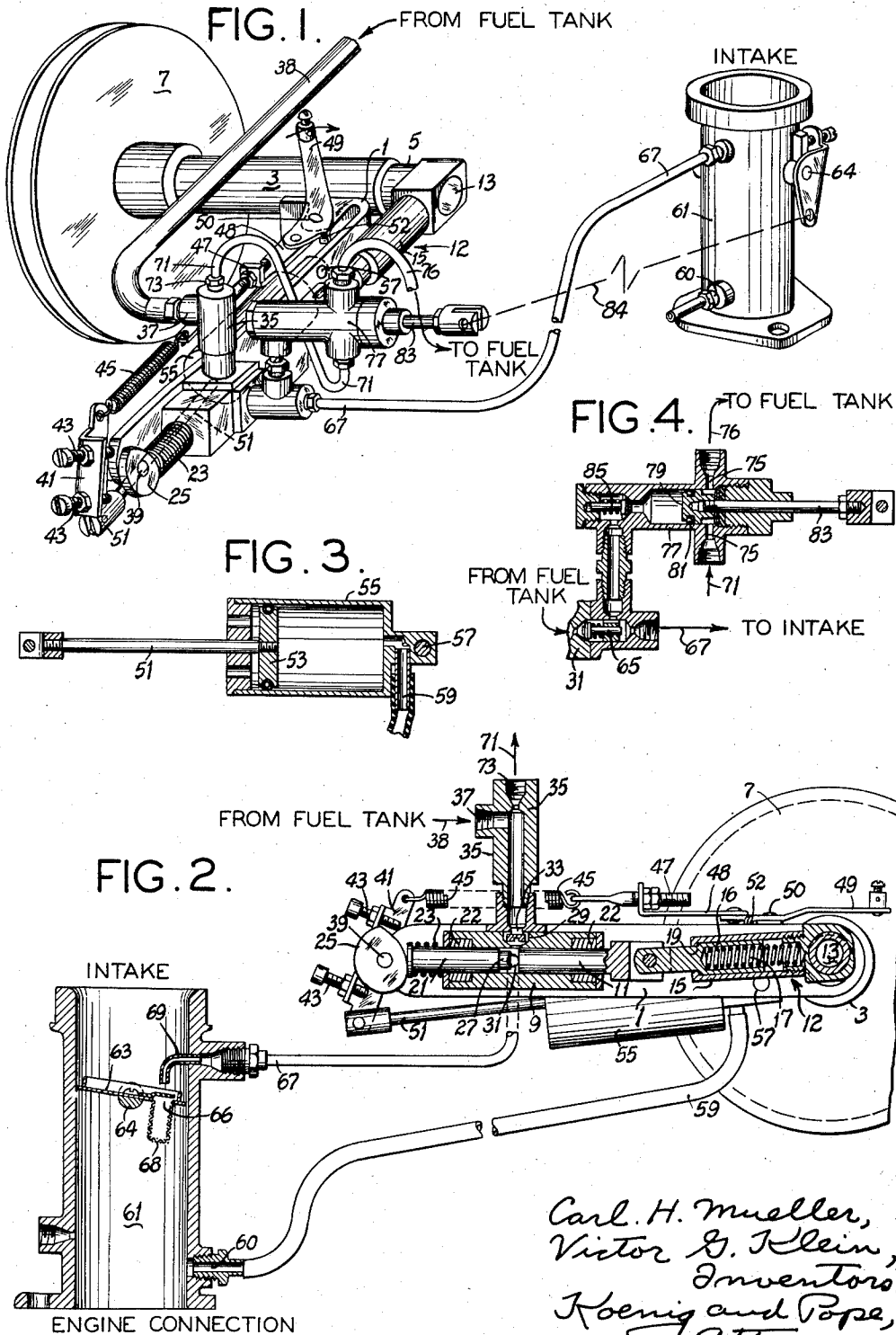


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ENGINE FUEL INJECTION PUMP

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ENGINE FUEL INJECTION PUMP

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1 Claim. (Cl. 123—140)

This invention relates to engine fuel injection pumps for supplying fuel to internal combustion engines, and more particularly to gasoline engines and the like.

Among the several objects of the invention may be noted the provision of a variable-stroke, positive-displacement fuel pump for more efficiently supplying fuel to internal combustion engines and to take the place of the presently used carburetors for the purpose, so as to eliminate the various disadvantages of the latter. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claim.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is an isometric view of apparatus embodying the invention;

Fig. 2 is an axial section through certain pump and intake parts of Fig. 1;

Fig. 3 is an axial section of certain vacuum cylinder parts of Fig. 1; and,

Fig. 4 is a cross section through certain accelerator pump parts of Fig. 1.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to the drawings, there is shown at numeral 1 a bracket for supporting the device in connection with the frame of the engine (not shown) to which the device is to supply fuel (gasoline, in the case of a gasoline engine). The bracket 1 carries a bearing 3 for a rotary crankshaft 5 driven by any suitable connection with the moving parts of the engine. For example, a pulley 7 may be used which may be belt driven from a pulley (not shown) on the crankshaft, camshaft, fan shaft or the like of the engine. Thus the speed of the shaft 5 is substantially proportional to the engine speed, although no precise timing is required for which a chain or gear drive would be needed. However, such chain or gear drive may be used for the purpose. At 9 is shown a pump cylinder block in which reciprocates a pump plunger 11 driven from an eccentric crank 13 on the crankshaft 5. The eccentric crank 13 is coupled to the plunger 11 by a connecting rod 12, consisting of telescoping cylinders 15 and 16, spring biased apart by means of a spring 17. Separating bias movement is limited by cooperating shoulders 19. Thus the rearward dead-center position of the plunger 11 is always the same, but its forward position may be changed by blocking its forward movement, with accompanying telescopic action between parts 15 and 16.

The forward position of the plunger 11 is determined by the position of a sliding stop 21 extending into the cylinder 9. Suitable packings 22 are used between the cylinder 9 and the plunger 11 and stop 21, respectively. The stop 21 is biased outward from the cylinder 9 by a spring 23. The stop is adapted to be pushed inward

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into the cylinder by a cam 25. The inner end of the stop 21 is formed as an extension 27 of reduced diameter, so that the stop 21 does not interfere with flow through an inlet port shown at 29, nor with flow to an outlet port 31. The inlet port 29 includes an inwardly opening check valve 33, which opens inward upon retraction of the plunger 11 to admit fuel (gasoline) from a container 35 which, through a connection 37 and pipe 38, has a connection with a fuel tank (not shown). It is understood that pipe 38 may connect directly to the fuel tank or connect to the fuel tank via a fuel pump.

The cam 25, which positions stop 21, is on a rotary shaft 39, which in turn is pivoted in the bracket 1. Attached to shaft 39 is a rocker lever 41 having motion-limiting adjusting screws 43. The rocker 41 is biased by means of a tension spring 45, attached at one end of the rocker and attached at the other end by an adjusting screw 47 and link 48 with a control lever 49 pinned at 50 to the bracket 1. By rocking the control lever 49, more or less spring bias can be placed on the rocker 41. A stop 52 on lever 49 engaging bracket 1 determines the initial position of the lever.

At the other end of the rocker 41 is pinned a piston rod 51, the latter being connected with a piston 53 in a vacuum cylinder 55, the latter being pivoted to the bracket 1 at 57. Connection 59 from the inside of the vacuum cylinder 55 leads to a port 60 in the side of an air intake tube or horn 61, forming part of the intake vacuum manifold of the internal combustion engine. The connection at 60 is made below the usual throttle valve 63, which is controlled from a throttle control arrangement 64.

The pump outlet port 31 (Fig. 4) is connected through an outlet check valve 65 and line 67 with an inlet nozzle 69, located in said tube 61 above the valve 63. The valve includes an idling port 66, covered by a screen cup 68 adapted to break the incoming stream of fuel under idling conditions into a spray of droplets. When the valve 63 is open under running conditions, the force of the fuel flow from nozzle 69 and the rush of air through the tube 61 produce an effective spray.

The container 35 has an upper outlet 73 which is connected through a pipe 71 to a cross port arrangement 75 at the rear end of an accelerator-pump cylinder 77. This cross port is connected to the fuel tank through a line 76. Thus if gasoline should vaporize under hot conditions of operation, it will not percolate (force its way) into the cylinder 9 to cause the pump to lose its prime. On the contrary, it will percolate from port 73 through port 75, line 76 and back to the gasoline tank.

The accelerator-pump cylinder 77 has a plunger 79 of reduced diameter behind its plunger packing 81, which forms part of said cross port arrangement. It is across this reduced portion that the percolating flow may occur back to the fuel tank. Plunger 79 is operated by a rod 83 which has a suitable connecting linkage, indicated diagrammatically at 84, with the throttle control 64. Cylinder 77 also has an outlet check valve 85 which leads to the downstream side of the check valve 65 and thence to the connection 67 with the nozzle 69. Thus when the throttle valve 63 is opened, the plunger 79 moves ahead in the cylinder 77 to give an immediate preliminary spurt of fuel through line 67, independently of the action of the pump, this being immediately followed by flow of fuel from the pump. When the plunger 79 is retracted in cylinder 77, the latter is recharged by flow of fuel past the packing 81, which is of the one-way-flow type. This new charge is received from the space around the reduced portion of the plunger 79 forming said cross passage 75 behind the packing 81.

Operation is as follows:

Assume that the engine is dead. No operating vacuum exists in the air intake tube 61 under valve 63. Consequently, there is no vacuum transmitted to the cylinder 55. Therefore, the spring 45 biases the rocker 41 so as to pull rod 51 to the left and also piston 53 to the left in cylinder 55. This places the lowest part of the cam 25 at stop 21, which is biased to the left by spring 23. This permits full stroking of the plunger 11 when the engine is cranked, since there is no impediment to the full stroke reciprocation of plunger 11 from crank 13 under bias of spring 17. Consequently, a maximum amount of fuel is drawn in from inlet port 29 and forced through the outlet port 31 to the nozzle 69. The screen cup 68 admits this fuel as a spray into the intake manifold through tube 61, even though the valve 63 may not be open, or at least not very far open.

The vacuum induced by cranking draws the fuel into the engine, in which the fuel becomes ignited, and the engine starts and accelerates. This increases the vacuum which is conveyed to cylinder 55 to draw piston 53 and rod 51 to the right, thus moving rocker 41 as well as cam 25. Lift portions of the cam then engage stop 21. This moves the stop to the right against bias of spring 23, so as to limit movement to the left of plunger 11. This shortens its stroke, thus reducing the rate of fuel feed. The feed rate will become automatically appropriate to idling conditions, since as the fuel feed is limited, so are the engine speed and vacuum. At a given setting of the throttle control 64, a balanced idling condition is reached. For positions of the stop 21 to the right of that for full stroke, the members 15 and 16 telescope, so as to permit rotation of the crank 13, despite the shorter stroke of the plunger 11.

To accelerate, say an automobile driven by the engine, or to drive against a heavier load, as by driving the car uphill (whether accelerated or not), the throttle 64 is manipulated to open valve 63 further. This momentarily reduces the manifold vacuum so that again piston 53 and rod 51 move to the left under bias of spring 45, thus repositioning the stop 21 for long stroke action of the plunger 11 to feed more fuel for the additional work to be done.

In the case of acceleration, as the engine speed increases, the vacuum is increased at a given setting of valve 63, thereby reversing the control action so as to move plunger 21 to the right until steady-state conditions are again reached at constant velocity of the engine.

In the case of a heavier load at constant speed, as in hill climbing, steady-state conditions will be reached at lower engine speeds corresponding to smaller vacuum in the manifold, with a resulting positioning of the stop 21 more to the left so as to continue to supply a sufficient amount of fuel for the increased work to be done.

Choking action for starting purposes, which is to say the supplying of more fuel at a lower engine speed such as during cranking, may be effected by swinging the lever 49 in the direction shown by the arrow in Fig. 1. This applies more tension to the spring 45, thus delaying the movement of stop 21 to the right (Fig. 2) in response to a given vacuum in the cylinder 55. Moreover, the richness or leanness of the fuel air mixture may be adjusted for all running conditions at the adjusting screw 47.

The apparatus has several advantages over a carburetor for supplying fuel to the tube 61. Thus performance is improved since, unlike the case of a carburetor, no hot air is required at the inlet of the tube 61 above valve

63. Therefore, the weight of oxygen is increased per unit volume of fuel supplied. Moreover, the unreliability of carburetor components, such as leaky floats, battered needle valves and seats, icing due to venturi throttling and expansion of inlet air, are all avoided. Fuel distribution is improved because of the positive mechanical spraying of the fuel, rather than the more unreliable spraying induced by air velocity in a carburetor venturi tube. By means of the pump, as compared to the carburetor, fuel is more accurately proportioned to throttle position because there is no overrunning action as is encountered in the case of a carburetor. The arrangement for bypassing the percolating fuel from the pump inlet chamber or container 35 and through the accelerator pump shown in Fig. 4 is advantageous in preventing loss of pump prime under hot running conditions.

It will be understood that the eccentric 13 forming the connection between the shaft 5 and connecting rod 12 is one of various equivalent structures that might be used for the purpose, such as short crank or the like. The term "eccentric" is used herein as generic to such equivalent structures. Likewise, the cam 25 is only one of various similar means that may be used to effect a connection between the rocker 41 and stop 21.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

35 A fuel injection pump for an engine having a vacuum intake, comprising a pump cylinder having an inlet check valve connected through a chamber to a fuel tank and having an outlet check valve connected to said intake, an accelerator pump having a supply connection with said chamber and the tank and having an outlet check valve connected to the downstream side of said outlet valve of the pump cylinder, a plunger in the pump cylinder, a rotatable eccentric, a drive from the engine adapted to rotate said eccentric, connecting means between the eccentric and said plunger comprising telescoping parts and means biasing them apart with a stop limiting the bias action, whereby the plunger may reciprocate in the cylinder under full stroke or less than full stroke conditions, a stop in said cylinder movable from a position allowing full stroke of the plunger to positions for engagement thereby at less than full stroke, means normally biasing said stop to its full stroke position, and means responsive to intake vacuum adapted to move said stop toward less than full stroke positions in response to increased vacuum.

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