

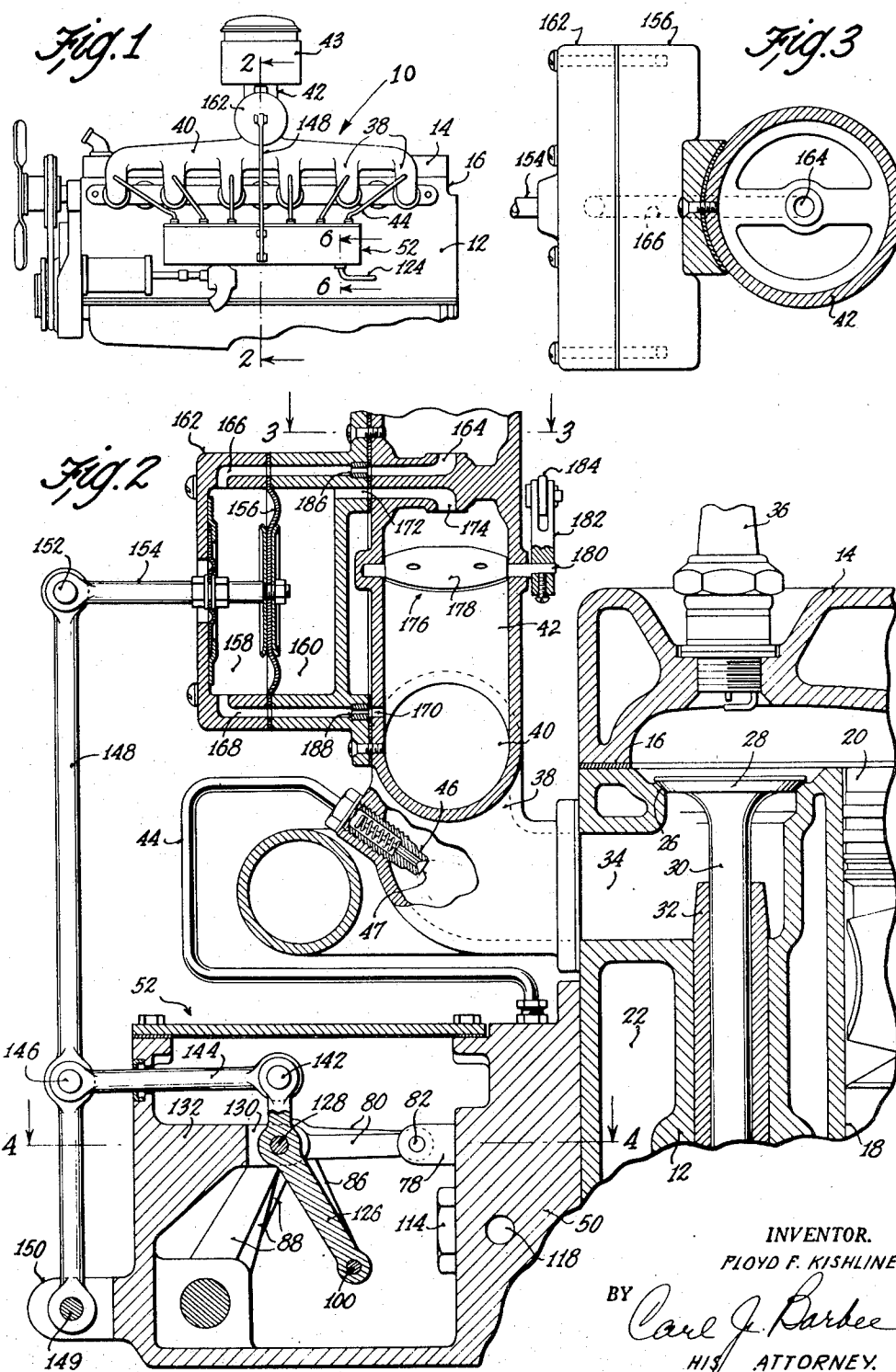
Aug. 14, 1951

F. F. KISHLINE
FUEL FEEDING DEVICE

2,563,939

Filed Dec. 6, 1943

2 Sheets-Sheet 1



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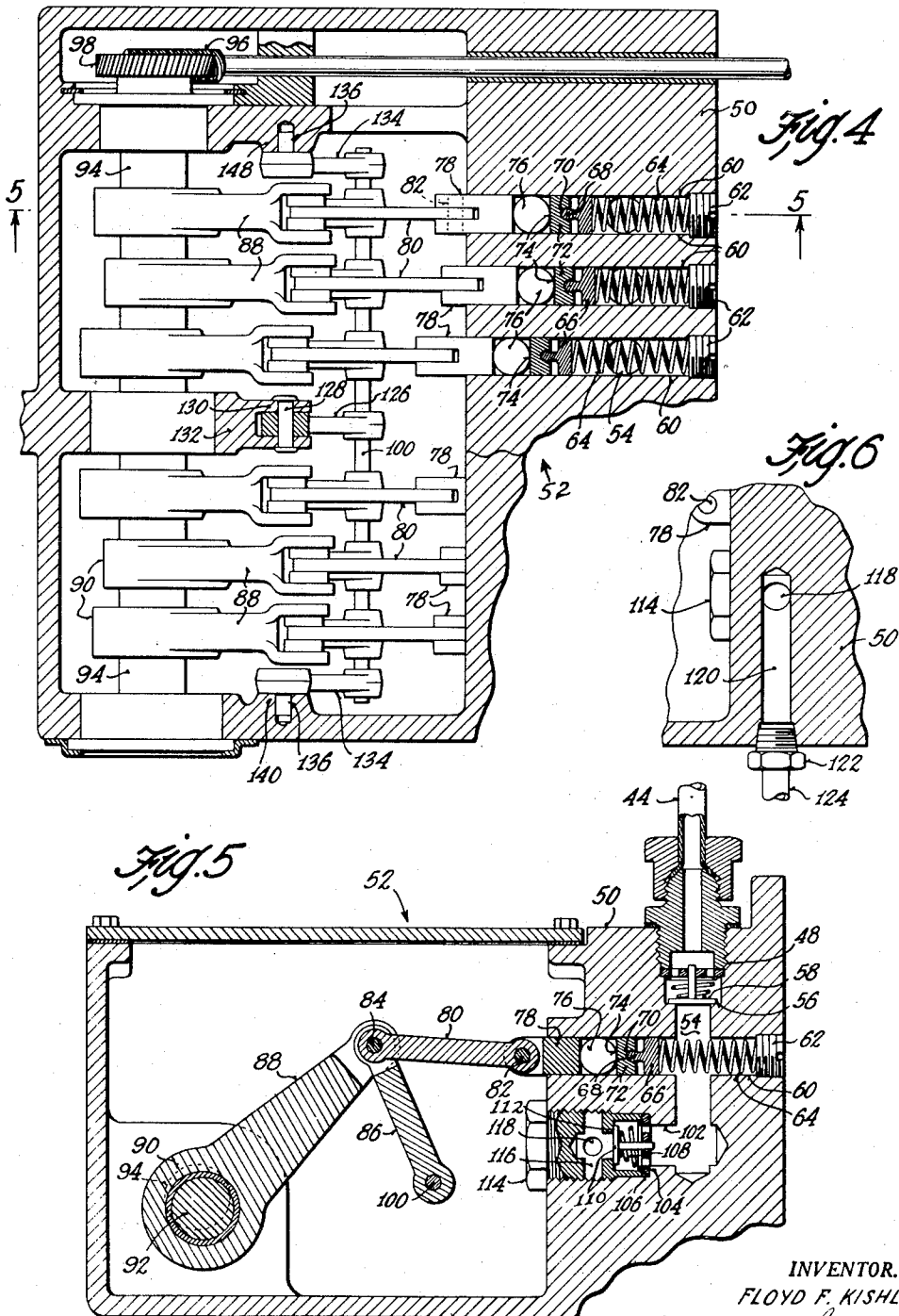
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2 Sheets-Sheet 2



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FUEL FEEDING DEVICE

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5 Claims. (Cl. 123-119)

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This invention relates to fuel feeding devices and more particularly to a fuel metering, distributing and fuel and air mixing device for use in conjunction with an internal combustion engine.

The large majority of internal combustion engines employ fuel induction systems in which the fuel is metered by means of a carburetor in proportion to the volume or weight of air passing through the carburetor, the carburetor serving as a mixing as well as a metering device. From the carburetor the mixture of fuel and air is distributed through an induction manifold to the various cylinders of a multiple cylinder internal combustion engine.

In the case of Diesel engines, atmospheric air is drawn into the cylinders, compressed, and, when compression has reached its highest point, metered quantities of fuel are injected into the combustion chamber under extremely high pressure in order to atomize the fuel and secure uniform distribution thereof. Diesel engines have the advantage that precisely the correct quantity of fuel is fed into each cylinder for each power stroke, whereas with the ordinary vacuum induction system, fuel distribution is entirely dependent upon the shape or configuration of the manifold pipe or upon external factors such as heat to assure uniform distribution.

The difficulty in securing uniform distribution in a fuel induction system lies in the large quantities of liquid fuel which are encountered in the manifold under ordinary operating conditions. It is extremely difficult to assure that under all conditions of performance and all ranges of throttle opening, equal quantities of the liquid fuel will be distributed to each of the combustion chambers and it is accordingly an object of this invention to overcome the difficulties inherent in such poor distribution characteristics of induction manifolds.

Another object of the invention is to provide a fuel distributing system in which measured quantities of fuel are fed directly into the port of the cylinder to be served so as to insure that all fuel intended for each cylinder will ultimately reach that cylinder.

It is a further object of the invention to meter the quantity of fuel going into each cylinder and to distribute uniform quantities of fuel into all cylinders so that the performance of all cylinders in a multiple cylinder internal combustion engine is identical.

It is a further object of the invention to provide means dependent upon the quantity of air be-

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ing drawn into an internal combustion engine for regulating the quantity of fuel which will be fed to each of the cylinders.

Further objects and advantages of the invention will appear hereinafter as the description proceeds and will be more particularly pointed out in the appended claims.

In the drawings, of which there are two sheets and which are to be taken as illustrative rather than as limiting the invention:

Figure 1 is a side elevational view of an internal combustion engine embodying the fuel feeding device of the present invention;

Figure 2 is a vertical transverse sectional view through the internal combustion engine shown in Figure 1 and taken substantially upon a plane as indicated by the line 2-2 of Figure 1;

Figure 3 is a horizontal sectional view taken upon a plane as indicated by the line 3-3 of Figure 2 and looking in the direction of the arrows;

Figure 4 is a horizontal sectional view through the pump mechanism taken substantially upon a plane as indicated by the line 4-4 of Figure 2 and looking in the direction of the arrows;

Figure 5 is a vertical sectional view taken upon a plane as indicated by the line 5-5 of Figure 4 and looking in the direction of the arrows; and

Figure 6 is a vertical sectional view through a portion of the pump mechanism taken upon a plane as indicated by the line 6-6 of Figure 1 and looking in the direction of the arrows.

Referring more in detail to the drawings, in which similar reference characters are used throughout to designate similar parts, the invention will be seen to be embodied in a pumping mechanism for supplying fuel to an internal combustion engine generally indicated at 10. The engine 10 comprises a cylinder block 12 of L-head type which has secured to its top surface a cylinder head 14 by means of studs (not shown) and gaskets 16 interposed between the head and block. The engine block 12 is suitably internally machined to provide cylinders 18, of which, in the instance illustrated, there are six, each cylinder being adapted to receive a piston 20 slidable therein in the usual manner. The motor block is also machined and cored to provide a cooling liquid jacket 22 as well as valve seats 26 against which the heads 28 of the usual poppet valves are adapted to seat. The stems 30 of the valves are received in guideways 32 in the usual manner. Valves 28 are adapted to open and close engine ports 34 so as to regulate the flow of fuel and air mixture thereinto. A spark plug 36 is

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provided for igniting the mixture after it has been compressed within the cylinder.

The structure thus far described is similar to that employed upon present day spark ignited internal combustion engines which employ a manifold induction system.

It will be noted that there are separate ports 34 provided for each cylinder, which is a slight departure from the usual practice in as much as two cylinders generally have their ports Siamesed under modern practice.

To the individual ports 34 there lead individual branches 38 which comprise, in the instance shown, right angle pipe elbows cast integrally with a header 40 which extends longitudinally of the engine 10. The header 40 is provided with an inlet 42 which extends upwardly therefrom at the central portion of the manifold header 40 longitudinally of the engine and is adapted to receive upon its upper end the usual form of air cleaner 43.

Each of the individual branches 38 is provided with an aperture within which there is secured a fuel feed tube 44, the end of which extends into the branch 38 and terminates in a downwardly opening nozzle 46 which may be closed by a check valve 47 opening only under a difference in pressure greater than fifteen pounds per square inch. This construction prevents so-called "slobbering" or leaking of fuel through nozzles 46 upon a sudden closing of the throttle valve 176. Each of the tubes 44 is connected at its opposite end to a drilled aperture 48 (see Figure 5) extending through a block 50 which forms a part of the body of the fuel pump generally indicated at 52. The aperture 48 constitutes an enlargement of a further manifold 54 which extends downwardly through the block 50 and terminates within the body thereof. The difference in diameters of the ducts 48 and 54 provides a shoulder 56 against which a valve 58 is spring urged to prevent return flow. The duct 54 constitutes, in conjunction with a transverse bore 60 within the block 50, a pumping chamber. The cylinder 60 is located transversely of the block 50, having one end closed by a plug 62 against which one end of a spring 64 abuts, the other end of the spring 64 being seated upon a piston 66 reciprocable in the cylinder 60.

The piston 66 is provided with a ball extension 68 which is seated in a hemispheric depression 70 formed upon one surface of a piston block 72. The flat surface 74 of the piston block 72 opposite to the depressed surface 70 bears against a hardened steel ball 76 carried within the cylinder 60 and the steel ball 76 is in turn propelled upon the power stroke of the piston by means of a slide 78.

Slide 78 is driven by a link 80 pivoted thereto at 82, the opposite end of the link 80 being pivoted upon a pin 84 forming a knee joint between the links 86 and 88. The opposite end of the link 88 is driven by means of an eccentric strap 90 from an eccentric 92 mounted upon an eccentric shaft 94, the eccentric shaft 94 being driven from the crank shaft of the engine 10 by means of a worm 96 driven in any suitable manner by the engine crank shaft and worm wheel 98. Eccentric shaft 94 is driven at one half the crank shaft speed of the internal combustion engine so as to provide a power stroke of each pump assembly once for every two revolutions of the engine.

The lower end of the link 86 is pivoted upon a rock shaft 100 which extends longitudinally of

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the engine 10 and generally parallel to the eccentric shaft 94. The position of the rock shaft 100 may be adjusted in an arc as will later be described.

The pumping arrangement shown in Figure 5 is completed by the drilled manifold 102 which extends generally parallel to the pump cylinder 60, manifold 102 being provided with a shoulder 104 upon which a washer 106 is held to provide a seat for a spring 108 which urges a valve 110 against a seat formed within a threaded plug 114. Threaded plug 114 is drilled as at 116 in order to connect the same to a feed manifold 118 extending longitudinally of the block 50. A duct 120 (see Figure 6) extending vertically in the block 50 is connected by means of a fitting 122 to a supply pipe 124 which may extend from the usual fuel pump of the engine.

The fuel pump (not shown) supplies fuel from the fuel tank under a relatively low pressure to the fuel feed manifold 118, this pressure being sufficient to unseat the valve 110 against the action of the spring 108 but being insufficient to unseat the valve 58. It will be understood that fuel under pressure is constantly present in the manifold 118 and upon the occurrence of vacuum within the cylinder 60 will flow to fill the cylinder 60 past the valve 110. The piston 66, upon its power stroke, operates to reduce the volume of the pumping chamber formed by the cylinder 60 and the ducts 54 and 102 will consequently lift the valve 58 from its seat 56 to discharge fuel into the feed line 44. This operation, as explained previously, occurs once for each two revolutions of the engine crank shaft (not shown).

In order to adjust the quantity of fuel fed to each cylinder in accordance with the demands of the motor, it is necessary to vary the length of the stroke of the piston 66. This is accomplished by altering the position of the rock shaft 100 so as to change the effective stroke transmitted from the link 88 to the link 80. It will be noted that the length of the stroke of piston 66 will be controlled by the positioning of rock shaft 100 about the axes of pins 128 and 136. The position of shaft 100 is determined by the rotation of bell crank lever 126 which will presently be explained. The position of rock shaft 100 controls the center about which the link 86 swings, controlling the stroke of piston 66. The length of the stroke of piston 66 will be shortened as shaft 100 is rotated in a counter-clockwise direction around the axes of pins 128 and 136 and said stroke will be lengthened as shaft 100 is rotated in a clockwise direction around said axes.

This change of position of the rock shaft 100 is accomplished by means of a bell crank lever 126 (see Figure 2) pivoted at 128 upon the ears 130 formed on a bracket 132 constituting a portion of the pump casing 50. The rock shaft 100 is also supported at its ends by means of idler links 134 pivoted at 136 upon bosses 140 of the case 50, pivot pins 136 being axially aligned with the pivot 128 supporting the central portion of the bell crank 126. Consequently any motion of the bell crank 126 will be followed by the links 134 to maintain the rock shaft 100 at all times in parallelism to the eccentric shaft 94.

The upper free end of the bell crank lever 126 is pinned at 142 to a link 144 which extends transversely through an aperture in the side portion of the casing 50. The outer end of the link 144 is pivoted at 146 upon a lever 148 fulcrumed at 149 between ears 150 formed upon the outer portion of the casing 50. The upper end of the lever

148 is pivoted at 152 to a rod 154 which has secured upon its inner end a diaphragm 156 constituting a piston for dividing pressure chambers 158 and 160 formed in a fuel metering cylinder 162.

The fuel metering cylinder 162 is arranged to reflect, through varying the positions that the diaphragm 156 and rod 154 assume, the quantity of air inspirited by the motor and flowing through the manifold inlet 42. Manifold inlet 42 is provided with an impact orifice 164 communicating by means of duct 166 with chamber 158. Orifice 164 consequently transfers the velocity head of the air passing through inlet 42 into a pressure head exerted upon the diaphragm 156 to move the rod 154 to the right as viewed in Figure 2 and consequently swing bell crank lever 126 in a clockwise direction to increase the length of stroke imparted through link 80 to the piston 66.

From the lower portion of chamber 158, a duct 168 leads to a compensating orifice 170, the purpose of which will be explained hereinafter.

Chamber 160 is provided with an outlet 172 which is connected to a suction orifice 174 located within the manifold inlet 42. A throttle valve 176 in the form of a plate 178 secured to a rock shaft 180 pivotally mounted transversely of the inlet 42 is adapted to be actuated by a lever 182 and link 184 under the control of an accelerator pedal (not shown) manipulated by the operator.

It should be noted that the ducts 166 and 168 are each provided with restrictors 186 and 188, respectively. These restrictors have for their purpose the calibration of air flow through the chamber 158 so as to balance the degree of movement and the position of the rod 154 to provide for the proper stroke of piston 66 to feed the correct quantity of gasoline to each cylinder.

Assuming the engine to be in operation and idling, the throttle valve 176 will occupy substantially the position shown in Figure 2 and a relatively small quantity of air will be flowing through inlet 42. Accordingly, the velocity head of the air flow will be relatively small and the vacuum below throttle valve 176 will be relatively great to produce a force which tends to retain the rod 154 in a position to the left as shown in Figure 2. The vacuum exerted upon suction orifice 174 will be small and this too will assist the diaphragm 156 in remaining at a leftmost position. Hence, the swing shaft 100 will seek a position toward the top of its travel to the right as shown in Figure 2, and the strokes of the pump pistons will be short to deliver the small quantity of fuel required for idling.

If it is desired to increase the speed of the motor from idling speed, the throttle valve 176 will be opened by rotation of the same about its shaft 180 and this will result in a new set of conditions. First, the vacuum existing in the manifold 40 will be relieved because of the removal of the restriction provided by the throttle valve 176 and consequently the force tending to hold the diaphragm to the left will be reduced. At the same time, the suction exerted upon suction orifice 174 will be increased as this orifice will have better communication with the manifold vacuum. Also, the velocity of air passing through the inlet 42 will increase because of the partial removal of the restriction occasioned by the throttle valve 176. All of these factors tend to move the diaphragm to the right as in Figure 2 with the pressure upon the left side of the diaphragm 156 gradually increasing as the engine gains speed.

Movement of diaphragm 156 to the right

causes the shaft 100 to move downwardly in a clockwise direction to increase the length of the piston strokes and feed more gasoline.

If, while the engine is running at a medium speed, a load is imposed, it would be normal, if the engine was installed in an automobile, to open the throttle wide in an effort to maintain speed. This action will still further increase the suction to the right of diaphragm 156 (due to removal of the throttle valve restriction) and will decrease still further the suction exerted through conduit 168. The velocity head reflected through duct 166 upon the left of diaphragm 156 will be substantially unchanged but the diaphragm will move to the right still further due to the increased suction in chamber 160 and the reduced suction in manifold inlet 42 below the throttle valve 176.

To reduce the speed of the engine after a run at high speed, the throttle valve 176 is closed, increasing the suction through conduit 168 and upon the left of diaphragm 156 and at the same time reducing the pressure in conduit 166 and the suction in conduit 172 so that the diaphragm 156 tends to move to the left as viewed in Figure 2.

If the compensating orifice 170 was not provided, the difference in pressure between chambers would be very small but exerted in such a direction as to cause the feeding of more fuel when less is desirable.

Similarly, at high speed ranges the difference in pressure between ducts 168 and 172 is so small that control would be lost and it is necessary to use the velocity head duct 166.

The restrictions 186 and 188 existing in ducts 166 and 168, respectively, are employed for the purpose of balancing off the pressure produced by the velocity orifice and the suction of the suction orifice. The restrictions may be varied by replacing them with different sized apertures until the pressure conditions within the chamber 158 are brought to the desired state. It will be understood that this calibration operation need be performed only upon installation of the fuel feeding device in a new type of engine and that operation of the device will be the same with the same size restrictors in all engines of the same design.

It will be recognized that introduction of the fuel at the outlet 46 into each port entrance 34 insures that identical quantities of fuel are fed to each cylinder within a certain speed range.

The interior of the pump mechanism 52 may be lubricated from any desired source. It would be possible to conduct lubricant from the engine lubricating system, supply it to the gears 96, 98 and the bearings for eccentric shaft 94, permitting the lubricant to drain into the crankcase therefrom. Such a lubricating system is not shown in the drawings and forms no part of this invention.

While I have described my invention in some detail, I intend this description to be taken as an example only and not as a limitation of my invention, to which I make the following claims:

1. A fuel feeding device including a fuel pump, means for varying the length of the pumping stroke to vary the quantity of fuel pumped, a pressure responsive element operatively connected to the stroke varying means, a member having an air inlet passage and an impact orifice therein, said impact orifice establishing communication between the atmosphere and a first surface of said pressure responsive element, said

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member also having a suction orifice in communication with a second surface of said pressure responsive element, a throttle valve located in the air inlet passage, said impact and suction orifices being located upon the atmospheric side of said throttle valve, said member having a compensating orifice located on the side of the throttle valve opposite the other orifices and communicating with the first surface of the pressure responsive element.

2. A fuel feeding device including a fuel pump, means for varying the length of the pump stroke to vary the quantity of fuel pumped, a pressure responsive diaphragm operatively connected to the stroke varying means to motivate the same, a member having an air inlet passage and an impact orifice therein, said impact orifice establishing communication between the atmosphere and a first surface of said pressure responsive diaphragm, said member also having a suction orifice in communication with a second surface of said pressure responsive diaphragm, a throttle valve located in the air inlet passage, said impact and suction orifices being located on the atmospheric side of said throttle valve, said member having a compensating orifice located on the side of the throttle valve opposite the other orifices and communicating with the first surface of the pressure responsive diaphragm, and means restricting the action of said impact and compensating orifices upon said diaphragm.

3. In a carburetion system, a device for metering the quantity of fuel to be fed comprising a housing member having an air inlet passage, a throttle valve in the passage, a movable pressure responsive element having an operative connection for adjusting the fuel metering device to deliver varying quantities of fuel in accordance with different positions assumed by said pressure responsive element, said housing member having a metered impact orifice and a suction orifice communicating with the air inlet passage and being located on the atmospheric side of the throttle valve, said orifices communicating respectively with opposite surfaces of the pressure responsive element, and said housing member having an independent compensating orifice on the side of the throttle valve opposite the atmospheric side and communicating with one of the surfaces of the pressure responsive element.

4. A fuel metering pump comprising a cylinder, a piston movable in said cylinder, a cam, a pitman arm driven by said cam, a connecting rod pinned to said piston and having the free end attached to said pitman arm, the connection between said pitman arm and connecting rod forming an oscillating knee, a link having one end secured to said knee and its other end movable into a plurality of positions within limits lying closely adjacent either the piston end of said rod or the cam end of said arm, and pressure responsive means for adjusting said link end to vary the

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length of stroke imparted to said piston from said cam.

5. A fuel feeding device comprising a housing member having a single inlet air passage, a fuel pump, said pump comprising a cylinder, a piston movable in said cylinder, a cam, a pitman arm driven by said cam, a connecting rod pinned to said piston and having the free end attached to said pitman arm, the connection between said pitman arm and connecting rod forming an oscillating knee, a link having one end secured to said knee and its other end movable into a plurality of positions within limits lying closely adjacent either the piston end of said rod or the cam end of said arm for varying the length of the pumping stroke to vary the quantity of fuel fed by the pump, a throttle valve in the air inlet passage, a pressure responsive element operatively connected at the link of the stroke varying means, said housing member having an impact orifice in said inlet passage and communicating with a first surface of said pressure responsive element, and said housing member having a suction orifice in said air inlet passage communicating with a second surface of said pressure responsive element, said impact and suction orifices being located upon the atmospheric side of said throttle valve, and said housing member having a compensating orifice communicating with said first surface and being located within said air inlet passage on the side of the throttle valve opposite the atmospheric side.

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