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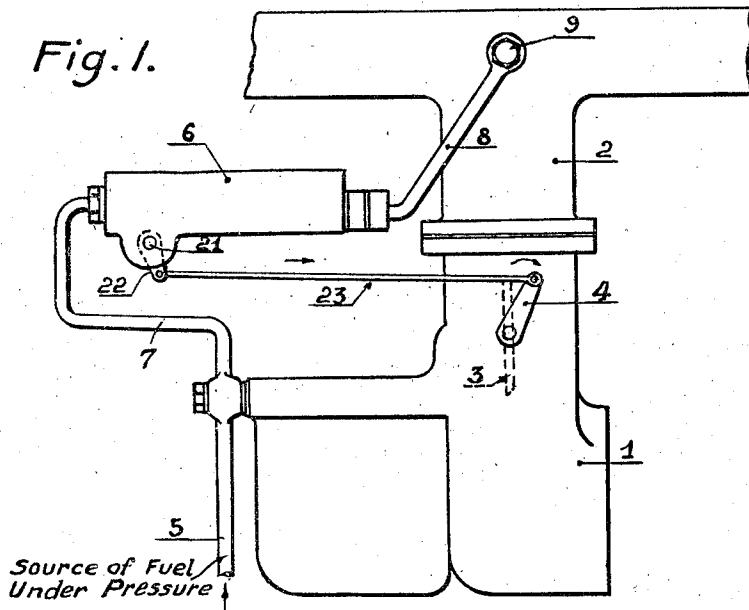
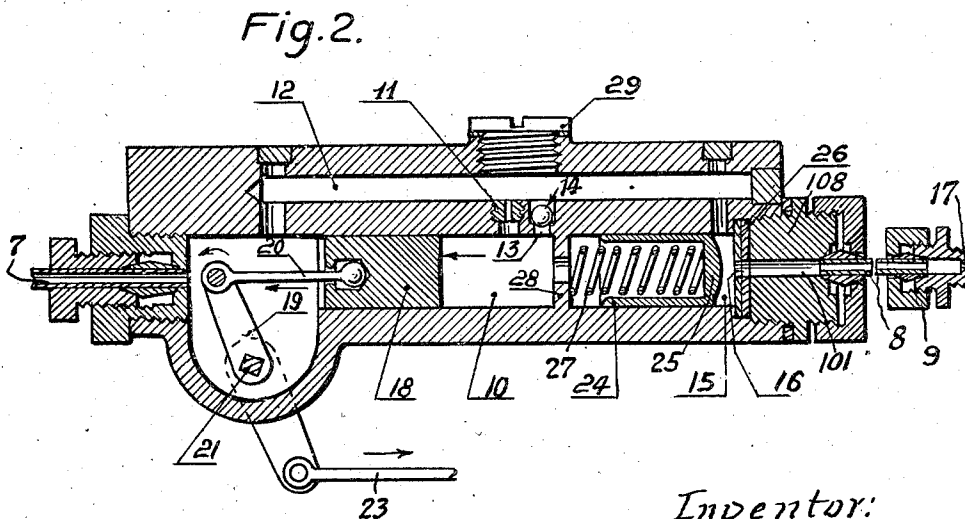
L. L. VIEL

2,092,685

FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed April 6, 1934

3 Sheets-Sheet 1



Inventor:
Louis Leon Viel,
By James B. Heller,
att'y.

Sept. 7, 1937.

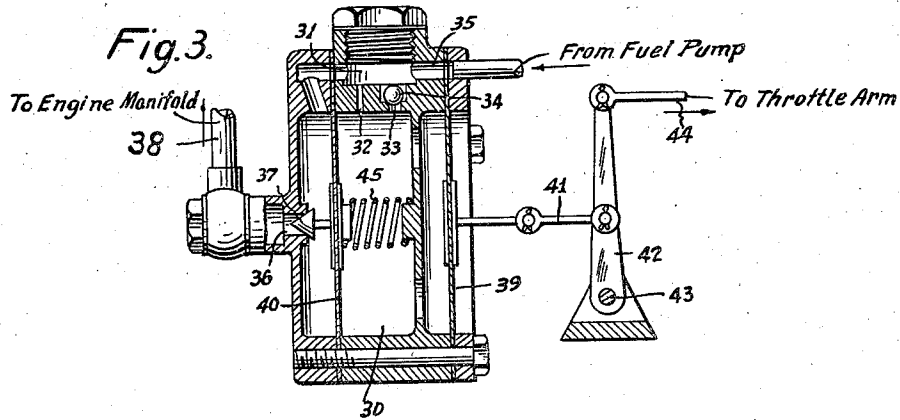
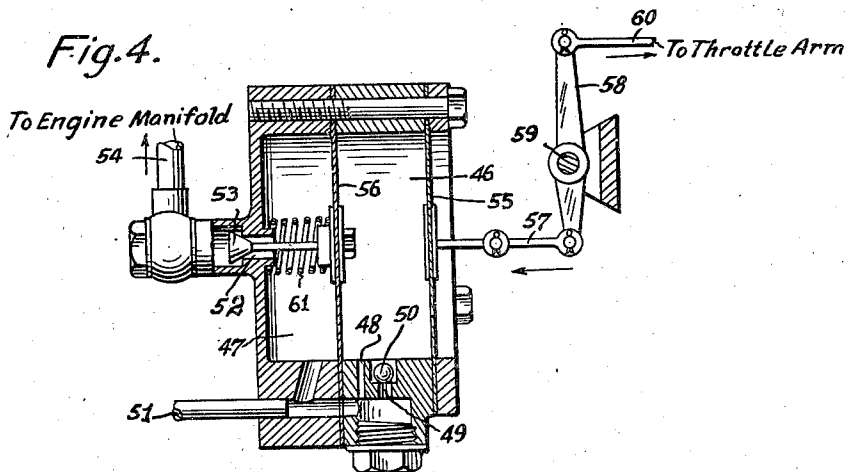
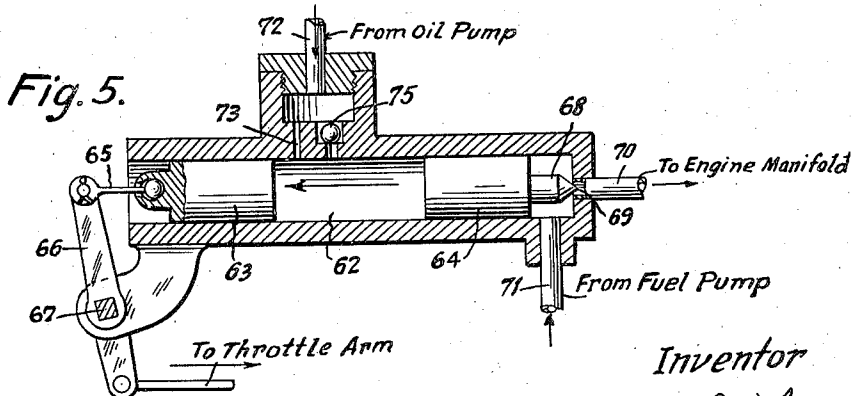
L. L. VIEL

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FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

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3 Sheets-Sheet 2



Inventor
Louis Leon Viel
By Jesse B. Steller,
Atty

Sept. 7, 1937.

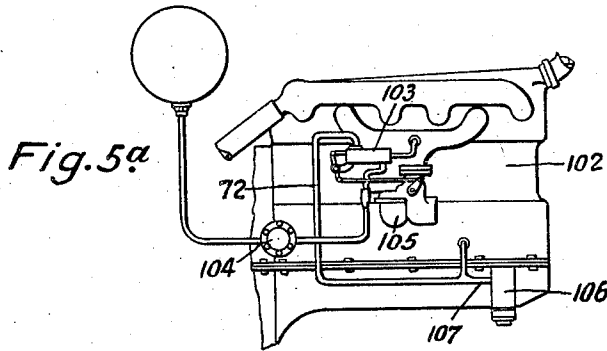
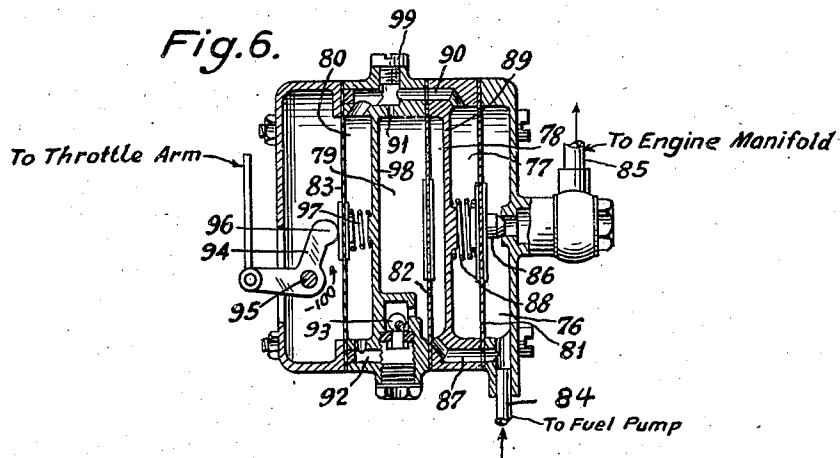
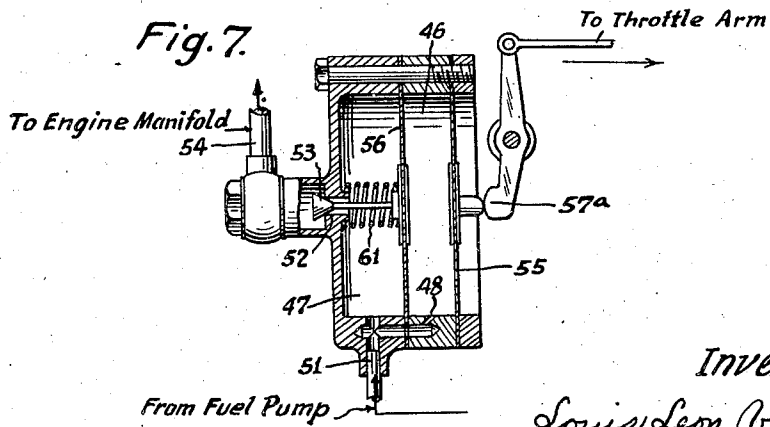
L. L. VIEL

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FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed April 6, 1934

3 Sheets-Sheet 3



Inventor:

Louis Leon Viel,

By *James B. Heller*
att'y.

UNITED STATES PATENT OFFICE

2,092,685

FUEL INJECTION DEVICE FOR INTERNAL COMBUSTION ENGINES

Louis Léon Viel, Ville-D'Avray, France, assignor
to Societe Generale des Carburateurs Zenith,
Levallois-Perret, France

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In France April 7, 1933

10 Claims. (Cl. 123—119)

My invention relates to fuel injecting devices for internal combustion engines and more especially engines provided with an intake pipe which receives a fuel mixture from a carburetor including a throttle valve.

The chief object of my invention is to provide a device of this type which is capable of injecting a supplementary amount of fuel into the engine when the throttle valve is being opened so that the engine may pick up more readily. My device also permits of injecting fuel into the intake manifold when the engine is being started.

The fuel injecting device according to my invention comprises a chamber communicating with a space filled with liquid through an orifice of small section, said chamber having two movable walls. One of these walls is operatively connected to the throttle valve of the engine, while the other wall is operatively connected with a valve controlling the flow of fuel through a circuit fed under pressure and opening into the intake manifold of the engine. The source of fuel feeding said circuit is adapted to supply fuel under super-atmospheric pressure to the fuel outlet of said circuit as said valve is open.

The space filled with liquid which communicates with the chamber of the injecting device may consist of the very source of fuel under pressure from which the injecting device is fed.

Preferred embodiments of the present invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is an elevational view of an engine intake manifold provided with a carburetor and an injecting device according to my invention;

Fig. 2 diagrammatically shows, in longitudinal section, the injecting device of Fig. 1;

Fig. 3 and Fig. 4 are diagrammatical views showing in longitudinal section, injecting devices embodying diaphragms;

Fig. 5 diagrammatically shows, in longitudinal section, a modification of the device shown in Fig. 2;

Fig. 5a is an elevational view of an engine fitted with the device shown in Fig. 5;

Figs. 6 and 7 show, in longitudinal section, further modifications of the device shown in Fig. 2.

In the embodiment shown in Fig. 1, a carburetor 1 is fitted on the intake manifold 2 of the engine. The amount of fuel mixture supplied by the carburetor is controlled by means of throttle valve 3 operated through arm 4. Fuel under pressure is fed to the carburetor through conduit 5. This conduit is preferably fed with fuel

by means of a pump. The injecting device 6 is fed with fuel through a conduit 7 connected to conduit 5. A conduit 8 connects the outlet of the injector 6 with a jet 9 opening into manifold 2.

The details of the injecting device 6 are shown in Fig. 2. In this figure, the numeral 10 represents a chamber communicating with a conduit 12 through an orifice of small section 11. Conduit 12 is permanently connected with feed conduit 7. Chamber 10 is also connected with passage 12 through an orifice 13 controlled by a check valve 14 through which fuel is prevented from flowing from conduit 12 into chamber 10. Conduit 12 further communicates with a space 15 in the wall of which is fitted a washer 26 bored in 16 and pressed by a threaded plug 103 having an axial bore 101. Space 15 communicates with the jet 9 through bores 16 and 101 and conduit 8. Jet 9 is provided at its end with a calibrated orifice 17.

A piston 18 is slidably mounted in a cylindrical part of chamber 10 and is connected to an arm 19 through a rod 20. Arm 19 is keyed on a spindle 21 which projects from the casing of the injecting device by passing through a fluidtight packing. On the outer portion of spindle 21 there is mounted a lever 22 connected, through a rod 23, to the arm 4 of the throttle valve (Fig. 1). A second piston 24 is slidably mounted in another cylindrical part of chamber 10. The end of piston 24 constitutes a valve which, when applied against washer 26, closes orifice 16. A spring 27, compressed between piston 24 and a shoulder 28, carried by the wall of chamber 10, tends to push this piston toward washer 26, to close orifice 16.

A plug 29 makes it possible to remove the air that may be contained in the apparatus.

The operation of the device takes place as follows: When throttle valve 3 and arm 4 are maintained in a given position, the engine is normally fed through carburetor 1. The port 16 of the injecting device is closed by the end 25 of piston 24, which is applied against surface 26, and jet 9 does not supply fuel.

If throttle valve 3 is suddenly opened from the idling position, the movement of arm 4 is transmitted, through rod 23, lever 22, spindle 21, lever 19, and rod 20, to piston 18. The arrow indicates the directions of the movements of the different parts when the throttle valve is opened. The displacement of piston 18 toward the left as viewed in Fig. 2 produces a suction in chamber 10 but the cross section of orifice 11 is too small for permitting a volume of fuel equal to the volume gen-

erated by the displacement of piston 18 to flow in a short time through said orifice 11. The pressure in chamber 10 therefore drops and piston 24 is drawn in, compressing spring 27. Port 16 is then uncovered, and fuel flows through conduit 7, conduit 12, orifice 16, conduit 8 and the orifice 17 through which this fuel is injected into the intake manifold 2. Spring 27 then pushes back piston 24, while fuel is entering chamber 10 through orifice 11. The low rate of flow through orifice 11 retards the return stroke of piston 24. Injection stops as soon as the end 25 of piston 24 comes back into contact with surface 26. The rate of flow of the injecting device is adjusted by varying the section of calibrated orifice 17, while the time for which injection takes place depends on the strength of spring 27 and the area of orifice 11. In Fig. 2, I have shown the various parts in the positions they occupy after the throttle valve has been opened, before the end of the injection.

When the throttle valve is suddenly closed, movement is again transmitted to piston 18, which tends to drive out the fuel contained in chamber 10. The low rate of flow through orifice 11 does not permit, by itself, a quick displacement of piston 18, but the increase of pressure created in this chamber lifts valve 14, so that fuel is evacuated simultaneously through orifice 11 and the orifice of large section 13. If orifice 13 did not exist, the rate of flow through orifice 11 would be too small to permit the quick displacement of piston 18 as the throttle valve is being closed, and this movement would be retarded.

The device above described is very efficient. On the one hand, while the engine is accelerating the calibrated orifice 17 is fed under the pressure of the fuel pump, which ensures a good spraying of the fuel despite the fact that the suction in pipe 2 at this time is very small. On the other hand, jet 9 opens into the intake manifold of the engine behind throttle valve 3 and preferably as close as possible to the inlet valves. With such an arrangement, the injected fuel goes directly to the inlet valves, without having had time to deposit on the walls of the manifold. The fact that the supplementary fuel fed while the engine is accelerating is discharged into the intake manifold behind the throttle valve is an essential feature of the present invention, and this arrangement constitutes an important feature whatever be the nature of the device that is utilized for the injection of supplementary fuel.

Pistons 18 and 24 can obviously be replaced by diaphragms, as shown in Fig. 3. In this figure, a chamber 30 communicates with a second chamber 31 through an orifice of small cross section 32 and a second orifice 33 provided with a check valve 34. Chamber 31 is connected, on the one hand through conduit 35, with the fuel pump or any other source of fuel under pressure, and, on the other hand, through an orifice 36, controlled by a valve 37, with a conduit 38 leading to a discharge jet, such as jet 9 in Fig. 1. Chamber 30 is closed by two diaphragms 39 and 40. Diaphragm 39 is connected, through a rod 41, with a lever 42 pivoting about an axis 43. Lever 42 is itself connected, through a rod 44, with the throttle valve control arm. Diaphragm 40, which separates chamber 30 from chamber 31, is connected to valve 37 for instance through a small rod as shown in the drawings. A spring 45 tends to bring diaphragm 40 back into the position wherein the valve 37 is closed.

The operation of the device is exactly the same as that above described with reference to Fig. 2, diaphragm 39 playing the same part as piston 18; diaphragm 40 playing the same part as piston 24; valve 37 playing the same part as the end 25 of piston 24; and orifice 32 playing the same part as orifice 11 in the preceding example.

In the embodiment of Fig. 4, a chamber 46 communicates with a second chamber 47 through an orifice of small cross section 48 and an orifice 49 controlled by a check valve 50. Chamber 47 is connected, on the one hand through a conduit 51, with the fuel pump or any other source of fuel under pressure, and, on the other hand through an orifice 52 controlled by a check valve 53, with a conduit 54 leading to a jet such as jet 9 of Fig. 1. Chamber 46 is closed by two diaphragms 55 and 56. Diaphragm 55 is connected, through a rod 57, with a lever 58 pivoting about axis 59. Lever 58 is itself connected, through a rod 60, with the throttle valve control arm. Diaphragm 56, which separates chamber 46 from second chamber 47, is connected to valve 53 for instance through a small rod as shown in the drawings and is subjected to the action of a spring 61 which tends to maintain valve 53 in the closed position.

This device operates in the following manner: Under normal conditions, valve 53 is closed, and the device does not feed fuel to the engine through conduit 54. When the engine is to accelerate, the throttle valve control arm drives rod 60, lever 58 and rod 57 in the directions indicated by the arrows. Diaphragm 55, displaced by rod 57, exerts pressure on the fuel contained in chamber 46. The pressure developed in this chamber forces valve 50 against its seat and the area of orifice 48 is too small to permit a sufficient rate of flow of the fuel driven out by diaphragm 55 through said orifice. Diaphragm 56 is therefore pushed toward the left as viewed in Fig. 4, compressing spring 61 and opening valve 53. Injection takes place. Spring 61 gradually brings back diaphragm 56 into its initial position, driving out fuel from chamber 46 through orifice 48. Injection ceases when valve member 53 returns to its seat. In the case of a sudden closing of the throttle valve, check valve 50 is lifted from its seat and permits of chamber 46 being filled through the orifice of larger section 49.

In the devices that have been above described use is made of the fuel itself for filling the chamber provided with movable walls. In Fig. 5 I have shown a modification of the device shown in Fig. 2 in which use is made of an independent liquid for filling this chamber. This device comprises a cylindrical chamber 62 in which are fitted two pistons 63 and 64. Piston 63 is operated, through a rod 65 and a lever 66, by a shaft 67 operatively connected to the throttle valve. The throttle valve is thus operatively coupled with piston 63, in the same manner as it is coupled with piston 18 in the modification of Fig. 2.

Piston 64 carries a valve member 68 which controls an orifice 69 through which passes the fuel flowing through conduits 70 and 71. One of these conduits is connected to a source of fuel under pressure, such as a fuel pump, while the other one is connected to a jet, such as jet 9, opening into the intake pipe of the engine. The direction in which liquid flows through orifice 69 is immaterial.

Chamber 62 is connected to a conduit 72 through an orifice of small section 73 and an

orifice of larger section 74 controlled by a check valve 75. Conduit 72 is connected with a reservoir (not shown in the drawings) filled with any fluid whatever.

Under normal conditions of working, piston 64 maintains valve member 69 applied against its seat, provided however that the pressure of the liquid that fills chamber 62 is higher than the pressure of the fuel present in conduit 71. The injecting device does not work. When the throttle valve is opened, piston 63 moves in the direction shown by the arrow, creating a suction that is transmitted to piston 64. Fuel injection takes place as piston 64 draws valve member 69 along with it and opens orifice 69. Piston 64 is then brought back into its initial position by the pressure of the liquid contained in chamber 62 as the liquid is penetrating into this chamber through orifice 73.

In case of a sudden closing of the throttle valve, the liquid driven out by piston 63 is evacuated through orifice 74 by lifting check valve member 75 from its seat.

The liquid under pressure that fills chamber 62 may consist of lubricating oil under pressure from the engine. It suffices to connect conduit 72 with any point of the lubricating circuit. The use of lubricating oil has the advantage of lubricating pistons 63 and 64 and of eliminating sticking of these pistons in cylinder 62, as may happen when the pistons are immersed in gasoline.

This modification is illustrated by Fig. 5a showing the engine 102, the whole accelerating device of Fig. 5 pointed out as 103, the fuel pump 104 feeding fuel to the carburetor 105 and to the accelerating device 103, the lubricating pump 106, and the conduit 72 connected to the outlet pipe 107 of lubricating pump 106.

The presence of air or gas bubbles in the chamber provided with movable walls as above described is detrimental to the proper working of the device. As a matter of fact, the displacement of the movable wall that carries the valve by which the flow of fuel is controlled immediately follows the movements of the movable wall mechanically actuated by the throttle only if the chamber closed by these two movable walls contains a practically incompressible liquid. If this chamber contains air or gas bubbles, these air bubbles have a tendency to expand when one of these walls is actuated by the throttle in the direction that increases the volume of this chamber, and the displacement of the other wall is thus reduced and can even become zero if the quantity of gas contained in the chamber is sufficiently great, which prevents the device from working in a satisfactory manner. On the contrary, when the chamber contains a liquid entirely free from gases, the displacements of the two movable walls correspond to strictly equal volumes, which ensures a uniform and reliable working of the apparatus.

In order to avoid the eventual presence of gases or vapors in the chamber of the apparatus, in a modification shown by Fig. 6 the space with which said chamber is connected is closed by a movable wall, the whole of said chamber and said space constituting an entirely closed volume. This volume is initially filled with a liquid which is preferably little volatile, then it is thoroughly freed from any air or gases that it may contain, after which it is definitely closed. In this manner, the presence of gases or vapors inside the chamber is obviously avoided.

This arrangement is shown in Fig. 6:

The device comprises five compartments: 76, 77, 78, 79, 80. Compartments 76 and 77 are separated from each other by a deformable diaphragm 81. Compartments 78 and 79 are separated from each other by a deformable diaphragm 82. Compartment 80 is closed by a deformable diaphragm 83. Compartment 76 is connected with the inlet fuel conduit 84 and with the outlet fuel conduit 85 which communicates with the engine intake pipe. The connection between compartment 76 and the outlet conduit 85 is controlled by a valve member 86 fixed to diaphragm 81. Compartment 76 is further connected to compartment 78 through a passage 87. A spring 88 disposed between diaphragm 81 and wall 89 which separates compartments 78 and 79 from each other, tends to push diaphragm 81 toward the right hand side of the figure and to close valve member 86. Compartment 77 communicates with compartment 80 through a relatively large conduit 90, and these two compartments communicate with compartment 79 through an orifice of small section 91. Compartments 79 and 80 are further interconnected through a conduit 92 controlled by a check valve member 93, which permits the free passage of liquid from compartment 80 toward compartment 79, but which prevents liquid from flowing in the opposite direction. A lever 94 mounted on an axis 95 and operatively connected to the engine throttle valve carries a heel member 96. A spring 97, interposed between the wall 98 that separates the two compartments 79 and 80 from each other and diaphragm 83, tends to maintain this diaphragm applied against heel member 96. Spring 97 is stronger than spring 88.

The whole of compartments 80 and 77 constitutes what has been called in connection with the previous modification the first chamber of the device, while compartment 79 constitutes what has been called the second chamber communicating with this first chamber through the orifice of small section 91. The filling of the chamber takes place by removing plug 99 which is located at the top of chamber 80—77 so as to permit of easily freeing chamber 80—77 and compartment 79 from the air and the gases that they may contain. Once chamber 77—80 has been filled with a liquid which is a little volatile and the gases have been driven out, the chamber and the space are definitively closed by replacing plug 99.

The operation of this device is the following:

When the throttle valve is opened, lever 94, which is mechanically connected with the throttle valve, is actuated in the direction of arrow 100. Heel member 96 moves away from diaphragm 83, but spring 97 pushes the diaphragm until it is brought back into contact with heel member 96. This displacement of diaphragm 83, which produces an increase in the volume of compartment 80, draws in through conduit 90 the liquid contained in compartment 77 and, therefore, to draw in membrane 81 while compressing spring 88. This displacement of diaphragm 81 causes valve member 86 to be moved to open position. The outlet conduit 85 then is in free communication with conduit 84 which is fed with fuel under pressure, so that the device injects fuel under pressure into the intake manifold of the engine.

Spring 88 slowly pushes back diaphragm 81 as the liquid contained in compartment 79 is flowing into compartment 77 through the orifice of small section 91 and conduit 90, thus permitting the volume of chamber 77—80 to increase, as a result of the displacement of diaphragm 81 under the ac-

tion of spring 88. The flow of liquid from compartment 79 toward chamber 77—80 is accompanied by a displacement of diaphragm 82 which is subjected, on its face which forms one end of compartment 79, to the fuel feed pressure, since compartment 78 communicates through conduit 87 with fuel feed conduit 84.

With the arrangement shown in the drawings, the period of time for which injection takes place is independent of the fuel feed pressure. In fact, diaphragm 82 is subjected to no stress and there exists in compartment 79, and also in compartment 78, a pressure equal to the pressure in compartment 76, that is to say to the fuel feed pressure. The difference of pressure existing between compartments 76 and 77 corresponds to the thrust exerted by spring 88 and is distributed over the surface of diaphragm 81. This difference of pressure is independent of the fuel feed pressure. As the pressure in compartment 79 is always equal to the pressure in compartment 76, the difference between the pressures that exist in compartment 79 and in compartment 77 is equal to the difference between the pressures in compartments 77 and 76 respectively, and it is therefore independent of the fuel feed pressure. As the rate of flow through orifice 91, and consequently the time during which injection takes place, depend upon this difference of pressure, it is clear that the time during which injection takes place does not depend upon the fuel feed pressure.

The operation of the device shown in Fig. 6 is the following:

When the engine throttle valve is closed, lever 94 is actuated in the direction opposed to that indicated by arrow 100. The liquid driven by the corresponding displacement of diaphragm 83 penetrates into compartment 79, lifting valve member 93 from its seat and pushing back diaphragm 82, which itself drives out the fuel contained in compartment 78, which is freely connected with the fuel feed conduit 84. The only resistance opposed to this movement is due to the fuel feed pressure that is transmitted to diaphragm 82.

In all the devices that have been above described, I provide a discharge orifice controlled by a check valve and permitting a quick return stroke of the movable wall (piston or diaphragm) connected to the throttle valve, when the latter is being closed. Obviously this discharge orifice can be dispensed with, while permitting a quick return of the throttle valve to the closed position, by controlling the displacements of the movable wall through the throttle valve only in the direction of opening as shown in Fig. 7. Under these conditions, movable wall 55 is driven through cam 57^a when the throttle valve is being opened, but, when said throttle valve is suddenly closed, said movable wall 55 does not follow the movement of said cam 57^a and comes back slowly into contact therewith, whatever be the speed with which the throttle valve has been closed.

The device according to my invention can be utilized not only as a fuel injecting device when the engine is accelerating, but also as a fuel injecting device for the starting of the engine. It suffices, for this purpose, to operate either the throttle arm, or directly the arm of the injecting device, for obtaining either one injection of fuel into the intake pipe of the engine, or several repeated injections, when the engine is being started, provided, however, that the fuel conduit is under pressure.

Preferably, the above mentioned diaphragms

consist of a flexible material such as a fabric treated in any suitable manner in order to make it fluidtight. Such diaphragms undergo deformation without opposing any material elastic reaction.

While I have disclosed in the preceding description, what I deem to be practical and efficient embodiments of my invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition, and form of the parts without departing from the principle of my invention as comprehended within the scope of the appended claims.

What I claim is:

1. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls, and valve means in said passage operatively connected with the second movable wall for controlling the communication between said source of fuel and said conduit, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

2. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls, elastic means for urging the other movable wall in one direction, valve means in said passage, operatively connected with said second mentioned wall, for controlling the communication between the source of fuel and the conduit in such manner as to normally stop this communication when said second mentioned wall is subjected merely to the action of said elastic means and to open this communication when said second mentioned wall is moved against the action of said elastic means in consequence of a corresponding movement imparted to the first mentioned movable wall, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

3. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to the engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls in either of two opposite directions with respect to said first mentioned chamber, elastic means for urging the other movable wall in one direction, valve means in said passage, operatively connected to said second mentioned movable wall,

for controlling the communication between said source of fuel and said conduit, in such manner as normally to stop this communication when said second mentioned wall is subjected merely to the action of said elastic means and to open this communication when said second mentioned wall is moved against the action of said elastic means in consequence of a corresponding movement imparted to the first mentioned movable wall, a channel of relatively large section between said chambers, and a check valve in said last mentioned channel adapted to prevent the flow of liquid through said last mentioned channel in a direction corresponding to a displacement of said second mentioned wall under the action of said elastic means while the first mentioned wall is stationary, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

4. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls in either of two opposite directions with respect to said first mentioned chamber, elastic means for urging the other movable wall outwardly with respect to said first mentioned chamber, valve means in said passage, operatively connected with said second mentioned movable wall, for controlling the communication between said source of fuel and said conduit in such manner as normally to stop this communication when said second mentioned wall is subjected only to the action of said elastic means, and to open this communication when said second mentioned wall is moved inwardly against the action of said elastic means in consequence of an outward displacement imparted to the first mentioned movable wall, a channel of relatively large section of flow between these two chambers, and a check valve in said last mentioned channel adapted to prevent liquid from flowing through said last mentioned channel from the second mentioned chamber into the first mentioned chamber, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

5. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between this source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls in either of two opposite directions with respect to said first mentioned chamber, elastic means for urging the other movable wall inwardly with respect to said first mentioned chamber, valve means in said passage operatively connected with said second mentioned movable wall for controlling the communication between said source of fuel and said conduit in such manner as to normally stop this communication when said second mentioned wall is subjected only to the action of

said elastic means and to open this communication when said second mentioned movable wall is moved outwardly against the action of said elastic means in consequence of an inward movement imparted to the first mentioned movable wall, a channel of relatively large section of flow between these two chambers, and a check valve in said last mentioned channel adapted to prevent liquid from flowing through said last mentioned channel from the first mentioned chamber into the second mentioned chamber, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

6. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls in only one direction, elastic means for urging the other movable wall in one direction, and valve means in said passage, operative by said second mentioned movable wall, for controlling the communication between said source of fuel and said conduit in such manner as to normally stop this communication when said second mentioned wall is subjected merely to the action of said elastic means and to open this communication when said second mentioned wall is moved against the action of said elastic means in consequence of a movement imparted to the first mentioned wall through said first mentioned means, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

7. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a first chamber filled with said fuel, a second chamber communicating with said source of fuel, a channel of restricted section of flow connecting these two chambers with each other, said first mentioned chamber having two movable walls, means for actuating one of these walls, a passage between said second mentioned chamber and said conduit, and valve means in said passage, operatively connected with the other movable wall, for controlling the communication between said second mentioned chamber and said conduit, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

8. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said conduit, a first chamber filled with a liquid distinct from said fuel, a second chamber filled with the same liquid, a channel of restricted section of flow connecting these two chambers with each other, the whole of these two chambers having no connection whatever with said source of fuel, said conduit and said passage, said first mentioned chamber having two movable walls, means for actuating one of these walls, and valve means in said passage, operatively connected with the other movable

able wall, for controlling the communication between said source of fuel and said conduit, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are open.

5 9. An accelerating device for an internal combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to
10 said engine, a passage between said source of fuel and said conduit, a first chamber filled with a non-volatile liquid, a second chamber, of variable volume, filled with the same liquid, a channel of restricted section of flow connecting these
15 two chambers with each other, the whole of these two chambers being entirely closed and without communication with the outside, said first mentioned chamber having two movable walls, means for actuating one of these walls,
20 and valve means in said passage, operatively connected with the other movable wall, for controlling the communication between said source of fuel and said conduit, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are
25 open.

10. An accelerating device for an internal

combustion engine, which comprises, in combination, a source of fuel under pressure, a conduit, said conduit having a fuel outlet for feeding fuel to said engine, a passage between said source of fuel and said chamber, a first chamber filled with a non-volatile liquid, a second chamber filled with the same liquid, a movable wall to said second mentioned chamber, a channel of restricted section of flow connecting these two chambers with each other, the whole of these two chambers being entirely closed and without communication with the outside, said first mentioned chamber having two movable walls, means for actuating one of these two last mentioned movable walls, valve means in said passage operatively connected with the other of these two last mentioned movable walls for controlling the communication between said source of fuel and said conduit, and a chamber communicating with said passage and one wall of which consists of the movable wall of the second mentioned chamber, said source of fuel being adapted to feed said fuel outlet under super-atmospheric pressure as said valve means are
25 open.

LOUIS LÉON VIEL.