

S. I. FEKETE.

FUEL SUPPLY MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JULY 11, 1917.

Patented Jan. 13, 1920.

2 SHEETS—SHEET 1.

1,328,142.



Fig. 3.

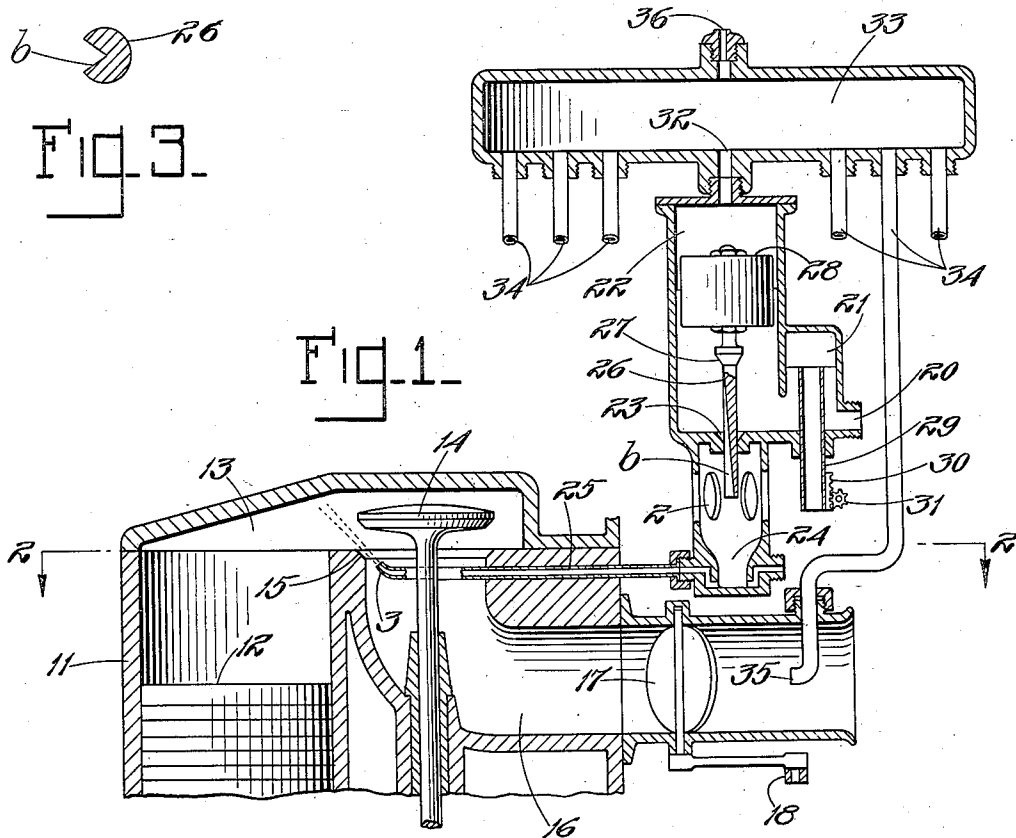


Fig. 1.

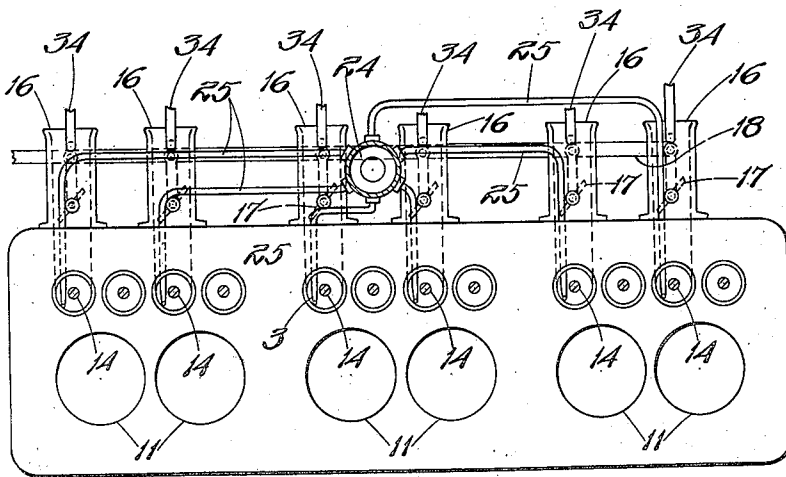


Fig. 2.

INVENTOR:

Stephen Ivan Fekete

by Maschke, Cohn, Copeland & Ditzg.

Attys.

S. I. FEKETE.

FUEL SUPPLY MECHANISM FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JULY 11, 1917.

Patented Jan. 13, 1920.

2 SHEETS—SHEET 2.

1,328,142.

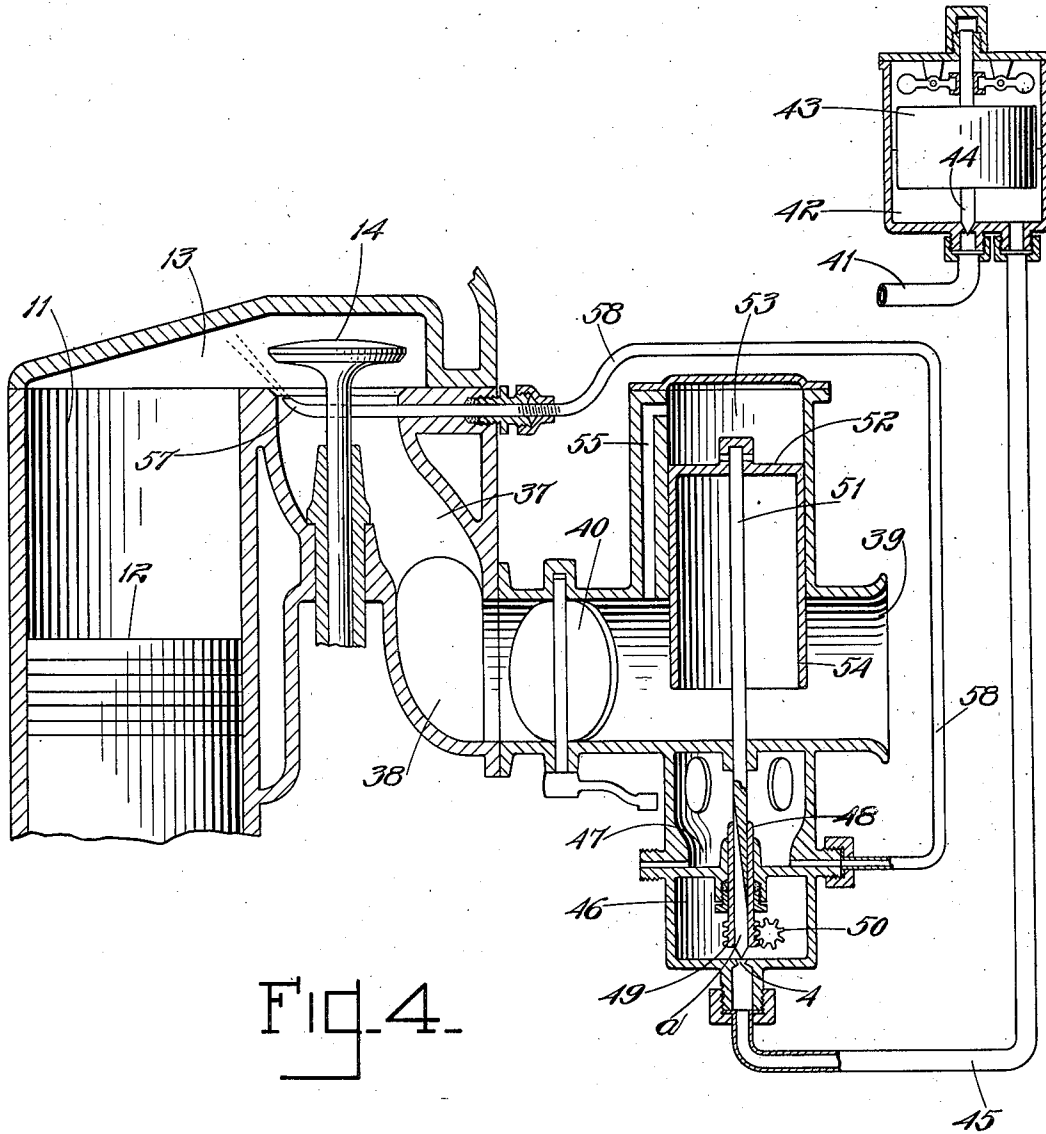


Fig. 4.

INVENTOR

by *Stephen Ivan Fekete*  
*Machod, Calver, Copeland & O'Keefe*  
Attys.

# UNITED STATES PATENT OFFICE.

STEPHEN IVAN FEKETE, OF DETROIT, MICHIGAN, ASSIGNOR, BY MESNE ASSIGNMENTS,  
TO ESSEX MOTORS, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

FUEL-SUPPLY MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

1,328,142.

Specification of Letters Patent.

Patented Jan. 13, 1920.

Application filed July 11, 1917. Serial No. 180,022.

*To all whom it may concern:*

Be it known that I, STEPHEN IVAN FEKETE, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Fuel-Supply Mechanism for Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to mechanism for supplying fuel to internal combustion engines in predetermined quantities dependent on the requirements of the engine under the conditions of speed and load prevailing at any given time. The device embodying my invention is applicable not only to two and four cycle engines of the type commonly employed in automobiles, motor boats and the like, but also to other types of internal combustion engines.

When applied to an ordinary four cycle engine, the device does away with the carbureter and makes it possible to employ heavy liquid fuels which cannot be satisfactorily mixed with air by the ordinary methods of carburetion.

As is well known to those skilled in the art, explosive mixture of a liquid hydro-carbon and air consists of finely divided particles of fuel suspended in the air. In order to prevent these particles from reuniting in larger drops and condensing, a certain minimum velocity of the mixture is necessary. The heavier the fuel, the higher this minimum velocity must be. It has, therefore, been necessary to make the intake passage of the motor small enough so that when the motor is running at its lowest speed with throttle closed, the velocity of the carbureted mixture will be great enough to carry the fuel with it. It results that the size of the gas passages is practically determined by the kind of fuel to be used and the minimum speed desired. With the low grades of fuel now supplied, these passages must be made so small that at high motor speeds gases cannot get through fast enough to charge the cylinders completely and therefore the volumetric efficiency is low and the motor speed and maximum power are limited. These considerations practically

prevent the use of kerosene or other heavy fuels in a motor where a considerable range of speed or throttle opening is required.

In addition to these considerations, it is well known that the tortuous passages of the intake manifold prevent the cylinders obtaining the maximum charge and this also decreases the volumetric efficiency of the engine. The cylinders farthest from the carbureter do not get as large a charge as those nearest the carbureter, and in V-motors since two or more valves are open at the same time, the flow of gas divides thus further decreasing the volumetric efficiency.

The only solution proposed has been the use of a rich mixture at low speed which is wasteful and the heating of the air to increase the vaporization of the fuel. Heating of the air decreases the volumetric efficiency.

In the device embodying my invention, the liquid fuel is sprayed directly into the combustion chamber when the inlet valve is open, the air being drawn in through a direct air passage. The result is that since the combustion chamber is intensely hot from the previous explosions the fuel is instantly and completely vaporized and mingles with the air producing an explosive mixture. The air passage may be made straight and as large as is required with the result that the engine will have a volumetric efficiency practically approximating that of the ideal engine. As the device does not depend for its operation on the necessity of producing a mechanical mixture of the fuel and air, it is possible to use heavy fuels without trouble from the various difficulties of carburetion which have heretofore been experienced.

The device embodying my invention supplies a predetermined and variable quantity of fuel directly to each cylinder at the proper time. Means controlled by the suction of the air through the air intake operates mechanism by which the quantity of fuel supplied for each charge is varied in accordance with the variations in pressure in the intake. A throttle is placed in the air intake so that the speed of the engine is regulated in the ordinary way, the amount

of the charge being automatically varied. Considered from another point of view my invention comprises an injector which injects fuel through the inlet valve of the engine. In the form shown in the drawings the injector is suction operated and controlled.

The invention will be fully understood when taken in connection with the accompanying drawings and the novel features thereof will be pointed out and clearly defined in the claims at the close of this specification.

In the drawings Figure 1 is a vertical section of a portion of an engine to which is applied a fuel supplying mechanism embodying my invention.

Fig. 2 is a section taken on line 2—2 of Fig. 1.

Fig. 3 is a section of the measuring pin.

Fig. 4 shows a device embodying my invention in modified form.

Referring now to Figs. 1 and 2 there are shown at 11 the cylinders, at 12 one piston, at 13 a combustion chamber and at 14 an inlet valve such as form part of an ordinary four cycle engine. It will be understood of course, that the inlet valve is operated in the usual manner, and opens and closes the port 15 through which air enters the combustion chambers of the engine. In the form shown in these figures of the drawings, each cylinder has an air intake 16 which is opened and closed by a throttle 17. The air intake for each valve is straight and leads directly to the open air thus increasing the volumetric efficiency. The throttles are connected by a rod 18 by which they may be moved in unison.

The fuel flows from a suitable source of supply (not shown) through a pipe 20 into a chamber 21 which communicates with a float chamber 22. From the chamber 22, it descends through a port 23 into a fuel pit 24 which is open to the atmosphere by means of ports 2. When the engine is running the flow of fuel to the fuel pit is continuous. The fuel pit is connected by pipes 25 to nozzles 3 one of which is located beneath each inlet valve 14 in such a position that it will be subjected to the suction created by the suction stroke of the engine and so that the fuel passing through the pipe 25 will be sprayed through the valve port into the combustion chamber. The flow of fuel from the float chamber 22 into the fuel pit 24 is controlled by a fuel valve which is preferably in the form of a measuring pin 26 having a groove *b* of a cross-section which diminishes toward the top of the pin. The fuel valve is also provided with a shoulder 27 which completely closes the port 23 when in lowest position. The upper end of the measuring pin is secured to a float 28 so that change in position vertically of the

float 28 operates to vary the opening into the fuel pit 24 and consequently the amount of fuel which will be deposited in the fuel pit in any given length of time. At 29 is shown a movable standpipe by means of which the level of the fuel in the float chamber may be changed. The standpipe is moved by means of a rack 30 and pinion 31.

The float chamber 22 is connected by a port 32 with a vacuum chamber 33. From the vacuum chamber 33, a pipe 34 extends into each of the air intakes 16 at a point between the throttle 17 and the mouth of the intake. The lower end 35 of the pipe 34 is turned away from the mouth of the intake 16 and forms a Pitot tube through which the air from the vacuum chamber 33 and float chamber 22 is exhausted. At 36 is shown a vent by which air may be admitted into the vacuum chamber 33, to adjust the degree of vacuum in the float chamber. When the engine is running, the vacuum in the vacuum chamber will be steady and will depend on the velocity of the air through the air intakes which varies with the speed of the engine.

The operation of the device shown in Figs. 1, 2 and 3 and thus far described is as follows: When the engine is started, the vacuum in the vacuum chamber 33 raises the level of the fuel in the float chamber 22 lifting the float 28 and raising the measuring pin 26 to produce an amount of opening of the fuel valve which is dependent on the speed of the engine. Thereupon the fuel flows into the fuel pit 24 and accumulates there until one of the inlet valves 14 opens. The suction on the nozzle 3 which is just below the inlet valve thereupon draws all of the fuel out of the fuel pit 24 and injects it directly into the combustion chamber 13. The heat in the combustion chamber from previous explosions instantly vaporizes the fuel even though it is heavy. The proper amount of air is drawn in through the air intake at the same time. Each cylinder in its turn repeats this operation, sucking through its nozzle 3 the amount of fuel which has accumulated in the fuel pit 24. As has been explained, this amount is regulated by the float 28 which is responsive to changes in pressure in the air intakes. The adjustment for richer or leaner mixture is made by raising or lowering the standpipe 29, or by varying the size of orifice of the vent 36. The device therefore injects into the combustion space a predetermined variable amount of fuel at the proper time during each cycle of the engine.

In Fig. 4, I have shown a device embodying my invention in a modified form, the cylinder, piston, combustion chamber and inlet valve being numbered 11, 12, 13 and 14 respectively as in Figs. 1 and 2. The inlet valve openings 37, one of which only

is shown, are connected to a single large chamber 38 provided with a single air intake 39 controlled by a throttle 40. The fuel is supplied by a pipe 41 to a float chamber 5 42 in which is a float 43 operating a float valve 44 which regulates the entrance of the fuel and maintains a constant head in the float chamber 42. A pipe 45 carries the fuel to a chamber 46 beneath a fuel pit 47. A 10 movable nozzle 48 operated by a rack 49 and a pinion 50 forms one member of a fuel valve, the other member being formed by a measuring pin 51 having a groove  $\alpha$  of varying cross section. The measuring pin 15 51 has a conical lower end and extends down through the nozzle 48 and seats on a conical seat 4 to shut off the flow of fuel into the fuel pit when the engine is stopped. The upper end of the measuring pin 51 is 20 secured to a bell-shaped piston 52 movable in a cylinder 53 formed on the upper part of the air intake 39. The flange 54 of the piston 52 extends down into the air intake and partly obstructs the air passage when 25 in its lowest position. The cylinder 53 is connected by a duct 55 with the air intake at a point on the outside of the throttle valve 40. At 57 is shown a nozzle located adjacent the inlet valve as before described and connected with the fuel pit 47 by a pipe 30 58. The operation of this form of my device is substantially the same as that which has been described in connection with Figs. 1 and 2. The fuel descends into the chamber 46 and then flows up into the fuel pit 47 35 through the port 4 under a fixed head determined by the position of the float 43 in the chamber 42. The amount of the flow into the fuel pit is regulated by the measuring pin 51 which is moved by the piston 52 40 in response to changes in pressure in the air intake. The charge of fuel which accumulates in the fuel pit is drawn through the pipe 58 and ejected into the combustion 45 chamber 13 when the inlet valve 14 opens. The flow of air into the engine is controlled by a single throttle 40 and this also controls the speed of the engine because the amount of fuel supplied to the fuel pit for each 50 charge is varied in response to the changes in pressure in the air intake 39 communicated to the cylinder 53 through the duct 55. To increase or diminish the amount of fuel in proportion to the amount of air, the 55 movable nozzle 48 is moved up or down slightly as required.

What I claim is—

1. The fuel supply mechanism for an internal combustion engine which comprises a 60 fuel pit, means for supplying fuel to the fuel pit in a continuous flow while the engine is running means for injecting into the engine the fuel which has accumulated in the fuel pit between successive strokes of 65 the engine, and regulating means responsive

to variations in pressure in the air intake of the engine to vary the flow of fuel to the fuel pit.

2. In combination with an internal combustion engine having an inlet valve, an air 70 intake, a fuel nozzle subject to the suction of the engine, an open fuel pit, connections from the fuel pit to the nozzle, an open air intake leading to the air inlet valve, and fuel measuring means controlled by the partial 75 vacuum in the air intake for depositing in the fuel pit a predetermined amount of fuel.

3. In combination with an internal combustion engine, a fuel nozzle subject to the 80 suction of the engine, an open fuel pit, connections from the fuel pit to the engine, a movable fuel measuring pin controlling the supply of fuel to the pit, an air intake for the engine, and a member connected to the 85 measuring pin and movable in response to changes in pressure in the air intake to control the position of the fuel measuring pin.

4. The device for supplying fuel to an internal combustion engine in predetermined 90 variable quantities which comprises a fuel pit having a capacity greater than the amount of fuel to be introduced into the engine for any single charge, connections 95 leading from the fuel pit to the engine and subjected to the suction thereof, means for supplying fuel in a continuous flow to the fuel pit in quantity insufficient to fill it, and means for varying the said flow, said parts 100 being proportioned and arranged so that all the fuel which has previously accumulated in the fuel pit will be drawn into the engine by the suction stroke thereof.

5. The device for supplying fuel to an internal combustion engine in predetermined 105 variable quantities which comprises a fuel pit, connections leading therefrom to the engine and subjected to the suction thereof, means for supplying fuel in a continuous flow to the fuel pit, means responsive to 110 changes in the suction for varying the said flow, said parts being proportioned and arranged so that all the fuel which has previously accumulated in the fuel pit will be drawn into the engine by the suction stroke 115 thereof.

6. In combination with an internal combustion engine having a plurality of cylinders, a fuel nozzle for each cylinder and subject 120 to the suction of the cylinder to which it pertains, and air intake for each cylinder, a fuel pit open to the atmosphere, connections from the fuel pit to the nozzle, a movable fuel measuring pin controlling the flow of fuel to the pit, and a member connected 125 to the measuring pin and movable in response to changes in pressure in the air intake to control the supply of fuel to the fuel pit.

7. The fuel supply mechanism comprising 130

a nozzle subjected to the suction of an internal combustion engine, an air intake for the engine, a fuel pit open to the atmosphere, connections from the nozzle to the fuel pit, a measuring pin supplying fuel in continuous flow to the fuel pit, a cylinder and piston responsive to changes in pressure in the air intake operatively connected to the measuring pin whereby the flow of fuel to the fuel pit is varied in accordance with the changes in pressure in the air intake.

8. The fuel supply mechanism comprising a nozzle subjected to the suction of an internal combustion engine, an air intake for the engine, a fuel pit open to the atmosphere, connections from the nozzle to the fuel pit, a fuel valve supplying fuel to the fuel pit, a float chamber, a float in said chamber connected to said fuel valve, and a duct leading from the air intake to the float chamber whereby changes in pressure in the air intake vary the position of the float and the said fuel valve.

9. In combination with an internal combustion engine having a plurality of cylinders, and an air intake for each cylinder, the fuel supply mechanism comprising a nozzle for each cylinder and subjected to the suction thereof, a fuel pit, connections from

the fuel pit to the said nozzles, a fuel valve supplying fuel to the fuel pit, a float chamber, a float in said chamber operatively connected to the fuel valve, a vacuum chamber, a duct leading therefrom to the float chamber, and ducts leading from each of the air intakes to the vacuum chamber whereby the changes in pressure in the said air intakes may be communicated to the vacuum chamber and thence to the float chamber and thus vary the position of the float and the fuel valve.

10. The fuel supply mechanism comprising a nozzle subjected to the suction of an internal combustion engine, an air intake for the engine, a fuel pit open to the atmosphere, connections from the nozzle to the fuel pit, a valve seat and a measuring pin cooperating therewith and having a groove of varying cross section therein supplying fuel to the fuel pit and having a shoulder thereon which can seat on the valve seat and close the passage to the fuel pit, and means operated by variations in pressure in the air intake to vary the position of the measuring pin.

In testimony whereof I affix my signature.

STEPHEN IVAN FEKETE.