Nov. 1, 1966 H. E. PHELPS 3,282,573

FUEL FEEDING SYSTEM

Filed Sept. 5, 1963 2 Sheets-Sheet 1

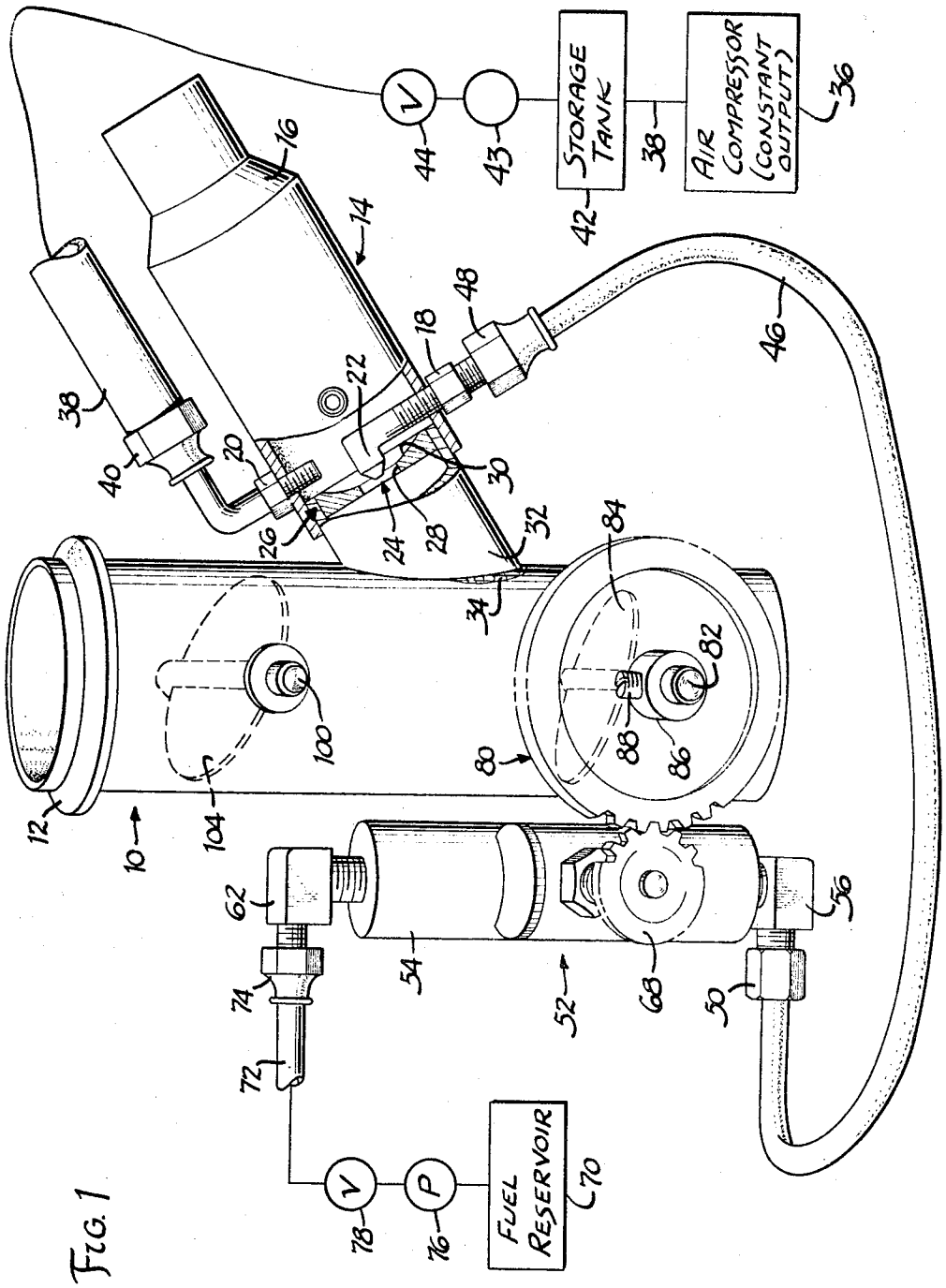


FIG. 1

INVENTOR.
HAROLD E. PHELPS
BY
WILSON, SETTLE & CRAIG
ATTORNEYS

Nov. 1, 1966 H. E. PHELPS 3,282,573

FUEL FEEDING SYSTEM

Filed Sept. 5, 1963 2 Sheets-Sheet 2

FIG. 3

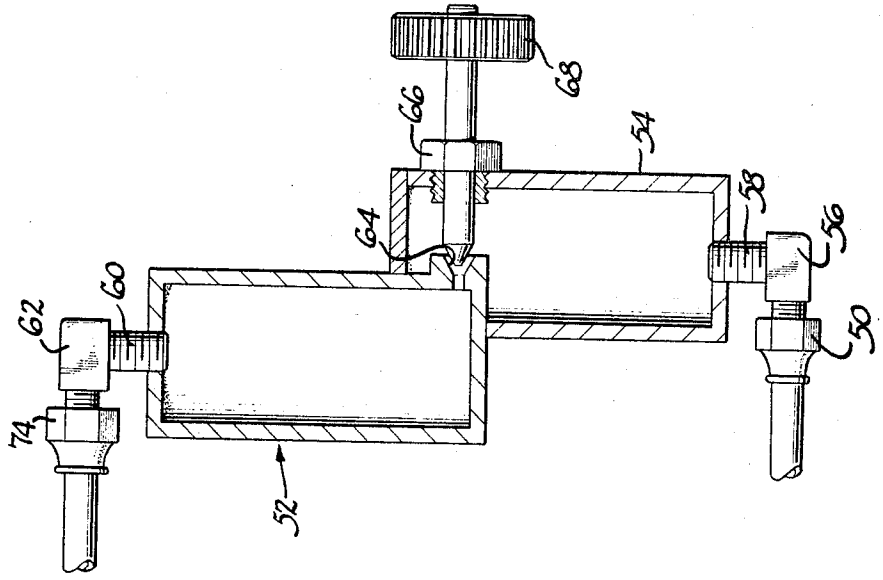
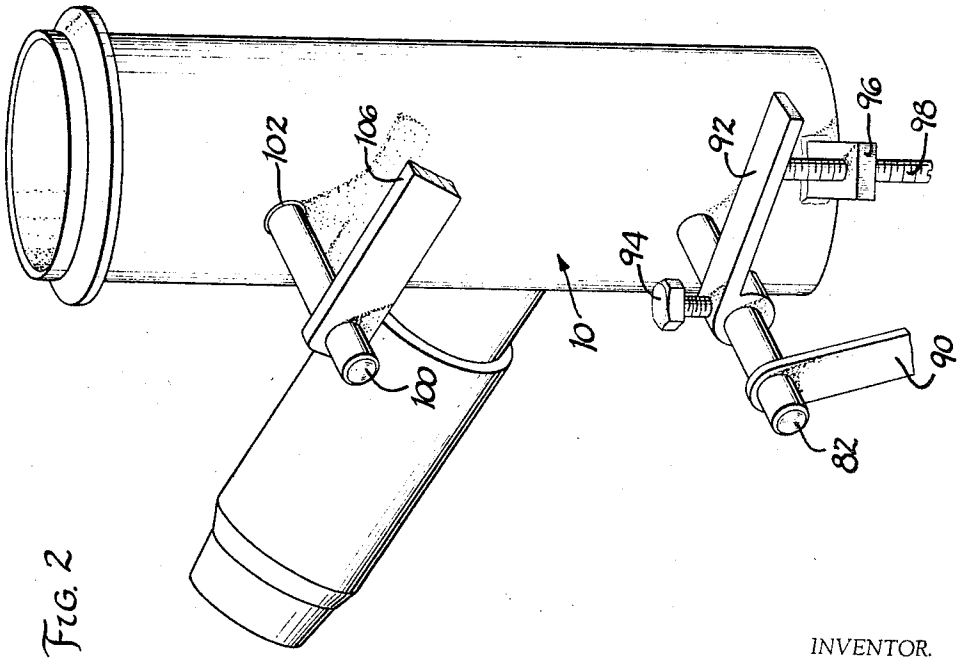


FIG. 2



INVENTOR.
HAROLD E. PHELPS
BY
WILSON, SETTLE & CRAIG
ATTORNEYS

United States Patent Office 3,282,573 Patented Nov. 1, 1966

3,282,573

FUEL FEEDING SYSTEM

Harold E. Phelps, 220 Burroughs, Plymouth, Mich.

Filed Sept. 5, 1963, Ser. No. 306,817
2 Claims. (Cl. 261—28)

This invention relates to fuel feeding systems, and more particularly to carburetors for internal combustion engines; still more particularly, this invention relates to carburetors for internal combustion engines of the type using carburetors for fuel vaporization, the present invention characterized by the fact that it enables an engine to provide greater economy without sacrificing performance.

The problem

The present state of the art of carburetors of the fuel vaporization type for internal combustion engines as used on automotive vehicles, boats, and many others, as distinguished from fuel injection systems for diesel engines, is relatively high. These devices have been developed to the point where they are fitted with automatic chokes, weather compensated, four throats or barrels, acceleration pumps, and the like. The result is that some of the larger carburetors used today with their float chambers, complex metering valves, orifices, needle floats, and others, is that they are relative monstrosities. Thus, they are extremely complex in nature. Further, they turn an automobile into what is known as a "gas hog."

Theoretically, the venturi throat of a carburetor will vaporize one part gasoline with a stoichiometric amount of air for a theoretically perfect combustion in the cylinders of the engine. However, this condition only exists at ideal levels of operation as follows: (1) when the engine is warm; (2) when the engine is running at a relatively constant speed.

From the foregoing, it will be understood that when an engine is cold, a choke is necessary for starting. Further, in order to provide adequate performance or acceleration under load, some means analogous to a choke to shoot in extra raw fuel is required. The latter instrumentality takes the form of an acceleration pump which, upon the driver depressing the accelerator pedal, delivers a stream of raw gasoline into the venturi throat to give the engine the extra burst of power which it needs for the quick acceleration.

A concise summary of the foregoing is that carburetors in use today, although they have performed very well for many years on millions of vehicles, have drawbacks of complexity, high fuel consumption, high costs and problems of adjustment for optimum operation.

Accordingly, a substantial advance in the art would be provided by a carburetor for internal combustion engines of the automotive type characterized by simple construction, economy of manufacture and operation, with undiminished performance, and other advantages as will become apparent in the following disclosure.

Objects

It is accordingly an important object of the present invention to provide a novel fuel feeding system for internal combustion engines of the automotive type using vaporized as distinguished from injected fuel.

A still further object is to provide a carburetor for an internal combustion engine of the automotive type that produces a uniform air-fuel gas mixture adequate to the needs of the automobile under all conditions of operation for improved economy without sacrifice of performance.

A further object is to provide a carburetor type fuel feeding system for an internal combustion engine that always produces a fuel-air mixture for efficient operation of an internal combustion engine, additionally providing

adequate performance, but without sacrifice of economy, by never injecting raw fuel into the intake manifold, either for acceleration or for starting.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

On the drawings:

FIGURE 1 is a perspective view of the fuel feeding or metering apparatus of the present invention;

FIGURE 2 is a perspective view of the other side of FIGURE 1; and

FIGURE 3 is a sectional view along line 3—3 of FIGURE 1.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Briefly, the fuel feeding system of the present invention, which may be called a carburetor inasmuch as it serves that function for an internal combustion engine, comprises a barrel-like casing as a mixture-forming throat; and having a fogging nozzle attached thereto with fuel and air under pressure being directed into the fogging nozzle, the air at a constant flow, but containing a fuel metering valve synchronized to the fuel mixture control valve, thus providing exact control of flow of fuel and mixture to the engine, in accordance with the requirements thereof.

The invention

Referring to FIGURE 1, we note that the carburetor barrel is designated by the reference numeral **10** having a flange **12** at the top for attachment of a suitable filtering device to prevent abrasive dust particles from entering the engine along with combustion air travelling through the barrel. At this point, we shall refer to the atmospheric air entering the barrel **10** through the filter attached to the open top thereof as secondary engine combustion air. The primary fuel or atomizing air will become apparent hereafter.

The fogging nozzle

Further, as shown in FIGURE 1, about midway down the length of the barrel **10**, there is attached a fogging nozzle designated generally by the reference numeral **14**. In FIGURE 1, this component is broken away in section to show the internal workings thereof. It will be noted that the nozzle **14** includes a cylindrical barrel **16** or body, into which are tapped and threaded the connection **18** for liquid fuel such as gasoline, and the connection **20** for the atomizing or primary air.

As will be noted, a short right angle tube **22** extends into the interior of cylindrical barrel **16** and terminates coaxially thereof in a very small nozzle orifice **24**. By virtue of connections which will be later described, raw fuel in liquid form such as gasoline is delivered to the nozzle orifice **24** and dispensed thereby coaxially into the cylindrical barrel **16** of the fogging nozzle **14**. The connection **20** for atomizing air merely penetrates the wall of the cylindrical barrel **16** to deliver air under pressure into the interior of the barrel **16**. Note that an atomizing mouth is formed in the downward end of the barrel **16** around the nozzle orifice **24** of delivery tube **22**. Thus, a wall **26** having a coaxial opening **28** is provided. The

opening 28 is in surrounding relationship to the nozzle orifice 24.

The interior of wall 26 is tapered along the line 30 to impart a swirling, mixing action to the compressed air delivered through connection 20 as it passes through opening 28 and around nozzle orifice 24 toward the interior of carburetor barrel 10.

It will be noted that a short tubular extension 32 extends from the wall 26 into connection with the exterior of wall 10, securement being provided by a weld 34.

From the foregoing, it will be evident that compressed air and liquid fuel are effectively combined to produce a finely dispersed primary fuel fog that enters the carburetor barrel to be mixed with the secondary intake air, in stoichiometric amount, as previously discussed.

Atomizing air production components

Prior to discussing the manner in which the raw fuel is metered and the manner in which the secondary air is controlled by an appropriate butterfly valve, it appears appropriate to enumerate at this time the components utilized for delivering atomizing air to the fogging nozzle 14.

This is shown in FIGURE 1 as comprising a constant output compressor 36, of course fitted with an appropriate dust filter and water trap. This is connected by means of a line 38 and compression fitting 40 to the connection 20 and thus the compressor 36 is effective to deliver clean, dehydrated air to the fogging nozzle 14. Connected into line 38 is a storage tank 42 and a metering orifice 43 for constant flow. A valve 44 controls on-off function.

The storage tank functions as follows:

(1) Provides stored quantity of air to operate the fogging nozzle prior to the time the engine 'takes hold" on the starting and powers up the compressor so that it can deliver; and

(2) An anti-surge chamber so that the air delivered to the fogging nozzle 14 will flow in a steady stream and without pulsation.

It should be pointed out that valve 44 is of the solenoid type or other equivalent, such as manifold vacuum operated, so that when the ignition key of the automobile is turned on and off, the primary air to the fogging nozzle will be turned on and off concomitant with the condition of the engine.

The fuel delivery portion of the system

Continuing to refer to FIGURE 1, we note that a line 46 has one end connected by compression fitting 48 to the connection 18 attached to the fogging nozzle 14. At the other end, line 46 is connected by means of a compression fitting 50 to a metering valve 52. Although not necessarily limited to that shown, FIGURE 3 illustrates one specific configuration of the metering valve adapted for use in the invention. Thus the housing 54 has a coupling 56 at the bottom end of an outlet tube 58 suitably connected to the body 54. At the top end, body 54 is provided with an inlet tube 60 and a coupling 62. As best shown in FIGURE 3, the interior of the body 54 is configured to define a needle valve seat 64 into which a needle 66 can be threaded in a controlled manner as will become apparent. The body of the needle 66 is threaded through an appropriate opening in the side of the body 54 and is provided at its outer end with a toothed wheel 68, rotation of which will establish the opening or closing adjustment of the metering valve 52.

The mechanism by which the toothed wheel 68 is rotated upon movement of the carburetor butterfly control valve will become apparent after immediately following description relating to the manner in which fuel is brought to the metering valve 52 from an appropriate reservoir.

Fuel supply components

Referring to the left side of FIGURE 1, we note a fuel reservoir or tank 70, suitably the fuel tank of an automobile. This is connected by means of a line 72 to coupling 62, being connected thereto by means of a compression fitting 74. A pump 76 is used in a conventional manner to move the fuel under pressure from the reservoir 70 to the metering valve 52 and thence into the system. An on-off valve 78 is optionally used, connected into the ignition on-off circuit to provide a positive shut-off or positive on condition to back up the metering valve when the system is shut down. This may be considered optional because it will be evident from the following description that when the engine is shut down, the metering valve is substantially closed and absent pressure from the pump, there would be little if any residual bleed of fuel from the system into the intake manifold of the engine during shutdown.

The combustion mixture throttle control

Continuing to refer to FIGURE 1, we observe at the central lower portion thereof, a larger toothed wheel 80 that is rotatably mounted in engagement with the smaller previously mentioned toothed wheel 68. The mounting of the toothed wheel 80 is effected through a shaft 82 that extends transversely through the carburetor barrel 10 and rotatably fitted into aligned openings provided in the wall of barrel 10. Inside the barrel 10, on the shaft 82, is fixedly mounted relative to the shaft and carried by the shaft, a butterfly valve 84. This is shown in phantom outline in FIGURE 1 and follows the construction principles employed in butterfly valves now used in carburetors for automotive engines. Thus, further and more complete description of this element is not believed to be necessary.

It should be pointed out, however, that the larger toothed wheel 80 is provided centrally with a hub 86, having a set screw 88 threaded therethrough and into locking engagement with the shaft 82. By this expedient, the toothed wheel 80 can be adjusted relative to the slant of the butterfly valve or plate 84 and thus the metering valve 54 and butterfly valve 84 set to zero position or slightly cracked open position as is necessary for proper idling. The manner in which the idling adjustment is set will be referred to later as will the connection of shaft 82 to the accelerator linkage, by reference to FIGURE 2.

FIGURE 2

As previously mentioned, FIGURE 2 is a perspective view of the opposite side from FIGURE 1 of the carburetor or fuel metering system of invention.

Here we note that shaft 82 extends out the other side of the barrel 10 and an accelerator linkage 90 is appropriately connected for rotating shaft 82, in accordance with the demands placed upon the engine. The idling adjustment or the manner in which the butterfly valve 84 is slightly cracked open to provide sufficient fuel mixture for slowly turning the engine includes an arm 92 fitted upon shaft 82 and held in adjusted position by means of set screw 94. A boss 96 suitably provided at the lower part of the housing 10 is tapped and drilled to receive a set screw 98 whereby the stop position of idler arm 92 can be adjustably established.

Optional choke

Referring now both to FIGURES 1 and 2, it will be evident that it is fully within the scope of invention to include a choke as for starting in severely cold weather. It should be pointed out that actual experience with the fuel feeding system of the present invention has shown that at temperatures as low as −5° F. no choke is required because the system provides a positive atomized spray of fuel and a fuel mixture in accordance with the needs of the engine and without the necessity of a richer mixture as provided by a choke on a conventional carburetor. This, incidentally, shows the high degree of efficiency and economy provided by the invention.

To continue, however, a choke can be utilized and this is built around a pivot shaft **100**, extending transversely through the upper part of barrel **10**. This shaft **100** extends through openings **102** of body **10** and is bushed and rotatably mounted in suitable manner. As shown in phantom outline, FIGURE 1, a choke butterfly plate **104** lies within the bore of housing **10** and pivots upon rotation of shaft **100**.

As shown in FIGURE 2, a choke linkage for rotating the shaft **100** as necessary includes an arm **106** connected to a suitable actuating mechanism such as a manual control cable or a thermostatic climatizer or choking mechanism, which dependent upon weather conditions will partially close the valve **104** and give a slightly richer mixture for starting. This is effected by cutting down the amount of air. Then as the engine warms, the actuating mechanism will be effective to completely open the choke valve plate **104** for normal operation where only a stoichiometric fuel-air ratio is required.

This about completes the description of the carburetor per se, except for a briew mention of other optional features that can be mentioned for further refinement in the event required.

Optional additions

A vacuum spark advance of known structure can be provided in conventional manner at the bottom of housing **10** below the main butterfly valve **84**.

The system in operation

Before discussing the operation of the system previously described, it should be pointed out, of course, that the accelerator linkage includes a return spring to bring the accelerator pedal and concomitantly the butterfly valve **84** back to a zero position when pressure is removed from the accelerator pedal.

Another thing that should be mentioned is that the air compressor **36**, FIGURE 1, is of the constant output type and suitably of about 1½ to 2 cubic feet per minute capacity for an average 100–200 horsepower engine, feeding through the flow orifice **43** for constant flow of atomizing gas or air into the fogging nozzle **14**.

Let us now go through the sequence of operation of the device as a driver enters an automobile, inserts the ignition key and turns it on to start the engine.

The turning of the ignition key will be effective to open the on-off fuel valve **78**, and as the starter turns the engine, the pump **76** will push fuel from the reservoir **70** through line **72** into the metering valve **52**. The driver will by automatic reflex press down on the accelerator pedal and this will open the metering valve **52** letting gasoline flow through line **46** to the fogging nozzle **14**.

We will presume that the car has previously been used and that the air storage tank **42** has retained therein some residual air by means of the on-off valve **44**. Be it noted that the on-off valve **44** will also have been opened by the turning of the ignition key, or if the vacuum type, opened by the engine being cranked and a vacuum produced in the intake manifold.

Under this set of conditions, gasoline pumped into the fogging nozzle **14** will be blasted into a jet by the released air from tank **42** and this primary charge and the secondary air flowing through the body **10** of the carburetor from the atmosphere will provide a stoichiometric fuel air mixture for ignition in the combustion chambers.

We presume that a couple of revolutions of the engine by the starter will kick the engine over and then the fuel pump will continue to operate, the air compressor will be placed in motion by running of the engine, being belted thereto by suitable means, and the system will deliver stoichiometric fuel-mixture under all conditions of operation of the vehicle.

It should be pointed out that the air compressor **36** is of the substantially constant output type, irrespective

of revolutions as imparted thereto by the engine, which as is well known, is not constant. However, the compressor can deliver from about 1½ to 2 cubic feet per minute, and by means of the control or flow orifice **43**, a constant flow of say 1½ cubic feet per minute is delivered to the fogging nozzle at all times for efficient fuel vaporization.

When acceleration or deceleration are called for, the driver applies appropriate foot pedal movement to change the setting of the butterfly valve **84** and this is effective through the geared relationship between large toothed wheel **80** and small toothed wheel **68** to provide an appropriate flow of gasoline. By the fact that there is always sufficient primary air to vaporize the incoming fuel by the constant output of the air compressor **36**, the secondary air flowing through the body **10** as determined by the setting of butterfly valve **84** provides stoichiometric mixture matched to engine requirements and assuring complete combustion and maximum economy and efficiency.

When the operator desires to shut the system down, he brings the vehicle to a stop and turns off the ignition key. Since the valve **44** is solenoid or vacuum operated, it will be shut off, retaining stored air in tank **42**. Shutting the engine down will also be effective to close valve **78**, preventing fuel from entering the engine as by gravity flow through parts of the system from the fuel reservoir in case that situation might exist. In case the fuel is always pumped against a gravity head, it will become evident that the valve **78** can be dispensed with because the metering valve **52** will control the actual flow and required amounts of fuel into the engine. Further, when the operator releases his foot from the accelerator pedal, the metering valve is shut down to an idling condition. With the pump stopped when the engine stops, it is doubted that there would be little waste as by line residual being pressured into the intake manifold. Accordingly, the valve **78** may be found in certain conditions to be an optional component of the system.

I claim:

1. In a fuel feeding apparatus,

a hollow housing having an atmospheric air inlet and a fuel mixture outlet,

a fuel mixture flow control valve of the butterfly type pivotally mounted between said inlet and said outlet and effective to regulate flow through said housing,

said flow control valve being mounted on a rotatable shaft extending transversely of said housing,

means including a fogging nozzle connected into the side of said housing to deliver a fog of primary air and finely dispersed liquid fuel droplets into said housing between said atmospheric air inlet and said flow control valve, a compressor metering orifice arrangement adapted to deliver a constant flow of a substantially like amount of cubic feet of air per minute to said fogging nozzle regardless of the quantity of liquid fuel delivered thereto,

means including a metering valve connected to said housing to deliver liquid fuel to said fogging nozzle,

said metering valve having a rotatable valve element to establish adjusted flow and said valve element having an exposed portion,

a toothed wheel operably mounted on said exposed portion,

a toothed wheel mounted on said rotatable shaft carrying said flow control valve,

and said tooth wheels being operably intermeshed,

whereby movement of the butterfly valve is effective to adjust the metering valve for delivery of liquid fuel to the fogging nozzle in accordance with the position of the butterfly valve.

2. In apparatus for producing a fuel mixture from a vaporizable liquid fuel and air,

a hollow housing having an atmospheric air inlet and a fuel mixture outlet,

a vaporized fuel mixture flow control valve of the butterfly type pivotally mounted between said inlet and said outlet and effective to regulate flow through said housing,

said flow control valve being mounted on a rotatable shaft extending transversely through said hollow housing,

a fogging nozzle connected into the side of said housing to deliver a fog of primary air and finely dispersed liquid fuel droplets into said housing between said atmospheric air inlet and said flow control valve,

means to deliver primary compressed air to said fogging nozzle at a relatively constant flow including a constant output compressor, a storage tank and a metering orifice,

a source of pressurized liquid fuel,

means for delivering fuel from said pressurized source into said fogging nozzle,

a metering valve operably connected to said fuel delivery means and also connected to said housing, for controlling flow of liquid fuel to said fogging nozzle,

said metering valve having a valve element rotatable to establish adjusted flow therethrough and said rotatable valve element having an exposed portion,

a first toothed wheel operably mounted on said exposed portion,

a second toothed wheel mounted on said rotatable shaft carrying said flow control valve,

and said toothed wheels being intermeshed,

whereby movement of the butterfly valve is effective to adjust the metering valve for delivery of liquid fuel to the fogging nozzle in accordance with the position of the butterfly valve.

References Cited by the Examiner

UNITED STATES PATENTS

1,402,749	1/1922	Du Pont.	
1,625,997	4/1927	Gronkwist.	
1,886,989	11/1932	Trumble.	
2,012,564	8/1935	Holmes	261—51 X
2,247,189	6/1941	DeGuyon	261—51
2,689,116	9/1954	Richardson	261—51
2,755,075	7/1956	Tivoli	261—51 X
2,942,596	6/1960	Carlson	261—39

HARRY B. THORNTON, *Primary Examiner.*

T. R. MILES, *Examiner.*