Nov. 19, 1929. L. P. BARLOW 1,736,033

FUEL SUPPLYING SYSTEM

Filed Dec. 10, 1928 2 Sheets-Sheet 1

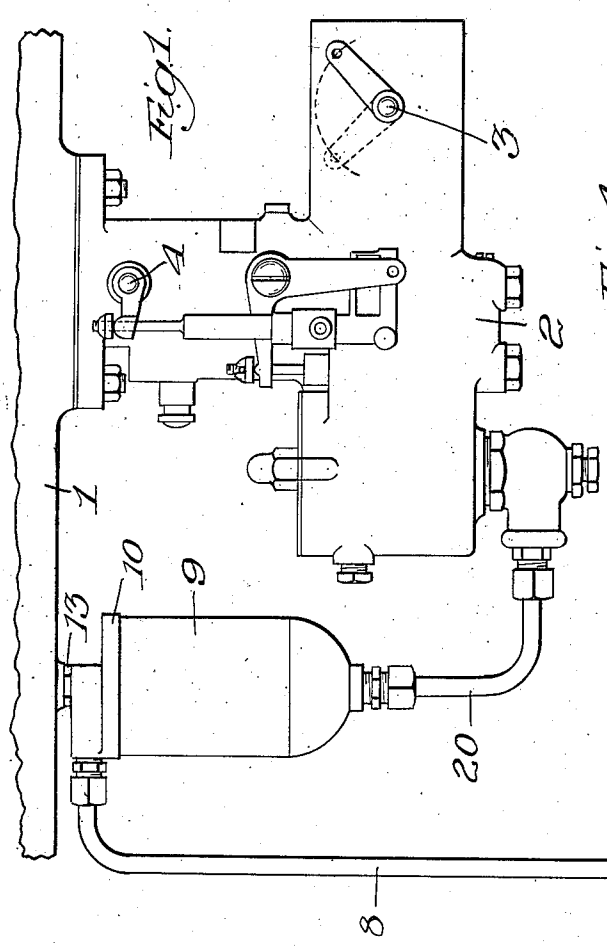

Fig. 1.

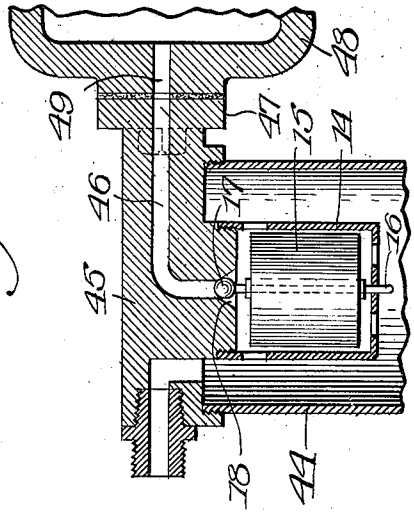

Fig. 4.

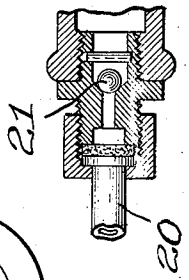

Fig. 3.

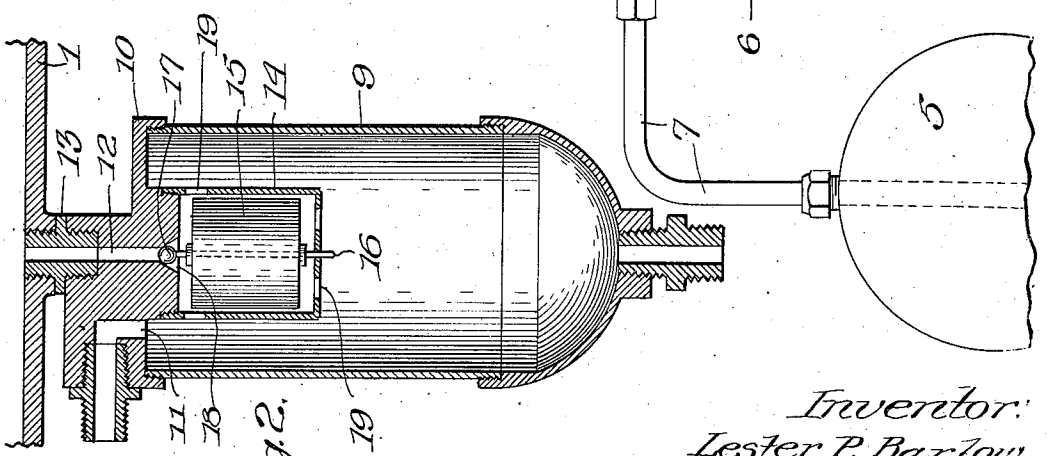

Fig. 2.

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Fig. 5.

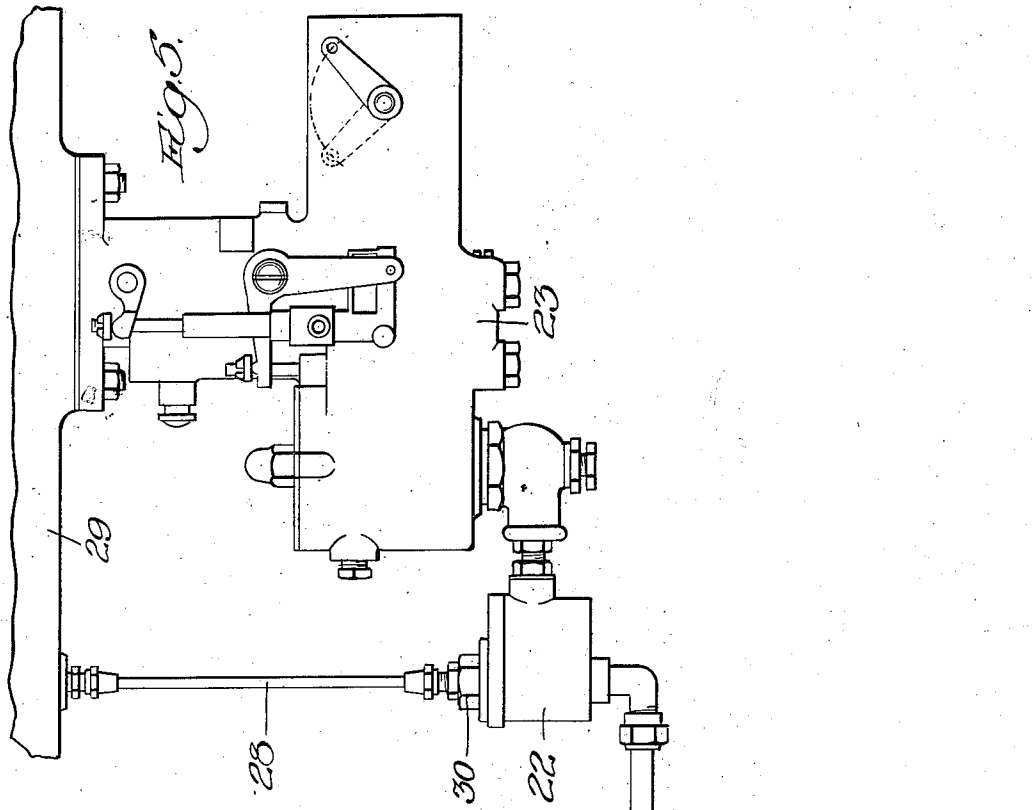
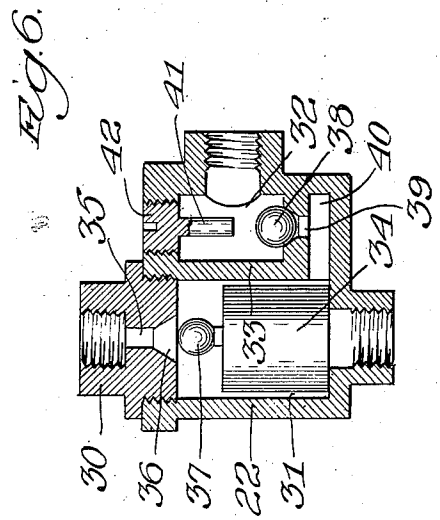


Fig. 6.



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UNITED STATES PATENT OFFICE

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FUEL-SUPPLYING SYSTEM

Application filed December 10, 1928. Serial No. 324,981.

This invention relates to liquid fuel supply systems for internal combustion engines.

The most prominent system heretofore used for this purpose has been the vacuum tank system which lifts the liquid fuel from a supply tank to a chamber above the carbureter of the engine by the suction effort of the engine. The fuel then flows by gravity to the carbureter. In order for this system to function satisfactorily, it is necessary to maintain a relatively high vacuum at all times at the fuel intake manifold of the engine. This is not always possible under the varying conditions of motor speeds and loads with the result that the suction effort of the engine on the system is so reduced at times, such as when running the engine wide open for long periods, that the system is subject to failure due to insufficient vacuum.

To overcome these objections, mechanically operated force feed liquid fuel supply systems have been introduced. In these systems, the liquid fuel is supplied to the engine through the carbureter at a predetermined pressure above that of the atmosphere at all speeds and loads of the engine so that there is practically no opportunity for failure of liquid fuel supply once the system has commenced to function. Because of the small quantities of liquid fuel consumed from time to time during the operation of the average internal combustion engine, as employed on a motor vehicle, the pump needed to force the liquid fuel to the engine must, for practical purposes, be of low capacity. Because of this, considerable time is required after the auxiliary starting arrangement of the motor has been put into operation for the pump to fill the system to furnish the supply required. At this point, I wish to say that I am referring to those force feed systems in which the forcing pumps are driven by the main engine. Motors during extreme cold weather, when thoroughly chilled, rotate slowly in starting and due to this extreme slow rotation, the pumps may fail to prime. In extremely hot weather, in those systems, having considerable surface exposed, as provided by long lengths of tubing, large strainer chambers, pump housings, etc., the liquid fuel may evaporate in the system in advance of the pump so that the evaporation is equal to the displacement of the pump. Because of this, the pump may fail to prime the system when the engine is rotated in the effort to get it started.

One of the main objects of my invention is to provide means for automatically priming the system with liquid fuel quickly and positively, regardless of the conditions which have effected priming of force feed system as heretofore.

In carrying out this main object, I utilize the suction effort of the rotating engine preliminary to starting the engine to prime the pump and the system. This allows a small capacity pump to be retained in the system and a quick and positive priming of the system effected by the large displacement of the main engine on the suction strokes of its positions. Practically all of this displacement may be placed on the fuel system for priming purposes by closing the choker valve on the carbureter. This accounts for rapid priming of the system even when empty or dry. From actual installations, I have been able to start an engine in cold weather with a dry system within three to five seconds.

Another object of my invention is to free the liquid gasoline of all air and free gases before the gasoline reaches the carbureter, and thereby supply the carbureter with solid liquid fuel which is essential to the proper performance of the carbureter.

A further object of my invention is to provide an air cushion for the gasoline in advance of the carbureter, so as to aid the acceleration of the liquid fuel supply to the carbureter and to also steady and regulate the pressure between the pump and the carbureter.

A still further object of my invention is to allow the excess of free air and vapors accumulating at the air cushion in excess of that required therefor to be consumed, in the cylinders of the motor as fuel and thus not waste the same as would occur should they be discharged in the atmosphere unburned.

The invention also consists in the novel structure and arrangements thereof in my

improved system and also in the methods by which the objects of my invention are accomplished. In addition to these, my invention consists further in the matters hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 shows a force feed liquid fuel system constructed in accordance with my invention;

Fig. 2 is an enlarged vertical sectional view of the vacuum controlling device used in said system;

Fig. 3 shows a check valve employed;

Fig. 4 shows another form of the vacuum control device;

Fig. 5 shows another form of my improved system; and

Fig. 6 is a vertical sectional view of the vacuum control device as used in said system.

In the drawings, 1 indicates the intake manifold of an internal combustion engine, and 2 indicates the carbureter connected to said manifold as in assemblies of this general kind. 3, 4, indicate the choke and throttle valves, respectively, as employed in these assemblies, the choke valve being in advance of the throttle valve, as shown.

The system for supplying liquid fuel to the engine through the carbureter 2, comprises a main fuel supply tank 5, usually arranged at the rear of the vehicle, and a force pump 6, which as illustrated, is of the rotary type and driven from the main engine, in any suitable manner. Any type of pump, as customarily used in these systems, may be employed, it only being essential that the pump have the capacity required to furnish the carbureter with its fuel supply during the regular and intended operation of the system.

A conduit 7, connects the intake side of the pump 6 with the supply tank 5, in the usual manner and a conduit 8, connects the discharge side of the pump with a receptacle 9, which is arranged above the carbureter in the system shown in Fig. 1. The receptacle 9 may be fastened to any suitable support close to the carbureter. As shown in Fig. 1, the receptacle 9 is fastened directly to one of the horizontal arms or portions of the intake manifold 1, so as to avoid the use of connecting tubing between the receptacle and the manifold. The connection shown is made through the cap 10 of the receptacle and said cap is provided with two passages, 11, 12, both opening into the interior of the receptacle. The passage 11 is connected with conduit 8, and the passage 12 is connected with the interior of the manifold 1, through a connecting nipple 13 which also suspends the receptacle from the manifold.

A cage 14 depends from the cap 10 within the receptacle 9, and provides a housing for a float 15 which has a rod 16 extending vertically through it and guided at its lower end in an aperture in the bottom wall of the cage. The ball valve 17 is at the upper end of said rod and co-operates with a seat 18 at the inner end of the passage 12 to open and close the same as the valve is moved off and on to its seat in the raising and falling of the float. The float may be a hollow metal one or it may be made of solid floatable material, such as cork. The cage 14 is provided with a number of openings 19, 19, preferably arranged in its bottom and upright walls so that the liquid fuel furnished the receptacle 9 in the functioning of the system may freely reach the float to operate it and also prevent the float from having piston effect as it raises and falls.

A conduit 20 connects the bottom of the receptacle 9 with the liquid fuel intake of the carbureter 2, and a non-return check valve 21 is provided at the connection as shown in Fig. 3. This valve could be located in the conduit 20 or at its connection with the receptacle 9, if desired.

The system shown and described operates as follows: Assuming that the system is empty, as when first installed, the tank 5 is first filled with liquid fuel as gasolene. The rest of the system will be empty and float 15 will seat on the bottom of the cage 14. The valve 17 will then be off its seat 18, to connect the interior of the receptacle 9 to the manifold 1, through the passage 12. On rotating the engine, through its auxiliary starting devices, either by hand cranking or by the usual starting motor, the suction effort of the engine on the suction strokes of its pistons will create a heavy suction on the fuel system through the receptacle 9, and draw liquid fuel from the tank 5 into the system and prime the pump 6. The system will receive the fullest effect of the engine suction if either the choke valve 3 or the throttle valve 4 at the carbureter is closed. As it is the usual practice to close the choke valve before or at the same time the starting devices are set in motion, the operator will not likely forget to close the choke in order to effect quick starting of the engine. The pump 6 being rotated by the engine will as soon as it is primed, aid the suction to quickly fill the receptacle 9. The suction on the latter will act through the pipe 20 to seat the check valve 21 and close the carbureter 2 to the system and prevent air being drawn into the receptacle 9 through the carbureter. The receptacle 9 will quickly fill under the combined action of the rotating pump and the engine suction and the suction on the system will be automatically cut off as soon as the receptacle is filled sufficiently to lift the float 15 to close the valve 17 against its seat 18. As soon as this happens, the receptacle 9 will be closed to the vacuum pull and the pump 6, by its continued rotations, will quickly build up a a liquid head in the receptacle 9 to a pressure above that of the atmosphere. This pressure

is usually two or three pounds with the type of pump employed, and the check valve 21 is forced off its seat so that the carbureter may be supplied with liquid fuel at this pressure. The operations described take place very rapidly, even with a dry or empty system, and the engine is quickly started under its own power, thereby saving wear and tear on the starting devices, as well as the battery. While the pump 6 is operating to supply liquid fuel to the carbureter 4, the system is operating as a force feed system. The valve 17 at this time is held closed against its seat 18 by the combined effect of three forces, the suction effort of the engine on the valve through the passage 12, the pressure of the pump and the lifting power of the float 15 as long as the liquid level in the chamber 9 stands high enough to keep the float raised. With the upper edges of the ports 19 in the side wall of the cage, positioned at some distance below the top of the cap 10, there is provided a recess or pocket in the chamber 9 above said ports to trap any air or vapors remaining in the chamber 9 as the liquid level rises to and above the upper edges of these ports. This provides an air cushion which compensates for the irregularity of the pump delivery and consumption of the carbureter, due to increasing or decreasing the speed of the pump or varying the consumption of the carbureter. If no appreciable amount of air or vapor is supplied to the cushion by the incoming liquid fuel through the passage 13, the liquid level in the chamber 9 will stand approximately at the flotation point of the float at the closing time of the valve 17. As the pump continues to furnish liquid to the chamber 9, the pressure in the chamber will be increased, and the liquid level in the chamber will rise directly in proportion to the amount of pressure supplied by the pump. In no event does this level rise much above the upper edges of the ports 19 for the reason that these ports are completely covered by the liquid and the air cannot escape, due to the liquid seal at the ports. This is the maximum height of the liquid in the chamber 9 and as indicated by the dotted line *a* in Fig. 2. With the tank 5 on a motor vehicle, the splash of gasoline therein due to the movement of the vehicle becomes aerated and quantities of air and fuel vapors are discharged into the chamber 9 through the air cushion, thereby augmenting the cushion and in time building up a volume of air and vapors sufficient to depress the liquid level to a point permitting the float to drop and open the valve 17. The excess amount of air and vapors thus supplied may escape into the manifold 1 and be burned as fuel in the engine cylinders and not go to waste as would occur should such excess air and vapors be discharged into the atmosphere. As the excess air and vapors escape, the liquid level is rapidly raised by the discharge of the pump into the chamber 9 and the rising level carries with it the float 15, causing the valve 17 to seat and prevent the liquid fuel from escaping through the vent. This action of the fluid is periodic and enables an air cushion to be continuously maintained in chamber 9 above the liquid level therein during the operation of the motor, so as to serve as a flexible compensating medium between the pump and the carbureter. For installations requiring extremely high lifts of liquid which may be required in stationary jobs, it is necessary to have a larger air space due to the higher vacuum in the chamber 9 necessary to prime. On the high lift job, when the prime takes place due to the rarification in the chamber 9, enough air space must be maintained above the liquid level to permit stretching of the entrapped air far enough to lower the level to permit the float valve to open and vent the chamber so that it may discharge.

Should the engine stop for any reason, as by the voluntary action of the operator or driver of the vehicle turning off the ignition, the receptacle 9 being connected through its cap 10 only with the pump 6, can not drain into the pump or the supply tank 5 should the valve 17 open by the lowering of the liquid level in the receptacle, as by leakage in the carbureter or for any other reason. With the receptacle 9 above the carbureter and being relatively large, it will hold a sufficient amount of liquid fuel in reserve for the carbureter to keep the latter filled by gravity while the valve 17 is open to condition the carbureter for quick starting of the engine on the operation of its auxiliary starting devices. With the valve 17 open and the engine dead, the system including its receptacle 9, is open to the atmosphere through the intake manifold 1, and the tubes or conduits 7, 8, and the pump 6, which is usually above the tank 5, may drain into the tank, thus requiring the suction effort of the engine on its rotation by the starting devices to prime the pump and the rest of the system to condition it for force feed operation.

In providing a reserve supply of liquid fuel for the carbureter the receptacle 9 must be made considerably larger than required merely to accommodate the float 15 and its valve 17 and its cage 14. This naturally increases the cost of the fixture, and adds to the cost of the entire system. To save expense in this regard, I make the system as illustrated in Fig. 5. This system operates on the same principle and in the same manner as before, the only material difference being in the size and location of the float containing receptacle. As shown in Fig. 5, the receptacle 22 is located below the carbureter 23, but above the pump 24 which is the same as the pump 6 and is connected by tubes 25, 26, with the supply tank 27, and the receptacle 22, respectively.

With the receptacle 22 located below the carbureter 23, it is necessary to provide a rather long length of tubing 28 to connect the top of the receptacle to the intake manifold 29 of the engine. The tube 26 which leads from the discharge side of the pump 24 is connected to the bottom of the receptacle 22 instead to the top of the same through its cap 30, as in Fig. 1.

The body of the receptacle 22 may be made in the form of a casting having two vertically arranged chambers 31, 32, located side by side and separated by a partition wall 33, as shown in Fig. 6. The chamber 31 contains the float 34 and is made just large enough to accommodate the float and permit it to have the required freedom of up and down movement without the necessity of providing any guides for the float other than the upright walls of the chamber. The tube 28 is connected to the cap 30 of the chamber 31 and opens into the center of said chamber through a passage 35 in said cap. The inner end of this passage is provided with a tapered seat 36 for a ball valve 37 carried on the upper side of the float 34 so as to open and close the passage 35 in the rising and falling of the float.

The chamber 32 contains a ball check 38 to close a port 39 in the bottom of the chamber, through which port the chamber 32 is connected to the chamber 31 by a passage 40 cored or drilled in the body of the receptacle 22. The chamber 32 contains a guard 41 in the form of a rod depending from a closing plug 42 to prevent undue displacement of the ball check 38 in its opening movement.

When the engine, with which the system of Fig. 5 is equipped, is idle, the float 34 lowers as soon as the engine stops and the system is open to the atmosphere through the manifold 29 by the valve 37 being open. This permits the system from the chamber 31 to drain into the supply tank 27. The carbureter 23 cannot drain into the tank or into the chamber 31 because its chamber 32 is closed at its bottom by the ball check 38.

When the engine is rotated, preliminary to starting by the operation of the engine starting devices, the suction effort of the engine acts on the system through the chamber 31 to prime the pump and fill the chamber 31 with liquid fuel from the tank 27. The rotating pump 24 aids the suction and as soon as the chamber 31 is filled with liquid fuel, the float 34 rises and closes the valve 37. This cuts off the suction effort on the system and the pump 27 acts as before to supply the carbureter 24 with liquid fuel by a force feed through the chambers 31 and 32, the ball check 38 being lifted off its seat by the pressure built up by the rotating pump.

In both systems, the suction effort of the engine during the starting period is employed to prime each system and its pump. Thereafter both systems automatically operate to supply liquid fuel to the carbureter on the force feed principle with all the advantages of a force feed operation. In both of the systems, the action of cutting in and out the suction effort of the engine is out of the control of the operator so that the suction of the engine is automatically set in operation whenever the systems require priming to condition them for their regular and intended force feed operation. While each system as a whole is one complete and integral system, each system is composed of two interconnected systems, one operating on the vacuum or suction principle for priming the other system and its force feed pump, and said other system thereafter operating on the force feed principle. In both systems, the liquid fuel is supplied to the carbureter or mixing device by the pump at a continuous pressure above that of the atmosphere. This makes possible the most desirable fuel metering conditions in the mixing device as well as a rapid and positive delivery thereto at all times regardless of the angularity of the vehicle. In having the liquid fuel for the mixing device pass through the receptacle 9 or 22, the liquid contents of the latter are maintained relatively cool by the incoming cooler fuel from the supply tank. This serves to keep the fuel in the receptacle below a temperature at which it will boil or vaporize either in extremely hot weather as well as when the receptacle is mounted directly on the manifold and close to the engine where it would be within the influence of the heat radiated therefrom. Another reason why this can be accomplished is because the liquid contents of the receptacle by the force of the pump thereon is rapidly changing which allows the receptacle to be made much smaller than the conventional vacuum tank with the resultant reduction in the outside area.

In Fig. 4, I have shown a cheaper and simpler way of connecting the float containing receptacle to the intake manifold of the engine when using the system of Fig. 1. As illustrated in Fig. 4, the cap 43 of the receptacle 44 (similar to receptacle 9) is provided with an integral web 45 which projects up from the cap and extends across the same on its outside side. Said web has passage 46 which opens at its inner end by a downward turn into the receptacle 44 through the cap and at its outer end through the exterior of the lug where it has flanges 47 for attaching the cap to the front side of the manifold 48 as shown in Fig. 4. The manifold 48 is provided with a flat surface on its front side to seat the flanges 47 and there has a port 49 to connect the passage 46 with the interior of the manifold. Gaskets may be placed between the manifold and the attaching parts of the cap 43 to make a gas-tight joint.

The details of structure and arrangement of parts shown and described may be vari-

ously changed and modified without departing from the spirit and scope of my invention.

I claim as my invention:

1. The combination with an internal combustion engine, carbureter and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, a check valve in the system at the carbureter, and means connected to the engine suction and to the system between the check valve and the discharge side of the pump for conditioning the system for regular operation above atmospheric pressure and for automatically controlling the priming of the system and the pump by engine suction, said means in its operation being responsive only to engine suction and the discharge fluids from the pump.

2. The combination with an internal combustion engine, carbureter and liquid fuel supply system, of a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, a check valve in the system in advance of the carbureter, a device connected to the engine suction and to the system between the check valve and the discharge side of the pump, and a valve in said device for automatically opening and closing the same to the engine suction, said valve being responsive only to the engine suction and to the discharge fluids from the pump for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open and for conditioning the system for regular operation above atmospheric pressure when the valve is closed.

3. The combination with an internal combustion engine, carbureter and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, a check valve in the system in advance of the carbureter, a chamber connected to the engine suction and to the system between the check valve and the discharge side of the pump and through which chamber the fuel passes from the pump to the carbureter, and a float valve in said chamber for automatically opening and closing the same to the engine suction, said valve being responsive only to the engine suction and to the discharge fluids from the pump for conditioning the system for regular operation above atmospheric pressure when the valve is closed and for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open.

4. The combination with an internal combustion engine, carbureter and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carbureter, a check valve in the system in advance of the carbureter, a chamber connected to the engine suction and to the system between the check valve and the discharge side of the pump and through which chamber the fuel passes from the pump to the carbureter, and a float valve in said chamber for opening and closing the same to the engine suction, said valve being responsive only to the engine suction and to the discharge fluids from the pump for conditioning the system for regular operation above atmospheric pressure when the valve is closed and for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open, said chamber being located above the carbureter and being of a size to provide a head of liquid fuel therefor.

5. The combination with an internal combustion engine, carbureter and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carbureter, a check valve in the system in advance of the carbureter, a chamber connected to the engine suction and to the system between the check valve and the discharge side of the pump and through which chamber the fuel passes from the pump to the carbureter, and a float valve in said chamber for opening and closing the same to engine suction, said valve being responsive only to the engine suction and to the discharge fluids from the pump for conditioning the system for regular operation above atmospheric pressure when the valve is closed and for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open, said chamber being located above the carbureter and being connected at its lower end to the carbureter and at its upper end to the discharge side of the pump so as not to drain into the pump on stopping the same.

6. The combination with an internal combustion engine, its intake manifold, carbureter and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carbureter, a check valve in the system in advance of the carbureter, a device connected to the engine suction through the manifold and to the system between the check valve and the discharge side of the pump, and a valve in said device for automatically opening and closing the same to the engine suction, said valve in its operation being responsive only to the engine suction and to the discharge fluid of the pump for conditioning the system for regular operation above atmospheric pressure when the valve is closed and for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open, said device being attached to and directly supported by the manifold.

7. The combination with an internal com-

bustion engine, carbureter and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, a check valve in the system in advance of the carbureter, a chamber connected to the engine suction and to the system between the check valve and the discharge side of the pump and through which chamber the fuel passes from the pump to the carbureter, the passing fuel also serving to keep cool the liquid contents of the chamber, and a valve in said chamber for automatically opening and closing the same to the engine suction, said valve being responsive only to the engine suction and to the discharge fluid from the pump for conditioning the system for regular operation above atmospheric pressure when the valve is closed and for conditioning the system for the automatic priming thereof and the pump by engine suction when the valve is open.

8. The combination with an internal combustion engine, and liquid fuel supplying system therefor, of means including a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, means connected to the engine suction and to the system between the carbureter and the discharge side of the pump for controlling the automatic priming of the system and the pump by engine suction and the operation of the system above atmospheric pressure, said means in its operation being responsive only to the engine suction and to the discharge fluid from the pump, and valve means at the carbureter for closing the system to the atmosphere when priming the same.

9. The combination with an internal combustion engine, carbureter and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carbureter at a pressure above that of the atmosphere, a chamber connected to the engine suction and to the system between the carbureter and the discharge side of the pump, a float valve in said chamber reponsive only to engine suction and to the discharge fluid from the pump for automatically opening and closing the chamber to engine suction for controlling the operation of the system above atmospheric pressure and the priming of the system and the pump by engine suction, said chamber being formed to provide a pocket therein above the valve for the accumulation of air or vapors to form an elastic cushion for the liquid fuel in said chamber, and means for closing the system at the carbureter to the atmosphere.

In testimony whereof I affix my signature.

LESTER P. BARLOW.