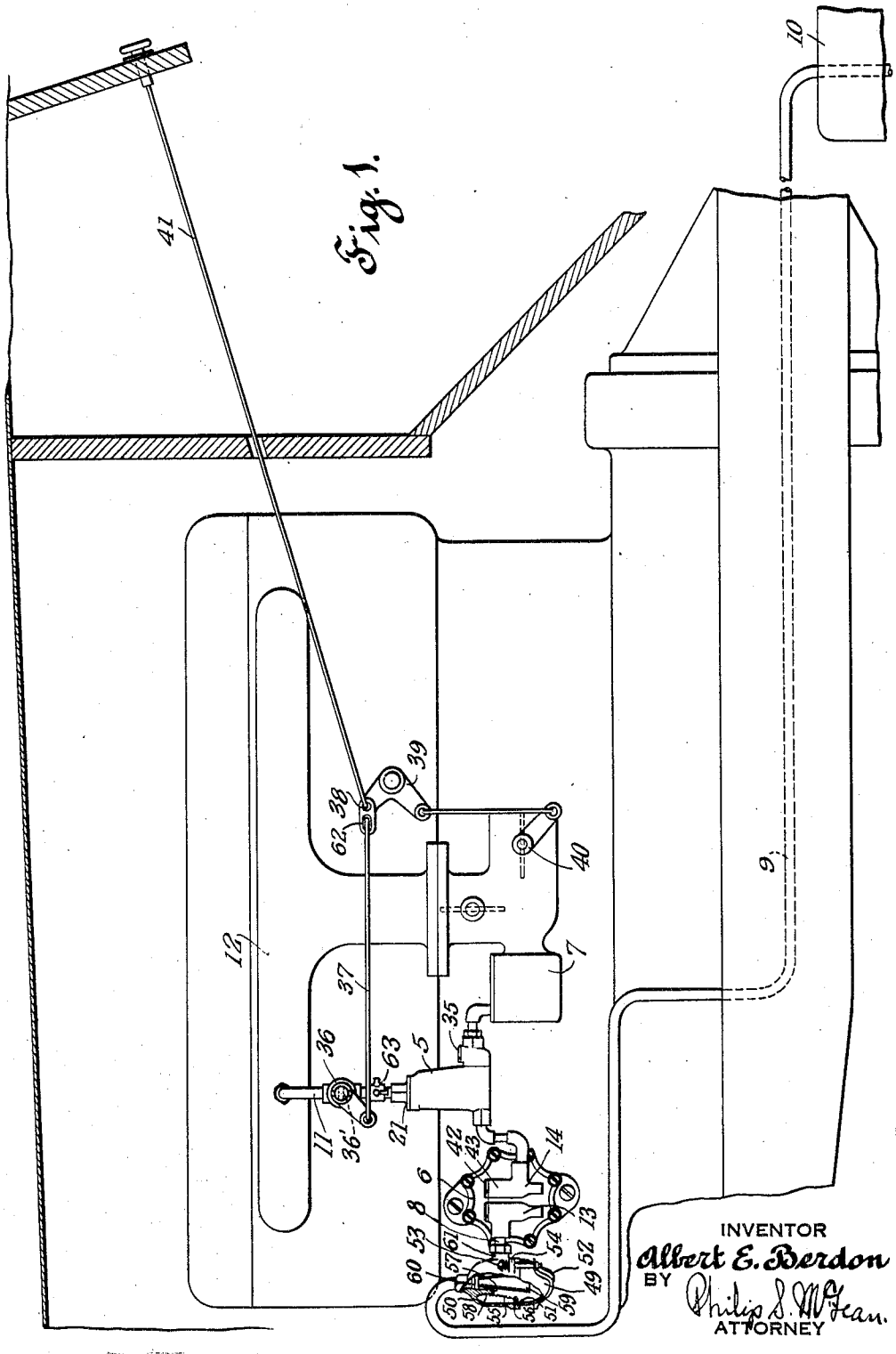
Oct. 6, 1931. A. E. BERDON 1,826,119

LIQUID FUEL SUPPLY SYSTEM

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Fig. 1.




INVENTOR
Albert E. Berdon
BY Philip S. McLean.
ATTORNEY

Oct. 6, 1931. A. E. BERDON 1,826,119

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Fig. 3.

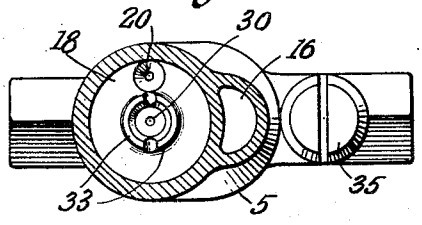
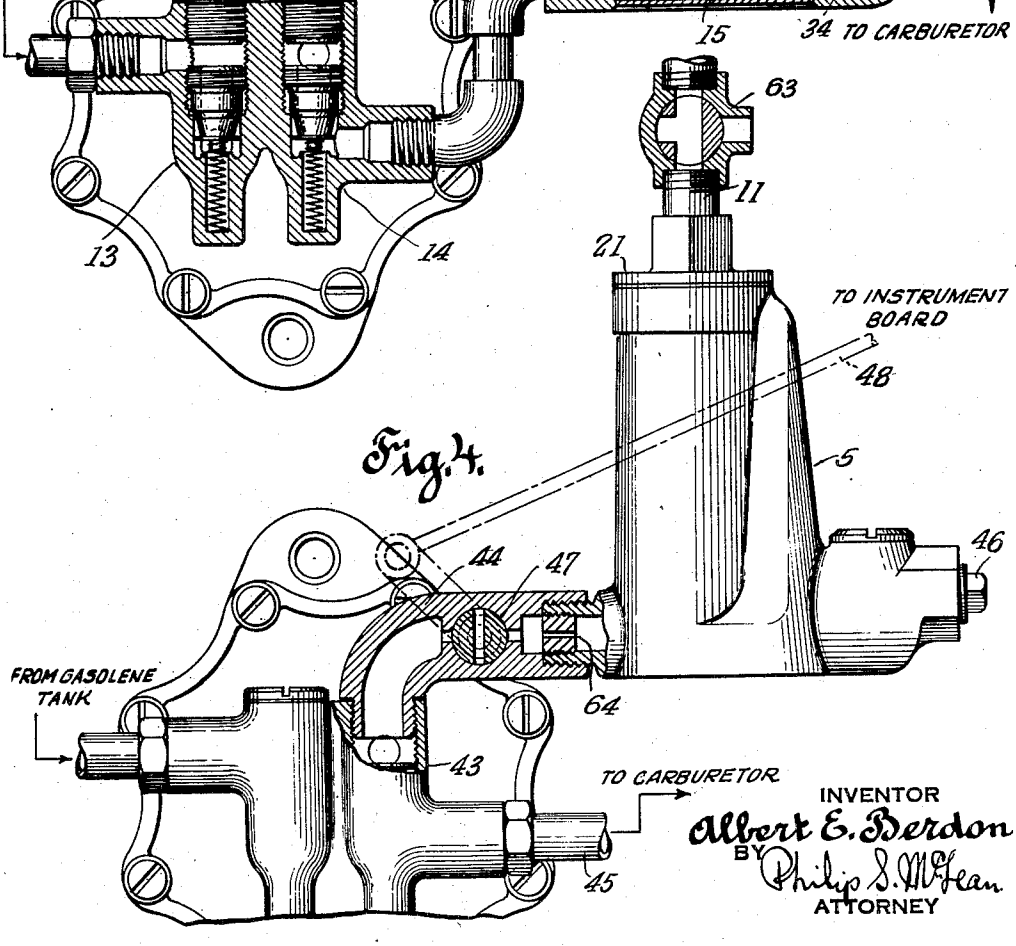



Fig. 2.




Fig. 4.




INVENTOR
Albert E. Berdon
BY
Philip S. McLean
ATTORNEY

Patented Oct. 6, 1931

1,826,119

# UNITED STATES PATENT OFFICE

ALBERT E. BERDON, OF DETROIT, MICHIGAN, ASSIGNOR TO A C SPARK PLUG COMPANY, OF FLINT, MICHIGAN, A CORPORATION OF MICHIGAN

## LIQUID FUEL SUPPLY SYSTEM

Application filed November 9, 1928. Serial No. 318,163.

This invention relates to the furnishing of liquid fuel to internal combustion engines and the like, and is particularly concerned with what is known as the Berdon system in which a small efficient pump driven by the engine provides the flow of fuel from a supply tank to the carburetor.

Under certain conditions and particularly in automobile service where the liquid is subjected to considerable agitation and heat, air and vapor are entrained and mingled with the liquid, reducing the efficiency and under some extreme conditions affecting the operativeness of fuel pumping systems.

Special objects of the invention are to effectively separate substantially all vapor and air from the liquid fuel in a pumping system and, in the case of an internal combustion engine to direct the liquid to the carburetor and the air and vapor to the intake manifold of the engine.

Further special objects are to utilize the pumping ability of the engine to effect the removal of the air and vapor from the liquid fuel, thus relieving the pump of this duty and enabling a relatively small size pump to be used; to utilize the pumping effect of the engine to actually aid the pump in maintaining the liquid flow to the fuel consuming device; to utilize the pumping effort of the engine to effect rapid and complete priming of the entire liquid supply system; and to automatically compensate and smooth out the pump impulses in the liquid flow.

The invention involves many novel features of construction, combination and relations of parts including in particular an automatic liquid and gas separator interposed in the flow line having its liquid side connected with the carburetor or fuel consuming device and its vapor side connected with the intake of the engine.

The details of the invention will appear as the specification proceeds.

The drawings accompanying and forming part of this specification illustrate certain practical embodminets and uses of the invention, but it will be understood that the invention is of broader scope than this particular disclosure and that the specification and claims are to be interpreted accordingly.

Fig. 1 is a broken side and part sectional view of an embodiment of the invention on an automobile engine; Fig. 2 is an enlarged broken sectional detail view of the combined separator and pump mechanism; Fig. 3 is a horizontal sectional view as on line 3—3, Fig. 2; Fig. 4 is a view similar to Fig. 2 illustrating a modified use of the separator.

The so-called separator is indicated at 5 in Fig. 1 connected in between the engine driven fuel pump 6 and the float valve control bowl 7 of the carburetor. There is also shown in this same view at 8 a flow regulator and screen, of the general construction disclosed in application 243,781 interposed in the supply line 9 extending from the supply tank 10 to the inlet side of the pump. The separator passes the liquid from the pump to the carburetor and has a connection 11 by which the "tops" or lighter products, the vapors and air in the fuel pass off and are consumed in the engine in this case by way of the intake manifold 12.

The pump is illustrated as of the Berdon diaphragm type Patent 1,647,768 operated from the cam shaft of the engine and having, as shown in Fig. 2, intake and exhaust valves 13, 14 operating with the pulsations of the diaphragm to effect transfer of liquid from the storage tank to the carburetor.

The separator as particularly shown in Fig. 2 consists of a relatively small casing which may be and usually is of a size to hold a sufficient body of priming liquid, say about one-half pint and which is constructed to effect a rapid separation of the lighter products from the liquid. In this disclosure, the liquid entering at the left flows into a relatively wide enlargement or chamber 15 from which rises a gradually contracting throat 16 having at the top one or more vapor outlets 17 communicating with a liquid well or float chamber 18. The chamber 15, it will be observed widens out gradually from the entry side permitting the inflowing fluid to expand so as to release content gas and air and the upward travel of the latter is facilitated by the generally upwardly inclined roof 19 of this chamber, thus enabling the entrained

lighter products to pass off readily up through the throat portion 16 and out through the vapor outlet at the top into the upper portion of the inside well or chamber 18. The latter is in communication at the bottom with the first liquid chamber 15 by means of a depenedent spout 20 having a downwardly contracted outlet opening into the lower liquid containing portion of chamber 15. Spout 20 must extend down low enough in chamber 15 to draw only clear liquid since vapor or air mixed with liquid in chamber 18 would so reduce the buoyancy of the fluid in chamber 18 as unfavorably to influence the proper closing sequence of valve 23. The air and vapor naturally rise to the upper strata of the separating chamber 15. The conical form of spout 20 leading to chamber 18 reduces the velocity of impact of the liquid jet against the lower end of the float and thus reduces the tendency to vibrate the float and cause imperfect valve action at 23.

The vapor take-off 11 communicates with the upper end of chamber 18, being shown as entered into a plug 21 screwed into the top of said chamber and to prevent liquid from being drawn off from the manifold suction through this vapor line, a float valve is provided in the chamber shown in the form of a light small diameter float 22 carrying a needle valve 23 for engaging valve seat 24 in the plug or cap 21 at the mouth of pipe 11.

A splash guard is shown at 25 in the form of a disc-like partition seated in the plug below the valve having an annular series of perforations 26 and a central guide 27 for the stem of the needle valve. With rise in the liquid level, it will be seen that the float valve will close off the vapor outlet in time to prevent withdrawal of liquid through that line, the parts being proportioned and designed to close this outlet while there is still a considerable vapor space above the float and in the upper extension of the entry chamber 15, the liquid level in the two chambers being substantially the same through the communicating passage provided at 20.

In the operation of the pump, it will be evident that a certain amount of pressure will be built up in the so-called air chamber or vapor space provided above the liquid in the two chambers. The pulsating diaphragm movements and valve actions of the pump produce synchronous compressions and expansions of the air and vapor and since air and vapor are more mobile than liquid and since the float cross section area is a large percentage of the cross section area of the chamber 18 there results a tendency of the float to vibrate in unison with the pump impulses. If the needle valve is integral with the float such vibrations cause or permit of gradual withdrawal by the manifold of all air and vapor and ultimate passage of liquid thru the conduit to the manifold thus defeating the purposes of the device. To overcome these tendencies, the valve and its float are resiliently connected so that the valve will be held closed despite fluctuation of the float. This resilient connection is illustrated as provided by a series of spring fingers 28 fastened at the center on the valve stem and bearing lightly on top of the float, the float having a loose motion over the valve stem against a stop shoulder 29 on the lower end of the stem. This lower end is shown as guided in a passage 30 in the bottom of chamber 18 so that the movement of valve stem and float will be straight up and down. The buoyancy of the float is sufficient to carry the needle valve firmly to its seat and the tension of the spring fingers 28 is sufficient to lift the valve stem to the valve closing position, from which it will be evident that the valve will remain closed even though the float be depressed by pressure building up in the vapor space. Hence, valve chattering tendencies created by the pump pulsations are overcome and the vapor take-off kept closed until and unless the liquid level is lowered to the point where the vapor should be drawn off. The shoulder 31 on the valve stem forms an abutment for the spring arms insuring that the float will positively close the valve against any failure or weakening of the compensating spring.

The plug or closure 21 is shown as having an annular flange 32 forming a guard over the vapor inlet 17. The float in its lowest position is indicated as resting on projections 33 above the bottom of the chamber 18.

A check valve is indicated at 34 opening to the carburetor tensioned by a light spring 35 to prevent draining back of the liquid, which might result from a leaky float valve in the carburetor in cases where the separator is placed at a lower level than the carburetor. The check valve is essential to prevent the manifold suction from withdrawing liquid from the carburetor float bowl that might result as when cranking at slow speed and full choke when pump alone may be unable to supply sufficient liquid to keep carburetor float bowl needle valve closed. Usually however, the separator will be placed at a higher level than the float chamber, as indicated in Fig. 1.

The outlet valve 14 of the pump in the disclosure serves to trap the liquid in the separator and to hold the same as a reserve supply, useful for priming purposes.

From the description thus far, it will be apparent that the suction of the motor will be utilized to draw off vapors from the fuel being pumped into the intake and that the liquid freed of such vapors will pass on into the carburetor, the result being that the vapors are utilized and at the same time the carburetor mixture is kept constant. This

intake suction in addition to carrying off the vapors at times slightly reduces the pressure at the discharge side of the pump, thus in effect augmenting the action of the pump and enabling a comparatively small pump to furnish at all times an ample supply of fuel. For example, at small throttle openings or when an air choke is used in the carburetor the intake vacuum is sufficient to pull liquid or (liquid and vapor) from the main supply tank up thru the line and both pump valves and to a liquid level in the separator where the valve 23 closes off manifold connection thus effectively priming the entire system at slow cranking speeds when the pump without such help would be insufficient. The vapor cushion also operates as a compensating action, evening out the pump pulsations and causing a relatively smooth flow of liquid to be passed onto the carburetor. The relatively powerful suction manifested by the motor also has the effect of priming the entire pump system enabling quick starting.

At times, when this extra "pumping" action is not required or desired, the manifold connection may be shut off as by means of a valve indicated at 36 in the vapor suction line and controlled for instance, by means of a rod or wire 37. This control may be operated from the dash and may, if desired, be coupled up with the "choke" control, as illustrated in Fig. 1, where it is shown connected at 62 with the bell crank 39 for operating the carburetor choke valve 40, the operation of the bell crank being effected by a choke rod 41 extending from the bell crank at 38 to the dash or other convenient location. It will be seen that when the rod 41 is pulled to choke the motor, the port 36′ of the valve 36 in the vapor suction line will be open and that when the choke is not in service, the vapor suction line will be closed. It is sometimes desirable to have the dash control arranged so that only a full choke position will cause the manifold to become effective in removing vapor from the line to cause quick priming and to this end the pull rod 37 may be operated by a lost motion slot such as shown at 62 in the bell crank 39 so that normal use of the choke will not serve to connect passage 11 to the manifold and such that only the full in (or wide open choke) position of choke control will cause closure of valve 36.

If desired, the vapor separator may be connected in a "parallel" instead of in a "series" relation with the pump and carburetor as indicated in Fig. 4, where the same is shown connected with its inlet side directly over the exhaust valve of the pump. This change is readily effected by removal of the plug 42 in the top of the pump outlet valve cavity and the replacement of said plug by the inlet neck or fitting 44 of the separator. In such case, the pump is left directly in the line with the discharge from the pump passing through pipe 45 to the carburetor and the separator is then in effect coupled in parallel with this line, "dead ended" at its liquid outlet side as by means of a plug 46 and having its vapor outlet connected with the intake manifold as before. A valve 47 placed at the inlet enables the separator in this case to be cut off from the pump. The exhaust valve of the pump in this particular arrangement then operates as a check valve for the separator, obviating return of fuel thereto from pipe 45. By means of the rod 48 controlling valve 47, the liquid in the separator may be held as a reserve supply and released to the carburetor when required for priming or the like. The normal functions of removing air and vapor from the fuel supply and quick priming thru manifold suction are performed as in series relation: but in this case the air chamber does not act so effectively as an outlet pressure regulator.

The structure of Fig. 1 may be operated by connection with the choke control either solid or by slotted linkage as before described to suit various requirements.

The regulator and strainer 8 which is interposed at the suction side of the pump is shown as constructed with a removable and preferably transparent bowl 49 held to the bottom of an inverted bowl-shaped casing 50 against a packing gasket 51 by a bridge 52 and spring supported screws 53 dependent from lugs 54 on the side of the casing. The strainer 55 is shown as of frusto-conical form having a flange 56 at the base sealed at the joint between the two members and having a flange 57 at the top engaging the dependent tubular sleeve portion 58 in the top of the casing. An inverted funnel shaped dispersing throat 59 is shown screwed into the upper end of the casing at 60, which forms with the wall 58 an annular air chamber space in the top of the casing above the liquid outlet 61. The air cushion thus created serves to even the impulses at the suction side of the pump, aiding the flow through the relatively long supply pipe to the pump and in cooperation with the air cushion of the separator enabling the pump though of relatively small size to meet the most extreme fuel requirements of the engine.

The liquid entering the top of the regulator through the wide mouth dispersing and velocity reducing tube 59, drops any foreign matter into the bowl 49 and rises up through the screen through the outlet 61, forming a liquid seal trapping the cushion of air about the down-flow pipe. The slowing up of the flow in this down-pipe and the air cushion about the same cooperate to reduce turbulence and insure the pump taking solid fuel. The air cushion is kept charged by evaporation of the liquid under the conditions of partial vacuum and by the trapping of air entrained

in the fluid being pumped being added to the air initially in the chamber.

The bowl 49 of the regulator is readily removable by pulling down on the same against the tension of the spring supported bolts, or by loosening the bolts the necessary extent. Thus water and screened-out particles may be quickly removed from the system and the screen itself as well as the dispersal throat may be taken out when the bowl has been removed.

The combination of the regulator at one side and the separator at the other side of the pump produces a pump action which is remarkably quiet and smooth and enables the pump to easily transmit a greater and more continuous flow of liquid than has heretofore been attained in a pump of the same given size. This will be understood upon considering that the suction pull of the pump produces a rarification of the air cushion in the regulator and that upon the closing of the pump intake, the flow continuing by inertia in the supply pipe. This cushion is compressed, storing energy to deliver liquid into the pump chamber the instant the intake valve opens. Concurrently, at the opposite side of the pump the relatively powerful suction of the engine is being applied to the liquid delivered by the pump, in the course of removal of the gas, and this lowered pressure may result in a drawing of the liquid from the pump practically as fast as the outlet valve of the pump will permit. The action of the pump may thus be aided at both sides and a positive supply of liquid assured even under the most adverse circumstances, such for instance, as result from hard running for extended periods in hot weather. Under such circumstances, and particularly after a stop has been made, the gasolene sometimes becomes so highly heated as to give off so much vapor that without the invention disclosed the pump will not prime itself and the entire pumping system therefore becomes inoperative. With this invention however, these conditions can not exist, because as soon as the engine is "cranked" the vapors in the line are drawn off and the pump immediately starts drawing liquid from the source of supply. With the regulator placed at the pump as indicated, the pump is actually "primed" at the start and so, will positively function even under the most extreme conditions.

The pump will function regardless of the vertical relation of the pump and separator but liquid from the separator will only flow by gravity to the carburetor when the separator is, as preferable, mounted above the level of the carburetor.

If the de-airing or de-gassing effect of the separator is not wanted, the same can be discontinued by closing the valve 36, leaving the separator then to function as a regulator aiding the pump in maintaining a continuous even flow.

Passage of liquid through the vapor take-off line is automatically prevented by the flow valve 23 which functions whenever the liquid rises in the separator beyond a predetermined point; and, as heretofore explained, the spring connection at 28 between the valve and float enables the float to hold the valve closed even with fluctuations in pressure in the air or gas chamber.

If desired, it is possible, within the present disclosure to simply connect the vapor take-off to atmosphere by means of the pet cock indicated at 63 in Figs. 1 and 4. This cock as shown, in one position establishes a passage between the vapor chamber and intake manifold and in a second position closes off connection to the manifold and establishes communication between the vapor chamber and atmosphere. This two-way valve may obviously be set to close the outlet pipe 11, and it may be manually operated and may have an operating connection extending to the dash.

A restriction is indicated at 64 in Fig. 4 to reduce the manifold suction when the separator is used in this way.

While the present embodiment of the invention has been found to be particularly efficient and practical, it will be apparent that many possible changes and modifications may be made in structure and arrangement, all within the broad scope of the appended claims.

What is claimed is:

1. In a liquid fuel supply system for internal combustion engines, reciprocatory liquid fuel pumping means connected to supply the engine, a vapor separator interposed in said connections and a vapor take-off extending from said separator directly to the intake manifold of the engine.

2. In a liquid fuel supply system for internal combustion engines, reciprocatory liquid fuel pumping means connected to supply the engine, a vapor separator interposed in said connections, a vapor take-off extending from said separator to the intake of the engine and means in said separator for automatically closing said vapor take-off against passage of liquid therethrough.

3. In a liquid fuel supply system for internal combustion engines, reciprocatory liquid fuel pumping means connected to supply the engine, a vapor separator interposed in said connections, a vapor take-off extending from said separator to the intake of the engine, and means for closing off said vapor take-off without shutting off flow of liquid through the separator.

4. The combination with a liquid fuel consuming device and reciprocatory means for supplying liquid fuel thereto at a pressure above that of the atmosphere, a vapor sep-

arator associated with said supply means and a vapor take-off for conducting separated vapors from said separator to the liquid fuel consuming device.

5. The combination with a liquid fuel consuming device and reciprocatory means for supplying liquid fuel thereto, a vapor separator associated with said supply means, a vapor take-off for conducting separated vapors from said separator to the liquid fuel consuming device and means for automatically closing said vapor take-off against passage of liquid.

6. The combination with a liquid fuel consuming device and reciprocatory means for supplying liquid fuel thereto, a vapor separator associated with said supply means, a vapor take-off for conducting separated vapors from said separator to the liquid fuel consuming device and with means for closing off the vapor take-off without shutting off flow of liquid through the separator.

7. In combination with an engine having an intake and a carburetor connected thereto, reciprocatory pumping means connected to supply liquid fuel to said carburetor, a gas separator interposed in said liquid side connections to the carburetor and a vapor take-off extending from said separator to the engine intake above said carburetor.

8. In combination with an engine having an intake and a carburetor connected thereto, reciprocatory pumping means connected to supply liquid fuel to said carburetor, a gas separator interposed in said liquid side connections to the carburetor, a vapor take-off extending from said separator to the engine intake above said carburetor and means for automatically closing said vapor take-off to flow of liquid.

9. In combination with an engine having an intake and a carburetor connected thereto, reciprocatory pumping means connected to supply liquid fuel to said carburetor, a gas separator interposed in said liquid side connections to the carburetor, a vapor take-off extending from said separator to the engine intake above said carburetor and means for automatically closing said vapor take-off against flow of liquid and irrespective of pressure variations in said separator.

10. In combination with a liquid fuel consuming device and reciprocatory means for supplying liquid fuel thereto, a vapor separator connected with said liquid supply means to pass liquid to the consuming device, a vapor take-off extending from said separator and means for automatically closing said vapor take-off against liquid flow and for holding same closed irrespective of pressure variations in the separator.

11. In combination with an internal combustion engine having an intake manifold and a carburetor connected therewith, a liquid fuel tank, a reciprocatory liquid fuel pump operated by the engine, a supply line extending from the supply tank to the intake side of the pump, an air cushion trapping flow regulator interposed in said supply line between the tank and intake side of the pump, a continuation of the supply line extending from the discharge side of the pump to the carburetor, a vapor separator interposed in said continuation of the supply line having a liquid chamber in communication with said supply continuation and a gas chamber in communication with said liquid chamber and a gas take-off extending from said gas chamber to the intake of the engine above the carburetor.

12. In combination with an internal combustion engine having an intake manifold and a carburetor connected therewith, a liquid fuel tank, a reciprocatory liquid fuel pump operated by the engine, a supply line extending from the supply tank to the intake side of the pump, an air cushion trapping flow regulator interposed in said supply line between the tank and intake side of the pump, a continuation of the supply line extending from the discharge side of the pump to the carburetor, a vapor separator interposed in said continuation of the supply line having a liquid chamber in communication with said supply continuation, a gas chamber in communication with said liquid chamber, a gas take-off extending from said gas chamber to the intake of the engine above the carburetor, said flow regulator and gas separator automatically maintaining air cushions on the liquid flow line at opposite sides of the pump and the gas separator having a float valve for automatically closing the vapor take-off on rise of liquid beyond a predetermined point therein.

13. In combination with an internal combustion engine having an intake manifold and a carburetor connected therewith, a liquid fuel tank, a reciprocatory liquid fuel pump operated by the engine, a supply line extending from the supply tank to the intake side of the pump, an air cushion trapping flow regulator interposed in said supply line between the tank and intake side of the pump, a continuation of the supply line extending from the discharge side of the pump to the carburetor, a vapor separator interposed in said continuation of the supply line having a liquid chamber in communication with said supply continuation and a gas chamber in communication with said liquid chamber, a gas take-off extending from said gas chamber to the intake of the engine above the carburetor, said flow regulator having a liquid well disposed above the pump intake and the liquid chamber in the separator being disposed above the carburetor intake.

14. A vapor separator for use in a liquid fuel system containing a reciprocatory pump supplying an engine, said separator compris-

ing a casing having a liquid passage therethrough and a liquid chamber forming a portion of said passage and provided with an upwardly extending gas passage, a vapor chamber in the upper portion of the casing and in communication with said liquid passage, a vapor relief in the upper portion of the casing, a valve controlling said vapor relief and a float controlling said valve, said relief being connected with said engine.

15. A vapor separator for use in a liquid fuel system containing a reciprocatory pump supplying an engine, said separator comprising a casing having a liquid passage therethrough and a liquid chamber forming a portion of said passage and provided with an upwardly extending gas passage, a vapor chamber in the upper portion of the casing and in communication with said liquid passage, a vapor relief in the upper portion of the casing, a valve for controlling said vapor relief, a float for closing said valve and a resilient connection between said valve and float enabling the latter to hold the valve closed irrespective of varying pressure conditions in the casing, said relief being connected with said engine.

16. A vapor separator for use in a liquid fuel system containing a reciprocatory pump supplying an engine, said separator comprising a casing having a liquid passage therethrough and a liquid chamber forming a portion of said passage and provided with an upwardly extending gas passage, a vapor chamber in the upper portion of the casing and in communication with said liquid passage, a vapor relief in the upper portion of the casing, a valve controlling said vapor relief and a float controlling said valve, the casing having a separate chamber therein containing said float and which chamber is in communication at the bottom with the lower portion of the liquid chamber, said relief being connected with said engine.

17. In combination with an internal combustion engine provided with a liquid supply line containing a reciprocatory pump, a liquid-vapor separator interposed in said supply line and provided with a liquid flow passage and with a vapor take-off chamber, a take-off connection between said chamber and the intake of the engine and valve means in said vapor take-off means operable to establish communication between said vapor chamber and the engine intake or to close the engine intake and to establish communication between the vapor chamber and atmosphere.

18. In combination with an internal combustion engine having a reciprocatory fuel pump and also a carburetor provided with a "choke", a liquid vapor separator connected with the liquid supply side of the carburetor and having a vapor separating chamber connected with the intake of the engine, a valve interposed in the vapor connections with the intake and operating connections for said choke and valve, to effect a sequential operation of the same.

19. In fuel supply systems, the combination with an internal combustion engine and a reciprocatory liquid fuel pump for supplying the fuel thereto, of a liquid gas separator connected between the pump and intake of the engine, said separator having a liquid chamber connected with the pump and a vapor take-off chamber connected directly with the intake and flow restricting means in the connection between the pump and the liquid chamber of the separator.

20. The combination with an internal combustion engine, carburetor and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carburetor at a pressure above that of the atmosphere, a check valve in the system at the carburetor, 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.

21. The combination with an internal combustion engine, carburetor and liquid fuel supply system, of a pump for forcing liquid fuel through the system to the carburetor at a pressure above that of the atmosphere, a check valve in the system in advance of the carburetor, 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.

22. The combination with an internal combustion engine, carburetor and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carburetor at a pressure above that of the atmosphere, a check valve in the system in advance of the carburetor, 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 carburetor, 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 dis-

charge 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.

23. The combination with an internal combustion engine, carburetor and liquid fuel supply system therefor, of a pump for forcing liquid fuel through the system to the carburetor, a check valve in the system in advance of the carburetor, 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 carburetor, 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 carburetor and being of a size to provide a head of liquid fuel therefor.

24. The combination with an internal combustion engine, its intake manifold, carburetor and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carburetor, a check valve in the system in advance of the carburetor, 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.

25. The combination with an internal combustion engine, carburetor and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carburetor at a pressure above that of the atmosphere, a check valve in the system in advance of the carburetor, 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 carburetor, 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 automatically priming thereof and the pump by engine suction when the valve is open.

26. 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 carburetor at a pressure above that of the atmosphere, means connected to the engine suction and to the system between the carburetor and 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 carburetor for closing the system to the atmosphere when priming the same.

27. The combination with an internal combustion engine, carburetor and liquid fuel supplying system therefor, of a pump for forcing liquid fuel through the system to the carburetor at a pressure above that of the atmosphere, a chamber connected to the engine suction and to the system between the carburetor and the discharge side of the pump, a float valve in said chamber responsive 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 carburetor to the atmosphere.

In testimony whereof I affix my signature.

ALBERT E. BERDON.