

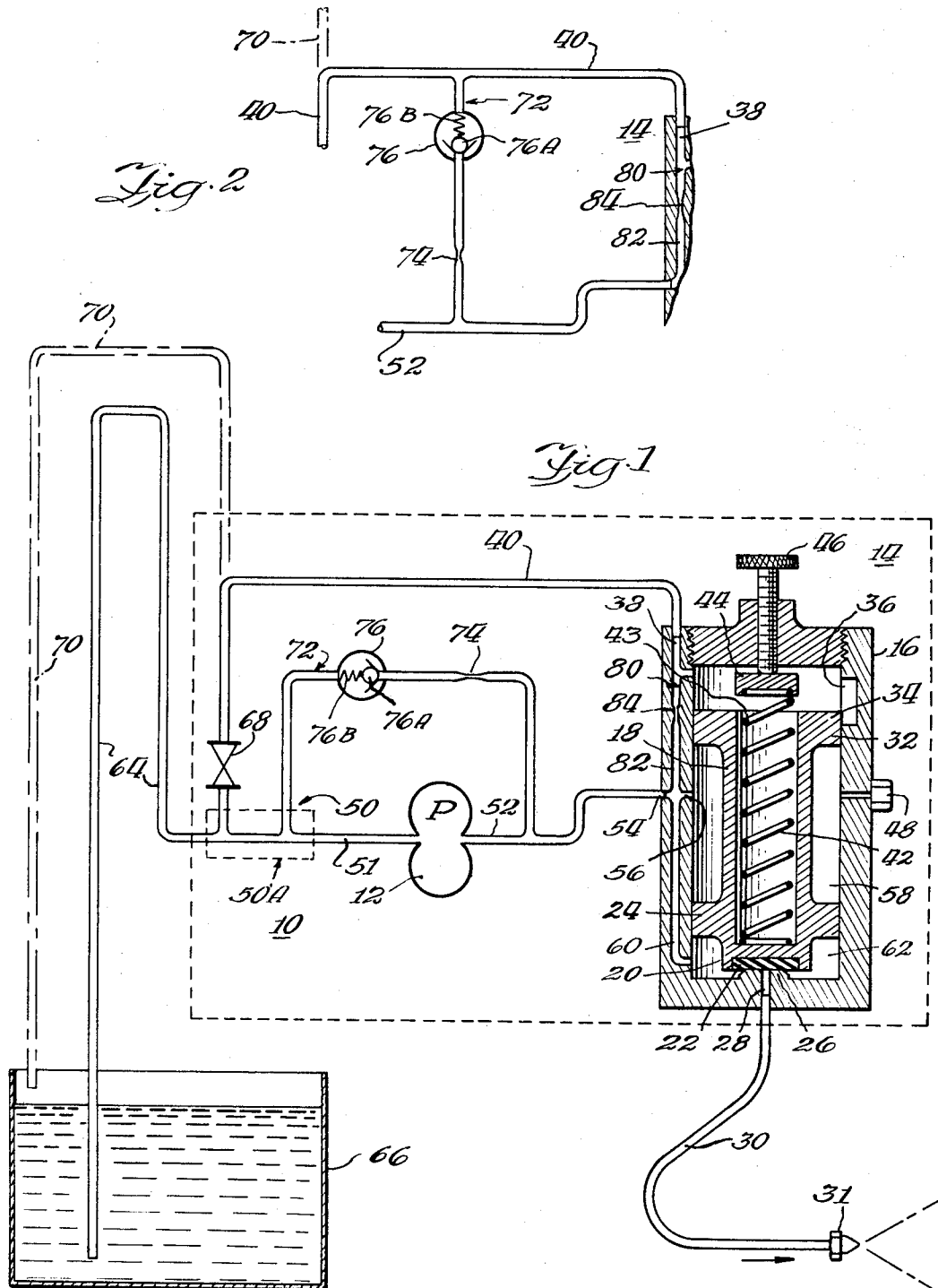
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FUEL SUPPLY APPARATUS

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FUEL SUPPLY APPARATUS

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ABSTRACT OF THE DISCLOSURE

The apparatus provides for automatic purging of air from a single pipe supply system and manual purging (by opening of an air vent) of a two pipe type system combined with high lift and fast cut off. A pump supplies oil through flow cut off-pressure regulating means, such as a duplex valve, as to a burner nozzle. A first flow restricting bypass is connected across the pressure regulating means and a second but less restrictive bypass including normally closed valve means is connected effectively across the pump, preferably directly across the pump outlet and inlet means, the latter being either the pump inlet or the pump inlet chamber with filter means therein supplying the pump inlet. Alternatively, the second bypass may be connected across the outlet and a return line from the pressure regulating means.

This application is a continuation-in-part of application Ser. No. 562,908, filed July 5, 1966, by John C. McAlvay, and assigned to the assignee of this application, now abandoned.

The present invention relates to fuel supply apparatus and has for its primary object the provision of new and improved apparatus particularly adapted for supplying oil to oil burners.

Fuel supply apparatus of the type to which the present invention relates are generally known as fuel units and customarily include an electric motor driven gear type oil pump, a pump inlet chamber comprising a filter, and cut off and pressure regulating valve means, such as a duplex valve, the motor generally also driving a fan supplying air to the burner nozzle. The valve is supplied from the pump outlet and performs primarily two functions, i.e., controlling the flow of oil to a utilization outlet and regulating pressure by causing excess oil to flow to an excess flow outlet adapted selectively to be connected by a return line to the pump inlet chamber in a one pipe system and to a source of fuel such as a fuel tank in a two pipe system.

Difficulties have been encountered with this type of apparatus upon start up, i.e., when first placed in operation after installation or servicing, particularly when used in connection with small heating units having a restricted flue passageway which disturbs combination characteristics to such an extent that fuel units operating satisfactorily elsewhere will not do so when, for example, they are installed in arrangements requiring a high lift of twenty feet or so. Such a high lift is required, for example, when the fuel supply inlet line is arranged in an inverted somewhat U-shaped configuration from the oil tank to the pump with the tank and pump located considerably below the topmost point of the line and with the tank lower than the pump. Further complications arise from a requirement for quick purging of air, for fast cut off of the flow of oil to the nozzle when the pump motor is de-energized, and for purging of air from the apparatus to be effected automatically when the two pipe connections are used. Manual venting through a manually op-

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erable vent valve is considered satisfactory for one pipe operation. If purging of air from the apparatus does not take place in a relatively short period of time, safety devices will de-energize the motor.

Avoidance of disturbances in combustion characteristics is generally achieved by providing the pressure regulator with a bypass. Some have been provided with a small area bypass, generally called a "standard slot" and others, to achieve a fast cut off, with a larger area bypass, generally called a "deep slot." However, the deep slot construction, while providing desirable faster cut off, offers so little restriction to air passage that even a modest lift, e.g., less than the mentioned often required lift of twenty feet or so, will result in recirculation of air through the pump rather than the air being expelled through the manually operable vent valve in two pipe operation. A standard slot provides high lift but not sufficiently fast cut off.

Attempts have been made to overcome the aforementioned difficulties. Passages with normally closed check valves have been connected across the pump outlet and return line or across the pump outlet and pump inlet chamber. Both of these arrangements have utilized a pressure regulator valve having no additional bypass. Other attempts have involved the use of normally closed check valves in the return line from a pressure regulator valve having a standard or deep slot associated therewith. However, the various arrangements of the prior art did not provide high lift on single pipe operation and automatic purging on two pipe operation in combination with fast cut off.

An object of the present invention is to provide a new and improved fuel supply apparatus comprising a fuel supply pump and cut off and pressure regulating means constructed and arranged to operate reliably within short time limits in single pipe and two pipe installations, and which provide a high lift, purges air automatically in two pipe operation, provides fast cut off of the fuel as to a utilization outlet and burner nozzle when the demand for oil is terminated, and which reduces the quantity of oil that needs to be filtered.

In brief, the fuel supply apparatus of the present invention is adapted for both single and two pipe operation and provides high lift, automatic purging of air from the apparatus in two pipe operation, manual purging in single pipe operation, fast purging of air, fast cut off of the flow of fluid, such as oil, to a utilization device which may be an oil burner nozzle, for both one and two pipe operation, and reduces the amount of oil required to be filtered, as well as required to be obtained from a fluid reservoir in two pipe operation. The apparatus includes a pump, which may be of the gear type and have a capacity exceeding requirements of the burner, and a valve of the duplex type controlling the flow of oil to the nozzle and the pressure at which the oil is supplied. Oil is supplied to the nozzle under control of the cut off portion and the pressure is controlled by the pressure regulator portion which returns excess oil through an excess flow return line to the pump inlet chamber for single pipe operation and to a reservoir in two pipe operation. The pressure regulator portion is effectively bypassed by a passageway having a small area restricted orifice, i.e., a standard slot, in parallel with the pressure regulating portion, i.e., across the pump outlet and return line. A second bypass with a relatively larger orifice and a normally closed check valve is effectively connected across the pump outlet and pump inlet means, i.e., to the pump inlet chamber directly to the pump inlet so there is no need to filter the recirculated oil. Alternatively, the second bypass can be connected to the return line. The normally closed check valve and the relatively more re-

stricted bypass across the pressure regulating portion, which is dimensioned to maintain oil in it by capillary force and to prevent the flow of air through it when the vent port is opened, prevent recirculation of air through the pump so that purging of air from the apparatus can be effected manually for a single pipe operation as upon initial start up or after servicing by opening an air vent port communicating with the pump outlet. After the purging the plug is replaced and oil flows through both bypasses in normal operation. Purging is effected automatically for two pipe operation through the relatively more restricted standard slot bypass with the vent port closed, as both oil and air flow through it and the air is purged into the reservoir. During this purging operation, the check valve maintains its associated bypass closed. The check valve opens at a pressure slightly in excess of the pressure generated by the pump with air in the system, i.e., at a pressure somewhat above fifteen p.s.i., so that it is closed for purging of air and thereafter automatically opens in response to higher pressure generated by the pump when pumping oil.

Other objects and advantages of the present invention will become apparent from the ensuing description of illustrative embodiments thereof, in the course of which reference is had to the accompanying drawing, in which:

FIG. 1 illustrates, largely diagrammatically, in embodiment of a fuel supply apparatus constructed in accordance with the present invention; and

FIG. 2 is a fragmentary view of a second embodiment of the invention.

Referring now to FIG. 1, the apparatus of the present invention comprises what is generally known as a fuel unit indicated as a whole by the reference character 10. It comprises an oil pump and duplex valve generally constructed as a unit. The pump 12 may be of the gear type and of a construction such as shown in Patent 2,966,118, McAlvay, granted Dec. 27, 1960, and driven by an electric motor that also drives a fan supplying air to the burner nozzle, the motor and fan not being shown. The duplex valve 14 itself is of conventional "standard slot" construction and constitutes valve means controlling oil to a utilization outlet and regulating the pressure of the oil. The duplex valve is, however, in the combination of the present invention made to provide a fast cut off of the flow of oil to the outlet line when the pump motor is de-energized, as will be described later.

The duplex valve includes a chamber or body 16 and a movable valve portion 18. A cut off portion 20 disposed at one end of portion 18 includes a movable valve element 22 below a land 24 on the movable portion. Element 22 cooperates with a stationary valve seat 26 to control the flow of oil to a utilization outlet 28 connected as by conduit 30 to an oil burner nozzle 31. The outlet is normally closed and is adapted to be opened at some desired pressure, such as about eighty p.s.i.

A pressure regulating portion 32 comprises a land 34 on the movable portion 18 that cooperates with an internal groove or slot structure 36 in the body so that the pressure of oil supplied to the nozzle is regulated by causing more or less of the oil from the pump to flow through the groove structure to an excess flow outlet 38 connected to passageway 40 constituting an excess flow or return line. Adjustment of the pressure maintained by the duplex valve is effected by control of the compression of a spring 42 utilized to bias the movable valve element 18 to its lowermost position, i.e., in a direction to maintain the outlet 28 closed. As illustrated, the spring extends into a central bore 43 within, and an end abuts, the valve portion 18. The upper end of the spring is secured to an abutment 44 adapted to be raised or lowered by adjustment of a thumb screw 46.

Purging of air from the apparatus on start up, i.e., when the apparatus is initially placed into operation or after servicing, is effected manually for the single pipe

connections through an air vent valve 48 effectively connected to the pump outlet and illustrated as being located on the valve body 16. It communicates with a chamber 58, to be referred to further and to which the pump outlet is connected.

The pump 12 has inlet means indicated generally by the character 50 and an outlet 52. The latter is connected to and supplies oil to the duplex valve, which has an inlet 54 connected by passage 56 to a chamber 58 formed between the lands 24 and 34, which chamber is thus effectively connected to the pump outlet and from which excess oil is supplied to the excess oil line through groove structure 36.

The inlet means 50 may comprise an inlet chamber indicated by the reference character 50A generally constructed as a part of the fuel unit and including filter means (not shown) and through which filtered oil is supplied to the pumping chamber through a pump inlet passageway 51. The term inlet means is used herein in a generic manner to refer to the pump inlet chamber 50 and the pump inlet passageway 51.

Fuel supply apparatus of the type to which this invention pertains is constructed so that it can selectively be used for one or two pipe operation. In one pipe operation the pump inlet 50 means is connected through a supply line 64 to a source of fuel such as a fuel tank 66 and the excess oil line 40 is connected through a manually operable and open valve 68 to the pump inlet means. In many installations, and as shown diagrammatically, the supply line has an inverted U-shaped configuration and the fuel tank is lower than the fuel unit and the latter is lower than the high point of the line. In a two pipe operation the valve 68 is closed and the return line 40 is connected by a return line 70 to the fuel tank. Actually, the fuel unit is, for the most part, constructed in known manner so that all of the apparatus described above, with exception of the supply conduit 64 and the two pipe return line 70, are built as a combined fuel unit and pressure regulator. The valve 68 is generally a pipe plug which may be inserted to disconnect line 40 from the pump inlet means for two pipe operation and which can be removed for single pipe operation.

In accordance with the present invention as illustrated in FIG. 1 and to provide the advantages of reliability, high lift, especially on single pipe operation, automatic purging under two pipe connections and fast purging and fast cut off of the flow of oil to the oil burner nozzle, the system is provided with a flow restricting bypass of the deep slot type indicated as a whole by reference character 72 connected directly across the pump outlet 52 and the pump inlet means 50. It should be noted that, as illustrated in solid lines, the inlet means is the inlet passageway 51. However, the inlet means could be the inlet chamber 50A. The advantage of connecting the bypass 72 across the pump outlet and inlet passageways is that the recirculated oil is not filtered. Accordingly, less filtering capacity is required.

The flow restriction in bypass 72 is provided by an orifice 74 and it includes a normally closed check valve 76, comprising a ball 76A and spring 76B, arranged to prevent flow from the outlet to the inlet means below a predetermined pump outlet pressure such as about fifteen p.s.i. The check valve primarily prevents recirculation of air (and also of oil) during purging of air from the apparatus but bypasses or recirculates oil from the pump outlet to inlet means after purging has been completed. The orifice is preferably between the pump outlet and the check valve so that, when the valve is closed, oil is maintained in the outlet side and orifice 74 in a manner akin to holding liquid in a straw by closing one end with one's finger. A check valve and orifice construction such as shown in the copending application of Louis J. Schwob, Ser. No. 562,656, filed July 5, 1966, now abandoned, may be used when the bypass 72 is connected to the inlet chamber 50A.

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A standard slot type of restricting bypass 80 is provided across the pressure regulating portion 32 of the duplex valve. It is illustrated as being in the valve body and effectively connected across the pump outlet and return line 40. It could be located elsewhere, as in and through the land 34. As shown, it comprises a passageway 82 provided with a flow restricting standard slot orifice 84 dimensioned to restrict flow of air to an extent such that the apparatus may be purged of air on start up when a single pipe connection is utilized, the purging being effected by opening the vent port 48. The orifice 84 is filled with oil at the factory as during testing of the apparatus when oil flows through the orifice and is retained in it by capillary action. The retention is such that air will not flow through the orifice when the vent port is opened for single pipe purging. In two pipe purging, as noted later, air will flow through the orifice and bypass at a pressure less than that at which the check valve 76 is opened. During the purging operation, the check valve 76 remains closed until the air is purged and the vent port closed. Gear pumps, such as pump 12, generate an air pressure of less than about fifteen p.s.i., which is sufficient to discharge air through vent 48 but insufficient to open check valve 76 or force any substantial amount of air through bypass 80. Automatic purging of the air is effected through the bypass 80 when the two pipe connection is utilized and the air vent valve is closed, the air being discharged at a pressure of less than about fifteen p.s.i. generated by the pump through the bypass and the return line 40 which, in the two pipe operation is connected to the oil tank through return line 70.

In a characteristic installation, the duplex valve 14 may be constructed and arranged to open the cut off portion at a pressure of eighty p.s.i. and supply from one to three g.p.h. to the nozzle. The pressure regulating portion may be adjusted to maintain a pump outlet pressure of about one hundred p.s.i. The pump should have a substantial output such, for example, as thirty g.p.h. The bypass 80 across the pressure regulating portion of the duplex valve may pass about four g.p.h. The bypass 72 from the pump outlet to the pump inlet means may pass about two to three times that flowing through bypass 80, i.e., eleven g.p.h., and the check valve 76 may open at a pressure of about fifteen p.s.i. These values may obviously be varied dependent upon the size of the unit and the demands of a particular installation. The relationship between the two bypasses must, however, be such that the check valve 76 not open until a substantial pressure has been developed at the pump outlet and thereafter a considerable portion of the pump outlet is bypassed through line 72. As noted earlier bypass 80 across the pressure regulating portion of the valve is dimensioned to prevent any substantial air flow through it when the vent 48 is opened but permits flow of air through when the vent port 48 is closed and the two pipe connection utilized so that automatic purging will occur in the two pipe operation. The reason for the pressure selected for the opening of check valve 76 is to insure it will not open to connect the pump outlet to the pump inlet means and thus recirculate air and oil at relatively low pump inlet or suction pressures. If it did, then satisfactory lift could not be obtained. The arrangement as described will effectively and reliably provide a high lift as of twenty feet or so when the single pipe connections are used, i.e., when the valve 68 is opened to connect the return line 40 to the pump inlet means 50. Also, fast cut off is provided because the pressure regulator valve handles only a relatively small quantity of oil so that the cut off valve element 22 has to move but a small distance to close the outlet when pump motor is de-energized.

The present invention thus provides fast cut off along with the many advantages heretofore described. This is done in a simple manner by the provision of the bypass 72 across the pump with the orifice and check valve means in it. Cut off of the flow of oil to the oil burner nozzle

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occurs at a sufficiently high pressure to insure proper atomization of the fuel delivered to the nozzle. The cut off takes place while the fan speed is still high enough to supply an adequate volume of air for atomization of the oil. Accordingly, undesirable air-oil mixtures sometimes occurring with previous arrangements are prevented. Furthermore, priming occurs sufficiently rapidly so as to be within the limits of operation of flame safety devices ordinarily used, i.e., within about one and one-half minutes. The bypass also reduces the amount of oil required to be supplied to the pump inlet from the tank in two pipe operation. Also, less filtering is required when the bypass is connected to the pump inlet passageway as the recirculated oil is not filtered. The arrangement of the invention is not a compromise and provides fast, effective and reliable operation for both one and two pipe systems.

All of the advantages set forth above, but for the lesser amount of oil required to be supplied to the pump from the tank and required to be filtered in two pipe operation, may be obtained with the modification illustrated in FIG. 2. In this modification, the bypass 72 with its orifice 74 and normally closed check valve 76 is connected across the pump outlet 52 and the return flow line 40. The only difference between the arrangement of FIG. 1 and that of FIG. 2 is that in the former the pump has to lift only sufficient oil from the reservoir 66 through the inlet line 64 to make up the oil supplied to the nozzle. In the FIG. 2 arrangement, the excess flow from the pressure regulator valve and the flow through the bypass 72 are both returned to the reservoir in two pipe operation, so that more oil has to be lifted by the pump and filtered. The terminology with respect to the valve bypass 72 being "effectively across the pump" is intended to apply to all three arrangements, i.e., where the bypass is connected from the pump outlet to the return line, or to the pump inlet chamber, or the pump inlet passageway.

Although the present invention has been described by reference to illustrative embodiments thereof, it will be apparent that numerous other modifications and embodiments may be devised by those skilled in the art and it is intended by the appended claims to cover all such modifications and embodiments which fall within the true spirit and scope of the present invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. Fuel supply apparatus for supplying liquid fuel to oil burners and the like through single pipe or two pipe connections including a fuel supply pump having a capacity in excess of burner requirements and an inlet adapted to be supplied from a source of fuel and an outlet, valve means connected to and supplied from the pump outlet of the type having cut off means controlling flow to a utilization outlet adapted to be connected as to the nozzle of an oil burner and regulating means with an excess flow outlet adapted selectively to be connected to pump inlet means in a single pipe connection or to the source of fuel in a two pipe connection and a normally closed air vent port effectively connected to the pump outlet and adapted to be opened for purging air in a single pipe connection wherein the improvement comprises a first flow restricting bypass effectively across the pressure regulating means and restricting flow of air to an extent such that the apparatus when connected for single pipe operation may be purged of air on start up by opening of the vent port, and permitting flow of air and restricted flow of oil with the vent closed whereby automatic purging of air through said first bypass is effected on start up of the apparatus when it is connected for two pipe operation, and a second flow restricting bypass effectively across the pump including a normally closed check valve means maintaining said bypass closed to prevent recirculation of air through the pump so that purging of air from the apparatus is effected through the vent port when the latter is opened.

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2. Fuel supply apparatus as claimed in claim 1, wherein said check valve opens at a pump outlet pressure above the pressure generated by the pump when air is present in the apparatus.

3. Fuel supply apparatus as claimed in claim 2, wherein said check valve opens at a pump outlet pressure somewhat higher than about fifteen p.s.i.

4. Fuel supply apparatus as claimed in claim 1, wherein said first flow restricting bypass is dimensioned to retain oil in it by capillary force and flow of air through it is prevented and the air is purged through the vent port when the latter is opened on start up with a single pipe connection.

5. Fuel supply apparatus as claimed in claim 1, wherein said second flow restricting bypass is dimensioned to provide a flow of fuel substantially greater than that through said first flow restricting bypass.

6. Fuel supply apparatus as claimed in claim 5, wherein the flow through said second flow restricting bypass is on the order of two to three times the flow of the second bypass.

7. Fuel supply apparatus as claimed in claim 4, wherein said second flow restricting bypass is dimensioned to provide a flow of fuel substantially greater than that through said first flow restricting bypass.

8. Fuel supply apparatus as claimed in claim 1, wherein said second flow restricting bypass comprises a flow restricting orifice between the check valve and the pump outlet.

9. Fuel supply apparatus as claimed in claim 1, wherein said second flow restricting bypass comprises a flow restricting orifice located between said check valve and the pump outlet and is dimensioned to provide a sub-

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stantial flow of oil such as about one-third of the total pump output and wherein said check valve opens at a pump outlet pressure of about fifteen p.s.i., and wherein said first flow restricting bypass is dimensioned to retain oil in it by capillary force and flow of air through it is substantially prevented when the vent port is opened whereby the apparatus may be purged of air on start up when a single pipe connection is utilized upon opening of the vent port with said check valve remaining closed until the vent port is closed, said first bypass providing flow of air and restricted flow of fuel when a two pipe connection is utilized whereby automatic purging of air through said second bypass and the excess flow line to the fuel source is effected on start up of the apparatus.

10. Fuel supply apparatus as claimed in claim 1, wherein the second flow restricting bypass is connected across the pump outlet and pump inlet chamber.

11. Fuel supply apparatus as claimed in claim 1, wherein the second flow restricting bypass is connected across the pump outlet and pump inlet passageway.

12. Fuel supply apparatus as claimed in claim 1, wherein the second flow restricting bypass is connected across the pump outlet and return line.

References Cited

UNITED STATES PATENTS

2,037,994	4/1936	Neubauer	158—36.3
2,209,856	7/1940	Smith et al.	103—42
2,931,314	4/1960	Erikson et al.	103—42 X
3,294,147	12/1966	Damon	158—36.3 X

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