Sept. 20, 1966 R. W. ROPER 3,273,513

OIL BURNER PUMP UNIT WITH AIR PURGING MEANS

Filed April 28, 1965 2 Sheets-Sheet 1

Fig. 1.

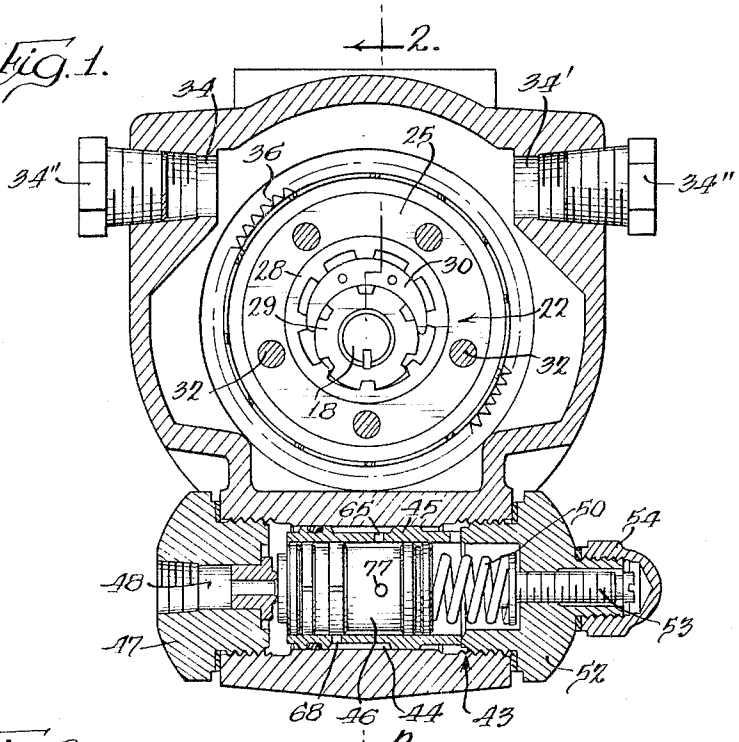
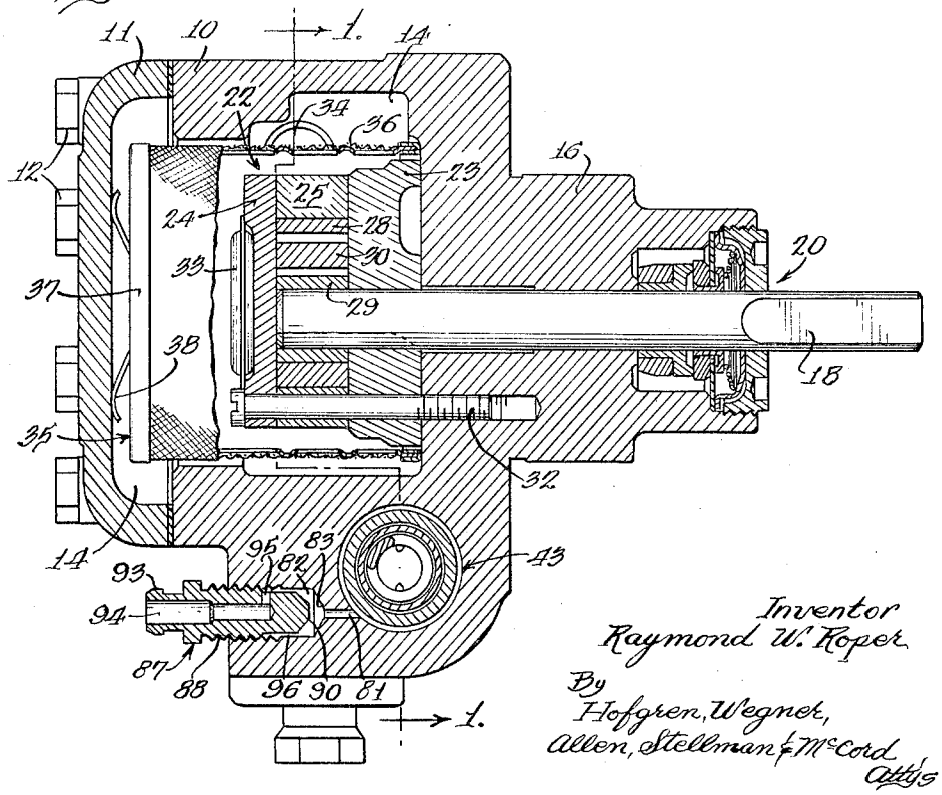


Fig. 2.



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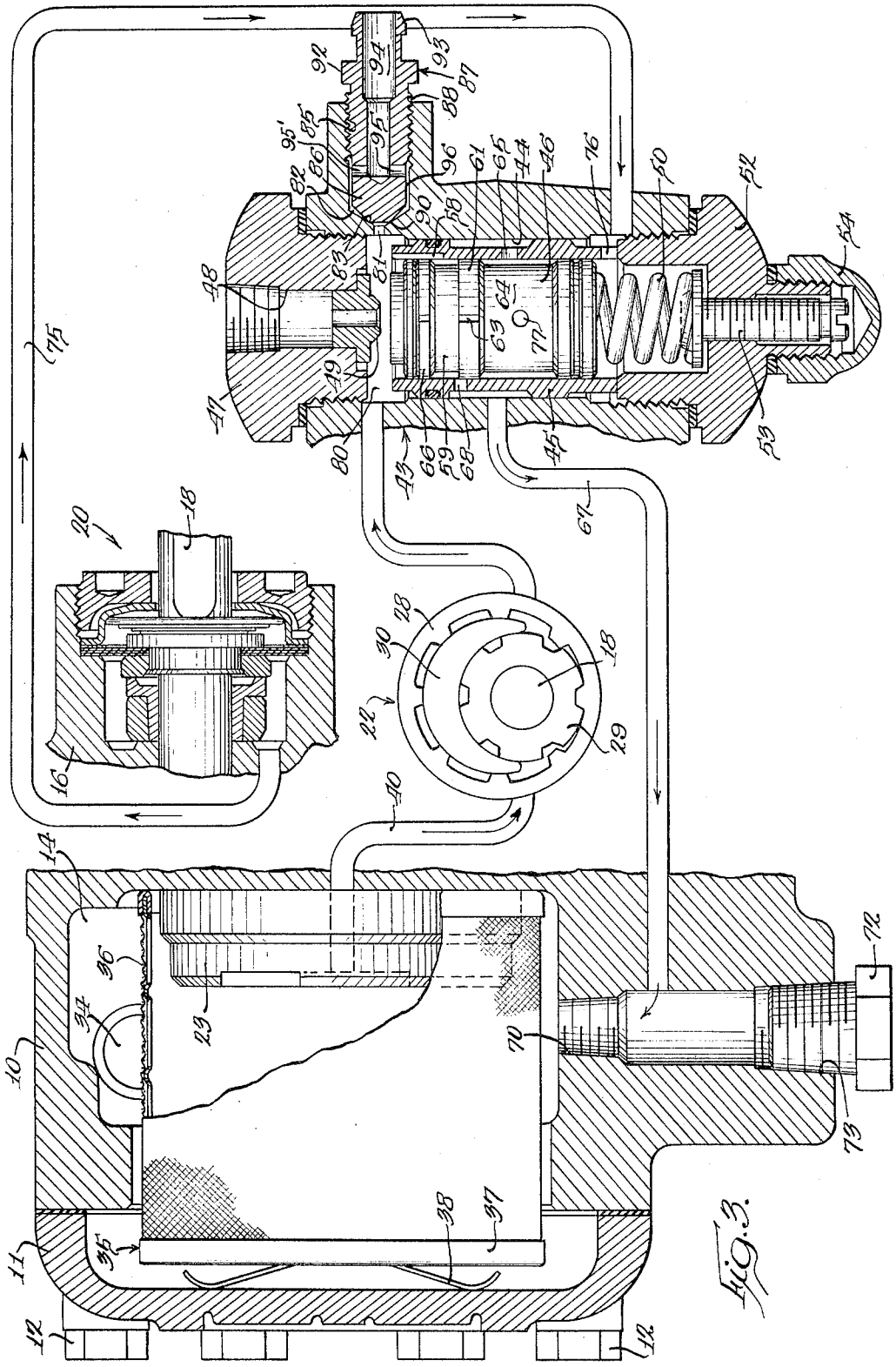


Fig. 3.

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OIL BURNER PUMP UNIT WITH AIR PURGING MEANS

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11 Claims. (Cl. 103—203)

This application is a continuation-in-part of my copending application Serial No. 430,095, filed February 3, 1965, now abandoned.

This invention relates to pumps, and especially oil burner pumps, and more particularly the invention relates to an oil burner pump unit with improved means for purging air from the unit as on starting operation following installation or shutdown.

It is a general object of the invention to provide a new and improved pump unit of the type described.

Another object of the invention is to provide a pump unit of the character mentioned with a new and improved manually controllable air purging valve.

A more specific object is to provide in a pump unit of the type described a new and improved air purging valve in the form of a threadably adjustable plug member mounted in the unit housing and communicating with the outlet of a pump in the housing, including means providing a restrictive annular passage limiting the flow of oil as purging is completed, in series ahead of a radial port in the plug, and a longitudinal passage through the plug of substantially greater capacity than the annular restrictive passage for purposes of reducing the velocity of fluid to provide a controlled relatively weak spout of oil on completion of purging.

While units of the character mentioned are often referred to as "pumps," they usually involve more than a pump per se. More particularly, in the typical unit, there is a suitable housing in which a pump is mounted to have an inlet adapted for communication with a source of oil and an outlet adapted to deliver fluid under pressure to a pressure responsive valve which establishes communication between the pump outlet and a burner port in the housing adapted to be connected with a suitable burner. On starting such equipment in operation, initially after first installation or after shutdown, as where the tank has run out of oil and been refilled, the passages communicating with the pump inlet, and with the outlet, are not always completely filled with oil so that for some limited period of time after starting, the pump functions merely to pump air. While it is necessary to remove such air from the system before pure oil can be delivered, it is undesirable to pump air or mixed air and oil to a nozzle at the burner as such conditions contribute to an improper ignition of the burner flame and/or poor combustion which has undesirable side effects.

Accordingly, in the past, it has been conventional to provide a purge port in the housing communicating with the pump outlet and normally closed during usual operating conditions, but operable on start-up to permit the pump to discharge air ahead of the valve controlled burner port until such time as air-free oil flows from the purge port, whereupon the latter may be again closed and flow to the burner port is controlled by the pressure responsive valve. While such purge ports have effectively served to rid the system of air, there have been disadvantages. For example, the pump is capable of developing a substantial pressure so that when the air is purged and the oil starts to flow from the purge port in an uncontrolled manner, it may be capable of spouting completely across the room in which the pump is installed. While there have been some attempts to control the discharge of oil on completion of air purging, before the purge port is closed, such attempts have generally enjoyed

poor reception because of unacceptable limitations. For example, in some cases the purge valving has been complex and expensive. In other situations, flow limiting restrictions have been so minute as to be difficult of manufacture and easy of plugging. Some have provided a fixed laterally directed purge outlet which may be appropriately aimed if the pump is mounted in one position but inappropriately aimed if the pump is inverted.

With the above considerations in mind, it is an object of this invention to provide a new and improved purge means in which the discharge is properly directed at all times whether the unit is inverted or obverted, wherein the oil rate of flow on completion of purging is limited to a controlled relatively weak spout, and wherein the flow limiting passages are restrictive enough and at the same time not subject to obstructive clogging due to dirt and the like.

Other objects and advantages will become readily apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a transverse cross section of a pump unit embodying the present invention, taken at about the line **1—1** of FIG. 2;

FIG. 2 is a longitudinal sectional view of the unit taken at about the line **2—2** of FIG. 1, FIGS. 1 and 2 showing the pressure responsive valve and the purge valve positioned for purging; and

FIG. 3 is a diagrammatic view of the pump circuit with the pressure regulating valve and the purge valve in condition for normal burner operation and with the pump proper omitted from the housing for simplicity.

While an illustrative embodiment of the invention is shown in the drawings and will be described in detail herein, the invention is susceptible of embodiment in many different forms, and it should be understood that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now in more detail to the drawings, a casing is provided in the form of a housing member **10** and an end cover **11** appropriately bolted together as by means **12**, for example, and forming an internal chamber providing a reservoir **14**. The housing member **10** is provided with an extension **16** appropriately supporting a pump drive shaft **18**, and adjacent the end of the extension **16**, the shaft **18** is surrounded by a shaft seal generally designated **20** to prevent leakage from the housing of fluid progressing along the shaft from the pump.

The shaft **18** extends into the reservoir **14** and is drivingly connected to a crescent gear pump **22**. The pump **22** is mounted in a housing provided by a plate **23** at one side (the right side as in FIG. 2), a plate **24** at the left side, and a surrounding ring **25**. Within the ring **25** and between the plates **23** and **24** there is an internally threaded ring-shaped gear member **28** meshing with an eccentric externally toothed gear member **29** on shaft **18**. Within the space between the gear members **28** and **29** there is a crescent shaped fixedly mounted member **30**. The members **23**, **24** and **25** are appropriately secured to the housing member **10** as by means **32**. On the exposed side of the plate **24** there is a vibration damping capsule as at **33**.

The reservoir **14** is adapted to be connected with a suitable source of fuel oil as through an inlet at **34** or **34'** in the form of a threaded port shown in FIG. 1 with a removable plug as at **34''**. Preferably, the pump **22** is surrounded by a filter **35** including a cylindrical screen **36** and an end plate closure **37** carrying a spring means **38** biasing the opposite end of the cylindrical screen against

the housing member **10** at the opposite end of the reservoir.

In operation, the arrangement is such that on rotation of the drive shaft **18**, the pump **22** is effective to draw oil from the source such as a tank into the reservoir through inlet **34** and into the pump through an appropriate inlet inside the confines of the filter **35** as illustrated diagrammatically at **40** on FIG. 3. The pump discharges fluid under pressure through an appropriate outlet **41** communicating with a pressure responsive valve **43** in the housing member **10**.

The valve **43** is mounted in a bore **44** and includes a stationary sleeve member **45** which receives a slidable valve member **46**. The upper end of the bore **44** (FIG. 3) is closed by threaded plug member **47** having burner port **48** adapted to be connected with a burner nozzle or the like, and the plug **47** terminates in a raised seat **49** against which the closed end of valve member **46** is biased by a spring **50**. The spring is seated in a closure plug **52** at the opposite end of bore **44** including an appropriate spring pressure adjusting screw **53** covered by a cap **54**.

Valve member **46** is movable from the position illustrated in FIG. 1, closing the burner port, to a position illustrated in FIG. 3, opening the burner port to communicate with the pump outlet, and the valve member is normally biased to the port closed position by means of spring **50**. Upon operation of the pump **22**, with the purge port closed, pressure builds up in the passage **41** to move the valve member **46** to port open position.

The sleeve member **45** is provided with one or more longitudinal slots as at **58** which communicate the passage **41** with a reduced portion **59** on the valve member between valve lands **60** and **61**. In order to assure rapid valve closure on shutting down the pump, land **61** includes a longitudinal bleed slot **63** which allows a limited amount of fluid to pass to the reduced portion **64** of the valve member, and the latter communicates through a sleeve port **65** with a by-pass or return passage **67**.

In operation, as pump outlet pressure builds up, and the valve member **64** moves to the valve open position illustrated in FIG. 3, groove **59** in the valve member communicates with a by-pass or return port **68** in the sleeve **45**, in turn communicating with the passage **67**, so that fluid in excess of that required at the nozzle may be returned to the reservoir **14** through the passage **67** and a threaded inlet port **70** adjacent the chamber **14**.

If desired, a closure plug **72** may be removed from the housing member **10**, and a closure plug may be inserted in the port **70** to permit return of excess fluid to the source tank connected to port **73** in place of plug **72**.

Leakage fluid is returned from the shaft seal **20** to the reservoir **14** through a passage as illustrated at **75** leading to the bore **44** and communicating with the interior of the sleeve **45** and the hollow interior of the valve member **46** through a sleeve port **76**. The interior of the valve member communicates with a groove **64** through a radial port **77**.

According to the present invention, in order to purge air from the pump system on start-up, the valve chamber **80** adjacent nozzle port seat **49** communicates with a purge port **81** leading to a purge chamber **82**, and at the entrance of the port **81** to the chamber **82** there is a valve seat **83**. The chamber **82** leads to the outside of the pump housing member **10** and terminates in a relatively long straight threaded portion as at **85**, and is adapted to receive a purge valve member **87** in the form of an elongate generally cylindrical plug member having a reduced end portion **86** in the chamber **82** adjacent port **81**, and a threaded external portion **88** adjustable in the threaded receptacle **85**.

The reduced end portion of the purge valve member terminates in a valving portion **90** adapted to seat at **83** to close the purge port **81** as shown in FIG. 3 and adapted to be adjusted to open the purge port as shown in FIG. 2.

The valve member **87** includes an enlarged polygonal flange **92** facilitating manual adjustment and terminates externally of the housing in a nipple end adapted to receive a rubber hose or the like, if desired, though no hose is necessary with a controlled discharge as provided by the present invention. Member **87** includes a central longitudinal passage **94** of substantial proportions, leading from the outer terminus to the vicinity of the reduced end portion **86** and communicating through a radial port **95** with a restrictive annular passage **96** between the surface of the reduced portion **86** and the wall of the chamber **82**.

In operation, when the valve member **87** is manually adjusted to open the bleed port or purge port **81**, as shown in FIG. 2, the pump outlet is connected to atmosphere through passage **41**, port **81**, chamber **82**, annular passage **96**, radial port **95** and longitudinal passage **94** so that air may be discharged from the system to atmosphere without opening the burner port **48**, and such communication is normally continued after some oil flow begins, until such time as air-free oil flows. In order to restrict the volume of oil that may be discharged, upon completion of air purging, the annular passage **96** provides a restriction limiting flow to a volume less than that which might in fact be accommodated by the port **95** and the passage **94**. The radial port **95** may thus be made of relatively larger proportions than otherwise would be possible in order to facilitate manufacture and in order to reduce the likelihood of obstructive clogging. The still larger proportions of passage **94** allow a reduction in the velocity of flow from the terminus of the valve member. At the same time, while the annular passage **96** limits the amount of flow, its relatively great circumferential extent reduces the likelihood of clogging, and the tolerances of the restriction may be adequately controlled by controlling the dimensions of the reduced portion **86** and of the chamber **82**.

In an actual construction which has operated satisfactorily, the outer diameter of the reduced portion **86** is .318", the radial thickness of the annular passage **96** is on the order of .01", and the radial port has a diameter of .062". It will be understood that so long as the radial thickness of the annular passage **96** is less than approximately the radius of the radial port **95**, the annular passage constitutes the controlling restriction. In the example given the effective area of such restriction may be considered as .01 times the circumference of the .062 diameter radial port.

The axis of the purge plug and its longitudinal passage **94** is parallel to the shaft axis so that oil is always directed axially of the unit regardless of the angular disposition of the unit about the axis of the shaft when mounted. Mounting is usually facilitated by appropriate mounting flanges associated with housing member **10**. The constant diameter of housing threads **85** and plug threads **88** throughout their length allows adjustment of plug **87** while maintaining a seal in all adjusted positions, and at the same time allows removal of the plug for insertion of a pressure gauge fitting with a tapered pipe thread.

While the invention has been illustrated in connection with a single stage unit, it will be understood that it may be embodied in a two-stage unit in which the first stage draws oil from the tank to the reservoir and returns the excess to tank, and the second stage pumps oil from the reservoir to the pressure regulating valve, with the excess also returning to tank or to the reservoir.

It will be understood that for the purpose of orderly collection of the fluid discharged from the passage **94** upon completion of purging, the oil should flow in a neat, steady stream rather than discharge in a spray or the like. While the oil may tend to be atomized into a spray in travel through the narrow annular passage **96**, discharge may be formed into a suitable stream, utilizing a

single radial port 95, by suitably controlling length of the longitudinal passage 94.

More specifically, if the length of the longitudinal passage is too short, with a single radial port 95, there may be some tendency for the oil discharge to spray rather than to flow. On the other hand, with a single radial port 95, the oil discharged may be controlled to a suitable stream by making longitudinal passage 94 of sufficient length to cause collection of the spray and formation of a smooth, even stream.

Alternative to controlling the discharge to form a stream rather than a spray by elongating passage 94, it has been found that the length of the passage 94 may be significantly shortened, while still discharging a stream by providing a second radial port as at 95' opposed to the first port 95. By this provision, the fluid entering from the two ports collides and the collision assists in reducing any spray to the form of a stream. As an example, radial port 95' may be of the same dimensions as the port 95, with other dimensions as in the example given above, where the length of passage 94 is about .937".

I claim:

1. In an oil burner pumping system, a casing, means providing an inlet to the casing adapted for connection with a source of burner oil, a drive shaft mounted in the casing, a pump in the casing driven by said shaft, having a low pressure intake communicating with said inlet and having a high pressure outlet, means providing a burner port in the casing adapted for connection with an oil burner, a discharge passage in the casing connecting the high pressure outlet and the burner port, a pressure responsive valve in the discharge passage adapted to establish communication between the high pressure outlet and the burner port upon the buildup of a predetermined discharged pressure, air purging means comprising a port in the casing communicating with said passage, a cylindrical recess in the casing communicating with said purge port and opening to the exterior of the casing, a manually operable air purge plug threadably adjustable in said recess, said plug comprising a cylindrical member having a reduced inner end portion slightly spaced from the recess wall and providing between the wall and the reduced portion a restrictive annular passage, a valving surface on the reduced end portion cooperable with said bleed port and movable relative to the bleed port upon threadable adjustment of the plug between a port closed position and a port open position, a longitudinal passage through the plug member from the exterior of the casing to the vicinity of the reduced end portion, and a radial port in the plug member connecting said annular passage and said longitudinal passage.

2. A combination as defined in claim 1, wherein the axis of the purge plug and the longitudinal passage therein are disposed parallel to the axis of the drive shaft so the spout of oil from the longitudinal passage is directed axially of the casing regardless of the angular disposition of the casing about the axis of the shaft when mounted.

3. A combination as defined in claim 1, wherein said annular passage has a radial thickness less than the diameter of said radial port.

4. A combination as defined in claim 1, wherein the product of the radial thickness of the annular passage and the circumference of the radial port are less than the area of the radial port.

5. A combination as defined in claim 4, wherein the longitudinal passage in the plug provides a relatively large flow area compared to the effective flow area of the annular passage so as to reduce the velocity of fluid flowing outwardly from the plug to a controlled rate producing a weak spout.

6. A combination as defined in claim 1, including at least one additional radial port in the plug member connecting said annular passage and said longitudinal passage and opposed to the first recited radial port.

7. A combination as defined in claim 1, including an additional radial port in the plug member connecting said annular passage and said longitudinal passage disposed in opposition to the first recited radial port so that fluid entering the longitudinal passage from the opposed ports collides to assist in reducing any spray to a stream, said annular passage having an effective passage area less than the area of the radial ports.

8. In an oil burner pumping system, a casing, means providing an inlet to the casing adapted for connection with a source of burner oil, a drive shaft mounted in the casing, means providing a reservoir in the casing communicating with said inlet, a pump in the casing driven by said shaft, having a low pressure intake communicating with said reservoir and the high pressure outlet, means providing a burner port in the casing adapted for connection with an oil burner, a discharge passage in the casing connecting the high pressure outlet and the burner port, a pressure responsive valve in the discharge passage adapted to establish communication between the high pressure outlet and the burner port upon the buildup of a predetermined discharge pressure, air purging means comprising a port in the casing communicating with said passage, a cylindrical recess in the casing communicating with said purge port and opening to the exterior of the casing, a manually operable air purge plug threadably adjustable in said recess, said plug comprising a cylindrical member having a reduced inner end portion slightly spaced from the recess wall and providing between the wall and the reduced portion a restrictive annular passage, a valving surface on the reduced end portion cooperable with said bleed port and movable relative to the bleed port upon threadable adjustment of the plug between a port closed position and a port open position, a longitudinal passage through the plug member from the exterior of the casing to the vicinity of the reduced end portion, a radial port in the plug member connecting said annular passage and said longitudinal passage, said annular passage having a radial thickness less than the radius of said radial port, so that the annular passage restricts the flow of fluid from the purge plug to a value less than that permitted by the size of the radial port.

9. In an oil burner pumping system, a casing, means providing an inlet to the casing adapted for connection with a source of burner oil, a drive shaft mounted in the casing, means providing a reservoir in the casing communicating with said inlet, a pump in the casing driven by said shaft, having a low pressure intake communicating with said reservoir and the high pressure outlet, means providing a burner port in the casing adapted for connection with an oil burner, a discharge passage in the casing connecting the high pressure outlet and the burner port, a pressure responsive valve in the discharge passage adapted to establish communication between the high pressure outlet and the burner port upon the buildup of a predetermined discharge pressure, said pressure responsive valve including a valve member cooperating with said burner port and movable between a port closed position and a port open position, and spring means biasing the valve member to port closed position, air purging means comprising a port in the casing communicating with said passage, a cylindrical recess in the casing communicating with said purge port and opening to the exterior of the casing, a manually operable air purge plug threadably adjustable in said recess, said plug comprising a cylindrical member having a reduced inner end portion slightly spaced from the recess wall and providing between the wall and the reduced portion a restrictive annular passage, a valving surface on the reduced end portion cooperable with said bleed port and movable relative to the bleed port upon threadable adjustment of the plug between a port closed position and a port open position, a longitudinal passage through the plug member from the exterior of the casing to the vicinity of the reduced end portion, and a radial port in the plug member connecting

said annular passage and said longitudinal passage, said annular passage having a radial thickness less than the radius of said radial port, so that the annular passage restricts the flow of fluid from the purge plug to a value less than that permitted by the size of the radial port.

10. A combination as defined in claim 9, wherein the axis of the purge plug and the longitudinal passage therein are disposed parallel to the axis of the drive shaft so the spout of oil from the longitudinal passage is directed axially of the casing regardless of the angular disposition of the casing about the axis of the shaft when mounted.

11. In an oil burner pumping system, a casing, means providing an inlet to the casing adapted for connection with a source of burner oil, a drive shaft mounted in the casing, means providing a reservoir in the casing communicating with said inlet, a pump in the casing driven by said shaft, having a low pressure intake communicating with said reservoir and the high pressure outlet, means providing a burner port in the casing adapted for connection with an oil burner, a discharge passage in the casing connecting the high pressure outlet and the burner port, a pressure responsive valve in the discharge passage adapted to establish communication between the high pressure outlet and the burner port upon the buildup of a predetermined discharge pressure, said pressure responsive valve comprising means providing a valve chamber communicating with said discharge passage and with said burner port, a valve member in the valve chamber controlling said burner port and movable between a port closed position and a port open position, spring means biasing the valve member to a port closed position, a by-pass port communicating with the valve chamber, and valving on the valve member establishing communication between said discharge passage and said by-pass port on

movement of the valve member to a port open position, a return passage leading from said by-pass port to said reservoir, air purging means comprising a port in the casing communicating with said passage, a cylindrical recess in the casing communicating with said purge port and opening to the exterior of the casing, a manually operable air purge plug threadably adjustable in said recess, said plug comprising a cylindrical member having a reduced inner end portion slightly spaced from the recess wall and providing between the wall and the reduced portion a restrictive annular passage, a valving surface on the reduced end portion cooperable with said bleed port and movable relative to the bleed port upon threadable adjustment of the plug between a port closed position and a port open position, a longitudinal passage through the plug member from the exterior of the casing to the vicinity of the reduced end portion, and a radial port in the plug member connecting said annular passage and said longitudinal passage, said annular passage having a radial thickness less than the diameter of said radial port, so that the annular passage restricts the flow of fluid from the purge plug to a value less than that permitted by the size of the radial port, the longitudinal passage in the plug providing a relatively large flow area compared to the effective flow area of the annular passage so as to reduce the velocity of fluid flowing outwardly from the plug to a controlled rate producing a weak spout.

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