

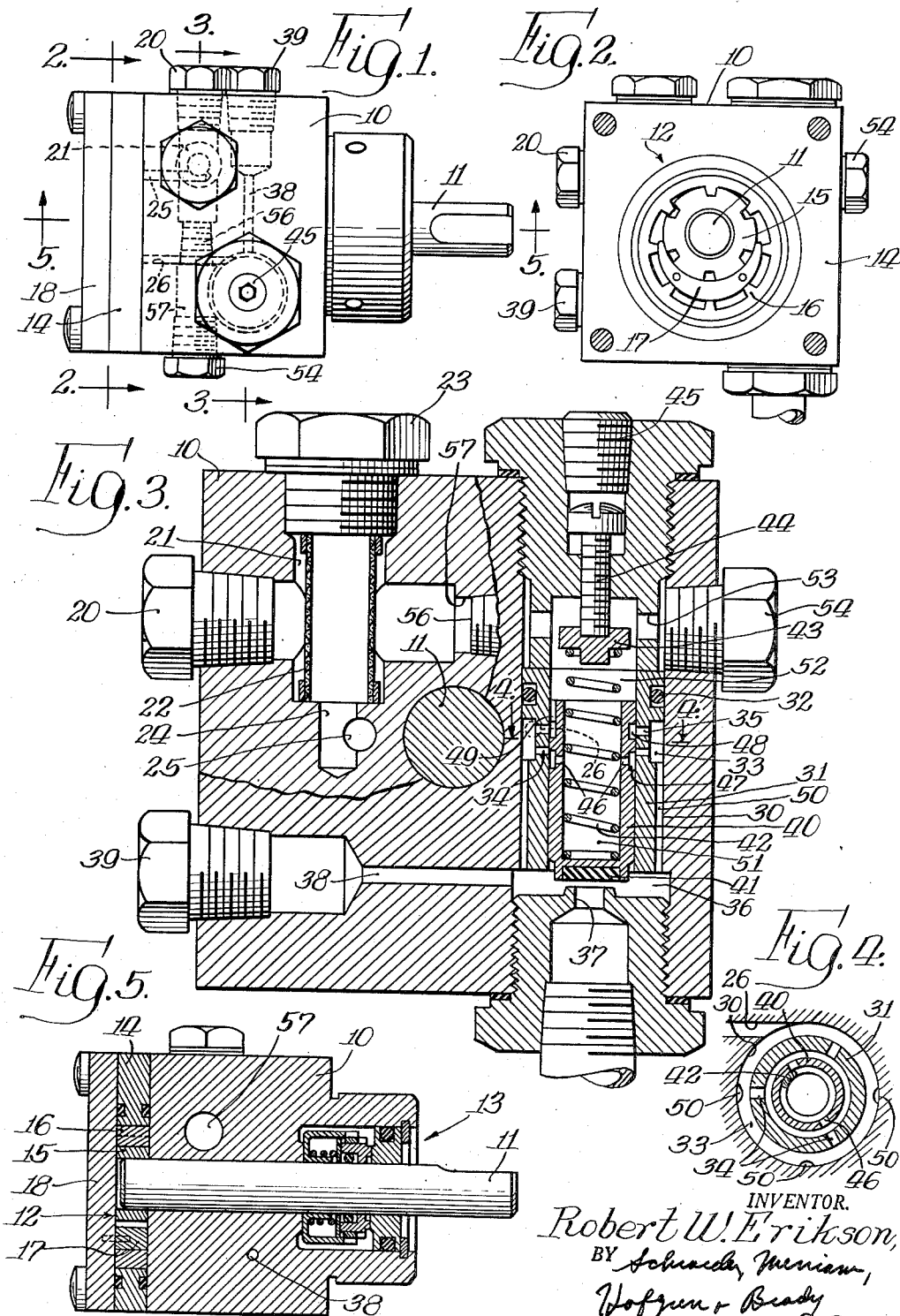
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AIR PURGING METHODS AND APPARATUS FOR FLUID PUMPS

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1

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AIR PURGING METHODS AND APPARATUS FOR FLUID PUMPS

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This invention relates to a pump and more particularly to a pump for liquids having means for purging air from the liquid moved by the pump.

It is the general object of this invention to produce a new and improved pump and air purging system of the character described.

A more specific object of the invention is to provide a fuel pumping method and apparatus for removing entrained air from the fuel before the same is delivered to a site of combustion.

Another object of the invention is to produce a pump provided with air purging means in the form of a centrifuge chamber to which liquid is delivered and in which the liquid is rotated, with the action being such as to force the heavier and hence air free liquid against the outer periphery of the chamber from which it is delivered to the pump outlet, while the air laden liquid near the inner periphery of the chamber is by-passed.

A further object of the invention is to produce a pumping means of the type described in the preceding paragraph for use in an oil burner system wherein the liquid is oil and wherein the rotation in the centrifuge chamber is caused by pumping oil thereinto in a direction tangent to the chamber.

Yet another object of the invention is to produce a liquid pump having flow passages so designed as to produce a relatively slow downward flow of liquid therethrough, with the speed of flow being less than the speed of rise through the liquid of an entrained air bubble and thus to provide, in effect, an air flotation separation chamber in which entrained air may rise with the lower portion of the chamber being connected to the pump outlet.

A more specific object of the invention is to produce an oil burner pump having pumping means for delivering oil under pressure to a valve bore in the pump, with the bore being provided with means defining a centrifuge chamber into which the oil is first delivered in a manner causing rotation of the oil therein, with the valve bore being provided with vertical passages opening at one end to the outer periphery of the centrifuge chamber so as to receive thereinto the heavier air free oil, with such passages being proportioned as to cause a relatively slow flow of oil therethrough, with the flow being at a speed less than the speed of rise of an entrained air bubble, and with the lower portion of the flow passages being connected to the pump outlet so as to deliver thereinto substantially air free oil.

Other and further objects of the invention will be readily apparent from the following description and drawing, in which:

Fig. 1 is a top plan view of an oil burner pump embodying the invention;

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along line 4—4 of Fig. 3; and

Fig. 5 is a sectional view taken along line 5—5 of Fig. 1.

While this invention is susceptible of embodiments in many different forms, there is shown in the drawing and

2

will herein be described in detail one specific embodiment, with the understanding 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.

In most fuel systems it is desirable that the fuel delivered to the site of combustion be substantially free of air. This is particularly true in a system for supplying oil under pressure to a pressure atomizing nozzle for atomizing the fuel for consumption. If air is entrained in the oil delivered to the nozzle, such air is compressed in the oil and upon shut down of the pump and the closing of a valve upstream of the burner nozzle, the air in the oil downstream of the valve expands, ejecting a slug of solid fuel from the nozzle. This act is often called "after blurp" and the slug of oil, in burning, is apt to cause carbonization of the nozzle tip and the emission of the considerable smoke. In addition, a more even flame can be achieved during operation of the burner if the oil delivered to the nozzle is substantially free of air. Because of the applicability of the invention to an oil burner pump, the invention has been described as embodied in such a system although it will be readily apparent to those skilled in the art that the principles of the invention may be utilized for freeing fuel of entrained air in other types of installations or systems.

Referring now to the drawings, the pump comprises a casing 10 rotatably supporting a drive shaft 11 which is adapted to be secured to a suitable driving motor for operating the pump. Enclosed within the casing is a crescent type gear pump 12 and the shaft is provided with a shaft seal 13 for preventing liquid leaking along the shaft from escaping from the casing.

The pump 12 includes a plate 14 having an annular recess defining a pump chamber. Located within the pump chamber and secured to the shaft 11 is a pinion gear 15 having teeth which mesh with the teeth of an internally toothing ring gear 16, with the latter gear having a diameter in excess of the diameter of the pinion to provide space for an intervening crescent 17. The pump chamber defined by the plate 14 is closed on one side by the casing 10 and on the opposite side by a cover plate 18 suitably bolted to the casing.

An inlet port 20 is provided in the casing which opens into filter chamber 21 wherein a cylindrical filter screen 22 is positioned. The filter chamber 21 is closed at its top by a closure nut 23 which may be removed for cleaning the filter. At the bottom of the filter chamber there is provided a recess 24 connected to an intake passage 25 which opens in to the intake of the gear pump 12. Discharge from the gear pump is through a passage 26 which opens into a bore 30 formed in the casing.

Located within the bore 30 is a fluid pressure operated cut-off valve for controlling flow of fuel to the nozzle of the oil burner together with air purging means for delivering to the burner port oil which is substantially free of entrained air. To this end a sleeve 31 is press-fitted in the bore 30 and sealed thereto adjacent its upper end by an O-ring 32. The sleeve is provided with an annular groove defining with the bore a centrifuging chamber 33 to which the discharge 26 from the gear pump opens.

As it is desired to produce rotation of fuel in the chamber 33, such rotation can most simply be achieved by directing fuel flow tangentially into the chamber. Thus the passage 26 preferably opens to the chamber tangentially, or at least tangent to a circle whose center coincides with the center of the chamber. For all practical purposes, flow from the passage 26 directed tangentially to any such circle may be considered as being directed tangentially to the chamber and will be so considered in the description and claims. As the passage 26 is tangent

to the chamber 33, fuel delivered thereby to the chamber is caused to rotate rapidly in the chamber. Such rotation, by centrifugal action, causes the heavier (air free) fuel to follow the outer periphery of the chamber while the lighter (air carrying) fuel follows the inner periphery. Located at the inner periphery of the chamber and extending radially through the sleeve is a plurality of by-pass passages 34 and a second plurality of radial passages 35 positioned above the passages 34.

The sleeve 31 is spaced at its lower end above the lower end of the bore to provide thereat a valve chamber 36 which communicates with a burner port 37. Also communicating with the chamber 36 is a gauge passage 38 opening into a gauge port 39 adapted to receive a suitable gauge for measuring the oil pressure within the chamber 36.

Reciprocably received within the sleeve 31 is a piston valve 40 having a portion 41 controlling the burner port 37 and urged to a position closing the port by a compression spring 42. The opposite end of the spring 42 bears against a retaining washer 43 secured to the end of an adjusting screw 44 threadably received in the casing and a cover plug 45 is provided to cover the end of the screw 44, which plug may be removed for the purpose of adjusting the screw and hence the tension of the spring 42.

The interior of the piston 40 is provided with a plurality of radial ports 46 opening to the interior of the piston and communicating with an annular groove 47 formed on the exterior surface thereof, with the groove being adapted to be moved into a position wherein it communicates with the radial passages 34 when the piston valve is moved to the open position shown in Fig. 3 by the fluid pressure generated within the chamber 36.

A second annular groove 48 is formed on the exterior surface of the piston 40 which communicates with a bleeder slot 49 formed in the side walls of the piston and opening to the upper end thereof. The groove 48 is so proportioned as to be in constant communication with the radial passages 35 for the purposes hereinafter to be described.

A portion of the discharge of the pump introduced into the centrifuging chamber 33 is directed into the valve chamber 36 by a plurality of vertical flow passages 50 which extend downwardly at an angle of approximately 90° from the rotative direction of flow of fluid in the centrifuge chamber 33. Three such flow passages 50 are provided spaced around the sleeve 31, with all such passages opening into the outer periphery of the centrifuge chamber. Thus substantially air free fuel is delivered into the passages 50.

The total flow through the passages 50 is determined by the nozzle capacity. Further air purging may be achieved in the passages 50 by so proportioning the cross-sectional area of the passages relative to nozzle capacity as to produce a slow flow of fuel therein. Thus the area of the passages 50 is such that fuel flow downwardly therein is slower than the speed of ascent of an air bubble entrained in the fuel. Because of this arrangement, the passages 50 are, in effect, flotation separation passages and any air remaining in the fuel leaving the centrifuge chamber and entering the passages 50 may float upwardly and out of such passages to be swept into and along with the by-passed fuel. Not only is the cross-sectional area of the passageway 50 so proportioned that the escape velocity of air bubbles is greater than the oil velocity therethrough, the length of the channels 50 is proportioned to dampen the turbulence of the entrance conditions. By providing a substantial length for the passages 50 a streamline flow of the air-oil mixture therethrough is established and air separation may be accomplished by the opposing velocity created by the buoyant force of the air bubbles.

The interior of the piston 51 opens at its other end to the upper portion 52 of the bore which communicates with a by-pass outlet 53 and by-pass port 54. It is con-

templated that the port 54 will be used in two pipe systems. If a single pipe system is employed the port 54 may be closed by a plug and a plug 56 located in a passage 57 communicating with the filter chamber 21 may be removed so that excess by-pass fluid is returned to the intake of the gear pump 12. With plug 56 removed either port 54 or port 20 may be used as the inlet port.

In operation, fluid discharged from the gear pump 12 is delivered tangentially into the centrifuging chamber 33 and caused to rotate therein. A portion of the flow is directed downwardly through the flow passages 50 communicating with the outer periphery of the centrifuge chamber into the valve chamber 36. When the pressure of the fluid in the valve chamber 36 exceeds the setting of the spring 42, piston valve 40 opens to permit discharge of fuel into the burner port 37 which may be connected to a suitable pressure atomizing nozzle. As the piston valve 40 moves upwardly communication is established between the radial passages 34 communicating with the inner periphery of the centrifuge chamber and the by-pass groove 47 and passages 46 so as to direct a substantial portion, preferably the major portion, of the discharge from the pump into the interior 51 of the piston valve and thence outwardly through the by-pass. Proper discharge pressure to the atomizing nozzle is maintained by the piston valve 40 and should the pressure within the valve chamber 36 increase, the resulting upward movement of the piston valve 40 serves to move the annular groove 47 from the position shown upward slightly to increase the flow therethrough into the by-pass and thus reducing the pressure in the valve chamber 36.

The passages 35, groove 48 and slot 49 serve as a bleed for the pump and provide, in effect, a constant leak for the pump. On shut down, as the speed of the pump 12 diminishes, the pressure within the chamber 36 decreases rapidly and thus the valve 40 closes while the pump is still operating at some speed.

Inasmuch as during normal operation a substantial portion of the oil rotating in the chamber 33 flows through the by-pass passages 34, 47 and 46 and through the bleeder passages 35, 48 and 49, the lighter air carrying fuel is by-passed while the heavier air free fuel enters the passages 50. The relatively slow flow through the passages 50 permits any residual air bubbles to rise out of such flow and thus there is delivered to chamber 36 fuel which is substantially free of entrained air.

I claim:

1. In a liquid pump having an outlet, means for purging air from the liquid comprising pumping means, a centrifuging chamber connected to the discharge of the pumping means to receive liquid under pressure therefrom, means for causing rotation of liquid in the centrifuging chamber, a by-pass passage having an inlet end communicating with the inner portion of the chamber and an outlet end by-passing the pump outlet, a valve chamber, a flow passage connected at one end to the outer periphery of the centrifuging chamber and communicating at its other end with the valve chamber, a valve in the valve chamber adapted to be moved by increasing pump discharge pressure in said valve chamber to establish communication between the valve chamber and the outlet, and means on said valve controlling said by-pass passage and operating to open the by-pass passage upon movement of the valve.

2. In a fuel pump having a casing provided with an outlet, means for purging air from the fuel comprising pumping means on the casing, a bore in the casing, a sleeve in the bore and having a portion spaced therefrom to provide with the bore an annular centrifuging chamber, a passageway connected at one end to the discharge of the pumping means and opening at its other end tangentially to the chamber, a by-pass passage having a portion extending through the sleeve to communicate with the inner periphery of the chamber and having an outlet end by-passing the pump outlet, and a flow passage

5

connected at one end to the outer periphery of the chamber and communicating at its other end with the pump outlet.

3. In a fuel pump having an outlet, means for purging air from the fuel comprising a pump, an annular centrifuging chamber, a passageway connected at one end to the discharge of the pump and opening at its other end tangentially to the centrifuging chamber to cause rotation of fuel therein, a by-pass passage having a portion communicating with the inner periphery of the chamber and having an outlet end by-passing the pump outlet, a valve chamber, a vertically arranged flow passage having a cross sectional area proportioned to produce a flow of fuel therethrough at a speed less than the flotation rise of an air bubble entrained in the fuel flowing through said flow passage, said flow passage being connected near its upper end to the outer periphery of the centrifuging chamber and extending downwardly therefrom to communicate near its lower end with the valve chamber, and a valve in the valve chamber adapted to be opened by pump discharge pressure to establish communication between the valving chamber and the pump outlet.

4. In a fuel pump having an outlet to be connected to an atomizing nozzle of predetermined capacity, means for purging air from the fuel comprising pumping means having a capacity substantially in excess of the nozzle capacity, a centrifuging chamber, a passage means opening tangentially into the centrifuging chamber and connecting the discharge of the pumping means thereto, a plurality of by-pass passages communicating at one end with the inner portion of the chamber and at their other end by-passing the pump outlet, said by-pass passages being proportioned to by-pass the major portion of fuel delivered by the pumping means, and a plurality of flow passages having a cross sectional area proportioned to produce a flow of fuel through each flow passage at a speed less than the flotation rise of an air bubble entrained in the fuel flowing through said flow passages, with each flow passage being connected at one end to the outer periphery of the chamber and extending downwardly to communicate at its other end with the pump outlet for delivering the minor portion of the fuel received into the chamber to said pump outlet.

5. An oil burner fuel pump comprising a casing having a burner port to be connected to an atomizing nozzle of predetermined capacity, pumping means in the casing having a capacity substantially in excess of nozzle capacity, a bore in the casing, a sleeve in the bore having an annular groove in its outer surface providing with the bore an annular centrifuging chamber intermediate the ends of the bore, said sleeve having one end adjacent but spaced from one end of the bore to provide at said end of the bore a valve chamber, a piston valve in the sleeve and having a portion in the valve chamber, said piston valve being movable to open position in response to the build up of fuel pressure in the valve chamber to establish communication between the valve chamber and the burner port, a passage opening tangentially into the bore at the centrifuging chamber and connected to the discharge of the pumping means, a plurality of by-pass passages circumferentially spaced around the sleeve and

6

extending radially therethrough with each by-pass passage opening at one end to the inner periphery of said centrifuging chamber, an annular groove formed in the outer side walls of the piston valve and communicating with the interior of the bore with the last mentioned groove being adapted to be moved into communication with said by-pass passages when the piston valve is in open position, and a plurality of flow passages formed in the exterior surface of the sleeve each opening at one end to the outer periphery of the centrifuging chamber with each flow passage opening at its other end to said valve chamber with the aggregate area of the flow passages being proportioned to produce a flow of fuel therethrough at a speed less than the flotation rise of an air bubble entrained therein, with the aggregate area of the by-pass passages when the valve is in open position being proportioned to pass the major portion of fuel delivered to said centrifuging chamber into said by-pass passages.

6. The method for purging air from fuel discharged by a fuel pump which comprises introducing fuel discharged under pressure by the fuel pump tangentially into an annular chamber to rotate the fuel therein, directing a substantial portion of fuel from the inner periphery of the chamber into a passage by-passing the pump outlet, directing the remaining portion of the fuel from the outer periphery of the chamber into a vertically arranged flow passage, producing a downward fuel flow through the passage at a speed less than the flotation rise of an air bubble entrained in the fuel to permit entrained air to rise in the passage and pass into the chamber, directing fuel from the lower portion of the passage to the outlet, and directing air rising into the chamber into said by-pass passage.

7. In a liquid pump having an outlet, means for purging air from the liquid comprising pumping means, a centrifuging chamber connected to the discharge of the pumping means to receive liquid under pressure therefrom, means for causing rotation of liquid in the centrifuging chamber, a by-pass passage having an outlet end by-passing the pump outlet, a valve chamber, a flow passage connected at one end to the outer periphery of the centrifuging chamber and communicating at its other end with the valve chamber, a valve in the valve chamber adapted to be moved by increasing pump discharge pressure in said valve chamber to establish communication between the valve chamber and the outlet, and means for establishing communication between the inner portion of the chamber and said by-pass passage when the pressure in said valve chamber reaches a predetermined value.

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