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W. H. DE LANCEY

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VARIABLE CAPACITY VANE PUMP FOR OIL BURNERS

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3 Sheets-Sheet 1

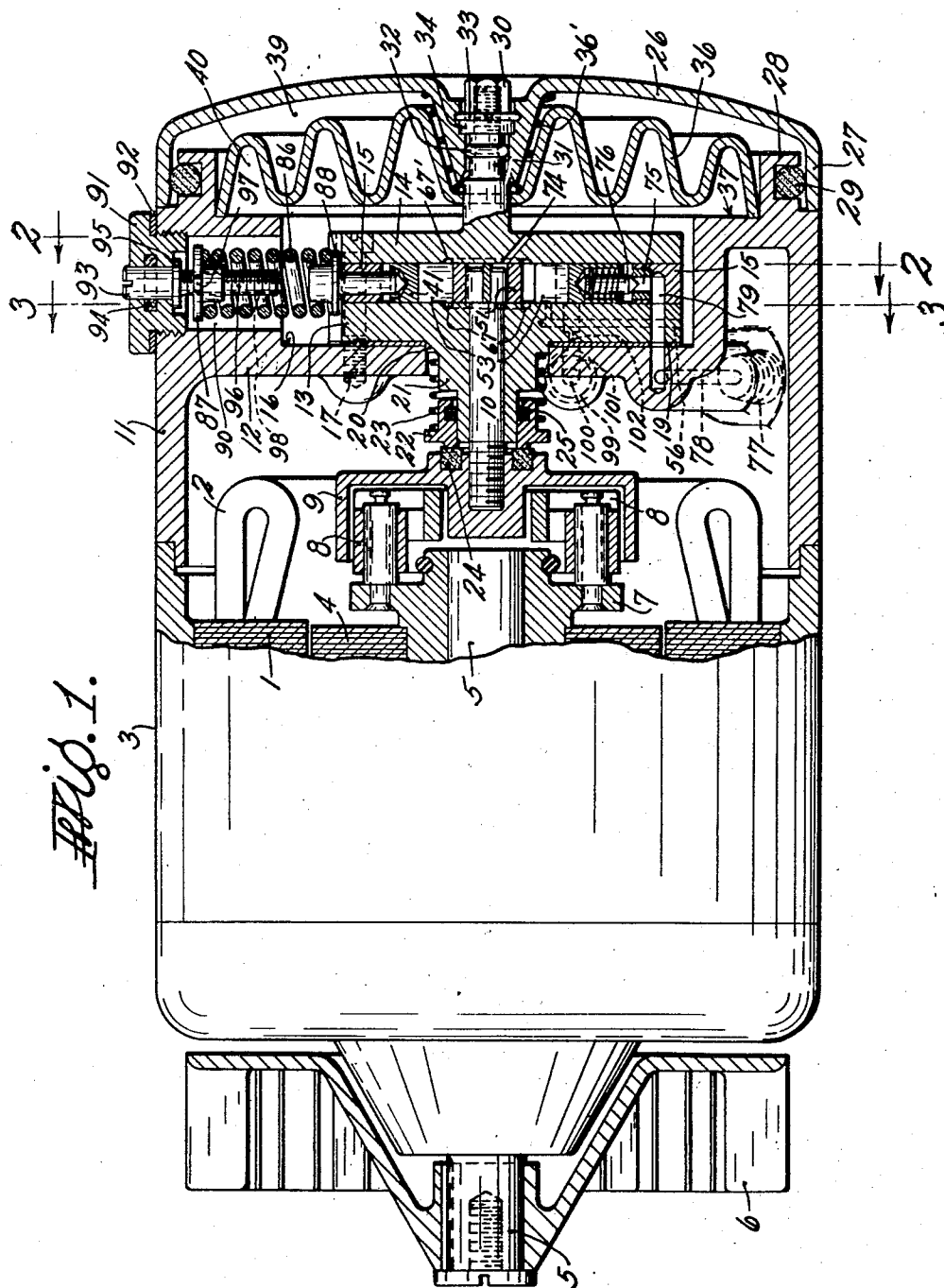


Fig. 1.

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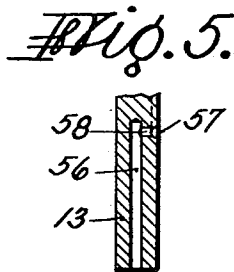
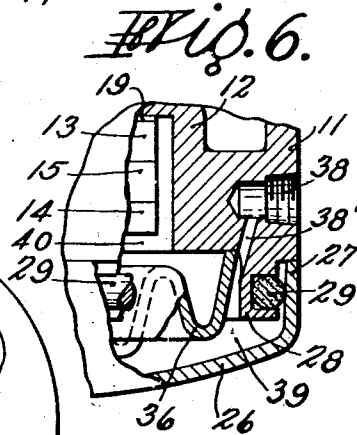
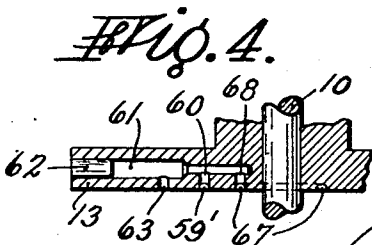
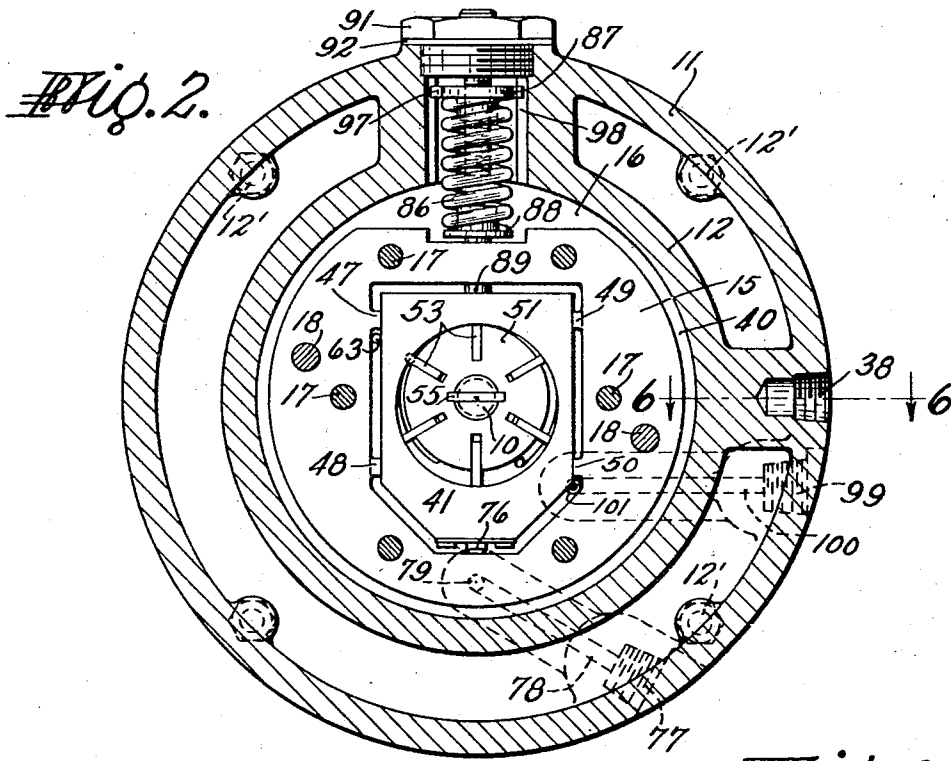
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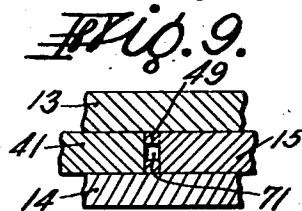
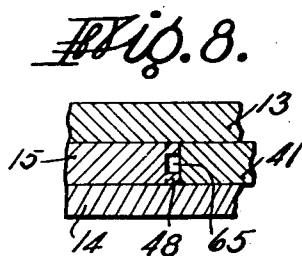
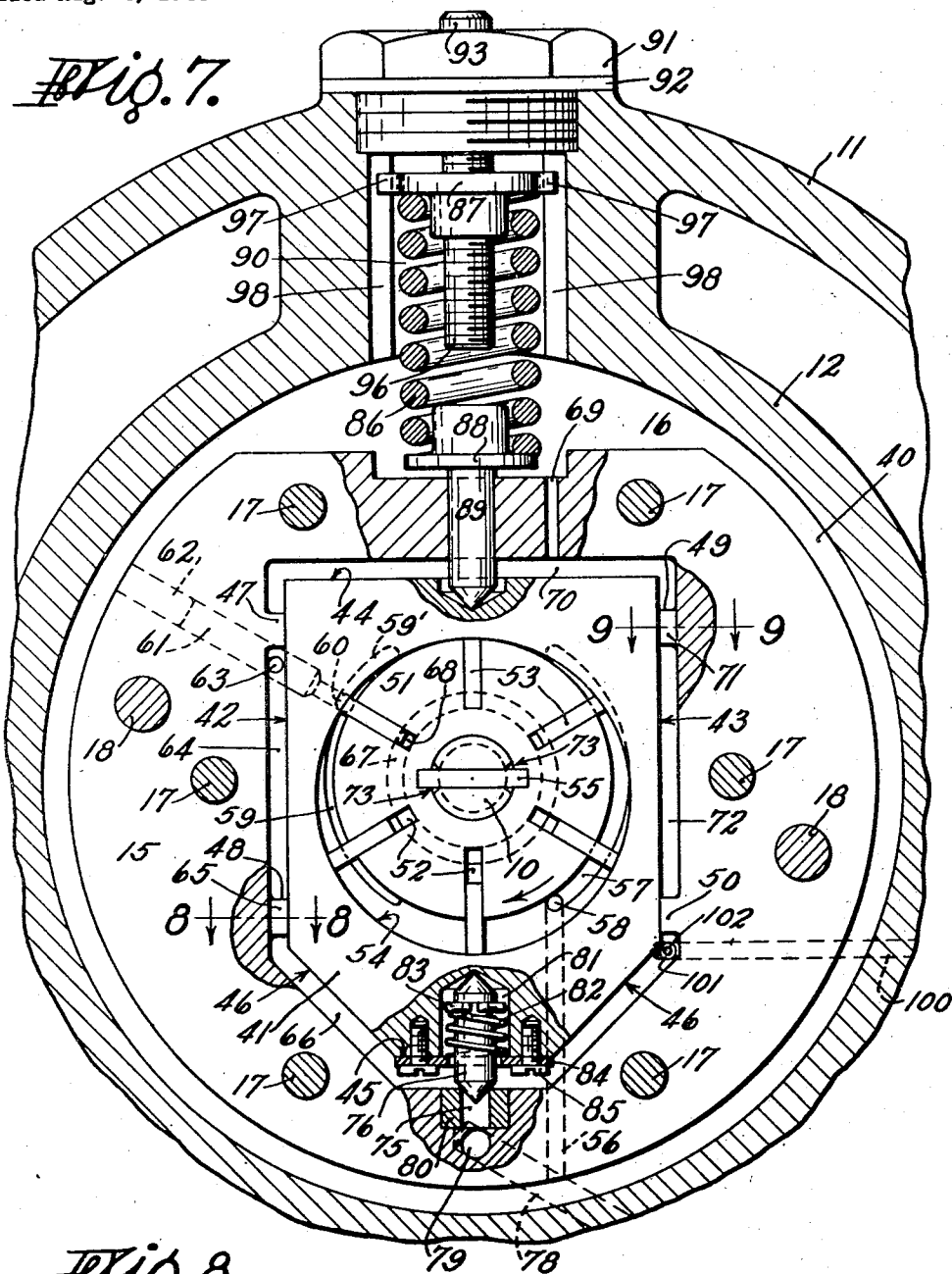
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VARIABLE CAPACITY VANE PUMP FOR OIL BURNERS

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3 Sheets-Sheet 3



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VARIABLE CAPACITY VANE PUMP FOR OIL BURNERS

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3 Claims. (Cl. 103—120)

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This invention relates to improvements in fuel supply units for oil burners.

More particularly, the invention provides a variable capacity pump for supplying liquid fuel at substantially the same rate as it is consumed by the burner and, accordingly, the unit can be made smaller and operated with less power than the units now in general use, where fuel is pumped at a rate many times that at which it is used and the greater part of the pumped oil is by-passed. No fuel need be by-passed in many installations served by the pumping unit of this invention. However, a constant but restricted by-pass is provided for priming purposes when the unit is used with a low-level tank. When the supply tank is above the level of the unit, this by-pass may readily be rendered ineffective.

One object of the invention is to provide a fuel supply unit for an oil burner having a variable-capacity pump in which the stator of the pump is reciprocable as a piston in a cylinder by the pressure of the pumped liquid and carries the burner cut-off valve—the latter being closed by spring pressure on the stator until the pressure of the pumped oil exceeds a predetermined value.

Another object of the invention is to provide a variable capacity pump in which the pump stator serves as a piston, being movable in its cylinder by pressure of the pumped oil acting against spring pressure and in which the pump stator is substantially balanced on one side against the inlet pressure and on the other side against the outlet pressure so that there is substantially no lateral thrust or pressure of the stator on its guides to interfere with its freedom of reciprocation.

Another object of the invention is to provide a variable capacity pump having a casing, providing within it a cylinder, a combined pump-stator and piston mounted in said cylinder and having a pump chamber with inlet and outlet ports, a pump rotor rotatable in said chamber, and a conduit connecting the outlet port to one end of said cylinder for acting directly on the stator as a piston to move the same to vary the pumping rate.

A further object of the invention is to provide a fuel supply unit for an oil burner in an end portion of the casing of a driving motor, such portion of the casing having fixed and removable end walls and between these walls a fuel reser-

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voir, containing a variable-capacity pump secured to the fixed wall—the latter having connections for a fuel supply pipe, a burner outlet pipe and a return pipe and passages from the several connections to the pump—the motor casing having inside it spring means which is adjustable from outside the motor casing and which acts on the stator of the pump in opposition to the pressure of the pumped oil to vary the capacity or pumping rate of the pump.

These objects and others will more particularly appear as the detailed description proceeds.

The invention will be disclosed with reference to the accompanying drawings, in which;

Fig. 1 is a sectional elevational view of a fuel supply unit, embodying the invention and shown as mounted in the casing of its driving motor;

Figs. 2 and 3 are full-size cross sectional views taken on the lines 2—2 and 3—3 respectively, of Fig. 1;

Figs. 4 and 5 are fragmentary sectional views taken on the lines 4—4 and 5—5, respectively, of Fig. 3;

Fig. 6 is a fragmentary sectional view taken on the line 6—6 of Fig. 2;

Fig. 7 is an enlarged fragmentary view taken similarly to Fig. 2 and showing the pump more clearly and in greater detail; and

Figs. 8 and 9 are fragmentary sectional views taken on the lines 8—8 and 9—9, respectively of Fig. 7.

Referring to these drawings and first to Fig. 1 thereof, the pumping unit of this invention is shown as mounted in one end portion of the casing of an electric motor which drives it. The stator of the motor is indicated at 1, its windings at 2 and the encompassing casing at 3. The rotor is shown at 4, fixed to the shaft 5, which, as shown, carries on one end a fan 6 for supplying air to the oil burner. The rotor has fixed thereto a plate 7, which carries the weight segments 8 of a speed-responsive coupling—such segments being adapted to move outwardly by centrifugal force at a predetermined speed and engage the inner periphery of a drum 9, fixed as indicated, to the inner end of a pump driving shaft 10. This coupling may be of the type disclosed in my copending application Serial No. 530,107, filed April 8, 1944, now abandoned. The motor has a special end casing having a cylindrical wall 11

and a transverse partition wall 12, subdividing its interior into an inner chamber, housing the speed-responsive coupling 8, 9, and an outer chamber housing the pump. This end casing is suitably fixed to casing 3 as by the bolts 12', indicated in Fig. 2.

The pump includes a casing having an inner end plate 13, an outer end plate 14 and an intermediate plate 15. These plates are secured together, and clamped to a finished annular flat face 16 of wall 12 by a plurality of cap screws 17, which thread into said wall. A pair of dowel pins 18, fixed in said wall pass through the several plates and serve to hold the same in exact alignment. A gasket 19 is interposed between plate 13 and the face 16 of wall 12 to seal the joint therebetween. In the wall 12 is a central hole to receive a pilot portion 20 of a hub 21 which projects rearwardly into one end of the motor casing and rotatably supports the pump shaft 10. Slidably mounted on the inner portion of hub 21 is a seal ring 22, the inner end face of which is pressed by a spring 23 against an end face 24 on the drum 9, as one means to prevent the escape of any liquid which may leak from the pump and pass between shaft 10 and hub 21. A rubber packing ring 25 prevents leakage from the pump from passing into the motor casing between the hub 21 and seal ring 22.

The outer end of casing 11 is closed by a cover 26, having an annular flange 27 which engages an end face of such casing. The latter has an annular flange 28, grooved to receive a packing ring 29 which bears against the interior peripheral wall of flange 27 and makes the joint liquid tight. The cover is held in place by a cap nut 30, threaded on the outer end of a stud 31, fixed to and projecting outwardly from the outer plate 14 of the pump housing. A packing ring 32, mounted in a groove in stud 31, at a point intermediate the ends of the latter, is compressed between the stud and the wall of the central hole in cover 26 to prevent escape of liquid. The cap nut 30 sets into a recess in the cover 26 and a snap ring 33 is held in a groove in the wall of such recess and engages the outer face of a flange 34 on the cap nut. This arrangement facilitates removal of the cover which is held tightly by pressure of the packing ring 29 on flange 27. By unscrewing nut 30, its flange 34 will press against the snap ring 33 and force off the cover, thus avoiding the prying off of the cover with tools as might otherwise be necessary.

The outer chamber in casing 11—that space between the wall 12 and cover 26—forms a reservoir for the liquid fuel. This space is partitioned by a filter 36 of any suitable form. As shown, the filter is of porous metal. It has a central opening to closely fit stud 31 and its outer rim is confined within the annular flange 28 and is seated against an annular shoulder 37 on wall 12. The filter is held against such flange by a spring 36'. There is a tapped hole 38 in the casing 11 forming a connection for a fuel inlet pipe (Fig. 6). This hole 38 is connected by a diagonal passage 38' to the inlet chamber 39, formed between the filter 36 and the cover 26. The space between the filter 36 and wall 12 forms a pump inlet chamber 40. The pump housing, above described, is located in this chamber 40 in a cylindrical recess formed in wall 12. The pump housing is spaced from the circular wall of such recess so that liquid can pass all around its marginal wall, as will be clear from Fig. 2.

The pump casing provides within it a cylinder

in which is slidably mounted the combined pump-stator and piston 41. This member 41 has parallel straight side walls 42 and 43 and a right-angularly disposed straight top wall 44. Its bottom wall consists of a short straight central portion 45, the ends of which are connected, one to the adjacent end of the wall 42 and one to the adjacent end of wall 43, by straight portions 46 disposed at an angle of 135 degrees to the wall 45. The peripheral wall of the cylinder is formed by the intermediate plate 15, which has a recess of substantially the same configuration as the stator-piston 41 but of larger size. The stator has flat parallel end faces which fit between and slidably engage the inner and outer end plates 13 and 14 which form the end walls of the cylinder. There are upper and lower lands 47 and 48, respectively, projecting inwardly from one side wall of the recess in plate 15 and there are upper and lower lands 49 and 50, projecting inwardly from the opposite side wall of such recess. The stator 41 slidably fits between the lands 47 and 49 and between the lands 48 and 50 and is free to move up and down but is confined against lateral movement.

The stator 41 is provided with a cylindrical opening therethrough to receive the pump rotor. The latter comprises a cylindrical body 51 having parallel flat end faces spaced apart by the same distance as the end faces of the stator so that it closely fits between the plates 13 and 14 but is free to rotate. The periphery of the body 51 is provided with a plurality (six as shown) of equally spaced, radially-disposed slots 52 in which a plurality of blades 53 are slidably mounted, one in each slot. These blades are forced outwardly so that their outer edges engage the inner peripheral wall 54 by hydraulic pressure as will later appear. The rotor has a central opening with keyways to receive the outer end of shaft 10 and opposite ends of a key 55 which passes diametrically through the shaft.

The inner plate 13 (Figs. 3 and 5) of the pump housing has a passage 56 leading from the peripheral wall of the plate upwardly. In the inner face of plate 13 is an arcuate groove 57 and forming an inlet port for the pump. This groove is coaxial with shaft 10, but located on one side thereof and near the side wall 43. The lower end of groove 57 is connected to the upper end of passage 56 by a hole 58. As will be clear from Fig. 7, liquid from the pump inlet chamber 40 can enter passage 56, hole 58 and groove 57, passing into the pockets between certain of the pairs of blades 53. The rotor, travelling clockwise, carries each pocket successively out of communication with groove 57 and into communication with an arcuate groove 59 formed in the inner face of plate 13 on the opposite side of shaft 10. Groove 59 is connected by a hole 60 with a radial passage 61 in plate 13. Groove 59 forms an outlet port for the pump and is located near the side wall 42. Beyond the hole 60, groove 59 is enlarged, as at 59', to provide a free escape of fluid from the rotor pockets just prior to their transition from the pressure to the suction side of the pump. The outer end of passage 61 is closed by a plug 62. A hole 63 in plate 13 connects passage 61 to the inner face of plate 13 at a location such as to deliver the pumped oil into the space 64, which is bounded by the lands 47 and 48, the wall 42 and the adjacent side wall of the cylinder. In the lower land 48 is a groove 65 (Fig. 8), so that liquid can pass into the outlet space 66 between the three-sided

lower end of the stator-piston and the correspondingly-shaped lower wall of the cylinder.

Also formed in the inner face of plate 13 is a circular groove 67 which is coaxial with shaft 10 and is connected at one point by a hole 68 with the outlet passage. As will be clear from Fig. 7, this groove 67 constantly communicates with the bottom of each slot 52 in the rotor, whereby liquid under outlet pressure is supplied beneath the blades 53 to force them outwardly against wall 54. A similar groove 67' is in the inner face of plate 14, also interconnects the bottoms of the slots and helps in the distribution of the liquid to the several slots.

Liquid under inlet pressure is supplied through a passage 69 in the upper part of plate 15 which passage connects the pump inlet chamber 40 to the space 70 between the top wall of the stator-piston and the adjacent top wall of the cylinder. The upper land 49 (Fig. 9) has a groove 71 therethrough which allows liquid under inlet pressure to flow into the space 72 between the side wall 43 and the adjacent side wall of the cylinder.

The edges of the keyway in shaft 10 are beveled as shown at 73 in Fig. 7. Four small channels are thus afforded through which liquid leaking radially inward between the plates 13 and 15 may pass to a drain channel 74 in plate 14 and be conducted into the pump inlet chamber 40. Leakage between the plates 14 and 15 will pass directly into this channel 74.

The outlet chamber 66 of the pump has an outlet passage 75, controlled by a needle valve 76, mounted on the lower end of the stator 41. A tapped hole 77 (Fig. 1) is provided in the casing 11 for an outlet pipe to connect with the nozzle of the burner. This hole 77 is connected to the outlet 75 by a passage 78 in casing 11 and by a series of registering holes 79 in casing 11, gasket 19, and plates 13 and 15. The valve 76 is mounted for adjustment in the stator 41 so that it may adjust itself to the seat in the hardened bushing 80 in which the outlet passage 75 is formed. In the lower end of stator 41 is a vertical opening 81 in which the upper part of the stem of valve 76 is received together with a spring 82, which encompasses the stem. The upper and pointed end of the stem of valve 76 is received in the pointed center of the upper conical wall of the hole 81. The upper end of this valve stem has a groove, in which a snap ring 83 is received, and the spring presses against this snap ring and holds the point of the valve stem in the point of the hole 82. The spring is held in place by a plate 84, secured by screws 85 to the lower wall 45 of the stator and the valve stem passes freely through a central hole in this plate.

The stator 41 is held in its lower position and valve 76 is held closed by a spring 86 acting between a fixed but adjustable spring seat 87 in casing 11 and a seat 88. The latter is formed on top of a stem 89 which passes freely through the upper wall of the intermediate plate 15 and has a pointed inner end which seats on the point of the conical bottom wall of a hole formed in the top wall of stator 41. The upper part of the spring 86 extends into a vertical hole 90 in casing 11. The upper end of this hole is closed by a threaded cap 91 and sealed by a gasket 92. A stem 93 is rotatable in cap 91 and is sealed by a packing ring 94 in the cap. On this stem is a flange 95 abutting the bottom face of the cap 91. On the stem, below the flange 95, is a screw 96 with which the spring seat 87 is engaged as a nut. This seat 87 has diametrically opposed ears

97, projecting from its periphery and engaged one in each of two longitudinal grooves 98 formed at diametrically opposite locations in hole 90.

A tapped hole 99 is provided in casing 11 for receiving a return pipe adapted to connect with the fuel supply tank. This hole 99 is connected by a passage 100 (Fig. 1) in casing 11 to a passage 101 which is formed in casing 11, gasket 19 and plate 14, and which opens into the outlet chamber 66. The passage 101 has intermediate its ends a restricted portion 102 which limits the amount of oil that can pass therethrough. The arrangement affords a continually open by-pass from the pressure side of the pump to the fuel-supply tank. This by-pass is needed only when a low-level supply tank is used. If the supply tank is above the level of the pump, the hole 99 will be closed by a pipe plug and the by-pass thus rendered inoperative. The sole purpose of this by-pass is to enable priming of the pump by the elimination of air from the pump and its suction line.

In operation, when the coupling members 8 and 9 engage at the predetermined motor speed, the shaft 10 is rotated and with it the pump rotor 51 which revolves in a clockwise direction as viewed in Fig. 7. The pockets between adjacent blades 53 of the rotor become increasingly larger as they move downwardly from their uppermost to their lowermost positions and a partial vacuum is created to draw liquid from the supply tank through the suction pipe into chambers 39 and 40 and through the passage 56 and groove 57 into the pump. As the pockets between the blades travel upwardly from their lowermost to their uppermost positions, the pockets become increasingly smaller and liquid is forced outwardly by way of groove 59, passages 60, 61 and 63 into the space 64 and through groove 65 into outlet chamber 66. The valve 76 is initially closed so there is no outlet for liquid except by way of the restricted by-pass 100, 101, and 102. Consequently, pressure builds up in chamber 66 and, when the liquid reaches the desired predetermined pressure, the stator 41 moves upwardly, compressing spring 86 and opening the outlet valve 76 so that oil can flow to the nozzle of the burner. As the stator 41 moves upwardly, the relative eccentricity of its pump chamber and the rotor 51 decreases and the rate of pumping decreases. If the pressure drops, the stator will move down to increase the aforesaid relative eccentricity and the pumping rate. With the burner consuming oil at a constant rate, the pump will operate at a constant rate, and the stator will come to rest in a position wherein the force of liquid pressure on it balances the force of the spring on it. The rate of pumping automatically adjusts itself to the rate of oil consumption in any particular burner. For instance, if a larger nozzle is placed in the burner, the pump will automatically supply oil at such increased rate as is necessary. Except for the constant but restricted by-pass, no more oil is pumped than is consumed. And such by-pass is not used except in connection with the so-called two pipe systems having a low level tank. With tanks located at a level above the burner, this by-pass is rendered inoperative by screwing a plug into the return pipe connection 99.

It should be noted that the stator 41 of the pump serves also as the piston of a hydraulic cylinder, whereby to move the stator directly by pressure of the pumped liquid in order to vary the rate of pumping. The stator also serves as the piston for moving the cut-off valve 76 of the

burner. The arrangement is exceedingly compact and the entire fuel unit with the reservoir and filter can be located in one end of the casing of the driving motor without any apparent increase in length of the casing.

Another important feature of the invention is that the stator is balanced against the inlet and outlet pressures so that there is no substantial lateral pressure on the guides, (in this case the several lands 47, 48, 49 and 50). The space 72 along one side of the stator is filled with liquid at inlet pressure, tending to thrust the stator to the left. Such thrust is substantially balanced by the thrust to the right due to liquid at inlet pressure acting on the right hand curved part of the peripheral wall 54 of the pump chamber. The space 64 along the opposite side of the stator is filled with liquid at outlet pressure, tending to thrust the stator to the right. This thrust is substantially balanced by the thrust to the left due to liquid at outlet pressure acting on the left-hand curved part of the peripheral wall 54 of the pump chamber. Thus, there is substantially no lateral pressure of the stator on its guiding lands 47, 48, 49 and 50. Also, these are made of as small area as feasible. Thus, friction of the stator in its cylinder is reduced to a very low figure, enabling easy and free reciprocation of the stator. The space 70 above the stator is connected to the inlet chamber for convenience. The only necessary function of this passage, however, is to let fluid pass into and out of the space 70 as the stator moves down or up in its cylinder. This might be otherwise effected by any suitable means and, of course, liquid could be supplied from chamber 40 to the space 72 in any other suitable way.

The invention provides a simple, compact construction of variable capacity pump which can readily be mounted in the casing of a small electric motor and operated therefrom with a small amount of power to supply fuel at a rate substantially equal to that at which it is consumed and at constant pressure.

I claim:

1. A variable capacity pump, comprising, a casing having a cylinder formed by a peripheral wall and two parallel end walls, a pump stator slidably mounted in said cylinder and engaged with said end walls, said stator having a cylindrical opening therethrough, a cylindrical rotor mounted in said opening, the end faces of said rotor being rotatably engaged one with each of said end walls, vanes movably mounted in the rotor and contacting the periphery of said opening, a drive shaft extending through one end wall into said opening and fixed to said rotor, a spring for moving said stator in said cylinder in one direction and tending to hold the stator in a position such that said opening and rotor are in eccentric relation, said stator having top, bottom and two side walls and the peripheral wall of the cylinder including top, bottom and two side walls each spaced from the corresponding wall of the stator, and inlet and outlet ports in said opening located one near one side wall and one near the opposite side wall of the stator, means for admitting liquid under inlet pressure to the space between the top walls and the space between the side walls adjacent the inlet port, means for admitting liquid under outlet pressure to the space between the other pair of side walls and to the space between the bottom walls, means preventing communication from the space between the top walls to the space between the side walls ad-

jacent the outlet port, and means preventing communication from the space between the bottom walls and the space between the side walls adjacent the inlet port.

2. A variable capacity pump, comprising, a casing having a cylinder therein with a top wall, a bottom wall, spaced parallel side walls and spaced parallel end walls, a pump stator having spaced parallel end walls slidably engaged one with each of the end walls of said cylinder and having also a top wall, a bottom wall and two parallel side walls; each side wall on the stator being located parallel with but spaced from an adjacent side wall of said cylinder, said stator having a cylindrical opening therethrough forming a pump chamber, a pump rotor mounted in said chamber and having end faces engaged one with each of the end walls of said cylinder, vanes movably mounted in the rotor and contacting the periphery of said opening, a driving shaft rotatably mounted in said casing and fixed to the rotor, pump inlet and outlet ports for said opening one near each side wall of the stator, two longitudinally spaced lands on each cylinder side wall projecting inwardly and slidably engaging the adjacent side wall of the stator; there being a space on each side of the stator bounded by the side wall of the stator, the adjacent side wall of the cylinder, the two lands on such cylinder side wall and the two end walls of the cylinder; means for admitting liquid under inlet pressure to said space near the inlet port, means for admitting liquid under outlet pressure to said space near the outlet port, a spring for moving the stator in one direction, and means for moving the stator in the other direction by liquid under outlet pressure.

3. A variable-capacity rotary pump, comprising, a casing having a chamber, a member slidable in a straight line in said chamber, one portion of said member serving as a pump stator which has a cylindrical pump chamber formed therein, another portion of said member serving as a piston which is slidable in an end portion of said first-named chamber, a cylindrical pump rotor mounted in the pump chamber, vanes movably mounted in the rotor and contacting the periphery of said pump chamber, a drive shaft for the rotor rotatably mounted in said casing and extending transversely to the direction of sliding movement of said member, said casing having an inlet and outlet leading to the pump chamber on opposite sides of the rotor, the relative eccentricity of the rotor and stator determining the pumping rate, the outlet side of the pump chamber being connected to said end portion of the first-named chamber, whereby to subject said piston directly to hydraulic pressure from the outlet side of the pump and move said member and the pump chamber in a direction for decreasing the pumping rate, means to apply spring pressure to said member to move it and the pump chamber in the opposite direction for increasing the pumping rate, whereby said member will be moved until the opposing forces are balanced and the pressure of the pumped fluid will be maintained constant at a predetermined value, and a valve carried by said member located in said end portion of the first-named chamber and controlling the outlet of the pump to maintain the same closed until a predetermined outlet pressure is established.

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