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2,460,047

VANE PUMP AND PRESSURE CONTROL MEANS.

Filed Nov. 19, 1942

2 Sheets-Sheet 1

FIG-1

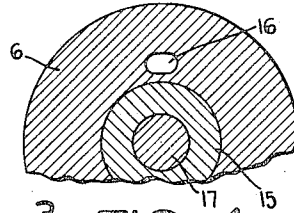
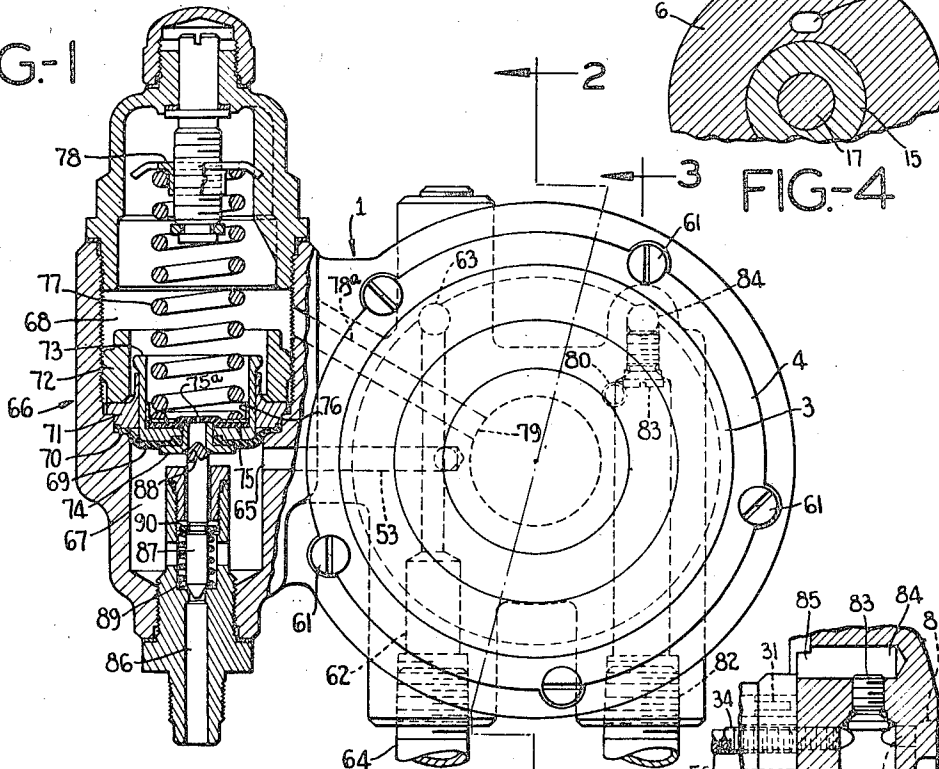


FIG-4

FIG-3

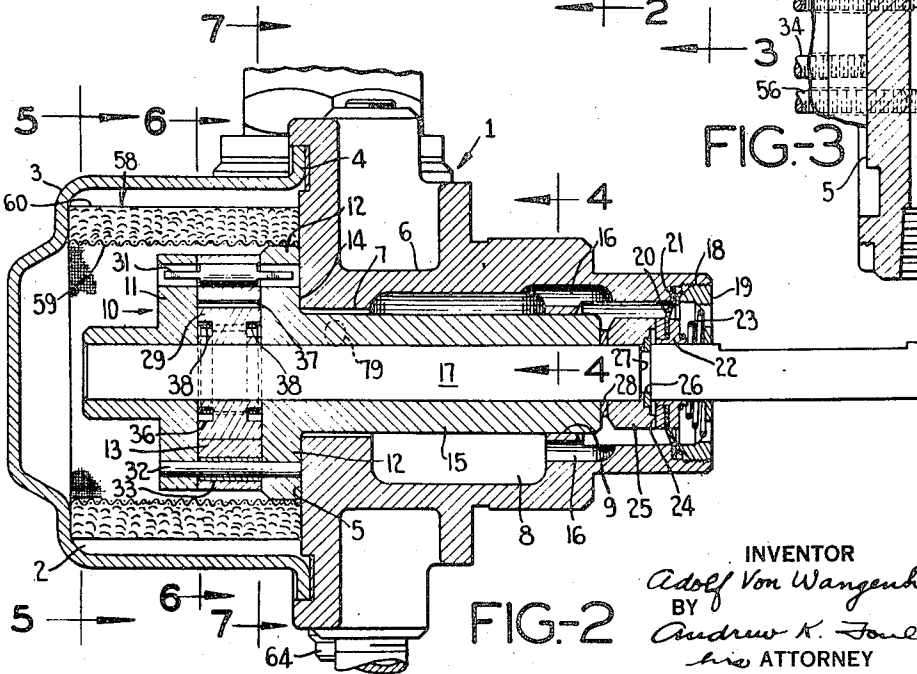
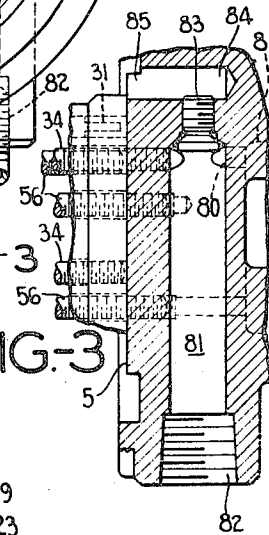


FIG-2

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VANE PUMP AND PRESSURE CONTROL MEANS

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2 Sheets-Sheet 2

FIG. 5

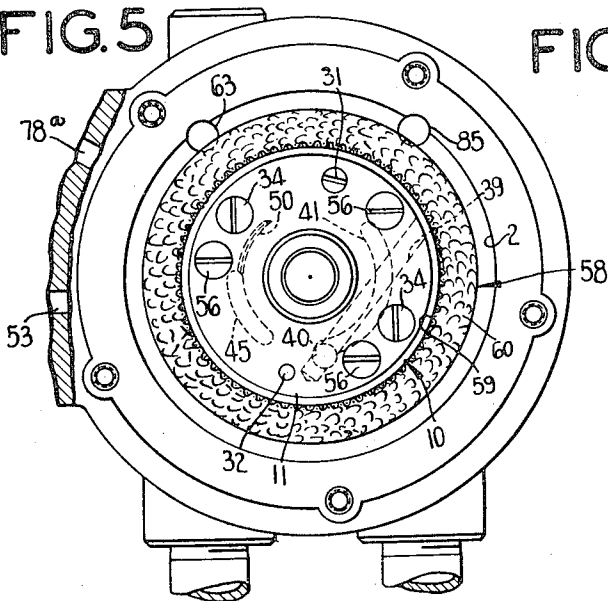


FIG. 7

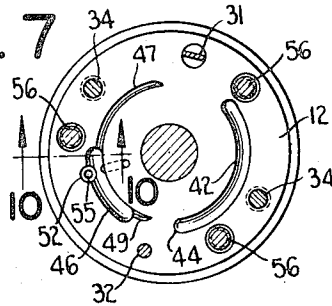


FIG. 9

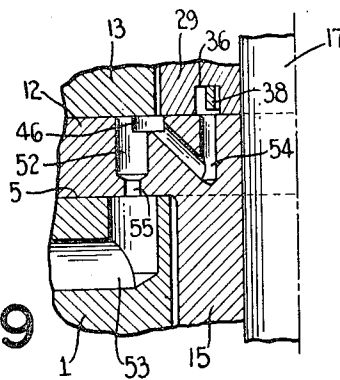


FIG. 10

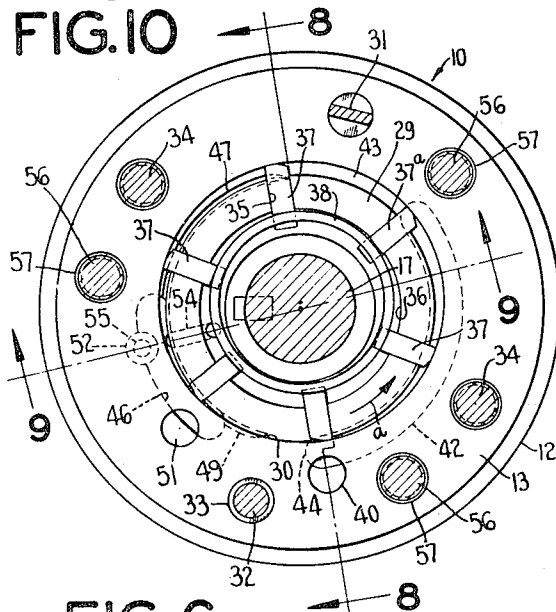


FIG. 6

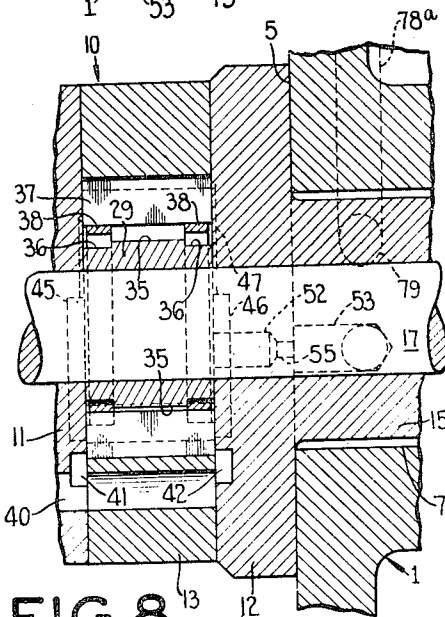


FIG. 8

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UNITED STATES PATENT OFFICE

2,460,047

VANE PUMP AND PRESSURE
CONTROL MEANS

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Application November 19, 1942, Serial No. 466,116

6 Claims. (Cl. 103—136)

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This invention relates to new and useful improvements in units for supplying liquid under pressure and more particularly to a combined pump, pressure regulating means and strainer.

An object of the invention is to provide a unit in which the component parts may be readily assembled with accuracy in commercial quantity production.

Another object is to provide a pump which will be highly efficient in operation and in which pump noises will be substantially eliminated.

Another object is to provide a pressure regulating valve in which hissing or other noise of discharging liquid will be silenced and substantially eliminated.

Another object is to provide efficient means for sealing a drive shaft of a pump.

The invention consists in the improved construction of parts and their cooperative relation to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings to be taken as a part of this specification, there is fully and clearly shown a preferred embodiment of the invention, in which drawings:

Figure 1 is a view in front elevation of a combined pump, strainer and pressure regulating valve embodying the invention, but showing the regulating valve in longitudinal central section;

Fig. 2 is a view in section on the line 2—2 of Fig. 1;

Fig. 3 is a detail view in section on the line 3—3 of Fig. 1;

Fig. 4 is a detail sectional view on the line 4—4 of Fig. 2;

Fig. 5 is a view in front elevation and partly in section of the pump portion of the unit and with the cover member of this portion removed to show internal construction;

Fig. 6 is a view of the pump substantially in section on the line 6—6 of Fig. 2 so that the front closure member is removed;

Fig. 7 is a view in section on the line 7—7 of Fig. 2, thereby showing the other end closure member of the pump in elevation;

Fig. 8 is a view in section on the line 8—8 of Fig. 6;

Fig. 9 is a detail view in section on the line 9—9 of Fig. 6, and

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Fig. 10 is a detail view in section on the line 10—10 of Fig. 7.

Referring to the drawings by characters of reference, 1 designates generally a body or housing member having a chamber 2 formed by a cup-like cover member 3 having a surrounding flange 4 which seats in and against the base of an annular recess in a flat chamber wall 5. Extending from the wall 5 and away from the chamber 2, there is a hollow extension 6 having a bore 7 extending longitudinally therethrough and opening into the chamber 2 through substantially the middle point of the wall 5. The bore 7 has, intermediate its ends, an enlarged diameter portion 8 and a bearing or guide portion 9 of reduced diameter relative to the diameter of the bore 7. Within the chamber 2 there is a pump casing 10 having end closure plate members 11, 12 between which there is clamped a hollow annular stator member 13. The end closure member 12 has an external flat face 14 which seats against the flat wall 5. Projecting from the face 14 there is a hollow extension 15 which extends through the bore 7 and fits the guide portion 9. The extension 15, except for its fit in the portion 9, is in circumferentially spaced relation to the wall of the bore 7 so as to provide for liquid flow in the bore 7 around the extension 15. The passageways 16 are provided in the wall of the hollow extension 6 to permit communication between opposite sides of the portion 9. Journaled in the pump casing extension 15 and projecting therefrom, there is a pump drive shaft 17 which extends out of the housing extension 6. Surrounding the shaft 17 and screw-threaded, as at 18, into the outer end of the bore 7, there is a closure member 19 which tightly clamps the marginal edge portion of a sealing member 20 against an outward facing shoulder 21 in the extension 6. The member 20 is preferably of flexibly resilient sheet material, such, for example, as a rubber, synthetic rubber, or other organic elastomer having inserted fabric. On the shaft 17 there is a two-part thrust member 22 which has a rotary fit on the shaft 17 and between the parts of which there is tightly clamped the inner peripheral portion of the annular sealing member 20. The thrust member 22 is urged toward the extension 15 by a coil spring 23 which abuts against the closure member 19 and urges the thrust member 22 into rotary sealing engage-

ment with the face of an annular flange 24 projecting from a collar 25, preferably press-fitted on the shaft 17. The collar 25 is limited against endwise movement toward the thrust member 22 by a split ring or washer member 26 which seats in a circumferential groove 21 in the shaft 17. A thrust washer or bearing pad 28 surrounds the shaft 17 and is positioned between the collar 25 and the end face of extension 15 to take the thrust of spring 23.

The drive shaft 17 extends through the casing 10 in eccentric relation to the internally cylindrical surface of the stator member 13 and is journaled in the end closure member 11. Keyed on the shaft 17 and fitting between the closure members 11, 12, there is a rotor 29 of annular form and concentric with shaft 17. The rotor 29 has tangential engagement with the cylindrical surface of stator 13 as at 30, see Fig. 6. Accurate tangential sliding fit is provided by means of the locating pins 31, 32 which have their longitudinal center lines intersecting an extended line at right angles to and joining the shaft longitudinal center line and the line of tangential contact. The pin 31 fits with the usual commercial clearance in a one diameter hole through the closure members 11, 12 and stator 13 but has its end portions, which are located within the closure members 11 and 12, cut or formed to provide a diametrical flat portion which, being transverse to the above mentioned extended line, will permit slight radial movement of the stator toward and from the rotor. Any such radial movement is, however, prevented after tight tangential contact is obtained and this is accomplished by means of the pin 32 which has a tight fit in aligned apertures in the closure members 11 and 12 and also has a tight fit in the bore of a bushing 33, which bore is aligned with the closure member apertures. The bushing bore is drilled or formed after the rotor and stator are in tight tangential contact so that no radial play of the stator relative to the rotor is permitted when the pin 32 has been inserted in its locking position. In order to eliminate any possibility of a shifting of the parts 11, 12 and 13 relative to each other, they are frictionally clamped tightly to each other by means of screws 34. In the circumference of the rotor 29 there are radial longitudinal slots 35 extending across the face of the rotor and extending radially inward substantially to the inner circumference or marginal edge of annular grooves 36 in the end faces of the rotor and concentric with the shaft 17. There are preferably 6 such slots 35 and they are equally spaced circumferentially of the rotor 29. In each of the slots 35 and having a radial sliding movement therein, there is a vane member 37. The radial length or depth of the vane members 37 is such that irrespective of the circumferential position of the vane member relative to the stator 13, there will always be a slight extension of the vane member into the annular grooves 36. The vane members are, of course, all similar in dimension with respect to each other. Within each of the grooves 36, there is a ring member 38 which has its external circumference fitting against the inner ends of the vane members 37 so as to tend to hold the vane members 37 in contact with the internally cylindrical surface of the stator 13. Opening from chamber 2 into the end closure member 11 substantially parallel to the plane of the rotor 29, there is an inlet conduit 39 which

terminates adjacent the point of tangential contact 30 and in registry with a cross passage 40 in the stator 13 and the abutting portion of member 11. This cross passage 40 opens into the pump inlet port which is in the form of arcuate recesses 41, 42 in the inner faces of the end members 11, 12 respectively, and which are in registry with the crescent-shaped space 43 between the rotor and the stator. The inlet ports 41, 42 are of arcuate form extending as recesses in the rotor engaging faces of the members 11 and 12, the recesses being concentric with the shaft 17 and being of a width to extend more than across the space 43. These inlet port recesses are each of a length greater than 120° and each starts, as at 44, closely adjacent but on the inlet side of the point 30. On the opposite side of the point 30 is located the exhaust port which comprises the arcuate recesses 45, 46 respectively in the closure members 11, 12 respectively. The main body portions of the exhaust port recesses 45, 46 are of equal size and extend circumferentially and concentrically of the shaft 17 in registering relation with the crescent-shaped space 43. These main recess portions are of greater width than the space 43 so that they are in opposed relation to the stator and to the rotor. The recess 46 has a leading portion 47 which is of materially reduced V-shaped cross section and extends toward the inlet port to a point so that the distance between the start of the portion 47 and the cut off end of the port recess 42 is equal to the space between adjacent ones of the vane members 37 at the external circumference of the space 43. It will therefore be apparent that as the space between adjacent vane members is cut off from the recess 42, that it will be substantially simultaneously opened into the leading exhaust portion 47. This exhaust recess 46 has a materially reduced V-shaped trailing portion 49 which terminates at the point 30 so that there will be no trapping of liquid in the space 43 as the vanes leave the main portion of recess 46. The recess 45 also has a leading portion 50 which is of materially reduced cross section and V-shaped. This leading portion 50 extends toward the inlet port for about two-thirds of the length of the leading portion 47. Through the stator 13 there is an aperture or cross passage 51 which connects the exhaust recesses 45, 46 adjacent the terminal end of the main recess portions. From the main portion of recess 46, there is an exhaust outlet port 52 which opens through the closure member face 14 into registry with an outlet passageway 53 in the housing member 1 and opening through the flat chamber wall 5. Establishing communication from the exhaust port, preferably the main portion of recess 46, there is a conduit 54 which registers with and opens into one of the annular grooves 36, see Fig. 9 so as to subject the inner shaft facing ends of the vane members 37 to the exhaust pressure, thereby to urge the vane members into engagement with the internally cylindrical surface of the stator 13. The exhaust outlet port 52 is preferably of reduced cross section, as at 55, in order to increase the back pressure in the recess 36 so as to enhance the holding of the vane members in contact with the stator. It will be noted that the recesses or annular grooves 36 are in communication with each other through the radial rotor slots 35. Solely by way of example, and without limitation of the relation of the porting in a 6 vane

pump, the following spacing may be embodied. Starting from the point of contact 30 and traveling counterclockwise, the angular degree distances may be

- To the start of inlet port—about 15°
- To the end of inlet port—about 130°
- To the start of the leading groove 47—about 198°
- To the start of the leading groove 50—about 228°
- To the start of main exhaust recesses 45, 46—about 285°
- To exhaust port outlet 52—about 298°
- To the end of main recesses 45, 46—about 337°

The pump casing 10 is secured rigidly in position and with the face 14 in tight sealing engagement with the flat chamber wall 5 so that the pump casing seals communication between the bore 7 and the chamber 2. This is accomplished by frictionally clamping the casing 10 to the wall 5 by means of screws 56, the screws 56 being of smaller diameter than the holes 57 through the casing 10 through which the screws 56 pass, so that the extension 15 can be accurately aligned with the guide portion 9, thereby eliminating any flexing or setting up of twisting stresses in the casing 10.

Within the chamber 2, there is a strainer member 58 of cylindrical form which fits over the closure member 12, which is of somewhat larger diameter than the external diameter of the stator 13 and closure member 11, so as to provide spacing between the pump casing and the internal diameter of the strainer member 58. The housing cover member 3 engages one end face of the strainer member 58 and holds it tightly clamped against the flat chamber wall 5, the strainer member 58 being of an external diameter to provide a clearance space around its external circumference within the cover member 3. This strainer member may be composed of an inner cylinder of foraminous material 59, such as wire screening, which serves as a base or support for a cylindrical pad of filter material 60. The cover member 3 is tightly clamped and sealed in position against the wall 5 by means of clamping screws 61 which engage the cover member flange 4.

In the housing member 1 there is an inlet passageway 62 which opens through the wall 5, as at 63, externally of the strainer member 58 so that fluid flowing through the conduit 62 must pass through the strainer member 58 in order to reach the pump inlet passageway 39. The inlet conduit 62 may have a pipe or other conduit member 64 secured thereto and leading from a source of fluid supply. The outlet conduit 53 from the pump extends through the wall of the housing 1 and opens, as at 65, into a pressure regulating valve means 66 and particularly into the pressure chamber 67 thereof. The regulating means 66 also includes a by-pass chamber 68 and these chambers 67 and 68 are separated by a pressure responsive member 69, preferably a sheet of flexible, stretchable, resilient material, such, for example, as Ameripol. Between the chambers 67, 68, the housing member has an internal annular shoulder 70 on which the marginal portion of the member 69 seats. A clamping ring and guide member 71 overlies the shoulder 70 and clamps the marginal edge of the member 69 in tight sealing relation thereto. The ring member 71 is held in position by a hollow clamping nut 72 screw-threaded within the chamber 68. Slidably guided within the ring member 71, there is a cup-shaped backing member 73 hav-

ing its base portion seating on the pressure responsive diaphragm member 69. Through the diaphragm member 69 and the cup member base portion, there is a central aligned opening through which there extends a tubular valve seat and guide member 74 having an annular clamping flange which seats against and tightly clamps the diaphragm member 69 to the cup member base portion. The seat member 74 extends through the cup member base portion and is rigidly secured thereto and has a projecting end portion within the chamber 68. Within the cup member 73 and seating on its base, there is a silencer disc member 75 of flexible, stretchable, resilient material, such, for example, as a rubber, synthetic rubber, or other organic elastomer and having a small opening 75^a therethrough registering with the bore of the seat member 74. This silencer member 75 is held at its marginal edge portion tightly against the bottom of the cup member 73 by a flanged washer 76 having a tight fit in the cup member 73 and by a helical coil spring 77 which seats at one end on the washer 76. The spring 77, at its other end, abuts an adjustment abutment means 78 by which the force of the spring 77 can be adjusted to determine the force acting on diaphragm member 69 in chamber 67, which will move the diaphragm member 69 toward the by-pass chamber 68. Leading from the by-pass chamber 68 through the wall of housing member 1, there is a by-pass conduit 78^a, which opens at its outlet end, as at 79, into the bore 7 around the extension 15 and between chamber 8 and the valve casing closure of bore 7. The fluid which empties into chamber 8 through conduit outlet 79 is free to pass through a port 80, see Fig. 3, into a passageway 81 which opens at its lower end, as at 82, externally of the housing 1 for connection of a pipe or conduit leading back, for example, to the source of fluid supply. The other or upper end of this passageway 81 may be closed by a screw plug 83, thereby closing off communication between the passageway 81 and a passageway 84 which opens into the chamber 2, as at 85, see Fig. 5. If desired, the passage outlet 82 may be closed by a plug and the plug 83 removed, so that flow from passageway 81 will pass through passageway 84 into the chamber 2 and return to the pump inlet passageway 39. The pressure chamber 67 has an outlet port or passageway 86 controlled by valve means 87, which is preferably in the form of a double ended valve member also controlling the flow through the seat member 74 into the by-pass chamber 68. The bore of the seat member 74 provides a by-pass outlet from the pressure chamber 67. The valve member end portion cooperable with the seat member preferably has a bleed slot 88, so that any entrapped air or gas will be discharged and not cause the pump to lose its prime or be air bound. The spring 77 urges the seat member 74 into closing relation against the double ended valve member 87 and urges this member 87 into closing relation with the outlet 86. A spring 89 tends to move the valve means 87 into open relation with respect to the outlet 86 and does so move the valve member 87 when pressure in the chamber 67 moves the diaphragm member 69 upward or toward the by-pass chamber 68. A stop member 90 is provided to limit the movement of valve means 87 by the spring 89, so that when the valve means has been opened a predetermined distance, the seat member 74 can thereupon move away from the valve means 87 to open the by-

pass port into the by-pass chamber 68. This action of the valve means 87 is well understood in the art and no further explanation is therefore necessary.

The operation of this combined pump, regulating means and strainer unit and of the parts of the same is as follows. It is, of course, assumed that the unit is utilized for supplying oil to an oil burner, for example, so that the outlet 86 is connected to the burner and the inlet conduit 64 is connected to a source of liquid fuel, and the outlet 82 is connected back to the fuel source. When the pump is started by counter-clockwise rotation of shaft 17 facing Figs. 1, 5, 6 and 7 and as indicated by the arrow *a*, Fig. 6, a vacuum will be created in the first half of the crescent-shaped space 43 by the vane members 37, thereby drawing oil into the chamber 2 through the inlet conduit 62. This oil in chamber 2 will be drawn through the strainer member 58 and through the inlet passageway 39 to the pump inlet port 41, 42. The oil supplied to inlet port 41, 42 will fill the expanding space between the rotor 29 and the stator 13 and the adjacent vane members. When a vane member, such as the member 37^a, see Fig. 6, leaves its inlet port, it will cut off communication of the inlet port with the space which precedes it, and as this vane member 37 passes the middle point of the crescent-shaped space 43, the vane member will start to compress the liquid between it and its preceding vane member. Substantially simultaneously with the cut off of the inlet port by the vane member 37^a, the space preceding this vane member will be opened into the leading exhaust groove 47, so that the bleeding of the liquid through this groove and the main exhaust recess portion 46 will cause a gradual discharge of the compressed liquid, thereby eliminating pump noise. As the vane member continues past the inlet of groove 47, it will come to the inlet or start of the exhaust bleed groove 50, thereby increasing the bleeding of oil into the main portion of the exhaust outlet 46 during the increasing compression on the oil. As the vane reaches the main exhaust recess portions 45, 46, the oil ahead of the vane member and between the stator and rotor will be forced out into the exhaust port and any oil which is retained ahead of the vane member after the vane member leaves the main recess portions 45, 46 will be discharged back into the main recess portions 45, 46 through the trailing groove 49. The oil discharged into the discharge recesses 45, 46 which are in communication through the cross passage 51 will be forced through the discharge outlet 52 and the restricted port 55 into the outlet passageway 53. Due to the conduit 54, oil will, of course, be held under compression in the annular grooves 36, thereby maintaining the vane members in contact with the cylindrical stator surface.

The oil which is discharged through the passageway 53 will be fed into the pressure chamber 67, see Fig. 1, and when the pressure has built up so that the force exerted against the diaphragm 69 is sufficient to overcome the force of the compression regulating spring 77, then the diaphragm member 69 will be moved toward the by-pass chamber 68, thus permitting the valve means 87 to move toward open position or upward, thereby permitting the discharge of oil through the outlet passage 86 to the burner. When the pump gets up to speed and is discharging oil at a rate to create the maximum desired pressure in chamber 67 and at the burner,

then the stop 90 will limit further opening of the outlet 86 and upon any pressure increase, the diaphragm member 69 will move away from the valve means 87, thereby opening the by-pass port through seat member 74. The extent of opening at the valve seat member 74 will, of course, vary with the pressure in chamber 67. The oil discharging into chamber 68 will be fed therefrom through the passageway 78 into the chamber 8 and thence through port 80 to the outlet of passage 81 which leads back to the supply tank. If, as above noted, the outlet 82 is closed by a plug and the screw plug 83 is removed, then this by-pass oil will be discharged through the by-pass 84 back into the chamber 2 for return to the pump.

The silencing feature of the pressure regulating means functions by automatically controlling the flow area of the small opening 75^a. The pressure in chamber 67, which is sufficient to lift the diaphragm member 69, will, if its flow is at a greater rate than can be handled by the small opening 75^a, cause the disc member 75 to stretch upward, thereby increasing the size of the small opening 75^a. Therefore, instead of the oil which discharges through the seat member 74 being sprayed into the chamber 68 with a hissing noise, the oil will be confined by the port or small opening 75^a and be discharged into chamber 68 as a solid stream. It will, of course, be apparent that the size of the opening 75^a will vary automatically, in accordance with the pressure of the liquid against the inlet side of the disc member 75.

It will, of course, be apparent that the pump and regulating means are each capable of separate use, but that they are here disclosed in mutually cooperative relation by reason of the particular ports and passageways.

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

1. A pump comprising a casing having internal opposed side walls joined by an internally cylindrical imperforate surface, a drive shaft journaled in said casing eccentric to said surface, a cylindrical rotor on and concentric with said shaft and having tangential contact with said surface, radially movable equi-spaced vane members carried by said rotor and contacting said surface, said casing having in at least one of its side walls an inlet port extending circumferentially of said rotor and opening transversely to the plane of the rotor into the space between said rotor and said surface and beginning adjacent the line of said tangential contact, said casing having in at least one of its side walls an exhaust port extending circumferentially of said rotor and opening transversely to the plane of the rotor into the space between said rotor and said surface and ending substantially at the line of said tangential contact such that said inlet port and said exhaust port are spaced at said line of contact a distance less than the space between adjacent vane members, and said inlet port terminating and said exhaust port beginning at points spaced substantially equi-distant to the spacing between said vane members at said surface, said exhaust port having a leading portion of reduced cross-sectional area relative to the remainder of said exhaust port and extending circumferentially of said rotor in a direction opposite to the rotation of said rotor.

2. A pump comprising a hollow casing having end plate members and a hollow member therebetween having an internally cylindrical imper-

forate surface, a drive shaft journaled in said casing and extending into said hollow member eccentric to said surface, a rotor concentric with and fixed on said shaft within said hollow member and having tangential contact with said surface, radially movable equi-spaced vane members carried by said rotor and contacting said surface, at least one of said plate members having in its side face an inlet port beginning adjacent the line of said tangential contact and extending circumferentially of said rotor, said inlet port opening transversely to the plane of said rotor into the space between said rotor and said surface, at least one of said plate members having in its side face an exhaust port terminating at the line of said tangential contact and extending circumferentially of said rotor, said exhaust port opening transversely to the plane of said rotor into said space between said rotor and said surface, the inlet port terminating and said exhaust port beginning a distance from each other substantially equal to the distance at said surface between adjacent ones of said vane members, said exhaust port having a leading groove of reduced cross-sectional area relative to said exhaust port opening therinto and extending circumferentially of said rotor in a direction opposite to the rotation of said rotor and of a length at least as long as the distance between adjacent ones of said vane members, said exhaust port having a trailing groove of reduced cross-sectional area relative to said exhaust port opening therefrom and extending circumferentially of said rotor in the direction of rotation of said rotor and terminating substantially at the line of said tangential contact, and said casing having an inlet passageway leading to said inlet port and an outlet passageway leading from said exhaust port.

3. A pump comprising a hollow casing having end plate members and a hollow member therebetween having an internally cylindrical imperforate surface, a drive shaft journaled in said casing and extending into said hollow member eccentric to said surface, a rotor concentric with and fixed on said shaft within said hollow member and having tangential contact with said surface, radially movable equi-spaced vane members carried by said rotor and contacting said surface, said plate members each having an arcuate inlet recess positioned axially of and at the ends of said rotor, said recesses being in opposed coextensive relation to each other and providing an inlet port beginning adjacent and on the inlet side of the line of said tangential contact, said hollow member having a passageway directly connecting said recesses, said recesses extending circumferentially of said rotor and opening transversely to the plane of said rotor into the space between said rotor and said surface, said plate members each having an arcuate exhaust recess positioned axially of and at the ends of said rotor, said exhaust recesses being in opposed coextensive relation to each other and each having a leading groove of reduced cross-sectional area relative to and opening into its exhaust recess, and extending circumferentially of said rotor in a direction opposite to the rotation of said rotor, one of said leading grooves beginning a distance from said inlet port substantially equal to the distance at said surface between adjacent ones of said vane members, the other of said leading grooves beginning a distance from said inlet port substantially one and one half times the distance at said surface between said vane members, said

plate member having said one leading groove also having a trailing groove of reduced cross-sectional area relative to and opening into its exhaust recess, and extending circumferentially of said rotor in the direction of rotation of said rotor, said trailing groove terminating substantially at the line of said tangential contact, said exhaust recesses, said leading grooves and said trailing groove cooperating to provide an exhaust port extending circumferentially of said rotor and opening transversely to the plane of said rotor into the space between said rotor and said surface, said hollow member having a passageway directly connecting said exhaust recesses, said plate member having said other leading groove also having an inlet passageway opening into its said inlet recess adjacent the line of said tangential contact, and said plate member having said one leading groove also having an outlet passageway opening from its said exhaust recess adjacent said leading grooves, and means to supply fluid at exhaust pressure to the shaft facing sides of said vane members.

4. A pump comprising a casing having end plate members and a hollow member therebetween having an internally cylindrical surface, a drive shaft journaled in said plate members and extending through said hollow member eccentric to said surface, a rotor on and concentric with said shaft within said hollow member and having tangential contact with said surface, radially movable equi-spaced vane members carried by said rotor and contacting said surface, said plate members and said hollow member having a one-diameter hole therethrough with its longitudinal centerline intersecting an extended line at right angles to and joining the shaft centerline and the line of said tangential contact, a pin member in said hole and permitting slight radial movement of said hollow member to assure absolute contact between said surface and said rotor, said plate members having aligned one-diameter holes having their common centerline intersecting said extended line on the opposite side of said shaft from said first-named hole, said hollow member having a hole therethrough aligned with and of larger diameter than said aligned holes, a bushing member in said last-named hole, and a pin member tightly fitting said aligned holes and said bushing member thereby to hold said hollow member and said rotor in said tangential contact with each other.

5. In a vane type pump, a casing having end plate members and a hollow member therebetween having an internally cylindrical surface, a drive shaft journaled in said plate members and extending through said hollow member eccentric to said surface, a rotor fixed on and concentric with said shaft within said hollow member and having tangential contact with said surface, said plate members and said hollow member having a one-diameter hole therethrough with its longitudinal centerline intersecting an extended line at right angles to and joining the shaft centerline and the line of said tangential contact, a pin member in said hole and permitting slight radial movement of said hollow member to assure absolute contact between said surface and said rotor, said plate members having aligned one-diameter holes having their common centerline intersecting said extended line on the opposite side of said shaft from said first-named hole, said hollow member having a hole therethrough aligned with and of larger diameter than said aligned holes, a bushing member in said last-named hole

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and having a hole therethrough of equal diameter to said alined holes and positioned concentric with said alined holes when said rotor and surface are in said tangential contact, and a pin member tightly fitted in and through said bushing hole and said alined holes thereby to hold said hollow member and said rotor in said tangential contact with each other.

6. A pump comprising a hollow casing having an internally cylindrical imperforate surface and a flat side face, a drive shaft eccentric to said surface, a cylindrical rotor on and concentric with said shaft and having solely a substantially single line tangential contact with said surface, radially movable equi-spaced vane members carried by said rotor and contacting said surface, a flat end plate member closing said casing and abutting said rotor, said plate member having circumferentially spaced arcuate slots therein registering transversely to the plane of said rotor with the space between said rotor and said surface, one of said slots being an inlet port and starting substantially at said tangential contact, the other of said slots being an exhaust port having a main portion and an arcuate leading portion extending in a direction opposite to the direction of rotation of said rotor and an arcuate trailing portion extending in the direction of rotation of said rotor, said leading portion being of equal and uniform cross-section substantially throughout its length and being of a length greater than the distance between adjacent vane members, said trailing portion terminating sub-

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stantially at said tangential contact and being of equal and uniform cross-section substantially throughout its length, and said main portion being of greater cross-section than said leading and trailing portions and of a length greater than the distance between adjacent vane members.

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2,335,284	Kendrick	Nov. 30, 1943

FOREIGN PATENTS

Number	Country	Date
220,600	Great Britain	Feb. 26, 1925
243,388	Great Britain	Nov. 23, 1925