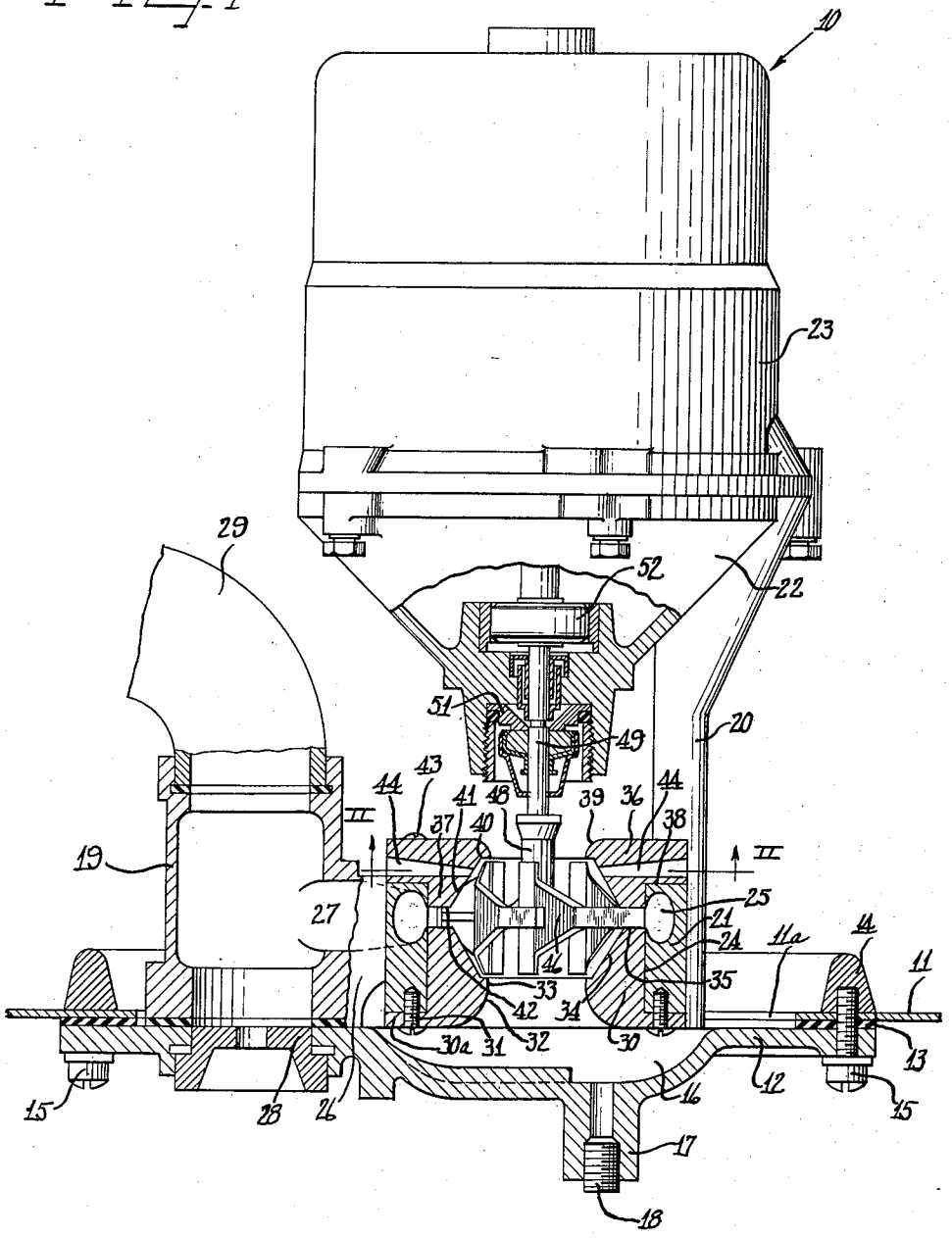
Jan. 26, 1960 M. L. EDWARDS 2,922,375

CENTRIFUGAL DIFFUSER TYPE VAPOR SEPARATING PUMP

Filed Sept. 11, 1953 3 Sheets-Sheet 1

Fig. 1



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Jan. 26, 1960 M. L. EDWARDS 2,922,375

CENTRIFUGAL DIFFUSER TYPE VAPOR SEPARATING PUMP

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Fig. 2

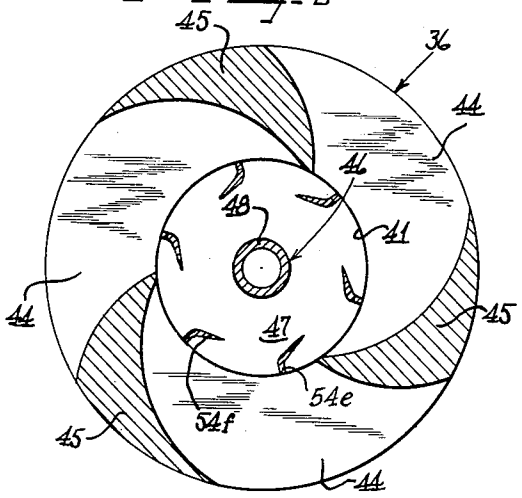


Fig. 3

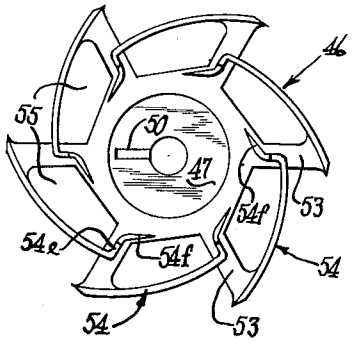


Fig. 4

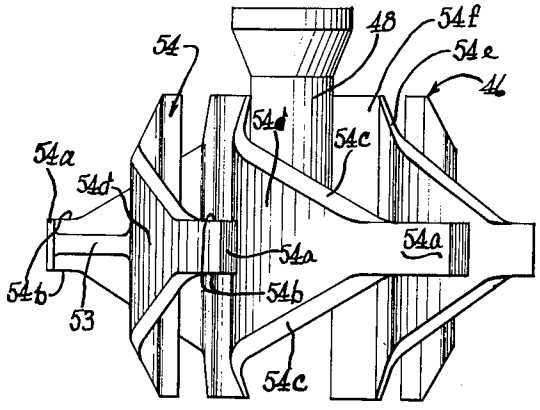
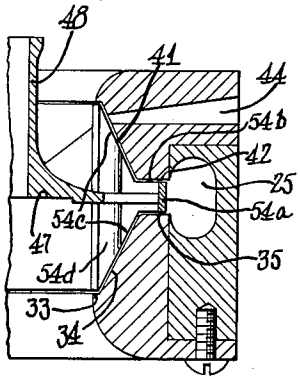


Fig. 5



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CENTRIFUGAL DIFFUSER TYPE VAPOR SEPARATING PUMP

Filed Sept. 11, 1953 3 Sheets-Sheet 3

Fig. 6

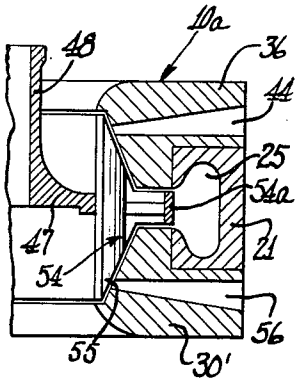


Fig. 7

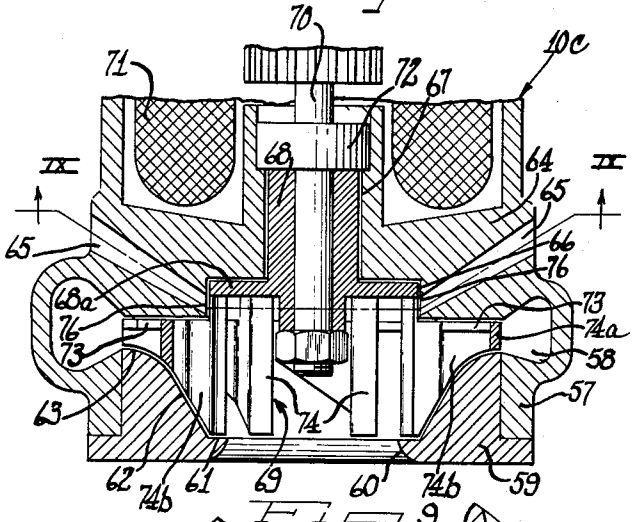


Fig. 8

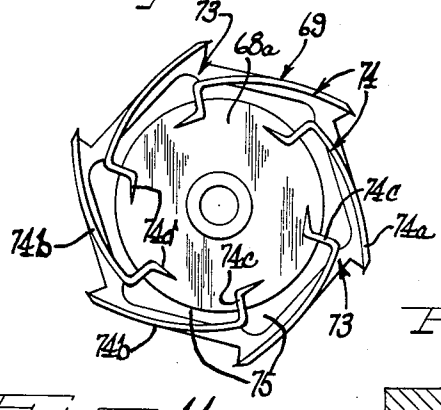


Fig. 9

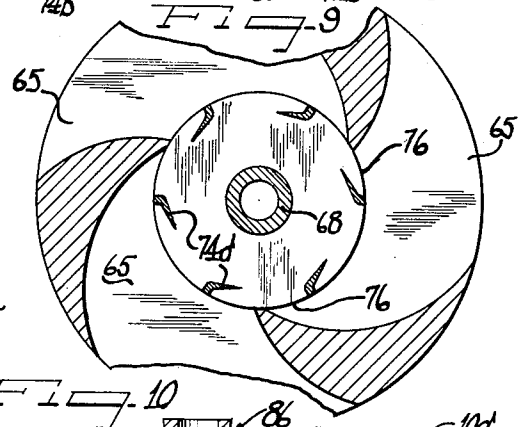


Fig. 10

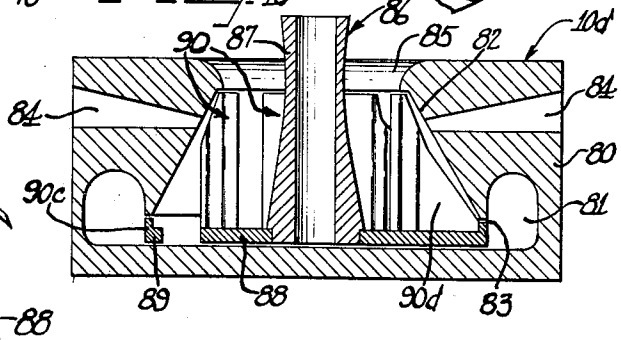
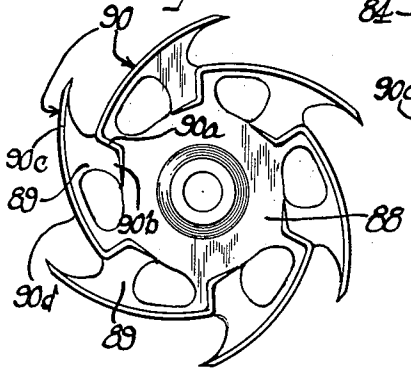


Fig. 11



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United States Patent Office

2,922,375

Patented Jan. 26, 1960

2,922,375

CENTRIFUGAL DIFFUSER TYPE VAPOR SEPARATING PUMP

Miles Lowell Edwards, Portland, Oreg.

Application September 11, 1953, Serial No. 379,642

12 Claims. (Cl. 103—113)

This invention relates to vapor separating pumps with large end-to-end vapor separating chambers in the impeller thereof which discharge the separated vapors laterally out of the pumps. Specifically, this invention relates to vapor separating pumps having centrifugal diffusers which discharge the separated vapors laterally from the separating chambers of the pump impellers around the periphery of the pump under positive centrifugal force.

The present invention now provides vapor separating pumps with impellers having large vapor separating chambers throughout their entire axial length. These chambers are unimpeded and open from end-to-end to permit free passage of vapor. Vapors from these chambers are diffused out of the pumps in a lateral direction around the periphery of the pumps thereby minimizing head room requirements. The discharge of the vapors under the influence of centrifugal force maintains a more sustaining effect on the flow of fluid through the diffuser. Since the diffusers discharge laterally, the pumps of this invention can have inlets in the top and bottom thereof. In such double entry pumps of this invention, a separating wall is provided on the impeller to divide the impeller chamber into upper and lower compartments but the end-to-end vapor separating chambers are not blocked by this wall. In this manner, the exposure of the upper compartment above liquid level will not break the prime in the lower compartment and the pump will continue to operate until the lower compartment is also above liquid level.

Pumps of this invention also include single entry pumps and double entry pumps equipped with a separate diffuser chamber for each entrance.

It is then an object of this invention to provide a vapor separating pump with a laterally extending annular vapor passage having diffuser vanes shaped for centrifugally discharging vapors after they are separated from the liquid being pumped.

Another object of this invention is to provide a vapor separating pump which diffuses vapors laterally out of the pump around the periphery of the pump.

A further object of this invention is to provide a vapor separating pump having an impeller with large end-to-end vapor separating chambers discharging into a peripheral diffuser under centrifugal force induced by the impeller.

Another object of this invention is to provide a vapor separating pump which diffuses vapors with a centrifugal propelling force.

A still further object of this invention is to provide a double entry vapor separating pump having a peripheral vapor outlet.

A specific object of the invention is to provide a double entry vapor separating pump with a barrier wall dividing the inlets of the pump into upper and lower compartments whereby the pump will continue to function even though the upper compartment is exposed to air.

A still further specific object of this invention is to provide a double entry diffuser type pump which discharges under centrifugal force to the side of the pump.

Other and further objects of this invention will be apparent to those skilled in the art from the following detailed description of the annexed sheets of drawings which, by way of preferred examples, illustrate three embodiments of the invention.

On the drawings:

Figure 1 is an elevational view, with parts in vertical cross section, of a pump and motor unit according to this invention mounted on the bottom wall of a fuel cell.

Figure 2 is an enlarged transverse cross-sectional view taken along the line II—II of Figure 1.

Figure 3 is a bottom plan view of the impeller in the pump of Figure 1.

Figure 4 is a side elevational view of the impeller of Figures 1 and 3.

Figure 5 is a fragmentary enlarged vertical cross-sectional view of a portion of the pump of Figure 1.

Figure 6 is a fragmentary vertical cross-sectional view similar to Figure 5 but illustrating a modified embodiment of the pump including two diffuser chambers for the pump.

Figure 7 is a fragmentary vertical cross-sectional view of a single entry pump and motor unit according to this invention.

Figure 8 is a bottom plan view, with parts in horizontal section, of the impeller in the pump of Figure 7.

Figure 9 is a transverse vertical cross-sectional view taken along the line IX—IX of Figure 7.

Figure 10 is a fragmentary vertical cross-sectional view of a single top entry pump.

Figure 11 is a top plan view of the impeller in the pump of Figure 10.

As shown on the drawings:

The pump and motor unit **10** of Figure 1 is illustrated as mounted on the bottom wall **11** of a fuel cell to communicate freely with liquid in the cell for pumping vapor-freed liquid out of the cell while returning the vapors to the cell. The unit **10** includes a base **12** spanning an opening **11***a* in the bottom wall **11** and anchored to this bottom wall for carrying the unit inside of the tank. The base **12** has a gasket **13** around the top marginal periphery thereof. This gasket sealingly engages the bottom **11** of the cell around the opening **11***a*. A mounting ring **14** is mounted on the bottom **11** and receives cap screws **15** extending from the base. In this manner, the base is rigidly affixed to the bottom of the tank.

The base **12** has a central sump portion **16** in full communication with the bottom of the cell. A drain outlet **17** closed by a plug **18** is provided on the bottom of the sump **16**.

A discharge nipple **19** is integrally formed on the base alongside of the sump **16** and one or more legs **20** project upwardly from the base to cooperate with the nipple **19** for supporting a pump casing **21** in spaced relation above the sump. The leg or legs **20** also support a motor casing head **22** receiving a motor **23** in bolted relation thereon.

The pump casing **21** is a cylindrical housing with a central bore **24** therethrough and having an annular volute chamber **25** therein around the bore **24** near the upper edge thereof. A neck portion **26** provides a passageway **27** joining the volute chamber **25** with the interior of the nipple **19**. This nipple can have either end thereof receive a discharge fitting. As illustrated, a closure plug **28** closes the bottom end of the nipple and the top end of the nipple receives a discharge fitting **29** connected with a discharge fuel conduit (not shown).

The bore **24** of the housing **21** receives a throat ring **30** in the lower portion thereof. The throat ring **30** has an outturned flange **30***a* anchored to the bottom face of the casing **21** by screws **31**. The throat ring **30** has a bell-shaped inlet mouth **32** converging to a flat shoul-

der 33. The shoulder 33 extends to a diverging side wall 34 which terminates at a flat top 35. This flat top 35 is at a level intermediate the top and bottom of the volute chamber 25.

The top of the pump casing 21 receives thereover and therein a diffuser disk 36 having a pilot portion 37 fitting snugly in the top end of the bore 24 and having a shoulder 38 fitting over the top of the casing 21. This diffuser disk 36 has a bell-shaped central mouth 39 converging to a flat outturned shoulder 40 which extends to a diverging wall 41 that terminates in a flat bottom 42 in spaced parallel relation above the top 35 of the throat ring. The diffuser disk 36 is secured to the casing 21 in any suitable way such as by means of screws 43 or the like.

A plurality of lateral diffusion passages 44 are provided in the disk 36. As shown in Figure 2, these passages 44 are separated by ribs or diffuser vanes 45 and have side walls of sweeping arcuate shape to produce tangential gaps or passages design for centrifugal discharge. The passages have inner ends in advance of the outer ends to diffuse the centrifugally whirling flow from the vanes into a laterally outward flow at high velocity. As shown in Figure 1, these passages 44 have upwardly sloping top walls and are deeper at their outer ends to enhance the lateral flow.

An impeller unit 46 is mounted within the pump casing 21 in relatively close running clearance relationship with the shoulders 33 and 40, the side walls 34 and 41, and the flat walls 35 and 42. This impeller has a central flat dividing wall 47 (Figures 2 and 3) level with the center of the gap between the walls 35 and 42. A hub 48 is provided on the center of this wall and extends upwardly through the center of the mouth 39. The hub 48 is attached to a drive shaft 49 for co-rotation. As shown in Figure 3, a key slot 50 is provided in the wall 47 to key the hub to the shaft. The drive shaft 49 depends from the head 22 of the motor casing and a seal assembly 51 is provided in the bottom of the head 22 to receive the shaft therethrough and prevent leakage of fluid into the interior of the motor compartment. A bearing 52 is also carried by the head 22 for the shaft. The shaft is driven by the armature of the electric motor 23.

As best shown in Figure 3, sprockets 53 project from the periphery of the wall 47 and carry at their outer ends the trailing ends of upstanding vanes 54. As shown in Figure 4, these upstanding vanes have narrow upright outer trailing ends 54*a* extending on both sides of the sprockets 53. These outer ends 54*a* have flat parallel top and bottom edges 54*b* for close running clearance relationship with the wall portions 35 and 42 as shown in Figures 1 and 5. The ends 54*a* terminate adjacent the inner periphery of the volute chamber 25 and the narrow portions of these trailing ends ride in the gap provided between the diffuser disk and the throat ring.

The parallel top and bottom edges 54*b* merge into diverging edges 54*c* which have close running clearance relation with the wall portions 34 and 41 as shown in Figures 1 and 5. Relatively wide vane faces 54*d* are provided between these diverging edges 54*c* and these wide portions 54*d* have curved front faces designed for centrifugal discharge as they are rotated in a clockwise direction as viewed in Figures 1 and 5 or in a counterclockwise direction as viewed in Figure 3. The contour of the wide faces 54*d* is continued in the narrow trailing portions 54*a* between the edges 54*b*.

The edges 54*c* diverge to inwardly offset ribs 54*e* of upstanding flat faced vane portions 54*f* which are anchored at their midpoints to the wall 47. These portions 54*f* have sharp vertical leading edges disposed just inwardly from the periphery of the dividing wall 47 as best shown in Figures 2 and 3. The offsets 54*e* are integral with the sprockets 53 while the portions 54*f* are integral with the separating wall 47 just inside of the periphery of this wall. Thus, each blade 54 has an offset leading edge anchored to a sprocket and a narrow trailing edge anchored to the next adjacent sprocket. The distance between the top and bottom edges of the vane portions 54*f* extends the full height of the space between the shoulders 33 and 40 and has close running clearance relation therewith. The trailing edge, on the other hand, extends into the gap between the walls 35 and 42.

The vanes 54 are thus arranged in a ring around the dividing wall 47 and extend equidistant on opposite sides of this wall to provide vertical sharp leading edges just inwardly from the periphery of the dividing wall and merged through substantially radially extending offset portions 54*e* to pumping faces 54*d* which converge to narrow trailing edges for discharging into the volute chamber. The leading edges are radially inward from the trailing edges and the vane shape is such as to slice off liquid entering the pump through the bottom mouth 32 and the top mouth 39 and discharge the liquid into the volute chamber while separating bubbles of vapor from the liquid under the influence of centrifugal force.

As shown in Figure 3 open vertical channels 55 are provided between the wall 47 and the inner faces of the pumping vanes 54. These channels are large, unimpeded throughout their entire axial length, have open ends and at their tops communicate with the diffuser passages 44. The large channels extend from one end to the other end of the impeller and permit free passage of vapor so that only one diffuser outlet is necessary to remove vapors generated at both ends of the impeller. The large channels are provided by the spoke-like projections from the hub which have inner portions anchoring and supporting the leading part of one vane and then extend outwardly to support the trailing end of the preceding vane.

In operation the pump is submerged in liquid such as gasoline, in the fuel cell and this liquid freely enters both the top and bottom inlets of the pump to fill the chambers above and below the wall 47. These chambers are surrounded by the ring of pumping vanes and when the impeller is rotated, this liquid is sliced off by the leading vane edges 54*f* and the outer periphery of the column of liquid is caused to rotate by the offset portions 54*e* of the leading edges 54*f*. The rotating annulus of liquid is flung outwardly by centrifugal force and is propelled by the blade faces 54*d* and 54*a* into the volute chamber. However, the lighter gases entrapped in the liquid lag behind the heavier liquid material and rise in the channels or passages 55 to be centrifugally discharged through the diffuser passages 44 to the outside of the pump. The diffuser passages are shaped to expedite centrifugal discharge of the gases. Therefore, the separated vapors and gases are positively ejected under the influence of centrifugal force and are discharged laterally of the pump while the top and bottom of the pump is free to receive liquid. The fully liquid material pumped into the volute 25 is discharged through the passage 27 and into the nipple 19.

In the event the top mouth 39 of the pump is exposed to air as when the liquid level in the fuel cell falls below this top mouth, the dividing wall 47 will prevent the pump from losing its prime and it will continue to operate as long as it receives liquid from the sump 16. Since this sump 16 is actually below the bottom level of the fuel cell, the pump is effective to completely empty the fuel cell.

In the modification shown in Figure 6, the unit 10*a* has elements thereof identical with those illustrated in Figures 1 to 5 marked with the same reference numerals. In the modification 10*a*, however, the throat ring 30' has diffuser discharge passages 56 provided therein to receive the vapors from the channels 55 adjacent the lower

ends of the channels. These passages **56** are arranged in the same manner as the passages **44** shown in Figure 2 and function in the same manner. The channels **55** of the impeller, therefore, have top and bottom diffuser discharge passages. Therefore, the vapors in the channels **55** can discharge out of both ends of the channels. Otherwise, the pump operates in the same manner described above in connection with Figures 1 to 5.

In the modification **10***c* shown in Figures 7 to 9, a single entry pump is provided. As illustrated in Figure 7, a casing **57** has a volute chamber **58** around the inner periphery thereof and receives a bottom throat ring **59** having a bell-shaped mouth **60** converging to a flat shoulder **61** which shoulder in turn, extends to an outwardly sloping side wall **62** terminating in a curved top **63** above the bottom of the volute chamber **58**. A diffuser passage-containing wall **64** is provided on the casing **57** and has passages **65** therethrough similar to the passages **44** shown in Figure 2 but having an upward slope. Slopes of from 20 to 28 degrees from the horizontal have been found to be satisfactory.

The center of the wall **64** has a counterbore **66** merging with a bore **67** of the casing. The counterbore **66** receives the hub **68** of an impeller **69** mounted on a drive shaft **70** of a motor **71** in the casing. As illustrated, the motor field can extend down to the wall **64** and the motor bearing **72** can be closely adjacent the hub **68**. In this arrangement, head room requirements are minimized and the entire pump and motor unit can be made very short to fit in low tanks.

The impeller **69** has a radial hub flange **68***a* in the counterbore **66** surrounded by a ring of spokes **73** at a level beneath the flange. These spokes have pumping vanes **74** depending therefrom. These vanes **74** have narrow vertical trailing edges **74***a* fitting in the gap between the walls **63** and **64** to discharge into the volute chamber **58**. The vanes increase in height to follow the contour of the wall **62** of the throat ring **59** and provide wide pumping faces **74***b*. These pumping faces extend between the spokes **73** and the shoulder **61** of the throat ring. The forward ends of these vanes are inwardly offset as at **74***c* and the inner offset ends have pointed forwardly extending leading ends **74***d*. The portions **74***c* and **74***d* extend above the spokes **73** into the counterbore **66** and are secured to the hub flange **68***a*. This provides an angle section correction between the hub flange and the main part of the blade system which gives a desired structural strength for withstanding operating stresses. The leading ends of the vanes **74** are thereby rigidly secured to the hub inwardly and above the spokes while the trailing ends of the blades are secured to the spokes **73** outwardly from the hub. The inner ends of the vanes are relatively deep while the outer ends are relatively shallow.

Vertical channels **75** are provided between the inner ends of the vanes bounded by the inwardly offset vane portions **74***c*. These channels **75** have full open communication at their top ends with the diffuser passages **65** because the hub flange **68***a* is above the entrance mouths **76** to these passages and the spokes are below and radially outward from these entrance mouths. Thus, the upwardly rising and rotating vapor-rich columns of fluid in the channels **75** will be flung into the entrance mouths **76** of the passages at the tops of the channels.

In operation, fluid entering the volute mouth **60** fills the space inside of the ring of vanes to form a column of liquid. The leading ends **74***d* of these blades then slice off liquid from this column inside the pump and the offset portions **74***c* rotate this liquid. As the liquid is rotated it is centrifugally thrown outwardly and follows the outer faces **74***b* of the pumping vanes to the trailing edges **74***a* where it is discharged into the volute **58**. The centrifugal action, however, separates the heavier liquid from the lighter gases and vapors entrained in the liquid and these gases and vapors rise through the channels **75** as a rotating lighter mass. As soon as the rotating lighter mass in the channels reaches the level of the entrance mouths **76** to the passages **65** it is discharged under the influence of centrifugal force through the passages to the side of the pump. Therefore, the pump separates gases under the positive force of centrifugal action and then also discharges the gases under this positive force.

In the modification **10***d* of Figures 10 and 11, a top inlet pump is provided with a centrifugal vapor diffuser in the top end thereof. As shown in Figure 10, a pump casing **80** has a volute **81** surrounding an open topped central pumping chamber **82** and in communication therewith around the bottom thereof through a narrow gap **83**. Laterally extending centrifugal diffuser passages **84** radiate from the upper portion of chamber **82**. These passages are similar to the passages **44** or **65** of the pumps described hereinabove. An inlet throat **85** is provided at the top of the casing **80** to be submerged in liquid to be pumped.

The impeller **86** for the pump **10***d* has a central hollow hub **87** extending through the central portion of the pumping chamber and carrying a radially extending flange **88** on the bottom end thereof. This hub **87** is adapted to be attached to the drive shaft of a motor or the like. The bottom flange **88** has spokes **89** radiating therefrom carrying an upstanding ring of pumping vanes or blades **90** in spaced relation around the hub **87** and closely fitting the wall of the pumping chamber **82**. Each blade **90** has an inwardly offset portion **90***a* with a forwardly projecting end **90***b*. The bottom of the portions **90***a* and **90***b* are anchored to the inner ends of the spokes **89**. The spokes then project outwardly from these portions of the blade to the trailing end portion **90***c* of a preceding blade in the ring. This trailing end portion **90***c* is relatively narrow and fits in the gap **83** as shown in Figure 10.

The blades have relatively wide faces **90***d* between the offset portions **90***a* and the trailing portions **90***c*. Vertical channels are thus provided between the offset portions **90***a*. These channels communicate at their outer ends with pumping channels between the broader faces and narrow trailing ends of the blades. The inner vertical channels, however, have full open communication at their top ends with the diffuser passages **84**.

Fluid entering the inlet throat **85** of the pump **10***d* will fill the pumping chamber to form a central column of liquid. The inwardly offset portions of the blades **90** will slice off liquid from the periphery of this central column in the pumping chamber. The sliced off liquid will be caused to rotate by the offset portions **90***b* and as it rotates, it will be flung outwardly through the pumping channels between the blades into the gap **83** and thence through the volute chamber **81** to the discharge outlet of the pump. Moreover, the rotating fluid will also have its lighter constituents separated from its heavier constituents by the action of centrifugal force in the channels between the offset portions. This lighter fluid will rise in the channels until it reaches the diffuser passages **84** whereupon it will be flung outwardly through the passages to be discharged around the periphery of the pump casing **80**.

The pump **10***d* requires a minimum of head room since the centrifugal diffuser passages extend laterally and surround the pumping vanes.

From the above descriptions it will be understood that this invention now provides an efficient vapor-separating pump which discharges vapors under positive centrifugal action in a lateral direction around the periphery of the pump casing from large vapor-separating channels which are unimpeded along their length and which have free, unobstructed communication with the radiating diffuser passages.

The impellers for the pumps of this invention are light in weight because they are constructed from a minimum amount of metal and yet have enhanced mechanical

strength due to the manner in which the ring of blades is carried from radiating spokes on a hub. Each spoke anchors the inner leading end portion of one blade and the outer trailing end portion of a preceding blade. The blades have inwardly offset portions which extend substantially radially to forwardly extending knife-like ends effective to slice off liquid around the periphery of a column of liquid in the pumping chamber. These offset portions have large vapor-separating channels therebetween and extend beyond the liquid pumping portions of the vanes so that the channels will have free, unimpeded open communication with the centrifugal diffuser passages surrounding the inner ends of the vanes.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. A vapor separating pump which comprises a pump casing having a central inlet, a pumping chamber surrounding said inlet in communication therewith around the periphery thereof, laterally extending diffuser passages having inner ends communicating with the inlet chamber and outer ends discharging around the side of the pump, a vapor separating impeller rotatably mounted in the pump, said impeller having a ring of pumping vanes with shallow trailing ends extending into the inlet of the volute chamber and deep forward ends extending vertically throughout the entire height of the inlet chamber to slice off liquid from the column therein, vertical channels behind said vanes communicating with the diffuser passages, and the deep forward ends of said vanes having inwardly offset portions to create a ring of rotating fluid in the channels while discharging the liquid centrifugally into the volute chamber and the gas-rich lighter portion of the liquid into the diffuser passages.

2. A double entry vapor separating pump which comprises a housing having a central passage therethrough with top and bottom inlets, a diffuser passage surrounding said central passage and discharging laterally of the central passage, a pumping chamber surrounding said central passage in spaced separated relation from the diffuser passage and having a peripheral outlet, a vapor separating pump impeller rotatably mounted in said central passage and having a flat barrier wall dividing the passage midway of its axial length into upper and lower compartments, and a ring of vapor separating vanes on said impeller outwardly from said barrier wall arranged to centrifugally discharge liquid into the pumping chamber and defining axially extending channels communicating with said diffuser passage for discharging gas-rich material into the diffuser passages, said barrier wall being effective to maintain operation of the pump even after the top inlet is uncovered, the vanes extending equidistantly on opposite sides of the barrier wall to provide vertical sharp leading edges inwardly from the periphery of said wall, said vanes being further provided with trailing edges radially outwardly of the leading edges and radially extending offset portions between said trailing and leading edges, said leading edges slicing off liquid from the column in the central passage and the outer periphery of said column being rotated by the offset portions and flung outwardly into the pumping chamber.

3. A vapor separating pump impeller which comprises a central hub having a flat radial flange, sprockets extending from the periphery of said flange, and a ring of upstanding pumping vanes having leading end portions attached to the flange and trailing end portions attached to the sprockets, each vane having a leading end portion secured to one sprocket and a trailing end portion attached to an adjacent sprocket, said vanes extending equidistantly on opposite sides of the flange and being arranged spirally around the flange to effect centrifugal pumping and centrifugal vapor separation.

4. A pump impeller for a double entry vapor separating pump which comprises a hub having a flat radial flange, sprockets in spaced relation extending from the periphery of the flange, upstanding pumping vanes mounted on the sprockets and having deep vertical inner ends on both sides of the flange and shallow trailing ends intermediate the deep inner ends and secured to the flange, said inner ends having radially inwardly offset portions attached to the sprockets with flat faces adapted for slicing off liquid from a column inside of the chambers on opposite sides of the hub flange, and said vanes being spaced outwardly from the periphery of the hub flange to provide open ended vertical vapor separating chambers between said vanes and said flange.

5. A diffusion type vapor separating pump impeller which comprises a hub having sprockets radiating therefrom, relatively narrow blades mounted on said sprockets and having deep inner ends and shallow outer ends, said blades having radially inwardly offset portions and flat faces on the inner ends of the offset portions, the sprockets having inner portions supporting the offset portion of one vane and said sprockets extending outwardly to support the outer end of the preceding vane, said inwardly offset portions and flat faces coacting with the back faces of adjacent blades and with the sprockets to define axially extended open channels extending axially through the spaces between the blades.

6. A pump impeller which comprises a hub, a flat flange radiating therefrom, spokes radiating from said flange at spaced intervals around the periphery thereof, a ring of pumping vanes surrounding the hub and extending equidistantly on opposite sides of the flange and mounted on said spokes, each vane having an inwardly offset leading end portion adjacent the periphery of the flange and anchored to an inner end portion of a spoke, each vane having an outer end portion trailing the inner end portion and anchored to the outer end portion of an adjacent spoke, and said vanes having the inner end portions thereof projecting above the trailing end portions to provide therebetween axially elongated vapor-separating channels.

7. A vapor separating pump comprising a housing having a central passage therethrough and a peripheral volute chamber communicating with said central passage, a diffuser coaxial with said central passage and having passages therein arranged to discharge vapors radially from the pump housing, an impeller rotatably mounted in said central passage and having a flat central wall dividing said central passage into upper and lower compartments, upright vanes on said impeller arranged in a ring on the wall and extending equidistantly on opposite sides thereof to deliver liquid into said volute chamber, said impeller having means defining axially extending channels radially inwardly of said vanes to permit passage of gases into said passages in said diffuser.

8. A vapor separating pump comprising a housing having a central passage therethrough with top and bottom inlets and a peripheral volute chamber communicating with said central passage, a diffuser coaxial with said central passage and having passages therein arranged to discharge vapors radially out of the pumps, an impeller rotatably mounted in said central passage and having a flat central wall dividing said central passage into upper and lower compartments, and upright vanes on said impeller arranged in a ring on the wall and extending equidistantly on opposite sides thereof to deliver liquid into said volute chamber, said impeller having means defining axially extending channels radially inwardly of said vanes to permit passage of gases into said passages in said diffuser.

9. A vapor separating pump comprising a housing having a central passage therethrough with top and bottom inlets and a peripheral volute chamber communicating with said central passage, a diffuser coaxial with said central passage and having passages therein arranged to discharge vapors radially out of the pump, an impeller

rotatably mounted in said central passage and having a central wall dividing said central passage into upper and lower compartments, and upright vanes on said impeller arranged in a ring on the wall and extending equidistantly on opposite sides thereof to deliver liquid into said volute chamber, said impeller having means including the upstanding walls of said vanes defining axially extending channels radially inwardly of said vanes to permit passage of gases into said passages in said diffuser.

10. In a vapor separating pump, a housing having an end inlet opening, a tapered pumping chamber with a gradually increasing diameter inwardly from said inlet opening, and an exterior lateral surface surrounding said pumping chamber; a tapered impeller of gradually increasing diameter rotatable in one direction with close running clearance in said pumping chamber; and a plurality of lateral diffuser passages opening at their outer ends through said exterior lateral surface of said housing at points spaced from said inlet end and opening at their inner ends in portions of said pumping chamber which are swept by peripheral portions of said impeller, said diffuser passages having tangential walls extending forwardly from their inner to their outer ends with respect to the direction of rotation of the impeller.

11. A vapor separating liquid pump comprising a housing and an impeller, said housing having a wall portion surrounding and defining a pumping chamber for said impeller, means for mounting said pump so that the outer surface of said wall portion is submerged in a body of liquid to be pumped, said wall portion having a generally conical inner surface with a gradually increasing diameter in said pumping chamber, said housing having an inlet opening at the small diameter end of said inner wall surface and a volute chamber communicating with said pumping chamber at the maximum diameter of said inner wall surface, said impeller having peripheral portions of gradually increasing diameter rotatable in one direction with close running clearance within said inner wall surface to move said liquid through said pumping chamber from said inlet opening to said volute chamber, and a plurality of generally tangential diffuser passages extending throughout their length in a common plane perpendicular to the axis of the impeller, the outer ends of said passages opening through said outer surface of said wall portion at a distance from its inlet end in unrestricted communication with said body of liquid and the inner ends of said passages opening through the inner surface

of said wall portion within the area thereof which is swept by said peripheral portions of said impeller, said tangential diffuser passages having their inner ends beginning in advance of their corresponding outer ends.

12. A vapor separating liquid pump comprising a housing having an end inlet opening, said housing defining a tapered pumping chamber with a gradually increasing diameter inwardly from said inlet opening, said housing having an exterior lateral surface adapted to be submerged in a body of liquid to be pumped, and a tapered impeller of gradually increasing diameter rotatable in one direction with close running clearance in said pumping chamber, said housing having a plurality of lateral diffuser passages extending therethrough in a forward tangential direction with respect to the direction of rotation of the impeller, said passages having leading inner ends in said housing at said pumping chamber which are swept by peripheral portions of said impeller and said passages having trailing outer ends opening through an outermost lateral wall surface of the housing in unrestricted communication with said body of liquid.

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