Dec. 11, 1956 W. GEMEINHARDT 2,773,453

ROTARY PUMPS

Filed Sept. 12, 1952 2 Sheets-Sheet 1

FIG. 1

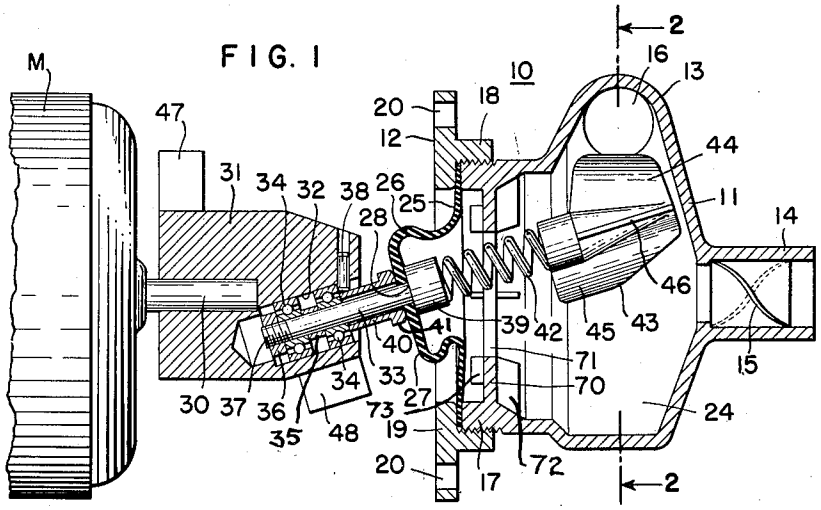


FIG. 3

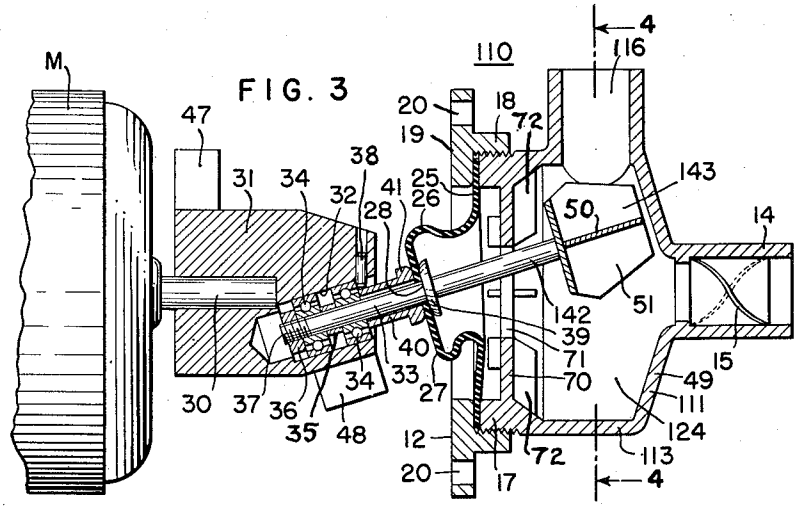
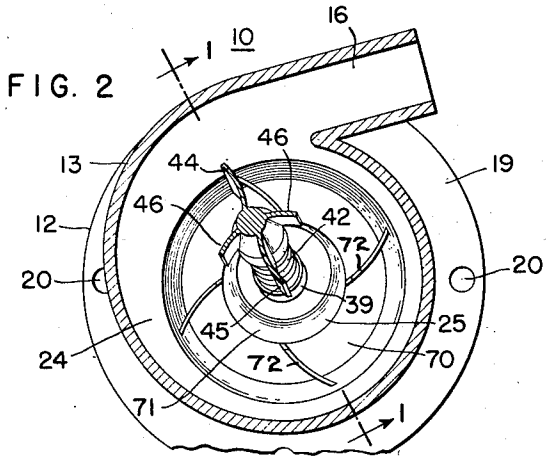


FIG. 2



INVENTOR.
WILLIAM GEMEINHARDT
BY
J. T. Wobensmith 3rd
ATTORNEY.

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FIG. 5

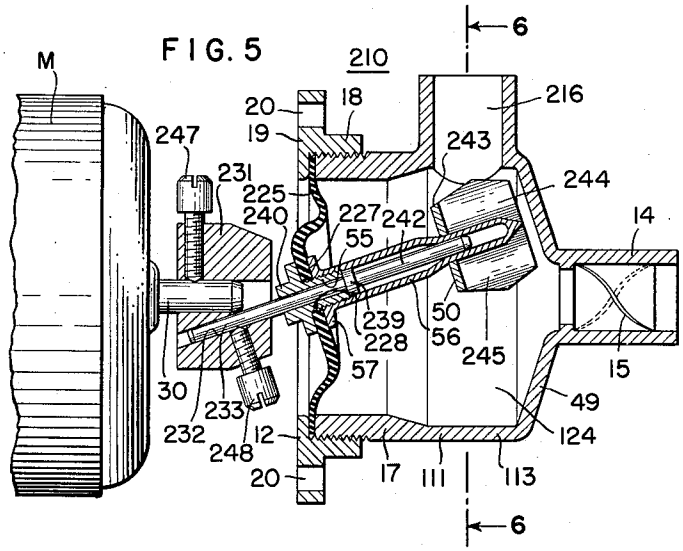


FIG. 4

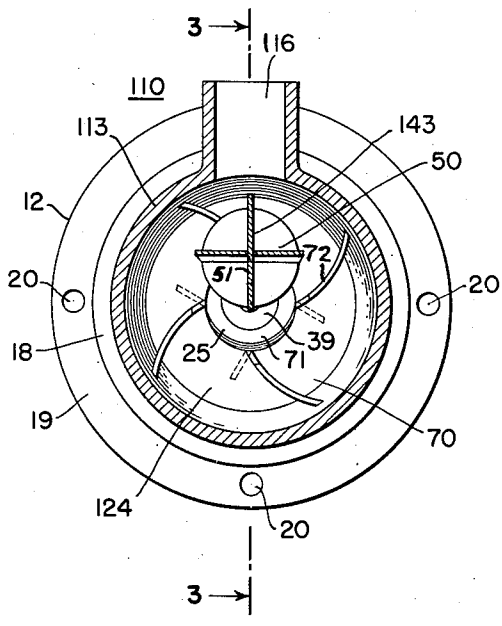
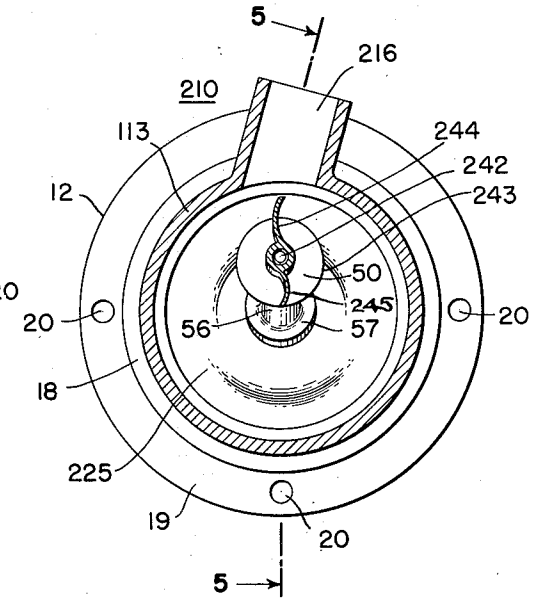


FIG. 6



INVENTOR.
WILLIAM GEMEINHARDT
BY J. T. Wobensmith 3rd
ATTORNEY.

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ROTARY PUMPS

William Gemeinhardt, Philadelphia, Pa.

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4 Claims. (Cl. 103—83)

This invention relates to rotary pumps and particularly to rotary pumps for pumping liquids.

It is the principal object of the present invention to provide a pump which has a wide field of use, particularly in the pumping of liquids.

It is a further object of the present invention to provide a pump which is simple in construction and which may be readily cleaned.

It is a further object of the present invention to provide a pump, the constituent parts of which may be readily constructed of suitable materials which are resistant to corrosive effects of the liquid to be pumped.

It is a further object of the present invention to provide a pump for liquids which does not require any packing glands or sealing devices.

It is a further object of the present invention to provide a pump having an impeller movable in a circular orbital path with driving mechanism therefor movable in a conical path.

It is a further object of the present invention to provide a pump having a pressure reduction plate therein.

It is a further object of the present invention to provide a rotary pump which does not have any rubbing or sliding parts within the pumping chamber requiring lubrication and generating heat.

It is a further object of the present invention to provide a rotary pump which has a pumping chamber free from contamination by lubricants.

It is a further object of the present invention to provide a rotary pump which by reason of freedom from mechanical friction has no locations at elevated temperature within the pumping chamber and thus is particularly suitable for pumping low boiling point liquids such as gasoline and alcohol.

It is a further object of the present invention to provide a pump which is capable of operation at high rotational speeds, if desired, and at speeds in excess of ten thousand revolutions per minute.

It is a further object of the present invention to provide a pump for liquids in which the pump chamber is hermetically sealed so as to avoid fire hazard with explosive liquids.

It is a further object of the present invention to provide a rotary pump which by reason of freedom from sliding or rubbing parts within the pump chamber is particularly suited for handling fluids with abrasive materials carried therein.

Other objects and advantageous features of the invention will be apparent from the specification and claims.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawings forming part hereof, in which:

Figure 1 is a longitudinal sectional view of a pump in accordance with the invention, taken approximately on the line 1—1 of Fig. 2;

Fig. 2 is a transverse sectional view taken approximately on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal sectional view of another pump in accordance with the invention, taken approximately on the line 3—3 of Fig. 4;

Fig. 4 is a transverse sectional view taken approximately on the line 4—4 of Fig. 3;

Fig. 5 is a longitudinal sectional view of another pump in accordance with the invention, taken approximately on the line 5—5 of Fig. 6; and

Fig. 6 is a transverse sectional view taken approximately on the line 6—6 of Fig. 5.

It should of course be understood that the description and drawings herein are illustrative merely and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Like numerals refer to like parts throughout the several views.

Referring now more particularly to Figs. 1 and 2 of the drawings, the pump there shown has an exterior housing 10, of suitable metal or synthetic plastic in accordance with the fluid to be pumped, so as to be resistant to corrosion, and capable of being readily cleaned if desired. The housing 10 is preferably made in two sections shown at 11 and 12. The housing section 11 is illustrated as having a portion 13 in the form of a volute and has, in communication therewith, an inlet pipe 14 axially disposed and preferably having axially interiorly thereof, a helical guide plate 15 provided for imparting a rotary movement to the entering fluid. The volute portion 13 is provided with a tangentially outwardly extending outlet or delivery pipe 16 for the delivered liquid.

The housing section 11 has an end cylindrical portion 17, on the opposite side thereof with respect to the inlet pipe 14 and in coaxial and concentric relation thereto. The cylindrical portion 17 is externally threaded and is adapted to be received within a complemental internally threaded cylindrical portion 18 of the housing section 12, the portion 18 being formed on an annular plate 19.

The plate 19 is provided with holes 20 for mounting the housing 10 at the desired location for use.

Interposed between the housing sections 11 and 12 a diaphragm 25 is provided, preferably made of suitable elastic and flexible material which is resistant to the fluid being pumped and is of suitable thickness in accordance with the pressures developed in the pump. The diaphragm 25 may advantageously be made of rubber, natural or synthetic, one particularly suitable material being neoprene, or of metal.

The diaphragm 25 is clamped, at its periphery, between the end of the cylindrical portion 17 and the plate 19 to provide an end closure wall of a fluid tight pump chamber 24 within the housing section 11. While the diaphragm 25 may be of any desired shape it is preferably molded so as to have, between its clamped peripheral edges and the center thereof, a deformable cylindrical wall portion 26 with a closed end wall 27, an opening 28 being provided through the end wall 27 for purposes to be explained.

A driving motor M is provided, having a driven shaft 30 extending therefrom. The driven shaft 30 has mounted thereon for rotation therewith a driving block 31 which is provided with a bore 32 in a common plane with, but disposed with its axis at an acute angle to and intersecting the longitudinal axis of the shaft 30. While this angle may be varied as desired, the smaller the angle the less the flexing of the diaphragm, the longer the useful life of the diaphragm, the longer will be the pump assembly.

The bore 32 is adapted to have mounted therein a pump shaft 33, supported in ball or roller bearings 34 which engage with the bore 32 and shaft 33. The bearings 34 are preferably held in spaced relation by a sleeve

35 on the shaft 33, and a nut 36, in engagement with a threaded end portion 37 of the shaft 33 holds the bearings 34 and sleeve 35 in position. A pin 38 in the block 31 prevents outward displacement of the bearing assembly and shaft 33.

The shaft 33 extends through the opening 28 in the diaphragm 25 and has an enlarged head 39 which is held in fluid tight engagement with the interior face of the end wall 27 of the diaphragm 25 by a sleeve 40 mounted on the shaft 33 and having at one end an enlarged head 41 also engaging the exterior face of the end wall 27 of the diaphragm 25. The sleeve 40, at its other end, engages with the inner raceway of the contiguous bearing 34 so that the nut 36 permits of tightening the engagement of the heads 39 and 41 with the end wall 27.

The head 39 preferably has secured thereto the inner terminus of a helical coil 42, an impeller 43 being secured to the outer terminus of the coil 42.

While the impeller 43 may be of any preferred type, one suitable form of impeller as illustrated includes an outwardly disposed vane 44 and an inwardly disposed vane 45, both substantially in alinement with a radial plane through the central longitudinal axis of the housing 10.

The vane 44 preferably extends outwardly a greater distance than the vane 45 extends inwardly but to an extent to clear the interior of the volute shape of the housing 10 during its movement. The vanes 44 and 45 are preferably of equal effective areea on each side of the longitudinal axis passing through the coil 42 and the shaft 33, so as to be in a torque balanced relation during movement. In addition, if desired, side vanes 46 may also be provided.

In order to provide for proper static and dynamic balance of the rotor system, projections 47 and 48 of the proper mass and at the proper axial locations may be formed on the driving block 31.

If desired, a partition wall or pressure reduction plate 70 may be provided in the housing portion 17 with a central opening 71, vanes 72 on the outer face thereof and vanes 73 on the inner face thereof.

Referring now to Figs. 3 and 4 of the drawings, the pump there shown has a housing 110, also of suitable material in accordance with the liquid to be pumped.

The housing 110 is also made in two sections 111 and 12.

The housing section 111 is illustrated as having a cylindrical portion 113, concentric with the central longitudinal axis of the housing 110, and is connected by a frusto conical wall 49 to an inlet pipe 14 disposed axially and preferably having axially interiorly thereof a helical guide plate 15 provided for imparting a rotary movement to the entering fluid. The cylindrical portion 113 also preferably is provided with a radially outwardly extending outlet or delivery pipe 116 for the delivered fluid, this type of pump being capable of operation in either direction of rotation.

The housing section 111 has an end cylindrical portion 17 axially oppositely disposed with respect to the inlet pipe 14 and is concentric with the central longitudinal axis of the housing 110.

The cylindrical portion 17 is externally threaded as previously pointed out and clamps the diaphragm 25 as previously explained, to provide a pumping chamber 124.

The pump shaft 33, exteriorly of the diaphragm 25 is mounted in the manner previously explained although the pin 38 has been positioned to permit of a limited sliding movement axially of the shaft 33.

The pump shaft 33 interiorly of the diaphragm 25 has an extension 142 with an impeller 143 at its free end. The impeller 143 includes a disc 50 and impeller blades 51 extending therebeyond with suitable clearance with respect to the interior of the wall 49.

Referring now more particularly to Figs. 5 and 6, the pump there shown has an exterior housing 210, of suitable material with two sections 111 and 12, as before, with a cylindrical portion 113, axial inlet 14 with guide plate 15, and with an outlet or delivery pipe 216 for the delivery of liquid.

The housing section 111 has a cylindrical portion 17 externally threaded and engaging in an internally threaded portion 18 of the housing section 12.

Interposed between the housing sections 111 and 12, a diaphragm 225 is provided, of suitable elastic and flexible material, as before, and clamped at its periphery between the end of the cylindrical portion 17 and the plate 19 to provide an end closure wall of a fluid tight pump chamber 124.

The diaphragm 225 is preferably slack within its clamped peripheral edges and has a central portion 227 with an opening 228 therethrough.

A driving block 231, secured to the driven shaft 30 of a motor M is provided and has a small bore 232, positioned like the bore 32 with a shaft 233 fixedly mounted therein. While any suitable securing structure may be employed, in place of the projections 47 and 48, studs 247 and 248 having enlarged heads may be used as balancing means mounted in the driving block 31, the stud 248 intersecting the bore 232 and holding the shaft 233 in fixed position and the stud 247 engaging the shaft 30 and serving as a set screw.

The shaft 233 has an inner enlarged head 239 with an axial extension 242 therebeyond.

A collar 240 having an exteriorly threaded extension 55 is provided, the collar 240 engaging with the outer face of the diaphragm 225. The inner end of the extension 55 serves as an abutment for limiting movement with respect to the head 239 as hereinafter explained.

A sleeve 56 is provided, having an enlarged head 57 at one end thereof, for engagement with the inner face of the diaphragm 225 and engaging with the threaded extension 55 so that with the collar 240 engaging the outer face of the diaphragm 225 fluid tight sealing engagement with the diaphragm 225 is effected. The sleeve 56 at the other end thereof, and preferably formed integrally therewith, has a disc 50 and an impeller 243 with vanes 244 and 245.

The interior of the sleeve 56 may be filled with grease or other suitable lubricant and permits of a turning movement of the shaft 233, head 239 and extension 242, with respect thereto and a sliding movement of the collar 240, sleeve 56 and impeller 243 with respect to the head 239 and extension 242, as limited by the abutment of the extension 55 with the head 239.

While the diaphragm 25 or 225 may be made of flexible material of substantially uniform thickness it is preferred for some uses to make the diaphragm, as shown in Figs. 1 and 5 of greater thickness contiguous to the center and at the place of maximum tendency to bending and thinner where there is less tendency to bending. The thickening of the diaphragm tends to change and distribute the location of the bending and increase the useful life of the diaphragm.

The mode of operation will now be pointed out.

Referring first to Figs. 1 and 2 of the drawings, upon rotation by the motor M of the shaft 30, a rotary movement will be imparted to the block 31. As the block 31 rotates, it imparts a movement to the pump shaft 33, spring 42 and impeller 43 in a conical path with the minimum of movement or apex point of the conical movement substantially at the diaphragm wall 27. While this conical movement is effected, there is relative rotary movement between the shaft 33 and the block 31, at the bearings 34 so that there is a minimum of any tendency of the shaft 33 to twist the diaphragm 25.

As the conical movement above referred to is effected, the diaphragm 25 is continuously deformed in an annular path from a maximum inward position as shown at the lower central part thereof on Figs. 1 and 3 to a maximum

outward and expanded position as shown on the upper central part thereof of Figs. 1 and 3.

The impeller 43 moves in a substantially annular path or circular orbit in the housing section 11 and as fluid enters through the inlet 14 with a circular movement imparted thereto by the plate 15, it is impelled in a circular path by the impeller and delivered to the outlet pipe 16 for discharge.

The coil 42 permits of accommodation by the impeller 43 to the centrifugal effect of rapid annular movement of the impeller and lengthens the life of the diaphragm 25.

In the form of the pump shown in Figs. 3 and 4, the impeller 143 is also moved in an annular path or circular orbit for a pumping action similar to that previously described. The shaft extension 142 is not, of course, as resilient and does not deflect to the same extent as is permitted by the coil 42.

The position of the pin 38 permits of limited movement of the pump shaft 33 and the parts connected thereto in a direction axially of the pump shaft 33 to permit accommodation of the point of minimum flection of the diaphragm.

The projections 47 and 48, by proper selection as to mass and axial location permit of static and dynamic balancing of the rotating members.

In the form of pump shown in Figs. 5 and 6, the impeller 243 is moved in an annular path or circular orbit for a pumping action similar to that previously described.

As previously pointed out the shaft 233 is fixed in the block 231 and as it is moved by the block 231 it imparts, through the head 239 and extension 242, movement to the sleeve 56 and impeller 243. The relative movement is effected by the journaled relation of the head 239 and extension 242 with respect to the sleeve 56.

A limited relative movement of the diaphragm 225, sleeve 56 and collar 240 axially of the shaft 233 is also permitted, as limited by the engagement of the head 239 with the end of the extension 55.

In the various forms of the invention, by selection of the proper shapes and areas, and provisions for bending of the impeller vanes torsion in the diaphragm 25 or 225, can be avoided with resultant longer useful life of the constituent parts. The diaphragm 25 or 225 is not utilized as a support for or fulcrum for the driving mechanism for the impeller, 43, 143 or 243, the main support being provided from the driving block 31 or 231.

The plate 70, if used, permits of employing a lighter diaphragm 25, the opening 71 being at the suction or lowest pressure zone within the housing section 11 or 111. The vanes 71, shown as short inclined vanes reduce the tendency of the liquid to rotate, while the oppositely disposed vanes 72 guide the fluid in the direction in which rotation is imparted thereto by the impeller 43 or 143.

The pump as herein disclosed is suitable for a wide variety of liquid transfer applications including the pumping of foods and beverages, oils, gasoline, corrosive chemicals, abrasive liquids and many other materials.

I claim:

1. A rotary liquid pump comprising a closed housing having a pumping chamber therein and a flexible end closure wall, inlet and outlet connections in communication with said pumping chamber, a rotary driving member exteriorly disposed with respect to said housing wall, a vane type liquid impeller in said pumping chamber movable in a circular orbital path, said impeller having oppositely disposed vanes, and driving means for said impeller interposed between said impeller and said driving member and extending through said wall in fluid tight relation, said driving means including a shaft connected to said driving member with the longitudinal axis thereof disposed in a common plane with the rotational axis of said driving member and at an acute angle to the rotational axis of said driving member for movement of said driving means in a conical path with an apex point of the conical path intermediate the driving member and the impeller, said driving means including a spring for supporting said impeller, and said vanes being radially disposed with respect to said longitudinal axis.

2. A rotary liquid pump comprising a closed housing having a pumping chamber therein and a flexible end closure wall, inlet and outlet connections in communication with said pumping chamber, a rotary driving member exteriorly disposed with respect to said housing wall, a vane type liquid impeller in said pumping chamber movable in a circular orbital path, said impeller having oppositely disposed vanes, and driving means for said impeller interposed between said impeller and said driving member and extending through said wall in fluid tight relation, said driving member being in supporting relation to said driving means, said driving means including a shaft in supporting relation to said impeller and connected to said driving member with the longitudinal axis thereof disposed in a common plane with the rotational axis of said driving member and at an acute angle to the rotational axis of said driving member for movement of said driving means in a conical path with an apex point of the conical path intermediate the driving member and the impeller, said vanes being radially disposed wtih respect to said longitudinal axis, said driving means including an enlarged head on said shaft engaging the inner face of the wall, a sleeve mounted on said shaft exteriorly of said wall and having an enlarged head engaging the outer face of the wall, spaced bearings on said shaft outwardly of said sleeve, a spacer on said shaft separating said bearings, and a member on said shaft for holding said bearings, spacer and sleeve in position with said heads in engagement with said wall.

3. A rotary liquid pump comprising a closed housing having a pumping chamber therein and a flexible end closure wall, inlet and outlet connections in communication with said pumping chamber, a rotary driving member exteriorly disposed with respect to said housing wall, said driving member having a bore with its longitudinal axis disposed in a common plane with the rotational axis of the driving member and at an acute angle to the rotational axis of said driving member in intersecting relation thereto, a vane type liquid impeller in said pumping chamber movable in a circular orbital path, said impeller having oppositely disposed vanes, and driving means for said impeller interposed between said impeller and said driving member and extending through said wall in fluid tight relation, said driving member being in supporting relation to said driving means, said driving means including a shaft in supporting relation to said impeller connected to said driving member with the longitudinal axis thereof disposed in alinement with the longitudinal axis of said bore for movement of said driving means in a conical orbital path with an apex point of the conical path at the place of intersection of said driving means and said closure wall, said vanes being radially disposed with respect to the longitudinal axis of said shaft, said driving means including an enlarged head on said shaft engaging one face of the wall, a sleeve mounted on said shaft and having an enlarged head enagging the opposite face of the wall, spaced bearings on said shaft, a spacer interposed between said bearings, and a member on said shaft for holding said bearings, spacer and sleeve in position with said heads in engagement with said wall.

4. A rotary liquid pump comprising a closed housing having a pumping chamber therein and a flexible end closure wall, inlet and outlet connections in communication with said pumping chamber, a rotary driving member exteriorly disposed with respect to said housing wall, a vane type liquid impeller in said pumping chamber movable in a circular orbital path, said impeller having oppositely disposed vanes, and driving means for said impeller interposed between said impeller and said driving member and extending through said wall in fluid tight relation, said driving member being in supporting rela-

tion to said driving means, said driving means including a shaft in supporting relation to said impeller and connected to said driving member with the longitudinal axis thereof disposed in a common plane with the rotational axis of said driving member and at an acute angle to the rotational axis of said driving member for movement of said driving means in a conical path with an apex point of the conical path intermediate the driving member and the impeller, said vanes being radially disposed with respect to said longitudinal axis, a partition wall being interposed between the inlet and the diaphragm with an opening therethrough through which a portion of the driving means extends.

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