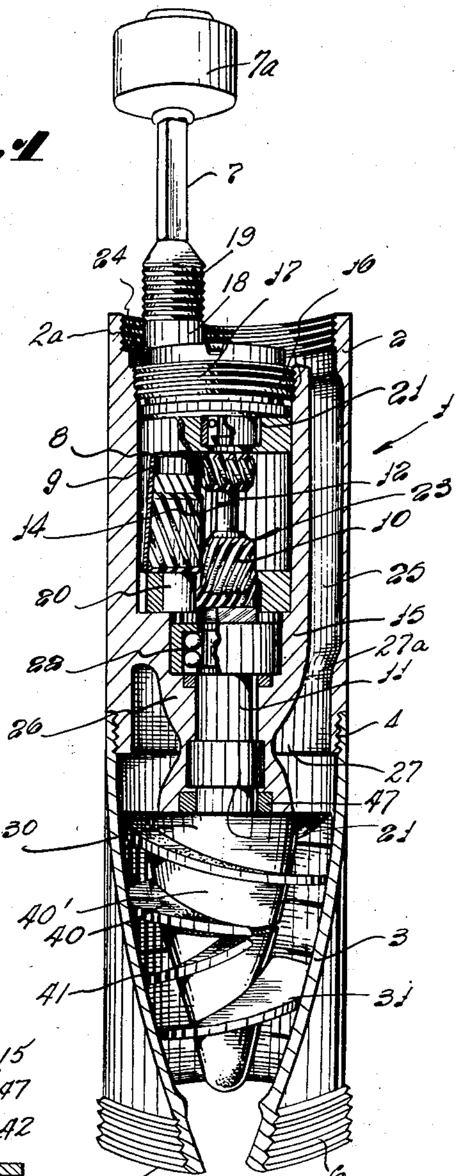
RE. 25116

Nov. 20, 1956 G. F. BAEZ 2,771,036

ROTARY PUMPS AND THE LIKE

Filed Jan. 19, 1955 2 Sheets-Sheet 1

Fig. 1



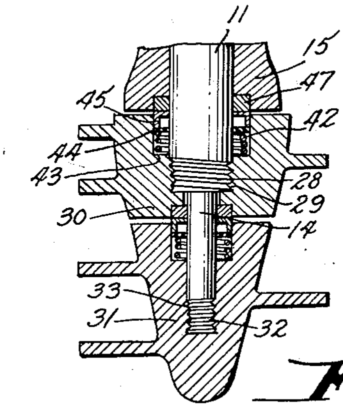




Fig. 5

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ROTARY PUMPS AND THE LIKE

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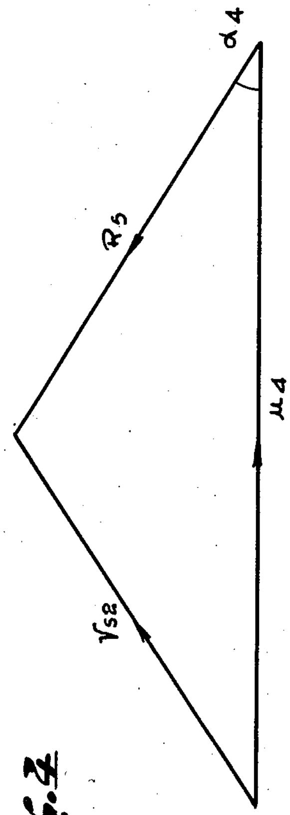


Fig. 4

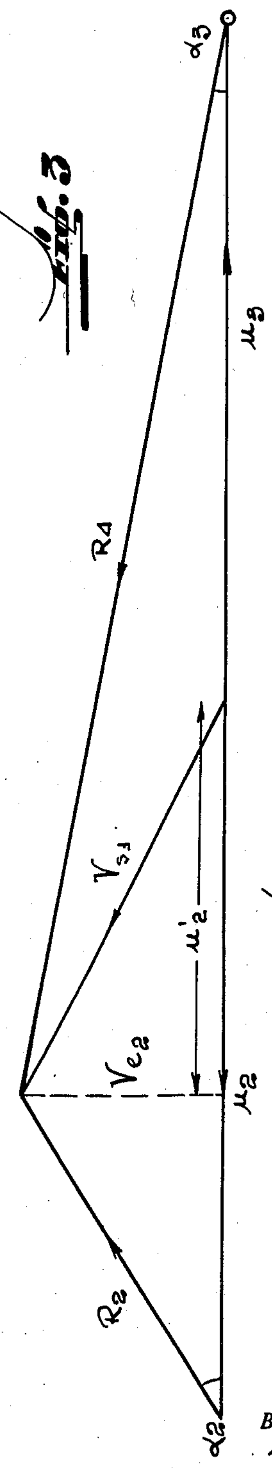


Fig. 3

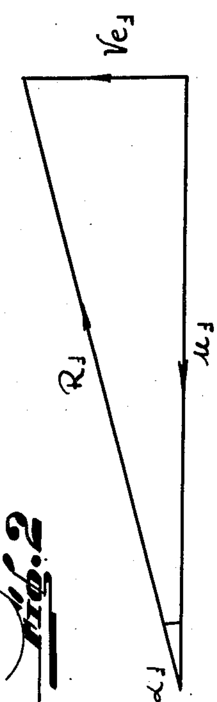


Fig. 2

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United States Patent Office

2,771,036

Patented Nov. 20, 1956



2,771,036

ROTARY PUMPS AND THE LIKE

Guillermo Federico Baez, Buenos Aires, Argentina

Application January 19, 1955, Serial No. 482,815

4 Claims. (Cl. 103—90)

The present invention refers to improvements in pumps, compressors and the like. More particularly it refers to improvements in the rotary pumps described and claimed in my U. S. Patent No. 2,620,735 of December 9, 1952.

The cited patent discloses a rotary pump which as an essential feature includes two rotors rotating in opposite directions. When the blades of the first rotor deliver the fluid to the blades of the second rotor a specific effect of impact is obtained which results in an increase of the lifting power as compared with conventional centrifugal or turbine pumps.

The present invention is based on the discovery that in order to obtain optimum results the blades of one rotor must have a given slope or pitch with regard to that of the blades of the other rotor. However, the improvement of the present invention is applicable not only in connection with the pump described in the cited patent, but also in connection with other similar structures wherein two or more rotors rotating in opposite directions are employed.

One of the main objects of the present invention is therefore to provide a rotary pump including two or more rotors rotating in opposite directions having their blades inclined or pitched in such a way that an optimum lifting effect is obtained.

Another object of the invention is to simplify the structure shown in my United States Patent No. 2,620,735 in order to obtain the same or better yields.

Another object of the invention is to render unnecessary in the cited structure the use of certain parts, since these may be disposed of when the blades are given such inclination or pitch which according to the present invention allows optimum results to be obtained.

These and other objects of the invention will be evident from the following more detailed description of one embodiment of the invention which has been illustrated in the accompanying drawings wherein

Figure 1 is an elevation, with parts broken away, partially in cross-section, of a rotary pump according to the present invention;

Figures 2, 3 and 4 are graphical representations showing the relative inclination or pitch of the rotor blades; and

Figure 5 is an enlarged sectional view showing the seals between relatively moving parts of the rotor.

Throughout the figures the same reference numerals and characters have been employed in order to designate the same or corresponding parts.

Referring to Figure 1, it will be seen that the rotary pump, according to the embodiment of the invention illustrated therein, comprises a cylindrical housing **1**, consisting of an upper portion **2** and a lower portion **3**, screwed or otherwise hermetically joined together at **4**. Inside, the two portions form a single chamber. The lower portion **3** has a lower open end **5**, which is preferably provided with a screw thread **6**, or other means which



allow such end to be attached to pipes, hoses or the like, which lead to the supply or source of liquid to be lifted.

The upper portion **2** of the housing **1** is designed to contain mianly the power transmitting mechanism for driving the rotors housed in the lower portion **3**. Such transmission is contained within an inner housing **15** provided at its upper end with an inner thread **16** into which the cap **17** is screwed. Cap **17** is provided with an upper extension **18** having an external thread **19** from which the driving shaft **7** projects. The driving shaft **7** is adapted to be rotated by any source of power represented diagrammatically at *7a*, such as for example, an electric motor or a combustion engine.

The upper end of portion **2** of the housing **1**, is also provided with internal threads **2a** in order to permit a cover (not shown) to be fixed to the assembly. Such cover would have a central opening through which extension **18** projects to the exterior. A hose or similar cover for the shaft **7** may be fixed to the external threads **19** on the extension **18**.

The shaft **7** mounted in suitable bearings **8** and **20** carries within the upper portion or body **2**, a pinion **9** which meshes with pinion **10** secured to driven shaft **11** which is mounted in suitable bearings **21** and **22**. The upper portion of pinion **9** meshes with a pinion **12** mounted on a satellite shaft **23**, while pinion **12** meshes with another pinion **13** secured to driven shaft **14** which extends within the hollow shaft **11** already mentioned. It will be understood that shafts **11** and **14** will rotate in opposite directions. The relations between the sizes of the several pinions are such that the two driven shafts rotate at the same speed which may be equal to that of driving shaft **7** or greater or smaller than the latter. The ratios will be selected in accordance with the work for which the pump is destined and according to the speed of shaft **7** which again depends on the motor employed and on the presence or absence of speed reducers inserted between the motor and shaft **7**.

As can be seen from the drawings, the inner housing **15** is arranged eccentrically so that at one lateral side thereof there is a vertical passage **25** which serves as an outlet for the liquid or fluid lifted or compressed. The lower end of inner casing **15** is tapered so as to form a lower extension **26** which occupies the center of the lower portion **2** of the casing **1** and the widened end portion of which projects into the upper central part of the lower body **3** to serve as a housing for the bearing **21** already mentioned and also to enclose the lower end of hollow shaft **11**. The lower extension **26** is surrounded by an annular chamber **27** which receives the liquid or fluid discharged by the rotors and which through a helical passage *27a* is in free communication with passage **25**.

The lower end of hollow shaft **11** is provided with external threads **28**, whereto the upper rotor **30**, is screwed by means of its corresponding internal thread **29** (Fig. 5). The pitch of the threads extends in such direction that, when the transmission already described causes the shaft **11** to rotate, said shaft tends to be screwed onto the rotor **30**. In a similar way, the lower rotor **31** is joined to the inner shaft **14** by means of threads **32** and **33** the pitch of which extends in an opposite direction as compared with threads **28**, **29**. Therefore, when shaft **7** rotates, the rotor **30** will rotate in an opposite direction and rotor **31** in the same direction as shaft **7**, and both rotors will rotate at the same speed.

Each of the rotors **30**, **31** has two helical blades **40** and **41**, respectively, the pitch of the respective blades being in opposite directions so that the four blades, when the rotors **30**, **31** rotate in opposite directions, will lift the liquid or fluid towards the annular receiving chamber **27**.

In order to achieve a seal between the rotary parts of the device and the inner casing **15**, conventional stuffing boxes may be employed, or preferably use may be made of the system illustrated in Fig. 5, which includes a spring **42** mounted on an annular seat **43** on the rotor **30**. The opposite end of spring **42** urges a rubber washer or the like **44** against the casing **45** which has the form of an inverted cup and which is fixed to shaft **11**. The entire assembly rotates with the shaft, and the pressure of the spring on the washer **44** provides a very efficient seal; the sealing effect is increased during rotation, due to the action of threads **28, 29**.

The upper face of the cup **45** bears against a ring-like structure **47** secured to the inner casing structure **15**.

A similar arrangement is employed in connection with the inner shaft **14** and its rotor **31**, to provide a seal for the inner casing **15**. The individual parts of such arrangement can be easily ascertained from the drawings and are therefore not described in detail.

It will be seen that each rotor **30, 31** carries two helical blades **40** and **41**, respectively. It will be evident that any desired number of blades may be mounted on each rotor.

It will also be evident that whilst a pump for liquids has been illustrated and described, a similar arrangement may be employed for fluids and also for compressing gases . More particularly, it is within the purposes of the invention to employ the general principle described in the construction of turbine compressors such as for instance compressors for jet engines. In this connection it will be clear that the system of the present invention greatly increases the output as compared with conventional systems inasmuch as the conventional stator blades are replaced by rotary blades moving in an opposite direction relative to the rotor blades.

Returning now to the pairs of blades **40** and **41**, it will be seen that each of the blades **40** of rotor **30** is developed as a helix, so that between the two blades **40** a divergent path **40'** for the fluid is formed. I have found that, in order that the transformation of energy in path or channel **40'** between the blades **40** be effected in the best possible manner, the blades must have a given inclination or pitch with respect to the rotor shaft, whereby optimum results are obtained. The basic principle has been illustrated in the vectorial graphs of Figures 2 to 4. In these representations it has been assumed that the fluid passing through the rotor is ideal, that is, that it flows without any dynamic losses due to friction, whirls, etc., and without losses in volume (i. e., a continuous, not intermittent, flow is assumed). In the same way, it has been supposed that the blades are infinitely thin so that they do not interfere with the flow of the fluid. In order to obtain the values to be employed in practice it is therefore necessary to modify those hereinafter set forth, as will be obvious to those familiar with the art.

Furthermore, the drawings have been made on the basis of the values corresponding to average speeds, that is, the speeds occurring at the centre of each blade.

Referring now to Figure 2, it will be seen that the same illustrates the order of movement corresponding to rotor **31**, and relates to the admission of the fluid as follows:

$n_1$=mean tangential velocity at the entry of rotor **31**;
$Ve_1$=velocity of the admission of fluid to rotor **31**;
$R_1$=relative velocity between the fluid and the rotor **31** (which determines the inclination or pitch of the admission blade **41'**, or in other words, the angle $\alpha_1$ at the admission end of blade **41'**).

From the foregoing it will be evident that the angle $\alpha_1$, may be selected according to the amount of the flow of fluid desired. The angle or pitch of blade **41** at the outlet end of rotor **31** will determine, on the other hand, the impetus which the fluid is given by the rotor **31**. This can be seen from Figure 3 wherein

$n_2$=tangential mean velocity at the outlet end of rotor **31**;



$R_2$=relative velocity of the fluid at the outlet end of rotor **31** (which determines the angle $\alpha_2$ and the inclination or pitch at the outlet of rotor **31**, and the impulse or impetus given to the fluid depends on this angle);
$V_{5_1}$=velocity of the fluid at the outlet of rotor **31**.

The angle or pitch $\alpha_3$ of the blade **40** of rotor **30** must be related, according to the present invention, to the angle $\alpha_3$ in order to obtain maximum results by taking up the impulse in the rotor **30** which rotates in an opposite direction. This relation is also illustrated in Figure 3 wherein:

$n_3$=mean tangential velocity of the counter-rotation at the inlet end of rotor **30**.

The ratio $V_{5_1}$ and $n_3$ determine the relative velocity $R_4$ and therefore the inclination or pitch which in view of the rotation in an opposite direction must be given to the blade **40'** at the inlet end of rotor **30** (and which is the angle $\alpha_3$).

From the foregoing it may be deduced that the outlet velocity $V_{5_1}$ of the rotor **31** can be decomposed into two factors, to wit

$Ve_2$=axial velocity at the outlet end;

$$n'_2=\sqrt{V_{5_1}^2-Ve_2^2}$$

Consequently,

$$tg\alpha_3=\frac{Ve_2}{n'_2+n_3}$$

in which equation $n_3$ is the tangential counter-rotation velocity.

Figure 4 illustrates the inclination or pitch of blade **40** at the outlet end of rotor **30** as angle $\alpha_4$ which preferably is selected to be equal to the angle $\alpha_2$.

In Figure 4

$n_4$=mean tangential velocity at the outlet end of rotor **30**;
$R_5$=relative velocity of the fluid at the outlet of rotor **30**, which determines the angle $\alpha_4$ (=pitch of blade **40** at the outlet end);
$V_{5_2}$=velocity of the fluid at the outlet of rotor **2**.

It will be seen that the known values permit the optimum value of the pitch of blade **40** at the inlet end of rotor **30** to be determined.

I claim:

1. A device for lifting or compressing fluids, which comprises a casing having an inlet opening and an outlet opening; a first rotor mounted within said casing and provided with a plurality of blades adapted to move the fluid from said inlet opening towards said outlet opening; a second rotor mounted within said casing between said first rotor and said outlet opening, and provided with a plurality of blades extending in a direction opposite to that of the blades of the first rotor; a motor; and a mechanism for transmitting motion from said motor to said rotors in order to drive said first rotor in such a direction that the fluid is moved from said inlet towards said outlet and to drive said second rotor at the same speed as said first rotor but in an opposite direction, the pitch of the blades of said second rotor at the end adjacent the first rotor corresponding to the equation

$$\alpha_3=\frac{Ve_2}{n'_2+n'_3}$$

wherein

$\alpha_3$ is the pitch of said blades;
$Ve_2$ is the axial velocity at the outlet end of said second rotor;
$n_3$ is the tangential velocity of the counter-rotation; and
$n'_2$ is $\sqrt{Ve_1^2-Ve_2^2}$

wherein

$Ve_1$ is the velocity of the admission of fluid at the inlet end of the first rotor; and
$Ve_2$ is the velocity of the fluid at the discharge end of said first rotor.

2. A device for lifting or compressing fluids according to claim 1, wherein each rotor is provided with a shaft, the shaft of one of said rotors being hollow and the shaft of the other rotor extending within said hollow shaft.

3. A device for lifting or compressing fluids according to claim 1, wherein said second rotor is provided with a hollow shaft and said first rotor is provided with a shaft extending within said hollow shaft, said mechanism comprising a first pinion mounted on a shaft driven from said motor and meshing with a second pinion secured to said hollow shaft and with a third pinion mounted on a satellite shaft, said third pinion meshing with a fourth pinion secured to the shaft of the first rotor.



4. A device for lifting or compressing fluids according to claim 1, wherein said mechanism is also housed within said casing.

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