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APPARATUS FOR INTRODUCING ONE FLUID INTO ANOTHER

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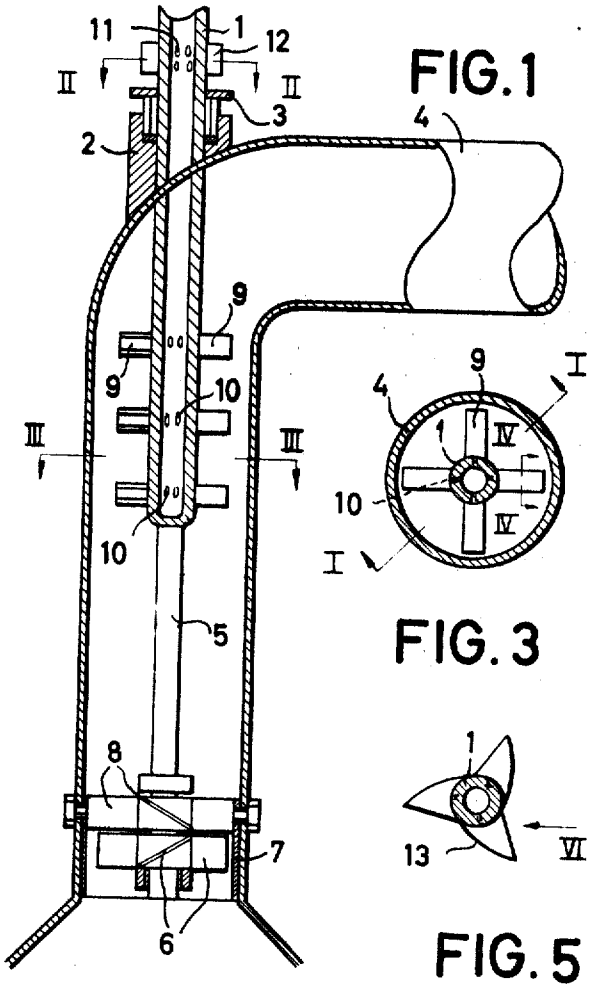

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

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APPARATUS FOR INTRODUCING ONE FLUID INTO ANOTHER

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ABSTRACT OF THE DISCLOSURE

An apparatus for combining two fluids, comprising a hollow shaft, rotating in one of the fluids and provided with a number of vanes behind which partial vacuums occur, holes being provided in the shaft at the places where the vacuums occur and the interior of the shaft being in communication with the other fluid, whereby the latter fluid is drawn into the former fluid through the interior of the shaft and the holes therein.

The invention relates to an apparatus for introducing one fluid into another comprising a driven shaft on which a number of vanes are disposed.

The said fluids may be constituted of two liquids, two gases, or of one liquid and one gas. Apparatuses of the type here referred to may e.g. be used for introducing atmospheric air or possibly pure oxygen into water, but many other mixtures and solutions may also be produced by means of the apparatus.

An apparatus is known for aerating water, the said apparatus comprising a pump housing in which a pump rotor comprising a great number of vanes or blades is mounted. The rotor and thereby also the pump housing are divided into two parts by means of a partition disposed at right angles to the axis of rotation of the rotor in the symmetry plane of the rotor. The apparatus is provided with two inlets, viz an axial inlet on either side of the said partition, and a number of outlets distributed along the circumference of the housing. The known apparatus is intended for being placed in an artificial pool or pond, one inlet being in communication with the water, while the other inlet is in communication with a tube carried up over the water surface. The apparatus is intended for functioning in the way that when the pump rotor is started rotating, water is drawn in through one inlet and air through the other, whereupon the said two fluids are mixed in the pump housing and in the outlets. A drawback of the known apparatus is, that in practice it is impossible to adjust the rate of revolution for the rotor in such a way that an effective pumping of the water as well as of the air is achieved. If the speed of rotation is set at a value suited for water, the part of the apparatus intended for pumping air will work at far too low a speed. If, on the other hand, the speed of rotation is set so that an effective pumping of the air is obtained, the speed of rotation will be far too high for attaining an optimum pumping of water. To this must be added, that the presence of air in the pump housing will to some degree reduce the capacity of the apparatus to pump water and thereby the efficiency of the apparatus.

The object of the present invention is to provide an apparatus which does not suffer from the said drawbacks of the known apparatus.

To achieve this, the apparatus, according to the invention is characterized in that the shaft is hollow and that the vanes have such a shape that, when due to the rotation of the shaft they move in one of the said fluids,

a partial vacuum will be formed at their backs, calculated in the direction of movement, while the shaft is provided with holes at the points where the said partial vacuums occur, and its interior is put in communication with the second of the said fluids. In this case, the most suitable rate of revolution is dependent solely on the movement of the vanes in one of the said fluids, so that the speed of rotation may easily be set at the optimum value. If the vanes move in a liquid, the speed of rotation should be comparatively low, while an essentially higher speed of rotation will be expedient, if the vanes move in a gas.

The vanes may, according to the invention, expediently have a V-shaped cross section. Vanes of this shape offer a comparatively slight resistance to the movement, and a comparatively large partial vacuum will occur between the prongs of the V.

The front edge of the vanes may according to the invention be curved backwards taken in the direction of movement. This will also reduce the resistance to the movement of the vanes and will at the same time cause objects, if any, caught, by the vanes to slide off easily again.

According to the invention the symmetry planes of the vanes may form angles other than 90° to the axis of rotation. By this means the vanes will yield a certain pumping effect in the direction of the axis of rotation, so that the apparatus according to the invention may e.g. serve as a stirrer.

The hollow shaft may according to the invention in the place, where it is put in communication with the second fluid, be provided with a number of holes and behind each of these, taken in the direction of rotation, a screen with such a shape that, when the shaft rotates, an elevated pressure will be formed at the place of the holes. This means a still more effective introduction of the second fluid into the first, a higher total difference in pressures between the two fluids being achieved.

The apparatus according to the invention may comprise a tube, the axis of which at least approximately coincides with the axis of rotation and in which the vanes can rotate. In this case there may according to the invention in the immediate vicinity of the vanes be provided a number of guide vanes secured in the tube. These guide vanes may in combination with the above-mentioned obliquity of the vanes cause a more effective pumping action and may, furthermore, contribute to preventing the first fluid from being subjected to a rotary motion, undesirable in certain cases, by the vanes.

According to the invention, a pump rotor may be mounted on the shaft. In this case the first fluid may possess a considerable axial velocity when passing the vanes, which in this case are expediently given such an obliquity that they cause no braking of the liquid or may even increase the axial flow velocity.

The invention will in the following be further explained with reference to the diagrammatical drawing in which

FIG. 1 shows an apparatus according to the invention, partially in section,

FIG. 2 a section on line II—II of FIG. 1,

FIG. 3 a section on line III—III of FIG. 1,

FIG. 4 a section on line IV—IV of FIG. 3,

FIG. 5 another embodiment of the vanes in an illustration corresponding to that shown in FIG. 3, and

FIG. 6 part of the construction shown in FIG. 5 viewed in the direction of the arrow VI in FIG. 5.

The apparatus shown in FIGS. 1–4 comprises a hollow shaft **1** which by means of an extension piece **2** and a bushing **3** is carried watertight and revolving through the wall of a tube **4**. At its top the shaft **1** is driven by means, not shown, so that viewed from above in FIG. 1 it rotates clockwise. At its lower end the shaft **1** is ex-

tended with a solid shaft **5** on which a pump rotor with obliquely disposed vanes **6** is mounted.

In the lower end of the tube **4** a short pipe length **7** is secured which carries a set of guide vanes **8** together with a bearing for the shaft **5**.

When the shaft **1**, **5** rotates, as indicated above, and the lower end of the tube **4** is in a fluid, e.g. water, the said fluid will be pumped up through the tube.

On the part of the hollow shaft **1** located in the tube and thereby in the said fluid a number of vanes **9** are disposed, the construction of which appears clearly from FIGS. 3 and 4. As will be seen, each vane consists of sheet material bent into V-shape, and when the shaft rotates as indicated above, the apex of the V will be foremost in the direction of movement, so that a partial vacuum will occur between the limbs of the V. At the points where the vanes **9** are secured to the shaft **1**, holes **10** are provided between the limbs of the V in the wall of the shaft, so that the partial vacuum will spread to the interior of the hollow shaft.

Outside the tube **4**, the interior of the hollow shaft **1** is put in communication with another fluid, e.g. atmospheric air, by means of holes **11** which in the embodiment shown are disposed pairwise above each other. Behind each pair of holes, taken in the direction of movement, a screen **12** is placed, and it will be seen that when the shaft rotates in the direction indicated above there will within each screen be produced an elevated pressure which will tend to force the said fluid, e.g., air in through the holes **11** to the interior of the shaft. The screens **12** are not necessary for attaining the effect that is the object of the present invention, but they cause an increase of the effect produced by means of the vanes **9**, the said effect consisting in that the fluid, in which the holes **11** are located, is through the holes **10** sucked out into the fluid flowing through the tube **4**.

As appears from FIG. 4, the symmetry planes of the vanes **9** are oblique in relation to a plane at right angles to the shaft **1**, **5**. This entails that the vanes **9** can exert a certain pumping action in the direction of the shaft **1**, **5**. If the pump rotor **6** was not present, the vanes **9** might therefore by themselves cause a pumping of the fluid present in the tube **4**, provided that the back-pressure was not too high. The pumping effect can be increased if the vanes **9** are combined with stationary guide vanes corresponding to the vanes **8** shown in FIG. 1. Also in the case where the vanes are combined with a pump proper, as shown in FIG. 1, may the obliquity of the symmetry planes of the vanes be advantageous, as a given obliquity, dependent on the axial velocity of the fluid flowing through the tube **4**, will offer the least possible resistance to the movement of the vanes in the said fluid.

FIGS. 5 and 6 show another form of the vanes, which are here designated by **13**. In this case the front edges of the vanes, taken in the direction of movement, are curved slightly backwards, and this will cause the objects, if any, in the fluid flowing in the tube **4** that are caught by the vanes **13** will easily slide off again. Also in this case may the symmetry planes of the vanes be oblique so that a pumping effect in the direction of the shaft is achieved.

The apparatus described above is particularly well suited for introducing a gas, e.g. atmospheric air, into a liquid, e.g. water. By a suitable dimensioning the apparatus according to the invention may, however, also be used for introducing one liquid into another liquid or one gas into another gas or even for introducing a liquid into a gas.

As by means of the vanes **9** or **13** and the screens **12**, if any, a pressure difference is produced, the fluid flowing into the hollow shaft may furthermore be brought to perform a work, so that a transmission of forces may be involved.

The vanes need not have the shapes shown in the drawing. They should only be so shaped that a partial vacuum is produced behind the vanes. The vanes may be designed as worms when only their rear surfaces, taken in the direction of movement, are given such a shape that the necessary partial vacuums occur.

The vanes need not move within a tube as shown in the drawing. They may e.g. move in a large tank for the particular fluid. If in this case the symmetry planes of the vanes are at right angles to the axis of rotation, they serve solely for introducing one fluid into the other. If the symmetry planes are given an obliquity, the vanes will, furthermore, function as the vanes in a stirrer.

The number of the vanes may be chosen at will. It is possible for example, particularly in the case where the vane is designed as a worm, to let a single vane suffice.

Even if, as mentioned above, the apparatus according to the invention may be used for many different purposes, it will be particularly useful for aerating water, e.g. for use in fish-ponds.

I claim:

1. In an apparatus for introducing a first fluid into a second fluid, comprising:

(a) a driven hollow shaft having the interior thereof communicating with the first fluid and a part thereof situated in said second fluid,

(b) a plurality of vanes of V-shaped cross section secured to said part of said shaft, and

(c) a plurality of apertures provided in said shaft between the interior thereof and places situated in the V-shaped vanes, the planes of symmetry of said V-shaped vanes forming angles other than zero degrees with a plane perpendicular to the longitudinal axis of said shaft.

2. In an apparatus as set forth in claim **1** further comprising:

(a) a tube in which said shaft is rotatably mounted and in which said V-shaped vanes can move, and

(b) a plurality of guide vanes secured in said tube in the vicinity of said V-shaped vanes.

3. In an apparatus as set forth in claim **2** wherein a pump rotor is secured to said shaft.

References Cited

UNITED STATES PATENTS

1,264,315	4/1918	McCarty	103—6
1,919,847	7/1933	Kunz	230—108
2,319,228	5/1943	Harrington	230—108
2,772,863	12/1956	Harney	103—7
2,911,137	11/1959	Edwards	230—108
2,990,779	4/1961	Reinecke	103—6
3,405,865	10/1968	Lagelbauer	230—120

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103—5; 259—95