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ROTARY FLUID FLOW MACHINE HAVING ROTOR VANES CONSTRUCTED ACCORDING TO THREE DIMENSIONAL CALCULATIONS

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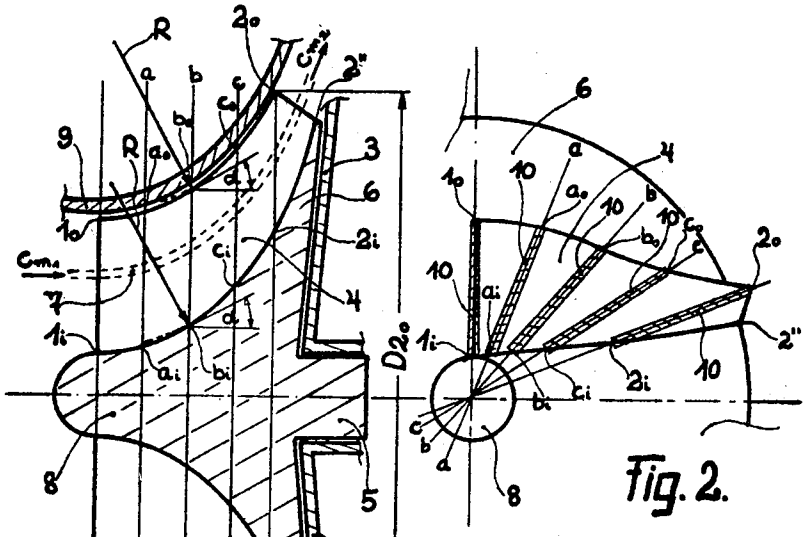


Fig. 2.

Fig. 1.

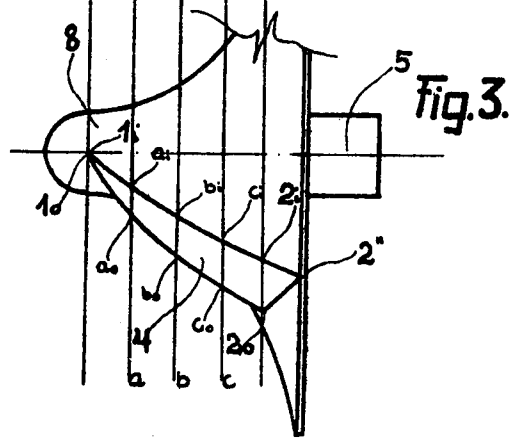


Fig. 3.

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ROTARY FLUID FLOW MACHINE HAVING ROTOR VANES CONSTRUCTED ACCORDING TO THREE DIMENSIONAL CALCULATIONS

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This invention relates to a new and advantageous turbomachine which can be used as an engine, a pump, a compressor, a turbine, or for compressing or decompressing, gaseous fluids or for the delivery of compressible or non-compressible fluids.

Turbomachines in use today are designed and constructed upon an old traditional pattern, that is, single-dimensional treatment, by which is meant the construction of the rotor or impeller rests upon mathematical reasoning which considers the flow of the fluid through the rotor with respect to a single dimension only. These conventional machines have various disadvantages, first, a relatively low efficiency, second, a quite usual deficiency of the hydraulic stability in relation to the characteristic of delivery, third, the appearing of eddy flows, which are principally responsible for losses of efficiency, and fourth, a certain deficiency of mechanical behavior during the running of the engines, such as vibrations, and surging, etc.

By three-dimensional calculation of the flow the above-mentioned deficiencies of conventional turbomachines can be eliminated to a vast extent if, based on the invention, a rotary flow machine is built in such a way that:

(1) All the rotor vanes are disposed perpendicularly with respect to the rotor axis throughout their width.

(2) The extent of points of the inner and outer longitudinal sectional profile lines of the vanes, which can be cut by one and the same perpendicular projection onto the rotor (or impeller) axis, have at least approximately the same, identical, or congruent form of curvature.

A rotary flow engine designed and constructed according to these principal characteristics of invention has, in relation to the traditional turbomachines, surprisingly higher rates of efficiency, a quite more stable way of hydraulic performance and a better mechanical behavior.

Regardless of whether such rotors or impellers, provided with both above-mentioned design characteristics of the invention, are used as the impellers for pumps and blowers, as well as for turbines, the same success is attained. In the following description the invention will be described as applied to pumps and compressors only, for reasons of simplicity.

In the accompanying drawings FIGURE 1 is a diagrammatic longitudinal sectional view showing, schematically, the rotor of the new flow turbomachine in a general way.

FIG. 2 is a diagrammatic view of part of FIG. 1, viewed from the left illustrating approximately one quadrant of the machine, a vane being illustrated as being cut by a series of transverse radial section planes.

FIG. 3 shows the width of one rotor vane, viewed vertically in FIG. 1.

According to the above-mentioned second characteristic of invention, both profile lines 1_o—2_o and 1_i—2_i must have the same curvature (mathematically defined by the value of $1/R$) and also the same angle α parallel to the rotor axis assuming they are cut by one and the same perpendicular lead onto the said rotor axis. In FIG. 1 one such radius R is indicated for one such lead designed by the line b—b. This permits the employment in a precise way, instead of an approximate one as has been customary, of a three-dimensional contemplation of

the flow for the creation of the new turbomachine, where the value of

$$\frac{C_m 2}{R}$$

is of importance for the calculation of the inner hydraulic forces. (C_m=value of meridional flow velocity.) In order to determine such said curvature $1/R$ it is commendable to form both congruent meridional vane profile lines 1_o—2_o and 1_i—2_i according to any, mathematical equation $y=f(x)$ that has a second derivative or differential coefficient $f''(x)=y''=d^2x/dy^2\neq 0$, because the curvature $1/R$ is a function of said second derivative. By circumstances the form of said profile lines can be formed by the composition of various of such equations divided in various sections of the rotor.

A turbomachine designed and constructed according to these characteristics of the invention has, in relation to the traditional turbomachine surprisingly higher rates of efficiencies, quite a more stable way of hydraulic performance and a better mechanical behavior.

Even when such rotor or impeller, provided with both characteristics of the invention, serves as the impeller for pumps and blowers or for turbine rotors, the same success is attained. In the description it is applied to pumps and compressors only for reasons of simplicity.

In the drawings the rotor comprises outer meridional profile lines 1_o—2_o—$2''$ and inner shroud **6**, between which extend vanes **4**, to the shape of which the present invention is principally concerned. They translate the flow, of which one imaginary streamline **7** enters with the velocity Cm_1 and leaves the rotor with the velocity Cm_2. The rotor is closely enclosed by outer wall **9** and inner wall **3**. The vanes **4** are fixed on the impeller hub **8**, which is impelled by shaft **5**.

Because of the second characteristic of invention which prescribes that the outer and inner profiles of the vanes 1_o—2_o and 1_i—2_i are equal and congruent, it appears that the radial extent of said vanes 1_i—1_o, a; —a_o, b: —b_o, c; —c_o and 2_i—2_o are all of equal length.

I claim:

A turbomachine of the radial flow type having a rotor provided with vanes, said vanes being perpendicularly disposed with respect to the rotor axis throughout their extent, said vanes having circumferentially and outwardly curved inner and outer profiles, said profiles between two axially spaced planes being of equal length and of congruent curvature.

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