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FLOATING NON-STICKING BLADES OR VANES

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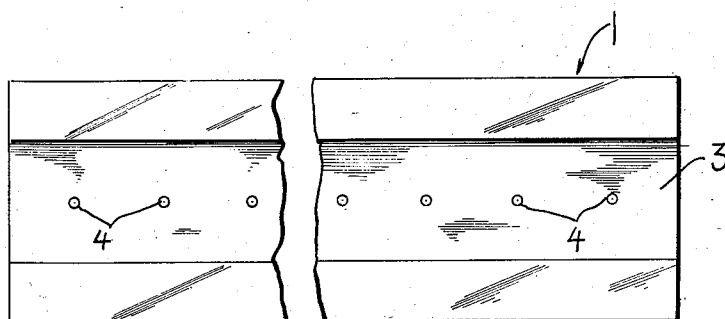
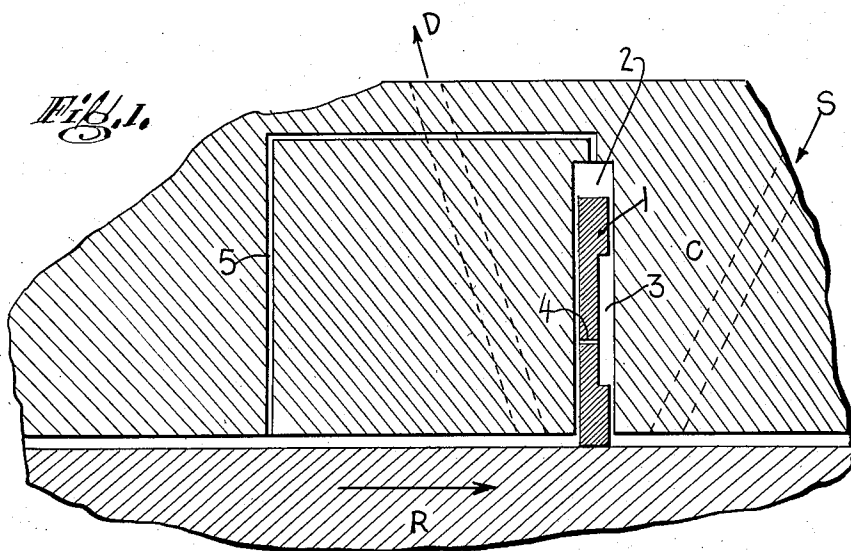
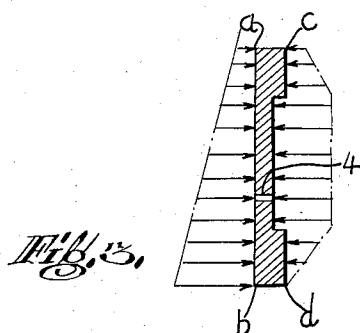


Fig. 2.



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FLOATING NON-STICKING BLADES OR VANES

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Application June 5, 1956, Serial No. 589,530

4 Claims. (Cl. 103—84)

This invention relates to floating non-sticking blades and more specifically to doctor blades or vanes adapted for use in fluid pumps operating on the viscosity or fluid wedge principle, as exemplified by the pumps shown in Modrovsky and Sherwood application Serial No. 465,078, filed Oct. 27, 1954, now Patent No. 2,777,394, and in Fazekas and Modrey application Serial No. 563,750, filed Feb. 6, 1956.

It is an object of the invention to provide such blades which will effectively serve the purpose of forming a sufficiently positive stop for the fluid entrained by relative motion of a rotor and stator separated by a small clearance space, while ensuring that the blades will retain an adequate measure of mobility in order to be self-adjusting to rapidly or slowly changing conditions, i. e., the blades should close to a considerable extent, the clearance space but must be free to float and not be rigidly fixed in position or subject to binding or jamming under any possible operating conditions.

The desired result is attained, in the device shown and described herein, by drawing fluid under pressure from a selected point on one vertical face of the blade and bleeding it to the opposite vertical face under conditions such that the total opposed forces are substantially equal. Means may be provided also for balancing to a desired extent the forces acting on the top and bottom of the blade.

A practical embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 represents a detail section through a wiper or doctor blade, taken in a plane at right angles to the axis of a rotor, shown here for simplicity as being of infinite radius, parts being broken away;

Fig. 2 represents a side elevation of the blade, viewed from the right of Fig. 1, and

Fig. 3 represents a pressure diagram showing approximately the distribution of pressure values on opposite faces of the blade.

Referring to the drawings, a rotor R is assumed to be moving, in the direction of the arrow, with respect to a stationary casing C, with a clearance between the adjacent surfaces of said rotor and stator, all as more fully explained in the copending applications cited above. A fluid of some viscosity (e. g., an oil to be pumped) is supplied to the clearance at a point downstream from a wiper or doctor blade 1 and is drawn from said clearance, for delivery wherever desired, at a point near said blade on the upstream side thereof, considered with reference to the direction of movement indicated by the arrow, said supply and delivery lines being designated S and D, respectively. The blade 1 is shown as having the cross-sectional form of a vertically elongated rectangle, and is accommodated with a close sliding fit in the slot 2 formed in the stator C, the slot having a vertical depth at least as great as the height of the blade. The blade may be of extended length, as indicated in Fig. 2, and the slot is of a corresponding length. In order to effect the desired balancing, the vertical face of the blade, on

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the downstream side, is provided with a recess 3 extending from end to end of the blade and vertically throughout a major part of its height, said recess being connected to the opposite face of the blade by a plurality of small holes 4, preferably disposed somewhat lower than the midway level of the height of the blade.

The blade is hydraulically balanced in the horizontal direction by providing a hydrostatic force on the face $a-b$ (Fig. 3) substantially equal to the opposing force on the face $c-d$. The point of highest pressure is at the corner b on the upstream side of the blade where it projects from the slot 2 and tends to close the clearance space. Assuming that there will be some leakage upward along the face $a-b$, the pressure will drop linearly as represented by the arrows of different lengths at the left in Fig. 3. By bleeding the pressure fluid through the holes 4 to the recess 3 on the opposite face, a zone of uniform pressure (having a value corresponding to that at the level of the holes 4) is established on the face $c-d$ throughout the extent of the recess, this zone being bounded at the lower land by a zone having a linear drop to zero (inlet pressure) at the corner d and at the upper land by a zone having a linear drop to a value at the corner c corresponding to that at the corner a . By locating the holes 4 at a proper level the total hydrostatic force on face $c-d$ can be made to approximate very closely that on face $a-b$; although the pressure patterns are not symmetrical, any turning moment which may result is not sufficient to cause binding or jamming of the blade in the slot.

Since the point of highest fluid pressure is at the corner b it will be evident that leakage between the bottom of the blade and the surface of the rotor creates a lifting force tending to move the blade away from said surface. Such a force can be balanced by providing one or more bleed conduits 5, extending from the top of the slot 2 to the clearance between the rotor and stator at a point spaced somewhat upstream from the blade where the entrained fluid is at a pressure less than its maximum but sufficient to balance, when applied to the top face $a-c$ of the blade, the lifting force on the bottom face $b-d$. If the bottom face lies parallel to the rotor surface, the pressure pattern thereon will show a steep linear drop from maximum at corner z to zero (or inlet pressure) at corner d and the total force to be balanced can readily be calculated.

While the terms "top" and "bottom" have been used herein for convenience, referring to the parts as shown in the drawing, it will be understood that pumps or the like in which such blades are used may employ a plurality of blades disposed symmetrically (or otherwise) and mounted in any position whatever with respect to the earth's surface—upside down, sideways, on end, etc. As an order of magnitude, the blades presently contemplated are conceived as having a height of about one inch or less, a length of a few inches, and being adapted for use in connection with a viscous fluid such as oil in a clearance space measured in thousandths or hundredths of an inch.

The balancing of the blades is important in order to ensure efficient and dependable operation of a pump, for instance, in which the rotor turns at high (constant or variable) speeds and from which the fluid is delivered at pressures which may be several thousand p. s. i.

It will be understood that various changes may be made in the form, construction and arrangement of the several parts without departing from the spirit and scope of the invention.

What I claim is:

1. In a pump or the like having a stator and a rotor separated by a clearance and provided with means for supplying a viscous fluid to said clearance and means

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for delivering the fluid therefrom, a blade and mounting therefor comprising, a slot formed in said stator and opening into said clearance, and a wiper or doctor blade fitting freely in said slot, said blade having the cross-sectional form of an elongated rectangle, being so disposed as to present a narrow edge toward the rotor, being provided with a shallow recess so located as to remain wholly within the slot while extending throughout a major part of one side face, and being provided with small holes connecting said recess with the opposite side face.

2. A blade and mounting therefor according to claim 1 in which said small holes are located at a level below the midway level of the height of the blade.

3. A blade and mounting therefor according to claim 1

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which includes a fluid conduit extending from the clearance at a point spaced from the slot and blade to the top of the slot.

4. A blade and mounting therefor according to claim 1 in which said shallow recess is located on the downstream side face of the blade, considered with respect to the direction of movement of the rotor surface while operating as a pump.

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