

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 82200165.7

(51) Int. Cl.³: **F 04 C 2/344**
F 01 C 21/08, F 01 C 19/08

(22) Date of filing: 11.02.82

(30) Priority: 13.02.81 NL 8100705

(43) Date of publication of application:
25.08.82 Bulletin 82/34

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: De Kok, Abraham
Koningin Wilhelminaweg 293
NL-3737 BA Groenekan(NL)

(72) Inventor: De Kok, Abraham
Koningin Wilhelminaweg 293
NL-3737 BA Groenekan(NL)

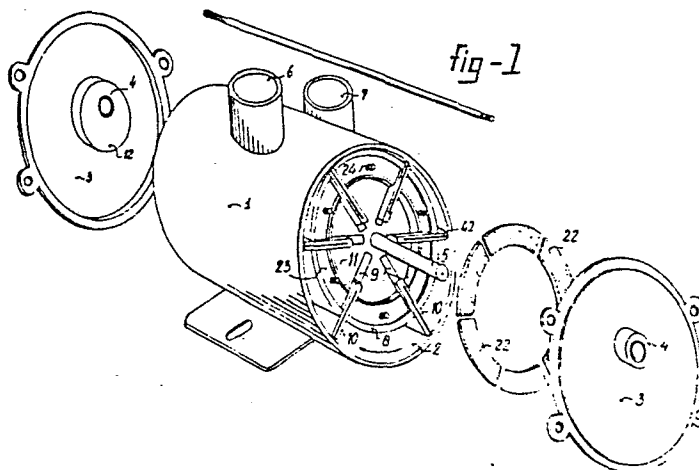
(74) Representative: van der Beek, George Frans et al,
Nederlandsch Octrooibureau Johan de Wittlaan 15 P.O.
Box 29720
NL-2502 LS Den Haag(NL)

(54) **A rotating vane-pump or -motor.**

(57) The invention discloses designmeasures to improve the (volumetric) efficiency of known rotating vane-type pumps or -motors.

A control-means (12, 14) is disclosed which mechanically controls the radial inward and outward movements of each vane (10) in its slot (9) in the rotor (11) during its rotation along the cylindrical inner-running-surface (2) of the housing (1) of the machine, in addition to the normal centrifugal force acting on the vanes (10).

Additional springs urging the vanes outward and appropriate wear-resisting running- and sealing inlays (42) for the vanes sliding over the housing and the endcovers are resealed as well. So are sealings (22) or -plates between the rotor-end faces and the endcovers. All the above measures reducing blow-by and wear.



A rotating vane-pump or -motor

This invention relates to a rotating vane-pump or -motor provided with a circular-cylindrical rotor with slots in which vanes are guided slidably, which rotor is supported eccentrically in a casing with a circular-cylindrical interior, which is closed at both ends by internally substantially plane end faces.

Such rotating machines are known already a long time, not only as pumps but also as pneumatic motors. Both embodiments have found a wide field of application notwithstanding the often low efficiency as a result of internal leakage and the dependency on the speed of rotation for moving the vanes outwardly in the correct time intervals and angular regions.

It is an object of this invention to increase the efficiency of such structures considerably while maintaining the existing advantages. By such an improvement it is possible to apply a very much wider field of applications both as pumps and as motors, to increase the applicability and suitability of the structure and it is thereby also possible to choose a more compact structure for the same purpose and output, in which it is even possible to apply wider manufacturing tolerances of the composing parts and an easier assembly.

To obtain this object the structure is improved according to the invention in essence by making the movement of the vanes independent from the speed of rotation and by providing very good sliding seals between casing and rotor and between casing and vanes.

The invention will now be explained further with reference to the enclosed drawings showing by way of example several possible embodiments, in which description features and advantages of the invention will become apparent.

Fig. 1 shows an exploded view of a simple embodiment of a rotating vane-pump or -motor. The means for causing the radial movement of the vanes 10 include a cam or disc 12 on each side rigidly connected to the covers 3 of the casing 1. The sliding

seal between the end faces of the rotor 8 and the covers 3 is obtained by segmental plates 22 between the vanes 10, which plates are supported under pressure of springs 24 in annular chambers 23 in the ends of the rotor 8. The vanes themselves
5 are provided with slot shaped recesses along the sides directed to the inner wall of the casing, said recesses taking up resilient sealing strips 42.

Fig. 2 shows a partial axial section of such a structure according to the invention, in which in an open chamber 11
10 concentric with the rotor axis and in the ends thereof there is a separate and as such freely rotatable ring 14 between the ends of the vanes directed towards the axis, which ring provides for the control of the movement of the vanes.

Fig. 3 shows a similar view and section of part of the
15 structure with a loose rotatable ring 14 as in Fig. 2, but here active in a recessed corner 18 at the ends of the sides of the vanes directed towards the axis, ring 14 being shown at a distance from its operative position in recessed parts 18

Fig. 4 shows a similar view and section as Figures 2 and
20 3, in which the vanes 10 have a recess 19 opening towards the adjacent cover of the casing and taking up the separate movable control ring 14, which in this case controls movement of the vanes positively both outwardly and inwardly.

Fig. 5 shows an exploded view of the same part of a
25 structure according to the invention in a further embodiment in which the casing cover 3 is provided with a circular hub 17 concentric with the axis of the rotor and having a separate and separately rotatable ring 14 which, in this case, is of greater axial length to engage both around this hub 17 and in
30 the recesses 19 of the vanes 10.

Fig. 6 shows a diagrammatic end view of a rotor of a structure according to the invention in another embodiment in which the vanes 10 at their ends near the axis of the rotor have a widened part 20 giving a better contact with the
35 controlmembers such as control ring 14. The vanes have inner end faces perpendicular to their radial direction so as to compensate for differences in contact angle by the eccentric position of the rotor in the casing.

Fig. 7 shows an end view of a rotor of a structure according to the invention, having, as in Fig. 1, separate segments 22 between the vanes 10. These segments are made of particularly wear-resistant and/or self-lubricating material and are taken up in an annular chamber in the rotor between the vanes, while they are resiliently pressed against the casing covers by springs 24.

Fig. 8 shows from a direction inclined with respect to the axis the end of a rotor of a structure according to the invention with a chamber with a deeper portion 11 and a shallow portion 26 outwardly thereof. A disc 25 of wear-resistant and/or self-lubricating sealing material has a central hole 28 and radial slots 27 for taking up the ends of the vanes. There may be spring means not shown such as 24 in Fig. 1 and 7 to push this disc 25 towards the adjacent casing cover, and there may be a pin 31 on the rotor in shallow chamber portion 26 engaging a hole in the disc 25 to avoid that the entire force for rotating disc 25 with the rotor should be exerted by the vanes only.

Fig. 9 shows the end of a rotor with an end disc 29 embodied as a cap engaging and slidably fitting around an end part 30 of the rotor with smaller diameter. There are springs 24 for urging this cap against the inner end face of the casing and pins 31 engaging in holes in disc 29 to keep this disc in position.

Fig. 10 shows an exploded view of an embodiment of the structure according to the invention with the rotor 8 having in a recessed annular part 34 at both ends an annular body 3 of wear-resistant and/or self-lubricating material having radial slots 33 for taking up the ends of the vanes. In this case, the end covers 3 of the casing have an annular recess part 35 for taking up the outer ends of the rings 32 axially outside the slots 33 so as to have the rings 32 fitting but being easily rotatable therein.

Fig. 11 shows an axial section for the movable sealing between the rotor and the casing cover, the rotor 8 having at its outer periphery a protruding annular part 37 engaging by a sliding fit in an annular chamber 38 of casing cover

with interposition of wear-resistant material. This material may be resilient to give a good sealing. Instead thereof the annular chamber 38 may engage around the protruding part 37 with some clearance and this chamber 38 may be filled by grease of sufficiently high viscosity. There may be sealing material in the remainder of this end face of the rotor and at the righthand end of the rotor as indicated by 21.

Fig. 12 shows diagrammatically a vane 10 for a structure according to the invention in front and end view, the vane having a slot shaped recess in which three separate sealing strips are mounted with a sliding fit. These strips may be maintained in sealing contact with the cylinder wall and the casing covers under a resilient pressure.

Fig. 13 shows this vane 10 of Fig. 12 in section parallel to its side faces and through the slot taking up the sealing strips. The slot is indicated by 47, the side sealing strips by 42 and the outer sealing strip by 48. A spring 51 embodied as a resilient wire of leafspring is positioned in the bottom of the slot 47 to urge the sealing strips 42 and 48 outwardly. The ends of this spring are bent outwardly as at 52.

Fig. 14 shows in perspective an embodiment of the sealing strips indicated by 49 giving a better and uninterrupted sealing around three sides of the vane; and

Fig. 15 shows such a sealing strip embodiment in position on the vane 10 in a peripheral slot 47 thereof as in Fig. 13. In this case, the ends of the spring 51 are bent inwardly at 52 and are taken up in suitable small openings in the bottom of the recess 47.

Fig. 16 shows an embodiment of a pump according to the invention with an end cover removed and seen axially from one end. The fluid enters through inlet 7 and leaves the design through outlet 6. It is always necessary to have a sufficient running clearance between the rotor and the casing, the vanes providing for the sealing between inlet 7 and outlet 6, with their different pressures.

Nevertheless it cannot be avoided that more than negligible fluid-volumes are moved along by said clearance-spaces from the outletsector to the inletsector, causing appreciable

volumetric losses.

According to the execution as shown in Fig. 16, the invention provides between the outlet 6 and the inlet 7 for a bypass opening 53 in the pumpcasing; said bypass opening 53 is positioned such that between the outlet 6 and opening 53 and between opening 53 and inlet 7 there is at any time at least one vane. The same is true for the bypass opening 54 between inlet 7 and the outlet 6, being separated from each at any time by at least one vane. The bypass openings 53 and 54 are interconnected by a pipe, hose or the like 55. Said bypass duct 55 thus forms a connection between the spaces with the smallest dead volume, as soon as this volume is separated from the outlet opening by at least one vane and still separated by at least one vane from the inlet opening and another space with lower pressure in the suction-sector of the pump which is also separated from the suction-opening and the outlet opening by at least one vane. In doing so, with the machine working as compressor, "pumping around" compressed fluid and the compressed fluid-losses due to this, as well as still further increasing losses in case the back-pressure at the outlet increases, are substantially avoided. Higher compression ratios in one stage become possible as well. Should this machine act as vacuum pump, then through said bypass fluid will be sucked out from the spaces with the smallest dead volume (generally filled with fluid at atmospheric pressure) by an inactive space with reduced pressure. As a result an appreciably lower vacuum can be attained

CLAIMS

1. A rotating vane-pump or -motor provided with a circular-cylindrical rotor (8) with slots (9) in which vanes 10 are guided slidably, which rotor (8) is supported eccentrically in an internally circular-cylindrical casing (1) closed at both ends by covers (3) of mainly plane inner surface characterized in that at least one of the axial ends of the rotor (8) within the outer periphery thereof there are control members (12, 14 or 17) keeping the vanes (10) constantly in contact with the cylinder wall (2) of the casing (1).

2. A structure according to claim 1, characterized in that on at least one of the casing covers (3) a disc or cam (12) is provided, concentrically with the cylindrical inner wall of the casing, the vanes (10) being guided slidably by the periphery of this disc or cam (12) between it and the inner wall (2) of the casing (1).

3. A structure according to claim 2 characterized in that a preferably circular-cylindrical disc, annular cam or ring (14) is freely movable with the rotor (8).

4. A structure according to claim 1 characterized in that in at least one of the end walls of the rotor concentrically therewith a circular chamber (11) is provided in which a separate disc or cam ring (14) is present, having a periphery axially parallel to the inner cylindrical wall (2) of the casing (1) and that all the vanes (10) have parts fitting slidably between the periphery (16) of the disc or of the cam and the inner wall (2) of the casing (1).

5. A structure according to claim 4 characterized in that the cam ring (14) is rotatably supported about a circular hub (17) rigid to the casing cover (3).

6. A structure according to any of the preceding claims characterized in that in an endwall of the rotor (8) concentrically therewith a circular chamber (11) is recessed in which a separate circular disc with a periphery axially parallel

to the internal cylinder wall(2) of the casing (1) is provided and that the vanes(10) have parts making a sliding fit between the periphery of the disc and the inner wall(2) of the casing(1), the rotor shaft(5) being supported rotatably
5 only in the casing cover (3) at the other end of the rotor.

7. A structure according to any of the preceding claims characterized in that the vanes(10) slide in contact with the cam rings(14) or the discs (12) with the side of a recess(18), which is directed towards the rotor axis(5),
10 said recess being provided in the vanes 10 inside of the outer periphery of the rotor (8).

8. A structure according to any of claims 3 to 5, characterized in that the vanes(10) at their ends directed towards the rotor axis(5) have inside the outer periphery of
15 the rotor at the ends directed to the casing covers(3) a recess(19) at least partially surrounding the cam ring (14).

9. A structure according to any of the preceding claims characterized in that parts(20) of the vanes(10) directed towards and guided by the control or cam means(12, 14 or
20 17) are wider than the thickness of the remainder of the vane bodies.

10. A structure according to any of the preceding claims characterized in that between the ends of the rotor(8) and the casing covers (3) inside the outer periphery of the
25 rotor (8) sealing rings(21) of wear-resistant and/or self-lubricating material are present between the vanes.

11. A structure according to claim 10 characterized in that sealing between the ends of the rotor(8) and the casing covers (3) is obtained by wedged shaped segmental plates (22) of
30 wear-resistant and/or self-lubricating material between the vanes (10), the ends of the segments (22) resting against the vanes (10), which segments(22) are supported in an annular chamber (23) provided concentrically in the end wall of the rotor (8), there being resilient means(24) to urge the segments
35 (22) into contact with the adjacent casing cover(3).

12. A structure according to claim 10, characterized in that the sealing between the ends of the rotor(8) and the casing covers(3) is obtained by a circular disc(25) of wear-resistant and/or self-lubricating material taken up in
5 a circular chamber(26) being provided concentrically in the end wall of the rotor(8), the disc being interrupted by slots (27) forming elongations of the slots (9) for the vanes in the rotor body (8) and having a central circular opening (28) for passage of the rotor axis(5), the disc (25) being urged out-
10 wardly against the adjacent casing cover(3) by resilient means (24).

13. A structure according to claim 10 characterized in that the sealing between the ends of the rotor(8) and the casing covers (3) is obtained by a cap-shaped member (29) engaging with a sliding fit around and over one end(30) of the
15 rotor (8), which end(30) has a smaller diameter than the rotor body so that the outer diameters of the cap-shaped member(29) and the rotor body are equal, said cap(29) being urged by resilient means (24) away from the rotor body, there being one
20 or more guide means (31) to prevent rotation of the cap-shaped member (29) with respect to the rotor (8).

14. A structure according to claim 10 characterized in that the sealing between the ends of the rotor(8) and the casing covers (3) is obtained by an annular member(32) of wear-
25 resistant and/or self-lubricating sealing material, provided at the side of the rotor with corresponding recesses(33) for allowing passage of the vanes(10), said member(32) being in part taken up in an annular chamber (34) being concentrically provided in the end wall of the rotor (8) and said member(32)
30 being at its other side rotatably taken up in a corresponding annular chamber (35) in the casing cover (3).

15. A structure according to claim 10 characterized in that the rotor (8) at at least one end has a protruding annular part protruding axially outside the vanes (10) and
35 rotatably taken up in a chamber (37) in the casing cover(3), there being between the end wall of the rotor(8) and the chamber (37) in the casing cover (3) resilient sealing means (38)

or grease of high viscosity.

16. A structure according to claim 10, characterized in that the vanes (10) at their sides directed towards the casing covers (3) have a slot-shaped recess (41) over their entire length, in which a strip (42) of wear-resisting and/or self-lubricating sealing material is taken up with a sliding fit, there being resilient means (43) to urge the strip (42) outwardly against the adjacent casing cover (3).

17. A structure according to claim 10 characterized in that the vanes (10) at their side directed towards the inner wall (2) of the casing (1) are provided over their entire length with a slot-shaped recess (44) in which a strip (45) of wear-resisting and/or self-lubricating sealing material is taken up, there being resilient means (46) to urge the strip (45) outwardly towards the inner wall (2) of the casing (1).

18. A structure according to claims 16 and 17 characterized in that the slot-shaped recess (41) at the sides of the vanes directed towards the casing covers (3) and the recess (44) at the side of the vanes directed to the inner wall (2) of the casing (1) together constitute a continuous slot-shaped recess (47), a strip (48) of wear-resistant and/or self-lubricating material being taken up with a sliding fit between the sealing strips (42) adjacent the casing covers (3).

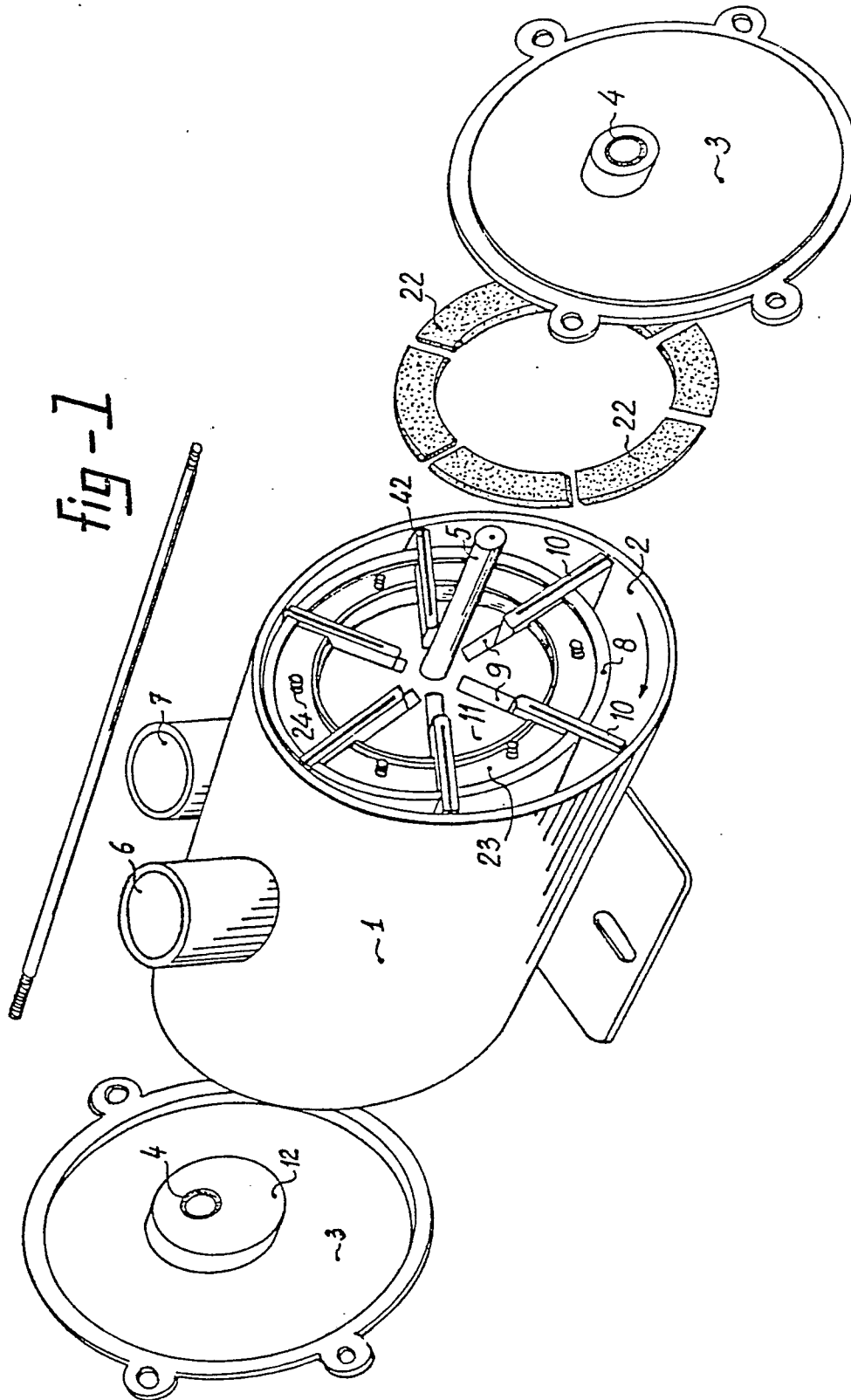
19. A structure according to claim 18, characterized in that in the continuous slot-shaped recess (47) in the vanes (10) two sealing strips (49) in the shape of a carpenter's square are taken up having their adjacent ends near the inner wall of the casing (2) in mutually overlapping relationship with local thinner strip parts (50).

20. A structure according to claims 18 and 19 characterized in that the sealing strips (42) and (48) or (49) at the three sides of the vanes are under an outwardly directed resilient pressure by a single U-shaped spring (51) of resilient wire or leaf material having an outwardly directed curve in the sides directed towards the casing covers (3) and having two outwardly directed curves in the part directed towards the inner wall (2) of the casing.

21. A structure according to claim 18 characterized in that the U-shaped spring (51) has hooked ends (52), which hooks engage behind the ends of the strips (42) directed towards the rotor axis (5).

5 22. A structure according to any of the preceeding claims applied as pump, characterized in that in the circular-cylindrical casing (1) between inlet and outlet there are openings (53) and (54) mutually connected by a closed passage (55) and positioned so that between the in- and outlet
10 openings and these openings (53) and (54) there is always at least one vane.

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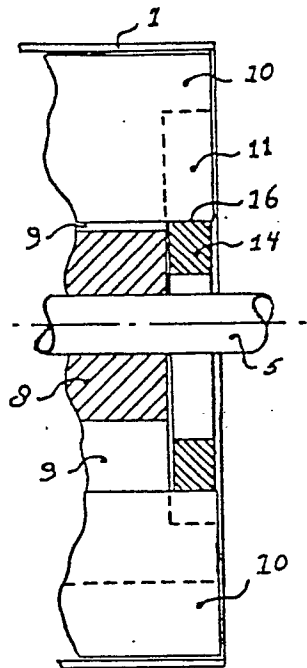


Fig. 2

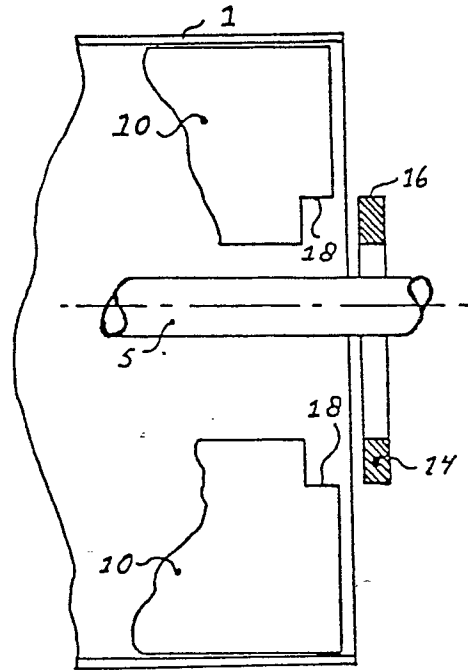


Fig. 3

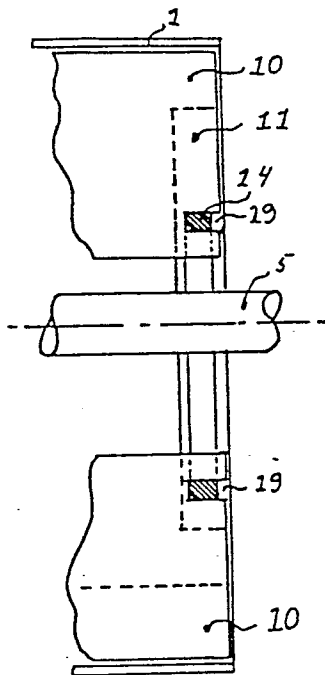


Fig. 4

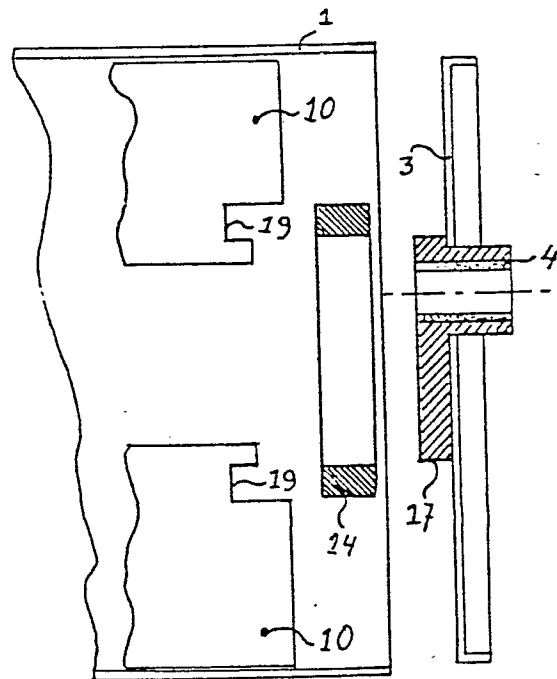


Fig. 5

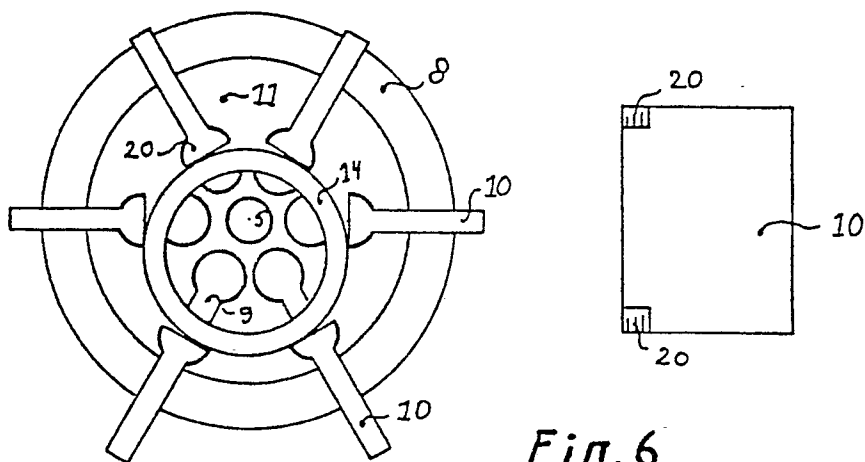


Fig. 6

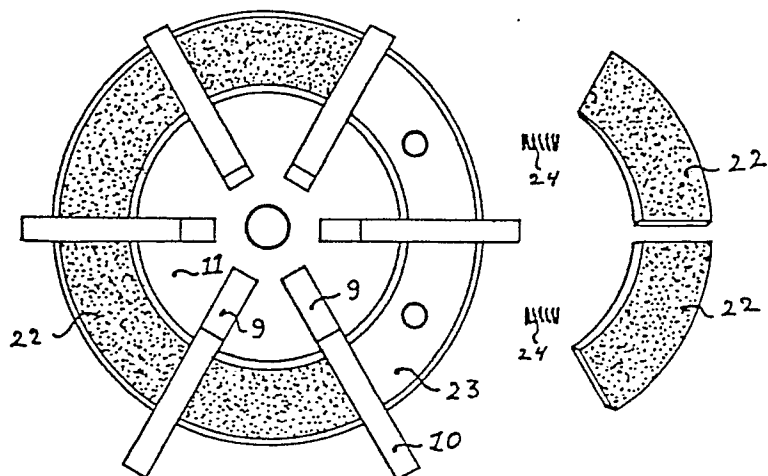


Fig. 7

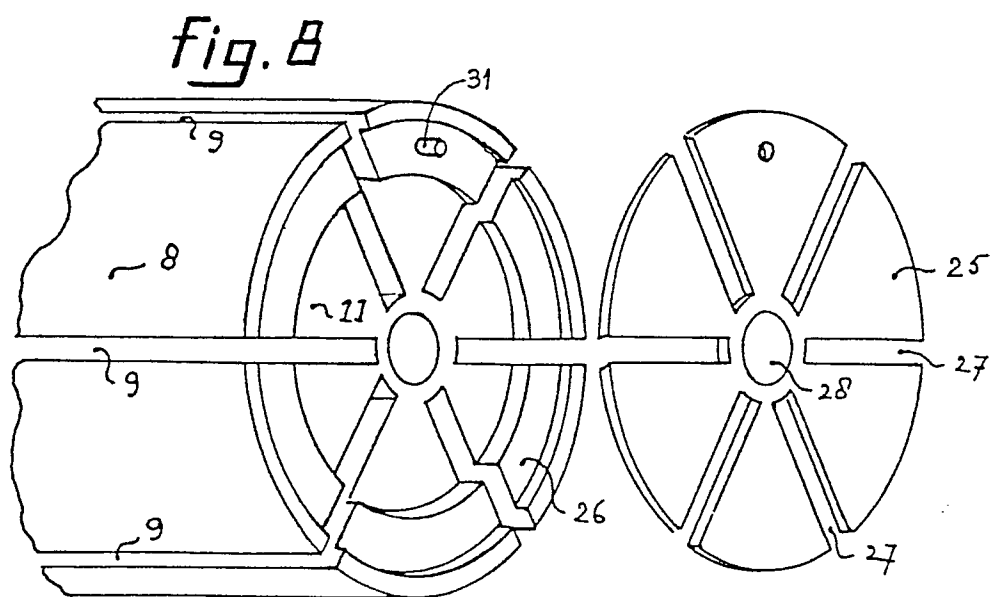
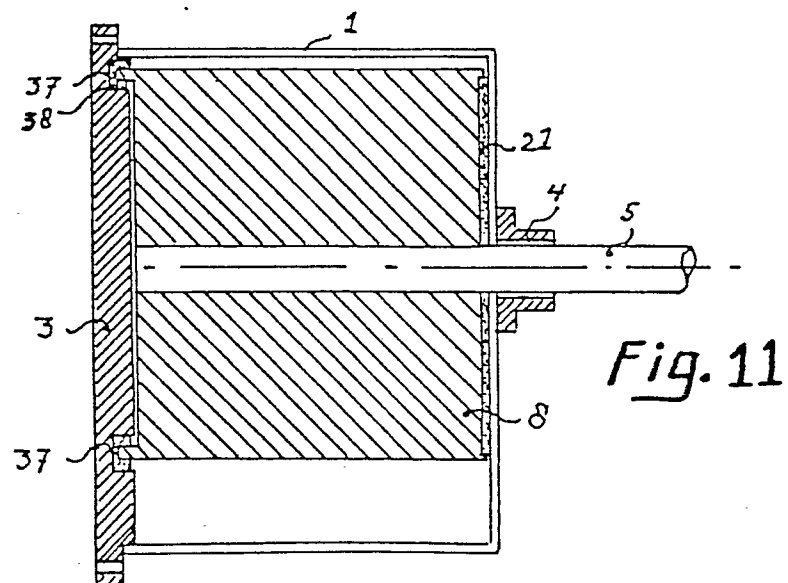
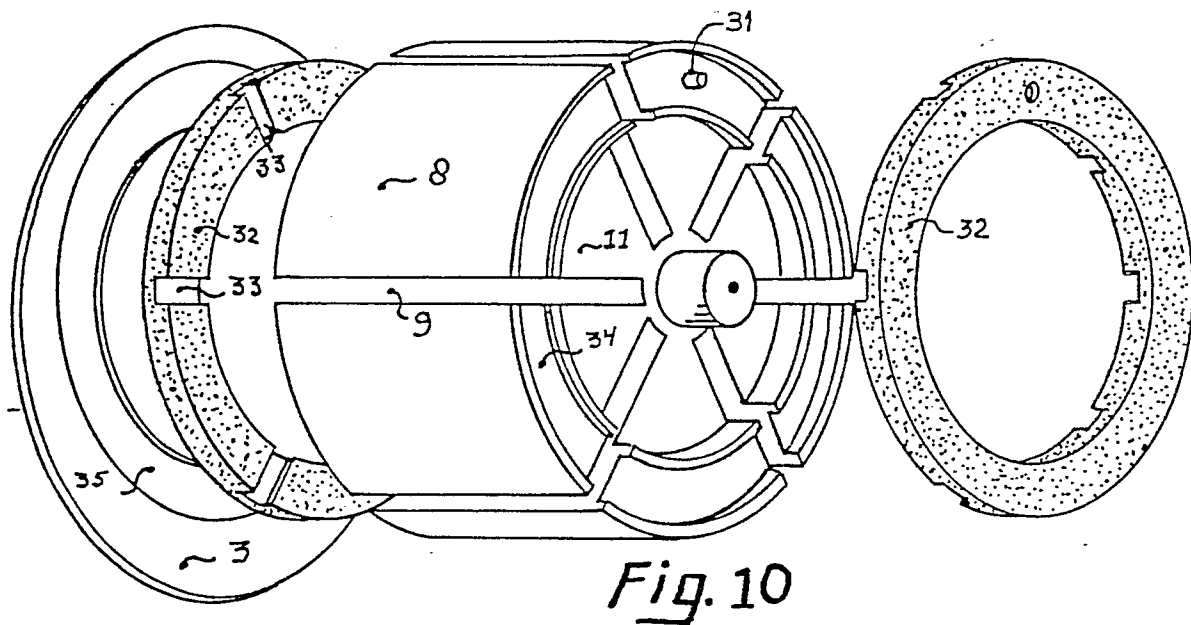
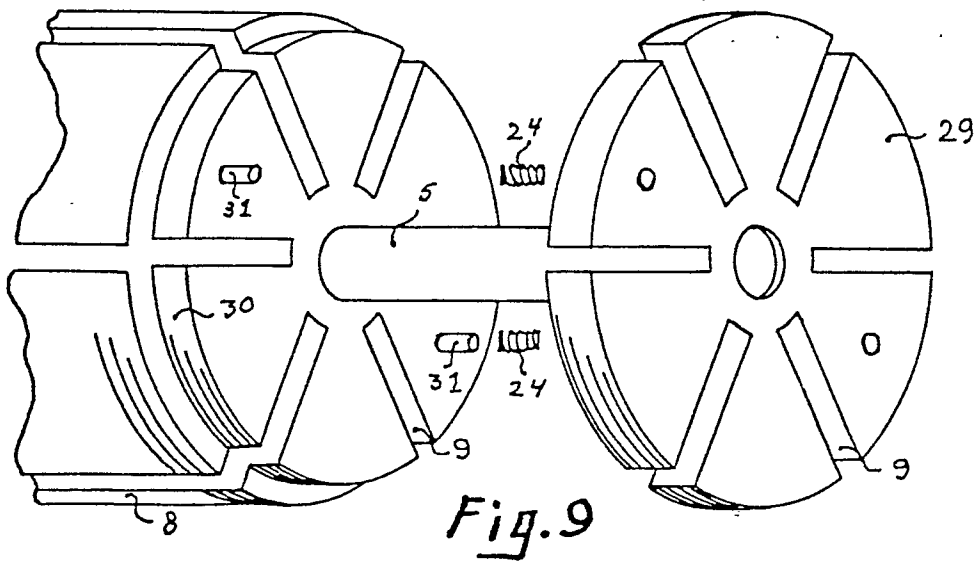


Fig. 8



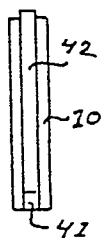


Fig 13

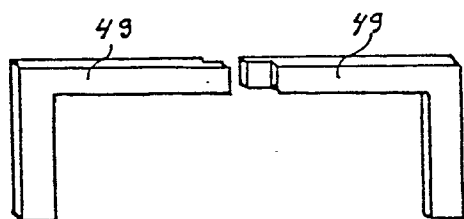
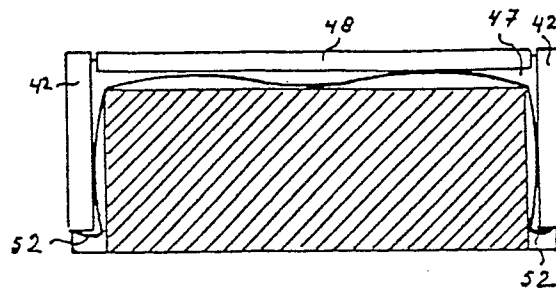


Fig 14

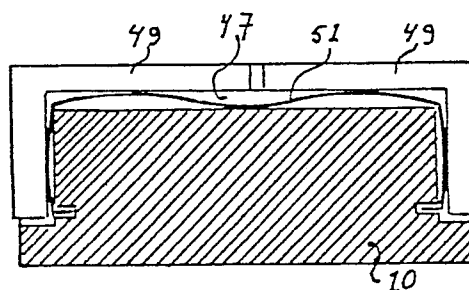


Fig 15

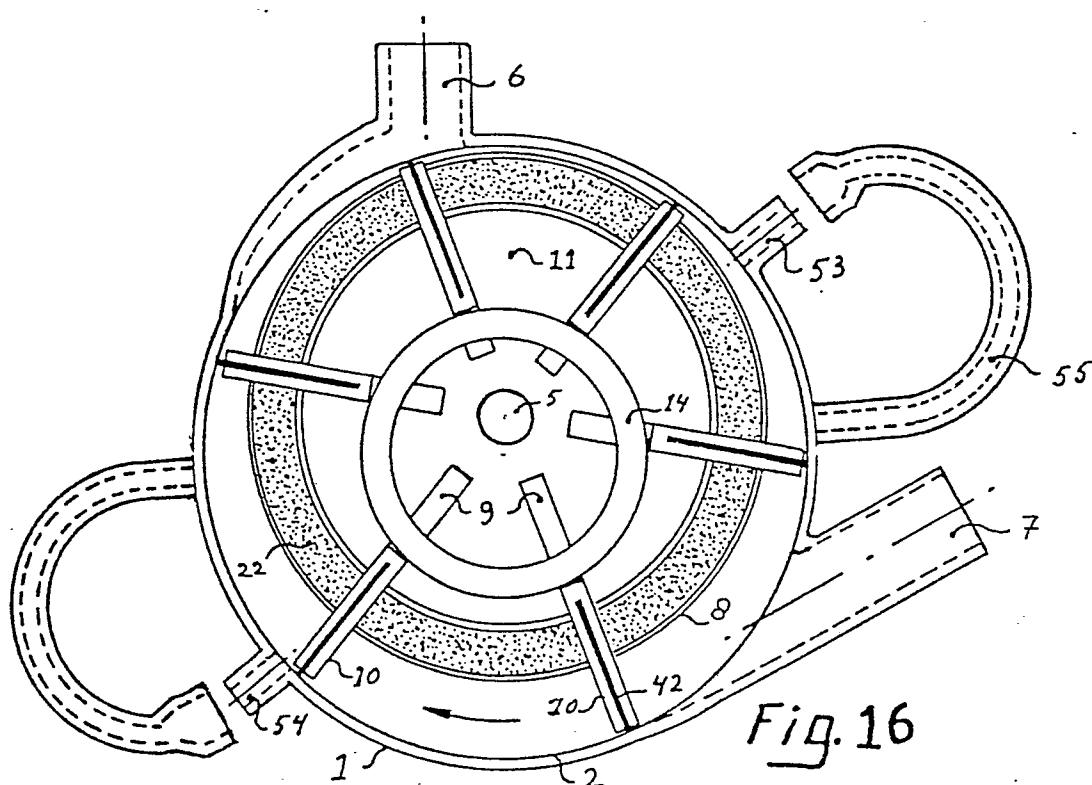


Fig. 16



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EUROPEAN SEARCH REPORT

0058456

Application number

EP 82 20 0165

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X	US - A - 2 311 162 (DU BOIS) * page 2, left-hand column, lines 49-59; figures 2,4,6 * ---	1,2,4	
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X	FR - E - 22 604 (MALLARD) * page 1, 2 last paragraphs; page 2, 2 first paragraphs; figures * ---	1,4,5,6,8	
X	FR - A - 498 952 (HENRY) * page 2, line 13 to the end of the page; figures 1,2 * ---	1-4,6,8	CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons
Y	US - A - 2 672 282 (VAZQUEZ) * column 2, last paragraph; figures 3,6,8,11 * ---	1,2,3,6,9,10	
☒ The present search report has been drawn up for all claims			&: member of the same patent family, corresponding document
Place of search		Date of completion of the search	Examiner
The Hague		01-06-1982	KAPOULAS



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0058456

Application number

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