(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 159 968**
A2

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **85830096.5**

(22) Date of filing: **22.04.85**

(51) Int. Cl.⁴: **F 04 C 18/344**

(30) Priority: **24.04.84 IT 5330484 U**
17.12.84 IT 5417884 U

(43) Date of publication of application: **30.10.85**
Bulletin 85/44

(84) Designated Contracting States: **DE FR GB SE**

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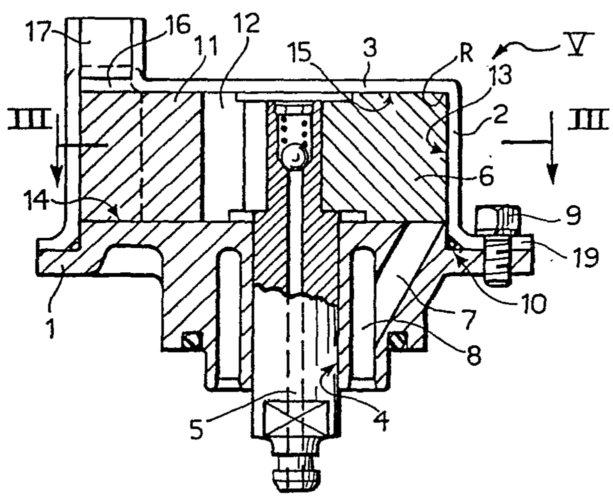
(54) Pneumatic vane pump with body of stamped sheet-metal.

(57) In a pneumatic vane pump of known type, the outer casing is formed from a cast support (1) and a cylindrical body (2) of stamped sheet metal which constitutes the cylindrical seat for the rotor (6), with a consequent notable reduction in cost compared to the conventional solution with a cast cylindrical body.



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Pneumatic vane pump with a stamped sheet metal body

The present invention relates to a pneumatic vane pump of the type comprising:

- a rotor carrying the vanes and rotating in a cylindrical seat about an axis different from that of the seat itself,
- an outer casing in which the cylindrical seat is formed,
- inlet and outlet openings and unions for the air.

Pumps of this type are commonly used on diesel engines for motor vehicles to create the low pressure needed to work vacuum-operated users including, for example, the servobrakes.

Generally, such pumps have a cast outer casing closed by a cover which may also be cast or formed from sheet metal of sufficient thickness.

Such solutions present no particular problems but are rather expensive, particularly because of the outer casing which requires rather complicated manufacturing equipment and rather long working times.

The object of the present invention is to find a type of construction which simplifies the working with less complicated equipment, shorter times, and lower overall costs.

This object is achieved by the invention in that the outer casing of the pump is constituted by (a) a cylinder of drawn sheet metal closed at one end by a base formed directly by the drawing of the cylinder itself, and (b) a support fixed to the motor and carrying the seat for rotation of the spindle of the rotor, a main flange which closes the cylinder and against which an end face of the rotor slides, the outlet ducts and openings for the air and the lubricating oil for the pump, and a second flange against which the stamped sheet metal cylinder bears and to which it is fixed.

With this solution, the working of the cylindrical seat of the pump is eliminated since it is made by stamping; the costs of the pump and the casting are thus reduced in that casting is limited only to the flanged support which is easy to cast and work, and the equipment needed for mass-production is simplified.

Further advantages and characteristics of the pneumatic vane pump of the invention will become clear from the detailed description which follows with reference to the appended drawings, provided purely by way of non-limiting example, in which:

- Figure 1 is a longitudinal section of the pump with the air inlet opening and union located at its base,

- Figure 2 is a partially sectioned side view of the pump with the air inlet opening and union located in correspondence with the support,

- Figure 3 is a section taken on the line III-III of Figure 1,

- Figure 4 is a partially sectioned view of a detail of Figure 2 on an enlarged scale,

- Figure 5 is an enlarged detail of Figure 1, and

- Figures 6, 7 and 8 show in detail different types of fixings of the cylinder to the support from those illustrated in Figure 1 and Figure 2.

With reference to the drawings, the outer casing of the pump is constituted by a support 1 and a cylinder 2 having a base 3. The support 1 carries a seat 4 for rotation of the spindle 5 of the rotor 6, as well as outlet ducts 7 and 8 for the air and lubricating oil.

The cylinder is fixed to the support by screws 9 and a rubber ring 10 ensures sealing from the exterior.

The vanes 11 are housed in grooves 12 in the rotor and slide against the iner surface 13 of the cylinder 2, against the flange 14 of the support and against the inner face 15 of the base 3. As shown in Figure 1, the air inlet slot 16 and union 17 are formed in the base 3.

Figure 2 illustrates another arrangement of the air inlet opening and union, in which the support 1 includes an air inlet duct 16a and a seat 17a for an air inlet union 28. The union 28 incorporates a non-return valve constituted by a sleeve 29, preferably of plastics material, having an outer end 30 for attachment of the air inlet pipes and an inner portion 31 provided at its end with an apertured flange on which a rubber washer 32 bears. The washer 32, urged by the pressure difference existing between its two faces, prevents air from returning towards the inlet when the pressure of the air drawn in is less than that of the air in the pump.

It is known that, in a vane pump, when the number of vanes is increased, the compression or expansion ratio increases and the flow rate also increases slightly.

Going from four to five vanes, the ratio increases by about 40% and the flow rate by 3%.

It is possible to use these characteristics to compensate for the loss of air through leakage, which is sometimes greater in a pump according to the invention than in conventional pumps in which the working tolerances for the cylindrical seat and the sliding flanges are stricter, these being made by working with tools instead of by stamping.

Figure 3 shows just such a rotor with five vanes.

Figure 5, however, illustrates a device which may be used to simplify the formation of the vanes and improve the delivery of the pump.

The drawing of the cylinder 2 in fact usually requires a radius R at the junction between the base 3 and the cylindrical wall 2, the value of which must not fall below a certain limit, generally equal to the thickness of the sheet metal. Clearly, the vanes 11 must be rounded with the same or a slightly greater radius at their corners which slide against the junction.

On the opposite side, however, where there is no junction between the flange 14 of the support and the wall 2 of the cylinder, the vane 11 must have a sharp corner.

Apart from the difficulty of ensuring the constancy of the radius R in stamped cylinders, errors could arise during assembly of the pump, whereby the vanes could be mounted upside down with the corner in correspondence with the junction. In such a case, a passage for the air in correspondence with the flange 14 of the support would be forcibly created and left, with a resulting loss in volumetric efficiency.

This disadvantage can be avoided by reducing the radius R through a coining or partial blanking operation on the base 3, obtaining a form of the type illustrated in Figure 5. With this operation, which can be simultaneous with or follow the drawing of the cylinder, the radius R may even be completely eliminated. In some cases, a small gap 18 may remain between the walls of the cylinder 2 and the base 3 which is so small, however, of the order of a tenth of a millimetre, as not to affect the operation of the pump. This gap has been shown artificially large for greater clarity in Figure 5.

Again, in order to reduce the costs of the pump, the rotor 6 may be constructed from plastics material with a suitable choice of the material and the incorporation of the spindle 5 during moulding. Thus, the working of the latter, which does not require precise tolerances in the portion of coupling with the rotor, is simplified.

The fixing of the cylinder 2 onto the support 1 may be effected in the conventional manner shown in Figures 1 and 3, that is, by clamping the flange 19 of the cylinder 2 to the support 1 by screws 9 or other simpler means.

Figure 6 shows a particular fixing solution wherein the support 1 has a groove 20 for the insertion of the cylinder 2 which has a small flange 21 to which the outer edge 22 of the groove 20 is rivetted. The sealing ring 23 ensures sealing between the cylinder 2 and the support 1.

Figure 7 shows a different fixing solution: the support 1 has two grooves 24 and 25 and a flange 26. A rubber ring is housed in the groove 24 to effect sealing between the cylinder 2 and the support 1. The sheet metal cylinder 1 is brought into contact with the flange 26 and a sufficient number of portions of the end of its cylindrical wall are pressed into the groove 25 to ensure the connection.

Figure 8 shows a variant of the solution of Figure 7, in which the sheet metal is cut and forced into the groove 27 instead of being pressed.

Naturally, the constructional details of the device may be varied from those described and illustrated by way of non-limiting example, in order to improve its operation and make it even cheaper, without thereby departing from the scope of the present invention.

CLAIMS

1. Pneumatic vane pump of the type comprising:

- a rotor (6) carrying the vanes (11) and rotating in a cylindrical seat about an axis different from that of the seat itself,

- an outer casing in which the cylindrical seat is formed,

- inlet and outlet openings and unions (7, 8, 16, 17; 16a, 17a) for the air,

characterised in that the outer casing is constituted by (a) a cylinder (2) of drawn sheet metal closed at one end by a base (3) formed directly by the drawings of the cylinder itself, and (b) a support (1) fixed to the motor and carrying the seat (4) for rotation of the spindle (5) of the rotor (6), a main flange (14) which closes the cylinder (2) and against which an end face of the rotor (6) slides, the outlet ducts and openings (7, 8) for the air and the lubricating oil for the pump, and a second flange against which the stamped sheet metal cylinder (2) bears and to which it is fixed.

2. Pneumatic vane pump according to Claim 1, characterised in that the air inlet opening and union (16, 17) are located in correspondence with the base (3).

3. Pneumatic vane pump according to Claim 1, characterised in that the air inlet opening and union (16a, 17a) are located in correspondence with the support (1).

4. Pneumatic vane pump according to Claim 3, characterised in that the air inlet union (17a) is constituted by an element (28) formed in the casting of

the support (1) and incorporating the non-return valve (31, 32) of the pump.

5. Pneumatic vane pump according to any one of the preceding claims, characterised in that the base (3) of the sheet metal cylinder (2) is pressed down towards the interior of the cylinder so as to eliminate entirely or reduce to several tenths of a millimetre the radius (R) at the junction between the base (3) and the cylindrical wall (2), the pressing down being effected by a coining or partial blanking operation.

6. Vane pump according to any one of the preceding claims, characterised in that the number of vanes (11) is greater than four, so as to increase the expansion or compression ratio of the pump and thus compensate for the larger working tolerances due to the making of the cylindrical seat by stamping.

7. Pneumatic vane pump according to any one of the preceding claims, characterised in that the cylinder (2) is fixed to the support (1) by a flange (19) on the cylinder itself and by connecting means constituted by screws (9), bolts or rivets.

8. Pneumatic vane pump according to any one of Claims 1 to 6, characterised in that the cylinder (2) is fixed to the support (1) by rivetting the outer edge (22) of a circumferential groove (20) formed on the flange (14) for sliding of the rotor (6) against a flange (21) provided on the cylinder (2) itself.

9. Pneumatic vane pump according to any one of Claims 1 to 6, characterised in that the support has two grooves

(24, 25) one of which houses a sealing ring and into the other of which the wall of the cylinder (2) is pressed along its entire circumferential extent or only some portions thereof, to ensure the connection of the cylinder (2) to the support (1).

10. Pneumatic vane pump according to Claim 9, in which the wall of the cylinder (2) is cut at several places and forced into the fixing groove (27) instead of being pressed.

FIG. 1

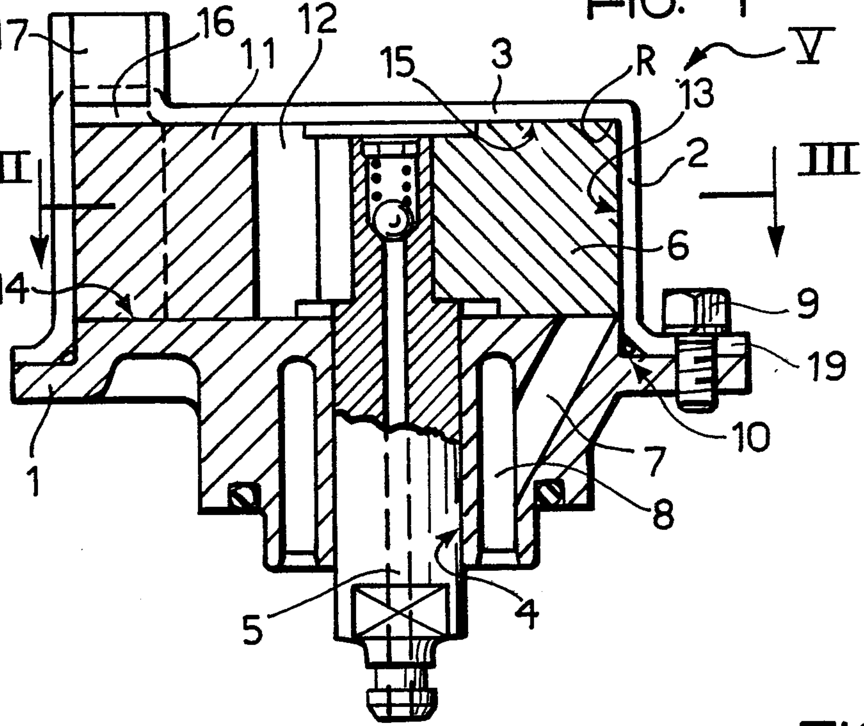

FIG. 2

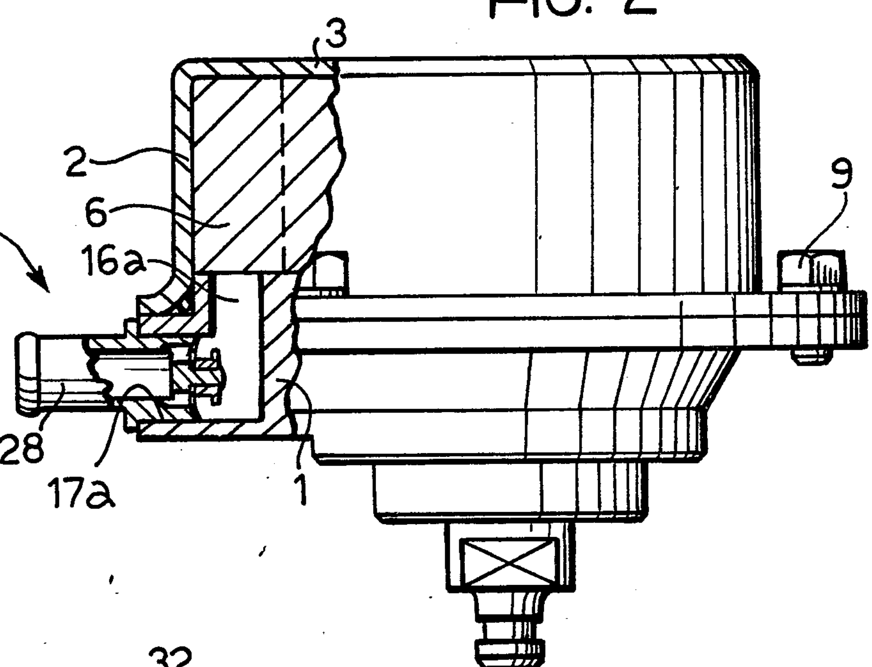

FIG. 4

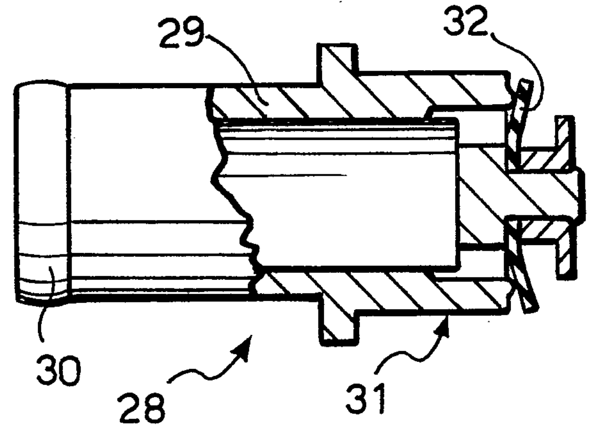

FIG. 3

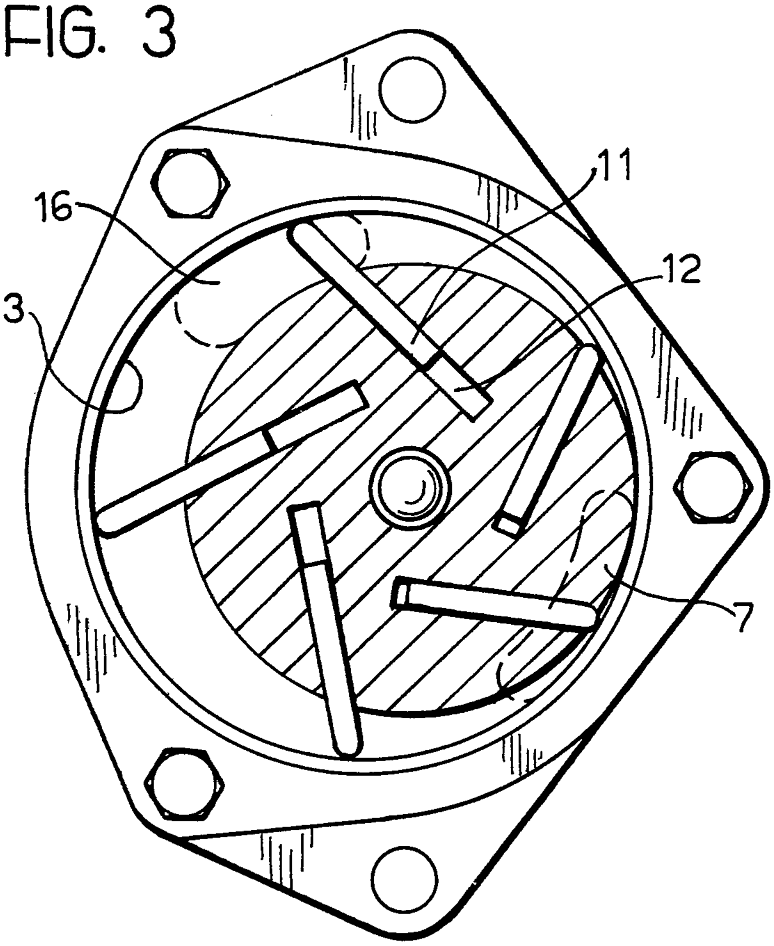

FIG. 5

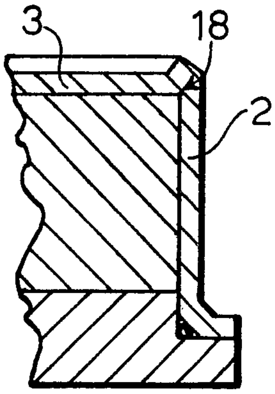

FIG. 6

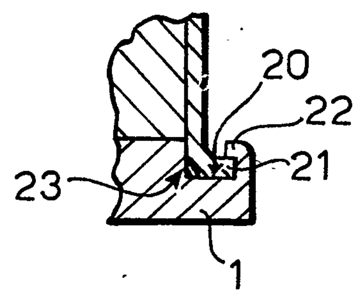

FIG. 7

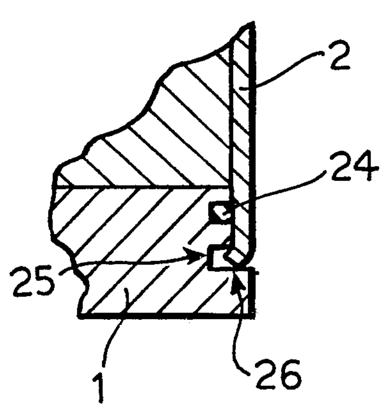

FIG. 8