June 19, 1956 E. STURM 2,750,895

ROTARY PUMP AND MOTOR HYDRAULIC TRANSMISSION

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Fig. 1

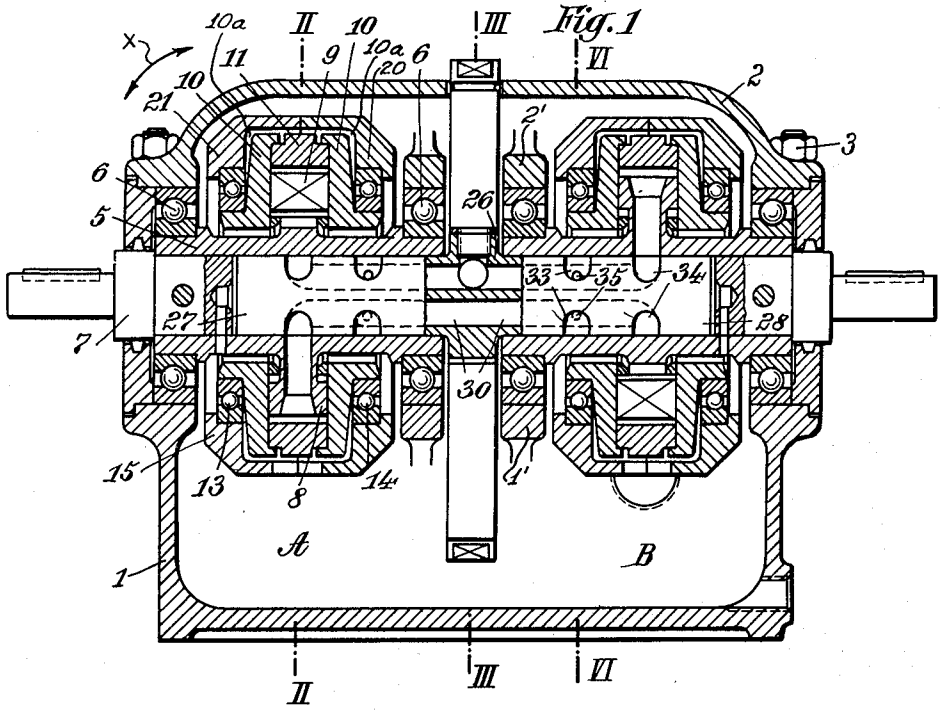
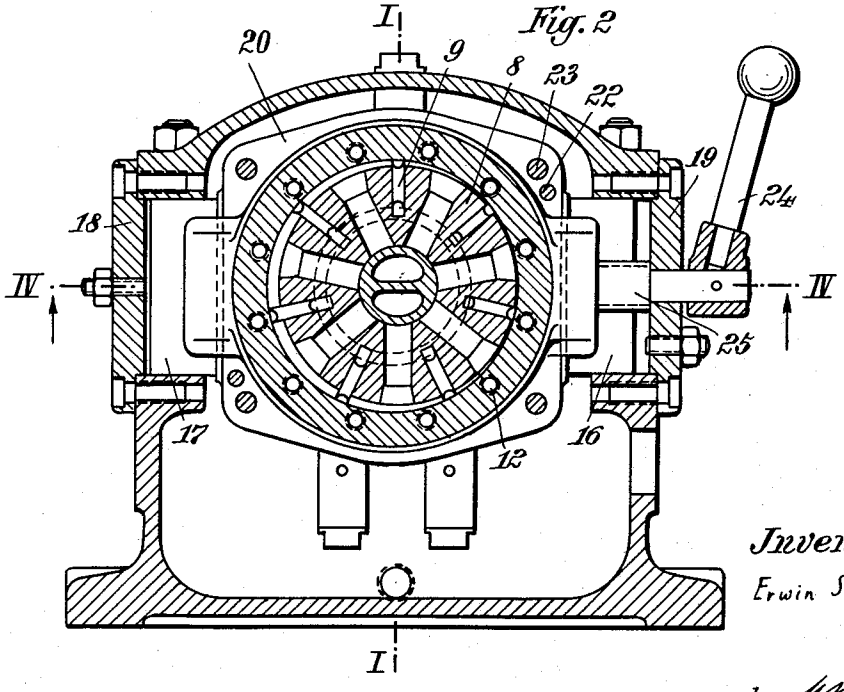


Fig. 2



Inventor:
Erwin STURM

by
Attorney

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Fig. 3

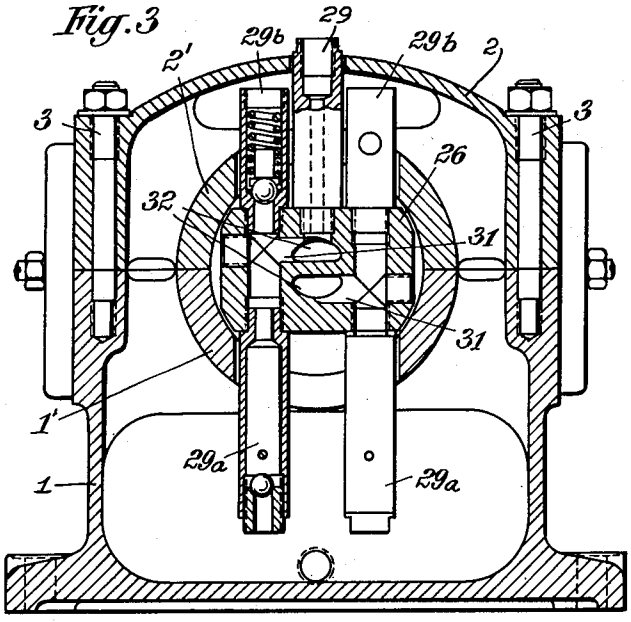


Fig. 6

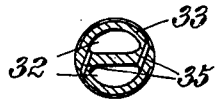


Fig. 4

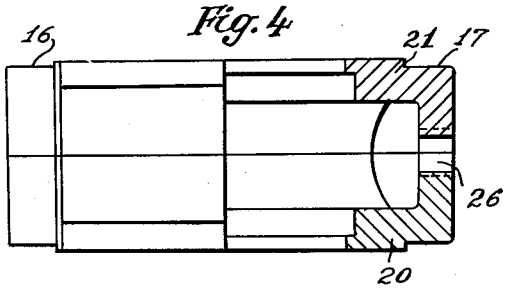
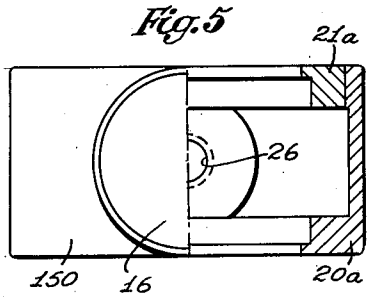


Fig. 5



Inventor:
Erwin STURM

by Yates & Finch
Attorney

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ROTARY PUMP AND MOTOR HYDRAULIC TRANSMISSION

Erwin Sturm, Boll near Goppingen, Germany

Application October 9, 1950, Serial No. 189,207

Claims priority, application Sweden October 14, 1949

12 Claims. (Cl. 103—120)

This invention relates to rotary machines, and more particularly to rotary machines having at least one vane drum with a plurality of vanes mounted therein, and having a casing enclosing the same.

Preferably rotary machines of this kind are used for hydraulic drives wherein two rotary machines are hydraulically coupled with each other, one of said hydraulic machines being employed as a pump, the other being employed as a motor. In hitherto known hydraulic drives of this type each casing enclosing a vane drum and the vanes mounted therein is carried my means of two ball bearings or roller bearings in a support, which, in turn may be adjusted eccentrically to the main axis of the drive. Unavoidable inaccuracies in the construction of the bearings cause non-uniform strains and friction losses in such known hydraulic drives. Efforts have been made to overcome such disadvantages by the use of additional means or by a preliminary setting of the drive on a testing stand. These efforts, however, proved to be unsatisfactory, as in the first instance, the manufacturing costs are increased, and in the second instance, the disadvantages may re-occur at intervals during the operation of the drive.

An object of the present invention is to overcome above mentioned disadvantages of hydraulic drives in a satisfactory manner.

Another object of the present invention is to improve on the art of rotary machines as now ordinarily made.

Other objects and structural details of the invention will be apparent from the following description when read in conjunction with the accompanying drawings forming part of this specification, wherein:

Fig. 1 is a vertical sectional view of a hydraulic drive according to the invention, taken on line I—I of Fig. 2;

Fig. 2 is a sectional view of the hydraulic device, taken on line II—II of Fig. 1;

Fig. 3 is a sectional view of the hydraulic drive taken on line III—III of Fig. 1;

Fig. 4 is a top plan view, partly in section along line IV—IV of Fig. 2, of the support of the casing enclosing the vane drums, and

Fig. 5 is a side elevational view, partly in section, of another embodiment of a support of the casing.

Fig. 6 is a sectional view of the guide shaft taken on line VI—VI of Fig. 1.

Referring now to the drawings, the housing of the hydraulic drive comprises a lower portion 1 and an upper portion 2 connected with each other by a plurality of bolts 3. As best shown in Fig. 3, the line of separation between said two portions 1 and 2 of the housing is in the same horizontal plane as the main longitudinal axis of the drive. As best shown in Fig. 1, the hydraulic drive has two equal component parts, one of which is employed as a pump, the other as a motor. These component parts are connected with each other in a manner known per se by conduits extending through the guide shaft 4. Each component part includes a vane drum, the hub 5 of which encircles the associated end or bearing portion of the guide shaft 4; each vane drum is rotatably

mounted in the housing 1, 2 by means of ball bearings 6. The inner ball bearings 6 are engaged with semicircular lugs 1' and 2' arranged on the lower and upper portions 1 and 2 respectively of the housing. The input- or output-stud 7 is connected with the hub 5 by a pin or the like in a manner known per se. The wheel-like portion 8 of the vane drum receives the vanes 9 in a manner known per se. According to the embodiment shown in the drawings, the vane drum of each component part is provided with seven vanes 9. A casing comprising two front covers 10 and a jacket 11 rigidly connected with each other by bolts 12 enclose the vane drum and the vanes arranged therein. A ball bearing 13 or 14, respectively, is arranged between each front cover 10 of the casing and a support 15. The inner races of said ball bearings 13 and 14 snugly fit on the hubs of the casing 10, 11, while the outer races of said ball bearings snugly fit into the recesses of the suport 15. According to the invention, said support 15 is provided with two journals 16 and 17 (see Fig. 2) inserted into apertures of the housing closed by covers 18 and 19. Furthermore, as best shown in Fig. 1, the outer surfaces of the covers 10, beyond their contact with the inner races of the ball bearings 13, 14, are of conical shape, while the inner surfaces of the support 15 are in a plane perpendicular to the longitudinal axis of the vane drum, whereby spaces increasing in width towards the circumference of the casing 10, 11 are formed between the covers 10 and the inner walls of the support 15. Therefore, the support 15 being rockably mounted in the housing 1, 2 by the journals 16, 17 (Fig. 2) may perform oscillations in the direction of the double arrow X (see Fig. 1) about an axis of rotation determined by the line of intersection between the horizontal center plane located in the axis of the vane and a vertical center plane located centrally with reference to the ends of the vane drum.

The support 15 is in the shape of a box surrounding the casing 10, 11, the lateral inner surfaces of said box-like supports 15 being in planes perpendicular to the axis of rotation of the vane drum and forming in conjunction with the lateral surfaces of the casing 10, 11, facing same, the above mentioned space 10*a* increasing in width towards the circumference of the casing.

According to the embodiment shown in Figs. 1 to 4, said support 15 of the casing 10, 11 comprises two symmetrical halves 20 and 21 connected with each other by set pins 22 and bolts 23. The cylindrical journals 16 and 17 are integral with the associated support 15 of the casing 10, 11.

Fig. 5 illustrates a different embodiment of a support 150 of the casing 10, 11, seen in the direction of the axis of rotation of said support; the left hand portion of Fig. 5 is a side elevational view and the right hand portion of Fig. 5 is a vertical central sectional view of said support. Again, the support 150 is in the shape of a box 20*a*, one side wall of said box 20*a*, however, being formed by a detachable ring 21*a*. The support 150 may be swingably mounted in the housing 1, 2 by means of journals 16 and 17 arranged at diametrically opposite portions of said box.

In order to adjust the support 15 of the casing 10, 11 eccentrically to the main axis of the drive, the threaded end of a spindle 25 rotatably arranged in a bore of the cover 19 and provided with a setting handle 24 is engaged with a threaded bore of said support 15. Thus, the support 15 may be displaced by a rotation of the handle 24 along an axis of adjustment identical with above described axis of rotation of said support.

A more detailed description of the construction and arrangement of the guide shaft in the machine can be found at the end of this description.

According to the embodiment shown in Fig. 5, the support 150 capable of carrying the casing enclosing the vane drum of the hydraulic drive is in the shape of a shell 20*a* having a removable annular cover 21*a* inserted therein.

Owing to above described oscillatable mounting of the support 15 or 150 in the housing of the machine inaccuracies in the construction of the ball bearings 13 and 14, or differences of pressure between the ball bearings 13 and 14 are automatically compensated for by a corresponding inclination of the support 15 or 150. Thus a uniform bearing action of the ball bearings 13 and 14 is obtained whereby friction losses are reduced to a minimum and a special oil cooling arrangement may be dispensed with.

Moreover, as the axis of the oscillating journals is in the same horizontal plane as the line of separation between the lower and upper portions 1 and 2 of the housing of the machine, the assembly comprising the rotary parts of the machine together with the guide shaft inserted into the center bores of the vane drums may be readily mounted on the lower portion 1 of the housing.

Furthermore, the two-sectional construction of the support of the casing enclosing the vane drum contributes to an extremely high resistance of said support to bending strain. According to the embodiment shown in Figs. 1 to 4, the line of separation between the two sections 20 and 21 of the support 15 is in a plane of symmetry including the longitudinal axis of the oscillating journals 16 and 17, and being perpendicular to the axis of rotation of the vane drums of the machine. According to the embodiment shown in Fig. 5, the two sections of the support 150 comprise the shell 20*a* and the annular cover 21*a*.

The guide shaft 4 consists of a center piece 26 and bearing portions 27 and 28, respectively, into which the center piece continues axially at each of its sides, said center piece 26 is integral with said bearing portions 27 and 28. A connecting piece 29 carried by the center piece 26 passes through an aperture of the portion 2 of the housing 1, 2 of the drive, whereby the guide shaft 4 is prevented from rotation. Check valves 29*a* projecting into the oil chamber are arranged at the lower side of the center piece 26; one of said check valves 29*a* is associated with the suction conduit, the other one is associated with the pressure conduit. In a similar manner two safety valves 29*b* are arranged at the upper side of said center piece 26, one of said safety valves 29*b* being associated with the suction conduit, the other one being associated with the pressure conduit.

As best shown in Fig. 3, there is a clearance 30 between the ring portions 1', 2' of the housing 1, 2 and the center pieces 26, and connecting pieces 29, so that the center pieces and, consequently, the entire guide shaft may be radially displaced somewhat in the housing. The bearing portions 27 and 28, however, snugly fit into the bores of the vane drums without play. Therefore, the guide shaft may follow the radial movements of the vane drums caused by the bearing play of the ball bearings 6. Such construction permits a reduction of the hitherto customary tolerances between the guide shaft and the bores of the hubs of the vane drums by the amount of the entire bearing play of the ball bearings of the vane drums.

The connecting pieces 29 communicate with the suction- and pressure-conduits 32 through bores 31 extending transversely through the center piece 26 of the guide shaft 4.

In order to obtain a pressure relief, the bearing portions 27, 28 of the guide shaft 4 are provided with arcuate shallow recesses 33 corresponding, with respect to area, to the openings of the suction- and pressure-conduits 32. As best shown in Fig. 6, each of the recesses 33 is connected with the opposite conduit 32 by means of a bore 35, so that the pressure in the opposite conduit is led to the associated recess. This arrangement of surfaces of pressure relief is a contributing factor to a reduction of the friction between the guide shaft and the vane drums to a minimum.

Preferably, oil is used as driving medium for the hydraulic drive described above. The operation of hydraulic drives of this kind is known, so that a detailed description thereof is unnecessary.

The construction according to the invention may also be applied to drives equipped with pumps with rotating pistons.

I have described a preferred embodiment of my invention, but it is understood that this disclosure is for the purpose of illustration and that various omissions or changes in shape, proportion and arrangement of parts, as well as the substitution of equivalent elements for those herein shown and described, may be made without departing in any way from the spirit and scope of the invention as set forth in the appended claims.

What I claim is:

1. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support, journals arranged on said support at opposite sides thereof, said journals being axially displaceably and oscillatably mounted in said housing, a pair of bearings on said support, said casing being rotatably mounted in said bearings of said support, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment realtive to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising two sections detachably connected with each other, the line of separation of said two sections being in a plane of symmetry including the longitudinal axis of said journals and being perpendicular to the axis of rotation of said vane drum.

2. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support, journals arranged in said support at opposite sides thereof, said journals being integral with said support and being axially displaceably mounted in said housing, a pair of bearings on said support, said casing being rotatably mounted in said bearings of said support, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment releative to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising two sections detachably connected with each other, the line of separation of said two sections being in a plane of symmetry including the longitudinal axis of said journals and being perpendicular to the axis of rotation of said vane drum.

3. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support, journals arranged on said support at opposite sides

thereof, said journals being axially displaceably and oscillatably mounted in said housing, a pair of bearings on said support, said casing being rotatably mounted in said bearings of said support, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment relative to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising a shell-like body and a covering element detachably mounted on the latter.

4. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support, journals arranged on said support at opposite sides thereof, said journals being axially displaceably and oscillatably mounted in said housing, a pair of bearings on said support, said casing being rotatably mounted in said bearings of said support, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment relative to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising a shell-like body and an annular cover detachably mounted on the latter.

5. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support movably mounted in said housing, said support being in the shape of a hollow body enclosing said casing, a pair of ball bearings engaged with said support and said casing for a rotatable arrangement of said casing in said support, said casing and said support having respectively, side walls facing each other, said side walls diverging from said ball bearings towards the circumference of said casing so as to form spaces, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment relative to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising two sections detachably connected with each other.

6. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support movably mounted in said housing, said support being in the shape of a hollow body enclosing said casing, a pair of ball bearings engaged with said support and said casing for a rotatable arrangement of said casing in said support, said casing and said support having respectively, side walls facing each other, said side walls diverging from said ball bearings towards the circumference of said casing so as to form spaces, said support being displaceable along an axis of adjustment determined by the line of intersection between the horizontal plane located in the axis of said vane drum and a vertical center plane located centrally with reference to the ends of said vane drum, and adjusting means associated with said support for displacing same along said axis of adjustment for an adjustment of the eccentric position of said support relative to said vane drum, said support being rockable about said axis of adjustment relative to said casing for an automatic compensation for differences of pressure in said bearings during an operation of the machine, said support comprising two sections detachably connected with each other, journals rotatably mounted in said housing being arranged on said support, and the line of separation of said two sections being in a plane of symmetry including the longitudinal axis of said journals and being perpendicular to the axis of rotation of said vane drum.

7. In a rotary machine, the combination of: a housing, a vane drum including a series of vanes, said vane drum being rotatably mounted in said housing, a casing enclosing said vane drum with said vanes, a support, a pair of ball bearings on said support, said casing being rotatably mounted in said ball bearings of said support, journals arranged coaxially on said support so as to have a common axis, said journals supporting said support displaceably in said housing, the common axis of said journals being arranged perpendicularly to the axis of rotation of said vane drum, and adjusting means cooperating with said support for adjusting the eccentric position of said casing with respect to said vane drum, said casing and said support defining an axial clearance having a width allowing a lateral rocking of said support from the direction of displacement of said support enabling the compensation of the tolerances required for the manufacture of said ball bearings and the seats thereof, and a uniform loading of both said ball bearings.

8. In a rotary machine as claimed in claim 7, said casing having conically shaped side walls defining said axial clearance with said support.

9. In a rotary machine as claimed in claim 8, said support having side walls arranged in planes substantially perpendicular to the longitudinal axis of said vane drum and defining said axial clearance with said conically shaped side walls of said casing.

10. In a rotary machine as claimed in claim 7, said support being designed as a hollow body including two sections detachably connected with each other, the line of separation of said two sections being in a plane perpendicular to the axis of rotation of said vane drum, one of said two sections forming one piece with one of said journals.

11. In a rotary machine, the combination of: a central axial body having inlet and outlet conduits, a housing enclosing said axial body, suction and pressure conduits connected to said inlet and outlet conduits, a vane drum arranged in said housing for rotation about said axial body, said vane drum including a series of radial slots and radial channels, a series of vanes arranged in said radial slots of said vane drum so as to be displaceable with respect to the latter, a casing enclosing said vane drum with said vanes, said casing rotating freely and being displaceable with respect to said vane drum, said casing forming with said vane drum a variable crescent-shaped working chamber subdivided by said vanes into parts connected by said conduits in said axial body to said suction and pressure conduits, a support designed as a hollow body enclosing said casing, journals connected to said support and arranged perpendicularly to the axis of rotation of said vane drum, said journals supporting said support displaceably in said housing, a pair of ball bearings arranged between said support and said casing, a pair of outer races forming part of said ball bearings, respectively, first side walls forming part of

said support and adjoining said outer races towards the perimeter of said support, and second side walls forming part of said casing and being separated from said first side walls by a clearance having a width enabling, during operation of the machine, the compensation of the tolerances required for the manufacture of said ball bearings and the seats thereof, and a uniform loading of both said ball bearings.

12. In a rotary machine as claimed in claim 11, said support including two equal sections detachably connected with each other, the line of separation of said two sections being in a plane of symmetry including the longitudinal axis of said journals and being perpendicular to the axis of rotation of said vane drum, each of said sections forming one piece with the associated one of said journals.

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