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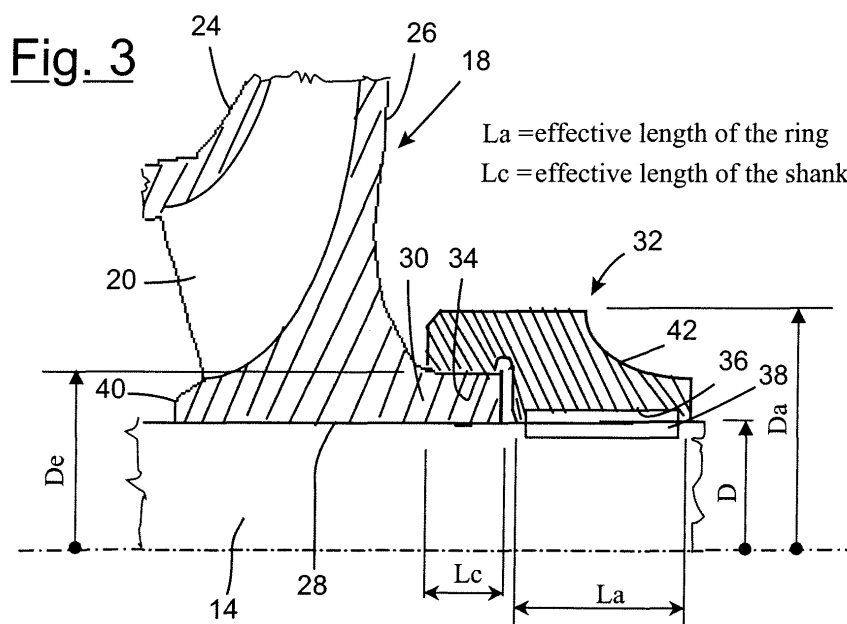
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(54) **Anchorage system for the rotors of a rotating fluid machine**

(57) An anchorage system is described for a rotor (18) of a rotating fluid machine (10). The rotor (18) has a profile which comprises a first front surface (24) substantially concave and a second rear surface (26) substantially convex, opposite to the first front surface (24). The rotor (18) also has a central portion (28), configured for being constrained with interference on a rotating shaft (14) of the machine (10) and equipped with a shank (30)

connected with the second rear surface (26). The system comprises at least one check ring (32) assembled by interference on the shank (30) of the rotor (18). The check ring (32) has a first internal circumferential surface (34), coupled by interference with the shank (30), and a second internal circumferential surface (36), coupled by interference with the shaft (14), to increase the torque which can be transmitted from the shaft (14) to the rotor (18).



Description

FIELD OF THE INVENTION

[0001] The present invention relates to an anchorage system for the rotors of a rotating fluid machine and, more specifically, to an anchorage system between a rotor and rotating shaft of a compressor of the centrifugal type.

BACKGROUND OF THE INVENTION

[0002] It is known that a compressor is a machine capable of raising the pressure of a compressible fluid (gas) with the use of mechanical energy. Among the various types of compressors used in industrial process plants, so-called centrifugal compressors can be mentioned, in which the energy is supplied to the gas in the form of centrifugal acceleration due to the rotation, generally driven by a driver (electric motor or vapour turbine), of an organ called rotor or turbine wheel.

[0003] Centrifugal compressors can be provided with a single rotor, in the so-called single-phase configuration, or with several rotors situated in series, in this case called multiphase compressors. More specifically, each phase of a centrifugal compressor normally consists of a suction duct for the gas to be compressed, a rotor, which is capable of providing the gas with kinetic energy, and a diffuser, whose function is to convert the kinetic energy of the gas leaving the rotor into pressure energy.

[0004] The rotors of centrifugal compressors are generally in the form of a disk in the central part of which there is a hub capable of supporting a varying number of vanes. The hub is equipped with a central pass-through hole which allows the rotor to be constrained, normally by wedging, to the rotating shaft of the centrifugal compressor.

[0005] One of the problems which arise with rotors of the known type, especially if made of light metallic alloys (for example aluminum) rather than steel in order to be able to operate with particular fluids, is maintaining a sufficient interference with the shaft during the functioning of the compressor. Maintaining an adequate interference between the rotor or rotors and the shaft during the functioning of the machine is in fact a necessary condition for maintaining the equilibrium of the rotor and transmitting the torque required by the work energy of the rotor itself, from the shaft to the rotor. This second aspect is above all particularly critical for rotors fitted onto the shaft. The radial dilation of the rotor hub, especially if made of an aluminum alloy, due to thermal dilation and also to the effect of centrifugal forces, is in fact extremely high with respect to the same end-products made of steel, consequently facilitating the total or partial loss of interference, and in any case insufficient for transmission of the torque.

[0006] In particular, rotors made of light aluminum alloy cannot be simply fitted onto the shaft, as these aluminum alloys have a low elastic modulus, which corresponds to a low rotor hub-shaft specific contact pressure and a high

thermal dilation coefficient, which causes a major loss in interference during the functioning of the rotor. At present, the only known application of rotors made of aluminum envisages their fitting onto the head of the shaft, i.e. at the end of the compressor shaft, where the centering system and transmission of the torque is extremely facilitated.

[0007] An objective of the present invention is therefore to solve the problems relating to the rotors according to the known art, by providing an anchorage system for the rotors of a rotating fluid machine and, more specifically, an anchorage system between a rotor and the rotating shaft of a compressor of the centrifugal type, suitable for guaranteeing the transmission of power by interference between shaft and rotor, especially in the case of the use of rotors made of aluminum alloys.

[0008] A further objective of the invention is to provide an anchorage system for the rotors of a rotating fluid machine which allows the assembly of rotors made of aluminum alloys also along the shaft of a compressor of the multiphase type and not only in correspondence with one of its ends, guaranteeing adequate centering and torque transmission.

[0009] These objectives according to the present invention are achieved by providing an anchorage system for the rotors of a rotating fluid machine as specified in claim 1.

[0010] Further details of the invention are indicated in the subsequent claims.

SUMMARY OF THE INVENTION

[0011] The characteristics and advantages of an anchorage system for the rotors of a rotating fluid machine according to the present invention will appear more evident from the following illustrative and non-limiting description, referring to the enclosed schematic drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

figure 1 is a partial sectional view of a generic multiphase centrifugal compressor, equipped with a series of rotors fitted onto the shaft between two supporting bearings;

figure 2 is a sectional schematic view of the anchorage system for the rotors of a rotating fluid machine according to the present invention; and

figure 3 is another sectional schematic view of the anchorage system for the rotors of a rotating fluid machine according to the present invention, in which some fundamental magnitudes are indicated.

DETAILED DESCRIPTION OF THE INVENTION

[0013] With reference in particular to figure 1, this

shows a generic centrifugal compressor, of the multiphase type, indicated as a whole with the reference number 10. The compressor 10 comprises a casing or stator 12 in which a shaft 14 is rotatably assembled, which rests on a series of supporting bearings 16. A series of rotors 18 is fitted onto the shaft 14, each of which equipped in turn with a series of circumferential vanes 20 having a substantially radial development. Channels or diaphragms 22 are situated on the casing 12, which allow the compressible fluid (gas) to be sent towards a first phase and, from this, to the subsequent phases to be then expelled, under pressure, from the compressor 10.

[0014] With reference to figure 2, this is a sectional view of a single rotor 18, preferably made of aluminum alloy and assembled on the shaft 14 with interference, analogously to what occurs with the more common steel rotors.

[0015] The rotor 18 has a profile which comprises a first front surface 24, substantially concave, and a second rear surface 26, substantially convex, opposite to the first front surface 24.

[0016] The central portion 28, commonly called "hub", of the rotor 18 and configured for being constrained with interference to the shaft 14 of the compressor 10, is equipped with a shank 30 having a suitable length, connected with the rear surface 26 of the rotor 18 itself.

[0017] According to the invention, a check ring 32 having two distinct internal circumferential surfaces 34 and 36 with a different diameter, is assembled by interference on the shank 30 of the rotor 18. The first circumferential surface 34, having a larger diameter, is coupled with interference with the external diameter D_e (figure 3) of the shank 30, whereas the second circumferential surface 36, having a smaller diameter, is coupled with interference directly onto the shaft 14. In this way, an increase in interference can be obtained, which is generated between the external diameter of the shank 30 and the check ring 32, during the functioning of the compressor 10.

[0018] In order to increase the interference between the parts and boost the transmissibility of the torque from the shaft 14 to each rotor 18, one or more keys 38 are preferably inserted between the outer surface of the shaft 14 and the second inner surface 36 of the check ring 32, as shown in figure 2.

[0019] In order to further increase the torque which can be transmitted from the shaft 14 to the rotor 18, the check ring 32 can also be applied onto the front side of the rotor 18, i.e. in correspondence with the eye 40 of the rotor 18 itself.

[0020] On the basis of experimental tests and controls on the efficiency of the compressor 10, it was found that the ratios of the diameter D of the shaft 14 with the external diameter D_e of the shank 30 are fundamental, and also with the external diameter D_a of the check ring 32 and with the lengths L_c and L_a , measured along the axial direction of the shaft 14, which respectively represent the

effective length of the shank 30 and the length of the second surface 36, or effective length of the check ring 32 (see figure 3).

[0021] A good compromise between dimensions, tensions and efficiency has been obtained with the following ratios, referring to the diameter D of the shaft 14:

$$\frac{D_e}{D} = 1.10 \div 1.25$$

$$\frac{D_a}{D} = 1.40 \div 1.60$$

$$\frac{L_c}{D} = 0.25 \div 0.35$$

$$\frac{L_a}{D} = 0.40 - 0.70$$

As the check ring 32 extends in length, in the axial direction of the shaft 14, in addition to the shank 30 of the rotor 18, as shown in figures 2 and 3, in order to respect the axial encumbrances or, in other words, the pitch of the rotors 18 in the multiphase compressor 10, the check ring 32 itself can be equipped with a portion 42 of its outer surface suitably shaped in correspondence with the diaphragms 22, increasing the diameter of the interphase labyrinth seals.

[0022] It can thus be seen that the anchorage system for the rotors of a rotating fluid machine, in particular between a rotor and the rotating shaft of a compressor of the centrifugal type, according to the present invention, achieves the purposes previously specified. The system in fact allows the necessary torque to be transmitted from the shaft to the rotors even if these are made of light alloy (aluminum alloys), and also maintains the centering of the same rotors on the shaft of the machine, eliminating the danger of inducing disequilibrium on the rotor during the functioning of the compressor.

[0023] The anchorage system for the rotors of a rotating fluid machine of the present invention thus conceived can in any case undergo numerous modifications and variants, all included in the same inventive concept; fur-

thermore, all the details can be substituted by technically equivalent elements. In practice, the materials used, as also the forms and dimensions, can vary according to technical demands.

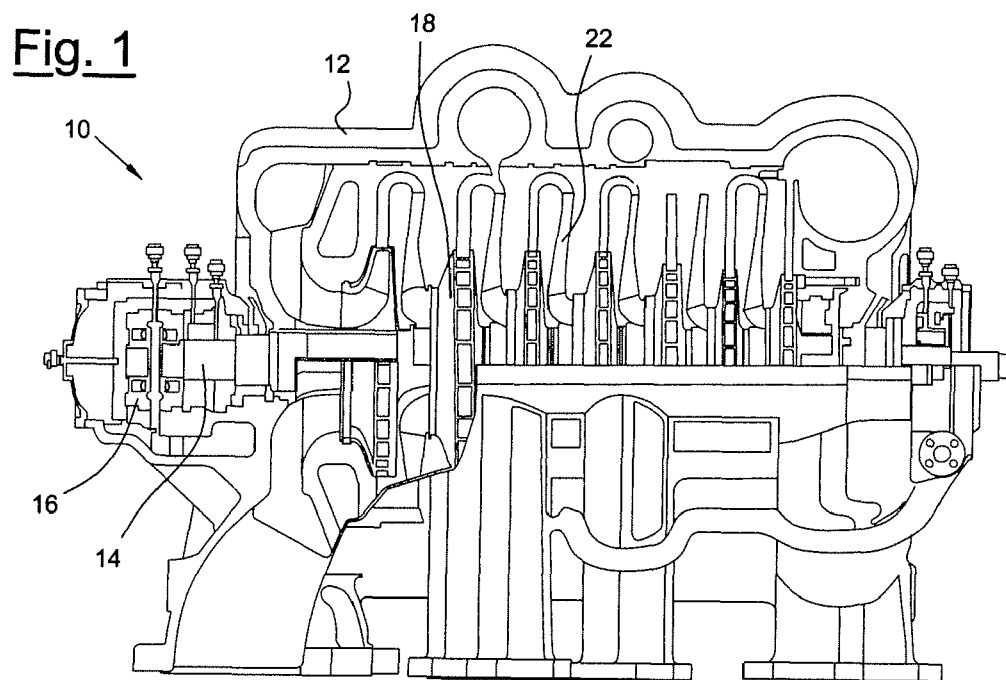
[0024] The protection scope of the invention is therefore defined by the enclosed claims.

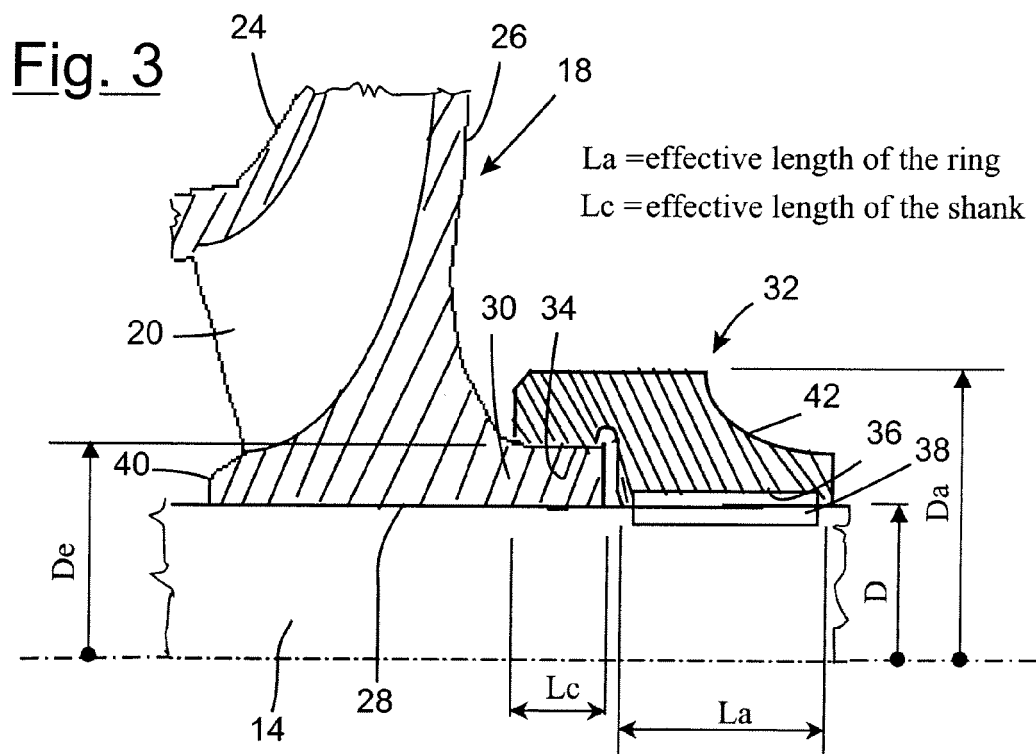
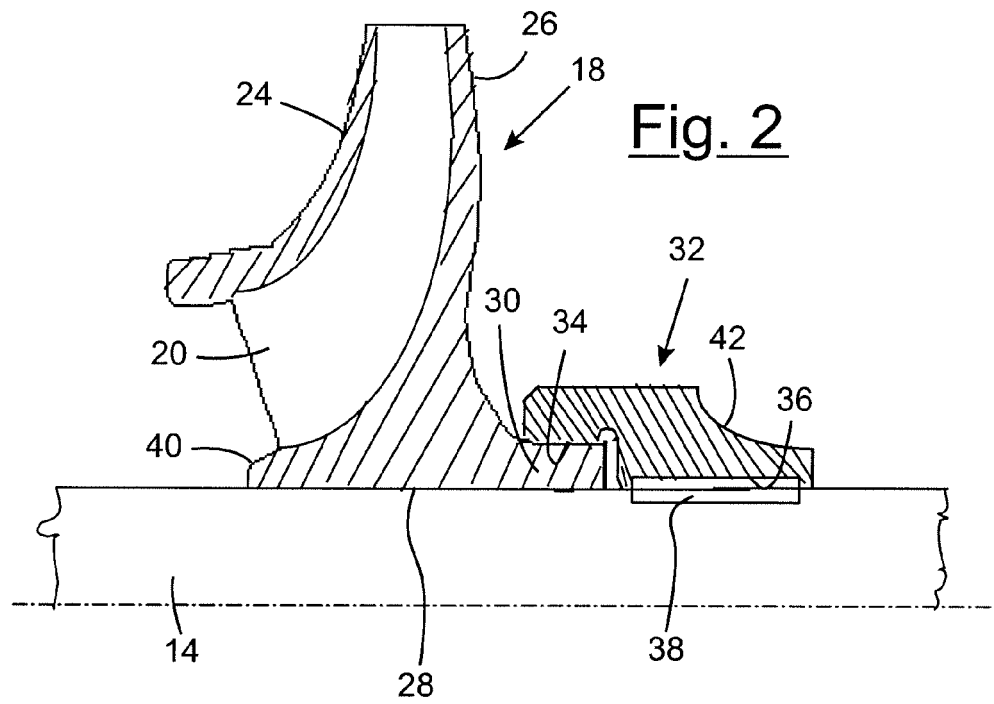
Claims

1. An anchorage system for a rotor (18) of a rotating fluid machine (10), said rotor (18) having a profile which comprises a first front surface (24) substantially concave and a second rear surface (26) substantially convex, opposite to the first front surface (24), a central portion (28) of said rotor (18), configured for being constrained with interference on a rotating shaft (14) of said machine (10) and being equipped with a shank (30) connected with said second rear surface (26) of said rotor (18), **characterized in that** it comprises at least one check ring (32) assembled by interference on said shank (30) of said rotor (18), said check ring (32) having a first internal circumferential surface (34), coupled with interference with said shank (30), and a second internal circumferential surface (36), coupled with interference with said shaft (14), to increase the torque which can be transmitted from said shaft (14) to said rotor (18).
2. The system according to claim 1, **characterized in that** said first internal circumferential surface (34) has a larger diameter with respect to said second internal circumferential surface (36).
3. The system according to claim 1 or claim 2, **characterized in that** between the outer surface of said shaft (14) and said second internal circumferential surface (36) of said check ring (32), one or more keys (38) are inserted to increase the interference between the parts and boost the transmissibility of the torque from said shaft (14) to said rotor (18).
4. The system according to any one of the preceding claims, **characterized in that** the ratio between the external diameter (D_e) of said shank (30) and the diameter (D) of said shaft (14) is within the range of 1.10 and 1.25.
5. The system according to any one of the preceding claims, **characterized in that** the ratio between the external diameter (D_a) of said check ring (32) and the diameter (D) of said shaft (14) is within the range of 1.40 and 1.60.
6. The system according to any one of the preceding claims, **characterized in that** the ratio between the length (L_c) of said shank (30), measured along the

axial direction of said shaft (14), and the diameter (D) of said shaft (14) is within the range of 0.25 and 0.35.

7. The system according to any one of the preceding claims, **characterized in that** the ratio between the length (L_a) of said second internal circumferential surface (36), measured along the axial direction of said shaft (14), and the diameter (D) of said shaft (14) is within the range of 0.40 and 0.70.
8. A rotating fluid machine (10) **characterized in that** it comprises an anchorage system for a rotor (18) according to any of the previous claims.







European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 7091

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 44 45 297 C1 (MAN B & W DIESEL AG [DE]) 14 March 1996 (1996-03-14) * the whole document *	1-8	INV. F04D29/26
X	DE 41 41 427 A1 (STROEMUNGSMASCHINEN GMBH [DE]) 17 June 1993 (1993-06-17) * the whole document *	1-8	
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 September 2008	Examiner Giorgini, Gabriele
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 & : member of the same patent family, corresponding document			

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EPC FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 15 7091

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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22-09-2008

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