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(54) **CENTRIFUGAL SEPARATOR**

(57) A centrifugal separator comprising, a centrifugal rotor (4), a rotatable spindle (1) to which said centrifugal rotor (4) is fixedly attached, a stationary frame member (7), at least one bearing (3) journaling said spindle (1) in said stationary frame member (7), a support device (6) which comprises a bearing holder (9), directly supporting said bearing (3). The bearing holder (9) is connected to the stationary frame member (7) by a ring-formed elastic support member (8) having an inner ring-formed part (8a) connected to said bearing holder (9) and an outer ring-formed part (8b) connected to said stationary frame member (7) thus forming an elastic connection between said bearing holder (9) and said frame member (7).

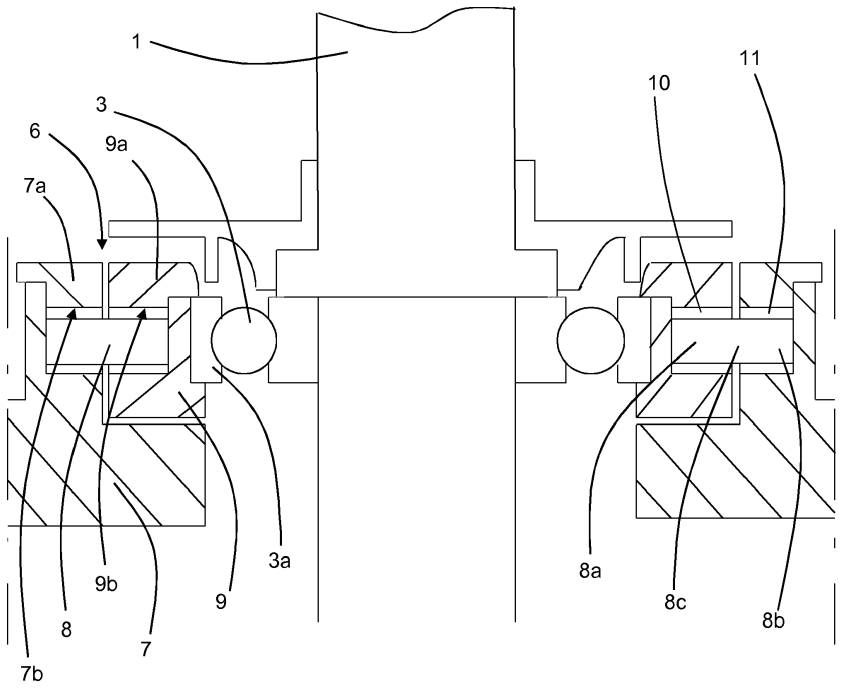

FIG 2

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Description

AREA OF INVENTION

[0001] The present invention refers to a centrifugal separator comprising, a centrifugal rotor, a rotatable spindle, rotatable around an axis, to which said centrifugal rotor is fixedly attached, a stationary frame member, at least one bearing journaling said spindle in said stationary frame member, a support device which comprises a bearing holder, directly supporting said bearing.

BACKGROUND OF INVENTION

[0002] Conventional spindle support devices for centrifugal separators are mainly of two different kinds, namely support devices, in which helical springs apply a force to oscillation-dampening friction buffers, and support devices, which are constructed by resilient rubber elements producing a dampening effect by inner friction.

[0003] Such known support devices comprise many components, which make them complicated and expensive. The dampening properties of the friction buffers as well as of the rubber elements are difficult to calculate. On the friction dampening surfaces coatings (coke) are formed, which change the dampening properties and result in a great risk for jamming. In the friction buffers, wearing particles are formed, which reduce the lifetime of the support device. The conduct of heat is insufficient in these known support devices, since rubber has a low heat conductivity and the friction surfaces of the friction buffers deteriorate the conduct of heat.

[0004] WO89/10794 discloses an example of such a known support device for a centrifugal separator having a centrifuge rotor which is rotatable in a frame member by means of a bearing member. The support device comprises a number of support members extending radially outwardly from the bearing member and which each encloses a helical spring element. Consequently, these support members are arranged to permit relative radial movements between the centrifuge rotor and the frame member by being compressed in a respective space of the frame member. The helical spring elements thereby act on a piston movable in the space and abutting the outer wall of a bearing housing. By means of the spring constant of the helical spring elements, a certain stiffness of the known support device is obtained, which together with the resiliency of, for instance, the rotor spindle, determines the critical number of revolutions of the centrifuge rotor. In centrifugal separators, the helical springs of this type have to be dimensioned to the frequently very high stresses and fatigue risks to which they are subjected.

[0005] WO99/46052 discloses a known support device similar to the one described in WO89/10794. The helical spring elements are embedded in resilient rubber in several different embodiments.

[0006] The dampening of the radial movements is obtained by means of the friction which arises between the piston and its contact surfaces, in particular the outer wall of the bearing housing. The friction which arises, results in addition to the dampening of the relative movements, also in the generation of heat. Such a heat generation is not desirable and forces the bearing to operate at a relatively high temperature, which reduces the lifetime of the bearing. Another problem is that the arrangement of moving pistons is rather space requiring. Such a space may be difficult to provide for the support device in a centrifugal separator, in particular outside the so-called neck bearing. In addition, these known support devices have a rather complicated construction, which of course makes the manufacture and the mounting labour demanding and expensive. In addition, it is difficult to conduct heat away from the bearing member.

DISCLOSURE OF INVENTION

[0007] The object of the present invention is to provide a support device, which from a construction point of view is less complicated than the support devices known up to now and by which the problems mentioned above may be remedied. Further aspects of the invention are apparent from the dependent claims and the description.

[0008] This object is obtained by the support device initially defined, which is characterized in that the bearing holder is connected to the stationary frame member by a ring-formed elastic support member having an inner ring-formed part connected to said bearing holder and an outer ring-formed part connected to said stationary frame member thus forming an elastic connection between said bearing holder and said frame member.

[0009] In comparison with previously known, similar support devices, a support device designed in this manner is space saving. Furthermore the elastic characteristics is evenly distributed around the circumference of the spindle

[0010] Said elastic support member may have a ring-formed central part which ring-formed surface is free from contact with said bearing holder and said stationary frame member.

[0011] Said inner ring-formed part of said elastic support member may be fitted in a ring-formed radially inner space in said bearing holder, and said outer ring-formed part of said elastic support member is fitted in a ring-formed outer space in said stationary frame member.

[0012] The inner ring-formed part of said elastic support member may be fitted with a ring-formed inner plate on an axially upper and a lower ring-formed surface respectively of said inner ring-formed part, and the outer ring-formed part of said elastic support member is fitted with a ring-formed plate on an axially upper and a lower ring-formed surface respectively of the outer part of said elastic support member.

[0013] Said ring-formed inner plates and said ring-formed outer plates may be made of a metallic material.

[0014] Said ring-formed inner plates and said ring-

formed outer plates may be vulcanized onto said elastic support member.

[0015] Said ring-formed inner plates and said ring-formed outer plates may be glued onto said elastic support member.

[0016] Said elastic support member may be made of rubber.

[0017] Said stationary frame member may comprise a ring-formed outer cover attached by screws to said frame member, said ring-formed outer cover together with said frame member defining said ring-formed outer space.

[0018] Said bearing holder may comprise a ring-formed inner cover attached by screws to said bearing holder, said ring-formed inner cover partly defining said ring-formed inner space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The present invention is now to be explained by means of different embodiments described as examples and with reference to the drawings attached, in which

Fig 1 discloses schematically a side view of parts of a centrifugal separator having a support device according to the invention.

Fig 2 discloses a radial section through the support device according to the invention.

DETAILED DESCRIPTION OF DIFFERENT EMBODIMENTS

[0020] Fig 1 discloses schematically parts of a centrifugal separator having a vertical spindle 1, which is journalled in a lower bearing 2 and an upper bearing 3. The lower bearing 2 is most often arranged to absorb essentially radial forces acting on the spindle 1 and the upper bearing 3 is most often arranged to absorb essentially radial and axial forces acting on the spindle 1. The spindle 1 carries at its upper end above the upper bearing 3 a centrifuge rotor 4. The spindle 1 and the centrifuge rotor 4 are rotatable about an axis x of rotation and driven in the example disclosed by a motor (not shown) via a screw gear 5, but may of course instead be belt driven or direct driven by a motor acting directly on the spindle.

[0021] In the example disclosed in fig. 2, the upper bearing 3 is supported by means of a support device 6 which comprises a bearing holder 9 directly supporting the outer bearing ring 3a and a substantially stationary frame member 7. The bearing holder 9 is connected to the stationary frame member 7 by a ring-formed elastic support member 8. The ring-formed elastic support member 8 has an inner ring-formed part 8a connected to said bearing holder 9 and an outer ring-formed part 8b connected to said stationary frame member 7 thereby forming an elastic connection between said bearing holder 9 and said frame member. The elastic support member 8 may be made of rubber or any elastic material with suitable characteristics.

[0022] The stationary frame member 7 comprises a ring-formed outer cover 7a which may be a separate component attached by screws to the frame member 7, or may be a part of said frame member 7. Together they define a ring-formed radially outer space 7b open radially inwardly. The bearing holder 9 comprises a ring-formed inner cover 9a which may be a separate component attached by screws to the bearing holder 9, or may be a part of said bearing holder 9. Together they define a ring-formed radially inner space 9b open radially outwardly.

[0023] The inner ring-formed part 8a of the elastic support member 8 is fitted in said ring-formed inner space 9b in the bearing holder 9 and the outer ring-formed part 8b of said elastic support member 8 is fitted in said outer space 7b in the frame member 7.

[0024] A ring-formed center part 8c of said elastic support member 8 is positioned radially between said inner space 9b and said outer space 7b forming a zone of the elastic support member 8, which ring-formed surface is free from contact with said bearing holder 9 and said stationary frame member 7. The bearing holder 9 and the frame member 7 thus do not have any metallic contact with each other. The support device 6 is thereby arranged to permit a limited pivoting movement of the spindle 1, and details connected thereto, such as the centrifuge rotor 4, and the upper bearing 3 in relation to the frame member 7.

[0025] To further enhance the functionality of the support device 6, the elastic support member 8 may, as is shown in fig. 2, be fitted with a ring-formed inner plate 10 on an axially upper and a lower ring-formed surface respectively of said inner ring-formed part 8a of the elastic support member 8, and a ring-formed outer plate 11 on an axially upper and a lower ring-formed surface respectively of the outer ring-formed part 8b of said elastic support member 8. The inner and outer plates 10, 11 are preferably of metal and vulcanized or glued onto the elastic support member 8 to form a complete elastic buffer.

[0026] Without the inner and outer plates 10, 11, the elastic support member 8 would wear a lot because of a lot of relative movement between the elastic support member 8 and the frame member 7 when the centrifuge rotor 4 creates dynamic forces to the elastic support member 8.

Claims

1. A centrifugal separator comprising, a centrifugal rotor (4), a rotatable spindle (1), rotatable around an axis, to which said centrifugal rotor (4) is fixedly attached, a stationary frame member (7), at least one bearing (3) journaling said spindle (1) in said stationary frame member (7), a support device (6) which comprises a bearing holder (9), directly supporting said bearing (3), which bearing holder (9) is connected to the stationary frame member (7) by a ring-

formed elastic support member (8) having an inner ring-formed part (8a) connected to said bearing holder (9) and an outer ring-formed part (8b) connected to said stationary frame member (7) thereby forming an elastic connection between said bearing holder (9) and said frame member (7).

2. A centrifugal separator according to claim 1, wherein said elastic support member (8) has a ring-formed central part (8c) which ring-formed surface is free from contact with said bearing holder (9) and said stationary frame member (7).

3. A centrifugal separator according to one of claims 1 or 2, wherein said inner ring-formed part (8a) of said elastic support member (8) is fitted in a ring-formed radially inner space (9b) in said bearing holder (9), and said outer ring-formed part (8b) of said elastic support member (8) is fitted in a ring-formed radially outer space (7b) in said stationary frame member (7).

4. A centrifugal separator according to one of claims 1-3, wherein the inner ring-formed part (8a) of said elastic support member (8) is fitted with a ring-formed inner plate (10) on an axially upper and a lower ring-formed surface respectively of said inner ring-formed part (8a), and the outer ring-formed part (8b) of said elastic support member (8) is fitted with a ring-formed plate (11) on an axially upper and a lower ring-formed surface respectively of the outer part (8b) of said elastic support member (8).

5. A centrifugal separator according to claim 4, wherein said ring-formed inner plates (10) and said ring-formed outer plates (11) are made of a metallic material.

6. A centrifugal separator according to one of claims 4 or 5, wherein said ring-formed inner plates (10) and said ring-formed outer plates (11) are vulcanized onto said elastic support member (8).

7. A centrifugal separator according to one of claims 4 or 5, wherein said ring-formed inner plates (10) and said ring-formed outer plates (11) are glued onto said elastic support member (8).

8. A centrifugal separator according to one of claims 1-7, wherein said elastic support member (8) is made of rubber.

9. A centrifugal separator according to one of claims 4-8, wherein said stationary frame member (7) comprises a ring-formed outer cover (7a) attached by screws to said frame member (7), said ring-formed outer cover (7a) together with said frame member defining said ring-formed outer space (7b).

10. A centrifugal separator according to one of claims 4-8, wherein said bearing holder (9) comprises a ring-formed inner cover (9a) attached by screws to said bearing holder (9), said ring-formed inner cover (9a) together with said bearing holder (9) defining said ring-formed inner space (9b).

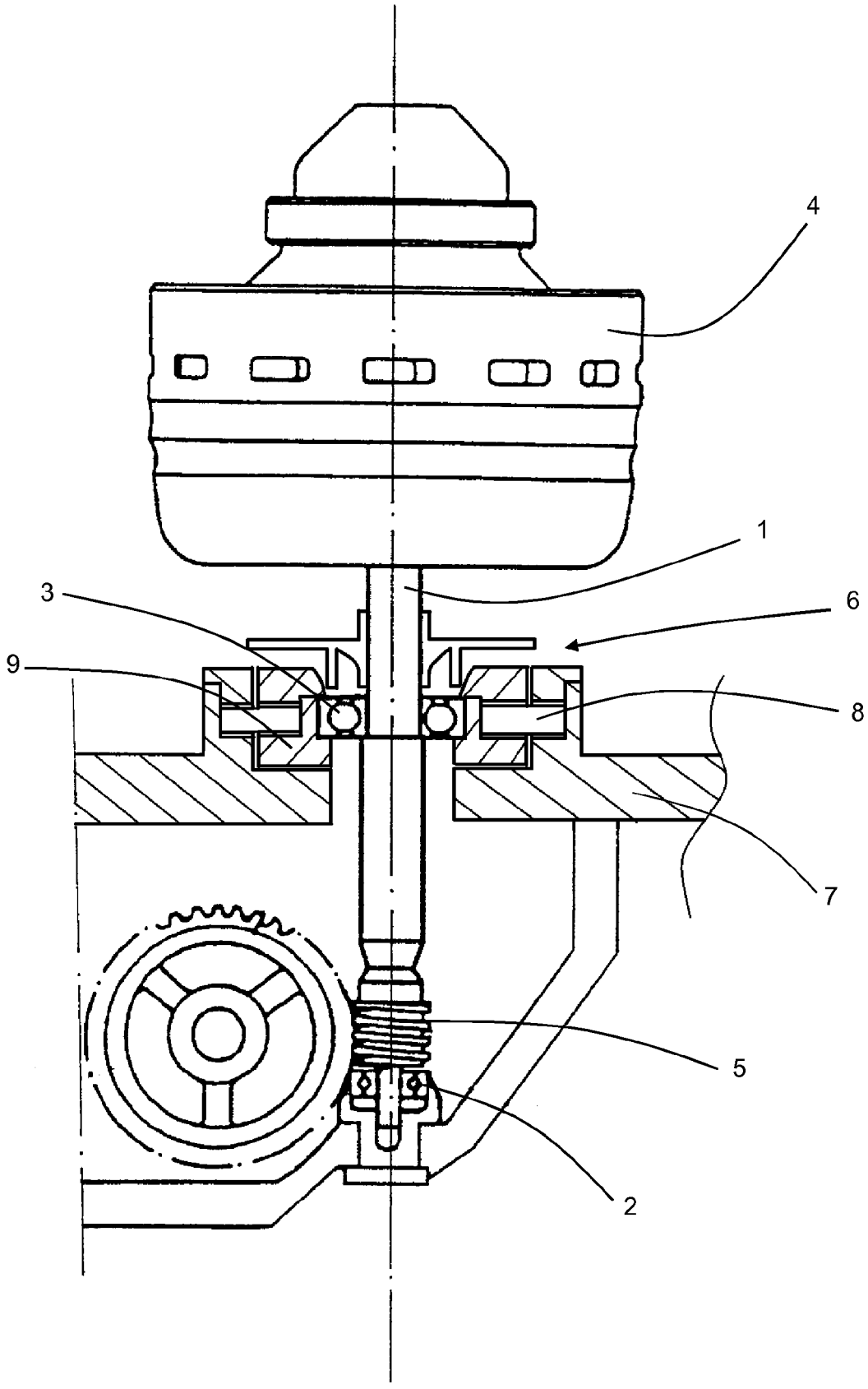

FIG 1

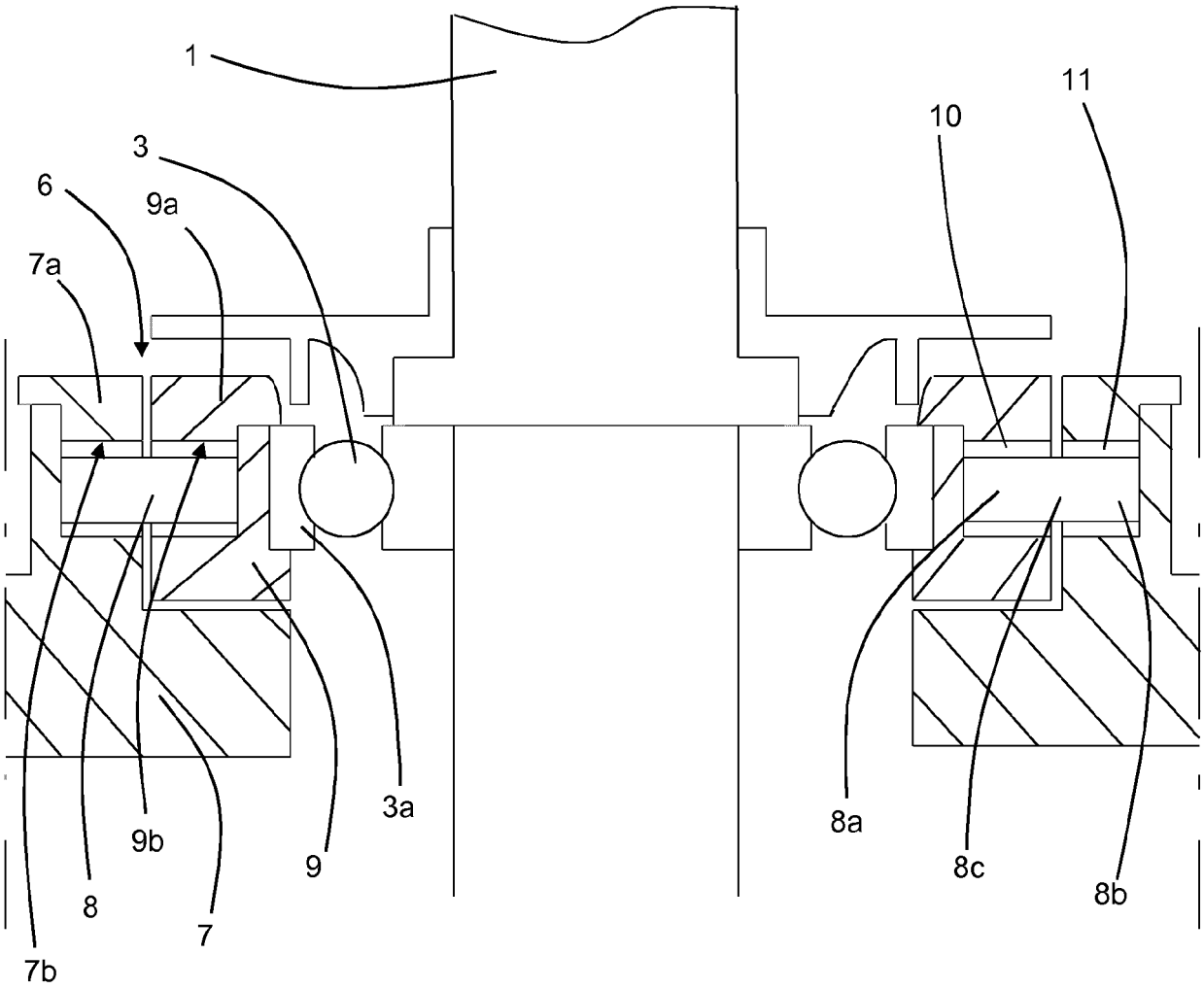

FIG 2

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EUROPEAN SEARCH REPORT

Application Number
EP 16 20 5429

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	WO 80/01248 A1 (WESTERN STATES MACHINE CO [US]) 26 June 1980 (1980-06-26) * figures * -----	1 4-7,9,10	INV. B04B9/12
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TECHNICAL FIELDS SEARCHED (IPC)

B04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	12 June 2017	Kopacz, Ireneusz

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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