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(54) ASSEMBLY COMPRISING A ROTATABLE ROTOR INSTALLED IN A HOUSING

(71) We, ULTRA CENTRIFUGE NEDERLAND N.V. a Body Corporate organised and existing under the Laws of The Netherlands, of Scheveningseweg 44, The Hague, The Netherlands, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an assembly comprising a rotor mounted in a housing for rotation about a generally vertical axis and supported at its lower end by bearing means which permit radial displacement against restoring forces and at its upper end by a magnetic field between a first body of magnetic material secured to the rotor and a second body of magnetic material attached to a fixed part of the housing.

Such assemblies can be used for a wide variety of purposes. The rotor can revolve slowly, for example in a measuring instrument, or at high speed to act, for example, as a chopper or as a reflector for scanning a reflected beam over a surface. They may also be used as laboratory instruments for determining molecular weights of substances having very high molecular weights.

In accordance with the invention, in an assembly of the kind specified above, the bearing means at the lower end comprises a support on which the rotor rests by way of a pivot shaft in such a manner that universal swinging movement of the rotor about the lower end of the pivot shaft is possible while the lower end of the pivot shaft is secured against radial displacement with respect to the support, and the support and the second body of magnetic material are each connected to the housing by damped resilient means providing for radial displacement of the support and the said second body.

In order to make the swinging motion of the rotor about the pivot as unobstructed as possible, a preferred embodiment provides for the lower end of the pivot shaft to be designed substantially as a ball, at least half of which rests in a spherically shaped socket.

The aforementioned support should be so supported for the purpose of a good damping effect that displacements from the central position resulting from vibration movements are possible, but that a restoring force continues to act in the direction of the central position.

For the restoring force, use may be made of a resilient force, which may be supplemented by the force of gravity.

For this purpose, the support according to one embodiment is supported by at least three suspension wires, the suspension points of which are evenly distributed along the circumference of a circle, and the lower ends of which are clamped in this support or in a damping body attached to it, the upper ends being supported in a part which is attached to the housing. The upper ends of the suspension wires can each be fitted in a small tube through which this wire passes to the top end of this small tube, where such a wire can be fixed in the small tube by pinching the tube end together or by soldering the wire in this small tube.

According to another method of attachment, the top end of a wire is attached to a deformable projection of a part which is rigidly fastened to the housing. This makes it particularly simple to adjust the proper position of the bearing, since all that needs to be done is to deform such a projection with pliers in such a way that the desired position is reached.

For the attainment of self-adjusting centring. the wires can be so arranged that they lie on a surface of revolution. This means that these extensions can lie on a conical surface or on a one-plane hyperboloid of revolution.

The upper ends of the wires can be fastened in a ring, the lower side of the ring being convex and so designed that it can be accommodated on a bowl-shaped fixed support.

According to another method of suspension, the support is supported by a resiliently flexible tubular member which surrounds the support at one end of this member, while the other end is rigidly connected to the housing. In order to improve the flexibility, this member is provided with at least one bellows-type fold along the circumferential surface. This fold can point inwardly as well as outwardly. At least on the outside of the resilient member, a damping surface is provided, preferably cylindrical, which is separated by a damping slot filled with damping medium from a wall of the housing which is located outside it and installed in fixed position. This surface can be the outside of the tubular resilient member itself, or the outside of a separate damping element can be attached for this purpose to the tubular member.

For optimum support and damping effect it is important that the support is hermetically sealed in the lower part of the resilient member, thus forming a reservoir for lubricating liquid, which is separated from the damping medium, which is present outside the resilient member, since it is now possible to select for damping a different medium than for the lubrication.

A circulation duct can be provided in the support for connecting the aforementioned reservoir to the bottom of the pivot socket. This enables the lubricant to circulate, so that the support can continue to perform its function for a very much longer period without further supervision.

Some examples of embodiment of the invention will now be further explained on the basis of the following figures.

The example of embodiment selected relates to a so-called chopper, but this example does not in any way restrict the manner in which the invention can be used. As has been stated in the preamble, the invention can be applied to a wide variety of machines or instruments.

A chopper as mentioned hereinabove is described, for instance, in United States Patent No. 3,427,455. In the following figures:

Fig. 1 is a vertical transverse section through a chopper; such an assembly is described and claimed in our U.K. Patent Application No. 28730/76 (Serial No. 1,544,489).

Fig. 2 is a vertical transverse section through a bottom bearing an assembly according to the invention;

Fig. 3 is a vertical transverse section through a variant of Fig. 2.

In Fig. 1, the rotor 1 is installed inside a housing 2, which is closed by means of two covers 3 and 4. The rotor is equipped at its bottom with a supporting shaft end 5 which is supported in a bearing 6. The rotor is equipped at its top with a magnetic ring 7. The numbers 8 and 9 indicate openings in the rotor 1 through which, for example, a neutron beam can be passed, which beam is transmitted through windows in the vertical wall of the housing 2. These windows are not shown in this case, since they are known from the aforementioned United States Patent No. 3,427,455.

Above the rotor is a magnet ring 10 which is arranged inside a box 11, in such a way that this ring is suspended with the aid of metal wires 12 and 13 in points of attachment 14 and 15. These points of attachment are formed by the pinched ends of a pair of small tubes 16 and 17. These small tubes are mounted on the upper surface of the magnet box 11. The magnet box is clamped inside an opening 19 provided in the cover 3, in which a corrugated clamping ring 23 is accommodated which is secured tightly both against the outside of the hollow 22 and against the outside wall 24 of the magnet box. It is also possible to bead over the lower edge 25 of the cylindrical opening in the cover 3, thus securing the magnet box 11 against axial downward displacements. The wall of the magnet box is made of thin material which is preferably soldered or welded in at least one point 26. In the centre of the magnet box 11, a passage 27 is left open which can serve for several purposes. In combination with a channel 28 provided above it in the lid 4, it is possible, for example, to inspect the inside of the rotor 1 through the opening 27. It is also possible to attach to the rotor 1 a shaft which passes through the channel 28 so that the rotor 1 can thus be driven from outside.

For the drive it is also possible, however, to use the shaft 5 on the underside of the rotor, or even to provide an electrometer stator inside the housing portion 29. In such a way that this stator acts upon the part 30 of the rotor 1. The number 31 indicates a closing cap for the channel 28, and the numbers 32 and 33 indicate sealing rings which are secured against the housing and the covers 3 and 4.

Fig. 2 indicates in vertical transverse section how the lower bearing can be designed and constructed. The wall 2 of the housing accommodates an electromoter 34, the aforementioned part of which serves as stator, the rotor of this motor being constituted by the bottom part 35 of the unit 1. Attached to the bottom of this unit is also a pivot 5, the lower end of which terminates in a pivot ball 36. This ball rests in a support 37 which is provided with a spherical socket and with a duct 38 through which the lubricating oil 39 can circulate.

The aforementioned support is placed inside a resilient, substantially cylindrical tubular member 40, which is provided at its top with an outwardly facing flange 41, while an inwardly directed flange 42 is provided at the underside. The cylindrical part 40 is interrupted approximately in the middle by a bellows-type fold 43 which increases the flexibility of 40, so that it can deflect more easily. On the underside of 40, and on the outside there-

of, a damping body 44 is so arranged that a narrow damping slot 45 is formed around it, which is filled entirely with damping medium.

Fig. 3 illustrates, likewise in vertical transverse section, in what ways variants are possible of the design and construction discussed hereinabove. The support 37 is here supported by a damping element 46 which is supported by suspension wires. One possibility of attaching these suspension wires is shown in the left half of the figure, a variant being shown in the right half of the figure.

The suspension wires 47 are clamped at their underside at 48 in the damping element, while they are fastened at their upper end in a small tube 49 of which the upper edge 50 is beaded over, the lower end being pinched together at 51. This small tube can furthermore be filled at the top with solder 52.

At least three of such suspension wires 47 are provided and fastened at their tops in a ring 53, the underside of which has a spherical supporting surface 54 which rests upon a correspondingly formed concave bearing surface 55. The latter is provided on the cover 56 of the damping space 57. At least three suspension wires 47, evenly divided along the circumference, should be provided.

The right half of the figure illustrates a variant for fastening suspension wires 58. On their underside, they are again clamped in the damping element 46, if required with the aid of a clamping screw 59; the wires are attached at their upper end to a deformable member 60, which is screwed down on the cover 56. The end 61 thereof is bent over and folded back, so that the wire end can be gripped between it, with the further possibility of applying solders. The suspension wires pass through an opening 62 provided in the cover 56. In this form of embodiment it is a simple matter to make any desired corrections in the position of the damping element 46 by slightly bending with pincers the leaf-shaped end of part 60.

The damping element 46 comprises on its underside a hollow 63, inside which a core body 64 is arranged which is provided in at least three places on its circumferential surface with a leaf spring 65 which is fastened upon 64 and which is in sliding contact with the inside wall 66 of the hollow 63. The leaf springs 65 provide the resilient restoring force which causes the damping element 46 to return to the central position after having been displaced.

In order to be able to modify the action produced by the damping slot 67, the core body 64 is movably fitted by means of a screwed connection 68 in the bottom 69 of the housing 2. The cover 70 provides a leak-tight seal.

WHAT WE CLAIM IS:—

1. An assembly comprising a rotor mounted in a housing for rotation about a generally vertical axis and supported at its lower end by bearing means which permit radial displacement against restoring forces and at its upper end by a magnetic field between a first body of magnetic material secured to the rotor and a second body of magnet material attached to a fixed part of the housing, wherein the bearing means at the lower end comprises a support on which the rotor rests by way of a pivot shaft in such a manner that universal swinging movement of the rotor about the lower end of the pivot shaft is possible while the lower end of the pivot shaft is secured against radial displacement with respect to the support, and the support and the second body of magnetic material are each connected to the housing by damped resilient means providing for radial displacement of the support and the said second body.

2. An assembly as claimed in claim 1 in which the lower end of the pivot shaft is in the form of a ball of which at least half rests in a part-spherical socket in the support.

3. An assembly as claimed in claim 1 or 2 in which the support is connected to the housing by a resilient tubular member one end of which surrounds the support while the other end is rigidly connected to the housing.

4. An assembly as claimed in claim 3 in which the resilient tubular member has a bellows - type fold in its wall.

5. An assembly as claimed in claim 3 or 4 in which the resilient tubular member is provided on the outside with a damping surface separated from a surrounding wall of the housing by a damping slot filled with damping medium.

6. An assembly as claimed in claim 3, 4, or 5 in which the support is hermetically sealed in the lower end of the tubular member to form a reservoir for lubricating liquid.

7. An assembly as claimed in claim 6 in which the support has a circulation duct connecting a pivot socket with the reservoir.

8. An assembly as claimed in claim 1 or 2 in which the support is carried by at least three suspension wires whose lower ends are clamped in the support or in a damping body attached to the support and whose upper ends are supported by the housing.

9. An assembly as claimed in claim 8 in which the upper end of each wire is secured within a tubular holder mounted on the housing.

10. An assembly as claimed in claim 9 in which the lower end of the tubular holder grips the wire.

11. An assembly as claimed in claim 9 or 10 in which the wire is secured in the holder by soldering.

12. An assembly as claimed in any of claims 7 to 11 in which the upper ends of the wires are attached to a ring.

13. An assembly as claimed in claim 12 in which the wires lie in a conical surface.

14. An assembly as claimed in claim 12 in which the ring has a convex lower surface resting on a bowl-shaped fixed support.

15. an assembly as claimed in claim 8 in which the upper end of each wire is fastened to a deformable projection of a part which is rigidly connected to the housing.

16. An assembly as claimed in claim 1 or 2 or any of claims 8 to 15 in which a damping body attached to the support carrying the rotor and disposed in a chamber filled with damping liquid has a cavity on its underside in which is located a core body rigidly connected to the housing, a damping slot being formed between the core body and the wall of the cavity.

17. An assembly as claimed in claim 16 in which spring members are disposed within the damping slot to provide a radial restoring force.

18. An assembly as claimed in claim 17 in which the spring members are leaf springs.

19. An assembly as claimed in claim 17 or 18 in which the axial position of the core body is adjustable.

20. An assembly comprising a rotor mounted in a housing for rotation about a vertical axis by means of upper and lower bearings substantially as described with reference to Figs. 1 and 2 or Figs. 1 and 3 of the accompanying drawings.

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1559461 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

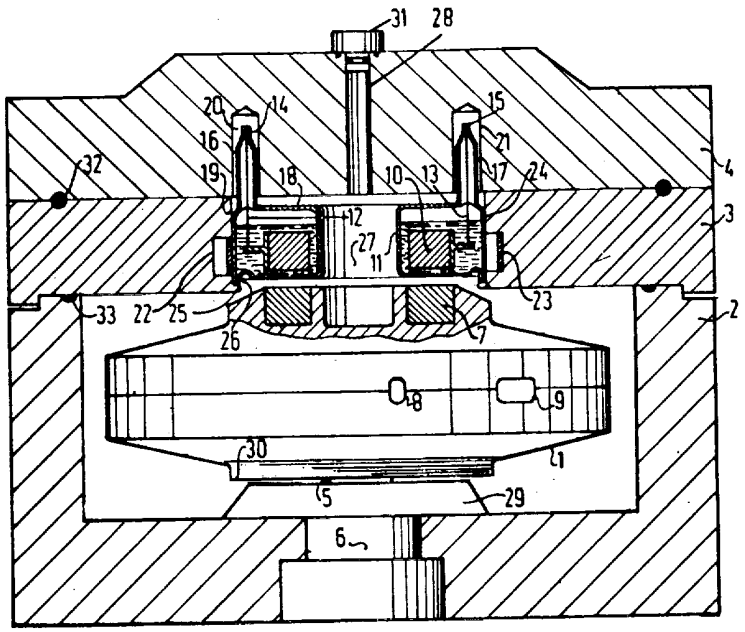


FIG.1

FIG.2

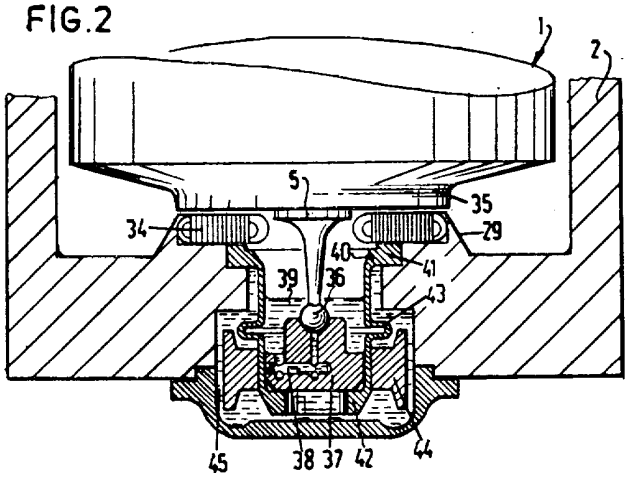
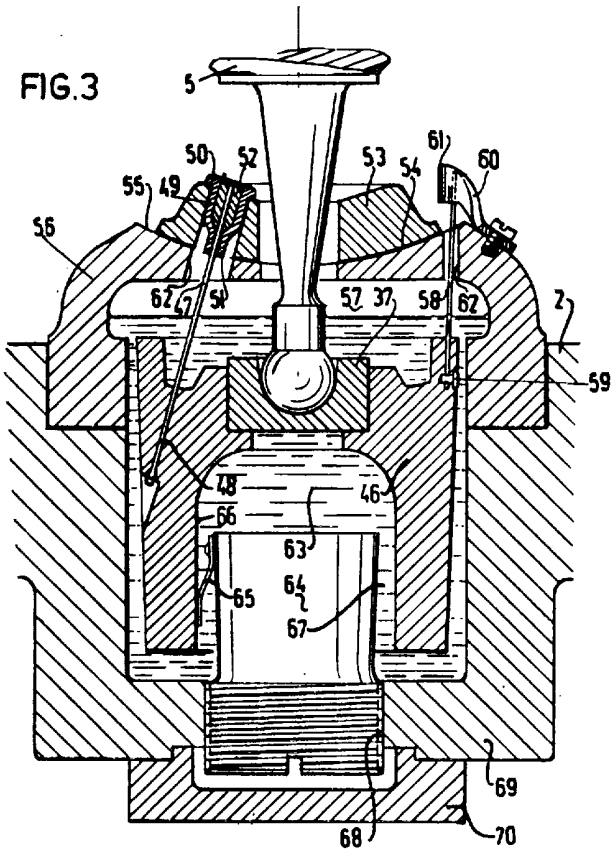


FIG.3


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