An impeller for a fan having a hub that can be easily fastened to a shaft is disclosed. A multiplicity of vanes is fastened to the hub. At least one elastic damping body is provided in the hub between the receptacle and the vanes to damp the transfer of vibrations from the shaft to the vanes, and prevent vibration of the vanes relative to each other. A slotted central sleeve in the inner section of the hub forms the receptacle for the shaft and is surrounded by an annular spring.
IMPELLER FOR A FAN

[0001] The present invention relates to an impeller for a fan, e.g., for a room fan or a built-in fan for cooling and/or air circulation in an electrical appliance.

[0002] Particularly in the case of small-format high-speed fans, vibrations of a drive motor, being transferred to the impeller of a fan, can provoke a resonant frequency of the impeller. This results in considerable operating noise of the fan, in addition to which the vibration can lead to material fatigue of the impeller and to its destruction in the course of time.

[0003] The object of the present invention is to specify an impeller for a fan, which impeller is insensitive to possible vibrations of a drive motor.

[0004] In the case of a fan impeller having a hub in which a receptacle for a driving shaft is formed, and having a plurality of vanes which are fastened to the hub, the object is achieved by means of the hub having at least one elastic damping body that is arranged between the receptacle and the vanes.

[0005] In order to damp the transfer of vibrations from the shaft to the vanes, and as far as possible to prevent vibrations of the vanes relative to each other, the vanes are preferably fastened to a hub outer ring which is connected via the damping body to a hub inner section having the receptacle.

[0006] According to a first specific embodiment, the damping body can occupy an annular intermediate space between the outer ring and the inner section.

[0007] Alternatively, it is also possible to arrange a plurality of damping bodies, these being circumferentially distributed, in an annular intermediate space between the outer ring and the inner section.

[0008] The damping body preferably consists of a different material than the outer ring and/or the inner section, in particular of a material having high elasticity. In particular, this material can be a silicon or a rubber.

[0009] However, an embodiment is also conceivable in which the plurality of circumferentially distributed damping bodies are embodied integrally with the outer ring and the inner section. In this case, the required elasticity of the damping bodies can be achieved by means of said damping bodies having a smaller wall thickness than the outer ring or the inner section.

[0010] If the damping bodies are not embodied in one piece with the ring or the inner section, it is advantageous for the ring and/or the inner section to have recesses into which the damping bodies engage positively, such that ring and inner section cannot be rotated in opposite directions.

[0011] In order to ensure that the damping bodies are held firmly, the recesses can be undercut.

[0012] The inner section preferably comprises a central sleeve, which forms the receptacle, and an annular wall that runs annularly around the sleeve at a distance. An annular spring surrounding the slotted sleeve can therefore be introduced for the purpose of fastening the impeller to a shaft.

[0013] The central sleeve and the annular wall can be connected in one piece in order to simplify manufacture.

[0014] A connecting piece which connects the central sleeve to the annular wall is preferably arranged at an end face of the hub. An axially extending intermediate space can therefore be created between the central sleeve and the annular wall, wherein said space can comfortably accommodate an axially extending spring which acts to fasten the hub to the shaft.

[0015] According to an alternative embodiment, an annular spring can also surround the inner section, and the at least one damping body is arranged in an annular intermediate space between the outer ring and the inner section so as to be axially offset relative to the spring.

[0016] The impeller is preferably used in a fan which is arranged in a domestic appliance such as a refrigerator. It is thereby possible to prevent an unpleasant noise level when the fan is operating, particularly during a rest phase of the compressor.

[0017] Further features and advantages of the invention emerge from the following exemplary embodiments with reference to the appended figures, in which:

[0018] FIG. 1 shows a perspective sectional view of an impeller according to the present invention;

[0019] FIG. 2 shows a radial section through the hub of an impeller according to a second embodiment of the invention;

[0020] FIG. 3 shows a section, similar to that in FIG. 2, according to a third embodiment;

[0021] FIG. 4 shows a section, similar to that in FIG. 2, according to a fourth embodiment;

[0022] FIG. 5 shows a perspective sectional illustration of an impeller according to a fifth embodiment.

[0023] The impeller shown in FIG. 1 has a hub 1 of essentially cylindrical form, from whose outer circumference a plurality of vanes 2 project. The number of vanes 2 is largely arbitrary, the example illustrated here comprising four vanes 2, of which only two are visible in the figure. These vanes 2 are integrally connected to an outer ring 3 of the hub 1. A plurality of silicone damping bodies 6 are arranged circumferentially at equal intervals in an annular cavity 4 between the outer ring 3 and an inner section 5 of the hub 1, said inner section 5 being arranged within said outer ring 3. Of the four damping bodies here, three can be seen in the figure, of which two in cross section. The damping bodies 6 are the only frictional connection between the outer ring 3 and the inner section 5.

[0024] The inner section 5 comprises an outer annular wall 7 and, surrounded by this and concentric relative thereto, a sleeve 8 which is open in the direction of an end face of the hub 1, said end face facing away from the observer, in order to accommodate a shaft (not shown) of a drive motor. A slot 9, which is open towards the end face facing towards the observer, extends transversely through the sleeve 8. The annular wall 7 and the sleeve 8 are connected in one piece at the end face facing away from the observer by a radially oriented wall 10. The wall 10, the annular wall 7 and the sleeve 8 respectively form the base and two side walls of an annular groove 11, which is open in the direction of the end face of the inner section 3, said end face facing towards the observer, in order to accommodate a slotted annular tension spring 12. As a result of the two halves of the sleeve 8 being pressed together by the tension spring 12, a secure press fit is achieved in respect of the impeller on the drive shaft that is accommodated in the sleeve 8.

[0025] Any transfer of unevennesses (in the shaft movement) to the outer ring 3 or the vanes 2 is damped by means of the damping bodies 6. Because the damping bodies 6 damp any movement of the annular wall 7 and the inner section 5 relative to each other, they also suppress the development of sympathetic vibration of the vanes 2.
[0026] Depending on elasticity and damping ability of the damping bodies 6, it can be effective to increase their number or their circumferential extent until the extreme case as shown in FIG. 2 (in cross section along the line II indicated in FIG. 1) is reached, in which the cavity 4 is completely occupied by a single annular damping body 6.

[0027] In the embodiments shown in FIGS. 1 and 2, the friction between the damping bodies 6 and the outer ring 3 or the inner section 5 essentially prevents any lasting rotation of the ring 3 relative to the inner section 5. For this purpose, it is necessary for the damping body 6 to be elastically deformed at all times, in order to establish the required pressure against the ring 3 and the inner section 5. This can prove problematic, particularly if the fan is exposed to low temperatures (e.g. when used for circulating cold air in a domestic refrigerator), since many of the rubber-elastic materials that are suitable for the damping bodies 6 have an elasticity that decreases significantly at low temperatures. Different thermal expansion coefficients of the selected materials can also contribute to the marked temperature dependency of the friction between the damping bodies 6 and the ring 3 and the inner section 5.

[0028] In order to achieve a damped elastic while nonetheless rotation-resistant coupling between the outer ring 3 and the inner section 5, irrespective of the temperature, a further developed embodiment makes provision for recesses into which the damping bodies 6 engage on the opposing surfaces of the inner section 5 and the ring 3. Particularly secure fixing of the damping bodies is achieved if, as illustrated in a section in FIG. 3 which is similar to that in FIG. 2, the recesses on the outer ring 3 and the inner section 5, designated 13 and 14 respectively, are undercut and the damping bodies 6, having an H-shaped cross section here, engage positively in the undercuts of the recesses 13, 14. In this embodiment, no pre-tensioning of the damping bodies 6 is required in the balanced state, and therefore the damping bodies 6 can yield slightly to a torque acting between the ring 3 and the inner section 5. The more yielding the damping bodies 6, the lower the resonance frequency of any rotational shearing of the ring 3 and the inner section 5 relative to each other. By selecting this resonance frequency such that it is sufficiently remote from any frequency component of the motor movement, rotational shearing of the ring 3 relative to the inner section 5 can be effectively prevented or damped to a level that is not relevant in terms of noise development.

[0029] A simplified modification is illustrated in FIG. 4. In this case, the damping bodies 6 that are made of silicone and fixed to the walls of the ring 3 and/or the inner section 5 are replaced by narrow bridges 15, which are molded integrally with the ring 3 and the inner section 5 and whose elasticity is derived from their considerably thinner wall thickness in comparison with the outer ring 3 and the inner section 5.

[0030] A further simplified embodiment is illustrated in FIG. 5 in a view which is similar to that of FIG. 1. In this embodiment, the annular wall 7 of the embodiments considered above is omitted and the slotted sleeve 8 is connected in one piece to the outer ring 3 (which carries the vanes 2) via a radial wall 16 at the end face of the hub 1, said end face facing towards the motor of the shaft. The thickness of the wall 16 is clearly less than that of the wall 10 in the previously considered embodiments; it allows a vibration of the outer ring 3 relative to the sleeve 8 along an axis which runs transverse to the rotational axis of the hub 1. At the same time, any such vibration is significantly damped by an annular damping body 17 which is pressed into an annular groove 18 between the sleeve 8 and the ring 3.

[0031] As explained with reference to FIG. 1, a tension spring 12 is axially pushed onto the sleeve 8 in order to clamp a shaft that is accommodated in the sleeve 8. It is also possible to omit the tension spring 12 and to apply the pressure to the sleeve 8 by means of the pressed-in damping body 17 alone, said pressure being required for the purpose of clamping the shaft.

1-15. (canceled)
16. An impeller for a fan having a shaft, said impeller comprising:
a plurality of vanes;
a hub having an outer ring to which the vanes are fastened and an inner section in which a receptacle for the shaft is formed;
at least one elastic damping body arranged between the receptacle and the vanes that connects the inner section of the hub to the outer ring of the hub; and
a slotted central sleeve in the inner section of the hub, said slotted central sleeve forming the receptacle, said slotted central sleeve being surrounded by an annular spring.
17. The impeller of claim 16, for use in a domestic appliance.
18. The impeller of claim 16, wherein the damping body occupies an annular intermediate space between the outer ring of the hub and the inner section of the hub.
19. The impeller of claim 16, wherein a plurality of damping bodies are arranged in a circumferentially distributed manner in an annular intermediate space between the outer ring of the hub and the inner section of the hub.
20. The impeller of claim 19, wherein the ring has recesses in which the damping bodies positively engage.
21. The impeller of claim 20, wherein the recesses are undercut.
22. The impeller of claim 16, wherein the inner section has recesses in which the damping bodies positively engage.
23. The impeller of claim 22, wherein that the recesses are undercut.
24. The impeller of claim 16 wherein the damping body is made of a material having a higher elasticity than the outer ring of the hub.
25. The impeller of claim 16 wherein the damping body is made of a material having a higher elasticity than the inner section of the hub.
26. The impeller of claim 25, wherein the material of the damping body is a silicone or a rubber.
27. The impeller of claim 16, wherein the damping bodies are connected in one piece with the outer ring of the hub and the inner section of the hub.
28. The impeller of claim 16, wherein the inner section of the hub comprises an annular wall running annularly around the sleeve at a distance.
29. The impeller of claim 28, wherein the central sleeve and the annular wall are connected in one piece.
30. The impeller of claim 28, further comprising a connecting piece arranged at an end face of the hub for connecting the central sleeve to the annular wall.

31. The impeller of claim 16 wherein at least one damping body is arranged in an annular intermediate space between the outer ring of the hub and the inner section of the hub so that the at least one damping body is axially offset relative to the spring.

32. A fan, comprising:
   a shaft;
   an impeller having a plurality of vanes;
   a hub having an outer ring to which the vanes are fastened and an inner section in which a receptacle for the shaft is formed;
   at least one elastic damping body arranged between the receptacle and the vanes that connects the inner section of the hub to the outer ring of the hub; and
   a slotted central sleeve in the inner section of the hub, said slotted central sleeve forming the receptacle, said slotted central sleeve being surrounded by an annular spring.