

IMPROVEMENTS IN AND RELATING TO AXIAL FANS

The invention relates to a fan having a tubular housing (ie. flow duct) which terminates on each side in a respective end plane, perpendicular to the
05 central axis of the tubular housing and whose axial length is smaller than its smallest internal radius. An electric drive motor is coaxially mounted completely within the tubular housing, with spokes for fixing the stator of the drive motor to the tubular
10 housing extending entirely within the latter at one end thereof along the associated end plane. A ring of blades fixed to the motor rotor extends entirely within the tubular housing in an annular flow channel and a protective grating is provided at the tubular
15 housing side opposite the spokes and extends along the associated end plane.

In the case of a fan of this type known from German Patent 17 28 338, the protective grating is positioned upstream of the motor and therefore takes
20 up additional space.

Fans of the aforementioned type are fitted where space is limited, so that in many cases there is no additional space for a protective grating.

An object of the present invention is to equip a
25 fan of the aforementioned type with a grating, which does not take up any additional space.

According to the present invention, there is provided a fan having a tubular housing which terminates on each side in a respective end plane perpendicular to the central axis of the tubular housing and whose axial length is smaller than the smallest internal radius thereof; an electrical drive motor coaxially completely mounted within the tubular housing; spokes fixing the stator of the drive motor to the tubular housing extending completely within the tubular housing at one end thereof along the associated end plane; a ring of blades fixed to the motor rotor and extending completely within the tubular housing in an annular flow channel; and a protective grating at the other end of the tubular housing and extending along the associated end plane, wherein the protective grating extends within the tubular housing and has an opening coaxial to the tubular housing and wherein an end of the drive motor projects into said opening.

The protective grating extends entirely within the space which would in any case be taken up by the fan. By providing an opening in the protective grating, the space available for the drive motor is not reduced by the grating. This is especially important for fans with a very small axial length, for example 20 to 25mm, because the active length of the

motor is completely used and at the same time there is a relatively large space for the bearings in which the rotor is rotatably journalled and a relatively large space for lubricant between the bearings.

05 The protective grating may be located at the upstream or downstream side of the tubular housing.

 The drive motor may be an internal rotor motor but preferably is an external rotor motor. In the case of external rotor motors, the drive motor end
10 tranversing the protective grating rotates and is not protected against external access through the protective grating. However, this is acceptable, because the rotating end can be made smooth and thereby there is little risk of injury. The situation
15 is quite different in the vicinity of the fan blades, which would cause considerable injury if fingers were inserted and would be damaged if objects were inserted. The fan blades are however protected by the aforementioned protective grating.

20 If the motor end passing through the protective grating belongs to the stator, then the protective grating can be fixed to the motor. However, in most cases the end belongs to the rotor and it is then recommended to fix the protective grating to the
25 tubular housing and to leave a tolerance gap between the inner edge of the protective grating and the drive

motor.

The protective grating can be fitted into a corresponding recess in the tubular housing and can be screwed, riveted, wedged or bonded there.

05 An advantageous further development of the invention, making it possible to assemble the tubular housing and protective grating from two castings, is that the tubular housing comprises a spoke part and a grating part placed against one another with their
10 radially inner walls contiguously aligned. The spoke part is a casting comprising a partial length of the tubular housing with the spokes integral therewith and with a hub flange coaxial to the tubular housing axis held by the spokes mounting the drive motor and
15 extending along the associated end plane within the tubular housing. The grating part is a casting comprising a partial length of the tubular housing with the protective grating integral therewith.

 In many cases the space which is available for
20 fitting such a fan has the shape of a cylinder with a square base. In such a case, the space available is particularly well utilized by an embodiment of the invention in which, on the protective grating-side end of the tubular housing is provided a flange with a
25 square outer contour, which extends within the axial length of the tubular housing and which in the

narrowest region between adjacent flange corners is not significantly thicker than the material thickness of the tubular housing. In such cases, it is advantageous for reinforcement purposes to mount
05 support webs for the flange corners externally on the tubular housing, which webs are located in the angular region between a respective flange corner and the tubular housing and are shaped onto the flange corner and tubular housing.

10 When the fan is situated at an outer wall, eg. an iron sheet wall, of a device which has to be cooled, the protective grating preferably is aligned with the relevant wall, whereby the axial length required for the fan is minimized. A corresponding embodiment of
15 the present invention has a radially outwardly extending flange at the side end of the tubular housing having the protective grating and one or more recesses are provided in the outer face of said flange to receive an annular area of a wall of a device to be
20 cooled by the fan, which annular area surrounds an opening in which the protective grating is to be aligned.

In the simplest case, the protective grating comprises grating bars, which appropriately have a
25 crossing angle of 20° to 160° with respect to the edges of the blades facing the grating bars, so that no

unnecessary intermittent turbulence is produced, which would lead to disturbing noise in the timed sequence of the running blades.

A particularly stable construction of the fan
05 protective grating comprises a plurality of annular grating bars (ie. rings) coaxial to the tubular housing axis, and a plurality of radial grating bars, which cross said rings in spoke-like manner.

In order to provide stability, it is preferred
10 that the protective grating has a inner stable ring which defines the opening of the grating. Use of this stable ring enables the available cross section of the tubular housing not to be unnecessarily reduced. In one embodiment of the present invention,
15 the stable ring is located in an annular peripheral recess with a tolerance gap therebetween.

The following is a description by way of example only and with reference to the accompanying drawings, of the presently preferred embodiments of the
20 invention.

In the drawings:-

Figure 1 is a view against the flow direction of a fan in accordance with one embodiment of the present invention.

25 Figure 2 is a partial section on a larger scale than Figure 1 corresponding to section II of Figure 1

of a modification of the embodiment of Figure 1;

and Figure 3 is a view corresponding to Figure 2 of a further embodiment of a fan in accordance with
05 the present invention.

Figures 1 and 2 show a tubular housing 1, which terminates on each side in a respective end plane 2, 3, which extends at right angles to the central axis 4 of the tubular housing. The axial length, indicated
10 by double arrow 5 of the tubular housing is smaller than its smallest internal radius along arrow 6. Electric drive motor 7 is mounted coaxially completely within the tubular housing and is constructed as an external rotor-type motor having a stator 8 and a
15 rotor 9.

Distributed round the circumference of the tubular housing within the latter are provided along end plane 2, four spokes 10, 11, 12, 13 by means of which a hub flange 14 is fixed to the tubular housing.
20 The hub flange is positioned coaxially within the tubular housing along end plane 2. Stator 8 is fixed to the hub flange 14.

A ring of five fan blades 16 to 20 is fixed to rotor 9 and these blades extend within the tubular
25 housing in an annular flow channel 21. Protective grating 22 extends entirely within the tubular housing

along end plane 3. This grating 22 has a coaxial opening 23 into which projects the drive motor 7. In order to be able to house as large a motor as possible in the available limited space, drive motor 7 extends
05 from end plane 2 to end plane 3. The end of rotor 9 extending through the protective grating is externally smooth. The protective grating is positioned with its outer ring 24 in a correspondingly shaped recess 25 of tubular housing 1 and is screwed down there. The
10 inner edge of protective grating 22 is formed by a stable ring 26. The stable ring is concentric to the central axis 4 and protrudes radially into an annular peripheral recess in the rotor 9 with a tolerance gap therebetween.

15 Protective grating 22 preferably is made from metal and specifically from three rings 30, 31, 32 (Figure 1) or four rings 30, 31, 32, 33 (Figure 2) extending coaxially to the fan axis 4, between the aforementioned stable ring 26 and outer ring 24.
20 Eleven grating bars 35 to 45 cross rings 30, 31, 32 and, if present, 33 and extend in spoke-like, approximately radial manner. All the rings 30 to 33 and grating bars 35 to 45 extend in non-parallel manner to the edges of the fan blades facing end plane
25 3, eg. to edge 47 of fan blade 16. The crossing angle for the grating bars 35 to 45 is approximately 20° and

for rings 30 to 33 approximately 70°. Correspondingly, spokes 10 to 13 are inclined to the rearward edges of the blades by an angle of approximately 20°. This sloping position is
05 appropriate for the purpose of avoiding unnecessary noise.

At both ends, tubular housing 1 is extended in respective flanges 51, 52. The flanges extend within the axial length of the tubular housing and within a
10 space which is defined by a cylinder with a square base. The outer contour of each flange 51, 52 is square, with a side length the same as the diameter of flow channel 21 along the end planes 2, 3, plus the material thickness in each case. Thus, flanges 51, 52
15 between the flange corners are not significantly thicker than the material thickness of the tubular housing indicated by double arrow 53.

Flange 52 in which the protective grating 22 is mounted, is reinforced in the vicinity of the corners
20 by respective support webs 55. These webs 55 are located externally on the tubular housing and extend in the angular region between the respective flange corner 56 and the tubular housing 1 and are shaped onto both said flange corner and tubular
25 housing .

The corners of flange 52 have respective recesses

60 to 63 in their outer faces. These recesses extend radially inwardly from the apex of the respective corner to an arcuate boundary 59 concentric with the fan axis 4. As shown in Figure 2, a protruding part
05 46 can be provided between the recesses 25, 60-63 for fitting in an opening in the wall of a housing 57 of a device to be cooled. The protective grating 22 extends accordingly in alignment with the housing wall 57. Alternatively, as shown in Figure 1, the recesses
10 25, 60-63 can be conterminous, whereby the ring 46 of the protective grating 22 fits in said opening.

Figure 3 shows a modified embodiment, in which the tubular housing 70 comprises two parts, namely a spoke part 71 and a protective grating part 72. These
15 two parts are placed against one another with their inner walls 73 contiguously aligned and are screwed together by bolts passing through holes 74 provided in the vicinity of the four flange corners. The spoke part is a casting and comprises a partial length of
20 the tubular housing with integral spokes 75 and a coaxially disposed hub flange 76 for mounting the drive motor 84. The hub flange is held by the spokes and extends along end plane 77 within the tubular housing. Grating part 72 is a casting and comprises
25 the remaining length of tubular housing 70 with integral protective grating 79. This grating 79

extends along the end plane 78 within the tubular housing and, like the protective grating of grating of Figure 1, comprises coaxial rings 80, 81 and 82 and an inner staple ring 86 and
05 circumferentially spaced spoke-like bars 83. Drive motor 84 projects through a central opening of the protective grating up to end plane 78. An annular recess corresponding to the recess 48 in the embodiment of Figure 1 and 2 is not provided in the
10 rotor of this embodiment. However, corner recesses corresponding to recesses 60-63 are provided to be received in an opening in a housing 87 of a device to be cooled. Otherwise the embodiment of Figure 3 is constructed in exactly the same way as the embodiment
15 according to Figures 1 and 2.

It will be appreciated that the invention is not restricted to the particular embodiments disclosed above but that numerous modifications and variations can be made without departing from the scope of the
20 invention as defined in the following claims.



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CLAIMS

1. A fan having a tubular housing which terminates on each side in a respective end plane perpendicular to the central axis of the tubular housing and whose
05 axial length is smaller than the smallest internal radius thereof; an electrical drive motor coaxially completely mounted within the tubular housing; spokes fixing the stator of the drive motor to the tubular housing extending completely within the tubular
10 housing at one end thereof along the associated end plane; a ring of blades fixed to the motor rotor and extending completely within the tubular housing in an annular flow channel; and a protective grating at the other end of the tubular housing and extending along
15 the associated end plane, wherein the protective grating extends within the tubular housing and has an opening coaxial to the tubular housing and wherein an end of the drive motor projects into said opening.
2. A fan as claimed in Claim 1, wherein the
20 protective grating is fixed to the tubular housing and a tolerance gap is formed between the protective grating inner edge defining the opening and the drive motor.
3. A fan as claimed in Claim 2, wherein the drive
25 motor is an external rotor motor and an end of the



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external rotor projects into said opening.

4. A fan as claimed in Claim 3, wherein said rotor end terminates along the associated end plane.

5. A fan as claimed in any one of the preceding
05 claims, wherein the opening in the protective grating is defined by a stable ring of said grating.

6. A fan as claimed in Claim 5, wherein said stable ring is located in an annular peripheral recess of the rotor with a tolerant gap therebetween.

10 7. A fan as claimed in any one of the preceding claims, wherein the tubular housing comprises a spoke part and a grating part placed against one another with their radially inner walls contiguously aligned; the spoke part being a casting comprising a partial
15 length of the tubular housing with the spokes integral therewith and with a hub flange coaxial to the tubular housing axis and held by the spokes mounting the drive motor and extending along the associated end plane within the tubular housing, and the grating part being
20 a casting comprising a partial length of the tubular housing with the protective grating integral therewith.

8. A fan as claimed in any one of the preceding claims, wherein on the protective grating-side end of
25 the tubular housing, is provided a flange with a square outer contour, which extends within the axial



length of the tubular housing and in the narrowest region between adjacent flange corners is not significantly thicker than the material thickness of the tubular housing.

05 9. A fan as claimed in Claim 8, wherein support webs for the flange corners are externally mounted on tubular housing, extend in the angular region between a respective flange corner and the tubular housing and are shaped onto both the flange corner and the tubular
10 housing.

10. A fan as claimed in any one of the preceding claims, wherein the protective grating comprises grating bars.

11. A fan as claimed in Claim 10, wherein said
15 grating bars subtend a crossing angle of 20 to 160° to the edges of the blades facing said grating bars.

12. A fan as claimed in Claim 10 or Claim 11, wherein the protective grating comprises a plurality of annular grating bars, coaxial to the tubular housing
20 axis, and a plurality of radial grating bars crossing said annular bars in spoke-like manner.

13. A fan as claimed in any one of the preceding claims, wherein the tubular housing has a radially outwardly extending flange at its protective grating-
25 side end and one or more recesses are provided in the outer face of said flange to receive an annular area



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of a wall of a device to be cooled by the fan, which annular area surrounds an opening in which the protective grating is to be aligned.

14. A fan as claimed in Claim 1 and substantially as
05 hereinbefore described with reference to and as shown in Figures 1 and 2.

15. A fan as claimed in Claim 1 and substantially as hereinbefore described with reference to and as shown in Figure 3.

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