

The invention relates to a bearing support for a drive motor of a minifan according to the preamble of claim 1 and to a bearing support for a commutatorless direct current motor according to the preamble of claim 2.

A minifan is e.g. described in DE-A-33 40 292.

The bearing support of the drive motor shaft in such fans takes place in ball bearings or slide bearings, which are generally retained in a bearing support tube. In particular in the case of long-term operation, with high temperature differences and/or higher speeds the bearings are subject to loosening in their seats, particularly in injection moulded casings, and cause an increasing amount of operating noise, so that finally either the entire fan or at least the bearings must be replaced.

This problem exists both with metal casings made from alloys of zinc (Zamak), magnesium, aluminium and with plastic casings, i.e. in the case of materials which are subject to so-called cold flow or which have widely differing thermal expansion coefficients with respect to the bearing parts, i.e. particularly in the case of plastics. This problem is made worse by the heat losses of the motor.

It is not possible to produce precisely aligned bearing seats in plastic injection mouldings. Due to the limited possible angular displacement of the bearing rings with respect to one another, it is possible to fit ball bearings, but a satisfactory quality is only ensured for a relatively short operating time. In the case of slide bearings the poor alignment is not compensated and the bearing seats have to be refinished.

GB-A-1 154 812 discloses a fan, in which the bearing tube is made from sintered metal and is given an external diameter such that it is rigidly held by press fit in a support tube. No bracing or spring means are provided for holding the bearing tube in the support tube.

CH-A-623 965 discloses an electric minimotor with a plastic bearing bush, which is inserted in a bearing receptacle in the return iron and is axially fixed by a flange.

The problem of the present invention is to so construct the bearing support of a drive motor of a minifan or the bearing support of a commutatorless direct current motor, that there is no need for a machining refinishing of the bearing seats and the preparation for the assembly with the same is in itself simple and also any axial clearance occurring in operation is automatically compensated.

In the case of a bearing support according to the preamble of claims 1 or 2, this problem is inventively solved by the features contained in the characterizing parts thereof. Advantageous further developments of the invention can be gathered from the subclaims.

With the solution of the problem according to the characterizing part of claims 1 or 2 the one-piece slide bearing unit in the form of a sintered bearing provides a particularly large reservoir for lubricating oil. Thus, the oil is better retained in the sintered material pores than in other

reservoirs (e.g. felt, grease, etc.). In addition, on heating, e.g. felts lose the oil much more rapidly than sintered bearings.

Embodiments of the invention are described in greater detail hereinafter relative to the drawings, wherein show:

- Fig. 1 An embodiment of a fan in axial plan view.
- Fig. 2 A partial section along the line II-II in fig. 1.
- Fig. 3 A larger-scale, broken-away sectional view of a first embodiment of the inventive bearing support for a shaft in a fan.
- Fig. 4 A larger-scale, broken-away sectional view of a second embodiment of the inventive bearing support for a shaft in a fan.
- Figs. 5 to 8 Four further embodiments in a simple representation as in fig. 3.

Identical or identically acting parts are given the same references hereinafter. The expressions top, bottom, right and left relate to the representation of the particular drawing.

A fan 1 (figs. 1 and 2) comprises a casing 2, which forms a flow channel surrounding an impeller and whose webs 3 are connected to a flange 4 on which is provided a bearing support tube 5. Preferably the casing 2, the webs 3, the flange 4 and the bearing support tube 5 are constructed in one piece as a plastic injection moulding, but in certain cases construction as a metal die-cast part is possible. A drive shaft 6 (fig. 2) is fixed to the rotor of the drive motor. To the rotor is fixed the impeller with blades 7 (dot-dash line).

Fig. 3 shows a larger-scale part sectional view of the bearing support for the shaft 6. The bearing support tube 5 is constructed in such a way that it is suitable for the use of slide bearings and ball bearings. At its upper end 8 the bearing support tube 5 has a first bearing seat 9. This is followed towards the lower end 10 by a first shoulder 11, a bore 12 with a smaller diameter than the bearing seat 9, at a given, axial spacing a second shoulder 13 and finally second bearing seat 14, preferably having the same diameter as the bearing seat 9, so that if necessary ball bearings can be inserted (e.g. for very high speeds).

A slide bearing in the form of a preferably sintered, one-piece slide bearing unit 15 is inserted in the bearing support tube 5, which has a through bearing bore 16, which serves as a running surface for the shaft 6. On one face the bearing unit 15 is provided with an extension 17, whose external diameter corresponds to that of the bearing seat 9 of the bearing support tube 5, i.e. the extension 17 can be fitted with medium sliding fit in the bearing seat 9. The latter radially guides the bearing unit 15. On the other face the bearing unit 15 is provided with a flanged-over or

upsettable rim 18 (in broken line form), which after inserting the bearing unit 15 in the bearing support tube 5 and inserting a spring element 18, 21 is flanged-over or upset in the axial direction.

This centring extension 17 has been placed on the bearing support tube end adjacent to the side of the bottom of a bell-shaped rotor 25 of the external rotor motor, in order to absorb and support the rotary mass with unbalance.

One side i.e. the left-hand side of fig. 3 shows the use of the spring element, which is here constructed as a coil spring 19 with a round wire cross-section. This coil spring 19 engages with the necessary pressure axially on the one hand on the plane surface of the shoulder 13 of the bearing support tube 5 and on the other on a disk 20, which is held by the rim 18.

In place of the coil spring 19, on the right-hand side of fig. 3 is provided a corresponding coil spring 21 with a square wire cross-section, which makes it possible to economize on the disk 20. The spring element constituted by the coil spring 19 or 21 axially fixes the bearing unit 15, i.e. the spring element is so designed that said unit is always pressed against the bearing surface of the shoulder 11, even in the case of a length change of the bearing support tube 5 (e.g. due to thermal or moisture influences). This is very important for plastic bearing support tubes, but this advantageous effect is also obtained for metal bearing support tubes.

Fig. 4 shows another embodiment of a slide bearing unit 35, which has at one end an extension 37 (corresponding to the extension 17 on the bearing unit 15), whilst at the other end is provided a smaller external diameter extension 38. After inserting the bearing unit 35 in the bearing support tube 3, a locking disk 39 is engaged over the extension 38 up to the plane surface 13 and the inner segments 40 of the locking disk 39 engage in the circumferential surface of the extension 38 and consequently axially fix the slide bearing unit 35. Thus, here the locking disk 39 acts in the same way as the aforementioned coil springs 19 or 21.

One of the following possibilities can be adopted for preventing rotation:

- a) three or more teeth 41 end face sintered onto the plane surface 22 (cf. figs. 3 and 4), which are pressed in on engaging the bearing unit 15, 35 in the bearing surface of the shoulder 11, or
- b) similar teeth 42 fitted to the diameter of the bore 9, or
- c) the bearing surface of the shoulder 11 is serrated throughout, so that the friction is significantly increased.

Axially the shaft 6 is secured in one direction by means of a thrust washer 43 and a retaining ring 44, whereas in the opposite direction the rotor 25 of the drive motor engages on the bearing unit 15, 35.

Fig. 5 shows another possibility for inventively incorporating a slide bearing unit 55 in an injection moulded casing in such a way that dimensional changes to said casing (in this case the bearing support tube 5) are

automatically compensated and that no cutting finishing is necessary with respect to the manufacture and installation of the slide bearing unit. The bearing support tube 5 has a conical bearing seat for injection moulding reasons. Axially parallel longitudinal ribs 51 provided on the wall permit a subsequent calibration for producing a cylindrical bearing seat 49, whose depth is limited by a flange 48. A through-hole 50 is provided for the fitting of the shaft 6. After insertion (medium sliding fit) of the slide bearing unit 55 in the bearing seat 49 up to the flange 48, a locking cap 45 is so introduced into the bearing seat 49, that it is on the one hand embedded in the wall of bearing seat 49 and therefore excludes any axial displacement at this point and on the other hand spring projections 46 of the locking cap 45 press the slide bearing unit 55 axially against the flange 48.

Fig. 6 shows an inventive embodiment in which between the flange 48 and one face of the slide bearing unit 55 a coil spring 19' is so inserted that it exerts an axial pressure on the slide bearing unit 55. On the opposite face of said slide bearing unit is fitted a locking element 47, which tooth-engages in the wall of the bearing seat and consequently fixes the unit 55 from this side. Here and also in the aforementioned embodiments, the bearing support tube 5 is made from injection mouldable material, such as e.g. plastic, aluminium or magnesium alloys, Zamak, etc.

The inventive bearing support is advantageous whenever very different expansion coefficients and other factors, such as e.g. shrinkage, cold flow, moisture absorption, etc. occur, which is particularly the case with plastic injection moulded casings.

Due to the minimum heat losses with plastic casings, i.e. also plastic bearing support tubes, the drive motor is particularly advantageously constituted by a commutatorless direct current motor for single or double-pulse operation with a so-called auxiliary reluctance moment, which is brought about in that the electrodynamic moment from the stator winding only has an alternating field and the magnetic resistance of the magnetic circuit in the stator area is so changed over the rotation position of the impeller that magnetic energy is stored for as long as there is a pulsewise drive of the electrodynamic moment and in the pulse gaps the stored magnetic energy is freed again accompanied by torque formation through the cooperation of the rotor permanent magnets and the stator iron.

Such motors are described in detail in DE-B-22 25 442 and DE-C-23 46 380 (= CH-A-597 715) and in the journal "asr-digest", No. 1-2/77, etc. These motors are advantageously external rotor motors, in whose rotor is provided a permanent magnet in the form of a permanent magnet ring or a permanent magnet band bent in circular manner. Magnetization is advantageously trapezoidal or approximately trapezoidal over the pole pitch in the case of a relatively small pole gap. However, it is possible in the same way to use other permanent magnets, e.g. bonded-in half-shells, etc. The electronics for regulating such a motor (described in DE-A-30 10 435) requires less components than conventional d.c. motors of this type. It is therefore possible to house the electronics for switching the motor within the external dimensions of the casing 2 of the fan 1 and namely within the motor, particularly in the vicinity of the flange 4. EP-A-84 156 describes a commutator circuit with few elements which can be used to particular advantage here.

In place of the aforementioned double-pulse commutatorless d.c. motor with auxiliary reluctance moment (cf. DE-C-23 46 380), it is also possible to operate with a double-pulse commutatorless d.c. motor without an auxiliary reluctance moment (cf. DE-A-27 30 142). Also in conjunction with such a motor the central bearing tube can be made from plastic and can be injection moulded in one piece with the flange, webs and outer casing. However, it is particularly advantageous to use a double-pulse auxiliary reluctance moment motor, because its efficiency is particularly high (particularly if constructed according to DE-C-23 46 380) and whose heating is correspondingly low, which ensures a relatively high bearing tube stability. An even older drive motor is also advantageous in conjunction with the present invention and also only requires one rotor position sensor and which is constructed according to DE-C-1 276 796.

Clearly the outer contour of the fan casing has no influence on the bearing support tube stability and the housing of the commutation electronics within the motor. Fig. 7 shows a circular casing 2, i.e. the most general shape for a point symmetrical outer contour. A so-called single-pulse motor is described in DE-A-22 60 069.

In fig. 7 the one-piece bearing unit 15 is inserted from the side of the flange 4 so as to abut against the face of the shoulder 13 in the bearing support tube 5 which, together with the flange 4, the webs, the surrounding casing 2, as in fig. 8 (and also preferably the other embodiments) is injection moulded in one piece from plastic. The sliding fit in a cylindrical surface 121 extends on either side of the axial centre of the bearing unit (sintered body 15) approximately over half the total axial length thereof. A cross-sectionally S-shaped collar-like part 119 made from spring steel or the like centres the left-hand end of the bearing unit 15 in the "bore" 112' and secures the same against inadmissibly large axial displacements by hooking its radially inner, sharp edge in a cylindrical surface 117, i.e. in the relatively soft sintered body metal.

Fig. 8 shows an embodiment which is similar to fig. 7. The bearing support tube 5 is connected in one piece to the plastic casing, e.g. via the flange 4. A stator plate package 105 is located on its outer face. In the case of such one-piece plastic casings (like components 2, 3 and 4 with the plastic bearing support tube 5), ball bearings are fundamentally to be braced. However, it is decisive that the running surfaces 115 and 116 of the shaft 6 or the bearing unit 15 are well aligned, so that the imprecision of the plastic injection moulded casing has no detrimental effect on the bearing quality. In the embodiment of fig. 8 the bearing unit 15 is inserted in the tube 5 from the flange 4. The plastic bearing support tube 5 has a contour which is also suitable for the ball bearings. The bearing support tube 5 has two faces 9 and 112 offset on the shoulders 13 and 11. It is here a question of the one-piece sintered bearing body forming the slide bearing unit 15 to be inserted in the cylinder with the face 9 so as to tightly engage in abutting manner on the face 13. Faces 106 and 9 should at least have a certain concentricity with respect to one another. If this is ensured the bearing support of the rotor in the bearing unit 15 should not cause any problem, at least not in the case of fans with motors having a relatively large air gap, e.g. double-pulse reluctance moment motors (or other single or double-pulse commutatorless d.c. current motors, as indicated hereinbefore). The bearing unit 15 is offset. It has an

intermediate piece with a cylindrical outer face in its axial centre and the running or cylindrical sliding faces 115 and 116, which can also form a through sliding bearing face (aligned from 115 to 116). The faces 115, 116 need not necessarily be aligned with one another, but they should be coaxial to one another to a high degree. The tubular bearing unit 15 to be inserted in the bearing tube 5, after striking against the shoulder 13, is centred on the other side at the shoulder 11 by a ring 110 (e.g. made from Perbunan) and is then secured in spaced manner via an intermediate element 111 in a cylindrical recess forming the face 112. The intermediate element 110 could also be an additional lubricant reservoir, i.e. a correspondingly constructed porous ring body, and also a spring spacing element which can be purchased from the catalogue as a mass produced article and in the manner shown in fig. 7.

With such a one-piece sintered bearing/plastic bearing support tube of the casing in one piece therewith (2 to 4) or also in metal bearing tube casings with not adequately aligned or not adequately coaxial bearing seats, such a one-piece sintered bearing construction leads to an economic solution advantageous for mass production and requiring no mechanical working. Due to the injection moulding procedure the face 12 can be conical, whereas faces 9 and 112 can be cylindrical, i.e. they can be made adequately accurately cylindrical by non-cutting calibration as a bearing seat. This is particularly easily achieved with the aforementioned longitudinal ribs 51 in the face 9. The seat face 106 should also be to some extent concentric.

The invention is advantageously generally usable for a commutatorless d.c. motor and specifically such a motor mounted in plastic bearing parts and is not restricted to a minifan, although the above embodiments relate to such a fan.

CLAIMS

1. Bearing support for the drive motor of a minifan with a bearing support tube (5) serving as the mounting support for the motor shaft (16), in which
 - (a) the bearing support of the shaft (6) is constructed as a bearing unit (15, 35, 55) and
 - (b) the bearing support tube (5) is connected to a retaining flange (4), characterized in that
 - (c) at least in an axial partial region of the bearing support tube (5), the bearing unit (15, 35, 55) is radially fixed with respect to said part of the bearing support tube (5) by a sliding fit,
 - (d) the bearing support tube (5) and the retaining flange (4) are produced in one piece from injection mouldable material and
 - (e) with the tension of at least one spring element (19, 21, 39, 46), the bearing unit (15, 35, 55) is urged against a stop member (11, 48).
2. Bearing support for a commutatorless direct current motor with a bearing support tube (5) serving as the mounting for the shaft (16), in which
 - (a) the bearing support of the shaft (6) is constructed as a bearing unit (15, 35, 55) and
 - (b) the bearing support tube (5) is connected to a retaining flange (4), characterized in that
 - (c) at least in an axial partial region of the bearing support tube (5), the bearing unit (15, 35, 55) is radially fixed by a sliding fit to this part of the bearing support tube (5),
 - (d) the bearing support tube (5) and the retaining flange (4) are produced in one piece from injection mouldable material and
 - (e) with the tension of at least one spring element (19, 21, 39, 46) the bearing unit (15, 35, 55) is urged against a stop member (11, 48).
3. Bearing support according to claim 1, in which the minifan is constructed as an axially compact fan with the central motor, particularly a commutatorless direct current motor, secured by means of the retaining flange (4) and the bearing support tube (5), and an impeller (7) fixed thereto, the fan casing (2) forming a flow duct surrounding the impeller (7), characterized in that the bearing unit is constructed as a one-piece slide bearing unit (15, 35, 55).
4. Bearing support according to one of the claims 1 to 3, characterized in that the spring element is a coil spring (21) with square wire cross-section and engages on the one hand axially against a face (13) of the bearing support tube (5) and on the other against a flanged-over or upset rim (18) of the bearing unit (15) under pressure.
5. Bearing support according to claim 4, characterized in that the coil spring (19) has a round wire cross-section and between the rim (18) and the coil spring (19) is also positioned a disk (20).
6. Bearing support according to one of the claims 1 to 3, characterized in that the spring element is a locking disk (39), which on the one hand engages on the outer wall of the bearing unit (35) and on the other acts against the face (13) of the bearing support tube (5) with axial pressure.



7. Bearing support according to one of the preceding claims, characterized in that the bearing unit (15, 35) has at least one raised point (42) with respect to the outer circumference of a larger diameter extension (17, 37).
8. Bearing support according to one of the claims 1 to 6, characterized in that there are at least three protuberances (41) on a plane surface (22) engaging on a shoulder (11) of the bearing unit (15, 35).
9. Bearing support according to one of the claims 1 to 3, characterized in that the bearing unit (55) is pressed by means of the spring projections (46) of a retaining cap (45) in axial manner against a flange of the bearing support tube (5).
10. Bearing support according to claim 9, characterized in that the bearing unit (55) on the one hand axially engages against a locking element (47) and on the other is subject to the action of an axially acting spring (19, 21), which engages on one side on the flange (48) and on the other side presses against the bearing unit (55).
11. Bearing support according to one of the claims 1 to 10, characterized in that the motor is a commutatorless direct current motor for single or double-pulse operation.
12. Bearing support according to one of the preceding claims, characterized in that the bearing unit (35) is secured against axial displacement by means of a locking element (39), which positively engages in its outer face.
13. Bearing support according to one of the preceding claims, characterized in that the bearing unit (35) is fixed against axial displacement by means of an element (39, 119), which acts radially thereon by means of force closure.
14. Bearing support according to one of the preceding claims, characterized in that the axial partial region is located in the vicinity of one end of the bearing support tube (5), which is adjacent to the impeller hub, particularly the bottom of a bell-shaped external rotor (25).
15. Bearing support according to claim 14, characterized in that the spring elements (19, 21, 45, 46) and/or the locking elements (39, 47) are provided in the vicinity of the other end of the bearing support tube (5) and in particular on the side of the flange (4).
16. Bearing support according to one of the claims 1 to 13, characterized in that the partial region is located about the axial centre of the bearing support tube (5).
17. Bearing support according to one of the claims 1 to 14, characterized in that the spring elements and/or locking elements (19, 21, 45, 46) are provided in the vicinity of the end of the bearing support tube (5) axially remote from the flange (4).
18. Bearing support according to claims 14 or 16, characterized in that



the partial region extends about the centre up to the end of the bearing support tube (5) axially remote from the flange (4).

19. Bearing support according to claim 18, characterized in that at the end of the bearing support tube (5) axially remote from the flange (4) is provided a radially inwardly extending collar (48), on which the bearing unit (55) is axially supported, preferably accompanied by the interposing of the axially acting spring element (19, 21, 45, 46).

20. Bearing support according to claim 17, characterized in that the partial region is provided in the axial end region of the bearing support tube (5) adjacent to the flange (4).

21. Bearing support according to one of the preceding claims, characterized in that the bearing support tube (5) is constructed as a one-piece plastic injection moulding with a casing (2) via webs (3) and the flange (4).

22. Bearing support according to one of the claims 1 to 20, characterized in that the bearing support tube (5) is constructed as a one-piece metal die cast part with a casing (29) via webs (3) and the flange (4).

23. Bearing support according to one of the claims 1 to 6, characterized in that the bearing surface of a shoulder (11) of the bearing unit is serrated throughout.

24. Bearing support according to one of the claims 1 or 2, characterized in that the bearing unit (15, 35, 55) has at least one ball bearing (fig. 7).

25. Bearing support according to one of the claims 1 or 2, characterized in that the bearing unit (15, 35, 55) preferably has two ball bearings (fig. 7).

