

Feb. 7, 1967

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3,302,867

FAN ASSEMBLY

Filed Oct. 23, 1965

2 Sheets-Sheet 1

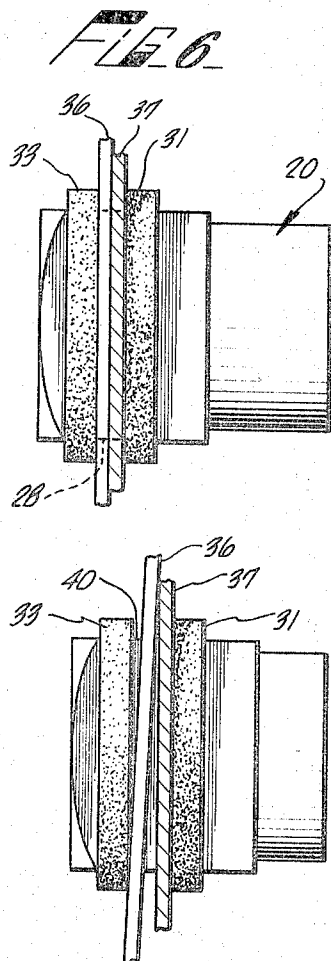
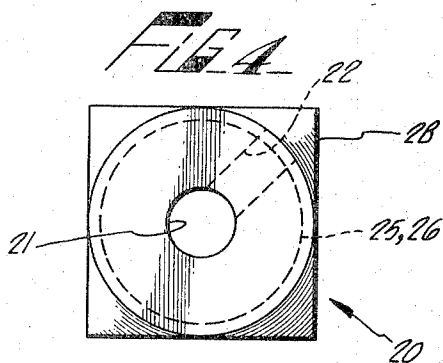


FIG 1

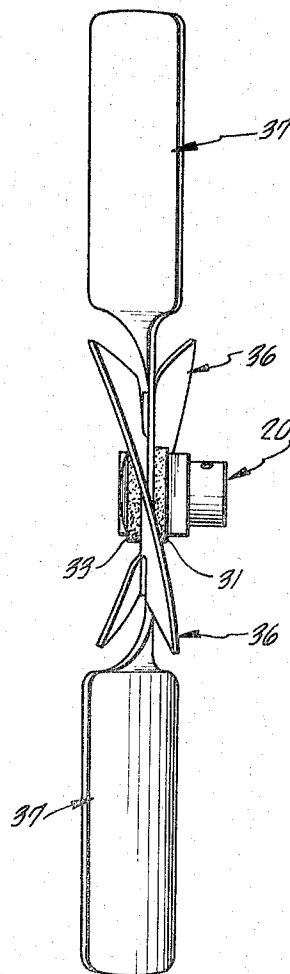


FIG 5

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2 Sheets-Sheet 2

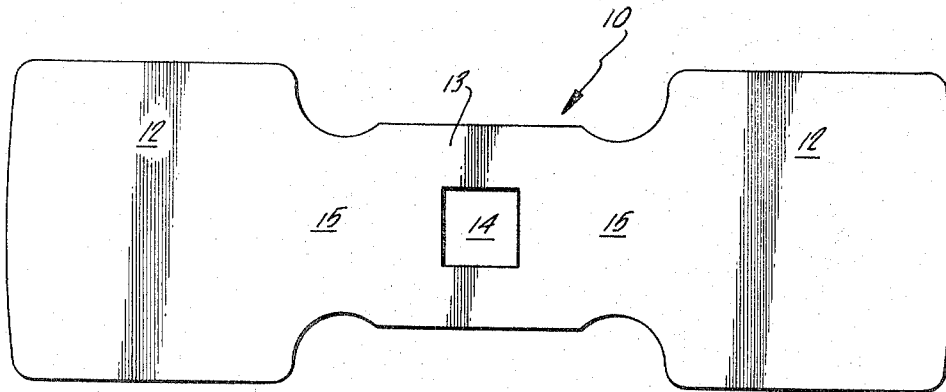


FIG. 1

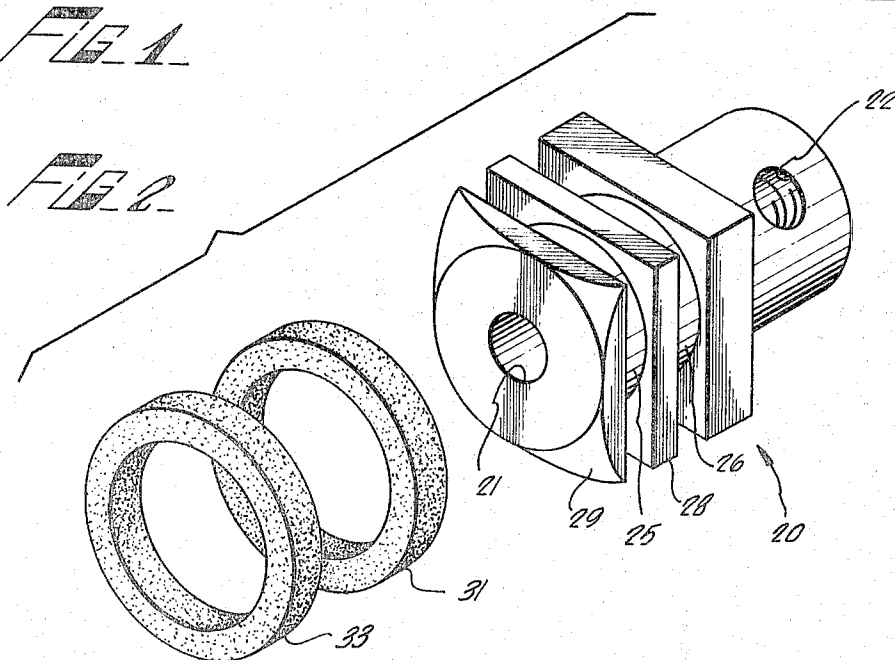


FIG. 2

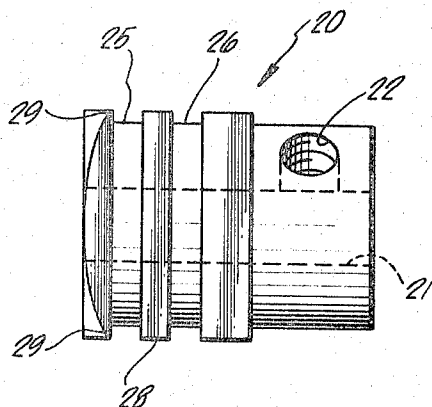


FIG. 3

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3,302,867

FAN ASSEMBLY

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2 Claims. (Cl. 230-134)

This invention relates to a fan assembly, and specifically to an assembly in which fan-blade members are readily removed from or installed on a hub.

Air-circulation fans are used in many different applications, and typically include a plurality of fan blades which are individually rigidly fixed by screws or rivets to a blade-mounting spider. The center of the spider is secured to a hub which is adapted for rotation by a motor.

Such fans present problems from the standpoints of both the manufacturer and the user. Manufacturing cost is high because mounting the blades on the spider requires separate production steps to drill and tap the necessary mounting holes and to install the screws or rivets. Furthermore, careful dynamic balancing of each fan is required to insure quiet, vibration-free operation.

Even if perfect balance is achieved by the manufacturer, conventional blade-mounting spiders tend to warp in use, introducing rotational unbalance which results in noisy operation and shortened drive-motor bearing life. The rigid spider-and-blade assembly also tends to act as a sounding board which transmits motor noise into the area where the fan is used. Conventional fans are also bulky to store and ship, as the assembled fan occupies a relatively large volume.

In many applications, the user may want to remove the fan from the drive-motor shaft in order to clean the blades. For example, the blades of a kitchen exhaust fan accumulate a substantial amount of dust and grease in a relatively short time, and periodic cleaning is needed to restore balance and to avoid slinging of grease from the blades. Removing the fan often requires special tools which are not available in the average household, and is typically an awkward and dirty job because the setscrews securing the hub to the shaft are commonly difficult to reach.

The fan assembly of this invention includes a hub on which unitary fan-blade members may be installed without need for a separate blade-mounting spider. The assembly is designed for low manufacturing cost, and may be shipped in a "knocked-down" condition in a very compact container. The user can easily assemble the blade members and hub, and the blade members are readily removed for cleaning without use of tools. The blades are adapted to fit over a non-circular boss on the hub, and are free to move longitudinally along a limited extent of the boss whereby they are self-balancing during rotation. The fan-blade member is formed from a simple sheet-metal stamping, and a variety of different sizes of blade members may be used on a single standard hub.

Briefly stated, the fan assembly of this invention includes at least one fan-blade member having a central non-circular aperture, and a rotatable hub having a non-circular boss substantially conforming in shape to the non-circular aperture. The boss has a groove around at least a portion of its periphery, the groove having a major plane normal to the hub axis of rotation. Means are secured to the boss for forming an annular shoulder on the boss, the shoulder being generally parallel to and spaced from the groove. The hub is disposed through the aperture whereby the member is engaged with the boss between the shoulder and the groove. Releasable resilient retaining means are engaged in the groove for retaining the member on the boss.

Preferably, the boss has a longitudinal extent somewhat greater than the total thickness of the fan-blade member

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or members, and the members are free to move longitudinally within a limited range along the boss between the shoulder and the retaining means. The boss is preferably slightly smaller in cross section than the complementary aperture in the fan-blade member whereby the member is free to tilt within a limited range about the hub axis of rotation to improve the self-balancing quality of the fan. The resilient retaining means preferably comprises an elastic ring which can be stretched over the hub to snap into the groove.

The invention will be described in detail with reference to the attached drawings in which:

FIG. 1 is a plan view of a fan-blade member as stamped from flat sheet stock, and before introduction of pitch and camber in the blades;

FIG. 2 is a perspective view of a hub as used in the invention;

FIG. 3 is a side elevation of the hub;

FIG. 4 is a front elevation of the hub;

FIG. 5 is an elevation of two fan-blade members assembled on the hub;

FIG. 6 is an enlarged elevation of the hub showing how the fan blade members are secured in place; and

FIG. 7 is a view similar to FIG. 6 showing a preferred form of the invention in which the fan-blade members are free to move within a limited range on the hub.

Referring to FIG. 1, a fan-blade member 10 includes a pair of spaced-apart blades 12 joined by a web section 13. The web section has a centered, square aperture 14 therethrough. The web is narrowed at each end where it joins the blades to form a pair of shank portions 15. The narrowed shank portion "ventilates" the rear of the member to avoid production of a partial vacuum in this region when the fan is operated.

Preferably, the fan-blade member is stamped from sheet aluminum, and may be produced in any convenient size. The shank portions of the stamping are twisted to introduce a pitch to the blades relative to the web section. The blades are preferably slightly cambered to improve their structural strength and to provide quiet operation. The shape of the fan-blade member after introduction of pitch and camber is shown in FIG. 5.

Referring to FIGS. 2-4, a hub 20 is machined from bar stock, and includes an axial hole 21 for engagement with a shaft of a drive motor (not shown). A threaded hole 22 through the hub into axial hole 21 is provided to accept a set-screw (not shown) to secure the hub to the shaft. To minimize machining operations, the hub is preferably formed from square-section bar stock.

A pair of spaced-apart annular grooves 25 and 26 are formed in the hub, the major plane of the grooves being perpendicular to the hub axis of rotation. The portion of the hub between the two grooves retains its square cross section to form a boss 28. Preferably, corners 29 at the front of the hub are bevelled rearwardly toward the grooves to eliminate protruding edges which might engage clothing or other articles accidentally brought into contact with the fan. A retaining ring 31, formed of an elastic material such as neoprene, has a central opening 32 with a diameter substantially equal to the inside diameter of groove 26. A second identical retaining ring 33 is adapted to seat in groove 25.

To assemble the fan, ring 31 is stretched over the hub to seat in groove 26. The ring extends radially beyond at least a portion of the hub periphery to form an annular shoulder on the hub. As best seen in FIGS. 5 and 6, the hub is then inserted through the central apertures in a pair of perpendicularly oriented fan-blade members 36 and 37. The members engage boss 28 on the hub, rear-most member 37 abutting the annular shoulder formed by ring 31. Ring 33 is then stretched over the front of the hub to seat in groove 25, forming a second annular shoulder

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der on the hub. The fan-blade members are thus confined on the boss portion of the hub between the two rings.

In a preferred form of the invention shown in FIG. 7, the length of a boss 40 on the hub exceeds the combined thickness of the fan blade members whereby the members are free to move longitudinally along the hub within a limited range between the retaining rings. Adequate freedom of movement is made available if the length of the boss portion exceeds the combined thickness of the fan-blade members by an amount approximately equal to the thickness of a single fan-blade member.

Preferably, the boss is also dimensioned to be slightly smaller than aperture 14 in the fan blade members whereby the members may tip fore and aft on the hub. Only a small amount of clearance is required to provide adequate freedom for this tipping action, approximately 0.010 inch spacing between the outside of the boss portion and the aperture in the fan-blade members being satisfactory.

I have found that this "loose" mounting of the blade members on the hub allows the members to be self centering when the fan assembly is rotated. That is, the fan-blade members tend to position themselves on the hub to eliminate any dynamic unbalance in the fan assembly, insuring quiet, vibration-free operation.

The fan blade members are readily removable from the hub for cleaning by simply removing elastic ring 33 and sliding the members off the hub. Accumulated dust and grease can thus be removed from the members without having to remove the entire fan assembly from the motor shaft. No tools are required to remove the fan-blade members, and the entire operation can be quickly and neatly accomplished.

The fan assembly of this invention is especially advantageous in that a large inventory of fan-blade members and hubs may be stored in a small space. The fan-blade members nest nearly together, and occupy a much smaller storage volume than required for an assembled fan. Individual fans can also be packaged for shipment in a "knocked-down" condition, the fan-blade members, hub and rings fitting neatly into a much smaller package than is required for a conventional fan.

Although the invention has been described in terms of a hub having a square-section boss, it is to be understood that the invention extends to include boss portions of other non-circular shapes. Any convenient non-circular shape may be used for a two-blade fan having but one fan-blade member. Polygon shapes would normally be used for fans using more than one blade member. For example, a six-blade fan using three blade members would typically include a hub having a hexagonally shaped boss. The apertures in the fan-blade members

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would of course correspond in shape to the selected shape of the boss.

Other types of retaining rings may also be used to secure the fan-blade members on the boss portion of the hub. For example, resilient metal C-rings may be engaged in the hub grooves. The rear retaining ring may also be replaced by an integral flange formed on the hub. The square-section boss and resilient rings pictured in the drawings are preferred as they represent a simple and inexpensive form of the invention.

I claim:

1. A fan assembly comprising a fan-blade member having a central non-circular aperture, a hub rotatable about an axis and having a non-circular boss substantially conforming in shape to the non-circular aperture, the boss having a pair of spaced-apart grooves having major planes substantially perpendicular to the hub axis of rotation, the hub being disposed through the aperture whereby the member is disposed between the grooves in engagement with the boss, and a pair of resilient retaining rings, one ring being releasably engaged in each respective groove and extending radially outwardly from the periphery of the boss to confine the member on the boss.

2. A fan assembly comprising a pair of perpendicularly oriented fan-blade members each having a central square aperture, a hub rotatable about an axis and having a square boss having a side length slightly smaller than the side length of the square aperture, the boss having a pair of grooves having major planes substantially perpendicular to the hub axis of rotation, the grooves being spaced apart a distance exceeding the combined thickness of the fan-blade members, the hub being disposed through the apertures whereby the members are disposed between the grooves in engagement with the boss, and a pair of resilient retaining rings, one ring being releasably engaged in each respective groove and extending radially outwardly from the periphery of the boss to confine the member on the boss.

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