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FAN CONSTRUCTION

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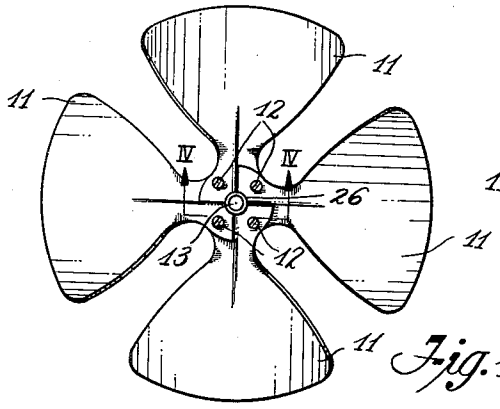


Fig. 1

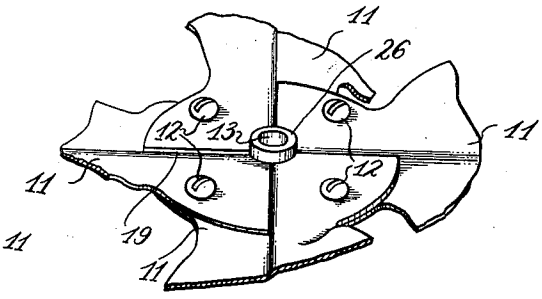


Fig. 3

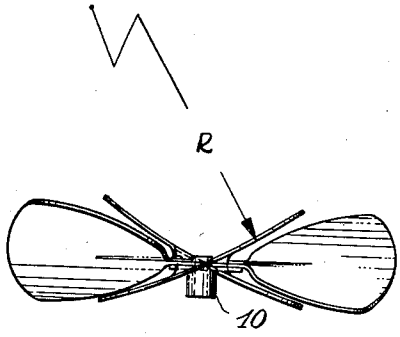


Fig. 2

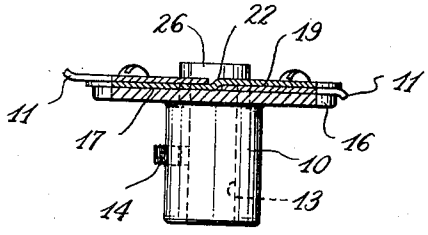


Fig. 4

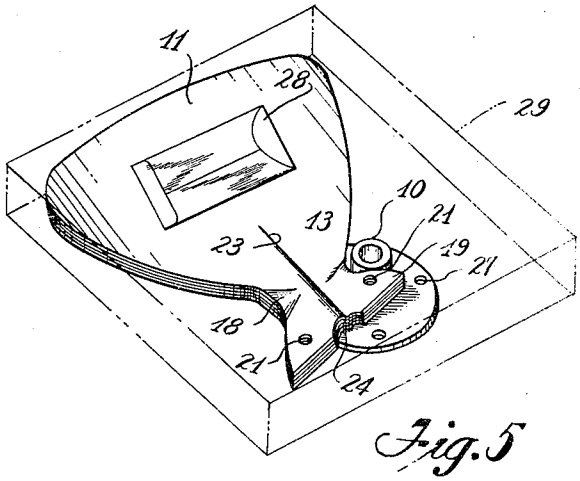


Fig. 5

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FAN CONSTRUCTION

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1 Claim. (Cl. 170—173)

1

My invention relates to rotary fans, and has particular reference to a hub and blade construction having inherent dynamic balance.

Rotary fans of the type usually employed, for example for air circulation in homes and offices, generally include a plurality of blades riveted to a central spider. The spider ordinarily is made of sheet metal and has the short projecting legs, to which blades may be secured, bent at an angle. The fan blades are then generally riveted or otherwise secured to these spider legs, and may be flat blades or slightly curved. Inasmuch as it is commercially impractical to make spiders with legs of absolutely identical shape and size and of identical bend, the finally assembly fans must be dynamically balanced if they are to be operated at speeds in excess of several hundred revolutions per minute. Accordingly the more efficient fans which operate at a speed in excess of 1000 R. P. M. universally are dynamically balanced.

The operation of dynamically balancing fans includes the placing of the finally assembled fan upon a dynamic balance indicator machine to determine the amount and location of the unbalance. Balance weights are then secured to the fan in accordance with the indication by one of several constructions, and the balanced blade is again tested for dynamic balance. If the particular weights applied do not dynamically balance the fan, a different weight must be substituted.

This testing, applying weights and again testing, adds expensive and time-consuming operations to fan assembly. In addition, there is the expensive construction for providing means for receiving the blade weights on one or more of the fan blades. The assembled and balanced fan must be delicately handled so that none of its parts will become bent or otherwise distorted, in which event the fan would have to be dynamically balanced again. Accordingly it is not sufficient to merely package such an assembled fan for shipment, but in addition packing material must be carefully placed about the blades, particularly for the export trade.

My invention embodies the use of a hub instead of the conventional fan spider. The hub may be provided with a radially extending flange to which fan blades may be secured. The fan blades preferably have a wide base for greatest rigidity for attachment to the flange. Inasmuch as lapping the wide base of the blades upon each other would result in minutely disposing some of the blades out of the plane of rotation of others

2

of the blades, I provide an interlocking construction for the blade bases that permits all the blades to rotate in the same plane and thus assures dynamic balance. I prefer also to make all of the blades on a single die for any one fan, and thus the size, shape and construction of all of the blades of one fan may be made absolutely identical.

I prefer also to attach the blades of my fan to my hub construction by screws instead of rivets. The fan accordingly may be easily assembled even by the most unskilled of help and with a minimum of equipment. Accordingly my fan may be shipped in a knocked-down condition inasmuch as little difficulty is encountered in final assembly. In packaging my fan components for such knocked-down shipment, the blades may nest together, reinforcing each other and thus requiring no packing material. For example, this knocked-down packaging permits the use of a carton as small as 6" x 6" x 1½" for a regulation 12" fan instead of the usual carton size of 14" x 14" x 4" for fans of this size. Accordingly the ability of my fan construction to be shipped in a knocked-down condition saves as much as 90% of the shipping space. In addition, shipping in a knocked-down condition permits reboring of the hub for different sizes of motor shafts before the assembly operation takes place.

It is therefore a general object of my invention to provide an improved fan construction.

Another object of my invention is to provide a fan construction that is inherently dynamically balanced.

Another object of my invention is to provide an improved fan construction that is inexpensive to manufacture.

A further object of my invention is to provide a fan construction utilizing a hub instead of the usual spider.

Still a further object of my invention is to provide identical blades for a fan construction.

A still further object of my invention is to provide a fan construction wherein blades are assembled to a central member in an interlocking manner.

Another object of my invention is to provide a blade construction incorporating a radial crease to reinforce the blade in addition to permitting an interlocking assembly of the blades.

Another object of my invention is to provide a fan blade having a simple circular curvature that decreases turbulence and accordingly increases fan efficiency.

Another object of my invention is to provide a fan construction that lends itself to ready shipment in a knocked-down condition and wherein the blades reinforce each other.

A still further object of the invention is to provide a fan that may be readily assembled or disassembled so that the hub thereof may be readily rebored on a machine of small size.

Another object of my invention is to provide a fan construction wherein the blades may be replaced without destroying the dynamic balance of the fan.

Other objects and advantages of my invention will be apparent from the following description and claims, considered together with the accompanying drawings, in which

Fig. 1 is a plan view of an assembled fan construction embodying my invention;

Fig. 2 is an elevation view of the fan construction of Fig. 1;

Fig. 3 is an enlarged perspective view of the central portion of the fan construction showing the interlocking of the fan blades;

Fig. 4 is an enlarged sectional view of the central portion of the fan taken along the line IV—IV of Fig. 1; and

Fig. 5 is a perspective view of the fan blade construction of Fig. 1 in a knocked-down condition with an indication of the package size which will contain the elements of the fan.

Referring to all of the drawings, it will be noted that my fan construction may employ a central hub 10 to which may be secured identical fan blades 11 by means of screws 12. The hub 10 may be provided with a central bore 13 so that the fan may be mounted on a suitable shaft such as a projecting shaft of an electric motor. A set screw 14 may be provided through a side wall of the hub so that the set screw may engage a flat on the motor shaft for providing a driving engagement between the shaft and the fan. The hub 10 is also provided with a radially extending flange 16 made particularly in accordance with the invention and having one surface 17 thereof formed quite accurately planar. This surface 17 is formed with a high degree of accuracy so that the fan blades 11 may be secured thereto with assurance that all blades will be disposed at the same angle with respect to the hub axis, and preferably disposed in a single plane.

The hub 10 is preferably formed on a machine that causes the stock material of the hub to rotate so that all surfaces may be formed with respect to a single axis so as to assure absolute symmetry in all portions. This symmetry is particularly important on the flange 16 inasmuch as this projects outwardly from the axis of the hub and accordingly if not accurately made may provide an element of unbalance. The hub 10 may be formed accordingly on a lathe, screw machine, or other suitable rotary tool, and I have found that an accurately formed die cast also serves this purpose quite satisfactorily. The set screw 14 is made just slightly longer than the thickness of the wall into which it is threaded, and is preferably of the socket type so as to have a minimum of material on its outer end.

Referring to Fig. 1, it will be noted that the width of the fan blades 11 may be approximately one-half of the fan diameter, or in other words, the fan blades may be as wide as they are long. I prefer to form my fan blades from sheet material, and have found sheet aluminum to be quite satisfactory, resulting in a light-weight fan construction. It will be obvious, however, that any other suitable material may be used, such as plastic, molded compounds, or other sheet metals. Referring to Fig. 2, it will be noted that my fan blades incorporate a simple circular curve of radius R, which radius may be approximately the same as the diameter of the entire fan. I have found that a simple circular curve on the fan blade results in a higher efficiency and much quieter operation than is customarily achieved with the multiple curve blades wherein the leading or trailing edges may be disposed at a different angle from the central body of the fan blade.

Referring to Fig. 5, it will be noted that the fan blades 11 may be of general petal shape and may be provided with a restricted portion 18 between the main body thereof and an enlarged base 19. The base 19 may include two screw holes 21. By reference to Figs. 3 and 4 it will be noted that the blade bases 19 are flat. Accordingly the main body of the blades 11 may be bent at the restricted portion 18 to provide an inclined surface to give pitch to the blade for the movement of air. I have found that a general incline on the blades of 30° is satisfactory for a 12'' fan operating at approximately 1500 R. P. M.

As noted previously, all of my fan blades are disposed within the same plane of rotation. This I achieve in spite of the wideness of the bases 19 and the blades by interlocking the bases of the blades. This construction is shown most clearly in Fig. 4, wherein it will be noted that a fan blade base 19 is provided with a central off-set 22 which may be of the same thickness as the metal from which all of the blades are formed. Accordingly, therefore, as is apparent in Fig. 3, one-half of the base 19 of each fan blade will be disposed against the planar surface 17 of the hub flange 16, and the other half of the fan base 19 will overlie an adjoining fan blade base portion. I prefer to make the off-set 22 in the form of an elongated crease 23 that extends past the narrow portion 18 of the blades and into the main body of the fan blade. This crease accordingly not only provides the off-set 22 required for interlocking the blade bases, but also serves as a stiffening construction for the entire fan blade, particularly for the narrow portion 18 thereof where the fan blade would otherwise be the weakest.

I prefer to form all of the blades 11 for any one fan upon the same die so that all of the blades will be of the same size and shape and will have the same angle of bend and the same size and extent of crease 23. The provision of the interlocking arrangement of the fan blade bases disposes all of the blades within the same plane of rotation, which is in contrast to the lapping of one upon another which would be required if the off-set 22 were not provided.

The assembly of the blades 11 to the hub 10 may be facilitated by providing each blade base 19 with a circularly relieved portion 24 which may fit about a raised collar 26 on the upper end of the hub 10. Accordingly the assembler may merely dispose two blades at right angles to each other so that their relieved portions 24 abut against the raised collar 26, and he may then pass one of the screws 12 through the aligned apertures 21 of the blades and into threaded apertures 27 on the hub flange 16. Two other blades may be similarly set at right angles and disposed against the collar 26 and their overlapping joints secured by a second screw 12. The

other two screws may then be readily inserted without holding the blades, since they will be automatically held in position by the screws already set when the blades are urged against the central collar 26. In this connection it will be noted that the blade bases 19 are generally semi-circular in extent with respect to the annular flange 16 of the hub.

Illustrated in Fig. 5 is a knocked-down form of the fan of Fig. 1 wherein it will be noted that all of the fan blades 11 may be nested together and will be generally aligned in this nesting position by the crease 23 in each blade. The four blades thus form a very compact and solid unit which cannot be bent or damaged, even by a severe blow such as might be encountered in extremely rough handling during shipment. The hub 10 may be positioned near the narrow portion 18 of the blades so that the shank of the hub may nest against this curve in the blade group. A small envelope 28 may include the four screws 12 that are necessary for assembly and in addition may include lock washers for these screws. The whole unit, therefore, for a 12" fan, may be disposed within a carton or other container 29 that is not greater than 1½" thick and may be 6" x 6" in the other dimensions. Accordingly, therefore, an extremely small package is sufficient to safely enclose my fan construction for shipment.

Inasmuch as many different styles of motors are provided for rotary fans and may have a large variety of shaft sizes, the reboring of the hub 10 to form a different sized shaft bore 13 therethrough is a common operation. The ability to readily disassemble a fan of my construction permits this reboring operation to take place on a small sized drill-press or lathe.

The fans of my construction are operated in the same fashion as any other conventional fan. They may be assembled by an unskilled operator merely by the use of a screwdriver. The operator may remove the screws from the envelope 28 and then overlap two fan blade bases 19 and pass a screw through their aligned apertures 21 and thread the screw into the threaded aperture 27 of the hub flange 16. Another pair of blades is similarly grasped and disposed at right angles and disposed on the opposite side of the hub 10, and a screw passed through their aligned holes 21. The passing of screws 12 through the other remaining holes completes the assembly.

If, during operation, one of the fan blades becomes damaged so that it is inefficient or unbalances the fan assembly, a new blade made on the same die may be substituted therefor by merely removing the two screws passing through the damaged blade and inserting the new blade. Since all of the blades will be identical in size and shape, the replaced blade will not interfere with the dynamic balance of the entire fan assembly.

Not only does my construction employing an accurately formed hub and identical fan blades secured thereto provide an inherently dynamically balanced fan, but it also permits this fan to be shipped in a knocked-down condition for assembly. This is in contrast to the usual fan now found on the market which must be accurately balanced dynamically prior to shipment and the fan delicately handled thereafter. In addition to being inherently dynamically balanced, the construction is inexpensive compared to the usual type of fan blade and is more efficient. The use of a simple curve on the fan blades results in extremely quiet operation.

Although I have described my invention with respect to a particular embodiment thereof, I do not care to limit myself to this embodiment, nor otherwise, except by the terms of the following claim.

I claim:

A fan construction comprising a central hub having an annular planar flange formed thereon and having a collar projecting from the annular flange, four identical sheet metal fan blades each having bases that are generally semi-circular in extent with respect to the annular flange and also having relieved portions on the base to contact the hub collar, and having a radial step defined by an off-set in the blades extending from the base portion into the body portion of the blades to interconnect portions of the bases and dispose the same in different parallel planes, the off-set being equal to the thickness of the sheet metal, and screws for securing the blades to the annular flange so that one portion of each blade rests upon the flange and the other portion overlies an adjoining blade portion resting on the flange, whereby each blade may be placed in a single plane of rotation, insuring dynamic balance.

JOSEPH T. ROFFY.

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