April 12, 1966 F. P. RODWICK 3,245,476

HUB MOUNTING

Filed Oct. 26, 1964

Fig. 1.

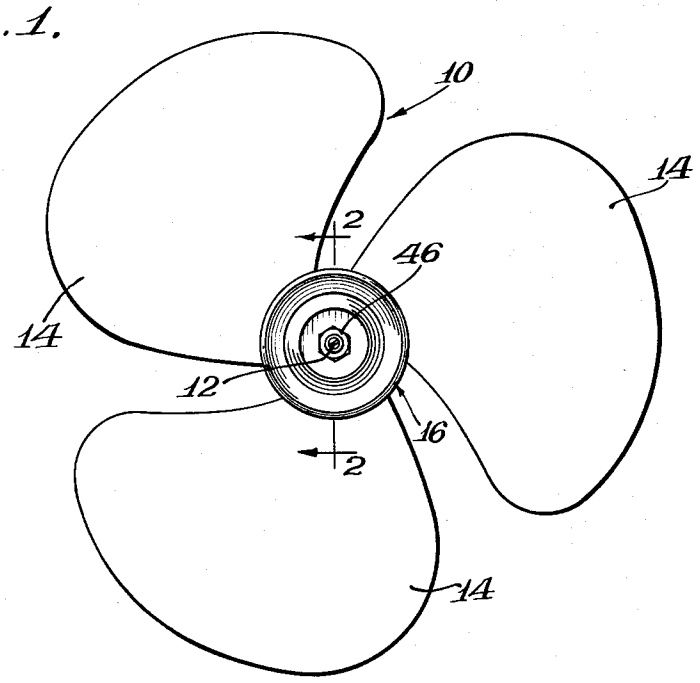


Fig. 2.

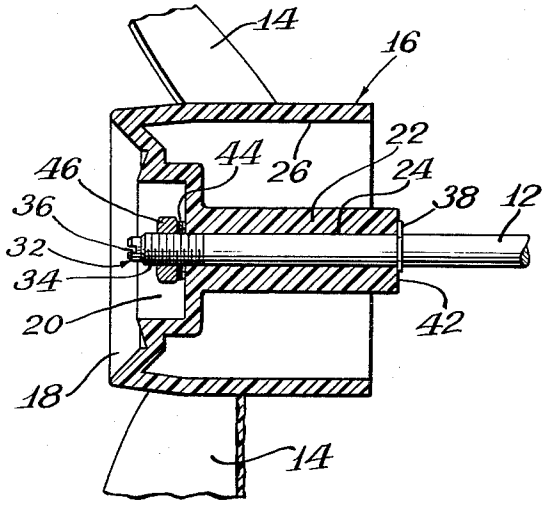
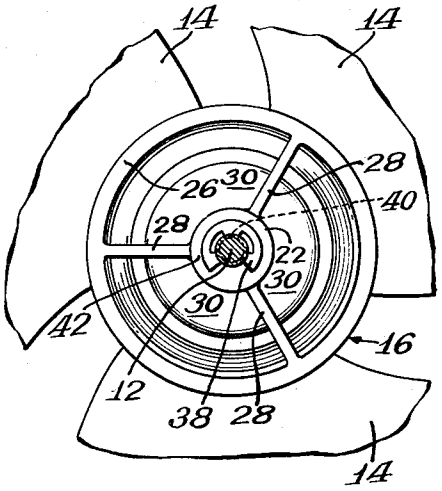


Fig. 3.



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HUB MOUNTING

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This invention relates to improved mounting means for securing a hub of a rotating device on a shaft and it particularly relates to improved means for securely mounting a plastic fan blade hub on a rotating motor shaft.

Generally speaking, there is always a problem associated with mounting a plastic part on a metallic part as a result of the wide variance between the coefficients of expansion of each of such parts and also as a result of cold flow that occurs with plastic material, and particularly in the case of thermoplastic materials. One area in which considerable difficulty has been encountered in obtaining a suitable mounting of a plastic part on a metallic part is in the mounting of a plastic fan blade on a metallic motor shaft. One significant problem associated in mounting a plastic fan blade on a motor shaft is that it is important that the fan blade be tightly secured on the shaft in order to avoid an excessively high noise level, such as would be caused by wobbling of the fan on the shaft during rotation. It is also very important in electric fans that the motor shaft be extremely straight, desirably in the range of .000 to .005 inch deviation of total indicator reading. If the type of mounting used causes a deviation from this desired straightness, the fan would have an eccentric rotation and cause vibration. This would seriously shorten the life of the motor bearings, would cause an excessively high noise level while the fan is operating, and would cause excessive wear in the gear mechanism of the fan.

Although some available motor shaft mountings may satisfy one or another of the foregoing requirements, no known mounting satisfies these requirements while at the same time providing a highly economical construction for the mounting. One of the primary advantages of utilizing a molded plastic fan blade is the economy of its construction. Therefore, in assemblies where the construction cost is increased as a result of an expensive type of mounting, as is now required for use with a plastic fan blade, the economic advantage of using a plastic fan blade may be lost.

It is therefore an important object of this invention to provide an improved mounting for plastic fan blades wherein economy of construction and assembly is effected and wherein the disadvantages of existing mounting constructions are substantially avoided.

It is also an object of this invention to provide an improved plastic fan blade mounting wherein the fan blade is maintained in rigid or firm securement on the motor shaft, to thereby substantially avoid undesired vibrations or movement of the fan blade on the motor shaft during operation.

It is a further object of this invention to provide an improved mounting for a plastic fan blade wherein the mounting arrangement also assists in maintaining the motor shaft in a straight condition, to thereby substantially avoid the adverse effects of eccentric rotation of the fan blade.

Further purposes and objects of this invention will appear as the specification proceeds.

A particular embodiment of the present invention is illustrated in the accompanying drawings wherein:

FIGURE 1 is a front elevational view of a fan blade utilizing my improved mounting construction;

FIGURE 2 is an enlarged fragmentary sectional view taken along the line 2—2 of FIGURE 1; and

FIGURE 3 is an end view taken looking from the right of FIGURE 2.

Referring to the drawings, a molded, integral fan blade **10** is shown mounted upon a metallic motor shaft **12**. The fan **10** defines a plurality of individual blades or paddles **14** which project outwardly from a fan hub **16**. The shaft **12** extends from a motor (not shown) that drives or rotates the fan **10** at a relatively high rotational speed. At this speed, it is important that the fan **10** be held in rigid or firm securement on the motor shaft **12** and that the rotation of the fan be substantially free of eccentricity.

The cylindrical hub **16** defines an outer cylindrical hub wall **26**, a transverse wall **18** of irregular cross-section as seen in FIGURE 2, and a tubular central sleeve **22** coaxial of hub wall **26**. The forward facing side of transverse wall **18** defines depressed annular recess or well **20**. The elongated bore **24** defined by sleeve **22** receives shaft **12**. The terminus of sleeve **22** projects rearwardly of the axial extent of hub wall **26**. A plurality of rigidifying ribs **28** extend radially between hub wall **26** and sleeve **22**, thereby defining a plurality of hollows **30** rearwardly of transverse wall **18**. Although the fan **10** may be constructed of any material commonly used for fan blade construction, including metal, it is preferred for economy of construction that the fan be made of a plastic material. Preferably, the fan blade **10** is constructed of a thermoplastic material, such as propylene or styrene acrylonitrile.

The elongated bore **24** is formed with such dimensions as to slidably receive therein the motor shaft **12**, to thereby provide means toward the end of a firm and rigid mounting of the fan blade **10** upon the shaft **12**. The forward or outer terminus **32** of the motor shaft **12** has a threaded portion **34** and also a screwdriver-receiving slot **36** defined at its extremity.

In positioning the fan **10** upon the shaft **12**, a retaining ring or stop washer **38**, of C-shape for snap mounting, is first mounted upon the shaft **12** by snapping into a suitable groove **40**, that is spaced from the threaded end of the shaft **12**. The hub **16** is slid onto the shaft **12** until the terminus **42** of sleeve **22** abuts the washer **38**, which acts to stop further movement of the fan **10** along the shaft **12**. The axial length of tubular part **22** is greater than the spacing between groove **40** and the threaded end portion of shaft **12**. A resilient toothed lock washer **44** and screw nut **46** on threaded portion **34** of the shaft **12** complete the assembly.

For tightening the nut **46** upon the shaft **12**, a screwdriver may merely be inserted into the slot **36** at the outer end of the shaft **12**, and any appropriate means may be used for tightening up the nut **46** upon the threaded portion **34**. This clamps the lock washer **44** between transverse wall **18** and nut **46**, to secure the fan blade **10** on the shaft **12**.

The threads on the shaft **12** and in the nut **46** may be either left-handed or right-handed, depending upon the rotation of the fan **10**. If the fan rotates in a clockwise direction, left-handed threads are utilized, while if the rotation of the fan is in a counterclockwise direction, right-handed threads are utilized. The reason for this is that this provides for self-tightening of the nut **46** upon the threaded portion **34** while the fan is operating. This is considered important since plastic materials, particularly thermoplastic materials, are subject to cold flow, so that the initial force, such as compression applied to tubular part **22** is likely to vary with time. Therefore, by providing a self-tightening nut, the rotation of the fan **10** will tend to maintain the nut and lock washer **44** tightly against the hub body **16**. It is also important that the lock washer **44** be of the resilient expansible type, so that there is a substantial difference be-

tween its overall thickness while in the free condition and while in its compressed condition, and preferably, this resilience provides a range of expansion of about .020 inch.

The resiliency of the lock washer **44**, together with a substantially high torque on the tightening nut **46** (preferably about 10 inch-pounds) assures a tightening force which will hold the tubular portion **22** of the fan hub **16** in compression between the stop ring **38** and the lock washer **44**. A compression force is maintained even after cold flow, as a result of the compressibility or resiliency of the lock washer **44** and the self-tightening of the nut **46** upon the shaft **12**. By maintaining the hub **16** in compression, the motor shaft **12** is maintained in a substantially straight condition and generally within the desired range of .000 to .005 inch deviation of total indicator reading. If a groove **40** were provided in the shaft **12**, and if no compressive force were involved in the construction of the mounting, the motor shaft **12** would be weakened and would bend quite readily. The maintenance of the central portion **22** in compression thus assists in maintaining the straightness of the motor shaft **12**.

The isolation of cylindrical hub wall **26** from tubular part **22** by spacing therefrom except through radial ribs **28** insures that the axial compression forces on tubular part **22** are normally isolated from hub wall **26**, thereby avoiding distortion in the mounting for the blades **14**.

A further advantage of my construction is that the screwdriver slot **36** enables the nut **46** to be removed or tightened upon the shaft **12** without the necessity of gripping or holding a paddle **14**. Only a simple household screwdriver and a simple household tool such as pliers are needed for manipulating the nut **46** and for restraining the slotted end of the shaft **12** from moving, with both operations occurring at only one end of shaft **12**. It is desirable not to restrain the fan **10** by holding one of the paddles **14**, so as to avoid any strains upon the fan **10**.

While in the foregoing, there has been provided a detailed description of a particular embodiment of the present invention, it is to be understood that all equivalents obvious to those having skill in the art are to be included within the scope of the invention as claimed.

What I claim and desire to secure by Letters Patent is:

1. A fan and shaft construction comprising a metal drive shaft, a plastic hub, at least one plastic blade connected to said hub, said shaft having a slotted and threaded outer end with a resilient lock washer thereon and a circumferential groove spaced from said end, a retaining washer securely mounted in said groove, said hub comprising a central tubular mounting portion with a bore therethrough, the part of the shaft between the retaining washer and the lock washer being received in said bore, a nut threadably secured on the outer end of the shaft compressing the hub between the washers and securing the hub to the shaft, said hub further comprising a coaxial cylindrical hub wall supporting said blade and spaced from and surrounding the tubular mounting portion, and a transverse wall portion connecting the cylindrical hub wall and the tubular mounting portion and including a depressed annular recess which surrounds the nut and lock washer.

2. A fan and shaft construction as in claim **1** wherein the threads on the end of the shaft are selected so as to be self tightening where the shaft is driven in a normal direction of rotation.

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