March 14, 1961 R. S. RADCLIFFE 2,974,502

RESILIENT MOUNTING OF FAN ON SHAFT

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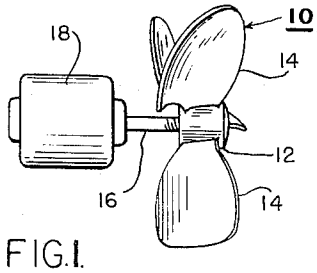


FIG.1.

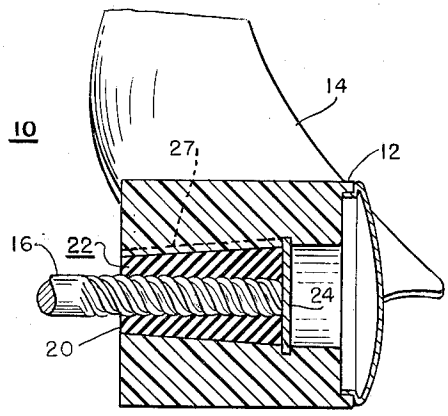


FIG.2.

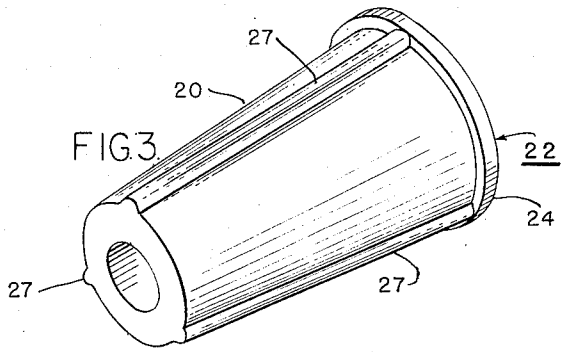


FIG.3.

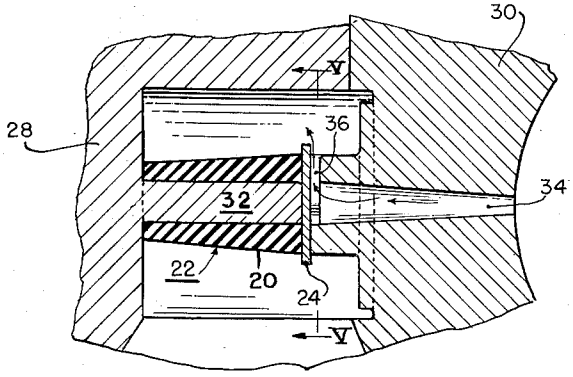


FIG.4.

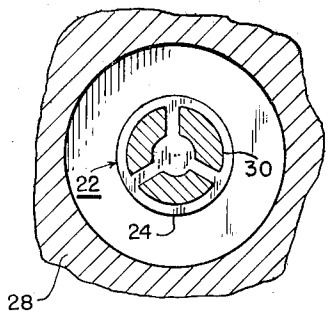


FIG.5.

WITNESSES

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RESILIENT MOUNTING OF FAN ON SHAFT

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This invention relates to fan apparatus and more particularly to the connection between a fan and its driving shaft.

In the past, the operating noise of fans has been minimized through the use of resilient sleeves or bushings for establishing a driving connection between the fan hub and its driving shaft. For the most part, these sleeves have been inserted in the hub after the molding of the fan; and they are removable, even after assembly. In the interest of manufacturing economy and expediency it is desirable to secure the sleeve to the hub when molding the fan. Preferably the sleeve is temporarily mounted on a holding or locating pin within the mold cavity and the fan is then molded about the sleeve, the material being introduced under very high pressure to a central region of the mold and then made to flow to the mold extremities.

Previous attempts to avail of the attractively simple and economical construction of a "molded-in" sleeve insert for a molded fan have met with little success, primarily because of the difficulty of preventing deformation of the resilient sleeve and keeping the mold material from flowing between the locating pin and the internal surface of the sleeve.

As a solution to this problem, the present invention provides an insert comprising a tubular sleeve member having a rigid plate closing one end of the sleeve member. The plate is braced by the locating pin during the molding of the fan to receive the force of the molding material injected axially into the mold cavity without appreciable deflection. The plate not only prevents material from being forced between the locating pin and the sleeve, but also cooperates with the nozzle portion of the die in redirecting the mold material toward the outer extremities of the mold.

Preferably, the sleeve member is so tapered on its outer surface that it is impossible or at least difficult to remove from the hub. The larger end of the sleeve member is inwardly, relative the hub bore, of its smaller end. Furthermore, the plate is secured to the larger end of the sleeve member and has radial dimensions larger than the hub bore so that the plate edges are, in effect, buried in the internal surface of the hub. With this arrangement the insert is secured against axial movement relative the hub.

The various objects, features and advantages of the invention will appear more fully from the detailed description which follows, taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a side elevational view of fan apparatus embodying the invention;

Fig. 2 is a sectional view taken through a fan hub constructed according to the invention;

Fig. 3 is a perspective view of the bushing insert;

Fig. 4 is a sectional view taken through fragments of the molding die and showing the insert positioned in the mold cavity; and

Fig. 5 is a sectional view taken along line V—V of Fig. 4.

Referring to the drawing in detail, a fan 10 comprising a bladed tubular hub 12 is adapted to be mounted on, and driven by, a rotatable shaft 16 of a motor 18. Both the fan 10 and the shaft 16 are of fairly rigid construction and would transmit vibrational energy from one to the other were it not for a resilient tubular sleeve 20 interposed between them. The sleeve 20 forms part of an insert assembly, designated generally by the numeral 22, and may be made of neoprene, rubber, or other rubber-like material.

The shaft 16 may have any suitable shape, but when used with a uni-directional motor it is preferably provided on its exterior surface with steep, multiple, helical threads, as shown. Shafts of this kind and their advantages are described in detail in the copending application of Gustav H. Koch, Serial No. 814,080, filed May 18, 1959, a continuation-in-part of his earlier filed application Serial No. 684,772, filed September 18, 1957, and now abandoned.

The insert assembly 22 comprises, in addition to the sleeve 20, a disc-like plate 24 which is adhesively secured to the larger or inner end of the sleeve 20 for closing it at that end. The plate 24 is made of metal, such as steel, and is sufficiently thick to be rigid when subjected to a jet of molding material entering the die cavity, as will be explained later. As best seen in Fig. 2, the sleeve 20 is shorter than the hub 12 in an axial direction and it tapers away from the plate 24 to the other or open end, which is flush with the corresponding end of the hub. The diameter of the plate 24 is larger than the hub bore and the sleeve proper, or a major portion of the inner end of sleeve 20, so that its periphery or edge is buried in, or interlocked with, the internal surface of the hub 12 at a location between the ends of the hub bore, as shown in Fig. 2. With this arrangement, the taper of the sleeve 20 prevents the removal of the insert 22 after assembly from the left-hand end of the hub bore, and the interlocking of the plate 24 with an annular groove in the internal surface of the hub prevents the removal of the insert from the right-hand end of the hub bore. The sleeve 20 is further provided on its outer surface with axially elongated, radially outwardly extending driving ribs 27, three for example, to establish a driving relationship with the hub 12 for the transmission of torque between these parts.

The fan 10 is molded from suitable plastic materials commercially available under such names as "Bakelite" and "Styrex," although there are other molding materials equally suitable. Now referring to Fig. 4, a molding die is shown which includes two halves or parts 28 and 30, respectively having the coaxially aligned locating pin 32 and diverging injection nozzle 34. When mounted on the locating pin 32 the plate 24 is braced thereagainst for resisting the full force of the plastic material entering the mold cavity through the injection nozzle 34. Attempts to mold a fan hub about a tubular insert not having an end wall were unsuccessful because some molding material was forced between the locating pin and the insert; this is obviously objectionable. In previous arrangements wherein the insert 22 had a closed end molded integrally with the sleeve 20 and of the same resilient material, the end deformed in compression as a result of the entering material jetting against it. This is prevented by the plate 24 which assists the die in changing the axial direction of flow for the molding material toward the radial extremities of the die and away from the end of the sleeve 20. In the present arrangement a plurality of gates 36 provide a passageway for the molding material between the nozzle 34 and the die cavity; and

these gates extend radially between the plate 24 and the die half 30.

Upon completion of the molding operation and the separation of the mold parts 28 and 30, the locating pin 32 is withdrawn from the insert 22 and it is only necessary to separate from the hub 12 any material attached thereto which remains from having solidified in the nozzle 34 and the gates 36. The fan 10, with its "molded-in" insert 22 is then ready to be mounted on the shaft 16 of the motor 18 by a threading action.

Referring again to Fig. 1, wherein the motor shaft 16 is threaded to establish a driving connection with the insert 22, it will be noted that operation of the motor 18 tends to cause counter-revolutionary movement of the hub 12 and insert 22 with respect to the shaft 16. This is due to the blades tending to resist rotation as a result of air resistance; and in this situation the shaft 16 advances in the insert 22 until the shaft "bottoms" or engages the plate 24. Binding of the shaft threads in the insert 22 results, and a driving connection is established. Clearly, then, the plate 24 is better able to withstand the thrust of the shaft 16 than the resilient end walls of the prior art.

From the foregoing it can be seen that a highly practicable insert has been devised which permits a resilient bushing or sleeve to be "molded-in" a bladed hub, with the advantages of preventing its deformation during the molding operation, preventing the flow of molding material between its inner surface and the locating pin, and providing a rigid thrust-resisting end wall.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. The combination of a rigid shaft, a molded hub, and a resilient bushing for establishing a driving connection between said shaft and said hub, said hub having a generally tubular bore extending along the rotational axis thereof, said hub being molded about said bushing; said bushing comprising a tubular member adapted to receive said shaft and which, in an axial direction, is tapered from one end to the other on its outer surface, and a rigid plate intermediate the ends of said bore secured to said member for closing said one end of said member, said plate being diametrically larger than said hub bore, said plate being adapted to receive the axial force of the molding material which is injected adjacent said one end of said tubular member during the molding of said hub.

2. The combination of a rigid shaft, a molded hub, and a resilient bushing for establishing a driving connection between said shaft and said hub, said hub having a generaly tubular bore extending along the rotational axis thereof and being molded about said bushing; said bushing comprising a tubular member which, in an axial direction, is shorter than said hub and is tapered from one end to the other on its outer surface, and a rigid plate secured to said member for closing said one end of said member, said plate being diametrically larger than said hub bore and extending radially outwardly beyond a major portion of said one end of said member in interlocking relationship with said hub.

3. The combination of a rigid shaft, a tubular hub, and a resilient driving bushing for attaching said hub to said shaft and for transmitting torque from the shaft to the hub, said hub being molded about said bushing and comprising: a resilient tubular member which, in an axial direction, is shorter than said hub and is tapered from one end to the other on its outer surface, and a rigid plate secured to said member for closing said one end of said member and extending radially outwardly beyond a major portion of said one end of said member, and axially elongated protuberances extending radially outwardly from the outer surface of said member.

4. A resilient bushing for establishing a driving connection between a rigid shaft and a hub having a generally tubular bore extending along the rotational axis thereof, said hub being molded by the injection of molding material axially into a central region thereof; said bushing comprising a tubular member which, in an axial direction, is shorter than said hub and is convergingly tapered from one end to the other on its outer surface, said other end of said member being flush with the corresponding end of said hub, and a rigid metallic disc secured to said member for closing said one end of said member and extending radially outwardly beyond adjacent internal surface portions of said hub.

5. The combination of a rigid shaft, a molded hub having a generally tubular bore extending along the rotational axis thereof, and a resilient bushing for establishing a driving connection between said shaft and said hub, said hub being molded about said bushing; said bushing comprising: a resilient tubular member adapted to receive said shaft, and a rigid plate intermediate the ends of said bore closing one end of said tubular member; said plate being adapted to receive the axial force of the molded material which is injected adjacent said one end of said tubular member during the molding of said hub.

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