Jan. 24, 1939. J. R. THORP 2,144,860

FAN

Filed July 10, 1937

Fig. 1.

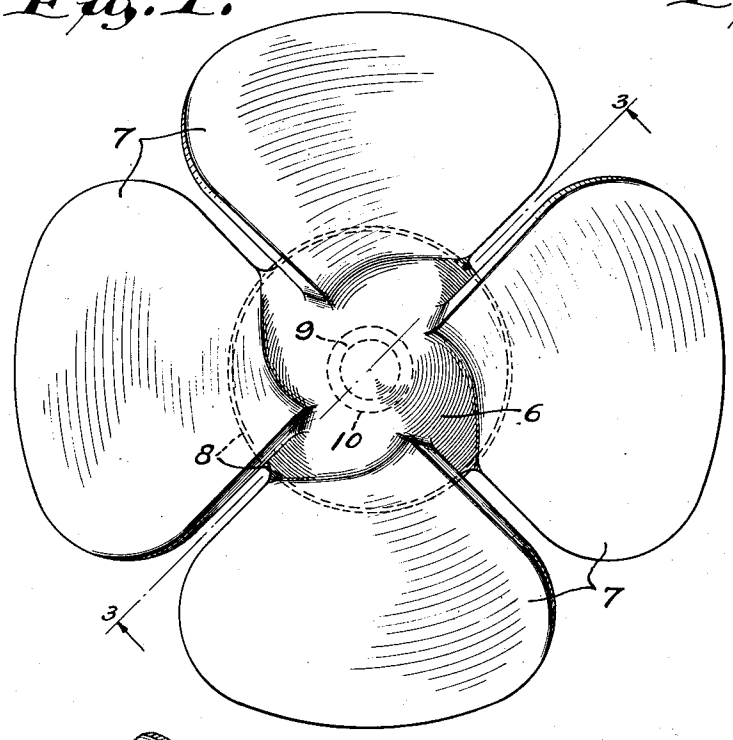
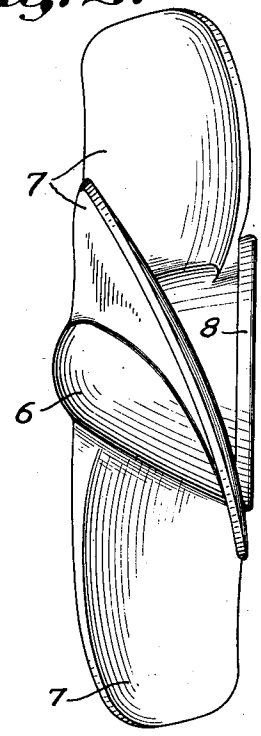



Fig. 2.



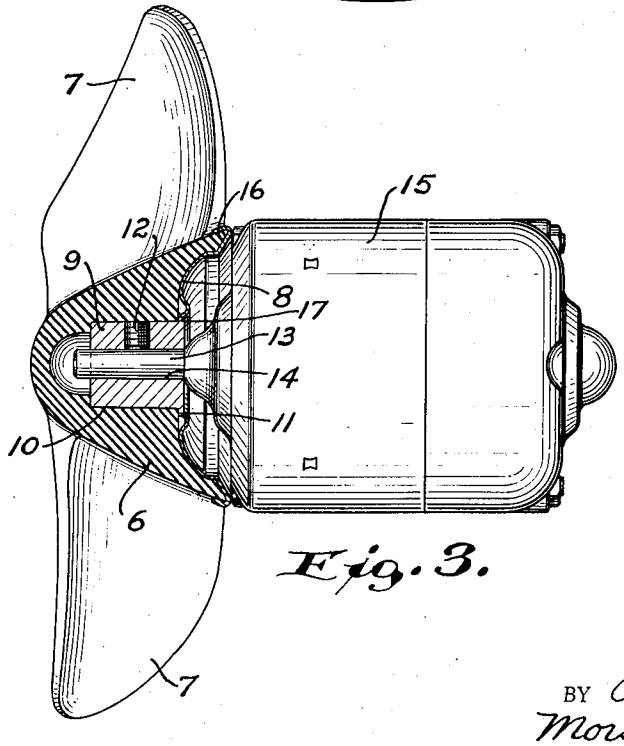




Fig. 3.

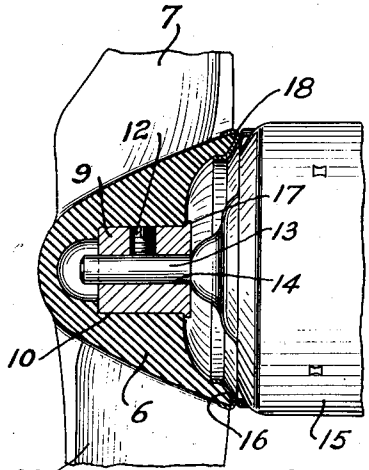



Fig. 4.

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# UNITED STATES PATENT OFFICE

2,144,860

## FAN

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Application July 10, 1937, Serial No. 152,946

4 Claims. (Cl. 170—159)

The present invention relates in general to improvements in the art of manufacturing impellers for fluids, and relates more specifically to improvements in the construction and operation of fan rotors or the like.

Generally stated, an object of my invention is to provide an improved flexible bladed rotor which may be readily constructed, and which is also highly efficient in operation.

Several types of fans having flexible bladed rotors, have heretofore been proposed, and while some of these prior devices accomplish the purpose of substantially eliminating danger of injury when the blades are contacted while the fan is in operation, they are all either quite complicated or flimsy in construction. In order to avoid annoying noises while such rotors are operating at high speed, they must be perfectly balanced and accurately centered with respect to the axis of rotation, and the manufacture of such impellers is greatly facilitated if the flexible blades are formed integral with the supporting hub. The blades moreover should have sufficient rigidity to provide effective impellers, while at the same time introducing sufficient flexibility to make the use of guard cages unnecessary, and none of the prior flexible blade fan rotors embody all of these desirable features.

It is therefore a more specific object of my present invention to provide a new and useful flexible bladed rotor which does in fact embody all of the above mentioned desirable features, and which may be manufactured and sold at moderate cost.

Another specific object of the invention is to provide an improved rubber rotor having the blades and hub thereof formed integral, and provided with means for effecting and insuring convenient mounting thereof on a supporting shaft.

A further specific object of my invention is the provision of a propeller type of rotor formed entirely of semi-flexible material such as pliable rubber, wherein the blades are sufficiently stiff to normally impel the fluid but will yield to obstructions inserted within their path of revolution.

Still another specific object of this invention is to provide a simplified mounting for a rotor having a rubber hub, whereby the hub may be conveniently and effectively attached to a shaft in accurately centered position.

These and other specific objects and advantages of the present invention will be apparent from the following detailed description.

A clear conception of the several features constituting the present improvement, and of the mode of constructing and of utilizing rotors built in accordance with my present invention, may be had by referring to the drawing accompanying and forming a part of this specification wherein like reference characters designate the same or similar parts in the various views:

Fig. 1 is a full front or plan view of one of my improved flexible bladed rotors;

Fig. 2 is a side elevation of the rotor shown in Fig. 1;

Fig. 3 is a central section through the rotor of Figs. 1 and 2 taken along the line 3—3, showing the same mounted for direct propulsion by an electric motor; and

Fig. 4 is a fragmentary central vertical section of an assemblage similar to that of Fig. 3, but showing a modified mounting for the rotor.

While I have shown and described my invention herein as being specifically embodied in a flexible bladed fan rotor directly operable by an electric motor, it is not the intent to thereby unnecessarily limit or restrict the scope or use of the invention, since the improved impellers may also be used as propellors for boats or the like and for many other purposes.

Referring to the drawing, and especially Figs. 1, 2 and 3, the improved fan assemblage shown therein comprises in general a rotor formed of one piece of rubber and having a substantially conical or dome shaped central hub 6 and a series of four fan shaped helicoidal flexible blades 7 radiating from the hub 6; a sheet metal reenforcing and centering ring 8 clamped to the larger extreme end of the hub 6; a metallic centering bushing 9 coacting with the central bore 10 of the rubber hub 6 and with the central opening 11 in the ring 8, and having an attaching set screw 12; a driving shaft 13 snugly fitting the central bore 14 of the bushing 9 and to which the bushing is firmly attached by means of the set screw 12; and an electric motor 15 or other propelling means associated directly with the drive shaft 13.

The rubber rotor is preferably formed by casting the hub 6 and blades 7 integral with each other, and the central bore 10 of the hub 6 is preferably of such diameter that the bushing 9 when driven into this bore will tightly engage the hub and will drive the same by frictional contact. The blades 7 should be so formed and located as to produce a dynamically balanced rotor, and these blades 7 besides being helicoidal in shape are gradually thickened toward the central axis of the rotor so as to insure a durable con-

nection with the tapered hub 6. The formation of the blades 7 of relatively soft rubber will however permit flexing of these blades when an object such as a human hand is brought into the path of revolution of the blades 7, but the thickening of the blades at their bases will cause the same to normally resist undesirable deflection.

The reenforcing and centering ring 8 may be formed of sheet metal with the aid of dies, or it may be spun into shape, and the peripheral portion of this ring has a V-shaped groove 16 which tightly embraces the correspondingly V-shaped annular enlarged end of the dome shaped hub 6. The entire end surface of the ring 8 snugly engages the adjacent end of the hub 6, and the flange at the ring periphery is forced into engagement with the hub periphery so as to clamp the ring in position. The central opening 11 of the ring 8 is accurately centered relative to the rotor axis, and may be slightly tapered by beading the ring as shown in Fig. 3 so as to facilitate insertion of the bushing 9.

The bushing 9 may be formed of any relatively hard material and is generally cylindrical in shape but may be slightly tapered for convenient endwise insertion within the hub bore 10. The outer end of the bushing 9 is provided with a flange 17 which performs the dual function of providing a stop for limiting the inward movement of the bushing relative to the hub 6, and of centering the bushing 9 within the ring opening 11. The periphery of the flange 17 snugly engages the opening 11 thereby positively centering the ring 8 relative to the bushing 9 when these parts are finally assembled. The set screw 12 is of the headless type and the bushing 9 may be firmly attached to the shaft 13 with the aid of the screw 12 before the bushing is driven into the rotor bore 10.

The driving shaft 13 should snugly fit the bore 14 of the bushing 9, and may be direct driven by an electric motor 15, or it may be belt driven through a pulley. The electric motor 15 shown in the drawing has an external diameter substantially equal to that of the ring 8, and also has a front bearing disposed within the cavity formed by the ring 8, thereby providing an extremely compact assemblage.

The modified assemblage of Fig. 4 is quite similar to the structure of Fig. 3 except that the sheet metal end ring 18 coacts only with the dovetailed annular peripheral portion of the hub 6, and does not contact the bushing 9 directly. The ring 18 is also formed of sheet metal and is clamped upon the hub end concentrically with the bore 10.

When the several parts have been properly constructed in the manner above described, the rotor may be pressed upon the bushing 9 which has previously been firmly attached to the drive shaft 13 with the aid of the set screw 12, and will thus be frictionally secured to the bushing 9. Because of the relatively large external diameter of the bushing 9 and of the fact that the bushing is forced into snug engagement with the bore 10, the rotor will not slip and will be operated at the same speed as the shaft 13 whenever the motor 15 is operating. The formation of the helicoidal blades 7 and the integral attachment thereof to the hub 6, will normally prevent undesirable deflection of these blades, but if they encounter a solid obstruction they will flex so as to avoid damaging the blades and injuring the obstruction.

From the foregoing detailed description, it will be apparent that the improved rubber rotor may be readily constructed and mounted upon a drive shaft so as to insure accurate centralizing and balancing of the impeller. The formation of the hub 6 of rubber and integral with the blades 7, permits convenient application of the rotor to the bushing 9, or removal therefrom. The use of a centering and retaining ring 8 coacting with the enlarged end of the hub 6, provides an effective reenforcement for the hub end and permits the formation of the hub 6 with relatively large external diameter and internal bore 10, without materially interfering with the efficiency of the rotor. The helicoidal formation and disposition of the blades so as to provide for maximum projected area on a plane perpendicular to the rotor axis, also enhances the efficiency to a maximum, and the rotor assemblage may obviously be manufactured at moderate cost and presents an extremely neat appearance.

It should be understood that it is not desired to limit this invention to the exact details of construction herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

I claim:

1. A rotor comprising, a tapered rubber hub having a central hole therein and flexible blades formed integral with said hub, a bushing pressed within said hole, and a centering ring firmly secured to the larger end of said hub centrally of said bushing, said ring having a central opening engaged by said bushing.

2. A rotor comprising, a dome shaped hub having a central bore and flexible blades of varying thickness having their thickest portions formed integral with said hub, a centering bushing snugly fitting said bore, and a reenforcing ring having a dome shaped groove engaging the peripheral end portion of said hub centrally with respect to the axis of said bushing.

3. A rotor comprising, a dome shaped hub having a central bore and flexible blades of varying thickness having their thickest portions formed integral with said hub, a centering bushing snugly fitting said bore, and a reenforcing ring having a dome shaped groove engaging the peripheral end portion of said hub centrally with respect to the axis of said bushing, said ring having a central opening coacting directly with an end portion of said bushing.

4. A rotor comprising, a dome shaped hub formed of rubber and having a central bore and flexible rubber blades of varying thickness having their thickest portions formed integral with said hub, a centering bushing snugly fitting said bore and having an end flange abutting the end of said hub, and a sheet metal ring firmly secured to the peripheral portion of the larger end of said hub and having a central opening snugly embracing said bushing flange.

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