July 5, 1938. E. S. PRESTON 2,123,146

RUBBER BLADED FAN

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Fig. 1

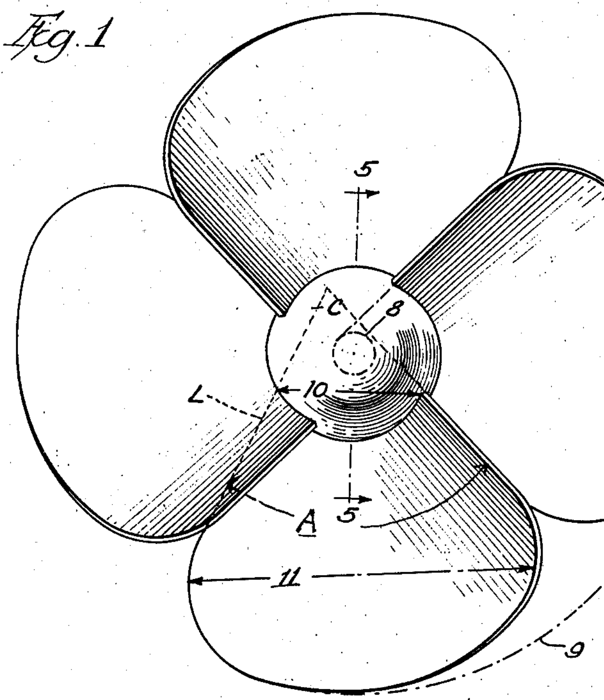

Fig. 4

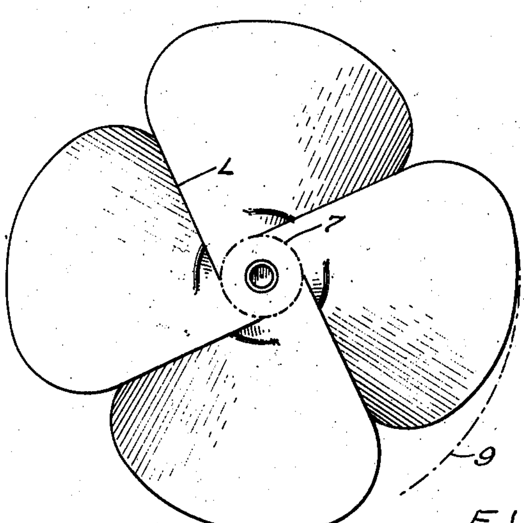

Fig. 3

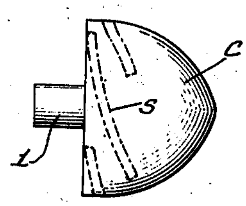

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Fig. 2

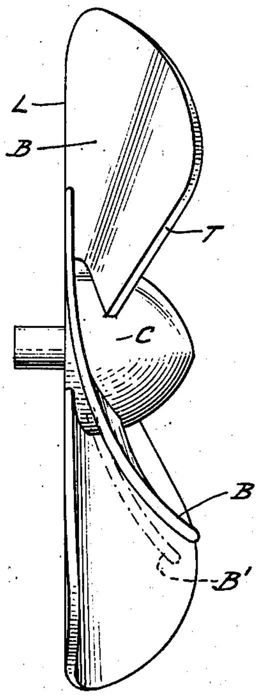


Fig. 5

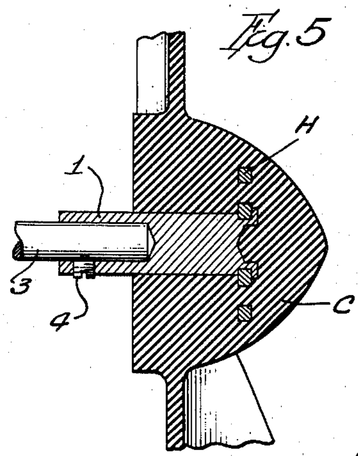


Fig. 6

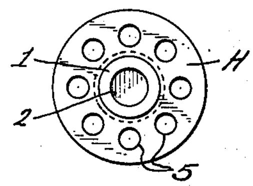


Fig. 7

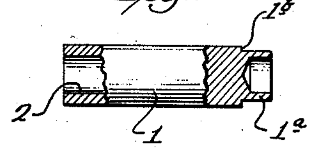


Fig. 9

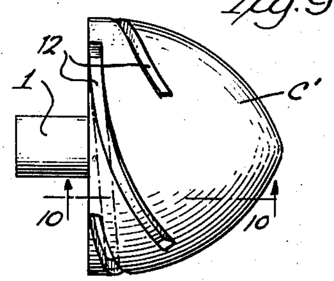


Fig. 8

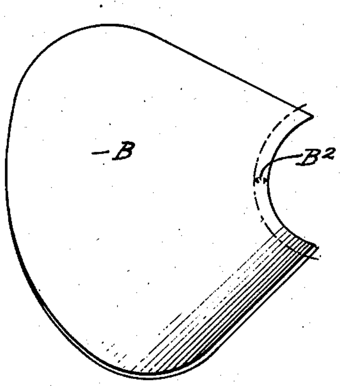
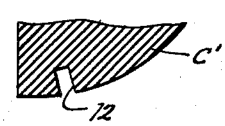


Fig. 10



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Patented July 5, 1938

2,123,146

UNITED STATES PATENT OFFICE

2,123,146

RUBBER BLADED FAN

Edward S. Preston, Chicago, Ill., assignor to Chicago Electric Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application August 7, 1936, Serial No. 94,775

5 Claims. (Cl. 170—159)

My invention relates to the rotating fan-blade members of electric fans, its general objects being those of providing an easily and inexpensively manufactured assembly of fan blades with the hub member supporting these blades, which will permit the fan blades to be of a suitably flexible rubber so as to eliminate the need of a wire guard housing the blades.

Furthermore, my invention aims to provide a fan-blade member in which flexible rubber blades are mounted on a frontal and forwardly tapering hub portion, the peripheral face of which hub portion guides part of the air to the blades so as to increase the efficiency of the fan. For this purpose, my invention aims to provide a fan-blade member in which such a forward hub portion can either be moulded integral with the blades, or have the inner end portions of the blades socketed into it so as to permit the said hub portion to be of a harder material than that of the blades.

In addition, my invention aims to provide a simple and effective assembly of such a frontal hub portion with a metal hub part adapted to be attached to the shaft which rotates the fan-blade member.

In manufacturing and selling household electric fans on a large scale I have found that the extensiveness of their use has been greatly retarded both by the noise due to the interference of portions of the usual wire guards with the free movement of the air propelled by the fans, and by the accidents which can readily occur if a finger of a hand enters the interior of the wire guard. Furthermore, the manufacturing and attaching of a wire guard involves a considerable cost, and the objectionable noisiness of electric fans is often caused either by a loosening of some portion of the guard-attaching provisions or by a relative loosening of constituent portions of the wire guard.

My present invention aims to overcome all of the above recited handicaps and objections, and particularly aims to provide a fan member which will not be apt to injure the hands of children when used without any guard around it, and which can readily be employed in connection with the usually employed fan motor constructions.

Illustrative of the manner in which I accomplish the above recited objects,

Fig. 1 is a front elevation of a hub and fan-blade member embodying my invention, in which the blades and the blade-carrying frontal hub portion are integral.

Fig. 2 is side elevation of the same member.

Fig. 3 is a side elevation of the entire hub member, including the metal stem through which that member is attachable to a shaft, with dotted lines indicating the junctures of blades with the conoidal hub portion of the said member.

Fig. 4 is a rear elevation of the hub and fan-blade member, drawn on a smaller scale than Figs. 1 and 2.

Fig. 5 is an enlarged section through the central portion of the hub and fan-blade member, taken along the line 5—5 of Fig. 1, and including part of a shaft to which that member is attached.

Fig. 6 is a front elevation of the head of the said metal stem, drawn on the same scale as Fig. 5.

Fig. 7 is a partially sectioned elevation of the shank part of the said metal stem, showing this as it appears when initially formed.

Fig. 8 is an elevation of an initially flat rubber blade suitable for having its inner portion socketed in a notch in a separately formed conoidal hub part, drawn on the same scale as Fig. 1.

Fig. 9 is an elevation of a separately manufactured hub member provided with notches in which the inner ends of blades, such as the one shown in Fig. 8, can be socketed, drawn on the same scale as Fig. 5.

Fig. 10 is a fragmentary section, taken along the line 10—10 of Fig. 9.

In constructing the hub and fan-blade assembly of Figs. 1 to 5, I first provide a generally cylindrical stem shank 1 having an axial bore 2 extending forwardly into it for receiving the forward portion of a motor shaft 3, and having a lateral and threaded bore near its rear end for receiving a screw 4 to fasten the said shank to the said shaft. The stem shank 1 has its forward end portion 1a reduced in diameter so as to present a forwardly facing annular shoulder 1b, and this forward portion is bored to constitute a thin-walled tube, as shown in Fig. 7.

Next I provide a disk-like stem-head H (Fig. 6) having an axial bore which will fit over the tubular shank portion 1a, and having longitudinal bores 5. This stem-head is slid rearwardly on the said shank portion until it seats on the annular shoulder 1b, and the forwardly projecting end of the said tubular shank portion is thereafter expanded to clinch it against the face of the stem-head H as shown in Fig. 5, thereby making this head effectively integral with the shaft-supportable stem 1.

Then, by using a suitable mold into a portion of which the rear end of the said stem shank is set, I mold the desirably conoidal hub portion C around the forward parts of the said metal stem, in doing which the rubber fills the bores 5 of the stem-head so as to lock the stem against rotation with respect to the rubber body of the said hub portion. With a suitably constructed mold, the blades B of the fan can readily be molded in this manner simultaneously with the said hub portion, thereby expediting the manufacture and causing my hub member to present a frontal central portion which, because of the yielding nature of the rubber, will not damage a hand contacting with it.

Each such blade preferably decreases gradually in thickness from its trailing edge to its leading edge, as shown in Fig. 2, thereby reducing the flexing action of air pressure on the blade part near the leading edge, but may have its extreme inner end portion of a uniform thickness as shown by the dotted lines S in Fig. 3. The radial length of each blade also preferably decreases gradually from the midwidth portion of the blade to its trailing edge, as shown in Fig. 4 by comparison with a dotted arc 9 concentric with the fan-blade member.

Each of the blades has its inner end, namely the juncture of the blade with the conoidal hub portion, extending spirally of the periphery of the said hub portion (as shown by the dotted lines S in Fig. 3) and concaved forwardly to a sufficiently greater extent than that which would be required (if the blade were inflexible) for giving the blade the desired curvature, or screw-thread pitch, such as that shown in dotted lines at B¹ in Fig. 2. This difference in curvature can readily be determined experimentally according to the flexing effect of the back thrust of air on a blade of a given grade of rubber at the speed of the motor shaft which is to rotate the blade member, so that the back pressure of the air moved by the blade will flex the blade from its shaping B′ (when the fan is not running) to the effective operative shape B of the blade.

Consequently, when the fan is rotating, each blade will still be skewed (out of a plane at right angles to the axis of the fan) sufficiently for effectively scooping up and propelling air.

In practice, each blade desirably has the rear face of the inner end portion of its leading edge L substantially flush with and tangential to the flat rear end of the conoidal hub portion C. This leading edge also desirably has its major and radially inner portion straight and tangential to an imaginary circle 7 (shown dotted in Fig. 4) of considerably smaller diameter than the rear end of the said hub portion C, and has the outer end of each edge curvedly connected to the radially outer end of the blade. Moreover, the trailing edge T of each blade desirably has a straight portion tangential to an imaginary circle 8 (Fig. 1) of less diameter than the aforesaid circle 7, the last named straight edge portion being shorter than the straight portion of the leading edge but also of more than half the entire length of the said trailing edge.

Moreover, the part of each blade adjacent to both the leading edge L of that blade and the hub portion C desirably extends behind a portion of the next blade (as shown in Fig. 1) and is sufficiently spaced rearwardly from the latter portion to permit a part of the mold to extend into this space and to facilitate movement of air between the consecutive blades.

I also have found it desirable to have the straight portions of the leading and the trailing edge of each blade converge at an angle A (Fig. 1) sufficiently less than 360 degrees divided by the number of blades, so that the juncture S of the blade with the hub member will be adequately long to have the desired effect on the curvature of the faces of the blade. That is to say, for a four-bladed fan the said angle A then is considerably less than 90 degrees, as for example only 65 degrees in Fig. 1, so that each of blade juncture portions S in Fig. 3 extends along more than a quarter of the circumference of the hub portion C.

Thus constructed, and with the spread 10 of the inner ends of each blade not more than half the maximum width 11 of the blade, as shown in Fig. 1, I have found my novel hub and blade member highly efficient in a four-blade type as here illustrated. However, it should be obvious without separate picturing that either a smaller or a larger number of blades might be used with the same hub member and with the blades otherwise disposed as previously described.

Likewise, instead of molding the blades integrally with the conoidal hub portion by a single operation, the blades of my novel hub and blade member may initially be formed separately and thereafter attached to the hub part. To accomplish this after the manner of Figs. 8 to 10, I form the conoidal hub part C¹ (while molding it around part of the metal stem) with surface grooves 12 as shown in Fig. 9, each of which grooves corresponds in shape and spiral pitch and position to one of the blade and hub juncture outlines S in Fig. 3, and each of which grooves is of sufficient depth to house an inner end portion B² of a blade which is correspondingly lengthened at its inner end as shown in Fig. 8. Then I insert the inner end of each blade into one of the said slots and anchor it there by means of a rubber cement or the like. By proceeding in the just recited alternative manner, I can have the blade-supporting hub part vulcanized to a greater extent than the blades, so as to give this hub part a smoother exterior which will produce less friction; and with such separately formed blades the blade-supporting part could also be made of metal, plastic composition or other solid material.

So also, while I preferably make the blade-supporting part of my hub member of a forwardly tapering conoidal shape, this shape may be varied, as also the provisions for fastening the said part to the shaft of the motor, and many other changes obviously might be made without departing either from the spirit of my invention or from the appended claims.

I claim as my invention:

1. An impeller of the class in which blades are supported by and project radially from a hub of molded material, a hub and stem assembly comprising a metal stem having its rearward portion constructed for attachment to a shaft coaxial with the stem; the stem having its forward part extending axially into and imbedded in the molded material of the hub, and having a portion of the said imbedded part shaped so that portions of the molded material in which the said portion is imbedded will prevent a relative movement of the hub with respect to the stem both longitudinally and rotationally of the stem.

2. An impeller of the class in which blades are supported by and project radially from a hub of

molded material, a hub and stem assembly comprising a metal stem having its rearward portion constructed for attachment to a shaft coaxial with the stem; the stem having a diametrically enlarged forward portion imbedded in the molded material of the hub, the said enlarged stem portion having bores in which portions of the molded material are also imbedded.

3. An impeller of the class in which blades are supported by and project radially from a hub of molded material, a hub and stem assembly comprising a metal stem having its rearward portion constructed for attachment to a shaft coaxial with the stem; the stem having a diametrically enlarged forward portion imbedded in the molded material of the hub, the said enlarged stem portion having bores extending through it parallel to the axis of the stem, and filled with portions of the molded material of the hub.

4. In an impeller of the class in which blades project radially from a hub of molded material, a stem member coaxial with the hub and having its forward part imbedded in the material of the hub; the stem member comprising a shank having a diametrically reduced forward facing annular shoulder adjacent to the rear end of the said diametrically reduced portion, and a centrally perforated head sleeved upon the said reduced portion and bearing rearwardly against the said shoulder, the said reduced portion of the said shank having its forward end expanded to clamp the head rigidly against the said shoulder.

5. In an impeller of the class in which blades project radially from a hub of molded material, a stem member coaxial with the hub and having its forward part imbedded in the material of the hub; the stem comprising a shank having at its forward end a diametric enlargement presenting a forward face and also presenting a rearwardly facing annular face, the said enlargement having bores extending through it and opening through the said face; the hub having portions of its molded material firmly imbedded against the said forward face, the said annular face and a part of the shank adjacent to the said annular face, and also having portions of the molded material filling the said bores.

EDWARD S. PRESTON.