Aug. 26, 1941. L. ZAIGER 2,254,024

FLEXIBLE-BLADED FAN

Filed Aug. 5, 1938

Fig.1.

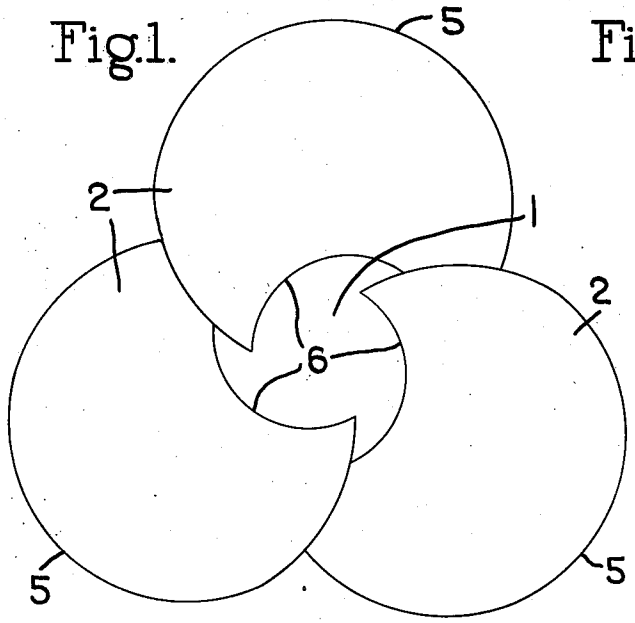



Fig.2.

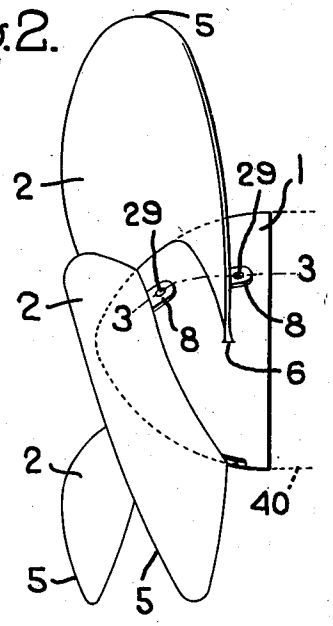



Fig.4.

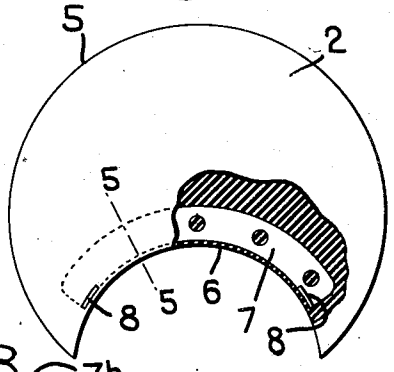



Fig.3.

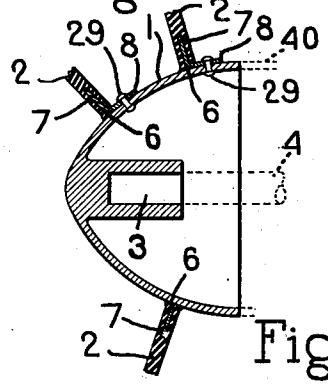



Fig.5.

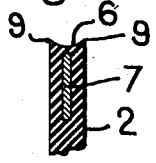



Fig.10.

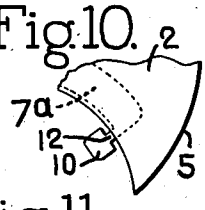



Fig.8.

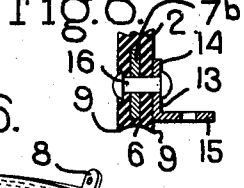



Fig.9.

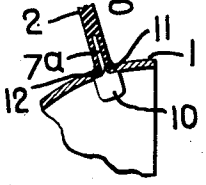



Fig.11.

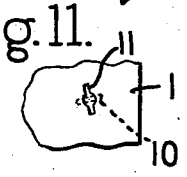



Fig.6.

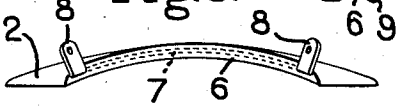
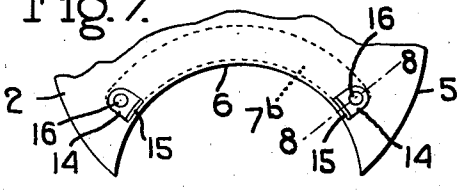



Fig.7.




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# UNITED STATES PATENT OFFICE

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## FLEXIBLE-BLADED FAN

Louis Zaiger, Lynn, Mass.

Application August 5, 1938, Serial No. 223,241

9 Claims. (Cl. 170—173)

This invention relates to flexible-bladed fans and particularly to fans of this type wherein the blades are made as separate units which are secured to a hollow hub member.

One of the objects of the invention is to provide a fan of this type in which each blade is interiorly reinforced to such an extent as to give it sufficient rigidity to maintain its pitch angle, the interior reinforcement being of such character that it does not interfere with the flexible character of the blade.

In a fan embodying my invention, the reinforced blades are preformed to give them the required curved shape and pitch angle and then are secured to the exterior of the hollow hub member by a connection which, of itself, would not produce the required curved shape of and pitch angle in the blade, such curved shape angle being maintained by the interior reinforcement of the blade.

Other objects of the invention are to provide various improvements in flexible-bladed fans which will be more fully hereafter set forth.

In the drawing wherein I have illustrated some selected embodiments of my invention:

Fig. 1 is a front view of a fan embodying my invention;

Fig. 2 is a side view of the fan;

Fig. 3 is a section on the line 3—3, Fig. 2;

Fig. 4 is a view of one of the blades as it is molded;

Fig. 5 is an enlarged fragmentary section on the line 5—5, Fig. 4;

Fig. 6 is an edge view of the blade shown in Fig. 4 illustrating the blade deformed to the required pitch angle;

Fig. 7 is a fragmentary view of a blade showing a modified form of the invention;

Fig. 8 is an enlarged section on the line 8—8, Fig. 7;

Fig. 9 shows a fragmentary sectional view of still a different embodiment of the invention;

Fig. 10 is a fragmentary view of a blade illustrating the form of the invention shown in Fig. 9;

Fig. 11 is a fragmentary view of a portion of the hub showing the slots therein by which the blade shown in Fig. 10 is secured to the hub.

In the drawing, 1 indicates the hub portion of the fan and 2 are the flexible blades. The hub of the fan is shown as in the form of a hollow shell member provided with an interior boss 3 adapted to receive the end of the motor shaft or driving shaft 4. In some fans of this type the hollow hub 1 may form a continuation of a motor housing 40 enclosing a motor, the shaft of which is shown at 4 in dotted lines in Fig. 3.

The blades 2, which may have any desirable shape, are preferably made of rubber or some other suitable flexible material, each blade presenting the outer convexly curved edge 5 and the inner concavely curved edge 6 which fits against the hub portion 1 and which is referred to as the "mounting edge" since it is the edge of the blade which is mounted on the hub.

The soft rubber or other flexible material of which the body of the blade is made has not of itself sufficient rigidity to maintain the blade in any predetermined curved shape or at any given pitch angle when the fan is in operation, but each blade is interiorly reinforced adjacent its inner edge by a suitable reinforcing member 7, which may be a strip of sheet metal or may be fabric or any other reinforcement which has of itself sufficient rigidity to maintain the required curved shape of and pitch angle to the blade. This reinforcement is located entirely adjacent the inner or mounting edge 6 of the blade and extends only a short distance from said edge so that the greater portion of the blade is non-reinforced and is sufficiently flexible so that it will yield when it strikes an object. The blade, however, has the capacity of resuming its normal shape as soon as the deforming pressure against the blade has been removed.

For attaching the blade to the hub, said blade is provided with two attaching ears, one adjacent each end thereof, which ears are secured to the hub by some suitable means. In Figs. 2 and 3, the reinforcing strip 7 is formed with two laterally extending ears 8 at the edge 6 of the blade. These ears 8 lie against and are riveted or otherwise rigidly secured to the outer face of the hub 1 as shown at 29.

In making the blade 2, it is preferably molded to shape in a flat condition, the reinforcing strip 7 being molded into the blade. After the blade is molded, then the reinforced blade is deformed or curved slightly from its leading edge to its trailing edge as shown in Fig. 6, in order to give it the required curved shape and pitch angle, and the reinforcement 7 is of such character that it will preserve the blade in its deformed shape and will thus maintain the required pitch angle of the blade independent of the means by which the blade is secured to the hub.

Each blade is preferably molded with a concave mounting edge 6 as shown in Fig. 5, and hence the blade presents at its base the two

flexible edges 9. These edges project somewhat beyond the inner edge of the reinforcing member 7 and beyond the ear 8. As a result, when the blade is attached to the hub by riveting or otherwise securing the ear 8 thereto, these edges 9 of rubber yield laterally and tightly hug the exterior surface of the hub 1 thereby making a preferably tight joint between the inner edge of the blade and said hub.

In Figs. 9 and 10, I have shown a different way of attaching the blade to the hub. In this embodiment, the reinforcing strip is indicated at 7a and it is formed with two attaching ears or lugs 10, one at each end, which normally lie in the plane of the reinforcing member, and are connected thereto by a neck portion 12. The hub 1 is provided with slots 11 to receive the lugs 10, the central portion of each slot being of greater width than the end portions. In attaching the blade to the hub, the lugs 10 are inserted through the slots 11, and when the blade is positioned with its inner edge fitting tightly against the hub, the neck portions 12 of the ears or lugs will be occupying the enlarged portions of the slots 11. Each ear 10 is then twisted or turned into a position extending across its slot, the twist taking place in the necks 12 which occupy the enlarged central portions of the slots and which are large enough to allow for this twisting action, as shown in Figs. 9 and 11. The blades are thus firmly secured to the hub.

In this embodiment of the invention the reinforcement 7a has sufficient rigidity to maintain the desired curved shape and pitch angle of the soft rubber blade. The ears 10 and their necks 12 together with the slots 11 simply serve to position the blade on the hub, but the curvature of the blade from its leading edge to its trailing edge and the pitch angle of the blade is maintained by the reinforcing member 7a.

Each blade is at least as thick as the widest dimension of the slots 11 and when the blade is in position on the hub, the inner edge 6 thereof covers and conceals the corresponding slots 11 in the hub.

With the construction shown in Figs. 9 to 11, therefore, the means for securing the blade to the hub is entirely concealed within the hub, no part of such securing means being visible on the outside of the hub. The reinforcing member 7a with its ears 10 may be designated as a mounting member, since it is the means by which the blade is mounted on the hub. Such mounting member is thinner than the edge of the blade which contacts with the hub, said edge of the blade being sufficiently thick or wide to cover the widest portion of the slots 11. This concave edge of the blade which rests against the hub may also be designated as a mounting edge.

Another way of attaching the blades to the hub is shown in Figs. 7 and 8.

In this embodiment, the attachment is made by means of angular attaching clips 13, one leg 14 of each clip being riveted or secured to the blade and the other leg 15 of the clip being riveted or otherwise secured to the hub member 1. The interior reinforcement of the blade provides a sufficient anchorage for the rivet 16 by which the leg 14 of the clip is secured to the blade. All embodiments of the invention comprise a composite hub and blade structure embodying a hollow hub of hard material and a sheet-like blade of relatively soft material having a mounting margin terminating in a mounting edge, and a member for mounting said blade on said hub comprising a strip of pliant sheet metal having a portion of its width bonded to said mounting margin of the blade, and in the embodiment shown in Figs. 9, 10 and 11, the hub or hard material has slots therethrough, and the pliant sheet metal which is bonded to the mounting margin of the blade has a portion of its width extending beyond and free from the material of the blade and divided into separate bendable sections shaped and disposed to enter the slots in the hub and to be bent independently of one another for securing said blade to said hub.

Furthermore, in the embodiment shown in Figs. 9, 10 and 11, the pliant sheet metal 7a is thinner than the blade, and the material of the blade terminates at an edge which flanks the face of the pliant sheet metal and abuts against the exterior surface of the hub, and the projecting lugs 10 by which the blade is secured to the hollow hub are closeted within the body of said hub and are thus concealed.

I claim:

1. A flexible-bladed fan having a hub portion, a plurality of separate blades of rubber projecting from the hub portion and each blade having its inner edge engaging the exterior of the hub, said inner edge of each blade being concave transversely, and means to secure each blade to the hub with the edges of the concavity pressed against the hub and deflected laterally, such deflected edges forming a tight joint between the blade and the hub.

2. A flexible bladed fan having a conical hub portion, a plurality of separate blades of soft flexible rubber projecting from the hub, each blade being curved from its leading edge to its trailing edge and having a concavely curved inner edge which fits and lies against the exterior of the hub, each blade having two attaching ears, one adjacent the leading edge of the blade and the other adjacent the trailing edge, by which the blade is attached to the hub, each blade also being provided along its inner curved edge with a reinforcing member of sufficient rigidity to maintain the soft rubber blade in its curved form and at the required pitch angle independently of the means for attaching the blade to the hub.

3. A flexible bladed fan having a hollow hub portion, a plurality of separate blades of soft flexible rubber projecting from the hub, each blade having a concavely curved inner edge to fit the hub and being curved from its leading edge to its trailing edge, means to attach the blade to the hub comprising a pair of slots in the hub for each blade with each slot having a portion of increased width, and two attaching ears extending from the inner edge of each blade, each ear being connected to the blade by a neck portion, the ears of each blade extending through the slots of the corresponding pair of slots and being twisted into positions transversely to the slots with the necks occupying the enlarged portions of the slots, and a reinforcing member embedded in the rubber of each blade at its inner edge and having sufficient rigidity to maintain the soft rubber blade in its curved form and at the desired pitch angle independent of the means for securing the blade to the hub.

4. A flexible bladed fan having a hollow hub portion, a plurality of separate blades of soft flexible rubber projecting from the hub, each blade having a concavely curved inner edge to fit the hub and being curved from its leading

edge to its trailing edge, means to attach the blade to the hub comprising a pair of slots in the hub for each blade with each slot having a portion of increased width, and two attaching ears extending from the inner edge of each blade, each ear being connected to the blade by a neck portion, the ears of each blade extending through the slots of the corresponding pair of slots and being twisted into positions transversely to the slots with the necks occupying the enlarged portions of the slots, and a reinforcing member embedded in the rubber of each blade at its inner edge and having sufficient rigidity to maintain the soft rubber blade in its curved form and at the desired pitch angle independent of the means for securing the blade to the hub, the inner edge of each blade overlying and covering the corresponding slots in the hub and thus concealing the blade-attaching means.

5. A flexible bladed fan having a hollow hub portion provided with slots, a plurality of separate sheet-like fan blades of relatively soft material, each having a mounting margin terminating in a mounting edge which is wider than said slots and which engages the exterior surface of the hub, and a mounting member for mounting each blade on the hub comprising a strip of pliant sheet metal thinner than the mounting edge of the blade and embedded in the blade at its mounting margin, said mounting member having bendable projecting portions which extend through the slots in the hub member and are bent to extend transversely of the slots, said projecting portions being closeted within the body of the hub, the mounting edge of each blade overlying and covering the corresponding slots in the hub and thus concealing the blade-attaching means.

6. A flexible bladed fan having a hollow hub portion, a plurality of separate blades of soft flexible rubber projecting from the hub, each blade having a concavely curved inner edge to fit the hub and being curved from its leading edge to its trailing edge, means to attach the blade to the hub comprising a pair of slots in the hub for each blade, and two attaching ears extending from the inner edge of each blade, the ears of each blade extending through the slots of the corresponding pair of slots and being disposed transversely to the slots inside said hollow hub portion, and a reinforcing member embedded in the rubber of each blade near its inner edge and having sufficient rigidity to maintain the soft rubber blade in its curved form and at the desired pitch angle independently of the means for securing the blade to the hub.

7. A flexible bladed fan having a hollow hub portion, a plurality of separate blades of soft flexible rubber projecting from the hub, each blade having a concavely curved inner edge to fit the hub and being curved from its leading edge to its trailing edge, means to attach the blade to the hub comprising a pair of slots in the hub for each blade, and two attaching ears extending from the inner edge of each blade, the ears of each blade extending through the slots of the corresponding pair of slots and being disposed transversely to the slots inside said hollow hub portion, and a reinforcing member embedded in the rubber of each blade near its inner edge and having sufficient rigidity to maintain the soft rubber blade in its curved form and at the desired pitch angle independently of the means for securing the blade to the hub, the inner edge of each blade overlying and covering the corresponding slots in the hub and thus concealing the blade-attaching means.

8. Concealed structure for mounting an impeller blade of rubber or the like material in edgewise abutting and upstanding relation to the body of an impeller hub, embodying a plate-like member thinner than said blade in part embedded within said material, and in part projecting therefrom, and having each of its embedded faces overlapped by a thickness of said material terminating at an edge flanking the face of the plate-like member, all of the projecting part of said member being closeted within the body of said hub and said flanking edge of said rubber or like material abutting against the exterior surface of said hub.

9. A composite hub and blade structure embodying in combination with a hub of hard material having slots therethrough, a sheet-like blade of relatively soft material having a mounting margin terminating in a mounting edge, and a member for mounting said blade on said hub comprising a strip of pliant sheet metal having a portion of its width bonded to said mounting margin of the blade, and having a remaining portion of its width extending beyond and free from the material of said blade and divided into separate bendable sections shaped and disposed to enter said slots in the hub and to be bent independently of one another for securing said blade to said hub.

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