ABSTRACT OF THE DISCLOSURE

A rotor blade construction includes a blade of fiber-reinforced plastic which may be hollow or filled with a foam or similar core. The structure includes loops of fibers so that the webs extend longitudinally along the blade in a longitudinally extending cavity behind the nose portion. The strands are directed around a trimming weight in the cavity and extend radially inwardly parallel to the longitudinal axis of the blade and are either connected directly to the blade at the inner end thereof or to a securing element mounting the blade on a rotor.

SUMMARY OF THE INVENTION

This invention relates, in general, to a rotor blade construction and, in particular, to a new and useful rotor blade, particularly for helicopters, which is made of a fiber-reinforced plastic and which includes a trimming weight within the blade which is secured in position therein by an encirclement of strand elements or rovings of fiber materials.

Modern rotor blades have an exactly determined rigidity and mass distribution which varies over the span width of the blade. Frequently, a special mass concentration is necessary at some points of the blade, for example, as a damping mass which is located in the vibration loop of blade bending vibrations. Such masses are secured in conventional rotor blades to the interior of the blade on the structure which consists of a spar and fins. Plastic rotor blades of this type have a completely smooth inner surface. The front portion of the plate profile is usually occupied by a solid or box-shaped spar of resin-impregnated fibers, for example, glass fibers, and the rear portion is usually designed as a torsion shell which is filled with a light supporting foam core. In most instances such spar and shell constructions cannot withstand damage or weakening by screw bores. For this reason, fastening of the trimming weights by screws or rivets is not possible. The foam core cannot withstand the centrifugal forces acting on the trimming weight in operation, and the weight cannot move out of its position or detach itself completely from the foam. It has therefore been suggested that the trimming weight should be clamped to the exterior surface of the blades. This type of fastening, however, has the disadvantage of greater aerodynamic resistance.

In accordance with the present invention, there is provided a blade structure made of a reinforced fiber glass material which includes a weight which is slung in rovings or strands which are connected radially to the inside of the blade supporting structure. The rovings are dimensioned so that they can absorb the centrifugal forces acting on the trimming weight and the resulting elastic elongation which will occur as a result will be equal to the local elongation of the spar itself. The fiber rovings are secured by shafting or cementing them to the spar body at a location such as adjacent the nose portion. Because of such a fastening construction the centrifugal forces can be absorbed in a very advantageous manner on a relatively large surface so that no local stressing or stress peaks will be produced such as would occur when the fastening is effected with screws or bolts.

According to another feature of the invention, the fiber rovings holding the trimming weights are connected longitudinally through a hollow portion of the blade to a blade suspension bolt for mounting the blade to a rotor. This construction is particularly applicable for rotor blades having a blade root which is designed as a thimble through which the blade suspension bolt passes.

In practice, the fiber rovings forming the spar are combined with the fiber rovings holding the trimming weights so that they form a thimble together. The trimming weight is advantageously provided with recesses for receiving the loops of the strands or rovings so that the roving strands guided during manufacture before they can harden to a location at which they cannot slip off. Alternatively, the loops may be fastened to surround the weight in the form of a net or grid pattern. Accordingly, it is an object of the invention to provide an improved rotor blade structure having a trimming weight formed within the structure which is held in position against centrifugal forces by strands or rovings which extend longitudinally inwardly along the blade and are advantageously joined to the blade or the support therefor.

A further object of the invention is to provide a rotor blade construction which is formed of a reinforced fiber plastic and which includes a hollow portion adjacent the nose which carries a trimming weight, the weight being secured in a position by rovings which extend in the longitudinal direction in the hollow portion and are secured to the forward nose portion of the blade.

A further object of the invention is to provide a blade structure in which the blade carries a weight which is secured in position by a net formed of reinforcing fibers.

A further object of the invention is to provide a rotor blade construction which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a partial top plan and partial sectional view of a rotor blade constructed in accordance with the invention;

Fig. 2 is a section taken on the line 2—2 of Fig. 1; and

Fig. 3 is a side elevational view of a construction for securing the trimming weight within the rotor blade structure.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, in particular, the invention embodied therein as indicated in FIGS. 1 and 2 includes a plastic rotor blade 1 constructed in accordance with the invention. The blade 1 includes a forward or nose portion 3, a top flange 4, a bottom flange 5, and a web portion 6 adjacent a trailing portion 12 filled with foam plastic. A longitudinally extending cavity is formed behind the nose 3 by the flanges 4 and 5, the nose portion 3 and the web 6. Into this cavity is inserted a trimming
weight 8 having an outside dimension corresponding substantially to the inside dimension of the cavity 7. In the embodiment illustrated in FIGS. 1 and 2, the trimming weight 8 has recesses 9 into which the fiber strands or rovings 10 are inserted. The fiber rovings 10 are pulled inside, that is, in the direction of the longitudinal axis of the rotor toward the rotor head mounting (not shown), and cemented to the rear of the nose 3. In some instances, they are directed to the rotor head and secured around a rotor blade suspension bolt (not shown).

In the embodiment illustrated in FIG. 3, a trimming weight 20 is surrounded by fiber rovings 21 which are formed in a grid or net pattern. The fiber rovings 21 are directed at their inner ends around a thimble 22 through which a blade suspension bolt (not shown) is adapted to pass. With such a construction, all of the rovings participate equally in the absorption of the centrifugal forces and the inner ends are secured in the same manner as that indicated in FIGS. 1 and 2.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A rotor blade construction comprising a blade body formed of fiber reinforced plastic material having a nose portion and a trailing web portion with a cavity defined in the vicinity of the nose portion, a trimming weight located in said cavity, and fiber rovings engaged with said trimming weight and connected radially inwardly to said blade body.

2. A rotor blade construction, according to claim 1, wherein said fiber rovings comprise loops extending around the weight and secured to said nose portion.

3. A rotor blade construction, according to claim 1, wherein said blade includes a root portion having a thimble through which a blade suspension bolt is adapted to pass, said fiber rovings being continued along said blade portion inwardly for securing to said thimble.

4. A rotor blade construction, according to claim 1, wherein said trimming weight has recesses for receiving the fiber rovings.

5. A rotor blade construction, according to claim 1, wherein said fiber rovings surround the trimming weight and are constructed in the form of a net.

6. A rotor blade construction, according to claim 1, wherein the blade body includes a longitudinally elongated cavity disposed between said nose portion and said web, a flange formed on each side of the cavity connecting said nose portion to said web, said body including a trailing portion filled with foam plastic, said rovings extending around said weight and being directed along the rear portion of said nose portion within said cavity and being secured to said nose portion.

References Cited

UNITED STATES PATENTS

2,076,090 4/1937 Myers.
2,404,678 7/1946 Muench.
2,484,141 10/1949 Alex.
2,588,570 3/1952 Pitcairn.

FOREIGN PATENTS

1,334,446 7/1963 France.
1,036,064 8/1958 Germany.

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