

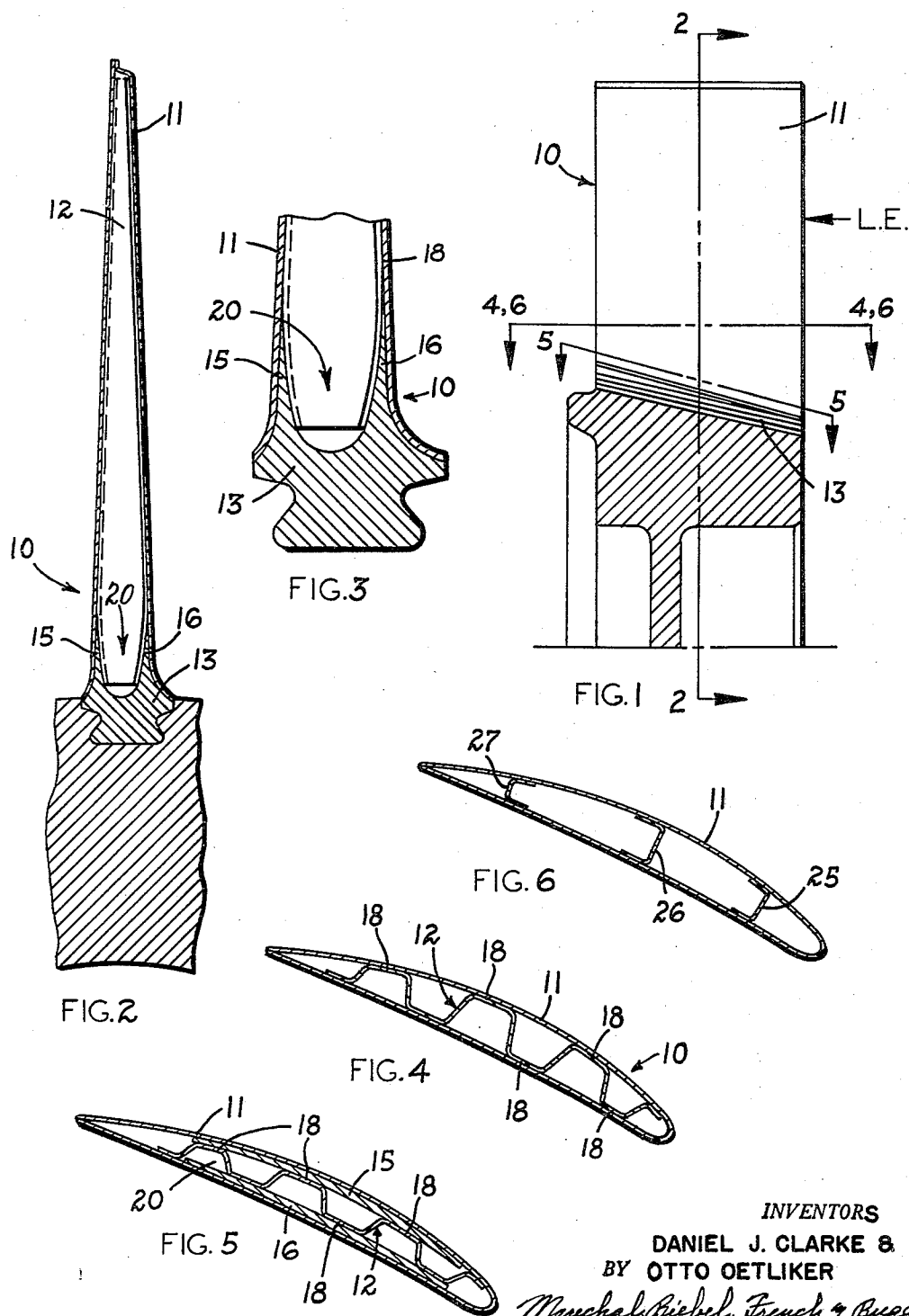
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BLADES FOR COMPRESSORS, TURBINES AND THE LIKE

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BLADES FOR COMPRESSORS, TURBINES AND THE LIKE

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2 Claims. (Cl. 253-77)

This invention relates to blades for compressors, turbines and the like.

An object of the invention is to provide a composite blade which is strong, light and substantially free from stress concentrations.

Another object is to provide a disengageable blade of composite construction free from abrupt changes in cross sections of the structural elements thereof.

The above objects are accomplished by the means illustrated in the accompanying drawings in which,

FIG. 1 is a fragmentary section through a rim of a bladed rotor according to our invention;

FIG. 2 is a section on line 2-2 of FIG. 1;

FIG. 3 is an enlarged view of the blade base and a portion of the blade body;

FIG. 4 is a section on line 4-4 of FIG. 1;

FIG. 5 is a section on line 5-5 of FIG. 1; and

FIG. 6 is a section on 6-6 of FIG. 1 showing an alternate internal structure.

In copending application Serial No. 744,942 filed June 27, 1958 by E. A. Stalker there is disclosed a composite blade which reduces the tendency to fatigue failure at the junction of the blade shell with the blade base. There are however certain problems in the construction shown in that it is difficult to provide a flange of the blade base which laps the shell exteriorly and is faired to the shell surface, more particularly because such a flange must terminate with a substantial thickness to facilitate production. A fillet to be successful should have a concave surface which fairs into the shell and base tangentially to each without abrupt changes in the fillet. Furthermore it is desirable to have the external fibers of the shell take the bending stress rather than the solder forming a fillet. This is especially desirable where nickel base braze alloys are used since these alloys tend to dissolve into the shell and cause an abrupt change in its elasticity which acts similarly to an abrupt change in cross section with respect to resistance to fatigue.

In the present invention, at the locality where the shell joins the blade base, the shell is external to the base flange so that the braze material is internal to the shell. The flange tapers in thickness toward its end and any abruptness due to its termination is offset by the stiffener within the shell which laps the inside surface of the flange and is bonded thereto. Thus the effective stiffness of the shell and stiffener at the locality of the edge of the flange is actually greater than at either side thereof because the stiffener and shell wall are actually spaced apart, making for increased stiffness. From this locality the stiffener approaches and fays the inside surface of the shell along the generous curve eliminating any abrupt changes.

Referring now to the drawings the blade is indicated generally by 10 comprising the shell 11, the stiffener 12, and the blade base 13.

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The blade base 13 is formed integrally on opposite sides of the blade with flanges or projections 15, 16 which extend tipward and over which the shell is received in closely fitting relation. Each base flange is preferably defined by curved surfaces of fairly long radius and tapers in thickness, terminating in a relatively thin edge 17 which fairs with the inner surface of the walls of the shell and defining a recess 20 between the flanges at the root end of the shell. The flanges are contoured chordwise on their outer surfaces to fit to the inside surfaces of the shell within brazing clearances thereto, and are bonded thereto by fused metal.

The stiffener 12 is preferably a corrugated element having chordwise extending stiffener flanges of substantial chordwise extent whose lands 18 radially outward of flanges 15, 16 are bonded to the internal surfaces of the shell 11. The stiffener extends radially inward into the recess 20 between the flanges, faying the inner surface of both base flanges 15, 16 to which its lands 18 are also bonded by fused metal such as brazing material.

It will be clear that the local stiffness of the combined stiffener wall and shell wall at the ends of the base flanges is great because such flanges are spaced apart by the thickness of the blade. This provides a smoothly varying structural thickness which precludes structural failure from fatigue caused by vibration and effects a smooth distribution of stress and transfer of the load from the shell on spanwise opposite sides of the edges of the flanges into the blade base. Thus at one side of the blade the local structure comprising the shell, the flange 16 and the stiffener lands or flanges 18 carry local bending stresses chiefly in the shell and stiffener flange rather than in the brazing material or solder bonding the parts. That is, the shell and stiffener flanges protect the brazing material against alternating compression and tension stresses while providing a strong brazed joint in shear.

FIG. 6 shows an alternate form of internal structure comprising a plurality of chordwise spaced elements preferably channels 25, 26, 27, having their flanges fitted and secured to the opposite walls of the shell 11. These channels also extend into the recess 20 and fit closely to the flanges 15, 16 to which they are brazed along the legs of the channels.

The junction of the blade body with the base is inspectable by X-rays through the flanges and the shell. The radiograph will indicate any voids in the brazing making the joint between these parts since the flanges are thin enough to give the necessary contrast on the negative.

It will now be clear that we have provided a strong and light blade which will resist fatigue failures since the shell and stiffener blend into the base without abrupt changes in cross sections of the structural parts.

We claim:

1. In combination in a blade for compressors, turbines, and the like and subject to vibratory stresses, a blade shell, a blade base at the root end of the shell, said base having a thickened inner portion merging smoothly into integral spaced flanges extending tipward into said shell at said root end thereof each lapping a side wall of said shell and being bonded thereto, said base flanges extending upwardly and inwardly from said thickened portion and smoothly tapering in thickness

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tipward to a thin edge, said flanges defining a recess therebetween within said root end, a stiffener within said shell bonded to opposite inside surfaces of said side walls, said shell extending inward to the point at which said thickened portion merges with said flanges to provide a contacting area of substantial radial extent for securing said shell thereto, said stiffener extending into said recess and having chordwise extending stiffener flanges of substantial chordwise extent bonded to the inside surfaces of said base flanges, each said base flange being positioned between a wall of said shell and said stiffener flange to provide smoothly varying structural thicknesses to preclude structural failure from fatigue caused by said vibratory stresses.

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2. A blade as defined in claim 1 in which the blade shell extends radially inward substantially beyond the inner end of the stiffener.

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