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AIR-COOLED, STRUT SUPPORTED TURBINE BLADE

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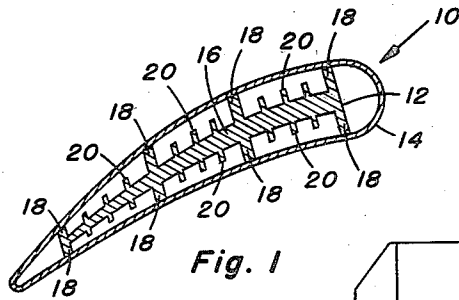


Fig. 1

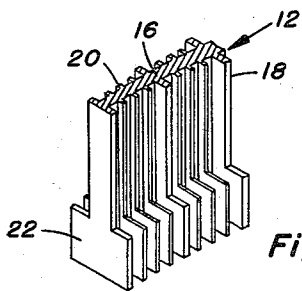


Fig. 2

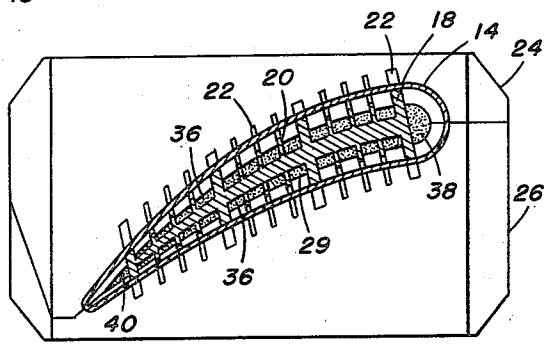


Fig. 4

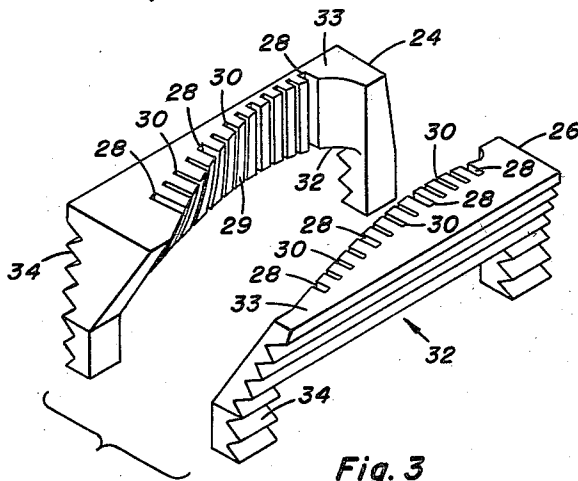


Fig. 3

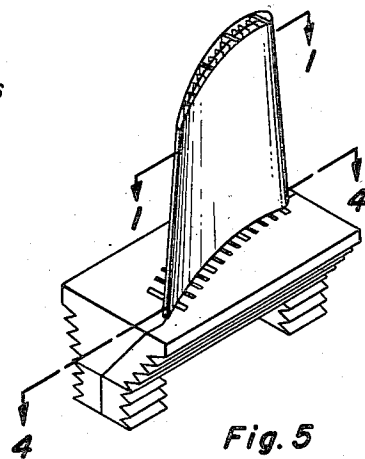


Fig. 5

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AIR-COOLED, STRUT SUPPORTED TURBINE BLADE

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2 Claims. (Cl. 253—39.15)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to an air-cooled strut-supported turbine blade and more particularly to the design of such a blade having few parts and being relatively easy to manufacture and assemble.

Turbine blades heretofore made have not possessed the advantages of both acceptable air cooling and ease of manufacture and assembly.

An object of the present invention, therefore, is the provision of a turbine blade having relatively few parts.

Another object is to provide turbine blade in which the parts are relatively easily manufactured from a number of manufacturing processes.

A further object of the invention is the provision of a turbine blade meeting the above objects and also having suitable cooling characteristics.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a cross-sectional view taken along line 1—1 of Fig. 5, of a preferred embodiment of the invention;

Fig. 2 is a perspective view, partially broken away, of the strut of the present invention;

Fig. 3 is a perspective view of the two parts of the base;

Fig. 4 is a cross-sectional view taken along lines 4—4 of Fig. 5, and

Fig. 5 is a perspective view of an assembled turbine blade.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 a turbine blade 10 comprising an air-cooled strut 12 supporting an airfoil-shaped shell 14. The strut 12 has a main section 16 extending from root to tip, and somewhat less than the full chord of the blade. Extending from the main section 16 to the inside surface of shell 14, and brazed thereto, are a plurality of primary fins 18, which serve to support shell 14. Between the primary fins 18 are a plurality of secondary fins 20 which do not contact the shell 14; these secondary fins 20 serve to augment the cooling surface of strut 12. The shell 14 has an airfoil shape, as shown, and may be made in either one or two parts. If shell 14 is made in two parts the juncture lines lie adjacent the leading and trailing edges, and the parts are bonded together. If shell 12 is made in one part, it may be formed from tube stock.

In Fig. 2, the strut 12 is shown comprised of main section 16, primary fins 18 and secondary fins 20. As turbine blades are subjected to high centrifugal forces, it is necessary to insure that they do not fly off of the rotor to which they are attached. To that end, the turbine blade strut 12 of the present convention is made somewhat in the shape of the letter T, inverted. That is, the

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root 22 of the strut extends laterally of main section 16, and is comprised of extensions of the primary fins 18 and secondary fins 20.

The strut 12 may readily be made to support a shell 5 which is either twisted, tapered or untwisted, and lends itself to manufacture by machining, forging, casting or powder metallurgy. For machining, bar stock may be machined to the airfoil shape of the blade desired, reduced in size by the thickness of the shell. Grooves are cut in the blank to form the fins, and are preferably formed by 10 saw slotting; the saw or the blank may be moved in a straight line for any shape airfoil, thus resulting in grooves which are rectilinear throughout their lengths. It is apparent that this is a relatively simple machining operation. The height of the secondary fins is then reduced 15 by machining.

Where forging is used, two of the machining operations mentioned above are eliminated—the machining of the bar stock to produce the airfoil contour, and the machining 20 of the secondary fins to reduce their height.

For a cast strut, no machining at all is necessary since the strut can be cast to finished sizes.

Powder metallurgy manufacture of the strut would also provide a manufacturing method in which no machining 25 would be required.

The blade base is shown in Fig. 3 to comprise two parts 24 and 26. Slots 28 are formed in the interior faces 29 of each part to receive the strut primary fins 18 and slots 30 are formed therein to receive the strut secondary fins 30 20. A large recess 32 is formed in the bottom of the base, and coacts with the rotor to form a plenum chamber for supplying cooling air to the blade 10. The height of the base from recess 32 to the upper surface 33 is approximately equal to the span-wise height of the root 22 of strut 12. The parts 24 and 26 have grooves 34 in their outer surfaces to coact with the rotor and form a strong union preventing the throwing of the blades 10 by centrifugal force. The base configuration shown in Fig. 3 is known as a "Christmas-tree" base, 35 but this shape is not critical. As will be readily apparent, the base parts 24 and 26 can be easily manufactured by the methods available for the manufacture of the strut 12.

The construction of the present invention in providing a turbine blade which is adequately air cooled, particularly the strut thereof, is illustrated in Fig. 4, wherein the two base parts 24 and 26 are shown assembled with the 40 strut 12 in place between them. Rectangular passages 36 are formed between interior face 29, main section 16, and fins 18 or 20. A semi-circular passage 38 and a triangular passage 40 are formed between interior faces 29 and fins 18. All air passages communicate with the plenum chamber below recess 32. The root part 22 of primary fins 18 extend into the slots 28 and the root part 22 of secondary fins 20 extend into the slots 30; all fins are brazed to the base. Above the surface 33 of the base, the air issues from the rectangular passages 36 to the passages formed (see Fig. 1) by two primary fins 18, main section 16 and shell 14, of which there are six in the invention as herein illustrated.

It is also an advantage of the present invention that the configuration herein taught permits the strut and blade base to be cast as an integral unit. This would eliminate brazing, with certain attendant disadvantages. Further, the strut configuration permits the casting of the strut material around primary fins of a different material.

Where the saw slotting method of manufacture is utilized, the air passages formed between fins 18 or 20 and strut 12 will usually have walls which are at right angles to each other.

It will thus be seen that the blade of the present invention is readily manufactured, and provides a strong construction readily and adequately air cooled.

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Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A turbine blade assembly comprising an airfoil-shaped shell, a strut within said shell, said strut having a main spanwise and chord-wise extending section and fins extending from said section, said shell being supported at intervals by some of said fins so as to provide spaces between said strut and said shell, said fins having a relatively greater extension from said section at the root of said blade assembly, a base comprising two complementary parts, each of said parts having slots therein receiving said greater fin extensions, the interior faces of said parts of said base adjacent said main section being

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spaced from said main section, whereby air may pass from below said base into said spaces.

2. A base for an air-cooled strut-supported turbine blade comprising two complementary parts, relieved interior faces in said parts, said faces having slots therein adapted to receive the fins of a strut having a main section and fins extending therefrom, said faces being separated a distance greater than the thickness of said main section when said parts are assembled.

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