

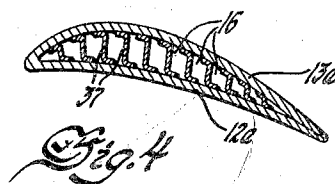
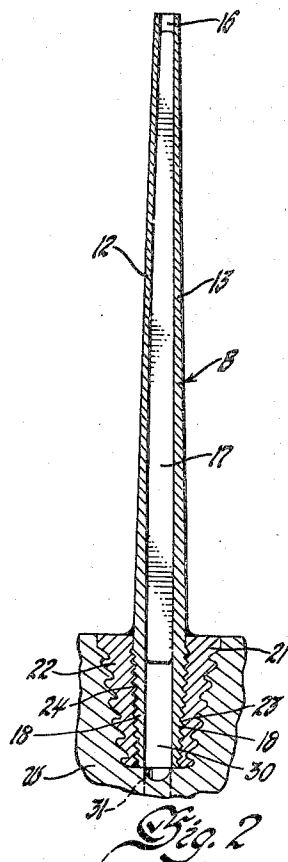
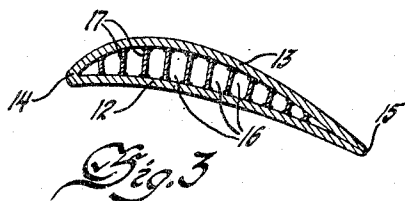
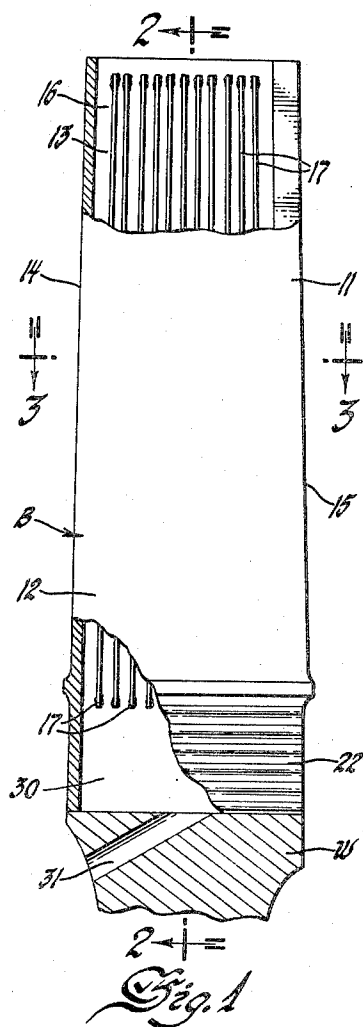
Dec. 24, 1957

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2,817,490

TURBINE BUCKET WITH INTERNAL FINS

Filed Oct. 10, 1951



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TURBINE BUCKET WITH INTERNAL FINS

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Application October 10, 1951, Serial No. 250,654

4 Claims. (Cl. 253—39.15)

My invention relates to turbine buckets or blades and the like and, more particularly, to a bucket especially suited for use in gas turbine engines.

In view of the high temperature of the gas stream in gas turbines and the desirability of increasing the tolerance of the turbine for high temperatures, many proposals for cooling the nozzles, vanes, and buckets of gas turbines have been advanced. One approach to the problem involves the use of hollow blades (by which term such elements as nozzles, stator vanes, and turbine rotor blades or buckets are intended) with circulation of a cooling medium such as air through the blade.

With such hollow blades, the rate of heat transfer from the wall of the blade to the air stream flowing through the blade is much lower than would be desirable. My invention contemplates the provision in the passage through a hollow blade of radiating fins bonded to the wall of the blade which will greatly increase the heat transfer surface and thereby greatly improve the cooling of the blade.

Among the features of the invention are the provision of a bucket of relatively light weight, a bucket which is adapted to be manufactured primarily from sheet metal by forming and welding or brazing and the like, and a bucket which is particularly adapted for internal cooling and which is of high strength.

The principal objects of the invention are the improvement of gas turbines, the improvement of turbine buckets, to provide a bucket which is particularly adapted to the provision of cooling so that it can better resist the high temperature encountered in gas turbines, to provide a bucket which does not require casting, to eliminate or reduce the necessity for the use of critical materials in turbine buckets, to provide a structurally reinforced sheet metal bucket, and to provide an improved foot or base construction for a sheet metal turbine blade.

The manner in which these and other objects of the invention are realized will be more clearly apparent to those skilled in the art from the succeeding detailed description of preferred embodiments of turbine buckets in accordance with the invention.

Referring to the drawings: Figure 1 is a side view of a bucket in accordance with the invention, mounted in a turbine wheel, only a portion of which is shown; Figure 2 is a longitudinal sectional view of the same taken on the plane indicated by line 2—2 in Figure 1; Figure 3 is a transverse sectional view of the same taken on the plane 3—3 indicated in Figure 1, and Figures 4 and 5 are transverse sectional views of modified forms of the invention.

Referring first to Figures 1, 2, and 3, a single blade or bucket B is illustrated as mounted in a conventional dovetail groove in the rim of a turbine wheel W, shown fragmentarily. The bucket comprises a blade portion or body 11 comprising side walls 12 and 13 which may be of any form suitable for the desired purposes, such

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as the generally airfoil form most clearly illustrated in Figure 3. The blade portion may be formed from sheet metal to define a leading edge 14 and a trailing edge 15, the metal being spot-welded or brazed at the trailing edge to provide a closed tubular section. As best shown in Figure 2, the walls of the blade preferably taper in thickness toward the tip. As will be readily apparent, this blade form may be provided by rolling a tapered sheet and then folding and forming the same in dies according to known techniques of metal forming. In order to mount the bucket in the wheel W, a root is provided which may be of any suitable form such as the conventional dovetail form illustrated. The root is composed of two parts 21 and 22, the internal surfaces 23 and 24 of which conform to the surface of the walls 12 and 13 and are serrated transversely to the length of the blade or, in general, parallel to the axis about which the blade rotates. The outer surfaces of the walls 12 and 13, at the inner end or base portion 18 of the walls of the blade, are serrated complementarily to the root members 21 and 22. These root members may be formed by casting or forging and are fixed to the serrated base portion 18 of the blade by brazing or soldering. The dovetail grooves of the outer surfaces of the members 21 and 22 may be reduced to final dimensions after the assembly is completed.

It will be apparent that the serrated surfaces of the blade and of the base members extend spanwise and chordwise of the blade and that the serrations extend chordwise of the blade.

The internal opening 16 of the blade between the walls 12 and 13 is bridged by a plurality of metal strips 17 which, preferably, extend from slightly within the rim of the wheel W to or nearly to the tip of the blade. These strips, which may be cut from sheet metal and may be brazed or spotwelded to the walls of the blade, serve to provide cooling fins for removal of heat from the walls of the blade. The strips 17 also strengthen the blade and eliminate any tendency to vibration of the surface of the blade in response to the impact of gases.

Air is preferably circulated spanwise through the bucket from the root to the tip. As shown in Figure 1, air may be brought into the base 18 of the blade in any suitable manner, as by a passage 31 in the wheel W, so as to enter the chamber 30 defined by the root of the blade and flow outwardly between the strips or partitions 17 to the tip of the blade. The strips 17 may be of such number and thickness as substantially to reduce the total area of the path for flow of air through the blade if desired. In any event, the strips greatly increase the area available for transfer of heat from the bucket to the cooling air and greatly increase the efficiency of cooling. This is important, since air supplied for cooling entails a loss of power output of the engine.

The strips 17 may be inserted from the end of the blade after the blade is folded and held in proper position by any suitable fixture during the spot-welding or brazing operation.

Figure 4 is a cross-sectional view of a blade of similar characteristics to that previously described, illustrating a modified form of cross member. In this form the cross members 37 corresponding to the members 17 of Figures 1 to 3 are formed with flanges against the walls 12a and 13a.

In the modification of Figure 5 the partitions or cooling fins are provided by a corrugated strip 47 which zig-zags back and forth between the walls 12b and 13b of the blade. This form is believed to be the preferred form insofar as ease of manufacture is concerned, although it may not be adaptable to blades of some forms. The strip 47 may be formed from a piece of sheet metal

in appropriate dies, inserted into the blade, and brazed or spot-welded in place. This form of radiating fin structure is self-locating.

Preferably, the internal fins of any of the forms of blade are fixed in place before the root portions 21 and 22 are united to the base of the blade.

Because of the serrations at the joint between the base 18 of the blade and the root members and the mounting of the root members in the dovetail groove of the wheel W, retention of the blade is largely mechanical and is not primarily dependent upon the strength of the brazed or soldered joints of the parts.

It will be understood that the blade portion might be formed from a tube with tapered walls rather than from a sheet, or could be provided by casting, although one of the advantages of the invention lies in the ready use of sheet metal or tubing for the blade structure.

The description herein of the preferred embodiments of the invention for the purpose of illustrating the principles thereof is not to be considered as limiting the invention, since many modifications thereof within the scope of the invention will occur to those skilled in the art.

I claim:

1. As an article of manufacture, a turbine blade or the like comprising a body of airfoil form with the walls thereof defining a passage extending through the body, the body terminating in a base portion having a serrated exterior surface extending spanwise and chordwise of the body with the serrations thereon extending chordwise of the body, and a root member having a serrated surface complementary to and engaging the said serrated surface of the base portion and fixed thereto.

2. A turbine bucket or the like comprising a tubular blade portion defining a passage extending longitudinally thereof; a base portion at one end of the blade portion, the base portion defining a chamber for reception and distribution of cooling fluid; means defining a plurality of strips extending lengthwise of the blade portion and extending across the passage within the blade portion and bonded to the walls thereof, the strips providing cooling fins for conduction of heat from the walls of the blade portion and defining passages for the cooling fluid extending spanwise of the blade portion; the base portion having serrated exterior surfaces extending spanwise and chordwise of the blade portion with the serrations thereon extending chordwise of the blade portion;

and root members having serrated internal surfaces complementary to and engaging the said serrated surfaces of the base portion and fixed thereto.

3. As an article of manufacture, a turbine blade or the like comprising a body of airfoil form having walls defining a passage extending through the body, the body terminating in a base portion having serrated exterior surfaces extending spanwise and chordwise of the body with the serrations thereon extending chordwise of the body, root members having serrated surfaces complementary to and engaging the said serrated surfaces of the base portion and fixed thereto, and cooling fins bonded to the walls of the body extending from wall to wall across the passage.

4. As an article of manufacture, a turbine blade or the like comprising a body of airfoil form having walls defining a passage extending through the body, the body terminating in a base portion having serrated exterior surfaces extending spanwise and chordwise of the body with the serrations thereon extending chordwise of the body, root members having serrated surfaces complementary to and engaging the said serrated surfaces of the base portion and fixed thereto, and cooling fins bonded to the walls of the body extending from wall to wall across the passage, the cooling fins being constituted by a corrugated strip extending over the major part of the chord of the blade with the corrugations extending lengthwise of the blade and the peaks thereof bonded to alternate walls of the body.

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