March 29, 1960

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2,930,580

TWO-PIECE TURBINE BUCKET

Filed March 12, 1953

2 Sheets-Sheet 1

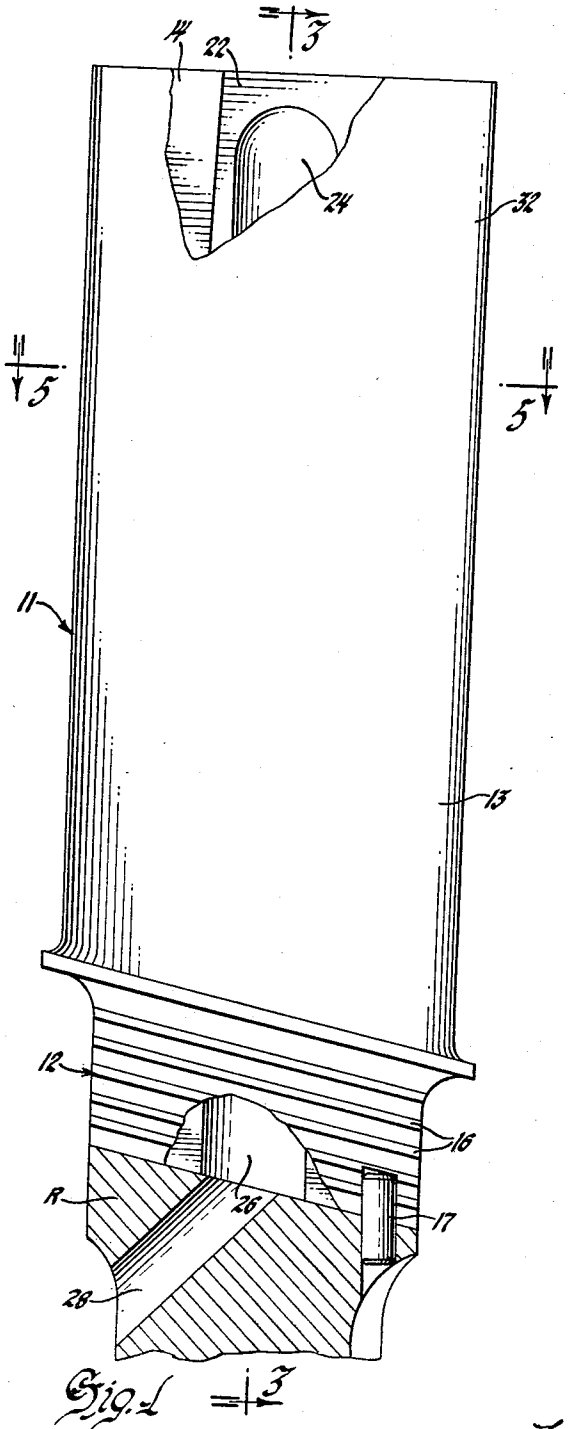


Fig. 1

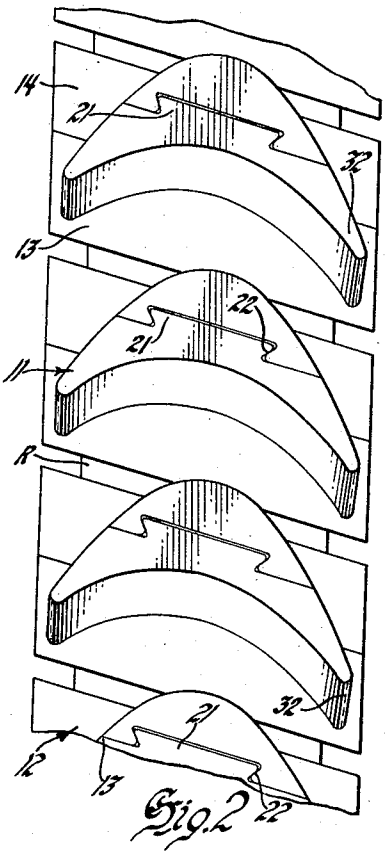


Fig. 2

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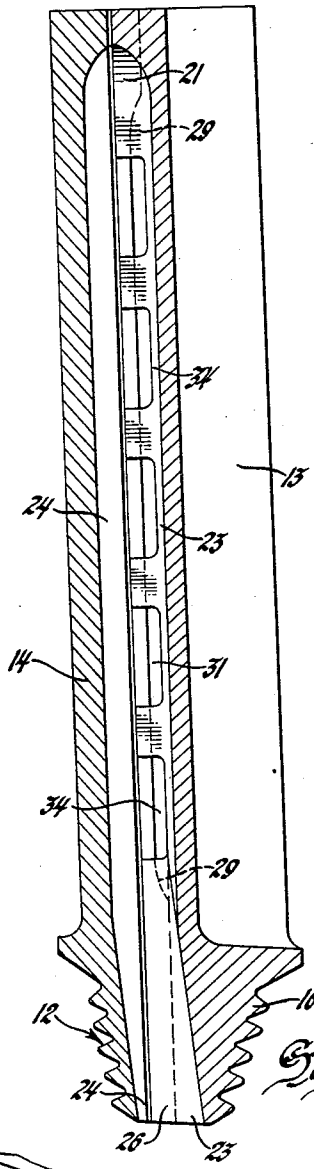


Fig. 3

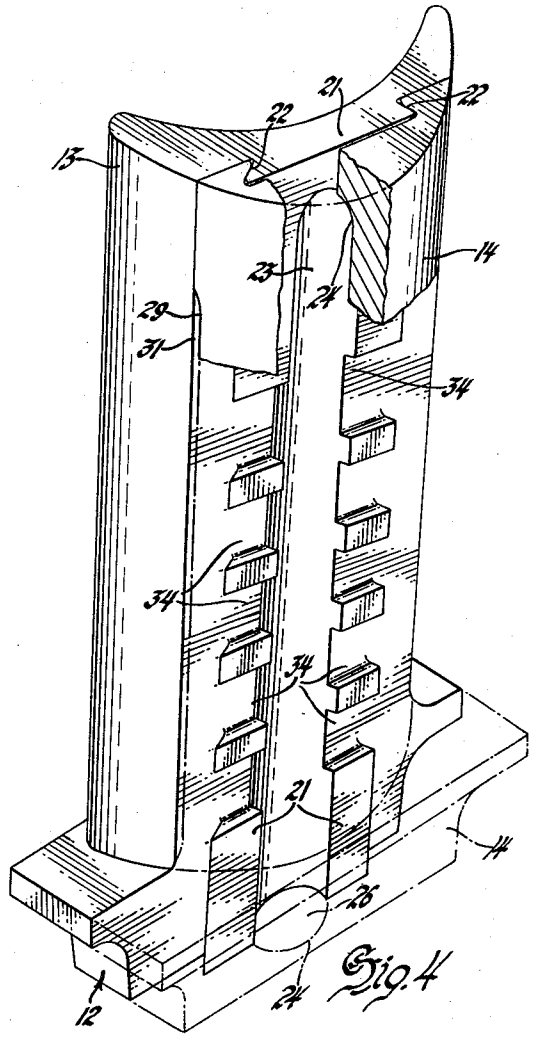


Fig. 4

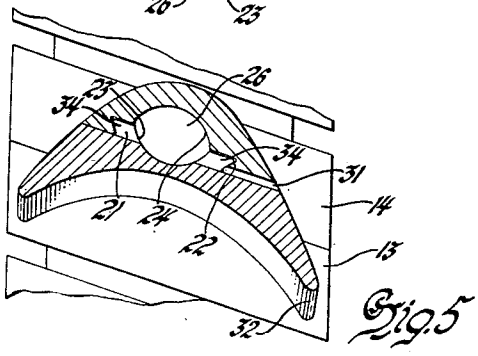


Fig. 5

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TWO-PIECE TURBINE BUCKET

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Application March 12, 1953, Serial No. 341,908

7 Claims. (Cl. 253—39.15)

My invention relates to turbine buckets and other similar elements and is particularly directed to the provision of a turbine bucket having arrangements for improved cooling and having greater strength than conventional buckets.

The invention is described herein as embodied in a turbine bucket of conventional external configuration, although it will be understood that the invention may be applied to buckets for other blade and root configurations or to analogous elements such as fluid directing vanes of turbine nozzles and the like.

A turbine bucket according to the preferred embodiment of the invention as described herein comprises a blade portion and a root portion, the latter serving to mount the bucket on a turbine rotor. These two portions are constituted by two parts extending in abutting parallel relation and joined by a dovetail connection between the two parts extending longitudinally of the blade.

The mating faces of the two parts are relieved or provided with channels therein which, when the parts are assembled, define passages which serve to conduct a cooling fluid such as air through the bucket. The bucket involves improved provision for distributing the air through the body thereof to reduce the temperature of the bucket and thereby improve resistance to the hot motive fluid.

By virtue of the fact that the bucket is constituted by two parts in dovetail relation, a very high degree of damping of vibrations which may be excited in the operation of the turbine is provided. Also, the two part construction facilitates the provision of properly distributed and dimensioned coolant passages.

The nature of the invention and the advantages thereof will be more clearly apparent to those skilled in the art from the succeeding detailed description and the accompanying drawings, in which:

Fig. 1 is a longitudinal view of a turbine bucket in accordance with the invention mounted on a fragmentary portion of a turbine rotor;

Fig. 2 is a developed view of the turbine wheel rim with buckets mounted thereon;

Fig. 3 is a longitudinal sectional view of the bucket of Fig. 1 taken on the plane indicated by the line 3—3 in Fig. 1;

Fig. 4 is an axonometric view showing one part of the bucket with the other part largely broken away; and

Fig. 5 is a cross-sectional view taken on the plane indicated by the line 5—5 in Fig. 1.

As will be apparent from the drawings, the turbine bucket illustrated therein is of conventional external form or configuration and it is to be understood that the invention is not concerned with the aerodynamic form of the blade nor with the arrangement of dovetail grooves or other attaching structures of the blade root. The bucket comprises a blade portion 11 and a root portion 12 and is formed of two parts, a part 13 defining approximately half of the root, the concave face of the blade, and the leading and trailing edge portions, and a part 14 defining the remainder of the root and blade. As will

be apparent, these parts abut approximately along a mean plane of the root and along the extension of this plane into the blade as illustrated. It is not essential, however, that the junction be plane and it may divide the bucket into parts along any meeting surface deemed advisable or convenient. When the two parts 13 and 14 are assembled, the external configuration of the assembly may be conventional. The root is provided with serrations or grooves 16 of the well known multiple dovetail type for mounting in a mating slot in a turbine rotor wheel indicated fragmentarily as R in known manner, the root being retained by a pin 17 extending through the rim of the wheel and into a slot in the root.

The two parts 13 and 14 are assembled by means of a dovetail joint or tongue and groove connection which permits them to be slid together as will be most clearly apparent from Figs. 2 and 4. The part 13 is provided with a tongue 21 extending the length thereof and projecting from the face which abuts the blade part 14. The blade part 14 is formed with a groove or slot 22 extending the length thereof dimensioned to mate with the tongue 21. The blade parts may be forged and the mating faces machined. The parts may be left free to slip relative to each other or may be tacked together or otherwise fixed at the root. It is not necessary for them to be attached since, when the parts are mounted in the blade slot of the rotor, each part is held so that neither can fall free of the other.

Intermediate the outer edges of the tongue 21 and slot 22 a channel 23 is formed in the tongue of the part 13 and a channel 24 in the grooved portion of part 14, these channels extending from the inner end of the root through the root and blade and terminating short of the tip of the blade. When these parts are assembled, the channels 23 and 24 form a passage 26 through which cooling fluid such as air may be carried from the blade root into the blade. This air may be supplied in any suitable fashion to the root of the blade as, for example, through a passage 28 in the rim of the rotor R from any suitable source. The inner face of the blade part 14 is cut back as indicated at 29 (Figs. 3 and 4), from the plane of the inner face of the part 13 to define a slot 31 through which the cooling air is discharged. Such a slot is shown in Figs. 4 and 5 located between the passage 26 and one edge of the blade, specifically the trailing edge 32. Throughout the central part of the blade the dovetail rib 21 on the part 13 is cut away transversely to the channel 23 to provide branch passages 34 through which the cooling fluid escapes from the passage 26 and is discharged through the slot 31 and generally at the junction of the parts. Smaller quantities of cooling air will flow through the fissure or joint between the two parts at the outer end of the blade and along the face of the blade. However, if the cut 29 is of any considerable depth most of the air will escape through the resulting slot 31. The fit of the dovetail parts and the mating faces preferably should be slightly loose to promote leakage of the cooling air, since the cooling air leaking from the passage 26 cools the parts past which it escapes.

It will be apparent from the foregoing that the two parts of the bucket may be readily forged and the mating faces may be simply machined, preferably most of the machining being accomplished by broaching or possibly by milling. The parts may be easily assembled and, when assembled, are highly resistant to vibration because of the frictional damping due to rubbing of the parts if any flexure occurs. The invention facilitates the provision of the principal passage for introduction of fluid and the branch passages by which it is distributed, and the issuance of the cooling fluid from the blade in a sheet from an elongated slot or fissure provides for film cooling of the blade. Such a fissure may be due to clearance

of the parts apart from any relieving or it may be enlarged as indicated at **29**.

The detailed description herein of the preferred embodiment of the invention for the purpose of explaining the principles thereof should not be considered as limiting or restricting the invention, since many modifications thereof may be devised by the exercise of skill in the art.

I claim:

1. A blade element for a turbomachine or the like comprising two parts abutting face-to-face along a surface extending spanwise and chordwise of the blade element and joined by a slidable dovetail joint extending longitudinally of the blade element centrally of the chord of the blade element, the dovetail joint being defined by a tongue on one part and a groove in the other part, the parts being partially spaced to define a coolant passage therebetween.

2. A blade element for a turbomachine or the like comprising two parts abutting face-to-face along a surface extending spanwise and chordwise of the blade element and joined by a slidable dovetail joint extending longitudinally of the blade element, the dovetail joint being defined by a tongue on one part and a groove in the other part, the parts being partially spaced to define a coolant passage therebetween extending within the dovetail joint and to define branch passages extending transversely from the said coolant passage.

3. A turbine bucket or the like comprising a root portion adapted for mounting in a supporting structure and a blade portion extending from the root portion; the bucket comprising two parts disposed in parallel abutting face-to-face relation along a surface extending spanwise and chordwise of the blade portion, the parts continuing from the blade portion into the root portion and defining the root portion, the root portion of each part being configured to interlock with the supporting structure; the two parts being joined by a slidable dovetail joint with the dovetail extending longitudinally of the blade portion, the dovetail joint being defined by a tongue on one part and a groove in the other part.

4. A turbine bucket or the like comprising a root portion adapted for mounting in a supporting structure and a blade portion extending from the root portion; the bucket comprising two parts disposed in parallel abutting face-to-face relation along a surface extending spanwise and chordwise of the blade portion, the parts continuing from the blade portion into the root portion and defining the root portion, the root portion of each part being configured to interlock with the supporting structure; the two parts being joined by a slidable dovetail joint with the dovetail extending longitudinally of the blade portion, the dovetail joint being defined by a tongue on one part and a groove in the other part and the parts being spaced from each other internally of the dovetail joint to define a cooling air passage extending from the root portion substantially through the blade portion.

5. A turbine bucket or the like comprising a root portion adapted for mounting in a supporting structure and a blade portion extending from the root portion; the bucket comprising two parts disposed in parallel abutting relation and extending spanwise of the blade portion, the parts continuing from the blade portion into the root portion and defining the root portion, the root portion of each part being configured to interlock with the supporting structure; the two parts being joined by mating elements thereon providing a slidable dovetail joint between the parts with the dovetail extending longitudinally of the blade portion and the parts being partially spaced from each other internally within the dovetail joint to define

a cooling air passage extending from the root portion substantially through the blade portion, at least one of the mating elements of the dovetail joint being cut away to provide branch passages communicating with the first-mentioned passage and with the exterior surface of the blade for discharge of cooling air from the first-mentioned passage.

6. A turbine bucket or the like comprising a root portion adapted for mounting in a supporting structure and a blade portion extending from the root portion; the bucket comprising two parts disposed in parallel abutting relation and extending spanwise of the blade portion, the parts continuing from the blade portion into the root portion and defining the root portion, the root portion of each part being configured to interlock with the supporting structure; the two parts being joined by mating elements thereon providing a slidable dovetail joint between the parts with the dovetail extending longitudinally of the blade portion and the parts being partially spaced from each other internally within the dovetail joint to define a cooling air passage extending from the root portion substantially through the blade portion, at least one of the mating elements of the dovetail joint being cut away to provide branch passages communicating with the first-mentioned passage for discharge of cooling air from the first-mentioned passage and the parts defining a fissure between the abutting portions thereof communicating with the branch passages and with the surface of the blade portion for discharge of the cooling air from the blade portion.

7. A turbine bucket or the like comprising a root portion adapted for mounting in a supporting structure and a blade portion extending from the root portion; the bucket comprising two parts disposed in parallel abutting relation and extending spanwise of the blade portion, the parts continuing from the blade portion into the root portion and defining the root portion, the root portion of each part being configured to interlock with the supporting structure; the two parts being joined by mating elements thereon providing a slidable dovetail joint between the parts with the dovetail extending longitudinally of the blade portion and the parts being partially spaced from each other internally within the dovetail joint to define a cooling air passage extending from the root portion substantially through the blade portion, at least one of the mating elements of the dovetail joint being cut away to provide branch passages communicating with the first-mentioned passage for discharge of cooling air from the first-mentioned passage and the parts defining a fissure between the abutting portions thereof communicating with the branch passages and with the surface of the blade portion for discharge of the cooling air from the blade portion, one of the parts being substantially spaced from the other part over part of its length to define a slot wider than the fissure.

References Cited in the file of this patent

UNITED STATES PATENTS

994,166	Kienast	June 6, 1911
1,255,650	Samuelson	Feb. 5, 1918
1,603,966	Lorenzen	Oct. 19, 1926
2,183,158	Bennett	Dec. 12, 1939
2,701,120	Stalker	Feb. 1, 1955

FOREIGN PATENTS

528,031	France	Aug. 6, 1921
611,650	Great Britain	Nov. 2, 1948
679,931	Great Britain	Sept. 24, 1952
760,328	France	Dec. 6, 1933