Aug. 18, 1970 J. A. PETRIE ET AL 3,524,712

COMPRESSOR BLADE FOR A GAS TURBINE ENGINE

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Fig. 1.

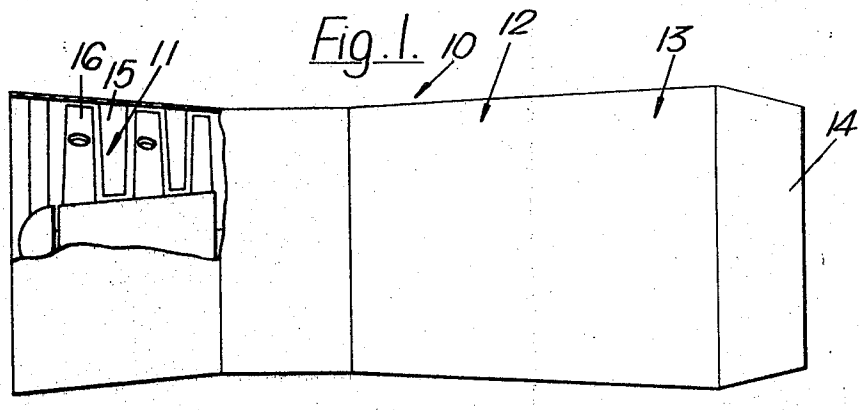


Fig. 2.

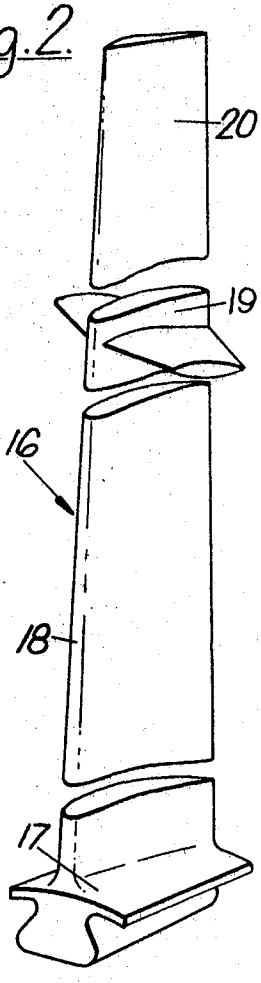
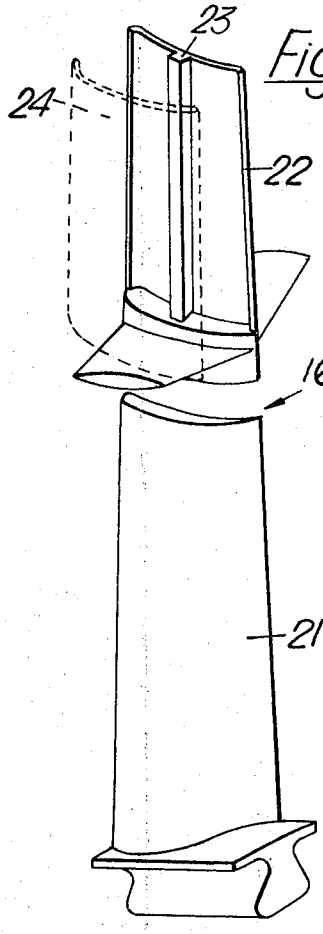


Fig. 3.



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Fig. 4.

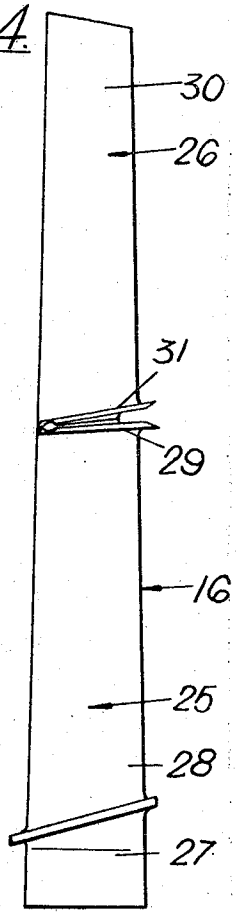
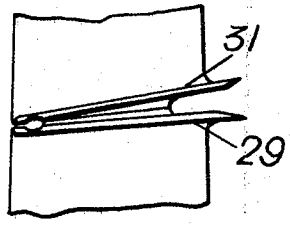


Fig. 5.



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COMPRESSOR BLADE FOR A GAS TURBINE ENGINE

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Int. Cl. F01d 5/10
U.S. Cl. 416—233 2 Claims

ABSTRACT OF THE DISCLOSURE

A clappered compressor blade for a gas turbine engine comprising a plurality of forged pieces bonded together by electron beam welding or other metallurgical technique to form at least the working section of the blade. The joint surfaces between the major pieces extend transversely across the blade so that they can easily be machined to match accurately before the bonding process.

This invention relates to a compressor blade for a gas turbine engine.

Throughout this specification the term "clapper" is to be taken to mean a lateral projection from the blade working surface situated between the longitudinal extremities of the working surface and adapted to abut with a similar projection on the next adjacent blade when the blades are assembled into a blade row.

Clappered blades for compressors have been increasing in size as gas turbine engine technology has advanced and it has been increasingly difficult to produce the blades in one piece by the conventioinal forging techniques. The present invention provides such blades without the necessity to forge very large pieces.

According to the present invention a compressor blade for a gas turbine engine comprises a root, an aerofoil shaped working section and a clapper projecting from both the concave and the convex flanks of the blade, the working section being made up of at least two pieces welded, bonded or otherwise joined together along a surface extending across the blade, said surface crossing the longest axis of the blade.

The clapper may be formed on a separate section of working surface, two further pieces being joined to said separate section to form said working section.

The tip of said blade may be hollow and ribs may be used internally to strengthen the blade.

The root of the blade may be formed solely on one of said pieces and the clapper formed solely on another of the pieces.

The individual pieces comprising the blade may be produced by forging.

The invention will now be particularly described merely by way of example with reference to the accompanying drawings in which—

FIG. 1 is a broken away elevation of a gas turbine engine incorporating compressor blades according to the present invention;

FIG. 2 is a perspective view of the pieces making up one form of blade according to the invention;

FIG. 3 is a view similar to FIG. 2 of a second embodiment of the invention;

FIG. 4 shows a further embodiment; and

FIG. 5 is an enlarged view of part of FIG. 4.

FIG. 1 shows a gas turbine engine **10** having a compressor **11**, a combustion section **12**, a turbine section **13** and a final nozzle **14** in flow series. The compressor **11** is visible through the broken away casing and comprises stator blades **15** and rotor blades **16**. The various forms of blade described with reference to the remaining figures are rotor blades **16** although the invention could equally well be applied to the stator blades **15**.

FIG. 2 shows a blade made up of separate pieces comprising a root portion **17**, an inner working section **18**, a clapper bearing portion **19** and a tip working surface section **20**. It will be seen that the blade is divided laterally, along a surface which crosses the longest axis of the blade and which is in fact substantially perpendicular to this axis, to form these various portions. The various parts **17**, **18**, **19** and **20** are assembled together substantially in the form shown in FIG. 2 and the joints electron beam welded to form a single blade. The separate pieces **17**, **18**, **19** and **20** are each made by forging from separate blanks, and the surfaces to be beam welded are machined so as to fit together accurately.

FIG. 3 shows a second construction in which the inner working surface and the root form a single inner section **21**. The clapper and the concave flank of the tip working section are formed as an integral outer section **22** of the blade. The tip section of the blade is hollow in this case, the section **22** being formed with a strengthening rib **23** and there being a separate flank section **24** which forms a convex flank of the tip section.

Again the blade **16** is formed by assembling sections **21**, **22** and **24** together and electron beam welding them together so as to form a blade having a hollow tip section, and again the joint surface is substantially perpendicular to the longest axis of the blade. The separate pieces are all forged from blanks, and again the surfaces to be welded are machined to fit accurately prior to welding.

It would of course be possible to produce a blade with a solid tip rather than a hollow one as above; this would be heavier but simpler to fabricate.

FIG. 4 shows another modification in which the blade is formed in two forged sections **25** and **26**. The inner section **25** comprises the root **27**, the inner working surface **28** and a platform **29** which forms part of the clapper. The outer section **26** comprises outer working surfaces **30** and a platform **31** which forms the remainder of the clapper. FIG. 5 shows how the sections **29** and **31** are attached along a surface perpendicular to the longest axis of the blade to form a single clapper and also to connect the sections **25** and **26** together. Attachment of the sections is again performed by electron beam welding.

A possible modification of the constructions illustrated would be to produce the separate pieces by forging with oversize sections at those surfaces where joining is to take place. The surplus material would then be machined away after welding the pieces together.

The material used for the blades may be any suitable material such, for example, as titanium or steel.

It will be seen that the present invention provides a way in which large clappered blades can be made without the necessity for forging the whole blade and clapper which would be difficult, both because of the large size and because of the fact that the clapper extends perpendicular to the major axis of the blade. The main surfaces to be beam welded in the present construction cross the major axis of the blade, and are not of complex shape. They are therefore easily machined and can hence be made to fit together accurately, enhancing the subsequent bonding process.

Although the embodiments described have all used electron beam welding to join the sections it would be possible to use other metallurgical bonding processes such as diffusion bonding.

We claim:

1. A compressor blade comprising

a root,

a first individually forged blade-like working section integral with said root and extending outwardly therefrom having an aerofoil cross section with concave and convex flanks,

a second individually forged blade-like working section including a concave flank section and a vertical rib member supporting said concave flank section,

said first and second working sections having formed on the outboard and inboard ends thereof, respectively, machined surfaces metallurgically joined in a mating relationship, the joint so formed between said first and second working sections extending transversely of said blade and crossing the longitudinal axis thereof,

a clapper integral with an extending laterally from both sides of said second working section inboard of said concave flank section, and

a convex flank member joined to said concave flank section of said second working section to form a blade of aerofoil cross section having concave and convex flanks extending outwardly of said clapper and forming a hollow space therebetween and enclosing said vertical rib member.

2. A compressor blade as claimed in claim 1 and in which said metallurgically joined surfaces are substantially perpendicular to the longitudinal axis of the blade.

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