United States Patent

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[31] 58478/67

[54] **BLADES FOR FLUID FLOW MACHINES**
6 Claims, 4 Drawing Figs.

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[51] Int. Cl. F01d 5/16
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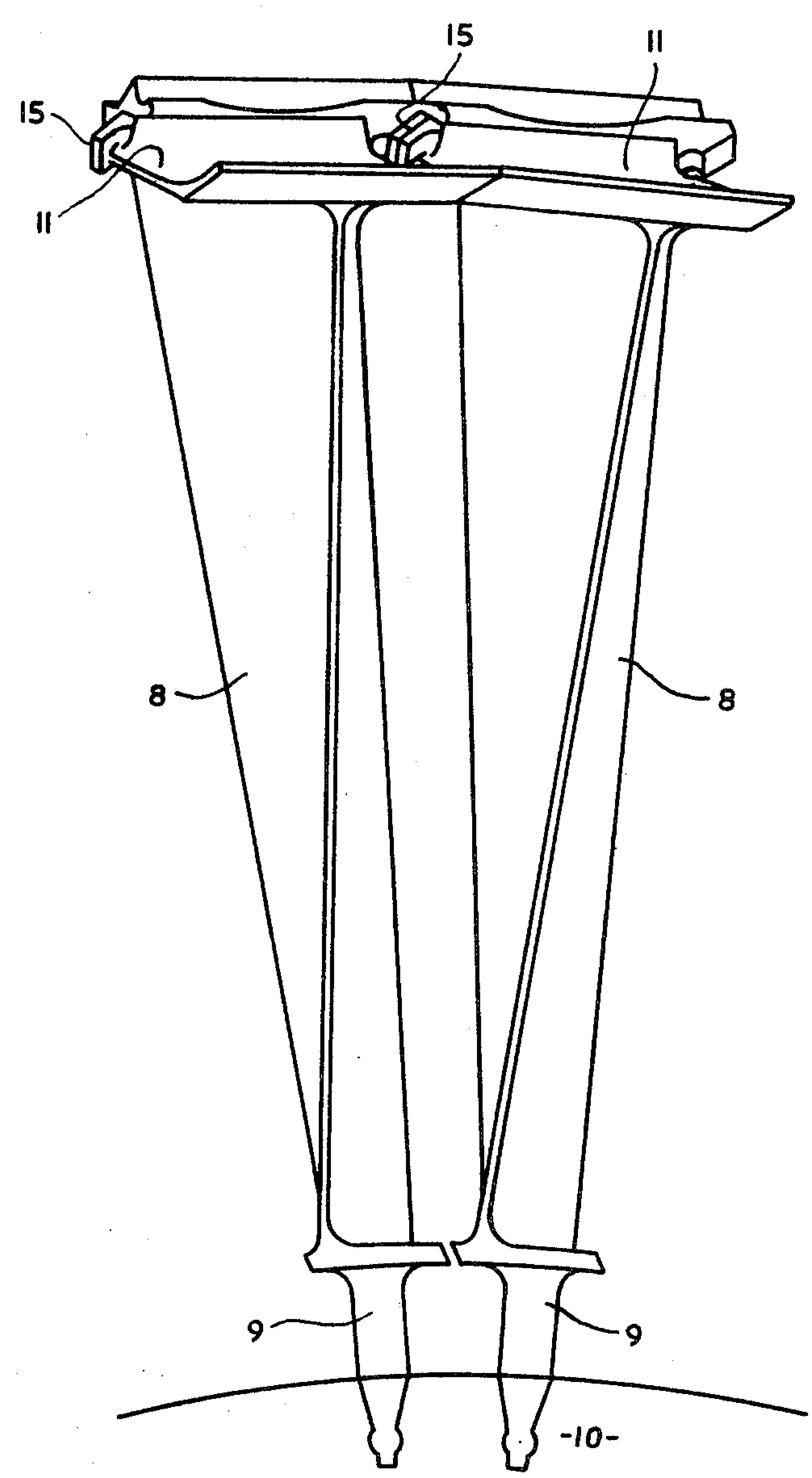
ABSTRACT: In a bladed rotor for a gas turbine engine each blade in a turbine blade ring has a shroud portion which is adapted to abut the next adjacent shroud portions of blades in the blade ring. The abutting surfaces are provided by the wear-resistant ends of a bridgepiece which fits over the shroud and is brazed into position.



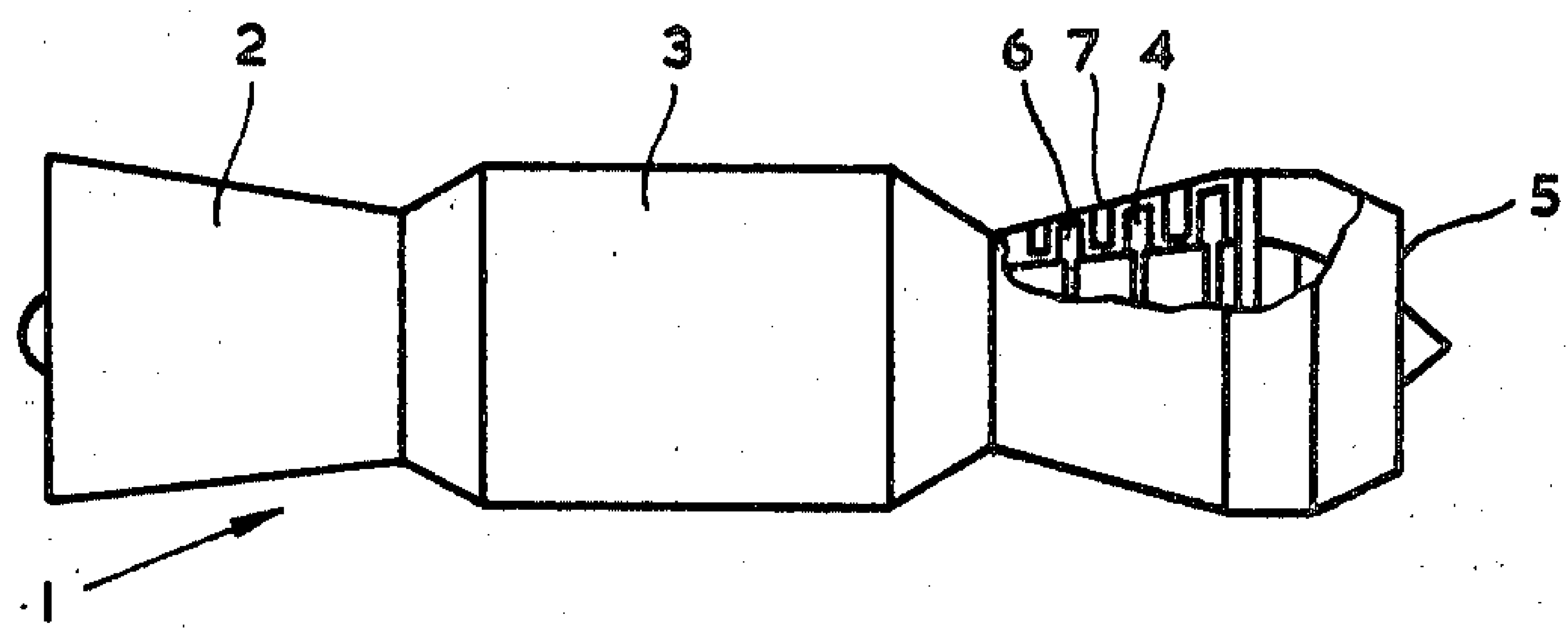


FIG. 1.

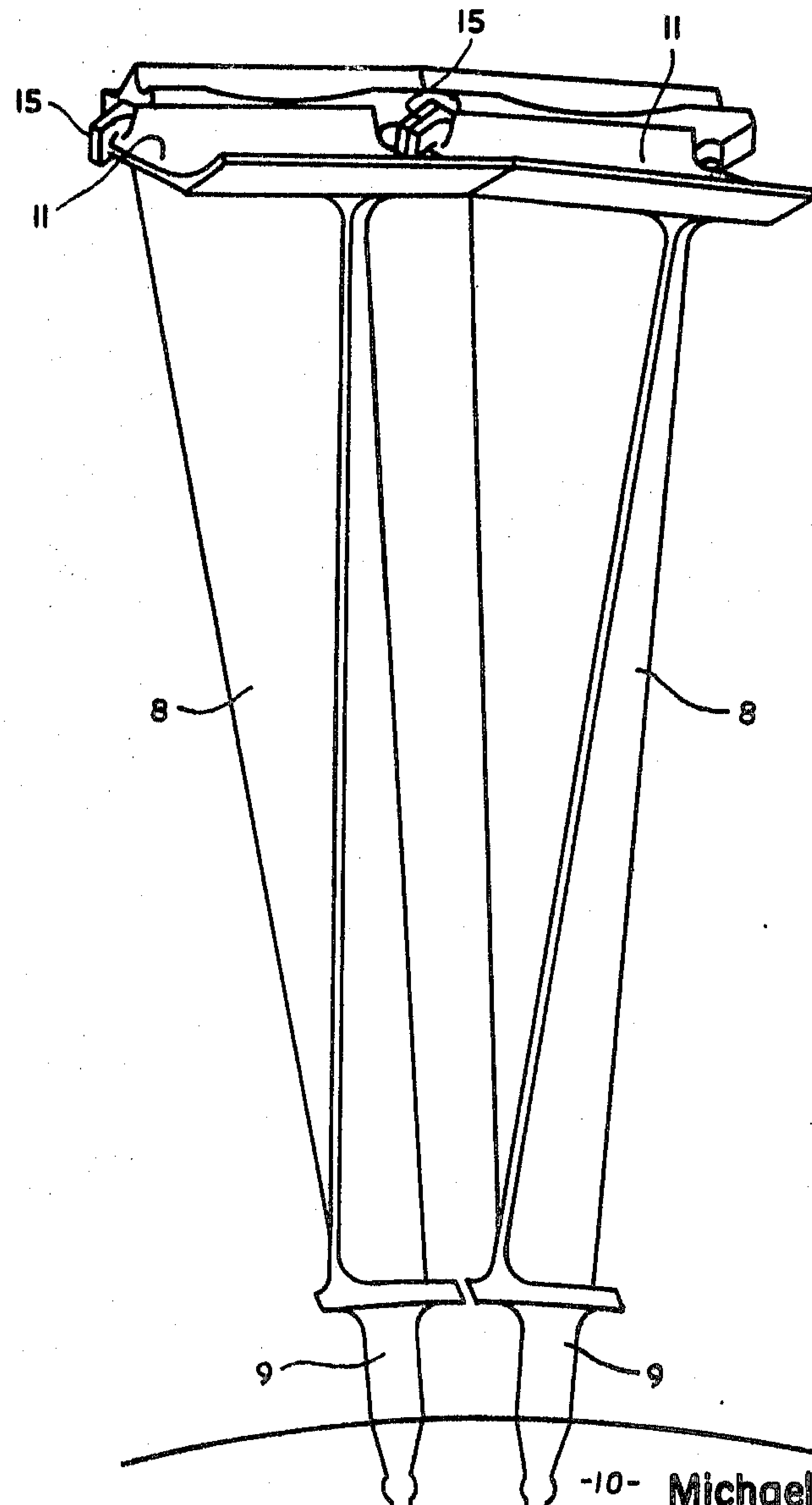


FIG. 2.

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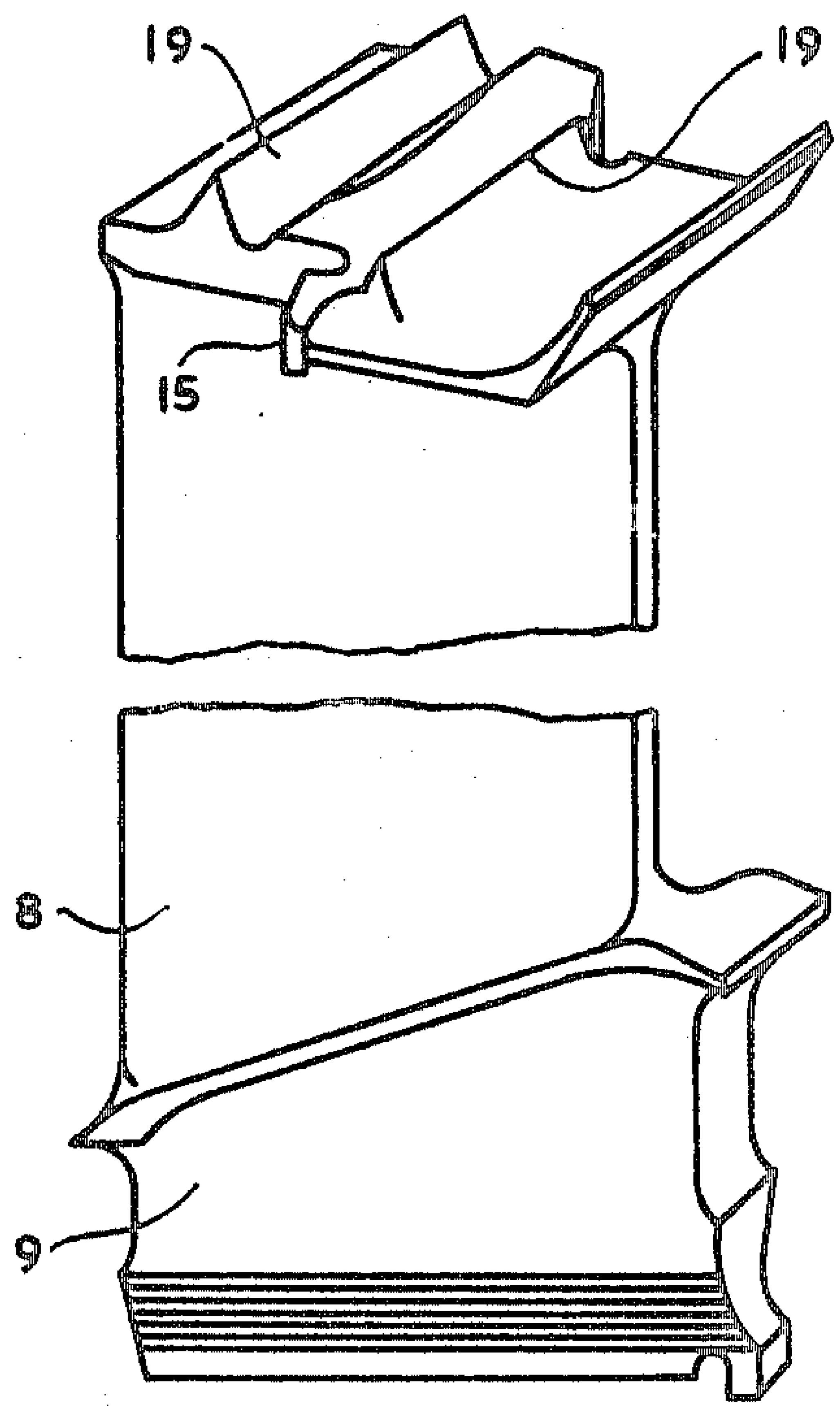

FIG. 3

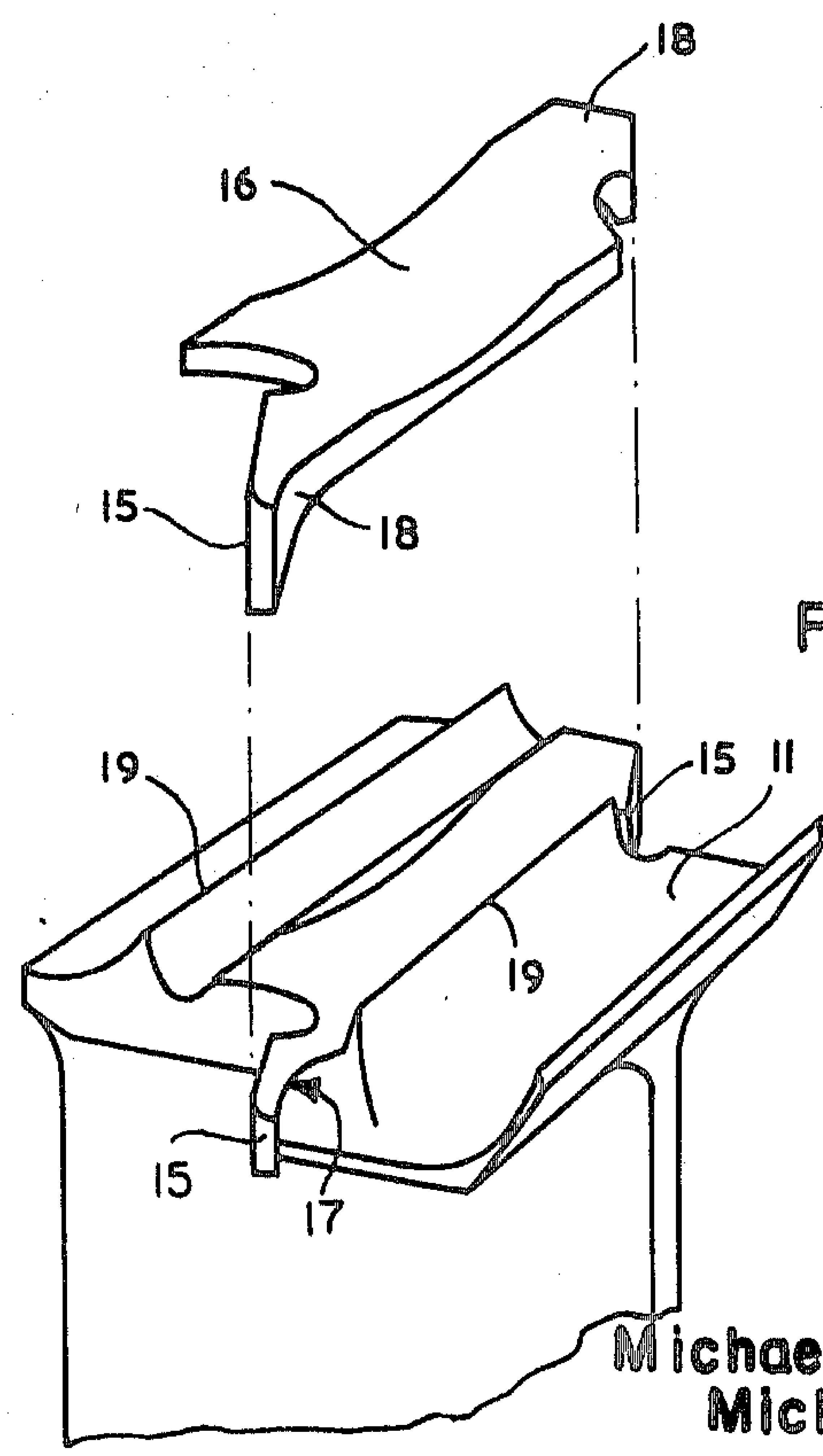

FIG. 4.

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BLADES FOR FLUID FLOW MACHINES

The present invention relates to blades for fluid flow machines and has particular but not exclusive reference to rotor blades for a compressor or turbine of a gas turbine engine.

According to the present invention there is provided a blade for a fluid flow machine which blade has a shroud portion at its tip, said shroud portion being adapted to extend circumferentially when the blade is positioned in a ring of blades and terminating in circumferentially opposite end faces, a bridgepiece connected to the shroud portion and extending between said end faces, the bridgepiece having end portions which are made of material having greater wear resistance than the blade, which end portions are positioned over the end faces of the shroud portion, so that the end portions of the bridgepiece provide abutment surfaces for abutment with corresponding surfaces provided on the shroud portions of adjacent blades of said ring of blades.

The areas of the abutment surfaces of the bridgepiece may be greater than the areas of the end faces of the shroud portion over which they fit.

The abutment surfaces of the bridgepieces on two adjacent shroud portions also preferably provide an interference fit between the shroud portions and are inclined at an angle to the engine axis thereby providing a twist on blade.

The invention also includes a blade rotor comprising a ring of blades, as described above, mounted on a rotor member.

According to another aspect of the invention a method of making a blade for use in a bladed rotor of a fluid flow machine, comprises the steps of forming a blade with a shroud portion at its tip, the shroud portion being adapted to extend circumferentially when the blade is positioned in a ring of blades, and terminating in circumferentially opposite end faces, making a bridgepiece having end portions, at least the end portions of which are made of a material which has greater wear resistance than the material of the blade, locating the bridgepiece on the shroud portion so that it extends between said end faces of the shroud portion and the end portions overlie said end faces of the shroud portion, and connecting the bridgepiece to the shroud portion.

The invention will now be described in more detail, merely by way of example, with reference to the accompanying drawings wherein:

FIG. 1 shows a gas turbine engine with the turbine casing broken away.

FIG. 2 shows part of a ring of rotor blades of the turbine of the engine of FIG. 1.

FIG. 3 is an enlarged pictorial view of one of the turbine blades of FIG. 2.

FIG. 4 is an exploded view of the blade of FIG. 3 illustrating the position of the bridge piece.

Referring now to the drawings, in FIG. 1 there is shown a gas turbine engine 1 having compressor means 2 combustion equipment 3, turbine means 4 and a propulsion nozzle 5 all in flow series.

The turbine means 4 consists of a plurality of rotor stages 6 and stator stages 7.

FIG. 2 shows one of the rotor stages 6 which comprises a plurality of aerofoil-shaped blades 8 mounted by means of root portions 9 on the periphery of a rotor disc 10. Each blade has a shroud portion 11 at its tip, each shroud portion extending circumferentially and cooperating with the shroud portion of the next adjacent blades to form a shroud ring. Each shroud portion has abutment surfaces 15 for abutment with the next adjacent shroud portions of the ring to form an interference joint which puts a slight twist on each blade and assists in damping out vibration of the blades. The abutment surfaces 15, seen more clearly in FIG. 3 are inclined to the longitudinal axis of the engine in order to provide a reaction on the blade which provides the twist.

As shown in FIG. 4 the abutment surfaces 15 form part of a bridgepiece 16 which is fitted over the top of the shroud portion 11 and the abutment surfaces 15 are provided by the end faces of end portions 18 of the bridgepiece, which overlie the circumferentially opposite end faces 17 of the shroud portion 11. The bridge piece 16 is shown both in position on the blade shroud portion 11 and displaced thereabove, as in an exploded view.

The bridgepiece 16 is made of a material which is more wear resistant than the material of the blade, for example the material sold under the trade name of Stellite, the blades being made of a material sold under the trade name of Nimonic 115. The bridgepiece 16 is shown both in position on the blade shroud portion 11 and displaced thereabove, as in an exploded view.

In a prior construction of a bladed rotor the end faces 17 have been made to provide the abutment surfaces and these faces have suffered from the disadvantages that, the material of the blades has not been sufficiently hard to resist frictional wear during vibration of the blade, and the cross-sectional area of the shroud portion has been kept small to reduce weight and cost of production. It has been found difficult to attach separate small hardened pads to the end faces 17 due to their small size and the difficulties of locating the pads on the surface in order to attach them.

The use of a bridgepiece of hard material has simply and effectively solved this problem and at the same time enables the surface areas of the end faces to be increased. The bridgepiece is simply and accurately located circumferentially on the blade by the end portion 18 and axial location is made between two projections 19 on the shroud portion 11.

The bridgepieces are brazed in position and hence may be utilized in the case of blades which are made of nonweldable material. Thus the bridgepiece has the further advantage that in the event of excessive wear it may be machined off and replaced without detriment to the blade.

It will be clear that the bridgepiece itself may be fabricated from two Stellite end portions 18 the intermediate portion 20 being made of a different material.

The intermediate portion 20 of the bridgepiece may be reduced in thickness by machining after attachment to the shroud portion to reduce the weight of the assembly.

We claim:

1. A blade for a fluid flow machine, a shroud portion at the tip of the blade, said shroud being adapted to extend circumferentially when the blade is positioned in a ring of blades and terminating in circumferentially opposite end faces, a bridgepiece connected to the shroud portion and extending between said end faces, the bridgepiece having end portions which are made of material having greater wear resistance than the blade, which end portions are positioned over the end faces of the shroud portion, so that the end portions of the bridgepiece provide abutment surfaces for abutment with corresponding surfaces provided on he shroud portions of adjacent blades of said ring blades, said bridgepiece being replaceable without detriment to the blade.

2. A blade as claimed in claim 1, wherein the whole of the bridgepiece is made from the material having greater wear resistance than the blade.

3. A bladed rotor comprising a rotor member, a plurality of blades mounted on the rotor member, each blade having a shroud portion at its tip which extends circumferentially of the rotor, and terminates in circumferentially opposite end faces, a bridgepiece connected to the shroud portion and extending circumferentially of the rotor, the bridgepiece having end portions which are made of a material having greater wear resistance than the blade, which end portions are positioned over the end faces of the shroud portion and provide abutment surfaces which abut corresponding surfaces provided on the shroud portions of adjacent blades of the rotor, said bridgepiece and end portions being replaceable to provide new abutment surfaces.

4. A bladed rotor according to claim 3 wherein the abutment surfaces of the bridgepieces on two adjacent shroud portions provide an interference fit between the shroud portions.

5. A blade for a fluid flow machine, a shroud portion at the tip of the blade, said shroud being adapted to extend circumferentially when the blade is positioned in a ring of blades and terminating in circumferentially opposite end faces, a bridgepiece connected to the shroud portion and extending between said end faces, the bridgepiece having end portions which are made of material having greater wear resistance than the blade, which end portions are positioned over the end faces of the shroud portion, so that the end portions of the bridgepiece provide abutment surfaces for abutment with corresponding surfaces provided on the shroud portions of adjacent blades of said ring of blades, the areas of the abutment surfaces of the bridgepiece being greater than the areas of the end faces of the shroud portion over which they fit.

6. A method of making a blade for use in a bladed rotor of a fluid flow machine, comprising the steps of:

forming a blade with a shroud portion at its top extending circumferentially when the blade is viewed in a ring of blades;

forming circumferentially opposite end faces on said shroud portion;

forming a bridgepiece having end portions of a material which has greater wear resistance than the material of the end faces of the shroud;

locating the bridgepiece end portions in overlying relation to the end faces of the shroud by placing the bridgepiece over the blade shroud portion;

affixing the end portions of the bridgepiece to the end faces of the shroud; and

removing at least a portion of the bridgepiece after the end portions are affixed.