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COOLED ROTOR BLADE

Filed June 8, 1967

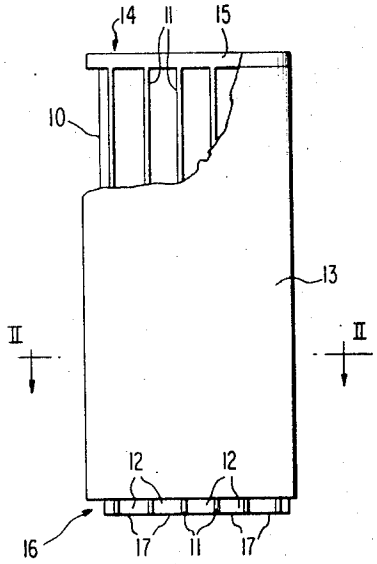


FIG.1

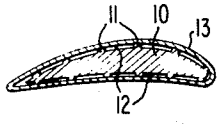


FIG.2

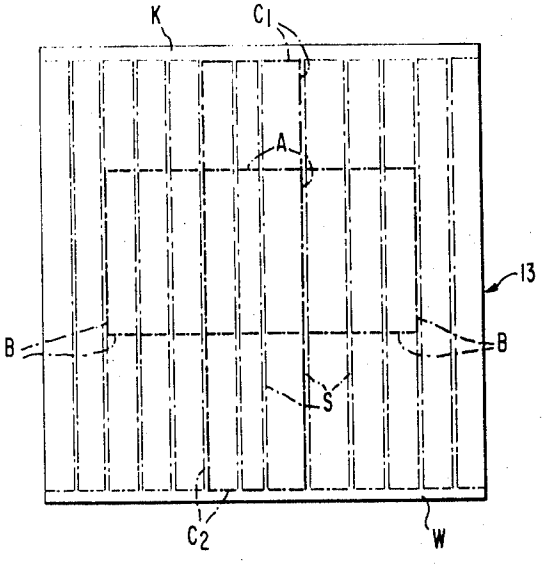


FIG.3

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COOLED ROTOR BLADE

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U.S. Cl. 253—39.15 7 Claims

ABSTRACT OF THE DISCLOSURE

A cooled rotor blade, especially for internal combustion turbines, in which the inner body is provided with elongated ribs forming channels for the cooling medium and a shirt surrounding the inner body is formed by a sheet-metal-like jacket secured to the inner body and provided with discharge apertures, whereby the discharge apertures are so distributed as to assure substantial temperature uniformity in the blade structure.

Background of the invention

The present invention relates to a cooled rotor blade, especially for internal combustion engines, in which the cooling medium enters at the blade root into channels of the blade interior body and leaves through openings of the blade shirt, and in which the temperature differences at the outer surface of the blade shirt are essentially equalized by an arrangement and/or construction of the discharge apertures in the blade shirt taking into consideration this temperature distribution.

With the prior art rotor blades of this type, the blade shirts consist of porous metal fabric or cloth over which an additional material is sprayed in order to change locally the porosity of the cloth or fabric for the cooling medium corresponding to the temperature distribution at the rotor blade. Such rotor blades with metal cloth or fabric involve high material costs and are difficult to manufacture. The spraying of additional material has to be separately realized for each individual rotor blade in individual tests.

Summary of the invention

The purpose and aim of the present invention essentially resides in improving a rotor blade of the aforementioned type.

For this purpose, provision is made according to the present invention that the blade shirt forms a sheet metal-like case or jacket body in which are accommodated or provided cross-sectional flow apertures for the discharge of the cooling medium.

A rotor blade constructed with the features and characteristics of the present invention entails considerable advantages. The high material costs for the metallic cloth or fabric used with the prior art rotor blades can be economized with the present invention. The manufacture of the blade shirt from a sheet-metal-like casing or jacket is considerably less expensive than the manufacture from an easily destructible fabric or cloth. The costly spraying-on of additional metal is also dispensed with by the present invention. In particular, the discharge apertures for the cooling medium may be realized and accommodated in the blade shirt in a considerably more simple and rational manner by the present invention—for example, by the effect of charged carrier beams. It is possible thereby, in particular to cause electron beams to act on the developed jacket or casing body of the blade sheet metal according to a stored program—corresponding to the once determined temperature distribution at the rotor blade. The manufacture of the blade shirts can be automated thereby and the assembly of the rotor blades rendered considerably less expensive.

Accordingly, it is an object of the present invention to provide a cooled rotor blade, especially for combustion turbines, which avoids by simple means the aforementioned shortcomings and drawbacks encountered with the prior art constructions.

Another object of the present invention resides in a cooled rotor blade which entails the advantage of considerably less costly manufacture and assembly and which obviates the need for expensive materials needed for the manufacture of the blade.

A further object of the present invention resides in a cooled rotor blade which dispenses with the requirement for costly and easily destructible materials.

Still another object of the present invention resides in a cooled rotor blade which lends itself to mass production by automation techniques.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein:

FIGURE 1 is a side elevational view of a rotor blade in accordance with the present invention, with parts thereof broken away for sake of clarity;

FIGURE 2 is a cross-sectional view through the rotor blade taken along line II—II of FIGURE 1; and

FIGURE 3 is a plan view on the blade shirt of FIGURE 1, developed into the plane of the drawing.

Referring now to the drawing wherein like reference numerals are used throughout the various views, and more particularly to FIGURES 1 and 2, the blade interior body **10** is solid and is provided along its circumference with web-like ribs **11** between which extend the channels **12** for the cooling medium. The blade interior body **10** is surrounded by a blade shirt **13** whose sheet metal-like casing or jacket body abuts against the ribs **11** and is rigidly connected therewith, for example, by electron-beam-welding. The blade interior body **10** is provided at one end with a blade head generally designated by reference numeral **14** against which the blade shirt **13** abuts sealingly. The blade shirt **13** is securely connected with the lateral surfaces **15** of the blade head **14** also by means of electron-beam-welding so that the cooling medium channels **12** are sealed in a pressure-tight manner in the direction toward the blade head **14**.

At the end opposite the blade head **14** the blade interior body **10** projects a distance out of the blade shirt **13** and forms in this manner a blade root generally designated by reference numeral **16** for the fastening of the rotor blade at its respective turbine rotor. When the rotor blade is inserted into the turbine rotor, the ends **17** on the side of the root of the channels **12** form the inlet apertures for the cooling medium.

The blade shirt **13** is provided with bores for the discharge of the cooling medium out of the rotor blade. The blade shirt **13**, illustrated in FIGURE 3 in its developed form, is provided with a central surface area A indicated in dash and dot lines, within which are accommodated in the blade shirt larger discharge bores, for example, with 0.065 mm. diameter. The surface area A may be provided with a porosity of about 25%, i.e., 25% of a surface unit of this area are free flow-cross-section. The bores themselves are omitted in the illustrated showing by reason of the selected scale of the drawing for the illustrated embodiment of a rotor blade according to the present invention.

Two surface areas B adjoin in the circumferential direction of the blade shirt **13** its surface area A, within

which medium or average flow bores, for example, having 0.050 mm. diameter, are accommodated in the blade shirt. The surface areas B then exhibit, a porosity of, for example, 20%. Also these passage or flow bores are not illustrated within these areas of the blade shirt 13 for the same reasons stated above.

Two surface areas C_1 and C_2 adjoin the center surface area A in the direction of the blade ends within which the blade shirt is also provided with medium or average flow bores. Also, these surface areas C_1 and C_2 may be provided with a porosity of about 20%. The respective bores thereof are also not illustrated in the drawing.

A rim surface K is indicated at the end of the blade shirt 13 near the head of the blade by means of which the blade shirt 13 is welded to the blade head 14 and which is free of cross-sectional apertures.

A rim surface W is provided at the end of the blade shirt 13 near the root which also is not provided with any flow apertures.

Surface strips S connecting the rim surfaces K and W are provided in the blade shirt 13 corresponding to the arrangement of the webs 11 at the interior body 10 of the blade which surface strips S are excluded or spared from the accommodation of the flow apertures.

The remaining residual surfaces of the blade shirt 13 are provided with smaller flow apertures, for example, having 0.040 mm. in diameter. These residual surfaces then possess a porosity of about 15%. Also, the smaller flow apertures are not illustrated in the drawing.

As a result of the described distribution of larger, medium and smaller flow apertures at the blade shirt 13, different operating temperatures do not occur thereat since the cooling medium rate of flow is matched accurately to the heat quantities to be conducted away locally by the indicated aperture distribution.

While I have shown and described one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and I therefore do not wish to be limited to the details shown and described herein but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

I claim:

1. A cooled rotor blade structure, especially for internal combustion turbines, comprising inner body means, blade shirt means surrounding said inner body means, said blade shirt means being constituted by a sheet metal-like casing body, channels formed between said inner body means and said shirt means, said channels providing for the passage of cooling medium therethrough, inlet means near the root portion of said blade permitting the entry of cooling medium into said channels, and means for locally equalizing temperature differences occurring at the blade including aperture means provided in said shirt means for the discharge of the cooling medium therefrom.

2. A rotor blade structure according to claim 1, wherein the sheet metal-like shirt means is provided with an aperture distribution effecting substantial temperature uniformity throughout the blade.

3. A cooled rotor blade structure according to claim 2, wherein the inner body means is provided with longitudinally extending rib means forming said channels, said blade shirt means being provided with connecting surface strip means devoid of apertures for connection with said rib means.

4. A rotor blade structure according to claim 3, wherein said inner body means is provided with a head portion and a root portion, and said blade shirt means is provided with rim surface portions devoid of any apertures along which the shirt means is securely connected with the head and root portions of the inner body means.

5. A rotor blade structure according to claim 1, wherein said inner body means is provided with a head portion and a root portion, and said blade shirt means is provided with rim surface portions devoid of any apertures along which the shirt means is securely connected with the head and root portions of the inner body means.

6. A cooled rotor blade structure according to claim 5, wherein the inner body means is provided with longitudinally extending rib means forming said channels, said blade shirt means being provided with connecting surface strip means devoid of apertures for the connection with said rib means.

7. A cooled rotor blade structure according to claim 6, wherein said aperture means vary, with respect to the size and distribution thereof, in accordance with a predetermined distribution of cooling medium, over the area of said blade shirt means.

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