Feb. 5, 1946. G. ZELLBECK ET AL 2,394,353

METHOD FOR THE MANUFACTURE OF BLADES FOR EXHAUST TURBINES

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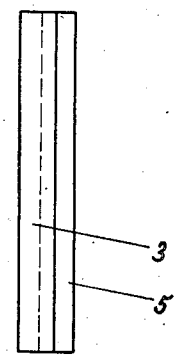



Fig. 1

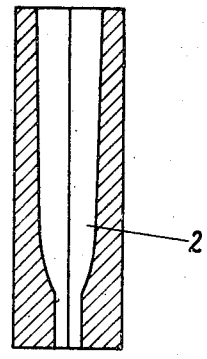



Fig. 3

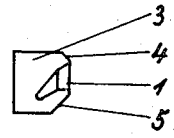



Fig. 2

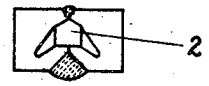



Fig. 4

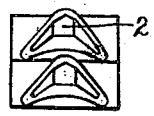



Fig. 6



Fig. 5

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## METHOD FOR THE MANUFACTURE OF BLADES FOR EXHAUST TURBINES

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Application January 17, 1940, Serial No. 314,204
In Germany January 26, 1939

1 Claim. (Cl. 29—156.8)

This invention relates to the method for the manufacture of blades for exhaust turbines, particularly of blades of the radially extending type which have a passage for cooling fluid extending through the blade lengthwise, the blades being usually formed with a concave working surface and a convex leading surface.

It is an object to provide a method for the manufacture of such blades by forming them from two pieces of metal which are joined along a single plane at right angles to the axis of the turbine and near the center of said blades, the said pieces being first milled or otherwise formed to produce depressions which form the cooling fluid passage and being thereupon welded together, whereafter the concave and convex faces thereof are formed.

Another object is to provide, as a step in the process, the insertion of a core within the cooling fluid passage to assure against the entry of welded metal into said passage and the provision of smooth surfaces within the passages.

It is another object to arrange the welded joint in such a way that it will not be subjected to stresses arising from centrifugal forces nor to excessive thermal stresses.

Another object is to provide a method of making a hollow turbine blade especially well adapted for exhaust gas turbines or turbines using other high temperature working fluids made by the method comprising the present invention.

Other objects will appear from the following description of an illustrative embodiment of the invention taken together with the attached drawing wherein:

Fig. 1 is an elevation of a rectangular blank which is to form one-half of the turbine blade;

Fig. 2 is a top view thereof, it appearing therefrom that one face thereof has been milled or otherwise formed to produce a cooling fluid passage and that the corners thereof have been chamfered to facilitate welding;

Fig. 3 is a radial axial cross-section of an unfinished blade showing the two halves together;

Fig. 4 is a top view of the parts shown in Fig. 3; and

Fig. 5 is an elevation showing the finished turbine blade.

Fig. 6 is an end view of two juxtaposed finished turbine blades made in accordance with the invention.

Referring to said drawing, the numeral 3 indicates one of the two blanks of which the turbine blade is formed. 1 indicates the groove milled or otherwise formed in each half-blade blank 3, which together with the cooperating groove in the mating blank forms the passage 2. Numerals 4 and 5 indicate chamfered corners to facilitate welding.

In the manufacture of turbine blades according to the present invention, the respective complementary blade blanks preformed substantially in accordance with Figs. 1 and 2 are juxtaposed as shown in Figs. 3 and 4 and their meeting edges welded, leaving an internal passage 2 of the desired area and shape through which air or other cooling fluid may pass.

In order to prevent the formation of welding beads or the like during the welding process, a core is preferably inserted within the complementary depressions which form the cooling fluid passage. This core consists of suitable material coated for example with a graphite coating. This core assures that the cooling fluid passage remains perfectly smooth and that none of the welding material will enter said passage to cause the unbalancing of the rotor. Furthermore, the resulting smooth inner surface of the passage offers a minimum of resistance to the flow of the cooling air or other fluid. After welding the core is removed and thereupon the exterior of the blade is finished to provide a blade of generally known form usually provided with a concave working surface and a convex leading surface which cooperates with the concave surface of the preceding blade to provide a passage of the desired shape for the working fluid.

The resulting blade has the advantage of cheapness of construction in that the desired conformation of the cooling fluid passage may be achieved by forming complementary depressions in the blanks before the blanks are united so that the blanks may be prepared by forging and/or milling, or other conventional economical methods, whereas the external finishing of the blades after the blanks are welded together, may also be accomplished economically by conventional milling and other machine operations.

The method and product also have the advantage that the welded junction is along a single plane so that fitting together of the parts is simple.

A further advantage is that the junction is located in such a way that it is not subjected to centrifugal stresses and also subjected to a minimum extent to thermal stresses. When using high temperature working fluid, such as exhaust gases, the corners of the blade where the hot gases strike are subjected to great thermal stresses which are not present in the same degree

at those parts of the blade which lie substantially in the central plane of the rotor.

It will be noted that the construction shown and the process described will serve admirably to accomplish the objects stated above. It is to be understood however that the method and product disclosed are intended merely as illustrative of the invention and not as limiting as various modifications therein may be made without departing from the invention.

We claim:

A method of making a hollow turbine blade which comprises producing a pair of blanks, each having at least one plane face, producing a longitudinal concavity in said plane face of each blank, the concavities being complementarily symmetrical, juxtaposing the two blanks so that the meeting, treated faces so relate the two concavities as to form a single interior passage, welding the blanks to one another along the edges of the meeting faces, producing a root for the blade symmetrically formed from the two blanks, and thinning the wall formed about the passage by the welded blanks to concave one face to form a working surface of the blade and convex another face to form the leading surface of the blade, the said outer faces being so formed that the common plane of the said meeting faces is at right angles to the axis of the turbine when the blade is mounted.

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