Dec. 26, 1944. R. C. ALLEN 2,366,142

BLADE SHROUDING

Filed July 14, 1943

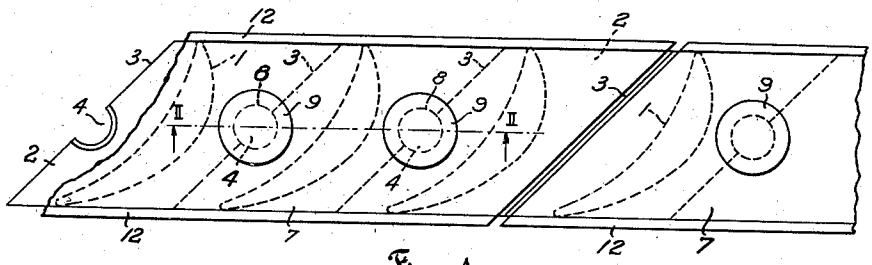


Fig. 1

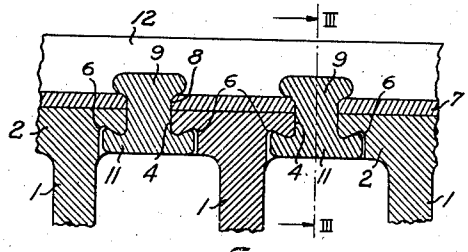


Fig. 2

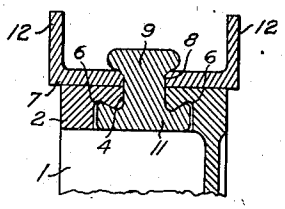


Fig. 3

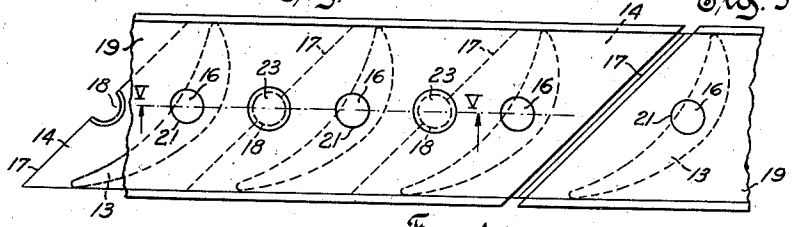


Fig. 4

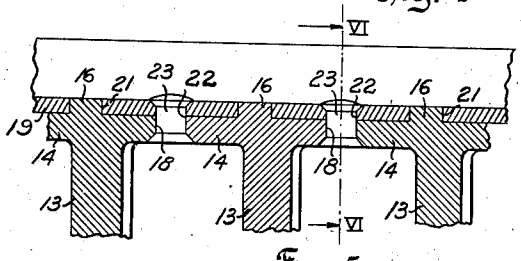


Fig. 5

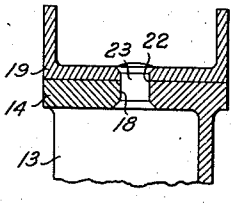


Fig. 6

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Patented Dec. 26, 1944

2,366,142

UNITED STATES PATENT OFFICE

2,366,142

BLADE SHROUDING

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Application July 14, 1943, Serial No. 494,644

9 Claims. (Cl. 253—77)

This invention relates to turbine blading and has for its object the provision of a shroud construction which can be readily applied to and removed from a group of blades without injuring or damaging same.

A further object of this invention is to provide an improved shroud construction which can be readily riveted to a group of tenonless blades.

In accordance with this invention, one or more of the above stated objects may be accomplished in whole or in part by a construction embodying a plurality of blades positioned in passage forming relation and having integral shroud portions presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening, a strip spanning said integral portions and having therein an aperture alined with said opening, and a rivet extending through said aperture and opening for securing said strip to the integral shroud portions on adjacent blades.

The invention accordingly consists of the various details of construction, correlations of elements and arrangements of parts as is more fully set forth in the appended claims and in the detailed description, reference being had to the accompanying drawing, in which:

Fig. 1 is a plan view of a partial blade row embodying the invention;

Fig. 2 is a partial section taken on line II—II of Fig. 1;

Fig. 3 is a section taken on line III—III of Fig. 2;

Fig. 4 is a plan view of a partial blade row embodying a modified construction;

Fig. 5 is a partial section taken on line V—V of Fig. 4; and

Fig. 6 is a section taken on line VI—VI of Fig. 5.

Referring to the drawing and particularly to Figs. 1–3, inclusive, it is seen that apparatus embodying the invention may include a plurality of turbine blades 1 disposed in passage forming relation and having on adjacent blades integral shroud portions 2 presenting edge surfaces 3 which are disposed in opposed contiguous or abutting relation and which are grooved or otherwise shaped to provide therebetween an enlarged rivet receiving opening 4, a substantially continuous rivet head receiving depression 6 formed in the inner surface of the integral shroud portions 2 in surrounding relation about the inner end of the rivet receiving opening 4, a strip 7 spanning the integral shroud portions 2 and having therein spaced apertures 8 alined with the rivet receiving openings 4, and rivets 9 which extend through said alined apertures and openings and have on their inner ends head portions 11 which extend within the depressions 6 and act to unite and retain the outer ends of the blades with the edge surfaces 3 on adjacent shroud portions 2 disposed in the opposed contiguous or abutting relation specified when the opposite ends of the rivets are upset or headed to firmly secure the strip 7 to the substantially continuous outer surface presented by the integral shroud portions 2.

The strips 7 may be made plain or provided with one or more sealing flanges 12 as shown and the length of said strips is preferably such that each strip spans a selected number of blades constituting a group, thereby requiring several blade groups and a corresponding number of strips placed in end to end relation on adjacent groups, as indicated in Fig. 1 in order to form a blade row. The edge surfaces 3 of the integral shroud portions 2 may be grooved or otherwise shaped to form the rivet receiving openings 4 and depressions 6 either before or after the blades are positioned in passage-forming relation, and likewise the apertures 8 in strip 7 may be formed either before or after the strip is positioned on the group of blades to be spanned thereby. A showing of the root ends of the blades has been omitted in the interest of simplicity, as it is immaterial in what manner the blades are mounted on the rotor element carrying same.

The construction just described permits the rivets being readily and uniformly upset or headed by means of a small rivet press having a C-clamp type anvil positionable between adjacent blades in engagement with the rivet head and a pneumatic-hydraulic force multiplying arrangement operable to apply the same upsetting force to each rivet, thereby eliminating the lack of uniformity and other objectionable effects resulting from manually upsetting or peening-over rivets or tenons with a hammer. In addition, the rivets can be readily removed when necessary simply by chipping or grinding off their heads or upset ends after which the seal strip can be removed and a new one placed in position and secured to the blades by riveting without replacing or altering the blades in any respect. Likewise if only some of the blades in a group are damaged, only the damaged blades need be replaced since the removal of the rivets and strip does not necessitate altering the remaining blades.

The aforementioned desirable features and advantages are also present in the modified construction shown in Figs. 4–6, inclusive, which em-

bodies blades 13 positioned in passage-forming relation and a shroud structure comprising integral shroud portions 14 on adjacent blades having outwardly extending projections or tenons 16 and opposed contiguous or abutting edge surfaces 17 which are grooved or otherwise shaped to form therebetween an enlarged rivet receiving opening 18, a shroud strip 19 spanning the integral shroud portions 17 and having therein openings 21 receiving the tenons 16 and apertures 22 alined with the rivet receiving openings 18, and rivets 23 extending through the alined apertures and openings for securing the shroud strip to the integral shroud portions 14.

The tenons or projections 16 function to unite and retain the outer ends of the blades in their proper passage forming relation with the edge surfaces 17 on adjacent shroud portions 14 disposed in the opposed contiguous or abutting relation specified. In other words, the tenons 16 and the tenon receiving openings 21 provided on and in the shroud portions and strips 14 and 19, respectively, perform exactly the same retaining function as do the rivet head receiving depressions 6 and the rivet heads 11 shown in Figs. 1–3. The modified construction shown in Figs. 4–6, inclusive, which may be preferable in that a simple form of rivet can be employed, and that shown in Figs. 1–3, inclusive, can be readily assembled in an obvious manner and a further description in this connection is deemed unnecessary for a complete understanding of the invention. However, both constructions embody blades having integral shroud portions and means including a strip spanning said shroud portions for uniting and retaining the outer ends of the blades in their proper passage forming relation.

The invention is applicable generally to elastic fluid turbines embodying blades having integral shroud portions, and it should therefore be understood that it is not intended to limit the invention to the exact details of construction herein shown and described, as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portions, a strip spanning said integral portions and having therein an aperture alined with said rivet receiving opening, and a rivet extending through said aperture and opening for securing said strip to the integral shroud portions on adjacent blades.

2. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surface of said shroud portions, a strip spanning said integral portions and having therein an aperture alined with said rivet receiving opening, and means including a rivet extending through said aperture and opening for uniting and retaining the shrouded ends of adjacent blades with said edge surfaces positioned in opposed contiguous relation.

3. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades having outwardly extending projections and opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portions, a strip spanning said integral portions and having therein openings receiving said projections and an aperture alined with said rivet receiving opening, and a rivet extending through said aperture and opening for securing said strip to the integral shroud portions on adjacent blades.

4. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portions, a strip spanning said integral portions and having therein an aperture alined with said rivet receiving opening, means including said strip and integral portions for positioning the shrouded ends of adjacent blades in correct passage forming relation, and a rivet extending through said aperture and opening for securing said strip to the integral shroud portions on adjacent blades.

5. In combination, a plurality of turbine blades positioned in passage forming relation and embodying on adjacent blades integral shroud portions presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portions, said integral portions having their inner surfaces provided with rivet head receiving recesses disposed adjacent said opening, a strip spanning said integral portions and having an aperture therein alined with said rivet receiving opening, and a rivet extending through said aperture and opening and having a head portion disposed in said recesses for uniting and retaining the shrouded ends of adjacent blades with said edge surfaces positioned in contiguous opposed relation.

6. In combination, a plurality of turbine blades positioned in passage forming relation and embodying on adjacent blades integral shroud portions presenting opposed contiguous edge surfaces shaped to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portions, a strip spanning said integral portions and having an aperture therein alined with said rivet receiving opening, and a rivet extending through said aperture and opening for securing said strip to said integral portions, said rivet and the underside of said integral shroud portions having contiguous surface portions coacting to unite and retain the shrouded ends of adjacent blades with said edge surfaces positioned in contiguous opposed relation.

7. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades presenting abutting edge surfaces grooved to provide there-

between an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portion, a strip spanning said integral portions and having therein an aperture alined with said rivet receiving opening, and a rivet extending through said aperture and opening for securing said strip to the integral shroud portions on adjacent blades.

8. In combination, a plurality of turbine blades positioned in passage forming relation and embodying a shroud structure comprising integral shroud portions on adjacent blades presenting abutting edge surfaces grooved to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portion, a strip spanning said integral portions and having therein an aperture alined with said rivet receiving opening, and means including a rivet extending through said aperture and opening for uniting and retaining the shrouded ends of adjacent blades with said edge surfaces positioned in abutting relation.

9. In combination, a plurality of turbine blades positioned in passage forming relation and embodying on adjacent blades integral shroud portions presenting abutting edge surfaces grooved to provide therebetween an enlarged rivet receiving opening which extends in a direction approximately normal to the fluid confining surfaces of said shroud portion, said integral portions having their inner surfaces provided with complementary recesses forming a continuous rivet head receiving depression surrounding said opening, a strip spanning said integral portions and having an aperture therein alined with said rivet receiving opening, and a rivet extending through said aperture and opening and having therein a head portion disposed in said depression for uniting and retaining the shrouded ends of adjacent blades with said edge surfaces positioned in contiguous opposed relation.

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