Aug. 20, 1940. C. R. SODERBERG 2,211,866

TURBINE BLADE FASTENING

Filed March 31, 1939

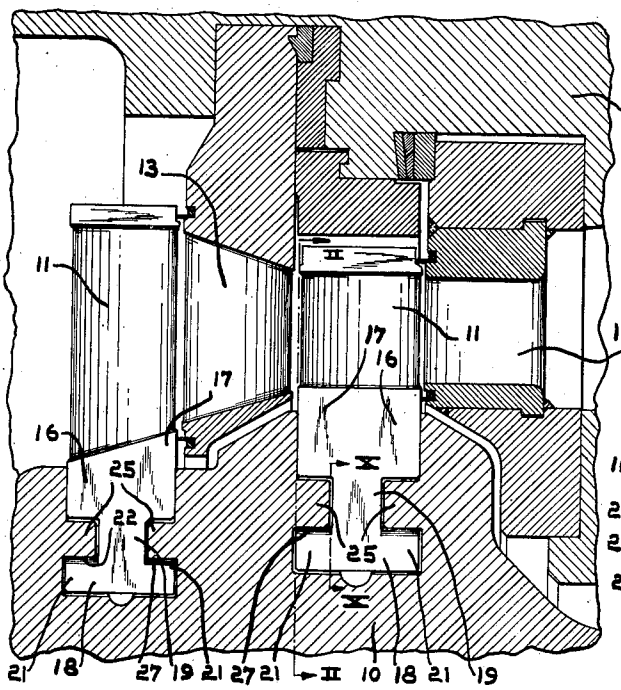
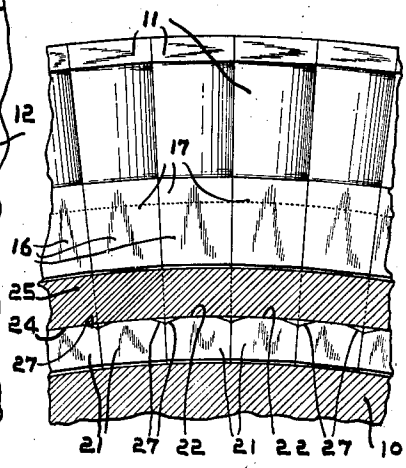


FIG. 1.

FIG. 2.



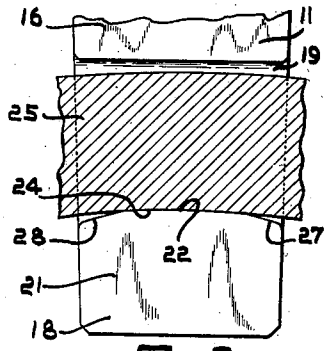


FIG. 3.

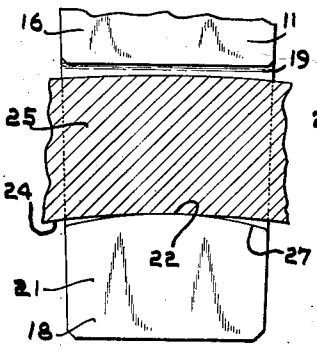


FIG. 4.

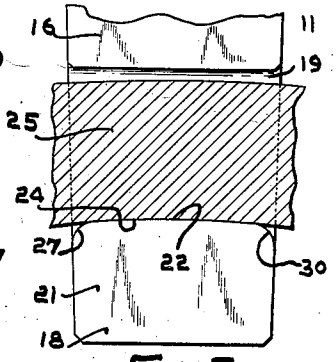


FIG. 5.

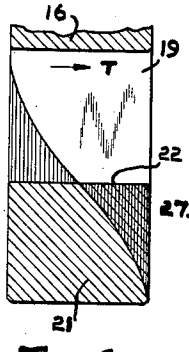


FIG. 6.

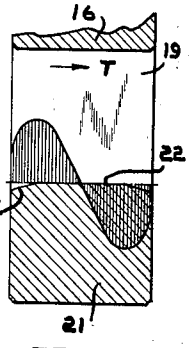


FIG. 7.

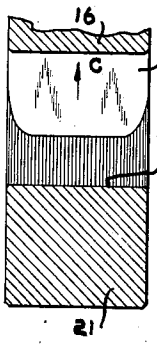


FIG. 8.

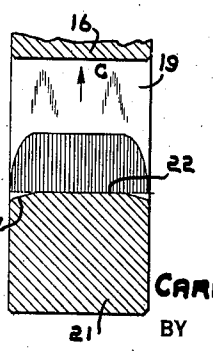


FIG. 9.

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TURBINE BLADE FASTENING

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Application March 31, 1939, Serial No. 265,113

4 Claims. (Cl. 253—77)

This invention relates to elastic fluid turbines and it has for an object the provision of improved blading for apparatus of this character.

Another object of the invention is the provision of blades of the T-root type, the outer surfaces of whose lateral root lugs are relieved at the front and back edges thereof to provide for a stronger root construction and one in which the maximum stresses are substantially reduced.

These and other objects are effected by this invention as will be apparent from the following description and claims taken in connection with the accompanying drawing forming a part of this application, in which:

Fig. 1 is a fragmentary, longitudinal sectional view through two rows of impulse blading embodying the invention;

Fig. 2 is a transverse sectional view taken along the line II—II of Fig. 1, looking in the direction of the arrows;

Fig. 3 is an enlarged fragmentary view of a portion of the structure shown in Fig. 2;

Figs. 4 and 5 are views similar to Fig. 3, showing two modifications of the structure thereof;

Fig. 6 is a stress diagram for the previously known form of T-root blade, under tangential loading;

Fig. 7 is a stress diagram for a T-root blade made in accordance with the present invention, under tangential loading; and,

Figs. 8 and 9 are stress diagrams corresponding to those of Figs. 6 and 7, respectively, but showing stresses under radial loading rather than under tangential loading.

Figs. 6, 7, 8, and 9 correspond to sections taken on the line X—X of Fig. 1.

Referring now to the drawing, there is shown a rotor 10 carrying two rows of blades 11, adapted to have rotary movement imparted thereto by a motive fluid supplied through the nozzles 12 and the reversing blades 13 carried by the stator 14.

Each blade 11 includes a root part 16 comprised by a spacing portion 17, a head portion 18 and a neck portion 19 joining the spacing and head portions.

The head portion 18 has lugs 21 extending laterally of the neck portion and having outer surfaces 22 adapted to engage the inner surfaces 24 of the usual rotor blade groove projections or ribs 25.

Heretofore, the outer blade groove rib-engaging surfaces 22 of the lugs 21 have extended for the full width of the latter from the front to the back. With this construction, the application of centrifugal or tangential forces to the blade has resulted in a maximum concentration of stresses in the neck portion of the blade root adjacent the edges thereof (Figs. 6 and 8), and localized overstressing of blade roots in this manner subjects the blades to greater likelihood of failure than would be the case if the overstressing could be avoided.

To reduce the aforesaid maximum stresses, as shown in Figs. 3, 4, and 5, the side edges of the outer surfaces 22 are relieved, as at 27, whereby the maximum stresses occur at points spaced inwardly (Figs. 7 and 9) with reference to the front and back surfaces of the root, the surfaces of the root corresponding to front and back surfaces of the blade being designated in like manner. Inward transference of the location of maximum stresses results in substantial reduction in the maximum value thereof, for example, in the ratio of 9 to 5, and in consequence, the blade roots are stronger and less likely to crack at the edges.

The lug top surfaces 22 may be relieved at the front and back edges in any suitable manner. In Fig. 3, the top surface is chamfered, at 28, adjacent to the edges; in Fig. 4, relief at the front and back edges is afforded by having the top surface 22 formed on a radius which is less than the radius of the inner circumferential surface 24 of the groove rib 25, each surface 22 so provided being curved with respect to an axis parallel to the rotor axis; and in Fig. 5, the top surfaces 22 are relieved by rounding them to a relatively small radius, as shown at 30.

Fig. 6 shows diagrammatically the stresses present in the neck portion when the blade is subjected to tangential forces or loading, where the outer surface 22 of the lug 21 engages the inner rib surface 25 for its full width from the front to the back, the maximum stresses occurring in the neck portion of the root at the front and back edges of the lugs.

Fig. 7 shows a corresponding stress diagram for blade roots constructed in accordance with the present invention, this construction resulting in re-location of the maximum stresses at points disposed inwardly of the side edges of the blade root neck. As indicated, this results in reducing the maximum stresses to about ⅝ of their original value.

Figs. 8 and 9 show the stresses present in the previously known blades and in blades constructed in accordance with the invention, respectively, when subjected to centrifugal or radial loadings. The same general results are obtained under these conditions, the maximum stresses being moved

inwardly and reduced to about 5/8 of their original values.

Throughout the specification and claims all terms and expressions relating to location or direction refer to such location or direction with respect to the axis of rotation of the blade-carrying member or rotor 10.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. A turbine blade comprised by blade and root parts and said root part including a spacing portion, a head portion, and a neck portion joining the spacing and head portions and having less width than the latter, whereby the head portion has lugs extending laterally from the neck portion for underhanging relation with respect to blade groove ribs and the top surfaces of the lugs being relieved at their front and back edges.

2. A structure as specified in claim 1, wherein the lugs are relieved at the front and back edges of their outer surfaces by chamfers.

3. A structure as specified in claim 1, wherein the lugs are relieved at the front and back edges of their outer surfaces by rounding of said edges.

4. A structure as specified in claim 1, wherein the outer surfaces of the lugs are formed on a radius which is less than the radius of the surfaces with which they are adapted to engage, said radii being about axes parallel to the axis of rotation of the blade-carrying member.

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