April 16, 1940. J. C. BOHAN 2,197,335

TURBINE BLADE SHROUD

Filed Sept. 14, 1938 2 Sheets-Sheet 1

Fig. 1.

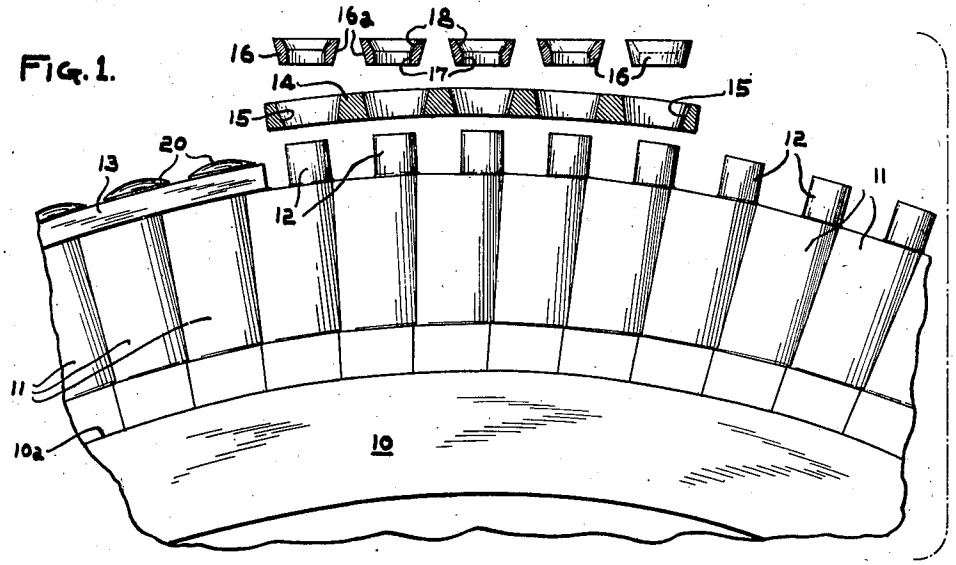
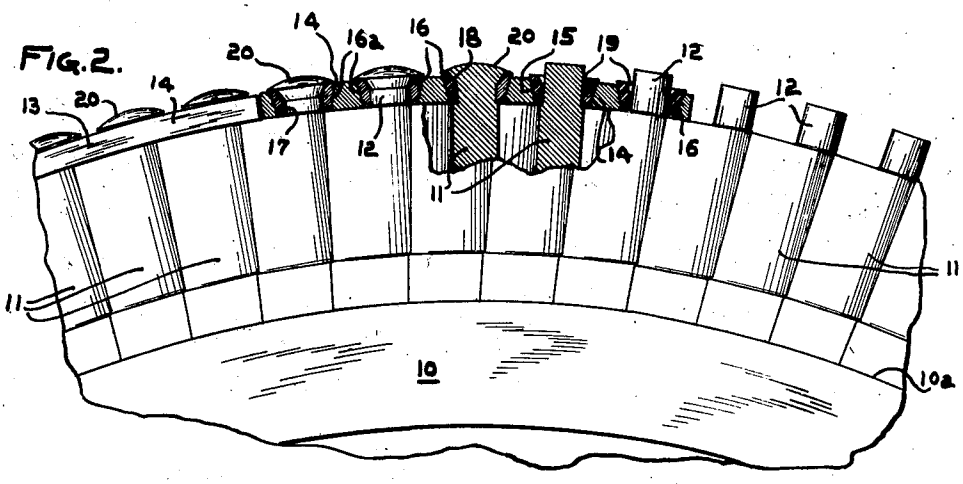


Fig. 2.



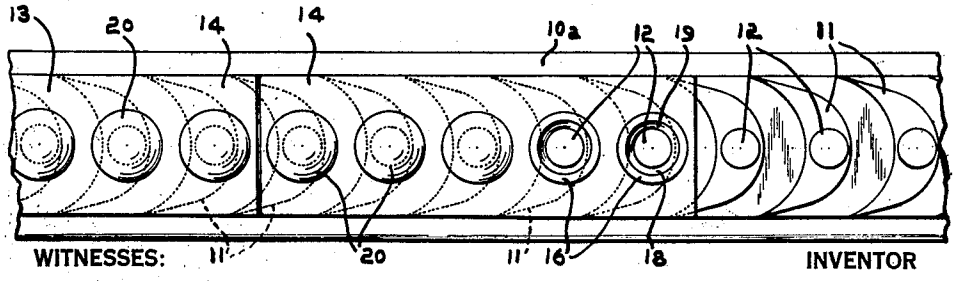


Fig. 3.

WITNESSES:

Ralph T. French

James R. Mosser

INVENTOR

JOSEPH C. BOHAN.

BY A. B. Rivers

ATTORNEY

April 16, 1940. J. C. BOHAN 2,197,335

TURBINE BLADE SHROUD

Filed Sept. 14, 1938 2 Sheets-Sheet 2

FIG. 4.

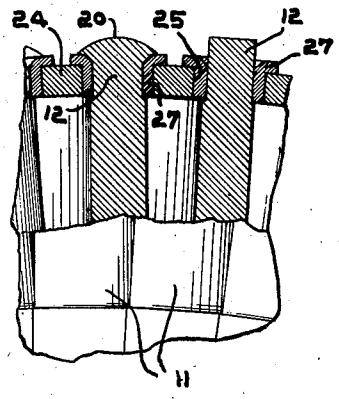
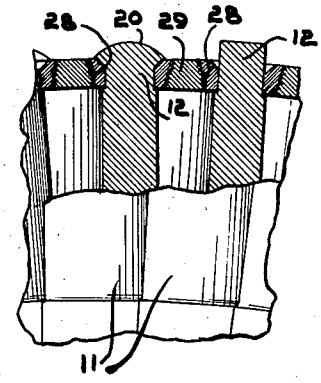


FIG. 5.



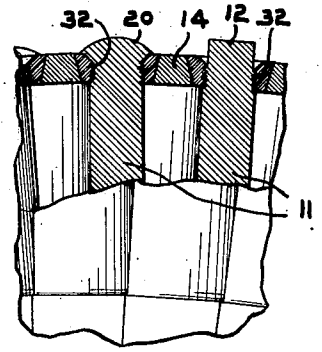


FIG. 6

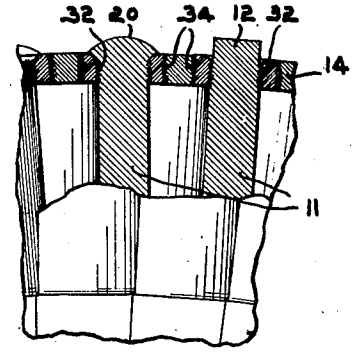


FIG. 7.

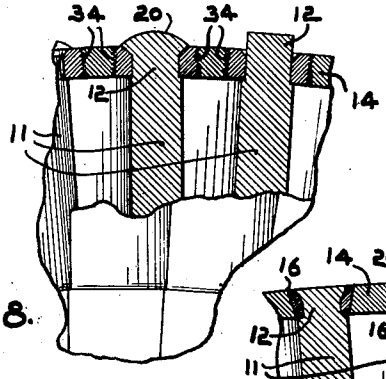


FIG. 8.

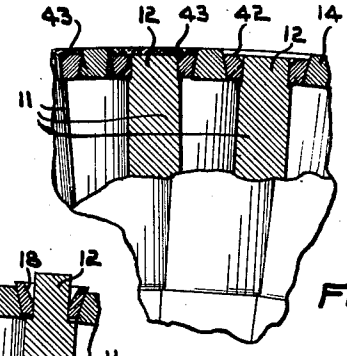
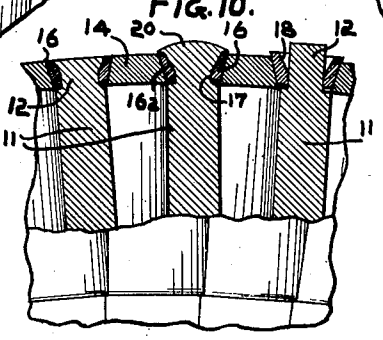


FIG. 9.

FIG. 10.



WITNESSES:

Ralph T. French

James K. Mosser

INVENTOR

JOSEPH C. BOHAN.

BY

A. B. Rice

ATTORNEY

253 MOTORS- FLUID,
77
Search Room

Patented Apr. 16, 1940

2,197,335

UNITED STATES PATENT OFFICE

2,197,335

TURBINE BLADE SHROUD

Joseph C. Bohan, Prospect Park, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application September 14, 1938, Serial No. 229,815

10 Claims. (Cl. 253—77)

The invention relates to shrouded turbine blading and it has for an object to provide a tenon and shroud connection permitting the use of a relatively thick shroud.

Another object of the invention is the provision of a blade and shroud connection wherein the blades are provided with cylindrical tenons extending through openings in the shroud, which openings are of relatively greater diameter than the tenons with the result that, irrespective of shroud thickness and the radial disposition of the blades and their tenons, assembly of the shroud on the tenons may be accomplished without interference.

A further object of the invention is the provision of ferrules filling the spaces between the tenons and the walls of the shroud openings.

Yet another object of the invention is the provision of a novel connection between the ferrules and their associated parts.

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

Fig. 1 is an exploded view, in side elevation and partly in section, of the invention;

Fig. 2 is a side elevational view, partly in section, showing a shroud strip partially connected in assembled relation to its blades;

Fig. 3 is a top plan view of the structure shown in Fig. 2;

Figs. 4 to 9 are fragmentary, side elevational views, partly in section, each showing a further modification of the invention; and,

Fig. 10 is a fragmentary, side elevational view, partly in section, showing the arrangement of Figs. 1 to 3, with the projecting heads finished off flush with the outer surface of the shroud.

Referring now to the drawings more in detail, in Figs. 1 to 3, there is shown, at **10**, an inner supporting member or rotor element having an arcuate outer periphery **10***a* with a row of turbine blades **11** extending radially outward from the latter. The blades may be attached to the supporting member **10** in any well known manner.

The outer free ends of the blades are provided with radially outwardly extending cylindrical tenons **12**. The outer ends of the blades are braced by means of a relatively thick shroud ring **13** comprised by segments **14** having outwardly flaring tapered openings **15** for the reception of the tenons, the openings **15** being substantially larger than the tenons **12** to avoid interference with assembly on account of inward convergence of the tenons. In this connection, the openings **15** are so spaced that, with the inner face of the shroud strip contacting with the blade ends, the strip may be positioned to bring the openings into coaxial relation with respect to the tenons.

Bushings or ferrules **16** encompass the blade tenons and fit the shroud strip openings. Accordingly, such bushings have outwardly flaring tapered walls **16***a*, corresponding both in size and taper to the openings **15** in the shroud segments and have inner cylindrical walls **17** for the cylindrical tenons **12**, the outer ends of the openings preferably being chamfered, as at **18**, to provide inwardly-converging annular spaces **19** into which the tenon ends may be deformed, as by peening or spinning, to provide heads **20** for retaining the shroud strips, tenons and blades in assembled relation.

The structure disclosed in Fig. 4 differs from that just described in that the openings **25** in the shroud strip are cylindrical rather than conical, and the ferrules have corresponding cylindrical outer surfaces fitting the openings and have annular ribs or lips **27** overlying and engaging the outer peripheral surface of the shroud strip **24**.

The arrangement shown in Fig. 5 differs from that of the preferred embodiment, illustrated in Figs. 1 to 3, in that the ferrules **28** have threaded connections with the shroud strip **29**; and, in Fig. 6, the threaded connections **32** are arranged between the tenons and the ferrules.

The construction in Fig. 7 combines the features of Figs. 5 and 6 in that the ferrules are threaded both to the tenons and to the shroud strip; however, the external threaded connection **34** is preferably cylindrical instead of being conical, as in Fig. 5.

In Fig. 8, the ferrules are cylindrical, as in Fig. 4, but, instead of having outer ribs or flanges forming parts of the compressive connections between the tenons and the shroud strips, external threaded connections **34** serve the purpose thereof.

Fig. 9 differs from the preceding constructions in that the blade tenons and the ferrules are of a length materially less than the thickness of the shroud strip to provide recesses **42** for weld metal **43** autogenously connecting the ferrules, tenons and shroud strip.

To avoid windage losses due to the projecting heads on the tenons, the structure is modified to eliminate such heads. Aside from the structure of Fig. 9 inherently accomplishing this purpose,

where the weld and shroud strip outer surfaces are flush, those of the remaining views may be modified for this purpose. For example, as shown in Fig. 10, the preferred structure of Figs. 1, 2 and 3 may have the heads 20 removed if the ferrules are chamfered sufficiently for tenon deformation adequate for the connections.

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. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of said supporting member, tenons extending radially from the free ends of said blades, a segmental shroud ring having openings for said tenons, said openings being materially larger than the tenons and concentric relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blade and including ferrules filling the spaces between the tenons and the walls of the openings.

2. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the free ends of the blades, a segmental shroud ring having openings for the tenons, said openings being of such size and shape as to provide concentric annular spaces about the tenons, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including ferrules filling said spaces.

3. A structure as specified in claim 2, wherein there are heads on the tenons engaging the outer surfaces of the ferrules.

4. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the free ends of the blades, a segmental shroud ring having outwardly flaring tapered openings for the tenons, said openings being materially larger than the tenons and concentric relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including ferrules filling the spaces between the tenons and the walls of the openings and means for retaining the ferrules on the tenons.

5. A structure as specified in claim 4, wherein inner walls of the ferrules are chamfered at their outer ends, and the means for retaining the ferrules on the tenons includes heads on the tenons filling the spaces provided by the chamfers.

6. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the outer ends of the blades, a relatively heavy shroud ring having outwardly tapered circular openings for the tenons, said openings being materially larger than the tenons and concentric relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including ferrules closely surrounding the tenons and filling the spaces between the latter and the walls of the openings and having their inner walls chambered at their outer ends, and means for retaining the ferrules on the tenons including heads on the tenons filling the spaces provided by the chamfers and said heads and ferrules being flush with the outer surface of the shroud ring.

7. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the free ends of the blades, a relatively heavy shroud ring having openings for the tenons, said openings being materially larger than the latter and concentrically disposed relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including ferrules having threaded connections with the tenons and filling the spaces between the latter and the walls of the openings.

8. In a turbine, a support having an arcuate periphery, blades extending radially from the periphery of the support, cylindrical peg-like members extending radially from the free ends of the blades, a relatively heavy annular shroud member having openings for the peg-like members which openings are materially larger than the latter and are disposed concentrically relative thereto, and means forming connections between the peg-like members and the shroud to hold the latter in place with respect to the blades and including ferrules associated with the peg-like members and the shroud member and filling the spaces therebetween, each ferrule having a threaded connection with at least one of the members with which it is associated.

9. In a turbine, a supporting member having an arcuate periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the outer ends of the blades, a relatively heavy shroud ring having openings for the tenons which openings are of materially greater diameter than the latter and are concentrically disposed relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including ferrules filling the spaces between the tenons and the walls of the openings and having threaded connections with the latter.

10. In a turbine, a supporting member having an annular periphery, blades extending radially from the periphery of the supporting member, cylindrical tenons extending radially from the free ends of the blades, a relatively heavy shroud strip having openings for the tenons which openings are materially larger than the latter and are concentrically disposed relative thereto, and means forming connections between the tenons and the shroud to hold the latter in place with respect to the blades and including cylindrical ferrules surrounding the tenons and filling the spaces between the latter and the walls of the openings, annular shoulders at the outer ends of the ferrules overlying and contacting the outer surface of the shroud ring, and heads on the tenons retaining the ferrules thereon.

JOSEPH C. BOHAN.

393-75

CERTIFICATE OF CORRECTION.

Patent No. 2,197,335. April 16, 1940.

JOSEPH C. BOHAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 5, claim 6, for the word "chambered" read --chamfered--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of June, A. D. 1940.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.