United States Patent

Conrad

[15] **3,652,184**

[45] **Mar. 28, 1972**

[54] **AFTER-GUIDE-BLADING OF AN AXIAL COMPRESSOR**

[72] Inventor: **Oswald Conrad,** Schmiden, Germany

[73] Assignee: **Daimler-Benz Aktiengesellschaft,** Germany

[22] Filed: **May 13, 1970**

[21] Appl. No.: **36,752**

[30] **Foreign Application Priority Data**

May 17, 1969 Germany......................P 19 25 172.0

[52] **U.S. Cl.**................................**415/181,** 415/209, 415/210

[51] **Int. Cl.**....................**F01d 1/02,** F04d 29/02, F04d 19/00

[58] **Field of Search**..............416/194, 1, 196; 415/181, 209, 415/79, 207, 211, 208; 60/269, 270

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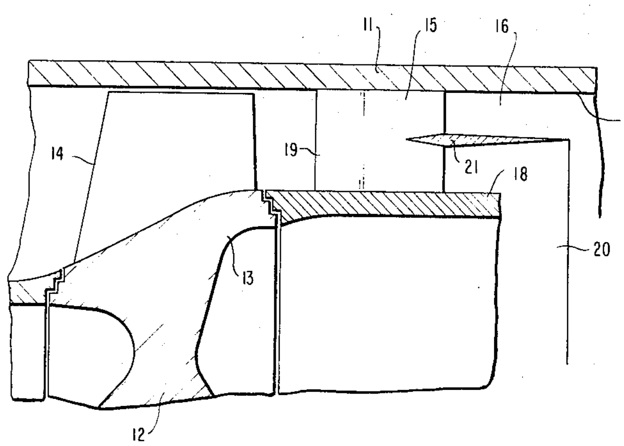
Primary Examiner—Henry F. Raduazo
Attorney—Craig, Antonelli & Hill

[57] **ABSTRACT**

An after-guide blading of an axial compressor, particularly of a supersonic axial compressor, in which a profile ring is provided between the walls defining the after-guide blading which partially projects into the guide blades; the cross-sectional configuration of the profile ring in a plane parallel to and passing through the compressor axis is such that it increases in a first section and decreases again in a second section.

19 Claims, 3 Drawing Figures



PATENTED MAR 28 1972 3,652,184

FIG. 1

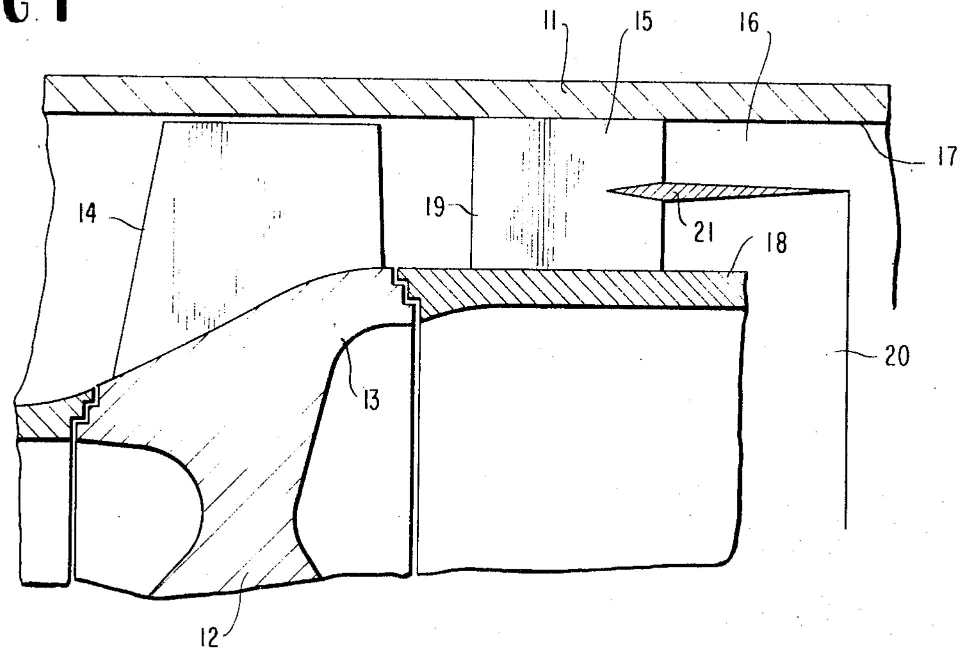


FIG. 2

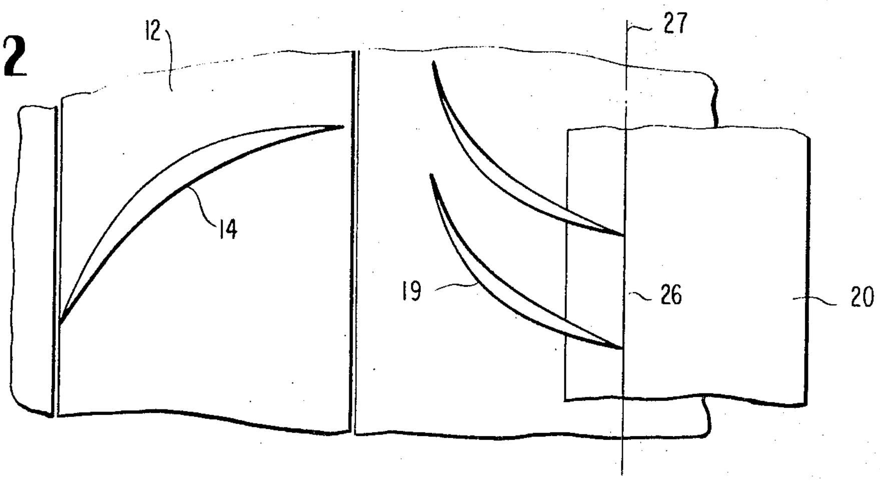
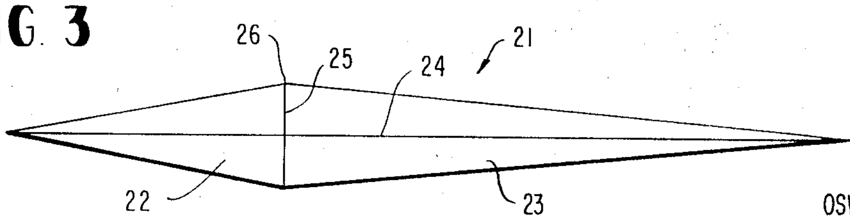


FIG. 3



INVENTOR
OSWALD CONRAD
BY Craig, Antonelli, Stewart & Hill
ATTORNEYS

AFTER-GUIDE-BLADING OF AN AXIAL COMPRESSOR

The present invention relates to an afterguide blading or guide baffles of an axial compressor, especially of a supersonic axial compressor. The flow is very strongly deflected and decelerated in the afterguide blading which may lead to a separation of the flow, i.e., the flow becoming nonlaminar. This is true to a particularly large extent for supersonic axial compressors in which the deceleration is partially initiated by a perpendicular compression shock. The danger of flow separation can be reduced in a known manner in that downstream of the place at which the compression shock occurs, the deceleration is separated from the deflection. This separation can be attained in that one causes the housing walls to converge within the deflection area in such a manner that the flow is only deflected whereas one decelerates the deflected flow without substantial change in direction by the divergence of the walls downstream of the blading. The bend or brake occurring at the transition of the converging into the diverging wall parts thereby effects a separation of the flow the more, the thicker the boundary layer of the arriving flow medium. Since the boundary layer at the housing wall and at the hub are already relatively thick as a result of the interactions in the rotor and of the compression shock in the afterguide blading, the flow separates with certainty at the bend or brake.

The present invention is concerned with the task to eliminate the danger of such a separation of the flow. This is achieved according to the present invention in that between the walls delimiting the afterguide blading, a profile ring is arranged coaxial thereto and projecting partially into the guide blading, whose profile height increases in a first section and decreases again in a second section. The cross-sectional configuration is thereby influenced in this area in such a manner that a break-free design and guidance of the walls is possible. A separation of the flow is avoided thereby whereas a significant boundary layer cannot form on the relatively short, first section of the profile ring which is disposed in front or upstream of the maximum profile height thereof.

A favorable influencing of the flow can be achieved according to the present invention in that the profile ring projects into the guide blading so far that the transition from the first to the second section thereof is located within the area of the discharge plane of the guide blades.

A particularly advantageous type of construction of the present invention for supersonic axial compressors resides in that the profile of the profile ring is a quadrangle with a long diagonal parallel to the compressor axis and with a short diagonal perpendicular thereto.

Accordingly, it is an object of the present invention to provide a guide blading of an axial compressor, especially of a supersonic axial compressor which avoids by simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in an afterguide blading of an axial compressor which effectively eliminates the danger of flow separation.

A further object of the present invention resides in a guide blading of the type described above which not only avoids the danger of flow separation but permits a configuration of the inner and outer walls within the area of the guide blades that is substantially free of any bends or breaks.

A still further object of the present invention resides in an axial compressor provided with afterguide blading in the discharge from the compressor blades, which precludes the formation of a significant boundary layer.

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:

FIG. 1 is a longitudinal cross-sectional view through a part of a supersonic axial compressor;

FIG. 2 is a plan view, unfolded into the plane of the drawing, of the illustrated rotor and afterguide blading of FIG. 1; and

FIG. 3 is a view, on an enlarged scale, illustrating the profile of the profile ring of the afterguide blading.

Referring now to the drawing wherein like reference numerals are used throughout the various views to designate like parts, and more particularly to FIG. 1, a rotor **12** consisting of a hub disk **13** and of compressor blades **14** is conventionally supported within the housing **11** of a supersonic axial compressor. An afterguide blading **15** adjoins the rotor **12** which is arranged in the annular channel **16** between an outer wall **17** and an inner wall **18** of the housing **11**.

The afterguide blading **15** consists of guide blades **19** and of a profile ring **20** arranged approximately in the center of the annular channel **16** and coaxial thereto. The thickness of the profile generally designated by reference numeral **21** of the profile ring **20** thereby increases in a first section **22** and again decreases in a second section **23**. More particularly, the profile **21** has the configuration of a quandrangle with a long diagonal **24** parallel to the compressor axis and a short diagonal **25** perpendicular thereto. The first section **22** of the profile ring **20** thereby projects so far into the guide blades **19** that the transition **26** into the second section **23** is disposed within the area of the discharge plane of the guide blades **19**.

The profile ring **20** according to the present invention leads by reason of its profile **21** which produces a convergent-divergent cross-sectional configuration of the annular channel **16**, as well as by reason of its arrangement in relation to the guide blades **19** to a separation of the deceleration from the deflection of the flow in the afterguide blading **15**. As a result thereof, the flow within the area of the second, tapering section **23** of the profile ring **20** is decelerated whereas the danger of separation of the flow is strongly reduced at the outer wall **17** as well as at the inner wall **18** which can be constructed without bend or break by reason of the arrangement of the profile ring **20**.

The walls delimiting the afterguide blading have, in the illustrated embodiment, a cylindrical configuration. However, they may also be slightly inclined or curved without changing the effect of the profile ring of the present invention. The profile ring may, in addition to cross-sectional shapes that are defined by straight lines, for example, such as shown by the illustrated embodiment, or by a rhombic configuration, also possess a drop-shaped cross-sectional shape. The profiles may thereby also be constructed asymmetrical to the longitudinal axis thereof. Instead of the center position illustrated in the described embodiment, it is also possible to arrange the profile ring **20** closer to the inner wall or to the outer wall of the annular channel **16**.

Thus, while I have shown and described only 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 those 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. An afterguide blading assembly for an axial compressor with a longitudinally extending axis of the type having a rotatable compressor means and inner and outer housing walls for delimiting a space immediately behind the compressor means for the passage of air and other gases leaving the compressor; said assembly comprising a plurality of radially extending guide blades arranged in said space between said inner and outer walls for smoothing the flow of the output from the compressor means, said guide blades including leading edges disposed at the forward ends thereof for initially contacting said compressor output and trailing edges disposed axially rearwardly of said leading edges for the egress of said compressor output from the guide blades, and an annular profile ring means arranged between said inner and outer walls in substantially coaxial alignment with said walls, said ring means

including a first forward section having an increasing cross section in the axial direction of the flow of the compressor output and a second rearward section having a decreasing cross section in the axial direction of said flow, the most forward end of said ring means being disposed between the trailing and leading edges of said guide blades.

2. An assembly according to claim 1, characterized in that the cross-sectional shape of the profile ring means is substantially a quadrangle with a relatively long diagonal substantially parallel to the compressor axis and a relatively short diagonal substantially perpendicular thereto.

3. An assembly according to claim 1, characterized in that said profile ring means is of symmetrical construction.

4. An assembly according to claim 1, characterized in that said profile ring is of asymmetrical construction.

5. An assembly according to claim 1, characterized in that said profile ring means is arranged approximately halfway between said walls.

6. An assembly according to claim 1, characterized in that said profile ring means is arranged closer to one of said two walls than to the other wall.

7. An assembly according to claim 1, characterized in that the compressor is a supersonic axial compressor.

8. An assembly according to claim 1, characterized in that said first and second sections of said ring means have a common transition plane where the maximum cross section of said ring means occurs and in that said transition plane is axially aligned with the plane containing the trailing edges of said guide blades.

9. An assembly according to claim 8, characterized in that the cross-sectional shape of the profile ring means is substantially a quadrangle with a relatively long diagonal substantially parallel to the compressor axis and a relatively short diagonal in said transition plane substantially perpendicular to said compressor axis.

10. An assembly according to claim 8, characterized in that said profile ring means is of symmetrical construction with respect to the longitudinally extending axes therethrough which are parallel to the longitudinal axis of said compressor.

11. An assembly according to claim 8, characterized in that said profile ring means is of asymmetrical construction.

12. An assembly according to claim 9, characterized in that said profile ring means is arranged approximately halfway between said walls.

13. An assembly according to claim 8, characterized in that said profile ring means is arranged closer to one of said two walls than to the other wall.

14. An assembly according to claim 8, characterized in that the compressor is a supersonic axial compressor.

15. An assembly according to claim 1, characterized in that said inner and outer walls are substantially parallel to one another and to the longitudinal axis of the compressor throughout the space containing the guide blades and the ring means.

16. An assembly according to claim 15, characterized in that said first and second sections of said ring means have a common transition plane where the maximum cross section of said ring means occurs and in that said transition plane is axially aligned with the plane containing the trailing edges of said guide blades.

17. An assembly according to claim 16, characterized in that the cross-sectional shape of the profile ring means is substantially a quadrangle with a relatively long diagonal substantially parallel to the compressor axis and a relatively short diagonal in said transition plane substantially perpendicular to said compressor axis.

18. An assembly according to claim 15, characterized in that said guide blades are fixed to both said inner and outer walls.

19. An assembly according to claim 15, characterized in that the cross-sectional shape of the profile ring means is substantially a quadrangle with a relatively long diagonal substantially parallel to the compressor axis and a relatively short diagonal substantially perpendicular thereto.

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