Dec. 27, 1966 M. W. STANLEY 3,294,364

ROTOR ASSEMBLY

Filed Jan. 2, 1962

FIG 1

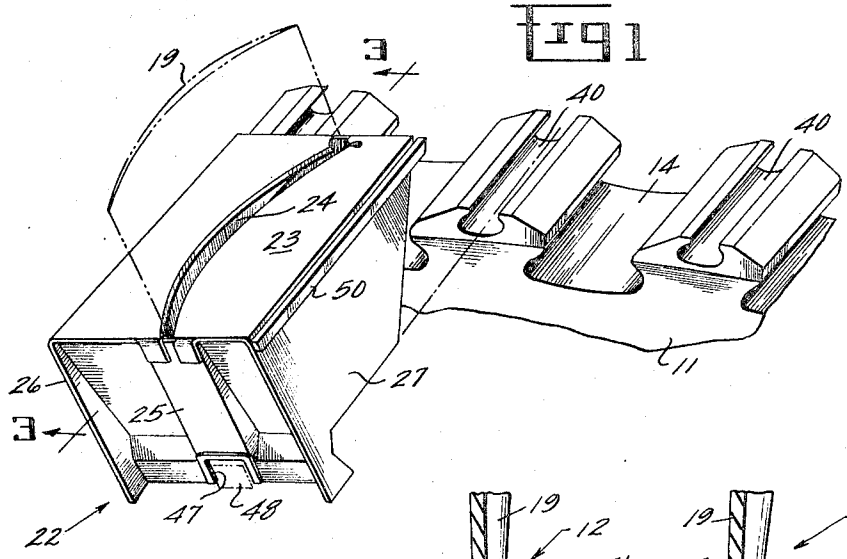


FIG 2

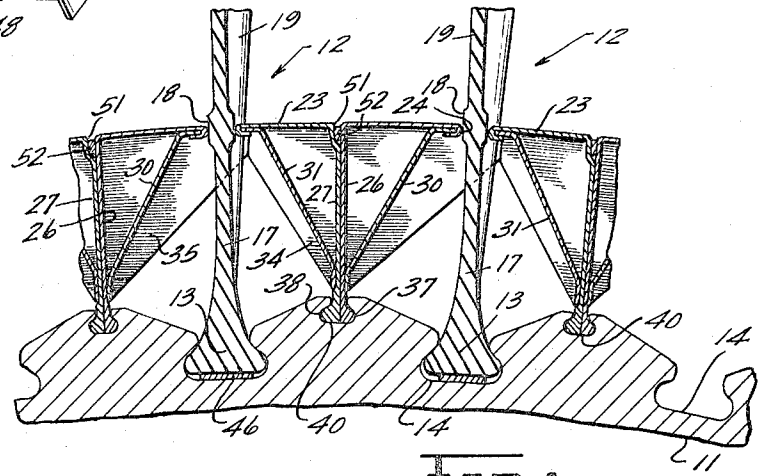


FIG 4

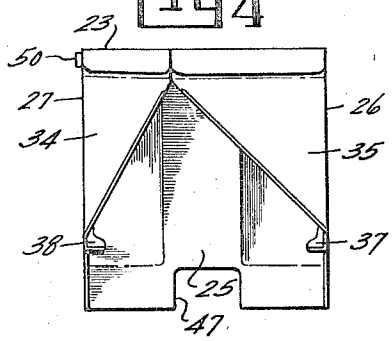
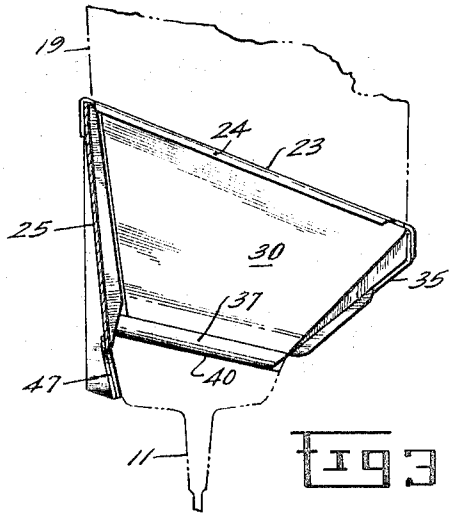


FIG 3



INVENTOR.
MAX W. STANLEY

BY
Harold L Moore

ATTORNEY

United States Patent Office 3,294,364 Patented Dec. 27, 1966

3,294,364

ROTOR ASSEMBLY

Max W. Stanley, Fairfield, Ohio, assignor to General Electric Company, a corporation of New York

Filed Jan. 2, 1962, Ser. No. 163,926
4 Claims. (Cl. 253—77)

This invention relates to a rotor assembly, and more particularly to a lightweight blade and baffle assembly for a turbomachine.

In turbomachines where the primary gas passage is formed by substantially concentric cylindrical members, the rotor assemblies may comprise a rotor blade assembly extending radially from a rotor wheel across the annular gas passage for either driving or being driven by this gas flow. The blades generally comprise an airfoil and shank portion with a base for attachment of the blade in some manner to the rotor wheel. It is subsequently necessary that substantially all of the gas flow pass by the airfoil portion of the blades to provide a high efficiency rotor assembly, therefore sealing is provided where feasible, such as around the outer peripheries of the blades.

Another critical area where sealing is critical is between adjacent blade shanks, which extend between the airfoil portions of the blades and the rotor wheels. Such a baffle here seals against the axial flow of gas, however since the effective weight of such a baffle may be multiplied thousands of times by centrifugal force acting on the assembly during operation, a lightweight construction is imperative. In addition, such a baffle should provide ease of assembly of the blade structures and the rotor wheel and also should be interchangeable to simplify maintenance on the assembly. Additionally, such a baffle may perform a damping function by limiting vibration between the adjacent blades thereby adding to the overall structural integrity of the rotor assembly.

In the past, rotor assemblies have generally utilized blades having circumferentially extending platforms between the shank and airfoil portions of the blades which serve to prevent the passage of gas radially along the blade axis and serve such other functions as damping vibration between adjacent blades. Further developments however have led to lightweight turbomachinery, particularly in turbomachines developed for aircraft, and it has been found advantageous to use fabricated blades and decrease the weight of the blade and rotor assemblies wherever possible. Naturally, solid platforms integrated structurally with the blades add weight to the rotor assembly by their own weight as well as added weight to the blade to support such heavier assemblies. However, in the past, such platforms have served an additional function of supporting a baffle as mentioned heretofore for sealing against the axial passage of gas between adjacent blade shanks. With the advent of the use of blades not having platforms integrated with the blade structure, the support of such baffles becomes more of a problem, also the functions able to be fulfilled by such baffles have increased. For instance, if no blade platforms are provided on the blades themselves, the baffle can be designed to damp vibrations between adjacent blades in addition to sealing against this radial and axial flow of gas. Such baffles must perform these functions and yet be of lightweight construction and if possible, self-supporting in some manner because if such baffles are supported by the blades, then additional structure must be added to the blade and to the blade support means to react the additional loading, all of this leads to a heavier rotor assembly.

It is accordingly a primary object of this invention to provide a lightweight rotor assembly for a turbomachine,

It is another object of this invention to provide a specific lightweight baffle and blade assembly with means for assembly with a rotor wheel,

It is another object of this invention to provide a particular lightweight baffle construction which performs such functions as sealing against air flow, damping vibration between adjacent blades and is self-supporting on the rotor wheel.

In accordance with one embodiment of the invention, there is provided a rotor assembly comprising the combination of a rotor wheel with a plurality of rotor blades having airfoil and shank portions attached extending radially from the wheel, with a baffle for preventing the axial and radial flow of gas adjacent the blade shanks comprising a first wall member normal to and surrounding the blade at the juncture of the airfoil and shank portions, with a second wall member extending between the first wall member and the rotor wheel on the upstream side of the blade, and two additional wall members extending transverse to the rotor wheel and on each side of the blade attached to the first and second wall members with separate attachment means to the rotor wheel.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of the rotor wheel and baffle assembly with the blade outlined in phantom,

FIG. 2 is a cross-sectional view taken along a plane normal to the rotor wheel axis and bisecting the rotor wheel at its midpoint,

FIG. 3 is a cross-sectional view of the baffle along the lines 3—3 of FIG. 1 with the rotor wheel and blade illustrated in phantom, and

FIG. 4 is an end view of the baffle from the downstream direction.

Referring now primarily to FIG. 1, therein is illustrated a turbine wheel **11** with attached radially extending blades **12** attached thereto by means of the base portions **13** interfitting with undercut axially extending grooves **14** in a manner well known in the art. The blades consist of a shank portion **17** extending from the base **13** with a small transition section **18** situated radially outward therefrom and connecting the shank with the airfoil portion **19**. A turbomachine in which this rotor assembly may be utilized consists of substantially concentric cylindrical casing members (not shown) forming an annular gas passage for either a compressor or turbine section with the rotor assembly representing either a compressor or turbine rotor wherein the airfoil portions **19** of the blades extend across the annular gas passage to either drive or be driven by the primary gas flow of the turbomachine. The rotor wheel **11** is rotatably supported to revolve about the axis of the annular gas passage which generally coincides with the axis of the turbomachine.

The concentric casing members described heretofore extend axially with the outer casing member closely adjacent to the outer ends of the rotor blades and the inner casing member discontinued a short distance along a plane normal to the axis of the turbomachine to allow insertion of the rotor assembly with the casing extending immediately adjacent to the transition portion **18** of the blades so that just the airfoil portion of the blades extends through the gas passageway.

In view of the fact that platforms are not provided integral with the blade structure, the space between adjacent blades must be sealed to prevent the flow of gas radially along the blade shank in order to provide a continuous annular gas passageway. In addition, since an absolutely gas-tight seal is not possible between the edge

of the inner casing and the upstream edge of the rotor assembly because of thermal expansion, etc. the space between adjacent blade shanks must also be sealed to prevent the axial passage of gas therebetween and therefore around the annular passage in which is located the blade airfoil. To accomplish this, there is provided the baffle **22** consisting of a first wall **23** acting as a blade platform having an opening **24** therethrough fitting the contour of the blade at the transition portion **18** and thereby sealing against the radial passage of gas along the blade. To seal against the axial passage of gas, front wall **25** is provided extending between the upstream edge of first wall **23** and the rotor wheel **11**. Additionally, side walls **26** and **27** extend in an axial direction substantially transverse to the first wall **23** and the front wall **25** on each side of the blade shank to add structural rigidity to the baffle assembly and to provide means for attachment to the rotor wheel **11** as will be explained later. Inner diagonally extending walls **30** and **31** are provided extending from the top wall **23** on each side and adjacent to the opening **24** down to the side walls **26** and **27** respectively. These walls provide added strength to the baffle particularly against forces extending circumferentially and radially on the baffle and also add rigidity by reinforcing the front wall **25**. End walls **34** and **35** are provided on the downstream end of the baffle as illustrated in FIG. 4 connecting the edges of the top wall **23**, side wall **26** and diagonal wall **30**; also the top wall **23**, the side wall **27** and the diagonal **31** respectively. The walls may be fastened together by any suitable means such as welding, brazing, riveting, etc.

To attach the baffle to the rotor wheel, the side walls **26** and **27** have base portions **37** and **38** respectively which when the baffles are assembled in the manner illustrated adjacent one another around the periphery of the rotor wheel, the base portions **37** and **38** of adjacent baffles abut to form a base cooperating with the axially extending undercut groove **40** to hold the baffle against being moved radially when being acted upon by centrifugal force during rotation of the rotor assembly. By this attachment means the baffle is allowed to be inserted axially with the rotor blade and securely held in position by reacting radially acting forces primarily through the base portions **37** and **38** and by reacting axially directed forces, generally in the downstream direction, by the interaction of the front wall **25** and the rotor wheel and blade.

To assemble the rotor assembly, the baffle being of a lightweight thin-walled construction and having the downstream wall split between the end walls **34** and **35** with the opening **24** extending across the top wall **23** to that cleavage in the downstream wall, the baffle may be sprung open sufficiently by flexing the front wall **25** to allow insertion of the rotor blade such that the transition portion **18** extends through and aligns with the opening **24** as illustrated. A locking means (not shown) may be provided at a point adjacent the downstream edge of the opening **24** to lock the baffle around the blade if necessary. Thereafter, the baffle and blade may be simultaneously inserted in an axial direction into the rotor wheel with the base **13** on the blade fitting into the slot **14** and the base portions **37** and **38** fitting into the groove **40** located adjacent the slot **14**. In this manner the complete rotor assembly may be built up of individually assembled blade and baffle components in a manner allowing for both ease of assembly and removal thereby simplifying maintenance and replacement. Thereafter a locking pin **46** may be inserted which fits through a slotted opening **47** in the front wall **25** and aligns with the bottom or radially inward side of the slot **14** between the base **13** and the slot wall to extend axially through the rotor wheel. The pin may be provided with an enlarged head **48** on the upstream edge to overlie the adjacent portions of the front wall **25** so as to lock this front wall against the rotor wheel. Thereafter the downstream edge of the pin may be bent or otherwise deformed against the downstream edge of the blade base **13** and the downstream face of the rotor wheel **11** to lock the complete assembly against axial movement. Since the base portions **13** of the blade and the base portions **37** and **38** of the baffles lock the baffle and blade against radial movement, the complete rotor assembly is formed as one integral self-locking unit.

With the baffles so assembled, it may be readily seen that the abutting edges of the top wall **23**, together with the top wall of the adjacent baffle, form a platform or wall extending between the blades to seal against radial passage of gas while the abutting front walls **25** form a substantially continuous upstream wall preventing the axial passage of gas. If additional sealing is desired, an insert **50** may be attached to the side wall **27** as by brazing as illustrated in FIG. 1, which may thereafter be machined to precisely dimension the width of the top wall **23** for closer fitting of the top walls between adjacent blades. Or in the alternative as illustrated in FIG. 2, the side wall **27** may have an indented area **51** in which may be fastened a similar strip **52** which may subsequently be machined in the same manner to closely abut the adjacent side wall **26** of the next adjacent baffle for more complete sealing.

With the top walls **23** forming a substantially continuous mid-platform about the periphery of the rotor wheel at the transition portion **18** of the blades, any vibrations between adjacent blades will be damped by these abutting walls **23**. By use of the diagonal walls **30** and **31** additional strength is provided against circumferentially acting forces between adjacent blades thereby providing a substantially rigid rotor assembly. Furthermore, by making the baffle self-supporting on the rotor wheel, the blade itself need not support the baffle against radial movement and therefore the size and weight of the blade base and shanks may be reduced substantially; this has the added effect of allowing the blade shanks to be more flexible thereby reducing vibrational problems often encountered with the use of rigid blade shanks.

While particular embodiments of the invention have been illustrated and described, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention and it is intended to cover in the appended claims all such changes and modifications that come within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A rotor assembly for an axial flow turbomachine comprising the combination of

a rotor wheel having a plurality of axially extending undercut grooves in the periphery thereof,

a plurality of rotor blades having airfoil shank and base portions,

said base portions shaped to interfit with alternate grooves in said wheel to hold and circumferentially space said blades to extend radially from said wheel,

a plurality of baffles for preventing the axial flow of gas between adjacent blade shanks,

each baffle comprising a first wall member extending normal to and around a blade at the juncture of said airfoil and shank portions and having an opening therethrough fitting the contour of the blade at that point,

a second wall means extending radially between said first wall member and said rotor wheel on the upstream side of said blade,

third wall members extending transverse to said rotor wheel on each side of said blade and attached to said first and second wall means,

said third wall members having means for attachment to said rotor wheel comprising a base portion which with the adjacent baffle third wall member interfits

with the remaining alternate undercut grooves to lock said baffles to said rotor wheel.

2. A rotor assembly for an axial flow turbomachine comprising the combination of

a rotor wheel,

a plurality of rotor blades having airfoil and shank portions,

means to attach said blades to extend radially from said rotor wheel,

said rotor wheel having a plurality of grooves spaced between said blades,

a baffle for preventing the flow of gas between adjacent blade shanks,

said baffle comprising a first wall member extending normal to and around a blade at the juncture of said airfoil and shank portions and having an opening therethrough fitting the contour of said blade at that point,

a second wall member extending between said first wall member and said rotor wheel on the upstream side of said blade,

third wall members extending transverse to said rotor wheel on each side and circumferentially spaced from said blade and attached to said first and second wall members,

means to support said third wall members in said rotor wheel grooves,

and a locking pin extending axially through said rotor wheel and said second wall means to lock said blades and baffle in place on the rotor wheel.

3. A rotor assembly for an axial flow turbomachine comprising the combination of

a rotor wheel,

a plurality of rotor blades having airfoil and shank portions,

means to attach said blades to extend radially from the periphery of said rotor,

said rotor wheel having a plurality of grooves spaced between said blades,

a baffle for preventing the flow of gas between adjacent blade shanks,

said baffle comprising a first wall member extending normal to and around a blade at the juncture of said airfoil and shank portions and having an opening therethrough fitting the contour of the blade at that point,

a second wall member extending between said first wall member and said rotor wheel on the upstream side of said blade,

a plurality of third wall members extending transverse to said rotor wheel circumferentially spaced from said blade and attached to said first and second wall members,

means to support said third wall members in said rotor wheel grooves,

and strip means attached to said third wall members which may be machined to the correct thickness to allow adjacent baffles to fit closely adjacent one another.

4. A baffle for sealing between adjacent blade shanks of blades supported on a rotor wheel of a turbomachine with said rotor wheel having undercut grooves alternating with and circumferentially spaced from said blade shanks, said baffle comprising,

a first four sided wall member having an opening therethrough fitting the contour of a blade,

additional wall members extending normal and fastened to three sides of said first wall member,

said two additional wall members on opposite sides of said first wall member including means for attachment to said rotor wheel at points circumferentially spaced from said blade shanks,

said means for attachment comprising enlarged base portions shaped to interlock with said rotor wheel grooves,

whereby said first wall means extends around and normal to said blade with said two additional wall members supporting said baffle from said rotor wheel.

References Cited by the Examiner

UNITED STATES PATENTS

2,819,870	1/1958	Wayne	253—77
2,853,272	9/1958	Odds	253—39.15
2,940,726	6/1960	Dennis	253—77
2,967,043	1/1961	Dennis	253—77
3,008,689	11/1961	Morley et al.	253—77

MARTIN P. SCHWADRON, *Primary Examiner.*

SAMUEL FEINBERG, BENJAMIN A. BORCHELT, *Examiners.*

S. W. ENGLE, *Assistant Examiner.*