

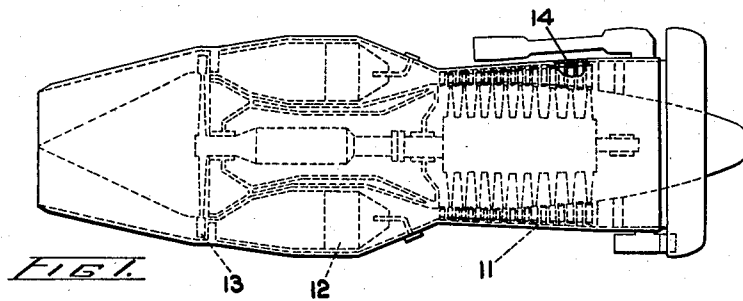
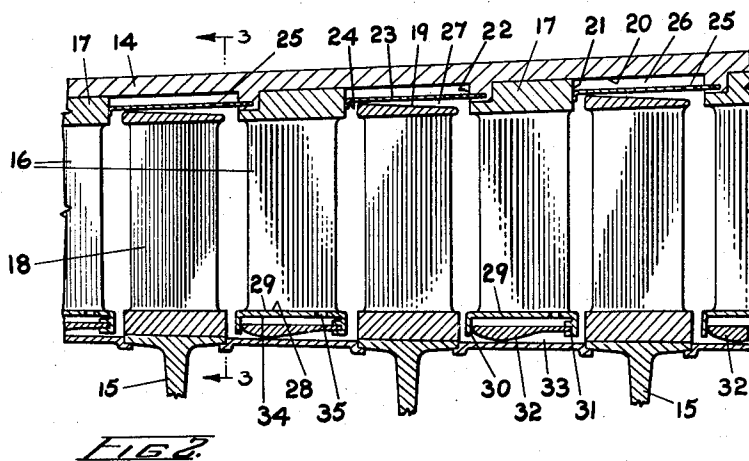
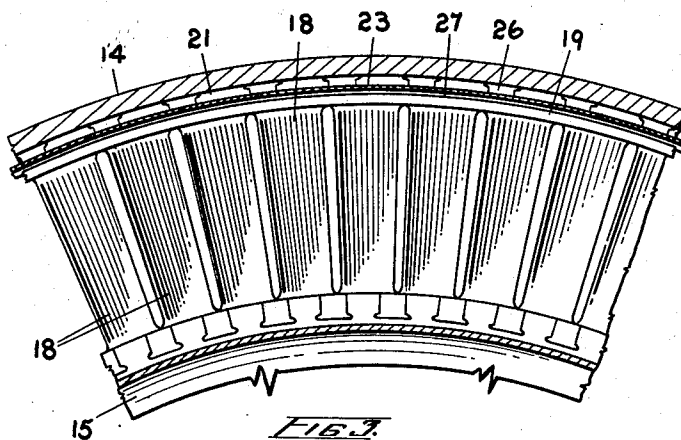
March 8, 1960

R. L. WARDLE
FLOATING BLADE SHROUDS

2,927,724

Filed Oct. 2, 1957

2 Sheets-Sheet 1



BY *Maybee & Legris*
ATTORNEYS.

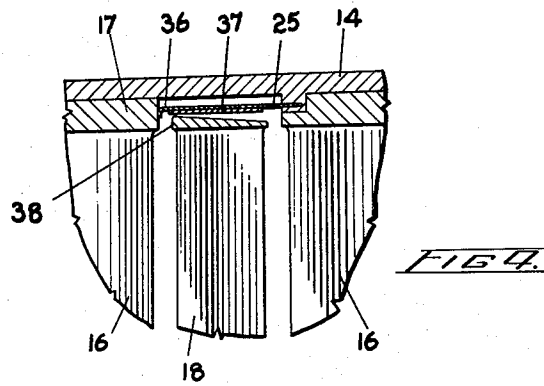
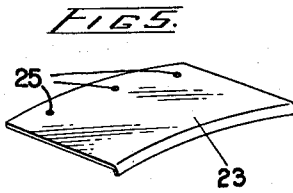
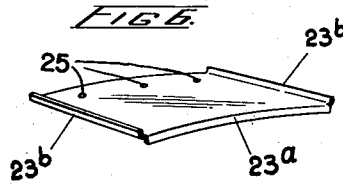
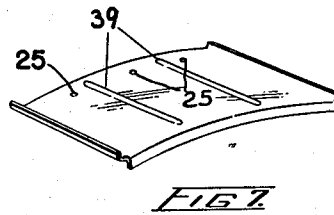
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2 Sheets-Sheet 2



INVENTOR

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2,927,724

FLOATING BLADE SHROUDS

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Application October 2, 1957, Serial No. 687,788

11 Claims. (Cl. 230—120)

This invention relates to seals for the blading of rotary machines of the class comprising turbines, compressors, blowers and the like and more particularly to seals for the blading of compressors of gas turbine engines.

Most conventional seals for compressor blading require the provision of shrouds opposite the blade tips which rotate relatively thereto. In order to provide an adequate seal it is necessary that close running clearances between the blade tips and the shroud be maintained, and this heretofore could be effected only by costly and time-consuming machining processes. Furthermore, as a result of temperature changes within the engines and changing loads imposed by aircraft manoeuvres, the close running tolerances required to provide adequate seals are sometimes insufficient to prevent damage to the blades due to contact with the shrouds.

A proposal which heretofore has been made to alleviate the aforementioned problem is that abrasive surfaces be provided on the shrouds to grind off the blade tips without generating excessive heat and without causing damage. Also, in some instances, segmental and even flexible shrouds have been constructed. However, none of these prior art shrouds automatically adjusts itself to variable running clearances. In a typical prior art flexible shroud construction, as exemplified by the arrangement disclosed in Hardigg United States Patent No. 2,634,090, the shroud is prevented by stops from approaching the blade closer than a predetermined distance. Such constructions suffer from the defect that the clearances between the blades and the shrouds are much greater than is desirable; furthermore, accurate machining of the blade tips and of the shrouds and their stops still is required.

It is an object, therefore, of this invention to provide effective and yet economical flexible sealing means between the blade tips and the opposed relatively rotatable member in rotary compressors, turbines, blowers and the like.

It is another object of the invention to provide flexible sealing means for rotary machines of the kind mentioned, which during operation of the machine, automatically will maintain an acceptable minimum distance between the sealing means and the opposed relatively rotatable member regardless of the strains in the machine caused by temperature fluctuations and manoeuvre loads.

The construction and operation of the invention will become apparent from a study of the following specification, taken in conjunction with the accompanying drawings, in which like reference characters indicate corresponding parts throughout the several views, and in which:

Fig. 1 is a side elevation of a typical axial flow gas turbine engine in which the invention is embodied;

Fig. 2 is an enlarged fragmentary radial section through the compressor of the engine of Fig. 1; and showing particularly two embodiments of sealing devices constructed in accordance with the invention.

Fig. 3 is a section taken through the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary section similar to Fig. 2, but

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showing another embodiment of a sealing device constructed in accordance with the invention;

Figs. 5, 6 and 7 are perspective views of various types of segmental laminar rings constructed in accordance with the invention.

An axial flow gas turbine engine 10, as shown in Fig. 1, comprises a compressor 11 in which air is compressed and passed to a combustion system 12 where it is mixed with fuel and burned to form gases of high temperature. The gases are then expanded through a turbine 13, which drives the compressor 11, and they are discharged rearwardly to provide a propulsive thrust.

The invention will be described as embodied in a compressor of a gas turbine engine, but it will be evident that the invention is equally adaptable for use with the turbine of such engines and in fact with any rotary machines of the class comprising turbines, compressors, blowers and the like and having a stator member and a rotor member mounted for rotation relative to the stator member, and radially arranged blades rooted at one end in one of the members with their tips or other ends opposite the other member but spaced therefrom.

The compressor 11 comprises a stator assembly and a rotor assembly, said assemblies including a stator member 14 and a rotor member 15 between which is an annular passage, and rings of blades of aerofoil section with their longitudinal axes radially disposed relative to the axis of rotation of the rotor member in the annular passage. Alternate rings comprise stator blades 16 having root ends 17 secured to the stator member 14 and their other ends extending toward the rotor member 15, while the other rings comprise rotor blades 18 having their root ends secured to the rotor member 15 and their outer ends extending towards the stator member 14. The blades may be secured to the stator member or to the rotor member by any conventional means.

In the engine illustrated in the drawings the flow of air is from right to left. As the air flows through the compressor there is a gradual increase in the pressure due to the work performed on the air by the rotating blades, and thus the pressure on the downstream side of a blade ring is higher than the pressure on its upstream side. The air constantly tries to escape from the high pressure side to the low pressure side through the clearance between the tips of the blades and the opposed member. A preferred embodiment of the invention for minimizing this escape of air is shown in Figs. 2 and 3 of the drawings. The sealing device for one of the rotor blade rings will first be described in detail.

Secured to the blade tips of each ring of rotor blades and encircling them is an annular shroud 19 which is spaced from the opposed member, that is from the stator member 14 in this case. The rotor assembly therefore comprises the rotor member 15, the rotor blades 18 and the shroud 19. Similarly the stator assembly comprises the stator member 14, the stator blades 16 and a shroud 20, described in detail hereinafter.

The portion of the stator member opposed to the shroud 19 can be considered as a channel provided by longitudinal circumferential wall 20 which is generally perpendicular to the longitudinal axes of the blades and spaced from the tips of the blades, and by transverse circumferential walls 21 and 22 which are substantially perpendicular to the longitudinal wall and spaced from the edges of the blades and of the shroud. In the space between the wall 20 and the shroud 19 is a laminar ring 23 secured at one edge in a circumferential slot machined in the wall 22, and which allows free movement of the ring in an axial direction while restricting movement of the secured edge in a radial direction. The ring 23 inherently is flexible and therefore in effect it is hinged mounted on the wall 22.

Preferably each laminar ring 23 comprises a plurality

of segments each having a radius of curvature equal to that of the slot in the wall 22 in which it is placed and a circumferential length of about 3 inches. The segments are arranged in end to end abutting relationship so that together they form a substantially continuous ring. At the free edge of the ring 23 is a lip 24 which is in substantially sealing contact with the wall 21 and is slidable relative thereto.

Small holes 25 (say, $\frac{1}{32}$ inch in diameter) are drilled in the ring 23 adjacent its hinged edge and are circumferentially spaced from each other by approximately one inch. These holes provide means which connect the chamber 26 defined by the walls 20, 21 and 22 and by the ring 23 to the fluid at the upstream or low pressure side of the blades, and thus prevent a build up of pressure in the said chamber which would otherwise occur due to any leakage of fluid between the lip 24 and the wall 21 from the high pressure side of the blade ring.

The face of the ring 23 which is opposed to the shroud 19 defines therewith a diverging passage 27. Any flow of air between the ring and the shroud will be from the high pressure side to the low pressure side; thus, the passage diverges downstreamly in the sense of the fluid flow therethrough.

The functioning of the sealing device of the invention is based on the fact that air drops in pressure when it accelerates through a passage, thus creating a suction on the walls which constitute the passage. Since one wall of the passage, namely the ring 23, is free to move, the gap between the shroud and the ring will vary to establish equilibrium between the suction forces on one side of the ring and the forces in the opposite direction; in other words the gap will narrow to an extent such that the forces balance each other.

It will be noted that the small amount of air which leaks through the gap between the shroud and the ring must first scrub against the lip 24 of the ring and be deflected thereby by approximately 90°. The force of the air applied against the lip as the air is deflected by the lip constantly will urge the lip into engagement with the wall 21 and the lip thus forms a substantially air-tight seal with the wall 21. However, as mentioned previously, the holes 25 allow any air that might leak between the wall 21 and the lip 24 to escape into the relatively low pressure region at the upstream side of the blade ring, thus preventing a build-up of pressure in the chamber 26. This will mean, of course, that the pressure in the chamber 26 is substantially the same as the pressure at the upstream side of the blade ring and therefore, the tilting movement of the ring 23 is governed by the flow of air in the diverging passage 27 between the shroud 19 and the ring 23. That is, as the gap widens the pressure drops in the diverging passage 27 and the ring is urged towards the shroud 19 by the pressure in the chamber 26. The ring cannot touch the shroud because of the existing pressure conditions, and the ring will tend to take up a position so that the pressure in the diverging passage 27 balances the pressure in the chamber 26.

The above-described functioning of the ring 23 occurs as described, even though there may be slight fluctuations in pressure in the chamber 26. As leakage air flows along diverging passage 27, its static pressure increases but it is to be remembered that the static pressure exerted by the high velocity stream in the throat or narrowest part of the converging passage 27 is extremely low and the increase therein due to divergence of the passageway is not sufficient to produce a real high pressure zone at the exit of the passage. While the pressure at that point may be slightly above the inlet pressure to the blade, it will not raise the pressure in chamber 26 very much above that inlet pressure even though it is transmitted through opening 25. The actual pressures existing in the diverging passage depend upon the quantity of air flowing therein. If that pressure becomes too high and increases the pressure in chamber 26, through opening 25, the effect

will be to flex ring 23 to further restrict passage 27 and thus reduce the quantity of air flowing with a consequent reduction in static pressure in the region of the openings 25. It is to be further remembered that air discharging from the passage 27 immediately drops to a pressure equal to the inlet pressure referred to.

The sealing ring illustrated in the lower part of Fig. 2 is in one respect an inversion of the construction previously described. Extending around the tips of one ring of the stator blades 16 is an annular channel section shroud generally indicated at 28 and which includes a web 29 secured to the blades and annular flanges 30 and 31. A laminar ring 32 is hinged at one edge to the flange 31, and the other edge of the ring is in sliding engagement with the flange 30 and is in substantial sealing contact therewith. One resilient plastic substance which has been used successfully for the ring 32 is manufactured by E. I. du Pont de Nemours & Company, Inc., and is sold under the trademark "Teflon." It is a substance which will withstand temperatures of the order of 500° C. and still remain resilient.

A diverging passage 33 is defined by the rotor 15 and by a portion of the ring 32. Between the ring 32 and the web 29 is a chamber 34 which is maintained at the relatively low pressure of the upstream side of the blade ring by the provision of holes 35 which are perforated in the shroud 28. In operation, the ring 32 is similar to the operation of the ring 23 previously described.

The embodiment of the invention illustrated in Fig. 4 is similar in all respects except one to the embodiment previously described with reference to the upper part of Fig. 2.

There is attached to the face of laminar ring 36, a rubbing strip 37 of any suitable plastic substance having the required characteristics of durability and of resistance to high temperatures.

The rubbing strip assures that the ring 36 suffers no damage should it under some conditions, especially at starting and stopping of the engine, contact shroud 38. A substance which has been used successfully for the rubbing strip 37 is that sold under the trademark "Teflon" and mentioned above. The "Teflon" may be bonded to the ring as a strip, or the required thickness of approximately 0.020 inch may be built up by spraying. It may be advantageous to impregnate the "Teflon" with graphite in order to reduce its co-efficient of friction.

In Fig. 5 is illustrated the preferred form of segmental laminar ring 23. An alternative segmental laminar ring 23a illustrated in Fig. 6 is provided at its longitudinal edges with flanges 23b which act as stiffeners to prevent warpage due to uneven temperature distribution.

It may also be desirable to construct rings having longer circumferential lengths than those previously described. In such a case the material thickness could be substantially reduced by providing stiffening ribs 39 evenly spaced circumferentially and disposed parallel to the engine axis, as illustrated in Fig. 7.

It will be understood that the form of the invention herewith shown and described is a preferred example and various modifications can be carried out without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator assembly, a rotor assembly rotatably mounted in the stator assembly, said assemblies including a rotor member, a stator member, blades rooted at one end in one of the members with their tips or other ends opposite a generally cylindrical portion of the other member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the other member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the other member from the high pressure side to the rela-

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tively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and said portion of the other member, means at one edge of the ring to hingedly secure the ring to the stator assembly in spaced relationship to the opposed portion of the rotor assembly and enabling the ring to tilt, the face of the ring which is opposed to the rotor assembly being angularly related to the opposed portion of the rotor assembly and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator assembly and being slidable relative thereto, the other face of the ring and the opposed portion of the stator assembly being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor assembly.

2. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator assembly, a rotor assembly rotatably mounted in the stator assembly, said assemblies including a rotor member, a stator member, blades rooted at one end in one of the members with their tips or other ends opposite a generally cylindrical portion of the other member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the other member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the other member from the high pressure side to the relatively lower pressure side; the sealing device comprising a plurality of laminar segments arranged in end to end relationship and which together provide a laminar ring in the space between the shroud and said portion of the other member, means at one edge of the ring to hingedly secure the ring to the stator assembly in spaced relationship to the opposed portion of the rotor assembly and enabling the ring to tilt, the face of the ring which is opposed to the rotor assembly being angularly related to the opposed portion of the rotor assembly and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator assembly and being slidable relative thereto, the other face of the ring and the opposed portion of the stator assembly being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor assembly.

3. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator assembly, a rotor assembly rotatably mounted in the stator assembly, said assemblies including a rotor member, a stator member, blades rooted at one end in one of the members with their tips or other ends opposite a generally cylindrical portion of the other member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the other member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the other member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the said portion of the other member, means at one edge of the ring to hingedly secure the ring to the stator assembly in spaced relationship to the opposed portion of the rotor

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assembly and enabling the ring to tilt, the face of the ring which is opposed to the rotor assembly being angularly related to the opposed portion of the rotor assembly and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator assembly and being slidable relative thereto, the other face of the ring and the opposed portion of the stator assembly being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber, and ports in the ring adjacent its hinged edge to connect the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor assembly.

4. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the rotor member with their tips or other ends opposite a generally cylindrical portion of the stator member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the stator member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and the stator member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the stator member, means at one edge of the ring to hingedly secure the ring to the stator member in spaced relationship to the opposed portion of the shroud and enabling the ring to tilt, the face of the ring which is opposed to the shroud being angularly related to the opposed portion of the shroud and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator member and being slidable relative thereto, the other face of the ring and the opposed portion of the stator member being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity of its said other edge relative to the shroud.

5. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the rotor member with their tips or other ends opposite a generally cylindrical portion of the stator member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the stator member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and the stator member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the stator member, means at one edge of the ring to hingedly secure the ring to the stator member in spaced relationship to the opposed portion of the shroud and enabling the ring to tilt, the face of the ring which is opposed to the shroud being angularly related to the opposed portion of the shroud and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator member and being slidable relative thereto, the other face of the ring and the opposed portion of the stator member being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber,

and ports in the ring adjacent its hinged edge to connect the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity of its said other edge relative to the shroud.

6. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the rotor member with their tips or other ends opposite a generally cylindrical portion of the stator member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the stator member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and the stator member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the stator member, means at one edge of the ring to hingedly secure the ring to the stator member in spaced relationship to the opposed portion of the shroud and enabling the ring to tilt, the face of the ring which is opposed to the shroud being angularly related to the opposed portion of the shroud and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, a lip at the other edge of the ring, the flow of fluid past said lip urging said other edge into substantial sealing contact with the stator member, the other face of the ring and the opposed portion of the stator member being spaced apart and, together with the hinged edge and the other edge, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity to the shroud.

7. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the rotor member with their tips or other ends opposite a generally cylindrical portion of the stator member but spaced therefrom, an annular shroud secured to the blade tips and spaced from said portion of the stator member, the surface of the shroud which faces the stator member being inclined relative thereto so that the space between the shroud and the opposed portion of the stator member is of progressively increasing width from the high pressure side to the relatively lower pressure side; and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the stator member from the high pressure side to the relatively lower pressure side, the sealing device comprising a laminar ring in the space between the shroud and the stator member, means at the edge of the ring which is in the relatively wide part of the aforesaid space to hingedly secure the ring to the stator member in spaced relationship to the opposed portion of the shroud and enabling the ring to tilt, the face of the ring which is opposed to the shroud being angularly related to the opposed portion of the shroud and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in substantial sealing contact with the stator member and being slidable relative thereto, the other face of the ring and the opposed portion of the stator member being spaced apart and, together with the hinged edge and the slidable edge, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the

relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the shroud.

8. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the stator member with their tips or other ends opposite a generally cylindrical portion of the rotor member but spaced therefrom, an annular shroud secured to the blade tips and spaced from the said portion of the rotor member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the rotor member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the rotor member, means at one edge of the ring to hingedly secure the ring in sealing engagement with the edge of the shroud which is subjected to the relatively lower pressure, the hinging means enabling the ring to tilt, the face of the ring opposed to the rotor member being angularly related to the opposed portion of the rotor member and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in slidable engagement with the other edge of the shroud and in substantial sealing contact therewith, the other face of the ring and the opposed portion of the shroud being spaced apart and, together with the hinged edge and the other edge of the ring, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor member.

9. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the stator member with their tips or other ends opposite a generally cylindrical portion of the rotor member but spaced therefrom, an annular shroud secured to the blade tips and spaced from the said portion of the rotor member, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the rotor member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring in the space between the shroud and the rotor member, means at one edge of the ring to hingedly secure the ring in sealing engagement with the edge of the shroud which is subjected to the relatively lower pressure, the hinging means enabling the ring to tilt, the face of the ring opposed to the rotor member being angularly related to the opposed portion of the rotor member and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other edge of the ring being in slidable engagement with the other edge of the shroud and in substantial sealing contact therewith, the other face of the ring and the opposed portion of the shroud being spaced apart and, together with the hinged edge and the other edge of the ring, defining a chamber, and ports in the shroud adjacent to the hinged edge of the ring to connect the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor member.

10. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the rotor member,

the stator member including a channel provided by a major circumferential wall generally perpendicular to the longitudinal axes of the blades and spaced from the tips of the blades and minor circumferential walls generally normal to the major wall and spaced from the edges of the blades, an annular shroud secured to the blade tips and spaced from the channel walls, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and the stator member from the high pressure side to the relatively lower pressure side; the sealing device comprising a laminar ring positioned between the shroud and the major channel wall, hinging means co-operating with the minor channel wall which is subjected to the relatively lower pressure to hingedly secure one edge of the ring so that the ring is in spaced relationship to the shroud, the said hinging means enabling the ring to tilt, the other edge of the ring being in substantial sealing contact with the other minor wall of the channel and being slidable relative thereto, the face of the ring which is opposed to the shroud being angularly related to the opposed portion of the shroud and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other face of the ring, together with the channel walls, defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid flow through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the shroud.

11. A rotary machine, of the class comprising turbines, compressors, blowers and the like, including a stator member, a rotor member rotatably mounted in the stator member, blades rooted at one end in the stator member with their tips or other ends opposite a generally cylindrical portion of the rotor member but spaced there-

from, and an annular channel-section shroud secured to the blade tips and spaced from said portion of the rotor member, the shroud including a web whereby it is secured to the blade tips and having circumferential flanges at each edge of the web, and a sealing device for preventing a substantial leakage of fluid between the tips of the blades and said portion of the rotor member from the high pressure side to the relatively lower pressure side; the sealing device comprising a ring positioned between the channel and the rotor member, the ring being hingedly secured at one edge to, and in sealing engagement with, the shroud flange which is subjected to the relatively lower pressure, the said hinging means enabling the ring to tilt, the opposite edge of the ring being in sliding engagement with the other channel flange and in substantial sealing contact therewith, the face of the ring which is opposed to the rotor member being angularly related to the opposed portion of the rotor member and thereby defining therewith a passage which diverges downstreamly in the sense of the fluid flow through the passage, the other face of the ring and the channel defining a chamber, and means connecting the chamber to the fluid at the low pressure side of the blades, the fluid which flows through the diverging passage causing the pressure in the passage to drop to a value less than the pressure in the chamber, the relative pressures in the passage and in the chamber tilting the ring to a position of optimum proximity relative to the rotor member.

References Cited in the file of this patent

UNITED STATES PATENTS

2,427,244	Warner	Sept. 9, 1947
2,611,532	Ljungstrom	Sept. 23, 1952
2,634,090	Hardigg	Apr. 7, 1953

FOREIGN PATENTS

852,789	Germany	Oct. 20, 1952
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