

[54] SEAL MEANS FOR BLADE AND SHROUD

[75] Inventor: **Richard E. Lee**, West Palm Beach, Fla.

[73] Assignee: **United Aircraft Corporation**, East Hartford, Conn.

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[51] Int. Cl. **F01d 5/18**, F01d 5/30, F01d 5/08

[58] Field of Search 415/115, 116, 128, 117; 416/97, 221, 92, 95, 96

[56] **References Cited**
UNITED STATES PATENTS

2,700,530	1/1955	Williams	415/116
2,786,648	3/1957	Ledwith	416/221
2,847,187	8/1958	Murphy	416/221
3,243,158	3/1966	Desmond	415/197
3,295,824	1/1967	Woodwell	415/178
3,703,808	11/1972	Stearns	415/115
3,728,039	4/1973	Plemmons	415/115

3,742,705	7/1973	Sifford	415/117
3,742,706	7/1973	Klompas	415/115

FOREIGN PATENTS OR APPLICATIONS

666,259	2/1952	Great Britain	416/95
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Primary Examiner—William L. Freeh

Assistant Examiner—Louis T. Casaregola

Attorney, Agent, or Firm—Jack N. McCarthy

[57] **ABSTRACT**

A turbine engine construction having a disc assembly with blades mounted therearound and a shroud construction for encompassing the ends of the blades. A sheet metal blade root seal is provided between the root of each blade and its cooperating slot in the disc for sealing cooling passages passing between the disc and blade. Each seal also holds its cooperating blade radially outward in its slot in the disc. A sheet metal shroud seal is provided between flange means on the engine casing and a liner on a rub strip seal member for sealing cooling passages passing through the flange means and liner. Each seal also holds the rub strip member radially inward.

5 Claims, 8 Drawing Figures

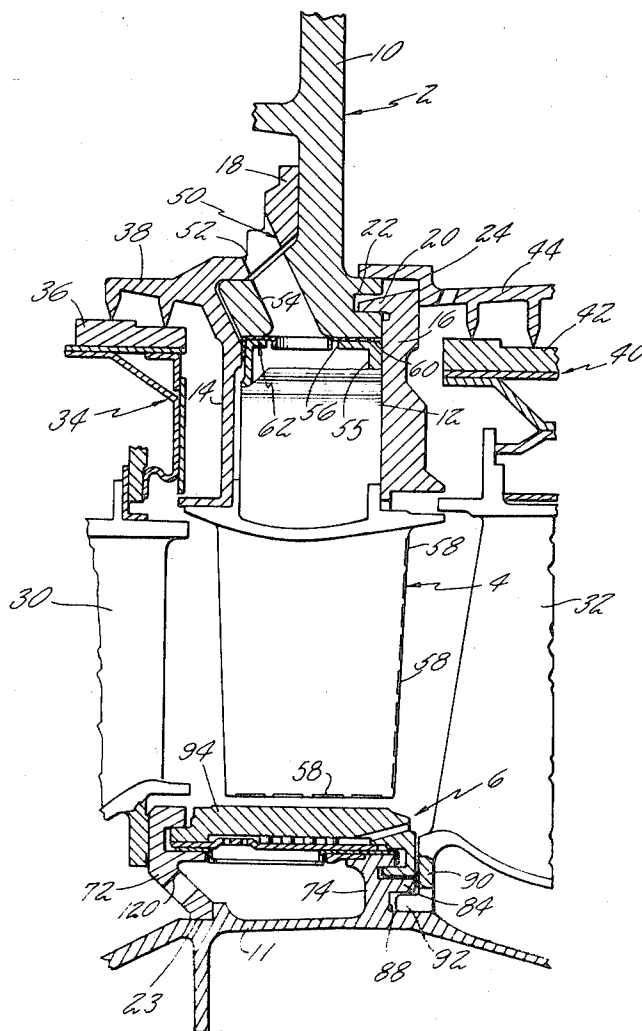
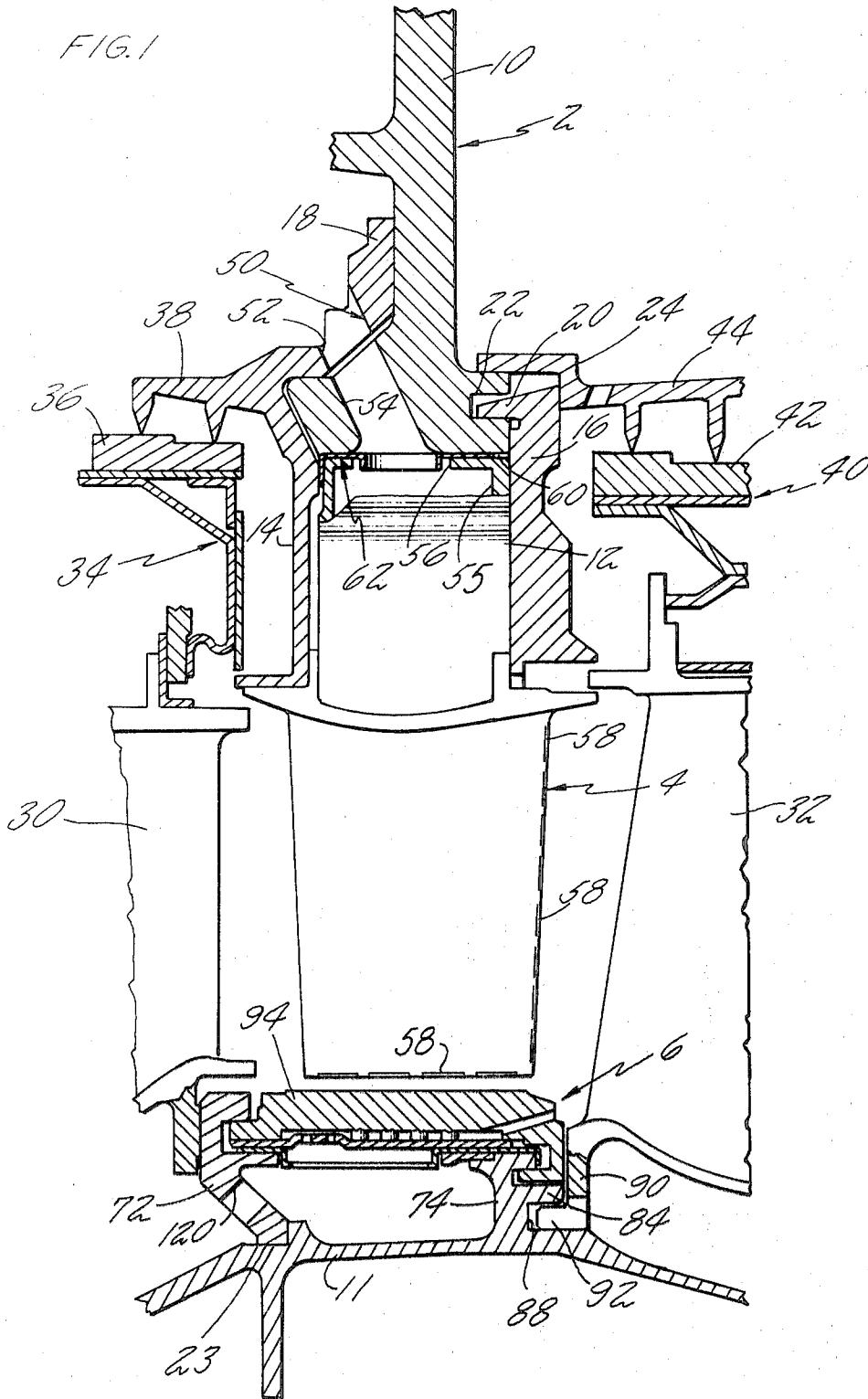


FIG. 1



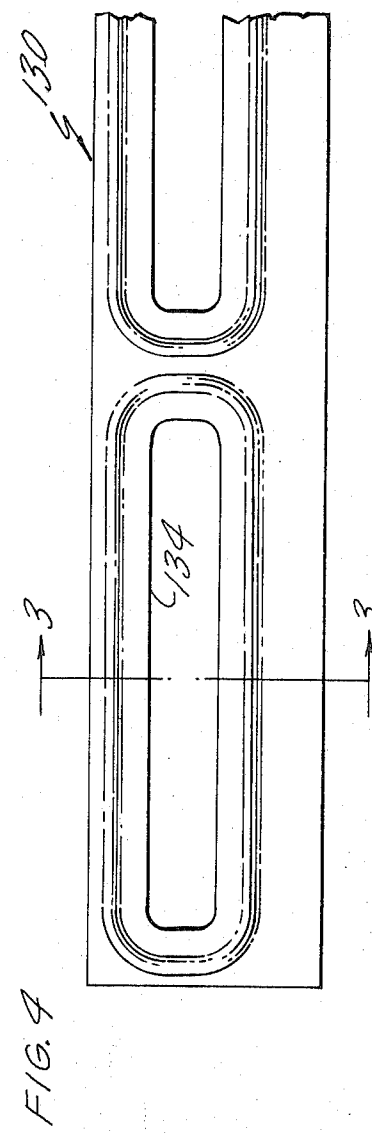
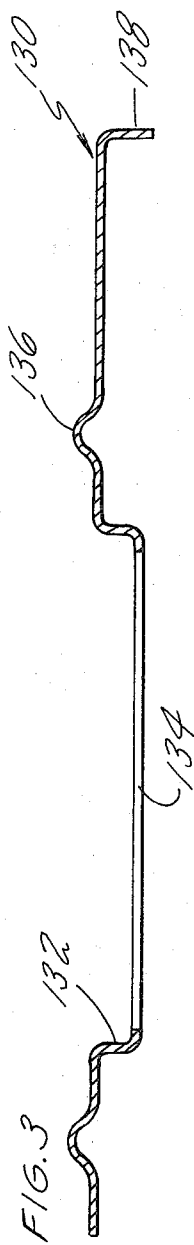
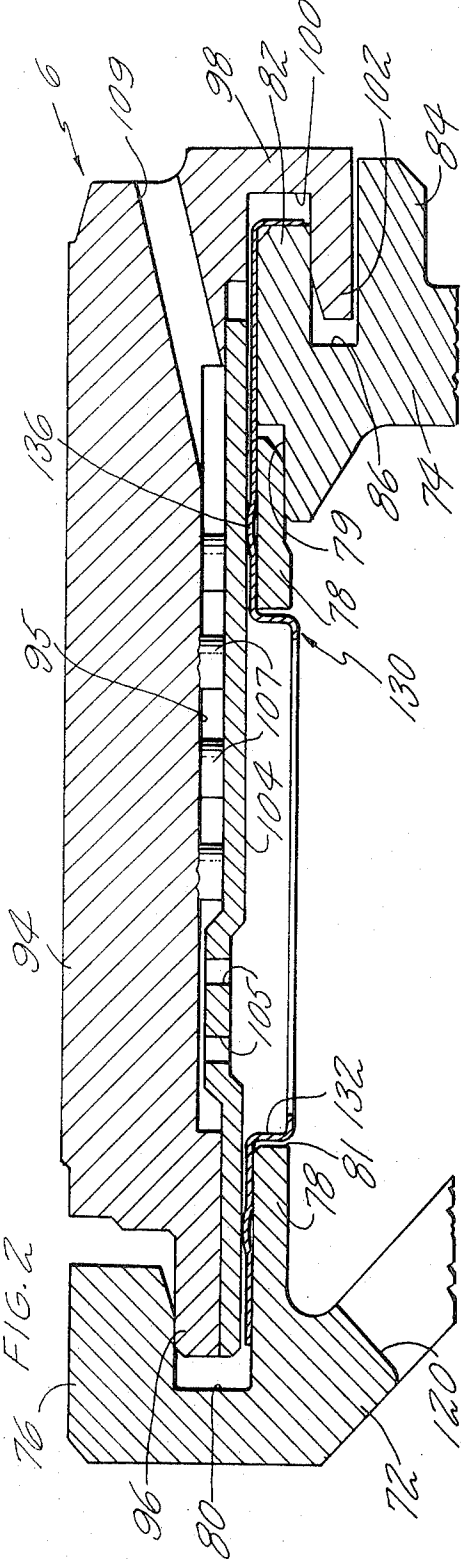


FIG. 6

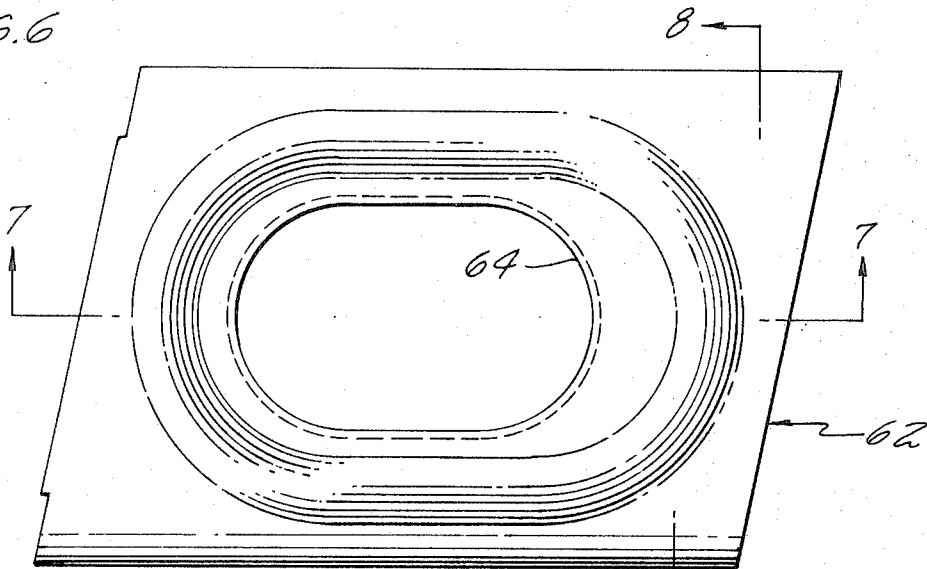


FIG. 7

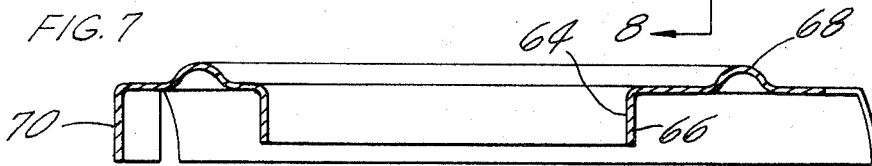


FIG. 8

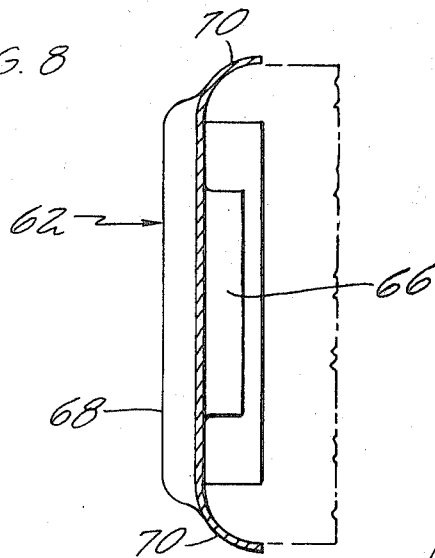
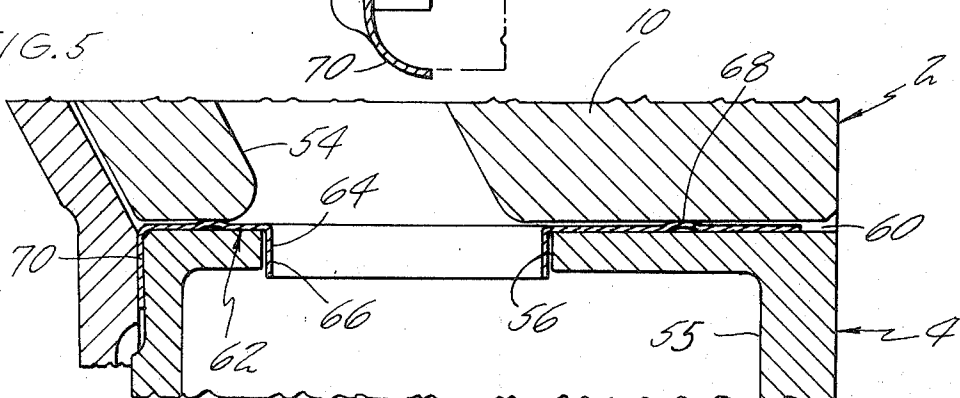


FIG. 5



SEAL MEANS FOR BLADE AND SHROUD

BACKGROUND OF THE INVENTION

This invention relates to means for providing a shroud for blades on a rotating body with means for providing a coolant flow through the blades and through the shroud. A prior art patent showing coolant flow through a shroud means is shown in U.S. Pat. No. 3,391,904. Prior art U.S. Pat. No. 3,370,830 shows a coolant flow between a disc and root of a blade. Other patents of interest are U.S. Pat. Nos. 2,786,648; 3,243,158 and 3,295,824.

SUMMARY OF THE INVENTION

A primary object of this invention is to provide a coolant blade and shroud arrangement wherein sealing means provides a positive sealing engagement and also provides means for biasing the blade and shroud member toward each other.

In accordance with the present invention, an embossed ring is provided on the sealing members around the cooperating ends of coolant flow holes to provide for deformation to provide for the positive seal and biasing force.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of the invention showing the disc, rotor blade, and outer shroud assembly.

FIG. 2 is an enlarged view of the outer shroud assembly.

FIG. 3 is an enlarged view of the sheet metal shroud seal in its relaxed state. This view is taken along the line 3—3 of FIG. 4.

FIG. 4 is a fragmentary view of the sheet metal shroud seal viewed from its outer surface.

FIG. 5 is an enlarged view of the connection of the blade and disc with a sheet metal blade root seal therebetween.

FIG. 6 is an enlarged view of the sheet metal blade root seal.

FIG. 7 is a view taken along the line 7—7 of FIG. 6.

FIG. 8 is a view taken along the line 8—8 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The construction shown in FIG. 1 is made of three main parts, the disc assembly 2, the blade 4, and a shroud construction 6 which encompasses the tips of the blades 4. The disc assembly 2 comprises a disc 10 with axially extended slots on its periphery, each of which receives the root 12 of one of the blades 4. Side plates 14 and 16 are fixed to the sides of the outer edge of the disc 10 to retain the blade roots of all of the blades therein.

The side plates 14 can be fixed to the disc 10 by any means desired and this can be done by the use of bolt means through the flange 18 of the side plate at the body of the disc 10.

The side plate 16 can be fixed in position by any means desired, however, it is shown with a projection 20 extending into a groove 22 in the disc for support against rotation and a sealing member 24 can be fixed to the disc to prevent axial movement.

A fixed vane 30 is located upstream of the blade 4 and a fixed vane 32 is located downstream of said blade. A fixed structure 34 extends between the fixed vane 30 and a seal member 36 which is located adjacent sealing edges on a flange 38 projecting from side plate 14. A fixed structure 40 extends between the fixed vane 32 and a sealing member 42 which is located adjacent sealing edges on a flange 44 projection which is part of sealing member 24.

Passage means 50 extends between the inner portion of the engine to the bottom of each slot. The passage means 50 is formed by an opening 52 in member 18 and a passageway 54 through the outer periphery of the disc. A plurality of blades 4 are fixed around the outer periphery of the disc with a contoured root similar in shape to the mating slot in the disc. A blade root slot construction is shown in U.S. Pat. No. 2,847,187. Other blade root configurations can be used as are well known in the art. A cooling fluid can be directed to the passage means 50 by any means desired. A conventional system usually directs compressed air from the compressor of the engine.

The blade 4 is of the type which is hollow having passage means 55 therein with an opening 56 at the bottom of the root and openings 58 at the trailing edge and at the tip of the blade. It is to be recognized that the exit openings can be located at various locations not departing from the invention. The blade configuration is formed smaller than the slot so that a small clearance is provided, such as at 60.

A sheet metal blade root seal 62 is positioned around the end of each blade root 12, the thickness of said sheet metal being slightly less than the clearance shown at 60. The sheet metal blade root seal has an opening 64 therein with an inwardly extending flange 66. A raised portion 68 extends around said opening 64 in a direction opposite to the flange 66. A flange 70 is located on the forward end and extends in the same direction as the flange 66 and is located between the blade and the side plate 14. This flange aids in positioning the sheet metal blade root seal to position the flange 66 with the opening 56 of the bottom of blade root 12.

As shown in FIG. 5 the sheet metal blade root seal 62 is located in position with the raised portion 68 resiliently deformed into position placing it in compression which provides an annular seal at that point and also forces the blade 4 outwardly with the mating portion of the blade root forced against the mating portion of the disc forming the cooperating slot. The sheet metal blade root seal 62 is curved at 71 to conform with the blade root as it curves upwardly on the contoured sides.

Engine casing 11 surrounding the outer tips of the turbine blades 4 is formed having a forward inwardly extending annular flange 72 and a rearward inwardly extending annular flange 74 which supports a shroud construction 6 which encompasses the tips of blade 4. Flange 72 is brazed to the casing 11 at 23. The shroud construction 6 is similar to a construction shown in U.S. Pat. application Ser. No. 101,481 to P. P. Sifford for a Thermal Response Shroud for Rotating Body, filed Dec. 28, 1970.

Vanes 30 have their rear ends outside of the outer platforms abutting the forward surface of the annular flange 72. Vanes 32 have their front ends outside of

their outer platforms connected to and spaced from the rearward surfaces of the annular flange 74.

Annular flange 72 has two rearwardly projecting cylindrical-like flanges 76 and 78. Flange 76 extends from the end of the flange 72. A cylindrical-like groove 80 is formed between said flanges. The flange 78 extends rearwardly and rests on an annular abutment 79 on the forward part of the inner end of flange 74. A plurality of openings 81 are positioned around the annular flange 78. Annular flange 74 has two rearwardly projecting cylindrical-like flanges 82 and 84 having a groove 86 formed therebetween. Flange 82 extends from the end of the flange 74. A cylindrical groove 88 is formed between the flange 84 and a portion of the inner casing 11. Stator vanes 32 have a flange 90 projecting outwardly therefrom with a plurality of notches cut therein around the entire circumference. Flanges 92 extend forwardly from the outer end of the flanges 90 to engage the groove 88 of the flange 74.

A rub strip seal member 94 is formed as a cylindrical-like member made in segments having an inner seal face. Segmenting permits rub strip thermal growth without changing the ring diameter. The forward end of said rub strip member 94 has a forwardly extending portion 96 of reduced diameter which projects into the opening 80. The rearward end of said rub strip member 94 has an outwardly extending flange 98 which has an annular groove 100 therein on its forward face. The annular groove 100 forms a forwardly projecting cylindrical flange 102 at the outer end of the flange 98.

Each segment of rub strip member 94 has an inwardly facing recess 95 on its outer face. A liner 104 is positioned over each recess 95 and brazed to the rub strip member 94 with the forward portion 96 projecting into the opening 80 along with the forward end of the liner 104. The outer surface of the liner 104 is even with the inner surface of the groove 100. Flange 82 extends into the groove 100 and flange 102 extends into the groove 86. Each liner 104 has inlet openings 105 at the forward end, and posts 107 fixed to member 94 project into recess 95 to support the liner 104. Openings 109 connect the recesses 95 to the exterior of the outer platform of the vanes 32.

The forward portion 96 and cooperating forward end of liner 104 is formed smaller than the groove 80 so that a small clearance is provided. Flange 82 is formed smaller than groove 100 and flange 102 is formed smaller than groove 86 so that a small clearance is provided. These clearances are similar to clearance 60.

A sheet metal shroud seal 130 is formed as a strip and is fixed to fit on the inner surface of flange 78 and inner end of flange 74. This surface is cylindrical and the seal 130 is provided with a split, one end of which is shown in FIG. 4. This provides for expansion and contraction of the seal 130; the thickness of said sheet metal being slightly less than the clearance provided between the cooperating portions of the member 94 and the flange 72 and 74. The sheet metal shroud seal has a plurality of openings 134 which are formed on raised portions 132 which project outwardly therefrom. The opening 134 is provided for each opening 81 of the annular flange 78. A raised portion 136 extends around each of said openings 134 in a direction opposite from the raised portion 132. A flange 138 is located on the rearward end of the sheet metal shroud member to aid in

positioning the seal. As shown in FIG. 2, the sheet metal shroud seal 130 is located in position with the raised portion 136 resiliently deformed into position, placing it in compression which provides an annular seal at that point and also forces the movable portion of the shroud construction 6 inwardly with the mating portion of the rub strip member 94 engaging the mating portion of the flanges 72 and 74.

A plurality of holes 120 extend through the flange 72 between the inner casing 11 and the outer ends of the vanes 30. These openings admit cooling fluid to the openings 134 of the sheet metal shroud seal 130, permitting the fluid to pass to openings 105 and then around posts 107 and out openings 109. While a coolant can be delivered to the holes 120 by any means desired, air from an engine compressor is usually provided in a conventional engine.

In one construction of a sheet metal blade root seal and a sheet metal shroud seal the material used was AMS 5544, which is a nickel alloy.

We claim:

1. In an engine a compressor, combustion means producing hot gases, a turbine rotor having a disc, contoured surface slots in the outer periphery of said disc, blades having contoured roots positioned in said slots, first coolant passage means passing through said disc and opening into the bottom of said slots, second coolant passage means passing through said blades and opening into the bottom of said roots, a sheet metal blade root seal means having sealing engagement with the root of each blade and the contoured surface of its cooperating slot for sealing the adjacent openings of the first and second passage means and having an opening inline with the openings of said first and second coolant passage means, said seal means having a raised portion around its opening for resilient engagement between the bottom of each root and the bottom of each slot, each seal means biasing its cooperating blades outwardly.

2. A combination as set forth in claim 1 wherein a shroud means extends around the tips of said blades, said shroud means being supported in support means with axially facing annular grooves with a small amount of radial clearance, third coolant passage means passing through said support means, fourth coolant passage means passing through said shroud means, a sheet metal shroud seal having sealing engagement with the shroud means and shroud support means for sealing between said third and fourth passage means.

3. A combination as set forth in claim 2 wherein said sheet metal shroud seal means has an opening inline with said third and fourth coolant passage means, said shroud seal means having a raised portion around its opening for resilient engagement between the shroud means and the support means, said shroud seal means biasing said shroud inwardly towards said blades.

4. A combination as set forth in claim 1 wherein side plates cover the contoured slots, each sheet metal blade root seal means having a flange means positioned between an end of each blade root and a side plate.

5. A combination as set forth in claim 2 wherein said second passage means also has an opening in the tip of the blade for directing a coolant onto said shroud means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,836,279 Dated September 17, 1974

Inventor(s) RICHARD E. LEE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

After the Abstract, insert the following sentence:

--The invention herein described was made in the course of or under a contract with the Department of the Air Force.--

Signed and sealed this 26th day of November 1974.

(SEAL)

Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents