Feb. 8, 1949. J. SCHUSTER, JR 2,461,239

COOLING TURBINE ROTORS

Filed Aug. 23, 1944 2 Sheets-Sheet 1

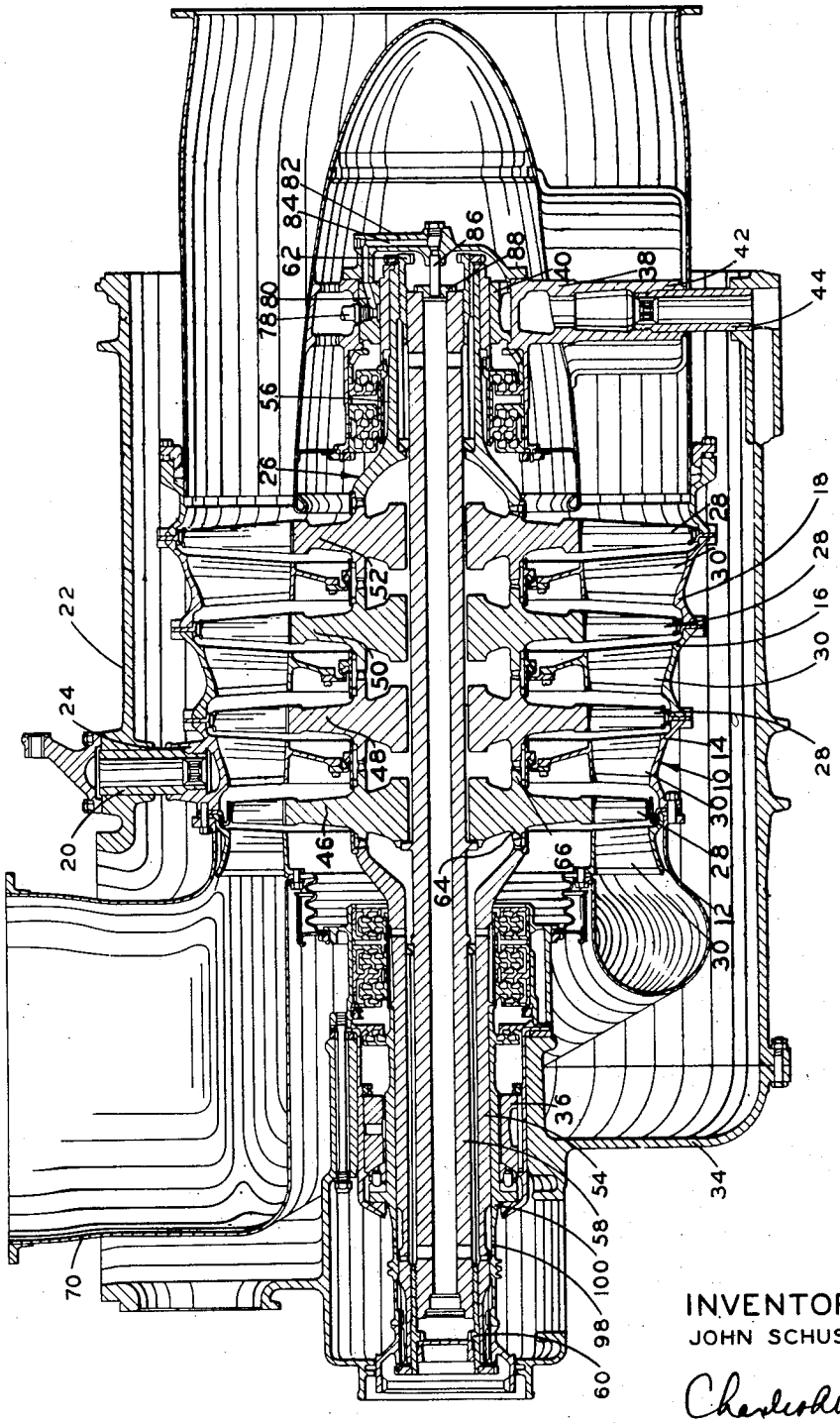


FIG. 1

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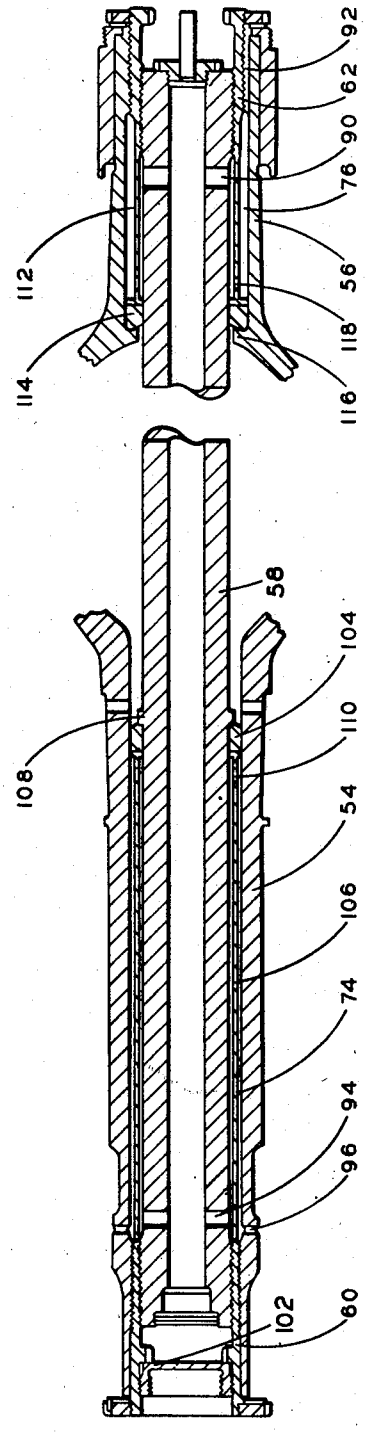


FIG. 2

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COOLING TURBINE ROTORS

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10 Claims. (Cl. 60—41)

1

This invention relates to cooling a turbine rotor particularly in a turbine adapted for operation by hot gases.

The copending application of Bodger, Serial Number 550,871, filed August 23, 1944, describes a rotor having a central bolt through which coolant is circulated to cooling chambers at both ends of the rotor. A feature of this invention is an arrangement of a partition in the cooling chamber to direct the flow of coolant through the chamber.

When the turbine rotor is built up of disk-carrying blades and end elements all held together by a central bolt the space within the end sections and outside of the bolt may form a cooling space through which coolant may be circulated for limiting the heat transfer from the power section of the rotor to the bearings on the end elements. A feature of this invention is an arrangement of the cooling chamber to provide a flow of coolant first over the surface of the bolt and then over the inner surface of the end element to assure thorough cooling.

The inner end of the cooling chamber may be closed by packing material and a feature of the invention is an arrangement of a partition in the coolant chamber which also holds the packing in place. Another feature is the formation of this partition as an integral part of the threaded sleeve by which the end element is connected to the central bolt.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

Figure 1 is a sectional view through the turbine.

Figure 2 is a fragmentary sectional view on a larger scale through the central bolt and end sections of the rotor showing the cooling chambers in detail.

The turbine includes a casing 10 built up of rings 12, 14, 16 and 18 and supported by radial pins 20 in a housing 22. These pins are slidable within the housing and engage bores in bosses 24 in one ring 14 of the casing. Rotor 26 within the casing has a number of rows of blades 28 alternating with the rows of nozzles 30 on the casing rings.

Housing 22 has a head 34 supporting a bearing sleeve 36 for the front end of rotor 26. At the other end of the turbine, housing 22 supports a mounting 38 within which is a bearing 40 for the rear end of the rotor. Mounting 38 has a number of legs 42 engaging with radial pins 44 which support the mounting within the housing.

2

Rotor 26 is made up of a number of disks 46, 48, 50 and 52 and shaft forming end elements 54 and 56. The disks and the shaft elements are all held together by a central bolt 58. The ends of the bolt are connected to the end elements by threaded sleeves 60 and 62. Each sleeve 60, 62 has inner and outer threads engaging with cooperating threads on the bolt and on the end elements. On one of the sleeves (sleeve 60 as shown) the inner thread has a greater pitch than the outer thread so that as the sleeve is screwed into place a tension is applied to the bolt.

To assist in aligning the disks during assembly and to prevent relative rotation in operation each disk has projecting annular flanges 64 and 66 on opposite sides, these flanges having interengaging elements preferably in the form of face splines cooperating with similar elements on the adjoining disk. The inner ends of shaft elements 54 and 56 have face splines engaging the splines on the end disks.

Gas enters the first stage nozzles of the turbine through an inlet scroll 70 attached to the end of casing 10. Gas is discharged from the turbine through a duct 72 connected to the end casing ring and surrounding the rear bearing mounting.

The shaft elements 54 and 56 are larger in diameter than the fastening bolt to form coolant chambers 74 and 76 surrounding the bolt. Coolant is admitted to the rearward end of the central bolt through a tube 78 mounted in one of the projecting legs 42 of the bearing mounting and connected with a passage 80 in bearing 40. A cap 82 on the bearing mounting has a connecting passage 84 by which coolant from passage 80 is guided through a tube 86 extending through a cap 88 on the end of the bolt.

The bolt has radial passages 90 adjacent its rearward end which communicate with chamber 76 permitting coolant to flow into this chamber and discharge through one or more grooves 92 in the end element 56. At the front end of the bolt, passages 94 permit coolant to flow from the bolt into chamber 74, coolant from this chamber discharging through passages 96 in the end element and adjacent passages 98 in a sleeve 100 surrounding said element. A cap 102 at the end of the bolt prevents the flow of coolant from the end of the bolt.

The inner end of chamber 74 is defined by a packing ring 104 surrounding the bolt and held in place by a sleeve 106 which may engage the end of sleeve 60. The packing is held against a rib 108 on the central bolt. Openings 110 near the inner end of sleeve 106 direct coolant from the in-

side to the outside of the sleeve and the sleeve forms a partition which causes a flow of fluid along the surface of the bolt to the inner end of chamber 74 and then along the inner surface of shaft element 54 to discharge through passages 96.

Similarly, at the rear end of the turbine rotor, chamber 76 is divided into inner and outer compartments by a sleeve 112 which may, if desired, be integral with sleeve 62 and which engages at its inner end a packing ring 114 to hold this ring in place against a projecting rib 116 on element 66. Openings 118 adjacent the inner end of sleeve 112 direct the flow of coolant through chamber 76 so that coolant first flows inwardly along the surface of the bolt and then outwardly along the inner surface of element 56. In this way circulation of coolant through the entire length of chamber 76 is assured and thorough cooling of the end element 56 is assured.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A turbine rotor having an annular chamber through which coolant is circulated, the inlet and discharge for said chamber both being adjacent one end and a substantially cylindrical partition in the chamber having an opening spaced from the inlet and discharge for the chamber and adjacent the opposite end thereof to guide the flow of coolant within the chamber.

2. A turbine rotor including a central bolt, an end element surrounding said bolt at one end and spaced from the bolt to form a coolant chamber surrounding the bolt, inlet and discharge passages to said chamber adjacent one end thereof, and means for guiding the flow of coolant within the chamber said guide means being constructed to cause axial flow within the chamber.

3. A turbine rotor including a central bolt, an end element surrounding said bolt at one end and spaced from the bolt to form a coolant chamber surrounding the bolt, inlet and discharge passages to said chamber adjacent one end thereof, and a substantially cylindrical partition within the chamber for guiding the flow of coolant said partition having a passage for fluid adjacent the opposite end of the chamber.

4. A turbine rotor including a central bolt, an end element surrounding said bolt and spaced from the bolt to form a coolant chamber surrounding the bolt, inlet and discharge passages to said chamber, packing at the inner end of the chamber between the element and the bolt, and a cylindrical partition extending through the chamber and engaging the packing for holding the packing in position and for guiding the flow of coolant within the chamber.

5. A turbine rotor including a central bolt, an end element surrounding said bolt and spaced from the bolt to form a coolant chamber around the bolt, inlet and discharge passages to said chamber, packing at the inner end of the chamber between the element and the bolt, and a cylindrical partition extending through the chamber and engaging the packing for holding the packing in position and for guiding the flow of coolant within the chamber, said partition being arranged to cause the coolant to flow over the surface of the bolt and then over the inner surface of the end element.

6. A turbine rotor including a central bolt, an end element surrounding said bolt and spaced from the bolt to form a coolant chamber around the bolt, inlet and discharge passages adjacent one end of the chamber, a cylindrical partition extending through the chamber and engaging the packing for guiding the flow of coolant, and an opening in the partition at a point axially spaced from the inlet and discharge passages for circulating the coolant in a predetermined path.

7. A turbine rotor including a central bolt, an end element surrounding the bolt adjacent one end and spaced from the bolt to form a coolant chamber around the bolt, a sleeve connecting the bolt and the end element and forming an end wall of the chamber, and a partition projecting from the sleeve into said chamber for guiding the flow of coolant through the chamber.

8. A turbine rotor including a central bolt, an end element surrounding the bolt adjacent one end and spaced from the bolt to form a coolant chamber around the bolt, a sleeve connecting the bolt and the end element and forming an end wall of the chamber, a partition projecting from the sleeve into said chamber for guiding the flow of coolant through the chamber, and packing at the inner end of the chamber between the element and the bolt to form the other end wall of the chamber, said partition engaging and holding the packing in place.

9. A turbine rotor having a number of discs each with a row of blades thereon, a central bolt extending through said discs and holding them in assembled relation, an end element engaging with an end disc, and said element surrounding said bolt adjacent one end and being spaced from the bolt to form a coolant chamber, said end element being held in position by said bolt, a sleeve connecting the bolt and the end element and forming an end wall of the chamber, inlet and discharge passages to said chamber adjacent one end, and a partition projecting from the sleeve into said chamber for guiding the flow of coolant through the chamber, said partition having an opening therethrough at the end remote from said passages.

10. A turbine rotor having a number of discs each with a row of blades thereon, a central bolt extending through said discs and holding them in assembled relation, an end element engaging with an end disc, and said element surrounding said bolt adjacent one end and being spaced from the bolt to form a coolant chamber, said end element being held in position by said bolt, inlet and discharge passages to said chamber, and a cylindrical partition in said chamber for guiding the flow of coolant through the chamber.

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