

March 24, 1953

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2,632,626

DIRT TRAP FOR TURBINE COOLING AIR

Filed Feb. 12, 1947

Fig. 1.

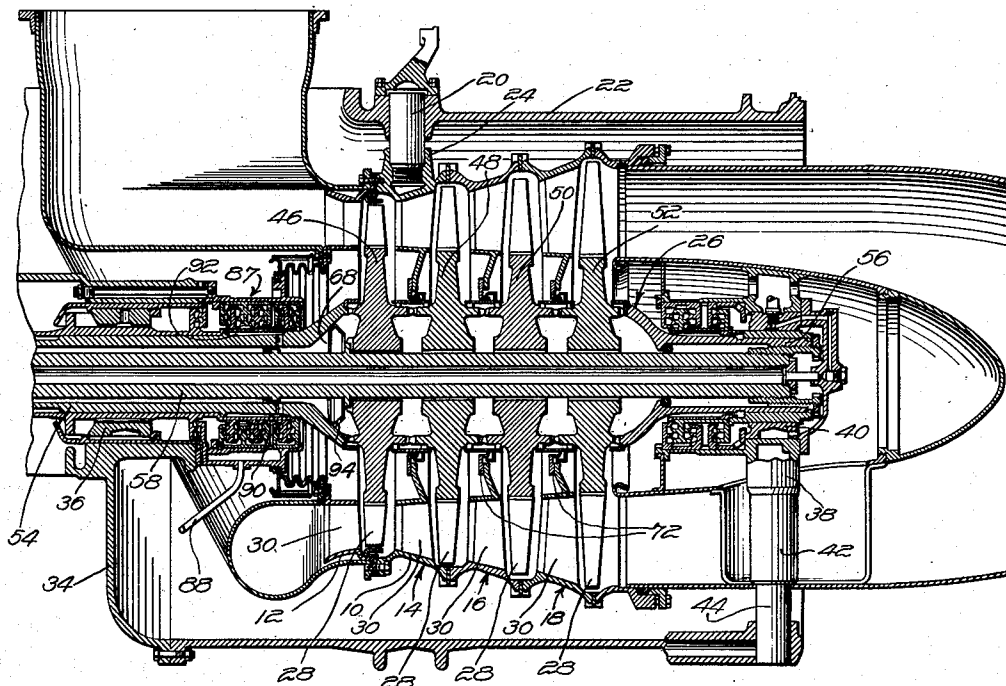
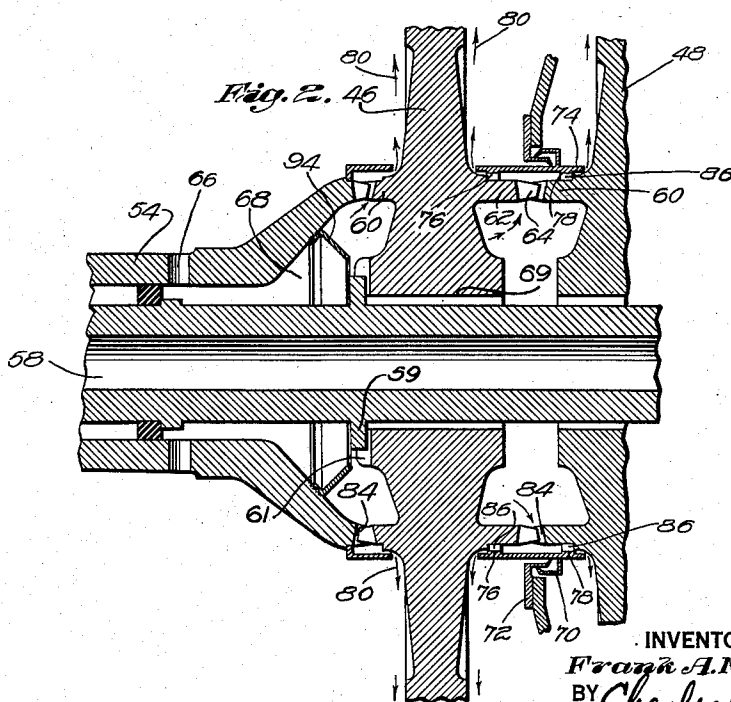


Fig. 2.



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2,632,626

DIRT TRAP FOR TURBINE COOLING AIR

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Application February 12, 1947, Serial No. 728,174

1 Claim. (Cl. 253—39.15)

1

The invention relates to a device by which to prevent dirt carried by the air which is used for cooling the turbine rotor from reaching the parts of the turbine rotor where it might interfere with the proper circulation of the cooling air.

In gas turbines it is essential, in obtaining reasonable turbine efficiencies, that the power fluid be at a temperature as high as possible without damaging the turbine parts. To prevent the turbine rotor from overheating and to maintain the blades at such temperatures that the stress on the blades does not exceed the strength of the blade material it has been advantageous to provide for a positive circulation of cooling air through and over the rotor surfaces. One example of an arrangement for cooling the rotor and the blades is disclosed in the copending application of Kalitinsky and Soderberg, Serial No. 550,885, now Patent No. 2,532,721, in which gas escapes from within the hollow rotor through passages on opposite sides of the adjoining turbine discs.

Solid material entrapped with the cooling air might so impede the flow of cooling air through the small passages normally provided for the cooling air that there would be localized heating of the rotor with resultant damage to the rotor discs or to the blades. A feature of this invention is a device within the turbine rotor for the removal of any dust or dirt particles before they reach the small passages through which the cooling air is intended to flow. Another feature is the arrangement of a conically shaped web within the rotor which not only will effectively remove dirt from the cooling air but also will retain the dirt within the web when the turbine is stopped.

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

Fig. 1 is a sectional view through the turbine.

Fig. 2 is an enlarged fragmentary sectional view showing the dirt trap in greater detail.

The turbine shown includes a casing 10 built up of nozzle rings 12, 14, 16 and 18 supported by radial pins 20 in a housing 22. These pins constitute the support for the casing 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 in the casing.

Housing 22 has a head 34 which forms a part of the housing and supports bearing sleeve 36 for the front end of the rotor 26. In the other

2

end of the turbine the housing 22 supports a mounting 38 within which is a bearing 40 for the rotor. Mounting 38 has a number of the legs 42 engaging with radial pins 44 which locate the mounting within the housing. The rotor 26 may be made up of a number of discs 46, 48, 50 and 52 and shaft-forming end elements 54 and 56. The discs and the shaft elements are held together by a central bolt 58 which has radial projections 59 engaging grooves 61 on disc 46 to prevent rotation of the bolt with respect to the rotor elements. To assist in lining the discs during assembly and to prevent relative rotation in operation, each disc has projecting annular flanges 60 and 62 on opposite sides having interengaging elements preferably in the form of face splines 64 cooperating with similar elements on the adjoining disc. The end elements have similar splines engaging with the end discs.

The rotor discs may be cooled by admitting gas under pressure through one or more passages 66 in the front end element 54 to the chamber 68 between this element and the first disc 46, this chamber being concentric to the axis of the rotor. The central openings 69 in the discs are larger in diameter than the central bolt and gas from the space 68 passes through the central openings and around each disc. A part of the cooling gas discharge past the interengaging face splines between the front end element 54 and the first disc 46 and also past the interengaging splines between adjoining discs for cooling the surfaces of the discs. The inner element 70 of the labyrinth seal 72 covers the face splines and has a sleeve 74 which is spaced from the flanges 60 and 62 on the discs by spaced ribs 76 and 78 to cause a flow of cooling gas, as indicated by the arrows 80, past the outer ends of the sleeves and outwardly over the surfaces of the discs. Slots 86 in the rib permit coolant to flow past the rib. As shown in Fig. 2 the teeth are so constructed that the interengaging teeth do not bottom in the grooves and thus define passages 84 for the flow of cooling gas.

Air under pressure may reach the rotor through the labyrinth seal 87 at the inlet end of the turbine. Air enters the seal through an inlet duct 88 and through a passage 90 in the seal to a chamber 92 communicating with the passages 66.

For the purpose of removing any particles carried by the cooling air as it passes through the turbine rotor the front end element 54 has mounted on the inner side adjacent to the face splines a conical web 94 which may be welded to

3

the end element. The cone of the web points toward the discharge end of the turbine and any dirt carried by the cooling air as it passes through the chamber 68 is collected in the groove formed between the conical web and the inner surface of the end element by centrifugal action. It will be apparent that as the turbine rotates at high speed the cooling air within the rotor is rotated with it and any solid particles carried by the air are carried outward by centrifugal forces against the inner surface of the end element. The conical shape of the web is such that, with the turbine on a horizontal axis, when the rotor is stopped, the dirt collected within the trap will, if it falls away, drop into the lowermost part of the trap and be retained therein after the turbine is started again.

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 claim.

I claim:

In a turbine construction, a rotor having end elements and blade-carrying discs mounted between said end elements, said rotor having small bleed passages for the flow of cooling fluid from within the rotor to points externally thereof, means for introducing the cooling fluid into one

4

of the end elements, said end element having a chamber therein in fluid communication with said passages, and a trap located in said chamber and concentric to the axis of the rotor in which dirt or fluid is collected by centrifugal action as the rotor spins, said trap including an annular substantially conical flange on the inner surfaces of said end element and extending into the chamber to form with said element a groove communicating with the chamber and arranged to receive dirt forced centrifugally out of the cooling fluid as it is rotated within said chamber.

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