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TURBINE COOLING

Filed Aug. 23, 1944 2 Sheets-Sheet 1

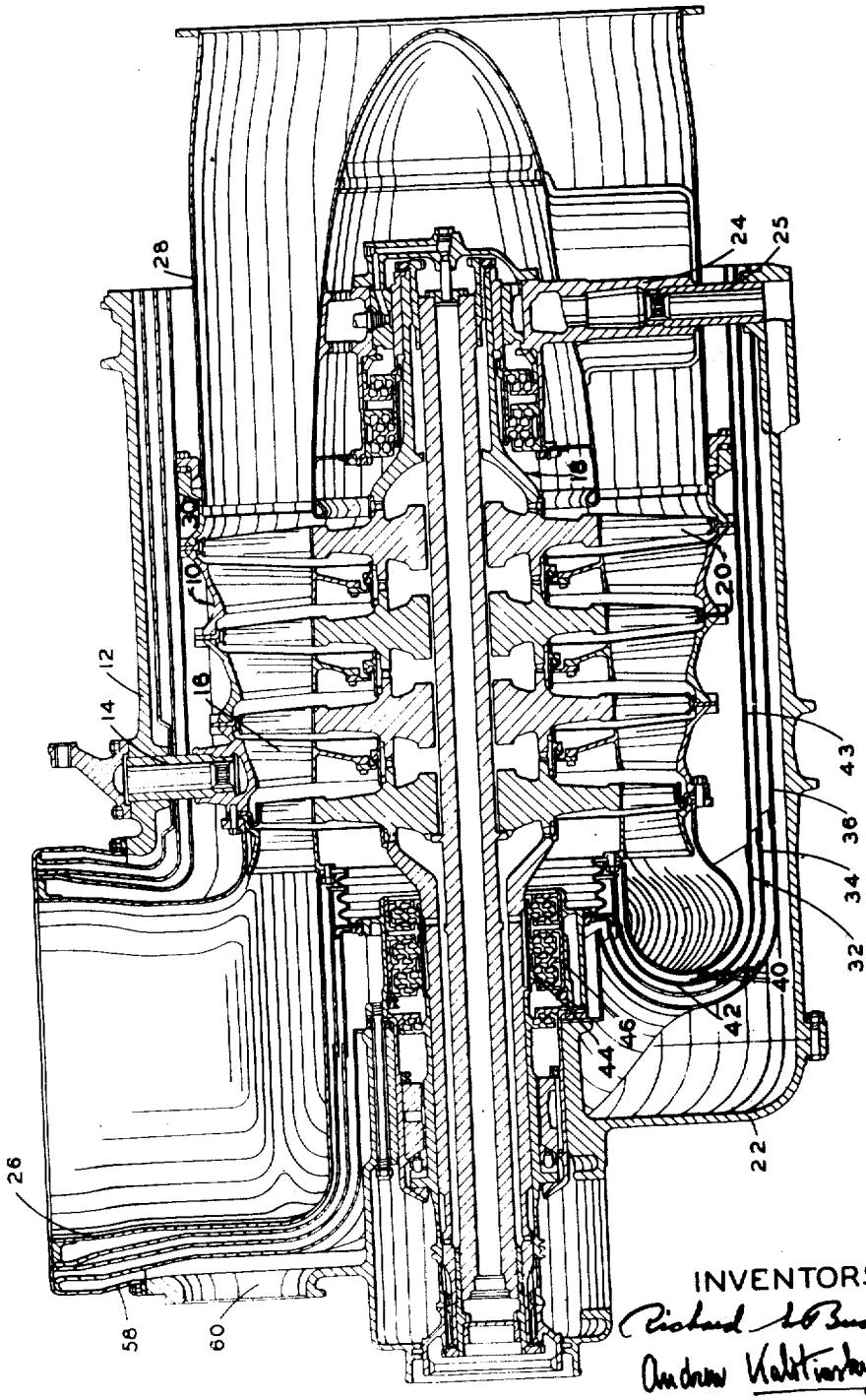


FIG. 1

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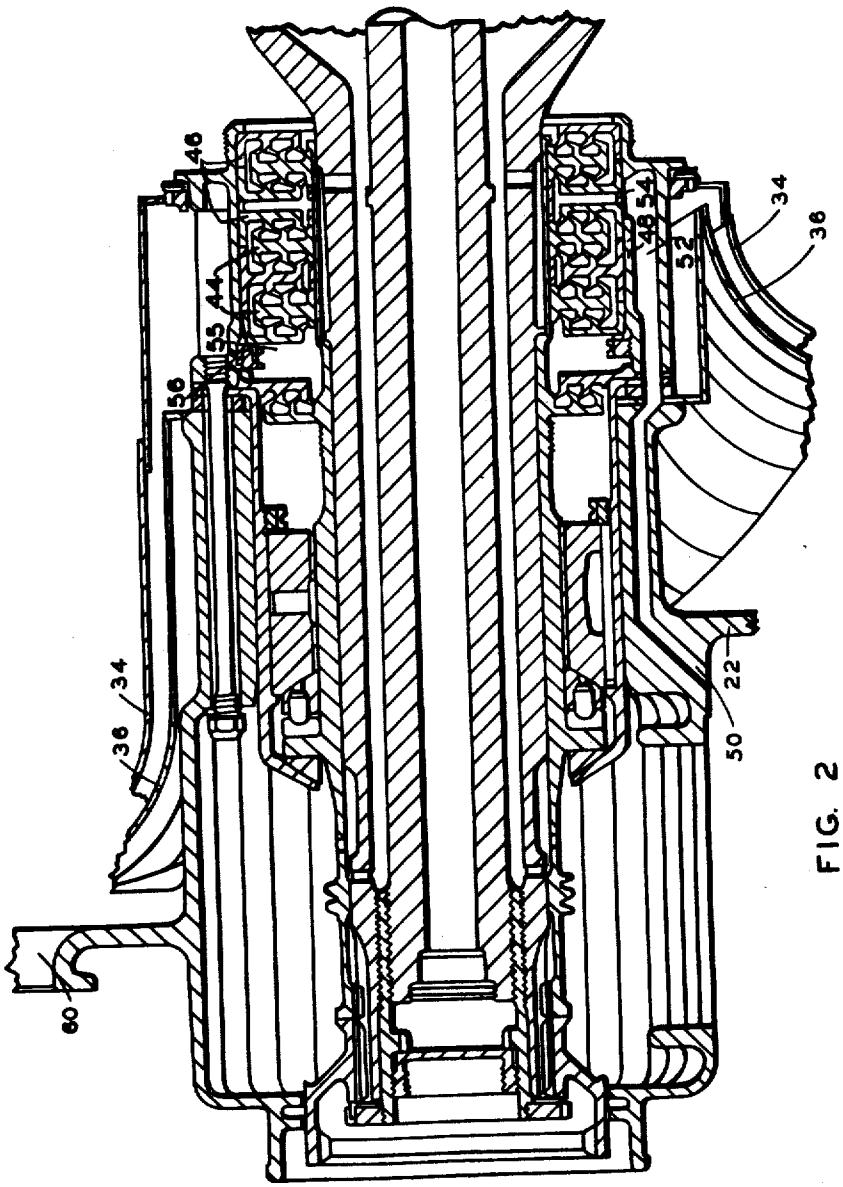


FIG. 2

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TURBINE COOLING

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Application August 23, 1944, Serial No. 550,873

6 Claims. (Cl. 60—41)

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This invention relates to elastic fluid turbines and particularly to the cooling of the outer turbine housing.

The copending application of Kalitinsky, Serial No. 550,882, filed August 23, 1944, discloses a turbine having a path for cooling fluid surrounding the elements that form the path for the power fluid. The cooling fluid has a higher pressure than atmospheric and is also generally at a higher temperature, especially if the fluid is taken from the turbine seal. This cooling may not be entirely adequate in high temperature turbines, particularly when the outer housing supports and maintains alignment between the nozzle rings and the rotor. A feature of this invention is a second cooling gas path for additional cooling fluid which is located between the path for power fluid and the outer housing.

One feature of the invention is the use of two separate cooling fluid spaces, each substantially surrounding the path for the power fluid. Another feature is the circulation of higher temperature coolant in the inner cooling space and a lower temperature coolant in the outer space, thereby avoiding excessive temperature differentials within the turbine. Another feature is the interposition of one or more radiation shields between the coolant spaces and the path for the hot power fluid.

One of the features of the invention is the cooling of light weight turbines for aircraft, especially those turbines which have an outer housing carrying bearings for supporting the rotor and also supporting the nozzle-carrying casing. For aircraft the outer housing must be light in weight and, therefore, in order to carry the loads imposed must be kept cool. A feature of the invention is the effective cooling of the outer housing by circulation of cooling fluids in at least two separate paths around the inner casing. Another feature is the arrangement of radiation shields between the casing and the outer housing so that the shields define the coolant paths.

Other objects and advantages will be apparent from the specification, 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 a fragmentary sectional view on a larger scale of the front seal.

The turbine includes a casing 10 supported in a housing 12 by a number of radially extending pins 14 which extend through bores in the housing and engage bores in the casing. These pins permit radial and axial expansion of the casing.

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Within the casing which may have several rows of nozzle-forming vanes 16 is the turbine rotor 18 having rows of blades 20 alternated with the rows of nozzles. The rotor is supported at one end by the head 22 which forms a part of the housing and at the other end by a spider 24 supported within the housing by pins 25.

Power gas enters casing 10 through an inlet duct 26 connected to the admission end of the casing and discharges through an exhaust duct 28 which surrounds the spider 24 and has a sliding connection 30 with the discharge end of the casing. The inlet duct, the casing and the exhaust duct form a path for the power gas which is within and spaced from housing 12.

To minimize heating of the housing when the turbine is operating, radiation shields 32, 34 and 36 are placed between the parts forming the gas path and the housing and are arranged to provide a substantially uniform spacing between the shields where possible. These shields may be held in position within the housing by the same pins 14 that hold the casing in position and also by the pins 25 that hold spider 24 in place. In addition, the spacing of the shields may be maintained by providing spaced projections 40 integral with one or another of the shields. For ease of assembly, the shields may be made up of overlapping sections which may be fitted together during assembly as, for example, shield 32 may have a front section 42 which is applied to the main section 43 of the shield after the inlet duct is in place.

To prevent leakage of power gas around the turbine rotor adjacent the inlet end of the turbine, the rotor supports the inner elements 44 of the labyrinth seal. The outer elements 46 are carried by a sleeve 48 mounted on the head 22. Sealing air at a pressure higher than that within the power section of the turbine is admitted to the seal between its ends as by introducing the sealing gas through a passage 50, Fig. 2, in the head 22, and a passage 52 in sleeve 48. From passage 52 the air enters the seal through a port 54.

This sealing air works in both directions through the seal, both into the power section of the turbine and into a space 55 at the outer end of the seal. This gas, which has a temperature higher than that of the surrounding atmosphere, is directed into the space between the shields 34 and 36 by one or more passages 56 in the sleeve 48. Gas entering between these shields circulates through the path defined by the shields and escapes at the discharge end of the turbine. The space between the shields may be closed at the

front end of the turbine by fastening the shields together adjacent the open end of the inlet duct, a connecting hood 58 extending over the ends of the shield.

The space inside of inner shield 32 and the space between shields 32 and 34 may be insulating spaces with static coolant, that is, without a circulation of coolant. The casing 10 and shield 32 are, as a result, not exposed directly to the cool gas, and extreme temperature differentials on opposite sides of the casing or the inner shields are avoided.

In addition to introducing gas escaping from the seals, between shields 32 and 34, it may be advantageous to introduce cooling fluid at a lower temperature between this gas path and the housing. For this purpose, head 22 of housing 12 may have an opening 60 adapted to be connected to a forwardly directed air scoop, not shown, which may admit air into the space between the outer shield 36 and the housing. This air is substantially at atmospheric temperature and at a pressure resulting from the forward motion of the airplane in which the turbine is mounted.

In this way, cooling of the housing is effected in two separate stages since the leakage gas from the seal, at a temperature considerably lower than that of the power gas, flows in a cooling path around the parts of the turbine which define the power gas path and much cooler atmospheric air flows in an independent path between the path for the leakage gas and the housing.

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.

We claim:

1. A turbine having a housing, a nozzle carrying casing positioned within and supported by the housing, a rotor supported by the housing and located within the casing, and inlet and exhaust ducts connected to opposed ends of the casing and defining with the casing a path for the power fluid, in combination with a number of radiation shields surrounding said casing and ducts and located between said casing and ducts and the outer housing said shields defining at least two separate substantially concentric paths for cooling fluid between the casing and the housing, and means for admitting cooling fluids at different temperatures to said cooling fluid paths.

2. A turbine having a housing, a nozzle carrying casing positioned within and supported by the housing, a rotor supported by the housing and located within the casing, and inlet and exhaust ducts connected to opposed ends of the casing and defining with the casing a path for the power fluid separate from the housing, in combination with a number of radiation shields surrounding said casing and ducts and located between said casing and ducts and the outer housing, said shields being located one within the other and spaced from each other to define substantially concentric spaces between adjacent shields, and means for admitting coolant to the space between the outermost pair of shields, and a lower temperature coolant between the outermost shield and the housing.

3. A turbine having a housing, a nozzle carrying casing positioned within and supported by the housing, a rotor supported by the housing and located within the casing, and inlet and exhaust ducts connected to opposed ends of the casing and

defining with the casing a path for the power fluid separate from the housing, in combination with a number of radiation shields surrounding said casing and ducts and located between said casing and ducts and the outer housing, said shields being located one within the other and spaced from each other to define spaces between adjacent shields, the spaces on opposite sides of the innermost shield being insulating spaces with static coolant.

4. A turbine having a housing, a nozzle carrying casing positioned within and supported by the housing, a rotor supported by the housing and located within the casing, and inlet and exhaust ducts connected to opposed ends of the casing and defining with the casing a path for the power fluid separate from the housing, in combination with a number of radiation shields surrounding said casing and ducts and located between said casing and ducts and the outer housing, said shields being located one within the other and spaced from each other to define spaces between adjacent shields, means for admitting leakage fluid from the turbine seal to the space between one pair of shields for cooling, and other means for admitting atmospheric air to the space between the outermost shield and the housing.

5. A turbine including an outer housing, a casing within and supported by the housing, an inlet duct extending through an opening in said housing and connected to one end of said casing, an outlet duct extending through another opening in said housing and connected to the other end of the casing, a rotor within the casing and supported by the housing, said inlet duct, casing, and outlet duct forming a path for power fluid within and out of contact with the housing, means surrounding said casing and ducts and located between the casing and housing and forming two substantially concentric gas paths between the casing and housing, and means at one end of the housing for introducing a separate cooling fluid to each gas path, said fluids being at different temperatures, the lower temperature cooling fluid being outside of the higher temperature cooling fluid.

6. A turbine having a housing, a nozzle carrying casing positioned within and supported by the housing, a rotor supported by the housing and located within the casing, and inlet and exhaust ducts connected to opposed ends of the casing and defining with the casing a path for the power fluid, in combination with a number of radiation shields surrounding said casing and ducts and located between said casing and ducts and the outer housing, said shields defining at least two separate substantially concentric paths for cooling fluid between the casing the housing and means at one end of the housing for introducing a separate cooling fluid to each gas path, said fluids being at different temperatures, the lower temperature cooling fluid being outside of the higher temperature cooling fluid.

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