Aug. 16, 1949. W. A. LEDWITH 2,479,046

LIMITING HEAT TRANSFER TO THE TURBINE ROTOR

Filed Aug. 23, 1944 2 Sheets-Sheet 1

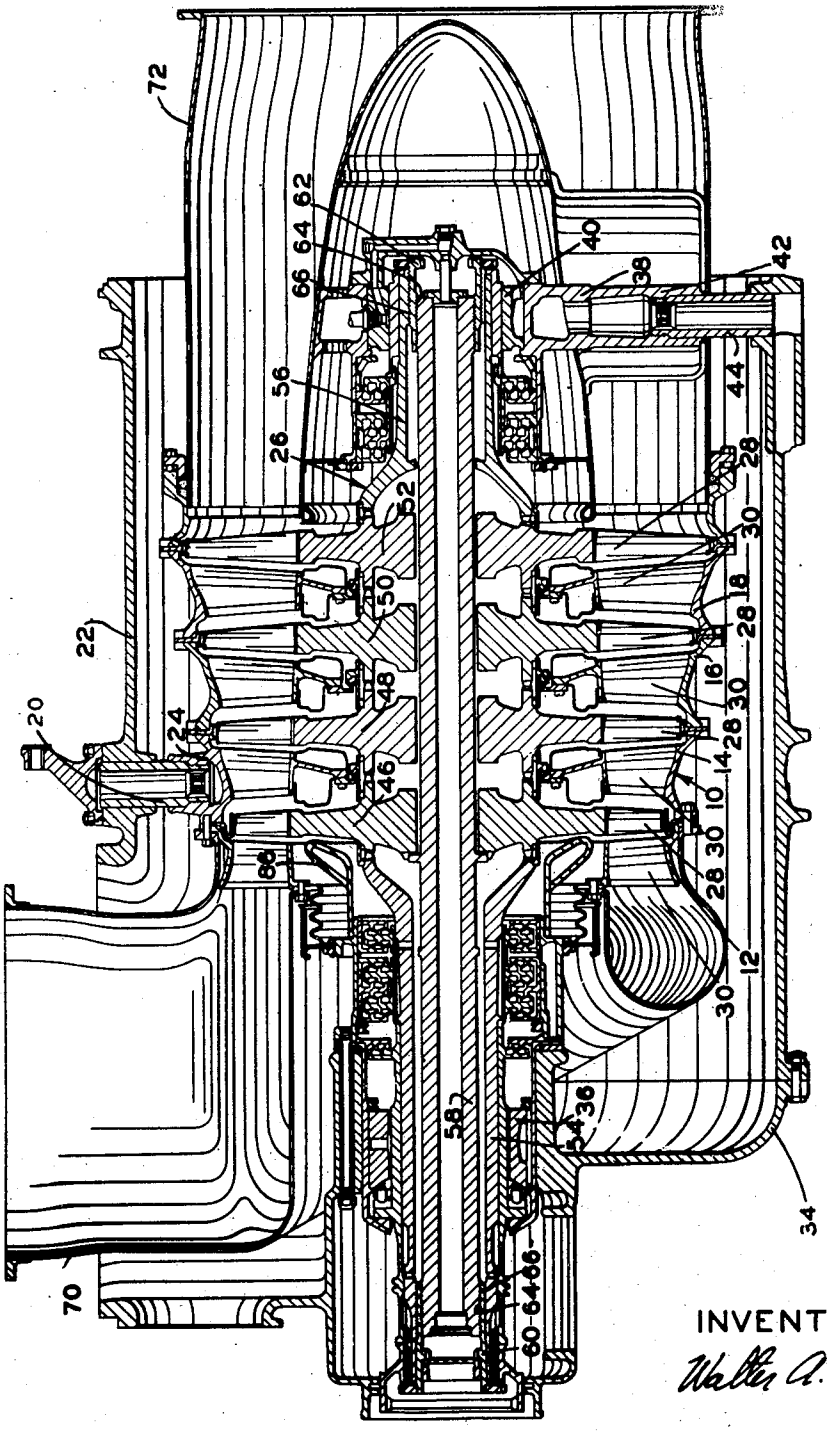


FIG. 1

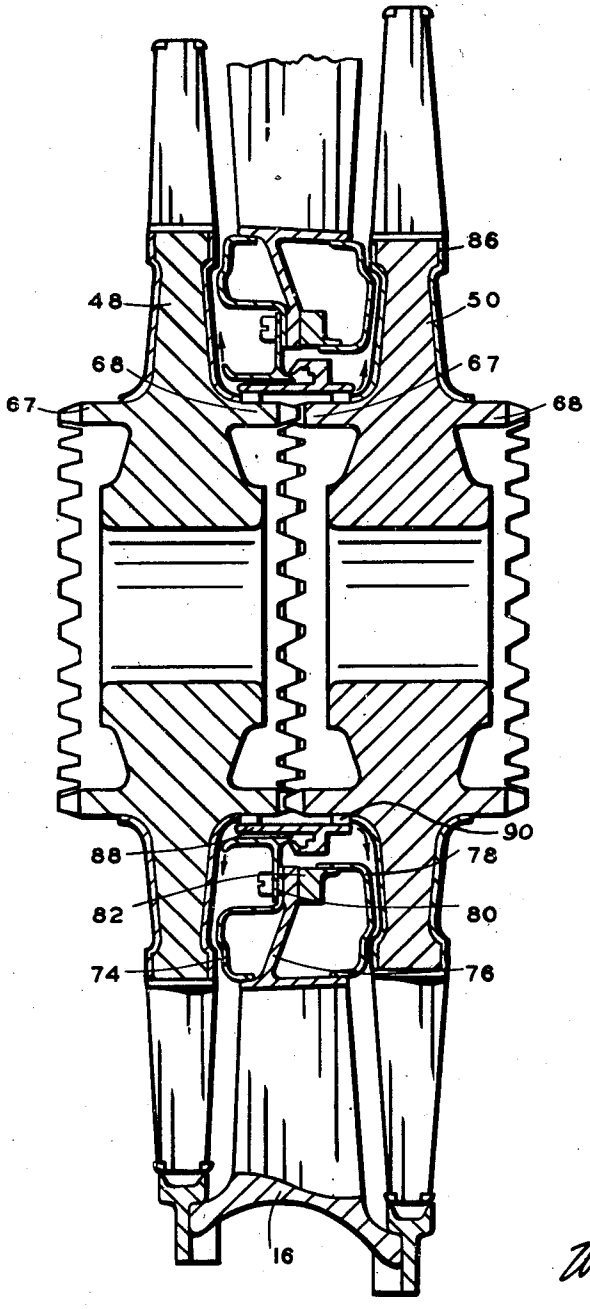
INVENTOR

Walter A. Ledwith

Aug. 16, 1949. W. A. LEDWITH 2,479,046

LIMITING HEAT TRANSFER TO THE TURBINE ROTOR

Filed Aug. 23, 1944 2 Sheets-Sheet 2



INVENTOR
Walter A. Ledwith

FIG. 2

Patented Aug. 16, 1949 2,479,046

UNITED STATES PATENT OFFICE

2,479,046

LIMITING HEAT TRANSFER TO THE TURBINE ROTOR

Walter A. Ledwith, Hartford, Conn., assignor to United Aircraft Corporation, East Hartford, Conn., a corporation of Delaware

Application August 23, 1944, Serial No. 550,891

4 Claims. (Cl. 60—41)

1

This invention relates to a turbine, particularly to an arrangement for limiting heat transfer to the turbine rotor in turbines operating at high temperatures.

In turbines operating at high temperatures the rotor may be heated to such an extent that the material of the rotor may be overstressed by the centrifugal loads resulting from its rotation. As the strength of most materials is lowered as the temperature increases it is advantageous to keep the rotor cool. A feature of this invention is the use of radiation shields for reducing the heat transfer to the rotor from the hot stationary parts of the turbine.

The projecting disks on the turbine rotor which carry rows of blades are normally directly exposed to the radiating surfaces of the nozzles and diaphragms of the turbine, these latter being substantially at the same temperature as the power gas driving the turbine. An object of this invention is to interpose between these heat radiating surfaces and the rotor radiation shields which will substantially reduce the heat transfer to the rotor.

A feature of the invention is the arrangement of radiation shields of this character on the stationary parts of the turbine so that they will not be subjected to the centrifugal forces acting on the rotor.

In many cases the shields cannot be constructed to shield the entire surfaces of the rotor disk against direct radiation from the nozzles, especially since a substantial axial clearance must be provided between the disks and the adjacent shields to permit expansion of the turbine parts. A feature of this invention is the use of heat shields in conjunction with a surface of low emissivity on the rotor which functions further to reduce the heat transfer.

In the copending Kalitinsky and Soderberg application, Serial No. 550,885, filed August 23, 1944, cooling fluid is circulated over the surfaces of the turbine disk to assist in cooling the rotor. A feature of this invention is the arrangement of the heat shields to form a path for the cooling fluid.

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 a fragmentary sectional view on a larger scale showing the arrangement of the heat shields.

The turbine shown includes a casing 10 built up of rings 12, 14, 16 and 18 supported by radial

2

pins 20 in a housing 22. These pins which are all in substantially the same plane and which constitute the support for the casing within the housing engage bores in bosses 24 in one ring 14 of the casing. Rotor 26 within the casing has rows of blades 28 alternating with rows of nozzles 30 in the casing.

Housing 22 has a head 34 which forms a part of the housing and supports a bearing sleeve 36 for the front end of the rotor. At the other end of the turbine housing 22 supports a mounting 38 within which is a bearing 40 for the rotor. The mounting has a number of legs 42 engaging radial pins 44 in the housing.

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 end elements are all held together by a central bolt 58, the ends of which are connected to the end elements by threaded sleeves 60 and 62. Each of sleeves 60 and 62 has inner and outer threads 64 and 66 engaging respectively with cooperating threads on the bolt and on the end elements. On one of the sleeves (sleeve 60) the inner and outer threads may differ in pitch so that a tension may be applied to the bolt as the sleeve is screwed into place.

To assist in aligning the disks during assembly and to maintain alignment in operation, each disk has radially projecting interengaging flanges 67 and 68, Fig. 2, on opposite sides which hold the disks in spaced relation. The inner ends of the shaft elements 54 and 56 engage with the flanges on the outer surfaces of 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 from the turbine discharges through a duct 72 connected to the end casing ring and surrounding the rear bearing mounting.

As shown in Figure 2, a heat shield 74 is mounted on the diaphragm 76 that extends inwardly from the row of nozzles and extends in parallel relation to the surface of the adjacent turbine disk 48, thereby interposing a shield directly between the hot nozzles and diaphragm and the surface of the turbine rotor. A similar shield 78 also carried by the diaphragm may shield the surface of the successive turbine disk.

Shield 74 may have one edge clamped between diaphragm 76 and the outer element 80 of the diaphragm seal. The outer edge of shield 74 may engage the nozzle structure as shown.

Shield 78 may be held in place by a ring 82 to which the shield is attached and which is clamped against diaphragm 76. The outer end of this shield may also engage the nozzle structure.

A shield 84, Fig. 1, may be supported by a stationary part of the turbine, to extend adjacent to and parallel with the forward surface of the first disc.

These shields reduce heating of the disks by direct radiation from the stationary parts of the turbine. For further reducing the heating of the turbine rotor these shields may, if desired, have a surface of substantially lower low emissivity than that of the material of the disc, as, for example, a gold plating may be applied, in accordance with the invention disclosed in the copending Bodger application, Serial No. 550,872, filed August 23, 1944.

Since these heat shields do not fully protect the surfaces of the rotor disks from radiation from parts of the nozzle it may be advantageous to provide on the turbine disks, at least over those parts not protected by the shields, or on the diaphragm, a surface of low emissivity. As shown in Fig. 2, a coating 86 of a material of low emissivity is applied to the surfaces of the parts of the turbine disks between the interengaging flanges 64 and 66 and the peripheries of the disks to which the blades are fastened.

The copending application of Kalitinsky and Soderberg, Serial No. 550,885, above referred to, describes the circulation of cooling air over the surfaces of the turbine rotor. With the heat shields arranged as shown and extending in substantially parallel relation to the surfaces of the disks it will be apparent that these shields form paths for the cooling air which escapes from within the rotor by passing between the interengaging flanges. The escaping air is directed over the surfaces of the rotor disk by a sleeve 88 positioned between the disks and spaced from the flanges as by slotted ribs 90 thereby permitting escape of cooling air at opposite ends of the sleeve, as shown by the arrows, Fig. 2.

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 including a rotor having a number of radially extending discs, each carrying a row of blades at its periphery, a casing with at least one row of nozzles located between adjacent rows of blades on the rotor, said row of nozzles having a diaphragm extending radially inward at the inner ends of the nozzles and extending between the adjacent discs, and radiation shields mounted on the diaphragm on opposite sides thereof and forming a radially extending shielding wall located between each side of the diaphragm and the adjacent turbine disc, each shield being spaced from both diaphragm and disc for substantially its entire area, each shield being supported at least at one edge on the diaphragm.

2. A turbine including a rotor having a number of radially extending discs, each carrying a row of blades at its periphery, a casing with at least one row of nozzles located between adjacent rows of blades on the rotor, said row of nozzles having a diaphragm extending radially inward at the inner ends of the nozzles and extending between the adjacent discs, and radiation shields mounted on the diaphragm on opposite sides thereof and forming a radially extending shielding wall located between each side of the diaphragm and the adjacent turbine disc, each shield being spaced from both diaphragm and disc for substantially its entire area, each shield being mounted on the diaphragm adjacent to the inner periphery of the diaphragm and extending outwardly substantially to the inner ends of the nozzles.

3. A turbine including a rotor having a number of radially extending axially spaced discs each carrying a row of blades at its periphery, means for supplying cooling fluid to the spaces between adjacent discs, a casing with at least one row of nozzles located between adjacent rows of blades on the rotor, said row of nozzles having a diaphragm extending radially inward at the inner ends of the nozzles and located between adjacent discs in combination with radiation shields mounted on the diaphragm on opposite sides thereof, each shield forming a radially extending shielding wall located between the diaphragm and the surface of the adjacent turbine disc, each shield being spaced from both diaphragm and disc for substantially its entire area, each shield being supported at least at one edge on the diaphragm and each shield being closely adjacent to and spaced from the adjacent disc to define a radially extending path for the cooling fluid, one wall of the path being the turbine disc.

4. A turbine including a rotor having a number of radially extending discs, each carrying a row of blades at its periphery, a casing with at least one row of nozzles located between adjacent rows of blades on the rotor, said row of nozzles having a diaphragm extending radially inward at the inner ends of the nozzles and extending between the adjacent discs, and radiation shields mounted on the diaphragm on opposite sides thereof and forming a radially extending shielding wall located between each side of the diaphragm and the adjacent turbine disc, each shield being spaced from both diaphragm and disc for substantially its entire area, the adjacent surfaces of the shield and disc forming opposed heat radiating and heat absorbing surfaces, in combination with a coating of a material of substantially lower emissivity than that of the material of the shields or the discs on one said adjacent surfaces to reduce the rate of transfer of heat from the turbine disc to the shield.

WALTER A. LEDWITH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,580,878	Dufour	Apr. 13, 1926
2,008,520	Soderberg	July 16, 1935
2,073,605	Belluzzo	Mar. 16, 1937
2,141,401	Martinka	Dec. 27, 1938
2,269,181	Clark	Jan. 6, 1942
2,401,826	Halford	June 11, 1946

FOREIGN PATENTS

Number	Country	Date
110,346	Switzerland	Oct. 1, 1925
452,412	Great Britain	Aug. 24, 1936