

Nov. 4, 1969

J. M. CAMPBELL ET AL

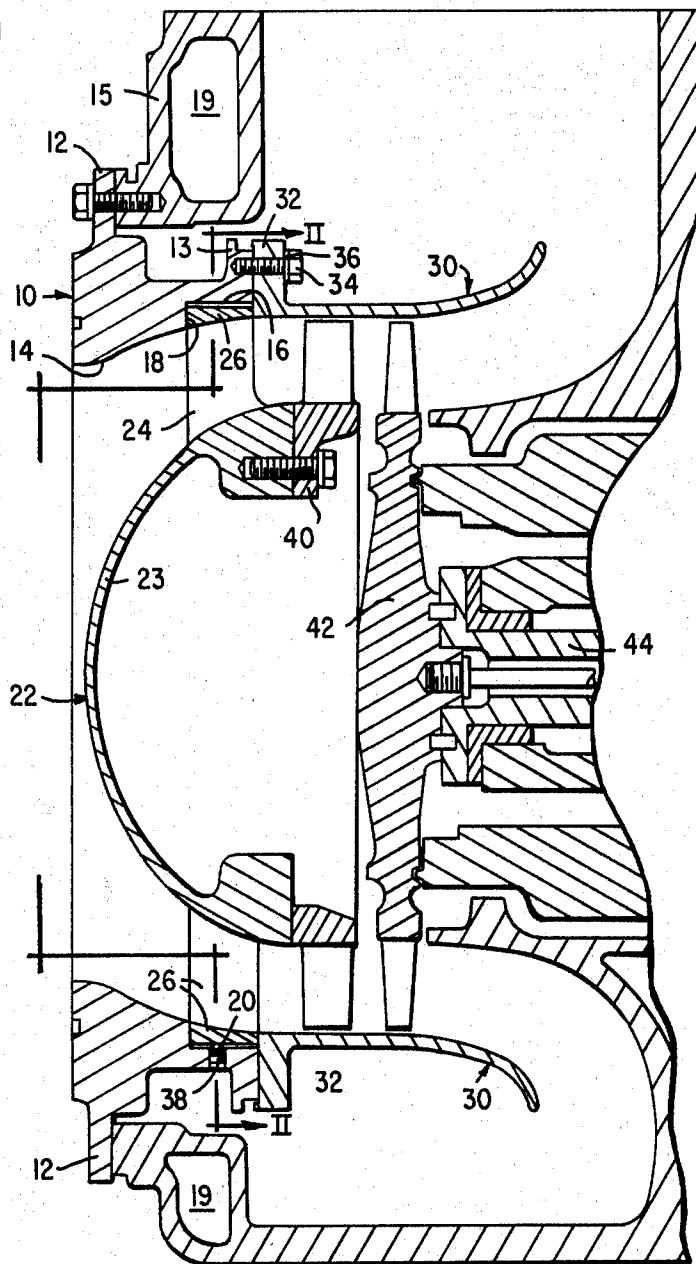
3,476,487

INLET CASING ASSEMBLY FOR TURBOMACHINE

Filed Feb. 21, 1968

2 Sheets-Sheet 1

FIG. 1



INVENTORS.
JOHN M. CAMPBELL.
ARTHUR J. MILLER.
BY *Raymond C. Curtis*
ATTORNEY.

Nov. 4, 1969

J. M. CAMPBELL ET AL

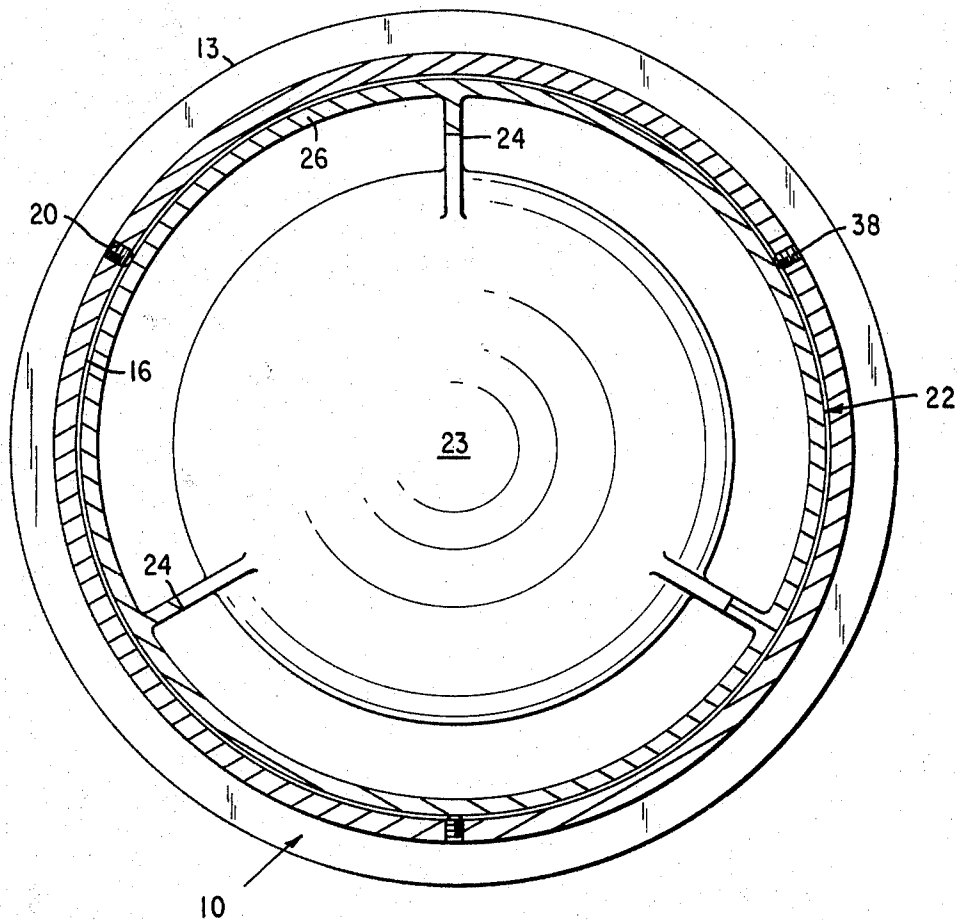
3,476,487

INLET CASING ASSEMBLY FOR TURBOMACHINE

Filed Feb. 21, 1968

2 Sheets-Sheet 2

FIG. 2



INVENTORS.
JOHN M. CAMPBELL.
ARTHUR J. MILLER.

BY

Raymond Curtis

ATTORNEY.

1

3,476,487

INLET CASING ASSEMBLY FOR TURBOMACHINE

John M. Campbell, Jeannette, and Arthur J. Miller, Irwin, Pa., assignors to Carrier Corporation, Syracuse, N.Y., a corporation of Delaware

Filed Feb. 21, 1968, Ser. No. 707-224

Int. Cl. F01d 1/04, 9/00

U.S. Cl. 415-134

1 Claim

ABSTRACT OF THE DISCLOSURE

An inlet casing for a turbomachine including a support ring encircling a nose cone having a radially spaced rim portion arranged within the support ring and engaging with the ring through set screws to define elastic sections for accommodating distortion due to thermal gradients across the assembly.

This invention relates generally to turbomachinery. More particularly, this invention relates to turbomachinery for handling high temperature, high pressure gases as a motive fluid. Still more particularly, this application pertains to an inlet casing construction for use with turbomachinery wherein the construction by its configuration may accommodate the forces generated by high temperature gases without fracture or failure.

BACKGROUND OF THE INVENTION

In turbomachines such as a turbocharger, the temperature of the gas employed as a motive fluid for the turbine section is relatively high, often on the order of 1300° F. The housings or casings employed with such turbines are usually provided with passages for the flow of a cooling medium in order that the heat, present in the parts of the machine by conduction, may be dissipated. By employing a cooling medium for this purpose, the temperature gradients across the individual parts of the turbine are increased. Because of these temperature gradients, the rate of growth of the parts due to the temperature gradients vary. If provision is not made for the varying rates of growth of the parts involved, a failure may occur.

The section of a turbine most affected by the temperature gradients is the inlet section which serves as a connection to the source of motive fluid. The inlet section usually comprises an assembly of parts, one of which is commonly referred to as a nose cone. A nose cone is positioned so that the flow of gas entering the turbine is directed into an annular path to a nozzle ring unit or stator unit. After passage through the nozzle ring, the gas strikes the blades of an impeller causing rotation of the impeller and a shaft associated therewith. The flow of gas then passes to an outlet section where it is exhausted from the turbine. This invention is directed to an inlet assembly including the nose cone or hub member referred to above together with certain supporting structure which functions as a closure member for the turbine.

SUMMARY OF THE INVENTION

The invention involves a novel construction of an inlet assembly and includes in addition to a hub member for supporting the nozzle ring from its rear surface, a support ring to which the hub member is assembled and a diffuser member having provision for connection to the support ring so as to secure the hub member therein. The support ring, in turn, is provided with an annular flange which permits the assembly of the parts described to be applied to the inlet end of a turbine.

The hub member is provided with a plurality of radial

2

arms extending from a central portion and is further provided with a rim section encircling the central portion and connecting the outer ends of the radial arms referred to above.

The hub member is assembled within the support ring and positioned therein by a plurality of set screws having a particular location relative to the radial arms. The diffuser ring is bolted to a flange on the support ring so as to cause the rim portion of the hub member to nest within a portion of the inner surface of the support ring.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a fragmentary view of a turbomachinery, partly in section, incorporating an inlet assembly constructed in accordance with this invention; and

FIGURE 2 is a view taken along lines II-II of FIGURE 1 illustrating certain of the details of the hub member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawings, the invention is shown as applied to a turbine into which gas at a high pressure and a high temperature is passed. Gas enters the turbine through the inlet section and flows over a nozzle ring through a rotor into an outlet section.

The invention is shown as the inlet section and includes the following parts as an assembly, an annular support ring 10, a hub member 22 and a diffuser ring 30. The support ring 10 includes flanges 12 and 13. The flange 12 connects to a support structure 15 forming a part of the turbine housing. The annular support ring 10 includes an inner surface 14 which is characterized by a section of constant diameter 16 defining a shoulder 18. In addition, the support ring 10 is provided with a plurality of circumferentially spaced openings 20 for a purpose to be later described.

Assembled within the support ring 10 is an annular hub member 22. The hub member comprises a central portion 23 presenting a convex surface to the gas entering the turbine. The hub member 22 includes a plurality of radial arms 24 located at circumferentially spaced positions about the central portion of the hub member. Connecting the outer ends of the radial arms 24 is a rim portion 26. As will be evident from a consideration of FIGURE 1, the hub member 22 is assembled within the support ring 10 by the engagement of shoulder 18 with the outboard end surface of the rim 26 and through the engagement of the outer surface of rim 26 with the surface 16 provided on the support ring 10.

The inlet casing assembly includes as a third member thereof a diffuser ring 30 provided with a flange 32 adapted to engage flange 13 on support ring 10. The parts are so constructed that the diffuser ring acts to prevent axial movement of the hub member relative to either the support ring or the diffuser ring and more particularly to prevent axial movement of the hub member relative to the axis of the turbine. The diffuser ring is secured to the support ring through bolts 34 and locking washers 36. In addition, set screws 38 are provided in the openings 20 for engagement with the outer surface of the rim 26 as it is assembled within the support ring as shown in FIGURE 1.

It should be understood that the inlet casing assembly described is connected to a support structure 15 forming a part of the turbine housing containing passages 19 through which a cooling medium is passed. Accordingly, a substantial thermal gradient is present across the support ring 10 in a direction perpendicular to the axis of the turbine. In addition, there is a substantial thermal gradient across the hub member so that the hub member as well as the support ring and diffuser ring tend to ex-

3

pand radially under the influence of the high temperature gas. In designing the dimensions of the individual parts, provision is made for a small clearance space between the annular hub member and the support ring. It is controlled by adjustment of the set screws 20 when the rim 26 is positioned as shown in FIGURE 1. It is important that the clearance space be maintained as small as possible in order to maintain mechanical stability of the assembly and resist vibration forces that may be exerted on the turbine. On the other hand, the relative growth in a radial direction of the hub member to the support ring requires the existence of the clearance space. With the construction described, the hub member will expand within the confines of the support ring and when temperatures in excess of those representing design temperatures are encountered, distortion of the rim portion of the ring and the hub member will occur. In the arrangement shown, there is provided a series of six separate inner sections each defined by the set screw point of contact and the adjacent radial arms. It has been observed that the separate sections deflect in the area between the points serving as the terminals of the section. In other words, the sections distribute the distortion throughout their extent so that while the yield point of the material from which the parts are formed may be exceeded, the elastic limit is not preventing failure of the assembly through fracture due to localized stress points.

In utilizing the invention, the parts are assembled in the manner described and a nozzle ring 40 secured to rear surface of the hub member. The resulting assembly is then applied to a turbine having an impeller 42 connected to a power shaft 44 supported in a housing equipped with conventional bearings and seals. The machine shown in FIGURE 1 is part of a turbocharger having a turbine section and a compressor section, not shown, integral therewith. The inlet assembly acts in the manner of an end

4

closure with provision for connecting a conduit thereto for supplying high pressure, high temperature exhaust gas or other motive fluid.

We claim:

In an elastic fluid machine for receiving relatively high temperature fluid, extracting energy from the fluid and thereafter exhausting it at a reduced temperature, an inlet casing assembly including:

an annular support ring having the inner surface provided with a shoulder defining a section of constant diameter and a plurality of circumferentially spaced openings;

an annular hub member adapted to be positioned in the fluid stream entering the machine, said hub member including a plurality of radial arms extending at circumferentially spaced locations on the hub member, and an annular rim connected to the outer ends of the radial arms and positioned within the ring at the portion of constant diameter;

a plurality of set screws arranged in the openings so as to engage the rim at locations circumferentially spaced from the juncture of the radial arms and the rim on said hub member; and

a diffuser ring connected to the annular support ring so as to confine the rim portion of the hub member against axial movement relative to the axis of the machine.

References Cited

UNITED STATES PATENTS

2,641,442	6/1953	Büchi	253—65
2,715,367	8/1955	Kodet et al.	253—65 X
3,050,282	8/1962	Allen et al.	253—65 X

EVERETTE A. POWELL, Jr., Primary Examiner