March 11, 1941. A. J. LARRECQ 2,234,767

COOLING ARRANGEMENT FOR GAS TURBINES

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Fig. 1.

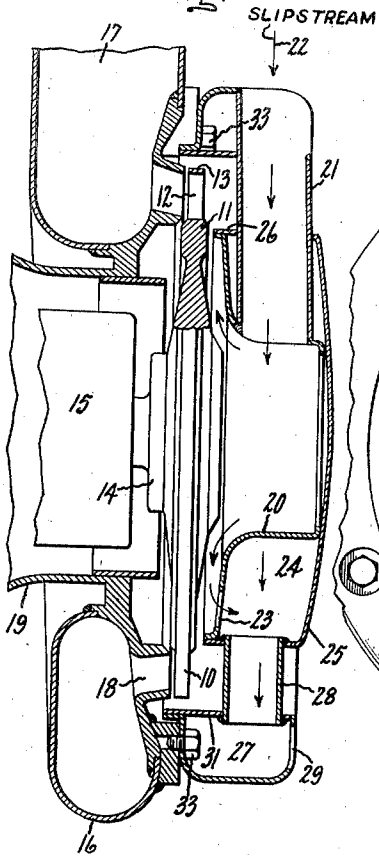
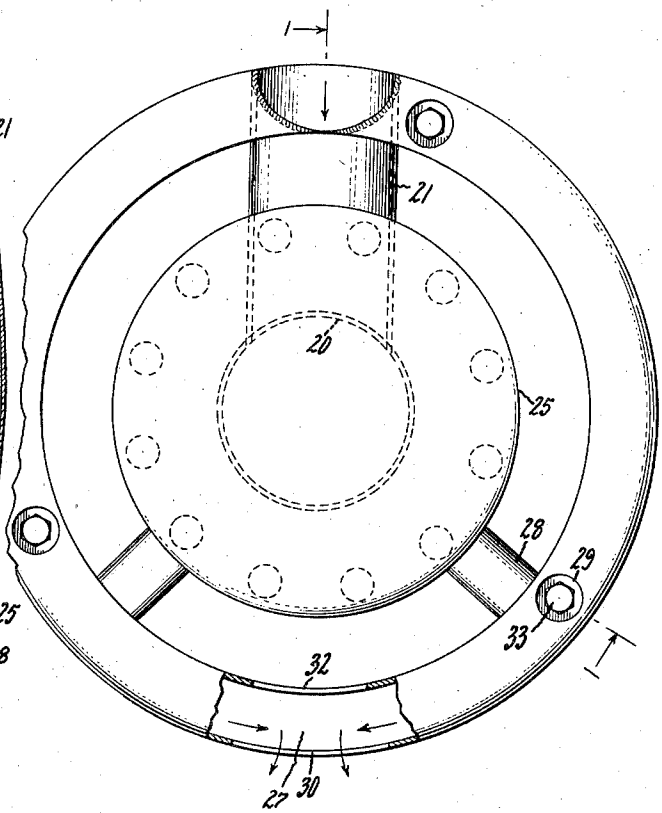


Fig. 2.



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COOLING ARRANGEMENT FOR GAS TURBINES

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4 Claims. (Cl. 60—41)

The present invention relates to cooling arrangements for gas turbines, especially of the type of turbines in which a bucket wheel is supported on an overhung shaft and has a row of buckets arranged to discharge gases directly to the atmosphere. Such turbines are often provided for driving superchargers or generators on aircraft. Difficulties have heretofore been experienced due to excessive heating of the bucket wheel by the gases issuing therefrom. The heating may be augmented by afterburning of the gases containing unburned fuel and after issuing from the bucket wheel and coming into contact with air in proximity to the wheel, and also in cases where the axis of rotation of the bucket wheel is perpendicular with the direction of the slip stream of an aircraft whereby gases issuing from the leading portion of the wheel are forced against the central portion thereof by the action of the slip stream.

The object of my invention is to provide an improved construction of cooling arrangements of gas turbines whereby such turbines may be safely operated with gases at high temperatures, for example, temperatures of the order of 750° C. and above.

For a consideration of what I believe to be novel and my invention, attention, is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing, Fig. 1 is a sectional view of a gas turbine embodying my invention, and Fig. 2 is a front view of a part of Fig. 1, Fig. 1 being a sectional view along line 1—1 of Fig. 2.

The arrangement comprises a gas turbine having a bucket wheel 10 with a solid disk forming a rim 11 on which an annular row of bucket blades 12 is mounted. The outer ends of the blades are connected by a band 13. The disk is secured to an overhung shaft 14 adjacent a shaft bearing 15. The latter may form part of a supercharger or like machine driven by the turbine. Gases are supplied to the bucket wheel by means of an annular nozzle box 16 mounted on one side thereof and having an inlet 17 for receiving gases from a suitable source such as the manifold of a combustion engine, not shown, and also including a row of partitions or blades 18 adjacent the buckets 12 for properly directing jets of gases to the bucket wheel. The nozzle box is supported by means including an annular wall 19 spaced between the box 16 and the bearing 15 and also acting to reduce radiation of heat from the box to the bearing and parts associated therewith. During operation gases are conducted to the nozzle box to be directed towards the blades of the wheel and to be discharged from the wheel into the atmosphere.

According to my invention I provide a device for protecting and cooling the bucket wheel. The device is located on the discharge side of the wheel, that is, on the side opposite the nozzle box, and comprises a wall 20 which broadly constitutes a cap opening towards the wheel with its outer edge closely spaced with the rim 11 of the wheel. Cooling air is conducted to the cap by a conduit 21 which in the present instance is arranged to receive cooling air from the slip stream, the direction of the slip stream being indicated by an arrow 22. The cooling air is forced into the cap and directed against the face of the bucket wheel. The outer portion of the wall 20 near the rim 11 has a plurality of openings 23 through which air is discharged into an annular space 24 formed between the wall 20 and another wall or cowl 25. The wall 25 has a cylindrical portion 26 slightly smaller in diameter than the smallest diameter of the buckets 12. The air is discharged from the annular space 24 into a ring chamber or annular channel 27 concentrically surrounding the space 24 and communicating therewith through a plurality of connecting conduits 28. Air is discharged from the ring chamber 27 through openings 29 and 30. The ring chamber 27 has an inner cylindrical wall 31 concentrically spaced from the aforementioned wall 26 and having a diameter somewhat larger than the maximum diameter of the bucket wheel. Thus, the two walls 26 and 31 form a ring space through which the gases issuing from the bucket wheel pass before they come into contact with the atmosphere. In this manner afterburning in proximity of the bucket wheel is substantially reduced. The walls of the ring chamber 27 prevent the slip stream from sweeping across the bucket wheel and forcing gases issuing from the leading portion thereof towards the central portion.

During operation, cooling air is conducted through the inlet 21 into the cooling chamber formed by the cap 20 where the air strikes the bucket wheel and is discharged through the openings 23 in the wall 20 into the annular space 24. The air is conducted from the space 24 through the connecting conduits 28 into the ring space 27 to be discharged therefrom through the openings 29, 30 into the atmosphere.

In the present arrangement, the inner wall 31

of the outer channel has an opening 32 near the trailing portion of the wheel whereby some of the gases issuing from said trailing portion pass through said opening 32 into the ring chamber 27 to be discharged therefrom together with cooling air into the atmosphere through the openings 29, 30.

The device is supported on the nozzle box by means including bolts 33. Thus, the cooling device according to my invention broadly includes a cap forming a cooling space with the central portion of the bucket wheel and two annular channels surrounding the cap in spaced relation and partially formed by the cap for discharging cooling air from the cap into the atmosphere and forming a ring space into which gases issue from the bucket wheel before they reach the atmosphere.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Gas turbine arrangement comprising a gas turbine having an axial flow bucket wheel, a nozzle box located on one side of the wheel for conducting operating gases thereto, and a device for cooling and protecting the wheel located on the opposite side of the wheel and supported on the nozzle box, said device comprising a cap located adjacent and opening towards a central portion of the wheel, means for conducting cooling air to the cap, an outer portion of the cap forming openings, a wall having a cylindrical portion of a diameter somewhat smaller than the minimum diameter of the turbine buckets and forming a space with the cooling cap to receive cooling air through said openings, and means for discharging the cooling air from said space comprising a channel concentrically spaced from said cylindrical wall and having an inner wall spaced from and surrounding the wheel.

2. Gas turbine arrangement for aircraft comprising a bucket wheel, a nozzle box located on one side of the wheel for conducting gases thereto, and a protecting and cooling device supported on the nozzle box and substantially located on the opposite side of the wheel, said device forming two annular concentrically-spaced series-connected channels, an outer channel surrounding the wheel, an inner channel having a maximum diameter smaller than the minimum diameter of the buckets, means for conducting cooling air towards the central portion of the wheel and means including said channels for conducting air from the central portion of the wheel into the atmosphere, the space between the channels permitting discharge of gases from the wheel directly into the atmosphere.

3. A device for cooling and protecting a gas turbine bucket wheel comprising a cap for forming a cooling space adjacent the central portion of the wheel, a conduit connected to the cap for conducting cooling air to such space, and means for discharging cooling air from such space, said means comprising two concentrically spaced annular channels surrounding the cap and defining a discharge space for gases between them and conduit means connecting the channels in series to the cooling space.

4. Gas turbine arrangement for aircraft comprising a bucket wheel, and a device for cooling the wheel, said device forming an annular channel surrounding the wheel, a cap adjacent the central portion of the wheel and forming a cooling space therewith, conduit means connected to the cap for conducting cooling air to said space and other conduit means connecting said space to the annular channel for discharging heated air from the cooling space into the atmosphere.

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