July 27, 1948. T. M. McKENZIE, JR 2,445,837

AIR COOLED GAS TURBINE

Filed Aug. 24, 1946 2 Sheets-Sheet 1

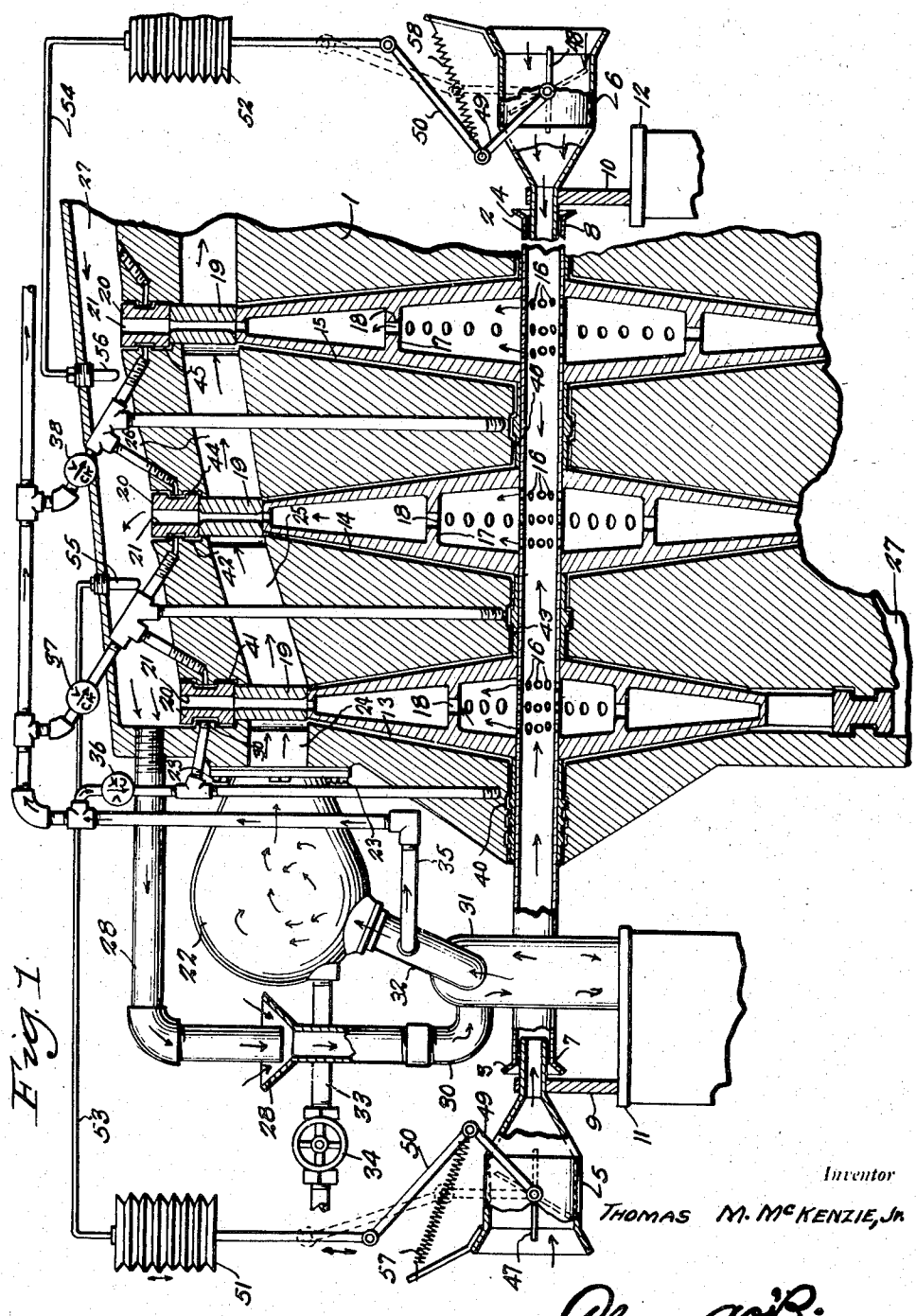


Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

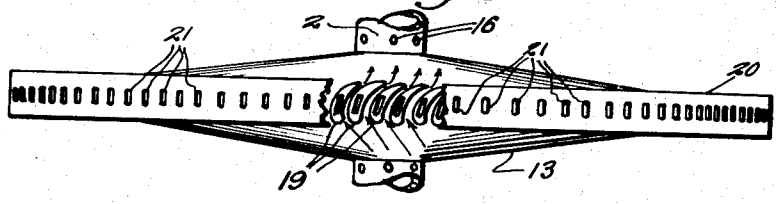


Fig. 3.

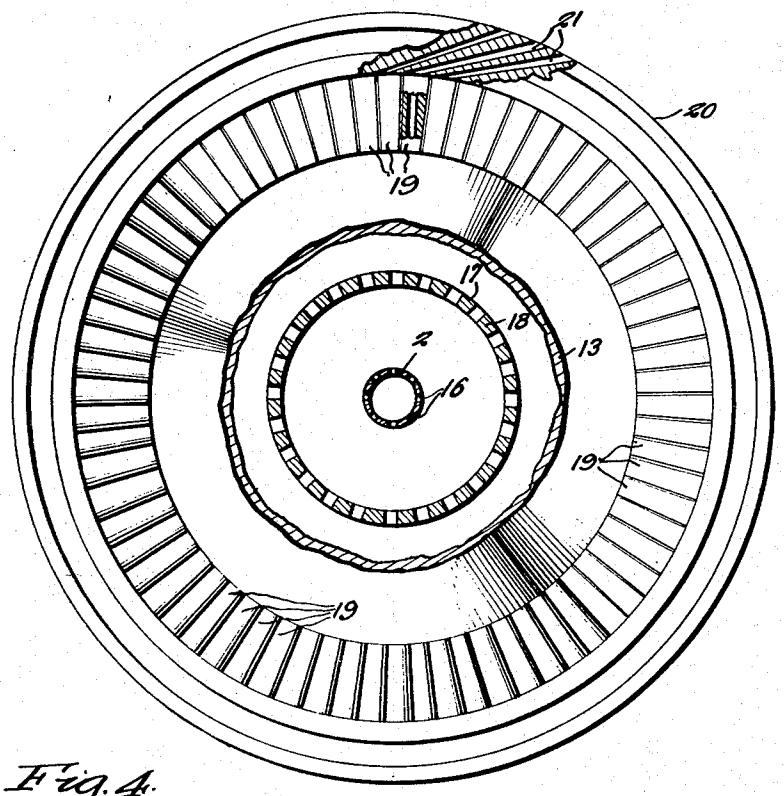


Fig. 4.

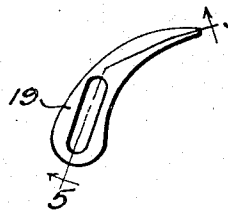
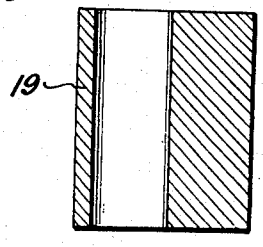


Fig. 5.



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Patented July 27, 1948

2,445,837

UNITED STATES PATENT OFFICE

2,445,837

AIR-COOLED GAS TURBINE

Thomas M. McKenzie, Jr., Hyattsville, Md.

Application August 24, 1946, Serial No. 692,802

7 Claims. (Cl. 60—41)

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This invention relates to improvements in air-cooled gas turbines.

An object of the invention is to provide an improved impulse type air-cooled gas turbine.

Another object of the invention is to provide an improved multiple stage impulse type air-cooled gas turbine.

A further object of the invention is to provide an improved multiple stage impulse type air-cooled gas turbine including a plurality of rotatable drums having axial air inlet means and hollow turbine blades supported radially about said drums through which air at atmospheric pressure will be lead, and a holding ring disposed about each drum having radial air passages formed therethrough adapted to hold the turbine blades in place and to act as a fan to suck the air into the turbine blades, said rings being designed to give the least wind resistance possible at the tips of the blades, which would otherwise be in danger of shearing off due to windage.

A still further object of the invention is to provide a multiple stage impulse type air-cooled gas turbine having automatically controlled means for cooling the turbine blades and the labyrinth packings about the hollow shaft and between the drums of the turbine, with an air compressor being connected to the combustion chamber of said turbine and having lines or pipes with reducing valves connected with said labyrinth packings at the opposite sides of said rings to prevent leakage of contaminated gases into the clean air, and also to increase the efficiency of the turbine.

Other objects will appear as the description proceeds.

In the accompanying drawings which form a part of this application:

Figure 1 is a schematic vertical sectional view through the improved impulse type air-cooled gas turbine;

Figure 2 is a plan view looking down on one of the turbine drums and rings, the same being partly broken away to show the cross-sectional shape of the hollow turbine blades;

Figure 3 is a vertical sectional view through one of the turbine drums, being partly broken away and in section to show the arrangement of the air-cooled turbine blades and holding ring;

Figure 4 is a plan view looking down on a hollow turbine blade; and

Figure 5 is a sectional view taken on the line 5—5 of Figure 4.

Like characters of reference are used throughout the following specification and the accompanying drawings to designate corresponding parts.

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In carrying out the invention, there is provided an improved impulse type air-cooled gas turbine having a casing generally denoted by the reference numeral 1, and a longitudinally extending hollow shaft 2 having flared ends 3 and 4 at its opposite ends, being adapted to receive the oppositely disposed funnel-shaped air inlet housings 5 and 6 whose reduced inner ends 7 and 8 are supported upon the frame members 9 and 10 disposed on the base standards 11 and 12.

The three stage impulse type air-cooled gas turbine is provided with the rotatably mounted drums 13, 14 and 15, each of which is received in a suitable recess in the casing 1, and are open at their central portions to receive air from the air inlet passages or apertures 16 formed through the wall of the hollow shaft 2.

Annular internal webs 17 are formed in each drum 13, 14 and 15, and are apertured at 18 to allow air to pass therethrough to the radially extending hollow turbine blades 19 supported about said drums and cooperating with the holding rings 20 which are labyrinth packed and ported at 21 to hold the turbine blades in place and to suck the air into the turbine blades.

The turbine blades 19 are transversely and arcuately curved, as clearly shown in Figure 4 of the drawings.

A combustion chamber 22 is secured to the end of the casing 1 by means of the bolts 23 and connects through the nozzle 24 with the turbine blades on the first stage drum 13, to direct the combustion gases at an approximate pressure of 150 pounds against and through said blades. After the gases pass through the blades on drum 13, the pressure will have dropped to approximately 100 pounds to be discharged through the nozzle 25 to and through the blades on the second stage drum 14. The combustion gases will then drop to approximately 50 pounds and be discharged through the nozzle 26 to and through the blades on the third stage drum 15, to be exhausted into the atmosphere or auxiliary heat transfer units where remaining heat may be utilized for other purposes.

The air casing or chamber 27 will be formed about the holding rings 20 to receive the air sucked through the turbine blades and rings 20, to be led through the pipe 28 into the funnel 29 on the air inlet pipe 30 connected with the air compressor 31. The air compressor 31 will be connected by means of the pipe 32 with the combustion chamber to discharge air thereto at

an approximate pressure of 200 pounds, while a fuel supply line 33 having a control valve 34 will be connected to said combustion chamber 22 from a suitable fuel pump and supply tank (not shown).

A compressed air pipe line 35 will branch from the air pipe 32, and will be provided with the three reducing valves 36, 37 and 38, which in turn have pipe lines extending to the combustion chamber side of the labyrinth packing 39 on the first stage holding ring 20 and to the labyrinth packing 40 on the hollow shaft 2, to the adjacent sides of the labyrinth packings 41 and 42 on the holding ring 20 on the second stage and to the labyrinth packing 43 on said hollow shaft, and finally to the labyrinth packings 44 and 45 on the holding ring 20 on the third stage and to the labyrinth packing 46 on said hollow shaft 2.

As before mentioned, the combustion gases will reach the three stages or drums at pressures of 150 pounds, 100 pounds and 50 pounds, respectively, while the reducing valves will direct the air at pressures of 175 pounds, 125 pounds, 75 pounds and 25 pounds to the various labyrinth packings to oppose and prevent any leakage of the contaminated gases into the fresh air supply to the air compressor.

The entrance of air at atmospheric pressure into the opposite ends of the hollow shaft will be controlled by the butterfly valves 47 and 48 connected by the arms 49 and 50 with the bellows type thermostats 51 and 52, which are in turn connected by means of the small pipes 53 and 54 with the bulbs 55 and 56 extending through the walls of the air casing or chamber 27, whereby the temperature of the air which varies at the opposite ends of the air chamber will be kept at an approximately even level. Coil springs 57 and 58 will be secured to the arms 49 to urge the butterfly valves 47 and 48 toward their closed positions.

From the foregoing description, it will be apparent that the air pressure from the air compressor will always be materially more than the pressure of the combustion gases at the various stages of the turbine where the compressed air is led to the labyrinth packings, thereby forcing back and preventing the contaminated combustion gases from entering into the fresh clean air which is fed back to the air compressor.

A suitable drive (not shown) will be connected with the hollow shaft upon which the turbine drums are mounted to operate any desired mechanism.

While the preferred embodiment of the instant invention has been illustrated and described, it will be understood that it is not intended to limit the scope of the invention thereto, as many minor changes in detail of construction may be resorted to without departure from the spirit of the invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said apertured hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, and controlled means for cooling said turbine blades.

2. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, controlled means for cooling said turbine blades, and labyrinth packing at the opposite sides of said drums and said rings.

3. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, controlled means for cooling said turbine blades, labyrinth packings at the opposite sides of said drums and said rings, and an air compressor having its inlet connected with said air compartment and its outlet connected with said combustion chamber.

4. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, controlled means for cooling said turbine blades, labyrinth packings at the opposite sides of said drums and said rings, an air compressor having its inlet connected with said air compartment and its outlet connected with said combustion chamber, and means connected with said air compressor for cooling said labyrinth packings and to prevent leakage of hot contaminated gases into the clean air supply.

5. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, controlled means for cooling said turbine blades, labyrinth packings at the opposite sides of said drums and said rings, an air compressor having its inlet connected with said air compartment and its outlet connected with said combustion chamber, means connected with said air compressor for cooling said labyrinth packings, and valves in the ends of said hollow shaft to control the admission of air to and through said turbine drums and blades.

6. An impulse type air-cooled multiple stage gas turbine comprising a casing, a hollow shaft extending axially therethrough, a combustion chamber on said casing, multiple stage turbine drums rotatably mounted in said casing having communication with said hollow shaft, hollow turbine blades supported by said drums, ported holding rings disposed about the outer ends of said turbine blades, an air compartment about said rings, controlled means for cooling said turbine blades, labyrinth packings at the opposite

sides of said drums and said rings, an air compressor having its inlet connected with said air compartment and its outlet connected with said combustion chamber, means connected with said air compressor for cooling said labyrinth packings, valves in the ends of said hollow shaft to control the admission of air to and through said turbine drums and blades, and bulbs in said air compartment connected with thermostats for controlling said valves and the admission of air to and through said turbine drums and blades.

7. The subject matter as claimed in claim 4, and air lines from said air compressor having reducing valves connected with said labyrinth packings for directing a pressure thereto greater than the pressure of the combustion gases to prevent the contaminated gases from entering the air compressor with the fresh air.

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