Nov. 5, 1957 W. S. BROFFITT 2,811,833

TURBINE COOLING

Filed June 5, 1953 3 Sheets-Sheet 1

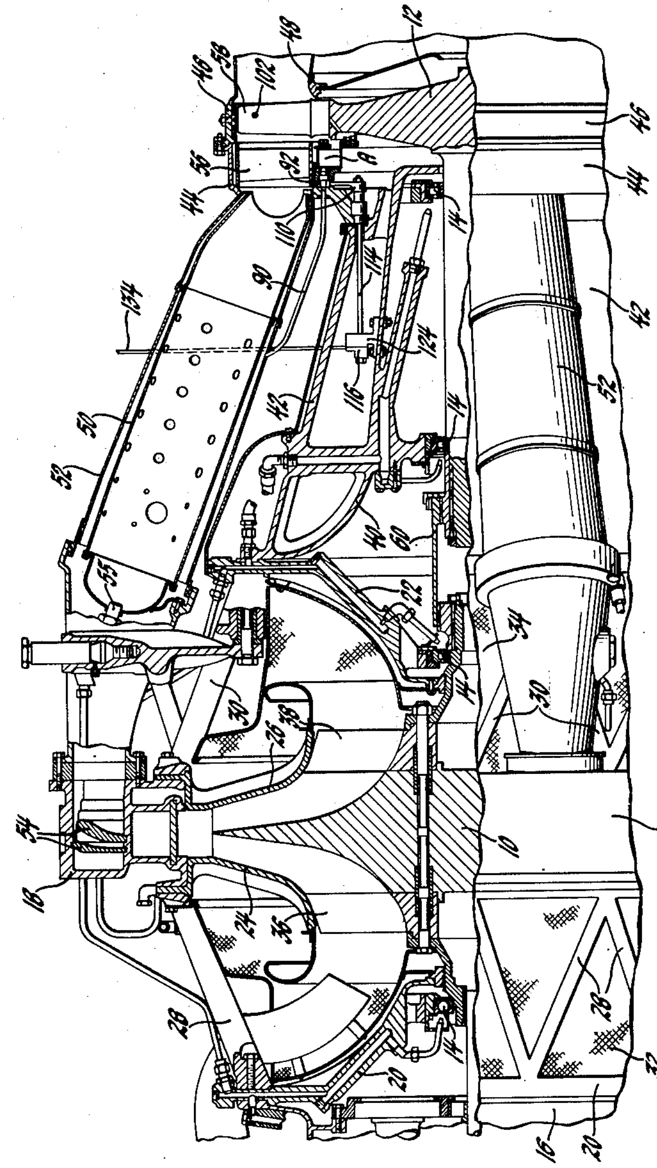

Fig. 1

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Nov. 5, 1957 W. S. BROFFITT 2,811,833

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Filed June 5, 1953 3 Sheets-Sheet 2

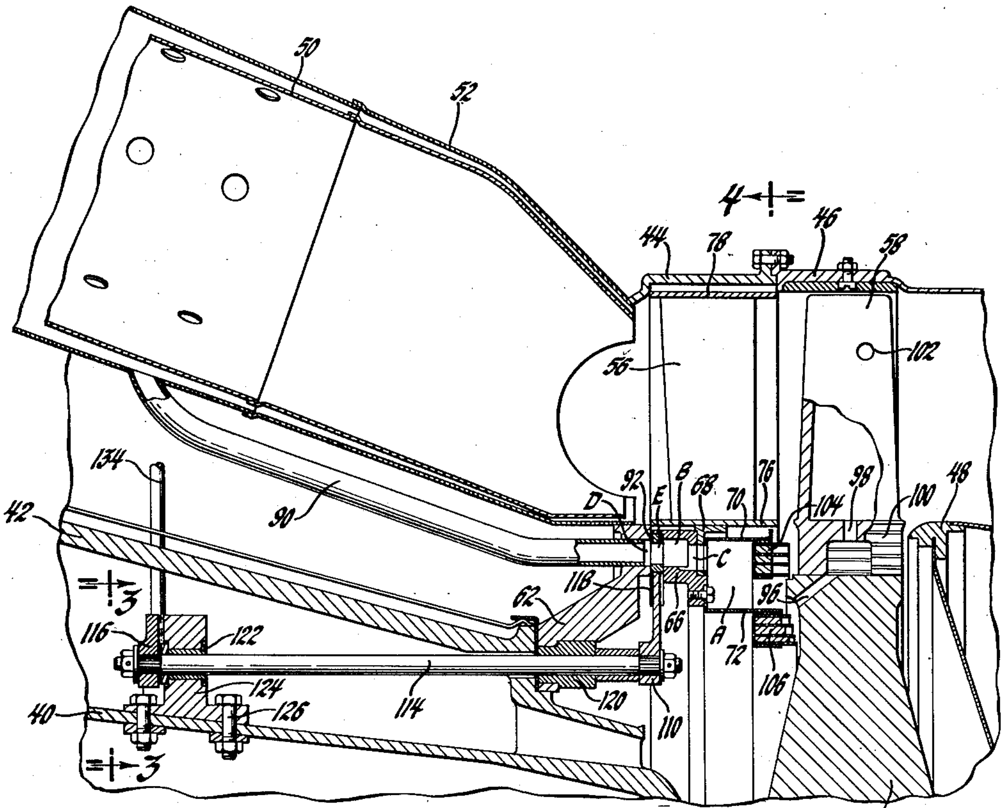

Fig. 2

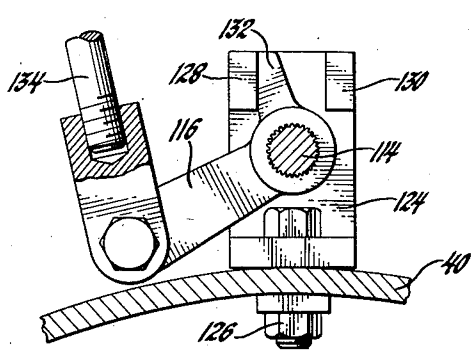

Fig. 3

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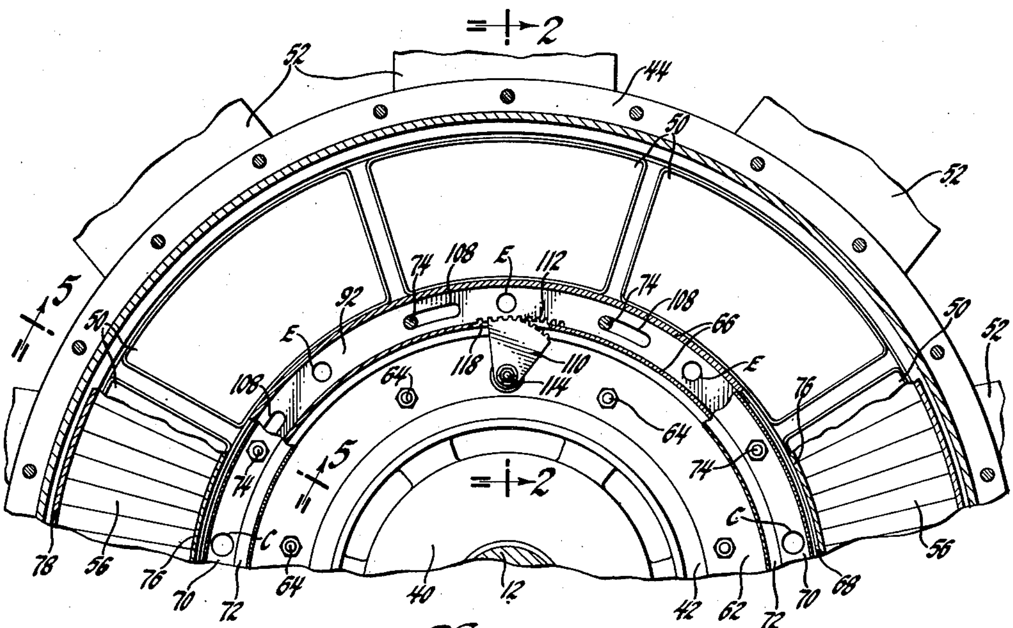

Fig. 4

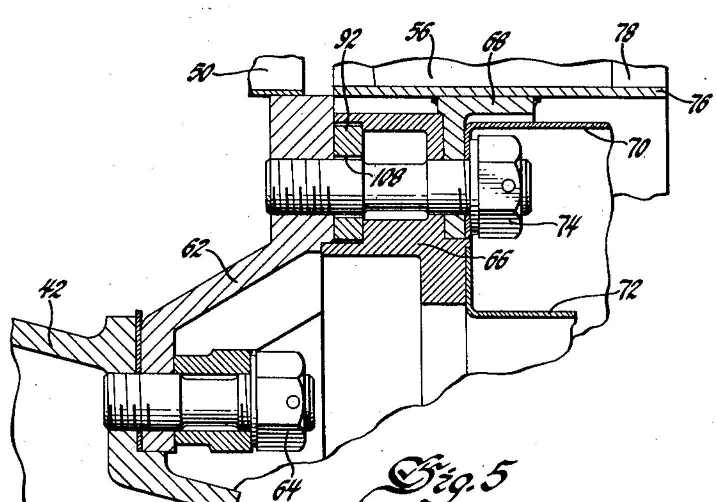

Fig. 5

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2,811,833

Patented Nov. 5, 1957

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2,811,833

TURBINE COOLING

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Application June 5, 1953, Serial No. 359,746

2 Claims. (Cl. 60—39.66)

This invention relates to gas turbine engines, and more particularly to an arrangement for cooling the turbine of such an engine.

An object of this invention is to provide means whereby the turbine wheel may be cooled by air from the compressor of the engine.

Another object of this invention is to provide means whereby the flow of turbine cooling air may be varied as desired.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a partial plan view, partially broken away, of a known type of turbojet engine incorporating the invention;

Fig. 2 is an enlarged fragmentary section taken substantially along the line 2—2 of Fig. 4 and also constituting an enlargement of a portion of Fig. 1;

Fig. 3 is an enlarged fragmentary section taken substantially along the line 3—3 of Fig. 2;

Fig. 4 is a reduced fragmentary section taken substantially along the line 4—4 of Fig. 2; and

Fig. 5 is an enlarged fragmentary section taken substantially along the line 5—5 of Fig. 4.

Referring now to the drawings in detail, the turbojet engine includes a centrifugal compressor rotor **10** and an axial flow turbine rotor **12** suitably supported by bearings **14** in the stationary frame and casing structure of the engine. The casing and frame structure includes an accessory housing **16** secured to the compressor housing which includes a central diffuser housing **18** and front and rear air inlet housings **20** and **22**. The air inlet housings **20** and **22** support the front and rear bearings of the compressor rotor **10** and connect with the diffuser casing **18** and the compressor outlet casings **24** and **26** by struts **28** and **30** which bridge the inlets of the compressor. The air inlets are provided with screens **32** and **34** to prevent foreign object damaging of the compressor blading **36** and **38**. The rear air inlet housing **22** is suitably secured to the forward end of the inner and outer shells **40** and **42** of the turbine shaft housing. A turbine nozzle casing **44** is supported by the outer shell **42** of the turbine shaft housing and provides support for the external casing **46** of the turbine. The inner tail cone **48** is supported from the exhaust portion of the turbine casing **46** by radial struts not shown. A plurality of combustors arranged around the turbine shaft housing include the flame tubes **50** concentrically supported in the outer air tubes **52**.

The engine operates in the usual manner, air from the compressor rotor **10** being fed through the diffuser-turning vanes **54** and into the perforated flame tube **50** by way of the combustor air tubes **52**. Fuel from the spray nozzles **55** is burned with the air in the flame tubes **50** and the motive fluid is fed by the turbine nozzle vanes **56** through the turbine rotor blading **58** to drive the compressor rotor **10** through a splined coupling **60**; the exhaust of the turbine furnishing jet motive power for the aircraft.

2

The combustion apparatus is supplied with a large excess of air over that required for combustion to reduce the temperature of the motive fluid and thereby prevent damage to the turbine. The maximum temperature of the motive fluid may be somewhat greater and the efficiency of the turbine be thereby increased if the turbine rotor is provided with some type of cooling system. In accordance with the invention a portion of the air flow from the compressor is by-passed by the flame tubes and is led to the forward face of the turbine rotor to cool the same before entering the motive fluid stream. The invention includes an arrangement whereby the flow of cooling air to the turbine rotor may be varied to suit different operating conditions of the engine.

The turbine nozzle and the rearward ends of the combustors are supported by an annular flange **62** secured to the turbine shaft outer housing **42** by bolts **64**. An annular U-sectioned channel **66** and L-sectioned rings **68**, **70** and **72** are secured to the annular flange **62** by bolts **74**. The inner shroud ring **76** is welded to ring **68** and the nozzle blades **56** are welded between the inner and outer shroud rings **76** and **78**. The L-sectioned rings **70** and **72** form an annular chamber A which is fed with cooling air from the annular chamber B of the U-sectioned member **66** by passages C in the channels **66**, **68** and **70**. The flange **62** is provided with passages D which are in registry with the passages C and which connect by conduits **90** to the air jackets **52**. A valve ring **92** is rotatably received in the interior of the channel **66** and bears against the rear face of the flange **62**. The valve ring **92** is provided with passages E which may be moved in and out of registry with the passages D of the flange **62** so that cooling air from the compressor may be supplied to the chamber A in varying amounts. If lower temperature cooling air is desired, the conduits **90** may be connected to the diffuser portion of the compressor instead of the combustor air jackets **52**.

The cooling air from the chamber A bathes the rim of the front face of the turbine rotor **12** to cool the same and is conducted through the hollow interiors of the turbine buckets **58** by passages **96** in the turbine rotor, by passages **98** in the bucket roots **100**, and by outlet passages **102** in the bucket blades. The flanges **70** and **72** are provided with labyrinth seals **104** and **106** to reduce radial air leakage at the front face of the turbine rotor. Circumferential slots **108** in the valve ring **92** permit sufficient rotation thereof to place the passages D and E in and out of registry without interference by the bolts **74**. A sector gear **110** meshes with an internally geared portion **112** of the valve ring **92** to impart rotation thereto upon actuation of the sector gear shaft **114** by the lever **116**. A peripheral slot **118** in the channel **66** allows gear engagement. The sector gear shaft **114** is journaled by a bearing **120** on the flange **62** and a bearing **122** in a bracket **124** secured on the turbine shaft inner housing **40** by bolts **126**. A pair of stops **128** and **130** cooperate with a lug **132** of the actuating lever **116** to limit the rotation of the ring valve. The ring valve **92** may be positioned by manual or automatic means as desired; for example, the actuating rod **134** may be operated by the throttle of the engine, by manual action or by any suitable device that reflects the output of the engine. The flow of cooling air should increase with increases in engine output as the high motive fluid temperature encountered at higher outputs necessitates increased cooling of the turbine rotor. An oversupply of cooling air would reduce the overall efficiency of the engine and maximum efficiency at different operating conditions is achieved by varying the supply to meet the particular operating condition.

While the preferred embodiment of the invention has been described fully in order to explain the principles of the invention, it is to be understood that modifications in structure may be made by the exercise of skill in the art within the scope of the invention, which is not to be regarded as limited by the detailed description of the preferred embodiment.

I claim:

1. A turbojet engine comprising an engine housing, a turbine and compressor having interconnected rotors supported therein, said turbine having an annular inlet nozzle, a plurality of combustors connecting said compressor to said turbine nozzle and delivering high temperature motive gases thereto, each of said combustors having a flame tube spaced concentrically in an outer air jacket, labyrinth sealing structure secured radially inward of said turbine nozzle and forming an annular chamber proximate the rim of the front face of said turbine rotor, conduits for conducting cooling air from each of said jackets to said chamber, and valve means secured radially inward of said turbine nozzle for controlling the delivery of said cooling air from said conduits to said chamber including a ring adjacent said chamber and having passages therein rotatable in and out of registry with said conduits.

2. A turbojet engine comprising an engine housing, a turbine and compressor having interconnected rotors supported therein, said turbine having an annular inlet nozzle, combustion apparatus connecting said compressor to said turbine nozzle and delivering high temperature motive gases thereto, labyrinth sealing structure secured to said housing radially inward of said nozzle and forming an annular chamber proximate the rim of the front face of said turbine rotor, a plurality of conduits for conducting cooling air from said compressor to said chamber, valve means secured radially inward of said nozzle for controlling the delivery of said cooling air to said chamber including an internally geared ring rotatably supported by said housing adjacent said chamber and having a plurality of passages therein for connecting and disconnecting said conduits and said chamber on rotation of said ring, and a sector gear rotatably mounted on said housing radially inward of said ring and meshed with said ring for actuation thereof.

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