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PRESSURIZED AFTERBURNER COOLING SHROUD

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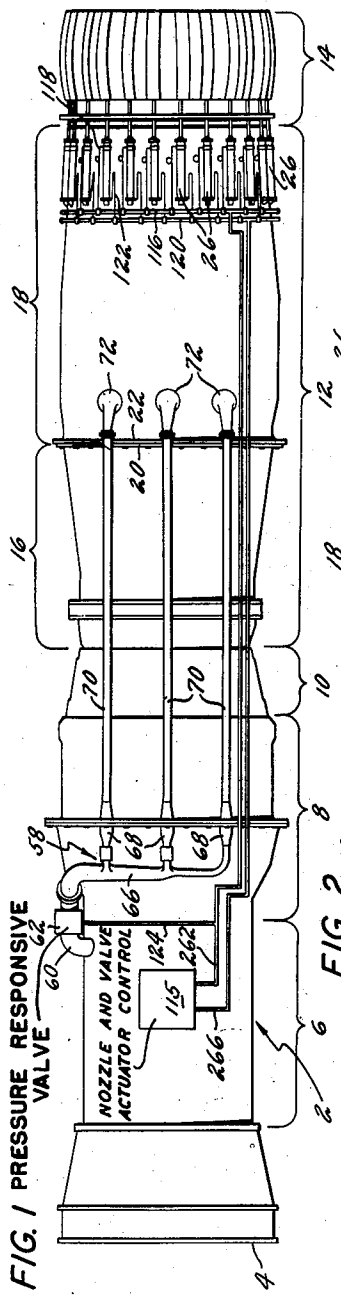


FIG. 1

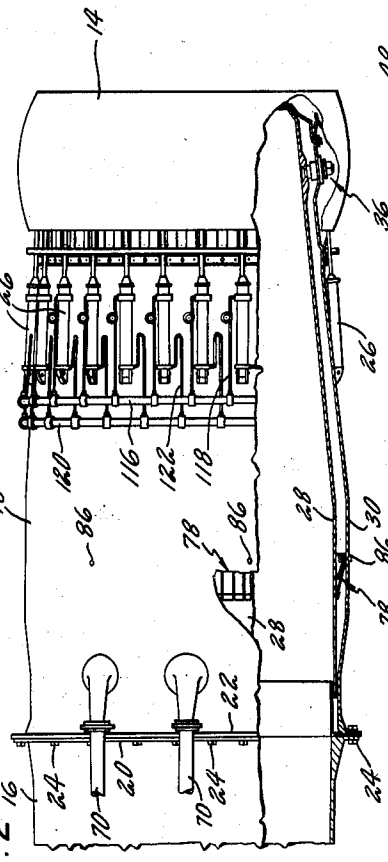


FIG. 2

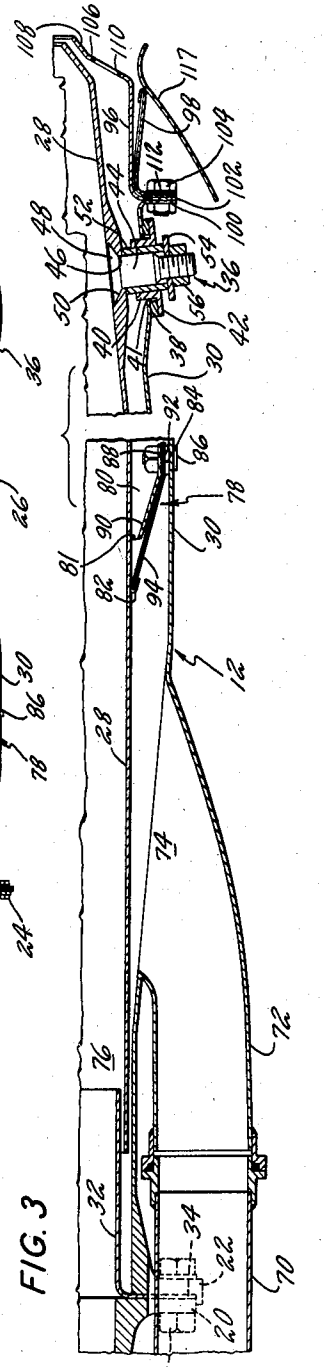


FIG. 3

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PRESSURIZED AFTERBURNER COOLING SHROUD

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2 Claims. (Cl. 60—35.6)

This invention relates to improvements in a pressurizing system for a duct and has particular reference to a pressurized shroud which, while not limited thereto, is particularly adapted to an afterburner of a jet engine.

An object of this invention is to pressurize a space around the afterburner when the afterburner is in operation.

Another object of this invention is to provide an afterburner cooling system which will permit an afterburner of a jet engine to operate at a high temperature and sustain high internal pressures.

A further object of this invention is to provide a cooling system whereby air is accelerated to a high velocity in a shroud at the aft end of an afterburner, thus providing efficient cooling of the skin of the afterburner.

Another object is to provide a cooling system which will permit the inner skin of the afterburner to be uniform in cross sectional thickness and to have no discontinuities.

Other objects and advantages will become apparent from the following description.

In the accompanying drawings there is illustrated a suitable mechanical embodiment for the purpose of disclosing the invention. The drawings, however, are for the purpose of illustration only and are not to be taken as limiting or restricting the invention. It will be apparent to those skilled in the art that various changes in the illustrated construction may be made without exceeding the scope of the invention.

Fig. 1 is a view in elevation of a jet engine and afterburner showing part of the cooling system.

Fig. 2 is an enlarged view of a section of the afterburner partially in cross section showing the construction of the pressurized cooling shroud.

Fig. 3 is an enlarged cross sectional view of the pressurized cooling shroud showing the forward support, the rearward support and the connection of the compressed air pipes with the shroud.

Fig. 1 shows a jet engine **2** having an air inlet **4**, a compressor section **6**, burner section **8**, turbine section **10**, and having an afterburner **12** and nozzle **14** attached thereto. The nozzle shown in these figures is shown and claimed in U. S. Patent No. 2,831,319. While a particular nozzle has been shown in these figures, it is to be understood that any type nozzle desired may be used.

The afterburner **12** includes a diffuser section **16** and a burner section **18**. These two sections, **16** and **18**, are attached by means of a flange **20** on the diffuser section **16** and a flange **22** on the burner section **18**. These flanges are held together by bolts **24**. The nozzle **14** is attached to the afterburner **12** and is actuated by pistons in cylinders **26**. An actuating fluid is directed to said cylinders in a manner to be hereinafter described.

As seen in Figs. 2 and 3 the burner section **18** of the afterburner is constructed having two shells, an inner shell **28** and an outer shell, or shroud, **30**. The outer

shell **30** is connected at its forward end to the diffuser section **16** of the afterburner by flanges **20** and **22** as herein described before. The forward end of the inner shell **28** is allowed to float between the forward end of the outer shell and a flat annular ring **32** which is secured in place by an integral flange **34** which is held between the flanges **20** and **22**. This forward mounting arrangement permits the inner shell to expand both longitudinally and radially. The rearward ends of the inner and outer shells are connected by a plurality of mounting devices **36**. These devices permit relative radial movement between the two shells, **28** and **30**.

These devices include two units. One unit is fixed in relation to the inner shell and the other unit is fixed in relation to the outer shell. The unit fixed to the outer shell consists of a spacer **38** and bushing **40** which has a circular flange **42** attached thereto. The bushing fits into a hole **41** in the outer shell and the spacer **38** and flange **42** are attached to the outer shell around said hole by any means desired. The unit fixed to the inner shell includes a bolt **44** which extends through a hole **46** in said inner shell and has a head tapered at **48** to fit in a tapered part **50** of the hole **46**. A sleeve **52** is placed with its inner diameter around said bolt and with its outer diameter engaging the inner diameter of bearing **40** in a manner to permit sliding motion therebetween, the length of the sleeve **52** being longer than that of the bearing **40**. A washer **54** is placed over the threaded free end of the bolt **44** against the end of sleeve **52**. A nut **56** is then placed on the threaded free end of the bolt **44** and positioned so as to fixedly mount this unit to the inner shell **28**. As it can now be seen, relative radial movement is permitted between the inner shell and the outer shell, or shroud **30** by an amount equal to the difference in length between the sleeve **52** and the bearing **40**.

Compressed air is introduced into the area between the inner shell **28** and outer shell, or shroud, **30** through a piping system **58**. This system as shown includes a pipe **60** connected to the compressor of the engine in such a manner that compressed air can be fed into it, a pressure valve **62** for controlling the admission of the compressed air which operates in a manner to be later herein described, and a Y section of pipe which permits a header **66** to extend down on either side of the engine (only one side being shown in Fig. 1). Each header has three connections **68** which are connected by pipes **70** to pipe sections **72** which are in turn connected to the outer shell, or shroud, **30** by a flared out section. These sections are flared to insure a smooth flow of air into the area to be pressurized and also to insure that the pressurized air will be introduced through a greater degree of arc to assist in circumferential distribution of the pressure. Sufficient pressure is introduced into the area between the shells at **74** so that the combustible gas at **76** will not flow through the forward mounting arrangement of the inner shell **28**. While the supply of compressed air is shown as the compressor of the engine, it is to be understood that the air may be supplied from any means desired. It is also to be understood that other types of cooling fluids besides air may be used.

Downstream from the points at which the air is introduced into the area between the inner and outer shells a circumferential restriction **78** is placed to further aid in equalizing the pressure of the air around the entire circumference of the volume between the inner and outer shells **28** and **30**. This restriction is formed by a rigid circumferential member **80**, a flexible circumferential seal member **82** and a plurality of spacers **84**. These three parts of the restriction are fixed to the outer shell by a plurality of bolts **86** spaced therearound.

The rigid circumferential member **80** is formed having a flat circular part **88** and a frustro-conical part **90**. The free edge of the frustro-conical part of this member **80** is spaced from the inner shell **28**. This spacing permits expansion of the inner shell in relation to the member. To restrict the annular opening **81** formed between the member **80** and the inner shell **28** a flexible circumferential seal member is used. This seal member **82** is formed from two members each having a flat circular part **92** and a frustro-conical part **94**. The frustro-conical portion of each member is segmented and the segments of one frustro-conical section cover the meeting edges of the segments of the other frustro-conical section. This arrangement provides a leaf spring action which restricts the annular opening **81** formed between the member **80** and the inner shell **28** as the inner shell and outer shell move in relation to one another. Each bolt **86** referred to above extends from the outer shell through a spacer **84**, a hole in the flat annular part **92** of the seal member **82** and a hole in the flat annular part **88** of the rigid member **80**. The height of the spacer **84** determines the size of the restricted opening.

From the restriction **78** to the end of shell, or shroud, **30** the annular space between the inner shell **28** and outer shell, or shroud, **30** is gradually decreased. At the end of the outer shell, or shroud, **30**, a ring **96** and a flexible circumferential seal member **98** are mounted. Ring **96** is mounted to the outer shell, or shroud, **30** by means of a flange **100** on said outer shell and a flange **102** on said ring. Bolts **104** secure one flange to the other. The free end of ring **96** has a frustro-conical section **106** with a flared portion **108**. This flared portion **108** is spaced from the free end of the inner shell **28**. The dimension of this space is such that when the nozzle **14** is open and the afterburner is "on" the free end of the inner shell will be approximately just in meeting contact with it. A ring of this type is shown and claimed in U. S. Patent No. 2,735,262. Holes **110** are provided in the frustro-conical section **106** of ring **96** to permit the air to flow through said outer shell, or shround, **30**.

Seal member **98** is also mounted on the outer shell **30**. A flange **112** on said member is secured to flange **100** by bolts **104**. The free end of said seal member contacts a member **117** of the nozzle **14** to prevent a leak at this point when the nozzle is in a closed position.

It is desired to have air flowing through the piping system **58** and between the inner and outer shells **28** and **30** when the afterburner is "on" and the nozzle **14** is "open." Conversely, it is desired that no air be flowing through the piping system **58** and between the inner and outer shells **28** and **30** when the afterburner is "off" and the nozzle **14** is "closed" since at this operating condition there is no need for this action.

While the above operation can be performed manually by having a manually controlled valve in place of pressure valve **62** and making nozzle **14** a manually operable nozzle, it is preferred that an automatic control be used. An automatic control of a type which could be used is shown and claimed in U. S. Patent No. 2,715,311. This control senses when the afterburner goes "on" or "off," and "opens" or "closes" the nozzle accordingly and maintains it in that position. When the afterburner is "on" this nozzle and valve actuator control **115** permits an actuating fluid to be directed by conduit **262** to manifold **116** and in turn delivered to the rearward ends of cylinders **26** by conduit sections **118**. This connection holds nozzle **14** "open." When the afterburner is "off" this nozzle and valve actuator control **115** permits an actuating fluid to be directed by conduit **266** to manifold **120** and in turn delivered to the forward ends of cylinders **26** by conduit sections **122**. This connection holds nozzle **14** "closed."

Pressure valve **62**, which regulates the admission of compressed air to the space between the inner and outer shells may be of several types depending on how it is connected to the nozzle and shroud actuator control.

One type is a pressure valve which is "normally closed" and arranged to open when subjected to a predetermined pressure. This valve can then be connected to conduit **262** by conduit **124** and the proper operation of both the cooling system and nozzle would be obtained. A second type is a pressure valve which is "normally open" and arranged to close when subjected to a predetermined pressure. This valve can then be connected to conduit **266** by a conduit and the proper operation of both the cooling system and nozzle would be obtained. A third type is a pressure valve which has two pressure actuated members, one arranged to open said valve when subjected to a predetermined pressure and the second arranged to close said valve when subjected to a predetermined pressure. The member of the valve which opens said valve can then be connected to conduit **262** by conduit **124** and the second member of the valve which closes said valve can then be connected to conduit **266** by a conduit and the proper operation of both the cooling system and nozzle would be obtained. This last type of pressure valve provides for positive actuation in both the opening and closing directions.

When the afterburner is turned on, the nozzle and valve actuator control **115** connects conduit **262** to an actuating fluid and connects conduit **266** to drain. This actuates pressure valve **62** through conduit **124** in an opening direction and nozzle **14** through manifold **116** and conduits **118** in an open direction. When the afterburner is turned off, the nozzle and valve actuator control **115** connects conduit **266** to an actuating fluid and connects conduit **262** to drain. This actuates pressure valve **62** in a closing direction and nozzle **14** through manifold **120** and conduit **122** in a closing direction.

Although a specific pressurizing system has been shown and described herein for purpose of illustration, it will be evident to those skilled in the art that the invention is capable of various modifications and adaptations within the scope of the appended claims. The specific mounting arrangement of a pressurized shroud as shown in this application is shown and claimed in application Serial No. 316,920, filed October 25, 1952, to Edmund D. Brown for an Afterburner Shroud Construction.

I claim:

1. A jet engine having in combination, a compressor, a turbine, an afterburner downstream of said turbine, said afterburner having two shells, and means for pressurizing the space between said shells with a cooling fluid and permitting said fluid to flow therethrough, means in the space between said inner and outer shells for restricting the flow of cooling fluid through said space, said last named means including an annular flexible member and a rigid annular member, the outer edge of said annular members being fixed to said outer shell with a plurality of spacers located between the members and said outer shell, the inner edge of said flexible member being biased against the inner shell while the inner edge of the rigid member is spaced from the inner shell to permit expansion of the inner shell in relation to the rigid member.

2. A jet engine having in combination, a compressor, a turbine, an afterburner downstream of said turbine, said afterburner having two shells, said two shells forming a space therebetween, and means for pressurizing the space between said shells with a cooling fluid and permitting said fluid to flow therethrough, said last named means including openings into the forward part of the space, means in the space between said inner and outer shell adjacent said openings for restricting the flow of cooling fluid through said space, said last named means including two juxtapositioned annular seal members each having a cylindrical portion and a segmented frusto-conical portion projecting inwardly therefrom and each having its cylindrical portion fixedly spaced from said outer shell with the segments of said frusto-conical portion of one of said seal members overlapping the segments of said

frusto-conical portion of the other of said seal members, and said seal members having the inner periphery of said segments biased against said inner shell.

References Cited in the file of this patent

UNITED STATES PATENTS

2,508,420	Redding	May 23, 1950
2,551,229	Alford et al.	May 1, 1951
2,599,470	Meyer	June 3, 1952
2,603,060	Brown	July 15, 1952
2,616,662	Mierley	Nov. 4, 1952
2,625,008	Crook	Jan. 13, 1953
2,625,793	Mierley et al.	Jan. 20, 1953
2,630,673	Woll	Mar. 10, 1953
2,631,796	Williamson et al.	Mar. 17, 1953
2,639,578	Pouchot	May 26, 1953
2,652,216	Hoffman	Sept. 15, 1953
2,715,311	Coar	Aug. 16, 1955