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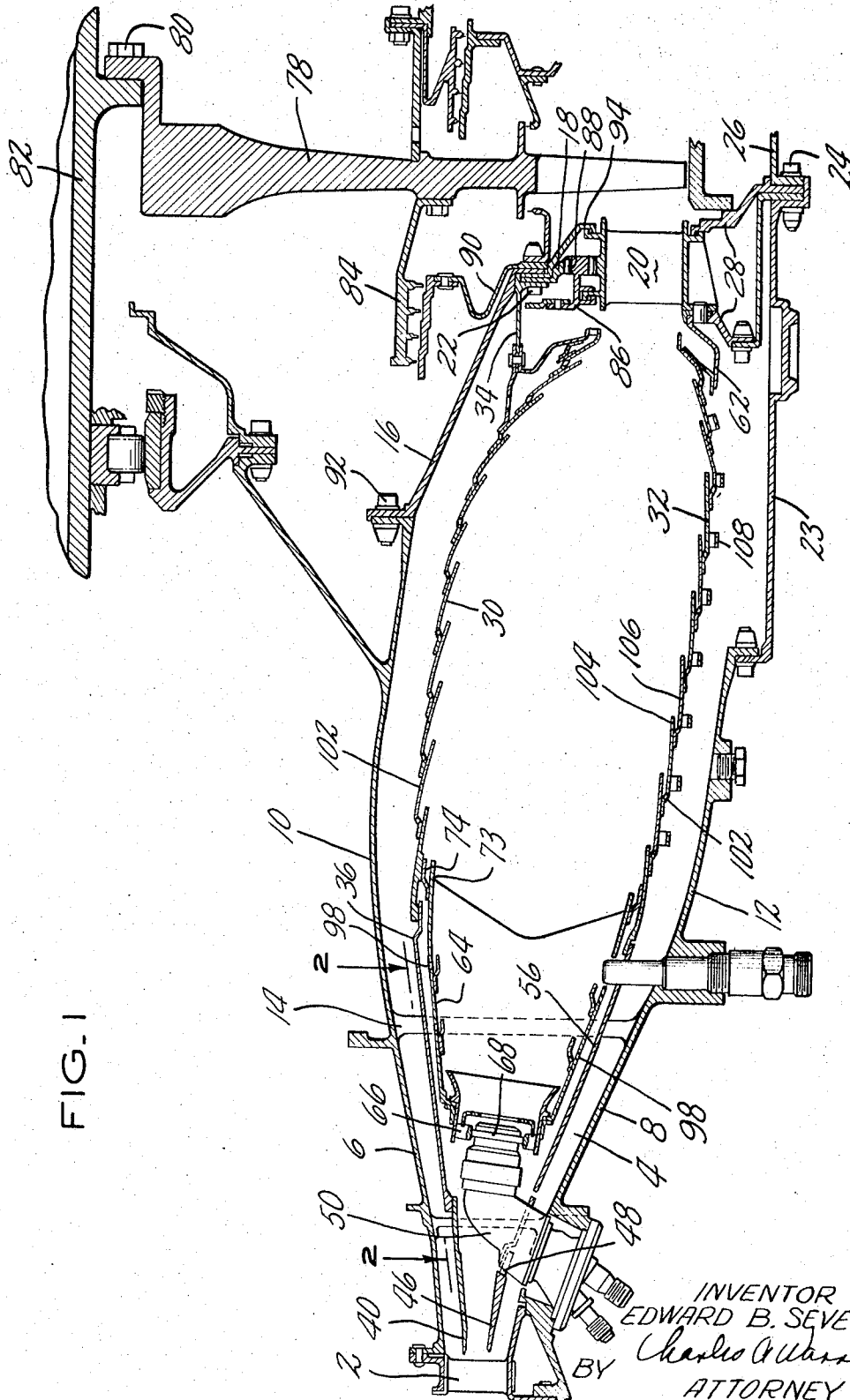
E. B. SEVETZ

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ANNULAR BURNER FOR A GAS TURBINE

Filed Nov. 25, 1966

3 Sheets-Sheet 1



INVENTOR
EDWARD B. SEVETZ
BY *Charles A. Warren*
ATTORNEY

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E. B. SEVETZ

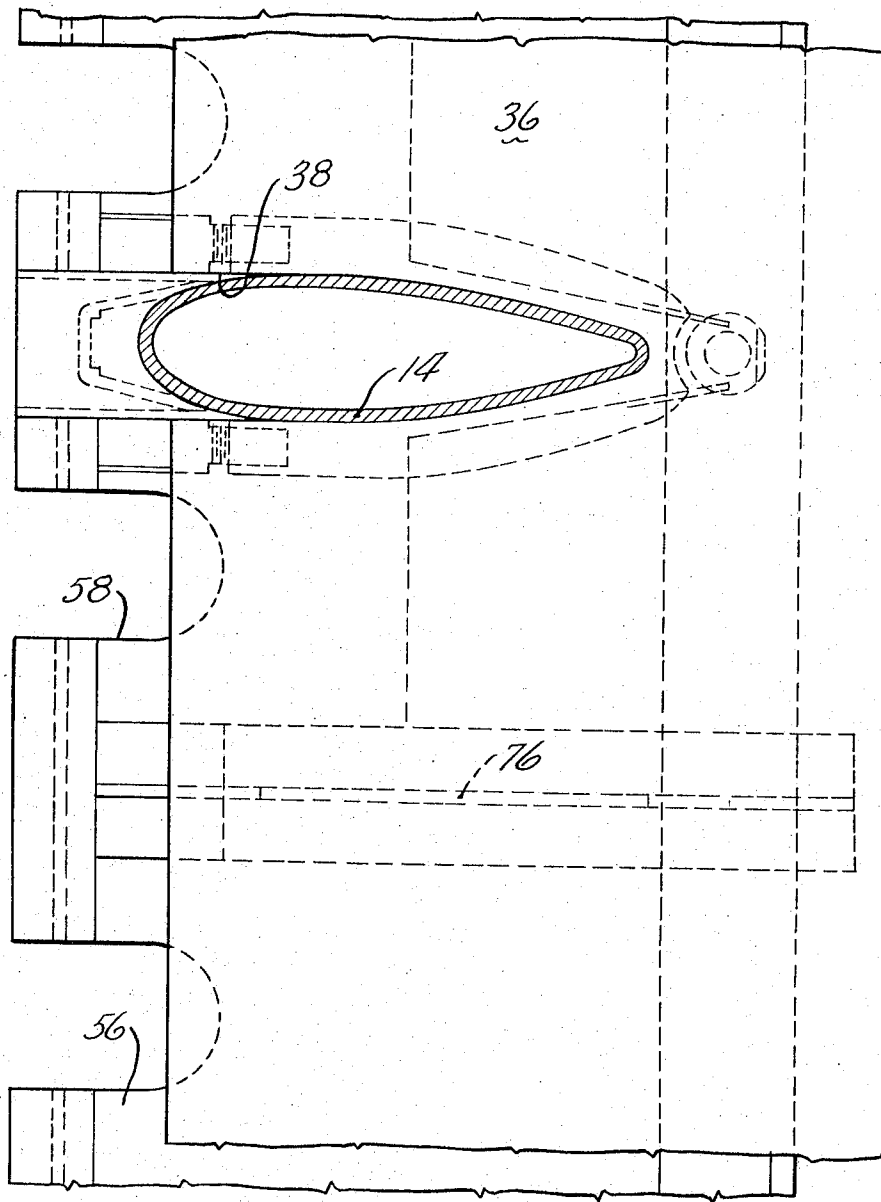
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FIG. 2



INVENTOR
EDWARD B. SEVETZ
BY *Charles A. Wamen*
ATTORNEY

March 12, 1968

E. B. SEVETZ

3,372,542

ANNULAR BURNER FOR A GAS TURBINE

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FIG. 3

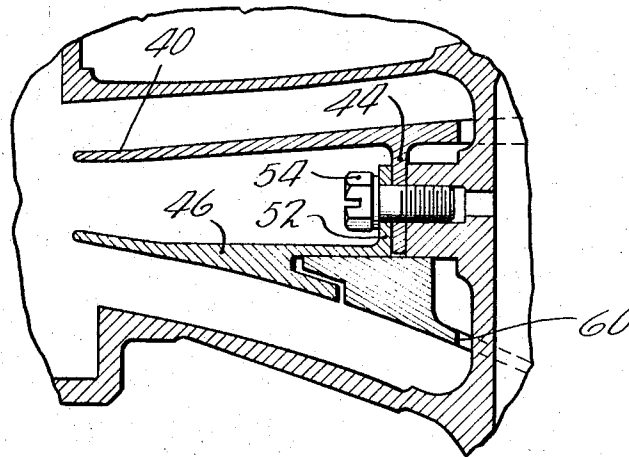
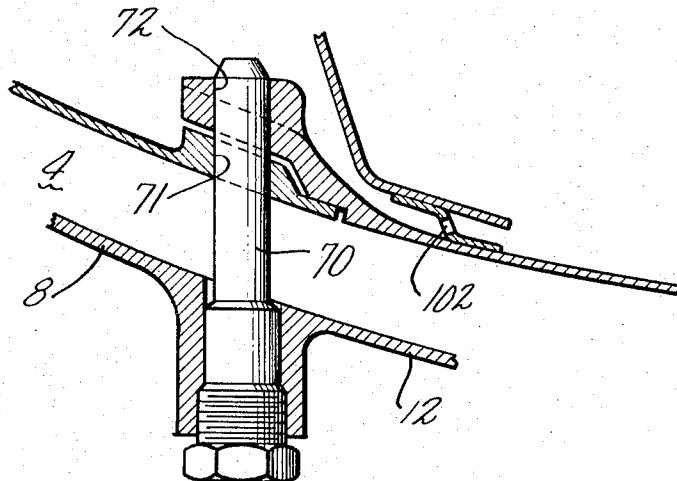


FIG. 4



INVENTOR
EDWARD B. SEVETZ
BY *Charles A. Warren*
ATTORNEY

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ANNULAR BURNER FOR A GAS TURBINE
Edward B. Sevetz, West Hartford, Conn., assignor to
United Aircraft Corporation, East Hartford, Conn.,
a corporation of Delaware
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11 Claims. (Cl. 60—39.69)

ABSTRACT OF THE DISCLOSURE

An annular burner construction for a gas turbine engine in which the burner inlet extends forwardly into the diffuser and includes a pair of diverging walls between which the fuel nozzle is located. Each nozzle is surrounded by a burner cup and the several cups are attached together to form an annulus positioned in and spaced from the diverging walls. Extending downstream from the ends of the diverging walls are the inner and outer walls of the flame annulus and these are held against axial movement within the outer combustion chamber walls.

The present invention relates to an annular burner construction for a gas turbine engine.

One feature of the invention is a relatively simple assembly and disassembly arrangement for the burner construction which permits easy assembly within the engine and easy removal of individual parts for replacement.

Another feature is the support of the several elements of the burner such that thermal expansion is permitted without imparting stresses to the individual elements.

One particular feature of the invention is the positioning of the several elements of the flame rings or burner walls such that the several parts are securely held in position while in operation but which are readily positioned in assembled relation within the combustion chamber and equally readily separable for removal when necessary by axial movement within the engine. The several parts are arranged to form substantially continuous inner and outer burner walls from a point adjacent the upstream end of the diffuser to a point just upstream of the turbine inlet and these walls form the combustion area into which fuel is discharged by fuel nozzles between the walls near the upstream ends thereof.

According to the invention, the annular burner construction is adapted for axial assembly within the surrounding annular combustion chamber and includes a pair of nose pieces that extend forwardly of struts that interconnect the opposite walls of the diffuser portion of the combustion chamber and burner walls extending downstream in spaced relation to the outer combustion chamber walls and are separately held in position within the chamber so that separate axial removal is possible. One of the burner walls may have mounted thereon a plurality of combustor cups which fit around the individual fuel nozzles and are removable with the wall to which they are attached.

Other features and advantages will be apparent from the specification and claims, and from the accompanying drawings which illustrate an embodiment of the invention.

FIG. 1 is a longitudinal sectional view through the burner.

FIG. 2 is a sectional view along the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary view of the detail.

FIG. 4 is a fragmentary view of a detail showing the pin attachment.

A gas turbine engine of the general type to which this

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invention is applicable is shown in Savin Patent No. 2,747,367.

As shown in FIG. 1, the compressor 2 discharges air under pressure into the diffuser 4, the inner and outer walls 6 and 8 of which diverge in a downstream direction. The downstream ends of the walls 6 and 8 are connected to the inner and outer walls 10 and 12 of the combustion chamber, these walls being annular about the axis of the engine. In the arrangement shown the inner walls 6 and 10 are unitary as are the outer walls 8 and 12, and are held in spaced relation to one another by struts 14 located in the diffuser area and also preferably integral with the inner and outer walls.

From the downstream end of the inner wall 10 is a wall element 16 extending downstream from wall 10 to the supporting ring 18 for the inner ends of the turbine nozzle vanes 20. Suitable bolts 22 hold the ring 18 in position. A sleeve 23 forms a downstream extension for the outer wall 12 and is connected by bolts 24 to the turbine casing 26. These bolts also carry the supporting structure 28 for the outer ends of the turbine vanes 20. The sleeve 23 telescopes over the wall 12 in disassembly of the engine.

Within the combustion chamber are inner and outer flame enclosing or burner walls 30 and 32. The inner wall is supported at its downstream end by a bracket 34 attached to the wall and engaged by the bolts 22 to hold the wall in axial position. The upper end of this wall 30 is axially slidable on an inner sleeve 36 extending forwardly in spaced relation to the diffuser wall 6 and having notches 38 to fit around the struts 14. The forward end of sleeve 36 is axially slidable on an inner nose piece 40 having notches 42 in its downstream end and having lugs 44 thereon by which the nose piece is secured to the struts.

Outside the inner nose piece 40 is an outer nose piece 46 spaced from the piece 40 and also spaced radially inward of the outer diffuser wall 8 and substantially parallel to it. This piece 46 has notches 48 to fit around fuel nozzle brackets 50, and also has lugs 52 by which this nose piece is secured to the struts. Bolts 54 extend through both lugs 44 and 52. An outer sleeve 56 forms a downstream extension of the outer nose piece 46, is axially slidable on the downstream edge of the outer nose piece and has notches 58 to fit around the fuel nozzle brackets, as shown. Other notches 60 in this sleeve 56 receive the struts 14, as will be apparent.

The outer burner wall 32 extends downstream from sleeve 56 substantially in spaced parallel relation to the outer combustion chamber wall and at its downstream end is engaged by a seal ring 62 attached to and extending from the supporting structure 28. This ring 62 engages externally with the wall 32, as shown, in order to facilitate assembly and disassembly of the engine.

The wall 32 has mounted thereon a plurality of combustor cups 64 welded together into a ring and in assembled relation extending forwardly into the space between the inner and outer sleeves 36 and 56. Each cup carries a swirl ring 66 at its upstream end fitting around the associated fuel nozzle 68 on the inner end of the fuel bracket 50. The swirl ring is axially slidable on the nozzle for assembly purposes.

The outer burner wall 32 with the associated cups 64 is held in axial position by a plurality of radial pins 70 mounted in the outer wall 8 and engaging with openings 71 and 72 in the outer sleeve 56 and the cups 64, respectively. The cups are circular at their upstream end and diverge to segmental shape at their downstream ends, as shown, to form an annular wall surface 73 having a ring 74 thereon which slidably engages the inner burner

wall 30. The inner and outer sleeves 36 and 56 are interconnected by radial webs 76 such that these form a single assembly element and the pins 70 thus serve to hold the inner sleeve as well as the outer sleeve in operative position.

Durability of the burner construction has become so dependable that replacement of the burner liner or burner walls and combustor cups is normally unnecessary only at major overhaul. Thus, disassembly of the burner occurs only at a major disassembly of the engine. Thus, for removal or replacement of the burner elements, the turbine rotor, represented by the bladed disk 78, is removed and the turbine nozzle vanes are removed. The disk is removed as by undoing a row of bolts 80 holding the disk to the rotor shaft 82, removing with the disk a seal ring 84 thereon. The nozzle vanes are arranged in two 180° segments of vanes and by moving the sleeve 23 forward each set of vanes is removable as a unit.

The particular arrangement of nozzle vane assembly is described in a copending application Ser. No. 596,663, filed Nov. 23, 1966.

Removal of the nozzle vanes takes with them the seal ring 62 as well as an inner locating ring 86 which is in 180° segments and serves to hold the inner ends of the nozzle vanes in position. The ring 86 has a spline connection 88 to the support ring 18 so that a short axial sliding movement of the nozzle vane segment will disengage the splines for removal of the segment.

The removal of the vane segments makes accessible the bolts 22 and removal of these bolts permits removal of a stationary seal ring 90. Removal of the seal ring 90 permits access to a row of bolts 92 that hold the wall element 16 in position. When this wall element is removed, the inner wall 30 may be withdrawn axially from its slidable engagement with the inner sleeve 36. Thereafter, by withdrawing the locating pins 70 to disengage the wall 32, the outer burner wall 32 may be slid axially carrying with it the combustor cups 64 which slide axially off the fuel nozzles. These two elements, the inner and outer burner walls 30 and 32, are normally the only parts requiring replacement at overhaul. While these parts are removed access to the fuel nozzles and the struts is permissible for visual inspection.

Obviously at this point, if desired, the inner and outer sleeves 36 and 56, interconnected by the webs 76 may be withdrawn axially by disengagement of the radial pins 70 since these elements have a sliding fit over the struts. Replacement of these parts is not required to the extent that replacement of burner walls 30 and 32 is necessary.

Reassembly follows the disassembly procedure in reverse. The outer burner wall 32 is moved axially into position and retained by the pins 70. The inner wall element 16 is then moved axially into position and the row of bolts 92 are reinstalled. The seal ring 90 is placed in position and the bolts 22 are installed, engaging the seal ring 90, the end of wall 16 and the bracket 34 thereby holding the burner wall 30 in axial and radial location. This same row of bolts 22 also holds an annulus 94 in a position to engage axially with the inner ends of the vanes 20 to limit axial movement of the vanes in a downstream direction.

The vane segments are then moved radially into position, together with a short axial movement to engage the splines 88 and also move the vane ends into contact with the annulus 94. The outer nozzle vane support structure now being in position, the outer sleeve 23 is slid rearwardly into position and the bolts are reassembled. Thereafter, reassembly of the rotor disk and the remainder of the turbine elements is completed in the usual way.

The combustor cups may have rows of openings 98 in the walls thereof shielded by attached Z-shaped strips 100 to control the flow of air entering these cups. The walls 30 and 32 also have rows of openings 102 therein shielded by downwardly extending flanges 104. These walls may be formed by overlapping rings 106, as shown.

Since there is a compressive load on the outer wall 32, the pressures being greater outside these walls than within the burner itself, suitable wiggle-strips 108 may be mounted on the outside of the outer wall for stiffening purposes. These wiggle-strips do not affect the thermal expansion of the walls, as will be apparent.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In an annular burner construction for a gas turbine engine including:

inner and outer annular combustion chamber walls for the burner,

inner and outer annular burner walls within and spaced from the chamber walls, and

a plurality of fuel nozzles located between said chamber walls near the inlet end, wherein a plurality of combustor cups are mounted on one of the burner walls in the form of a ring, one for each fuel nozzle, said combustor cups having an axially slidable engagement with the other burner wall.

2. A construction as in claim 1, wherein also the inner and outer burner walls are independently held in axial position within the chamber walls for axial removal of each burner wall individually.

3. A construction as in claim 1 wherein the combustion chamber walls are connected together by radially extending struts and the combustor cups extend between the struts.

4. An annular burner construction for a gas turbine having inner and outer annular combustion chamber walls extending from the compressor discharge to the turbine inlet and including a diffuser portion adjacent the compressor where the inner and outer wall diverge in a downstream direction and having struts extending radially between the walls in the diffuser portion, the improvement which comprises:

inner and outer annular diverging nose pieces in spaced relation to each other and within and spaced from the chamber walls, said pieces having means for attachment to the struts,

inner and outer sleeves forming downstream extensions of the nose pieces and having notches to receive the struts, said sleeves being interconnected by circumferentially spaced webs,

means in the outer chamber wall for holding said sleeves in axial position,

inner and outer burner walls forming downstream extensions of the sleeves and in radially spaced relation to the chamber walls and to each other, and

means for retaining the inner burner wall in axial position within the chamber, said burner walls being axially slidable on sleeves at the upstream ends of the walls.

5. A construction as in claim 4 wherein the outer burner wall is retained in axial position by the same means that retains the sleeves.

6. A construction as in claim 4 wherein the retaining means for the inner burner wall are secured to the inner combustion chamber wall.

7. A construction as in claim 4 wherein the burner walls are free of interconnection such that each wall is independently removable axially when the retaining means are disengaged.

8. A construction as in claim 4 wherein a plurality of combustor cups are positioned between the sleeves and are secured together circumferentially and to one of the burner walls for removal as a unit with said one of said walls.

9. An annular burner construction for a gas turbine having inner and outer annular combustion chamber walls extending from the compressor discharge to the turbine inlet and including a diffuser portion adjacent the com-

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pressor where the inner and outer walls diverge in a downstream direction and having struts extending radially between the walls in the diffuser portion,

a plurality of fuel brackets mounted in the outer chamber wall and extending into the diffuser portion between the struts, each bracket having a nozzle on its inner end, the improvement which comprises:

inner and outer annular nose pieces located within the diffuser portion upstream of the struts and in spaced relation to each other and to the chamber walls, the outer nose piece having openings therein to receive the fuel nozzle brackets,

inner and outer sleeves having axially slidable connections with the nose pieces and forming downstream extensions thereof, said sleeves having openings to receive the struts and having interconnecting webs therebetween, and

inner and outer burner walls slidably axially on the sleeves and forming downstream extensions thereof, each of said burner walls being axially movable independently of the other,

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releasable means for holding the inner burner wall axially in position, and other means for holding the outer wall axially in position.

10. A construction as in claim 9 in which a plurality of combustor cups are arranged in a ring between the sleeves, one for each fuel nozzle and with the upper end of the cup fitting around the associated nozzle, and in which

said cups are interconnected circumferentially and radially secured to one of the burner walls for assembly or removal therewith.

11. A construction as in claim 10 in which said cups have inlet ends to receive the fuel nozzles and in which the cups are attached to the outer burner wall for removal or insertion as a unit therewith.

No references cited.

20 JULIUS E. WEST, *Primary Examiner*.