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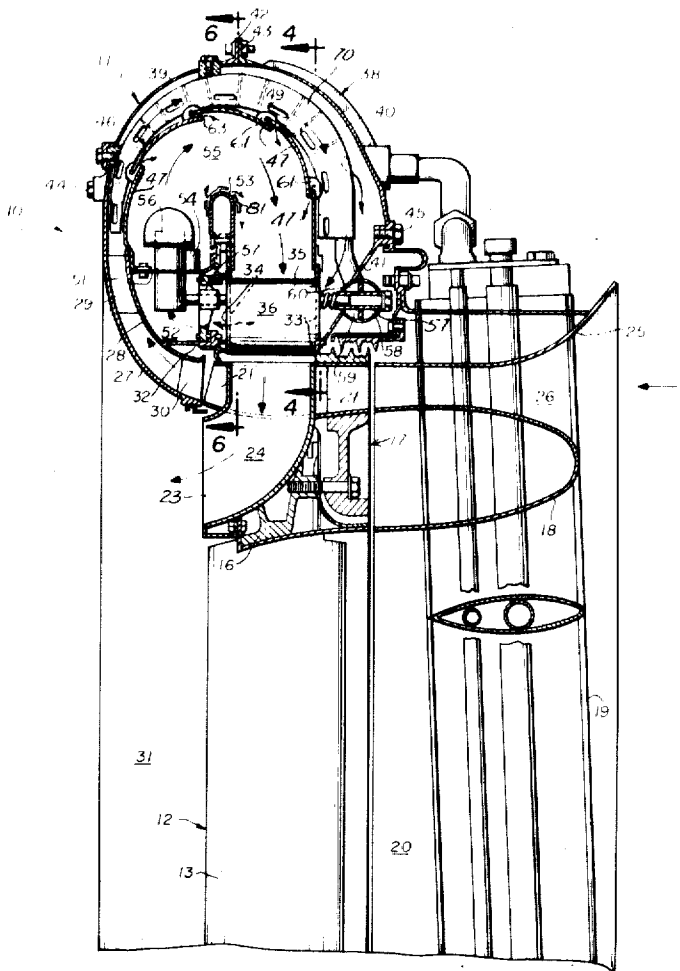
[54] **COMBUSTOR FOR GAS TURBINE HAVING A COMPRESSOR AND TURBINE PASSAGES IN A SINGLE ROTOR ELEMENT**
18 Claims, 7 Drawing Figs.

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60/39.43, 60/39.65, 60/39.71, 60/226
[51] Int. Cl..... **F02c 3/06,**
F02k 3/06
[50] Field of Search..... 60/39.43,
39.36, 39.65, 39.66, 39.75, 39.71, 226

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ABSTRACT: In a gas turbine engine having a compressor and turbine passages in a single rotor element, a combustor of annular, toroidal configuration comprises a segmentally constructed liner defining a combustion chamber providing a flow path of at least about 180° and spaced from a housing or shroud to define a diffusing combustion air supply passageway communicating with the annular outlet means of the compressor. The combustion chamber is provided with inlet means to receive air from the diffusing passageway and an outlet in communication with the turbine nozzles formed between next adjacent stator blades. Each of the stator blades has passage means therethrough to communicate the diffusing passageway with the combustion chamber inlet means to pass combustion air from the diffusing passageway to the latter and effect cooling of the stator vanes and heating of the combustion air. The liner has slip joints so constructed and arranged that unrestrained expansion and contraction can occur while maintaining a constant diffusing passageway dimensional characteristics.



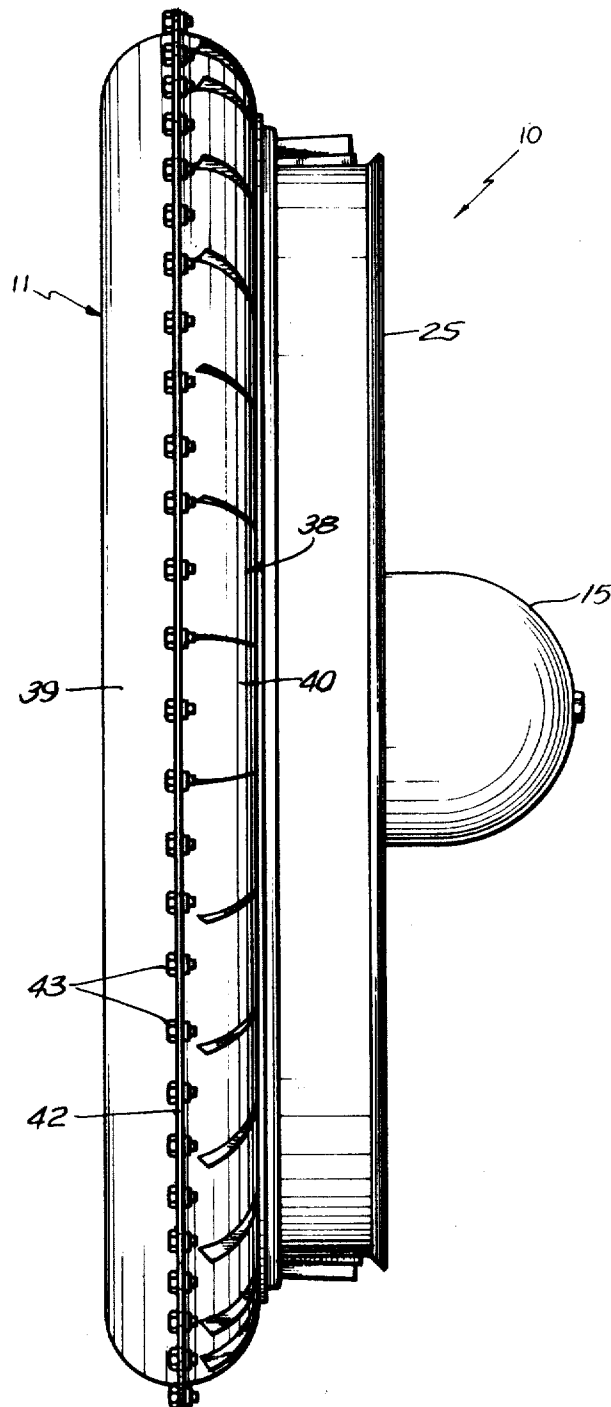


FIG. 1

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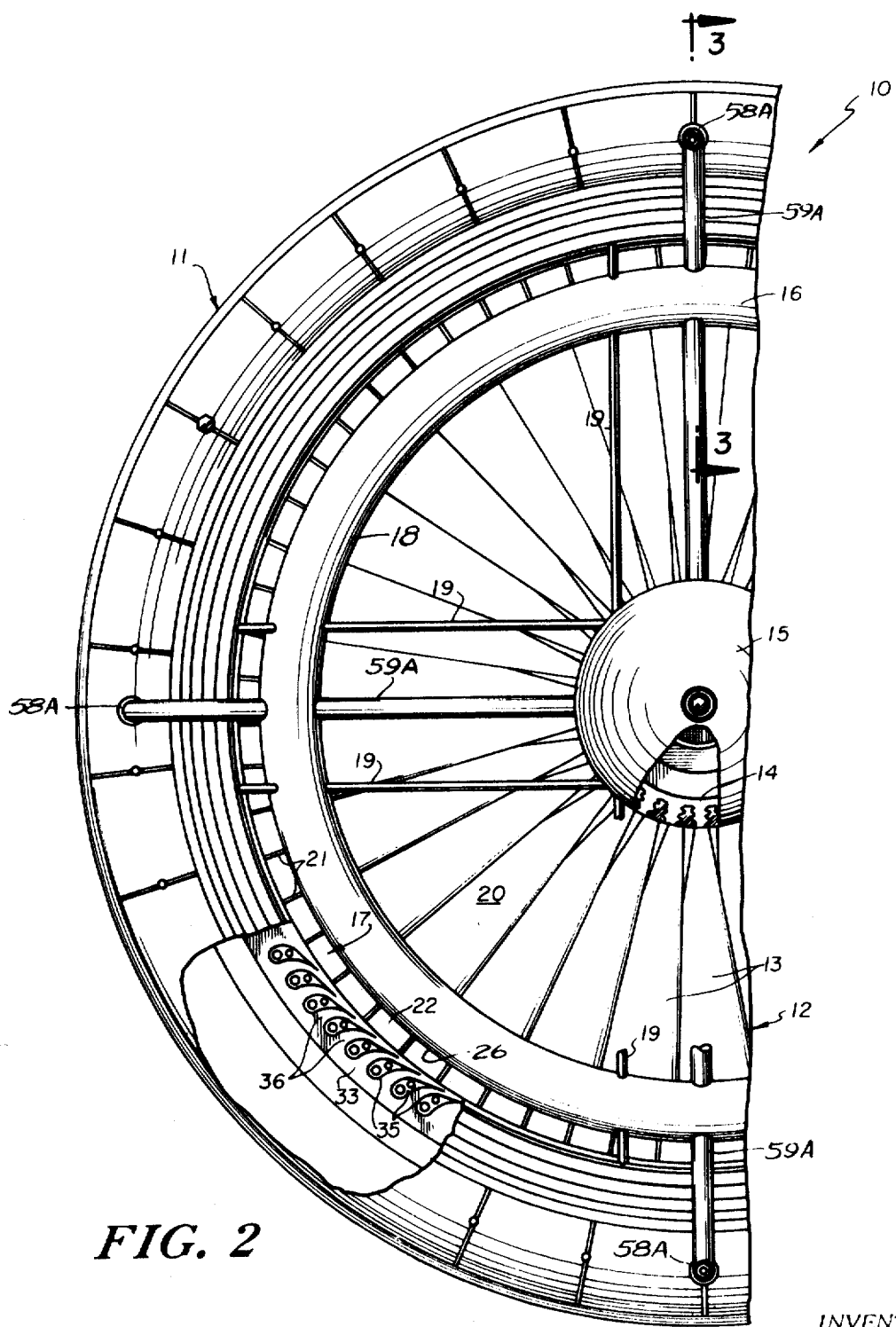


FIG. 2

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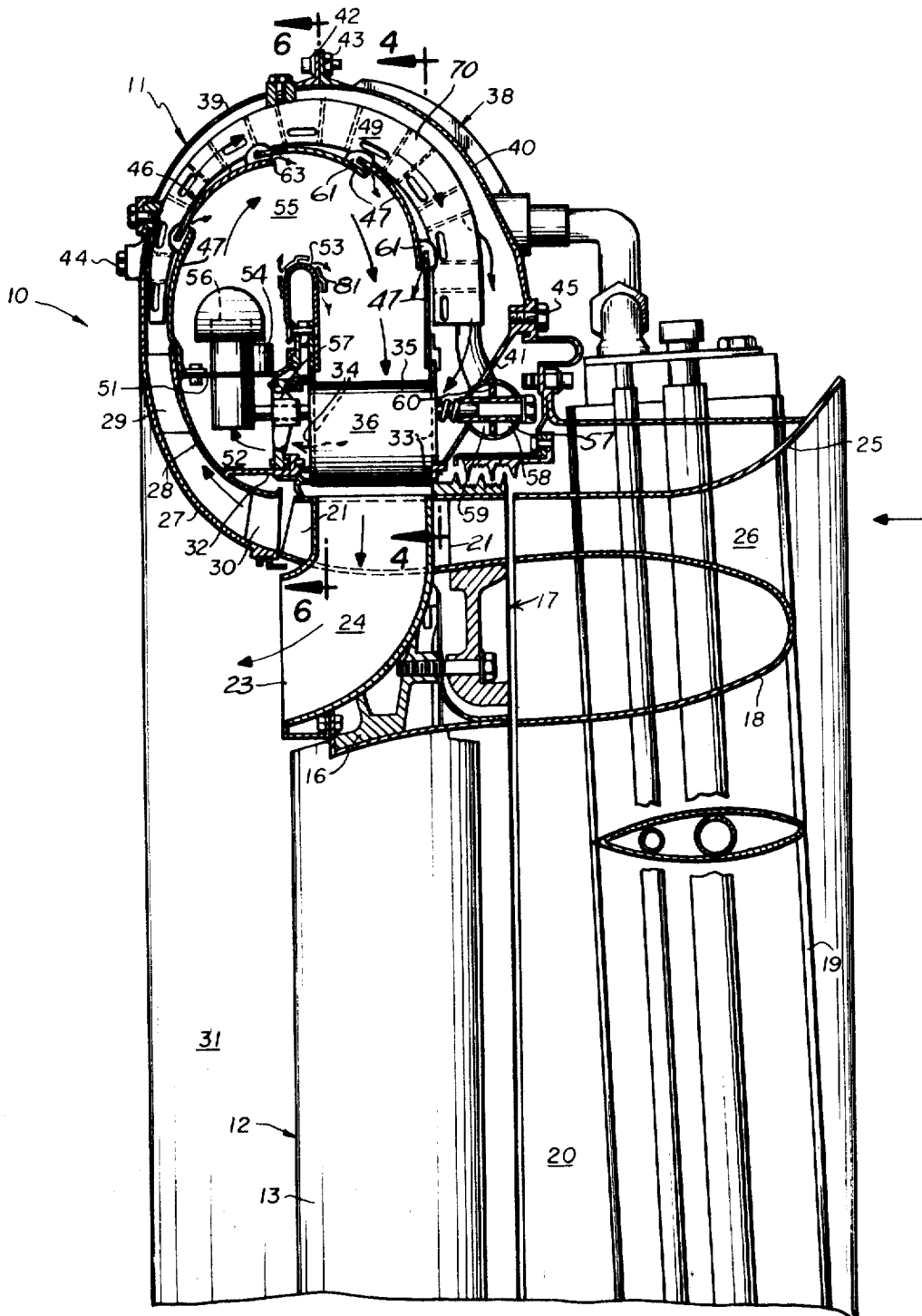


FIG. 3

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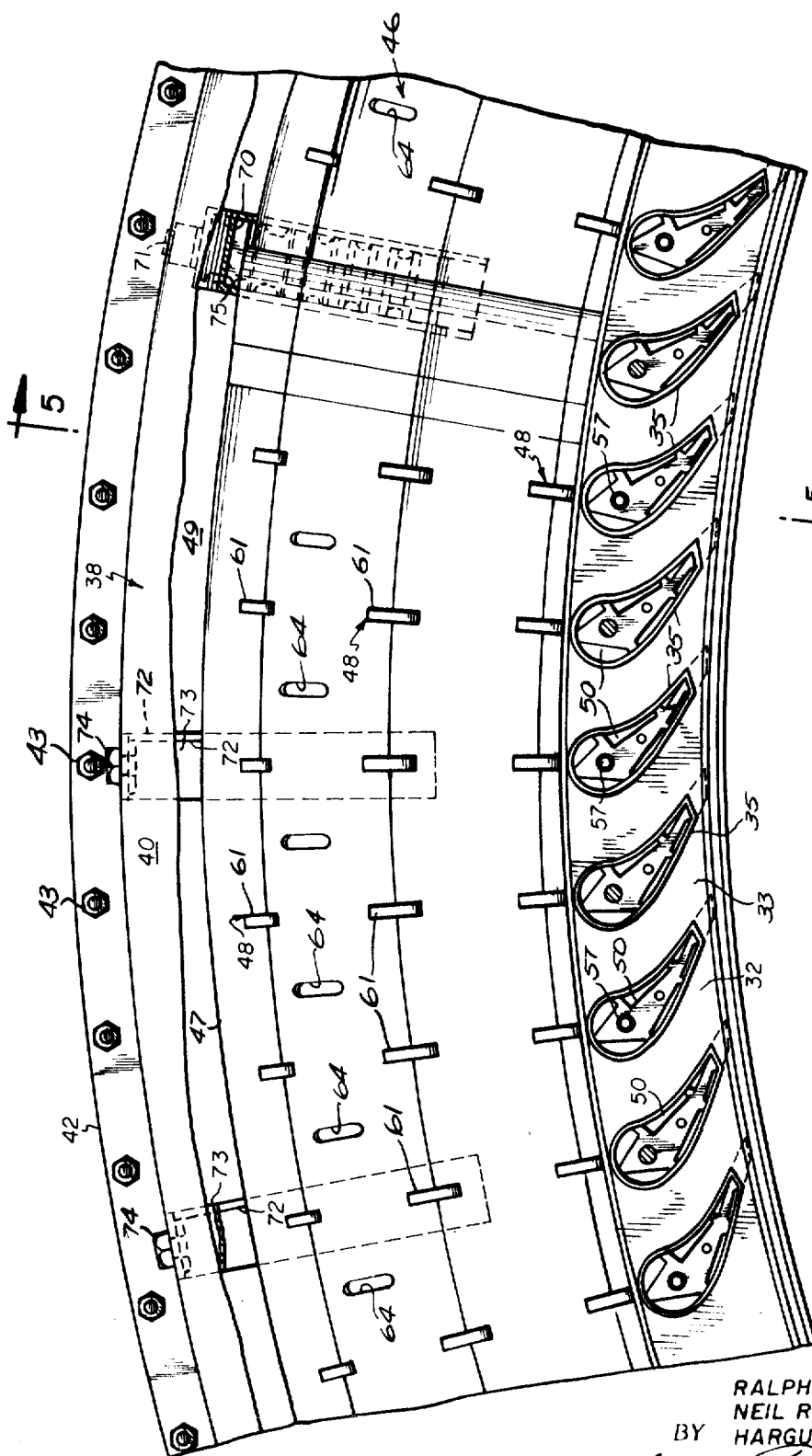


FIG. 4

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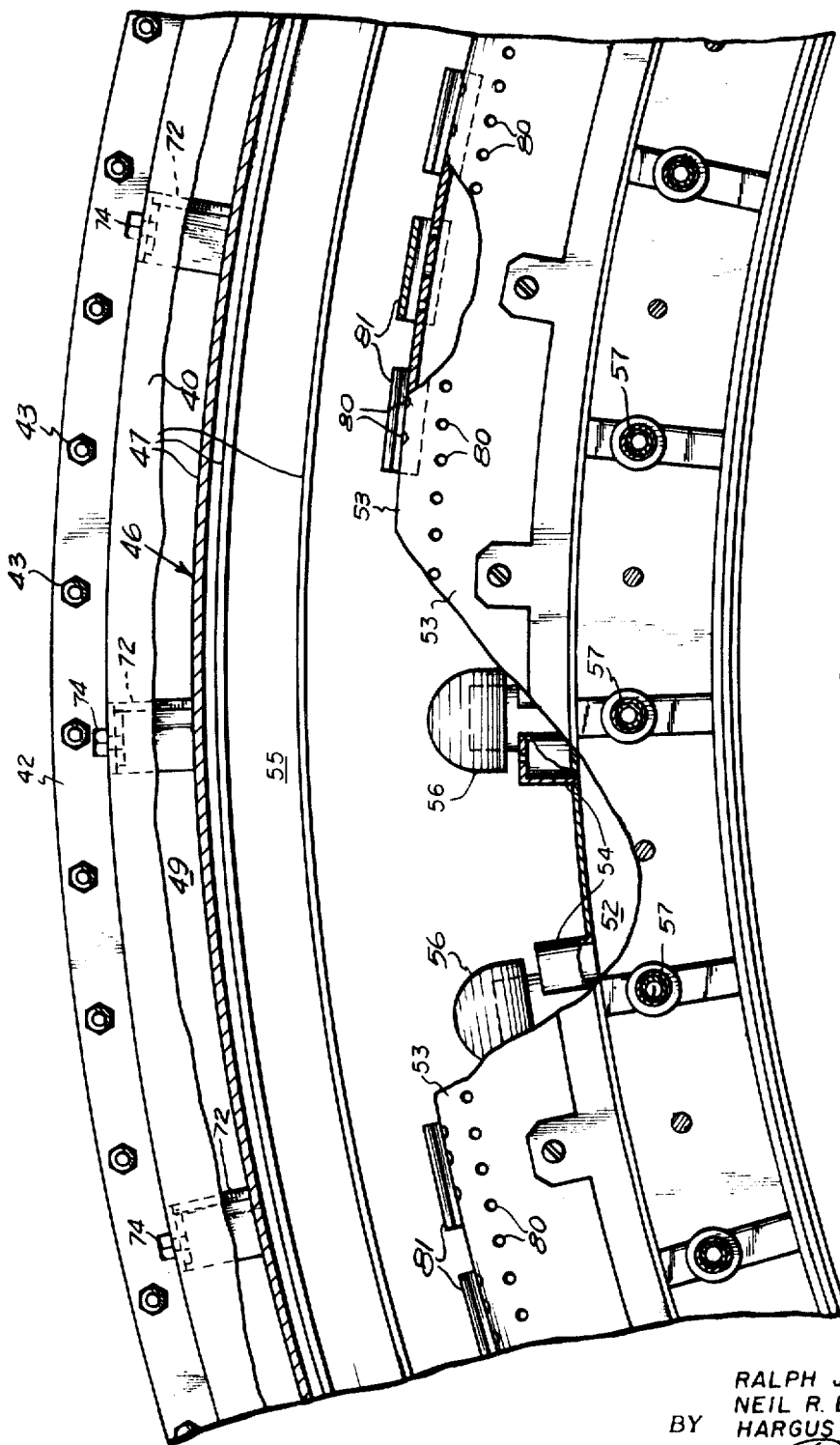


FIG. 6

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COMBUSTOR FOR GAS TURBINE HAVING A COMPRESSOR AND TURBINE PASSAGES IN A SINGLE ROTOR ELEMENT

BACKGROUND OF INVENTION

This invention relates to an improved gas turbine engine of the type having axial flow compressor passages and radial flow turbine passages in a single rotor element, hereinafter referred to as a single rotor compressor-gas turbine engine and, more particularly, to a fuel combustor for such engines.

To provide a single rotor, compressor-gas turbine engine which operates efficiently and has a desired operative life, it is essential to provide an efficient means for burning fuel and means for maintaining those parts exposed to the heat of combustion within temperature tolerances of the material out of which the parts are constructed. In single rotor, compressor-gas turbine engine, such as disclosed in the U.S. Pat. to Sabatiuk, No. 3,269,120, the fuel burner or combustor does not provide a diffuser passageway which maintains its dimensional characteristics under thermal expansion and contraction and, therefore, does not provide for efficient combustion of fuel and stable operation. It also provides a relatively short flame front which does not allow sufficient time for intimate mixing of fuel and air and, hence, substantially complete combustion of the fuel. In addition, air means for preventing the overheating of the turbine stator blades was heretofore unknown.

Accordingly, it is an object of the invention to provide in a single rotor, compressor-gas turbine engine, an improved means for providing combustion of fuel.

Another object of the present invention is to provide an improved combustor for a single rotor, compressor-gas turbine engine, which combustor is more efficient than heretofore-known combustors.

A further object of this invention is to provide in a single rotor, compressor-gas turbine engine, a means for combustion of fuel in which the turbine stator blades are prevented from overheating.

A still further object of the present invention is to provide in a single rotor, compressor-gas turbine engine, a combustor which includes fuel supply means wherein fluctuations from the design temperatures at the turbine inlet is minimized.

A feature of this invention is the provision of a segmentally constructed combustion liner which defines with a housing an annular, diffusing passageway for the air supply for fuel combustion which combustion liner has slip joints so constructed and arranged that unrestrained expansion and contraction can occur while maintaining a constant diffuser geometry.

Another feature of the present invention is the construction of the combustor in relation to the turbine stator vanes so as to provide for flow of the relatively cool compressor discharge air through the stator vanes to cool the same before passing into the combustion chamber of the combustor.

A further feature of this invention is the disposition of the fuel feed tubes to extend through each of the stator vanes so that the tubes are in a low velocity are thereby minimizing aerodynamic wake and the attendant pressure losses.

A still further feature of this invention is the provision of two fuel supply manifolds to which fuel feed tubes are alternately connected so that fuel combustion can be stages to, thereby maintaining substantially design turbine inlet gas temperature.

SUMMARY

It is therefore contemplated by the present invention to provide a novel fuel burner or combustor for a single rotor, compressor-gas turbine engine which comprises a segmentally liner constructed and arranged to form an annular, substantially toroidal, combustion chamber providing a flow path of combustion gases of at least about 180°. This combustion chamber configuration provides for a relatively long flame front to assist in achieving substantially complete combustion

of the fuel. The liner is spaced from a housing or shroud to define therebetween a diffusing combustion air supply passageway communicating with the air compressor outlet means to receive compressed air from the latter. The combustion chamber has an inlet means to receive air from the diffusing passageway and an outlet in communication with the turbine nozzles formed by the circumferentially spaced stator blades of the turbine. Each stator blade has a passage means therein to communicate the diffusing passageway with the combustion chamber inlet means to provide for flow of combustion air from the diffusing passageway to the latter and effect cooling of the stator vanes and heating of the combustion air. The segmental components of the liner are interconnected by slip joints to allow for unrestrained circumferential and radial expansion and contraction, so that the dimensional characteristics of the diffusing passageway is maintained substantially constant under varying temperature conditions.

The combustor also includes a fuel supply system which comprises a plurality of fuel supply tubes which are disposed to extend through the passage means in the stator blades, thus positioning the tubes in a relatively low velocity area and avoiding aerodynamic wake and pressure losses. The combustor is preferably provided with a plurality of fuel vaporizer tubes and cup-shaped air baffles which extend into the combustion chamber and are mounted in an annular header plate dividing the combustion chamber from the diffusing combustion air passageway. The primary air cups direct the combustion air into the combustion chamber while the fuel vaporizer tubes pass vaporized fuel into the combustion chamber as is fully disclosed in the U.S. Pat. to Sneed, No. 3,267,676. Each of the plurality of fuel supply tubes communicate with one of two annular fuel supply manifolds and a vaporizer tube to inject fuel into the latter. It is preferred to connect the fuel supply tubes alternately to each of the manifolds so that the combustor may be operated in stages to substantially maintain a uniform turbine inlet gas temperature circumferentially around the turbine. The annular fuel manifolds and the other fuel feed conduits are located on the air inlet side of the engine so that such components are cooled by exposure to relatively low temperature air.

All of the aforesaid features cooperatively function to provide a combustor for a single rotor, compressor-gas turbine engine of light weight and high combustion efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objectives and advantages of the present invention will appear more fully hereinafter from a consideration of the detailed description which follows when taken together with the accompanying drawings wherein one embodiment of the invention is illustrated and, in which:

FIG. 1 is a side elevational view of a single rotor, compressor-gas turbine engine having a fuel combustor according to this invention;

FIG. 2 is a fragmentary, elevational view of the air inlet side of the single rotor, compressor-gas turbine engine shown in FIG. 1;

FIG. 3 is a fragmentary, cross-sectional view taken substantially along line 3—3 of FIG. 2 and on an enlarged scale, showing the combustor of this invention;

FIG. 4 is a fragmentary cross-sectional view taken substantially along line 4—4 of FIG. 3 and with parts broken away and shown on an enlarged scale;

FIG. 5 is a transverse, cross-sectional view taken substantially along line 5—5 of FIG. 4, but on a somewhat smaller scale;

FIG. 6 is a fragmentary view in cross section taken substantially along line 6—6 of FIG. 3 with parts broken away for illustration purposes and on the same scale as FIG. 4; and

FIG. 7 is a fragmentary, perspective view, in cross section, of an alternate method of providing the segmental combustion liner components with slip joints.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Now referring to the drawings and more particularly, FIGS. 1 and 2, the reference number 10 refers to a single rotor, compressor-gas turbine engine of the type disclosed in the U.S. Pat., No. 3,269,120 to Sabatiuk, which engine is provided with a fuel burner or combustor 11 according to this invention. As shown in FIG. 2, the engine includes a fan 12 which provides for drawing ambient air therethrough to provide propulsion forces for STOL, VTOL, and conventional aircraft or other types of vehicles.

The fan 12 comprises blades 13 which are mounted at their inner ends to a disk 14, the disk being connected to a shaft (not shown) supported for rotation in a hub 15. The outer ends of blades 13 are secured in an annular frame 16 by means of clevises (not shown) which assemblies form part of rotor 17 of the engine (see FIG. 3). A fairing 18, having coplanar surfaces with 16, is supported by pairs of radial struts 19 concentrically to hub 15 to define with the hub an annular thrust air inlet opening 20 for fan 12.

The rotor 17 has a plurality of circumferentially spaced vanes 21 which form compressor passages 22 therebetween (see FIG. 5). Interposed between adjacent compressor passages 22 are turbine rotor vanes 23 which form turbine buckets or passages 24 (see FIG. 3). An outer fairing 25 concentrically supported in spaced relation to fairing 18 defines with the latter an annular compressor air inlet 26 which communicates with the compressor passages 22 to deliver air to the passages for compression. Spaced annular fairings 27 and 28, forming part of the combustor, define therebetween a compressor outlet passageway 29 in which a plurality of circumferentially spaced compressor stator vanes 30 are disposed. The inner peripheral surface of fairing 27 forms an outlet opening 31 through which air from fan 12 is forced and turbine exhaust gases from turbine passages 24 are discharged. Outwardly and concentrically to rotor 17 is disposed an annular structure 32 which forms the annular base for combustor 11. Disposed between axially spaced ring members 33 and 34 which are connected to base structure 32, are a plurality of circumferentially spaced stator vanes 33 which form turbine nozzles 36. The turbine nozzles are positioned to direct gaseous products of combustion into turbine buckets or passages 24 in rotor 17 to drive the latter, and which, in turn, rotatively carries the rotor vanes 21 of the compressor to compress combustion air entering inlet opening 26 and blades 13 of fan 12 to force air through inlet opening 20 and outlet opening 31. To provide the turbine with gaseous products of combustion efficiently generated, the burner or combustor 11 of this invention is included in the aforesaid assembly.

As best shown in FIGS. 3, 5, and 7, combustor 11 has an annular shroud or housing 38 which consists of a plurality of peripherally arranged, arcuate-shaped, segmental plates 39 and 40, fairing 27 and segmental sideplates 41. The plates 39 and 40 are secured together at abutting peripheral flanges 42 of the plates by a plurality of nut and bolt assemblies 43. The fairing 27 is secured to plates 39 by a plurality of circumferentially disposed bolt and clamp assemblies 44. The sideplates 41 are secured to its inner edges by suitable means, such as by welding to the base structure 32 adjacent wall 33 at a point radially inwardly of the turbine stator blades 35. The opposite, outer edges of plates 41 are secured by a plurality of circumferentially arranged bolts 45 to plates 40. The housing 38 is shielded from hot products of combustion by an annular, segmental liner 46.

The liner 46 comprises a plurality of arcuate, segmental plates 47 which are interconnected along their adjacent peripheral edges by slip joints 48, hereinafter more fully described, to form a toroidal shape. At one inner peripheral edge, the liner 46 is secured to fairing 28, while at the opposite inner peripheral edge, it is connected to wall 33 of base structure 32. The liner 46 is dimensioned and so positioned relative to housing 38, that it defines with housing 38 a diffusing com-

bustion air supply passageway 49 which communicates, at one end, with compressor outlet passageway 29 to receive compressed air from the latter and, at the opposite end, with air passages 50 in each of the turbine stator blades 35 (see FIGS. 4 and 5) to conduct air into the latter. An annular-shaped header plate 51 is disposed in spaced concentric relationship to base structure 32 and is connected along opposite peripheral edges to wall 34, at a point radially outwardly from turbine stator vanes 35 and to liner 46. The header plate 51 forms with the fairing 28, base 32 and wall 34, an annular air inlet plenum 52 which communicates with air channels or passages 50 in turbine stator blades 35 to receive air from such passages. A hollow U-shaped partition 53 is connected at its inner periphery to header plate 51 and wall 34 to extend outwardly to a point substantially short of the liner plates 47 so as to provide, within liner 46, an annular combustion chamber 55 which is U-shaped in cross section and having a combustion gas flow path of about 180°.

Fuel for the generation of gaseous products of combustion in combustion chamber 55 is provided by a fuel supply means which, preferably, includes a plurality of vaporizer tubes 56 of the type disclosed in the U.S. Pat. to Sneed, No. 3,267,676. Each of the vaporizer tubes 56, which comprises an open-ended, cylindrical tube with a cap mounted at one end, is supported in header plate 51 with the capped end within combustion chamber 55 and the opposite end projecting into air plenum 52 to communicate the latter with combustion chamber 55. As shown in FIG. 6, the combustor 11 is preferably provided with one vaporizer tube for each alternate turbine stator vane 35 and with a fuel supply pipe or tube 57 extending parallel to the rotor axis, through the passages in the adjacent stator vane 35, to the vaporizer tube 56 for delivering and injecting fuel into vaporizer tube 56. In addition to the mixture of air and fuel which is discharged into combustion chamber 55, via vaporizer tubes 56, primary air for combustion is passed into combustion chamber 55 through a plurality of inverted cup-shaped baffles 54 which are mounted on header plate 51. The baffles 54 have an opening through header plate 51 which communicates with air plenum 52 and a slotted opening at the closed end to pass air from plenum 52 into combustion chamber 55 where the air enters into intimate admixture with the mixture of vaporized fuel and air discharging into the combustion chamber from under the caps of the vaporizer tubes 56.

The fuel supply means also includes an ignition system (not shown) whereby combustion of fuel is initiated or maintained. In view of the relatively long U-shaped configuration of combustion chamber 55, a long flame front and residence time is provided in the combustion chamber so as to achieve substantial combustion of the fuel before discharge from the combustion chamber into the nozzles 36 formed between turbine stator blades 35.

The fuel supply means, preferably, further includes two annular manifolds 58 and 59 which are formed in a single pipe by a diametrically located dividing wall 60. The fuel supply tubes 57 are alternately arranged to communicate with either manifold 58 or manifold 59. This arrangement of fuel tubes permits the staging of combustion to minimize variation in the circumferential gas temperature at the turbine nozzles 36. Each of the manifolds 58 and 59 are supplied with fuel through a plurality of pipe connections 58A and communicating with a plurality of feed pipes 59A radially extending from hub 15 (see FIG. 2). The feed pipes 58 connect in hub 15 with other fuel conduits (not shown) which communicate with fuel pumping means (not shown) and fuel storage tanks (not shown).

As best illustrated in FIGS. 4 and 7, segmental plates 47 of liner 46 are interconnected by peripheral slip joints 48 which may comprise a plurality of slotted tabs 61 secured to one plate and receiving the next adjacent plate in the slotted openings 62 in the tabs. This slip joint provides for relative movement between plates 47 and supports the plates in spaced relation to each other to provide elongated ports 63

communicating the diffusing air supply passageway 49 with the combustion chamber 55. The ports 63 function to bypass relatively cool air into combustion chamber 55 to form an air film adjacent the inner surface of liner 46 to shield the latter from the intensely hot products of combustion. Also, the slip joints 48 provide the liner with a self-supporting characteristic. In addition to ports 63, a plurality of spaced slots 64 are provided in one of the plates 47 to admit additional air into combustion chamber 55 for the purpose of diluting the gaseous products of combustion (see FIGS. 4, 5, and 7). To maintain the dimensional flow area of the diffusing air passage 49 substantially constant, a spacer channel 70 (see FIG. 5) is disposed at opposite ends of each sector of the combustor 11, which channel is secured to housing 38 by bolt and spacer assemblies 71. Intermediate of the channels 70, spacer elements 72 are supported from an arcuate strap 73 secured to housing 38 by a plurality of fasteners 74. The channels 70 and the spacer elements 72 are dimensioned to extend into abutment against liner 46 and function to prevent liner 46 from expanding relative to shroud 38 and thus changing the flow characteristics of air supply passageway 49. As shown in FIG. 7, the ends of the annular liners 46 of each sector is provided with an expansion joint 75 to allow for relative circumferential expansion and contraction between adjacent sectors. The expansion joint 75 may be of an overlapping joint, similar to the bell mouth stove pipe joint. The slip or expansion joints 48 and 75, spacer elements 72 and spacer channel 70 cooperate to prevent expansion or contraction of liner 48 relative to housing 38 so that the geometry of diffusing air supply passageway remains substantially constant under change in operating temperature.

To cool and shield partition 53 from the hot combustion products, partition 53 communicates with air plenum 52 to receive air from the latter and, as best shown in FIG. 6, has a plurality of small openings 80 to pass air adjacent the partition. A baffle 81 is disposed over some of the openings 80 to deflect the gaseous products of combustion away from openings 80 and minimize the possibility of combustion gases infiltration into air plenum 52.

In operation of the single rotor, compressor-gas turbine engine 10, having combustor 11 according to this invention, fuel is delivered from a source thereof, such as aircraft fuel tanks (not shown), to manifolds 58 and 59 via components and conduits (not shown), radial feed pipes 59A and pipe connection 58A. From the manifolds 58 and 59, the fuel passes into fuel tubes 57 which conducts the fuel to the vaporizer tubes 56. In each of the vaporizer tubes, the fuel is at least substantially vaporized and mixed with primary combustion air flowing into and through the vaporizer tube from plenum 52. The fuel and air mixture discharges from the vaporizer tube into combustion chamber 55.

Simultaneously with delivery of fuel to combustion chamber 55, air compressed by compressor vanes 21 to a relatively high pressure, as for example, 114 inches Hg., is discharged into outlet passageway 29 and from the latter into diffusing air supply passageway 49. The air in flowing through passageway 49 is gradually reduced in velocity, from about 335 ft./sec. at the inlet, and with part of the air flowing from the passageway, through elongated ports 63, into the combustion chamber 55 to form a film of relatively cool air adjacent the liner surface to shield liner 46 from the hot products of combustion generated by the burning of fuel. The partition 53 is also shielded from the combustion products by relatively cool air flowing from plenum 52 through openings 80. The diluent entering the combustion chamber 55 through slots 64, provides dilution of the gaseous products of combustion to thus reduce the average combustion gas temperature to about 2,200° F. before it enters turbine nozzles 36. Also, the air in flowing through diffusing air supply passageway 49 absorbs some heat. The partially heated air discharges from passageway 49 absorbs some heat. The partially heated air discharges from passageway 49 into the channels or passages 50 formed in each of the turbine stator vanes 35 and in flowing

therethrough absorbs heat from the stator vanes to maintain the stator vanes relatively cool, as for example, at a temperature below 650° F., and hence, minimizes thermal distress and erosion of the stator vanes. The preheated combustion air, as for example, at a temperature of 380° F., passes from the passages 50 of stator vanes 35 into annular air plenum 52 from where a portion enters vaporizer tubes 56. The remaining preheated air flows from the air plenum 52 into air cups 54 and through openings 80 in partition 53 and, thence, into the combustion chamber 55 to supply the additional air necessary for substantially complete combustion of the fuel. In view of the relatively large combustion gas flow path provided by combustion chamber 55, a relatively long flame front is generated which effects substantially complete combustion of the fuel before discharge from the combustion chamber into turbine nozzles 36 formed between turbine stator vanes 35. From the turbine nozzles, the gaseous products of combustion at a high temperature, as for example, 2,200° F., are directed against the spaced turbine rotor vanes 23 to thereby effect rotation of rotor 17 and fan 12 carried by the rotor. The spent gaseous products of combustion are discharged from the turbine buckets 24 into the atmosphere past fairing 27.

It is believed now readily apparent that a novel combustor for a single rotor, compressor-gas turbine engine has been described which provides for the efficient combustion of fuel and, in which, the stator vanes are protected against rapid deterioration by the absorption of heat by the relatively cool combustion air. It is a combustor in which the fuel lines and other auxiliary equipment can be disposed on the relatively cool inlet side of the engine. The combustor further provides a diffusing air supply passageway the geometry of which remains substantially independent of temperatures.

We claim:

1. In a gas turbine engine having an axial flow air compressor passages and radial flow turbine passages formed between next adjacent stator blades, a combustor comprising a housing, a plurality of segmental elements within the housing interconnected to form an annular combustion liner defining a combustion chamber and spaced from the housing to define therebetween an air supply passageway communicating with the compressor passages to receive compressed air from the latter, said combustion chamber having air inlet means and combustion gas outlet means communicating with the turbine passages, means forming an air inlet plenum communicating with said air inlet means, fuel means for introducing combustible fuel into said combustor to effect burning and the generation of hot gaseous combustion products, the stator blades being provided with air passages therethrough communicating with said air inlet plenum and said air supply passageway to receive and pass compressed air from the latter to the air inlet plenum and thereby effect the cooling of the stator blades heated by the gaseous products of combustion flowing through the turbine passages.
2. The combination of claim 1, wherein said combustion liner is toroidal in configuration and defines with the housing and air supply passage having a flow path of about 180°.
3. The combination of claim 1, wherein said combustion liner is spaced from the housing to define a diffusing passageway to gradually reduce velocity of the airstream.
4. The combination of claim 1, wherein said combustion liner is annular, toroidal in configuration and is spaced from the housing to define a diffusing passageway having a flow path of about 180°.
5. The combination of claim 1, wherein said combustion liner is spaced from the housing so as to define an air supply passageway increasing in flow area in the direction of the air-flow, and wherein the plurality of segmental elements are interconnected by slip joints which permit relative expansion and contraction of the elements to thereby maintain the flow area dimensions of the diffusing passageway substantially constant.
6. The combination of claim 1, wherein the combustion liner elements are constructed and arranged with a multiplicity

ty of openings into which a portion of the air flowing in the air supply passage passes to provide a film of cool air adjacent the liner to shield the same from the hot products of combustion generated in the combustion chamber.

7. The combination of claim 1, wherein said fuel means includes a fuel supply tube disposed to extend through the passages in the stator blades to conduct fuel from a source thereof to the combustion chamber.

8. The combination of claim 1, wherein said fuel means includes at least one annular manifold connected to a supply of fuel and a fuel supply tube disposed to extend through the passages in the stator blades and connected to the manifold to conduct fuel from the latter to the combustion chamber.

9. The combination of claim 1, wherein said fuel means includes at least two independent annular manifolds connected to a reservoir of fuel to receive fuel from the latter and a fuel supply tube for each turbine blade disposed to extend through the passage in the turbine blades, the fuel supply tubes being alternately connected to the two manifolds and to the combustion chamber to thereby pass fuel from the manifolds to the combustion chamber.

10. The combination of claim 1, wherein said combustor comprises partition means forming an annular air inlet header which communicates with the passages in said stator blades to receive air from the latter, the air inlet means communicating with the air inlet header and the combustion chamber to pass air from the former into the latter.

11. The combination of claim 1, wherein an annular header plate closes the inlet end of the combustion chamber and an annular partition wall extending radially outwardly to a point short of the liner to define with the liner a combustion chamber having a U-shaped flow path.

12. The combination of claim 11, wherein a plurality of circumferentially spaced fuel vaporizer tubes are mounted in said header plate to extend into the combustion chamber and wherein said fuel means includes a fuel supply tube for each vaporizer tube communicating with a source of fuel and the vaporizer tube to deliver fuel to the latter.

13. The combination of claim 1, wherein said fuel means includes a plurality of circumferentially spaced vaporizer tubes and a fuel supply tube for each vaporizer tube disposed to extend to a vaporizer tube from a source of fuel to conduct fuel from the latter to the associated vaporizer tube.

14. In a gas turbine engine having axial flow air compressor passages and radial flow turbine passages formed in a single rotor element supported for rotation in a fixed frame including spaced stator vanes for the turbine and an annular outlet passage for the air compressor, a combustor comprising

- a. an annular, toroidal-shaped housing connected to the outer periphery of the fixed frame,

b. a combustion chamber liner connected to the fixed frame and disposed within and spaced from the housing to define therebetween a diffusing air supply passageway communicating with the annular outlet passage of the compressor to receive compressed air from the latter,

c. an annular partition means connected to the frame adjacent the stator vanes and extending in axial and radial-spaced relation to the combustion liner to define with the liner a U-shaped combustion chamber closed at the inlet end and communicating at the opposite end with the nozzles formed between adjacent stator vanes of the turbine to pass combustion products to the nozzles,

d. said partition means also defining with the frame an air inlet manifold adjacent said stator vanes,

e. the stator vanes being provided with passages therethrough communicating with the diffusing air supply passageway and with the air inlet manifold to pass air from the air supply passageway to the latter and absorb heat from the stator vanes,

f. air inlet port means in said partition means to pass air from the manifold into the combustion chamber, and

g. fuel supply means connected to conduct fuel from a source thereof to the combustion chamber for the generation of hot products of combustion.

15. The combination of claim 14, wherein said combustion liner consists of a plurality of segmental elements interconnected by slip joints to provide for expansion and contraction of the elements relative to each other and the housing while maintaining the flow area dimensions of the diffusing air supply passageway substantially constant.

16. The combination of claim 14, wherein said fuel supply means includes a plurality of circumferentially spaced vaporizing tubes connected to the partition means and extending into the combustion chamber to communicate the air inlet manifold with the combustion chamber, and wherein a fuel supply tube is provided for each vaporizer tube and disposed to extend through the air passage of a stator vane, the supply tube being in communication with a source of fuel and the associated vaporizer tube to conduct fuel to the latter for combustion in the combustion chamber.

17. The combination of claim 14, wherein said combustion liner is provided with a multiplicity of openings to pass a portion of the compressed air from the diffusing air supply passageway into the combustion chamber adjacent the liner to shield the liner from the hot products of combustion.

18. The combination of claim 16, wherein the housing is provided with depending spacing members which impinge the segmental elements of the combustion liner to prevent movement of the liner elements toward the housing upon heating.