

[54] GAS TURBINE ENGINE STRUCTURE

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617,977 2/1949 Great Britain 60/39.65

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[58] Field of Search 60/39.31, 39.32,
60/39.37, 39.69, 39.75; 417/409

[56] References Cited

UNITED STATES PATENTS

3,010,281	11/1961	Cervenka et al.	60/39.37
2,244,467	6/1941	Lysholm	60/39.32
3,327,473	6/1967	Smith	60/39.31

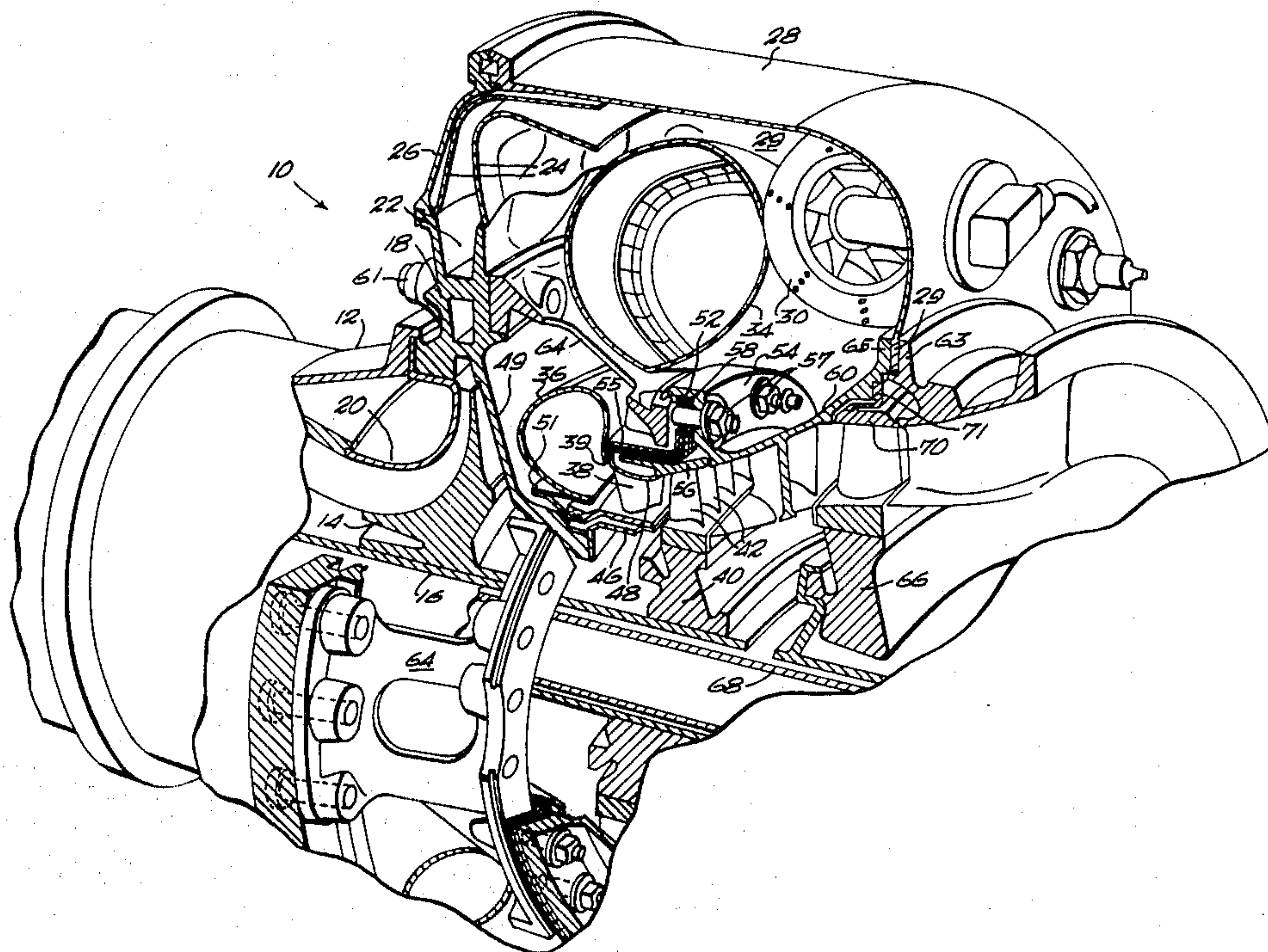
FOREIGN PATENTS OR APPLICATIONS

842,093	7/1960	Great Britain	417/409
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[57] ABSTRACT

The disclosure illustrates a gas turbine engine structure in which a turbine housing is structurally connected to a compressor housing by three equally spaced straight-lined struts. These struts pass in between three scroll-like ducts that carry combustion gases to an annular turbine inlet duct radially inboard of the straight-lined struts. The direct structural connection permits closer blade tip clearances and a substantial increase in efficiency. In addition it provides a lightweight design.

9 Claims, 3 Drawing Figures



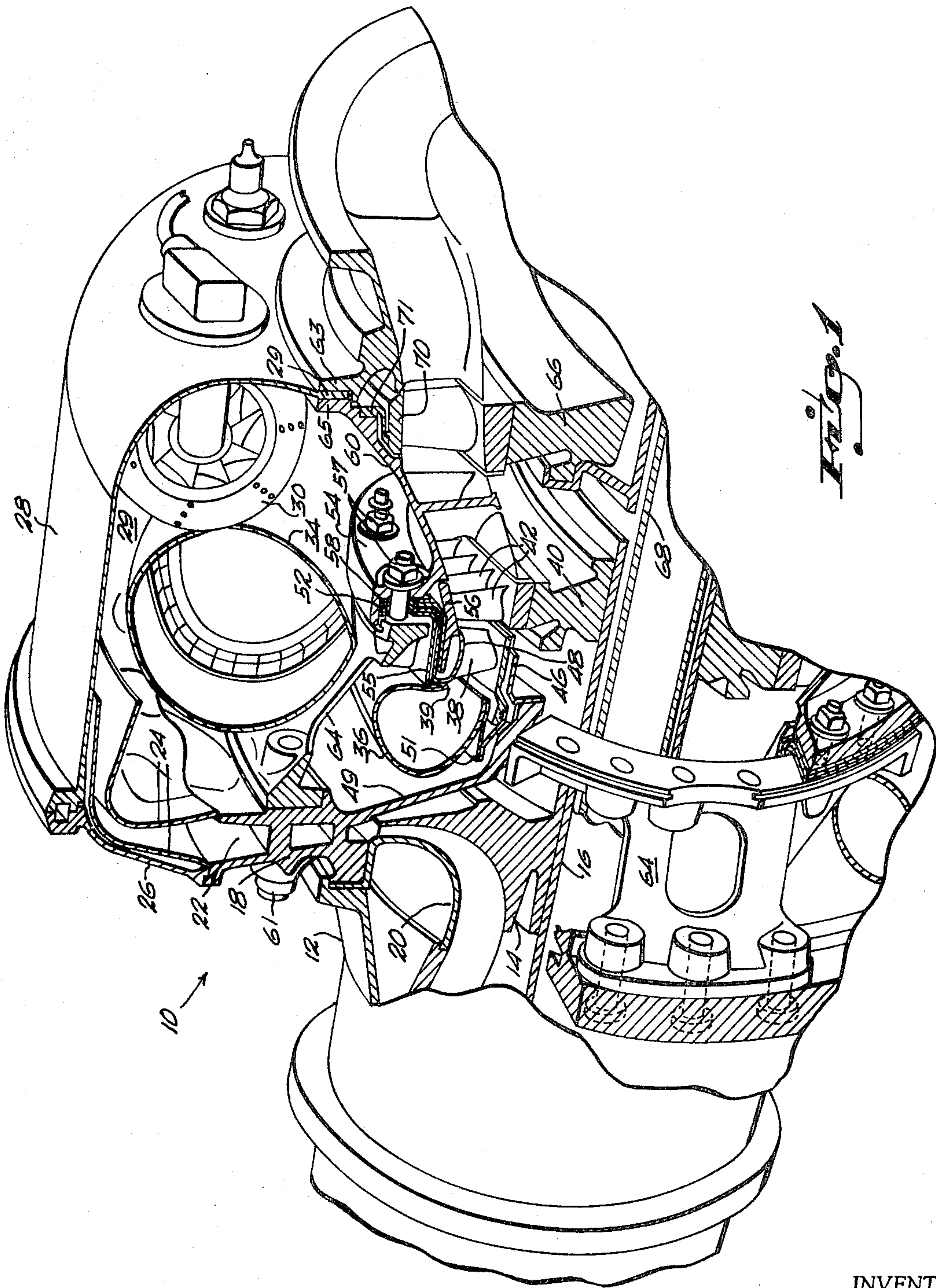


Fig. 1

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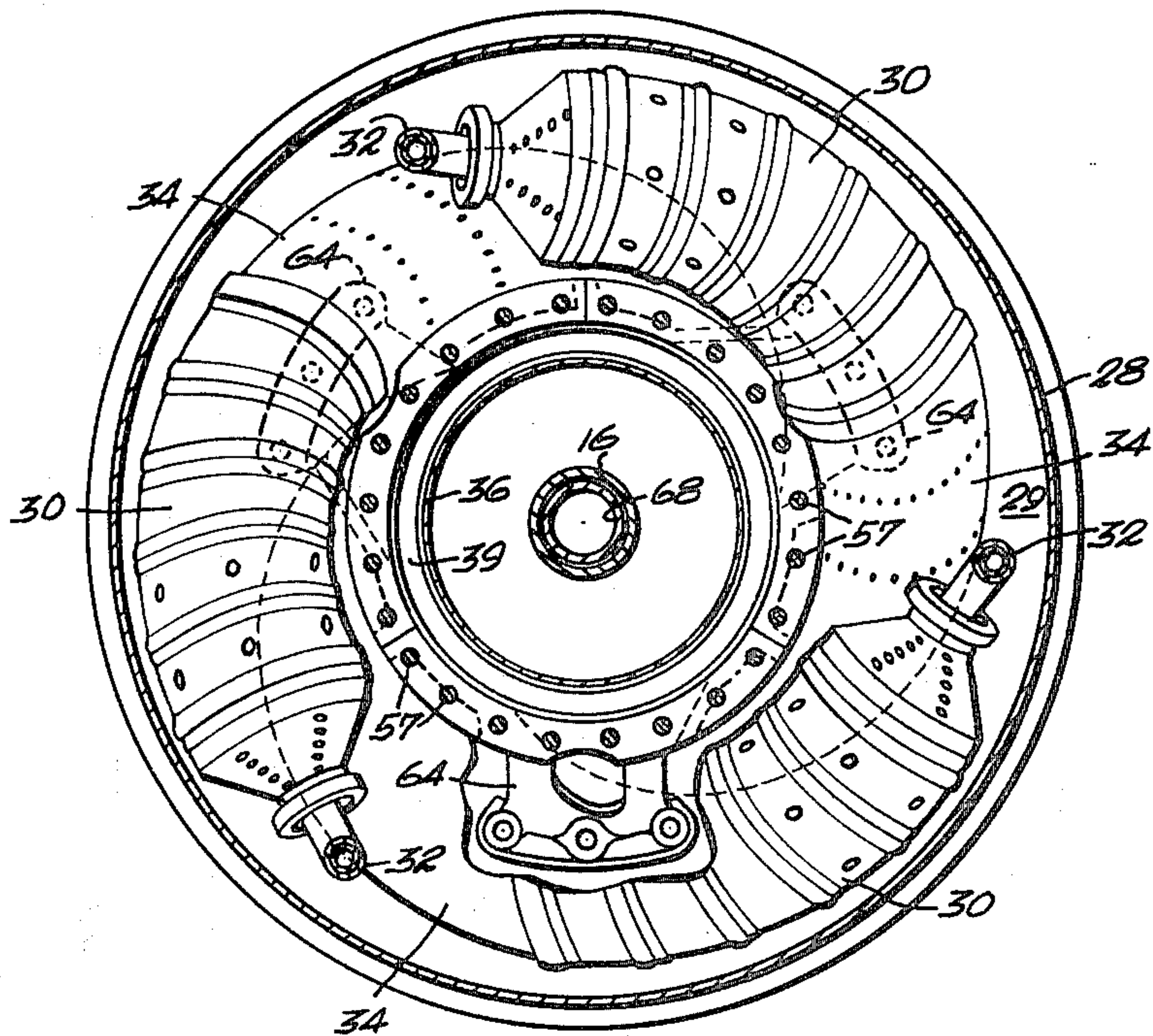


Fig. 2

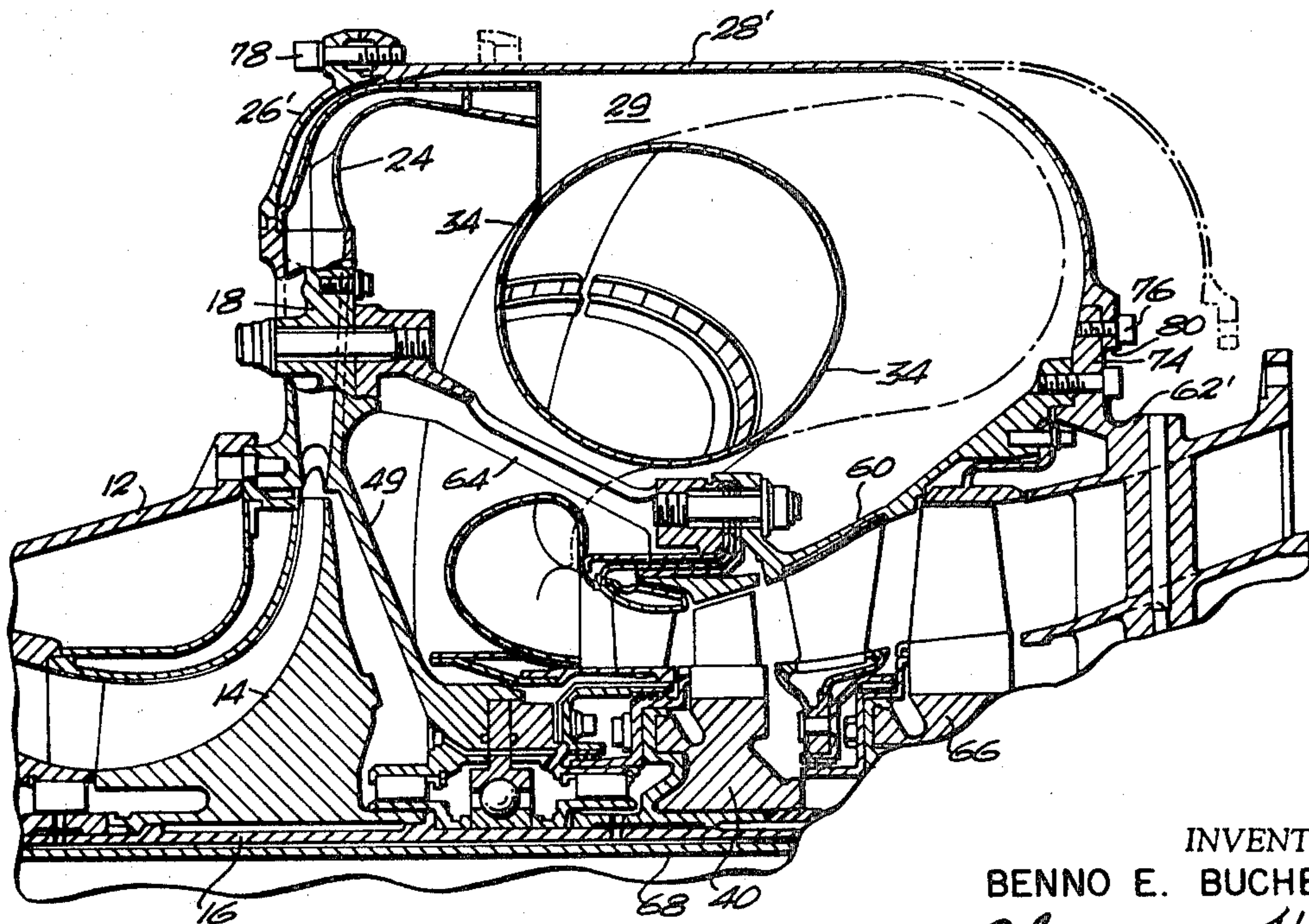


Fig. 3

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GAS TURBINE ENGINE STRUCTURE

The present invention relates to gas turbine engines and more particularly to the structural aspects of these engines.

Over the years the reverse flow type of gas turbine engine has enjoyed an ever increasing usage because of its short length and inherent stiffness. The reason for the short length is that the combustor unit is placed radially outboard from the turbine assembly, thereby permitting them to occupy the same axial spacing. An excellent example of this type of engine may be found in the patent to Anselm Franz, U. S. Pat. No. 3,088,278, and of common assignment with the present invention.

One of the problems that exists with this type of engine is that the turbine housing is not able to be closely coupled to the compressor housing. The reason for this is that the annular combustor and turbine inlet ducts completely surround the periphery of the turbine assembly, thereby necessitating support of the turbine shroud from the aft end of the combustor housing in a cantilever fashion. This requires that the large diameter housing surrounding the combustors be sufficiently stiff to carry the structural loads involved. As a result, the weight of the housing is substantially increased.

The substantial distance between the aft end of the engine and the turbine housing permits flexibility. As a result, the turbine shroud clearances must be maintained sufficiently great for the conical outer shroud contour to insure against rubbing of the turbine vanes during operation.

Therefore it is an object of the present invention to rigidly support the turbine housing in an engine of the above general type.

This is achieved by providing a plurality of scroll-like ducts that extend to an annular turbine inlet duct adjacent a turbine assembly. A series of struts extend from a structural portion of the engine housing directly between the scroll-like ducts to the turbine housing providing a direct connection through the straight line neutral axis of the struts.

The above and other related objects and features of the present invention will be apparent from a reading of the description of the disclosure shown in the accompanying drawing and the novelty thereof pointed out in the appended claims.

FIG. 1 is a fragmentary perspective view of a gas turbine engine embodying the present invention;

FIG. 2 is a cross-sectional view of the engine of FIG. 1; and

FIG. 3 is a fragmentary longitudinal section view of a gas turbine engine employing the invention.

Referring to FIG. 1 there is shown a gas turbine engine, generally indicated by reference character 10. The engine comprises an annular structural housing 12 in which a centrifugal compressor impeller 14 is mounted on shaft 16 which is journaled for rotation by appropriate bearing assemblies, which are not shown to simplify the description of the invention. The compressor may additionally comprise a series of axial stages (not shown for the sake of simplicity) that discharge pressurized air to centrifugal impeller 14. Centrifugal impeller 14 has a shroud 20 which is sandwiched between a flange on housing 12 and a diffuser housing 18 by suitable means. The diffuser 18 receives pressurized air from the periphery of impeller 14 and has a series of divergent passageways 22 formed in a radially outward and generally tangential direction to diffuse and

further pressurize the air. An annular outer flange 26 is suitably secured to the periphery of diffuser 18 and also forms a forward peripheral support for a generally annular outer housing 28. Housing 28 forms the outer bounds of a chamber 29 which receives pressurized air from diffuser 18 via a pair of diffusing and turning ducts 24.

A series of can-type perforated combustors 30 are positioned in chamber 29 generally in a tangential direction (see also FIG. 2). It should be noted in FIG. 2 that the median axes of combustors 30 are curved to minimize the outer diameter of the annular outer housing 28. The combustors 30 receive fuel via nozzles 32 from a suitable source and pressurized air within chamber 29 enters the combustors 30 to be mixed with the fuel.

The fuel-air mixture in combustors 30 is ignited and discharged into scroll-like ducts 34 that extend tangentially and somewhat forward to an integral annular turbine inlet duct 36. Duct 36 has an outlet 39 through which the gases pass aft a series of turbine inlet vanes 38 supported by inner and outer shrouds 46, 48 respectively. Inner shroud 48 is connected to a structural conical element 49 integral with diffuser 18. Inner shroud 46 forms a support for the inner wall of turbine inlet duct 36 through a suitable Z-joint 51.

The gases then pass across a bladed turbine rotor 40 mounted on shaft 16 and having a plurality of blades 42. Turbine rotor 40 is positioned generally within an annular structural turbine housing 60 having a forward mounting flange 54. An annular turbine shroud 56, surrounding the periphery of blades 42, is supported by flange 54 through a mounting element 58. A mounting element 52 for the shroud 48 abuts element 58. A mounting element 55 for the outer wall of turbine inlet duct 36 abuts mounting element 52. Mounting elements 58, 52 and 55 are held against flange 54 by bolt assemblies 57 suitably spaced around its periphery (see FIG. 2).

A plurality of struts 64 are secured to the sandwiched mounting elements 58, 52 and 55 by bolt assemblies 56 extending through flange 54. Struts 64 extend forward and slightly radially outward over the turbine inlet duct 36 to the diffuser 18 where they are secured by bolt assemblies 61 extending through the space between the diffuser passageways 22.

As shown in FIG. 2, struts 64 are positioned to extend in between the adjacent scroll-like ducts 34 to the diffuser housing 18. As herein illustrated there are three struts 64 positioned 120° apart. However, it will be apparent to those skilled in the art that other numbers may be utilized to structurally connect turbine housing 60 with diffuser 18.

Turbine housing 60 has an aft mounting flange 61 which receives an aft flange 29 of the housing 28. A mounting flange 63 of an exhaust duct housing 62 is secured to flanges 29 and 61 by a suitable arrangement.

A second bladed turbine rotor 66 is mounted on a shaft 68 within the engine outlet housing 62. Shaft 68 is suitably journaled for rotation and extends forward through shaft 44. Shaft 68 may be used to drive an additional compressor assembly or an output shaft. Turbine assembly 66 has a shroud 70 directly secured to structural element 60 through mounting element 71.

It will be apparent that the struts 64 enable a closely coupled direct structural support of the turbine housing 60 by the diffuser housing 18 which forms a part of the

outer structural housing of the engine. This greatly minimizes the deflection of the turbine housing 60 in response to the various stresses placed on it by the engine operating conditions.

The result of this direct connection is that the housing 28 need only be sized to support the pressure load from chamber 29 and the torque of the turbine for engine suspension at the compressor housing, rather than sized to provide the major support for the aft end of turbine housing 60. The reduction in overall engine weight due to the lower stress requirements of housing 28 is significant.

Additionally, because there is a reduced deflection of turbine housing 60, the shroud 56 which is supported by it may be formed to provide a closer clearance with respect to the turbine blades 42. This generally increases the efficiency of the engine and particularly for small engines having scroll-like combustors. The scroll-like combustors offer small engines the advantage of an ample amount of fuel per nozzle due to the small number of nozzles. Complicated ways of compensating for shroud deflection are also eliminated.

FIG. 3 illustrates a somewhat modified embodiment of the present invention. The combustors 30, as shown in FIG. 2, are removable from the scroll-like ducts 34 by slipping them out the end of ducts 34 and removing them radially outboard. In the embodiment shown in FIG. 3 a housing 28' is secured to a flange 74 integral with outlet housing 62'. A series of screws 76 attach the inner portion of housing 28' to the flange 74. A series of screws 78 secure the forward end of housing 28' to the housing 26'. It can be seen that the inner diameter 80 of housing 28' is sufficiently great to clear the maximum diameter of the annular outlet housing 62' so that the housing 28' may be removed in an axial direction, as shown in phantom, without disassembly of the engine. The result of this is that the combustors 30 may be removed radially for inspection or replacement without complete disassembly of the engine. This greatly facilitates maintenance of the engine.

While the preferred embodiment of the present invention has been shown, it will be apparent to those skilled in the art that modifications may be made without departing from the spirit and scope of the present invention.

Having thus described the invention, what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. A gas turbine engine comprising:
 - a generally annular structural housing;
 - a turbine journaled for rotation in said housing;
 - an annular outer housing for said turbine;
 - an annular turbine inlet duct adjacent said turbine, said turbine inlet duct having an annular outlet radially inward relative to said turbine housing;
 - a plurality of generally tangentially and inwardly directed scroll-like ducts receiving a hot gas stream at a point radially outward relative to said turbine housing and connecting with said inlet duct;
 - struts structurally interconnecting said turbine housing and said structural housing, said struts being positioned to extend directly between the scroll-like ducts outside of the hot gas stream passing into

said turbine inlet duct to a position on said structural housing axially spaced from said turbine housing and radially outward relative to said turbine shroud,

whereby said turbine housing is directly supported by said structural housing.

2. A gas turbine engine as in claim 1 further comprising:

a centrifugal compressor journaled for rotation in said housing and positioned so that the turbine inlet duct is in between the turbine and the compressor; a structural radial diffuser receiving the discharge from the periphery of said compressor and forming a portion of said engine housing,

said struts extending axially and radially outward from said turbine housing to said structural diffuser.

3. A gas turbine engine as in claim 1 wherein:

said annular turbine inlet duct discharges a hot gas stream across said turbine in an aft direction; and said scroll-like ducts extend forwardly to said turbine inlet duct.

4. A gas turbine engine as in claim 3 wherein:

said engine includes three scroll-like ducts equally spaced from one another; and said engine includes three struts spaced generally 120° apart and extending in between said scroll-like ducts.

5. A gas turbine engine as in claim 4 further comprising:

a combustor for each of said scroll-like ducts wherein said hot gas stream is generated; and a generally annular peripheral housing surrounding said combustors and forming a portion of said engine housing.

6. A gas turbine engine as in claim 5 wherein:

said combustors are removable from said scroll-like ducts in a direction which is generally radially outward with respect to the longitudinal axis of said engine housing; and

said peripheral housing for said combustors is removable from said engine in an axial direction whereby the combustors are free for radial removal.

7. A gas turbine engine as in claim 6 further comprising:

a centrifugal compressor journaled for rotation in said housing and positioned so that the turbine inlet duct is in between the turbine and the compressor; and

a structural radial diffuser receiving the discharge from the periphery of said compressor, said diffuser supporting the forward end of said struts and forming the forward connection for said peripheral combustor housing.

8. A gas turbine engine as in claim 1 wherein said turbine housing comprises an annular structural housing and an annular turbine shroud closely adjacent the periphery of said turbine.

9. A gas turbine engine as in claim 5 wherein the median axes of said combustors are curved to minimize the diameter of said annular peripheral combustor housing.

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