United States Patent

[11] 3,620,641

[72] Inventors **John Michael Storer Keen; Maurice John Byett; Francis Anthony Weston, all of Derby, England**

[21] Appl. No. **865,942**
[22] Filed **Oct. 13, 1969**
[45] Patented **Nov. 16, 1971**
[73] Assignee **Rolls-Royce Limited Derby, England**
[32] Priority **Oct. 6, 1966**
[33] **Great Britain**
[31] **44,764/66**
Continuation-in-part of application Ser. No. 668,387, Sept. 18, 1967, now abandoned. This application Oct. 13, 1969, Ser. No. 865,942

[54] **BEARING ASSEMBLY**
23 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **415/170, 415/217**
[51] **Int. Cl.** **F01d 11/08, F01d 1/02**
[50] **Field of Search** 415/115, 170, 219, 213, 180, 135, 217

[56] **References Cited**

UNITED STATES PATENTS

2,746,671	5/1956	Newcomb	415/115
2,937,847	5/1960	Stalker	415/213
3,421,686	1/1969	Coplin et al.	415/170
3,428,243	2/1969	Britt et al.	415/111

FOREIGN PATENTS

779,056	7/1957	Great Britain	415/135

Primary Examiner—Henry F. Raduazo
Attorney—Cushman, Darby & Cushman

ABSTRACT: A gas turbine engine comprises in flow sequence compressor means, combustion means and turbine means, the compressor means and the turbine means comprising bladed rotors, a shaft supporting at least one of said bladed rotors, a bearing in which said shaft is mounted, a fixed substantially cylindrical engine casing, two axially spaced apart substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, at least one of said panel members having a plurality of angularly spaced-apart dished portions, said portions being secured to the other of said panel members to brace together and interconnect the panel members.

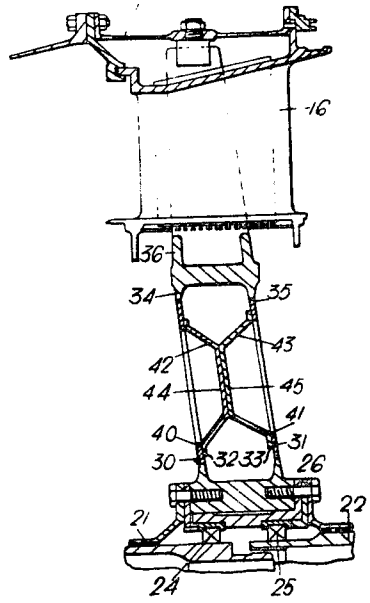


Fig. 1.

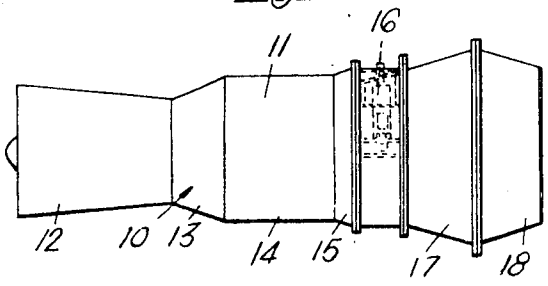
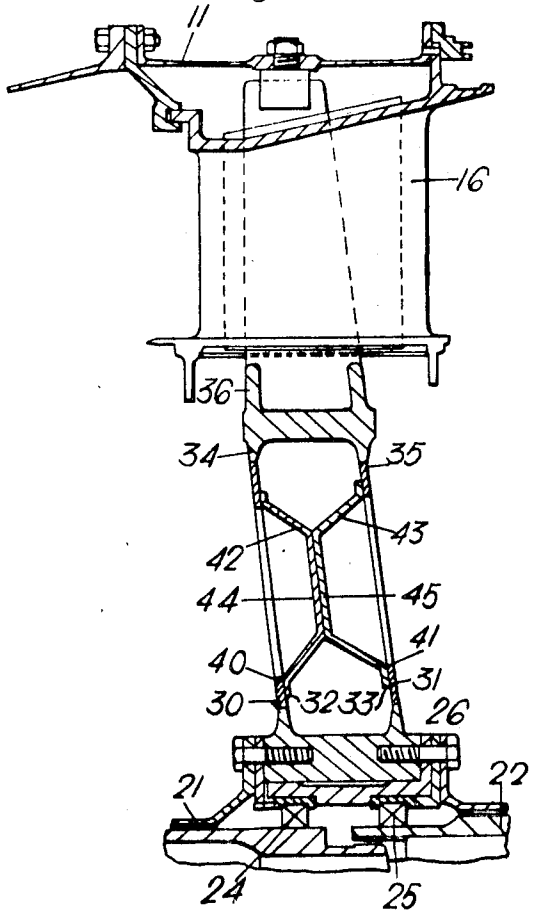
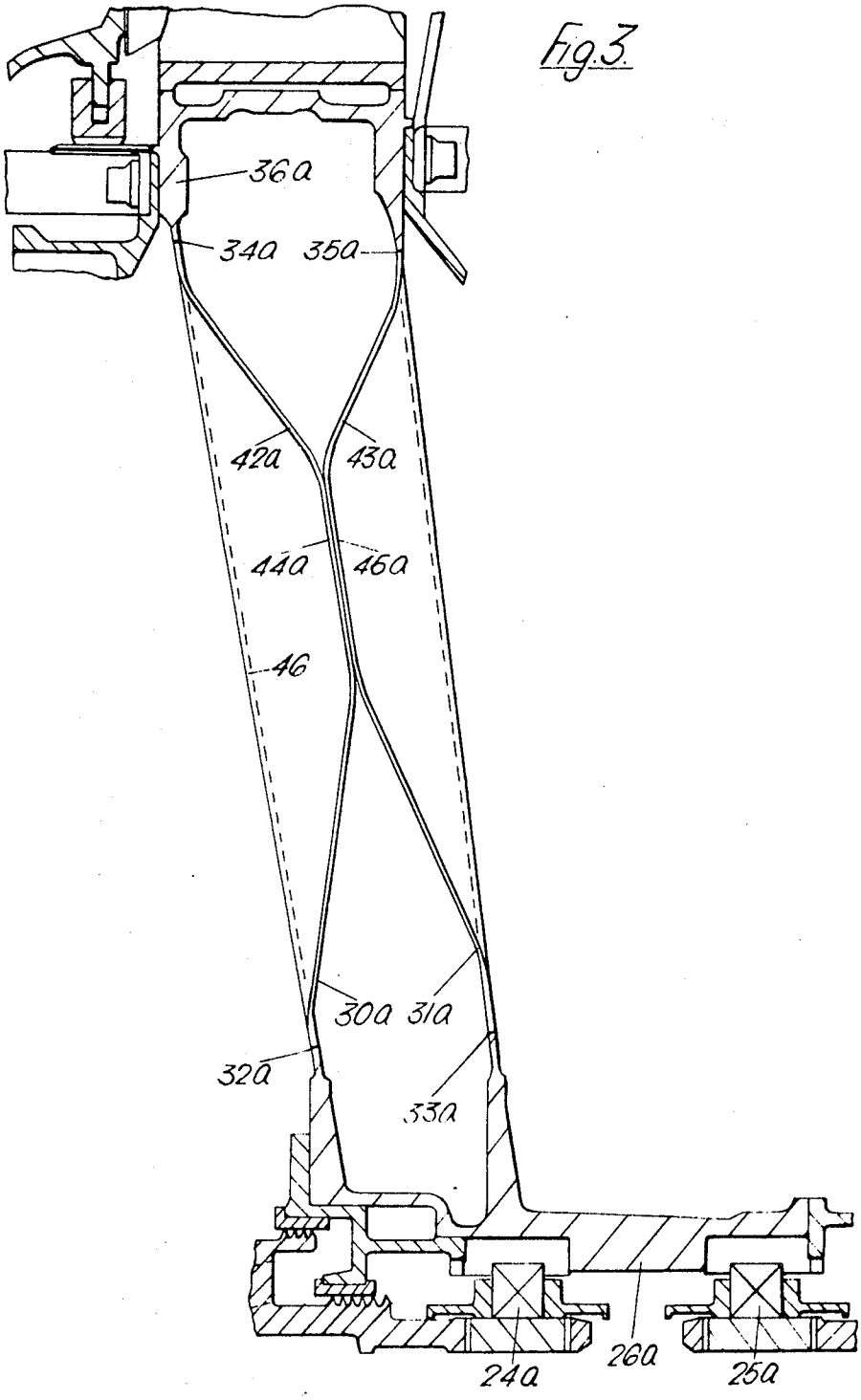


Fig. 2.



Inventors
JOHN MICHAEL STORER KEEN
MAURICE JOHN BYETT
FRANCIS ANTHONY WESTON
By
Cushman, Darby & Cushman
Attorneys

Fig.3.



Inventors
JOHN MICHAEL STORER KEEN
MAURICE JOHN BYETT
FRANCIS ANTHONY WESTON
By
Cushman, Darby & Cushman
Attorneys

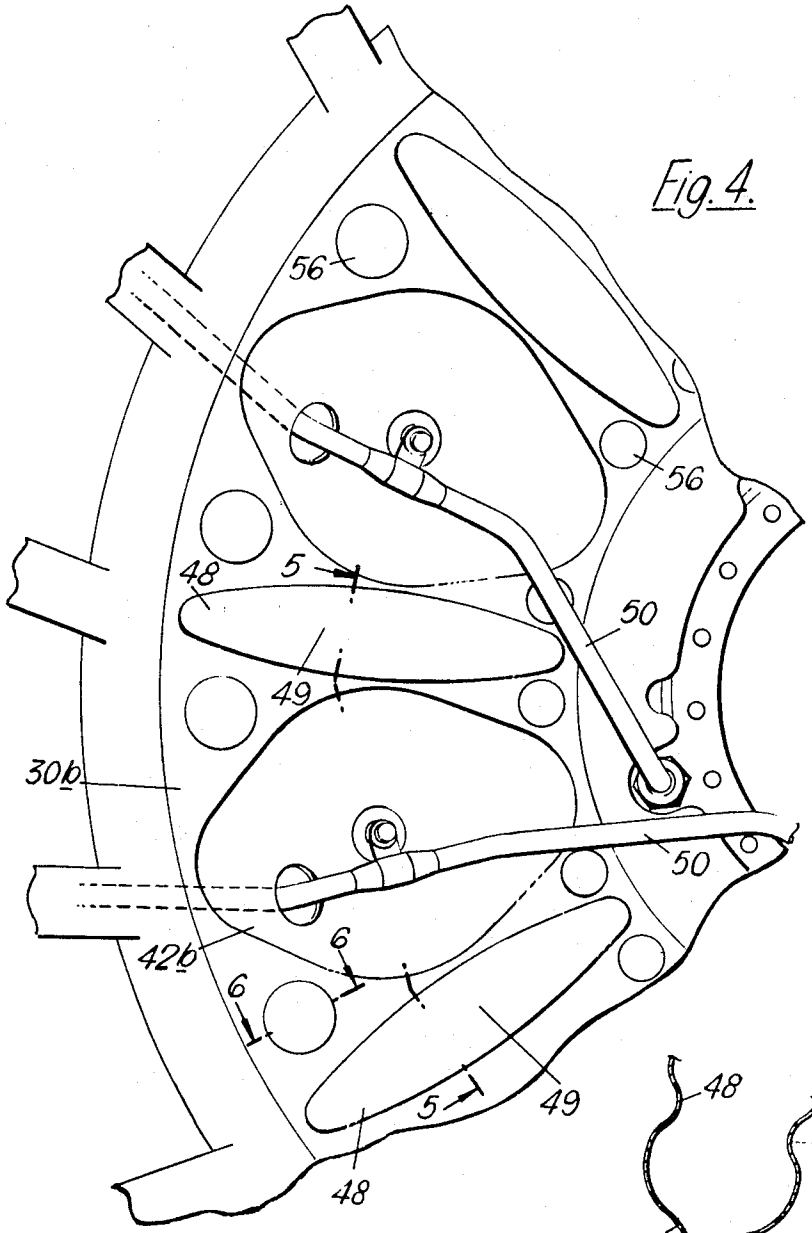


Fig. 4.

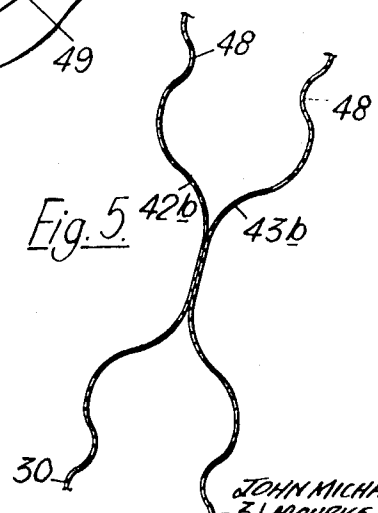


Fig. 5



Fig. 6.

Inventors
JOHN MICHAEL STORER KEEN
MAURICE JOHN BYETT
FRANCIS ANTHONY WESTON
By
Cushman, Darby & Cushman
Attorneys

Fig. 7.

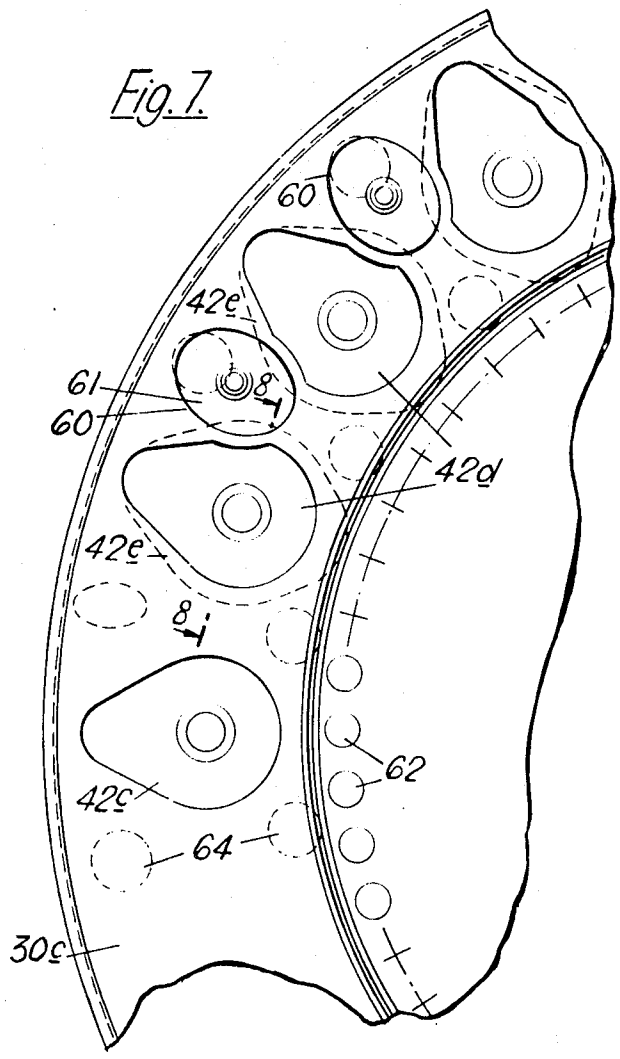
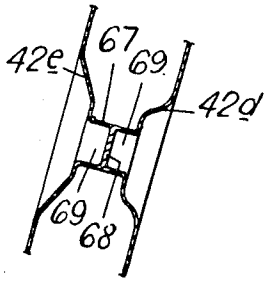


Fig. 8.



Inventors:
JOHN MICHAEL STOBER KEEN
MAURICE JOHN BYETT
FRANCIS ANTHONY WESTON
By
Cushman, Darby & Cushman
Attorneys

BEARING ASSEMBLY

This application is a continuation-in-part of our copending application Ser. No. 668,387 filed Sept. 18, 1967 and now abandoned. This invention concerns a bearing assembly of a gas turbine engine.

In aircraft gas turbine engines there is a continuous conflict between the weight and the necessary structural strength of parts of the engine. This conflict is particularly marked in the large structures that are employed to support the central shaft or shafts of the engine, that is to say the shafts each of which carry at least one bladed rotor of the engine.

Therefore, it is an object of the present invention to provide a bearing support structure having a high degree of stiffness in both the axial and radial directions, and also a high degree of stiffness against rocking motion of a shaft supported therein, while the weight of the structure is kept to an acceptable value.

Accordingly, the invention provides a gas turbine engine comprising in flow sequence compressor means, combustion means and turbine means, the compressor means and the turbine means comprising bladed rotors, a shaft supporting at least one of said bladed rotors, a bearing in which said shaft is mounted, a fixed substantially cylindrical engine casing, two axially spaced-apart substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, at least one of said panel members having a plurality of angularly spaced-apart dished portions, said portions being secured to the other of said panel members to brace together and interconnect the panel members.

The dished portions may be substantially lozenge shaped. By "lozenge shaped" we mean generally rounded in outline, but not necessarily symmetrical, and this term is intended to include shapes ranging from circular, through oval to markedly elongated or boat shaped.

Thus, the dished portions each may have major and minor axes, the major axis extending radially on the shaft.

Thus, the dished portions may be elliptical.

At least one panel member may have corrugated portions between the dished portions.

The corrugated portions may be constituted by elongated dished portions, the major axis of each elongated dished portion extending radially of the shaft.

Said dished portions may be of relatively rounded shape, further dished portions being interposed between the relatively rounded dished portions, and being of relatively elongated shape, each relatively elongated dished portion having a major axis which extends radially of the shaft.

There may be provided in each dished portion a deeper dished portion which secures the said dished portion to the other of said panel members.

There may be means defining apertures in regions of the at least one panel member which are not dished, the edges of the apertures being deformed out of the planes of the apertures, forming stiffened rims therefor.

The dished portions may be secured to the other offset panel members by welding.

The said dished portions may be integrally formed in said at least one panel member.

Said angularly spaced apart dished portions may be provided in both panels, said portions being arranged in pairs, one from each panel, the portions of each panel having their bases secured together.

There may be for each said pair of dished portions a connecting member extending between said bases securing them together, said connecting member being an open-ended tubular member having an internal dividing wall, each open end being respectively secured in an aperture in the respective base, forming a deeper dished portion therein.

There may be an axially extending bearing support ring, said bearing being supported by said ring and said panel members being connected to said ring, a further bearing also being supported by the ring.

There may be a plurality of angularly spaced-apart struts secured to said engine casing, said panel members being secured to said struts, a plurality of hollow nozzle guide vanes, each of said struts extending through one of said guide vanes.

The invention will be described, merely by way of example, with reference to the accompanying drawings, wherein:

FIG. 1 is a diagrammatic view of a gas turbine engine provided with a bearing assembly according to the present invention,

FIG. 2 is a broken away sectional view of a larger scale of part of the structure of the engine of FIG. 1,

FIG. 3 is a broken-away sectional view of a modification,

FIG. 4 is an axially facing view of another modification,

FIG. 5 is a section on line 5—5 of FIG. 4,

FIG. 6 is a section on line 6—6 of FIG. 4,

FIG. 7 is an axially facing view of another modification, and

FIG. 8 is a section on line 8—8 of FIG. 7.

In FIG. 1 there is shown a gas turbine jet propulsion engine **10** having an engine casing **11** within which are mounted in flow series a low-pressure compressor **12**, a high-pressure compressor **13**, combustion equipment **14**, a high-pressure turbine **15**, a plurality of angularly spaced-apart hollow nozzle guide vanes **16**, a low-pressure turbine **17** and an exhaust duct **18**.

The high-pressure turbine **15** drives the high-pressure compressor **13** by way of a shaft **21** (FIG. 2), while the low-pressure turbine **17** drives the low-pressure compressor **12** by way of shaft **22**, a portion of the shaft **21** being mounted concentrically within a portion of the shaft **22**.

The portion of the shafts **21**, **22** are mounted respectively within roller bearings **24**, **25** respectively. The bearings **24**, **25** are mounted within and supported by a common axially extending bearing support ring **26**.

The bearing support ring **26** is supported from the fixed cylindrical structure constituted by the engine casing **11**, by way of two axially spaced substantially radially extending annular panel members **30**, **31** which are welded to the bearing support ring **26** at **32**, **33** respectively. The panel members **30**, **31** are welded at **34**, **35** to a plurality of angularly spaced-apart common struts **36** each of which passes through a respective hollow nozzle guide vane **16** and is bolted to the engine casing **11**. Alternatively, fastenings such as nuts and bolts may be used to fasten the struts **36** to the panel members **30**, **31**.

The panel members **30**, **31** are respectively provided with a number of angularly spaced-apart holes **40**, **41** into which are welded circular or elliptical dished portions or members **42**, **43** respectively. The base **44** of each dished member **42** is welded to a base **45** of a corresponding dished member **43**. The dished members **42**, **43** thus interconnect the panel members **30**, **31** and also brace the panel members **30**, **31** together.

Alternatively, only one of the panel members **30**, **31** need be provided with angularly spaced-apart holes **40**, **41**, the dished members **42** then having their edges welded to the holes **40** and having their bases welded to the opposite panel member **31**.

In another alternative, each panel member **30**, **31** may have angularly spaced-apart holes **40**, **41**, the holes in one panel member being staggered relative to the holes in the other panel member so that the dished members **42**, **43** have their bases welded to one panel member while their edge portions are welded to the other panel member. Thus with this arrangement the dished members **42**, **43** are arranged so that they face alternately in the opposite directions with their bases and edge portions respectively fastened to alternate panel members **30**, **31**.

In FIG. 3 there is shown a modification in which a bearing support ring **26*a*** is employed, which houses roller bearings **24*a***, **25*a*** and whose upstream end is supported from a strut **36*a*** by way of two axially spaced substantially radially extending annular panel members **30*a***, **31*a*** which are welded to the bearing support ring **26*a*** at **32*a***, and to the strut **36*a*** at **34** Ia, **35*a*** respectively. The strut **36*a*** extends through hollow nozzle guide vanes as in the FIG. 2 construction.

The panel members 30*a*, 31*a* are respectively provided with a plurality of angularly spaced-apart lozenge-shaped (preferably substantially elliptically shaped) dished portions 42*a*, 43*a* whose bases 44*a*, 45*a* are respectively welded to each other, whereby to interconnect and brace the panel members 30*a*, 31*a* together. Each of the panel members 30*a*, 31*a* is provided, between its adjacent dished portions, with corrugated portions 46 to take radial loads from the bearings 24*a*, 25*a*. The dished portions 42*a*, 43*a* create an axially stiff structure to take axial gas loads.

A further possibility is for one only of the panel members 30*a*, 31*a* to have a plurality of angularly spaced-apart dished portions whose bases are welded to the other panel member.

The structure shown in FIGS. 2 and 3 is stiff both axially, radially and about a diametrical axis, and is relatively simple and inexpensive to manufacture. Moreover, it enables the bearings to be supported by structure extending through the nozzle guide vanes and thus without increasing the length of the engine. By reason of its said stiffness, the structure is such as to make it easy to provide passages (not shown) for cooling air and thereby to afford protection for oil pipes (not shown) in what is normally a very hot region.

The structures hereinafter described with reference to FIGS. 4 to 7 have similar advantages.

In FIG. 4, the panel members 30*b*, 31*b* (only one shown) have a number of angularly spaced-apart lozenge-shaped dished portions 42*b* of relatively rounded shape, further shallow dished portions 42*b* of relatively rounded shape, further shallow dished portions 48 being interposed between the relatively rounded dished portions 42*b*. The dished portions 48 are of markedly elongated form, and have their major axes 49 extending radially of the shaft 22 of the engine. As can be seen from FIG. 5, the relatively rounded dished portions 42*b*, 43*b* are welded together, but the shallow elongated dished portions 48, which are provided in both the panel members 30, 31, are not joined together and constitute corrugated portions between the relatively rounded dished portions 42*b*, 43*b*.

FIG. 4 also illustrates how pipes such as 50 may conveniently be routed through the panel members 30*b*, 31*b*.

Holes 54, 56 are provided in regions of the panel members which are not dished. As can be seen from FIG. 6, the edges of the holes 54, 56 are deformed out of the planes of the holes to form stiffened rims 58 therefor. By providing holes with stiffened rims, the weight of the structure is reduced, but the stiffness is not undesirably reduced.

In the embodiment of FIG. 7, panel members 30*c*, 31*c* have dished portions of different shapes. The panel member 30*c* (shown in full lines) has lozenge-shaped dished portions which are generally pear shaped as shown at 42*c*, 42*d*, it will be noted that the dished portions at 42*d* have small reentrant curves on their flanks to clear holes 60 in undished portions of the panel member 30*c*. The edges of the holes 60 are deformed in the same way as described with reference to FIG. 6, and may be arranged to permit the passage of, and support by means of webs 61, pipes or cooling air ducts.

Although the lozenge-shaped dished portions 42*c*, 42*d* are shown as having their larger ends radially inward, they may be reversed, so that the larger end is radially outward.

An undished region of the panel member 30*c* is provided with holes 62 having deformed edges as in FIG. 6.

The other panel member 31*c* is disposed behind the panel member 30*c*, when viewed as in FIG. 7, and has dished portions 42*e* of a generally rounded lozenge shape which are shown dotted in FIG, 7. The shape of these dished portions 42*e* is very similar to the dished portions 42*b* of FIG 4. Holes 64 (shown dotted) having rims as shown in FIG. 6, are provided in the undished regions of the panel member 31*d*.

Referring to FIG. 8, it will be seen that the pairs of dished portions 42*c*, 42*d*, 42*e* have their bases secured together by a connecting member 67 of open-ended tubular form, the connecting member 67 having an internal dividing wall 68. Each open end of the connecting member is respectively secured e.g. by welding or brazing in an aperture in the base of a respective dished portion 42*c*, 42*d* or 42*e*, thus forming a deeper dished portion 69 therein. Each tubular connecting member 67 may if desired be made in two cup-shaped parts joined at their bases to form the internal wall 68. Of course, if desired, the deeper dished portion 69 can be provided in the other types of dished portions 42 described previously Also, a single cup-shaped member may be employed to provide a dished portion 42 with a deeper dished portion 68 and to join it directly to the other panel member, instead of the base of another cup-shaped member.

We claim:

1. A gas turbine engine comprising in flow sequence compressor means, combustion means and turbine means, the compressor means and the turbine means comprising bladed rotors, a shaft supporting at least one of said bladed rotors, a bearing in which said shaft is mounted, a fixed substantially cylindrical engine casing, two axially spaced-apart substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, at least one of said panel members having a plurality of angularly spaced apart dished portions, said at least one panel member having corrugated portions between said dished portions, and said dished portions being secured to the other of said panel members to brace together and interconnect the panel members.

2. A gas turbine engine as claimed in claim 1 wherein the dished portions are substantially lozenge shaped, as herein defined.

3. A gas turbine engine as claimed in claim 2 wherein the dished portions each have major and minor axes, the major axes extending radially of the shaft.

4. A gas turbine engine as claimed in claim 2 wherein the dished portions are elliptical.

5. A gas turbine engine as claimed in claim 1 wherein the corrugated portions are constituted by elongated dished portions, the major axis of each elongated dished portion extending radially of the shaft.

6. A gas turbine engine as claimed in claim 1 wherein said dished portions are of relatively rounded shape, further dished portions being interposed between the relatively rounded dished portions, and being of relatively elongated shape, each relatively elongated dished portion having a major axis which extends radially of the shaft.

7. A gas turbine engine as claimed in claim 1 comprising in each dished portion a deeper dished portion which secures the said dished portion to the other of said panel members.

8. A gas turbine engine as claimed in claim 1 comprising means defining apertures in regions of at least one panel member which are not dished, the edges of the apertures being deformed out of the planes of the apertures, forming stiffened rims therefor.

9. A gas turbine engine as claimed in claim 1 wherein the dished portions are secured to the other of said panel members by welding.

10. A gas turbine engine as claimed in claim 1 wherein the said dished portions are integrally formed in said at least one panel member.

11. A gas turbine engine as claimed in claim 1 wherein said angularly spaced-apart dished portions are provided in both panels, said portions being arranged in pairs, one from each panel, the portions of each pair having their bases secured together.

12. A gas turbine engine as claimed in claim 11, comprising for each said pair of dished portions a connecting member extending between said bases securing them together, said connecting member being an open-ended tubular member having an internal dividing wall, each open end being respectively secured in an aperture in the respective base, forming a deeper dished portion therein.

13. A gas turbine engine as claimed in claim 1 including an axially extending bearing support ring, said bearing being supported by said ring and said panel members being connected to said ring, a further bearing also being supported by the ring.

14. A gas turbine engine as claimed in claim 1 including a plurality of angularly spaced-apart struts secured to said engine casing, said panel members being secured to said struts, a plurality of hollow nozzle guide vanes, each of said struts extending through one of said guide vanes.

15. A gas turbine engine comprising in flow sequence compressor means, combustion means, and turbine means, a shaft supporting at least one of said compressor means and said turbine means, a bearing in which said shaft is mounted, a fixed cylindrical engine casing, two axially spaced substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, at least one of said panel members having a plurality of angularly spaced-apart dished portions each of which is secured to the other of said panel members to brace together and interconnect the same, said dished portions being elliptical in shape, said at least one panel member having corrugated portions between the dished portions thereof.

16. A gas turbine engine as claimed in claim 15 wherein the said dished portions are integrally formed in said at least one panel member.

17. A gas turbine engine as claimed in claim 15 wherein said angularly spaced-apart dished portions are provided in both panels, said portions being arranged in pairs, one from each panel, the portions of each pair having their bases secured together.

18. A gas turbine engine as claimed in claim 15 including an axially extending bearing support ring, said bearings being supported by said ring and said panel members being connected to said ring, a further bearing also being supported by the ring.

19. A gas turbine engine as claimed in claim 15 including a plurality of angularly spaced-apart struts secured to said engine casing, said panel members being secured to said struts, a plurality of hollow nozzle guide vanes, each of said struts extending through one of said guide vanes.

20. A gas turbine engine comprising in flow sequence compressor means, combustion means and turbine means, the compressor means and the turbine means comprising bladed rotors, a shaft supporting at least one of said bladed rotors, a bearing in which said shaft is mounted, a fixed substantially cylindrical engine casing, two axially spaced-apart substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, at least one of said panel members having a plurality of angularly spaced-apart dished portions, said dished portions being secured to the other of said panel members to brace together and interconnect the panel members, said dished portions being of relatively rounded shape, and further dished portions being interposed between the relatively rounded dished portions and being of relatively elongated shape, each relatively elongated dished portion having a major axis which extends radially of the shaft.

21. A gas turbine engine as claimed in claim 20 comprising in each dished portion a deeper dished portion which secures the said dished portion to the other of said panel members.

22. A gas turbine engine as claimed in claim 20 comprising means defining apertures in regions of the said at least one panel member which are not dished, the edges of the apertures being deformed out of the planes of the apertures, forming stiffened rims therefor.

23. A gas turbine engine comprising in flow sequence compressor means, combustion means and turbine means, the compressor means and the turbine means comprising bladed rotors, a shaft supporting at least one of said bladed rotors, a bearing in which said shaft is mounted, a fixed substantially cylindrical engine casing, two axially spaced-apart substantially radially extending annular panel members, said bearing being supported from the fixed casing by way of said panel members, both panel members having a plurality of angularly spaced-apart dished portions, said dished portions being arranged in pairs, one from each panel member, and a connecting member for each said pair of dished portions extending between the bases of said dished portions and securing them together, each said connecting member being an open-ended tubular member having an internal dividing wall, each open end being respectively secured in an aperture in the respective base, forming a deeper dished portion therein.

* * * * *