

617005

COMMONWEALTH OF AUSTRALIA

Patents Act 1952

APPLICATION FOR A STANDARD PATENT

We, WESTINGHOUSE ELECTRIC CORPORATION of 1310 Beulah Road, Churchill, Pittsburgh, Pennsylvania, 15235, United States of America, hereby apply for the grant of a standard patent for an invention entitled:

"METHOD AND APPARATUS FOR VANE SEGMENT SUPPORT
AND ALIGNMENT IN COMBUSTION TURBINES"

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION:

<u>Country</u>	<u>Date</u>	<u>Number</u>
United States of America	19th October 1988	259,811

Our address for service is:

PETER MAXWELL & ASSOCIATES,
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5 Ross Street,
NORTH PARRAMATTA. N.S.W. 2151

Dated this 21st day of September, 1989

WESTINGHOUSE ELECTRIC
CORPORATION,
By its Patent Attorneys:
PETER MAXWELL & ASSOCIATES

P. Maxwell

To: Commissioner of Patents
File: 89 1 097

F011087 25/09/89

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952-1954

DECLARATION IN SUPPORT OF A CONVENTION
APPLICATION UNDER PART XVI FOR A PATENT

In support of the Convention Application made under Part XVI of the Patents Act 1952-1954 by WESTINGHOUSE ELECTRIC CORPORATION for a patent for an invention entitled "METHOD AND APPARATUS FOR VANE SEGMENT SUPPORT AND ALIGNMENT IN COMBUSTION TURBINES"

I, GORDON H. TELFER
of 252 PENHURST DRIVE, PITTSBURGH, PENNSYLVANIA, United States of America, do solemnly and sincerely declare as follows:

1. I am authorized by WESTINGHOUSE ELECTRIC CORPORATION, the applicant for the patent, to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in the United States of America on October 19, 1988, by the inventors nominated in clause (3) below.

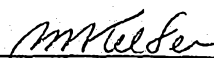
3. LEROY DIXON McLAURIN, ROLAND E. WILLIAMS, JOHN PAUL DONLAN, KENT GORAN HULTGREN of, respectively, 1727 Seneca Boulevard, Winter Springs, FL 32708, USA; 524-202 Via Verona Lane, Altamonte Springs, FL 32714, USA; 2357 Westminster Terrace, Oviedo, FL 32765, USA; 506 School Lane, Swarthmore, PA 19081, USA, are the actual inventors of the invention and the facts upon which WESTINGHOUSE ELECTRIC CORPORATION is entitled to make the application are as follows:

The said WESTINGHOUSE ELECTRIC CORPORATION is the assignee of the said LEROY DIXON McLAURIN, ROLAND E. WILLIAMS, JOHN PAUL DONLAN, KENT GORAN HULTGREN.

4. The basic application referred to in paragraph 2 of this declaration was the first application made in a convention country in respect of the invention the subject of the application.

Declared at Pittsburgh, Pennsylvania

This 12th day of September, 1989


G. H. Telfer
Senior Chief Counsel

To,
THE COMMISSIONER OF PATENTS,
COMMONWEALTH OF AUSTRALIA.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-41660/89
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 617005

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259811 19.10.88 US UNITED STATES OF AMERICA
- (43) Publication Date : **26.04.90**
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- (71) Applicant(s)
WESTINGHOUSE ELECTRIC CORPORATION
- (72) Inventor(s)
LEROY DIXON MCLAURIN; ROLAND E. WILLIAMS; JOHN PAUL DONLAN; KENT GORAN HULTGREN
- (74) Attorney or Agent
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- (56) Prior Art Documents
US 4286921
US 3829233
US 2942844
- (57) Claim

1. A combustion turbine having an inlet air compressor portion , a combustor portion and an exhaust portion and a rotor having rows of turbine blades mounted thereon and segmented vane structures supported in said turbine between outer and inner cylinders adjacent to the first row of turbine blades for directing the combustion gases onto said blades , characterized in that the vane segments of said segmented vane structures are supported at their outer circumference by said outer cylinder and that they have radial slots formed at their radially inner ends and further that bushing assemblies are supported in openings formed in support structure associated with said inner cylinder , said assemblies having eccentric pins projecting into the radial slots in said vane segments and being angularly adjustably mounted in said openings so as to permit adjustment of the inner support for said vane segments .



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Form 10

PATENTS ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

Int. Cl.:

Application Number:

Lodged:

Complete Specification—Lodged:

Accepted:

Lapsed:

Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: WESTINGHOUSE ELECTRIC CORPORATION

Address of Applicant: 1310 Beulah Road, Churchill, Pittsburgh,
Pennsylvania 15235, United States of America

Actual Inventor: LEROY DIXON McLAURIN
ROLAND E. WILLIAMS
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NORTH PARRAMATTA N.S.W. 2151

Complete Specification for the invention entitled:
METHOD AND APPARATUS FOR VANE SEGMENT SUPPORT AND ALIGNMENT IN
COMBUSTION TURBINES

The following statement is a full description of this invention, including the best method of performing it known to me:—

* Note: The description is to be typed in double spacing, pica type face, in an area not exceeding 250 mm in depth and 180 mm in width, on tough white paper of good quality and it is to be inserted inside this form.

This invention relates generally to combustion or gas turbines, and more particularly to combustion turbines having vane segment support and alignment devices.

5 Over two thirds of large, industrial combustion turbines are in electric-generating use. Since they are readily started, combustion turbines are primarily used by electric utility companies for peak-load duty.

10 A typical combustion turbine is comprised of four basic portions: (1) an inlet portion; (2) a compressor portion; (3) a combustor portion; and (4) an exhaust portion. Air entering the combustion turbine at its inlet portion is compressed adiabatically in the compressor portion, and is mixed with a fuel and heated at a constant
15 pressure in the combustor portion. Thereafter, the heated air is discharged through the exhaust portion with a resulting adiabatic expansion of the gases completing the basic combustion turbine cycle. This basic combustion turbine cycle is generally referred to as the Brayton or
20 Joule cycle.

A major reason for reduced turbine efficiency is misalignment of the vane segments in a turbine with respect to a stationary cylinder assembly. It is generally desirable to closely align the vane segments
25 radially between the inner and outer cylinders of the turbine unit so that aerodynamic drag on the vane segments is minimized. The aerodynamic forces should be taken up

directly by the casing of the combustion turbine.

Prior art arrangements utilize vane segments with inner and outer shrouds in a generally low-load environment wherein the vane segments and shrouds are firmly mounted to the inner and outer cylinders as shown for example in U.S. Patent 3,824,034. However, due to the large sizes of combustion turbines in use today it is impractical and uneconomical to physically remove the vane segments and shrouds from the cylinders in order to manually align and remount the vane segments when aerodynamic forces have reduced turbine efficiency. Furthermore, although misalignment of the vane segments in a turbine occurs relatively frequently especially in high-load environments, frequent fine-tuning alignment of the vane segments is impossible with the prior art designs.

Accordingly it is a general object of the present invention to provide combustion turbine, in which first row turbine vane segment alignment between the inner and outer cylinders of the combustion turbine may be readily adjusted.

With this object in view, the present invention resides in a combustion turbine having an inlet air compressor portion, a combustor portion and an exhaust portion and a rotor having rows of turbine blades mounted thereon and segmented vane structures supported in said turbine between outer and inner cylinders adjacent to the first row of turbine blades for directing the combustion gases onto said blades, characterized in that the vane segments of said segmented vane structures are supported at their outer circumference by said outer cylinder and that they have radial slots formed at their radially inner ends and further that bushing assemblies are supported in openings formed in support structure associated with said inner cylinder, said assemblies having eccentric pins projecting into the radial slots in said vane segments and being angularly adjustably mounted in said openings so as to permit adjustment of the inner support for said vane segments.

With this arrangement, misalignment of the vanes between the inner and outer cylinders caused by aerodynamic forces upon the vane segments of the first row of stationary vanes can easily be eliminated since the vane segment aligning structure can be readily operated to properly position the plurality of vane segment. Furthermore aerodynamically induced torques and moments are properly transferred to the inner and outer cylinders equally thereby reducing the chances for dynamic misalignment of the vane segments during turbine operation. Improved alignment of the vane segments in the combustion turbine dramatically improves turbine efficiency, thus reducing costs of electricity production. Additionally, vane segment alignment is easily performed in a minimal amount of time thereby reducing maintenance costs and down time for the combustion turbine.

The invention will become more readily apparent from the following description of preferred embodiments thereof described, by way of example only, in the accompanying drawings, wherein:

Figure 1 is a layout of a typical electric generating plant which utilizes a combustion turbine;

Figure 2 is an isometric view partially cut away of the combustion turbine shown in Figure 1;

Figure 3 shows one of a plurality of vane segments on a combustion turbine mounted to an inner and outer cylinder;

Figure 4 depicts a preferred embodiment of the vane segment support and alignment device as it engages a vane segment; and

Figure 5 is a cross section of the vane segment support and alignment device cut along the 5-5 line of Figure 4.

Figure 1 shows the layout of a typical electric generating plant 2 utilizing a well-known combustion turbine 4 (such as the model W-501D single shaft, heavy duty combustion turbine that is manufactured by the Combustion Turbine Systems Division of Westinghouse

Electric Corporation). As is conventional, the plant 2 includes a generator 6 driven by the turbine 4, a starter package 8, an electrical package 10 having glycol cooler 12, a mechanical package 14 having an oil cooler 16, and an air cooler 18, each of which supports the operating turbine 4. A silencer 20 is disposed at the turbine exhaust end. Terminals 22 are provided at the generator 6 for conducting the generated electricity therefrom. Figure 2 is an isometric view of the turbine 4 in greater detail. The turbine 4 generally has an inlet portion 24, a compressor portion 26, a combustor portion 28, and an exhaust portion 30. Air entering the turbine 4 at its inlet portion 24 is compressed adiabatically in a compressor portion 26, and is mixed with a fuel and heated at a constant pressure in the combustor portion 28. The heated fuel/air gases are thereafter discharged from the combustor portion 28 through the exhaust portion 30.

The compressor portion 26, is of an axial flow configuration having a rotor 32, which includes a plurality of rotating blades 34 mounted on a shaft 36. A casing 40 encloses the entire turbine.

Figure 3 shows a basic vane segment support arrangement wherein the vane segment 38 is mounted between an outer cylinder 42 and an inner cylinder 44. Vane segment 38 is generally fixed to outer cylinder 42 at 46.

As shown in Figure 3, the vane segment 38 is provided with a slot 48 by way of which it is supported circumferentially with respect to inner cylinder 44 while permitting radial expansion of the vane segment relative to the inner cylinder 44.

Referring now to Figure 4, the vane segment 38 is adjustably engaged with the inner cylinder 44. Slot 48 in vane segment 38 receives a pin 50 which is part of an eccentric assembly 52 mounted on the inner cylinder 44 thereby allowing pin 50 to adjust the vane segment 38 as the eccentric bushing assembly 52 is rotated. The bushing assembly 52 is supported by a torque plate 56 which is mounted to the inner cylinder 44 by bolts 72 and which has

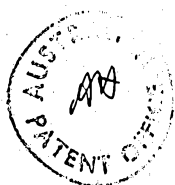
a bore 58 extending therethrough adjacent the slot 48 of an adjacent vane segment 38. The bore 58 has a central bushing assembly support section 59, a splined locking section 60 at its inner end and a threaded outer end receiving a cover plate 54. The bushing assembly 52 has a large diameter cylindrical mounting portion disposed in the support section 59 of the bore 58 and a splined locking portion 62 received in the locking section 60 from which the pin 50 projects eccentrically into the vane segment slot 48. The locking portion 62 is relatively short so that, upon loosening of the cover plate 54, the bushing assembly can be retracted so as to disengage it from the locking section 60 while the large diameter mounting portion of the bushing assembly 52 remains rotatably supported in the support section 59. The assembly may then be rotated for adjustment of the vane segment 38 and then re-engaged with the splined locking section 60. The cover plate 54 firmly screwed into the threaded outer end of the bore 58 retains the bushing assembly in the desired position to properly support the vane segments 38. The threads on the torque plate 56 and cover plate 54 are peened at 70 to prevent loosening of the cover plate 54.

A small axial clearance 64 is provided between the torque plate 56 and vane segment 38 to permit radial growth movement of the vane segment 38.

Figure 5 is a view of the vane segment alignment device viewed along the 5-5 line of Figure 4. Figure 5 illustrates the peening and splining arrangement of the eccentric bushing 52 with the torque plate 56 and cover plate 54. The peening area of the torque plate and cover plate is shown at 68.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A combustion turbine having an inlet air compressor portion, a combustor portion and an exhaust portion and a rotor having rows of turbine blades mounted thereon and segmented vane structures supported in said turbine between outer and inner cylinders adjacent to the first row of turbine blades for directing the combustion gases onto said blades, characterised in that the vane segments of said segmented vane structures are supported at their outer circumference by said outer cylinder and that they have radial slots formed at their radially inner ends and further that bushing assemblies are supported in openings formed in support structure associated with said inner cylinder, said assemblies having eccentric pins projecting into the radial slots in said vane segments and being angularly adjustably mounted in said openings so as to permit adjustment of the inner support for said vane segments.
2. A combustion turbine according to claim 1, characterised in that said support structure is a torque plate mounted on said inner cylinder adjacent to the slot area of said vane segment.
3. A combustion turbine according to claim 2, characterised in that said opening in said torque plate has a central bushing assembly support section and adjacent thereto a splined locking section of smaller diameter and smaller axial extent than said central support section such that said bushing assembly is firmly supported in said torque plate



when its splined locking section is disengaged from the corresponding splined section of the torque plate for adjustment of a respective vane segment.

4. A combustion turbine according to claim 3, characterised in that said torque plate has an outer end portion provided with internal threads and a cover plate is mounted therein to retain said bushing assembly in the opening of said torque plate.

5. A combustion turbine according to claim 4, characterised in that said cover plate is locked to said torque plate.

6. A combustion turbine substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 21st day of August 1991.

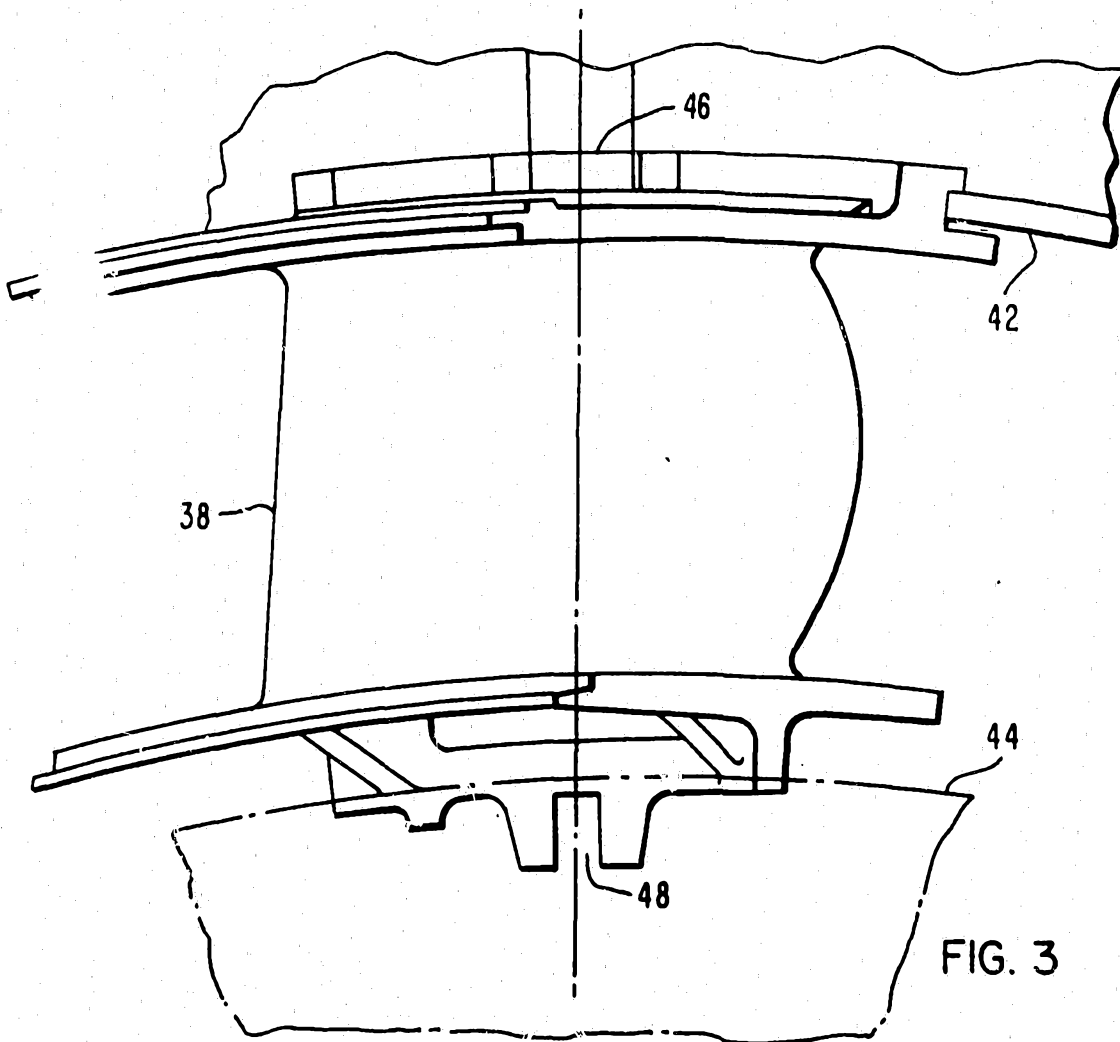
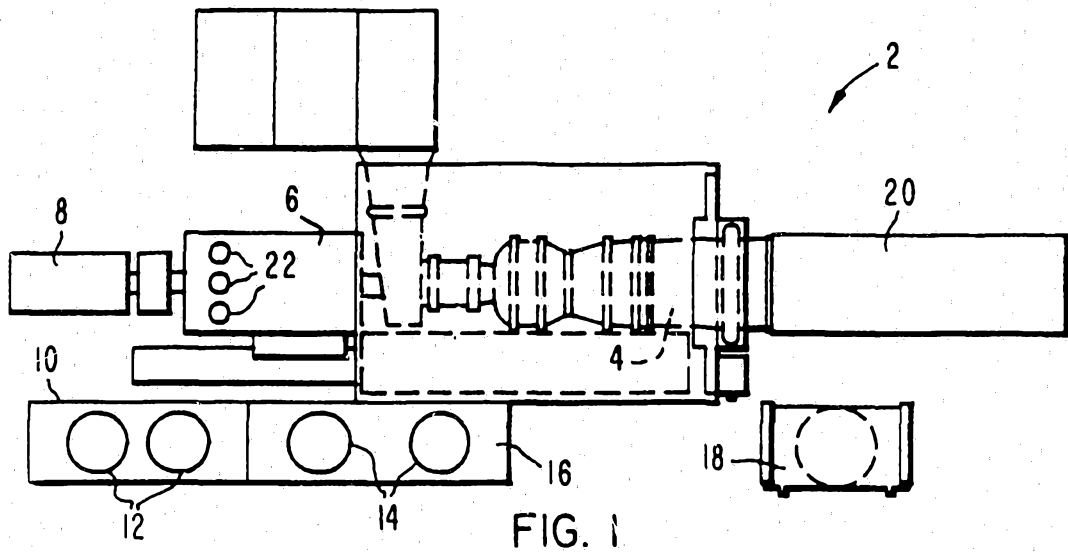
WESTINGHOUSE ELECTRIC CORPORATION,

Patent Attorneys for the Applicant:

PETER MAXWELL & ASSOCIATES



41660/89



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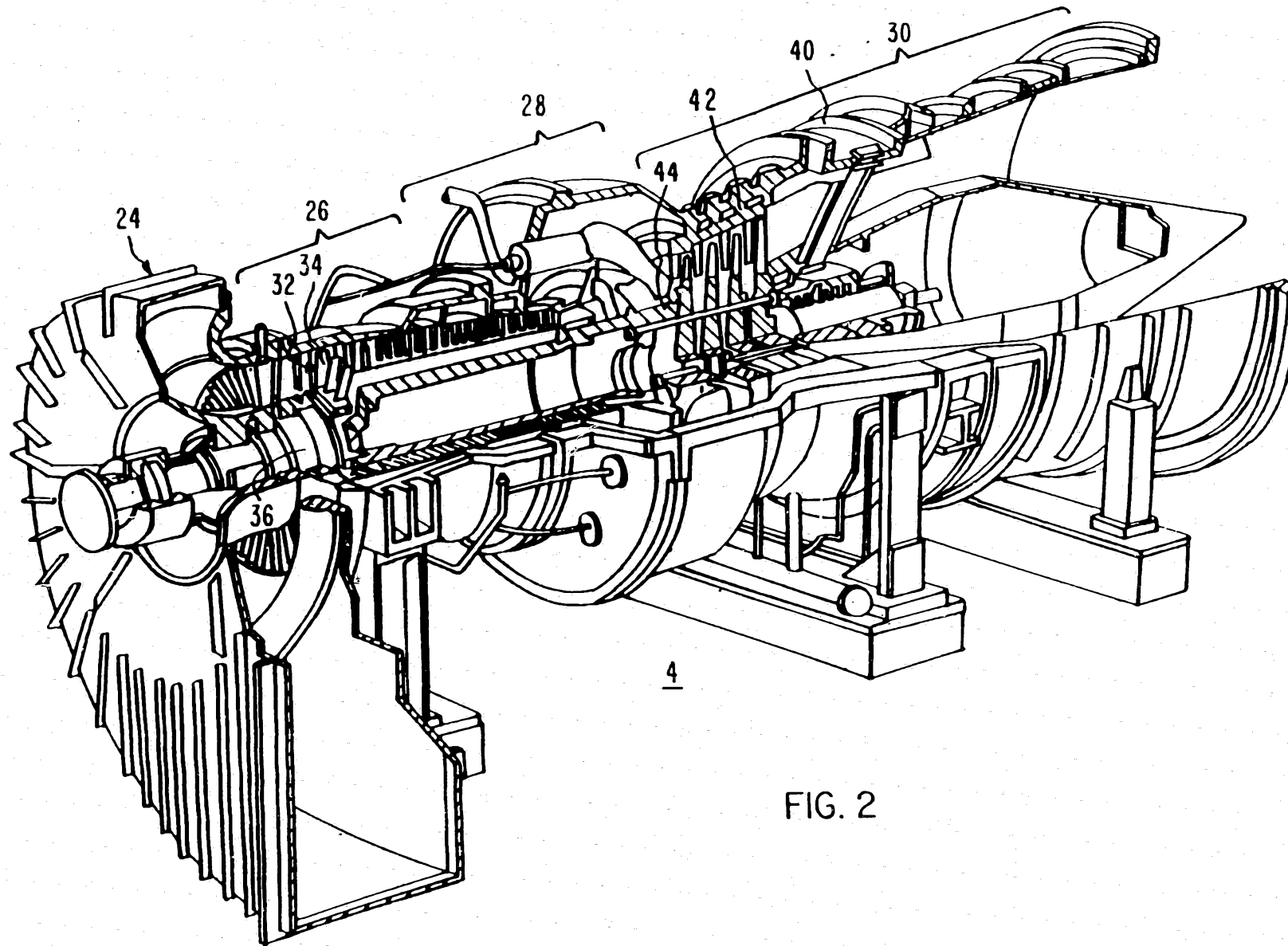


FIG. 2

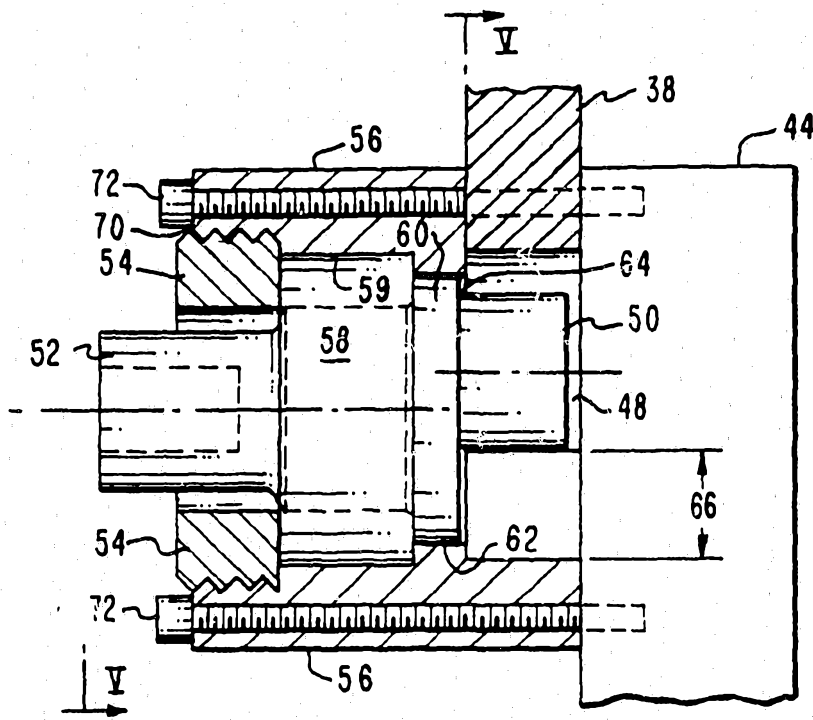


FIG. 4

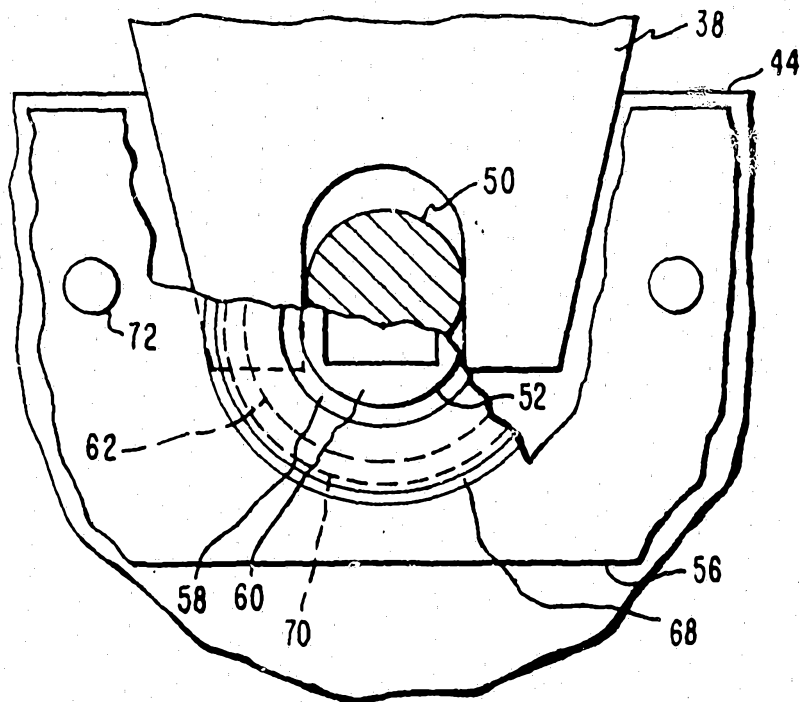


FIG. 5