United States Patent [19]

Peabody et al.

[11] **3,861,827**

[45] **Jan. 21, 1975**

[54] **DIAPHRAGM SUPPORT LUGS**

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[22] Filed: **Mar. 12, 1974**

[21] Appl. No.: **450,542**

[52] **U.S. Cl.** **415/219,** 415/217, 248/2

[51] **Int. Cl.** **F01d 25/24,** F01d 25/28

[58] **Field of Search** ..... 415/126, 219 R, 217, 218, 415/199; 248/2, 14, 17

[56] **References Cited**

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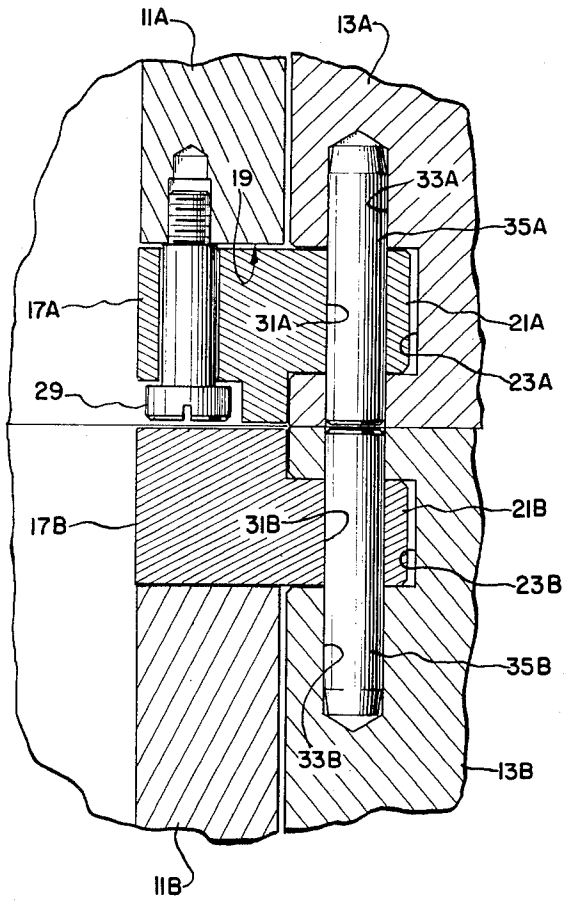
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[57] **ABSTRACT**

In a turbomachine casing divided along a horizontal joint into upper and lower casing halves, a diaphragm is supported on each side by upper and lower lugs including shoulder portions which interlock with respective upper and lower diaphragm halves. A vertical pin is inserted through each shoulder and into abutting diaphragm portions to prevent relative movement between the turbine casing and diaphragm.

5 Claims, 3 Drawing Figures



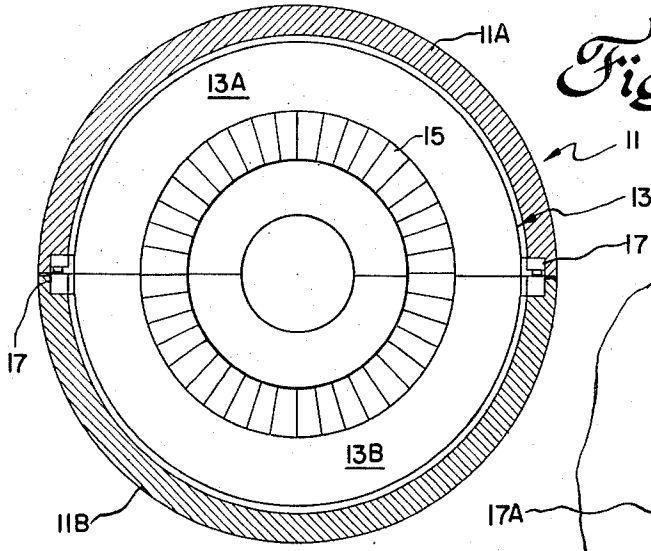


Fig. 1

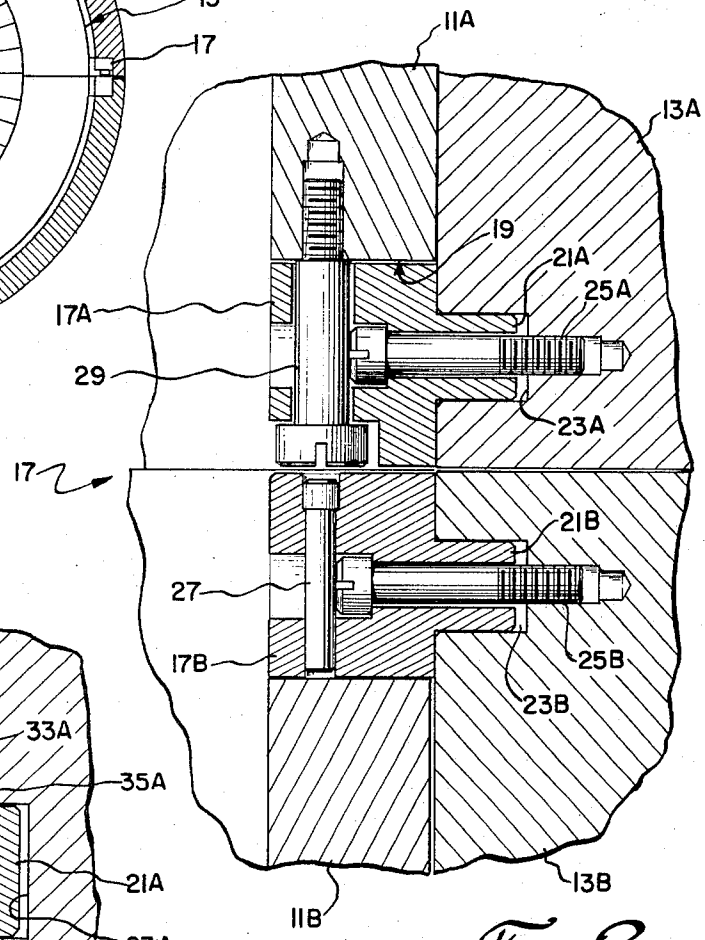


Fig. 2
(PRIOR ART)

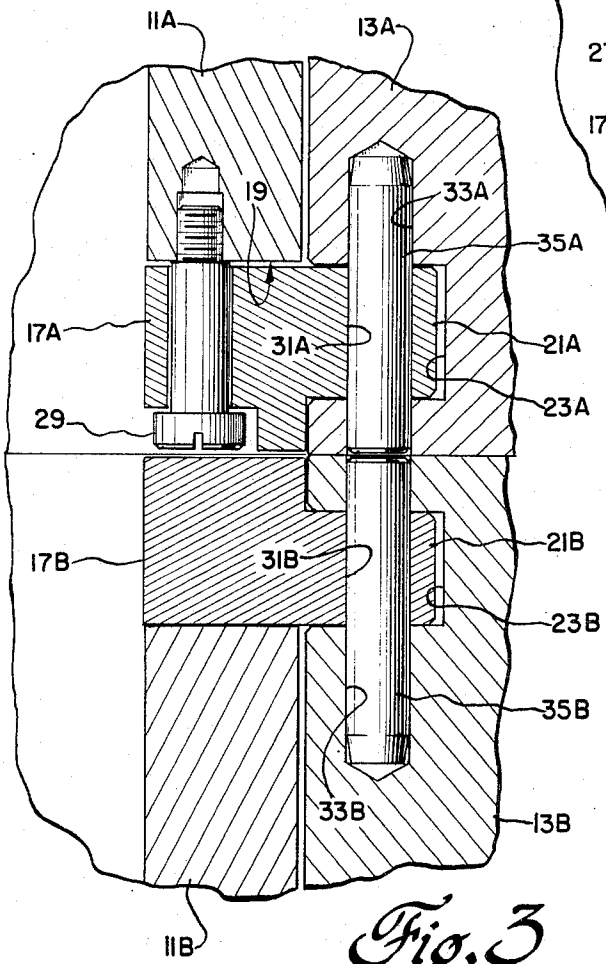


Fig. 3

DIAPHRAGM SUPPORT LUGS

BACKGROUND OF THE INVENTION

This invention was made under contract with the U.S. Government, Department of the Navy. The invention relates, in general, to turbomachines; and, in particular, to means for supporting a turbine diaphragm relative to the turbine outer casing.

A turbomachine such as a steam turbine includes an outer casing having a rotor mounted therein. An axial flow steam path may be defined by several stages each comprised of a turbine wheel and a diaphragm. Each turbine wheel is attached to the rotor, rotatable therewith, and includes an annular array of radial, outwardly extending blades. Each diaphragm is attached to the turbine outer casing and forms an annulus around the rotor. The diaphragm includes stationary nozzles approximately aligned with its respective turbine wheel blades and at its inner diameter includes shaft packings. As is well known in the art, the purpose of the diaphragm is to prevent axial leakage of steam while defining an axial flow path for steam through its nozzle portion. Accordingly, radial clearances between the diaphragm and outer casing; and, between the diaphragm and rotor are critical. Misalignment, caused by support lug failure may have deleterious effects on turbine operation such as loss of efficiency and packing rub which can necessitate turbine shutdown.

It is one object of the present invention to provide a diaphragm support capable of withstanding vertical shock loads.

It is another object of the present invention to provide a diaphragm support wherein staking screws are obviated.

The present invention is applicable but not limited to turbomachines used in naval applications such as submarines. Such vessels may encounter vertical shock loadings due to enemy ordnance such as depth charges. This invention is particularly useful in turbomachinery having an outer casing divided along its horizontal centerline into upper and lower casing halves. Each casing half on each side includes a step or cutout for accommodating upper and lower support lugs. Each support lug is formed with an axially extending shoulder which is inserted into a respective upper or lower diaphragm slot forming an interlocking joint on each side of the turbine casing upper and lower halves. Vertical dowels or pins are inserted through each lug shoulder and abutting diaphragm portions whereby relative movement is prevented between the turbine casing and diaphragm.

The novel features believed characteristic of the present invention are set forth in the appended claims. The invention itself, however, together with further objects and advantages thereof, may best be understood with reference to the following description, taken in connection with the appended drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an end elevation view of a turbomachine casing and diaphragm.

FIG. 2 is an enlarged side elevation view of a turbomachine horizontal joint in the axial direction according to the prior art.

FIG. 3 is an enlarged side elevation view of a turbomachine horizontal joint in the axial direction according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, a turbomachine outer casing 11, divided along its horizontal joint, includes upper and lower casing halves 11A and 11B, respectively. Within the outer casing is a diaphragm 13, also divided along its horizontal axis into upper and lower diaphragm halves 13A and 13B. When assembled, the diaphragm forms an annulus about the rotor (not shown) including an annulus of nozzle blades 15. Part of the diaphragm support is provided by lugs 17 on each side of the outer casing. There may be other support means provided between the diaphragm and outer casing such as a vertical adjustment screw (not shown) along the vertical axis in the lower casing but this does not form part of the present invention.

FIG. 2 shows one type of diaphragm support according to the prior art wherein like numbers correspond to like parts. Upper and lower casing halves include a step or cutout portion 19 along the horizontal axis at the diaphragm location. Lower lug 17B includes a shoulder 21B which extends axially into slot 23B formed in the lower diaphragm. A screw 25B is then inserted parallel to the horizontal joint through lug 17B and into the lower diaphragm 13B. The screw 25B is then staked by a vertical pin 27. Alignment of the diaphragm may be provided by shaving the underside of lower lug 17B.

The upper diaphragm 13A is assembled to the upper outer casing 11A in a similar manner. Upper lug 17A is inserted into cutout 19 and includes an axially extended shoulder 21A. The shoulder 21A is inserted into a slot 23A in the diaphragm and the assembly is held together by screw 25A. Screw 25A is staked by the bolt 29 which is drilled into the upper casing half. Bolt 29 is a lifting bolt so that when upper casing 11A is removed from the lower casing, the diaphragm will be retained in the upper casing.

Having described the prior art, and now referring to FIG. 3 wherein like parts are given like numbers, upper and lower casing halves 11A and 11B have a stepped or cutout portion 19 at the diaphragm location, one on each side of the turbine for each diaphragm. A lower lug 17B is axially inserted into the cutout and includes a shoulder 21B inserted into a diaphragm slot 23B of the lower diaphragm half 13B. An upper lug 17A is inserted into the cutout and includes a shoulder 21A inserted into a diaphragm slot 23A of the upper diaphragm half 13A. A lifting bolt 29 anchors the upper diaphragm to the upper casing.

Both the upper and lower lug shoulders 21A and 21B are formed with holes 31A and 31B, respectively, which are in the vertical direction. Each diaphragm half is formed with upper holes 33A and lower holes 33B which are vertical and aligned with the shoulder holes. An upper vertical fastener 35A and a lower vertical fastener 35B are inserted in the upper and lower shoulder and diaphragm holes. The vertical fasteners may be dowel pins.

The following advantages and operations are now pointed out with respect to FIG. 3. Staking pins in the lower support lugs are obviated. Vertical pins 35A and 35B are dowel pins and hence not threaded providing a stronger connection between the lug shoulders and diaphragms. Under vertical shock loading slight defor-

mations of the shoulders, in the arrangement shown in FIG. 2 (prior art) may cause failure in tension and bending of screws 25A and 25B whereas vertical loadings in the invention as shown and described in FIG. 3 can withstand considerably higher vertical shock loadings.

While there is shown what is considered, at present, to be the preferred embodiment of the invention, it is, of course, understood that various other modifications may be made therein. Such modifications may include a single dowel pin rather than upper and lower dowel pins for each side of the turbine casing. It is intended to claim all such modifications as fall within the true spirit and scope of the present invention.

What is claimed is:

1. A turbomachine including an outer casing divided along a horizontal joint into upper and lower outer casing halves and further including a diaphragm within the outer casing, the diaphragm divided into upper and lower diaphragm halves within the outer casing; and, means for mounting the diaphragm halves within their respective outer casing halves comprising:

upper and lower casing lugs mounted in a cutout portion on each side of the outer casing;

a shoulder formed on each lug;

a slot formed on each side of a respective diaphragm half, each shoulder extending into its respective diaphragm slot;

at least one substantially vertical fastener on each side of the turbomachine casing, each fastener having a portion thereof positioned in at least one shoulder and another portion thereof positioned in the diaphragm whereby movement of the diaphragm relative to the outer casing is prevented.

2. The device recited in claim **1** wherein there is one substantially vertical fastener for each casing lug, the fastener inserted through each shoulder and having each end terminating in a portion of the diaphragm abutting the shoulder.

3. The device recited in claim **1** wherein each vertical fastener is a smooth pin.

4. The device recited in claim **1** wherein each lug shoulder and each diaphragm slot extend in the axial direction.

5. The device recited in claim **1** wherein each vertical fastener is perpendicular to the horizontal centerline of the turbomachine.

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