

[54] **TURBINE WITH LOAD FORCE DETERMINING DEVICE**

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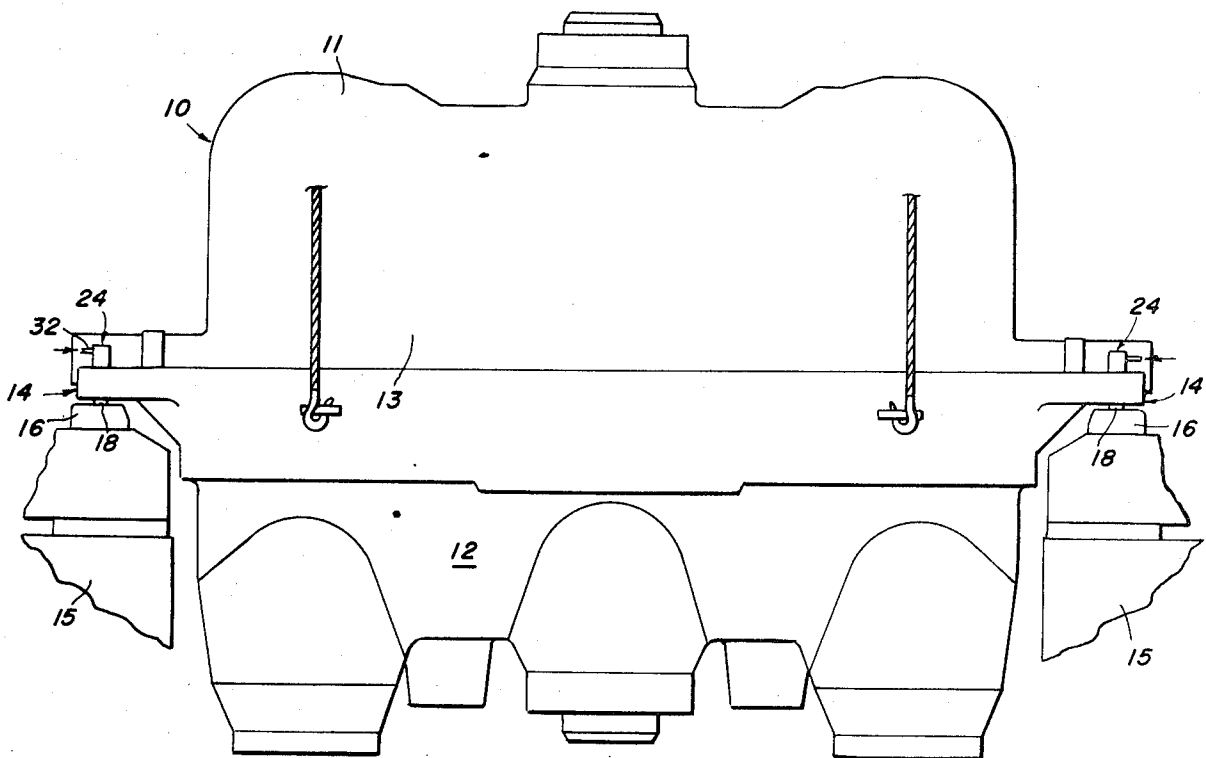
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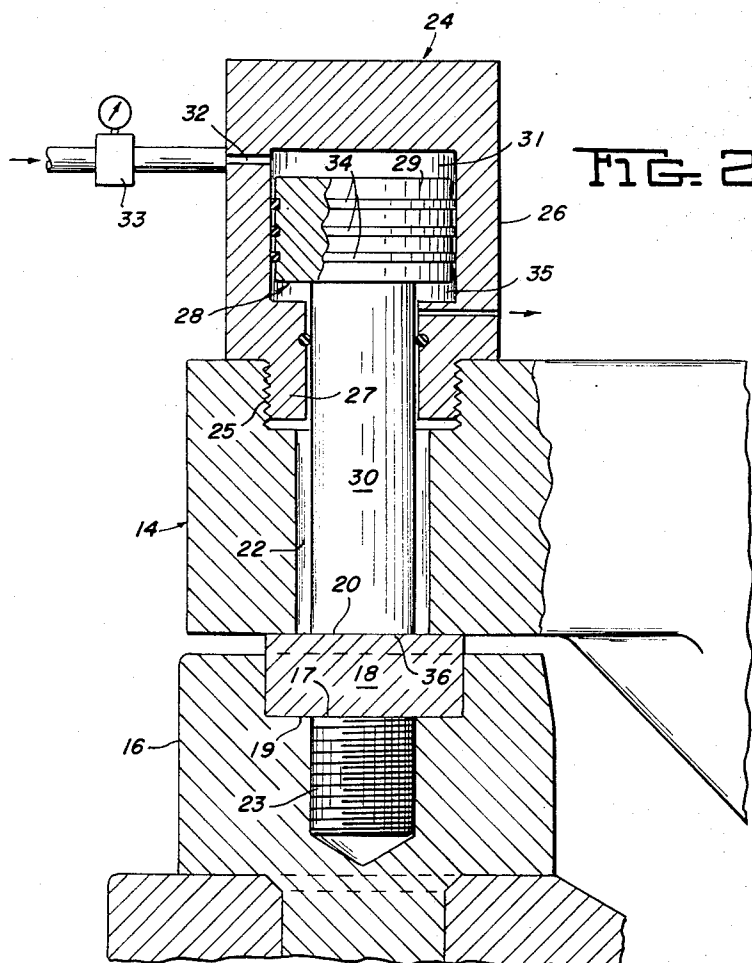
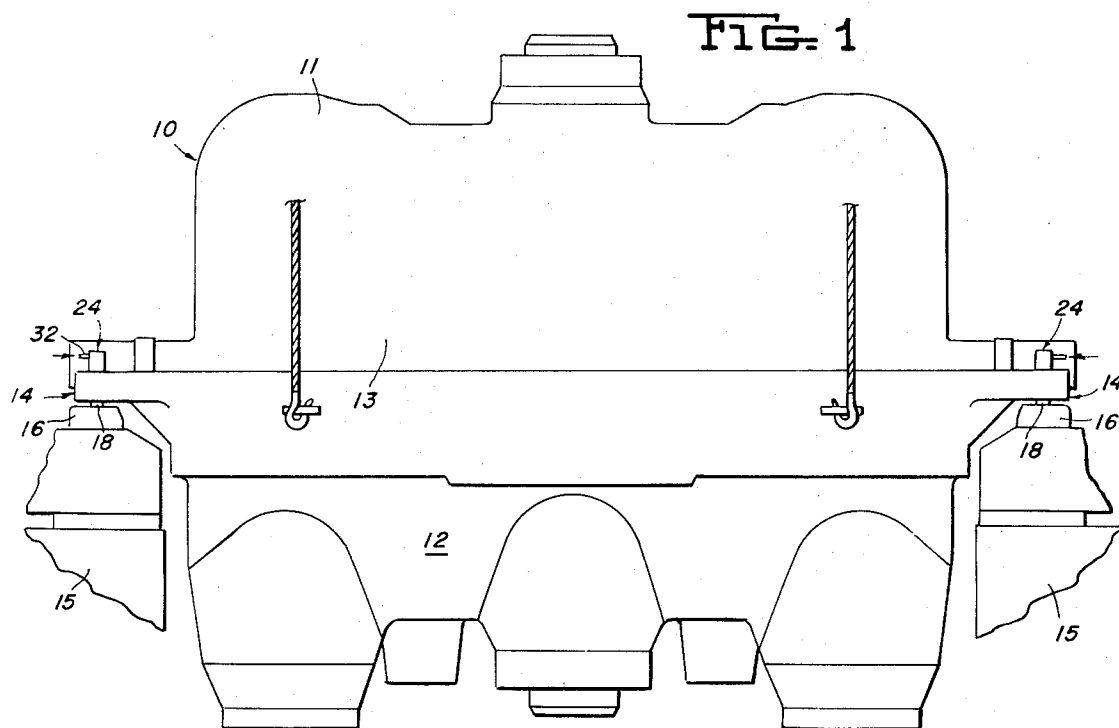
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ABSTRACT

The weight loading distribution of a turbine assembly upon respective supporting pedestals is determined to facilitate the adjustment of the loading to conform to the design value. A load determining device for use in combination with the turbine installation is set forth, as well as a method of achieving the design loadings.

7 Claims, 2 Drawing Figures





TURBINE WITH LOAD FORCE DETERMINING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to elastic fluid turbine installations. The modern day turbine is a massive, heavy apparatus which can weigh several hundred thousand pounds. It has, therefore, become very important to distribute the turbine weight accurately on the supporting installation according to the designed loadings.

In a high and intermediate pressure steam turbine installation, four support paws extend from the bottom casing of the turbine and are slidably supported on mounting pedestals which extend from the overall supporting foundation. The turbine rotor is inserted in place with its own bearing supports. Then the cover portion is put in place with the mating bottom casing forming an enclosing turbine casing or housing. A plurality of steam pipes are then connected to the turbine casing at predetermined locations.

It has been the practice in trying to properly distribute the turbine weight on the supporting structures, to get an indication of the loading of the assembled turbine on one support relative to the other supports. This is done by utilizing the station crane to lift each paw off its pedestal support, removing the support key upon which the paw sets, and thereafter taking the strain off the crane cable to allow the paw to droop or be displaced downwardly. The displacement from an initial reference position is next measured to give an indication of the relative loading of each paw upon its support pedestal. Shims are inserted beneath the paws, in a trial and error technique, until the droop measurements are approximately equal, if the loadings are designed to be equal.

It is desirable to be able to accurately determine the actual value of the individual paw loadings to facilitate distribution of the turbine weight in a predetermined manner on the mounting pedestals. This becomes even more important where due to non-symmetrical supporting effects from pipes attached to the turbine casing or cylinder, paw loadings are not designed to be equal.

The reason that the paw loading values are to agree with the design values is that, if there is an imbalanced loading condition during turbine operation, torque applied to the turbine housing or cylinder will act on an imbalanced housing. The turbine housing may then ride off a pedestal, or actually rotate some small degree about the turbine axis of rotation, thereby altering the internal seal clearances within the turbine, with the possibility of serious damage to the turbine. It is, therefore, very important that the design loading values be achieved so that the housing will be substantially unaffected by the torque acting on the turbine housing or casing.

SUMMARY OF THE INVENTION

A turbine installation combination is provided which makes it possible to accurately determine the loadings of individual turbine paws upon mounting pedestals from which the turbine is supported. The combination allows for a method of distributing the turbine weight according to a predetermined design.

An elastic fluid turbine installation comprises a turbine including a housing, and a plurality of support

paws extending therefrom. A foundation structure for supporting the turbine is included which has a plurality of support pedestals extending therefrom. Each support pedestal has a horizontal support surface upon which respective support paws of the turbine rest. In the improved combination a load force determining device is connected with the support paw and arranged so as to determine the loading force of the turbine on a respective support surface, upon lifting of a support paw from rest position. The determination of the loading force for each support surface facilitates distribution of the turbine weight in a predetermined, weight distribution pattern upon each support surface and support pedestal.

The load force determining device is readily usable in a method of providing a predetermined weight distribution pattern for the turbine upon the support structure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of an elastic fluid turbine installation constructed according to the present invention.

FIG. 2 is an enlarged view in section taken through the middle of a support paw showing the structure of the load force determining device in combination with turbine support portions.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention can be best understood by reference to the exemplary embodiment shown in the drawings. In the turbine installation shown in FIG. 1, the elastic fluid turbine 10 includes a casing 11 which comprises a bottom half portion 12 and a removable top half cover portion 13. A plurality of support paws 14, typically four, extend from the bottom portion 12 of the housing 11. Such support paws 14 are provided on high and intermediate pressure turbines, and while the invention is particularly adapted for such turbines, it is not limited thereto and may be utilized on other apparatus. The casing 11 is also referred to in the art as a housing, or a turbine cylinder.

A massive foundation 15, formed from reinforced concrete or other high strength material is generally rigid, supports the turbine 10 and has a plurality of support pedestals 16, which extend generally vertically therefrom. The pedestals generally have a horizontal support surface 17. In the illustrated embodiment, four support pedestals are shown, each having a horizontal support surface 17. Each pedestal 16 has a support liner 18 disposed within a recessed portion 19 of the pedestal. The top surface 20 of each support liner 18 also forms a substantially horizontal support surface upon which respective support paws 14 rest.

Each support paw 14 is provided with a vertically extending aperture 22 therethrough, which is aligned with a threaded aperture 23 provided in a respective support pedestal 16, to allow for insertion of a hold down bolt, not shown, which is screwed into place when the turbine weight distribution has been adjusted to agree with the design value for each support pedestal.

A load force determining device comprising a high pressure hydraulic jack assembly 24 is shown temporarily connected to the support paw 14. The top portion 25 of the paw aperture 22 is counterbored and threaded. The hydraulic jack assembly 24 comprises a

generally hollow body portion 26, preferably cylindrical and including a cylindrical neck portion 27 which is externally threaded to engage the top portion 25 of the paw aperture 22 whereby the hydraulic jack assembly 24 is connected to the support paw 14. The hydraulic jack assembly 24 has a generally cylindrical piston 28 with a piston head portion 29 disposed within the body portion 26 and a piston rod 30. The piston head portion 29 has an accurately determined surface area which is in contact with a high pressure hydraulic fluid. A hydraulic fluid chamber 31 is defined between the piston head 29 and the body portion 26. Hydraulic fluid inlet and outlet means 32 are provided on the body portion to allow injection and removal of hydraulic fluid from the chamber 31. A high pressure indicating gauge 33 is in the line from a cooperative hydraulic pump (not shown). A plurality of high pressure seals 34 are circumferentially disposed about the piston head 29, between the piston head 29 and the body portion 26, to prevent leakage of the hydraulic fluid. A hydraulic fluid collecting enclosure 35 is provided within the body portion 26, beyond the seals 34 and the piston head 29, to collect any fluid which does leak past the seals 34. The piston rod 30 extends from the piston head 29, and is generally an integrally formed part with the head. The piston rod 30 extends through the neck portion 27, and is of a length sufficient to be directed through paw aperture 22, with the furthest extending horizontal surface portion 36 of the rod portion 30 resting upon the support liner 18. A hydraulic pump (not shown) supplies high pressure hydraulic fluid to the jack assembly 24, and the body portion 26 is forced upwardly when the fluid pressure is sufficient to overcome the turbine loading. The rod portion 30 of the piston 28 supports the turbine loading. The body portion 26, being connected to the support paw 14, lifts the paw when the body portion 26 is displaced upward. This upward displacement should be minimized and be just sufficient for the support paw 14 to clear the support surface 20 of the liner 18, which is of the order of thousands of an inch displacement. Excessive displacement should be avoided as it can damage the internal seals within the turbine.

When the support paw 14 is clear of the support surface 20, a reading of the hydraulic fluid pressure on gauge 33 is taken. The turbine load or weight lifted by the jack assembly 24 is then determined as the product of the hydraulic fluid pressure and the area of the piston head 29 which is in contact with the fluid, i.e., the top surface area of piston head 29. A determination is then made of the loading of each support paw on respective support surfaces. This can be done successively or simultaneously.

When the load forces are thus known, a comparison is made with the calculated design load value for each support surface. The load forces can be adjusted to agree with the calculated design value by typically inserting shim means between the support surface and the support paw. This will adjust the weight distribution pattern of the turbine on the respective supports. This process is continued with a new load force being determined, until the load forces agree with the design values. The solid liner 18 shown in the drawings is then removed and an operational liner, not shown, is inserted in its place, the only difference being that the operational liner has an aperture through it which is aligned with the paw aperture and the pedestal aperture, to

permit a hold bolt to be inserted. The shim means, which can be simply metal sheet of predetermined thickness is inserted between the operational lines and the support surface. An overhead crane can be used to lift the support paw to permit the substitution of the operational liner and final shim means for the solid liner 18. The hydraulic jack assembly 24 is also removed to allow the insertion of this operational liner and shim means, with a hold down bolt being inserted through the aligned apertures.

By way of a typical example, the counterbore top portion 25 of the paw aperture 22 has a diameter of approximately 5 inches and is threaded with a pitch of about 6 threads per inch. The piston head portion 29 has an approximate diameter of 4 inches. The hydraulic jack assembly described has an approximate lift capacity of 125,000 pounds, with a hydraulic fluid pressure of about 10,000 pounds per square inch.

It has generally been the practice to design a turbine installation wherein the loading on the support surfaces are equal. Recent turbine installation designs, however, provide for variations of the loadings on the support surfaces because of the effect of piping connections on these loadings. The combination and method of the invention become all the more important in such installation.

The massive internal turbine rotors are designed with sealing tolerances between the rotors and the stationary turbine portions supported by the casing, which rely on the predetermined weight distribution pattern of the turbine upon the supports being achieved. The tremendous rotational forces acting on the housing can cause displacement of the casing and the stationary turbine portions which it supports if the weight distribution pattern is not per the design. This displacement can result in turbine wear or damage.

The combination and method of the present invention allow for a quick and accurate determination of the turbine weight distribution upon the supports and adjustment according to the predetermined weight distribution pattern. This permits correlation and adjustment of the loading force values to the design values, which insures proper operation of the turbine. The achievement of proper turbine weight distribution has become very important in view of the tremendous weight of the modern day turbine.

I claim:

1. A system for positioning and distributing the load on a multi-pad support for apparatus according to a predetermined weight distribution pattern, said system comprising a plurality of generally planar support pads disposed on a generally rigid foundation, a plurality of generally planar support paws disposed on said apparatus and having a surface which is generally parallel to said support pads, said support pads generally being disposed to register with said support paws, jacking means for each paw, fastening means cooperatively associated with said jacking means and said paws for temporarily fastening said jacking means to said paws, and means for indicating the weight being lifted by each jacking means, whereby each paw can be positioned generally parallel to a registering pad and the load carried by each paw can be adjusted to agree with a predetermined weight distribution pattern.

2. A system as set forth in claim 1, wherein the paws have apertures disposed therein and the apertures are generally centrally disposed with respect to the paw.

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3. A system as set forth in claim 2, wherein the pad has a hole disposed therein and the hole generally registers with the aperture in the registering paw.

4. A system as set forth in claim 2, wherein the apertures are threaded to provide the fastening means, which temporarily fastens said jacking means to the paws.

5. A system as set forth in claim 1, wherein the jacking means are hydraulic jacking means.

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6. Apparatus as set forth in claim 5 and further comprising means for supplying pressurized fluid to each of the hydraulic jacking means.

7. A system as set forth in claim 6, wherein the means for indicating the weight being lifted by the jacking means indicates the pressure of the hydraulic fluid being supplied to the jacking means.

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