Sept. 15, 1953 J. JENKINS ET AL 2,652,147

SHIPPING CONTAINER FOR TURBINE WHEELS

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Fig. 1.

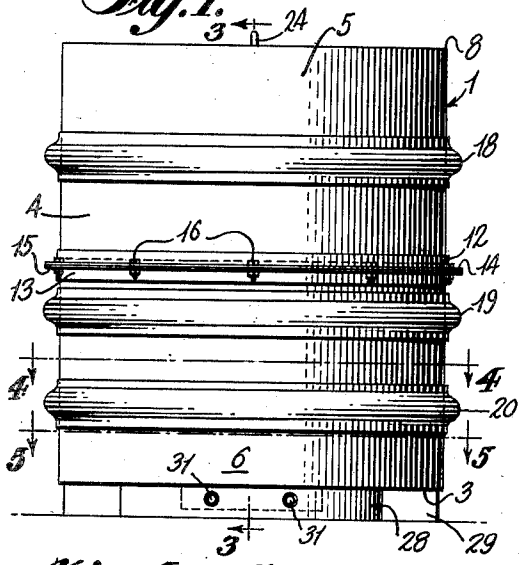


Fig. 2.

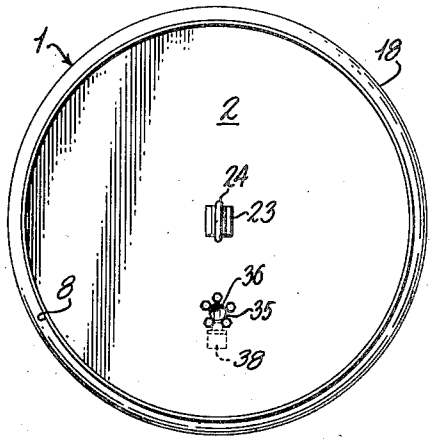


Fig. 4.

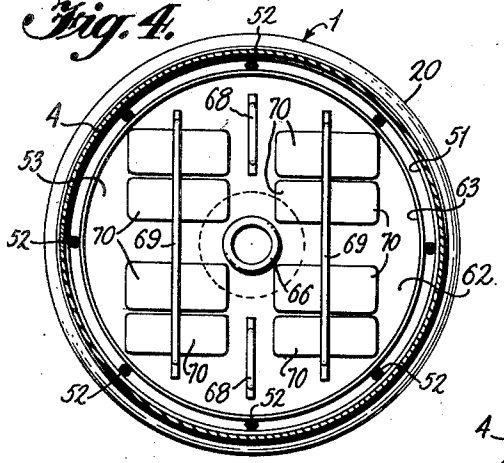


Fig. 5.

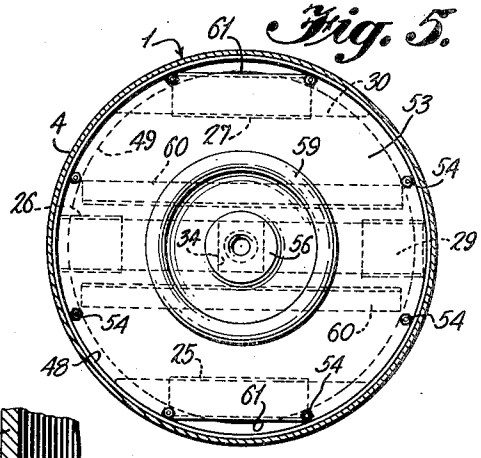
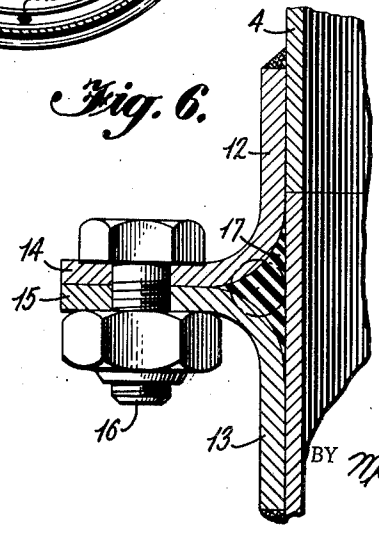


Fig. 6.



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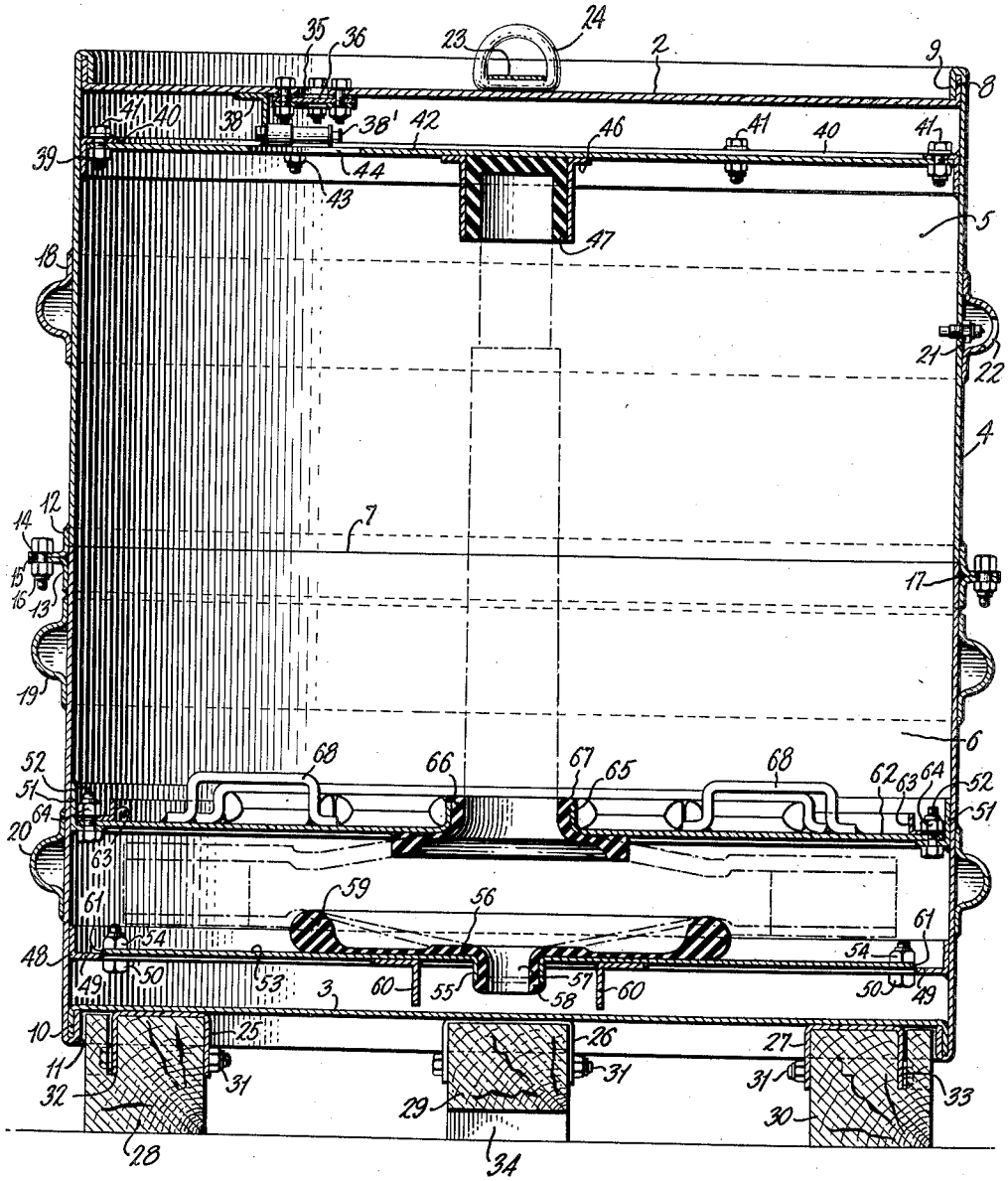
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Fig. 3.



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SHIPPING CONTAINER FOR TURBINE WHEELS

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Application March 7, 1951, Serial No. 214,286

7 Claims. (Cl. 206—46)

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This invention relates to special packages and particularly to one which is devised as a container for the rotor of a turbine, which as is generally known is a member of relatively delicate construction, made with utmost precision and perfect balance, and being readily damaged and rendered unusable by the ordinary hardships of transportation and storage, including exposure to corrosive influences such as moist or salt air.

The turbine wheel with which the present invention is particularly, although not exclusively concerned, is the type which is the essential part of an airplane jet engine, which drives the air compressor. The turbine wheels are shipped to various depots and airfields around the world as replacement parts for jet engines. They are shipped by all kinds of conveyances and are subject to the risks of rough handling both in transportation and in the warehouse such as an ordinary piece of heavy apparatus can take, but which might seriously damage the turbine wheel. Therefore, it is essential that the turbine wheel should be effectively supported and encased from the time it leaves the factory until it is unpacked at the time of its installation either in a new unit or as a replacement. The present invention provides such a protective container.

The general object of the invention is to provide a container sufficiently sturdy to withstand the hard use and abuse incident to transportation, forming a hermetically sealed casing about the turbine rotor, constructed to interfit with said rotor to position it fixedly within the container, and including intervening means for insulating said rotor from concussions to which the container may be subjected.

Another object of the invention is to provide a container of the type described, in which the external structure of the top and bottom are so definitely distinguishable as to indicate the position in which the container is normally to rest during shipment and storage, with means for supporting the turbine wheel parallel to the bottom, and the shaft coaxial with the container perpendicular to the plane of the bottom.

A further object of the invention is the provision of a container capable of re-use.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the following specification, and throughout the figures of which the same reference characters have been used to denote identical parts:

Figure 1 is a side elevation of a shipping container embodying the principles of the invention;

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Figure 2 is a top plan view;

Figure 3 is a vertical axial sectional view along the line 3—3 of Figure 1, the turbine rotor being shown in broken lines;

Figure 4 is a cross-section taken along the line 4—4 of Figure 1;

Figure 5 is a cross-section taken along the line 5—5 of Figure 1;

Figure 6 is a fragmentary section in a vertical plane showing details of the sealing means between the sections of the conveyor.

Referring now in detail to the several figures, the numeral 1 represents the container as a whole, which is a generally cylindrical metal drum having a top head 2 and a bottom head 3 at opposite ends of the cylindrical side wall 4. The container is divided into upper and lower sections, respectively, 5 and 6, which come together in an intermediate horizontal plane indicated by the line 7 in Figure 3. The top head 2 has an outwardly extending peripheral flange 8, which is seam welded to the side wall 4, the latter being peened over as at 9 on the inside of the flange 8 and in abutment with the head 2. The bottom head 3 is similarly constructed, having an outwardly extending flange 10, seam welded to the side wall 4, the latter being turned against the inside of the flange 10 and abutting the head 3, as shown at 11. The upper section has a flanged hoop 12 welded about its open end and projecting beyond the plane of separation 7, and the lower section 6 has a similar flanged hoop 13 welded thereto at a distance below said plane of separation, said hoops providing outwardly extending contacting flanges 14 and 15, which when drawn together by the bolts 16, bring the edges of the sections substantially into contact. An annular rubber gasket, Figure 6, normally of circular cross-section, is compressed within the space defined between the flanged hoops and the side wall of the lower section, being deformed so as to fill said space, producing a hermetic seal between the two sections. The reason that the seat for the gasket 17 is displaced with respect to the plane of separation between the sections is to avoid said gasket being forced between said sections, holding them apart, when the flanges 14 and 15 are bolted together.

The top section in the form of the invention illustrated is reinforced by an outwardly convex band 18, welded to the side wall 4, and the lower section is similarly reinforced by the convex bands 19 and 20, similarly secured. Before the band 18 was put in place, an air valve 21 was secured in an aperture in the side wall 4 in the

zone to be overlain by said band, so that the air valve projects within the convex portion of said band. To give access to said valve a hole 22 is present in the convex portion of said band adjacent said valve. The valve is for the purpose of exhausting the air from the container or for letting pressure into the container.

The top head 2 is provided centrally with a keeper plate 23, welded thereto, and a loop 24 hingedly mounted beneath said keeper. Said loop is for the purpose of receiving the hook of a crane for hoisting the container. When the loop 24 is down flat, it is below the level of the peripheral edge of the top head 2.

The bottom head 3 is provided with parallel metal channels 25, 26 and 27 welded thereto, in which are seated the parallel wooden skids 28, 29 and 30, said skids being secured by means of bolts 31 which pass through said skids and the corresponding channels. The outer channels have their outside flanges 32 and 33 sunk in slots in the skids 28 and 30, the bolts which pass therethrough being countersunk on the outer sides of said skids. The middle skid 29 is preferably notched at the middle, the notch being shown at 34 in Figure 3.

The top head 2 has a sight opening 35, and on its under side there is a transparent window 36 of Plexiglas or similar material interleaved between a pair of washers, and being bolted to the top head 2 around the margin of the opening 35. On the inside of the top head 2 and adjacent the sight opening, a bracket 38 is welded, to which bracket is screwed a moisture indicator 38' containing a substance exposed to the atmosphere within the container, and which changes color responsive to the humidity.

At a short distance below the top head the upper section 5 is provided with an angular hoop 39, having a flange in contact with the side wall 4, and being welded thereto. Said hoop provides a peripheral flange 40 in a horizontal plane extending continuously around the inner circumference of the container and at intervals having bolt holes, through which pass the downwardly extending bolts 41 which are welded to said flange. A removable disk 42 is inserted within the upper section 5, having perforations which pass over the fixed bolts 41 so that the disk rests upon the peripheral flange 40. It is removably secured by means of the nuts 43. This disk has an opening 44 therethrough which places the space above said disk in communication with the space below said disk so that the moisture indicator can respond to atmospheric conditions throughout the entire interior of the container. A deep cylindrical socket having an outwardly extending flange 46 at its base is welded centrally to the disk 42 and frictionally retains a cup-shaped rubber cushion 47, the bore of which compressively receives the free end of the shaft of the turbine wheel.

Now adverting to the lower section 6, this has an inner flanged hoop 48 welded to the side wall, providing a peripheral flange 49 in a horizontal plane, with perforations at intervals containing the upwardly extending bolts 50, which are fixed to said flange by welding. At a slightly higher level there is a similar flanged hoop 51, secured in like manner, and carrying at intervals the fixed bolts 52. Now returning to the lower flange 49, this supports a disk 53 having peripheral perforations at intervals which receive the bolts 50, the disk being secured in place by means of nuts 54. This disk has a central bore defined by the cylindrical flange 55, said bore retaining the rubber cushion 56 which has a hollow neck portion 57 within the flange 55 and an enlarged head portion 58 that overlies the end of the flange 55, and by means of which the cushion is retained. The upper face of said cushion lies against the disk 53 and terminates in a heavy peripheral bead 59. The hub of the turbine wheel fits compressively within the hollow neck portion 57, while the web of the wheel adjacent the blades rests upon the heavy bead 59. The disk 53 is reinforced by a pair of spaced parallel angle irons 60, having one flange of each welded to said disk, and having the other flange extending depthwise, but falling short of making contact with the bottom head 3.

It is to be noted that the opposite sides 61 of the disk 53 are flat, that is to say, they are parallel chords of the arc of curvature of the circumference of said disk, the purpose of these flat sides being to permit the disk 53 to pass through the opening of the flanged hoop 51, which is accomplished by tilting the disk 53 as it passes through.

Referring now to the flanged hoop 51, it supports a disk 62, which is peripherally reinforced by the flanged annular band 63 which is welded to the disk 62. Said band and said disk are provided with spaced peripheral perforations matching with the bolts 62, which pass over said bolts, the disk being secured by the nuts 64. The disk 62 has a central opening defined by the cylindrical flange 65, which opening receives the hollow neck portion 66 of a rubber cushion which is retained by an enlarged head portion 67 that overlies the end of the flange 65. The cushion extends outwardly against the under side of the disk 62 and bears against the portion of the turbine wheel which surrounds the root of the shaft. The disk 62 has a pair of handles 68 welded to its upper face at diametrically opposite points by which it may be conveniently manipulated, and the disk also has a pair of parallel metal straps 69 welded thereto at opposite sides of the handles, which function to hold in place packets 70 of suitable desiccant, as indicated in Figure 4.

The structural features of the container having thus been described, the mode of packing the turbine rotor will now be outlined. It is assumed that the two sections 5 and 6 are separated, each with its open end uppermost, and with the disks 42, 53 and 62 removed. A moisture indicator will first be secured to the bracket 37 and in position to be viewed through the window 36. The disk 53 will now be inserted in the lower section, passed through the hoop 51 and landed on the flange 49 with the bolts 50 protruding through the apertures in said disk. The disk is then secured by the nuts 54. The cushion 56 is already in place, being unitary with the disk 53. The turbine rotor is then carefully placed within the lower section 6, its hub being pushed through the neck 57 of the cushion 56, its web resting upon the bead 59. The shaft of said rotor will now be substantially vertical. The disk 62 is next lowered in place over the shaft of the rotor, the latter passing through the opening in the neck 67 of the cushion carried by the disk 62. Said disk is landed upon the flanged hoop 51 and secured in place. In the act of tightening the nuts 64, pressure is imposed upon the wheel of the turbine through the intervening cushions, somewhat compressing them. If the desiccant had not already been arranged previously, the packets 70 may now be pushed beneath the straps 69.

Before the upper section is inverted and put in place, the disk 42 is landed upon the flange 40

of the hoop 39 and secured to the bolts carried by said flange. The upper section is now inverted and carefully brought down so that the free or splined end of the rotor shaft registers with the recess within the cupped cushion 47. The end of said shaft is a little larger than said recess, but the cushion can be forced down upon it, the cushion being slightly compressed or deformed in doing so. Before the upper section is put in place, the gasket 17 is seated over the open end of the lower section and against the flanged hoop 13. The upper section is slipped down until its flanged hoop 12 contacts the gasket, then the upper section is angularly displaced until the bolt holes in the flanges 14 and 15 register. The bolts 16 are then put in place, the nuts tightened all around until the gasket is compressed and the flanges 14 and 15 are tight together. If it is now desired to exhaust the atmosphere from the container, this is done by a suitable vacuum hose coupled to the valve 21, accessible through the hole 22. The valve 21 may be an inwardly opening check, if desired, so that dry air or other gas under pressure may be admitted.

It will be obvious from the above description, and particularly from the drawing, that the turbine rotor is completely insulated by the several cushions from the transmission of concussion that may be received by the container. Slight relative inertia movements of the turbine rotor relative to the container are permitted without any strain to said rotor, by virtue of the slight compressibility of the cushions. Normally, the container will be transported in upright position with the weight and mass of the rotor substantially balanced. If it becomes necessary to move the container in any other position than vertical, the several disks which support the rotor at widely spaced points are sufficiently rigid to hold it in place. The reinforcing flanges 60 are spaced from the bottom head 3 so that if the container is dropped from a considerable distance upon the skids, any flexing of the bottom head 3 within its elastic limit is not transmitted through the flanged members 60 to the turbine wheel. The container is hermetically sealed; no moisture can get in over long periods of time, and the desiccant in the packets 70 takes care of any residual moisture. The degree of humidity within the container can be readily ascertained by observing the indicator 38 through the window 36, and if through long storage there is an indication of moist air leakage, the container may be again evacuated through the valve 21. It is contemplated that the container will remain unopened until a replacement has to be made, whereupon, the wheel will be found in as perfect condition as when it left the factory. Removal of the rotor is accomplished by performing the described operations in reverse order, and the replaced rotor if in condition for salvaging, may be packed in the container and sent back to the factory for reconditioning.

The dimensions of the particular container illustrated are 30 inches in diameter by 32 inches in height, with a weight of approximately 265 pounds. The weight of the turbine wheel which goes into this container is approximately 275 pounds. It may be readily figured from the above dimensions that the container with its contents is buoyant if dropped into the water. The invention is not limited to any particular size of container or of turbine wheel, but if the proportionate dimensions and weights are maintained, any sized container with the enclosed turbine wheel is floatable. The sturdiness and shock dampening qualities of this container are such that it is capable of withstanding hard transportation usage in any type of conveyance. It may even, if necessary, be dropped by parachute without the slightest damage to the wheel.

While we have in the above description disclosed what we believe to be a preferred and practical embodiment of the invention, it will be understood by those skilled in the art that the specific details of construction and arrangement of parts, as disclosed, are by way of illustration and not to be construed as limiting the scope of the invention.

What we claim is:

1. Special package comprising in combination, a turbine wheel and shaft, and a shipping container therefor comprising a cylindrical shell and top and bottom heads defining a chamber, transverse, spaced, centrally apertured supports adjacent said bottom head secured within said shell, at least the upper of said supports being removable, cushion means on the confronting faces of said supports, said turbine wheel being positioned between said supports with the shaft extended upwardly through the upper of said supports and being clampably held between said cushion means, out of contact with the rigid structure of said container, when said supports are secured.

2. Special package as claimed in claim 1, including also a support secured transversely within said shell adjacent the top head, and a cupped cushion carried centrally by said support snugly encompassing the end of said shaft.

3. Special package comprising in combination, a turbine wheel and shaft, and a shipping container therefor comprising a cylindrical shell and top and bottom heads defining a chamber, transverse, spaced, centrally apertured supports adjacent said bottom head secured within said shell, at least the upper of said supports being removable, cushion means on the confronting faces of said supports, said turbine wheel being positioned between said supports with the shaft extended upwardly through said upper support and being clampably held between said cushion means, out of contact with the rigid structure of said container, when said supports are secured, said container including also a partition transversely secured within said shell adjacent the top head, and a cupped cushion carried centrally by said last named support snugly encompassing the end of said shaft, said shell being divided in a transverse plane between said shaft support and said wheel supports forming upper and lower sections, and means for securing said sections together.

4. Shipping container for a turbine wheel with shaft comprising a tubular shell having fixed parallel top and bottom heads and being divided into upper and lower sections, exterior means at the adjacent peripheries of said sections for uniting them in a fluid sealed joint, said lower section having seating rings in spaced planes parallel to and above the bottom head, fixed to the inner periphery of said shell, a similar seating ring similarly secured within said upper section parallel to and spaced from said top head, bolts fixed at intervals about said rings with their threaded ends facing the meeting ends of said sections, supporting disks seated upon the respective rings having peripheral bolt holes registering with the bolts of said respective rings and being removably secured by said bolts, the lowermost

disk having opposite flat sides whereby it may be slipped through the intermediate seating ring, and having a central flanged hole to receive the hub projection of the turbine wheel, the intermediate disk having a central flanged hole for passage over the shaft of said wheel, cushions retained by the lower and intermediate disks lining said central holes and spread upon the confronting faces of said disks, the latter being so spaced as to clamp said wheel between said cushions, the uppermost of said disks having a centrally located socket on its under side, and a cupped cushion lining said socket compressively receiving the free end of said shaft.

5. Shipping container as claimed in claim 4, the lowermost disk having reinforcing bars of angle cross-section fixed to its under side with flanges extending depthwise and being out of contact with the bottom head.

6. Shipping container as claimed in claim 4, the intermediate disk having handles for assisting in placing and rotating said disk, and having straps for retaining units of desiccant.

7. Shipping container as claimed in claim 4, the top head having a transparent sealed window, and a support on its inner side for positioning a humidity indicator beneath said window

and above the uppermost disk, the latter having a hole establishing communication between the parts of the shell chamber above and below said disk.

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