

April 29, 1952

R. F. RIES
SHIPPING CONTAINER

2,594,586

Filed Nov. 15, 1948

5 Sheets-Sheet 1

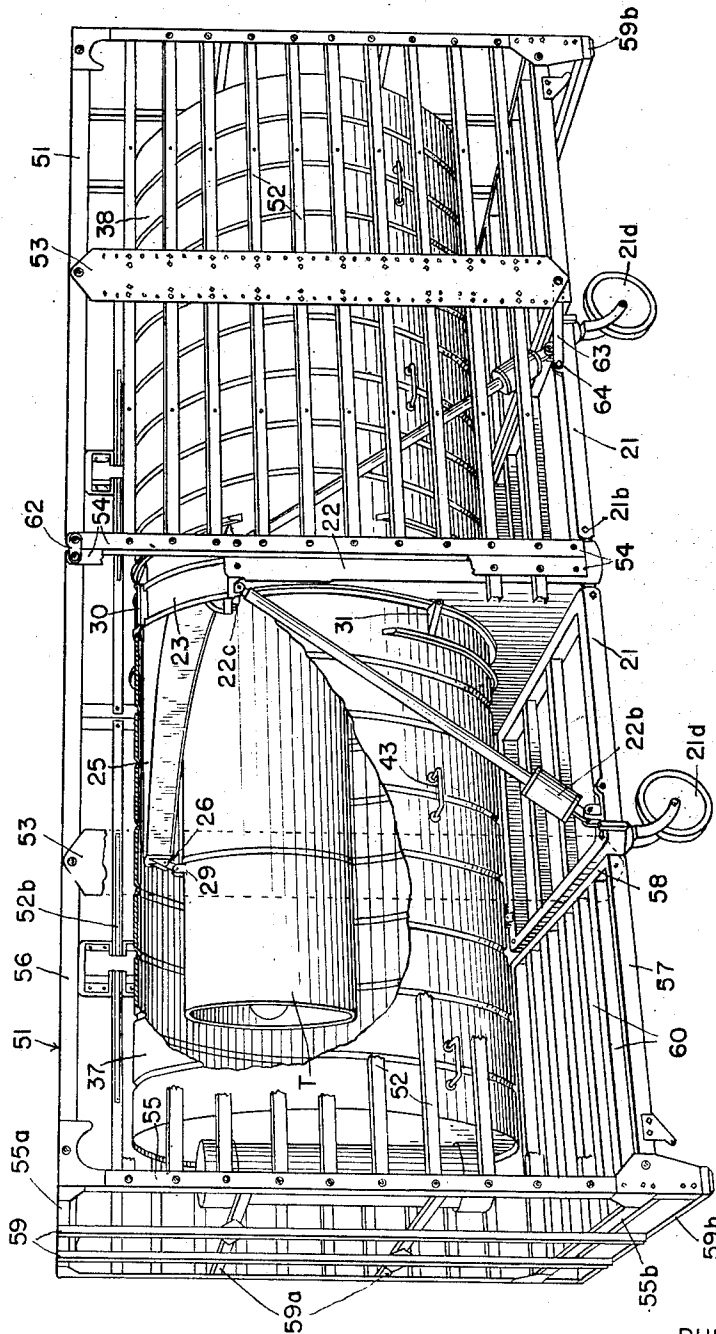


FIG. 1.

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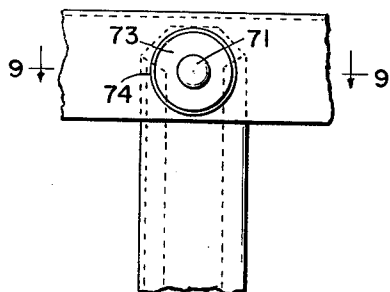


FIG. 8.

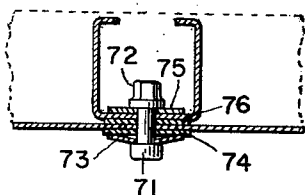


FIG. 9.

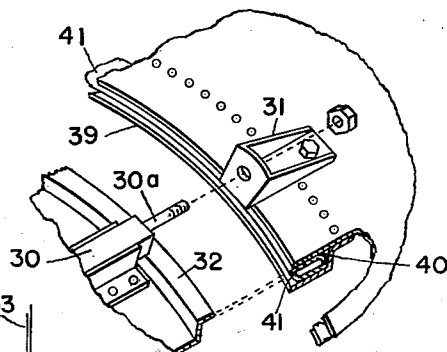


FIG. 5.

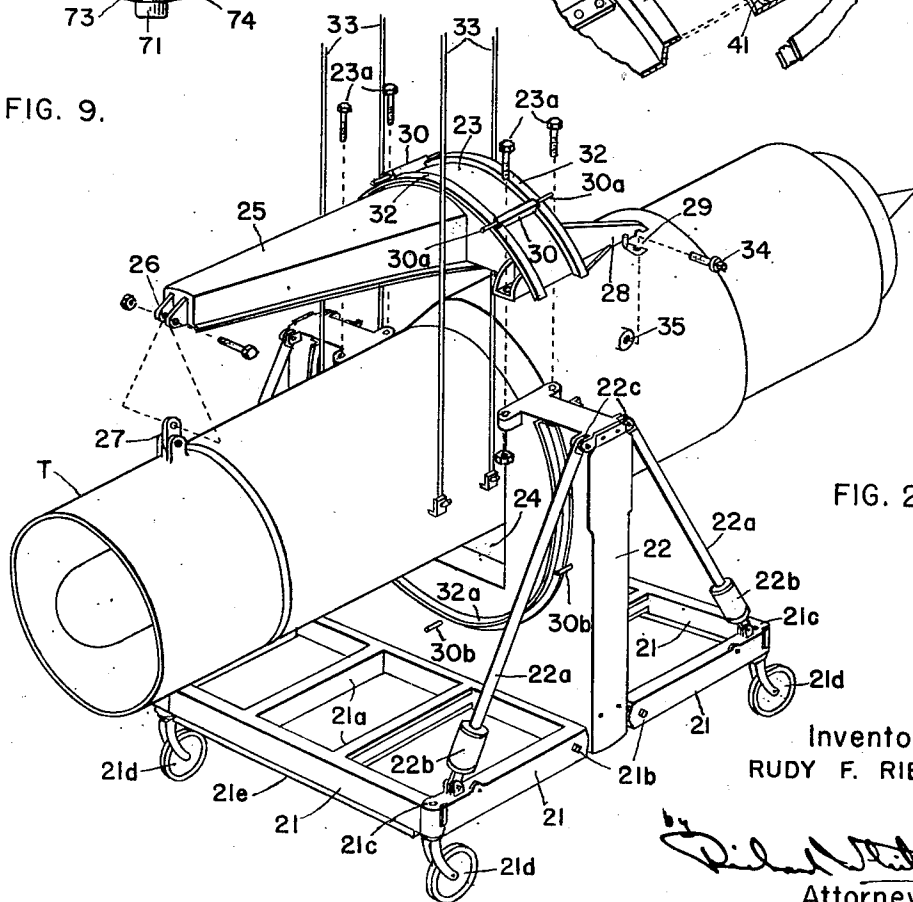


FIG. 2.

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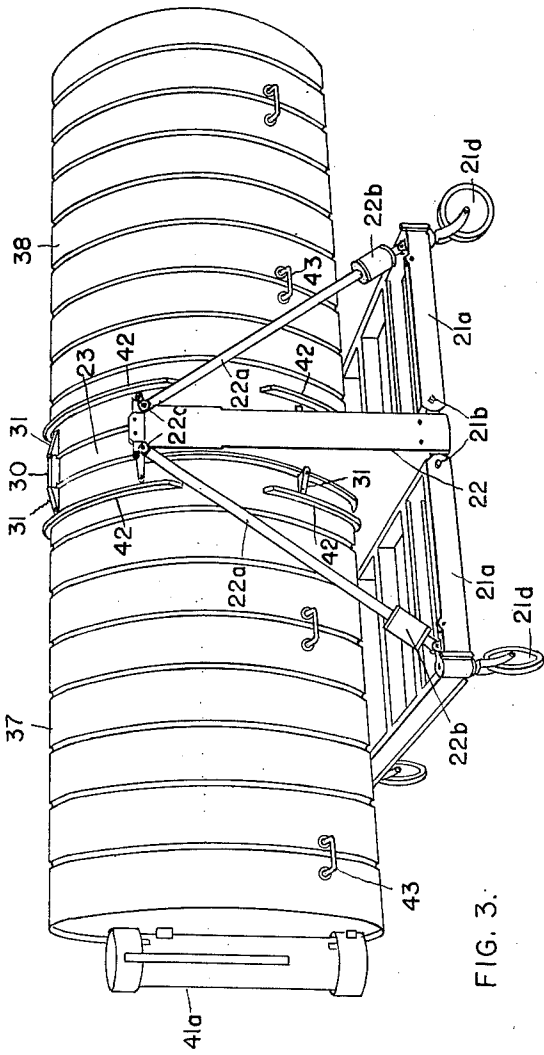


FIG. 3.

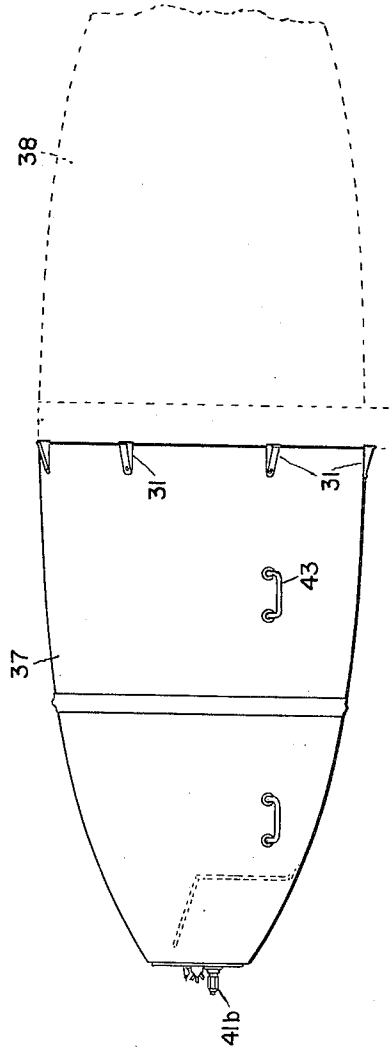


FIG. 4.

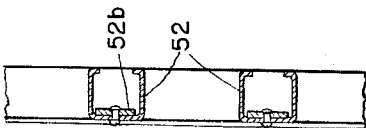


FIG. 11.

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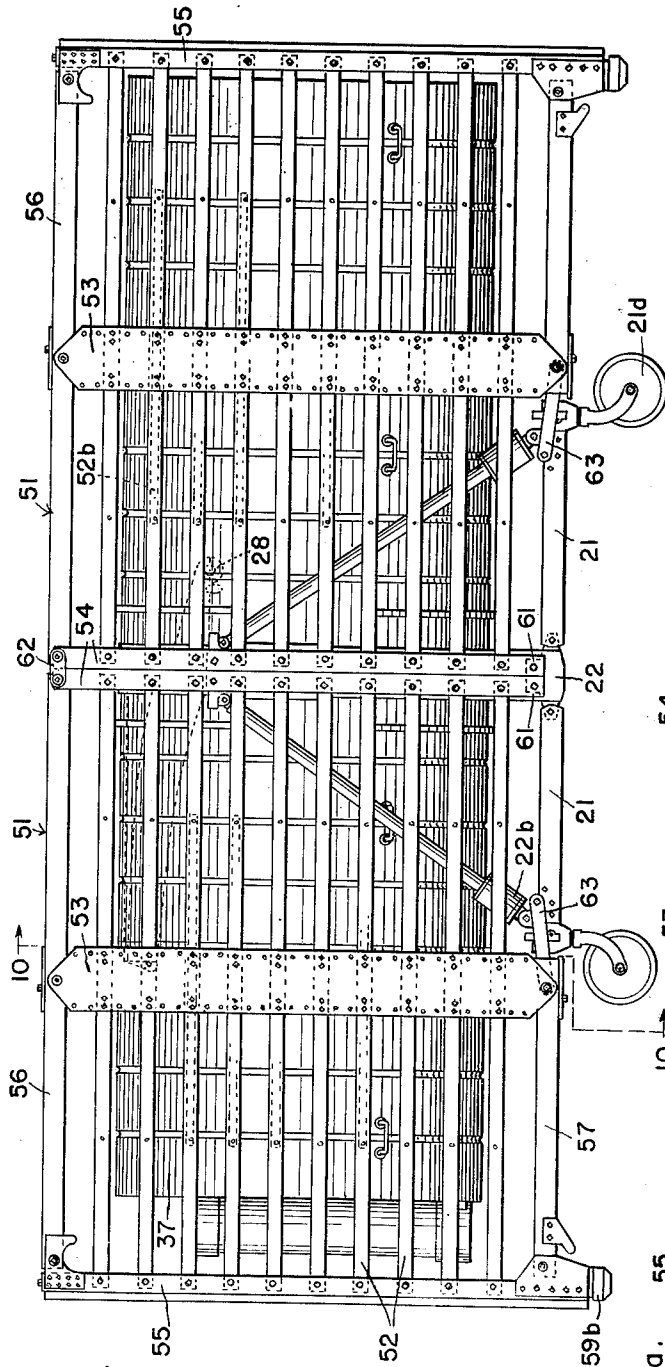


FIG. 6.

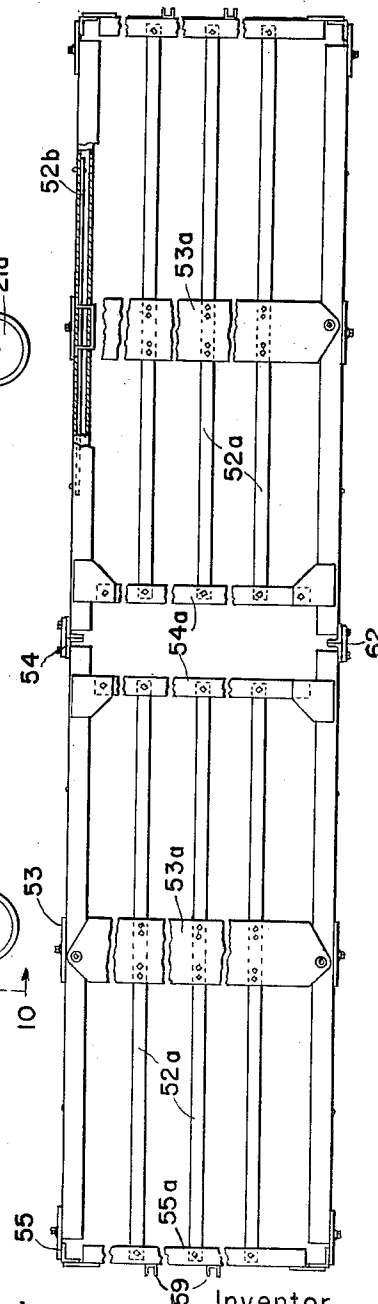


FIG. 6a.

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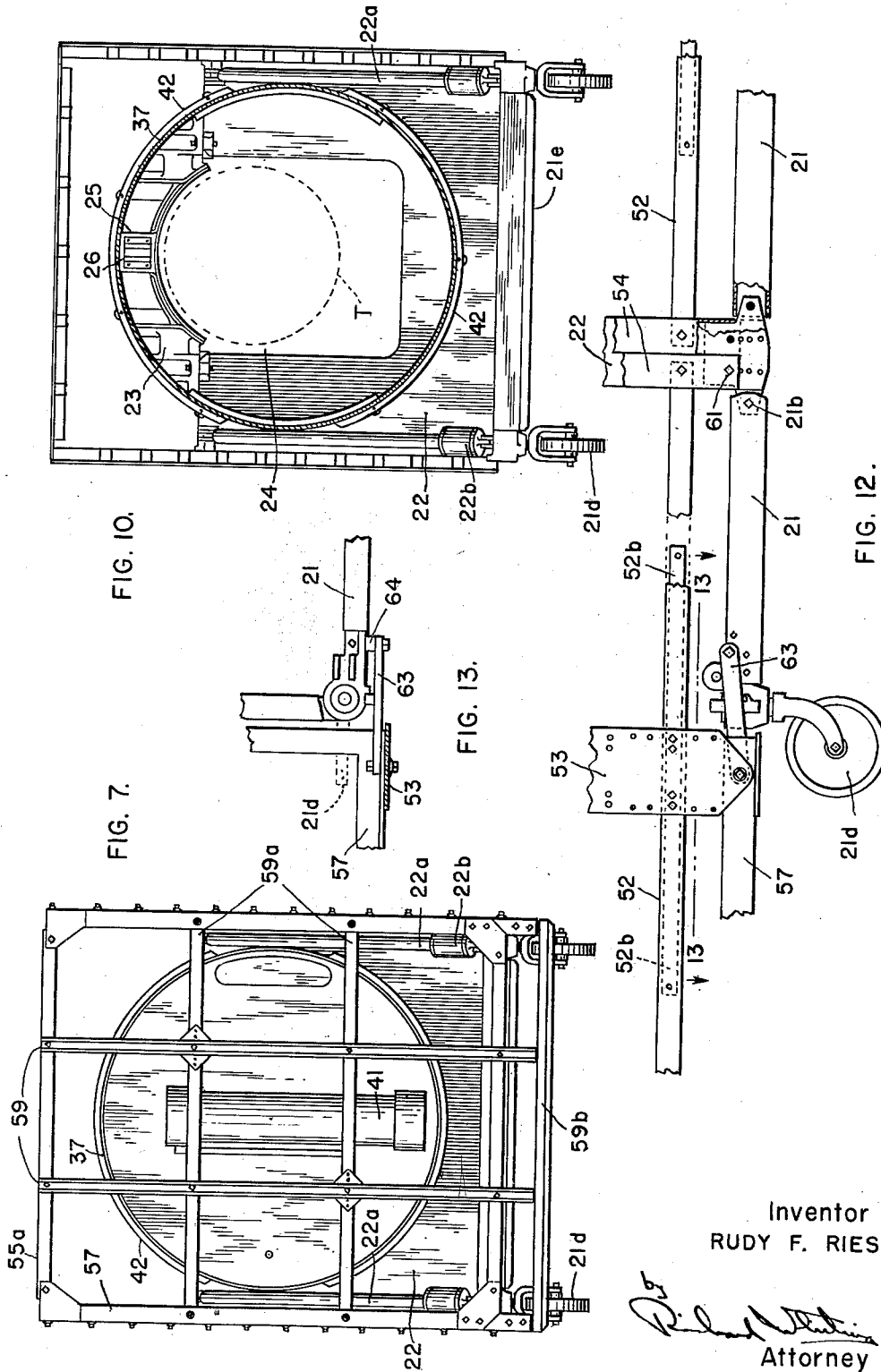
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UNITED STATES PATENT OFFICE

2,594,586

SHIPPING CONTAINER

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11 Claims. (Cl. 280-44)

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This invention relates to shipping and storage containers for heavy fragile objects. The specific embodiment of my invention hereinafter described is used to insulate a turbo jet aircraft engine from shock, vibration and moisture deterioration during shipment and storage and to provide a movable shock-absorbing stand for use in servicing the engine. My invention has, however, many other uses.

The object of my invention is to improve such containers, preferably by the provision of an inherent resiliency in the structural members of the container itself adequate to absorb the shock of rough handling. My novel container is composed of several parts which combine in a novel way for the purpose stated, but also are useful alone for certain purposes, as will appear.

In the drawings:

Fig. 1 is a perspective view of the shipping cage partly broken away showing a turbo jet engine within the moisture barrier and mounted on the engine stand within the cage.

Fig. 2 is a perspective view of a jet engine lowered into position in the engine stand, showing the additional stand parts required to secure the engine therewith.

Fig. 3 is a perspective view of a free breathing moisture barrier covering the engine and joined to the engine stand.

Fig. 4 is a side elevation of the forward half of a moisture barrier modified in construction, for adaptation to utilize pressurization, in lieu of the cylindrical shells and free breather and dehydration units illustrated in Fig. 3.

Fig. 5 is a perspective detail illustrating the manner in which the barrier is joined to the stand.

Fig. 6 is a side elevation of the cage attached to the engine stand and enclosing the stand and the moisture barrier.

Fig. 6a is a plan view of the cage.

Fig. 7 is a front end elevation of the cage shown in Fig. 6 and of the enclosed moisture barrier.

Fig. 8 is a detail plan view of a typical pin-jointed connection of the horizontal flexing members of the elastic cage.

Fig. 9 is a vertical section of the connection taken on the line 9-9 of Fig. 8.

Fig. 10 is a vertical section on the line 10-10 of Fig. 6, the jet engine having been removed.

Fig. 11 is an enlarged detail section through the horizontal flexing members of Fig. 10.

Fig. 12 is an enlarged detail of part of the lower parts of the apparatus shown in Fig. 6, taken left of center.

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Fig. 13 is a plan view of the link and caster mechanism shown in Fig. 12.

Referring to Fig. 2, the engine stand is constructed of two horizontal rectangular frames 21, having crosswise reinforcing members 21a, bolted at 21b to lugs formed on the vertical bulkhead 22, which extends normal to the plane of the frames 21. The open center 24 of the bulkhead 22 is large enough to clear the mid-section of the turbo jet engine T for which this embodiment of my invention has been designed, when such an engine is suspended within said opening. The bulkhead 22 is supported in its upright position by two shock absorbing struts 22a on both of its sides, said struts extending from the base frame corners 21c to the securing lugs 22c at the top of the bulkhead 22, and said struts being pinned both at their bulkhead and base frame terminals. Each of the struts 22a is provided with a spring or rubber shock-absorber 22b which I have located near the base terminals of the struts 22a. Below each of the corners 21c of the base frame 21, I provide a caster 21d which, when not needed, may be folded up into the base frame 21. Skids 21e are provided below the outer ends of the frames 21 and extend below the casters 21d when the latter are folded up into the stand.

The upper assembly of the engine stand includes a bridge 23 which, when placed upon the top of the bulkhead 22 and bolted thereto, spans the opening 24 and serves rigidly to support one end of a beam 25.

The forward end of this beam 25 is provided with a trunnion attaching fitting 26 to which an upright lug 27 on the forward end of the engine is bolted. From the opposite side of the bridge 23 and firmly fixed thereto, extend rearwardly on both sides two members 28 to which the engine is secured by bolts 34 threaded into the openings 35 formed in the engine side.

The moisture barrier, to be described, is attached to the stand for which purpose a number of appropriate fittings are provided. Thus, on top of the bridge, are two barrier attaching blocks 30, each having threaded bolt ends 30a protruding therefrom. Adjacent each side of the bridge 23 is an arcuate sealing flange 32 which, when the bridge is bolted onto the bulkhead 22, forms by juxtaposition with a flange 32a provided on the bulkhead, a complete circular sealing flange. On both sides of the bulkhead 22 at spaced intervals about but outside of the flange 32a, several protruding threaded bolt ends 30b to which the lower barrier attaching fittings 35 are secured, have been provided.

As construction materials for the stand, I have found that riveted Duralumin sheet and castings provide the lightest sturdy bridge and beam construction, although other types of elements, such as Duralumin or steel forgings and welded steel tubing, may also be employed.

To mount the engine in the stand described above, the upper assembly unit, which includes the bridge 23, the beam 25, the members 28, and associated attachments and fittings, is removed from the bulkhead 22. The engine T is then hoisted down by means of four cables 33, shown in Fig. 2, into, and suspended within, the opening 24, leaving adequate clearance between the sides of the engine and the bottom and sides of the opening. The upper assembly unit is then slipped between the cables 33 and the bridge bolted in place on the mounting bulkhead 22 by means of bolts 23a secured through companion lugs protruding from the bulkhead and bridge. The forward fitting 26 is bolted to the engine lug 27, and members 28 are secured by bolts 34. The engine is thus suspended in three places. The cables 33 are now detached and removed and the full weight of the engine is borne by the stand. As so mounted, the engine may be serviced and moved about on the casters 21d. It may now be enclosed within the moisture barrier.

The moisture barrier consists of two cylindrical, conical or bullet-shaped Duralumin shells 37, 38 (Figs. 3 and 4). Each shell is open at one end and closed at the other. The open edge is flanged at 39 (Fig. 5) to form a recess 40 extending completely around the opening. This recess is packed with sponge cord 41 and receives the circular flange 32, 32a of the bridge and bulkhead for an airtight fit.

To secure the two shells to the bulkhead and bridge, I provide at spaced intervals on the outside of the shells and about their open ends a series of apertured attaching fitting 31 which are welded or riveted to the shells 37, 38 and which receive the bolts 30a above referred to.

To maintain a rigid circular contour of each of the shells, a pair of stiffeners 42 (Fig. 3) of rigid arcuate metal pieces are riveted or welded at the top and bottom of each of the shells.

For convenience in mounting the shells 37, 38 to the stand, and in moving the stand and barrier about when the engine is mounted thereon and enclosed within the shells, handles 43 are provided as shown in Figs. 3 and 4.

The main purpose of the moisture barrier is to guard the engine enclosed therein against moisture deterioration. This I accomplish by providing a free breather unit 41a (shown in Fig. 3), or by modifying the contour of the shells 37, 38 to adapt them to utilize the principles of pressurization (see Fig. 4). The free breather allows external air to enter the moisture barrier only after substantially all moisture in the air has been removed therefrom and absorbed by the silica gel provided in the cylinder 41 through which the air must pass. Pressurization, on the other hand, involves pumping air of a desired relative humidity into the barrier (through orifice 41b) at higher than atmospheric pressure and sealing the same against escape, except through an appropriately set pressure relief valve. This prevents moisture-laden atmosphere from entering the barrier. An initial charge of silica gel is provided in the barrier whether it is adapted to free breathing or pressurization.

The mounting of the shells is accomplished

simply by slipping them over the engine in sleeve-like fashion toward the mounting bulkhead 22, lining up the attaching fittings 31 with the bolt ends 30a, 30b on the bridge 23 and bulkhead 22 respectively, and closing the recess 40, packed, as stated, with sponge cord 41, against the sealing flanges 32, 32a to form completely airtight junctions. Nuts and washers are then placed on the bolt ends protruding through the attaching fittings and tightened. The free breather unit 41 is then installed, if the free breather method is utilized, or pressurization is set up, if such method is utilized.

After the engine has been mounted within the stand and the moisture barrier placed over it and dehumidification effected in the manner just described, the engine and barrier are ready to be housed within the protecting shipping cage comprised of two identical halves 51 (Figs. 6, 6a) constructed as follows: A series of reenforced U-shaped flexing members 52 (Fig. 6), reenforced at their midsections by leaf springs 52b, are joined in a vertical plane at their midsections to a vertical plate 53, and at their ends to a center piece 54 and a corner member 55. The upper ends of the plate 53, the piece 54 and member 55 are secured to the element 56. At their lower ends, the plate 53 and member 55 are secured to an angle section 57. The frame thus formed and bounded by the top and bottom element 56 and angle section 57 and the end members 54 and 55, is joined with a similar frame on the opposite side by a corner member 55a (Fig. 6a), a center piece 54a, and a top mid-plate 53a. The bottoms of said frames are also joined by a lower corner 55b (Fig. 1) and a base piece 58. The top of the cage half (Fig. 6a) is provided with flexing members 52a parallel to members 52 and similarly attached to corner member 55a, center piece 54a and the top mid-plate 53a. Two pairs of cross-bars 59, 59a form the outwardly facing end of each half of the cage, while a series of bars 60 between member 55b and base piece 58 serve to complete the cage half. The cage has feet 59b and links 63 attached to and extending inwardly from the junction between the angle bars 57, the base pieces 58 and plates 53.

The parts of the cage are preferably constructed of aluminum alloy.

The two cage halves are put together over the moisture barrier and engine stand in the following manner: While the casters 21d are down, both halves of the cage are slipped toward each other over the barrier until they meet at the bulkhead 22 (Fig. 1). The center pieces 54 of the cage halves are then bolted to the bulkhead 22 by bolts 61 in holes provided for that purpose, and the adjoining pieces 54 are joined to each other at their upper extremities by the bolted piece 62. The links 63 are then connected to the receiving attachments 64 on the stand, (Fig. 1). Thereafter, the wheels 21d may be drawn up and the entire weight of the cage and enclosures rests on the feet 59b, being suspended therebetween.

According to the preferred embodiment of my invention all pinned joints effect frictional damping of cage deflections. Figs. 8, 9 show the detailed construction of a typical pin-connected joint including an aluminum alloy bolt 71 and nut 72. On the bolt head side of the joint is placed a heavy spring washer 73 which presses against the bolt head 71, and below the spring washer against the surface of the joint mem-

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ber, I place an over-sized fiber washer 74. On the nut side of the juncture, a similar fiber washer 75 is provided. In addition, a washer 76 of friction material is inserted between the faying surfaces of the structural members.

In use, I have found that a shipping container constructed as above described effectively protects the engine from shock and atmospheric conditions during shipment and storage.

Referring to Fig. 2, the stand itself absorbs a portion of the shock which would result from rough handling of the container. Since the center of gravity of the suspended engine is, by my construction, preferably located approximately in the plane of the bulkhead 22, a vertical dropping of the engine and stand results in a downward thrust of the bulkhead 22 rotating both frames 21 downwardly so that the shock is taken by the four shock absorbers 22b. If the container is subjected to a sudden longitudinal thrust, tending to displace the engine longitudinally relative to the stand, the bulkhead will yield by rotation, such yielding being resisted by the shock absorbers 22b. Thus, the stand serves as a convenient work-holding device and may be rolled about over rough terrain without damage to the engine. This stand thus provides an excellent means for servicing the engine, and, as hereafter shown, becomes an integral part of the crate-like shipping container.

The moisture barrier, dehumidified or pressurized as above described, effectively seals the engine against atmosphere. The stand and moisture barrier together and without the outer cage form a relatively lightweight air transport device capable of absorbing shocks normally incident to the more careful handling during such transport. For air shipment, the casters 21d are retracted, the entire weight of the engine and stand resting upon the skids 21c.

The outer cage, being crate-like in construction, shields the engine and moisture barrier against blows in a conventional manner. More important, however, this cage functions in a unique way to absorb the shock of rough handling. Thus, if the cage is dropped on either or both of its feet 59b, the casters 21d being retracted, the momentum of the engine will be evidenced by a downward thrust on the bulkhead 22 as above noted, but now that the casters 21d are retracted the thrust on bulkhead 22 relative to the ends of the cage will tend to deflect the bars 52 downwardly as the result of their connection with the pieces 54 attached to the bulkhead. A certain shock absorbing deflection is permitted by the inherent resiliency of the bars 52, but this deflection is at the same time resisted in several ways. Thus, the bars 52, while made of spring metal, are in the form of U-shaped channels which resist deflection. Each bar 52 is secured at spaced intervals to the vertical plates 53 disposed midway of the length of the bars so that deflection is prevented in that area of the bar with the result that the bar tends to assume a slight reverse, or S curve on distortion, thus further resisting deflection of the bars. It will be seen that the bars thus constitute a multiple spring panel which flexes as a unit. Moreover any deflection of the bars relative to the pieces 54 and 55 will result in a slight rotation of the ends of the bars about their connections with those pieces and this rotation is resisted by the frictional damping connections referred to with reference to Figs. 8 and 9. This frictional damping also serves to

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check oscillation of the suspended weight which might otherwise result from the tendency of the springy members to return to normal position.

While I have specifically described my invention as adapted to preserving and shipping jet engines, my invention may be used to protect other types of engines, such as radial engines, and also delicate heavy chemical or electrical devices and parts which must be guarded in shipping against vibration, shock and destruction by moisture.

I claim:

1. A shock absorbing stand for heavy objects comprising a vertical bulkhead within which the object is secured to dispose the center of gravity thereof in the approximate plane of the bulkhead, frames frictionally hinged on each side of the base of the bulkhead and extending outwardly in a plane normal to the plane of the bulkhead, struts extending between and pivotally connected to the edges of said frames disposed distant from said bulkhead and the upper area of said bulkhead, said struts having shock absorbing elements, and supports on the underside of the extremities of said frames to effect suspension of the stand therebetween.

2. A shock absorbing stand for heavy objects comprising a vertical bulkhead within which the object is secured to dispose the center of gravity thereof in the approximate plane of the bulkhead, frames frictionally hinged on each side of the base of the bulkhead and extending outwardly in a plane normal to the plane of the bulkhead, supports on the underside of the extremities of said frames to effect suspension of the stand therebetween, and shock absorbing struts between the upper part of the bulkhead and the outer extremities of the frames.

3. In a shipping crate, a multiple spring panel comprising a pair of vertical side elements, a horizontal corner piece pivotally joining the upper ends of said elements, a lower corner piece pivotally connected to at least one of the lower ends of said elements and extending parallel to the upper corner piece, a plurality of flexible horizontal members disposed between, and pivotally connected to, said side elements, and a vertical plate member disposed approximately midway between the vertical side elements, said plate member extending between said upper and lower corner pieces and pivotally connected at a single point to each of said corner pieces, said vertical plate member being rigidly secured to each of said horizontal flexible members, whereby when said panel is placed under vertical stress, the flexible members flex as a unit.

4. The multiple spring panel as described in claim 3 wherein the flexible members are of spring metal and are U-shaped in cross-section.

5. The multiple spring panel as described in claim 4 wherein reinforcing spring pieces are provided within the U-shaped spring members, said reinforcing pieces being shorter than the spring members and disposed approximately equidistant from each extremity of said spring members.

6. The multiple spring panel as described in claim 3, wherein the pivotable connections are effected by pins with frictional washers to prevent oscillation.

7. A shock absorbing container for a heavy object, consisting of a crate-like structure having at least two of its opposite sides each comprised of a plurality of flexible members, said members being maintained substantially parallel with respect to each other by the connection there-

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with of a plurality of crossing elements, thereby to form a multiple spring side panel which flexes as a unit particularly in the plane of said panel, and means within said structure to support the object on said panels whereby when the container is dropped, the momentum of the object is at least partly resisted by the flexure of the said side panels, the last said means comprising a vertical bulkhead disposed normally to the planes of said multiple spring side panels, each perpendicular side edge of said bulkhead being secured to one of the said crossing elements to which the said flexible members are connected, thereby placing the weight of the object upon said panels, and downwardly extending footing at the opposite ends of the container whereby there is effected a suspension of the object between the footings by means of said panels.

8. The container as described in claim 7 wherein the bulkhead is provided with means for mounting the heavy object, the bulkhead is further pivotally mounted to sway backward and forward with the object under longitudinal thrusts, and is further braced by struts having shock absorbing elements to limit such swaying.

9. A shock absorbing container for a heavy object comprising a crate-like structure having at least two of its opposite sides each formed of a pair of panels as described in claim 3, said panels being joined end-to-end in the same plane, members joining the corners of said sides to complete a rectangular form, a vertical bulkhead disposed normally to the planes of said pairs of panels, each side edge of said bulkhead being secured to said pairs of panels along their junction with each other, said bulkhead having means to support a heavy object upon it so as to dispose the center of gravity thereof approximately in the plane of the bulkhead, and footing extending below each of the lower corners of said crate-like structure to effect a suspension therebetween of the weight of said bulkhead and of the object which it is adapted to support.

10. A shock absorbing container for a heavy object comprising a crate-like structure having at least two of its opposite sides each formed of a pair of panels as described in claim 3, said panels being joined end-to-end in the same plane, members joining the corners of said sides to complete a rectangular form, a stand within which a heavy object may be supported, said stand being dimen-

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sioned to fit between the sides of said container and itself comprising a vertical bulkhead disposed normally to the planes of said pairs of panels, each side edge of said bulkhead being secured to said pairs of panels along their junction with each other, said bulkhead having means to support a heavy object upon it so as to dispose the center of gravity thereof approximately in the plane of the bulkhead, and a pair of horizontal base frames, one disposed on each side of said bulkhead in the vicinity of its lower edge, said bulkhead being pivotally attached at its lower corners to contiguous corners of said base frames, supporting struts extending between the outer edges of said base frames and the upper portion of the bulkhead, said struts containing shock absorbing elements, said base frames being further pivotally connected at their outer corners to the points of connection between the side plate members and the lower corner pieces of said spring panels, and footing extending below each of the lower corners of said crate-like structure to effect a suspension therebetween and on the spring panels of the weight of said bulkhead and of the object which the latter is adapted to support.

11. The shock absorbing container as described in claim 10 wherein retractable casters are provided in the vicinity of the outer corners of said base frames, said casters being adapted to extend below said base frames and below the level of said footing and being further adapted to be retracted above the level of said footing.

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