

United States Patent

Haynes

[15] 3,699,689

[45] Oct. 24, 1972

[54] UNDERWATER SHOCK-ABSORBING AND DECELERATION DEVICE

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[73] Assignee: The United States of America as represented by the Secretary of the Navy

[22] Filed: Feb. 26, 1971

[21] Appl. No.: 119,272

[52] U.S. Cl.61/69, 16/51, 114/16

[51] Int. Cl.B63c 11/36, B63q 8/00, E05f 3/04

[58] Field of Search.....61/69 R, 69 A; 16/51, 52, 53, 16/58; 248/318; 114/16 E, 16 F

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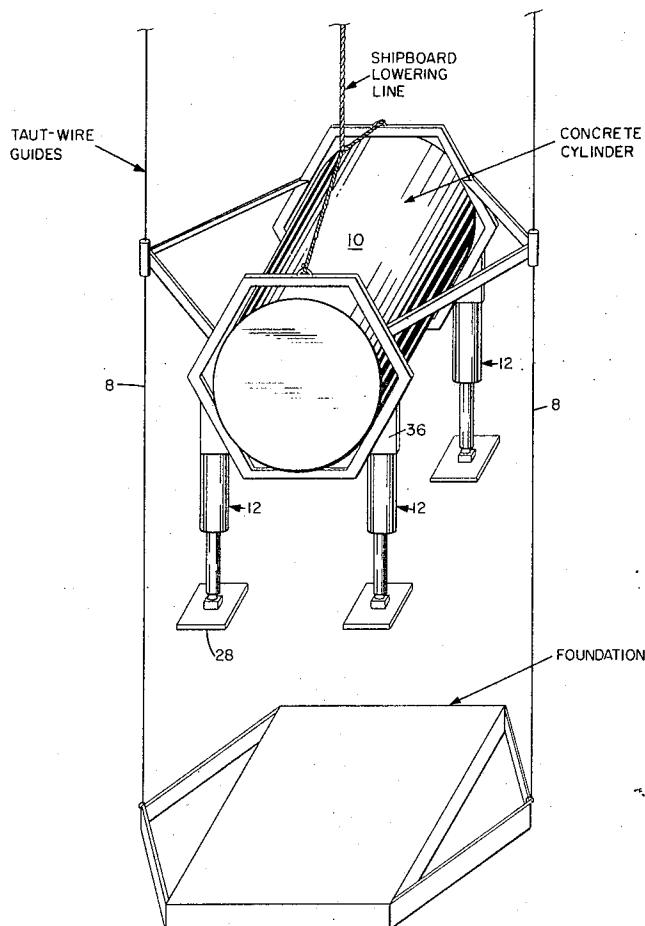
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[57] ABSTRACT

A device for cushioning the landing impact shock of a heavy underwater object during installation on the ocean bottom. It employs a set of telescoping leg assemblies each having an air entrapping cylinder and a dash-pot like piston moveable therein. Shock absorption is achieved through air pockets formed at the top of each piston.

5 Claims, 7 Drawing Figures



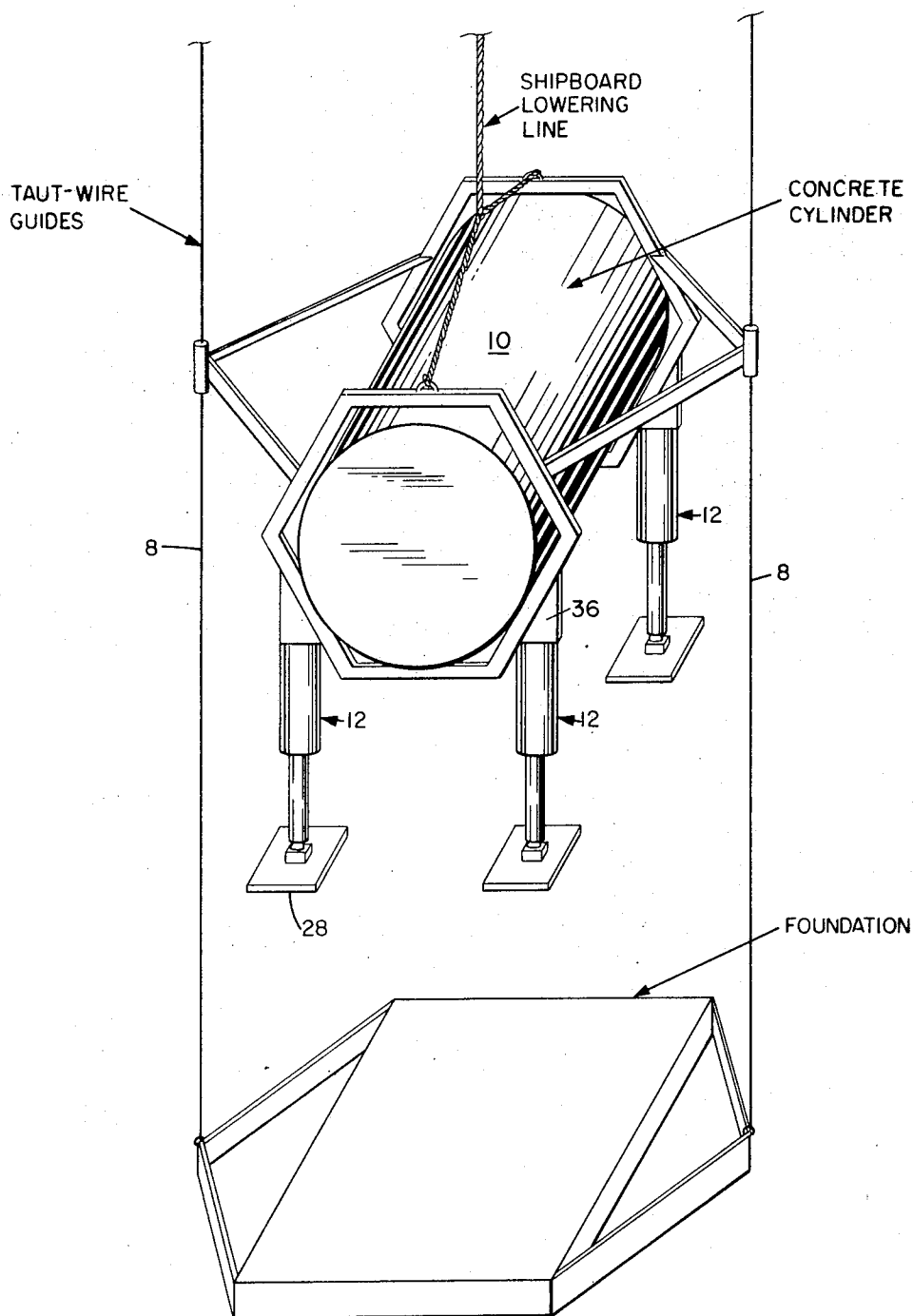


FIGURE I

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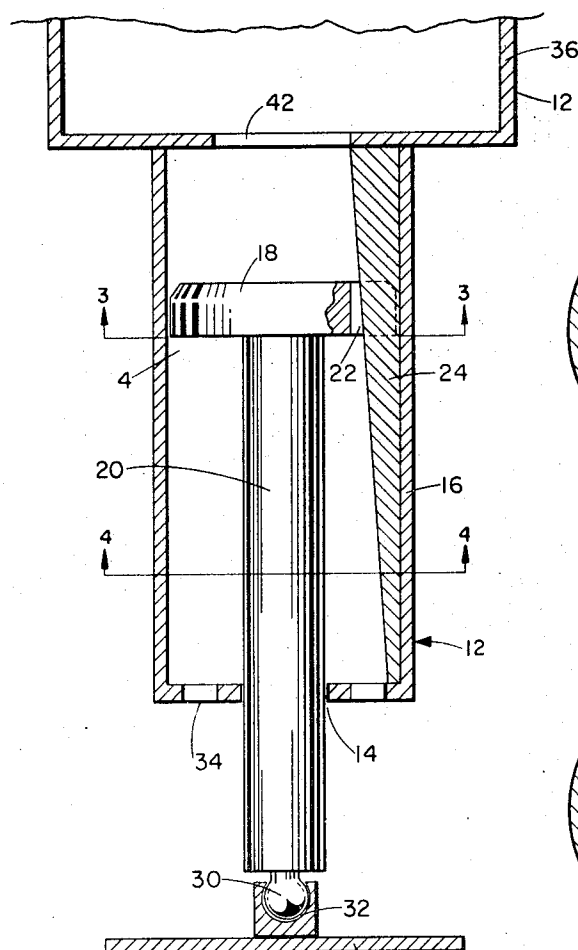


FIG. 2

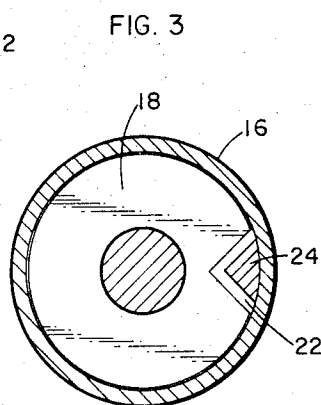


FIG. 3

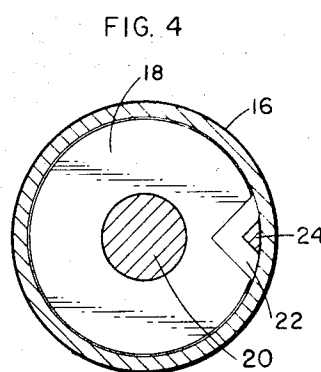


FIG. 4

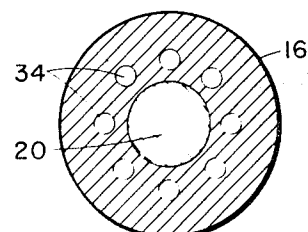


FIG. 6

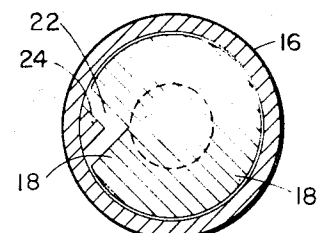


FIG. 7

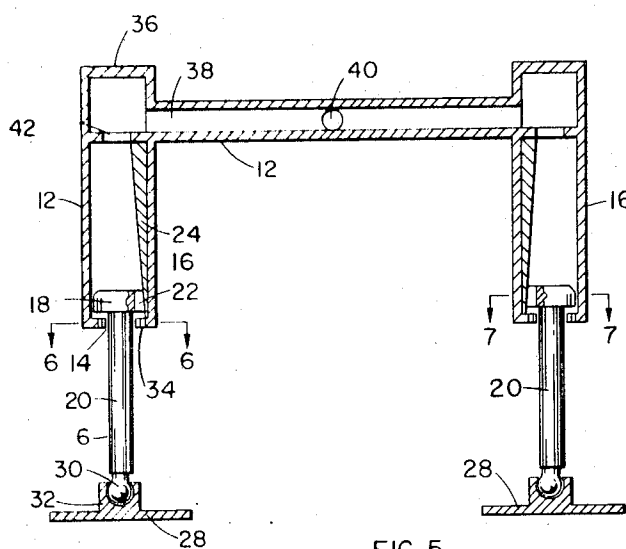


FIG. 5

UNDERWATER SHOCK-ABSORBING AND DECELERATION DEVICE

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The device of the present invention relates to impact cushioning apparatus and more particularly to an underwater shock-absorbing and deceleration means which enables a heavy undersea structure to be emplaced gently on the ocean floor.

2. Description of the Prior Art

Heretofore, in the emplacement of heavy structures on the ocean floor, the object is first ballasted to a slightly negative buoyancy and then lowered down taut cables to an existing foundation. The velocity of descent must be great enough to nullify the possibility of line tension ever becoming zero, thus the structure has to maintain a certain minimum average descent velocity even as it approaches the ocean floor.

The primary problem involved is how to minimize the impact forces created when the structure hits either the ocean floor or the foundation on which the structure is to be placed. One existing prior art approach to this problem is the hanging of sufficient weights below the structure to create a negative buoyancy so that on descent the weights initially will hit the sea floor, thereby producing a positively buoyant structure which will hover above the emplacement site. At this point ballast tanks attached to the structure are flooded creating a slight negative buoyancy which allows the structure to settle to the sea floor. Rubber pads on the bottom of the structure may help absorb some of the impact force upon contact with the bottom.

The foregoing method is common to a multitude of prior art techniques which may be employed depending upon the factors involved. However, one inherent disadvantage in many of such prior art techniques is the probability of line entanglement between the taut wire guides and the lines holding the suspended weights. Another disadvantage is that any attempt to flood ballast tanks at the lower depths is very precarious and may result in loss, misalignment or damage to the structure being placed on the ocean bottom.

The present invention will not only reliably protect the structure being emplaced on the ocean floor from initial impact forces but also will tend to level the structure prior to its complete emplacement at the underwater site.

SUMMARY OF THE INVENTION

The present invention includes a plurality of support legs secured to the under surface of an object being lowered to an underwater locale. Each leg has a hollow cylinder having an end wall at its bottom portion and a large chamber at the top.

A piston is slidably received in the cylinder and a rod is joined to the underside thereof. The rod passes through a central opening in the cylinder end wall and its lower end is connected to a foot by a ball and socket

joint. A notch is provided in the periphery of each piston and extending vertically along the inner surface of the cylinder is a tapered rib that is received in the piston notch. The rib extends from the top of the cylinder where it is of maximum width to the end wall where it is of minimum width. A port or series of ports is also formed in the cylinder end wall.

Just before impact the piston rod is extended out of the cylinder and the piston is in close proximity to the bottom thereof. At impact the piston is forced upwards in the cylinder which builds up air pressure in the chamber. Sea water enters the cylinder through the port. At first resistance to the movement of the piston is at a minimum because the notch in the piston is open to the greatest extent possible but as the piston moves upwardly the effective area of the notch is decreased thus increasing the resistance to movement of the piston.

STATEMENT OF THE OBJECTS OF THE INVENTION

Thus, one object of the invention is to provide an undersea shock-absorbing and deceleration system capable of reliably placing a structure on the ocean floor.

Another object is to provide a simple non-surface controlled means of placing a structure safely on the ocean floor.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the invention attached to the underside of a heavy structure being lowered to its underwater position.

FIG. 2 is a vertical sectional view of one independent leg assembly.

FIG. 3 is a transverse sectional view along line 3—3 of FIG. 2.

FIG. 4 is a transverse sectional view along line 4—4 of FIG. 2.

FIG. 5 is a vertical sectional view similar to FIG. 2 but on a reduced scale showing two interconnected leg assemblies.

FIG. 6 is a transverse sectional view taken along line 6—6 of FIG. 5.

FIG. 7 is a transverse sectional view taken along line 7—7 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, there is shown a heavy structure such as a concrete cylinder 10 being lowered along a pair of parallel guide wires 8 to a predetermined underwater position, which may be a fixed foundation. A plurality of leg assemblies 12 are secured to the under surface of the structure 10 and function both as shock-absorbing and deceleration devices, thus enabling the structure to gently contact and rest on the seafloor foundation.

Each leg assembly 12 comprises a hollow leg cylinder 16 inside of which a slidable piston 18 and attached rod 20 are positioned. The piston 18 has an angular or V-

shaped notch 22 cut in the periphery thereof, and a tapered rib 24 extending vertically along the inner surface of cylinder 16 is received in the V-shaped notch 22 substantially as shown in FIGS. 2 and 3. The rib 24 is of maximum width at the top of cylinder 16 and gradually diminishes in size until it is of minimum width at the bottom of the cylinder.

The rod 20 extends out of a central opening 14 in the bottom of leg cylinder 16 and is pivotally attached to footpiece 28 through a swivel joint formed by ball 30 and socket 32 as illustrated. An aperture 34 may also be provided in the bottom of cylinder 16 and any number of such apertures preferably small in size may be provided in order to keep debris from entering cylinder 16 and possibly clogging notch 22. See FIG. 6.

A large volume chambered body 36 may be interconnected to the top of cylinder 16 via the opening 42. If desired, the body 36 may also be connected to other cylinders 16 by passage 38 thereby in effect connecting all of the leg assemblies 12 employed in the cushioning operation. This chambered body 36 serves as an air reservoir and permits a larger internal volume of air to accumulate in the leg assembly 12 than is present in cylinder 16 alone. While body 36 is preferred as an ideal part of this invention, its elimination along with the interconnections to other similar chambered bodies 36 would only lessen but not eliminate the functions and operations of the leg assembly explained hereinafter.

OPERATION OF THE LEG ASSEMBLY

Due to the force of gravity, as a leg assembly 12 descends into the water, the rod 20 is fully extended out of cylinder 16 while the attached piston 18 is in close proximity to the bottom wall of the cylinder. Seawater may enter into the cylinder 16 through apertures 14 and 34 and V-notch 22, trapping a substantial volume of air in the large interconnected body 36.

Thus, the moment foot 28 contacts the seafloor or any foundation thereon, the peak impulse force transmitted to the structure 10 being positioned in the underwater locale is decreased because rod 20 and attached piston 18 are pushed into cylinder 16 a distance dependent on the change in volume of trapped air. The weight of the structure being lowered which forces the rod 20 into cylinder 16 soon creates an excess pressure within the upper part of the cylinder designed to exceed the pressure of the ambient seawater. This causes the volume of trapped air in chambered body 36 to decrease. Thus in effect a shock-absorbency is created as the rod 20 and piston 18 moves up rapidly for a short distance. This distance can be varied by changing the volume of chambered body 36 and the diameter of cylinder 16. It may also be varied by interconnecting the several chambered bodies 36 of each leg assembly 12 such as by the passages 38 and 40 shown in FIG. 5.

Simultaneously with the shock-absorbing effect of the air, seawater trapped inside cylinder 16 vents through V-notch 22 as the rod 20 and piston 18 move up inside the cylinder 16. The higher up piston 18 moves within the cylinder, the smaller the V-notch 22 becomes in size; accordingly, the quantity of water per unit time escaping through the V-notch 22 continually decreases and the rate the rod 20 enters the cylinder 16 also constantly decreases. In this manner the structure

being lowered to its underwater locale is decelerated from the original descent velocity to a very slow velocity just prior to coming to rest on the ocean floor.

It will be apparent that the structure 10 being lowered will tend to level itself before coming to a complete rest. For example should the structure being lowered have a slight tilt on descent, the leg assembly 12 that makes first contact with the bottom surface will shorten at a continually slower rate, while the other assemblies 12 will shorten at a more rapid rate because their V-notch 22 is initially larger in size than that of the leg assembly that made first contact.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. An underwater shock and deceleration device for cushioning a heavy underwater structure during installation on the ocean bottom comprising:

a hollow cylinder with an aperture in the bottom end thereof;

a separate chambered body positioned adjacent the top of said hollow cylinder and interconnected thereto, said body serving as an air reservoir;

dash-pot means positioned in said cylinder, said means including:

a piston slidably received in the cylinder and having a peripheral V-shaped notch;

a rib vertically located on the interior surface of the cylinder and extending from the top of the cylinder to the bottom thereof, said rib being received in said V-shaped notch of the piston and of maximum width at the top and of minimum width at the bottom;

a rod attached to the underside of the piston and extending out of the bottom of said cylinder, said rod adapted to move the piston upwards upon initial contact with the ocean floor;

thus as the piston moves upward, the effective area of the notch is decreased which increases the resistance to movement of the piston, said chambered body providing an additional cushioning effect.

2. An underwater shock and deceleration device for cushioning a heavy underwater structure during installation on the ocean bottom comprising:

a hollow elongate cylinder having an aperture in the bottom end thereof,

a rib vertically extending along the interior wall of said cylinder, said rib being of maximum width at the top of the cylinder and of minimum width at the bottom thereof,

a piston slidably received in said cylinder and having a notch in the periphery, said rib being received in the notch,

a rod attached to the underside of said piston and extending out of said cylinder through a port in the bottom thereof,

thus at impact the rod and piston are forced upwards into the cylinder with a minimum of resistance but as the width of the rib increases, resistance to movement of the piston also increases.

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3. The device of claim 2 wherein a chambered body is interconnected to the top of the cylinder to facilitate the cushioning action.

4. The device of claim 3 wherein a multitude of chambered bodies are interconnected to provide a cushioning effect from all devices employed.

5. The device of claim 2 wherein a foot is pivotally attached to the lower end of said rod.

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