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Tax et al.

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[54] **OSCILLATION DAMPING ARRANGEMENT FOR THE LOAD CARRIER OF A HOIST**

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[51] **Int. Cl.** **B66c 19/00**

[58] **Field of Search** 212/13, 14, 125, 212/10, 11, 128, 129

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[57] **ABSTRACT**

Oscillation of a load carrier on a travelling hoist in the direction of hoist travel is damped or suppressed by a stabilizing cable whose ends are wound on respective sections of the cable drum assemblies at the fore and aft ends of the hoist platform, while the central portion of the stabilizing cable is trained, in sequence, over a reversing guide pulley on the load carrier, a resiliently mounted pulley on the platform, and another reversing pulley on the load carrier. The central portion of the stabilizing cable diverges in a vertical plane parallel to the direction of hoist travel from the two pulleys on the load carrier toward the platform so that the frictionally engaged guide pulleys turn when the load carrier oscillates horizontally in the vertical plane. The pulley mounted on the platform is provided with a friction brake which impedes or suppresses its rotary movement, and thereby impedes or suppresses horizontal oscillation of the load carrier.

8 Claims, 3 Drawing Figures

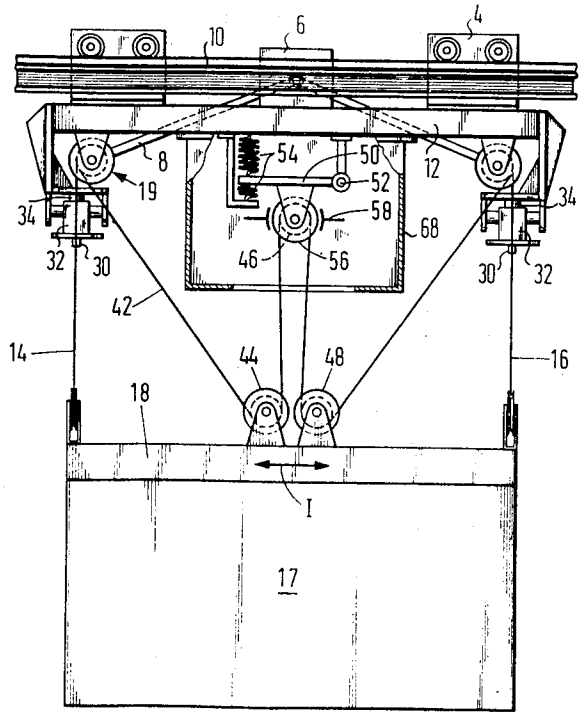

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Fig. 1

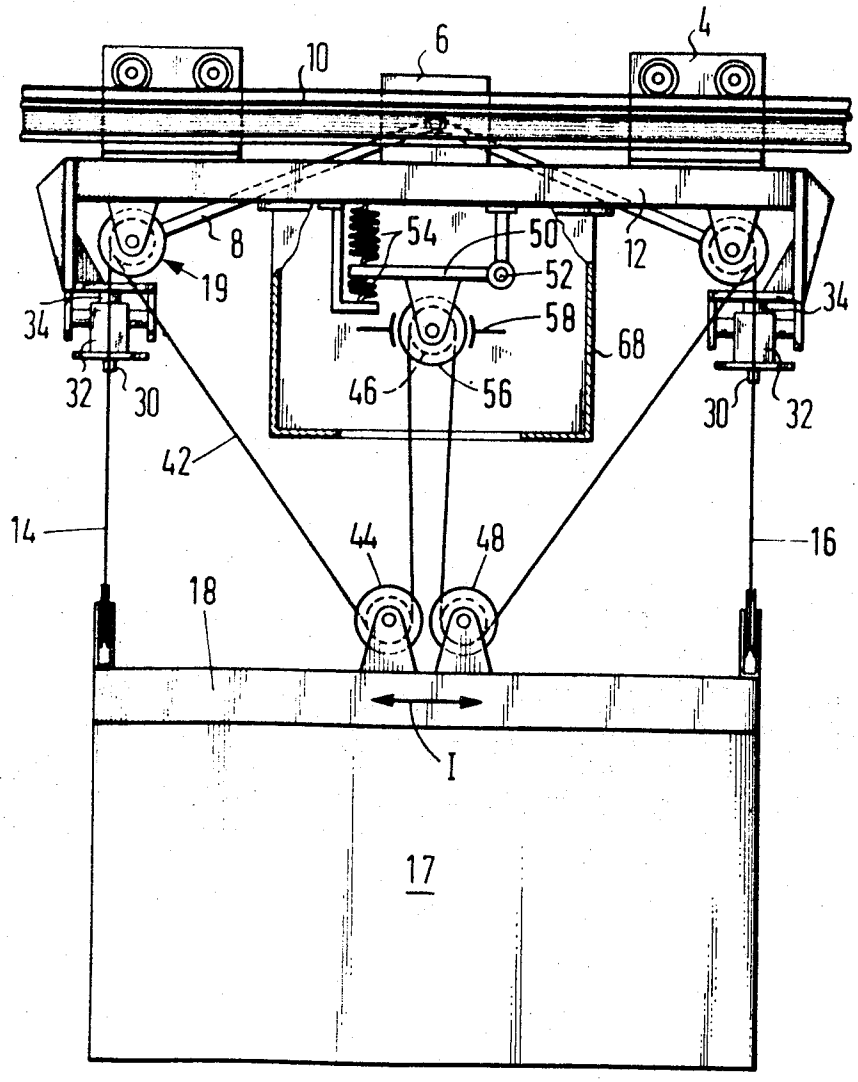

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Fig. 2

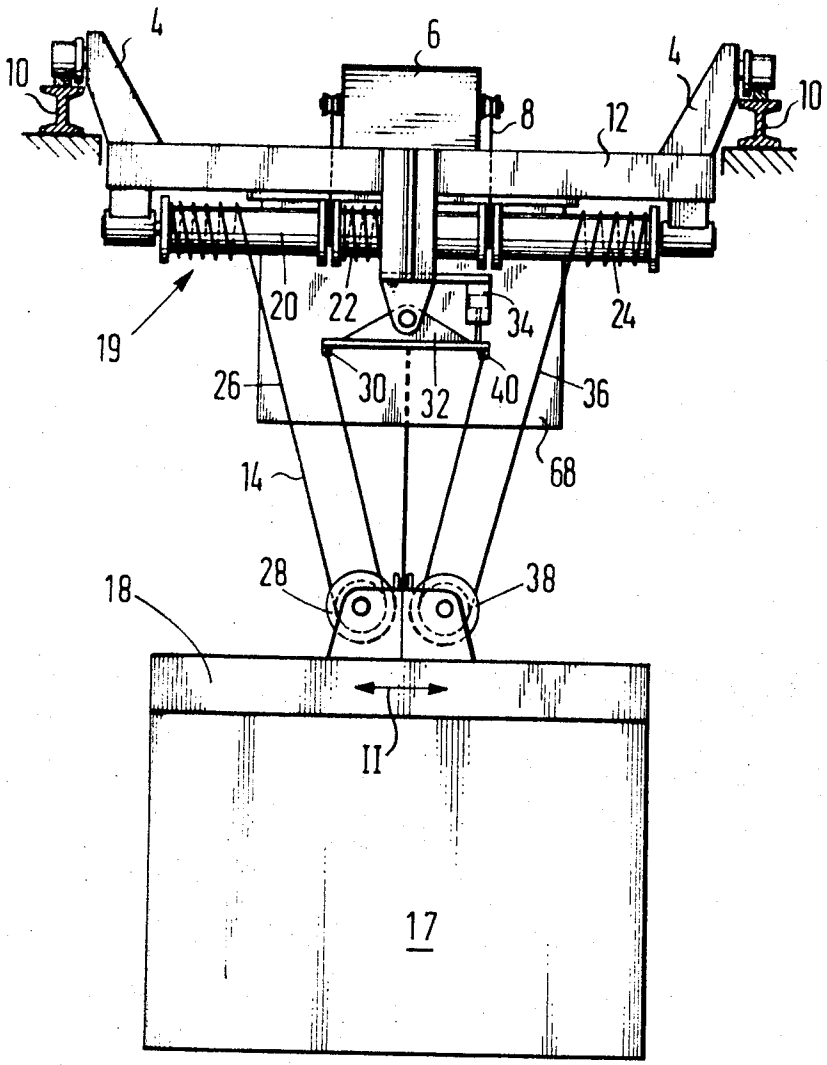

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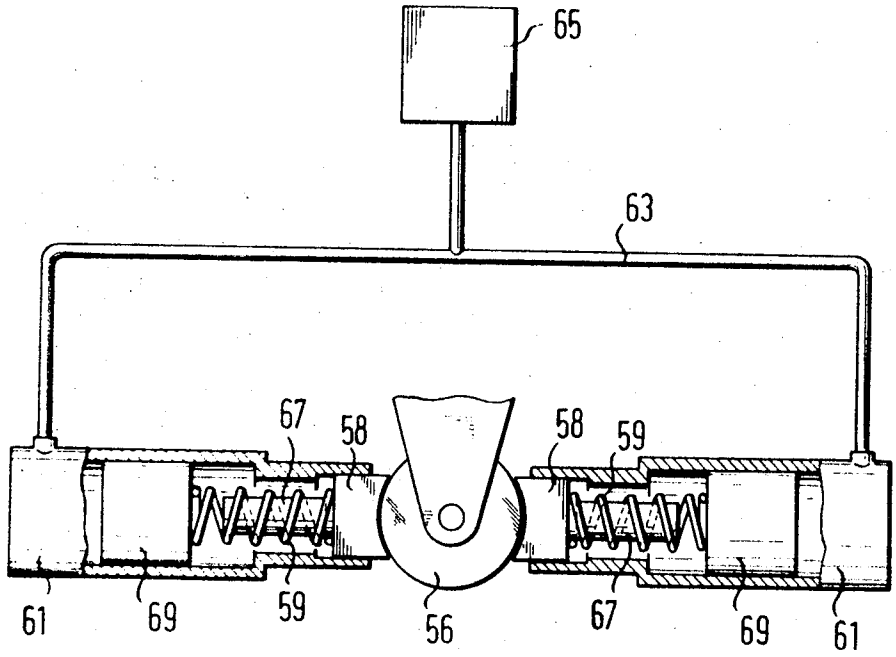
Fig. 3



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OSCILLATION DAMPING ARRANGEMENT FOR THE LOAD CARRIER OF A HOIST

This invention relates to hoists equipped with a load carrier suspended from cables in such a manner that it may oscillate horizontally, and particularly to an arrangement for damping the oscillations of the load carrier.

The invention will be described hereinafter in its application to the travelling hoist of a container crane, but the problem solved is encountered on other similar hoists as well.

The cranes employed for loading and unloading containerships are generally supplied with a bridge or boom on which a hoist travels between a position above the ship and a position above a pier. Cables depending from cable drums on the hoist are attached to a load carrier, usually referred to as a spreader, which may be coupled to the containers to be transferred. As the hoist accelerates or decelerates in its movement, the cable-supported spreader and its load tend to oscillate in a path which is practically horizontal in a vertical plane parallel to the direction of hoist movement. Oscillations transverse to the direction of travel may also occur.

The primary object of this invention is the provision of an arrangement for damping the oscillations in the direction of hoist travel.

Another object is the provision of such a damping arrangement which does not interfere with other devices intended to suppress or impede transverse oscillations.

With these and other objects in view, the invention is applicable particularly to hoist arrangements in which a first and a second cable drum are simultaneous turned about their axes by a suitable drive. Respective hoisting cables are wound on the two drums and have respective parts which depend from the common support of the drums, such as the hoist platform, in horizontally spaced relationship. Two horizontally spaced portions of a load carrier, such as a spreader, are attached to the depending cable parts respectively for raising and lowering the carrier when the drums are rotated. The improvement contributed by the invention to this basically known arrangement resides in a device for impeding oscillation of the load carrier in a vertical plane extending in the direction of spacing of the two depending cable parts.

The invention provides a third and a fourth cable drum on the same support and a stabilizing cable whose two end portions are respectively wound on the third and fourth drums. The central portion of the stabilizing cable which connects the two end portions is guided by pulleys in a direction from the third drum to the load carrier and thence toward the fourth drum substantially in the afore-mentioned plane of potential load carrier oscillation. The stabilizing cable is sequentially trained over the several guide pulleys in frictional engagement with the same, including a first guide pulley attached to the load carrier. Respective parts of the central portion of the stabilizing cable diverge from the load carrier toward the support of the cable drums, that is, in an upward direction. A brake cooperates with one of the guide pulleys for impeding rotation of the cooperating guide pulley.

Other features, additional objects, and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood by

reference to the following detailed description of a preferred embodiment when considered in connection with the appended drawing in which:

FIG. 1 shows a hoist arrangement according to the invention in side elevation, and partly in a diagrammatic manner;

FIG. 2 illustrates the apparatus of FIG. 1 in front elevation; and

FIG. 3 is a more detailed and enlarged view of the elements diagrammatically represented in FIG. 1.

Referring now to the drawing in detail, and initially to FIGS. 1 and 2, there is seen only as much of a bridge crane for loading and unloading containerships as is needed for an understanding of this invention.

Rails **10** extend horizontally along the crane bridge, not otherwise shown in detail, and carry trolleys **4** on which the horizontal platform **12** of a hoist is mounted. An electric hoist motor **6** is supported by the platform **12.** As is conventional in this art, the motor **6** is reversible and equipped with an electromagnetic internal brake, and it drives its output shaft through built-in reduction gearing. The motive power of the motor **6** is transmitted to two cable drum assemblies **19** by respective pairs of link chains **8** and pairs of sprockets on the output shaft of the motor and in the cable drum assemblies.

The cable drum assemblies are supported below the platform **12** for rotation about respective horizontal axes transverse to the direction of hoist movement on the rails **10** and respectively adjacent the front and rear ends of the platform **12.** Each assembly **19** has three axial cable drums or cable drum sections **20, 22, 24** coaxially fastened on a motion transmitting, common shaft **19***a* and separated from each other by the axially interposed sprockets for the two drive chains **8,** as is best seen in FIG. **2.**

Two sets **14, 16** of hoisting cables are respectively associated with the cable drum assemblies **19** in the same manner, and only the set **14** will be described in detail with reference to FIG. **2,** the other set **16** cooperating with the other drum assembly **19** and other elements in the same manner.

The front end of a spreader **18** carries two guide pulleys **28, 38** mounted in respective bearing blocks near the center of the front edge. Two hoisting cables **26, 36** are partly wound on the axially terminal cable drums or cable drum sections **20, 24** respectively, and parts of the cables depend from the drum assembly **19** toward the pulleys **28, 38** respectively, are trained over the pulleys and terminate at respective fasteners **30, 40** on the two arms of a lever or balance beam **32** pivotally mounted under the platform **12.** Pivoting movement of the beam **32** is damped by a dashpot **34** not significantly different from a conventional automotive shock absorber of the piston-and-cylinder type. The cylinder portion of the dashpot **34** is fixedly fastened on the platform **12** whereas the piston is connected to one arm of the beam **32.** The parts of the cables **26, 36** which extend between the cable drum assembly **19** and the guide pulleys **28, 38** diverge in an upward direction, that is, from the spreader or load carrier **18** toward the assembly **19** and the platform **12** which provides support for the assembly.

When the load carrier **18** moves horizontally in the vertical plane of FIG. **2** transversely to the direction of hoist movement on the rails **10,** as indicated by the double arrow II, the inclination of one cable **26, 36** rel-

ative to the vertical is increased, and that of the other cable is decreased, so that the cables tend to pivot the beam **32**. The dashpot **34** counteracts the forces exerted by the cables **26, 36** on the beam **32**, and therefore damps any transverse oscillation of the spreader **18** and of the container **17** suspended from the spreader by means of releasable couplings, conventional and not shown.

This invention is concerned particularly with the damping of oscillations of the spreader **18** and of the load supported thereby which may be caused by acceleration or deceleration of the platform **12** as it travels along the rails **10**.

Two guide pulleys **44, 48** are juxtaposed on the top surface of the spreader **18** in a vertical plane parallel to the rails **10** which bisects the cable drum assemblies **19**, and is parallel to the plane of FIG. **1**. The plane passes through the two central drum sections **22**, and the central portion of a stabilizing cable **42**, whose ends are wound on the two sections **22** respectively, extends at least approximately in that bisecting plane.

One end of a mounting arm **50** is secured on the underside of the platform **12** on a pivot **52**, and the other end is arranged between two coaxial, helical compression springs **54** mounted under the platform **12**. Another guide pulley **46** is mounted on the arm **50**. The central portion of the cable **42** is trained, in sequence, over the guide pulleys **44, 46, 48** and is kept taut by the spring **54**, so that the pulley **46** functions as a conventional tensioning pulley.

The cable **42** diverges from the pulleys **44** and **48** toward the cable drum assemblies **19** at an angle similar to the angle of divergence of the cables **26, 36** (FIG. **1**) and the identical angle of the cables in the set **16**, not shown. The cable drums **20, 21, 22** have the same diameters. When the motor **6** turns the cable drum assemblies in a direction to lower the spreader **18**, the two ends of the cable **42** are let out at almost precisely the same rate as the cables **26, 36**. During lowering of the spreader **18**, the pulleys **28, 38** turn, but the pulleys **44, 46, 48** stand still as longs as there is no horizontal movement of the spreader **18** in the direction of the double arrow I (FIG. **1**). Minor differences in the length changes of the cables **42** and **26, 36** are compensated by pivoting movement of the mounting arm **50** for the pulley **46**. The pulleys **44, 46, 48** do not normally turn when the spreader **18** is raised by the motor **6**, for obvious reasons.

Whether or not the cable drum assemblies **19** are arrested by the brake built into the motor **6** to hold the spreader in any desired vertical position, the pulleys **44, 46, 48** tend to turn when the spreader **18** moves in the direction of the rails **10**, as during sudden acceleration of the platform **12** by its nonillustrated drive. The resulting oscillation of the spreader is not affected by the devices described above with reference to FIG. **2**, but is damped by brake shoes **58** engaging a brake drum **56** fixedly fastened to the guide pulley **46** for coaxial rotation.

As is better seen in FIG. **3**, the cylinder **61** of two hydraulic motors are fixedly mounted on the arm **50** in a manner not explicitly shown, and may be supplied with hydraulic fluid through a flexible pressure hose **63** connected to a non-illustrated hydraulic pump and an equally non-illustrated oil sump by an electrically operated, remotely controlled distributor valve **65** of a type conventional in hydraulic equipment. The plungers **69** of the motors carry helical compression springs **59** and abutment rods **67** coaxial with the springs **59** but shorter than the latter in the illustrated relaxed condition of the springs. The brake shoes **58** are mounted on the free axial ends of the springs **59. 9**

When it is desired to damp oscillations of the spreader **18** in the direction of the arrow I, hydraulic fluid is admitted to the cylinders **61** by the crane operator who controls the valve **65**. The brake shoes **58** initially engage the friction face of the brake drum **56** under the resilient force of the springs **59** which may be adjusted by shifting the plungers **69**. If enough fluid is admitted to the cylinders, the abutments **67** directly engage the shoes **58** and press the shoes against the drum under the full hydraulic pressure of which the system is capable so that no further angular movement of the drum **56** and of the pulley **46** is possible, and horizontal movement of the spreader **18** in the direction of hoist travel is blocked. If applied with less pressure, the brake shoes **58** merely damp oscillation of the spreader.

While the invention has been described with reference to two cable drum assemblies **19** having each three sections or component drums, and such an arrangement is preferred, it is also applicable to hoists having only four cable drums, the first and second drum accomodating the hoisting cables, and the third and fourth drum carrying the stabilizing cable. Each of the last-mentioned drum sections may be connected with the associated hoisting cable drum by motion transmitting means other than a common shaft, and synchronized, individual motors acting on the four basic cable drums individually are specifically contemplated. Such motors need not be operated by electric current to make the system operative. If the cable drums for the hoisting cables and those for the stabilizing cable differ in diameter, they may be connected for rotation at different speeds as long as the third and fourth drums for the stabilizing cable are rotated during raising or lowering of the spreader **18** in such a manner as to substantially prevent rotation of the guide pulleys **44, 46, 48** in the absence of horizontal movement of the load carrying spreader **18** in the direction of the arrow I.

It should be understood, of course, that the foregoing disclosure relates only to a preferred embodiment of the invention, and that it is intended to cover all changes and modifications of the example of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

A housing **68** encloses the drum **56** and the brake shoes **58** and the structure **50, 52, 54** supporting the drum **56.**

What is claimed is:

1. A hoist arrangement comprising:

a. a support;

b. a load carrier having two portions spaced from each other;

c. hoisting means for raising and lowering said carrier relative to said support while keeping the spacing of said portions substantially horizontal and permitting horizontal movement of said carrier in the direction of said spacing, said hoisting means including:

1. a first cable drum and a second cable drum on said support,

2. drive means for simultaneously turning said drums about the axes thereof,

3. two hoisting cables wound on said cable drums respectively and having respective parts depending from said support and attached to said portions respectively for raising and lowering said carrier during the turning of said drums; and

d. stabilizing means for impeding said movement of said carrier including:

1. third and fourth cable drums on said support,

2. a stabilizing cable having two end portions respectively wound on said third and fourth drums and a central portion connecting said end portions, respective parts of said central portion diverging from said load carrier toward said support,

3. movably mounted guide pulley means guiding said central portion in a direction from said third drum to said load carrier and thence toward said fourth drum and including a plurality of rotatably mounted guide pulleys frictionally engaging said stabilizing cable,

4. yieldably resilient tensioning means cooperating with said guide pulley means to keep said central portion taut,

5. motion transmitting means connecting said third and fourth drums to said first and second drums, said motion transmitting means rotating said third and fourth drums during raising of said load carrier for shortening said stabilizing cable, and for lengthening said stabilizing cable during lowering of said load, said third and fourth drums being rotated at respective rates to substantially prevent rotation of one of said guide pulleys by the frictionally engaged stabilizing cable in the absence of said movement of said carrier while permitting rotation of said one pulley during said movement of said carrier, and

6. brake means cooperating with said one guide pulley for impeding rotation of the same.

2. In an arrangement as set forth in claim **1**, said hoisting cables being spaced from said stabilizing cable in opposite directions.

3. In an arrangement as set forth in claim **1**, said motion transmitting means fixedly connecting said first and second drums to said third and fourth drums respectively for joint, coaxial rotation.

4. In an arrangement as set forth in claim **1**, said tensioning means including mounting means movably mounting said one guide pulley on said support, and means biasing said one guide pulley in a direction to tension said central portion.

5. In an arrangement as set forth in claim **4**, said plurality of guide pulleys including a second guide pulley and a third guide pulley, said second and third guide pulleys being attached to said load carrier, said stabilizing cable being trained sequentially over said second guide pulley, said one guide pulley, and said third guide pulley, said diverging parts of said stabilizing cable extending from said second and third guide pulleys respectively toward said third and fourth cable drums.

6. In an arrangement as set forth in claim **4**, additional brake means for arresting said cable drums.

7. In an arrangement as set forth in claim **4**, means for varying the braking force exerted by said brake means on said one guide pulley.

8. In an arrangement as set forth in claim **7**, said brake means including a rotary brake member operatively connected to said one guide pulley for simultaneous rotation, a stationary brake member secured to said support, and biasing means biasing said brake members into frictional engagement.

* * * * *