

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) ANTI-SWAY MECHANISM FOR SUSPENDED LOADS

(71) We, FRUEHAUF CORPORATION a corporation organized and existing under the laws of the State of Michigan, United States of America, of 2350 Blanding Avenue, Alameda, California, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an anti-sway mechanism for suspended loads and more especially to an anti-sway mechanism for arresting or abating the pendulum motion of an elongated load suspended from a mobile lifting platform such as a crane trolley or a mobile crane.

A problem usually encountered in the handling of cargo by mobile cargo cranes and crane trolleys is sway of the load which occurs because the load is suspended by cables and must be moved horizontally by the crane while suspended. Due to this movement, the load usually experiences pendulum motion from the horizontal acceleration and deceleration forces inherent in the movement, and rotational motion from the centrifugal forces which occur in a mobile crane being steered in and around the storage area.

In order to accurately position the suspended load for deposition and release, it has been necessary to wait until the swaying motion of the load has subsided. The time lapse which occurs in waiting for the sway to abate increases the time of the cargo handling cycle of the crane whereby considerable time is lost over the course of a working day. To increase the handling capacity of the crane, it is of primary importance to reduce the time necessary for pendulum motion to abate whereby the cargo handling operation becomes more efficient.

When handling cargo containers by means of mobile cargo container handling cranes, or movable trolleys mounted on large cranes, it is necessary to be able to accurately deposit the load in a predetermined position. For instance,

when loading cargo containers on board ship, the containers must be spotted or accurately located over the hatch, or cell division of a hatch, so the containers will be properly aligned in the storage cell guides. 50

Comparable situations occur in the loading or unloading of cargo containers onto truck trailers and/or the loading of truck trailers, with the containers, onto railroad flat cars for rail transport. In these situations, it is necessary to either spot the container with respect to the trailer, or to spot the wheels of the trailer, when picking up both the trailer and the container, with respect to the trailer tie down positions on the railroad cars. As with the handling of the cargo containers for loading onto ships, swaying or swinging of the container, or the trailer and container combination, delays the loading operation. This is a condition very prevalent in the case of inexperienced or less skilled operators. 55 60 65

Many anti-sway devices have been developed for the preventing or arresting of pendulum motion. One of the most common is a spring-loaded tagline cable reel which is most often used in conjunction with clamshell buckets. 70

An anti-sway device most closely related to the present invention is disclosed in the Specification of United States Patent No. 3,179,259. The anti-sway mechanism of that device will be seen to be quite different from the present invention since all of the sway arresting lines disclosed therein have individual brakes. The disadvantage of that system is that the brakes work unevenly and do not effect a coordinated arresting of the pendulum motion. Even if the brakes are often adjusted, wear of the brake shoes quickly throws it out of adjustment. Further, with a separate brake unit for each tagline mechanism, there is greater opportunity for breakdown. 75 80 85

The present invention has the advantage of having a brake common to all of the sway arresting cables whereby there is coordinated arresting of any sway or rotational motion of the suspended load. 90

While the anti-sway mechanism is designed

primarily for use on container handling cranes to arrest the pendulum or rotational motion of the elongated containers when suspended by cables, it will be apparent, and it will be pointed out in detail, it can be utilized for arresting sway in a wide variety of suspended loads.

According to the invention there is provided an anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform, said anti-sway mechanism comprising at least one rope drum mounted on each end of a shaft rotatably secured to said platform, said drums each being mounted for unidirectional rotation relative to said shaft and having ropes reelable therefrom, said ropes being secured to said load, rewind means engaged with said drums for rotating said drums relative to said shaft for taking up slack in said ropes, and brake means mounted on said shaft for resisting rotation thereof for causing work to be done by rope being pulled off of said drums due to sway of the load.

Various preferred features and advantages of the present invention will become more apparent from the following exemplary description to be taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of a mobile cargo container handling crane with the invention installed thereon;

Figure 2 is an end elevation of the arrangement of the mechanism illustrating the reeving of the sway arresting ropes;

Figure 3 is a side elevation in section of the operating mechanism taken along line 3-3 of Figure 6;

Figure 4 is a cross-sectional view of the brake of the present invention taken along lines 4-4 of Figure 3;

Figure 5 is a cross-sectional view of an alternative brake means;

Figure 6 is a top plan view of the present invention secured to a lifting platform;

Figure 7 is a side elevation of Figure 6;

Figure 8 is a schematic perspective view of the present invention showing a suspended load moving in a first direction of pendulum motion;

Figure 9 is a schematic perspective view of the present invention showing a suspended load having rotational sway;

Figure 10 is a schematic perspective view of the present invention showing a suspended load being raised.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is made to the drawings for a description of the invention. The perspective view shown in Figure 1 illustrates a mobile cargo handling crane 11 having a movable trolley 13 supported on the cross beams 15 of the frame. A cargo container lifting spreader 17 is suspended by cables 19 below the movable trolley for picking up either cargo containers 21, individually, or truck trailers 23 with containers

on them. The reeving which suspends the lifting spreader and carries the load has substantially vertically depending wire ropes.

When the load is lifted, and the crane moved across the ground or dock, the acceleration, deceleration, and centrifugal forces experienced by the suspended load during movement and turning induce pendulum and rotational motion in it.

Reference is made to Figure 3 which shows the anti-sway mechanism 25 secured to a lifting platform 27 which is usually some form of movable trolley. The apparatus includes a shaft 29 which is rotatably secured to the platform by means of journal bearings 31. The shaft is divided into three portions whereby the outer end sections 33 may be independently removed for repair or replacement by removing the bolts in the rigid flange couplings 35. This permits the center section 37, including the brake assembly 39, to be left in position when the end sections are taken off, or it can be removed leaving the end sections in position.

A brake means is mounted on the shaft for causing work to be done when the arresting ropes 41 are lengthened due to the sway of the load. The brake means includes a rotatable brake drum 43 mounted on the shaft. A brake shoe 45 in the form of a band is secured to the platform 27 for arresting rotation of the brake drum. The shoe is secured with a spring mounting 47 whereby the tension of the band is variable by adjusting the spring retaining nut 49.

Two wire rope drums 51 are mounted on each end of the shaft and have wire ropes 41 which are reelable therefrom. The wire ropes extend in opposite directions from the two drums on the same ends of the shaft. Unreeling of the ropes from any of the drums causes unidirectional rotation of the shaft.

The wire ropes are reeved through direction changing shackle blocks 53 which are secured to the lifting platform. The ends of the ropes are secured to opposite edges of the suspended load 55. By reeving to the opposite edges of the lifting spreader as shown in Figure 2, the arresting ropes effect the maximum lateral force possible in retarding the swinging motion.

Each of the drums includes an independent internal clutch means (not shown) which interconnects each drum with the shaft for rotating the shaft when rope is pulled off of any one of the wire rope drums. The clutch means are commercially available and are formed to permit the drums to overrun while rope is being rewound onto the rope drums.

Rewind means are engaged with the drums for taking up slack in the ropes. This can include independent prewound spring motors 57 engaged with each of the drums. The motors wind the ropes on the drums when the lifting spreader is raised and when the ropes go slack during return sway of the suspended load.

The arrangement of a drum, a rope, and a

rewind means, without a brake, is known generally as a tagline.

Figures 5 and 6 show how the anti-sway mechanism 25 is mounted on the mobile crane.

5 The apparatus can actually be built into a removable frame 59 which can be secured as a unit to the bottom of a lifting platform. Thus, the apparatus can be relatively easily and quickly secured to the trolley of a crane as an accessory unit.

10 Figures 8, 9, and 10 illustrate the way in which the mechanism operates. The arrows show the direction of motion of the load; the direction the arresting ropes are moving; and the direction of rotation of the drums.

15 Figure 8 shows the load 55 moving with pendulum motion in a lateral direction. The arresting ropes 41 are being pulled off of the two lower drums 51 at the same end of the shaft by the swinging of the load toward the upper right. The unidirectional clutches turn the shaft causing work to be done on the brake 39 which puts an arresting force on the unreeling of wire ropes from the drums. Concurrently, the upper drums are overrunning and the ropes are being rewound onto them by the spring motors.

20 Figure 9 shows the load 55 moving with counterclockwise rotational motion. The pairs of drums at each end of the shaft are turning in opposite directions: one of each rewinding and one of each unreeling. The brake 39 applies an arresting force to the two ropes being pulled from the drums. When the load experiences both rotational and pendulum motion simultaneously, the sway is still arrested since any-
30 time the sway is great enough to pull rope from a drum, work must be done on the brake.

35 Figure 10 shows the load 55 being lifted whereby all of the ropes are being rewound onto the drums 51 which are overrunning and no work is done on the brake 39. If there is sufficient sway during lifting to pull rope from the drum, there will be work on the brake.

40 When the anti-sway mechanism is used on a low lift crane, such as that shown in Figure 11, the brake is permanently engaged as shown in Figure 4, and therefore does work while the load is being lowered. The heat dissipation from the brake can be made adequate for low lift cranes in order to leave the brake engaged at all times. When the mechanism is to be used with a high lift crane, a remotely controllable brake disengagement means can be employed, such as shown in Figure 5, whereby
45 the brake may be disengaged by the crane operator for lowering the load. A hydraulic cylinder 61 is shown, but an electric solenoid or even mechanical linkage could be used to effect the engagement-disengagement.

50 It is readily apparent that the apparatus could be effectively used to arrest sway of a point load, or one suspended from a single cable, by running all of the ropes from the direction changing shackle blocks to the hook
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of the load at the end of the lifting cable or to four opposed points on the load. Likewise, a simpler unit with only one drum at each end of the shaft, and one rope each, could be used for sway arresting under certain conditions.

70 The present invention has the unique advantage of having only one brake which is common to all of the taglines. This means that the arresting force on each rope is equal. If there are separate brakes, it is possible that unequal arresting forces can occur setting up rotational motion in what previously might only have been pendulum motion. This could be very undesirable in close clearance situations. This increased efficiency and simplicity of this device is an unmeasurable value, but comparison with the prior art shows that the present invention is a distinct improvement over what has been known.

WHAT WE CLAIM IS: —

85 1. An anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform, said anti-sway mechanism comprising at least one rope drum mounted on each end of a shaft rotatably secured to said platform, said drums each being mounted for unidirectional rotation relative to said shaft and having ropes reelable therefrom, said ropes being secured to said load, rewind means engaged with said drums for rotating said drums relative to said shaft for taking up slack in said ropes, and brake means mounted on said shaft for resisting rotation thereof for causing work to be done by rope being pulled off of said drums due to sway of the load.

90 2. The anti-sway mechanism of claim 1, wherein said brake means includes a remotely controllable brake disengagement means whereby during lowering of the load with respect to the platform, said brake means may be disengaged.

95 3. The anti-sway mechanism of claim 1 or 2, wherein said ropes are reeved from said drums to the load through direction changing shackle blocks.

100 4. The anti-sway mechanism of claim 1, 2 or 3, wherein said brake means includes a brake drum rotatably supported by said shaft, a brake shoe effectively secured to said platform for engaging said brake drum, and said rewind means includes independent clutch means engaged with each of said drums for rotating said shaft when rope is pulled off of the rope drums and for overrunning when rope is rewound onto the rope drums by the rewind means.

105 5. The anti-sway mechanism of claim 1, 2, 3 or 4, wherein at least two rope drums are mounted on each end of said shaft.

110 6. An anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform comprising a shaft rotatably secured to said platform, a rotatable brake drum secured to said shaft, a brake shoe secured to said platform for arresting rotation
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rewind means, without a brake, is known generally as a tagline.

Figures 5 and 6 show how the anti-sway mechanism 25 is mounted on the mobile crane.

5 The apparatus can actually be built into a removable frame 59 which can be secured as a unit to the bottom of a lifting platform. Thus, the apparatus can be relatively easily and quickly secured to the trolley of a crane as an accessory unit.

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20 Figure 9 shows the load 55 moving with counterclockwise rotational motion. The pairs of drums at each end of the shaft are turning in opposite directions: one of each rewinding and one of each unreeling. The brake 39 applies an arresting force to the two ropes being pulled from the drums. When the load experiences both rotational and pendulum motion simultaneously, the sway is still arrested since any-
 30 time the sway is great enough to pull rope from a drum, work must be done on the brake.

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40 When the anti-sway mechanism is used on a low lift crane, such as that shown in Figure 1, the brake is permanently engaged as shown in Figure 4, and therefore does work while the load is being lowered. The heat dissipation from the brake can be made adequate for low lift cranes in order to leave the brake engaged at all times. When the mechanism is to be used with a high lift crane, a remotely controllable brake disengagement means can be employed, such as shown in Figure 5, whereby the brake may be disengaged by the crane operator for lowering the load. A hydraulic cylinder 61 is shown, but an electric solenoid or even mechanical linkage could be used to effect the engagement-disengagement.

60 It is readily apparent that the apparatus could be effectively used to arrest sway of a point load, or one suspended from a single cable, by running all of the ropes from the direction changing shackle blocks to the hook

of the load at the end of the lifting cable or to four opposed points on the load. Likewise, a simpler unit with only one drum at each end of the shaft, and one rope each, could be used for sway arresting under certain conditions.

70 The present invention has the unique advantage of having only one brake which is common to all of the taglines. This means that the arresting force on each rope is equal. If there are separate brakes, it is possible that unequal arresting forces can occur setting up rotational motion in what previously might only have been pendulum motion. This could be very undesirable in close clearance situations. This increased efficiency and simplicity of this device is an unmeasurable value, but comparison with the prior art shows that the present invention is a distinct improvement over what has been known.

WHAT WE CLAIM IS:—

85 1. An anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform, said anti-sway mechanism comprising at least one rope drum mounted on each end of a shaft rotatably secured to said platform, said drums each being mounted for unidirectional rotation relative to said shaft and having ropes reelable therefrom, said ropes being secured to said load, rewind means engaged with said drums for rotating said drums relative to said shaft for taking up slack in said ropes, and brake means mounted on said shaft for resisting rotation thereof for causing work to be done by rope being pulled off of said drums due to sway of the load.

90 2. The anti-sway mechanism of claim 1, wherein said brake means includes a remotely controllable brake disengagement means whereby during lowering of the load with respect to the platform, said brake means may be disengaged.

100 3. The anti-sway mechanism of claim 1 or 2, wherein said ropes are reeved from said drums to the load through direction changing shackle blocks.

110 4. The anti-sway mechanism of claim 1, 2 or 3, wherein said brake means includes a brake drum rotatably supported by said shaft, a brake shoe effectively secured to said platform for engaging said brake drum, and said rewind means includes independent clutch means engaged with each of said drums for rotating said shaft when rope is pulled off of the rope drums and for overrunning when rope is rewound onto the rope drums by the rewind means.

115 5. The anti-sway mechanism of claim 1, 2, 3 or 4, wherein at least two rope drums are mounted on each end of said shaft.

120 6. An anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform comprising a shaft rotatably secured to said platform, a rotatable brake drum secured to said shaft, a brake shoe secured to said platform for arresting rotation



of said brake drum, at least one wire rope drum mounted on each end of said shaft and having ropes reeable therefrom, said ropes being secured to opposite edges of the suspended load, independent clutch means engaged with each of said drums for rotating said shaft when rope is pulled from said drums and for overrunning when rope is rewound onto the rope drums, and independent prewound spring motors engaged with each of said drums for rewinding the ropes on said drums when said ropes are slack.

7. The anti-sway mechanism of claim 6 wherein said brake means includes a remotely controllable brake disengagement means whereby during lowering of the load with respect to the platform, said brake means may be disengaged.

8. An anti-sway mechanism for arresting pendulum motion of a suspended load relative to its lifting platform comprising a shaft rotatably secured to said platform, a rotatable brake drum secured to said shaft, a brake shoe secured to said platform for arresting rotation of said brake drum, two wire rope drums mounted on each end of said shaft and having wire ropes reeable therefrom, said wire ropes being reeved from said drums through direction

changing shackle blocks and secured to opposite edges of the suspended load, independent clutch means engaged with each of said drums for rotating said shaft when rope is pulled from said drums and for overrunning when rope is rewound onto the rope drums, and independent spring motors engaged with each of said drums for rewinding the ropes on said drums when said ropes go slack.

9. The anti-sway mechanism of claim 8 wherein said brake means include a remotely controllable brake disengagement means whereby during lowering of the load with respect to the platform, said brake means may be disengaged.

10. The anti-sway mechanism of claim 8 or 9 including a frame for supporting said shaft and which may be secured to said platform whereby said mechanism is removably secured as an accessory unit to said platform.

11. An anti-sway mechanism for suspended loads constructed and arranged substantially as herein described with reference to and as illustrated in the accompanying drawings.

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