DEVICE FOR PREVENTING THE SWAYING OF THE SUSPENDING MEANS IN A CRANE

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ABSTRACT
Guide sheave frames are suspended between a trolley and a sheave block so as to control the angles between the ropes for lifting or lowering the sheave block which are suspended in the form of V between the trolley and the sheave block. In loading or unloading the guide sheave frames are adapted to be spaced apart by a suitable distance from or engaged with each other.

10 Claims, 6 Drawing Figures
DEVICE FOR PREVENTING THE SWAYING OF THE SUSPENDING MEANS IN A CRANE

The present invention relates to a device for preventing the swaying of the suspending means in a crane.

Because of the shortage of skilled container crane operators and of the increase in loading and unloading speed of the recently developed highly efficient automatic container cranes, the container cranes must be provided with a device for preventing the swaying of a container being suspended so as to maintain it in a level position.

In a device for preventing the swaying of the suspending means in a crane shown in FIG. 1, in addition to a rope (a) for lifting or lowering a sheave block (d), ropes (b) for preventing the swaying of the cargo is extended and crossed between the sheave block (d) and a trolley (c) so as to provide the sufficient tensions to prevent the swaying of a cargo. However the angle of crossing of and the tensions produced by the rope (b) are limited so that the satisfactory swaying preventive effect is not obtained. Furthermore the number of ropes is increased so that the number of sheaves is also increased, thus resulting in the complicated construction.

The split trolley system developed by Pacific Coast Engineering Co., Ltd. USA, is very effective to prevent the swaying of a cargo, but is complex in construction. Furthermore ropes for preventing the swaying of the cargo must be equipped so that the operation is complex and the cost of the cranes is very expensive.

The present invention was made to overcome the defects and difficulties encountered in the conventional swaying preventive devices. Briefly stated the present invention is characterized by comprising a guide sheave frame or frames suspended by means of ropes between a trolley and a cargo lifting or hoisting means in such a manner that said guide sheave frame or frames and said cargo hoisting or lifting means may be simultaneously or independently lifted or lowered, whereby the angles between ropes suspended in the form of V between said trolley and said cargo hoisting or lifting means may be varied.

The above and other features and advantages of the present invention will become more apparent from the following description of one preferred embodiment thereof taken in conjunction with the accompanying drawings.

FIG. 1 is a diagram illustrating a conventional device for preventing the swaying of the suspending means in a crane;
FIG. 2 is a perspective view of a preferred embodiment of the present invention;
FIGS. 3 and 4 are views used for the explanation of the mode of operation thereof;
FIG. 5 is a view on enlarged scale illustrating the relation between a guide sheave frame and a sheave block; and
FIG. 6 is a side view thereof.

Referring to FIGS. 2 – 6, one preferred embodiment of the present invention will be described hereinafter as being applied to a rope-trolley type container crane. Drums 1 and 2 for lifting a sheave block are mounted upon a main structural frame of the crane, and sheaves 6, 7, 8, 9 and equalizer sheaves 32, 33 are attached to end of the crane girder 5. A trolley which is generally indicated by 10 and adapted to travel along rails attached to the crane girder 5, sheaves 11, 12, 13, 14, 28, 29, 30 and 31 located at the four corners of the trolley, sheaves 42, 43, 44 and 45 are located of the trolley and for hoisting or lifting a guide sheave frame, sheaves 46 and 47 and 48 and 49 located between the sheaves 42 and 43 and between the sheaves 44 and 45, respectively, and drums 50 and 51 for lifting the guide sheave frame mounted at the center of the trolley and drivingly coupled through belt gear 52 and a reduction gear 53 to a torque motor 54 with a brake 55.

Two guide sheave frames 36 and 37 provided with guide sheaves 15, 16, 24 and 25: and 17, 18, 26 and 27, respectively, and a sheave block 19 comprises a spreader 34 provided with sheaves 20, 21, 22 and 23 fixed to the top thereof. Ropes 3 and 4 from the sheave block hoisting drums 1 and 2 pass over the sheaves 6 and 8 and the sheaves 11 and 13 upon the trolley 10 to be directed to pass over the sheaves 15 and 17 of the guide sheave frames 36 and 37 and over the sheaves 20 and 22 of the sheave block 19, and pass over the sheaves 24 and 26 of the guide sheave frames 36 and 37, and sheaves 28 and 30 upon the trolley 10, and said ropes end are fixed to the equalizer sheaves 32 and 33 attached to sea side end of the crane girder 5. Ropes 3' and 4' from the sheave block hoisting drums 1 and 2 pass over the sheaves 7 and 9 and the sheaves 12 and 14 upon the trolley 10 to be directed to pass over the sheaves 16 and 18 of the guide sheave frames 36 and 37 and over the sheaves 21 and 23 of the sheave block 19, and are returned to pass over the sheaves 25 and 27 of the guide sheave frames 36 and 37, and sheaves 29 and 31 upon the trolley 10, and said ropes end are fixed to the equalizer sheaves 32 and 33. That the equalizer sheaves 32 and 33 are provided for equalized of the rope tension between the rope 3 and 3' or rope 4 and 4' when the ropes 3, 3', 4 and 4' are replaced and a cargo hoisting or lifting means is swaying.

Ropes 38, 39, 40 and 41 from the drums 50 and 51 for hoisting or lifting the guide sheave frames 36 and 37 pass over the sheaves 46, 47, 48 and 49 on the trolley 10, and the sheaves 42, 43, 44 and 45, and the ropes 38 and 39 are fastened to the guide sheave frame 36 in a suitably spaced apart relation whereas the ropes 40 and 41 are fastened to the guide sheave frame 37 in a suitably spaced apart relation.

The ropes 3, 3', 4, 4', 38, 39, 40 and 41 are therefore extended in the form of V below the trolley 10. The guide sheave frames 36 and 37 are adapted to releasably engage with the ropes 3, 3', 4 and 4'. When the sheaves 20, 21, 22 and 23 on the sheave block 19 are located in such a manner that their axes of rotation are at right angles to those of the sheaves 11, 12, 13, 14, 28, 29, 30 and 31 on the trolley 10 in order to ensure the sway preventive action. Reference numeral 35 denotes a container and 56, a cell guide.

Next the mode of operation will be described. To hoist or lift the container 35, the ropes 3, 3', 4 and 4' are wound around the drums 1 and 2, and the guide sheave frame hoisting or lifting ropes 38, 39, 40 and 41 are wound around the drums 50 and 51 which are driven by the torque motor 54, which are driven by the torque motor 54, with the same winding speed with that of the ropes 3, 3', 4 and 4'. On the other hand, when the container 35 is lowered, the ropes 38, 39, 40 and 41 are extended against the torque motor 54 due to the weights of the guide sheave frames 36 and 37 and the
components of forces transmitted through the ropes 38, 39, 40 and 41.

In loading and unloading of containers on the ground or a container ship, the brake 55 is always released so
that the guide sheave frames 36 and 37 are placed upon
the sheave block 19 as shown in FIG. 3 so as to be
hoisted or lifted, lowered and moved in unison with
the sheave block 19 as indicated by the bolt line in FIG. 3.

When the sheave block 19 is placed in the container
ship, the ropes 3, 3', 4, 4', 38, 39, 40 and 41 which are
extended in the form of V would interfere with the cell
guide 56 and various parts on the ship. In order to over-
come this problem, as shown in FIGS. 2 and 4, the
guide sheave frames 36 and 37 are hoisted or lifted
when the sheave block 19 is lowered, and then stopped
by applying the brake 55 above a suitable height above
the sheave block 19. Thereafter only the sheave block
19 is lowered into the cell guide 56. When the sheave
block 19 is hoisting or lifted along the cell guide 56
and approaches the guide sheave frames 36 and 37, a limit
switch (not shown) is actuated so that the brake 55
is released. The torque motor 54 is driven so that the
guide sheave frames 36 and 37 are hoisting or lifted
with the same hoisting or lifting speed with that of
the sheave block 19. Limit switches or sensors may be
provided in order to automatically control the torque
motor 54, and the brake 55, and to detect the position
of a container being hoisted or lowered.

In order to absorb the shocks caused when the guide
sheave frames 36 and 37 are spaced apart from the
sheave block 19 or engaged therewith, a buffer 57 is
provided upon the sheave block 19 as shown in FIG. 5.
Alternatively the speed of the ropes 3, 3', 4, 4', 38, 39,
40 and 41 may be suitably controlled.

As shown in FIG. 6, the guide sheave frames 36 and
37 are provided with guide pins 58 in order to smoothly
combine them with the sheave block 19. The guide pins
58 are inserted into guide pin receiving holes 59
formed in the sheave block 19 so that the swaying in
the horizontal direction may be prevented.

In the instant embodiment the present invention has
been described as being applied to a rope trolley type
container crane, but it will be understood that the de-
vice of the present invention may be also applied to a
self-propelled type crane of the type in which the
drums of the present invention are mounted upon a
trolley. Furthermore various modifications and vari-
ations can be effected without departing from the spirit
of the present invention. For example, instead of the
two guide sheave frames, only one guide sheave frame
may be employed; the axes of the sheaves upon the
sheave block may be in the same direction with those
of the sheaves upon the trolley; means for maintaining
the engagement of the sheave block 19 with the guide
sheave frames is not required to be provided; and in-
stead of suspending the guide sheave frames from the
trolley, they may be directly suspended from the trolley
or crane girder.

The features and advantages of the present invention
may be summarized as follows:

i. Since the ropes are extended in the form of V, the
swaying preventive action can be ensured.

ii. Since the ropes and devices used for preventing
the swaying of a container may be eliminated, the num-
ber of wire ropes and sheaves may be eliminated, the
number of wire ropes and sheaves may be reduced, so
that the maintenance may be much facilitated and the
construction of the trolley may be simplified.

iii. An electrical control system for controlling the
travelling speed of the trolley so as to prevent the sway-
ing of a container may be eliminated.

iv. The positive operation may be ensured.
The cost may be considerably reduced as compared
with the conventional devices.

What is claimed is:

1. A crane comprising a guide track, a carriage mov-
able along said track, load lifting line sheaves spaced
apart on said carriage in the direction of movement
of said carriage along said track, a load supporting sheave
block below said carriage and including means for en-
gaging a load, a guide sheave block disposed between
said load supporting sheave block and said carriage
and including sheaves disposed closely together relative
ly to the spacing of said load lifting line sheaves, a load
lifting line trained over said load lifting line sheaves
and over sheaves of said load supporting sheave block
and being guided by sheaves of said guide sheave block
to form a V outline of which the apex is at the guide
sheave block, winch means and a guide sheave block
hoisting line connected to said winch means on said
carriage for raising and lowering said guide sheave
block independently of said load supporting sheave block
whereby the apex angle of said V outline can be
varied.

2. A crane as defined in claim 1 wherein said load
supporting sheave block and said guide sheave block
include co-operating means effective upon engagement
with one another releasably to secure said load support-
ing sheave block and said guide sheave block to one
another.

3. A crane as defined in claim 1 wherein said winch
means is operable to raise and lower said guide sheave
block in unison with said load lifting line and indepen-
dently thereof.

4. A crane as defined in claim 2 wherein said winch
means is operable to raise and lower said guide sheave
block in unison with said load lifting line and indepen-
dently thereof.

5. A crane as defined in claim 1 wherein said guide
sheave block and said load supporting sheave block are
provided with shock absorber means to absorb shock
caused when said guide sheave block is separated from
and engaged with said load supporting sheave block.

6. A crane as defined in claim 2 wherein said guide
sheave block and said load supporting block are pro-
vided with shock absorber means to absorb shock
caused when said guide sheave block is separated from
and engaged with said load supporting sheave block.

7. A crane as defined in claim 3 wherein said guide
sheave block and said load supporting sheave block are
provided with shock absorber means to absorb shock
caused when said guide sheave block is separated from
and engaged with said load supporting sheave block.

8. A crane as defined in claim 1 wherein one of said
guide sheave block and said load supporting sheave
block is provided with guide pins and the other of said
guide sheave block is provided with cooperating guide
pin receiving holes to prevent swaying in the horizontal
direction when they are engaged with each other.

9. A crane as defined in claim 2 wherein one of said
guide sheave block and said load supporting sheave
block is provided with guide pins and other of said
guide sheave block is provided with cooperating guide
pin receiving holes to prevent swaying in the horizontal
direction when they are engaged with each other.

10. A crane as defined in claim 3 wherein one of said
guide sheave block and said load supporting sheave
block is provided with guide pins and the other of said

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guide sheave block is provided with cooperating guide
pin receiving holes to prevent swaying in the horizontal
direction when they are engaged with each other.

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