

DEFLECTION DETECTING DEVICE OF SUSPENDED CARGO

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to a deflection detecting device of a suspended cargo for use in container cranes, etc.

Description of the Prior Art:

A conventional deflection detecting device of a suspended cargo used in a container crane is described. In Fig. 4, numeral 1 designates a trolley moving laterally on a crane (moving right and left in the figure), numeral 2 designates a suspension tool suspended from the trolley 1 via ropes 2a, and numeral 3 designates a suspended cargo held by the suspension tool 2.

To begin with, a deflection of a suspended cargo is described. As shown in Fig. 4, in case the trolley 1 is laterally moved from left to right, the suspended cargo 3 deflects relatively to the left side of the figure by an inertia force when the trolley 1 is accelerated, and the suspended cargo 3 deflects relatively to the right side of the figure by an inertia force when the trolley 1 is decelerated, contrary to the case of acceleration.

In this case, the suspended cargo 3 deflects, in the lateral direction with the trolley movement, with

a same period and with a same phase at both of the front end and the rear end, i.e. a parallel deflection, as shown in Figs. 5(A) and 5(B), occurs from a position shown by a full line to a position shown by a dotted and dash line. Further, if there is an eccentric load in the suspended cargo 3 or if an outside force of the wind acts ununiformly on a side of the suspended cargo 3, the suspended cargo 3 causes rotational movements, and a skew deflection, as shown in Figs. 6(A) and 6(B), occurs from a position shown in a full line to a position shown in a dotted and dash line, thus movements wherein parallel deflections and skew deflections are commingled, arise.

Here, a camera 4, fitted to the trolley 1 with its range of vision facing downwardly, catches a mark 5 attached on the suspension tool 2 at the center of the range of vision. The mark 5 is drawn white on the surrounding black ground, by which light and shade are distinguished clearly.

Meanwhile, the camera 4 sends a picture signal catching the mark 5 to a picture processing device 6, as shown in Fig. 4. Said picture processing device 6 detects, by processing the picture, the position where the mark 5 is within the range of vision of the camera 4 and computes, by the number of picture elements, the deviation amount from the center of the range of vision. This deviation amount is multiplied by a length per picture element decided by a

length of rope between the trolley 1 and the suspension tool 2, thereby a deflection amount is obtained.

However, in such conventional deflection detecting device, one camera being used to catch the movements only of right and left directions of one point of the mark, only parallel deflections which are movements of right and left directions of the suspended cargo can be detected, and there is such a disadvantage that skew deflections which are movements of the rotational directions cannot be detected.

Accordingly, a deflection detecting device of the prior art has a problem that a deflection correction control of parallel deflections is possible but that of skew deflections is not possible, thus deflection correction controls of movements wherein parallel deflections and skew deflections are commingled cannot be done.

SUMMARY OF THE INVENTION:

In view of the above-described problems inherent in the prior art, it is an object of the present invention to provide a deflection detecting device of a suspended cargo to make a deflection correction control of parallel deflections and skew deflections being commingled and to enhance a carrying efficiency of a suspended cargo by shortening of a deflection correction time.

The present invention therefore relates to a

deflection detecting device of a suspended cargo for use in a crane in which a suspended cargo is held by a suspension tool suspended from a trolley via ropes and said suspended cargo is carried together with movement of said trolley, characterized in comprising a mark recognition means provided under said trolley with its range of vision facing downwardly, a first and a second marks, such as signs, etc. provided opposingly to said mark recognition means on said suspension tool, a picture processing device to take a picture signal of the first mark on said suspension tool and a picture signal of the second mark on said suspension tool caught by the mark recognition means provided under said trolley, a deflection amount computing means on both sides of right and left of said suspended cargo in said picture processing device, and a deflection amount calculating means to calculate parallel deflection amount and skew deflection amount by use of said computed deflection amount.

According to such construction of the present invention, a first and a second marks on a suspension tool are caught as picture signals by a mark recognition means provided under a trolley, and, from these picture signals, mark positions are detected and a deviation amount from the center of the picture is obtained. From said deviation amount, deflection amount of both sides, right and left, of the suspended cargo is computed and, from this deflection

amount, parallel deflection amount and skew deflection amount are detected.

In addition to usual parallel deflections, skew deflections which are caused in case where there is an eccentric load in a suspended cargo or in case where an outside force of the wind acts ununiformly on a suspended cargo, also becomes detectable, thereby deflection correction controls for deflections wherein parallel deflections and skew deflections are commingled, can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Fig. 1 is an explanatory drawing by way of an entire perspective illustration showing a deflection detecting device of one preferred embodiment according to the present invention.

Fig. 2 is an explanatory drawing showing how a deflection of a suspended cargo of Fig. 1 is detected.

Fig. 3 is an enlarged block diagram showing a processing method of a picture processing device of Fig. 1.

Fig. 4 is an entire perspective illustration showing a deflection detecting device of a suspended cargo used in a container crane of the prior art.

Fig. 5 is an explanatory drawing showing a

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parallel deflection of a suspended cargo of Fig. 4, wherein Fig. 5(A) is a plan view and Fig. 5(B) is an elevational view.

Fig. 6 is an explanatory drawing showing a skew deflection of a suspended cargo of Fig. 4, wherein Fig. 6(A) is a plan view and Fig. 6(B) is an elevational view.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

One preferred embodiment according to the present invention will now be described in detail with reference to the drawings. Fig. 1 is an explanatory drawing by way of an entire perspective illustration showing a deflection detecting device of a suspended cargo according to the present invention, Fig. 2 is an explanatory drawing showing a picture processing device of Fig. 1, and Fig. 3 is an enlarged block diagram of a picture processing device of Fig. 1.

In the above figures, component parts similar to those shown in Fig. 4 are given like reference numerals. In Fig. 1, two cameras, or a pair of cameras, front and rear, are fitted to a trolley 1, facing to a pair of marks, front(first) and rear(second) 9 and 10 attached on a suspension tool 2, the front camera 7 catches the front mark 9 and the rear camera 8 catches the rear mark 10, thus the front and the rear cameras 7 and 8 send signals of the front and the rear

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marks 9 and 10, respectively, to a picture processing device 11.

The front mark 9 and the rear mark 10, both provided on the suspension tool 2, are, for example, lines drawn white on a black ground, so that the mark portion and the surrounding portion are clearly distinguished by colors of light and shade.

As to a processing by a picture processing device 11, as shown in Fig. 3, a picture processing is made for each of two picture signals caught by a pair of cameras, front and rear, and the mark positions are detected. As for a detecting method to detect a mark position, as shown in Fig. 2, a picture image is obtained by digitizing a picture signal and a luminance level is scanned on a horizontal line A so as to find a peak point of the luminance, which peak point is made a mark position. And a mark position when a deflection is zero (a mark position shown by dotted lines in Fig. 2) being a picture center, a deviation amount therefrom is computed by the number of picture elements.

As the actual length per one picture element is decided by a length of rope between a camera and a mark, or between a trolley and a suspension tool, the actual length of rope is detected to be taken into, and using a previously set up correlation formula of length of rope and actual length per one picture element, the actual length per one

picture element is obtained, by which the deviation amount is multiplied and the deflection amount is obtained.

Thus, from the deflection amounts X_1 and X_2 of the front part and the rear part of the suspended cargo so obtained by the picture processing device, the parallel deflection amount X_p and the skew deflection amount X_s are obtained by use of a formula (1) below mentioned, so that both of the parallel deflection amount and the skew deflection amount are detected:

$$\begin{aligned}\text{Formula (1)} \quad X_p &= (X_1 + X_2) / 2 \\ X_s &= (X_1 - X_2) / 2\end{aligned}$$

In this preferred embodiment, an example of using a camera as a mark recognition means is described, but as further preferred embodiments, a picture signal made by use of a mark recognition means, such as a laser beam receiver or an infrared camera, etc. gives same function and effect as those mentioned above.

As for a mark recognized by a mark recognition means, if a camera is used, a mark of luminous material, etc. can be used in addition to the color distinction mark of above-described preferred embodiment, if a laser beam receiver is used, a mark of luminous material, etc. can be used, and if an infrared camera is used, a mark of infrared rays, etc. can be used, respectively.

Incidentally, although two cameras are used in

this preferred embodiment, the present invention is not limited thereto but using three or more cameras is also possible, and even in such case, same function and effect can be obtained.

As a summary, according to the present invention, a deflection detecting device of a suspended cargo for use in a crane in which a suspended cargo is held by a suspension tool suspended from a trolley via ropes and said suspended cargo is carried together with movement of said trolley, comprises a mark recognition means provided under said trolley with its range of vision facing downwardly, a first and a second marks, such as signs, etc. provided opposingly to said mark recognition means on said suspension tool, a picture processing device to take a picture signal of the first mark on said suspension tool and a picture signal of the second mark on said suspension tool caught by the mark recognition means provided under said trolley, a deflection amount computing means on both sides of right and left of said suspended cargo in said picture processing device, and a deflection amount calculating means to calculate parallel deflection amount and skew deflection amount by use of said computed deflection amount, and thus said device makes deflection correction controls for deflections wherein parallel deflections and skew deflections are commingled and enhances a carrying

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efficiency of a suspended cargo by shortening a deflection correction time. The present invention therefore is extremely useful in the industry.

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WHAT is CLAIMED is:

1. A deflection detecting device of a suspended cargo for use in a crane in which a suspended cargo (3) is held by a suspension tool (2) suspended from a trolley (1) via ropes (2a, 2b) and said suspended cargo (3) is carried together with movement of said trolley (1), characterized in comprising a mark recognition means (7, 8), such as cameras, etc. provided under said trolley (1) with its range of vision facing downwardly, a first mark (9) and a second mark (10), such as signs, etc. provided opposingly to said mark recognition means (7, 8) on said suspension tool (2), a picture processing device (11) to take a picture signal of the first mark (9) on said suspension tool (2) and a picture signal of the second mark (10) on said suspension tool (2) caught by said mark recognition means (7, 8) provided under said trolley (1), a deflection amount computing means on both sides of right and left of said suspended cargo (3) in said picture processing device (11), and a deflection amount calculating means to calculate parallel deflection amount (X_p) and skew deflection amount (X_s) by use of said computed deflection amount.

2. A deflection detecting device of a suspended cargo as claimed in Claim 1, characterized in that said first and second marks (9, 10) are placed in the direction to cross the direction of movement of said trolley (1) on

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said suspension tool (2).

3. A deflection detecting device of a suspended cargo as claimed in Claim 1 or Claim 2, characterized in that said mark recognition means (7, 8) are provided under said trolley (1) in two places so as to correspond to each of said first and second marks (9, 10).

4. A deflection detecting device of a suspended cargo as claimed in Claim 1 or Claim 2, characterized in that said deflection amount calculating means is a device to calculate parallel deflection amount (X_p) consisting of $(X_1 + X_2)/2$ and skew deflection amount (X_s) consisting of $(X_1 - X_2)/2$, with respect to deflection amount X_1 of said first mark and deflection amount X_2 of said second mark.

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Fig. 1

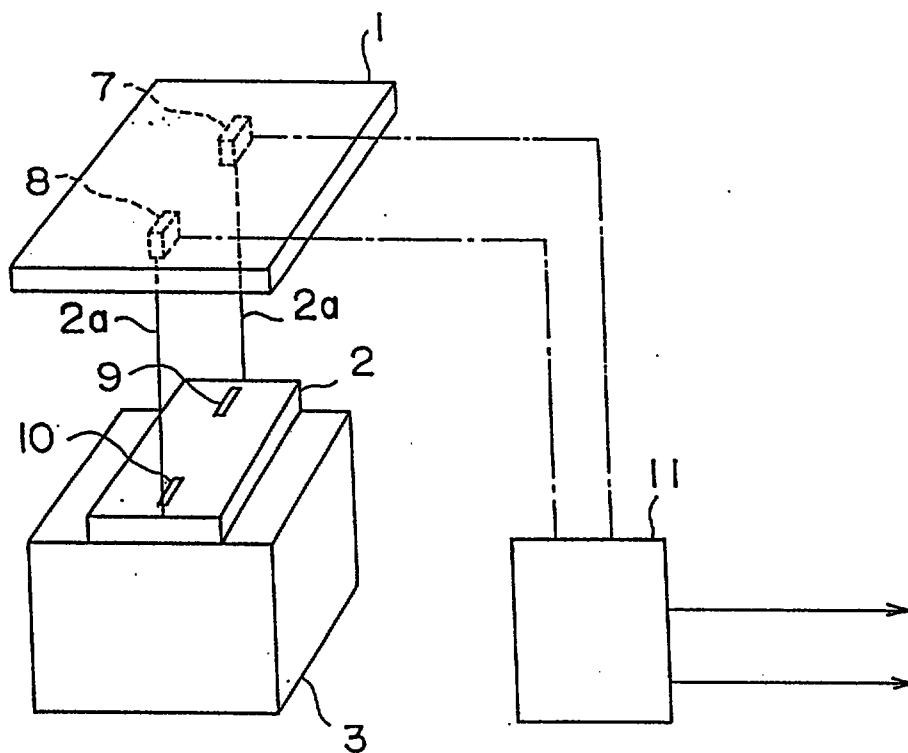


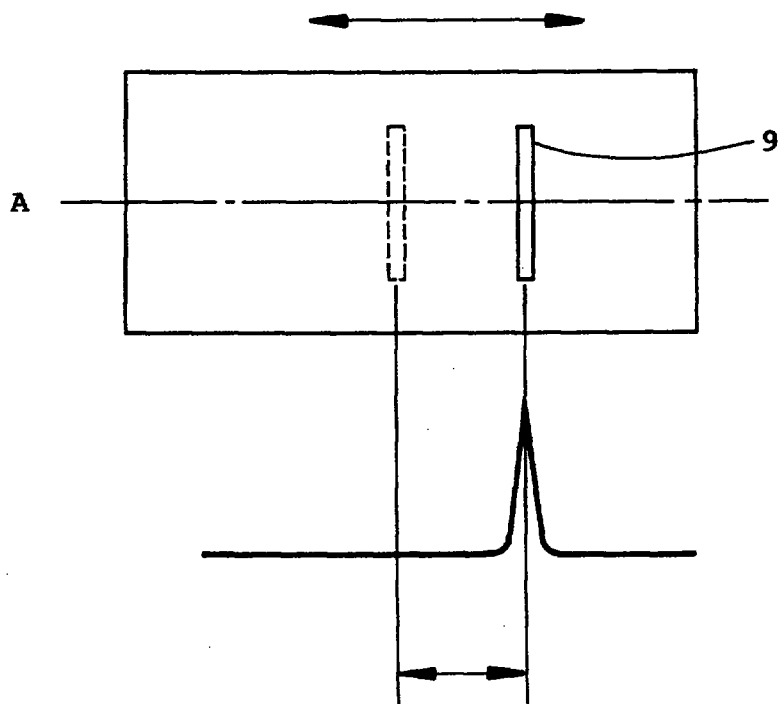
FIG. 2

Fig. 3

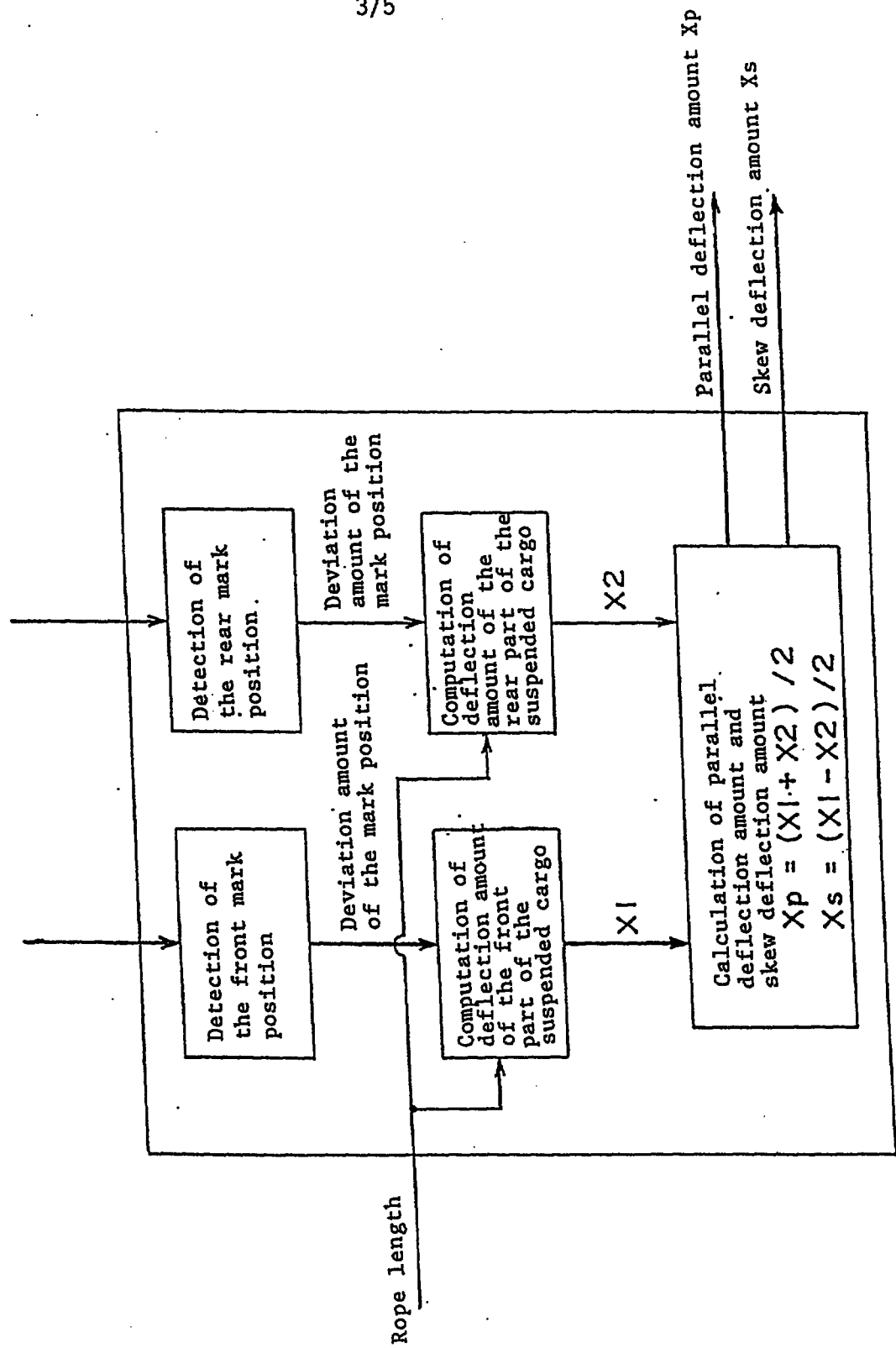


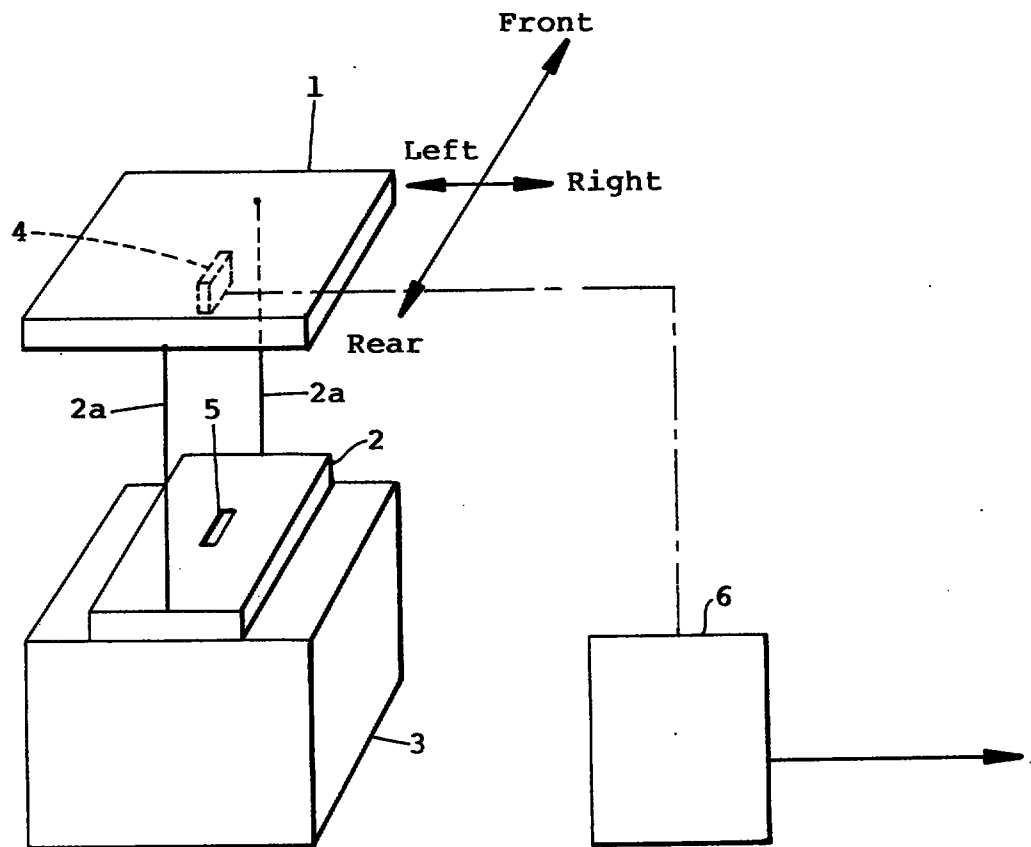
FIGURE 4

FIG. 5(A)

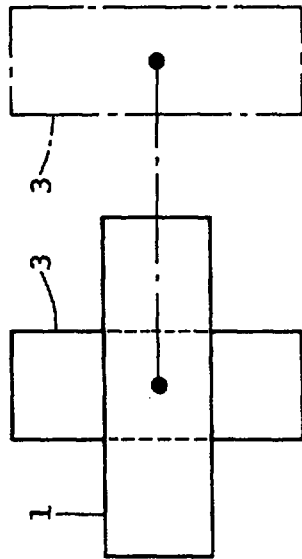


FIG. 5(B)

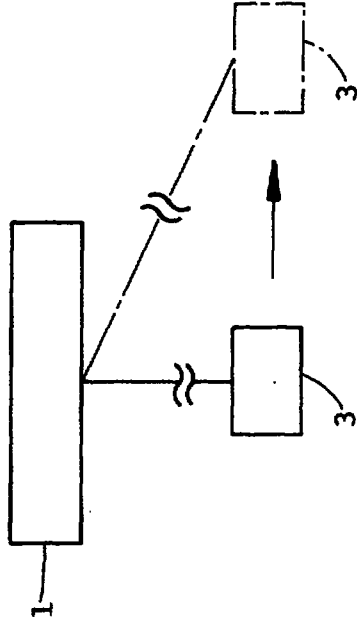


FIG. 6(A)

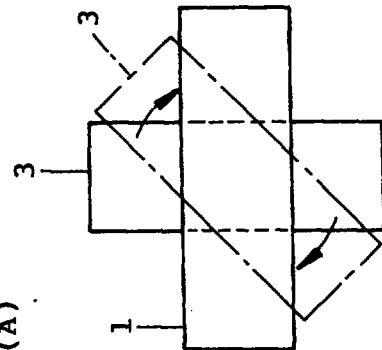
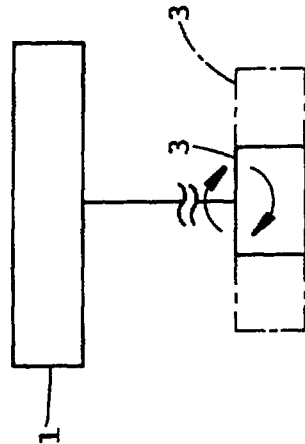


FIG. 6(B)



Abstract of the DisclosureDEFLECTION DETECTING DEVICE OF SUSPENDED CARGO

(Figure 1)

Object: A deflection correction control is made for deflections wherein parallel deflections and skew deflections are commingled, and a carrying efficiency of suspended cargo is enhanced by shortening of a deflection correction time.

Construction: A deflection detecting device of a suspended cargo (3) for use in a crane in which a suspended cargo (3) is held by a suspension tool (2) suspended from a trolley (1) via ropes (2a) and said suspended cargo (3) is carried together with movement of said trolley (1), comprises a mark recognition means (7, 8) provided under said trolley (1) with its range of vision facing downwardly, a plurality of marks (9, 10), such as signs, etc. provided opposingly to said mark recognition means (7, 8) on said suspension tool (2), a picture processing device (11) to take a picture signal of the first mark (9) on said suspension tool (2) and a picture signal of the second mark (10) on said suspension tool (2) caught by the mark recognition means (11) provided under said trolley (1), a deflection amount computing means on both sides of right and left of said suspended cargo (3) in said picture processing device, and a deflection amount calculating means to calculate parallel deflection amount and skew deflection amount by use of said computed deflection amount.

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FIG. 5 B

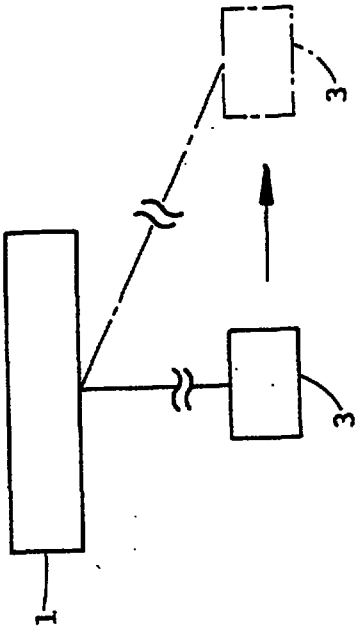


FIG. 6 B

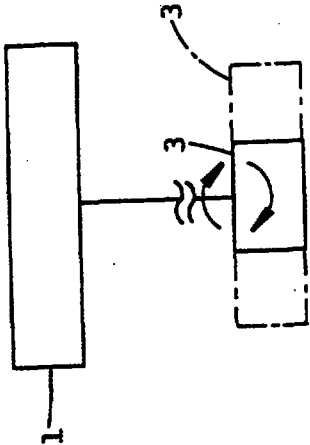


FIG. 5 A

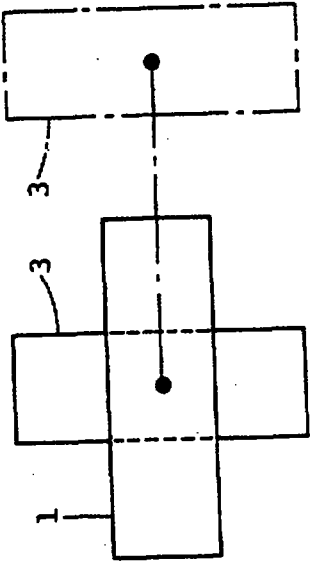
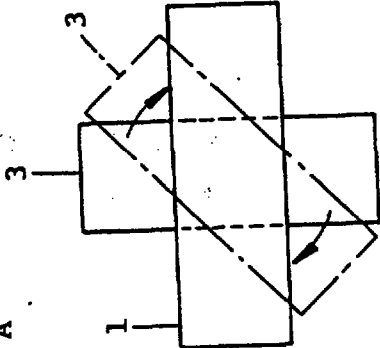


FIG. 6 A



Replacement Sheet (1/3/96)

Abstract of the Disclosure

DEFLECTION DETECTING DEVICE OF SUSPENDED CARGO

Object: A deflection correction control is made for deflections wherein parallel deflections and skew deflections are commingled.

Construction: A deflection detecting device of a suspended cargo (3) for use in a crane in which a suspended cargo (3) is held by a suspension tool (2) suspended from a trolley (1) via ropes (2a), comprises a mark recognition means (7, 8) provided under said trolley (1), a plurality of marks (9, 10), provided on said suspension tool (2), and a picture processing device (11) to take a picture signals of the first mark (9) and the second mark (10) caught by the mark recognition means (7, 8), the said picture processing device includes a deflection amount computing means on both sides of right and left of said suspended cargo (3), and a deflection amount calculating means and skew deflection amount calculating means.

Date: 15 APR 1996

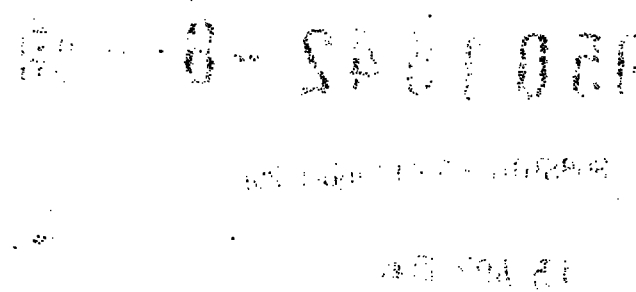
Replacement sheet - (15/4/96)

Abstract of the DisclosureDEFLECTION DETECTING DEVICE OF SUSPENDED CARGO

Object: A deflection correction control is made for deflections wherein parallel deflections and skew deflections are commingled.

Construction: A deflection detecting device of a suspended cargo (3) for use in a crane in which a suspended cargo (3) is held by a suspension tool (2) suspended from a trolley (1) via ropes (2a), comprises a mark recognition means (7, 8) provided under said trolley (1), a plurality of marks (9, 10), provided on said suspension tool (2), and a picture processing device (11) to take a picture signals of the first mark (9) and the second mark (10) caught by the mark recognition means (7, 8), the said picture processing device includes a deflection amount computing means on both sides of right and left of said suspended cargo (3), and a deflection amount calculating means and skew deflection amount calculating means.

(Figure 1)



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parallel deflection of a suspended cargo of Fig. 4, wherein Fig. 5(A) is a plan view and Fig. 5(B) is an elevational view.

Fig. 6 is an explanatory drawing showing a skew deflection of a suspended cargo of Fig. 4, wherein Fig. 6(A) is a plan view and Fig. 6(B) is an elevational view.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

One preferred embodiment according to the present invention will now be described in detail with reference to the drawings. Fig. 1 is an explanatory drawing by way of an entire perspective illustration showing a deflection detecting device of a suspended cargo according to the present invention, Fig. 2 is an explanatory drawing showing a picture processing device of Fig. 1, and Fig. 3 is an enlarged block diagram of a picture processing device of Fig. 1.

In Fig. 1, two cameras, or a pair of cameras, front and rear, are fitted to a trolley 1, facing to a pair of marks, front (first) and rear (second) 9 and 10 attached on a suspension tool 2, the front camera 7 catches the front mark 9 and the rear camera 8 catches the rear mark 10, thus the front and the rear cameras 7 and 8 send signals of the front and the rear

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WHAT is CLAIMED is:



1. A deflection detecting device of a suspended cargo for use in a crane in which a suspended cargo is held by a suspension tool suspended from a trolley via ropes and said suspended cargo is carried together with movement of said trolley, characterized in comprising a mark recognition means provided under said trolley with its range of vision facing downwardly, a first mark and a second mark provided opposingly to said mark recognition means on said suspension tool, a picture processing device to take a picture signal of the first mark on said suspension tool and a picture signal of the second mark on said suspension tool caught by said mark recognition means provided under said trolley, a deflection amount computing means on both sides of right and left of said suspended cargo in said picture processing device, and a deflection amount calculating means to calculate parallel deflection amount (X_p) and skew deflection amount (X_s) by use of said computed deflection amount.
2. A deflection detecting device of a suspended cargo as claimed in Claim 1, characterized in that said first and second marks are placed in the direction to cross the direction of movement of said trolley on said suspension tool.

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3. A deflection detecting device of a suspended cargo as claimed in Claim 1 or Claim 2, characterized in that said mark recognition means are provided under said trolley in two places so as to correspond to each of said first and second marks.
4. A deflection detecting device of a suspended cargo as claimed in Claim 1 or Claim 2, characterized in that said deflection amount calculating means is a device to calculate parallel deflection amount(X_p) consisting of $(X_1 + X_2)/2$ and skew deflection amount(X_s) consisting of $(X_1 - X_2)/2$, with respect to deflection amount X_1 of said first mark and deflection amount X_2 of said second mark.