HOISTING CRANE WITH HORIZONTAL LATTICE JIB AND BRAVELING CARRIAGE

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References Cited
UNITED STATES PATENTS
3,021,014 2/1962 Korensky 212/144
3,494,593 2/1970 Blagg 52/121
3,583,327 6/1971 Arndt 104/120

FOREIGN PATENTS OR APPLICATIONS
233,205 4/1964 Germany 212/18
208,913 2/1968 U.S.S.R. 212/18
1,248,256 8/1967 Germany 212/18
1,169,095 4/1964 Germany 212/18

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ABSTRACT

The travelling carriage of a lattice jib runs with its carrying wheels on frame bars with circular cross-section of the jib, the force resultant from the carrying wheels thereby intersecting the centre of gravity axis of the runway frame bar.

6 Claims, 3 Drawing Figures
BACKGROUND OF THE INVENTION

This invention relates to a hoisting crane of the kind comprising a substantially horizontal lattice jib with at least one upper and at least one lower longitudinal frame bar connected by connecting bars, at least one frame bar simultaneously serving as a runway for a travelling carriage with lifting means and carrying wheels.

In cranes of the aforesaid kind, the frame bars, which simultaneously serve as a runway for the travelling carriage, heretofore comprised rolled sections with sharp edges. These cranes showed substantially two disadvantages, viz. that the sharp-edge section produces a high wind load and that the sharp-edge runway frame bars due to geometric conditions cannot be connected centrally to diagonal and horizontal bars as the resulting stress concentrations involve a risk, especially from a fatigue point of view. Central connection here is to be understood such that the centre of gravity axes of the horizontal and diagonal bars intersect the centre of gravity axis of the runway frame bar.

SUMMARY OF THE INVENTION

The aforesaid disadvantages have been eliminated by the hoisting crane according to the present invention, which is characterized in that the runway frame bar or bars comprise tubes or solid bars of circular cross-section, that the runway frame bar and connecting bar are so connected that their centre of gravity axes intersect each other, and that the carrying wheel and runway frame bar are so arranged relative to each other that the force resultant from the carrying wheel also intersects the centre of gravity axis of the runway frame bar.

For illustrating the background of and the effect achieved by the invention, and for showing the importance of wind load and central connection, the following may be explained.

Within the building industry the development proceeds continuously to prefabricated wall and room moduli, which by means of hoisting cranes are lifted on place in the building under construction. This method resulted in a demand for building cranes with high lifting power, large reach and great lifting height. The development in this direction is not restricted to one country, but can be observed on an international scale.

Building cranes for the aforesaid demand heretofore were dimensioned after known construction principles. Accordingly, the cranes, particularly high building cranes, had a disproportionately heavy construction weight. The dimensioning factors for such a building crane include reach, lifting power and wind load. The wind speeds increase with the height above the ground, and also the distance between the mounting of the crane and the centre of the wind force application surface on a building crane increases with rising construction height. Due to these two circumstances, the wind load becomes a factor of growing importance in high building cranes. Attempts were, therefore, made to find new construction principles rendering possible a reduction of the wind load. A substantial part of the total building crane surface exposed to wind is formed by the jib.

Jibs usually comprise three or four horizontal frame bars, depending on whether the cross-section is triangular or rectangular. The frame bars are interconnected by diagonal bars. The lower frame bar or bars constitute simultaneously a runway for a travelling carriage carrying useful load.

In order to be able to serve also as a runway, the frame bars in known constructions comprise rolled sharp-edge section beams. For cranes of the size here in question, the cross-sectional height of such a beam exposed to wind load is between 200 and 250 mm. In a crane with a long reach, thus, the frame bars of the jib offer a large total application surface to the wind.

The air resistance coefficient, depending on the cross-sectional shape, varies between 1.8 and 2.0 for bars with sharp cross-section edges. This applies to all cases, irrespective of the wind speed. The air resistance coefficient c becomes evident from the relation \( P = c \cdot A \cdot \frac{v^2}{16} \), where \( P \) is the force of the wind on an object, \( A \) is the surface of the object projected in the wind direction, and \( v \) is the wind speed. For bars with circular cross-section and with a diameter here of interest, the air resistance coefficient decreases from about 1.2 at sub-critical flow (at wind speeds below about 35 m/s) to between 0.7 and 0.4 at super-critical flow. With increasing wind speed, the coefficient decreases to the limit value of about 0.4. According to Swedish crane standards, cranes higher than 30 m here referred to are to be dimensioned for super-critical wind speeds. Cranes for certain export markets are subjected to wind speeds exceeding considerably those under Swedish conditions.

In view of the fact that building cranes generally are constructed to a height of 30 m and above, it is understood that the wind load for a crane can be reduced to a large degree by providing the jib with frame bars of circular shape. The projection surface of circular tubes, besides, is substantially smaller than that of sharp-edge section bars having the same bearing capacity.

The construction principle applied to known cranes shows as one consequence that it always gives rise to local stresses in connecting bars at the joints for the frame bars, which simultaneously constitute a runway for the travelling carriage.

The reason for this is that sharp-edge frame bars, due to geometrical conditions, cannot centrally be connected to diagonal and horizontal bars, as the resulting stress concentrations involve a risk specially from a fatigue point of view.

In the invention described below, the frame bars acting as a runway are circular tubes. The wheels of the travelling carriage run on the upper surfaces of the tubes.

The construction principle applied according to the invention results in an ideal joint geometry. The centre of gravity axes for all bars connecting to a joint, and the forces transferred from the carrying wheels of the travelling carriage, all meet in a single point and, thus, the joint is free of moment. Connecting diagonal and vertical bars are flattened at their ends so as to allow a carrying wheel rolling on a frame bar to run past a joint.

By utilizing circular standard tubes as a runway and frame bars, some other advantages are obtained. Circular tubes, for example, always are most advantageous
with respect to buckling. Owing to the fact that tubes of a given outer diameter are kept in stock with several different wall thicknesses, the bearing capacity for a jib, or a part thereof, at maintained outer dimensions can be adjusted within wide limits. Circular tubes are also from a corrosion and maintenance point of view more advantageous than the sections heretofore used.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the invention is described in the following with reference to the accompanying drawing, in which

FIG. 1 is a side view showing a section of a jib with the travelling carriage according to the invention,
FIG. 2 shows the cross-section according to the marking II—II in FIG. 1, and
FIG. 3 shows an enlarged scale the left-hand joint in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The jib comprises three parallel frame bars 1, 2 and 3, which are tubes of circular cross-section. Said bars are interconnected by connecting bars 4, 5 and, respectively, 6, whereof the bars 4 connect the frame bars 1 and 2 on one side of the jib, and the bars 5 connect the frame bars 1 and 3 on the other side of the jib. The horizontal connecting bars 6 connect the lower frame bars 2 and 3 of the jib. The height of the jib cross-section exceeds the width thereof, see FIG. 2. The connecting bars are secured at the frame bars in joints such as at 7 which designates a joint at which two bars 4 (FIG. 1) or one or more bars 6 (FIG. 2) meet. At each joint the connecting and frame bars are so arranged that their centre of gravity axes intersect at one point. At the joint 7, for example, the centre of gravity axes 4A of the bars 4, the centre of gravity axis 2A of the frame bar 2, and the centre of gravity axis or axes 6A of the bar or bars 6 extend through one common point 8.

Below the jib is provided a travelling carriage 11 with upwardly directed arms 17, 18, on which carrying wheels 12 are mounted which run directly on the lower frame bars 2 and 3. The travelling carriage carries by wires 13 a lifting means 14. The carriage is moved horizontally by wires 15 and 16. Due to the circular cross-sectional shape of the lower frame bars, the resulting force F from the carrying wheel 12, see FIG. 3, acts through the centre of gravity axis of the frame bar.

In the embodiment shown in the drawing, the carrying wheels are so inclined that the angle α between the frame bar radius through the contact point of the carrying wheel and the horizontal plane is acute. The angle α can also be imagined to be right or obtuse. The connecting bars, which in the embodiment shown are tubes with circular cross-section, by being flattened at the connection to the runway frame bars provide more space to the carrying wheels. The travelling carriage is shown laterally guided by contact between the arms 17 and 18 and the runway frame bars. It is, of course, also possible to mount separate guide wheels on the carriage.

What I claim is:

1. A hoisting crane comprising,
   a substantially horizontal lattice jib with at least one upper and at least two lower longitudinal runway frame bars,
   connecting bars which interconnect said frame bars,
   a travelling carriage supported by said runway frame bars
   said travelling carriage having lifting means and including also carrying wheels which run directly on said runway frame bars,
   said runway frame bars having a circular cross-section and being interconnected to said connecting bars with the center of gravity axis of each connecting bar intersecting the central longitudinal axis of the relevant runway frame bar,
   each said carrying wheel having an essentially cylindrical configuration and being supported on the respective circular runway frame bar with its line of force intersecting the central longitudinal axis of said respective runway frame bar, said carrying wheel making an essentially point contact with said runway frame bar to thereby ensure the maintenance of intersection of said line of force with said longitudinal axis irrespective of the tilting of said carrying wheel as it rolls along said runway frame bar.

2. A hoisting crane according to claim 1, characterized in that it comprises two lower runway frame bars each of which supporting the carrying wheels of the travelling carriage.

3. A hoisting crane according to claim 1 characterized in that the jib cross-section is triangular.

4. A hoisting crane according to claim 1 characterized in that the angle between the force resultant from the carrying wheel and the horizontal plane is an acute angle.

5. A hoisting crane according to the claim 1 characterized in that the angle between the force resultant from the carrying wheel and the horizontal plane is a right angle.

6. A hoisting crane according to claim 1 characterized in that the connecting bars extending nearest to the carrying wheel are flattened at their connection to the runway frame bar so as to provide more space for the carrying wheel.

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