Title
Luffing jib crane erection process and system

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ABSTRACT

Luffing jib crane erection process and system

The process comprises using an auxiliary hoist (22) carried by the rotating part (4) of the crane and fitted with a cable (23) with a diameter smaller than that of the load and jib lifting cables for performing various erection operations: cabling of the jib lifting block, fitting of slings (24) for temporarily retaining the jib (9), mounting of the line of tie bars retaining the jib (9) as well as for maintaining the mechanisms carried by the counter-jib. The auxiliary hoist (22) is, in particular, mounted at the base of the jib gantry (6) of the crane.

Figure 3
COMPLETE SPECIFICATION
STANDARD PATENT

Application Number:
Lodged:

Invention Title: Luffing jib crane erection process and system

The following statement is a full description of this invention, including the best method of performing it known to us:
The present invention concerns, in general, luffing jib cranes of the type comprising a fixed or mobile supporting structure, in particular a vertical tower, surmounted by a rotating part, which can be swivelled around a vertical axis made up of a rotating pivot, a luffing jib directed forwards and articulated at its rear end around a horizontal shaft on the rotating pivot, a jib gantry extending obliquely upwards and rearwards from the rotating pivot and an essentially horizontal counter-jib directed rearwards and connected via its front end to the rotating pivot, the counter-jib carrying mechanisms of the crane and, a jib lifting system being provided, the latter comprising a jib lifting hoist belonging to the said mechanisms, a jib lifting cable passing over the top end of the jib gantry and through a jib lifting block connected by at least one lifting tie bar to the front part of the jib, the aforementioned mechanisms also comprising a load lifting hoist with a load lifting cable.

More specifically, this invention concerns erection of the rotating part of such a luffing jib crane and, even more especially, mounting of the components of the jib lifting system and, consequently, the mechanisms which equip the counter-jib, and thus the final erection operations, which make the crane operational.

A luffing jib crane of the type concerned here is described, for example, in the French patent application FR 2641773 A in the name of the Applicant or in the corresponding European patent EP 0379448 A.

To undertake erection of such a luffing jib crane at a place of usage and, in particular, on a construction site, the procedure first involves assembling the main structure of the crane, comprising the base frame, the tower, the counter-jib and the jib gantry, these operations being performed using an auxiliary lifting machine, which is usually a lorry-
mounted hydraulic crane. The jib is then erected, whilst being temporarily retained by at least one temporary sling connecting it to the top of the jib gantry. Erection is then completed by the following operations:

- fitting of a temporary jib-retaining sling or temporary jib-retaining slings,
- installation of the jib lifting cable in the jib lifting block,
- mounting of the final line of tie bars to be connected to the jib lifting block and to the jib lifting cable,
- removal of the temporary sling or temporary slings,
- passing of the load lifting cable over the corresponding pulleys.

Furthermore, servicing and maintenance of the mechanisms equipping the counter-jib should be ensured on the platform intended for receiving them.

These manual operations are usually performed using the load lifting hoist of the crane, already in place, and which can lift very high loads. This hoist is therefore fitted with a large-diameter load lifting cable, typically a cable with a diameter of the order of 18 millimetres, which is therefore a heavy cable and is difficult to handle. The final operations for erecting a luffing jib crane therefore remain, for the operator, long and arduous operations, which entail accident risks.

The present invention is intended to avoid the previously described disadvantages and its aim is therefore to simplify the mounting of additional elements of the rotating part of a luffing jib crane of the type concerned, in particular mounting of the jib lifting block and of the jib lifting cable, of the temporary jib retaining sling or slings and of the line of tie bars, such that the erection time is reduced and the work of the operator is facilitated, whilst limiting the risks of an accident.
For this purpose, the subject of the invention is essentially a process for erecting a luffing jib crane of the type described in the introduction, a process according to which an auxiliary hoist, in particular a hoist carried by the rotating part of the crane, is used, this hoist being fitted with an auxiliary cable with a diameter significantly smaller than that of the load and jib lifting cables, to perform an operation of cabling the jib lifting block with the jib lifting cable and/or to undertake fitting of at least one temporary sling intended for temporarily retaining the jib and/or to perform an operation of mounting the line of tie bars.

According to the method of implementing the invention process, the operation of cabling the jib lifting block comprises, after having pre-cabled in the workshop the jib lifting block with the auxiliary cable with a diameter significantly smaller than that of the jib lifting cable, connecting one end of the auxiliary cable to the jib lifting cable wound onto the drum of the jib lifting hoist, connecting the other end of the auxiliary cable to the auxiliary hoist and actuating simultaneously the jib lifting hoist and the auxiliary hoist such that the jib lifting cable is unwound and engaged in the jib lifting block, whilst the auxiliary cable is rewound onto the auxiliary hoist.

According to another method of implementing the invention process, the operation of fitting at least one temporary sling for retaining the jib comprises, for each temporary sling, storing a first sling element along the jib gantry and a second sling element, prolonging the first, along the jib, the front end of the second sling element being attached to the front part of the jib, attaching the top end of the first sling element to the cable of the auxiliary hoist, actuating this auxiliary hoist in the winding direction of its cable to tension the temporary sling and attaching the top end of the first sling element to the top of the jib gantry.
In the case in which two temporary slings are provided, the elements of these slings are advantageously stored on both sides of the jib gantry and of the jib respectively, and fitting of the first temporary sling, then fitting of the second temporary sling is successively undertaken using the auxiliary hoist and its cable.

According to yet another method of implementing the invention process, the operation of mounting the line of tie bars comprises, after passing the cable of the auxiliary hoist over a return pulley located towards the front of the jib, anchoring the end of the auxiliary cable on the jib lifting block, the rear end of the line of tie bars being also attached to the jib lifting block, actuating the auxiliary hoist in the winding direction of its cable and actuating the jib lifting hoist in the unwinding direction of its cable to pull the jib lifting block forwards and to connect finally the front end of the line of tie bars to the front part of the jib.

The auxiliary hoist can also be used, in combination with a bracket carried by the mechanism platform, itself carried by the counter-jib, for servicing or maintaining the mechanisms carried by this counter-jib, the cable of the auxiliary hoist then being directed towards the bracket and guided along this bracket.

The subject of the invention is also an erection system for a luffing jib crane intended for implementing the process defined hereinabove, this system comprising essentially an auxiliary hoist carried by the rotating part of the crane, this auxiliary hoist being fitted with an auxiliary cable with a diameter significantly smaller than that of the load and the jib lifting cables. In particular, the auxiliary hoist can be mounted at the base of the jib gantry of the crane.

The system comprises advantageously again, on the rotating part of the crane, means of guiding the
auxiliary cable, in particular pulleys, suitable for the operations performed using the auxiliary hoist and detailed hereinabove.

Finally, the subject of the invention is also a luffing jib crane, which is equipped with an erection system with an auxiliary hoist such as the one previously defined.

Overall, the invention thereby facilitates crane erection operations through using an auxiliary hoist, whose cable is thinner and therefore easier to handle than the load and jib lifting cables, the same auxiliary hoist being used during several erection operations performed successively.

The invention will be better understood by means of the following description, referring to the appended schematic drawing illustrating, as an example, a method of implementing this erection process for a luffing jib crane.

Figure 1 is a general side view of a luffing jib tower crane likely to be erected by the process according to the invention.

Figure 2 is a diagram illustrating the operation of cabling the jib lifting block of such a crane.

Figure 3 is a diagram illustrating, in its successive phases, the operation of fitting temporary slings for retaining the jib.

Figure 4 is a diagram illustrating the operation of mounting the line of tie bars.

Figure 5 is a last diagram illustrating the operation of servicing the mechanisms equipping the counter-jib.

The luffing jib crane represented in Figure 1 is here a tower crane, which comprises in a known way a base frame 2, fixed or moving on the ground, above which rises a vertical tower 3. Mounted at the top of the tower 3 through a swivelling system is a rotating part 4 comprising mainly a rotating pivot 5, a jib gantry 6, a counter-jib 7, a mechanism platform 8 and a luffing jib 9.
The rotating pivot 5 can be swivelled around the vertical axis A of the tower 3. It supports an operating cab 10 of the crane.

The jib gantry 6, also called a "stay" is solidly fixed to the rotating pivot 5 and extends from the latter upwards and obliquely with a rearward inclination.

The counter-jib 7 extends essentially horizontally to the rear from the rotating pivot 5. It carries the mechanism platform 8 and counterweights 11. This counter-jib 7 is suspended from the rear part of the jib gantry 6 by means of connecting tie bars 12.

On the mechanism platform 8, also visible in Figure 5, are mounted various equipment units, which include in particular a lifting hoist 13 for the jib 9 and a lifting hoist 14 for loads.

The luffing jib 9, composed of a lattice structure, for example of triangular cross section, has a rear end articulated around a horizontal shaft 15 on the rotating pivot 5.

The jib lifting hoist 13 has a drum around which is wound a jib lifting cable 16, which passes over pulleys 17 mounted at the top of the jib gantry 6 and which also passes over the pulleys in a jib lifting block 18, located in front of the jib gantry 6. The jib lifting block 18 is connected to the front part of "tip" of the luffing jib 9 by a line of tie bars 19.

The load lifting hoist 14 has a drum, onto which is wound a load lifting cable 20, which passes over pulleys mounted on the jib gantry 6, is then directed towards the tip of the luffing jib 9 and extends as far as a lifting hook 21, with or without a lifting block, the loads to be lifted being suspended from the hook 21, when the crane is used.

The luffing jib crane having therefore been described in its fully erected configuration, additional equipment units allowing erection of this crane are now described.
These equipment units comprise in particular an auxiliary hoist 22 mounted at the base and on one of the sides of the jib gantry 6. The auxiliary hoist 22 has a drum, onto which can be wound an auxiliary cable 23 with a diameter significantly smaller than the diameter of the jib lifting cable 16 and the diameter of the load lifting cable 20. For example, if the normal diameter of the jib lifting cable 16 and the load lifting cable 20 is of the order of 18 millimetres, the diameter of the auxiliary cable 23 can be of the order of 9 millimetres.

The equipment units in question comprise additionally two temporary slings 24, which are visible in Figure 3, for retaining the jib 9. Each of these two temporary slings 24 comprises a first sling element 25, which can be stored along the jib gantry 6, and a second sling element 26, which can be stored along the jib 9 (see basic position I shown in Figure 3). The two sling elements 25 and 26 are mutually articulated at one point 27 and the second sling element 26 is articulated at a point 28 on the front part of the jib 9. One of the temporary slings 24 formed thereby is stored on the right side of the jib gantry 6 and of the jib 9, whilst the other temporary sling 24 is symmetrically stored on the left side of the jib gantry 6 and of the jib 9.

Finally, the erection equipment units comprise, as shown in particular in Figure 5, a bracket 29 carried by the mechanism platform 8, which can be used with one of the hoists as detailed hereunder.

The operating procedure using the previously described erection equipment units is as follows.

Firstly, the jib lifting block 18 has been pre-cabled in the workshop with a small-diameter, for example of the order of 9 millimetres, temporary cable, which is the auxiliary cable 23 initially separated from the auxiliary hoist 22. The procedure continues, as illustrated in Figure 2, with final cabling of the jib lifting block 18. For this purpose, the jib lifting
block 18 being retained at the top of the jib gantry 6, one end of the auxiliary cable 23 is connected to the larger jib lifting cable 16 with, for example, a diameter of the order of 18 millimetres, which is wound onto the drum of the jib lifting hoist 13. The other end of the auxiliary cable 23 is attached to the drum of the auxiliary hoist 22. The simultaneous electrical control of the two hoists 13 and 22 is then actuated such that the auxiliary cable 23 winds onto the drum of the auxiliary hoist 22, whilst the jib lifting cable 16 unwinds from the drum of the jib lifting hoist 13. The auxiliary cable 23 therefore pulls the jib lifting cable 16 drawing it through the jib lifting block 18 and onto the pulleys of this lifting block 18, where it takes the place of the temporarily installed auxiliary cable 23. Finally, the auxiliary cable 23 is separated from the jib lifting cable 16, which makes this auxiliary cable 23 available for the following operations.

The procedure then continues with the fitting of two temporary slings 24 for retaining the jib, as illustrated in Figure 3, starting from the basic position I, in which the sling elements 25 and 26 are stored on each side of and along the jib gantry 6 and the jib 9 respectively.

On a first side, the cable 23 of the auxiliary hoist 22 is first attached by pinning to the top end 31 of the first sling element 25, whilst the front end of the second sling element 26 had already been attached by pinning at 28 to the front part of the jib 9. Only the auxiliary hoist 22 is then actuated in the winding direction of its cable 23, which passes over a pulley 32 at the top of the jib gantry 6, to tension gradually the sling 24 by passing through intermediate positions such as the one shown in II. The sling 24 is therefore tensioned, being pulled upwards, until the top end 31 of its first element 25 can be attached by pinning to the top of the jib gantry 6 (position III).
After the first sling element 25 has thereby been attached to the top of the jib gantry 6, it is separated from the auxiliary cable 23 and the same operation is repeated on the other side of the crane to fit the second temporary sling 24. The two temporary slings 24, thereby fitted, ensure that the jib 9 is temporarily retained whilst awaiting the next operation, which comprises installation of the line of tie bars 19.

Mounting of the tie bars 19 is illustrated by Figure 4. During this phase, the cable 23 of the auxiliary hoist 22 passes over a return pulley 33 located towards the front of the jib 9 and the end 34 of this auxiliary cable 23 is anchored to the jib lifting block 18, which is initially close to the top of the jib gantry 6. The rear end 35 of the line of tie bars 19 is attached to the jib lifting block 18, whilst its front end is still free. The procedure then continues with actuating of the control of the auxiliary hoist 22 in the winding direction of its cable 23, whilst the jib lifting hoist 13 is actuated in the unwinding direction of its cable 16. The jib lifting block 18 is thereby pulled forwards by the auxiliary cable 23, which moves it away from the jib gantry 6 and allows finally the front end of the line of tie bars 19 to be connected to the front part of the jib 9, as suggested at 30 on Figure 4. The front part of the jib 9 will therefore find itself connected to the jib lifting block 18 through the line of tie bars 19.

It then becomes possible to remove the two temporary slings 24, which till now have been retaining temporarily the jib 9.

Finally, the procedure may continue, as illustrated in Figure 5, with servicing of the mechanisms carried by the counter-jib 7 using the bracket 29 carried by the platform 8. For this purpose, the bracket 29 is used in combination with the auxiliary hoist 22 and with its relatively small
diameter cable 23. More specifically, the auxiliary cable 23, unwinding from the drum of the hoist 22, is first directed rearwards to the foot of the bracket 29 and it then extends along the column and arm of this bracket 29 with suitable guidance and returning ensured by pulleys 36, 37 and 38. The auxiliary cable 23 can therefore be used for example, as illustrated in Figure 5, for dismantling a hoist such as the load lifting hoist 14.

The scope of the invention, as defined in the appended patent claims, would not be moved away from by altering the position of the auxiliary hoist on the rotating part of the crane or by using cables with diameters other than those indicated or by using a single temporary sling instead of two or, again, by changing the order of certain crane erection operations.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Luffing jib crane erection process, the crane including a fixed or mobile supporting structure, in particular a vertical tower, surmounted by a rotating part which can be swivelled around a vertical axis made up of a rotating pivot, a luffing jib directed forwards and articulated at its rear end around a horizontal shaft on the rotating pivot, a jib gantry extending obliquely upwards and rearwards from the rotating pivot and an essentially horizontal counter-jib directed rearwards and connected via its front end to the rotating pivot, the counter-jib carrying mechanisms of the crane and, a jib lifting system being provided, the latter including a jib lifting hoist belonging to the said mechanisms, a jib lifting cable passing over the top end of the jib gantry and through a jib lifting block connected by at least one lifting tie bar to the front part of the jib, the aforementioned mechanisms also including a load lifting hoist with a load lifting cable, wherein an auxiliary hoist, in particular a hoist carried by the rotating part of the crane, is used, this hoist being fitted with an auxiliary cable with a diameter significantly smaller than that of the load and jib lifting cables, to perform an operation of cabling the jib lifting block with the jib lifting cable and/or to perform an operation of fitting at least one temporary sling intended for temporarily retaining the jib and/or to perform an operation of mounting the line of tie bars.

2. Process according to Claim 1 wherein the operation of cabling the jib lifting block includes, after having pre-cabled in the workshop the jib lifting block with the auxiliary cable with a diameter significantly smaller than that of the jib lifting cable, connecting one end of the auxiliary cable to the jib lifting cable wound onto the drum of the jib lifting hoist, connecting the other end of the auxiliary cable to the auxiliary hoist and actuating simultaneously the jib lifting hoist and the auxiliary hoist such that the jib lifting cable is unwound and engaged in the jib lifting block, whilst the auxiliary cable is rewound onto the auxiliary hoist.

3. Process according to Claim 1 or 2, wherein the operation of fitting at least one temporary sling for retaining the jib includes, for each temporary sling, storing a first sling element along the jib gantry and a second sling element, prolonging
the first, along the jib, the front end of the second sling element being attached to the front part of the jib, attaching the top end of the first sling element to the cable of the auxiliary hoist, actuating this auxiliary hoist in the winding direction of its cable to tension the temporary sling and attaching the top end of the first sling element to the top of the jib gantry.

4. Process according to Claim 3, wherein in the case of two temporary slings, the elements of these slings are stored on both sides of the jib gantry and of the jib respectively, and in that fitting of the first temporary sling, then fitting of the second temporary sling is successively undertaken using the auxiliary hoist and its cable.

5. Process according to one of Claims 1 to 4, wherein the operation of mounting the line of tie bars includes, after passing the cable of the auxiliary hoist over a return pulley located towards the front of the jib, anchoring the end of the auxiliary cable on the jib lifting block, the rear end of the line of tie bars being also attached to the jib lifting block, actuating the auxiliary hoist in the winding direction of its cable and actuating the jib lifting hoist in the unwinding direction of its cable to pull the jib lifting block forwards and to connect finally the front end of the line of tie bars to the front part of the jib.

6. Process according to one of Claims 1 to 5, wherein the auxiliary hoist is also used, in combination with a bracket carried by the mechanism platform, itself carried by the counter-jib, for servicing or maintaining the mechanisms carried by this counter-jib, the cable of the auxiliary hoist then being directed towards the bracket and guided along this bracket.

7. Erection system for a luffing jib crane, for implementing the process according to one of Claims 1 to 6, including an auxiliary hoist carried by the rotating part of the crane, this auxiliary hoist being fitted with an auxiliary cable with a diameter significantly smaller than that of the load and jib lifting cables.

8. System according to Claim 7, wherein the auxiliary hoist is mounted at the base of the jib gantry of the crane.
9. System according to Claim 7 or 8, further including on the rotating part of
the crane, means of guiding the auxiliary cable, in particular pulleys suitable for
the operations performed using the auxiliary hoist.

10. Luffing jib crane, wherein it is equipped with an erection system with the
auxiliary hoist according to one of claims 7 to 9.

11. Luffing jib crane substantially as herein described with reference to any
one of the embodiments illustrated in the accompanying figures.