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Noly

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[54] **CRANE WITH FOLDING MAST AND JIB**

[75] Inventor: **Jean Noly**, La Clayette, France

[73] Assignee: **Potain**, Chevilly Larue (Val de Marne), France

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **212/46 R**; 212/144

[51] **Int. Cl.** **B66c 23/68**

[58] **Field of Search** ..... 212/46 R, 46 A, 46 B, 144

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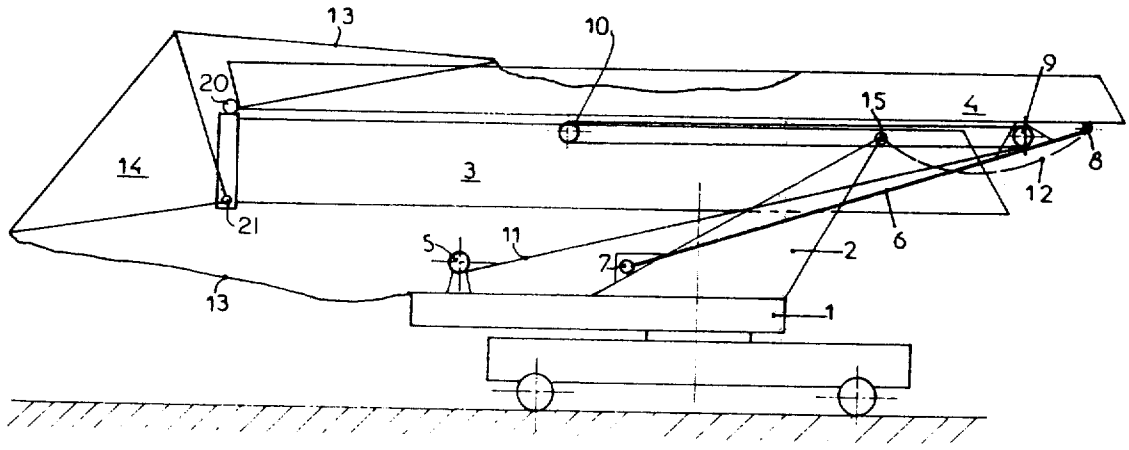
Primary Examiner—Evon C. Blunk
Assistant Examiner—Jeffrey V. Nase
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A crane of the type having a mast pivoted to a base for movement between a horizontal and vertical position and a jib pivoted to the top end of the mast is provided with a compensation bar to assist in the raising of the jib and mast to the operative position wherein the mast is disposed in a vertical position and a jib is disposed horizontally perpendicular thereto. The compensation bar is pivoted at one end to the base with the opposite end thereof disposed in movable engagement with the underside of the jib when the jib and mast are disposed in the horizontal folded transport position. A set of pulleys are provided adjacent said opposite end of the compensation bar and another set of pulleys is provided adjacent the mid-portion of the mast. A cable is disposed about said sets of pulleys and secured to a winch so that upon taking-up of the cable on the winch the distance between said sets of pulleys will be shortened to raise said compensation bar from a horizontal position to a raised position limited by a flexible member secured between said compensation bar and said base. The initial raising of the compensation bar will lift the free end of the jib and continued takingup of the cable on said winch will further shorten the distance between said sets of pulleys to raise the mast to the vertical position. An additional flexible member is secured to the mid-point of said jib and the base over the top of the mast to support the jib in a horizontal perpendicular position relative to said mast.

7 Claims, 5 Drawing Figures



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SHEET 1

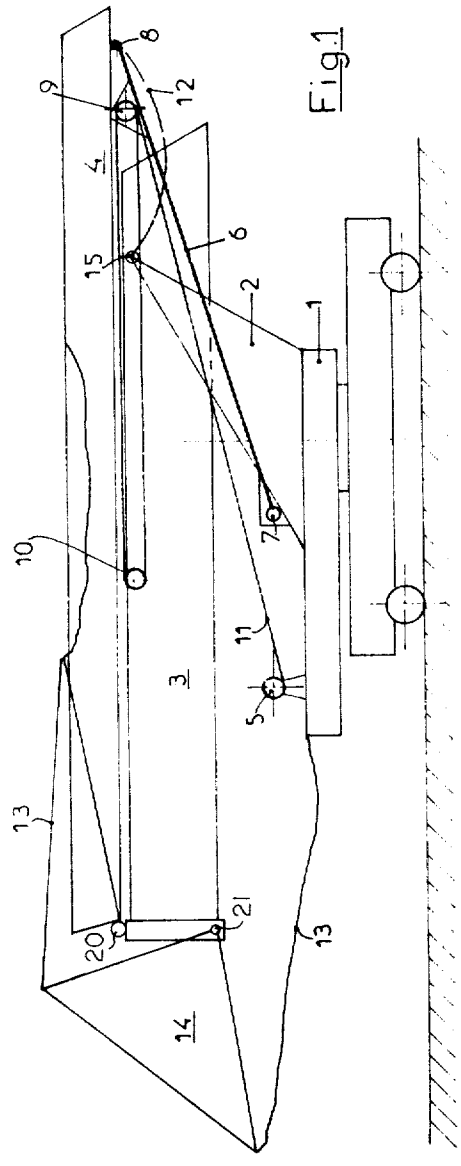


Fig.1

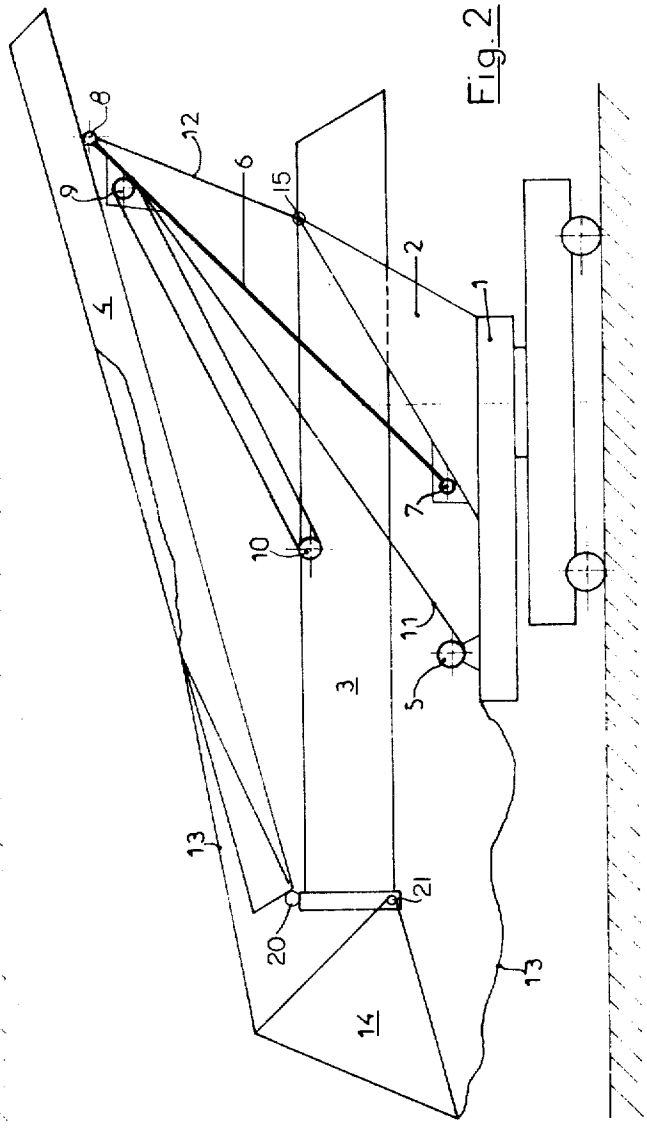


Fig.2

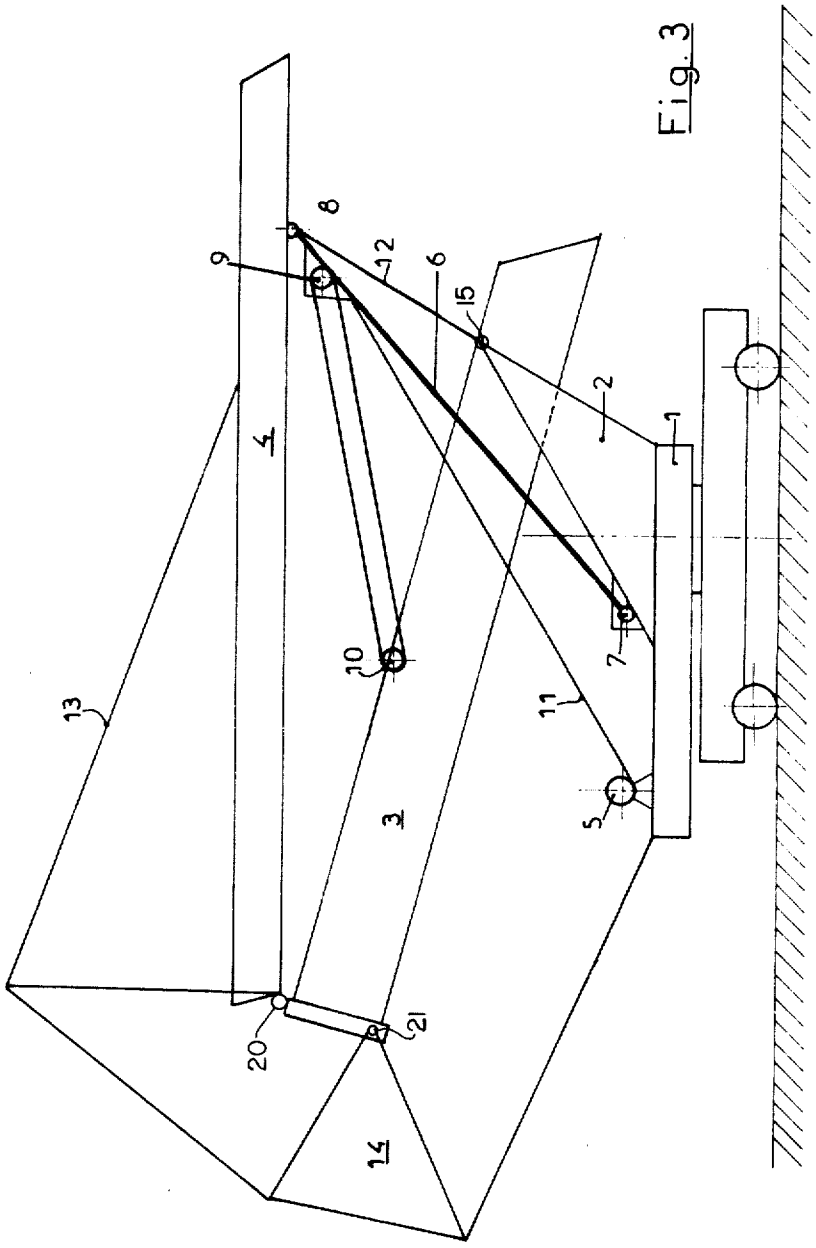
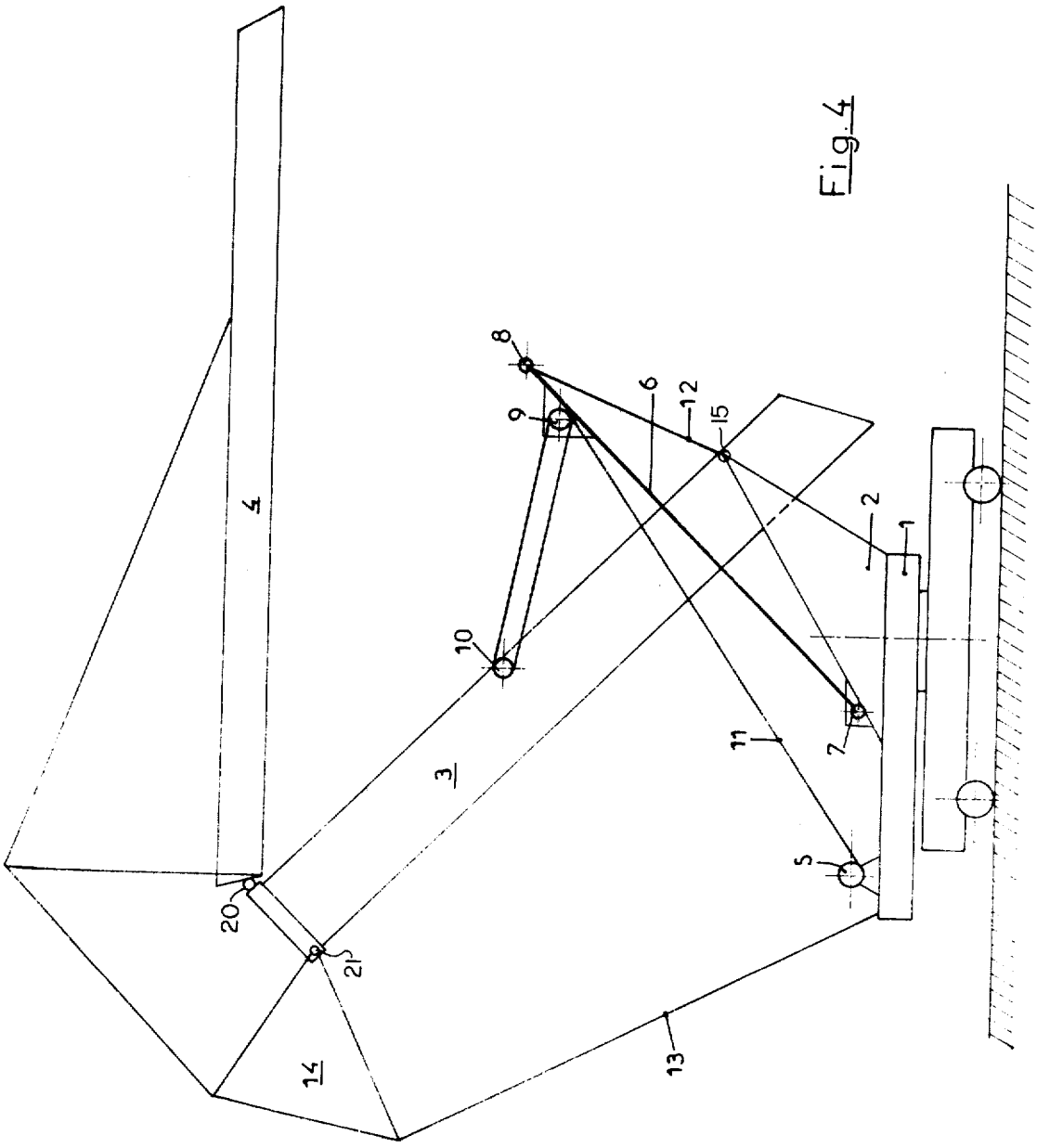


Fig. 3

Fig.4



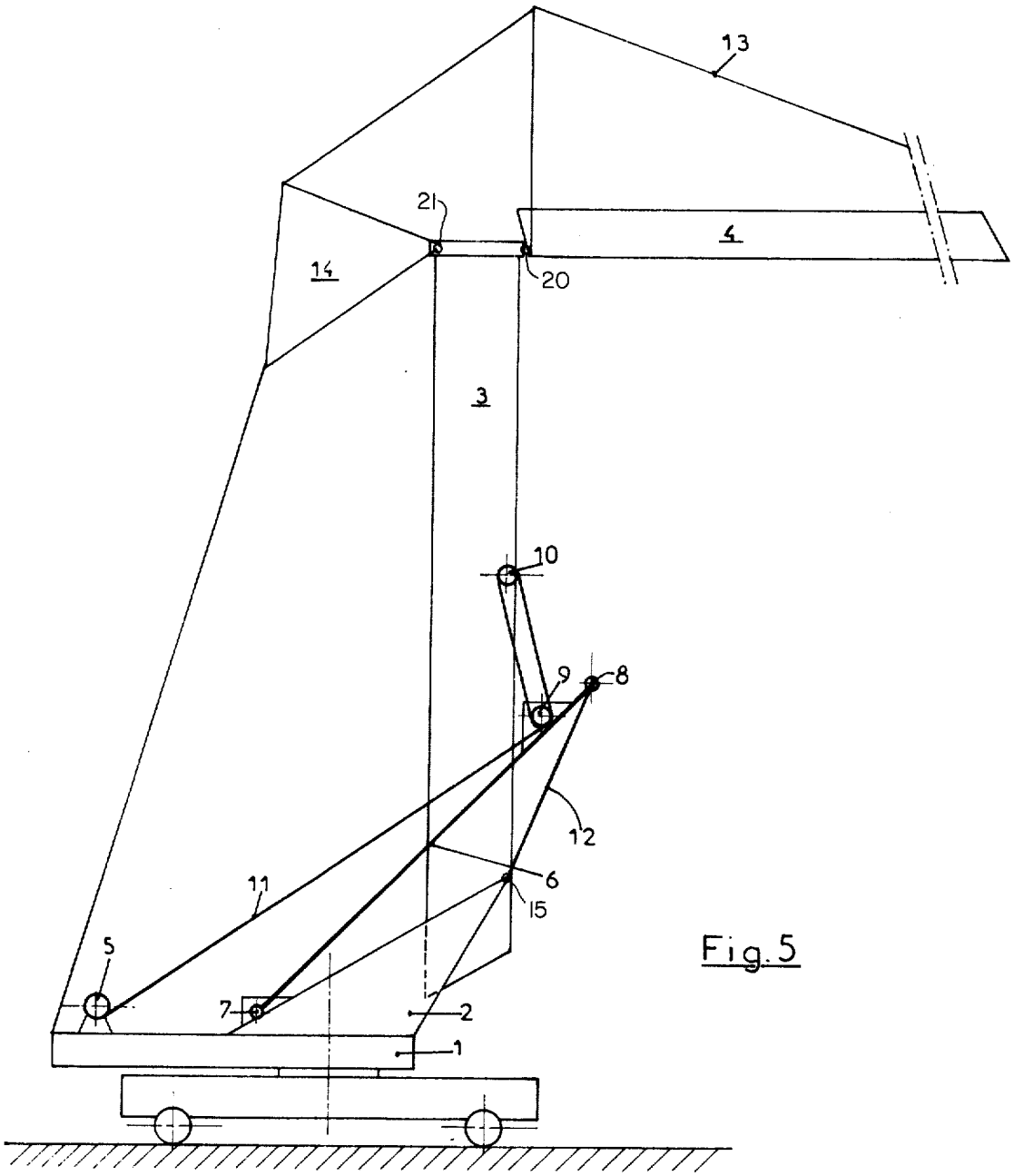


Fig. 5

CRANE WITH FOLDING MAST AND JIB

The present invention relates to a crane of a new type, the mast and jib of which are adapted to be brought back to a horizontal position when the crane is to be transported to another site.

In a crane of this type, it is known to pivot the lower portion of the mast about a pin carried by the top of a stand which is integral with the undercarriage. On the other hand, a raising cable is provided, which is wound on pulleys between the mast foot and the undercarriage, so that, when a pull is exerted on said cable, the distance between the pulley-blocks shortens, and the mast rises while pivoting about the pin mounted on the stand.

This known arrangement has several drawbacks, owing to the fact that, when the crane is folded, the mast is in a horizontal position, and the almost horizontal setting of the cable on the pulley-blocks defines a very short lever arm for the action of said cable. As a matter of fact:

— either it is necessary to exert an unduly intensive pull on the cable wound on the pulley-blocks, and to increase therefore the dimensions of the raising winch, in particular at the beginning of the mast raising operation,

— or it is necessary, when manufacturing the crane, to set the pivoting axis for the mast higher, so as to increase the lever arm at the beginning of the raising operation, which results in increasing the height taken up by the crane when the latter is ready to be transported.

The object of the present invention is to obviate such drawbacks by providing a crane, the position for road transport of which is very low, this being achieved without unduly increasing the stresses in the cable and tackle arrangement and, therefore, in the raising winch.

A foldable crane according to the invention includes an undercarriage, a stand integral with said undercarriage and provided at its top with a transverse pivot pin, a mast, the lower portion of which is capable of rocking about said pivot pin between a vertical working position and a horizontal transportation position, a jib pivoted to the top of said mast and capable of being folded back horizontally against the latter, a raising winch carried by the undercarriage, and is characterized in that it includes, besides, a compensation bar the lower end of which is linked or pivoted to the undercarriage and stand assembly, while its upper end carries means which allow it to roll or slide over the underside of the jib lower frame, the cable of the raising winch being wound between a set of pulleys carried by the upper part of the compensation bar and a set of pulleys carried by the mast between the raising pivot pin thereof and the pivot pin for the jib, while finally a flexible sling or member has one of its ends hooked to the compensation bar and its other end hooked to the undercarriage and stand assembly of the crane.

According to a further feature of the invention, the torque required for raising the jib alone from the horizontal position thereof by making the jib rock about its pivot pin on the mast, is lower than the torque required for raising the mast and jib assembly from the horizontal position thereof by making said assembly rock about the pivot pin for the mast.

According to a further feature of the invention, the cable and pulley assembly is directed substantially horizontally when the mast and the jib are folded back in a horizontal position too.

According to a further feature of the invention, the length of the sling is selected so as to stop the compensation bar when the latter has raised the jib by about 20° with respect to the horizontal direction of the mast.

According to an additional feature of the invention, a jib sling has one of its ends secured to the back of the jib and passes then over at least one post linked to the top of the mast, while the opposite end thereof is secured to the undercarriage of the crane, said jib sling tightening automatically as soon as the mast has been raised about its pivot pin according to a direction inclined by at least 10° with respect to a horizontal line.

According to an additional feature of the invention, the location of the apices of the polygon defined by the jib raising sling are selected, as well as the relative locations of the pivot pin for the mast and the pivot pin for the jib on the mast, in such a way that the jib is kept set in an unchanging direction during the whole stage of the mast raising operation wherein the mast is raised beyond its position corresponding to which the jib leaves the end of the compensation bar. In particular, it is possible to manage to keep said unchanging direction of the jib substantially horizontal.

According to a further feature of the invention, the means provided on the free end of the compensation bar to ensure the contact of the latter with the jib, are constituted by rollers capable of rolling along the lower frame or underside of the jib.

According to a further feature, the block-pulleys carried by the mast are are fitted to that side of the mast which faces upwards when the mast is in a horizontal position.

The appended drawings, which are given by way of non-limiting example, will enable the features of the invention to be more clearly understood.

FIG. 1 is a schematic view of a crane according to the invention, folded in position for transportation.

FIGS. 2 to 5 are schematic views of the crane which illustrate the successive stages of the raising of said crane.

The drawing shows a foldable crane, which includes an undercarriage **1**, a stand **2** integral with the undercarriage **1**, the top of said stand being provided with a transverse pin **15** about which a mast **3** is adapted to pivot between a vertical working position and a horizontal transport position. A jib **4** is pivoted to the top of the mast **3**, and is adapted to be folded horizontally against the latter when the crane is to be transported. A raising winch **5** is carried by the undercarriage **1** of the crane.

A compensation bar **6** has its lower end linked at **7** to the stand **2**, while its other end is provided with rollers **8** enabling it to slide over the underside of the jib. Said compensation bar **6** is provided, besides, with pulleys **9** towards that end thereof which carries the rollers **8**. The cable **11** of the raising winch **5** is wound between the set of pulleys **9** and a further set of pulleys **10** carried by the mast **3** between the raising pivot pin **15** and the pivot pin **20** for the jib, on that side of the mast facing upwards when said mast is in a horizontal position. The cable and pulley assembly is thus set in a substantially horizontal direction when the mast and the jib are in their horizontal positions too.

One end of a flexible sling or member **12** is hooked to the upper end of the compensation bar **6**, while the other end is hooked to the stand **2**.

A jib sling or flexible member **13** is secured to the back of the jib **4**, and passes over a post **14** linked or pivoted to the top of the mast **3** by a pivot **21**, and is then secured to the undercarriage **1**. Said jib sling is automatically tightened as soon as the mast **3** has been raised about its pivot pin according to a direction inclined by at least 10° to the horizontal.

The length of the flexible sling **12**, which is slack when the raising operation starts, is selected so as to stop the compensation bar when the latter has raised the jib by about 20° with respect to the horizontal direction of the mast.

The operation is as follows:

With the crane in its horizontal position for transportation as shown in FIG. **1**, the raising winch **5** is started. During the first stage of the raising operation, the mast **3** remains horizontal, the pulling action of the cable and pulley assembly causing only the compensation bar **6** to rock. This causes the jib to be raised with respect to the mast **3**, whereby the cable assembly **10–11** is brought to a position wherein it is capable of causing the mast **3** to rise, as the sling or flexible member **12** is now tight and locks the compensation bar **6** (FIG. **3**). As the raising proceeds, the mast **3** keeps pivoting in an upward direction, but the jib **4** remains horizontal (FIG. **4**), while moving away from the compensation bar. The raising proceeds in the same way till the crane is fully raised (FIG. **5**).

The advantages of a crane according to the invention are as follows:

— the transport position of the crane does not depend on the lever arm required between the raising cable assembly and the pivot pin **15** for the mast **3**, which makes it possible to have a very low transport position while not unduly increasing the stresses in the cable and pulley assembly and, therefore, in the raising winch;

— the crane may reach the working site and be raised thereon immediately, without it being necessary for it to follow a special route as is the case with "special dimension conveys."

I claim:

1. A folding crane including an undercarriage, a stand integral with said undercarriage and provided at its top with a first transverse pivot pin, a mast having a top portion and a lower portion, the lower portion of said mast being pivotally mounted on said first pivot pin for movement between a vertical working position and a horizontal transport position, a second transverse pivot pin secured to the top portion of said mast, a jib pivoted to the top of said mast on said second pivot pin and capable of being folded back horizontally against said mast in the transport position, a raising winch carried by said undercarriage, a third pivot pin on said stand adjacent said undercarriage, a compensation bar having an upper end and a lower end, said lower end of said bar being pivoted to said third pivot pin, means secured to the upper end of said bar for movement along a side of said jib which is disposed adjacent said mast in the transport position, first pulley means carried by said compensation bar adjacent the upper end thereof and second pulley means carried by said mast between said first and second pivot pins, said winch including a cable extending about said first and second pulley means, a flexible member having one end secured to the top end of said compensation bar and the other end secured to said stand to limit the pivotal movement of said compensation bar as said cable is taken up by said winch.

2. A crane as set forth in claim **1** wherein said cable extends between said first and second pulley means in a substantially horizontal direction when said mast and said jib are folded back in a horizontal position.

3. A crane as set forth in claim **1** wherein the length of said flexible member is selected so as to stop the raising of the compensation bar when the bar has raised the jib by about 20° with respect to the mast when said mast is in said horizontal transport position.

4. A crane as set forth in claim **1** further comprising an additional flexible member having one end thereof secured to said jib, a fourth pivot pin on the top of said mast, at least one post pivoted to said fourth pivot on the top of said mast, said additional flexible member extending over said post, said additional flexible member having the other end thereof secured to the undercarriage of said crane whereby said additional flexible member will be automatically tightened as soon as the mast has been raised about its pivot pin to at least a 10° angle with respect to the horizontal.

5. A crane as set forth in claim **4** wherein the points of securement of said additional flexible member to said jib and said undercarriage are so located relative to the locations of the first pivot pin for the mast and the second pivot pin for the jib on the mast that the jib will be maintained in a substantially horizontal position during a portion of the mast raising operation subsequent to a point where the jib leaves the upper end of the compensation bar.

6. A crane as set forth in claim **1** wherein the means provided at the upper end of said compensation bar to ensure movable contact of the latter with the jib are comprised of rollers adapted to engage and move along said side of said jib.

7. A crane as set forth in claim **1** wherein said second pulley means are secured to the side of the mast which faces upwards when the mast is disposed in the horizontal transport position.

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