March 18, 1952 A. WULLSCHLEGER 2,589,915

LOAD LIFTING ARRANGEMENT

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Fig. 1

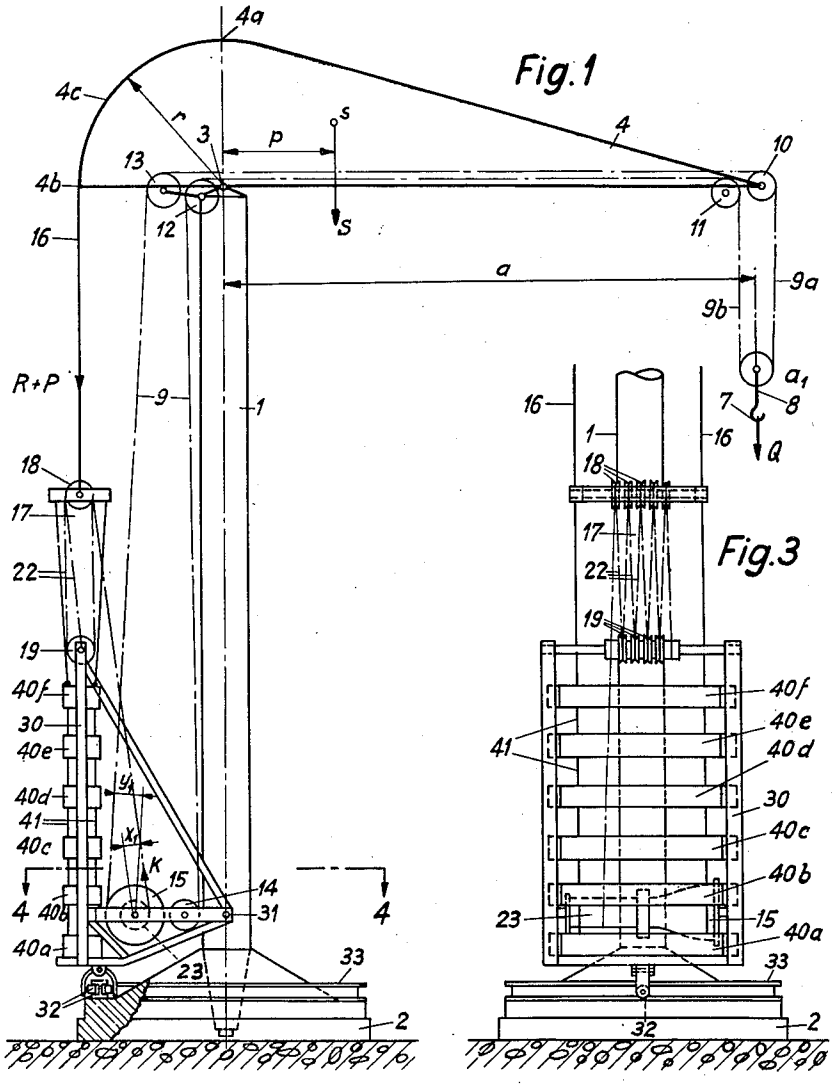
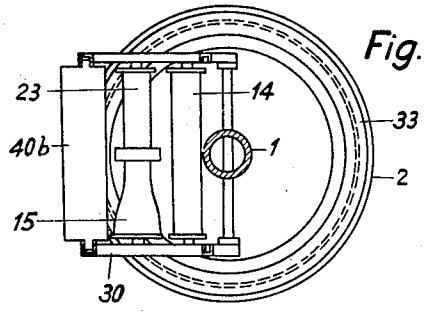


Fig. 3

Fig. 4



Inventor:
August Wullschleger,
by Singer, Stern & Carlberg.
Attorneys.

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Fig. 2

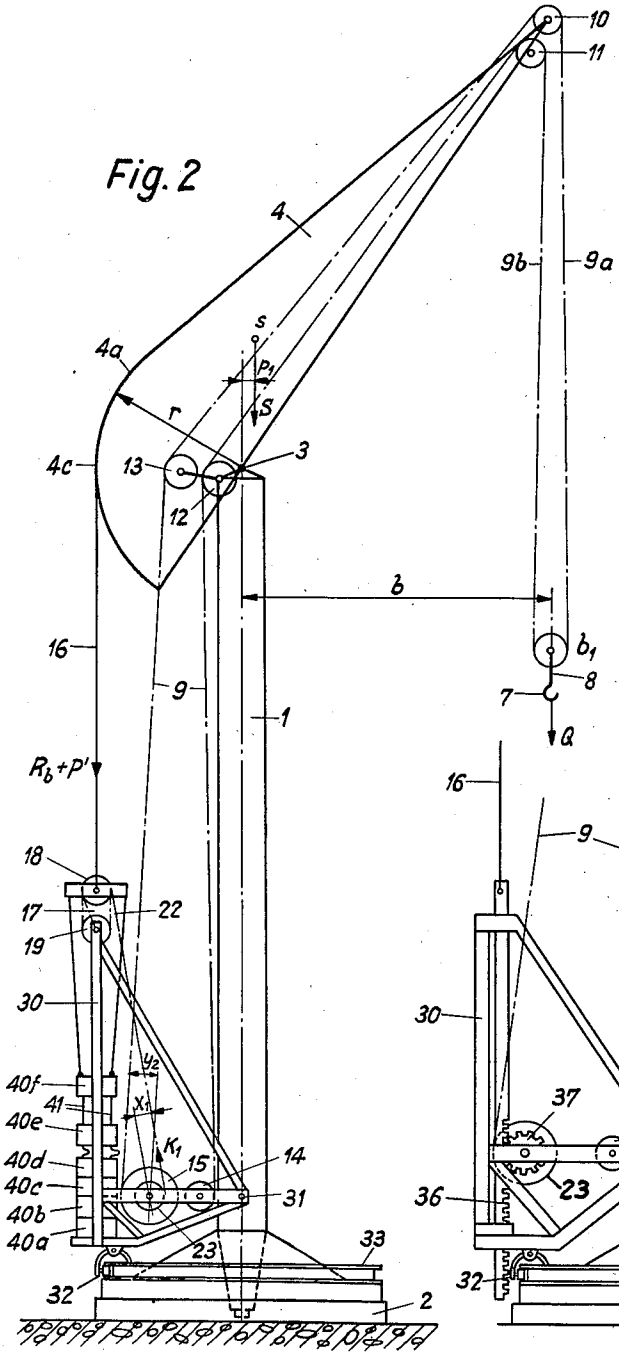
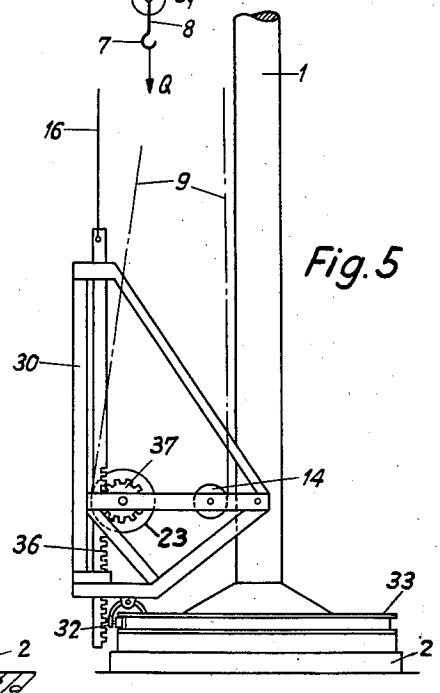


Fig. 5



Inventor:
August Wullschleger,
by Singer, Stern & Carlberg,
Attorneys.

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UNITED STATES PATENT OFFICE

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LOAD LIFTING ARRANGEMENT

August Wullschleger, Olten, Switzerland

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In Switzerland August 17, 1948

6 Claims. (Cl. 212—58)

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The invention relates to a crane comprising a jib tiltable in a vertical plane, and a load hoisting device attached to said jib.

It is an object of the invention to provide a crane of the kind referred to wherein additional work of load lifting is obviated when altering the handling radius of the crane.

It is another object of the invention to provide a crane of the kind referred to wherein the load reaction acting on the jib is compensated by the pull of the load cable.

According to a main feature of the invention, an automatic adjustment of the length of the load cable is achieved when tilting the jib in its vertical plane whereby the load is made to move in a horizontal plane while the handling radius of the jib is altered.

Other objects and features of the invention will become apparent from the following description of some embodiments of the invention, given merely by way of example and with reference to the accompanying drawings, wherein:

Fig. 1 shows the crane in side elevation at maximum handling radius,

Fig. 2 shows the same crane in side elevation at minimum handling radius,

Fig. 3 is a rear view of the crane.

Fig. 4 is a section along the line 4—4 of Fig. 1,

Fig. 5 shows part of a modified embodiment in lateral elevation.

The pillar crane shown in the drawing by way of example comprises a pillar 1 which is pivoted on a base plate 2. At the upper end of the pillar 1, a jib 4 is pivoted on a pivot 3 so as to be tiltable in a vertical plane.

On a load hook 7 with block 8 the load is suspended by means of the load cable 9 which is led double over the jib sheaves 10 and 11 pivoted on the outer end of the jib 4 and over the sheaves 12 and 13 pivoted on the pillar 1, and which is attached to the cable drums 14 and 15, respectively.

The rear portion of the jib 4 is preferably shaped as the arc of a circle having the radius r. On this circular arc 4c two flexible tension members 16 (e. g. chains or cables) are located which are attached on the one hand on the point 4a of the jib 4, and on the other hand on the block-and-tackle 17. The latter comprises a number of upper sheaves 18 and a number of lower sheaves 19, over which the cable 22 is passed. The one end of the cable 22 is attached to the block proper, the other end to a cable drum 23. The cable drums 15 and 23 are rigidly connected with one another. The load Q on the hook 7 produces,

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at the largest handling radius (Fig. 1), in the two strands 9a and 9b of the load cable 9 a load tension of Q/2 each, which tensions act on the cable drums 14 and 15, respectively. The belled cable drum 15 acts in the two extreme positions of the jib 4 with the radii y_1 (Fig. 1) and y_2 (Fig. 2), respectively, and the cable drum 23 acts with the radius x_1. The load cable tension Q/2 of the strand 9a of the cable produces on the cable drum 15 the turning moment

$$-y_1 \cdot \frac{Q}{2}$$

The load cable tension Q/2 of the strand 9b of the cable acts on the drum 14. The load Q produces a load reaction on the point 4b of the jib 4 (Fig. 1) which is parallel to the load Q and the magnitude

$$R = \frac{Q \cdot a}{r}$$

wherein a is the distance of the load Q from the centre of the pillar 1.

When a block-and-tackle 17 having n effective strands is selected, the force in the cable 22 is

$$K = R/n$$

If now the radius x_1 of the drum 23 is so determined that

$$+K \cdot x_1 = -\frac{Q}{2} 1 y_1$$

the two turning moments acting on the rigidly connected drums 15 and 23 cancel out one another.

When the cable drum 23 is driven clockwise by hand or by means of a driving motor, the upper sheaves 18 of the tackle are pulled downward by the cable 22 from the position according to Fig. 1 into the position according to Fig. 2. The flexible tension members 16 develop on the arc 4c of the jib, until the point of the jib has reached its highest position (Fig. 2). In this case the following conditions prevail on the cable drums 15 and 23, analogous to what has been stated hereinabove:

$$R_b = \frac{Q \cdot b}{r}; \quad K_1 = \frac{R_b}{n}; \quad x_1 \cdot K = -y_2 \cdot \frac{Q}{2}$$

wherein b is the distance between the load Q and the centre line of the pillar 1 in the tilted position of the jib 4 (Fig. 2), R_b is the load reaction in this position, and K_1 is the tension in the cable 22.

The values of n, $x1$, y_1 y_2 and r are to be so selected that upon rotation of the load cable drums 15 and 23 (e. g. clockwise) the jib gets with its

point from the lowest position (Fig. 1) into its highest position (Fig. 2). In the process the drum 15 allows a sufficient length of the load cable to be wound off in order to secure a horizontal shifting of the load from a_1 (Fig. 1) to b_1 (Fig. 2). The lower sheaves 19 of the block-and-tackle 17 are pivoted in a frame 30 which is supported by a fulcrum 31 on the pillar 1. This frame carries also the drums 14, 15 and 23 with their driving mechanism, moreover the rollers 32 which run on a circular track 33 fixed on the base plate 2.

In order to compensate the proper weight S of the jib 4 acting on its centre of gravity s in every position at least approximately, the upper sheaves 18 of the block-and-tackle 17 carry a number of counterweights 40_a, 40_b, 40_c etc. suspended at intervals from one another. The force P produced in the cable 16 by the proper weight of the jib amounts, according to Fig. 1, to:

$$P=\frac{S\cdot p}{r}$$

wherein p is the distance of the centre of gravity s from the centre line of the pillar 1 in the fully extended position of the jib 4. The counterweights 49_a, 40_b etc. are connected between themselves by tension members 41, and are so dimensioned that they correspond as a whole to the force P.

When now the jib is moved (by driving the drum 23 clockwise) from the position of Fig. 1 into that of Fig. 2, one counterpoise after the other is deposited on the frame 30 wherein they are guided vertically shiftable, whereby their effect as counterweights is eliminated. By this additional device for the compensation of loads, the proper weight of the jib is practically compensated in any position.

On the jib, when in its highest position, act the following moments:

$$P'\cdot r=S\cdot p_1$$

wherein P' is the weight of at least one of the counterpoises suspended on the block-and-tackle, and p_1 is the horizontal projection of the distance of the centre of gravity s from the centre line of the pillar 1.

The lateral drum 14 serves for lifting or lowering the load Q in any desired position of the jib, independently of the compensating mechanism. By the compensation of the load moment on the jib and of the proper weight of the jib on the one hand, and by the horizontal shifting of the load when varying the handling radius of the jib on the other hand, it has been achieved, that a comparatively low amount of energy is required for adjusting the jib, which has a favourable effect on the working speed and consumption of energy of the crane. The crane pillar 1 receives from the load Q and the proper weight S of the jib, in any position of the latter, a vertical force only, acting on its turning point 3, and practically no appreciable bending moments. This fact has the consequence that the pillar 1 of the jib can be made of a considerably reduced cross section which, in so called tower-cranes has the advantage of reduced air drag and increased stability.

Instead of the block-and-tackle 17, a mechanical lifting mechanism can be used as shown in Fig. 5, which comprises a toothed rack 35 in mesh with a gear wheel 37 which is rigidly connected to the drum 23. This rack 35 is connected with the cable 16.

I wish to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What I claim is:

1. A crane comprising a base, a pillar pivoted on said base, a jib pivoted on top of said pillar so as to be tiltable in a vertical plane, the said jib having a long, load carrying arm and a short, cam-shaped arm, a pair of sheaves journalled at the distal end of the said long arm, another pair of sheaves journalled on the jib near its pivot on the pillar, a load block and hook, a load cable running double over the said two pairs of sheaves and arranged to suspend the said load block and hook, a load lifting drum journalled on the said pillar, a first load compensating drum also journalled on the said pillar, the two ends of the said load cable being attached to and arranged for being wound on and off the said first compensating drum and the said load lifting drum, respectively, a second compensating drum rigidly connected to the said first compensating drum, a flexible tension member attached with one end to the said jib and arranged to hug the cam shaped arm thereof, and attached with its other end to the said second compensating drum for being wound on and off said second compensating drum, the said load cable and flexible tension member being arranged for producing moments of opposite sign and substantially equal value on their respective rigidly connected drums, and means for turning the said rigidly connected drums, the said first compensating drum being adapted to pay out or wind on so much of the said load cable when tilting the said jib that the load block and hook move substantially level when raising or lowering the said long arm of the jib.

2. A crane as claimed in claim 1 comprising as a first compensating drum a belled drum the effective diameter of which is arranged to vary according to the position of the jib.

3. A crane as claimed in claim 1 comprising a block-and-tackle arranged between the said flexible tension member and the said first compensating drum.

4. A crane as claimed in claim 1 comprising progressively acting compensating means for the proper weight of the jib, connected to the said flexible tension member.

5. A crane as claimed in claim 4 comprising as a progressively acting compensating means: a series of counterweights suspended at intervals from the said flexible tension member and adapted to be successively deposited and put out of action when the said flexible tension member is payed out when tilting up the long arm of the jib.

6. A crane as claimed in claim 4 comprising a frame attached to the crane pillar and arranged for housing the said load lifting drum, both compensating drums, and the compensating means for the proper weight of the jib.

AUGUST WULLSCHLEGER.

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