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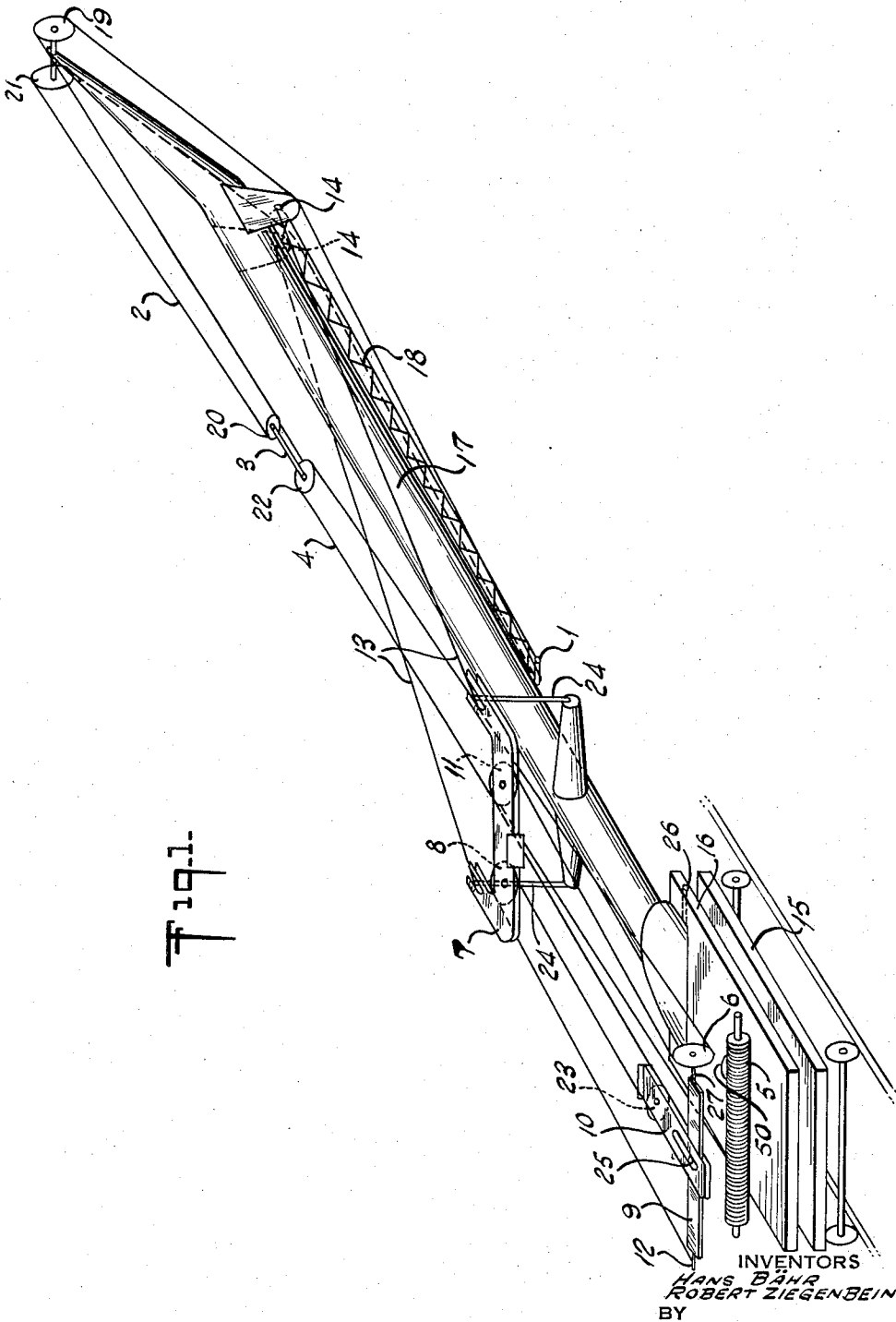
H. BÄHR ET AL

2,924,341

PULLEY ASSEMBLY FOR CRANES

Filed June 20, 1957

3 Sheets-Sheet 1



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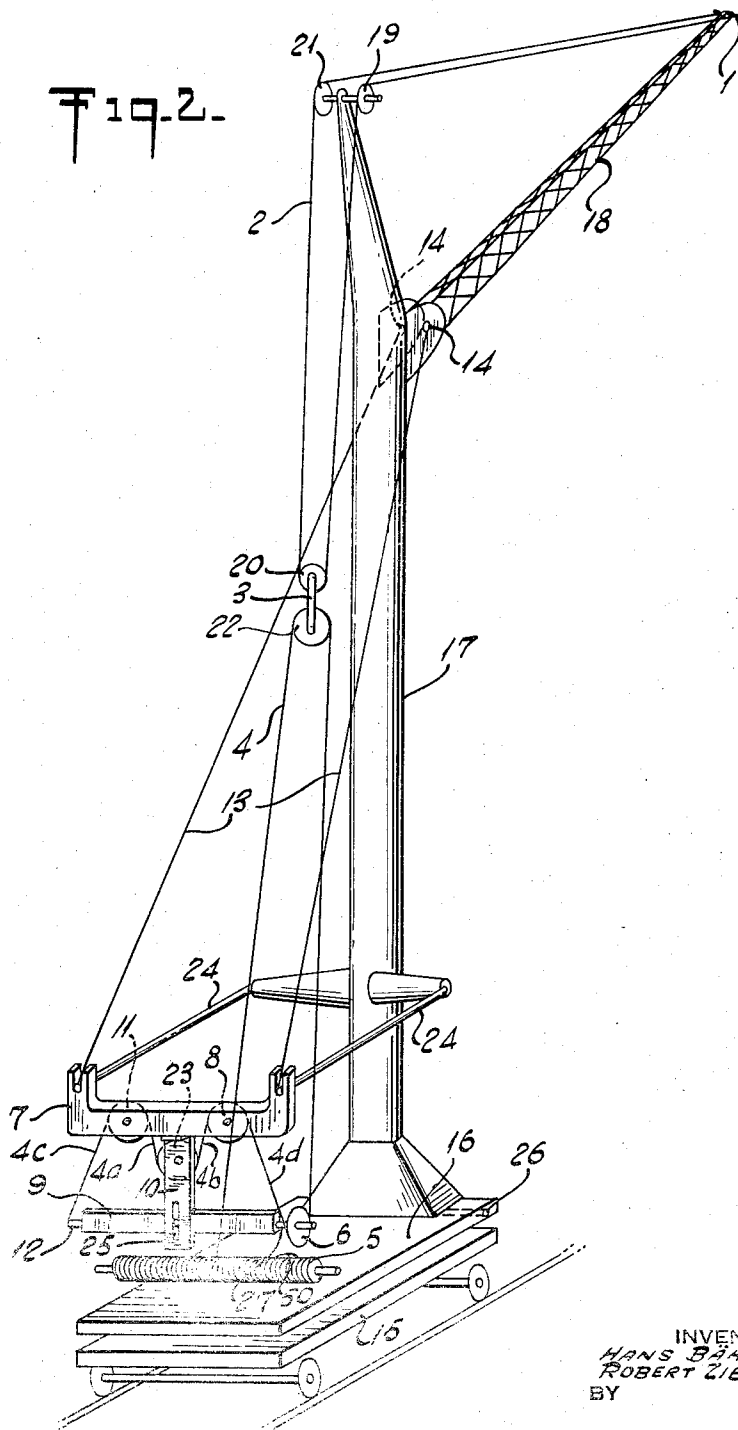
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3 Sheets-Sheet 3

Fig. 3.

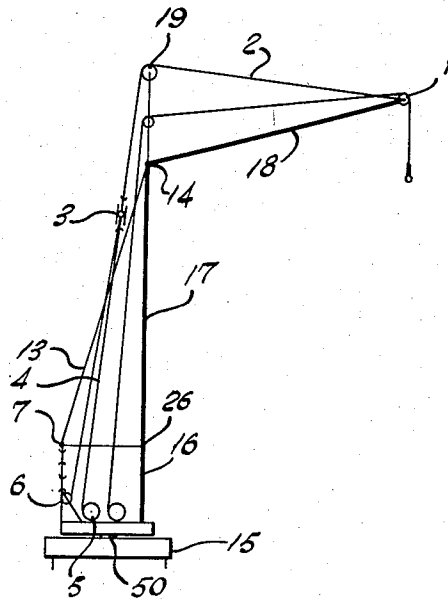
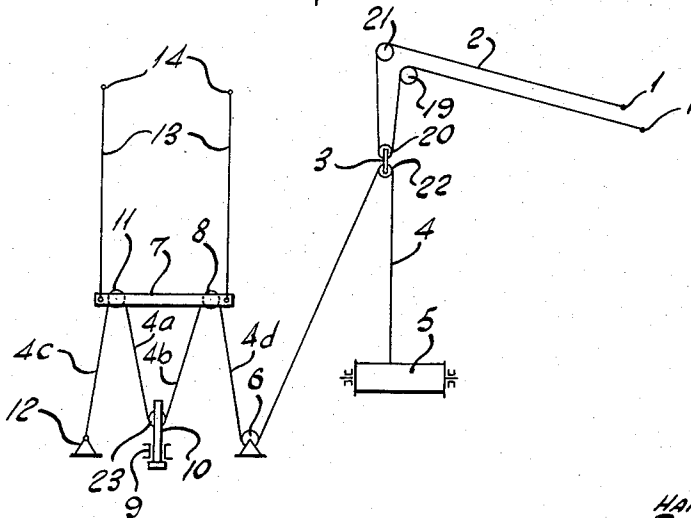


Fig. 4.



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1

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PULLEY ASSEMBLY FOR CRANES

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8 Claims. (Cl. 212—46)

This invention relates to improvements in cranes, for example of the building crane or tower crane type, and in particular relates to a new and improved pulley arrangement for obtaining a load-depending counter-moment in the erection and use of such cranes.

Pulley arrangements in building and tower cranes are well known. However, in erecting revolving tower cranes and the like, conventional pulley arrangements of the block and tackle type have invariably been used. In the erected, operative position of the tower, the force exerted by the block and tackle of the boom cable pulley becomes inactive or nullified through its own action, and cannot exert any further force upon the tower along the guy wires. That is, the pulley arrangement supplies a force acting on the tower which is equal to the force exerted by the load on the boom and therefore counteracts this force. The resultant force which acts on the tower is directed substantially along the axis of the tower.

The disadvantage of such conventional pulley arrangements is that large bending moments act upon the tower because of unequal stressing, which requires the towers to be made of greater structural weight.

The object of the present invention is to provide a pulley arrangement which, for any given load-moment, presents a counter-moment of opposite direction acting upon the tower. The counter-moment is so directed that the direction of the resultant forces (comprising both the forces of the structure itself and the weight of the load) acting on the tower is directed approximately along the tower axis.

In accordance with the invention, the aforementioned object is achieved by suspending a pulley between the upper part of the tower and the base carriage of the crane, a cable pull, depending on the load moment, being transmitted over the pulley in such a manner that the pulley exerts a tensioning force upon the tower in dependence upon the mechanical advantage of the pulley system. This tensioning force produces a moment which acts in the opposite direction to the load moment, and the magnitude of which is proportional to the magnitude of the load moment.

Another object of the invention is to provide a pulley arrangement in which the blocks and tackles are so mounted and arranged, that in the upright, operative position of the tower portions of the ropes or cables trained over the pulleys become automatically inactive. The pulley, which has been utilized for erecting the tower, then becomes operative to raise and lower the boom, with the required forces which have to be exerted by the pulley for any position of the boom, directed along a plane which is close to the tower axis.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings, in which:

Fig. 1 is a perspective view, shown partially schematically, of a crane made in accordance with the invention, the crane being shown in a lowered inoperative

2

position, and with only such structural parts included as are necessary for an understanding of the invention;

Fig. 2 is a perspective view of the crane illustrated in Fig. 1, but with the crane shown in its erected, operative position;

Fig. 3 is a side elevational view of the crane, shown in purely schematic form; and

Fig. 4 is a diagrammatic illustration of the pulley system incorporated in the crane.

Referring in detail to the drawings, there is shown a crane mounted to revolve on a pivot member 50 mounted on a base support 15, which may be mounted on wheels. The crane has a base carriage 16, rotatably mounted on the support 15, as shown at 50, and supporting a tower 17 upon which a boom 18 is swingably mounted. The tower 17 is hingedly mounted at the front of the carriage 16, as by a pivot rod 26, for movement between the upright, operative position shown in Figs. 2 and 3, and the lowered, inoperative position shown in Fig. 1.

The boom 18 is supported in its extended position by a cable 2, the ends of which are fixed to the free end 1 of boom 18. The cable 2 is guided over sheaves 19 and 21 at the top of tower 17, and the center of cable 2 carries a sheave 20 of a block 3.

A transverse beam 7 is mounted on the lower end of the tower 17 by a spacer structure including rods 24 which position the beam 7 above the rear end of the carriage 16 in the upright position of the tower shown in Fig. 2. A pair of spaced sheaves 8 and 11 are rotatably mounted on beam 7. Spaced centrally beneath the sheaves 8 and 11, a rail 10 is slidably mounted by a pin-and-slot connection 25 on a guide bar 9 pivoted at 27 to carriage 16. The rail 10 is mounted for sliding movement toward and away from the transverse beam 7, and carries at its upper end a sheave 23. Also immovably mounted on carriage 16, is a sheave 6 and an anchoring post 12.

Swinging movement of the boom 18 upwardly and downwardly is controlled by a pull cable 4 which is wound on a drum 5 mounted on the crane carriage 16. The pull cable 4 runs from drum 5 over the lower sheave 22 of block 3, then downwardly and around sheave 6, thence over sheave 8, downwardly and around sheave 23, upwardly and around sheave 11, and finally downwardly, the free end of cable 4 being secured to the anchoring post 12.

The sheaves 8, 23, and 11 form a pulley arrangement on the principle of a block-and-tackle to produce a load-depending cable pull on the tower 17 by means of cables 13 which connect the ends of the transverse beam 7 to fixed points 14 near the upper end of tower 17.

Fig. 1 shows the tower in its lowered, inoperative position. It will be observed that the transverse beam 7 is spaced a substantial distance from the rail 10 so that the sheave 23 is separated from the sheaves 8 and 11. The guide bar 9 is pivoted on the carriage about pivot point 27, so that both it and the rail 10 carried thereby are on the same plane as the transverse beam 7. The cable arrangement is on substantially parallel planes which are located close to and substantially along the axis of tower 17.

In erecting the tower to its upright operative position shown in Fig. 2, the drum 5 is rotated in a direction to wind the cable 4 thereon. This shortens the length of the cable 4 trained around the sheaves 8, 11 and 23, and draws the transverse beam 7 toward the rail 10, thereby raising the tower 17 by exerting a pulling force substantially along the axis of the tower 17 by means of cables 13. As the tower is raised, the rail 9 pivots to maintain the sheave 23 and rail 10 in the same plane as the transverse beam 7 and the sheaves 8 and 11 carried thereby.

3

The tower 17 is raised until the transverse beam 7 abuts the end of the rail 10, as shown in Fig. 2. At this point, the tower 17 is in upright position. When the beam 7 engages the rail 10, the portions 4a and 4b of cable 4 leading from the sheave 23 to the sheaves 8 and 11 are neutralized or cancelled so that they no longer have any effect, and the only force acting on the transverse beam 7 will be the force of the two end cable sections 4c and 4d. Further winding of the cable 4 upon drum 5 will now have the effect of lowering the block 3 which in turn raises the boom 18. Thus, once the tower 17 is in its upright position, the drum 5 can be operated to raise and lower boom 18.

When a load is being lifted by the boom 18, the weight of the load exerts a force upon the tower 17 through beam 18, tending to urge the tower downwardly to its lowered position. However, for any given load-moment, a counter-moment of opposite direction is made to act upon the tower 17 through the cables 13 connecting the tower to the transverse beam 7. This counter-moment is produced by tensioning of cable 4 as it is wound upon drum 5 to lift said load. This tensioning produces a downward force upon transverse beam 7 which in turn provides the counter-force upon the tower 17 through cables 13. The counter force is equal to the force exerted upon tower 17 by the load-moment and weight of the boom 18, and will, of course, vary in accordance with the magnitude of the load-moment.

By use of the pulley arrangement described above, the resultant forces are directed as close as possible to the tower axis. These resultant forces, which include the stresses of structural and load weight, are directed through the cable and pulley system which is approximately parallel to the plane of the tower axis and is located proximate thereto.

The pulley arrangement of the invention also has the further advantage of permitting the considerable reduction of the structural weight of the tower, and therefore also of the base structure.

While a preferred embodiment of the invention has been shown and described herein, it is obvious that numerous additions, changes and omissions may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In a crane having a carriage, a tower mounted on said carriage for movement between an erected operative position and a lowered, inoperative position, and a boom swingably mounted on the tower; a pulley arrangement for raising the tower to an erected position and for raising and lowering said boom relative to the tower, said pulley arrangement comprising a first pulley system including drum and cable means for raising said tower and maintaining the latter in erected position said pulley system including a portion arranged for guided movement along a path spaced from said tower and a second pulley system connected to said boom for raising and lowering said boom, means operatively connecting said first and second pulley systems whereby the load moment of said boom is translated into a corresponding counter-moment on said tower by said first pulley system.

2. A pulley arrangement according to claim 1 in which said connecting means comprises a block and tackle.

3. A pulley arrangement according to claim 2 in which said first pulley system includes a beam connected

4

to said tower and having at least one sheave mounted thereon, a sheave fixedly mounted on a portion of said carriage, a cable trained over said sheaves and anchored at one end to said carriage, and a wind-up drum connected to the other end of said cable.

4. A pulley arrangement according to claim 3 in which said cable is connected to said block and tackle and in which said first and second pulley systems are located close to the tower axis whereby the resultant of structural and load weight forces acting on the tower is directed close to and along the tower axis.

5. A crane comprising a carriage, a tower mounted on said carriage for movement between an erected operative position and a lowered, inoperative position, a boom swingably mounted on the tower, a beam mounted in a position spaced from said tower, cable means connecting said beam to the tower for supporting the latter in its erected position, a pulley arrangement for moving and supporting said beam, said pulley arrangement including a plurality of sheaves mounted on said beam, a rail member mounted on said carriage and carrying a sheave, a cable trained over said sheaves and fixed at one end to said carriage, the beam being spaced from said rail in the lowered position of said tower, and means for winding up the other end of said cable to bring said tower to its erected position, said beam being positioned to abut said rail in the erected position of the tower, whereby the mechanical advantage of said rail member sheave is nullified.

6. A crane comprising a carriage, a tower mounted on said carriage for movement between an erected operative position and a lowered, inoperative position, a boom swingably mounted on the tower, and pulley means for erecting the tower and operating said boom, said pulley means comprising an arm extending outwardly from said boom, a freely suspended beam held against said arm, cable means connecting said beam to the tower for erecting and supporting the latter in erected position, a plurality of pulley sheaves journaled on said beam, a fixed pulley sheave mounted on said carriage, a block and tackle having a pair of sheaves, a first cable connecting a first of said pair of sheaves to said boom for raising and lowering the latter relative to the tower, a second cable anchored at one end to said carriage and trained over the beam sheaves, the fixed sheave, and the second sheave of said block and tackle, and a wind-up drum connected to the other end of said second cable.

7. A crane according to claim 6 in which said wind-up drum is operative to wind up said second cable to draw said beam toward said carriage and bring said tower to its erected position, said beam engaging a portion of said carriage in said erected position of the tower and further operation of said wind-up drum actuates said boom.

8. A crane according to claim 7 in which said pulley means is arranged to produce a load-depending counter-moment acting to hold said tower in its erected position in opposition to the load moment of said beam.

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