April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 1

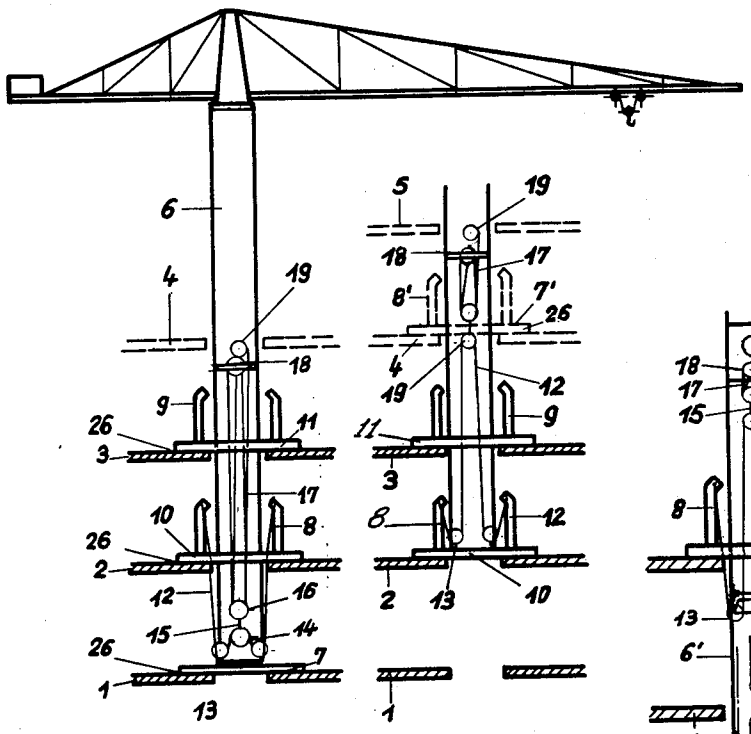


FIG.1

FIG.2

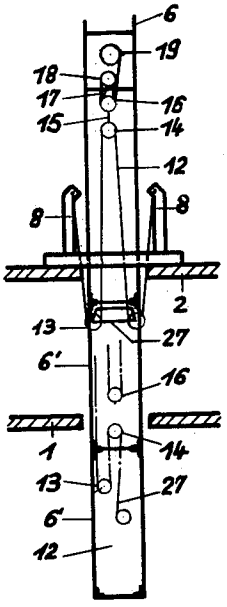


FIG.3

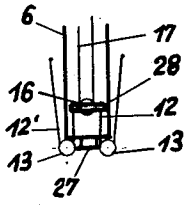


FIG.4

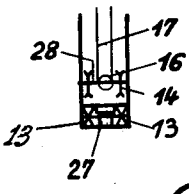


FIG.5

INVENTOR

Friedrich W. Schwing

BY Malcolm W. Fraser

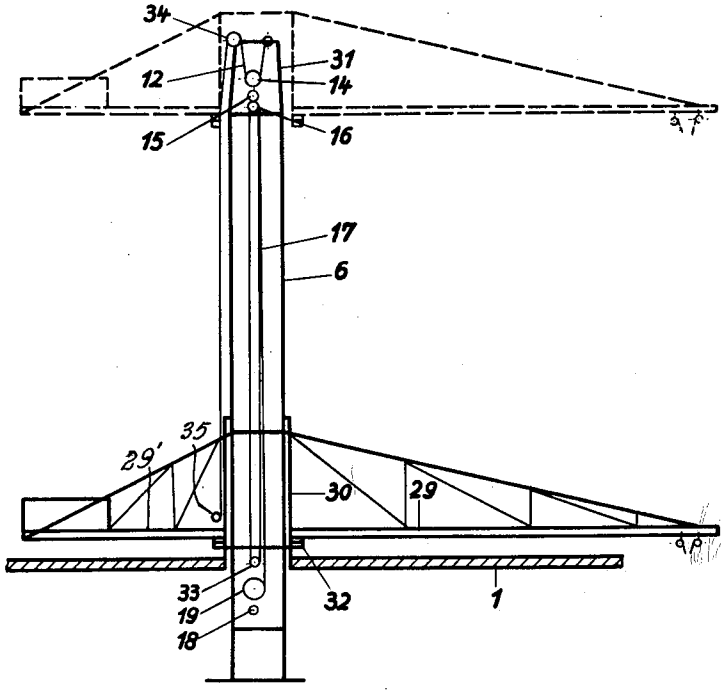
ATTORNEY

April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 2

FIG.6



INVENTOR

Friedrich W. Schwing

BY Malcolm W. Fraser

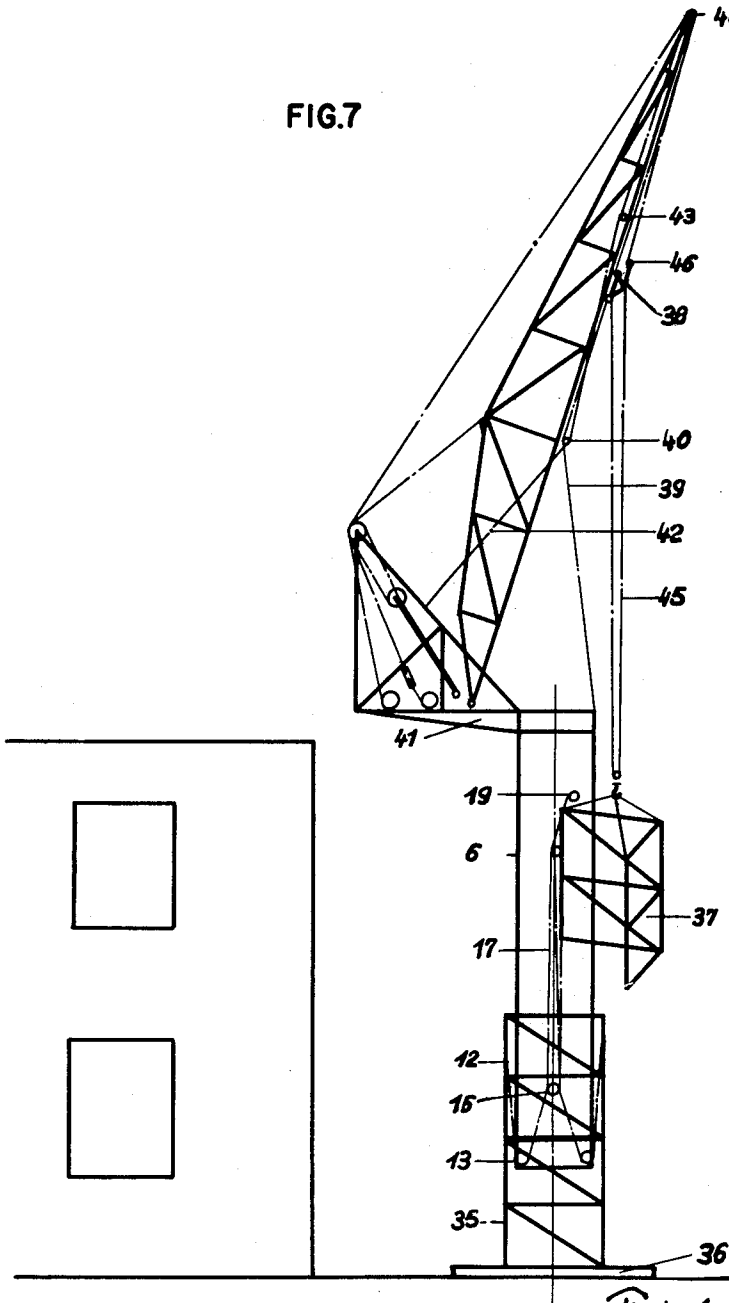
ATTORNEY

April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 3

FIG.7



INVENTOR

Friedrich W. Schwing

BY Malcolm W. Fraser

ATTORNEY

April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 4

FIG.8

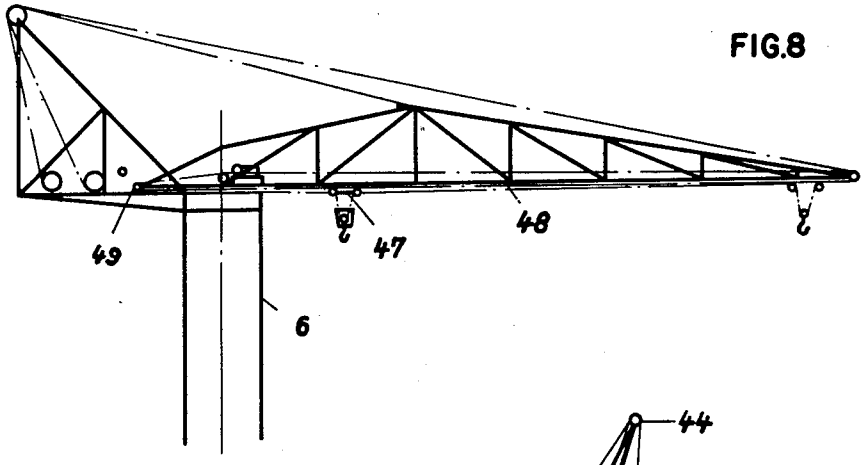
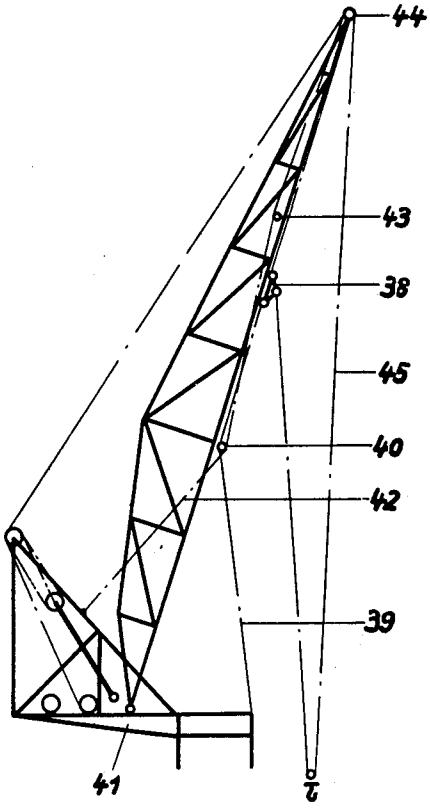


FIG.10



INVENTOR

Friedrich W. Schwing

BY Malcolm W. Fraser

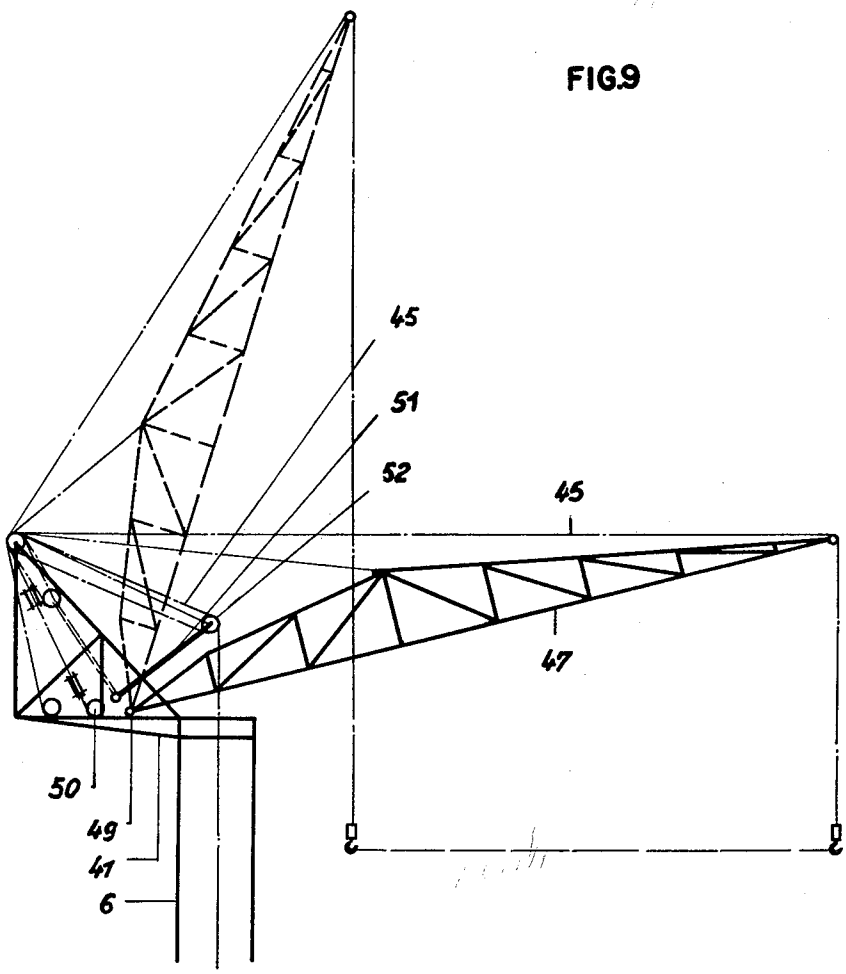
ATTORNEY

April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 5

FIG.9



INVENTOR

Friedrich W. Schwing

BY Malcolm W. Fraser

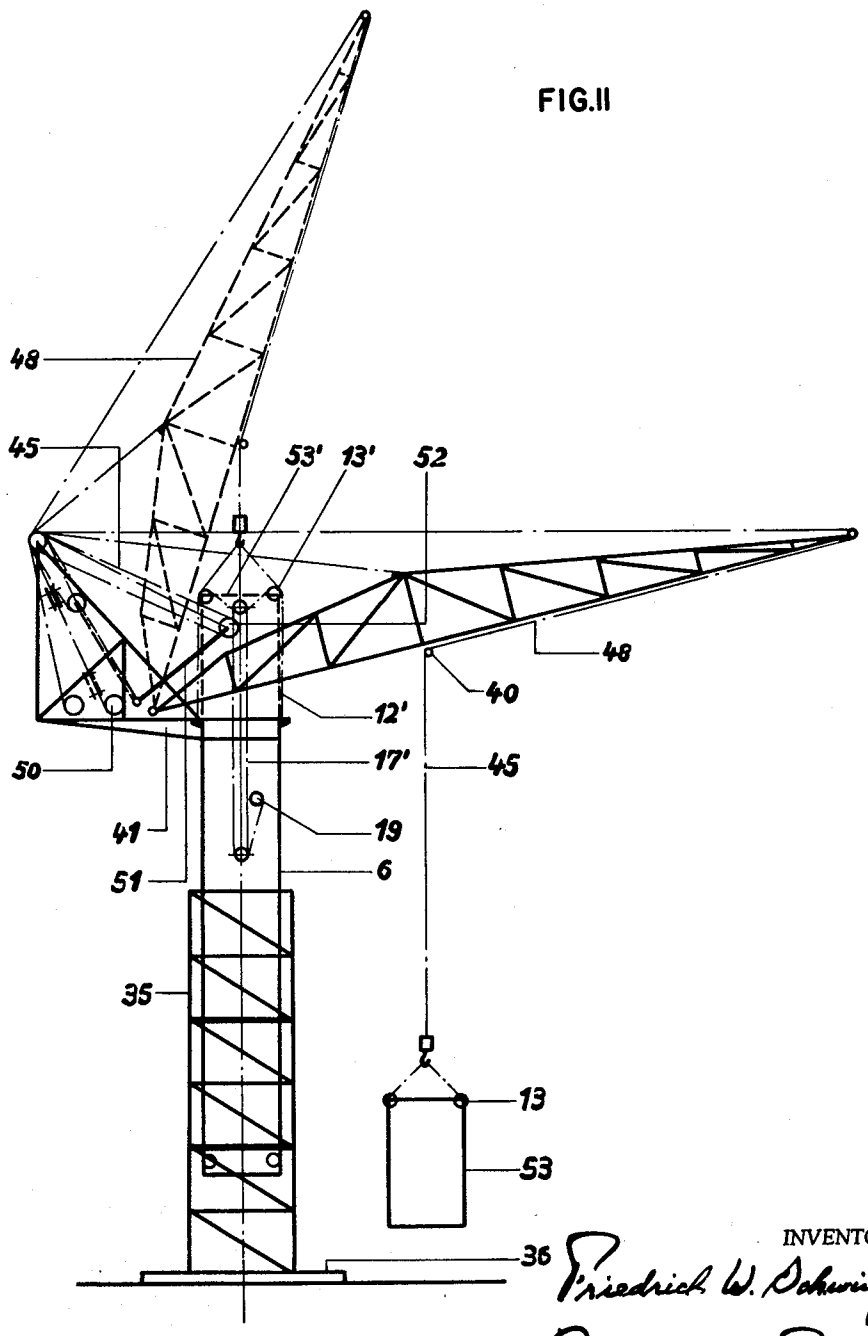
ATTORNEY

April 7, 1964 F. W. SCHWING 3,127,996

CLIMBING CRANES

Filed Oct. 10, 1960 6 Sheets-Sheet 6

FIG.II



INVENTOR
Friedrich W. Schwing

BY Malcolm W. Fraser
ATTORNEY

United States Patent Office 3,127,996 Patented Apr. 7, 1964

3,127,996

CLIMBING CRANES

Friedrich Wilhelm Schwing, 424 Dorstener Strasse, Wanne-Eickel, Germany

Filed Oct. 10, 1960, Ser. No. 61,530
2 Claims. (Cl. 212—57)

The evident concentration of building work in business centers on the most confined spaces makes the erection of skyscrapers more and more necessary. Such skyscrapers cannot, however, be erected economically with conventional rotary tower cranes even if these are dimensioned to suit the building site. For such cranes to operate safely they require an enlarged base on the ground or a wide track corresponding to their height.

Since, however, the need for skyscrapers is mostly dictated by lack of floor space, only in the rarest cases is there sufficient area available for the erection of a conventional rotary tower crane immediately beside the building work. Consequently, as the height of a building increases, the performance of tasks such as the precise positioning of a load on the ceiling which, for the time being, is the highest, the positioning of shuttering boards, the admission of reinforcement and the filling of vertical shuttering become more difficult.

Frequently the load can only be positioned by the jib at the edge of the building and must be further transported from there. This, however, is often combined with great expenditure of effort and time owing to the considerable weight involved as, for example, when transporting a reinforcement cage previously made ready on the ground.

It is therefore desirable to be able to sweep over the working surfacce at present in being and to be able to reserve the free surfaces outside the confines of the building, which are mostly only small, for the storage of material.

This requirement is fulfilled by the crane with a climbing arrangement according to the present invention which is positioned in a shaft, which may be formed by free openings in the ceilings of a building, and which at time can be adjusted in height according to the upward growth of the building.

A crane construction is already known comprising a column fixed outside the building work. This necessitates a considerable expenditure with respect to the setting up of the crane, its fixing and in the production of upward extensions thereof.

Other cranes employed in building work load the fresh upper ceilings, not yet capable of being loaded, which from technical building considerations is not practicable.

Further it is known to arrange a lifting winch in the column of a self-climbing tower crane. The necessary auxiliary devices are, however, arranged outside the column and thus necessitate greater openings in the ceilings. Furthermore, this construction of the column is only erected on a foot support, which must absorb both the vertical and horizontal forces. During the climbing process according to this construction the total load is superimposed on the recently concreted uppermost ceiling by way of an upper box frame, which is not permissible according to the rules of building construction.

The climbing crane acccording to the present invention also takes this requirement into account, since only deeper lying ceilings, which are capable of carrying loads, are used for erection and are loaded during the climbing, because of the lifting-apparatus, arranged inside the tower, whose movement takes part in and against guides, serving as abutments which are situated on the already loadable ceilings.

The crane may be provided with a horizontal jib and a travelling trolley or with an adjustable jib. In addition

to stationary employment it can also be movable arranged by means of a movable support.

An adjustable jib is advantageous in comparison with a horizontal jib when the building has to be erected in a gap, i.e., between already existing high buildings, which hinders the turning circle of the horizontal jib.

Cranes with adjustable jibs of the hitherto known type for building work have the disadvantage that the load cannot be moved so near to the crane tower as is possible in the case of a crane with a travelling trolley on a horizontal jib. The adjustable jib cannot be adjustable into the vertical position, since the danger of overturning exists and the jib cannot be lowered from the vertical position without external assistance.

This inherent deficiency of known cranes with adjustable jibs is removed by a subsidiary feature of the present invention according to which the pivot point for the jib is transferred further back, namely to behind the tower. In this manner it is possible to bring the load to the tower and, by means of an additional pulley on the jib, even to move it over the tower. This gives the further possibility of erecting tower pieces with the jib from above for the setting up and extension of the tower.

The adjustable jib may be provided with a travelling trolley. This has the advantage that, at the commencement of a building operation when neighbouring buildings prohibit operation with the jib horizontal, the adjustable feature of the jib can be employed. Whereas when the building work rises above that of the neighbouring buildings, the crane may be adapted to horizontal jib operation with the travelling trolley.

In present day building practice high buildings are known which either have no stage ceilings (e.g., cooling towers) or have only irregularly, often widely, spaced stage ceilings (e.g., silos) or have ceilings which are built-in subsequently or have stage ceilings which may not be employed for the erection of climbing cranes. In such cases the climbing crane according to the invention, in addition to the aforementioned extension of the tower with the appropriate jib, may be surrounded by an outer tower and climb up in this in like manner. The outer tower is erected in sections and possesses guides for the crane tower proper and for the coupling means for the climbing rope of the climbing apparatus. Hitherto it was necessary to shut down the crane when the tower had to be erected from above. It was a very dangerous job of several days' duration. Such interruptions were never desirable but were completely unavoidable in building structures erected by the slide building method and it is just these which require such a lifting device by reason of their great height.

Embodiments of cranes in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which

FIGURE 1 is a schematic view of a tower crane according to the invention prior to performing a climbing operation,

FIGURE 2 shows a part of the crane of FIGURE 1 after the climbing operation has commenced,

FIGURE 3 shows a detail of the climbing apparatus of the crane,

FIGURES 4 and 5 show details of modifications of the climbing apparatus,

FIGURE 6 illustrates the assembly and dismantling of a climbing crane according to the invention,

FIGURE 7 is a schematic view of a crane with an adjustable jib erected in an outer tower,

FIGURE 8 is a schematic view of part of a crane with a horizontal jib,

FIGURE 9 shows the crane of FIGURE 8 adapted for adjustment of the jib,

FIGURE 10 shows a detail of a crane with an adjustable jib, and

FIGURE 11 shows an example of a crane in which the crane tower is extended from above.

FIGURE 1 shows a climbing crane before commencement of a climbing operation. The ceilings of the fictitious building are designated by the reference numerals 1 to 4. The tower 6 is supported at its bottom on the ceiling 1 by means of a support 7 and is held laterally at the ceilings 2 and 3 by guide members 8 and 9, respectively. The guide members 8 are joined by a support 10 and the guide members 9 are joined by a support 11, the supports 10 and 11 being arranged on the ceilings 2 and 3, respectively. The ceiling indicated in broken lines has not yet assumed load-carrying capacity, so that at the commencement of the climb the tower is held here as necessary by wedges or stays.

A support rope 12, or some other suitable support means, for example a belt or a chain, is fastened to the guide members 8 and passes round support pulleys 13 and a compensating pulley 14. The latter is detachably joined at 15 to the lower block 16 of a pulley block system 17. The upper block 18 of the pulley block system 17, which system comprises a plurality of strands, is fixedly coupled together with the fixed point in the pulley block system 17 in the tower 6. The other end of the pulley block system 17 is wound up on the drum of a rope winder 19 when climbing takes place. Due to this the lower block 16 with the pulley 14 is raised, so that the rope 12 raises the tower 6 joined with the pulleys 13.

In this way the lower end of the tower reaches the level of the ceiling 2 (see FIGURE 2) where it is secured on the support 10. Until the next climb takes place the tower can be wedged or stayed laterally at the ceiling 5. For the next climb the pulley block system 17 is unwound and the support rope 12 is disconnected from the guide member 8 and made fast to the guide member 9 on the ceiling 3.

The support 7 on the ceiling 1 and the guide member 8 on the ceiling 2 are moved on to the ceiling 4. They are then in the positions indicated in broken lines at 7' and 8', respectively, in FIGURE 2.

In the next climbing operation the lower end of the tower reaches the ceiling 3, where it is secured. This alternate climbing and securing is repeated corresponding to the height of the building. The downward climb is effected in the reverse sequence. Whereas during the upward climb the crane jib remains stationary on the tower and is lifted with it, it is dismantled before the climbing down operation.

It is usual in concrete constructional work to join together the ceilings by props or posts.

The number of guides and rope attachments is so chosen that the forces are dealt with safely on load-strong building parts. In order to achieve a good distribution of the vertical forces on the individual ceilings, the supports 7, 10 and 11 rest on the ceilings by means of suitable intermediate layers 26, for example of elastic material.

FIGURE 3 shows that the pulleys 13 are not built into the lower end of the tower itself, but into a support member 27 which can be moved in the interior of the tower and can engage the latter. The support member 27 engages thrust flanges on the tower 6. In order to displace the tower extended by the joining on of the tower part 6', the support rope 12 is loosened from one of the guides 8 and then the support member 27 together with the pulleys 13 are run down in the tower by means of the pulley block system 17. During the running down of the support member, the latter hangs in an inclined manner so that it has sufficient clearance within the tower. Afterwards the other end of the rope 12 is loosened from the other guide 8 and both ends of the rope are passed out of the tower under the butt joint between the tower parts 6 and 6'. The rope ends are then anchored again

to the guides 8 and the support member 27 is brought into engagement with the tower, for example on the flanges of the butt joint between the tower parts 6 and 6', by drawing up the pulley block system 17. The position of engagement of the support member 27 with the tower is shown in the upper part of FIGURE 3.

According to the extended length of the pulley block system 17, more extension pieces can be added to the tower in the manner described and then the whole crane raised.

FIGURE 4 shows a modification in which the compensating pulley 14 is replaced by a rocker arm 28, which latter also supports the lower block 16. In this case the support rope is in two pieces 12 and 12', the pieces being anchored in an easily detachable manner at their ends to the rocker arm 28. FIGURE 5 shows that the number of ropes 12, 12' can be increased, for example doubled. In the example shown, a rocker arm 28 provided with two compensating pulleys 14 is employed. In FIGURE 5 the support member 27 is in the form of a frame having about the same dimensions as the cross-section of the tower, which frame surrounds the built-in pulleys 13 and is capable of being connected with the tower.

The assembly and dismantling of the crane is illustrated in FIGURE 6. The tower 6 is erected with its lower end for example on the cellar floor of the building work and held in the opening in the ceiling 1. The entire jib 29 rests on the ceiling 1, with the apex 30 of the jib surrounding the tower 6. The apex 30 supports a stand 31, which is merely used as a mounting stand or remains in the jib. In the latter case it is detached from the tower after the raising up of the jib and joined with the revolving connections 32 on the jib.

In order to raise the jib, the rope of the pulley block system 17 is attached at one end to the fixed point 33 and its block 16 is joined with the compensating pulley 14 by the quick-release coupling 15. The rope 12 is here employed as a pulling rope and is passed over a pulley 34 and attached to the jib part 29' at 35. By driving the rope winder 19 the pulley block system 17 is drawn up, so that the rope 12 brings the jib to the position shown in broken lines. The lowering of the jib takes place according to the reverse sequence.

FIGURE 7 shows a crane with an adjustable jib and an outer tower 35 which is adapted to climb in the way described with reference to FIGURES 1 to 5. The outer tower 35 stands on a base frame or other suitable foundation; in the example shown it is arranged on a stationary base frame 36. It is a wise precaution to construct tracks of the type used in building operations beneath this base frame 36.

The outer tower 35 is erected around the crane tower 6 before the commencement of the climbing operation, whereby most of the component parts have been previously made ready, as shown at 37. There are erected, for example, two such parts 37 on the outer tower 35 to which they are bolted on its long sides. After this the climbing operation proceeds in the previously described manner.

FIGURE 7 also shows a construction by which the load hook of the crane can be moved towards or over the tower center according to need, for example when extending the crane tower 6 of the outer tower 35 from above.

An auxiliary trolley 38 moves on the jib. On the occasion of jib adjustment the auxiliary trolley 38 is positively moved by the forward motion rope 39, which is led around the rope pulley 40 and is attached to the upper part 41 of the crane, and by the return motion rope 42, which is led over rope pulleys 40, 43 and 44 and is also attached to the upper part 41 of the crane.

In consequence, in the flat position of the jib the lifting rope 45 runs down directly at the jib point, while with steeper jib position the auxiliary trolley is positively drawn to the tower 6 by the forward motion rope 39.

Thus the lifting rope 45 is turned along the underside if the jib by a guide pulley 46 arranged on the auxiliary trolley 38, i.e., the range is additionally decreased, so that the load hook hangs over the tower center in the steeper positions of the jib. The path travelled by the load hook in the horizontal direction is greater than the path travelled by the point of the crane jib.

FIGURE 8 shows a crane with a known type of horizontal jib 48, but in which the pivot point 49 of the jib is positioned behind the crane tower 6, so that the crane travelling trolley 47 can be moved directly over the tower 6. FIGURE 9 shows the same crane in which the jib 47 has been adapted for use as an adjustable jib by the addition of a jib adjustment winch 50. In this case, it is a matter of indifference whether the trolley 47 remains in the jib or not.

In order to achieve a practically horizontal load movement when the jib is adjusted, a rope guide 51 is so linked to the upper part 41 of the crane that upon adjustment of the jib position by means of the winch 50 the rope guide 51, around whose rope pulley 52 the lifting rope 45 passes, is so adjusted that the load describes an almost horizontal path. With the pivot point 49 of the jib displaced behind the crane tower 6 the resulting dead space if cranes with adjustable jibs of conventional type between the hook and the crane tower is considerably decreased in the steeper jib positions.

FIGURE 10 shows an example of construction by which additional lateral movement of the load in the direction of the crane tower follows positively upon the upward movement of the jib, as in the case of the crane of FIGURE 7.

In this construction the fixed end of the lifting rope 45 is attached for example to the auxiliary trolley 38. The latter is moved according to the upward adjustment of the jib by the rope 39 which is attached to the rotary upper part 41 of the crane and which passes over the guide pulley 40. Upon downward adjustment, the rope 42, which passes over the rope pulley 44 on the jib point and over the guide pulleys 40 and 43 to the upper part of the crane 41, moves the auxiliary trolley in the direction of the jib point.

FIGURE 11 shows an example of construction of a building crane in which the crane tower is extended from above. The lifting rope 45 passes around the rope pulley

40 arranged on the jib 48 and the tower part 53 is suspended from the crane hook. By adjustment if the jib to the position 48' the tower part 53 is moved over the tower 6 to the position 53'. Thereupon the upper part 41 of the crane climbs up on the crane tower 6 by employment of a climbing device such as that shown in FIGURE 7 consisting of the pulley block system 17', winch 19', rope 12 and pulley 13. This process corresponds to the climbing process described with reference to FIGURE 6.

What I claim is:

1. In combination a climbing crane assembly, vertically spaced load supporting platforms, said crane assembly adapted for vertical movement through openings in the vertically spaced load supporting platforms; support means provided on said supporting platforms and adjacent the openings therein; and a block and pulley system, including cable means, interconnecting said climbing crane assembly and said support means for effecting vertical movement of said climbing crane assembly through the apertures in said load supporting platforms; said support means including a base member, a pair of spaced apart vertically extending arms, and means at the extremities of said arms for detachably securing said cable means.

2. The combination defined in claim 1 including an outer vertically extending tower structure surrounding said climbing crane and providing guiding support therefor.

References Cited in the file of this patent

UNITED STATES PATENTS

3,053,398	Liebherr et al.	Sept. 11, 1962

FOREIGN PATENTS

473,789	France	Oct. 15, 1914
814,504	Great Britain	June 3, 1959
830,176	Great Britain	Mar. 9, 1960
1,007,775	France	Feb. 13, 1952
1,052,372	France	Sept. 23, 1953
1,062,850	France	Dec. 9, 1953
1,064,223	Germany	Aug. 27, 1959
1,076,799	France	Apr. 21, 1954
1,110,707	France	Oct. 19, 1955
1,113,697	France	Dec. 5, 1955
1,203,098	France	July 27, 1959