March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 1 of 7

Fig.: 1

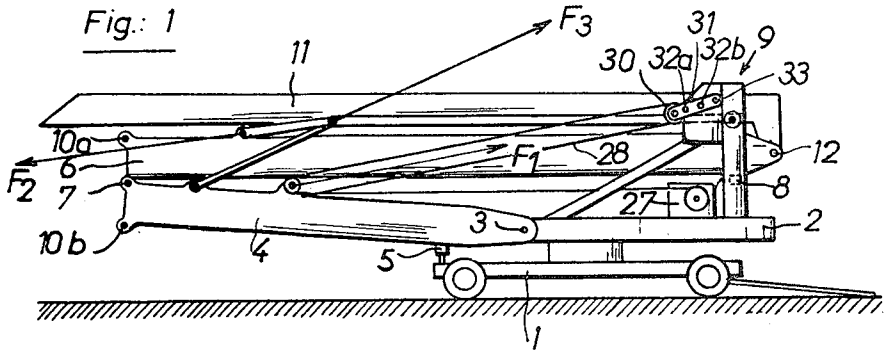
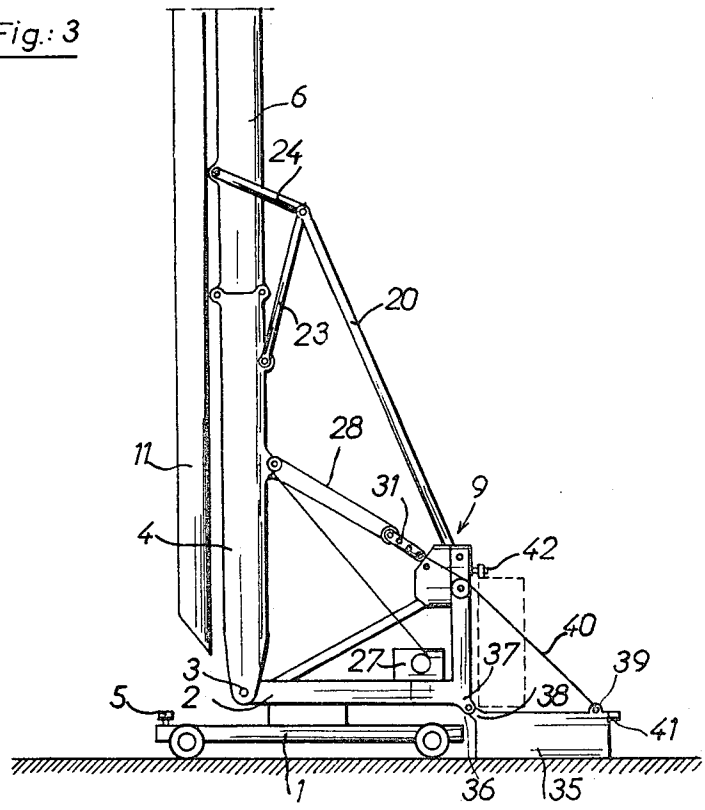


Fig.: 3



INVENTOR

Pierre Durand

BY

Watson, Cole, Grindle & Watson

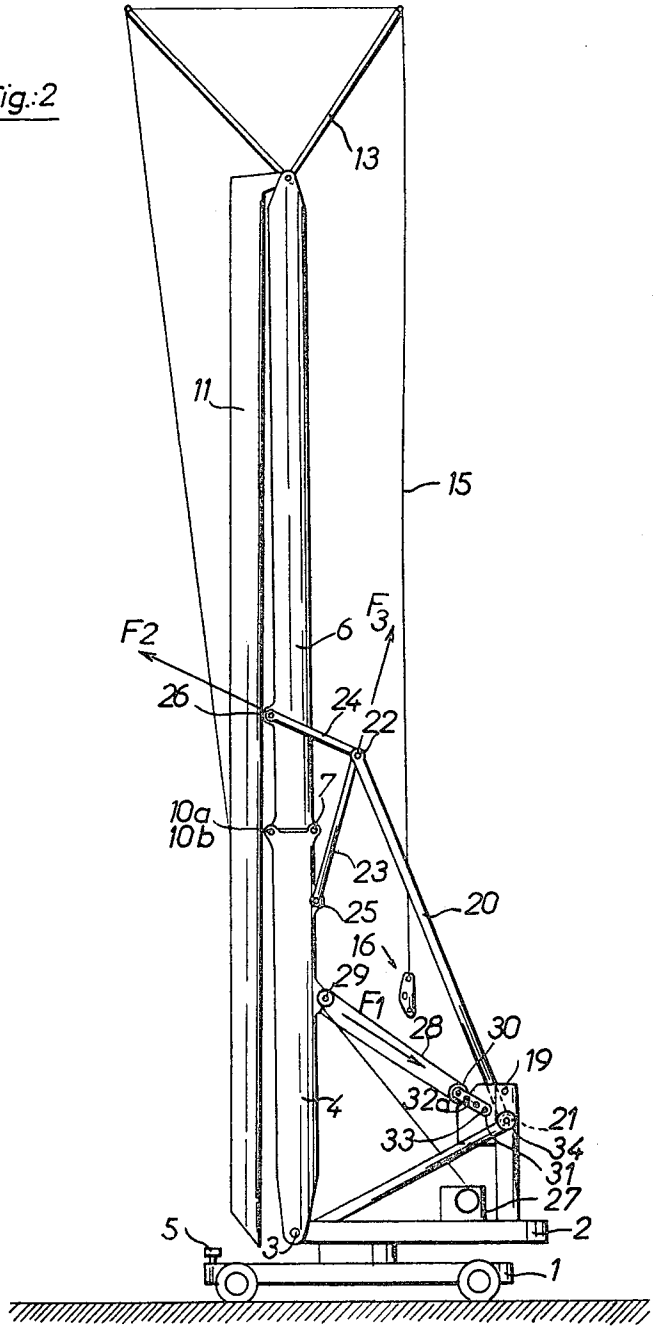
ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 2 of 7

Fig.:2



INVENTOR
Pierre Durand

BY
Watson, Cole, Grindle & Watson

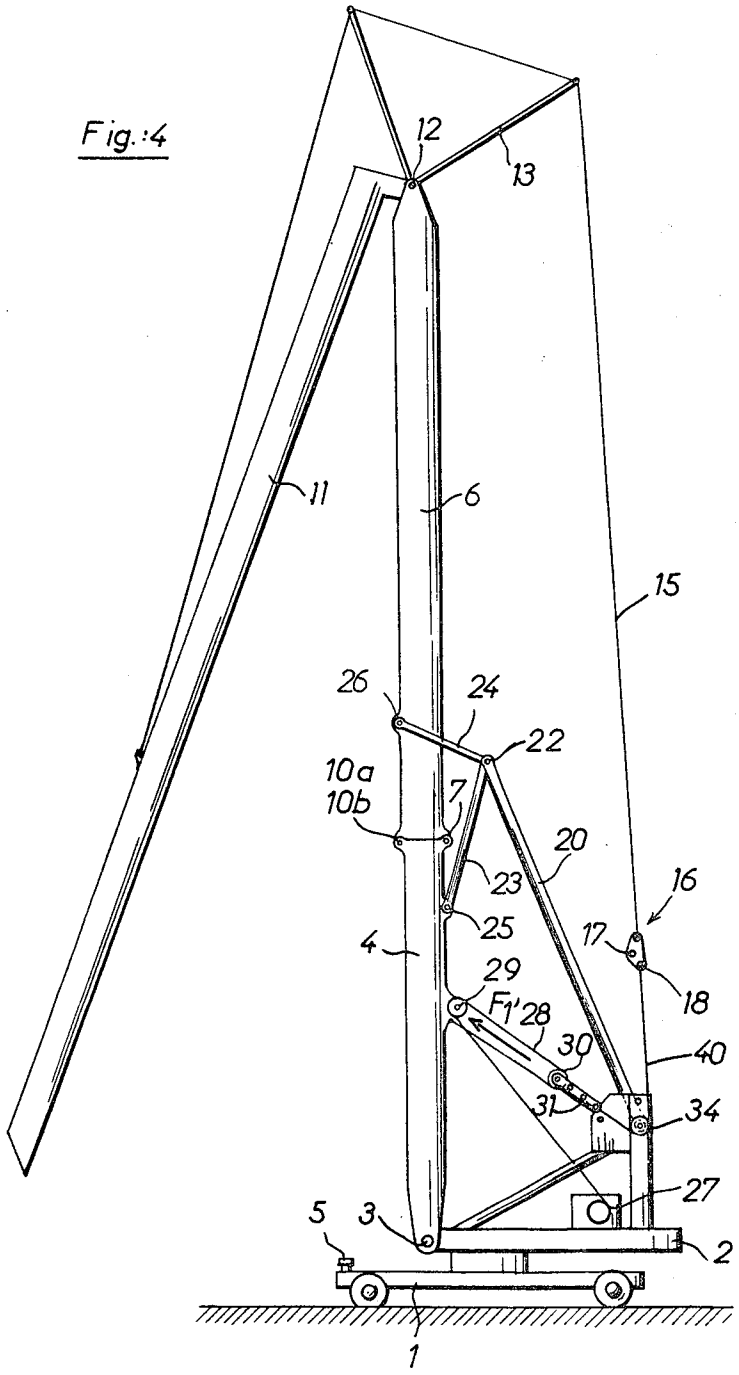
ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 3 of 7

Fig. 4



INVENTOR

Pierre Durand

BY

Watson, Cole, Grindle + Watson

ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 4 of 7

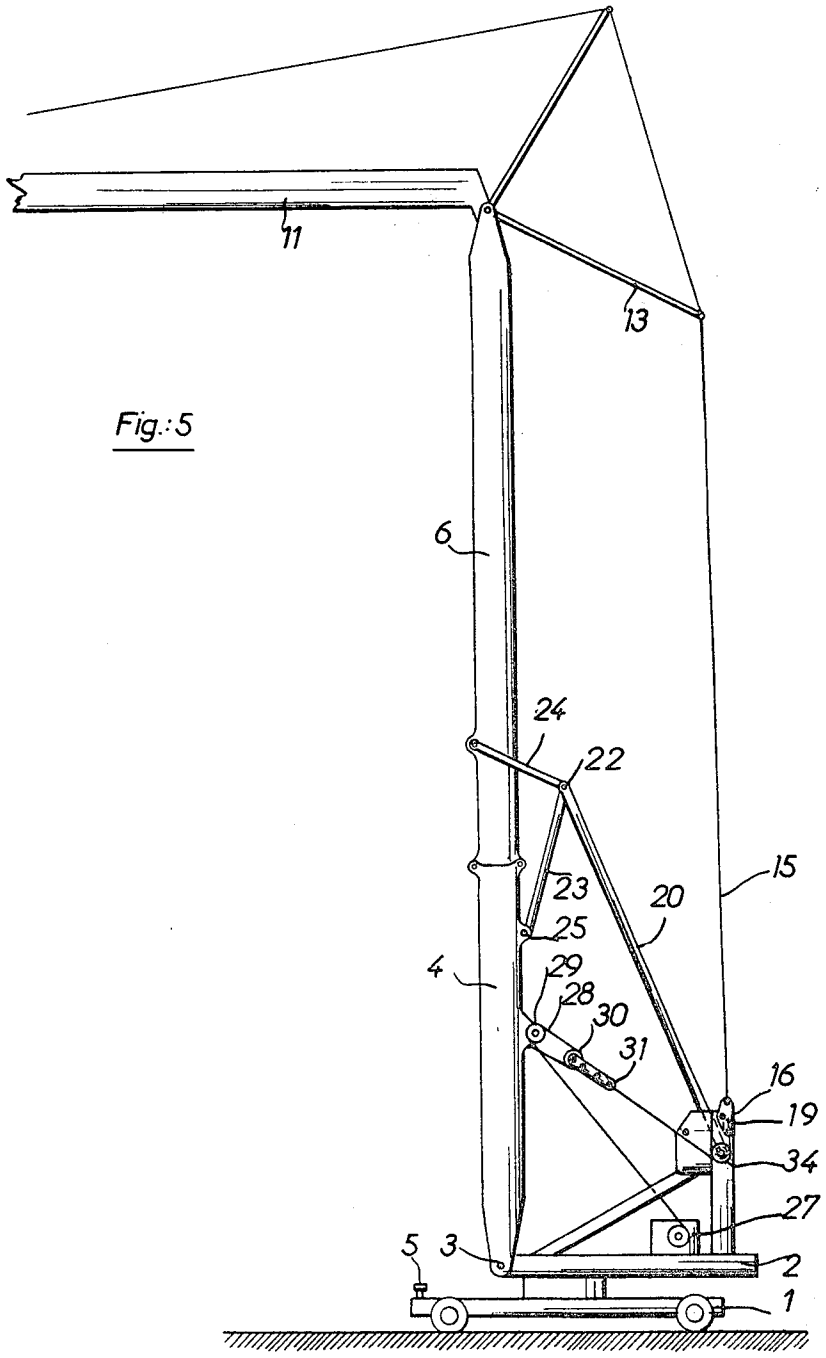


Fig. 5

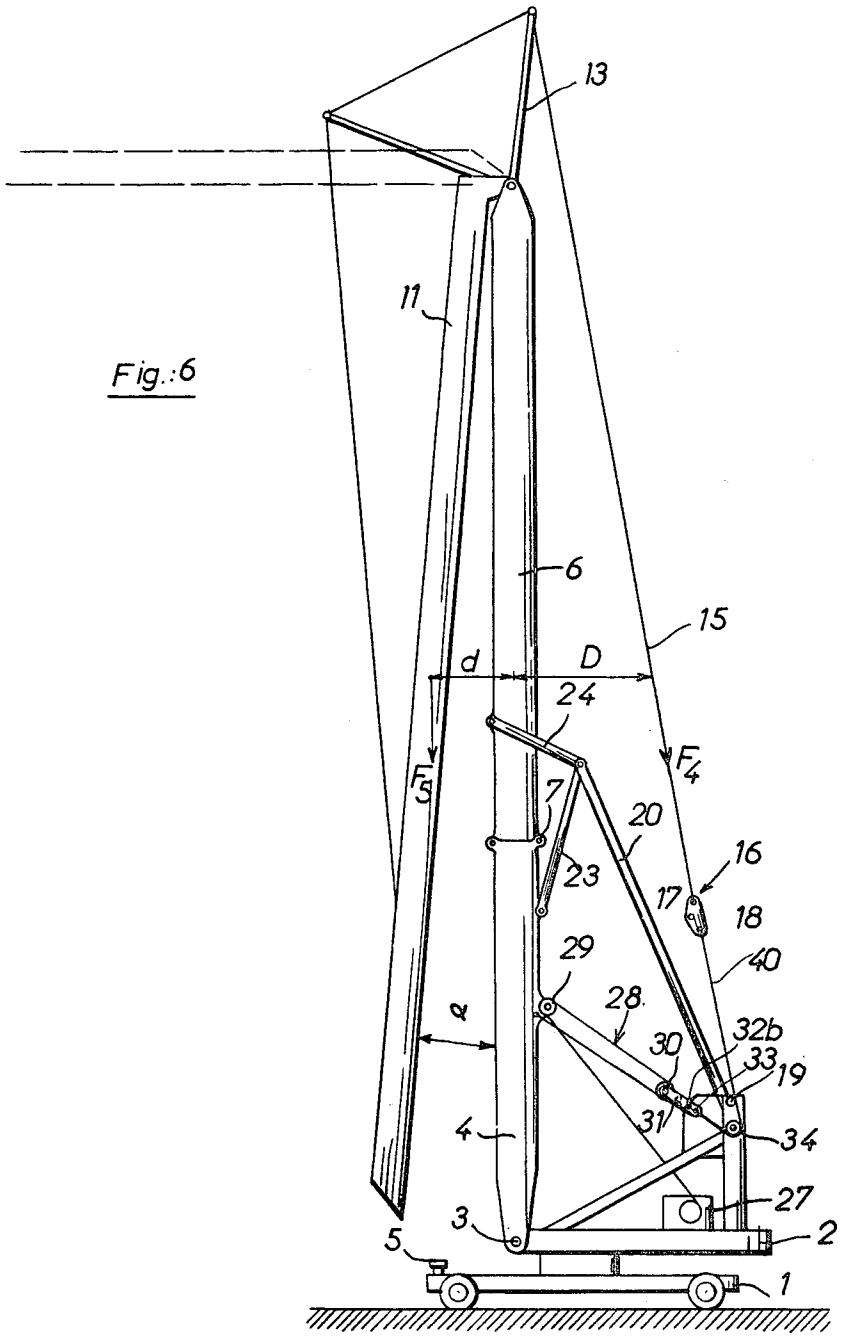
INVENTOR
Pierre Durand
BY
Watson, Cole, Grindle + Watson
ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 5 of 7

Fig. 6



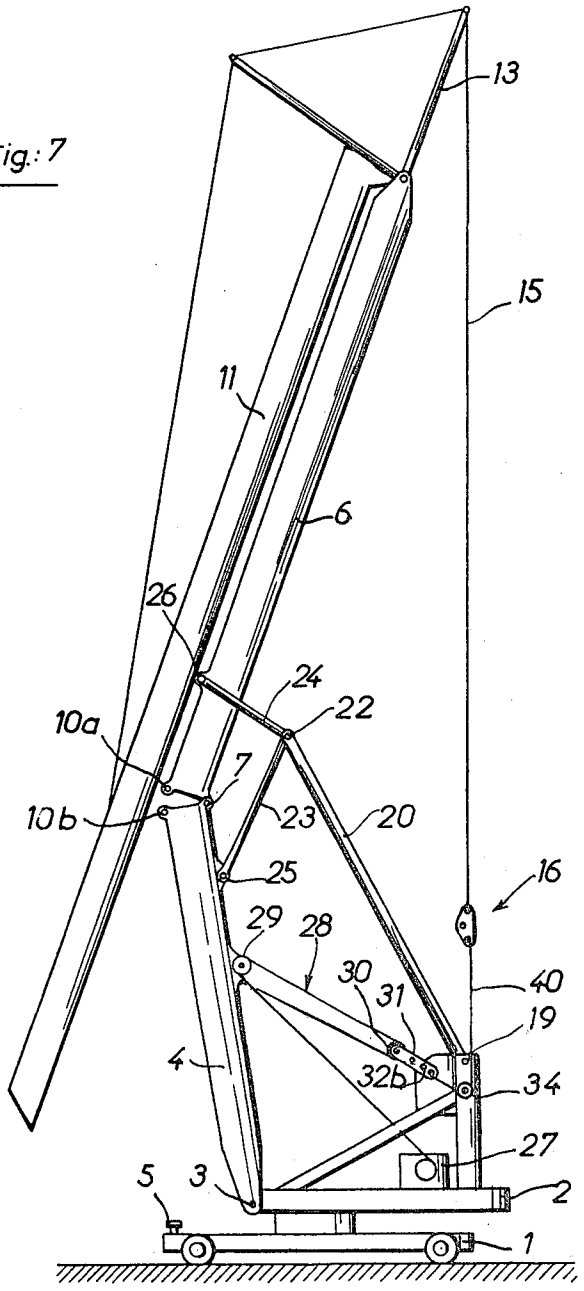
INVENTOR
Pierre Durand
BY
Watson, Cole, Grindle & Watson
ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 6 of 7

Fig. 7



INVENTOR
Pierre Durand
BY
Watson, Cole, Grindle + Watson
ATTORNEYS

March 18, 1969 P. DURAND 3,433,368

COLLAPSIBLE CRANE

Filed Dec. 26, 1967 Sheet 7 of 7

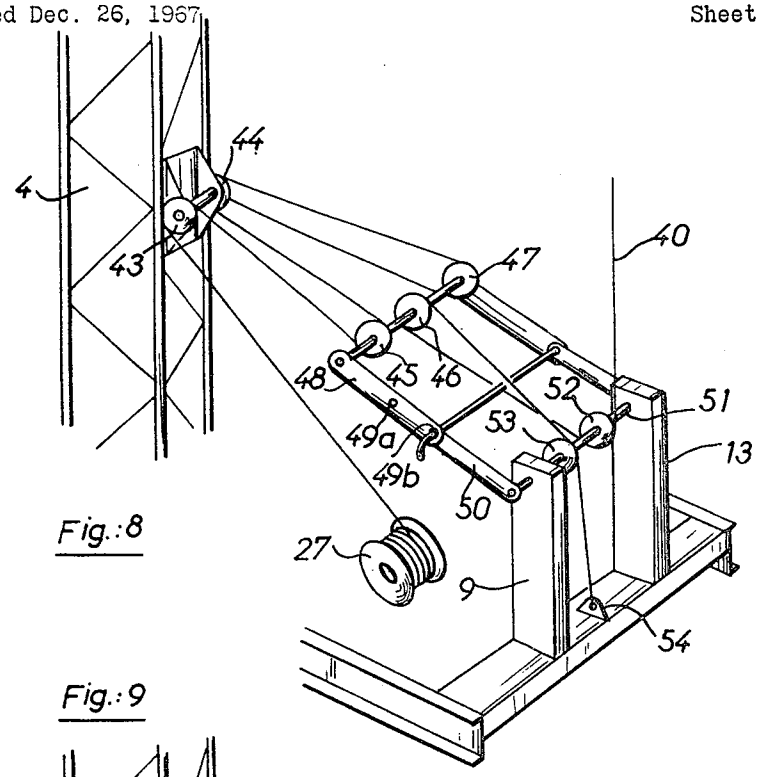
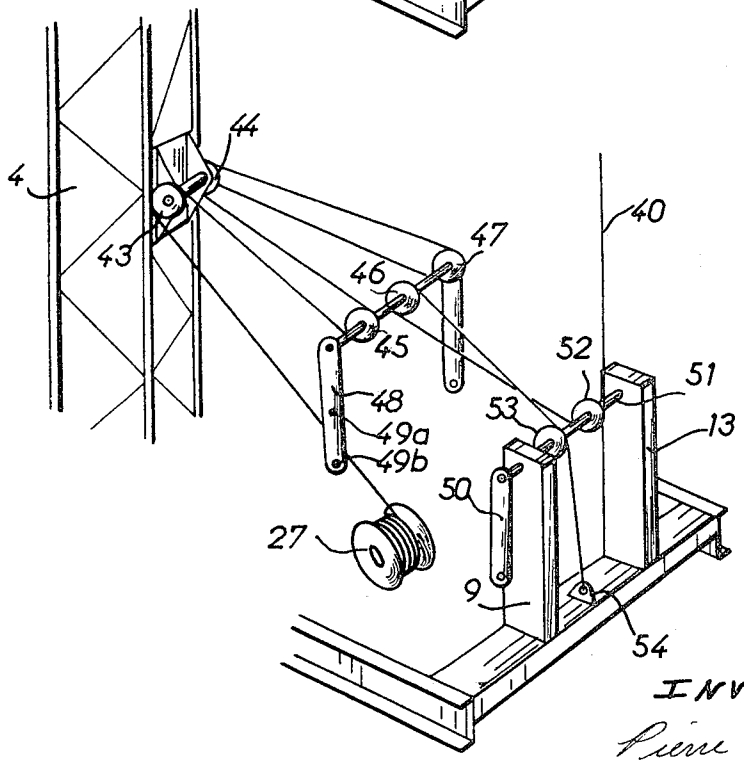


Fig.:8

Fig.:9



INVENTOR
Pierre Durand

BY
Watson, Cole, Grindle + Watson

ATTORNEYS

United States Patent Office 3,433,368
Patented Mar. 18, 1969

3,433,368

COLLAPSIBLE CRANE

Pierre Durand, Lyon, France, assignor to RICHIER, Paris, France, a company of France

Filed Dec. 26, 1967, Ser. No. 693,286
Claims priority, application France, Dec. 23, 1966, 88,737
U.S. Cl. 212—46 6 Claims
Int. Cl. B66b 23/68

ABSTRACT OF THE DISCLOSURE

A collapsible crane including superposed pivotally interconnected tower sections and a jib wherein the raising of the tower sections into vertical alignment is ensured by a winch acting on a tackle block inserted between the lower tower section and the frame to which the latter is pivotally secured. Said tackle block can be disconnected with reference to the frame and be connected with an auxiliary cable removably connected with the cable controlling the raising of the jib into a horizontal position and a collapse of the crane structure. The winch may thus control last-mentioned operations without unduly stressing the tower girders.

My invention has for its object an improved collapsible crane and more particularly a collapsible crane incorporating a pulley block which allows executing in succession the spreading out of the crane tower and the raising of the jib.

Cranes for the building industry are already known, which include tower sections and a jib which are pivotally interconnected, said crane being adapted to be brought from one position for which the crane is in its collapsed condition into an operative position for which the tower sections and jib are in their spread out condition. The French Patents 1,347,727 and 1,474,803 and also the German model of utility 1,825,633 describe such cranes. The spreading out starting from the first-mentioned or transportation position is generally performed by means of a tackle block which raises the tower sections while the jib is released with reference to the uppermost tower section and is brought into its horizontal operative position during the last stage of the crane-raising operation by the reaction of a cable of an unvarying length, one end of which is attached to the frame carrying the crane or to a superstructure rigid with said frame, while the other end of the cable is secured to a post or arm adapted to raise the jib. It has been found that during said last-mentioned stage, very large stresses may arise in the girders of the tower, chiefly in the case of a crane having a large hoisting capacity.

In order to cut out said drawback, and with a view to consequently reducing the weight of the framework of the crane, I provide a crane of the type considered, wherein the spreading out of the crane is performed in two successive stages, to wit: the raising of the tower sections and the setting of the jib in its horizontal position and, according to my invention, said crane carries a tackle block producing the desired erection of the crane; a number of pulleys of which serve as stationary or movable pulleys as required.

According to a particular feature of my invention, said tackle block may also serve, if desired, for the laying of ballast on the crane frame.

According to another advantageous feature of my invention, the pulley block can serve also if required, for furthering the folding up of the tower sections.

I will now proceed to describe, by way of example and in a non-limiting sense, a preferred embodiment of my

invention as illustrated in the accompanying drawings, whereby a proper understanding of my invention and of its various features may be obtained. In said drawings:

FIG. 1 is a diagrammatic elevational view of my improved crane in its collapsed condition ready for transportation.

FIG. 2 is a diagrammatic elevational view of the same crane whereof the tower sections have been set into their operative positions.

FIG. 3 is a diagrammatic elevational view of said crane showing how the pulley block of the crane can serve for laying a ballasting block on the crane frame.

FIG. 4 is a diagrammatic elevational view of said crane during the jib-raising operation.

FIG. 5 is a diagrammatic elevational view of the same crane in its final operative position.

FIG. 6 is a further diagrammatic elevational view of the crane during the jib-folding back operation.

FIG. 7 is a diagrammatic elevational view of the crane during the collapsing of the tower sections.

FIGS. 8 and 9 are diagrammatic perspective views of two different positions of a modification of the tackle block.

Turning to FIGS. 1 to 7, which illustrate my improved crane at different stages of its erection and of its collapsing, said crane includes a movable frame **1** carrying a rotary platfrom **2** on which the lower tower section **4** is adapted to revolve round a horizontal pivot **3**, said lower section **4** rests on the frame **1** through an abutment **5** when the crane is in its inoperative collapsed condition, as illustrated in FIG. 1. The upper section **6** of the tower is secured to the lower section **4** through the upper part of the latter as provided by a pivot **7** acting as a hinge, said upper section bearing, for the inoperative transportation condition of the crane on an abutment **8** rigid with the superstructure **9** carried by the platform **2**. The upper end of the tower section **4** and the lower end of the tower section **6** are provided with automatic locking means illustrated diagrammatically at **10***a* and **10***b*, wherethrough the sections **4** and **6** are constrained to remain in vertical alignment as soon as the erection of the tower has been executed. The crane jib **11** is pivotally secured at its inner end **12** to the upper end of the tower section **6** and is provided near said inner end with a jib-raising post or arm **13** which may be removed during the transportation of the crane and to which is secured a cable **15** of an unvarying length (FIG. 2), the other end of said cable **15** being secured to a fitting **17**. Said fitting **16** is provided with holes **17** and **18** (FIG. 3) which allow securing it selectively to a pivot **19** provided on the superstructure **9** and to an auxiliary cable **40** the part played by which will be disclosed hereinafter.

Two connecting rods **20** are arranged to either side of the tower sections, one of which connecting rods is shown in FIGS. 2 to 7. Said connecting rods are each pivotally secured at one of their ends (FIG. 2) to a horizontal pivot **21** on the superstructure **9**, while the other ends **22** of said connecting rods are connected with the ends of the links such as **23** and **24** by means of straps for instance. These links **23** and **24** are pivotally secured respectively at their other ends to the lower tower section **4** at **25** and to the upper section **5** at **26**. The lengths of the links **23** and **24** are different and their pivotal connections with the tower sections are defined by the kinematic conditions governing the tower raising and collapsing mechanism of the crane. The crane is also provided with a raising winch **27** actuating a tackle block **28** including pulleys **29** secured to the lower tower section **4** at a predetermined distance from the pivotal axis **3** and pulleys **30** carried by a fitting **31** secured removably to the superstructure **9** by means of a pivot or spindle adapted to be inserted in one of the holes **32***a* and

32*b* provided for this purpose in said fitting **31**. The latter is also provided with attachment means **33** for the auxiliary cable **40**, the part played by which will appear hereinafter as mentioned. Lastly, the superstructure **9** carries a guiding pulley **34** adapted to be engaged by said auxiliary cable.

The raising and folding of such a crane are performed as follows:

The crane being originally in its operative transportation condition illustrated in FIG. 1, that is with the fitting **31** secured to the superstructure **9** through the hole **32***a*, the operation of the winch **27** produces, through the agency of the tackle block **28** a tractional stress F1 and consequently a rocking of the lower tower section **4** round its carrier pivot **3**. The upper tower section **6** secured to the section **4** as provided by the hinge or pivot **7** is urged upwardly together with the jib **11** carried by it, while it simultaneously assumes an angular movement round the hinge **7** under the bracing action of the reaction forces F2 and F3 exerted by the connecting rod **20** and links **23** and **24**. The force F2 urges in fact the section **6** and the jib **11** into a rocking motion round the pivot **7**, while the force F3 the direction of which is at an angle with that of F2 urges into a vertical position the system constituted by the sections **4** and **6** and by the jib **11**.

FIG. 2 illustrates the crane in its intermediate position at the end of the tower-raising stage, during which the tower sections are brought into vertical alignment. When said vertical alignment has been obtained, the sections **4** and **6** are secured together by the automatic locking means **10***a* and **10***b*.

It is then of advantage to proceed with the laying on the platform **2** of a block forming a balancing ballast **35** through the means illustrated in FIG. 3. The balancing ballast **35** lying on the ground is pivotally secured to the platform **2** by means of horizontal spindles **36** extending through suitable fittings **37** and **38** which are welded respectively to the platform **2** and to the ballasting block **35**. A further fitting **39** provided on the ballasting block is then connected with the fitting **31** of the tackle block through the agency of the auxiliary cable **40** after the latter has been fed round the guiding pulleys **34**, care being taken to maintain said cable **40** in a tensioned condition. This being done, the fitting **31** is disconnected with reference to the superstructure **9**, as provided by removing the spindle engaging the hole **32***a*. The winch **27** is then actuated again so as to produce through the agency of the pulley block **28** a pivotal movement of the ballasting block **35** round the pivot constituted by the spindles **36**. When the ballasting block reaches the position illustrated in interrupted lines in FIG. 3, a securing lug **41** rigid with the ballasting block engages a stud **42** rigid with the superstructure **9**. It is then sufficient to lock the parts **41** and **42** together so that the ballasting block may be securely held on the platform **2** and on the superstructure **9** carried by the latter. Of course, the positioning of the ballasting block may be performed in any other suitable manner different from that described, which should be merely considered as an advantageous possible manner of proceeding. It is thus possible to position the ballasting block by means of a removable pivotal hoisting device such as a davit secured to the rear of the crane frame. For sake of clarity, the ballasting block has been omitted in FIGS. 4 to 7. The tower sections being now erected and the ballasting block positioned, it is possible to proceed with the raising of the job. To this end, the tackle block is loosened and a connection is provided between the fittings **31** and **16** through the auxiliary cable **40** which is caused to engage the guiding pulley **34**. This being done, the winch **27** and tackle block **28** are actuated so as to tension the cables **40** and **15** which are thus interconnected and to thereby raise the jib **11** as provided by the torque produced by the force F1 (FIG. 4) and the lever arm constituted by the post **13**. When the jib has reached its horizontal position, it is held fast in said position by securing the fitting **16** to the superstructure **9** by means of the pin or pivot **19**. The crane has thus assumed its operative position (FIG. 5).

When it is desired to return the crane into its collapsed position, it is first necessary to lower the jib **11** and to this end it is sufficient to disconnect the fitting **16** with reference to the superstructure and to loosen the tackle block **28** by releasing the winch **27** so that the cable **16** allows the jib **11** to drop until it forms an angle α of a few degrees with the alined tower sections; it is then possible to secure the tackle block fitting **31** to the superstructure **9** by inserting through the hole **32***b* of the fitting a pin or spindle to engage the part **9** (FIG. 6). As a matter of fact, it is necessary to produce for opening the hinge **7** with a view to folding the tower sections a torque F4D with reference to said hinge, which is larger than the torque F5*d* holding the tower sections in alignment. The excess value of the opening torque over the torque F5*d* is obtained by reason of the obliquity of the cable **15** and of its tensioning by the jib **11** forming an angle α with the tower axis. It is now sufficient to release the locking means **10***a* and **10***b* and to slightly slacken the tackle block so that the two sections of the tower are allowed to slightly rock round the hinge **7** in opposite directions, the lower section being no longer held in position by the tackle block **28** and this rocking movement continues until the tackle block has been thereby tensioned again (FIG. 7). A further gradual release of the tensioning of the tackle block ensures thereafter the complete collapse of the crane. During the collapsing movement, it should be remarked that the jib **11** engages gradually a position of rest over the upper tower section **6**.

FIGS. 8 and 9 illustrate a modification of the tackle block which modification may be incorporated with my improved crane whenever a large speed reduction is required. This modification distinguishes from the precedingly disclosed tackle block through the fact that the auxiliary cable **40**, instead of being secured to the fitting carrying the pulleys which are selectively stationary and movable, engages in succession a first pulley rigid with the superstructure carried by the crane frame, then over a pulley carried by the spindle carrying selectively stationary and movable pulleys and over a second pulley rigid with the superstructure, and is anchored to the crane frame. Thus, the modification includes the winch **27**, two stationary pulleys **43** and **44** secured to the lower crane section, pulleys **45**, **46**, **47** carried by a fitting **48** removably secured to another fitting **50** by means of a pin or spindle inserted through one of the holes **49***a* or **49***b* provided for this purpose in the fitting **48**. The fitting **50**, on the other hand, is pivotally secured to the superstructure **9** by means of a spindle **51** carrying two further pulleys **52** and **53**. The winch-controlled cable passes in succession over the pulley **43**, the pulley **45**, the pulley **44** and the pulley **47** before its anchoring in the tower section **4**.

As to the auxiliary cable **40**, in passes in succession over the pulleys **52**, **46** and **53** and is secured at **54** to the crane frame.

FIG. 8 illustrates last-mentioned tackle block with the pulleys **45**, **46** and **47** operating as stationary pulleys while FIG. 9 illustrates the same pulley block with the pulleys **45**, **46** and **47** operating as movable pulleys. The passage of one condition to the other is obtained merely by removing the pin or spindle inserted through the holes **49***a* or **49***b*. The operation of this modification is exactly the same as that disclosed with reference to FIGS. 1 to 7, as concerns the erection and collapsing of the crane structure.

Obviously, the above description is given solely by way of example and many modifications may be brought

thereto by resorting to technically equivalent means, without widening the scope of the invention as defined by the accompanying claims.

I claim:

1. In a collapsible crane including a carrier frame, a lower tower section pivotally secured to said carrier frame, an upper tower section pivotally secured through its lower end to the upper end of the lower tower section and a jib pivotally secured to the upper end of the upper tower section, the provision of a control system comprising a winch, a tackle block including first pulley means carried by said lower tower section, second pulley means carried by fitting means, a main cable controlled by the winch and engaging said first and second pulley means, an auxiliary cable controlling the movements of an arm rigid with the jib, and means for securing selectively said fitting means to a member rigid with the carrier frame to ensure, upon operation of the winch, the shifting of the tower sections from a collapsed position into a vertically alined position, and to the auxiliary cable to ensure the shifting of the jib between its collapsed and raised positions.

2. A control system as claimed in claim 1, wherein said fitting means can be secured in two different positions to the member rigid with the carrier frame.

3. A control system as claimed in claim 1, wherein said auxiliary cable comprises means for securing it to a member rigid with the carrier frame.

4. A control system as claimed in claim 1, comprising furthermore a ballasting means pivotally securable to the frame and adapted to be raised onto the later off a lower position, upon operation of the winch, said ballasting means being able to be connected to said fitting means through connecting means.

5. A control system as claimed in claim 1, comprising furthermore a guiding pulley carried by a member rigid with the frame, said auxiliary cable engaging said pulley and being secured to the fitting means before collapsing the tower sections whereby the tension of said auxiliary cable promotes the pivoting of the tower sections, one with respect to the other, upon slackening of the main cable.

6. A control system as claimed in claim 1, wherein said fitting means can be secured in two different positions to second fitting means pivotally mounted around an axis which is fixed on the frame and carries third pulley means, said auxiliary cable being anchored to the frame and operatively engaging at least one pulley of said second pulley means and said third pulley means.

References Cited

UNITED STATES PATENTS

3,335,876	8/1967	Durand	212—46
3,378,147	4/1968	Marrie	212—46

EDWARD A. SROKA, *Primary Examiner.*

U.S. Cl. X.R.

212—144, 49