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Noly

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[54] **CRANE WITH ROCKING MAST AND TELESCOPIC JIB**

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[73] Assignee: **Potain,** Chevilly Laru (Val de Marnen), France

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[30] **Foreign Application Priority Data**

Apr. 28, 1972 France 72.16905

[52] **U.S. Cl.** ..... **212/46 A,** 212/55, 212/144

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

[58] **Field of Search** 212/46, 55, 59, 144, 31, 212/35; 52/121, 118, 115

[56] **References Cited**

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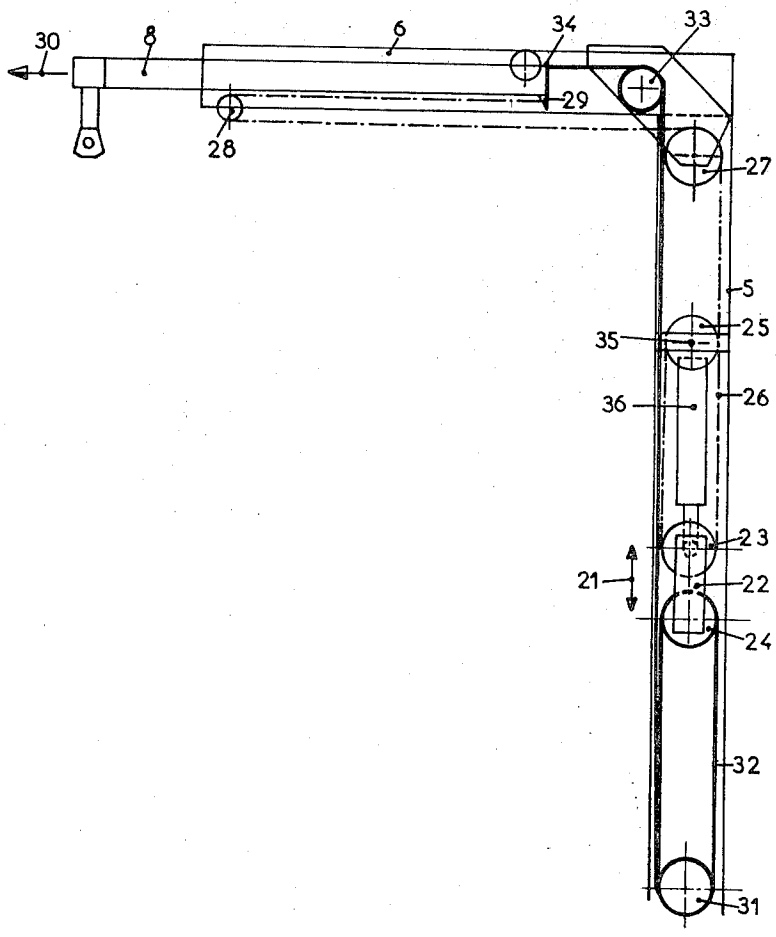
Assistant Examiner—James L. Rowland
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

A collapsible crane comprised of a mast and jib is provided with a jack for raising and lowering the mast. The jib is comprised of a jib head telescopically received in a jib foot pivoted to the mast and the jib foot is automatically extended relative to the mast by a jib tie as the mast is raised. First and second cables are attached to the jib head for extending and retracting the jib head and operably connected to a carriage which is slidably mounted within the mast. The movement of the carriage within the mast is coordinated with the raising of the mast so that the free end of the jib head initially moves along a substantially vertical trajectory and then along a substantially horizontal trajectory during the raising of the mast from a horizontal to a vertical position.

7 Claims, 15 Drawing Figures



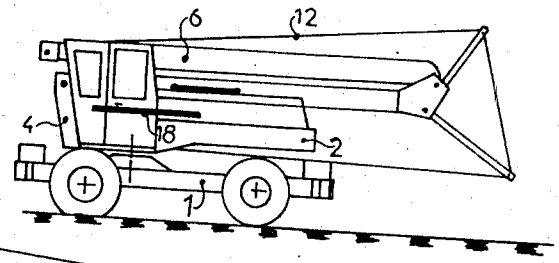


Fig. 1

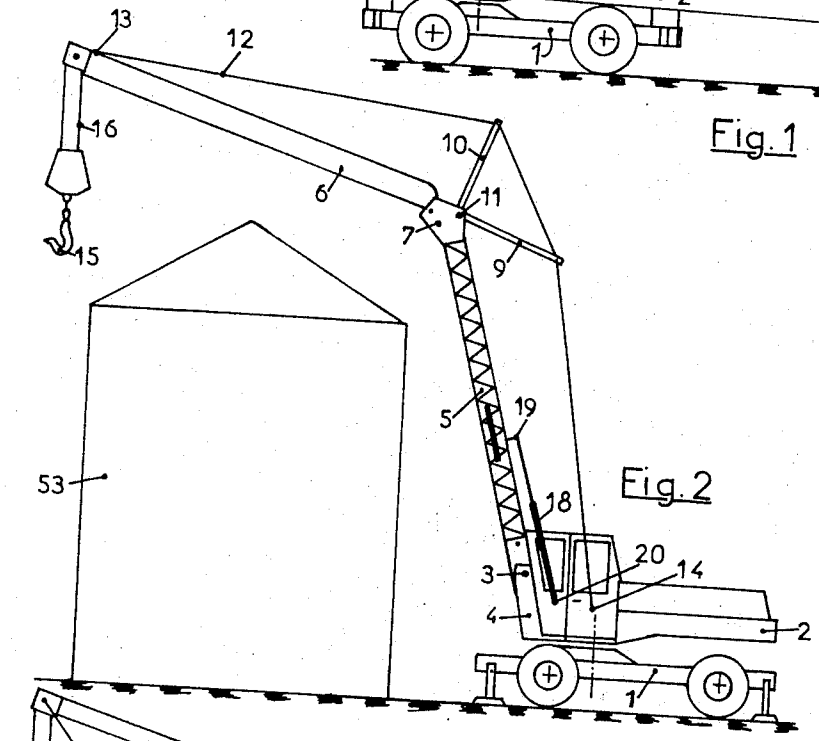


Fig. 2

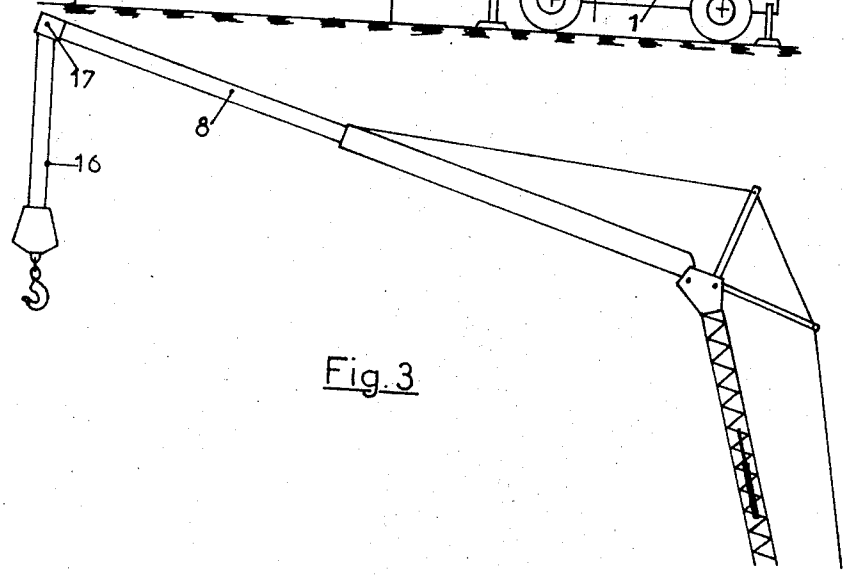


Fig. 3

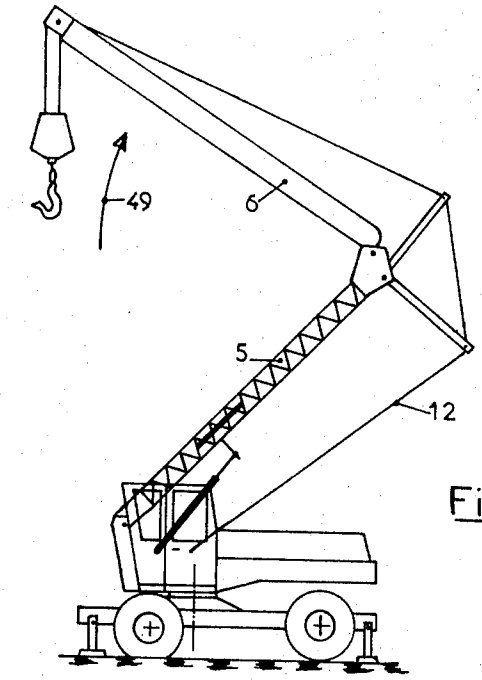


Fig.4

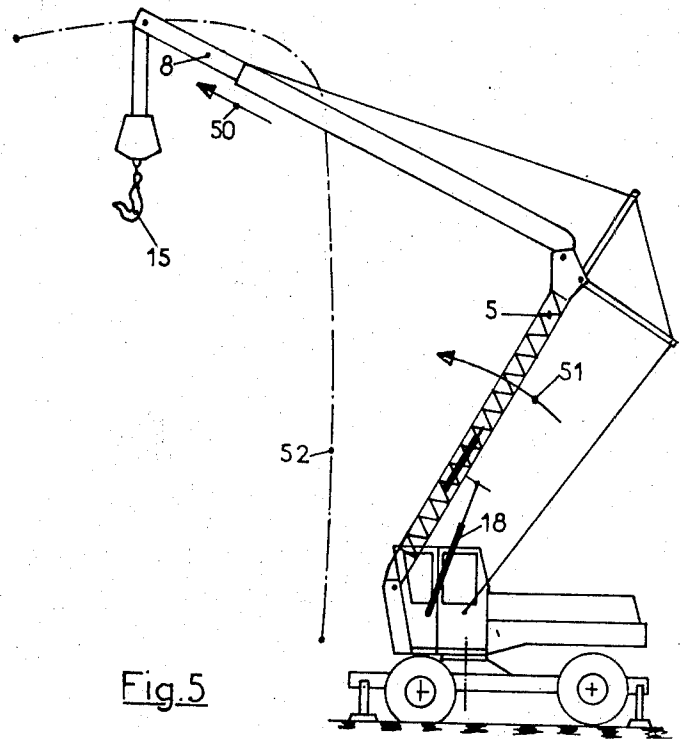


Fig.5

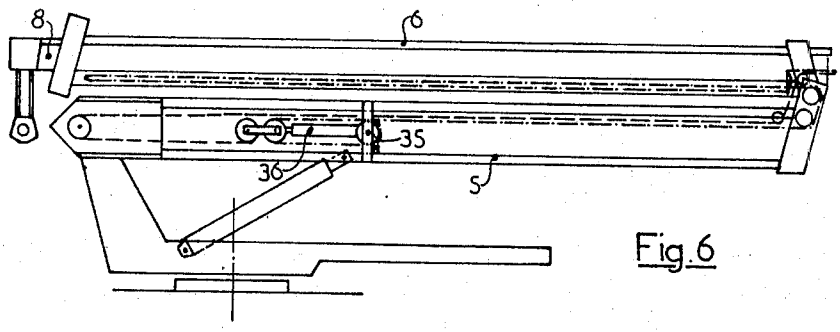
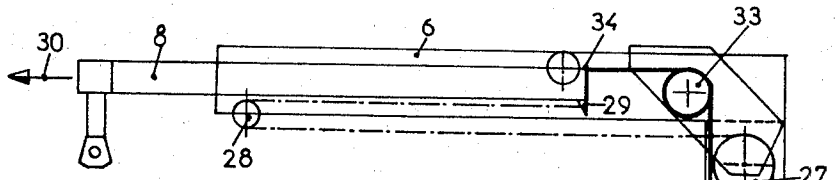


Fig.6



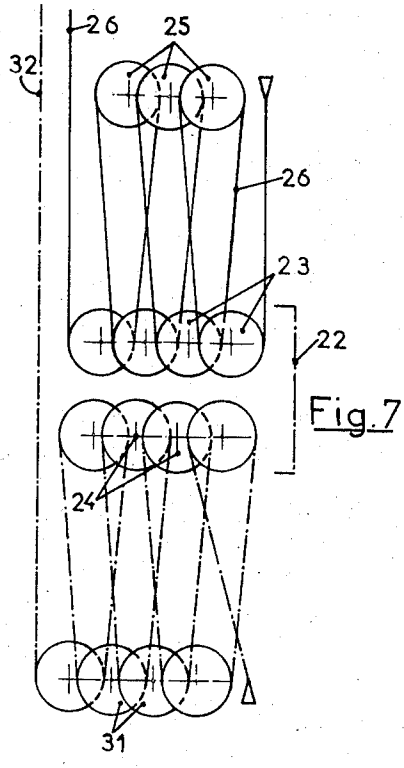


Fig.7

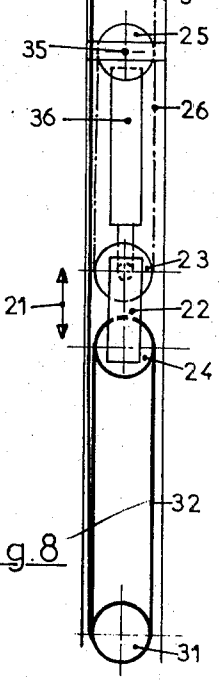


Fig.8

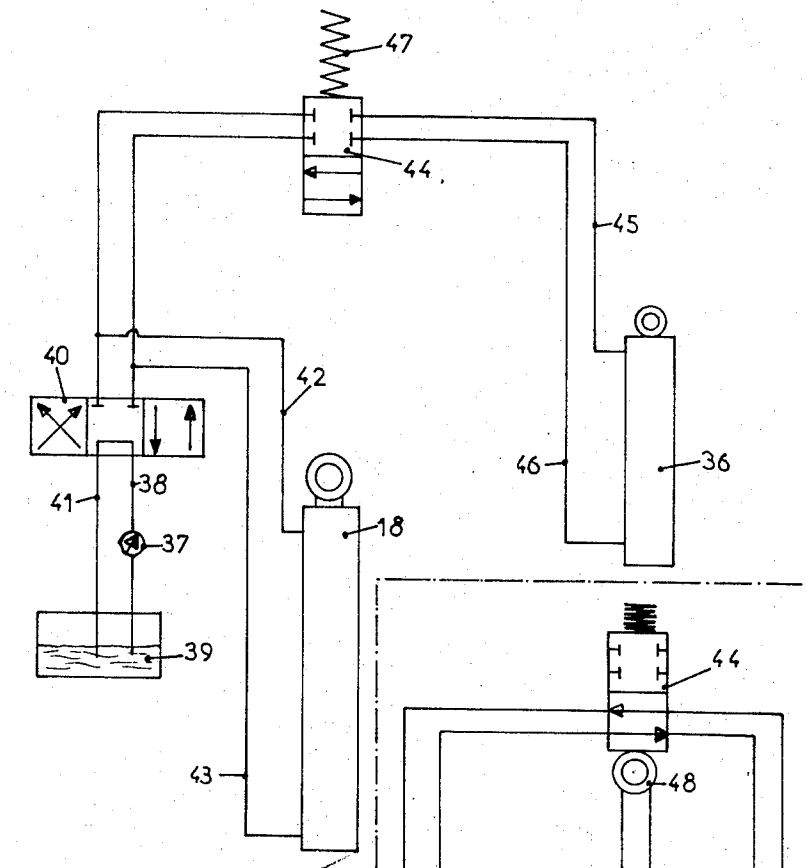


Fig. 9

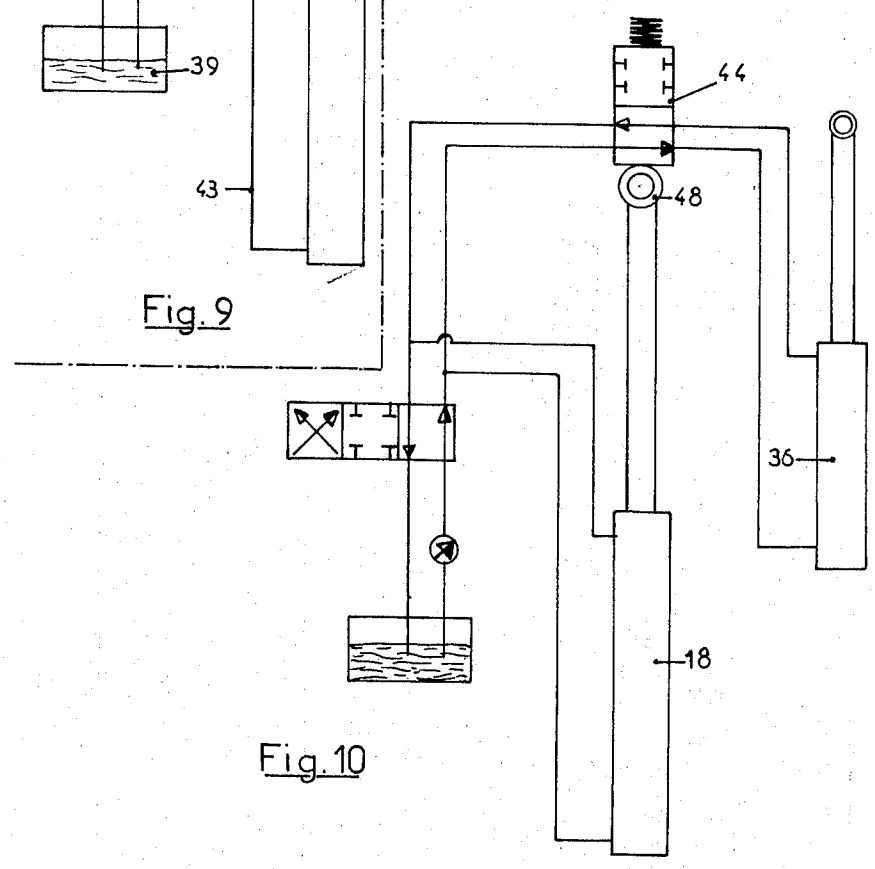


Fig. 10

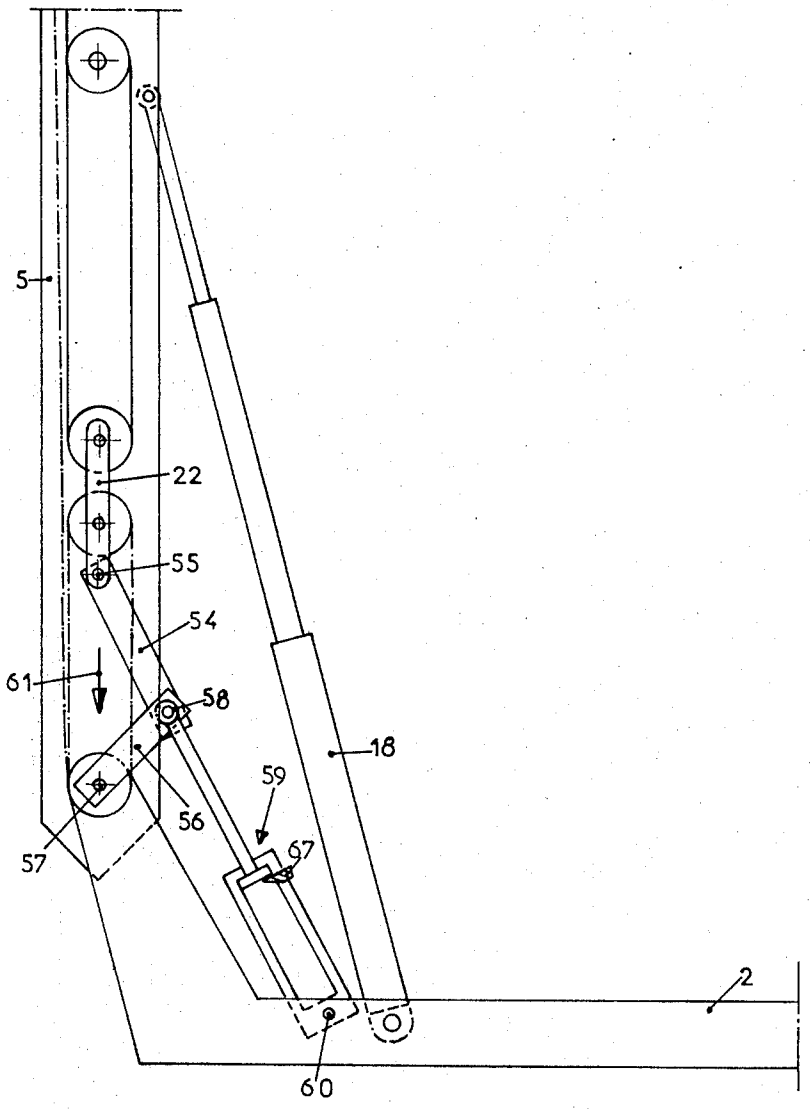


Fig. 11

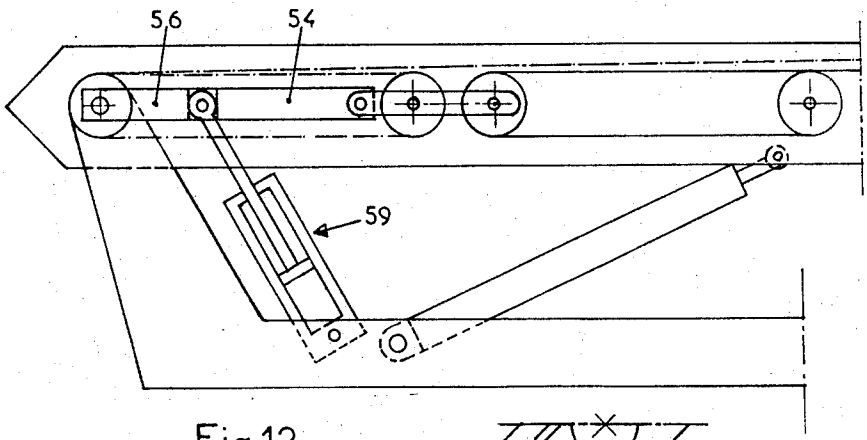


Fig.12

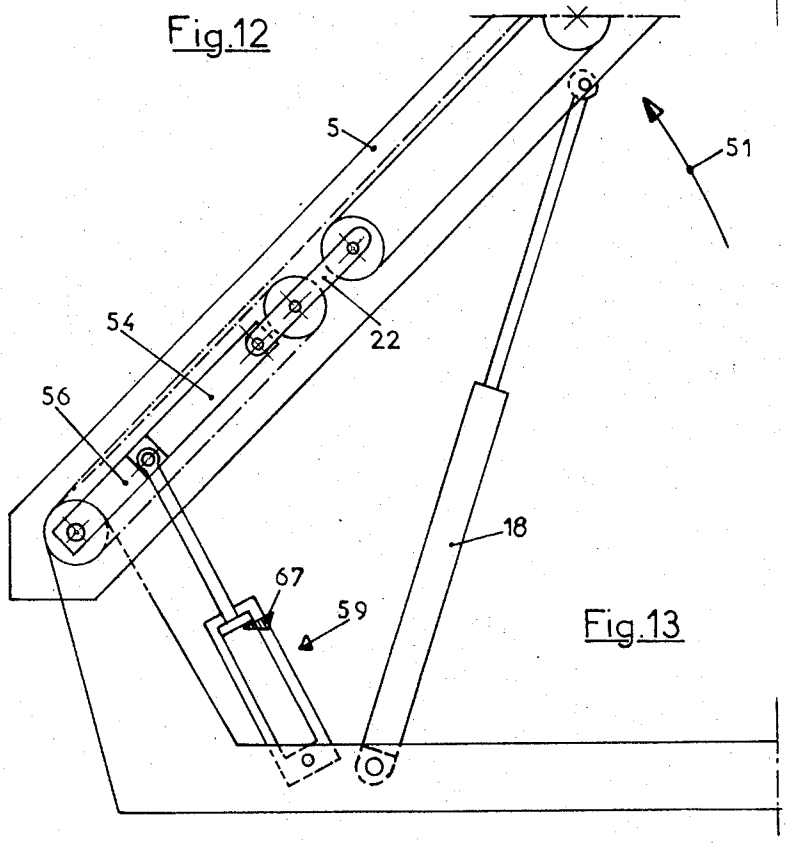


Fig.13

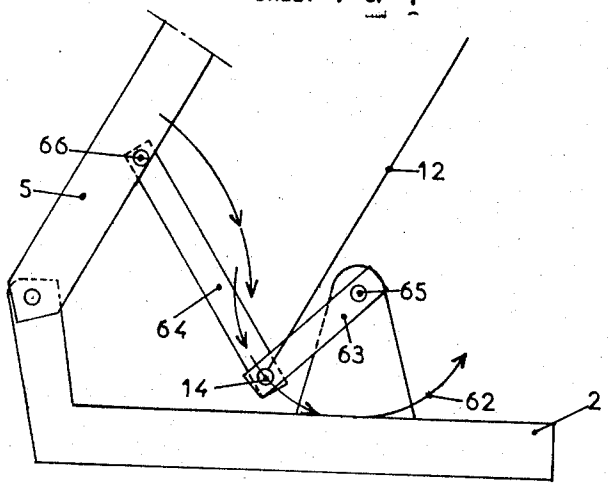


Fig. 14

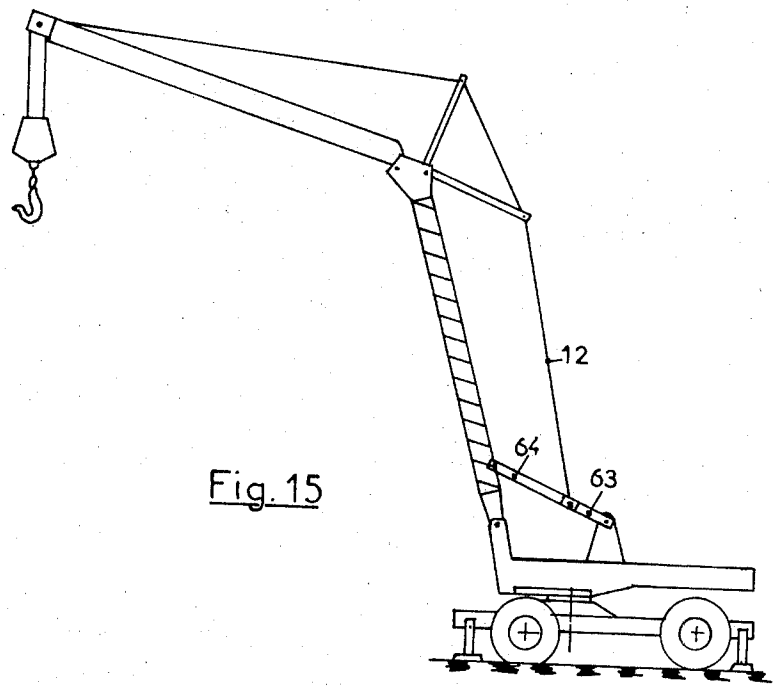


Fig. 15

CRANE WITH ROCKING MAST AND TELESCOPIC JIB

The present invention relates to cranes of the type having both a rocking mast and a telescopic jib. It relates more particularly, although not exclusively, to a self-propelling movable crane.

With a crane of the above type, it is known that, by acting simultaneously upon the rocking mast and the telescopic jib, it is possible to make the jib end describe a trajectory which enables said end to skirt obstacles or the like. When it is desired to use such a crane for building a house or a cottage, it is advantageous that said trajectory should follow the contour of the building, that is, the jib head should be able to describe a substantially vertical trajectory along the frontage, and then a substantially horizontal trajectory over the obstacle.

The object of the invention is to achieve this result by simple means, which ensure an automatic operation.

A crane according to the invention includes a base onto which the foot of a rocking mast is linked, the top of said mast receiving the linking arrangement for a jib foot within which a telescopic jib head is adapted to slide, while a tie connects the end of the jib foot to the base of the crane, said crane being characterized in that one end of a jib extending cable is located between the jib foot and the jib head to enable said jib head to extend, the other end of said cable being wound inside the mast between a first set of fixed pulleys and a first set of movable pulleys, while one end of the jib retracting cable is attached to the jib head, and the other end is wound between a second set of fixed pulleys and a second set of movable pulleys, the two sets of movable pulleys being carried by a single carriage adapted to slide within the mast, and actuated by means synchronized with the control means for the raising of the rocking mast.

According to a further feature of the invention, the control means for the carriage include a double-acting hydraulic jack mounted in the same hydraulic circuit as a mast raising jack linked between the mast and the base of the crane.

According to a modified embodiment, the control means for the carriage include two connecting rods linked to each other to form a knuckle joint, one of said rods being, besides, linked to the sliding carriage while the other one is linked within the mast, while the joint of the two connecting rods is linked to an arm connected to the platform. Said arm is preferably telescopic, and provided with a stroke-end stop limiting the length of extension of said arm. Owing to this arrangement, the knuckle joint starts breaking, that is, shifting the carriage in the direction of the extension of the telescopic jib, only after the mast is raised beyond a critical angular position.

According to a further feature of the invention, means are provided, besides, for varying the inclination of the jib as the mast rocks. Said means include preferably two king-posts linked onto the top of the mast to support the jib raising cable, the rear end of said cable being not fixed directly to the platform, but attached to a point provided with means which make it describe a given trajectory automatically as the mast is raised. Preferably, said trajectory is merely an arc of a circle, the guiding means being constituted by a crank arrangement turning about a fixed point on the platform, the end of the jib raising cable being fixed to the end of said crank, while a rocker arm is linked to said crank end, on the one hand, and to the rocking mast, on the other hand.

The appended drawing, given by way of non-limiting example, will enable the features of the invention to be better understood.

FIG. 1 shows a crane according to the invention, in its folded position.

FIG. 2 shows the crane of FIG. 1 in its extended position.

FIG. 3 shows the lifting hook in a partially lowered position.

FIGS. 4 and 5 show two intermediate positions of the crane.

FIGS. 6, 7, and 8 are detailed views of the two cables for extending and retracting te telescopic jib, respectively, in a modified embodiment controlled by a telescopic jack.

FIG. 9 is the hydraulic diagram of the control and synchronization system for the two jacks, in its neutral position.

FIG. 10 illustrates the same diagram in the mast raising and jib extending position of the system.

FIGS. 11, 12 and 13 show another modification, wherein the jib telescoping carriage is controlled by a "broken" or folding knuckle joint.

FIGS. 14 and 15 illustrate the automatic control system for the jib raising cable.

The crane shown in FIGS. 1 to 5 includes:

a movable frame 1;

a revolving platform 2;

a rocking pin 3 horizontally disposed at the top of a stand 4 on the platform 2;

a folding back mast 5 adapted to rock around the pivot 3;

a jib foot 6 linked through a pin 7 to the top of the mast 5;

a jib head 8 adapted to slide telescopically within the jib foot 6;

two king-posts 9 and 10 linked about a common pin 11 on the top of the mast 5;

a tie 12, the front end 13 of which is fixed to the jib foot 6, while its rear end 14 is directly or indirectly fixed to the platform 2;

a lifting hook 15 suspended from the end 17 of the jib head 8 through a lifting cable 16;

a mast raising jack 18, which is a double-acting jack, one end 19 of which is linked to the side of the mast 5, and the other end 20 of which is linked to the platform 2.

A carriage 22 is adapted to slide within the mast 5 in lengthwise direction (FIG. 8, double arrow 21). This carriage includes a first set of movable pulleys 23, and a second set of movable pulleys 24.

A cable 26 is wound between the movable pulleys 23 and a set of fixed pulleys 25, and passes then round a return pulley 27 fitted to the top of the mast 5, and then round a return pulley 28 fitted to the end of the jib foot 6, before it is fixed at a point 29 at the rear of the jib head 8. Said cable 26 is used for extending the telescopic jib, that is, pulling the jib head 8 out in the direction of the arrow 30.

A cable 32 is wound between the movable pulleys 24 and a second set of fixed pulleys 31 mounted within the mast 5, and passes then round a return pulley 33 provided in the jib foot near the point where the latter is

linked to the mast **5**, the end **34** of said cable being disposed directly on the rear part of the jib head **8**. The cable **32** is used for "retracting" the head **8** of the telescopic jib into the foot **6**.

A double-acting jack **36** is mounted between the carriage **22** and a fixed point **35** on the mast **5**. Said jack is controlled in synchronism with the jack **18** provided for raising the mast. Such synchronism is ensured by the hydraulic system illustrated in FIGS. **9** and **10**.

The hydraulic circuit shown in FIG. **9** includes a pump **37** which delivers oil into a line **38** from a tank **39**. The valve spool **40** for raising the crane is connected, on the one hand, to the feed line **38** and to a return line **41**, and, on the other hand, to two lines **42** and **43** which supply the two chambers of the raising jack **18**.

According to the invention, a further valve spool **44** in parallel is connected to the lines **42** and **43**, and supplies the two chambers of the jib telescoping jack **36** through two lines **45** and **46**. On the other hand, the valve-spool **44** is returned by a spring **47** to its closed position as shown in FIG. **9**. On the contrary, when the raising jack **18** reaches the end of its extension stroke, the head **48** of said jack comes to butt against the valve-spool **44** which is thus brought to its open position as shown in FIG. **10**, whereby the line **46** is pressurized and, as a consequence, the jib telescoping jack **36** extends.

The operation is as follows:

Starting from the folded position of the crane as shown in FIG. **1**, when the raising jack **18** is first actuated, the mast **5** rises as shown in FIG. **4**, while the tie **12** stretches and raises the jib **6** in the direction of the arrow **49**. The jib head **8** remains within the jib foot.

When once the mast is inclined to a maximum, the jack **18** is at the end of its stroke, and actuates the valve-gear **44** (FIG. **10**) which opens the supply to the telescoping jack **36**. Consequently, the jack **36** extends and actuates the carriage **22**, so that the jib head **8** moves out in the direction of the arrow **50** (FIG. **5**). This arrangement enables the end of the jib head **8** to describe a trajectory **52** adapted to move the load on the hook **15** around and above an obstacle such as as house under construction **53** (FIG. **2**).

The jib is automatically telescoped by the movement of the carriage **22**. If the jack **36** extends (FIG. **8**), this lowers the carriage **22** and pulls on the cable **26**, which causes the jib head **8** to come out. At the same time, the tackle **24–31** shortens, and releases a length of the cable **32**.

On the contrary, at the time the crane is folded back, the jack **36** is retracted, whereby the carriage **22** rises again and the cable **32** is tightened, and pulls in the jib head **8**. At the same time, the tackle **23–25** shortens and releases a length of the cable **26**.

FIGS. **11**, **12** and **13** illustrate a **22** embodiment, wherein the control of the carriage **2** is ensured by a knuckle system instead of a jack **36**. This knuckle system includes:

a connecting rod **54** linked at **55** onto the carriage **22**;

a connecting rod **56** linked at **57** onto the mast **5**;

a linking pin **58** connecting the two rods **54** and **56**, while acting as a pivot pin for a telescopic arm **59** connected to the platform **2** by a linking pin **60**. Said arm **59** is provided with a stroke-end locking pawl **67**, which locks automatically in the direction of the extension of the arm (raising of the mast). On the contrary, in the direction of its shortening, the arm **59** unlocks automatically only when the mast **5** is inclined by about 45°, with the jib head **8** fully retracted.

The operation is as follows:

In the folded back position of the crane, the telescopic arm **59** is contracted (FIG. **12**), wheras the two connecting rods **54** and **56** are aligned in prolongation of each other.

During the first stage of the raising of the mast **5** under the action of the jack **18** (FIG. **13**, arrow **51**), the telescopic arm **59** extends, while the two connecting rods **54** and **56** of the knuckle remain aligned. The carriage **22** remains unmoved, and the jib head **8** remains nested within the jib foot **6**.

When the mast **5** is sufficiently raised (about by 45°), the telescopic arm **59** reaches the end of its stroke. From now on, it cannot extend any longer, and, since the mast **5** keeps rising, the knuckle **54–56** "breaks," which causes a lowering of the carriage **22** (FIG. **11**) in the direction of the arrow **61**. As a result, and as in the preceding example, the telescopic jib **6–8** extends (FIG. **5**, arrow **50**). At the end of the extension stroke of the telescopic arm **59**, the latter is locked by the pawl **67** (FIG. **11**).

To define exactly the trajectory **53** of the end of the jib head **8**, it is possible, besides, to take advantage of the law governing the inclination of the jib **6–8**. To this end, the arrangement shown in FIGS. **14** and **15** may be used, said arrangement shifting the lower anchoring point **14** of the jib raising tie **12** according to a predetermined law. With this arrangement, the anchoring point **14** moves along a path **62** in the shape of an arc of a circle. The arrangement merely includes two connecting rods **63** and **64**, which are linked to each other at the point **14**. Besides, the rod **63** pivots about a fixed point **65** on the platform **2**, while the rod **64** is linked to the mast **5** through a pin **66**.

I claim:

1. A crane comprising a base, a hollow mast pivoted on one end at said base, first control means for moving said mast between a horizontal position and a vertical position about said one end, a jib foot pivoted at one end on the opposite end of said mast, an extendable jib head telescopically disposed in said jib foot, tie means connecting the opposite end of the jib foot to the base of the crane to cause said jib foot to pivot on said mast as said mast pivots on said base, cable means connected to the end of said jib head within said jib foot for extending and retracting said jib head relative to said jib foot, carriage means slidably mounted in said hollow mast and operatively connected to said cable means to extend and retract said jib head upon movement of said carriage means within said mast, second control means for moving said carriage within said mast and means for initiating the operation of said second control means subsequent to the initiation of said first control means whereby the free end of said jib head first moves along a substantially vertical trajectory and then along a substantially horizontal trajectory, said first and second control means are comprised of double acting hydraulic jacks and a common hydraulic circuit for said jacks.

2. A crane as set forth in claim **1** further comprising means for causing the inclination of the jib to vary automatically as the mast pivots about said base.

3. A crane as set forth in claim **2** wherein said means for varying the inclination of the jib automatically in-

cludes two king-posts linked to the top of the mast to support said jib raising tie, one end of said tie being indirectly secured to said base by means enabling said one end to describe a given trajectory automatically as said mast is raised.

4. A crane as set forth in claim **3** wherein the trajectory described by the point where said tie is connected is an arc of a circle, the means to which one end of said tie is connected being constituted by a crank turnable about a fixed point on said base, said one end of said tie being fixed to the end of said crank and a rocker arm pivoted to said crank end at one end and to said mast at the other end thereof.

5. A crane comprising a base, a hollow mast pivoted on one end at said base, first control means for moving said mast between a horizontal position and a vertical position about said one end, a jib foot pivoted at one end on the opposite end of said mast, an extendable jib head telescopically disposed in said jib foot, tie means connecting the opposite end of the jib foot to the base of the crane to cause said jib foot to pivot on said mast as said mast pivots on said base, cable means connected to the end of said jib head within said jib foot for extending and retracting said jib head relative to said jib foot, carriage means slidably mounted in said hollow mast and operatively connected to said cable means to extend and retract said jib head upon movement of said carriage means within said mast, second control means for moving said carriage within said mast and means for initiating the operation of said second control means subsequent to the initiation of said first control means whereby the free end of said jib head first moves along a substantially vertical trajectory and then along a substantially horizontal trajectory, said second control means for said carriage means includes two connecting rods linked to each other to form a knuckle joint, one of said connecting rods being pivoted to the carriage means while the other is pivoted to said mast and arm means connected to said base and the joint of said two connecting rods.

6. A crane as set forth in claim **5** wherein said arm means is comprised of two telescopically disposed members and is provided with a stroke-end stop which limits the length of extension of said arm means so that the knuckle joint is broken to shift said carriage means in the direction to cause extension of said jib head only after said mast is raised beyond a limiting angular position.

7. A crane as set forth in claim **6** wherein said arm means is provided with a stroke-end pawl which locks said arm means at the end of the extension stroke of said arm means and is automatically released at the time when the mast is folded back at an angle of about **45** degrees and the jib head is fully retracted.

* * * * *