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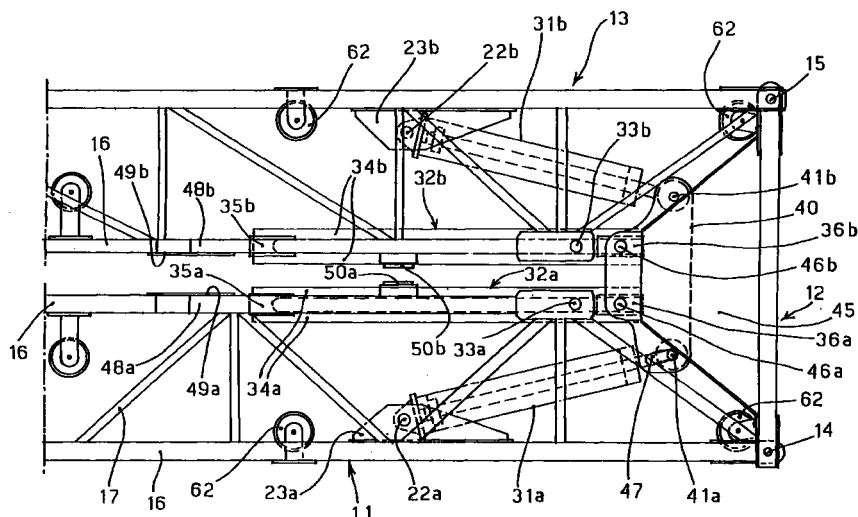
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(54) **A foldable jib of a tower crane**

(57) The present invention refers to a foldable jib for a tower crane comprising a proximal section (11) pivoted to the top of the tower, an intermediate section (12) pivoted to the proximal section (11) and a distal section (13) pivoted to the intermediate section (12); first means for operating the opening and the closing of said intermediate section (12) relative to said proximal section (11); second means for operating the opening and the

closing of said distal section (13) relative to said intermediate section (12), wherein said first means and said second means comprise, each, an active control device (31a, 31b) for the opening and the closing of the corresponding section of jib and a passive extensible arrest device (32a, 48a, 32b, 48b), said arrest device being suitable to maintain the jib in operating position.

FIG.3



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Description

[0001] The present invention refers to a foldable jib for a tower crane used in building industry.

[0002] A tower crane for the building industry comprises, generally, a foldable tower, divided in a lower section and an upper section pivoted together, and a foldable jib, divided in a proximal section, pivoted to the top of the tower, and a distal section pivoted to the proximal section.

[0003] Between said proximal and distal sections of the jib sometimes can be provided an intermediate section pivoted both to the distal section and to the proximal section.

[0004] Both the tower and the jib of the crane can be opened or closed operating on control means made of, generally, hydraulic devices or cables.

[0005] This way the crane can assume a closed configuration, for transportation, and an open configuration, for operation.

[0006] In the transport configuration the sections of the tower and those of the jib are positioned substantially horizontally, folded together.

[0007] In the operative configuration, the tower will be in a vertical position relative to the base of the crane and the jib will be in a horizontal position.

[0008] One main problem to be solved in designing a foldable tower crane is how to obtain the opening and the closing of the distal section of the jib, relative to the proximal section, in a safe and efficient way.

[0009] An example of a foldable jib for a crane is described in the Italian Patent n.1186207.

[0010] According to the teaching of said Italian Patent, the foldable jib of the crane comprises, between the proximal and the distal sections, an intermediate section having a shape substantially trunk-pyramidal.

[0011] Said trunk-pyramidal section has two of the opposite sides of the larger base pivoted to the proximal and distal sections of the jib and the smaller base pivoted to the extremities of corresponding hydraulic cylinders.

[0012] Said hydraulic cylinders have, moreover, the opposite extremities pivoted to the proximal and distal jib sections, in correspondence of the upper stanchions of the proximal and distal sections of the jib.

[0013] Again according to the teaching of said Italian patent, the opening and the closing of the crane's jib is obtained operating on the two hydraulic cylinders that, when the jib is completely open, also assume the function of horizontal tie rods, completing the trestle structure of the jib.

[0014] A first drawback of the system described in said Italian Patent rises from the fact that the two hydraulic cylinders, being an integral part of the load bearing structure, must be appropriately dimensioned in order to support the weight of the jib itself and the weight of the loads moved by the crane.

[0015] Moreover, the two hydraulic cylinders, being

obliged to support the load moved by the crane, will be strongly solicited and, consequently, its useful life will be reduced.

[0016] A not last drawback of the system described is represented by the fact that the substitution of even only one hydraulic cylinder must be made with the jib completely lowered, being the cylinders a structural part of the jib.

[0017] Another inconvenience of the generally known systems for opening and closing the jib of a crane rises from the fact that the jib cannot be raised when it is completely closed, but it must be previously partly opened, in order to allow the raising mechanism of the jib to operate safely.

[0018] With reference to Figure 1b it is shown schematically the jib of a tower crane in a partially open position for allowing the raising of the jib without damaging the couple of struts 61c that are positioned at the top of the tower.

[0019] As it is evident from Figure 1b, the raising of the jib around the pivoting point 9 is made by tensioning a cable 60 connected between the base of the crane and the proximal section of the jib.

[0020] Said cable 60 is guided by an aerial articulated structure 61a-61c provided on the top of the tower.

[0021] Said aerial articulated structure 61a-61c comprises, in particular, a couple of struts 61c placed triangularly and jointed at the top of the crane's tower.

[0022] When the crane is in the transport position with the jib lowered and folded, said couple of struts 61c will be folded between the proximal and distal sections of the jib.

[0023] Consequently, if the cable 60 is tensioned when the jib is completely closed, the couple of struts 61c cannot be raised or it will be seriously damaged.

[0024] It is therefore an object of the present invention to solve the above mentioned drawbacks providing a foldable jib for a crane whose realisation is easy and cheap.

[0025] The above and other objects are achieved by the foldable crane's jib for a tower crane as claimed in the attached claims.

[0026] The crane's jib according to the present invention has the advantage that it is lighter than the existing ones thanks to the use of small hydraulic cylinders.

[0027] This advantage is achieved by the employment of actuating means for the opening and the closing of the jib comprising an active control device and a passive arrest device.

[0028] Moreover, thanks to the provision of a slot in which it is pivoted one of said active control devices, it is possible the raising of the jib starting from the position in which the jib is completely closed.

[0029] Further characteristics and advantages of the invention will result more clear from the detailed description of a preferred embodiment, not exclusive, shown as an example, but not limiting, in the accompa-

nying drawings in which:

the Figure 1a is a schematic lateral view of a foldable tower crane in a working configuration;
 the Figure 1b is a schematic lateral view of a foldable tower crane having the jib in a partially open/close configuration;
 the figure 2 is a sectional view along line A-A of the crane's jib according to the present invention;
 the Figures 3 to 9 show in succession the opening steps of the jib according to the present invention;
 the Figure 10 is a top view of the jib of Figure 9, wherein, for better clarity, are represented only two jib sections;
 the Figures 11a-11c show schematically the safety mechanism provided in the jib according to the invention;
 the Figure 12 shows the jib according to the invention in a different embodiment.

[0030] With reference to the accompanying drawings, the foldable crane jib according to the present invention comprises three sections, respectively a proximal 11, an intermediate 12 and a distal 13.

[0031] As shown in Figure 1, said proximal section 11 is pivoted in 9 to the top of the crane's tower 1.

[0032] As illustrated in Figures 3 to 9 said intermediate section 12 has a substantially trunk-pyramidal shape and is pivoted in 14 to the proximal section 11 and in 15 to the distal section 13.

[0033] The crane 1 shown in Figure 1 comprises a tower 2 placed on a base 3 and divided in two sections, a lower 4 and an upper 5, pivoted together in 6 and in the lower part in 8.

[0034] An hydraulic cylinder 7 is provided for raising and lowering of the tower by opening and closing the two sections lower 4 and upper 5.

[0035] A metallic cable 60, guided through an aerial articulated structure 61a-61c provided on the top of the tower, is moreover provided between the base 3 and the proximal section 11 of the jib, for allowing the raising of the jib of the crane in an horizontal position relative to the tower 2.

[0036] As it is better visible in Figure 2 the proximal 11 and the distal 13 sections have a trestle structure with a triangular cross section.

[0037] The trestle structure of the proximal 11 and distal 13 sections is preferably realised by means of three parallel iron beams 16 placed on the vertices of the triangle and connected by metal elements 17 welded to said beams 16.

[0038] The beams 16 placed on the lower vertices of the triangle permit the sliding of the saddle 63 of the crane, which is trailed along the jib by means of a metallic rope (not shown) guided by pulleys 62.

[0039] Between said proximal section 11 and said intermediate section 12, and between said distal section 13 and said intermediate section 12 are, moreover,

provided, respectively, first and second opening means for the jib.

[0040] Said opening means for the jib comprises, each, an active extensible device for controlling the opening and the closing of the jib and a passive extensible device for the arrest of the opening movement when the jib is in the operating configuration.

[0041] According to the invention, the active extensible devices, when the jib is completely open in the operating configuration, assume preferably a configuration close to the maximum extension, so that they are not solicited by the jib's weight.

[0042] This way the replacement of the active extensible devices is always possible also when the jib is open and they, since they are not charged by the jib's weight, could be realised in reduced dimensions relative to the ones actually used.

[0043] In the example shown in the attached figures, the active extensible devices are hydraulic cylinders 31a, 31b placed, respectively, between said proximal section 11 and said intermediate section 12 and between said intermediate section 12 and said distal section 13.

[0044] More precisely, the hydraulic cylinders 31a, 31b have an end pivoted in 22a, 22b to a correspondent couple of brackets 23a, 23b, provided welded on the corresponding section of jib 11, 13, and the opposite end pivoted in 41a, 42b to a couple of parallel brackets 40, having a substantially trapezoidal shape, provided hanging from the smaller base of said trunk-pyramidal intermediate section 12 of the jib between the lateral walls 45 of said trunk-pyramidal intermediate section 12.

[0045] According to the invention, the hydraulic cylinders 31a, 31b have, when the jib is opened, an inclined position converging towards the top of the truncated-pyramidal intermediate section 12.

[0046] Again with reference to the example shown in the attached figures, the passive extensible devices are made of guides 32a, 32b for sliding of pins or cursors 33a, 33b fixed to the ends of corresponding forks 48a, 48b in which are received the guides 32a, 32b when the jib is closed in the rest configuration shown in Figure 3 or opened in the operating configuration shown in Figure 9 or 10.

[0047] As it is better shown in Figure 10, said proximal section 11 and said distal section 13 of the jib comprise a portion faced to the intermediate section 12 in which the upper stanchion 16 of the trestle structure of the jib is doubled in order to define the corresponding fork 48a, 48b.

[0048] Said forks 48a, 48b are joined to the upper stanchion 16 of the corresponding section of jib by means of a metallic plate 49a, 49b.

[0049] Advantageously, said fork 48a, 48b comprises a central reinforcement obtained by means of a metallic transom 50a, 50b welded in its upper part to the two branches of the fork 48a, 48b.

[0050] Said guides 32a, 32b have an end pivoted in 46a, 46b to said couple of brackets 40 and the opposite end free to oscillate, without however getting out from the trestle structure of the jib, between a position parallel to the corresponding fork 48a, 48b, and an oblique position substantially parallel to the direction of the corresponding hydraulic cylinder 31a, 31b.

[0051] The guides 32a, 32b comprise a couple of metallic bars 34a, 34b having a circular section and disposed parallel one to each other and maintained spaced by means of spacers 35a, 35b and 36a, 36b fixed to the ends of said guides 32a, 32b, in order to define a sliding channel 37a, 37b for the cursors 33a, 33b.

[0052] The spacers 36a, 36b are pivoted in 46a, 46b to the couple of plates 40 and the spacers 35a, 35b are preferably provided with a concave face facing the sliding channel 37a, 37b, in order to define a limit stop rabbet for the corresponding pin or cursor 33a, 33b.

[0053] Advantageously, said pins or cursors 33a, 33b can slide freely inside said guides 32a, 32b between a position in which they are in contact with the spacers 36a, 36b provided in correspondence with the couple of plates 40 and a position in which they are in contact with the spacers 35a, 35b provided in correspondence with the free end of said guides 32a, 32b.

[0054] Besides, said guides 32a, 32b shall rotate freely around the cursors 33a, 33b because of the oscillatory movement of the guides during the opening and the closing of the jib, favouring the relative position assumed by the sections of the jib in reciprocal rotation.

[0055] During the closing movement of the jib the guides 32a, 32b will suffer an oscillatory movement relative to the forks 48a, 48b until they stop against the metallic transoms 50a, 50b, as shown in Figure 3.

[0056] Preferably, the hydraulic cylinder 31a, provided between the proximal section 11 and the intermediate section 12, is pivoted to the couple of plates 40 in correspondence of slots 47 so shaped as to enable the free rotation of the intermediate section 12 relative to the proximal section 11 under the push of the couple of struts 61c, when the cable 60 is set in tension for raising the jib of the crane.

[0057] Advantageously, said slots will allow a free partial opening of the jib of approximately 15° sufficient to let the struts 61c to get out.

[0058] A roller or a sliding block, not illustrated, could be moreover provided on the free end of the struts 61c in order to avoid locks against the beam 16 of the distal portion 13 of the jib during the raising of the jib.

[0059] This way the jib of the crane shall be raised operating on the cable 60 up to the position illustrated in the figures 1b and 4, without the necessity of previously partially opening the jib by means of the hydraulic cylinders.

[0060] With reference to the Figure 12 it is illustrated a different embodiment of the invention in which the guides 132a, 132b, obtained by means of parallel

bars 134a, 134b defining sliding channels 137a, 137b, are fixed on the upper stanchion 16 in correspondence with the extremities of the proximal 11 and distal 13 sections that face the intermediate section 12.

[0061] Likewise, the forks 148a, 148b will be pivoted to a cursor 133a, 133b flowing into the channel 137a, 137b defined in said guides, and to the couple of brackets 40 provided in correspondence of the intermediate section 12.

[0062] Said guides 132a, 132b are moreover provided, on both the extremities, with spacers 135a, 135b and 136a, 136b in order to stop the sliding of the cursors 133a, 133b placed on the free extremities of the forks 148a, 148b.

[0063] Advantageously, according to this different embodiment, during the opening and closing movement of the jib the forks 148a, 148b will always be out of the trestle structure of the jib.

[0064] With reference to the Figures 11a-11c, it is illustrated the safety mechanism 70 coupled to the slots 47 that prevents the free rotary movement of the intermediate section 12 relative to the proximal section 11, once reached the configuration of free maximum opening of the jib shown in Figure 1b.

[0065] The safety mechanism 70 shown in the Figures 11a-11c comprises a circular sector 71, correspondent to around a quarter of a circle, welded along one of the spokes to the end of the hydraulic cylinder 31a, and a limit stop 72 welded between the couple of brackets 40.

[0066] In the transition from the closing position, shown in Figure 11a, to that of maximum free opening, shown in Figure 11b, and vice versa, the circular sector 71 and the limit stop 72 don't interfere each other and they therefore leave free to rotate the intermediate section 12 under the push transmitted by the struts 61c, while the pivot 41a is free to slide into the slots 47 from an end to the other.

[0067] When the hydraulic cylinder 31a begins its extension phase carrying the pivot 41a again against the opposite end of the slots 47 (Figure 11c), the limit stop 72 will be against the curved surface of the sector 71 and will prevent this way the pivot 41a from sliding in the slots.

[0068] Consequently, any risk of undesired free rotation of the jib's sections during the opening and closing phase of the same will be avoided.

[0069] Although in the illustrated example the slots 47 and the safety mechanism 71 are provided in correspondence with the pivoting point of the hydraulic cylinder 31a, it will also be possible that said slots and said mechanism be realised in correspondence with the pivoting point of the hydraulic cylinder 31b, provided between the distal section 13 and the intermediate section 12 of the jib.

[0070] According to the present invention, the hydraulic cylinders 31a, 31b that control the opening and the closing of the jib are preferably powered by the

same hydraulic circuit.

[0071] This way, being the cylinder that encounters less resistance to prevail on the other, in the opening phases the gradual opening of the intermediate section 12 will be achieved first, relative to the proximal one 11 and, subsequently, the opening of the distal section 13 relative to the intermediate one 12.

[0072] In an alternative embodiment of the invention, the extensible passive devices could be made of a plurality of small connecting rods pivoted together or made of other equivalent means what ropes or chains.

Claims

1. Jib of a foldable tower crane comprising:

- a proximal section (11), an intermediate section (12) and a distal section (13), said proximal section (11) being pivoted to the top of the tower of the crane and to said intermediate section (12) and said distal section (13) being pivoted to said intermediate section (12);
- first means for operating the opening and the closing of said intermediate section (12) relative to said proximal section (11);
- second means for operating the opening and the closing of said distal section (13) relative to said intermediate section (12), characterised in that said first means and said second means comprise, each, a control device (31a, 31b) for the opening and the closing of the corresponding section of jib and an arrest device (32a, 48a, 32b, 48b), said arrest device being suitable for preventing the further rotation in the opening phase of said intermediate section (12) relative to said proximal section (11) and of said distal section (13) relative to said intermediate section (12) when the jib has reached the operating position.

2. A crane's jib according to claim 1, wherein said control device (31a, 31b) comprises an active extensible device and wherein said arrest device comprises a passive extensible device.

3. A crane's jib according to claim 2, wherein said extensible active devices (31a, 31b), when the jib is in the operating position, are not solicited by the weight of the jib.

4. A crane's jib according to claim 2 or 3, wherein said passive extensible devices (32a, 48a, 32b, 48b; 132a, 148a, 132b, 148b) comprise a first body and a second body suitable to be inserted one into the other and to oscillate the one relative to the other.

5. A crane's jib according to claim 4, wherein said first body comprises an extension having the shape of a

fork (48a, 48b) of the upper stanchion (16) of the corresponding proximal (11) and distal (13) sections of jib, and wherein said second body comprises a guide (32a, 32b) for the sliding of a cursor (33a, 33b) fixed to an extremity of said fork, said guide (32a, 32b) being lodged in said fork (48a, 48b) when the jib is closed in the rest configuration.

6. A crane's jib according to claim 4, wherein said second body comprises a fork (148a, 148b) pivoted to the couple of brackets (40), and wherein said first body comprises a guide (132a, 132b) for the sliding of a cursor (133a, 133b) fixed to an extremity of said fork, said guide (132a, 132b) being lodged in said fork (148a, 148b) when the jib is closed in the rest configuration.

7. A crane's jib according to claim 5 or 6, wherein said guide (32a, 32b; 132a, 132b) comprises a couple of parallel bars (34a, 34b; 134a, 134b) maintained spaced by means of spacers (35a, 35b, 36a, 36b; 135a, 135b, 136a, 136b) placed on the extremities of said bars, in order to define between them a sliding channel (37a, 37b; 137a, 137b) for said cursors (33a, 33b; 133a, 133b).

8. A crane's jib according to any of the preceding claims, wherein said active extensible devices comprise an hydraulic cylinder (31a, 31b).

9. A crane's jib according to claim 8, wherein said intermediate section (12) has a substantially trunk-pyramidal shape whose small base comprises a couple of brackets (40) between which are pivoted said guides (32a, 32b) and said hydraulic cylinders (31a, 31b).

10. A crane's jib according to claim 9, wherein each of said brackets (40) has a slot (47) in which it is pivoted an extremity of the hydraulic cylinder (31a) placed between said proximal section (11) and said intermediate section (12), said slots (47) being so shaped as to allow the partial free rotation of said intermediate section (12) relative to said proximal section (11) when the jib is in a position comprised between the closed position and a partially open position.

11. A crane's jib according to claim 9, wherein each of said brackets (40) has a slot (47) in which it is pivoted an extremity of the hydraulic cylinder (31b) placed between said distal section (13) and said intermediate section (12), said slots (47) being so shaped as to allow the partial free rotation of said distal section (13) relative to said intermediate section (12) when the jib is in a position comprised between the closed position and a partially open position.

12. A crane's jib according to claim 10 or 11, wherein
are provided safety means (70) suitable for prevent-
ing the free rotation of said intermediate section
(12) relative to said proximal section (11) or of said
distal section (13) relative to said intermediate sec- 5
tion (12) when the jib is in a position comprised
between said partially open position and the totally
open position.
13. A crane's jib according to claim 12, wherein said 10
safety means (70) comprise a circular sector (71),
correspondent to around a quarter of a circle,
welded along one of the spokes to the extremity of
the hydraulic cylinder (31a), and a stop limit (72)
welded between said brackets (40). 15
14. Tower crane, characterised in that it comprises a
foldable jib realised according to any of the claims 1
to 13. 20

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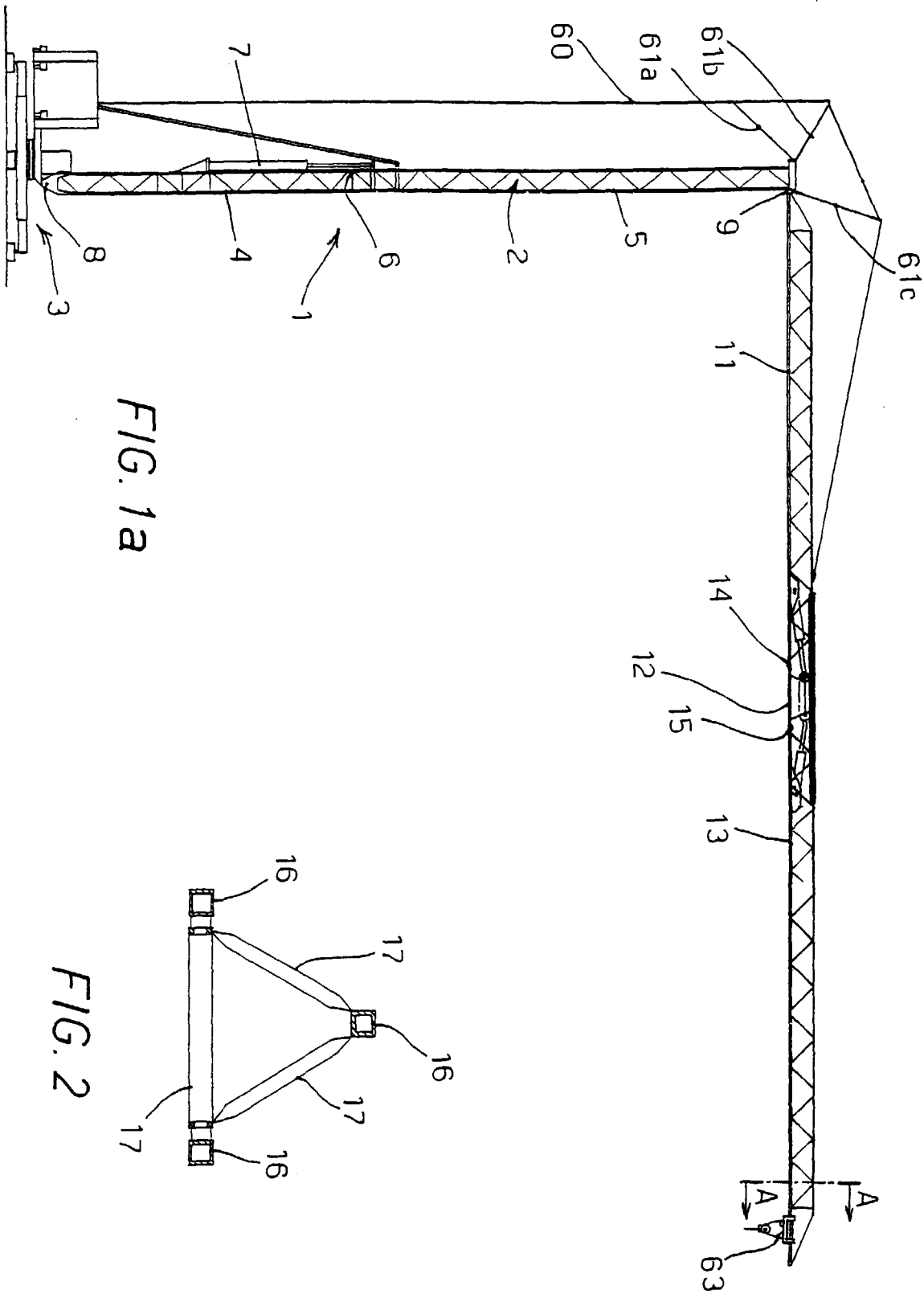
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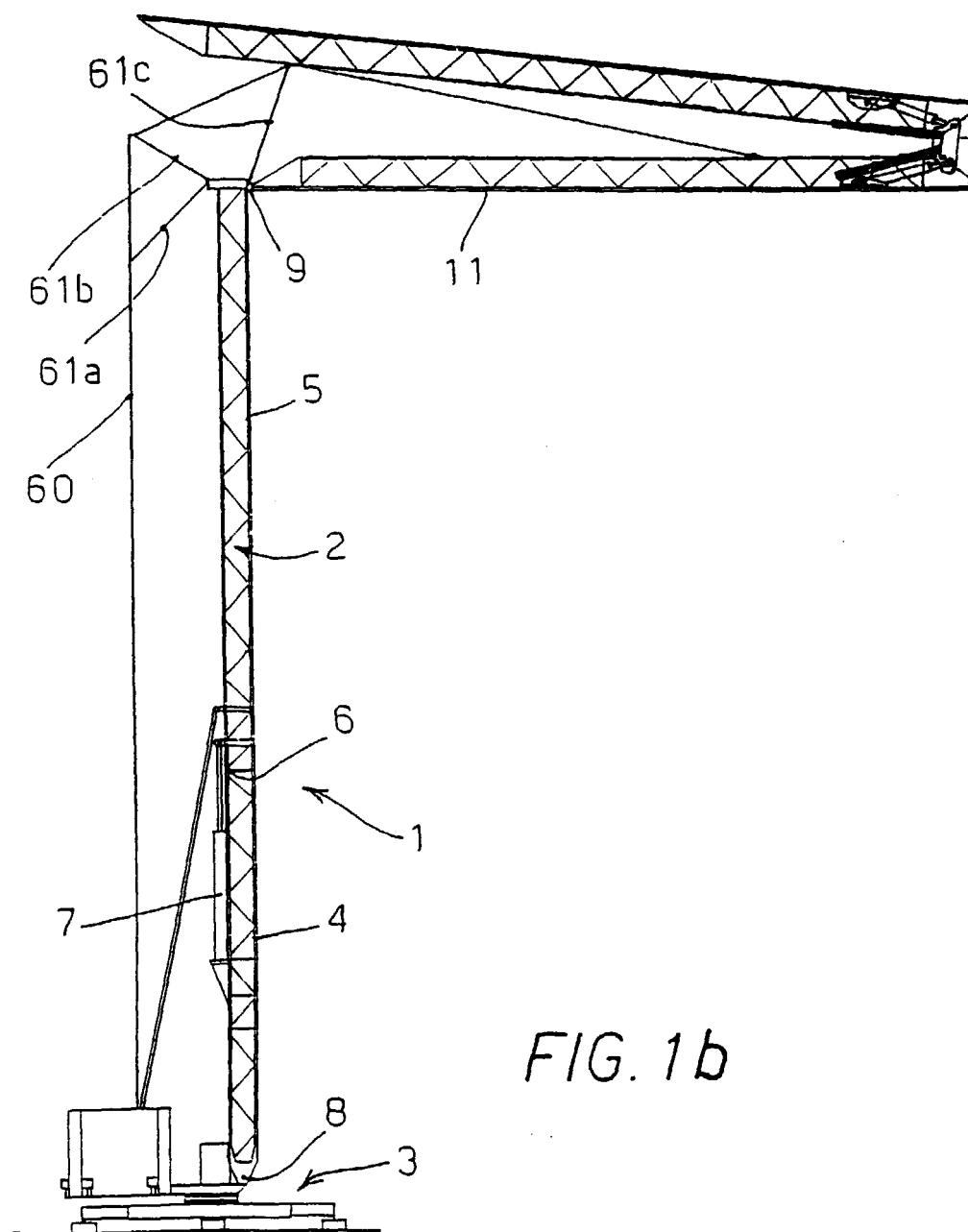
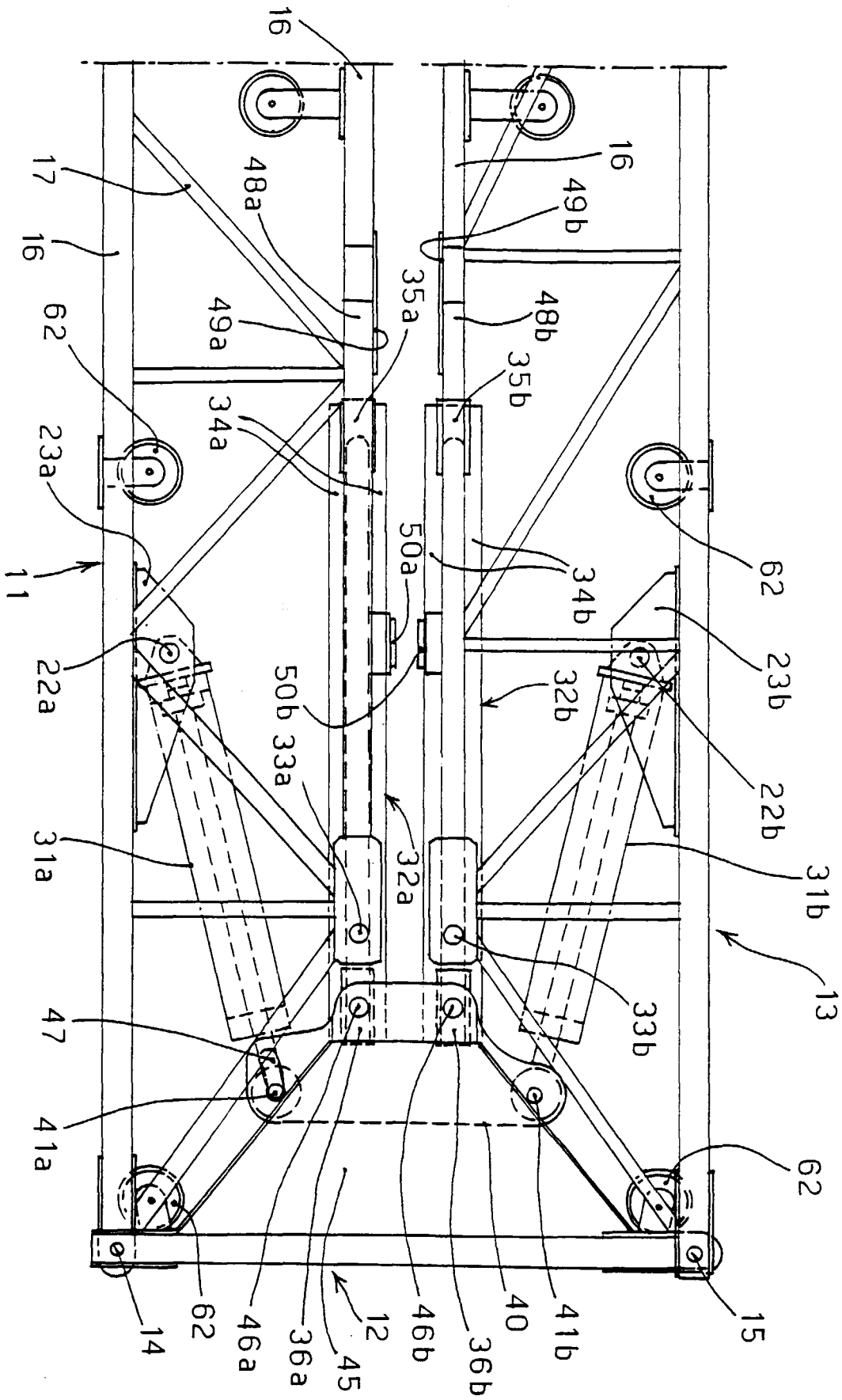
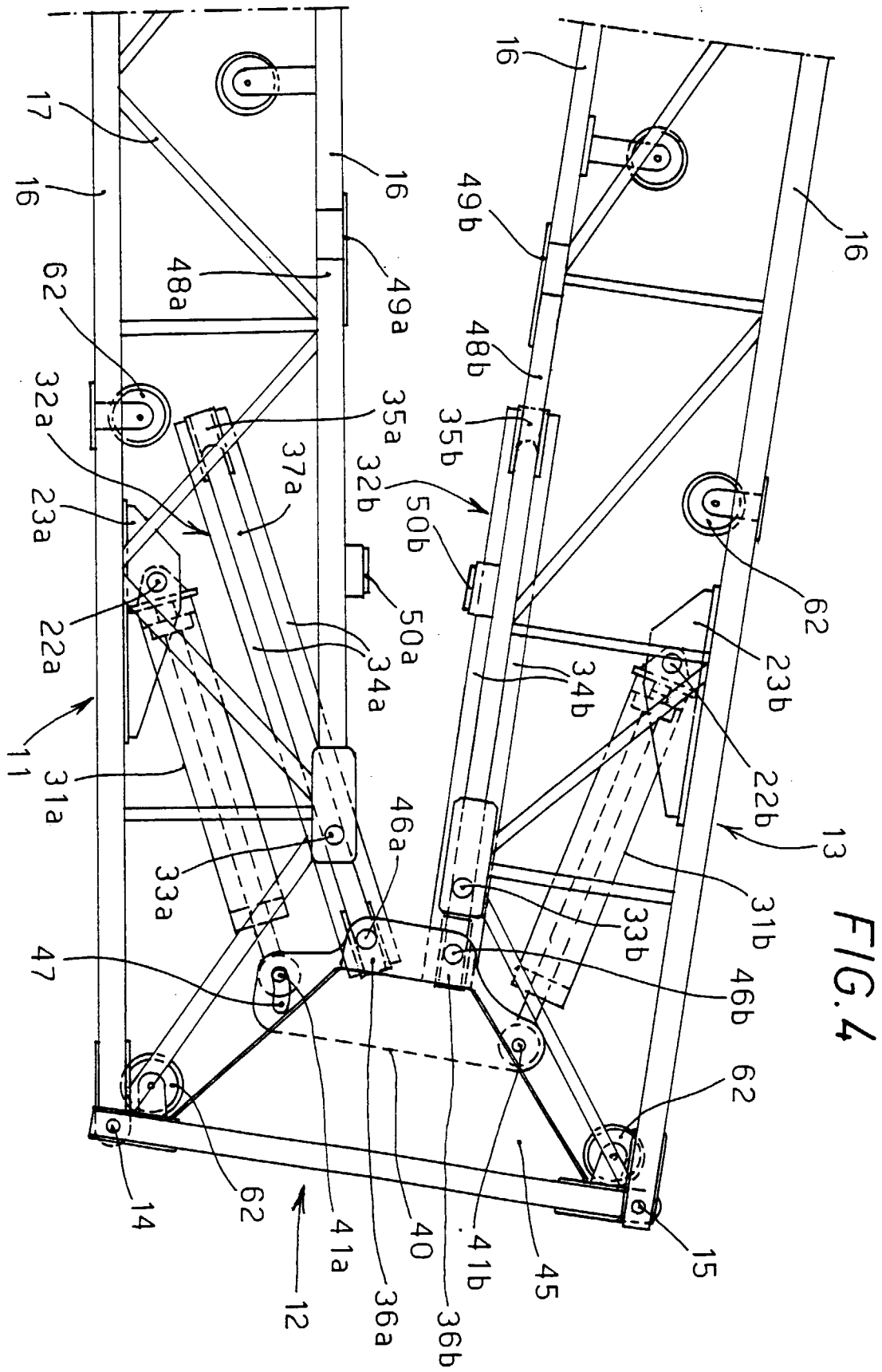
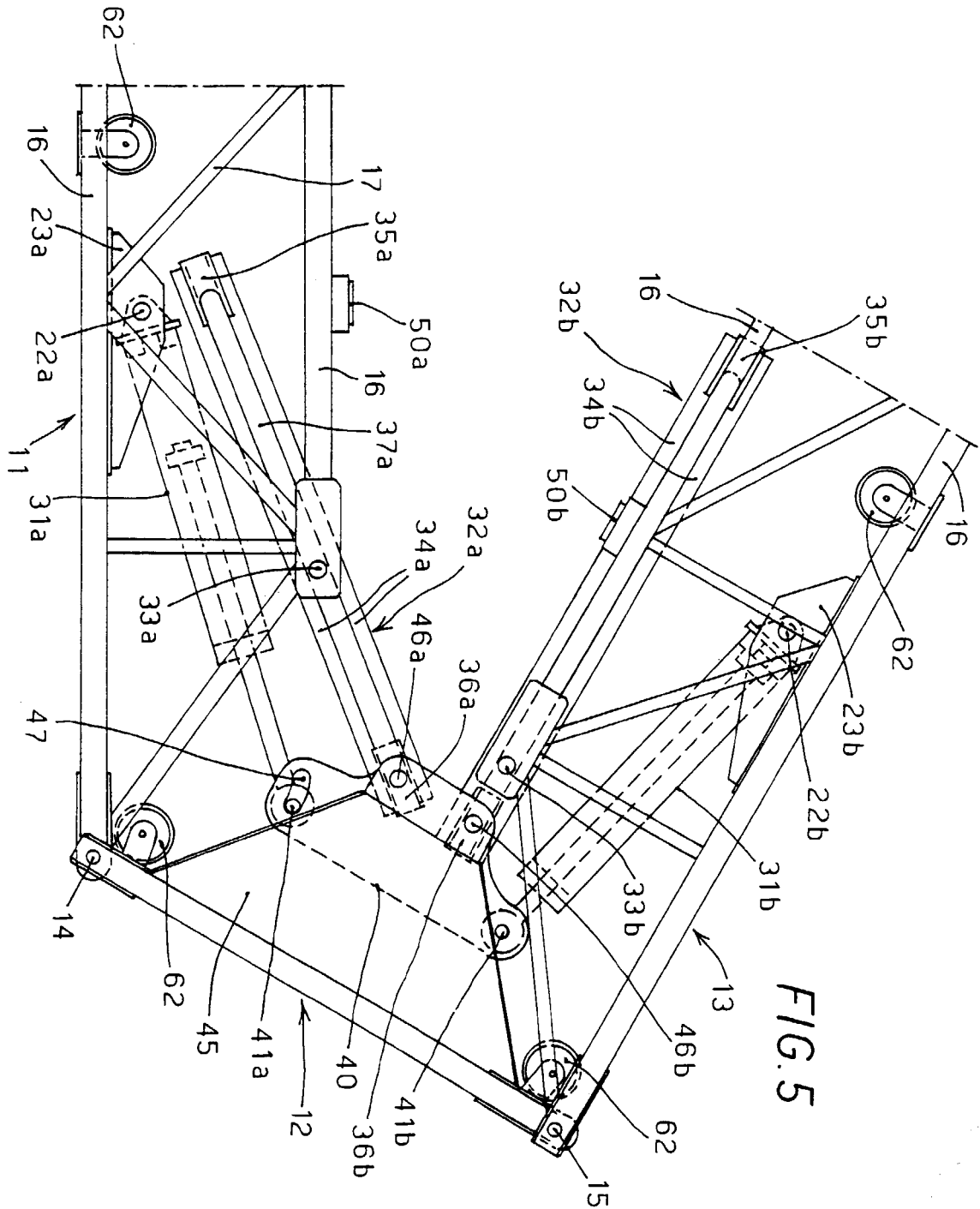


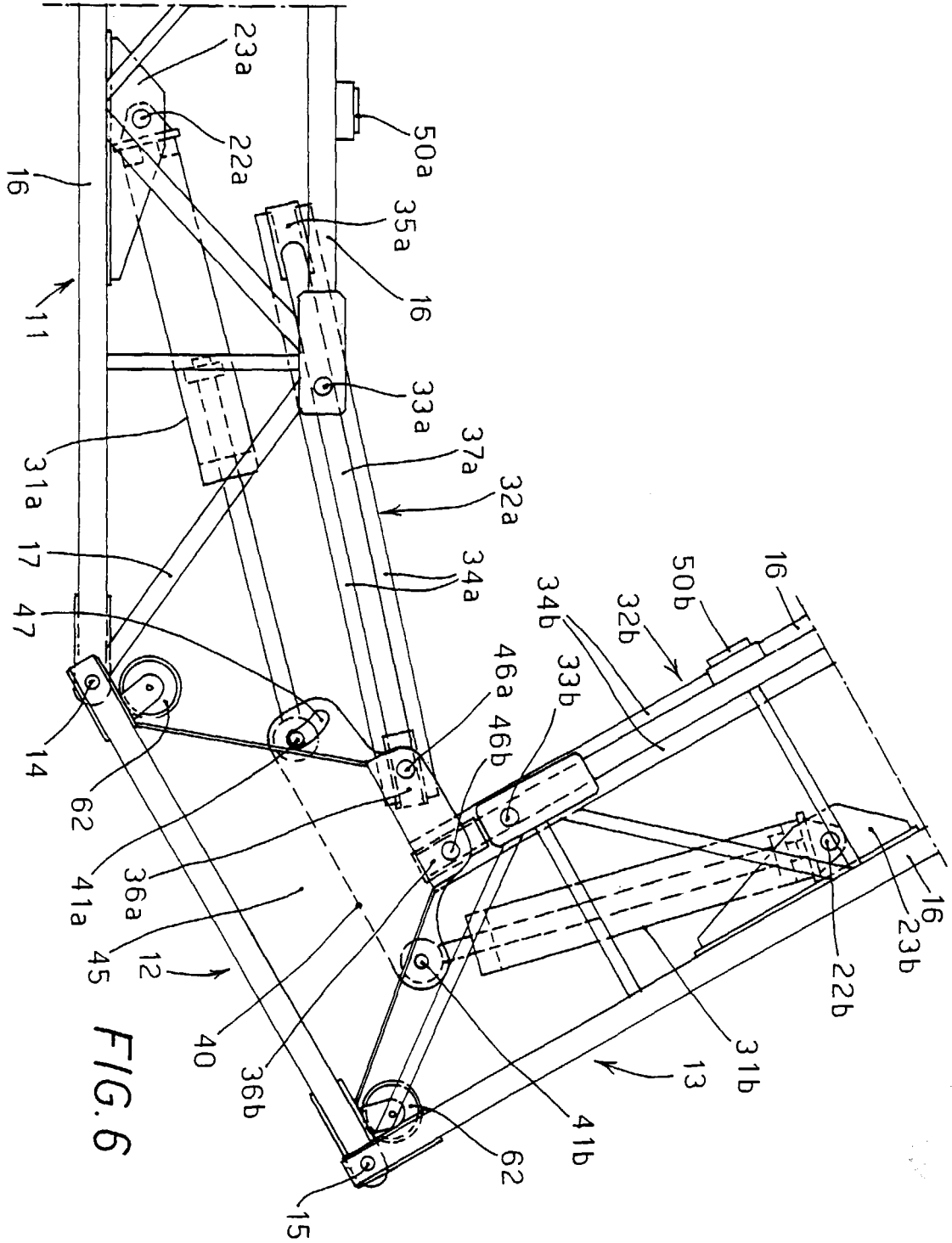
FIG. 1b

FIG. 3









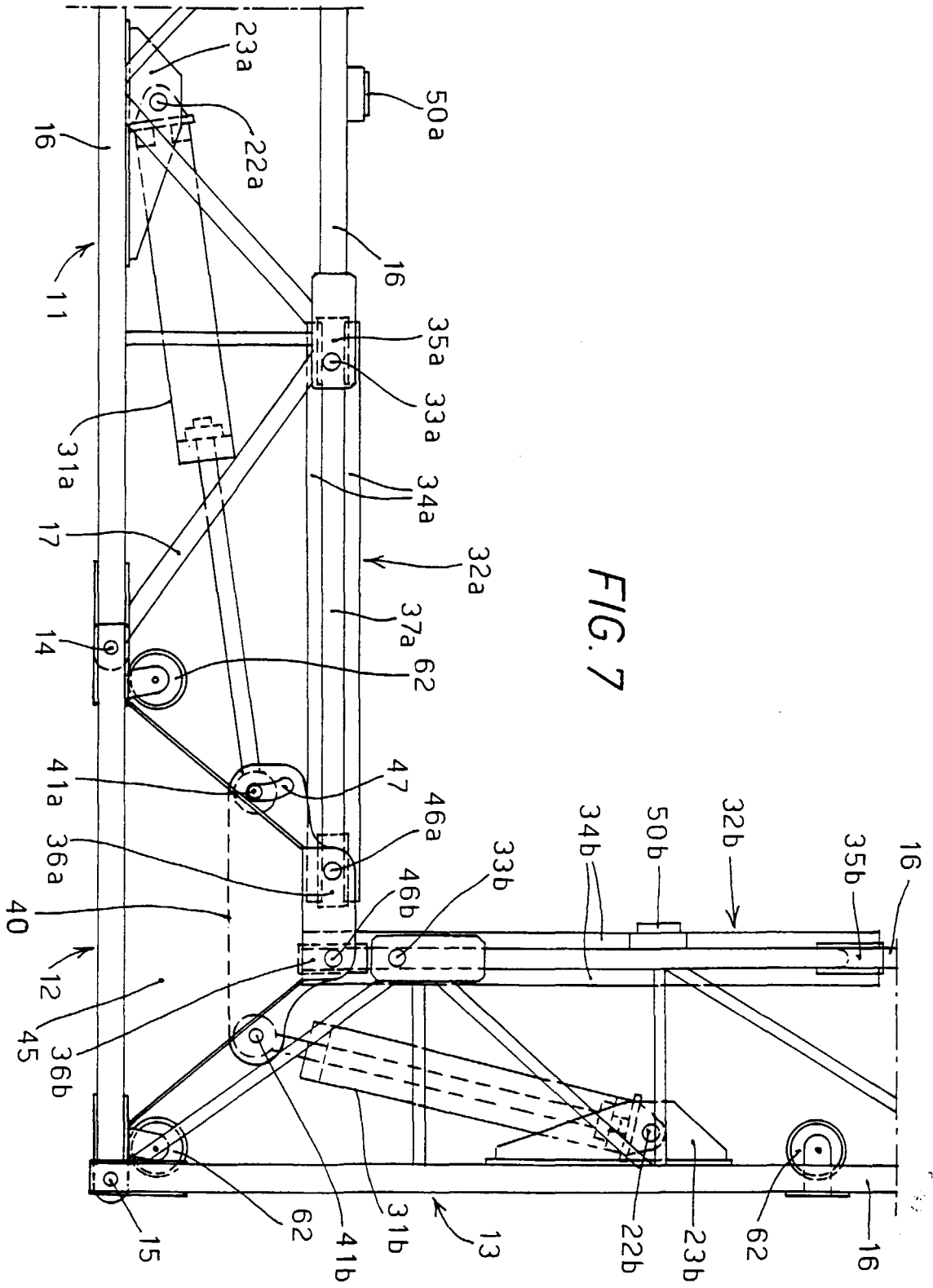
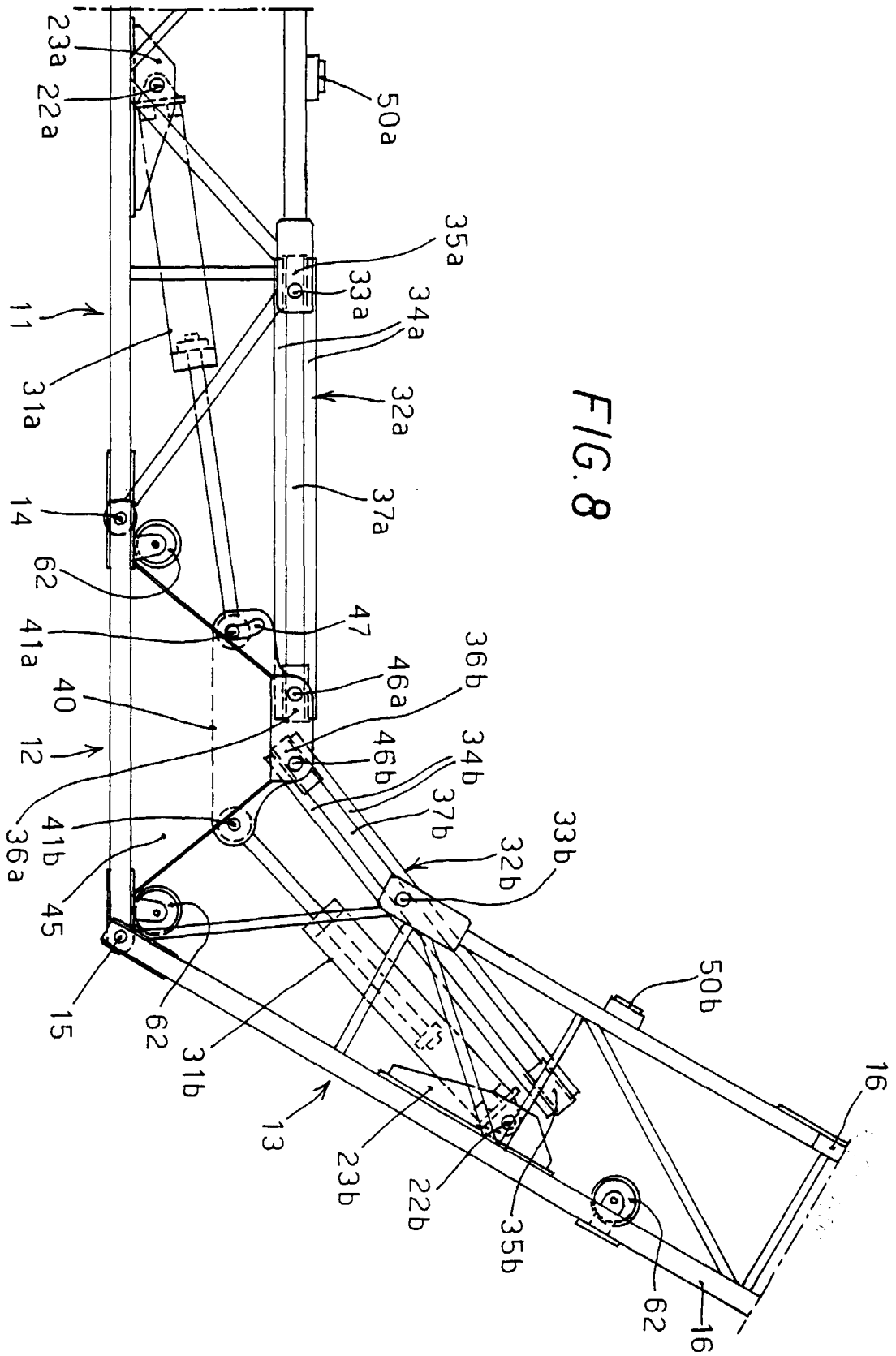


FIG. 8



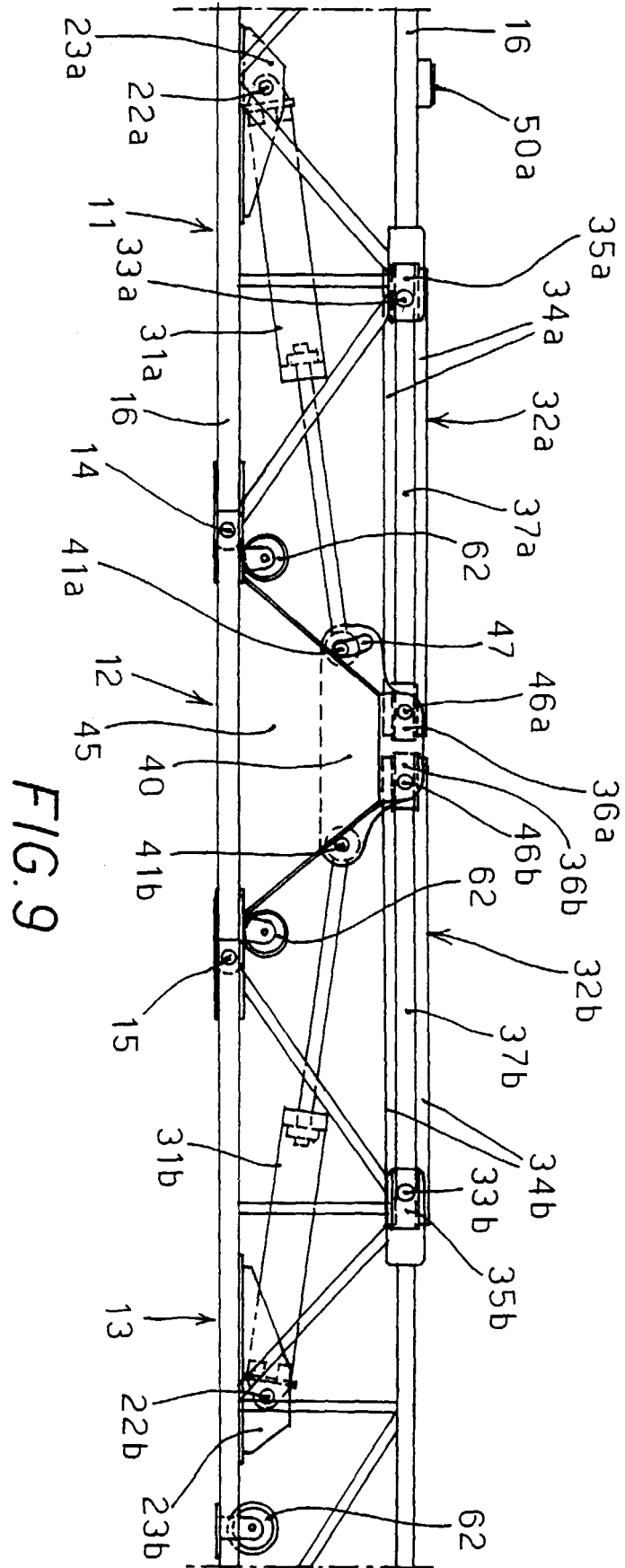
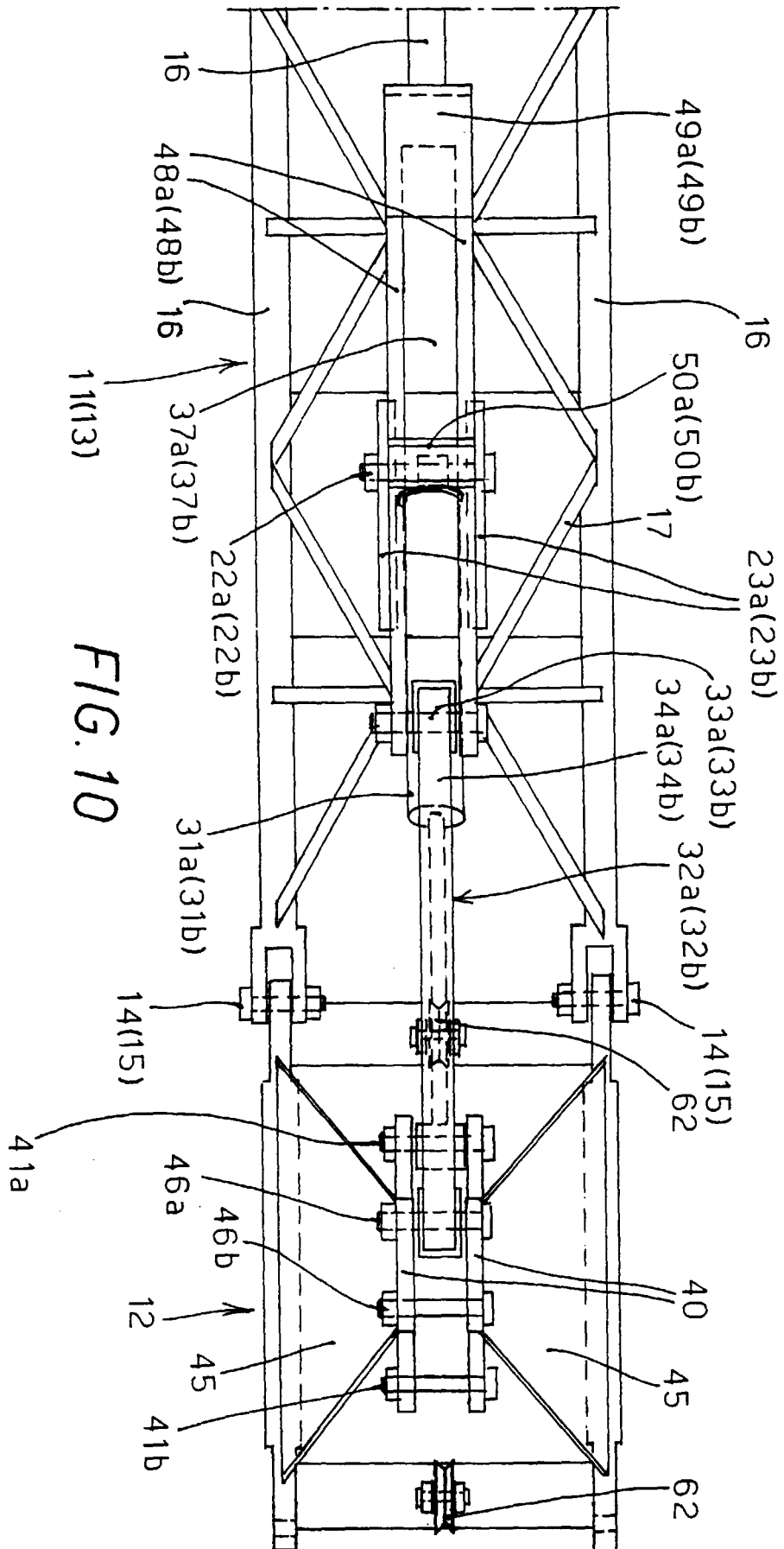
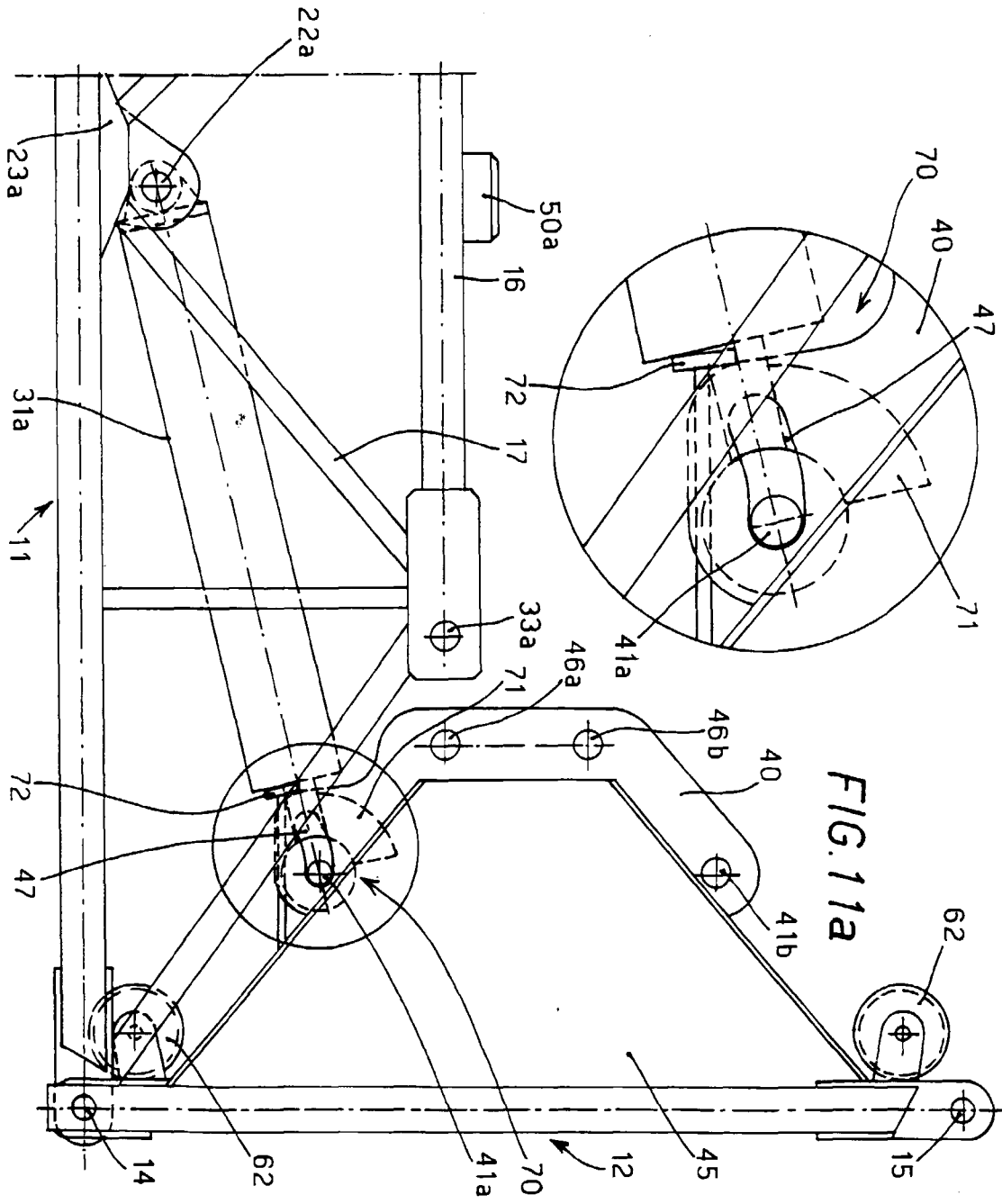
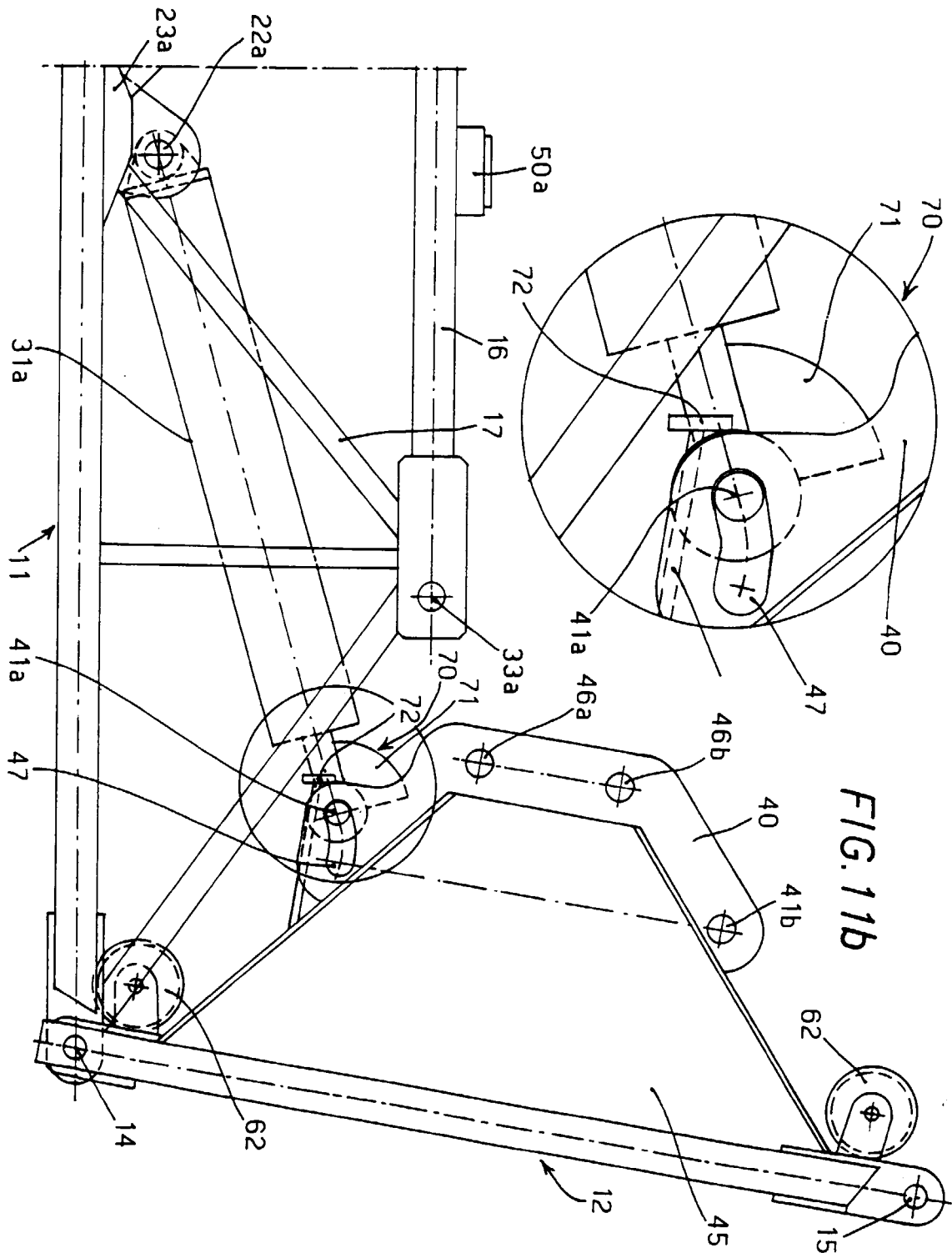
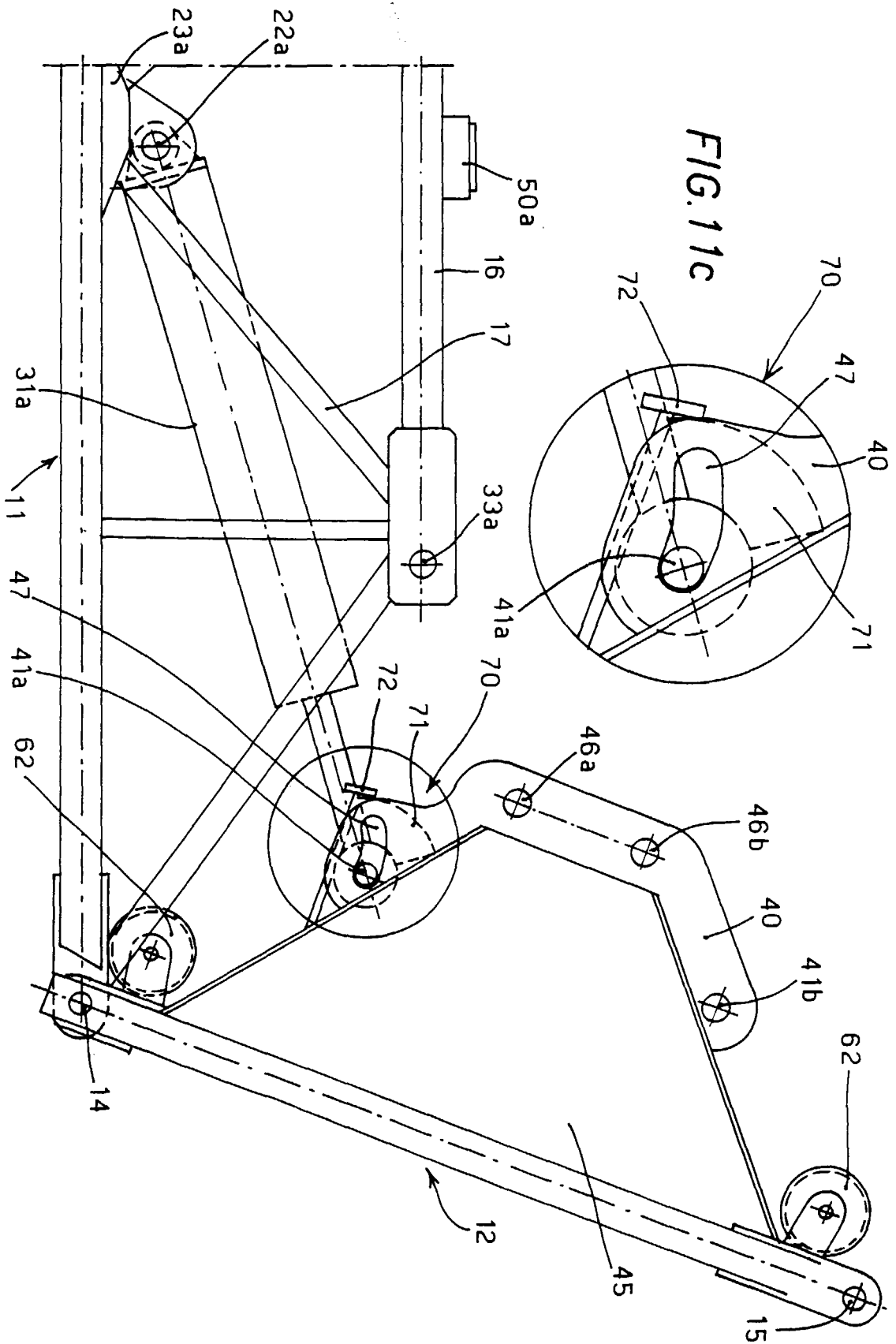


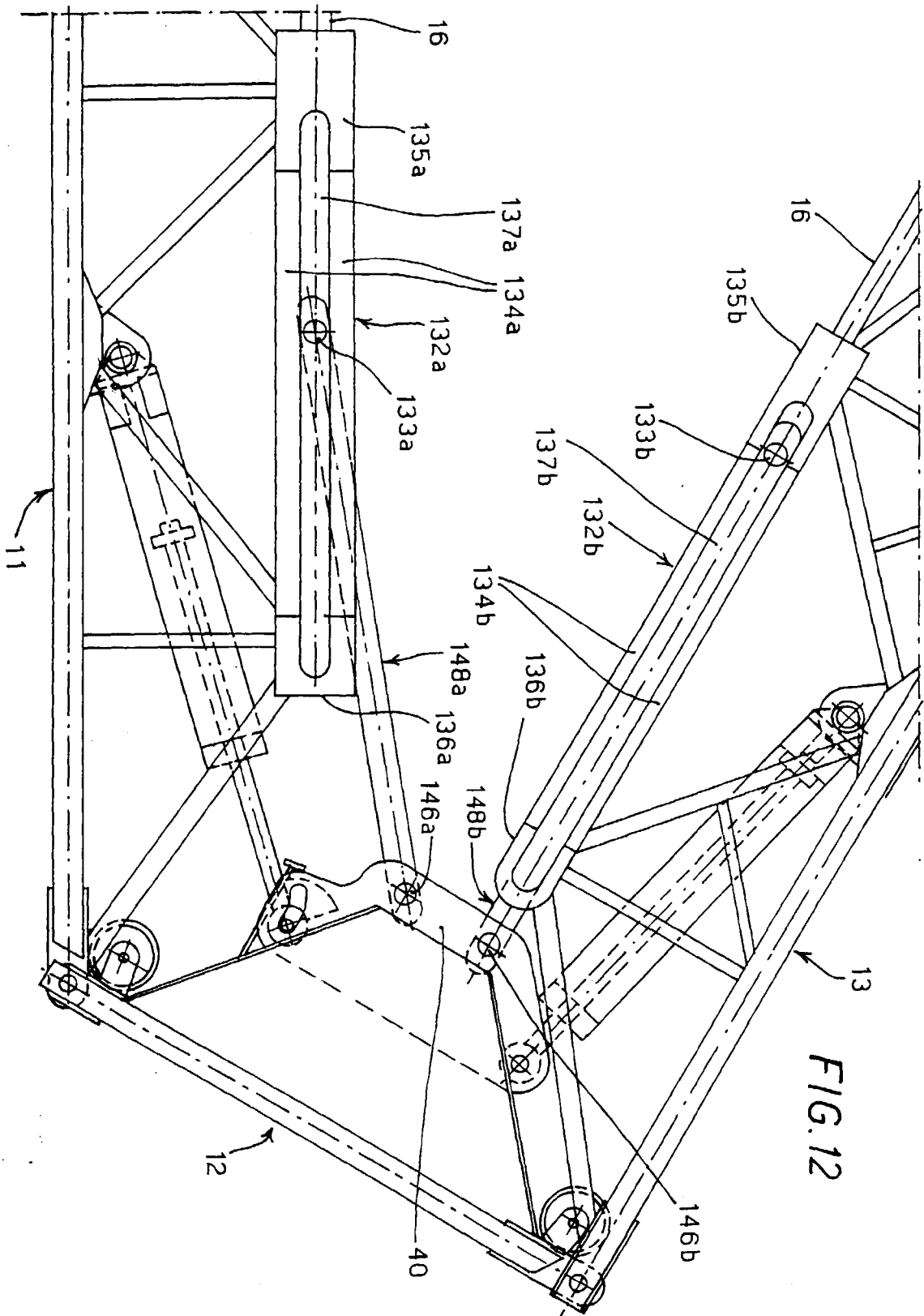
FIG. 9













European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 98 83 0667

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		9 April 1999	Van den Berghe, E
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P04/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 83 0667

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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