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CA 2937689 C 2019/07/09

(11)(21) 2 937 689

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2015/01/29
(87) Date publication PCT/PCT Publication Date: 2015/08/06
(45) Date de délivrance/Issue Date: 2019/07/09
(85) Entrée phase nationale/National Entry: 2016/07/22
(86) N° demande PCT/PCT Application No.: AT 2015/000013
(87) N° publication PCT/PCT Publication No.: 2015/113084
(30) Priorité/Priority: 2014/01/31 (AT GM 44/2014)

(51) Cl.Int./Int.Cl. *B66C 13/22* (2006.01), *B66C 13/40* (2006.01), *B66C 13/44* (2006.01), *B66C 13/48* (2006.01), *B66C 23/00* (2006.01)

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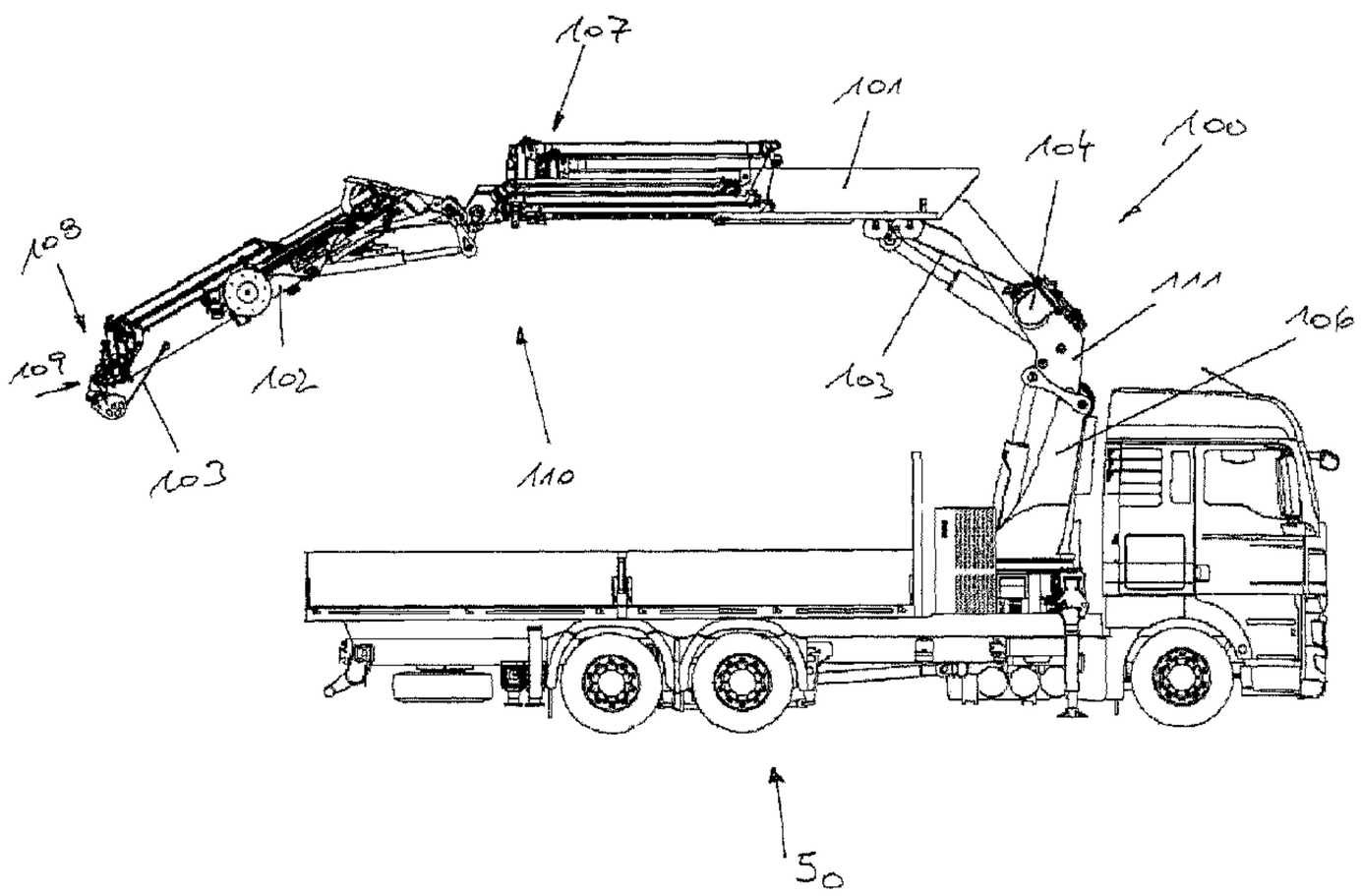
(54) Titre : COMMANDE DE GRUE
(54) Title: CRANE CONTROLLER



(57) Abrégé/Abstract:
The invention relates to a crane controller (10) for a crane (100), in particular a cargo crane, said controller having a first operating mode, in which the crane (100) can be user-operated by means of control commands from an operator and a second operating mode that can be activated by the operator, in which mode the crane geometry can be changed by the crane controller (10) in a predefined sequence of movements. The crane controller (10) has a menu-driven user interface (3), said interface (3) having a function (4, 5) which can be selected by the operator and by means of which the crane controller (10) switches from the first to the second operating mode.

Abstract

The invention relates to a crane controller (10) for a crane (100), in particular a cargo crane, said controller having a first operating mode, in which the crane (100) can be user-operated by means of control commands from an operator and a second operating mode that can be activated by the operator, in which mode the crane geometry can be changed by the crane controller (10) in a pre-defined sequence of movements. The crane controller (10) has a menu-driven user interface (3), said interface (3) having a function (4, 5) which can be selected by the operator and by means of which the crane controller (10) switches from the first to the second operating mode.

Crane controller

The present invention concerns a crane controller, a crane, in particular, but not limited to a cargo crane, having such a crane controller, and a vehicle having a crane of that kind.

All cranes have an operating mode in which the crane geometry, that is to say the relative position of the crane arms with respect to each other in a plane or relative to a crane column and the pivotal position of the crane arms together with the crane column relative to a crane base can be freely selected by a user. The user can alter the relative position of the crane arms and pivot the crane arms together with the crane column relative to the crane base for example by actuation of operating elements. In the background the operation of the crane is monitored by safety devices which intervene upon actuation of operating elements by the user, which lead to a safety-critical state. For example the stability of the crane can be monitored.

Cranes of the general kind set forth are also already known, in which the crane controller has a first operating mode in which the crane can be freely operated by a user by means of control commands and a second operating mode which can be activated by the user and in which the crane geometry is variable in a predetermined sequence of movements by the crane controller. The second operating mode serves to bring the crane in predetermined fashion from a parking position into a working position or to bring the crane in a predetermined manner from a possibly predetermined working position into the parking position.

Those cranes of the general kind set forth have a dead man's switch as an operating element, which is to be constantly pressed to activate the second operating mode and to maintain the second operating mode.

The object of the present invention is to provide a crane controller of the general kind set forth, a crane having such a crane controller and a vehicle having such a crane, which permits more comfortable operation which assists the user by

virtue of a predetermined sequence of movements for moving into the parking and the working position respectively.

According to an aspect of the present invention, there is provided a crane controller for a crane having a first operating mode in which the crane is freely operated by a user by means of control commands and a second operating mode which is activated by the user and in which a crane geometry of the crane is changed in a predetermined sequence of movements by the crane controller, wherein the crane controller has a menu-driven user interface, the menu-driven user interface having a function which is selected by the user, by which the crane controller switches from the first operating mode into the second operating mode.

According to another aspect of the present invention, there is provided a crane, for example, a cargo crane, having a crane controller as described above.

According to another aspect of the present invention, there is provided a vehicle having a crane, for example, a cargo crane, as described above.

According to another aspect of the present invention, there is provided use of a crane controller as described above in a cargo crane.

The aims set forth as objects of the invention are achieved in that the crane controller has a menu-driven user interface, wherein the menu-driven user interface has a function which can be selected by the operator, by which the crane controller switches from the first into the second operating mode.

Advantageous embodiments of the invention are described below.

In some embodiments, it is further preferably provided that the crane controller in the predetermined sequence of movements of the crane geometry also takes account of a second pivotal arm (fly jib) and correspondingly actuates and positions same to reach the parking position or working position respectively.

In some embodiments, it is further particularly preferred if with a second pivotal arm being provided (fly jib or other detectable crane configurations) the crane controller automatically actuates different intermediate positions and also different working positions in a predetermined sequence of movements of the crane geometry and thus the predetermined sequence of movements of the crane geometry describes a crane configuration-dependent trajectory.

In some embodiments, it can also be provided that by a display of lever assignment, corresponding activation and deactivation of the operating elements by the crane controller, there is a reduction in the risk of unwanted operating errors by the user, which enhances safety.

In a particularly preferred embodiment it is provided that at any desired moment in time while the crane controller is in the second operating mode, the crane controller pauses the succession of changes in the crane geometry by actuation of a switch (for example a dead man's switch on the control console) and all operating elements acquire their original function assignment. In that case the user can manually perform a correction where applicable to the crane geometry (for example to pass around an obstacle). After conclusion of actuation of the switch all operating elements are blocked again automatically by the crane controller and only the speed presetting is possible in order to be able to continue the interrupted sequence after renewed and positive safety checking by the crane controller.

In some embodiments, it is preferably provided that in the predetermined sequence of movements of the crane geometry the crane controller always moves to a parking position of the crane from a predetermined direction of rotation of a crane column of the crane relative to a crane base of the crane. It is thus possible to ensure that, to compensate for any measurement tolerances, the crane column is always moved from the same rotary direction and in addition from the same angular region into the parking position.

Further advantages and details of various embodiments of the invention are discussed with reference to the accompanying Figures in which:

Figure 1a shows the main menu of a menu-driven user interface of a crane controller according to an embodiment of the invention,

Figure 1b shows a sub-menu of the main menu of Figure 1a,

Figure 1c shows a safety query of the menu-driven user interface,

Figure 1d shows a further configuration of a sub-menu of the main menu of Figure 1a,

Figure 1e shows a further configuration of a safety query of the menu-driven user interface,

Figure 1f shows a further configuration of a sub-menu of the main menu of Figure 1a,

Figure 1g shows a further configuration of a safety query of the menu-driven user interface,

Figure 2 shows a perspective view of a vehicle with crane arranged thereon,

Figure 3 shows a control console for operation of a crane controller according to an embodiment of the invention and diagrammatically the crane controller with the crane sensor system,

Figures 4a through 4g diagrammatically show a sequence of changes to the crane geometry caused by a crane controller according to an embodiment of the invention which is in the second operating mode, starting from a working position and ending in a parking position,

Figures 5a through 5d diagrammatically show a sequence of changes to the crane geometry caused by a crane controller according to an embodiment of the invention which is in the second operating mode, starting from a parking position and ending in a working position.

Figure 1a shows the main menu of the menu-driven user interface of the crane controller. The main menu has selectable sub-menu points, in this preferred embodiment a menu bar arranged at the left-hand edge of the main menu. Access is given to the sub-menu "activation of the second operating mode" (Figure 1b) by selecting the appropriate icon.

Figure 1b shows the two selection options for activation of the second operating mode, namely "parking position" and "working position". Selection of the selection option "parking position", after a positively implemented check in respect of the safety situation, in particular the currently prevailing crane geometry and the

equipment state of the crane, by the crane controller and the user, causes a sequence of changes to the crane geometry, starting from a "working position" and ending in a "parking position". Selection of the selection option "working position", after a positively implemented check in respect of the safety situation, in particular the currently prevailing crane geometry and the equipment state of the crane, by the crane controller and the user, causes a sequence of changes to the crane geometry, starting from a "parking position" and ending in a "working position".

Figure 1c shows a safety query of the menu-driven user interface which in this embodiment appears at the transition from the translatory to the rotatory movement phase of the change in the crane geometry. Linked thereto the change in crane geometry is paused. The crane controller in that case remains in the second operating mode and waits for confirmation by the user. The aim and purpose of the safety query in this embodiment is to cause the user to perform a visual check of the safety situation. That can include for example:

- checking the equipment state of the crane in regard to ancillary equipment or loads which cannot be automatically detected by the crane controller, for example if a load mounting means where applicable is already dismounted, is there still a load on the crane?

- checking the equipment state of the guide means of the load cable and its cable winch,

- checking the crane for completely retracted thrust systems and manual jib extensions (of the crane and a fly jib where applicable), and

- checking the spatial aspects. Is there sufficient space for performing the sequence of changes in crane geometry into the "parking position" and "working position" respectively?

After confirmation by the user the crane controller continues processing of the remaining sequence of changes in the crane geometry to reach the desired end position. As long as no confirmation has been implemented by the user the crane controller remains in the second operating mode but does not cause any movements. If actuation by the user fails to occur within a predetermined period of time the function is broken off and the crane controller terminates the second operating mode. Confirmation by the user is necessary again in this preferred embodiment to change into the first operating mode.

Figure 1d shows a further configuration of a sub-menu with the two selection options for activation of the second operating mode, which again include "parking position" and "working position".

Figure 1e shows a further possible option in regard to the configuration of a safety query of the menu-driven user interface.

Figure 1f shows a further possible configuration of a sub-menu with the two selection options for activation of the second operating mode which again include "parking position" and "working position".

Figure 1g shows a further configuration of a safety query of the menu-driven user interface.

Figure 2 shows a side view of a vehicle 50 on which a vehicle crane 100 is arranged. The crane system 110 of the vehicle crane 100 in this case has the lift arm 111 and the pivotal arm 101. In this preferred embodiment the cable winch 104 is arranged on the lift arm 111. That cable winch 104 serves for lifting loads by means of the load cable 103.

Provided on the pivotal arm 101 – which is of a telescopic nature – is a hingedly arranged second pivotal arm which here is in the form of a fly jib 102. In this case the pivotal arm 101 has a plurality of boom extensions 107 and the fly jib 102 also has a plurality of boom extensions 108. The end of the crane system 110 forms the crane tip 109. It is to be noted here that this embodiment involves a variant of a crane system 110 of the vehicle crane 100, and naturally it is also possible to envisage any other configuration of a crane system 110, like for example a crane system 110 with a telescopic lift arm.

Figure 3 shows a control console 6 for the operation of a crane controller 10 according to the invention and diagrammatically shows the crane controller 10. Here the control console 6 preferably has a radio remote control means. Depending on the selection of one of the two options "parking position" 4 and "working position" 5 by the user the crane controller 10 automatically checks whether, insofar as can be detected by the crane controller 10, there are safety obstacles in regard to activation of the second operating mode.

For example the crane controller 10 checks whether the present crane geometry is suitable in safety terms at all as the starting point for the predetermined sequence of changes to the crane geometry into the "parking position" 4 or "working position" 5 respectively. If the crane 100 is in a working position a check is made for example to ascertain whether the angle between the outermost arm of the crane and

the crane column 106 is in a given range. It is also possible to check whether the pivotal angle of the crane column 106 relative to the crane base 206 is within an acceptable range. In addition the crane controller 10 can check whether there is a working cage on the crane 100. The generally known sensor system of a crane 100 of the general kind set forth can be used for all those functions.

Hitherto all operating levers 11, 31 are available to the user for free operation in accordance with the function assignment allocated at the factory.

If all operating levers 11, 31 are in the neutral position and the user has given his approval then all operating levers 31 except one are blocked, that non-blocked operating lever 11 after activation of the second operating mode serves for the user to be able to select the speed at which the crane geometry is changed, by deflection of the operating lever 11 out of its neutral position.

The remaining two Figures now show how specifically in the embodiment by way of example the predetermined sequence of change in the crane geometry takes place.

Figure 4a diagrammatically shows the crane 100 in a working position 12 with extended thrust systems 107 and 108 of the pivotal arm 101 and the fly jib 102 respectively. It is not possible to see in Figure 4a (but see Figure 2) that there is also a cable winch 104 in the working position with the cable 103 reeved thereon.

Figure 4b shows a view from above of the crane 100 in the working position 12 shown in Figure 4a in order to show the pivotal state of the crane column 106 relative to the crane base 206.

Figure 4c after activation of the second operating mode shows that crane geometry which occurs after retraction of the crane system 110 and the fly jib 102. The translatory changes in the crane geometry are thus concluded. Hitherto there have not yet been any rotatory changes in the crane geometry (change in the pivotal state of the crane column 106 with respect to the crane base 206, or a change in the relative angles between the crane arms 101, 102 and 111.).

In this embodiment the safety query 1 of the crane controller 10 is now presented to the user, as shown in Figure 1c.

It is assumed hereinafter that the safety query 1 was positive.

A change in the relative angles between the crane arms is now effected without altering the pivotal state of the crane column with respect to the crane base (Figure 4d). In that defined intermediate position of the crane a plausibility check in respect of the crane loading is effected by means of the pressure sensor 52, such loading,

depending on the crane configuration which can be detected by way of the crane controller (for example: whether a fly jib is or is not fitted), must be below predetermined limit values.

Figure 4e shows the crane geometry after the change has been made in the pivotal angle of the crane column relative to the crane base. In the transition from Figure 4b to Figure 4e the cable winch is also pivoted into the parking position.

Figure 4g shows the change in the relative angles between the crane arms 101, 102, 111 into the parking position 2. Shortly before the parking position 2 is reached the system preferably implements a switch-over from position regulation by means of the sensors 54 and 56 to pressure regulation by means of the pressure sensors 51 and 52 in order to work around a possible play in the crane arms 102, 111 or inaccuracy in position regulation. Shut-down is effected when a predetermined pressure level is reached.

There is naturally also a given play in regard to the change in the angle between the crane column 106 and the crane base 206, for which reason it is preferably provided that a pivotal movement of the crane column 106 relative to the crane base 206 is always effected from the same angle range (Figure 4f), that is to say if the crane column 106 should approach the parking position 2 from another angle range, then it goes beyond that position so that it can be moved into the parking position from the specified same angle range (see Figure 4f).

Similarly to Figure 4 Figure 5 shows the predetermined transition from the parking position 2 into the working position 12.

During the predetermined sequence of movements of the crane geometry the change in length caused thereby in respect of the reeved load cable 103 of the cable winch 104 is automatically compensated by the cable tension being regulated by the crane controller 10. That therefore prevents both the cable becoming slack and also an overload situation in respect of the cable winch 104.

It is further provided that the crane controller 10 performs automatic hydraulic biasing of the different thrust systems 107 and 108 and also the lifting cylinders for the pivotal movement of the crane arms 101 and 102.

At any desired point in time while the crane controller 10 is in the second operating mode a switch (dead man's switch) can be actuated, which has the result that the crane controller 10 pauses in the sequence of changes in the crane geometry and releases all operating levers 11, 31. In that case the user can manually perform a correction where applicable in the crane geometry (for example to pass around an

obstacle). After manual correction and release of the dead man's switch by the user the crane controller 10 begins again with the safety check in respect of the crane geometry prevailing at that time and possibly resumes the interrupted sequence.

It is further provided that the crane controller 10 also automatically turns down the speed of displacement or pivotal movement of the crane geometry. That is relevant specifically when the crane 100 for example approaches the limit range in terms of stability, end abutments or electronically adjustable blocking ranges.

Advantageously, beside the currently prevailing crane geometry, the crane controller 10 also detects the support state and can thus assess or establish whether the crane 100 is stable.

Both individual intermediate positions during the predetermined sequence of movements for reaching the parking or working position and also the working position itself are dependent on the crane configuration which can be detected by way of the crane controller 10. That is to be interpreted as meaning that the crane controller 10 accesses various parameter sets in equipment-specific relationship, in particular for the target values in terms of position regulation for the sensor 54 through 56.

The above description in regard to the succession of sequences in the changes in the crane geometry relates to a particularly preferred embodiment by way of example. In addition however the sequence itself can be altered and additional preferred parking and working positions can be established.

Thus it is preferably provided that sequences which are to be pre-defined by the user can be input into the crane controller 10, in that respect the idea is that for example service workshops can perform that. For safety reasons it is provided in that case that the workshops or the user can select or alter those sequences only from a predetermined range of values or also only chronological orders of the sequence of movements can be influenced.

CLAIMS:

1. A crane controller for a crane having a first operating mode in which the crane is freely operated by a user by means of control commands and a second operating mode which is activated by the user and in which a crane geometry of the crane is changed in a predetermined sequence of movements by the crane controller, wherein the crane controller has a menu-driven user interface, the menu-driven user interface having a function which is selected by the user, by which the crane controller switches from the first operating mode into the second operating mode.

2. The crane controller as set forth in claim 1, wherein the crane controller outputs a safety query to be confirmed by the user at a predetermined point in the predetermined sequence of movements.

3. The crane controller as set forth in claim 2, wherein the predetermined point in the predetermined sequence of movements is at a transition from a translatory movement phase to a rotatory movement phase of the change in the crane geometry.

4. The crane controller as set forth in claim 2 or claim 3, wherein at the predetermined point the crane controller pauses the predetermined sequence of movements of the crane geometry.

5. The crane controller as set forth in claim 4, wherein after the safety query confirmed by the user, the crane controller continues the predetermined sequence of movements of the crane geometry.

6. The crane controller as set forth in one of claims 1 to 5, wherein in the second operating mode the crane controller activates an operating lever of a control console and by actuation of said one operating lever the crane geometry is altered by the crane controller in the predetermined sequence of movements.

7. The crane controller as set forth in claim 6, wherein the crane controller controls a speed with the predetermined sequence of movements of the crane geometry in dependence in relation to a deflection of the one operating lever of the control console.

8. The crane controller as set forth in claim 6 or claim 7, wherein in the second operating mode other operating levers are deactivated by the crane controller.

9. The crane controller as set forth in any one of claims 6 to 8, wherein in the second operating mode by actuation of a switch, the crane controller pauses the sequence of changes in the crane geometry and operating elements of the control console – inclusive of the one operating lever and also the other deactivated operating levers – regain an original function assignment.

10. The crane controller as set forth in claim 9, wherein the switch is a dead man's switch.

11. The crane controller as set forth in claim 9 or 10, wherein after termination of the actuation of the switch, the crane controller cancels the pause of the sequence of changes to the crane geometry and activates the one operating lever of the control console and deactivates the other operating levers.

12. The crane controller as set forth in any one of claims 1 to 11, wherein in the predetermined sequence of movements of the crane geometry, the crane controller monitors a stability of the crane or a vehicle on which the crane is disposed.

13. The crane controller as set forth in any one of claims 1 to 12, wherein the crane controller also involves a crane tip in the crane geometry.

14. The crane controller as set forth in any one of claims 2 to 5 or 6 to 12 when dependent on claim 2, wherein the safety query to be confirmed by the

user is aimed at one or more of (1) accessory devices disposed on the crane, (2) a safety-critical spatial pivotal state of the crane, and (3) a correct equipment state of the crane.

15. The crane controller as set forth in claim 14, wherein the safety query to be confirmed by the user is aimed at a cable winch and a guide means of a load cable.

16. The crane controller as set forth in any one of claims 1 to 15, wherein during the predetermined sequence of movements of the crane geometry, the crane controller pivots and positions a second pivotal arm.

17. The crane controller as set forth in claim 16, wherein the second pivotal arm is a fly jib.

18. The crane controller as set forth in any one of claims 1 to 17, wherein during the predetermined sequence of movements of the crane geometry, the crane controller regulates a tension of a load cable.

19. The crane controller as set forth in any one of claims 1 to 18, wherein during the predetermined sequence of movements of the crane geometry, the crane controller pivots a cable winch of a load cable.

20. The crane controller as set forth in any one of claims 1 to 19, wherein the crane controller ascertains a crane loading by means of at least one pressure sensor and compares same – in dependence on a crane configuration – to predetermined limit values and when at least one of the predetermined limit values is exceeded blocks a change in the crane geometry.

21. The crane controller as set forth in any one of claims 1 to 20, wherein in dependence on the crane configuration, the crane controller automatically implements different intermediate positions and also different working positions in the predetermined sequence of movements of the crane geometry and thus the

predetermined sequence of movements of the crane geometry describes a crane configuration-dependent predefined trajectory.

22. The crane controller as set forth in any one of claims 1 to 21, wherein the crane controller performs automatic hydraulic biasing of at least one thrust system and of lifting cylinders for pivotal movement of arms of the crane.

23. The crane controller as set forth in any one of claims 1 to 22, wherein the crane controller regulates a position of the crane geometry in dependence on sensors, wherein before attainment of a given position of the crane, the crane controller effects switching over from position regulation to pressure regulation in dependence on a pressure sensor and displaces the crane into the given position by means of the pressure regulation.

24. The crane controller as set forth in claim 23, wherein the given position is a parking position.

25. The crane controller as set forth in any one of claims 1 to 23, wherein in the predetermined sequence of movements of the crane geometry, the crane controller always moves to a parking position of the crane from a predetermined direction of rotation of a crane column of the crane relative to a crane base of the crane.

26. The crane controller as set forth in claim 24, wherein in the predetermined sequence of movements of the crane geometry, the crane controller always moves to the parking position of the crane from a predetermined direction of rotation of a crane column of the crane relative to a crane base of the crane.

27. The crane controller as set forth in any one of claims 1 to 26, wherein the crane controller automatically changes the crane geometry in the predetermined sequence of movements.

28. The crane controller as set forth in any one of claims 1 to 27, configured for use in a cargo crane.

29. A crane having a crane controller as set forth in any one of claims 1 to 28.

30. A cargo crane having a crane controller as set forth in any one of claims 1 to 28.

31. A vehicle having a crane as set forth in claim 29.

32. A vehicle having a cargo crane as set forth in claim 30.

33. Use of a crane controller as set forth in any one of claims 1 to 28 in a cargo crane.

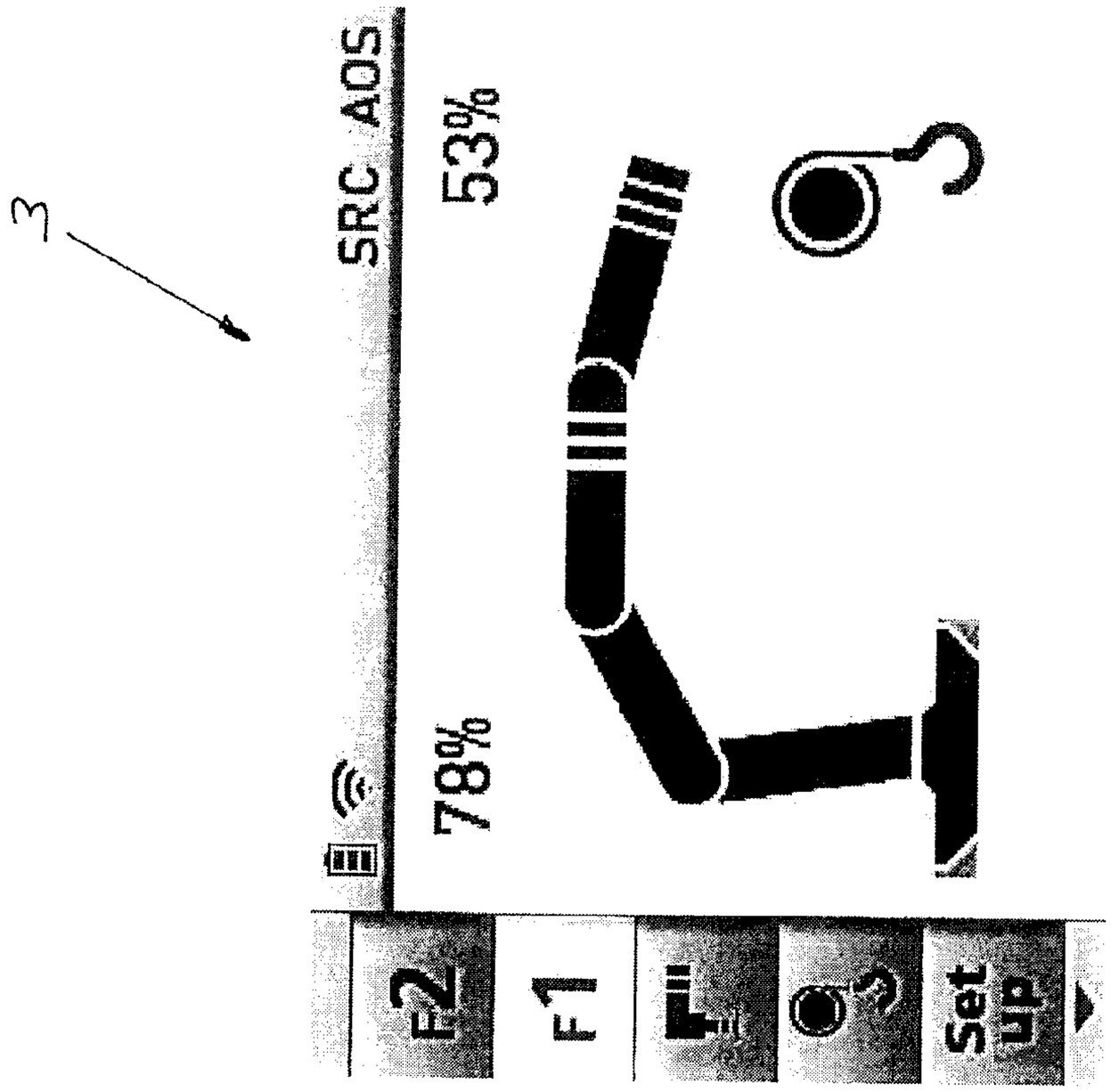


Fig. 1a

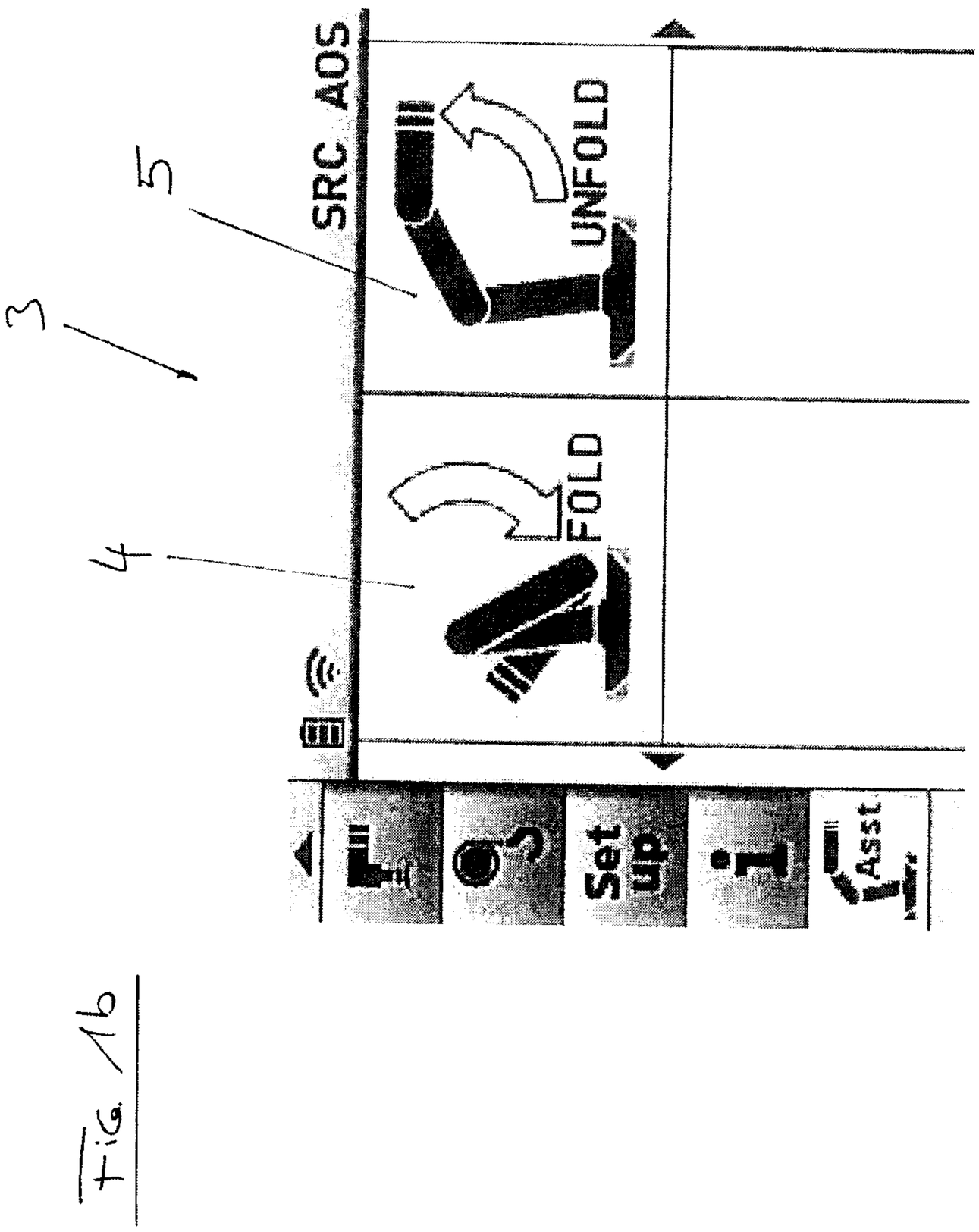


Fig 1b

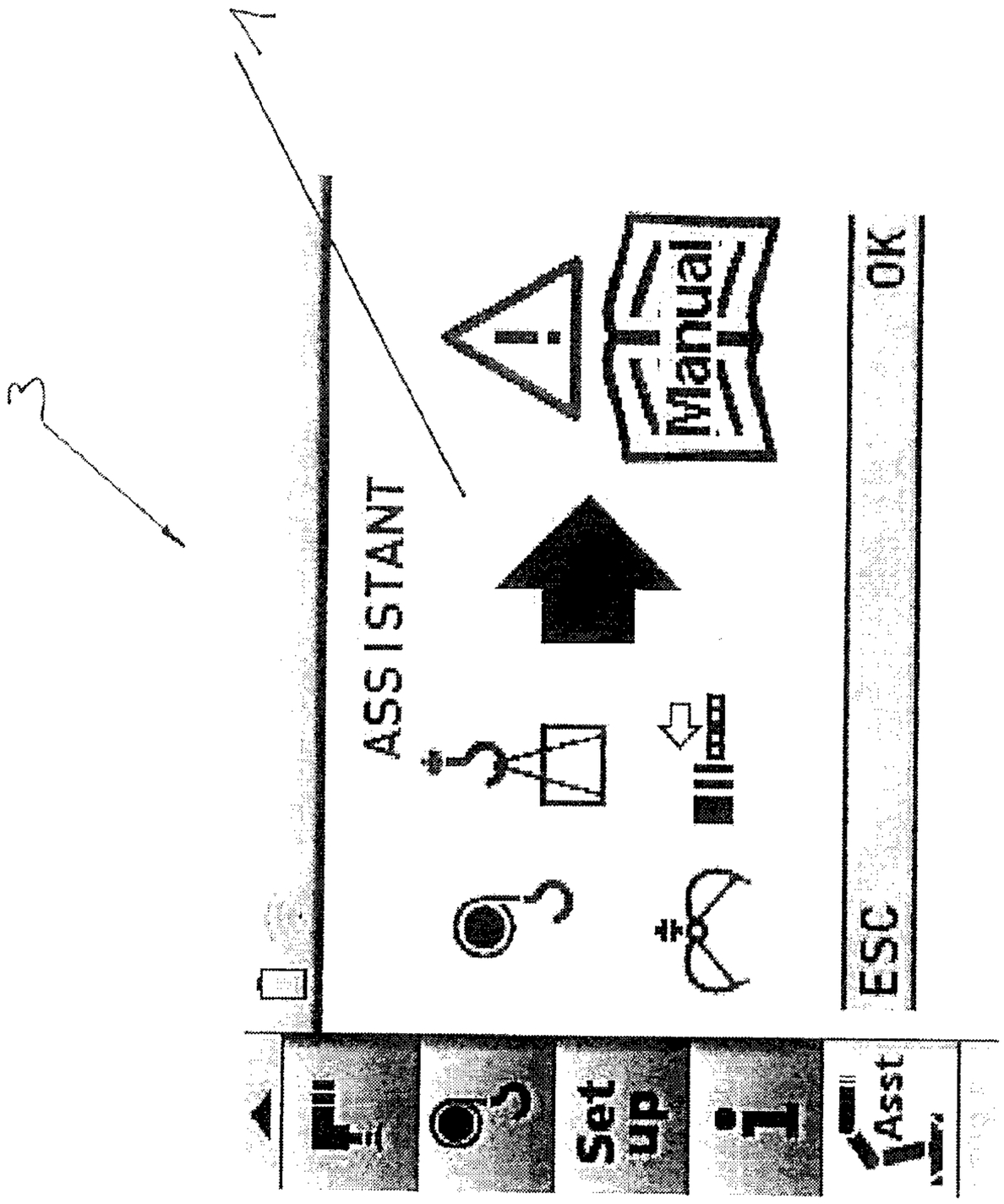


Fig. 12

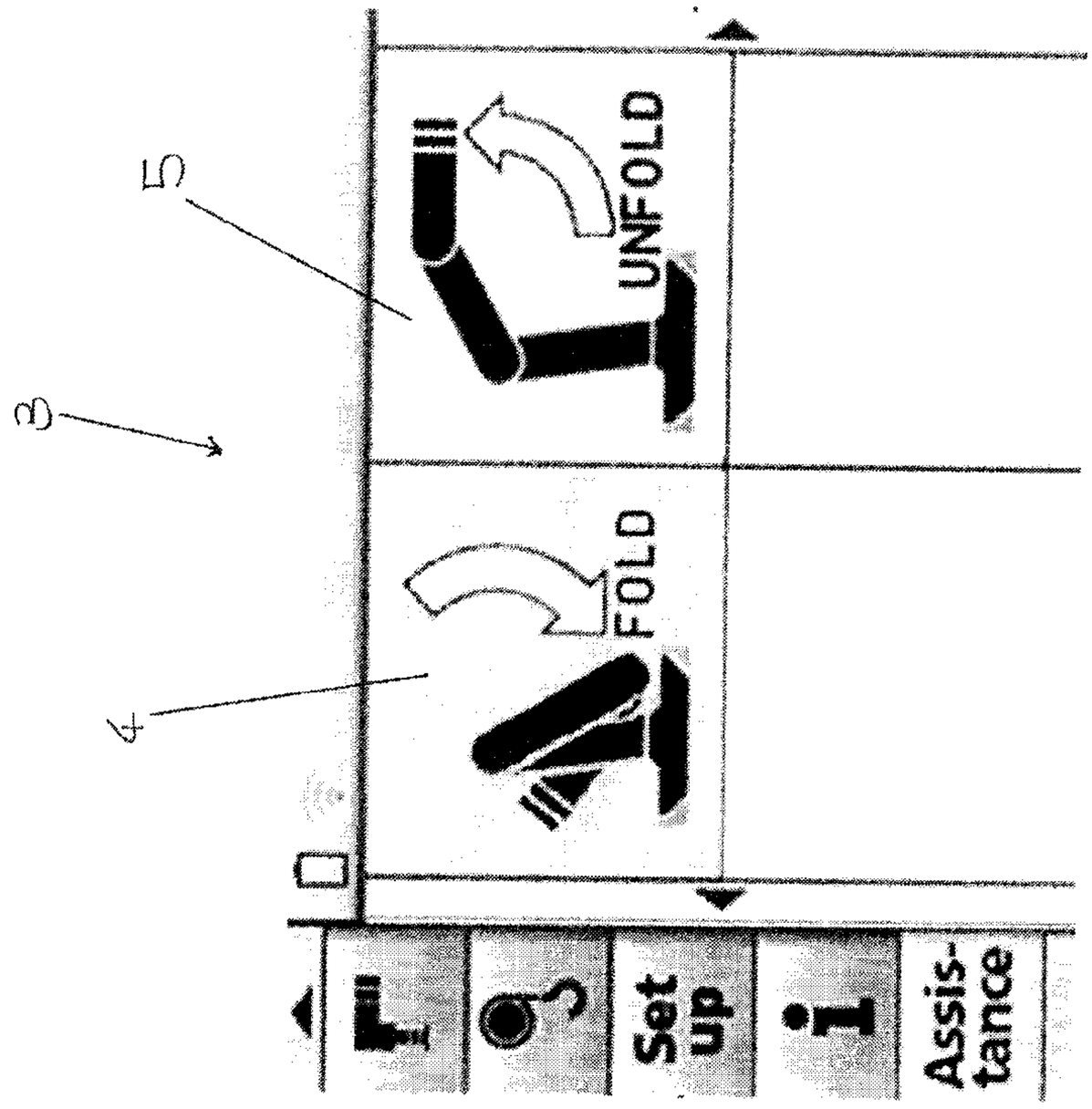


Fig. 1B

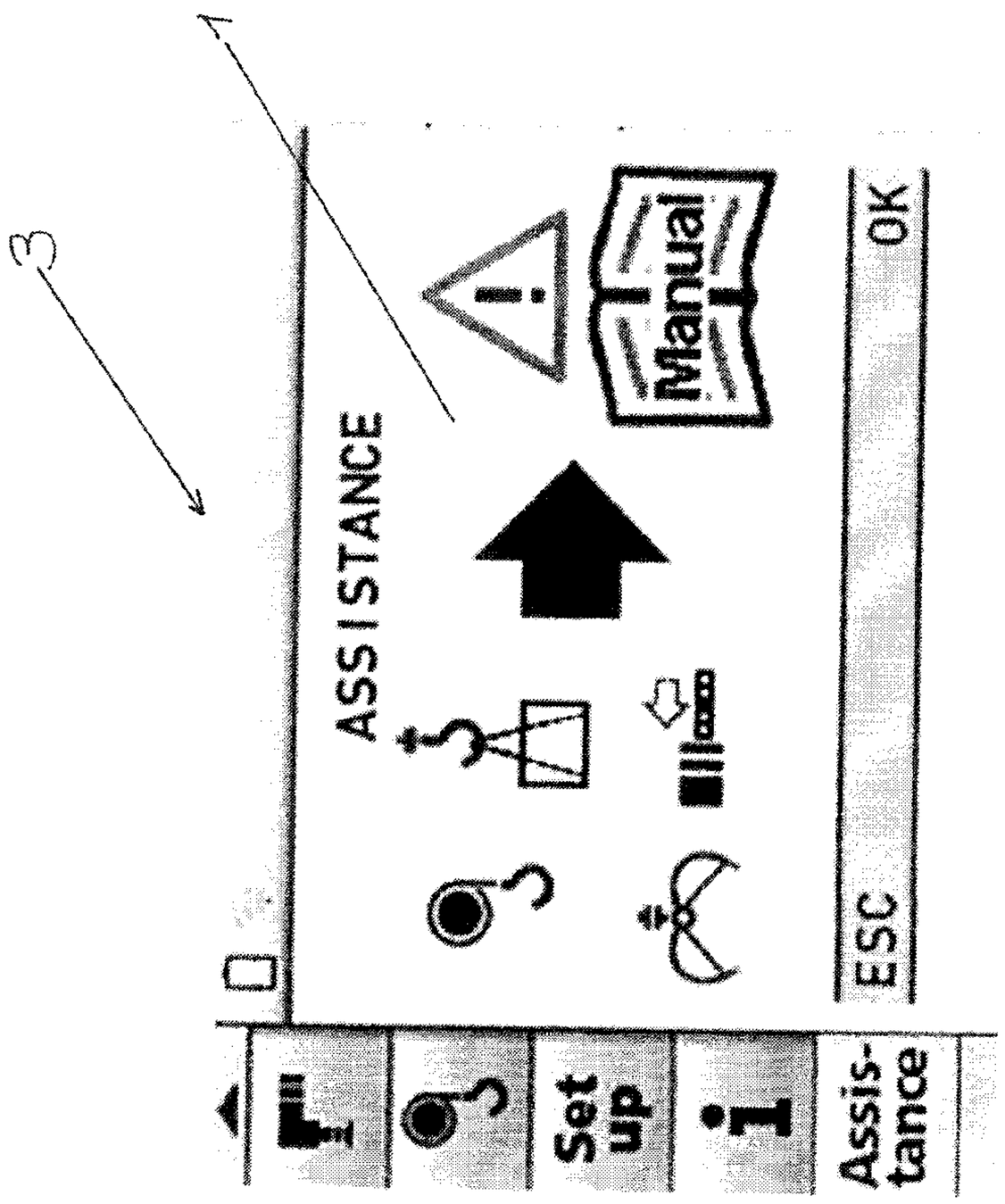


FIG 10

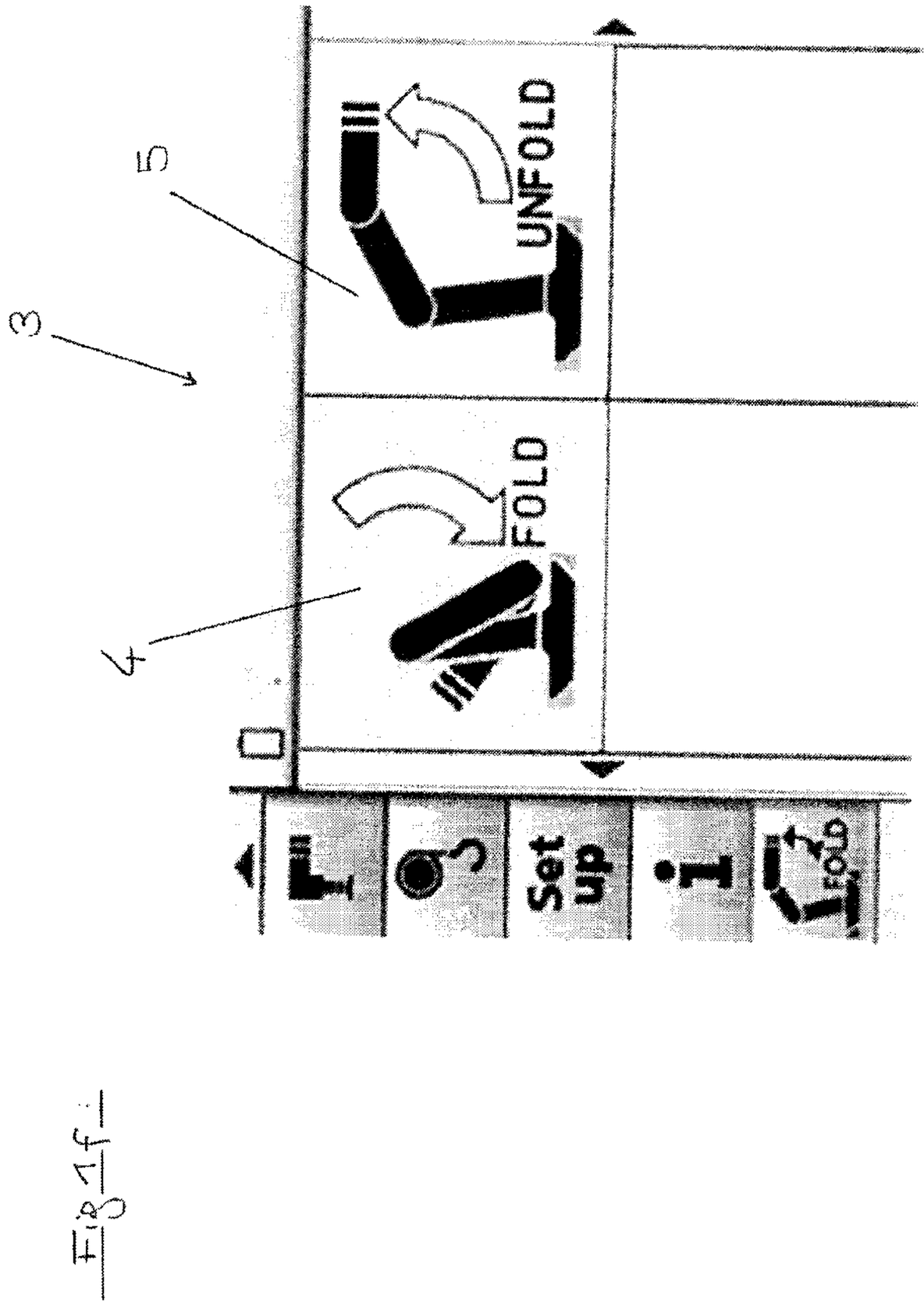


Fig. 1

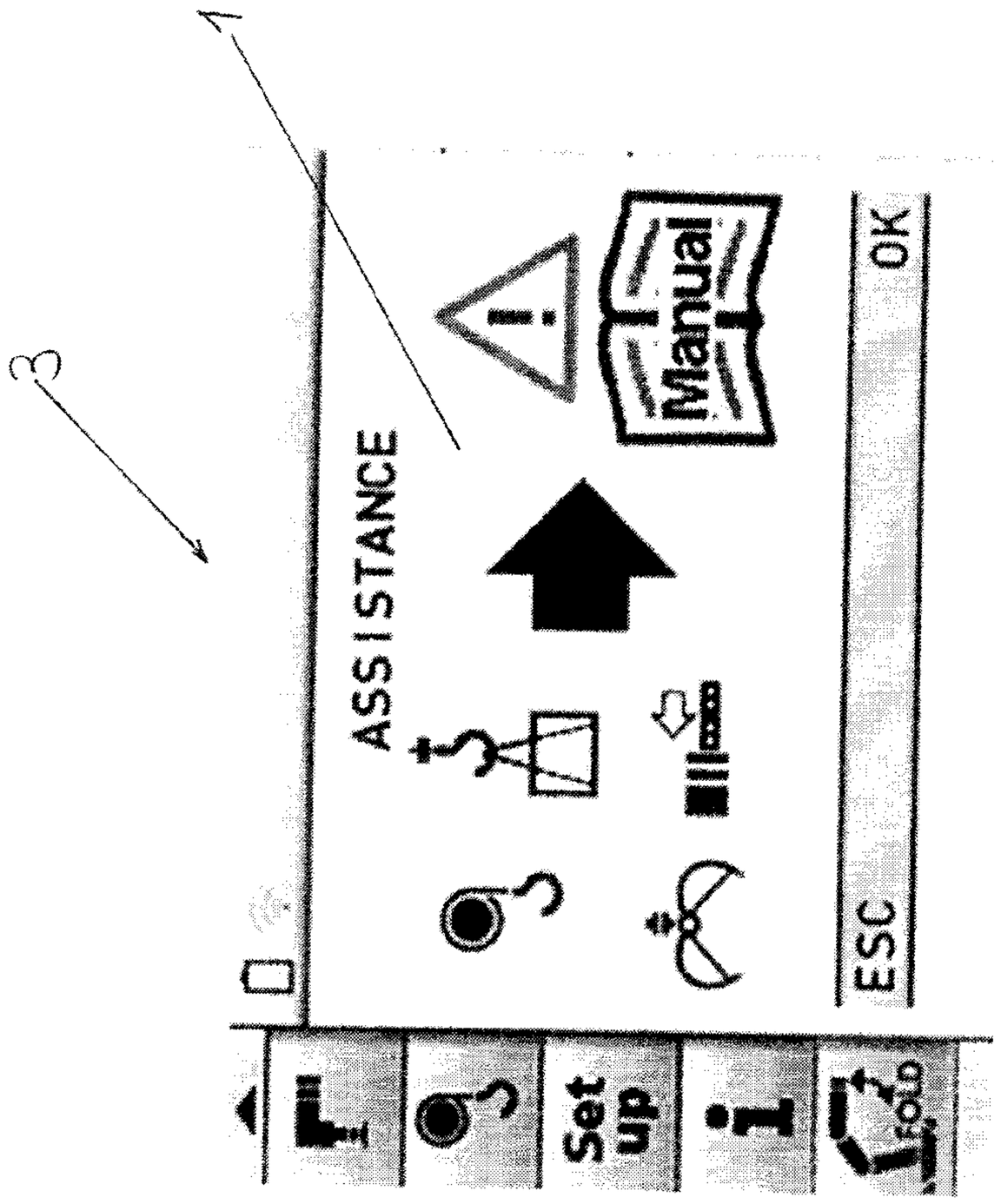


Fig 18

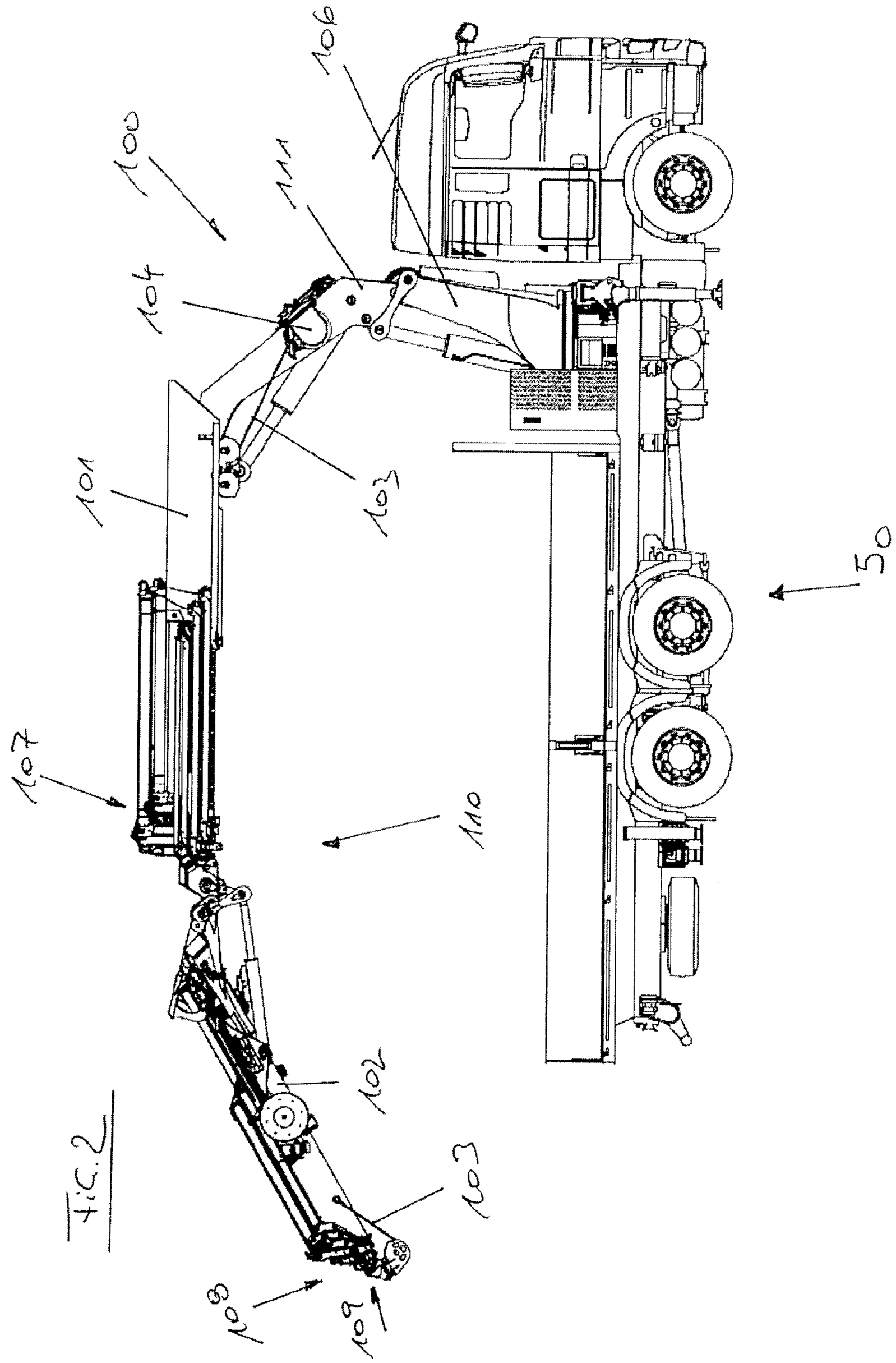
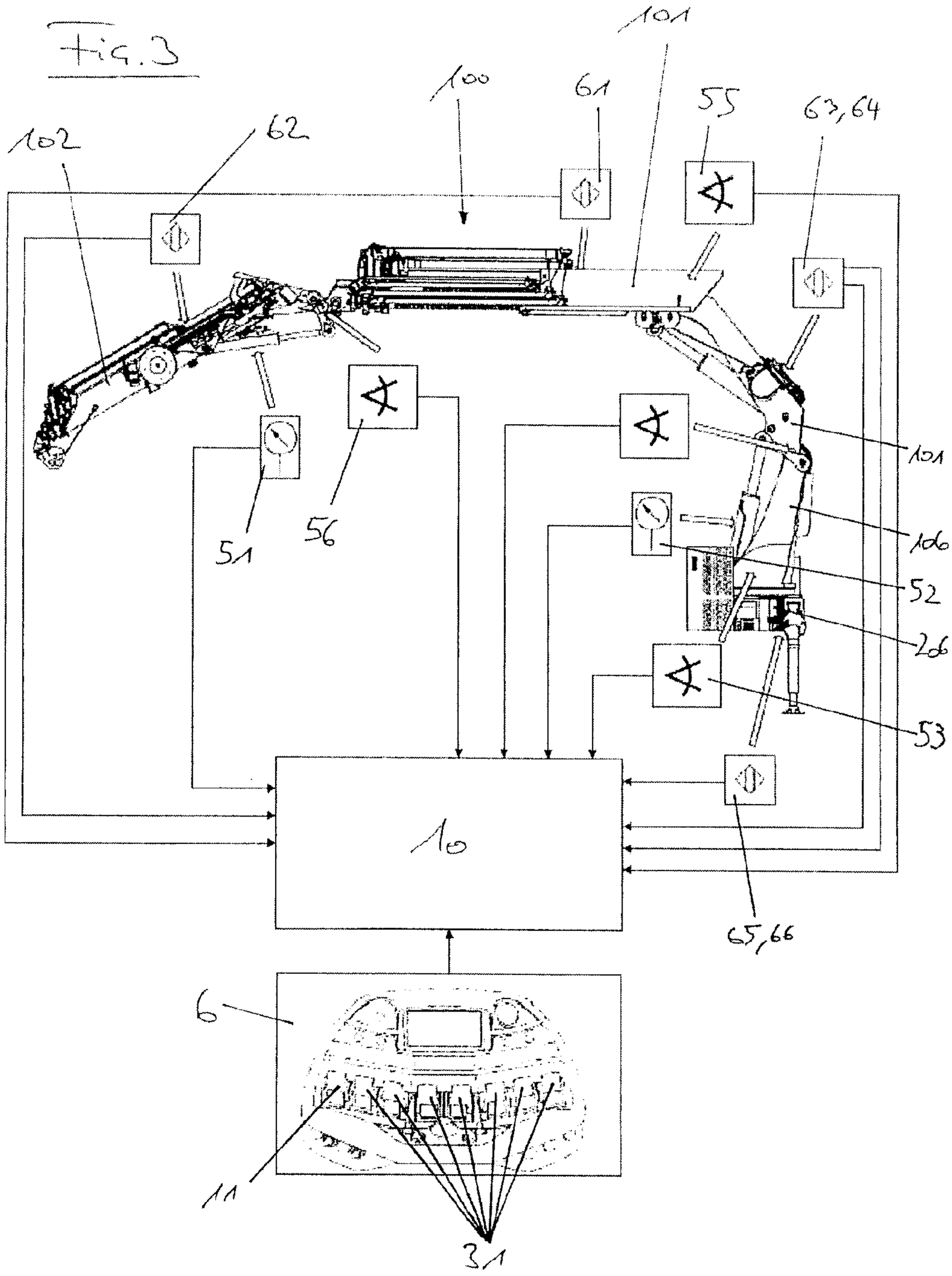


Fig.2

Fig.3



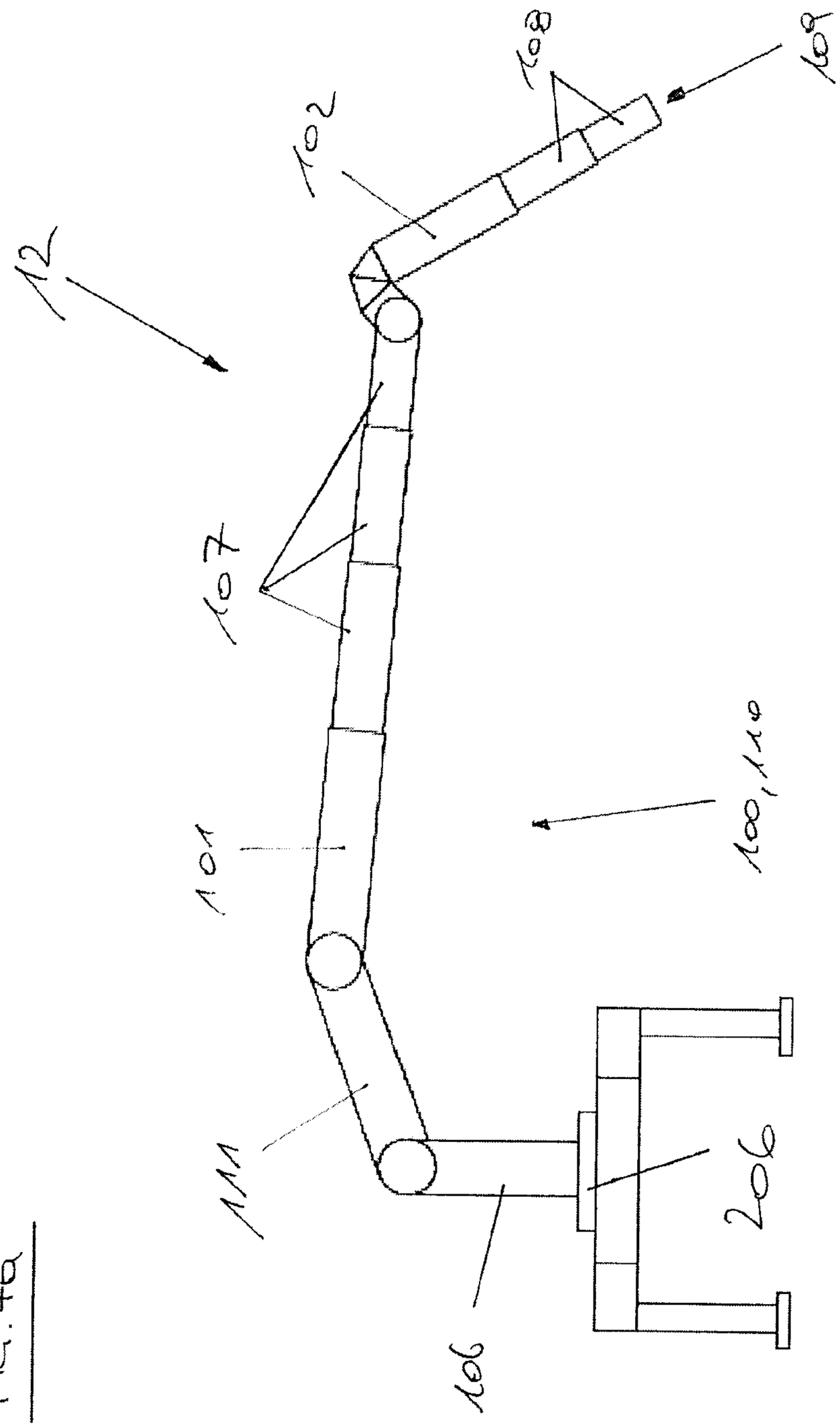


Fig. 4a

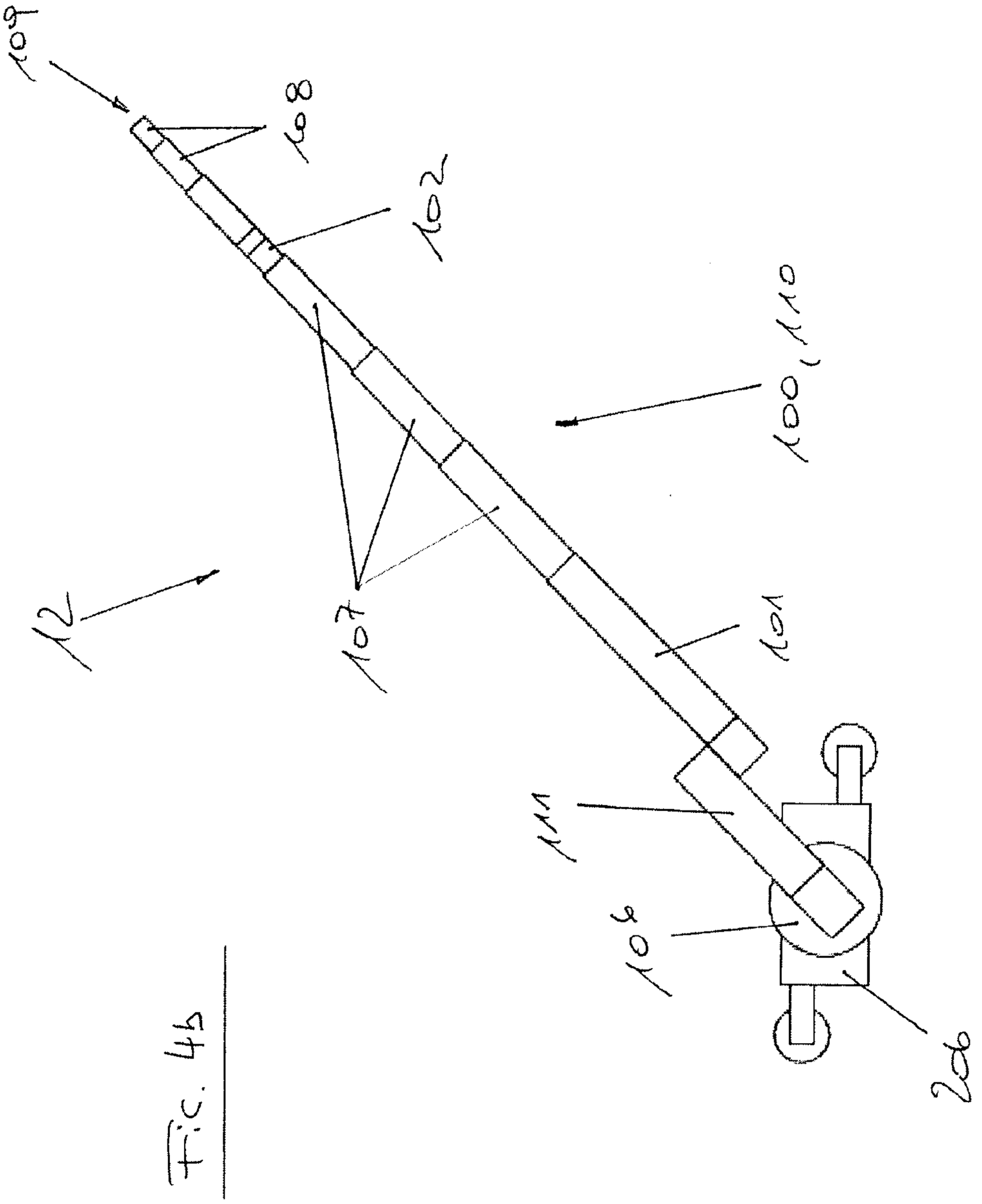


Fig. 4b

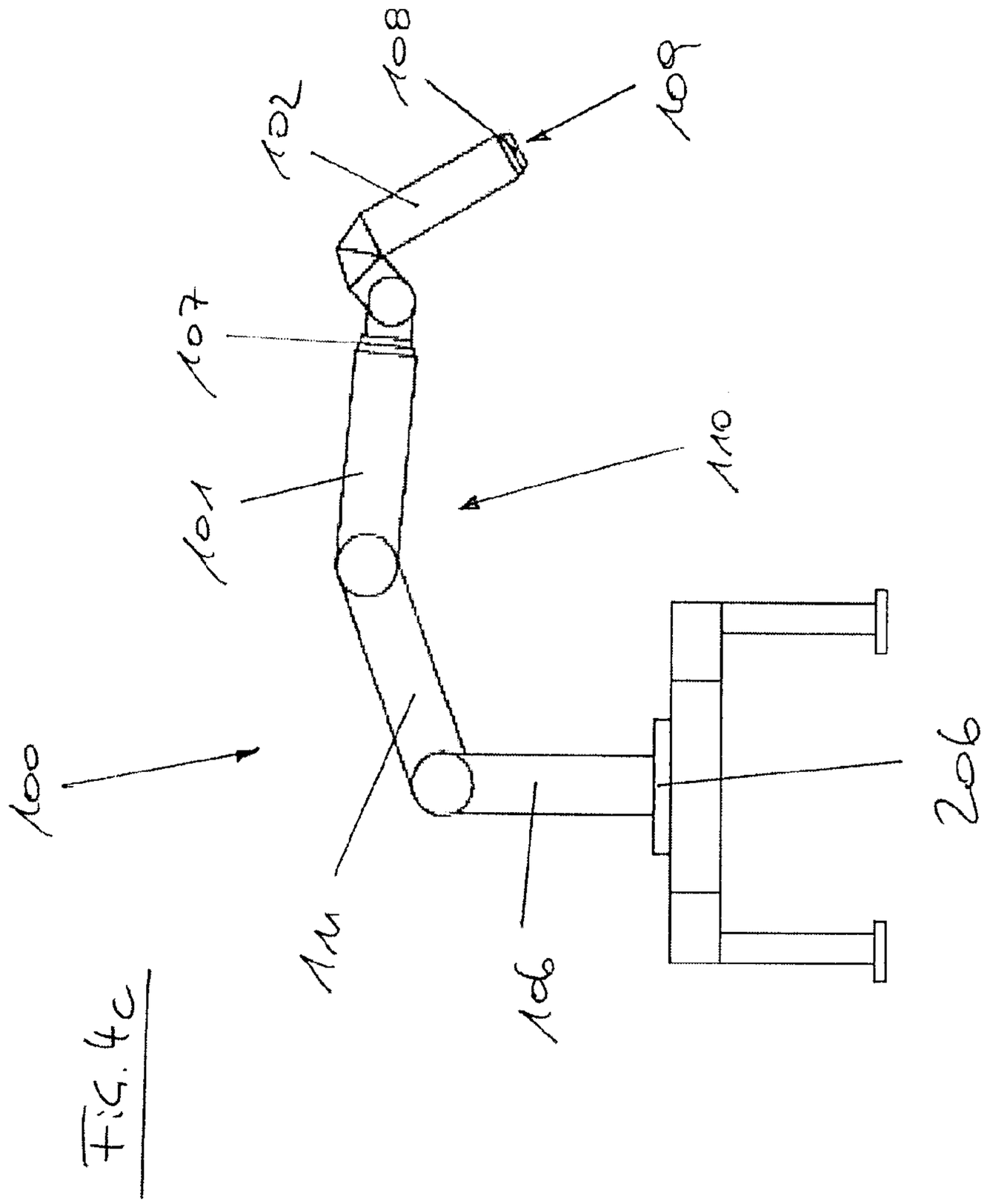


Fig. 4C

Fig. 4d

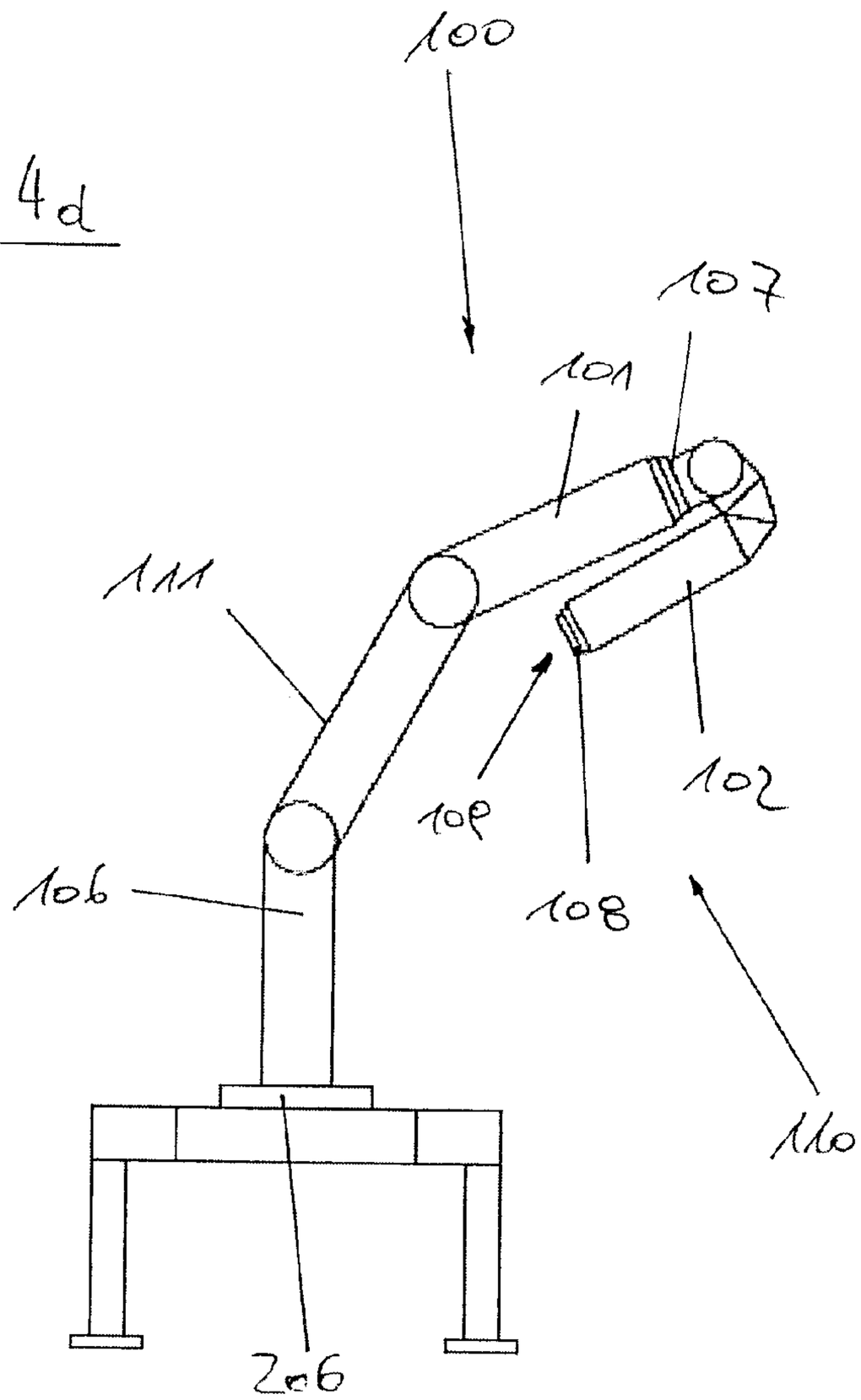
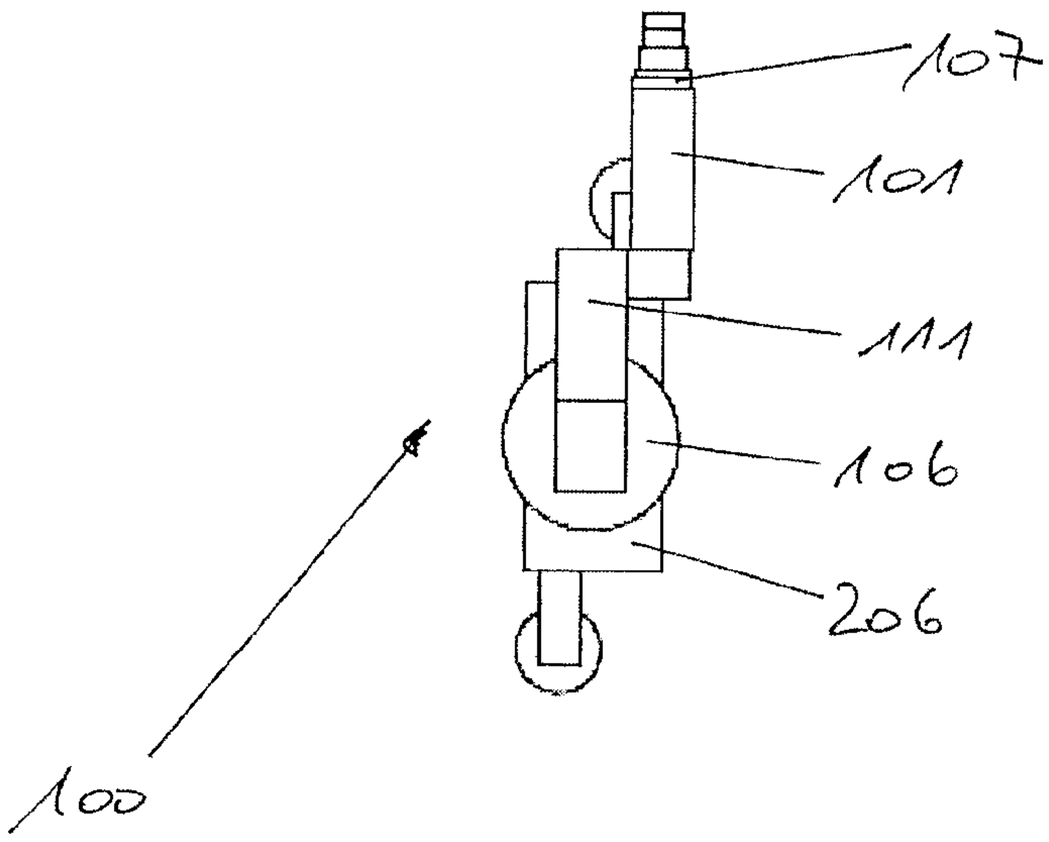


Fig. 4e



Fic. 4f

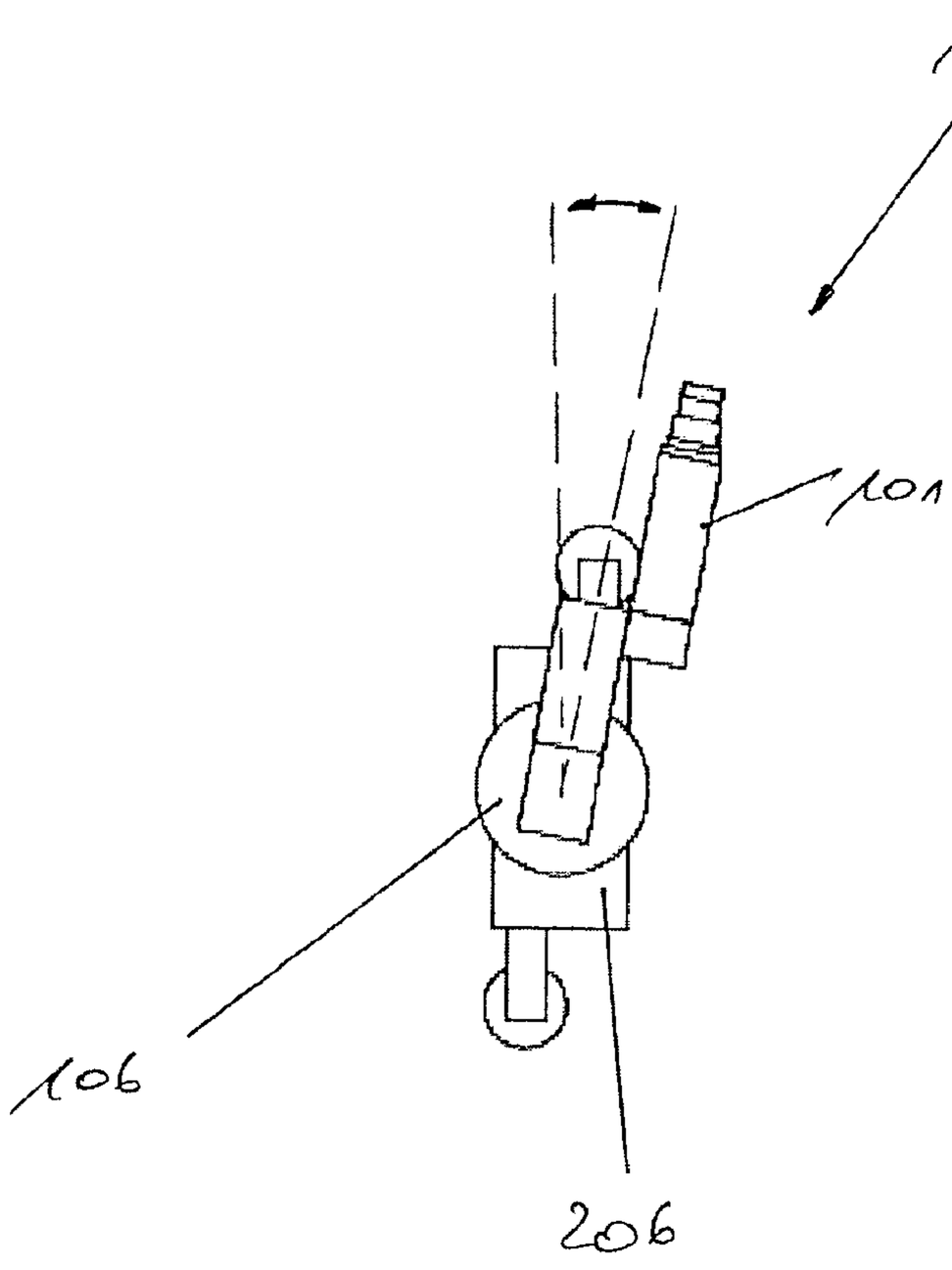


Fig. 4g

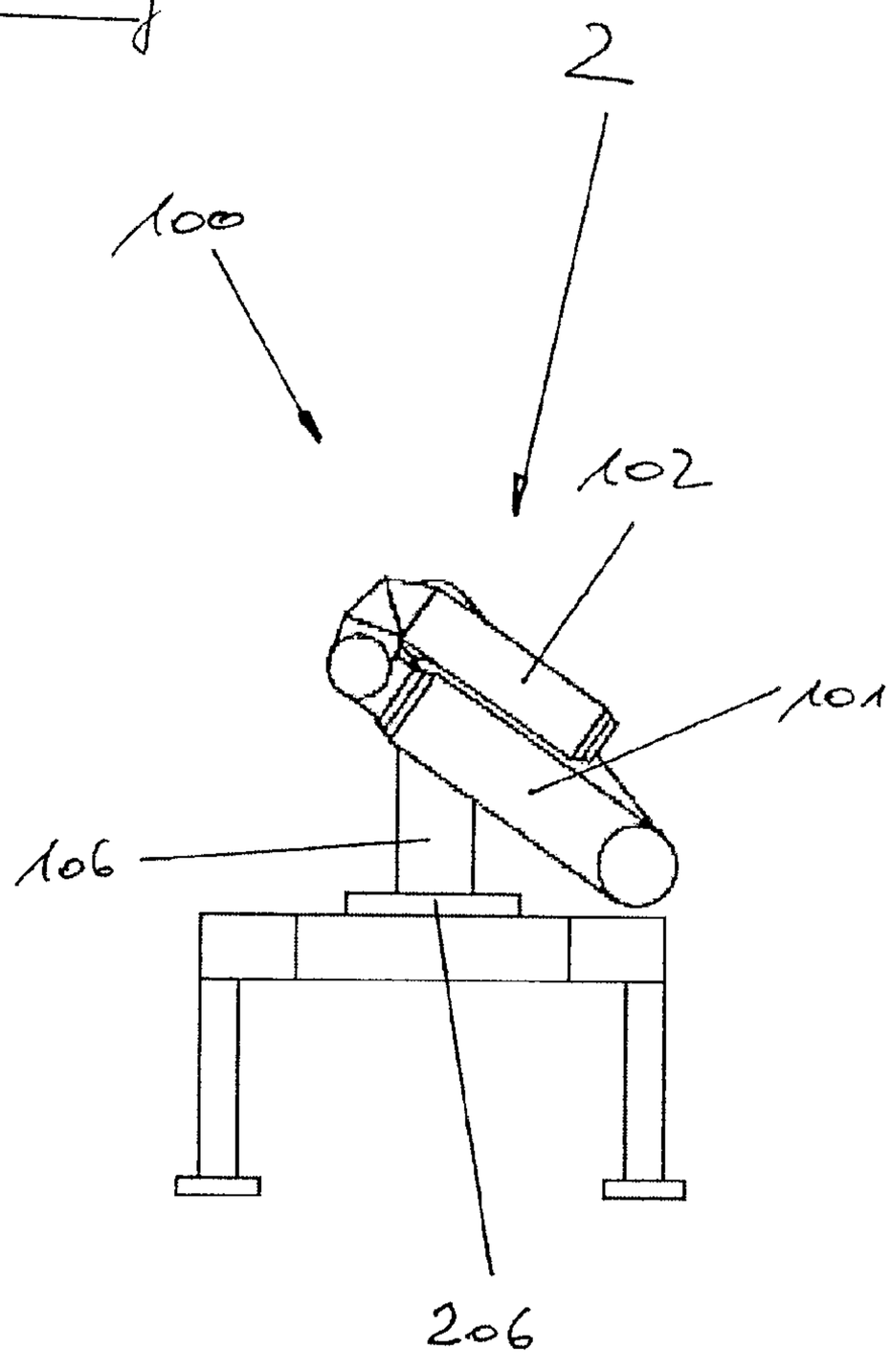


Fig. 5a

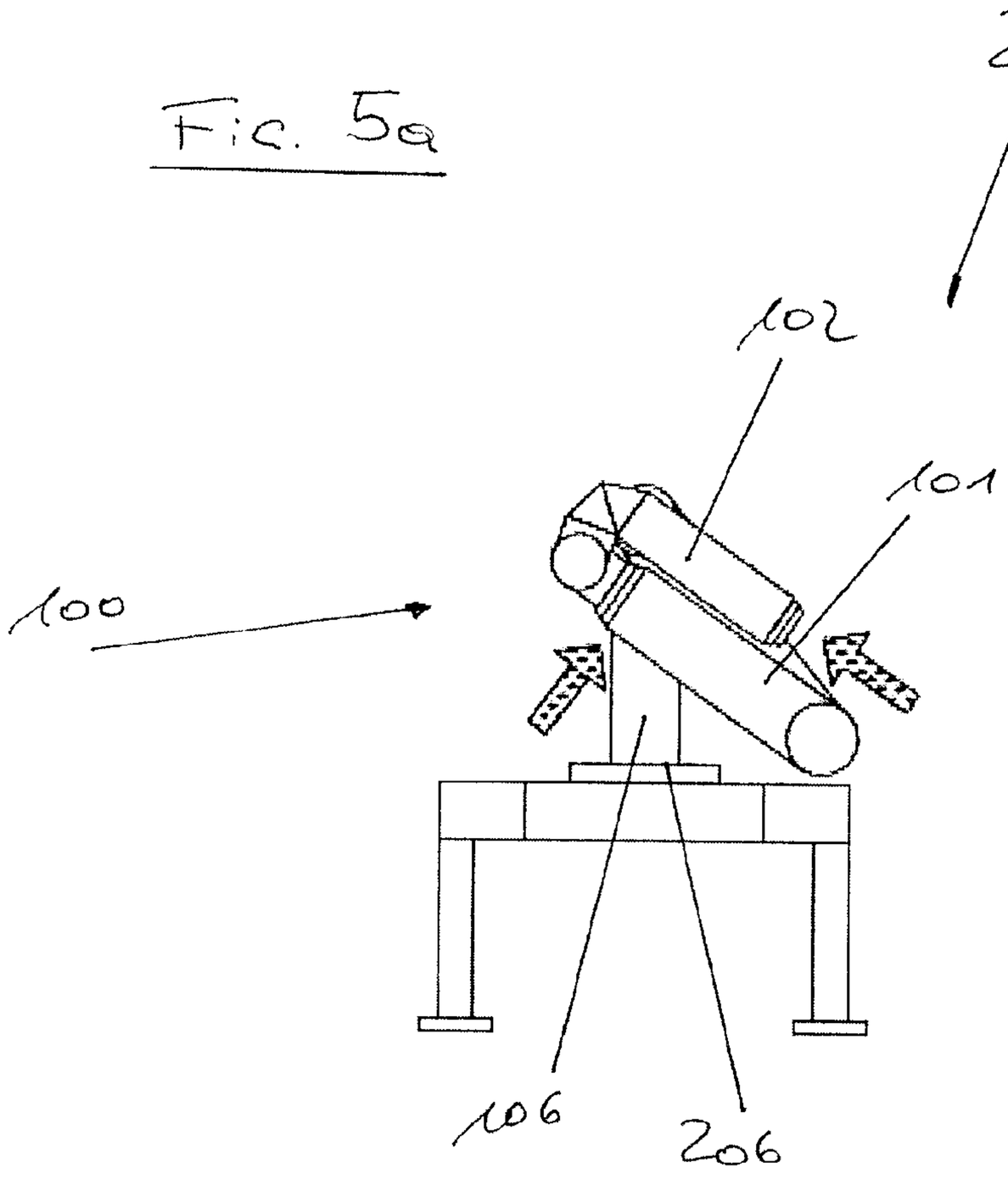
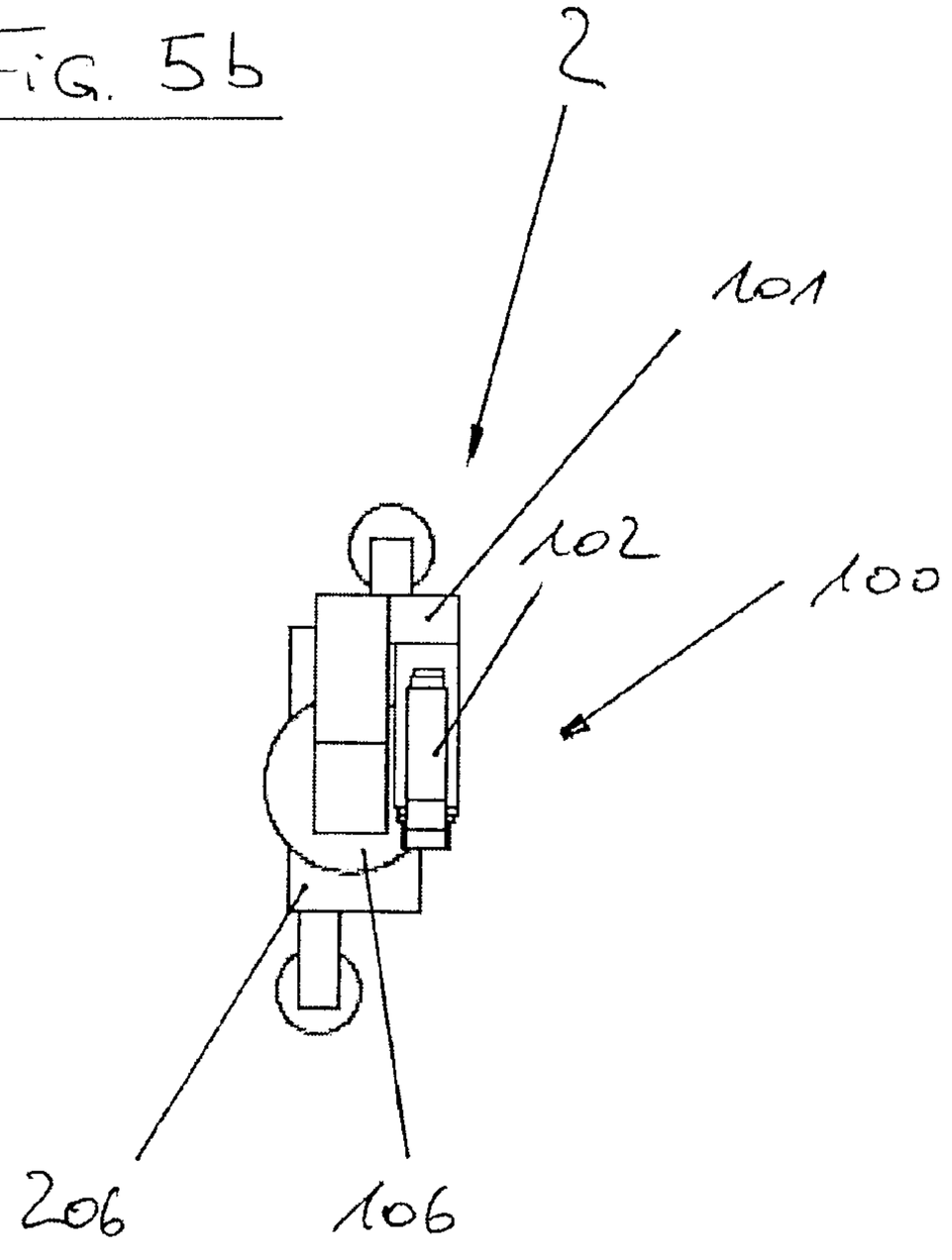


FIG. 5b



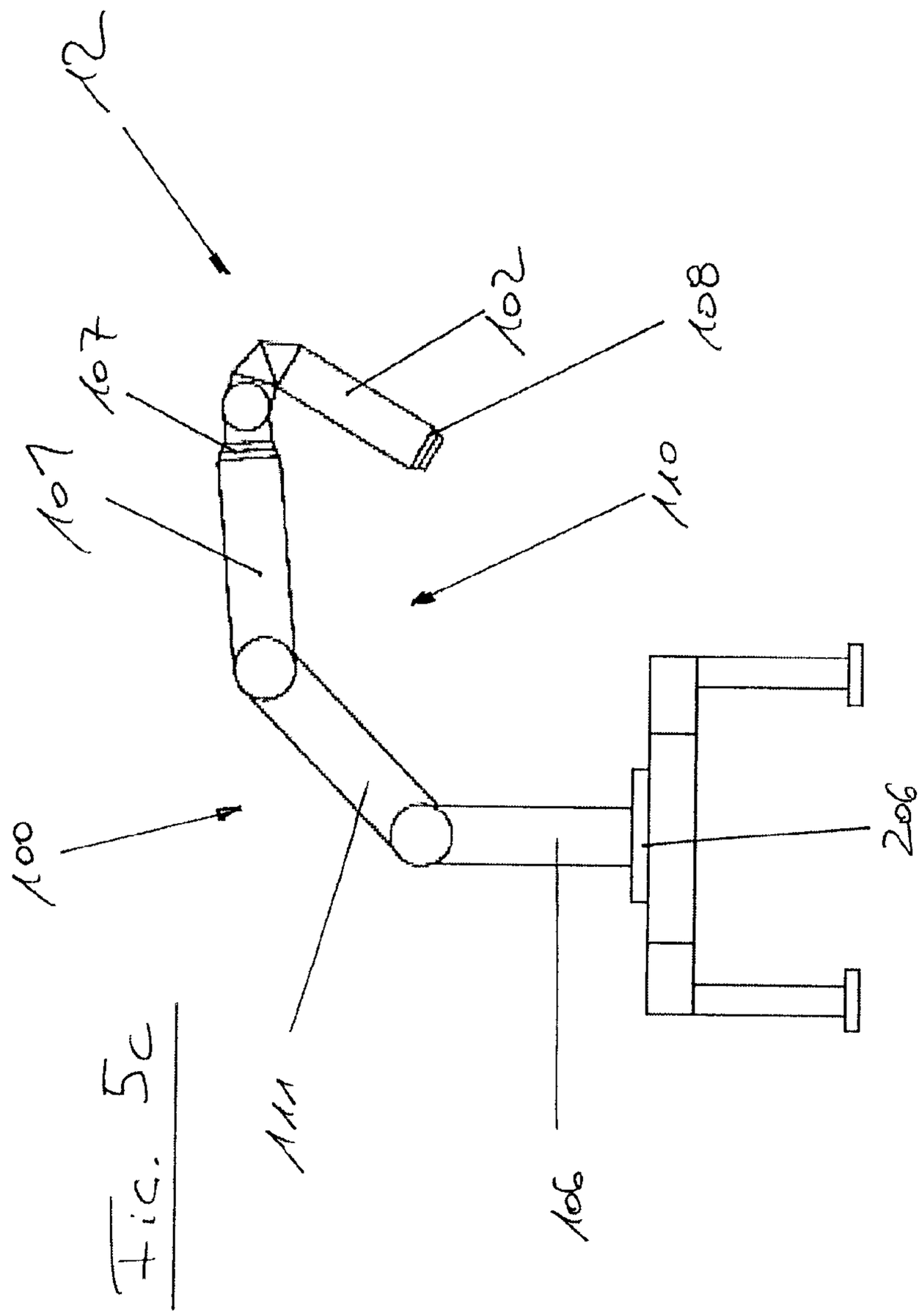
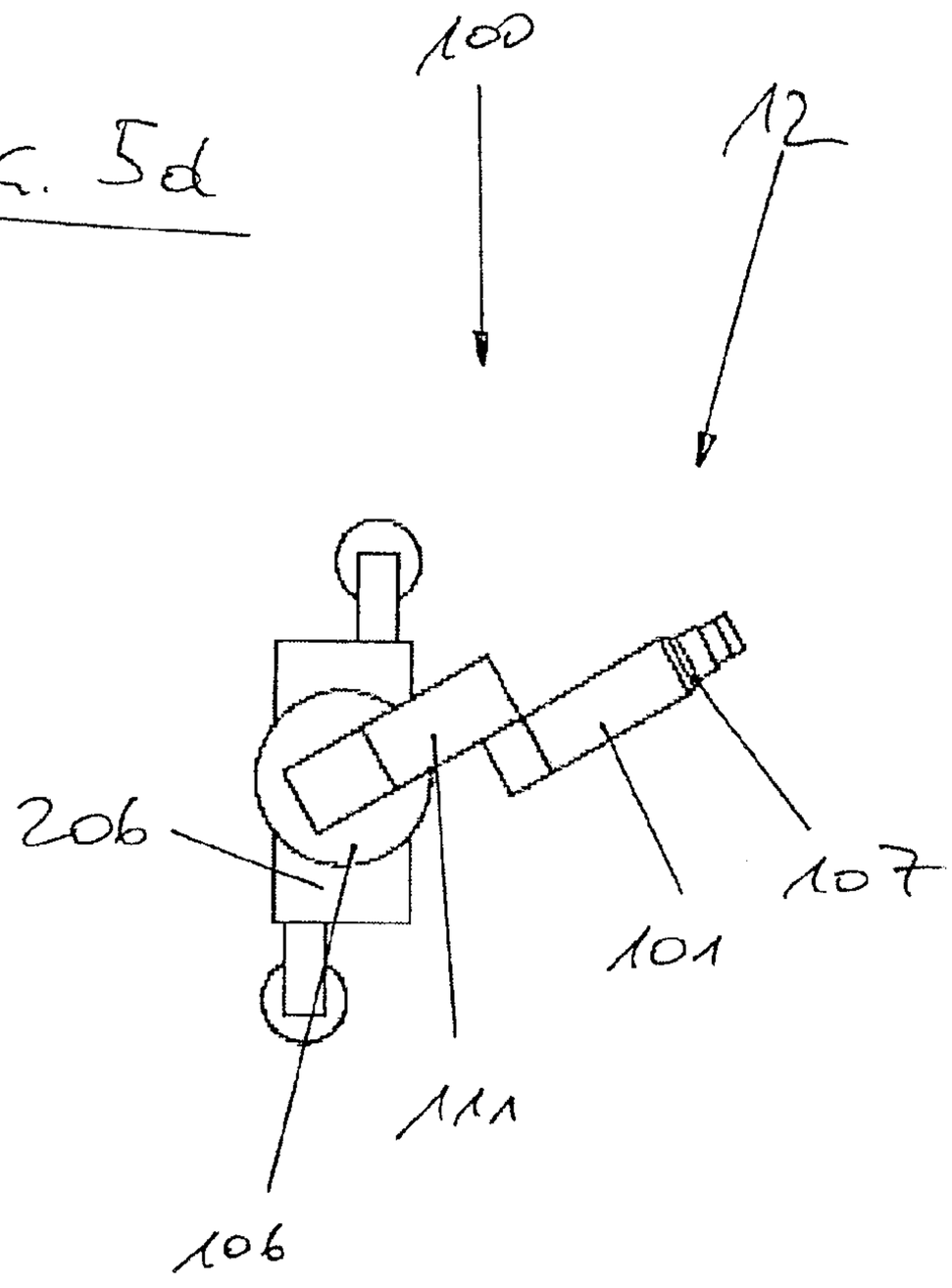
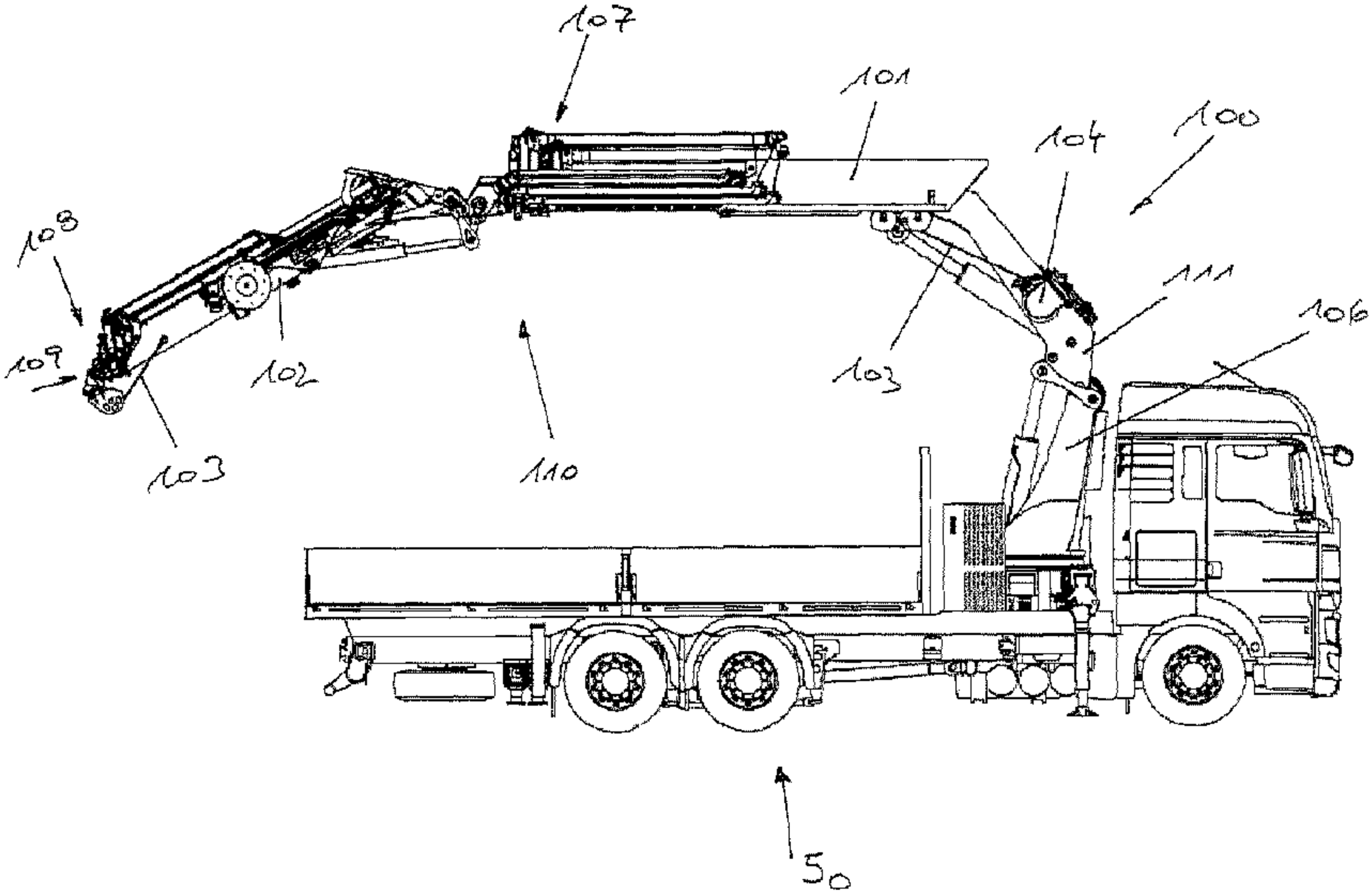


Fig. 5c

Fig. 5d

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