Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2885915 C 2020/07/21

(11)(21) **2 885 915**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2013/09/05
(87) **Date publication PCT/PCT Publication Date:** 2014/04/03
(45) **Date de délivrance/Issue Date:** 2020/07/21
(85) **Entrée phase nationale/National Entry:** 2015/03/25
(86) **N° demande PCT/PCT Application No.:** NL 2013/050640
(87) **N° publication PCT/PCT Publication No.:** 2014/051420
(30) **Priorité/Priority:** 2012/09/25 (NL2009515)

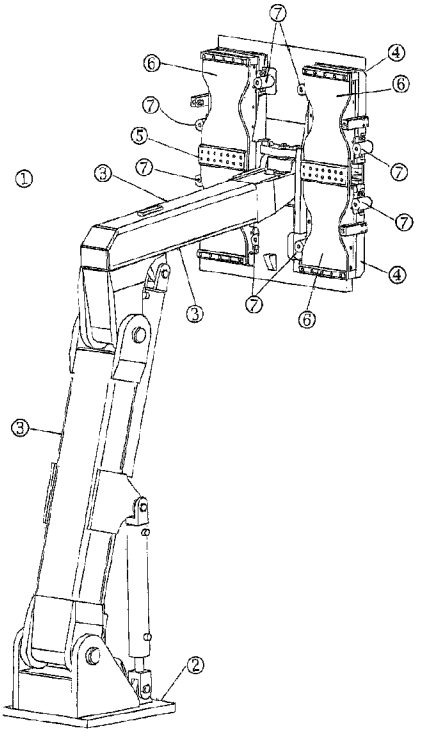
(51) **Cl.Int./Int.Cl.** ***B63B 21/02*** (2006.01)

(72) **Inventeurs/Inventors:**
BOERLEIDER, JOHAN MARLON, NL;
MAMPAEIJ, GERARDUS ANTONIUS JOZEF, NL;
LEENDERS, STIJN, NL;
VAN REENEN, WOUTER, NL

(73) **Propriétaire/Owner:**
EUROPEAN INTELLIGENCE B.V., NL

(74) **Agent:** ADE & COMPANY INC.

(54) **Titre : DISPOSITIF D'AMARRAGE POUR AMARRER UN NAVIRE**
(54) **Title: MOORING DEVICE FOR MOORING A SHIP**



(57) **Abrégé/Abstract:**
Mooring device for mooring a ship and comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the at least one magnet is arranged to attract the ship's hull, wherein at or near the at least one magnet a force generating device is provided comprising a movable force exerting part for applying a force on the ship's hull in order to test whether the magnet attracting the ship's hull provides at least a required mooring force, and that means for measuring for measuring the distance between the at least one magnet and the ship's hull are provided that are connected or connectable to a detection device for detecting whether or not the magnet is loose from the ship's hull.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 April 2014 (03.04.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/051420 A1

(51) International Patent Classification:
B63B 21/02 (2006.01)

(21) International Application Number:
PCT/NL2013/050640

(22) International Filing Date:
5 September 2013 (05.09.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2009515 25 September 2012 (25.09.2012) NL

(71) Applicant: **EUROPEAN INTELLIGENCE B.V.** [NL/NL]; Jacobus Lipsweg 38, NL-3316 BP Dordrecht (NL).

(72) Inventors: **BOERLEIDER, Johan Marlon**; c/o Jacobus Lipsweg 38, NL-3316 BP Dordrecht (NL). **MAMPAEIJ, Gerardus Antonius Jozef**; c/o Jacobus Lipsweg 38, NL-3316 BP Dordrecht (NL). **LEENDERS, Stijn**; c/o Jacobus Lipsweg 38, NL-3316 BP Dordrecht (NL). **VAN REENEN, Wouter**; c/o Jacobus Lipsweg 38, NL-3316 BP Dordrecht (NL).

(74) Agent: **VAN BREDA, Jacques**; Weteringschans 96, NL-1017 XS Amsterdam (NL).

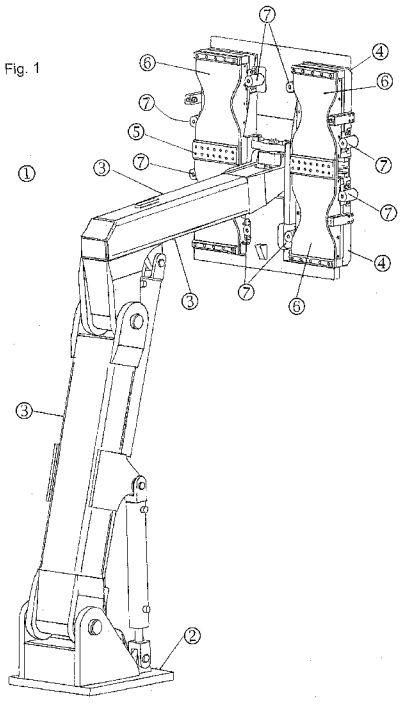
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: MOORING DEVICE FOR MOORING A SHIP

Fig. 1



(57) Abstract: Mooring device for mooring a ship and comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the at least one magnet is arranged to attract the ship's hull, wherein at or near the at least one magnet a force generating device is provided comprising a movable force exerting part for applying a force on the ship's hull in order to test whether the magnet attracting the ship's hull provides at least a required mooring force, and that means for measuring for measuring the distance between the at least one magnet and the ship's hull are provided that are connected or connectable to a detection device for detecting whether or not the magnet is loose from the ship's hull.

WO 2014/051420 A1

WO 2014/051420 A1

Published:

— *with international search report (Art. 21(3))*

Mooring device for mooring a ship

The invention relates to a mooring device for mooring a ship and comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the at least one mag- net is arranged to attract the ship's hull. The invention also relates to a method for mooring a ship using such a mooring device.

A mooring device according to the preamble is known from WO2010/053368. According to this citation the mooring device is placed ashore and is used for moving the magnet to the ship's hull and mounting the ship to the quayside. According to one of the aspects of the invention the mooring device can however also be mounted on the ship, wherein the magnet is connected to a magnetisable fixture onshore. The mooring device can also be used for connecting one ship to another ship. The magnet to be employed can be either permanent, semi-permanent or it can be an electromagnet.

There is a need to ensure, preferably automatically, that the ship is reliably moored when use is made of a mooring device according to the preamble.

From WO 2011/053140 a magnetic anchoring method and device is known comprising a magnet unit configured to generate a magnetic field to develop an attracting force between the magnet unit and a wall structure. The magnetic anchoring device of this citation further comprises a force generating device configured to engage the magnet unit, and to generate a test force in a predetermined direction between the magnet unit and the wall structure, and a force measuring device connected to the force generating device, and configured to measuring the test force.

An aspect of the invention is to improve and simplify the known magnetic anchoring method and device. A further object is to make the known method and device practically suitable for day to day use in a real life environment, and make it in principle possible that the anchoring or mooring of the ship can be performed at least in part automatically. These and other objectives will become apparent from the following disclosure of the invention.

According to a first aspect of the invention, at or near the at least one magnet of the mooring device a force generating device is provided comprising a movable force exerting part for applying a force on the ship's hull in order to test whether the magnet attracting the ship's hull pro- vides at least a required mooring force, and that means for measuring a distance between the at least one magnet and the ship's hull are provided that are connected or connectable to a detection device for detecting whether or not the magnet is loose from the ship's hull. In this very elegant way the requirement of WO 2011/053140 to measure the test force that is applied between the magnet and the ship's hull with a force measuring device is obviated so that the teaching of this citation is not used in the instant invention.

According to the invention a method for mooring a ship is proposed using said mooring device, wherein the ship's hull is attracted with the at least one magnet, and that after initial mooring wherein the magnet or magnets are close enough to attract the ship's hull, the movable force exerting part is activated for applying a force on the ship's hull in order to test whether the magnet attracting the ship's hull provides at least a required mooring force. According to the invention this is done by monitoring a distance between the magnet and the ship's hull so as to detect whether the magnet meets the required mooring force.

According to another aspect of the invention, there is provided a mooring device for mooring a ship having a hull and comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the at least one magnet is arranged to attract the ship's hull, wherein at or near the at least one magnet a force generating device is provided comprising a movable force exerting part for applying a force on the ship's hull in order to test whether the at least one magnet attracting the ship's hull provides at least a required mooring force, and wherein means for measuring a distance between the at least one magnet and the ship's hull are provided that are connected or connectable to a detection device for detecting whether or not the at least one magnet is loose from the ship's hull, wherein the movable force exerting part comprises a hydraulic cylinder fender having a preferential position in which the hydraulic cylinder fender protrudes beyond a surface of the at least one magnet for contacting the ship's hull so as to arrange that during mooring the a frontal surface of the hydraulic cylinder fender engages the ship's hull prior to the at least one magnet.

According to another aspect of the invention, there is provided a ship provided with one or more mooring devices as described above.

According to another aspect of the invention, there is provided a method for mooring a ship having a hull using a mooring device comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the ship's hull is attracted with the at least one magnet, wherein at or near the at least one magnet a force generating device comprising a movable force exerting part is activated for applying a force on the ship's hull in order to test whether the at least one magnet attracting the ship's hull provides at least a required mooring force, and wherein a distance between the magnet and the ship's hull is monitored so as to detect whether the at least one magnet meets the required mooring force, wherein an excursion of the movable force exerting part is measured for detecting whether or not the distance between the at least one magnet and the ship's hull is increased.

Suitably the means for measuring the distance be- tween the magnet and the ship's hull is embodied as a contact switch or proximity switch for measuring the presence of the ship's hull. Such a switch is all that is required to monitor whether the attachment of the magnet to the ship's hull is lost or not. It is however also possible that an excursion of the movable force exerting part is measured for detecting

whether or not the distance between the magnet and the ship's hull is increased in comparison with the distance when the initial mooring is complete.

Preferably the movable force exerting part comprises a hydraulic cylinder fender having a preferential position in which the fender protrudes beyond the magnet's surface for contacting the ship's hull so as to arrange that during mooring the fender's frontal surface engages the ship's hull prior to the magnet coming to its closest position with reference to the ship's hull. The moment the fender engages in contact with the ship's hull the fender's hydraulic system detects the change in hydraulic pressure, which may be used to initiate the final steps before coupling the mooring magnets to the ship's hull. These steps entail increasing the pressure exerted by the hydraulic cylinder fender onto the hull in such a manner that it will exceed the cylinder's force capacity, with a slow depression of said cylinder as a result. When the hydraulic system reaches the priorly established required forces for more than for instance 2 seconds, it can be concluded that the mooring device has reached its optimal position and the magnets of the device will be switched on and coupled with the hull. This arranges for a beneficial aspect of the method of the invention, in which the fender protruding beyond the magnet's surface arranges for a soft engagement with the ship's hull. Then after the initial mooring operation according to this method in which the fender gets depressed, the hydraulic cylinder of the fender is further loaded so as to apply a force on the fender towards its preferential position in order to detect whether the fender moves back to the said preferential position. If the fender does not move, the magnet meets the required mooring force.

Although the foregoing discusses the mooring device of the invention with reference to the application of at least one magnet, the mooring device of the invention preferably comprises a plurality of magnets, wherein each magnet is provided with a force generating device or devices assigned to that particular magnet. One preferred embodiment

has four magnets, positioned in a square of 2 x 2. When indeed the applied mooring device comprises four magnets positioned in a square of 2 x 2, and each magnet is provided with a force generating device or devices assigned to that particular magnet, the method of the invention to moor a ship is preferably carried out such that in a first step all force generating devices are activated, and that thereafter:
-if all the magnets meet the required mooring force, the ship is deemed moored; and that

- if a first one of the magnets does not meet the required mooring force, a first force it is able to attain is measured and the required mooring force minus this measured first force of the first detached magnet are redistributed among the remaining three magnets; and
- if all of the magnets then meet the required redistributed mooring force, the ship is deemed moored; and that
  - if after the redistribution of forces a second magnet fails to attain the increased required force, it is measured what second force it can then hold and the remaining needed force (total mooring force needed minus measured first hold force of the first detached magnet and minus the measured second hold force of the second detached magnet) is then redistributed over the remaining two magnets; and
  - if all of the magnets then meet the required redistributed mooring force, the ship is deemed moored; and that
    - If after the redistribution of forces a third magnet fails to attain the increased required force, it is measured what third force it can then hold and the remaining needed force (total mooring force needed minus measured first hold force of the first detached magnet, minus measured second hold force of the second detached magnet and minus measured third hold force of the third magnet is then redistributed to the remaining one magnet, and
    - if all of the magnets then meet the required

redistributed mooring force, the ship is deemed moored; and that

- if the fourth magnet does not meet the required mooring force the magnet and the ship are moved with respect to each other and the procedure is repeated with said first step.

The invention will hereinafter be further elucidated with reference to the drawing of a schematic representation of a single mooring device according to the invention.

In the drawing:

-figure 1 shows the mooring device of the invention in a perspective view from the back;

-figure 2 shows a perspective frontal view at the mooring device of the invention; and

-figures 3a, 3b and 3c show in a side view, frontal view and isometric view, respectively one magnet together with a force generating device or devices forming part of the mooring device of the invention.

Whenever in the figures the same reference numerals are applied, these numerals refer to the same parts.

With reference first to figure 1, the mooring device 1 of the invention is shown in a perspective view from behind. This mooring device 1 for mooring a ship comprises a base 2, a movable arm construction 3 supported by the base 2, and at least one but in practice usually several (preferably four) magnets 4 mounted in a frame 5. The magnets 4 are placed in a square of 2 x 2 as may be best seen in figure 2. The frame 5 is supported by the movable arm construction 3. As shown in figure 1 the frame 5 is provided with at least one but usually several leaf springs 6, wherein each magnet 4 is supported by one leaf spring 6.

Figure 1 and the perspective frontal view of figure 2 show that near to each magnet 4 several force generating devices 7 are provided that are assigned to such magnet. It is also possible to apply a single force generating device 7.

Figure 3a, 3b and 3c provide a detailed view of the

force generating device or devices 7 which are applied in combination with the magnet 4. The force generating device 7 comprises a movable force exerting part 8 which is intended for applying a force on a ship's hull 11. The force exerting part 8 is then used in order to test whether the magnet 4 attracting the ship's hull 11 provides at least a required mooring force. Further there are means 9 provided for measuring the presence of an object, in particular a ship's hull 11, which means 9 are connected or connectable to a detection device 10 for detecting whether or not the magnet 4 is loose from the ship's hull 11.

The means 9 for measuring the presence of the ship hull 11 can suitably be embodied as a contact switch or proximity switch 9. Of course other options are feasible as well. It is for instance possible to measure the excursion of the movable force exerting part 8, and take this as an indication whether or not the contact of the magnet 4 with the ship's hull 11 is lost.

Figure 3a, 3b and 3c show the preferable embodiment in which the movable force exerting part 8 comprises a preferably padded hydraulic cylinder fender 14. This fender 14 has a preferential position in which the fender 14 protrudes beyond the magnet's most forward surface 4' for contacting the ship's hull 11 so as to arrange that during mooring the fender's frontal surface 14' engages the ship's hull 11 first and prior to the magnet 4 arriving at its closest position with respect to the ship's hull 11 at the time that the initial mooring is complete, and testing of the then present mooring forces will be executed.

The hydraulic cylinder of the fender is activated for testing the mooring force of the magnet 4 as will become clear from the following description.

During use the mooring device of the invention operates as follows. After the initial engagement of the magnets 4 with the ship's hull 11, the movable force exerting part 8 of the force generating device 7 is activated for applying a force on the ship's hull 11 in order to test whether the magnet 4 attracting the ship's hull 11 provides at least

a required mooring force. During this process the distance between the magnet 4 and the ship's hull 11 is monitored with the means 9 for measuring the presence of an object, so as to detect whether the magnet 4 meets the required mooring force. This can also be done by measuring an excursion of the movable force exerting part 8 in order to detect whether or not the distance between the magnet 4 and the ship's hull 11 is increased in comparison with the distance immediately following the initial mooring when the attraction is brought about between the magnet 4 and the ship's hull 11.

In connection with the initial approaching of the magnet 4 and the ship's hull 11, a beneficial aspect of the mooring device of the invention is that the movable force exerting part 8 is embodied with a padded hydraulic cylinder fender 14 having a preferential position in which the button 14 protrudes beyond the magnet's surface 4' for soft engagement with the ship's hull 11. After the initial mooring operation with this soft engagement in which the fender 14 is depressed, the cylinder of the device is further loaded so as to apply a force on the fender 14 aimed at having it turn back towards its preferential position in order to detect whether the fender 14 indeed moves back to its preferential position or not. In the latter situation that it does not move back the concerning magnet 4 is deemed to meet the required mooring force.

When the applied mooring device as is shown in figure 1 and figure 2 comprises a plurality of four magnets positioned in a square of 2 x 2, and each magnet 4 is provided with a force generating device or devices 7 assigned to that particular magnet, the checking procedure applying to the mooring process is carried out such that in a first step all force generating devices 7 are activated, and that:
-if all of the magnets 4 meet the required mooring force, the ship is deemed moored; and that

- if a first one of the magnets 4 does not meet the required mooring force, a first force it is able to attain is measured and the required mooring force minus this measured first force of the first detached magnet are

redistributed among the remaining three magnets; and

- if all of the magnets then meet the required redistributed mooring force, the ship is deemed moored; and that
  - if after the redistribution of forces a second magnet 4 fails to attain the increased required force, it is measured what second force it can then hold and the remaining needed force (total mooring force needed minus measured first hold force of the first detached magnet 4 and minus the measured second hold force of the second detached magnet 4) is then redistributed over the remaining two magnets; and
  - if all of the magnets then meet the required redistributed mooring force, the ship is deemed moored; and that
    - If after the redistribution of forces a third magnet fails to attain the increased required force, it is measured what third force it can then hold and the remaining needed force (total mooring force needed minus measured first hold force of the first detached magnet 4, minus measured second hold force of the second detached magnet 4 and minus measured third hold force of the third magnet 4 is then redistributed to the remaining one magnet, and
    - if all of the magnets then meet the required redistributed mooring force, the ship is deemed moored; and that
      - if the fourth magnet does not meet the required mooring force the magnet and the ship are moved with respect to each other and the procedure is repeated with said first step.

As remarked above the mooring device of the invention may be placed ashore to connect to a ship's hull for mooring purposes. According to the invention it is however

also possible to provide a ship with one or more mooring devices according to the invention.

The appended claims provide the scope of protection of the instant invention, whereas the foregoing description is intended merely to elucidate any ambiguity that may possibly reside in these claims without the intent to limit the claims to the specific embodiment that has been discussed with reference to the drawing. The scope of protection that merits the invention is therefore solely defined by the appended claims and the construction of these claims should be as broad as is warranted by the invention in view of its contribution to the prior art.

CLAIMS

1. A mooring device for mooring a ship having a hull and comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the at least one magnet is arranged to attract the ship's hull, wherein at or near the at least one magnet a force generating device is provided comprising a movable force exerting part for applying a force on the ship's hull in order to test whether the at least one magnet attracting the ship's hull provides at least a required mooring force, and wherein means for measuring a distance between the at least one magnet and the ship's hull are provided that are connected or connectable to a detection device for detecting whether or not the at least one magnet is loose from the ship's hull, wherein the movable force exerting part comprises a hydraulic cylinder fender having a preferential position in which the hydraulic cylinder fender protrudes beyond a surface of the at least one magnet for contacting the ship's hull so as to arrange that during mooring the a frontal surface of the hydraulic cylinder fender engages the ship's hull prior to the at least one magnet.

2. The mooring device according to claim 1, characterized in that the means for measuring the distance between the at least one magnet and the ship's hull is embodied as a contact switch or proximity switch.

3. The mooring device according to claim 1, wherein upon activation of the hydraulic cylinder fender, the hydraulic cylinder fender applies a force towards a preferential position.

4. The mooring device according to claim 1, additionally comprising a plurality of magnets, wherein each one of the plurality of magnets is provided with a force generating device or devices assigned to that particular magnet.

5. The mooring device according to claim 4, comprising four magnets, positioned in a square of 2X2.

6. A ship provided with one or more mooring devices according to claim 1.

7. A method for mooring a ship having a hull using a mooring device comprising a base, a movable arm construction supported by the base, and at least one magnet mounted in a frame, which frame is supported by the movable arm construction, and wherein for mooring the ship the ship's hull is attracted with the at least one magnet, wherein at or near the at least one magnet a force generating device comprising a movable force exerting part is activated for applying a force on the ship's hull in order to test whether the at least one magnet attracting the ship's hull provides at least a required mooring force, and wherein a distance between the magnet and the ship's hull is monitored so as to detect whether the at least one magnet meets the required mooring force, wherein an excursion of the movable force exerting part is measured for detecting whether or not the distance between the at least one magnet and the ship's hull is increased.

8. The method for mooring a ship according to claim 7, wherein the movable force exerting part is embodied with a hydraulic cylinder fender having a preferential position in which the hydraulic cylinder fender protrudes beyond a surface of the at least one magnet for soft engagement with the ship's hull, and wherein after an initial mooring operation in which the hydraulic cylinder fender is depressed, the hydraulic cylinder fender is further loaded so as to apply a force on the hydraulic cylinder fender towards a preferential position in order to detect whether the hydraulic cylinder fender moves back to the preferential position and/or the at least one magnet meets the required mooring force.

9. The method for mooring a ship according to claim 7, wherein the mooring device, when applied, comprises a plurality of four magnets positioned in a square of 2×2, wherein each one of the four magnets is provided with a force generating device or devices assigned to that particular magnet, and wherein in a first step all force generating devices are activated, and wherein:

if all of the four magnets meet the required mooring force, the ship is deemed moored; and wherein

if a first one of the four magnets does not meet the required mooring force, a first attainable force is measured and the required mooring force minus this measured first attainable force of the first one of the four magnets are redistributed among remaining three of the four magnets; and

if all of the four magnets then meet the required redistributed mooring force, the ship is deemed moored; and wherein

if after the redistribution of forces a second one of the four magnets fails to attain the increased required force, a second attainable force is measured and the remaining needed force (total mooring force needed minus measured first attainable force of the first detached magnet and minus the measured second attainable force of the second one of the four magnets) is then redistributed over remaining two of the four magnets; and

if all of the four magnets then meet the required redistributed mooring force, the ship is deemed moored; and wherein

if after the redistribution of forces a third one of the four magnets fails to attain the increased required force, a third attainable force is measured and the remaining needed force (total mooring force needed minus measured first attainable force of the first detached magnet, minus measured second attainable force of the second detached magnet and minus measured third attainable force of the third one of the four magnets) is then redistributed to remaining one of the four magnets, and

if all of the four magnets then meet the required redistributed mooring force, the ship is deemed moored; and wherein

if a fourth one of the four magnets does not meet the required mooring force the fourth one of the four magnets and the ship are moved with respect to each other and the procedure is repeated with said first step.

Fig. 1

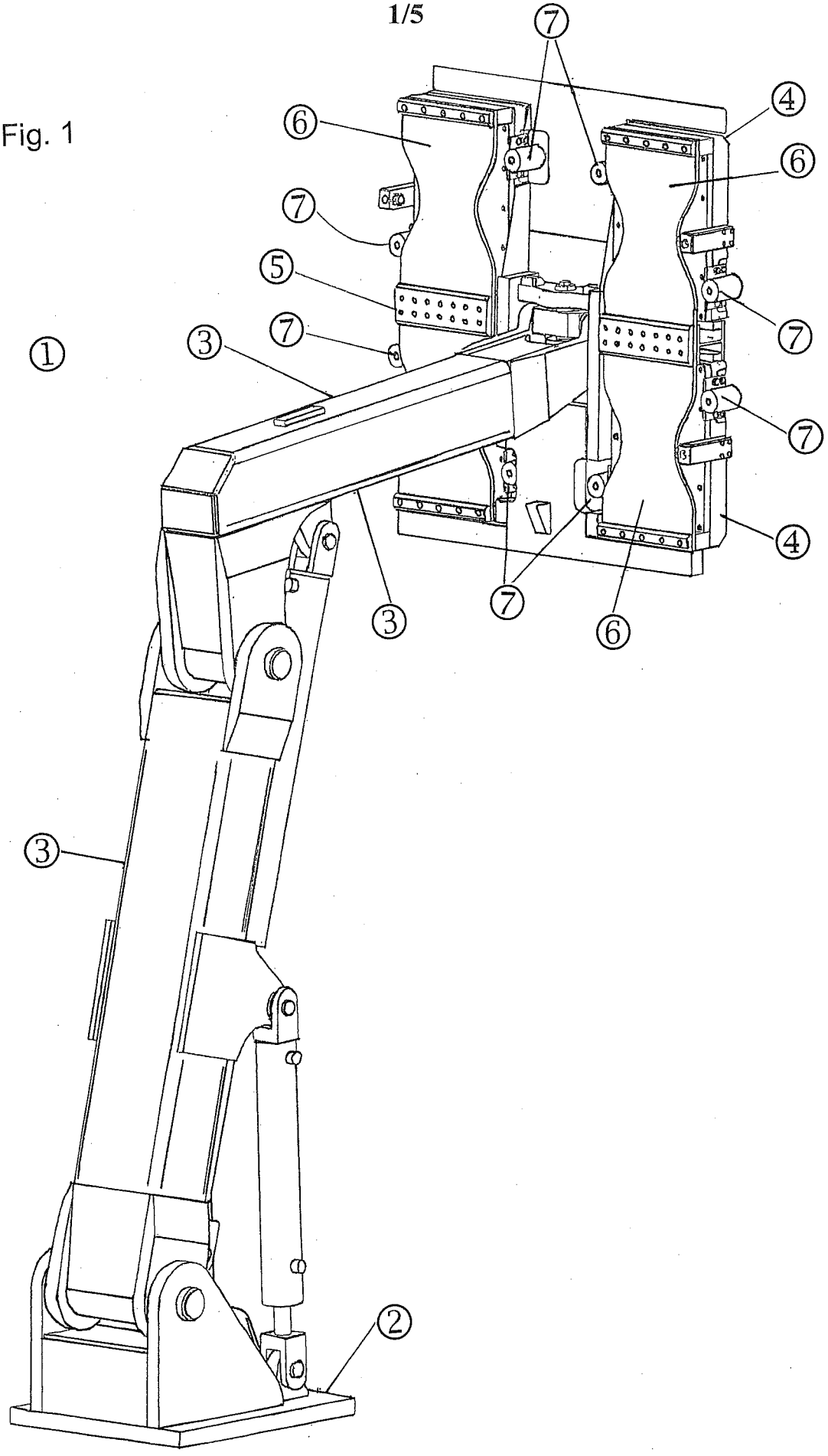


Fig. 2

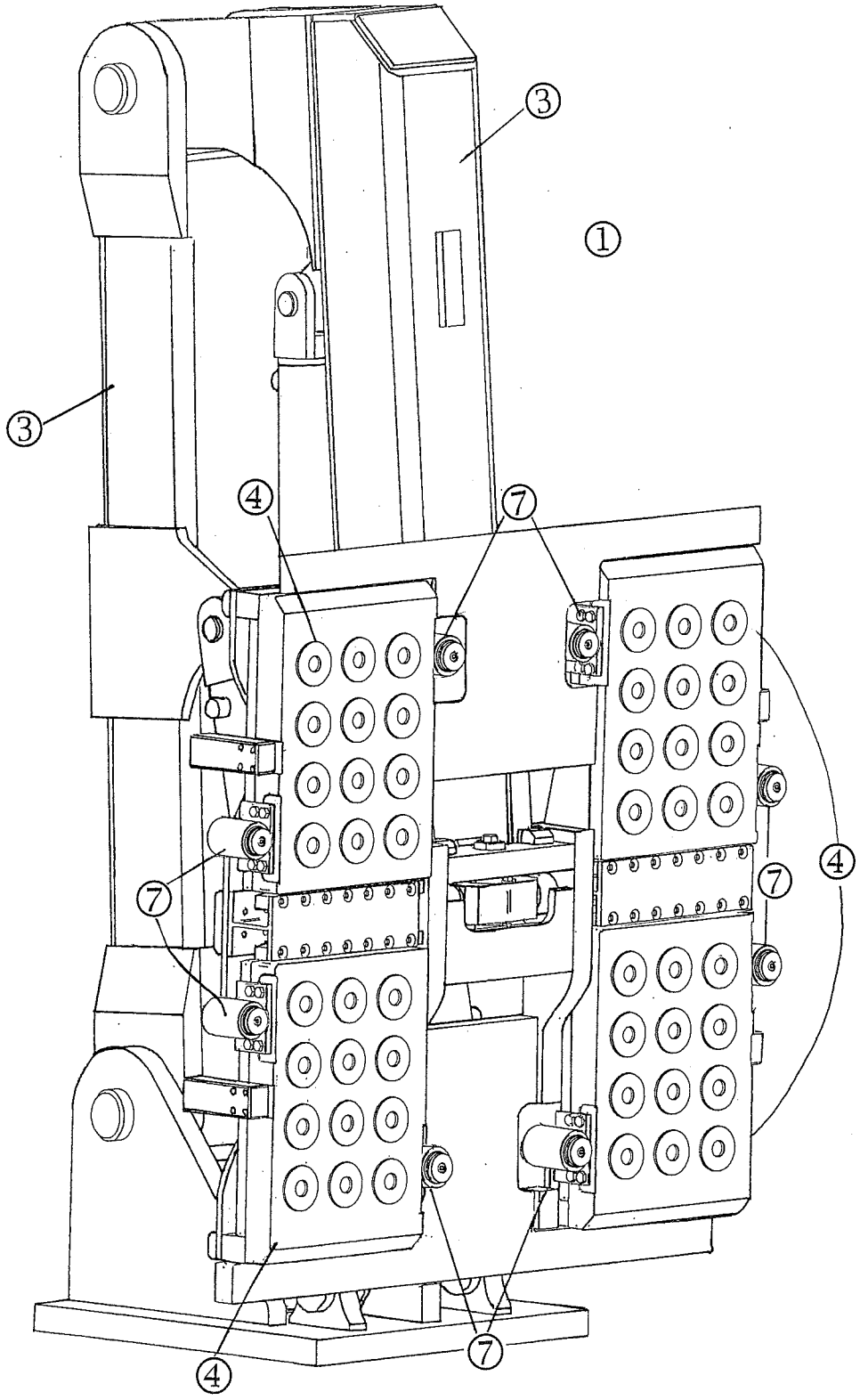


Fig. 3a

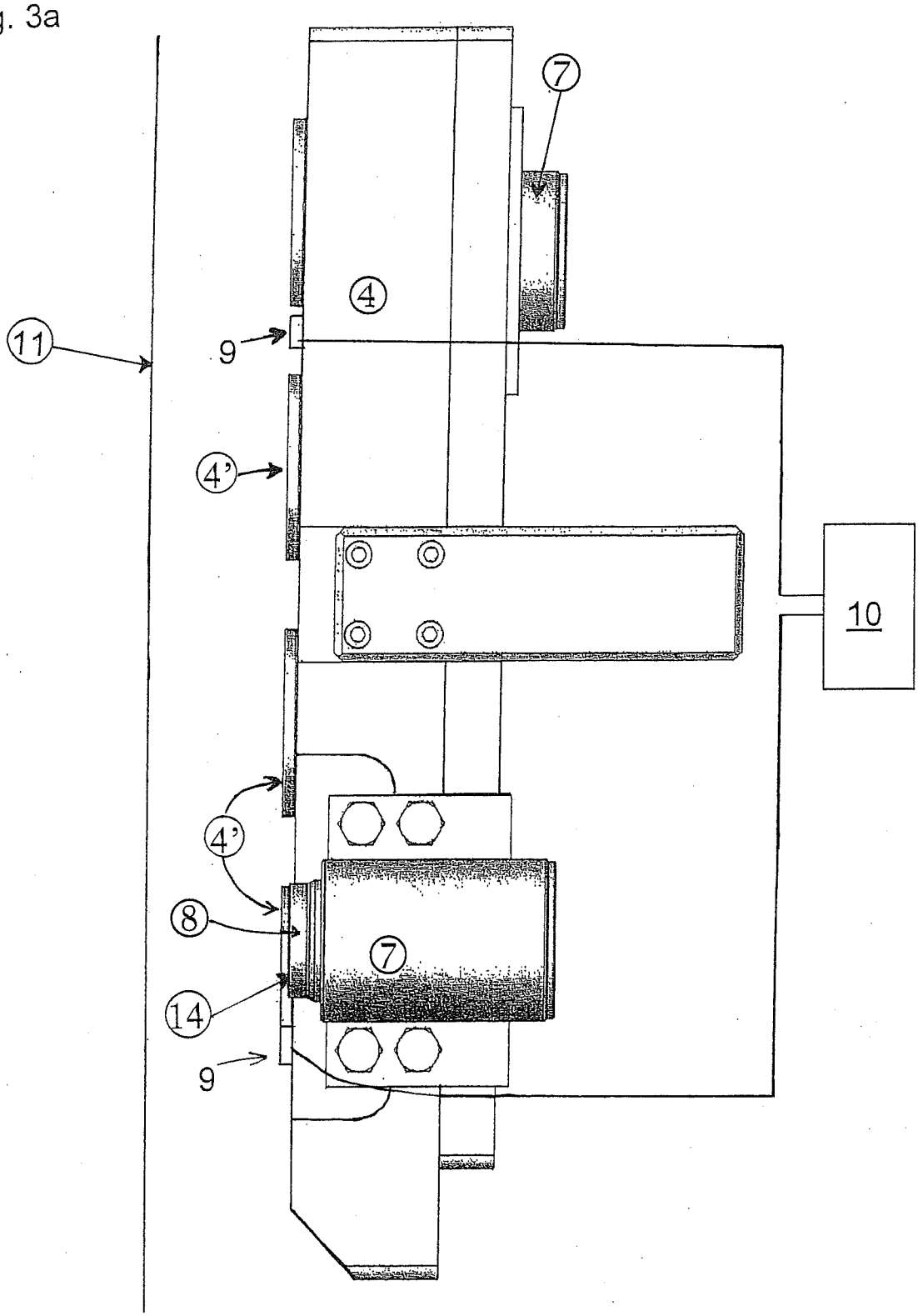


Fig. 3b

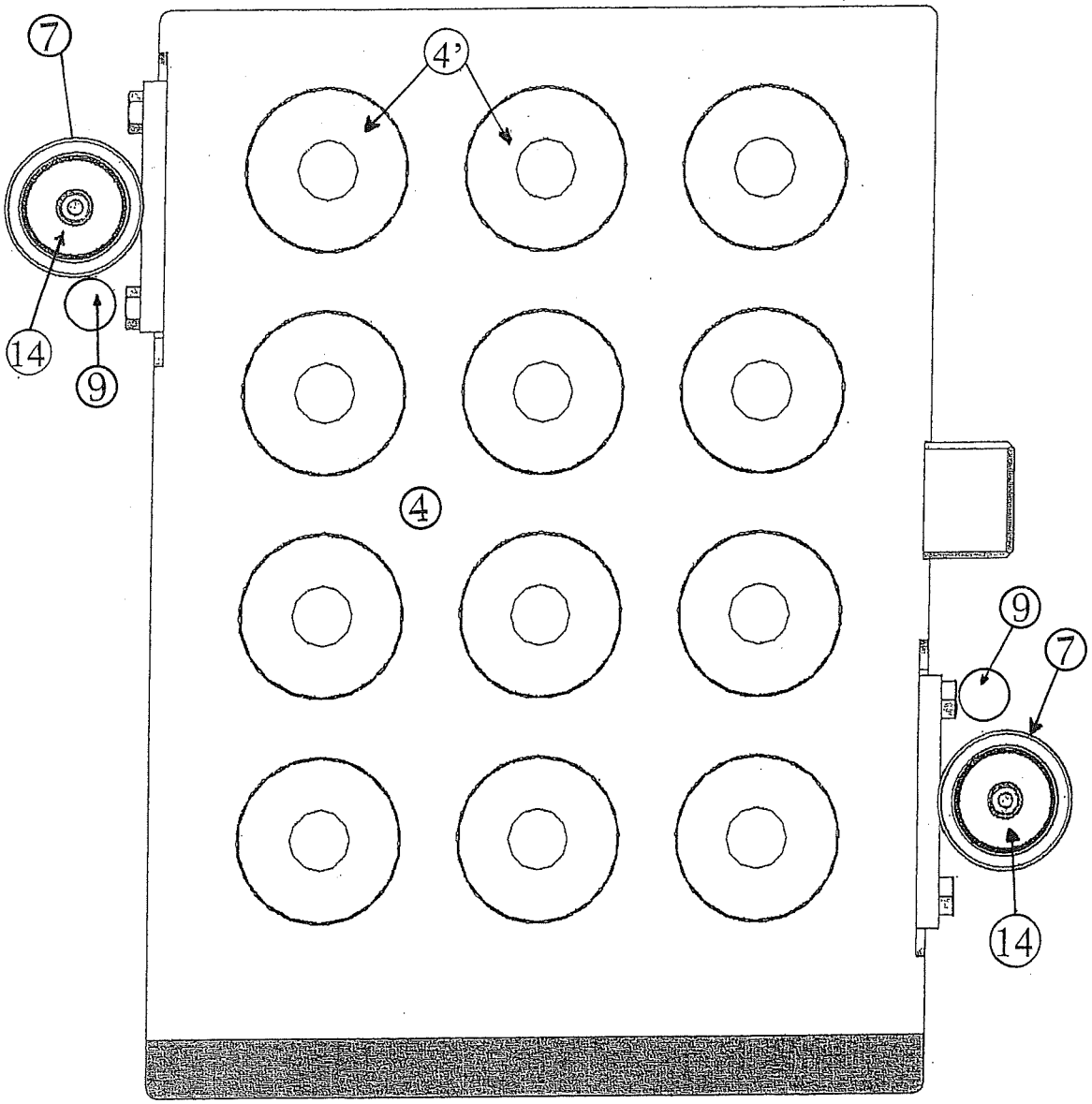
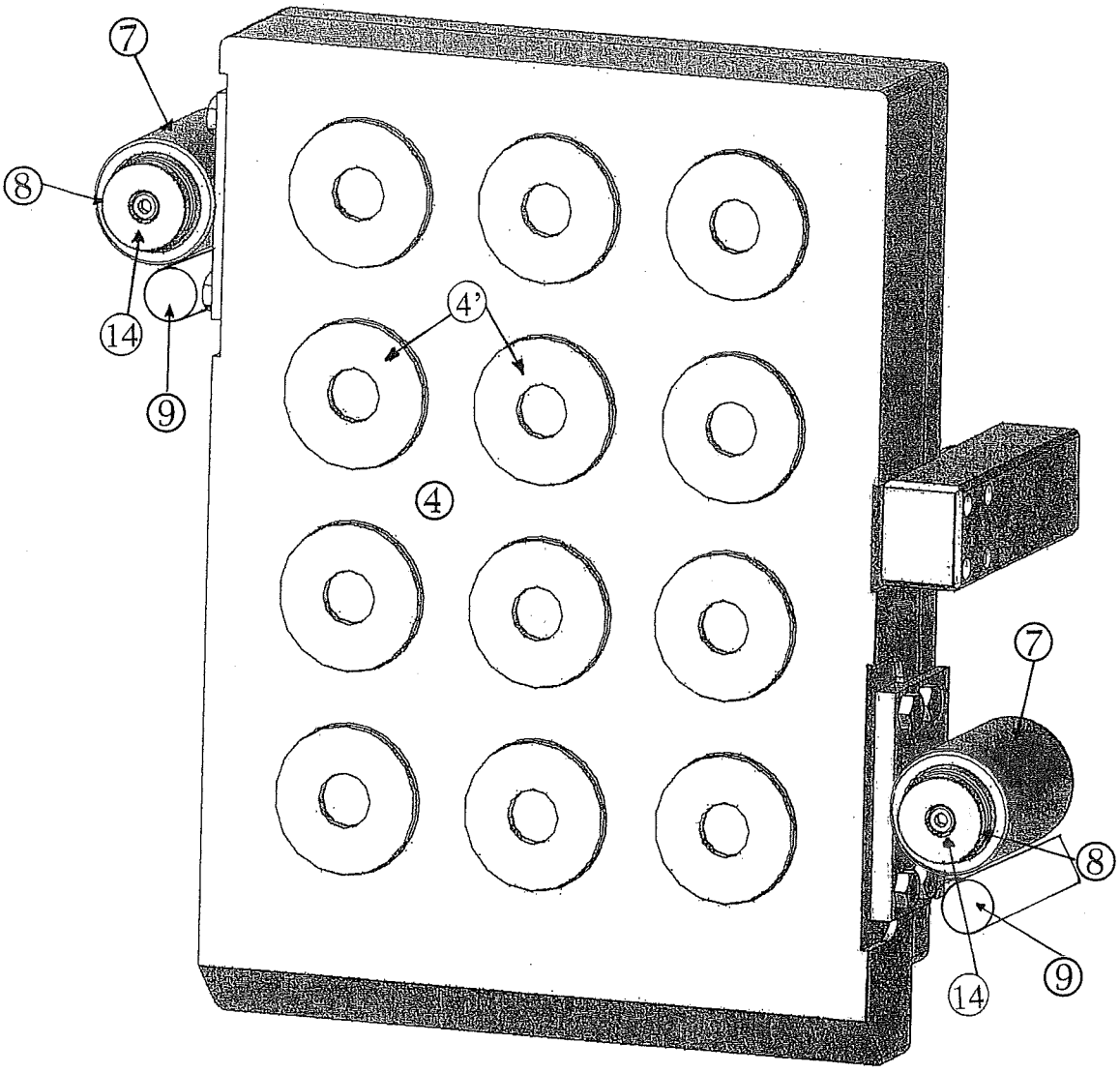
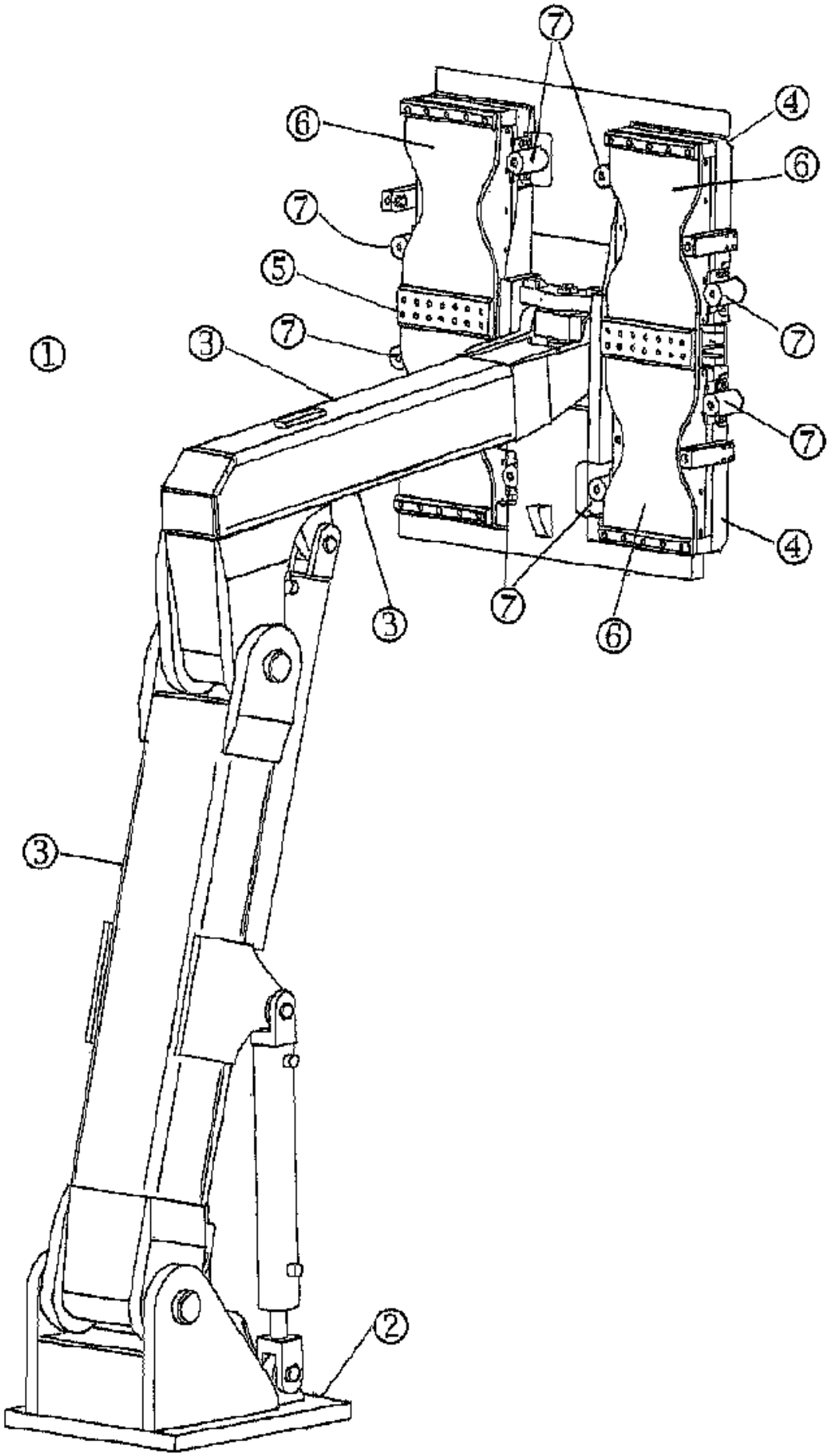


Fig. 3c




①
②
③
④
⑤
⑥
⑦