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(71) Applicant: **Operval S.r.l.**
11100 Aosta (AO) (IT)

(72) Inventor: **PRANDO, Andrea**
11020 Saint-Christophe (AO) (IT)

(74) Representative: **Metroconsult Srl**
Via Sestriere, 100
10060 None (TO) (IT)

(54) MACHINE OF THE EARTH-MOVING TYPE, COMPRISING A CONFIGURABLE TYPE OPERATING ARM, AND RELATED METHOD AND ADAPTER GROUP FOR CONFIGURING SAID OPERATING ARM

(57) The present invention relates to a machine (1) of the earth-moving type comprising a platform (20) and an operating arm (30), said operating arm (30) comprising:
- a first arm (31) rotatably articulated to the platform (20) about a first horizontal axis (30A) supported by the platform (20) and under the action of a first actuator device (41),
wherein said first actuator device (41) is articulated to the platform (20) about a first horizontal pivot pin (41A) and is articulated to the first arm (31) about a second horizontal pivot pin (41B);
- a second arm (32) rotatably articulated to the first arm (31) about a second horizontal axis (30B) supported by the first arm (31) and under the action of a second actuator device (42),
wherein said second actuator device (42) is articulated to the first arm (31) about a third horizontal pivot pin (42A) and is articulated to the second arm (32) about a fourth pivot pin (42B);
- an attachment (33) rotatably articulated to the free end of the second arm (32) about a third horizontal axis (30C) supported by the second arm (32), wherein the movement of said attachment (33) is controlled through a third actuator device (43) articulated to the second arm (32) about a fifth horizontal pivot pin (43A), said third actuator device (43) being articulated to the attachment (33) about a sixth horizontal pivot pin (43B);
wherein the machine (1) comprises an adapter assembly (50) constrained to the operating arm (30) for configuring said operating arm (30).

The peculiar feature of the present invention lies in the fact that said adapter assembly (50) comprises:
- a first tie bracket (51) and a second tie bracket (52) vertically facing each other so as to be substantially parallel, wherein said tie brackets (51, 52) are positioned on opposed side walls (32L) of the second arm (32) of said operating arm (30);
- a plate (53) integrally connected, in a substantially perpendicular manner, to a lower portion (511) of the first tie bracket (51) and to a lower portion (521) of the second tie bracket (52), said plate (53) comprising a mount (53A) apt to connect a tool to the adapter assembly (50),
wherein each one of said tie brackets (51, 52) comprises a respective seat (51A, 51B) apt to receive the fifth horizontal pivot pin (43A), so as to couple the adapter assembly (50) to said second arm (32) of the operating arm (30).

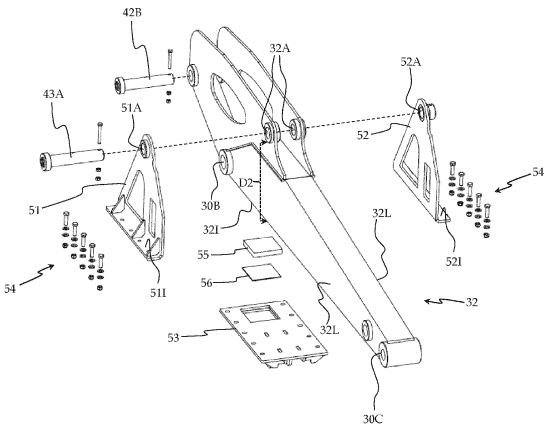

Fig. 2

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Description

[0001] The present invention relates to a machine of the earth-moving type comprising a configurable operating arm according to the preamble of claim 1; furthermore, the present invention relates to a related operating arm and a related adapter assembly for configuring said operating arm.

[0002] It is known in the art that earth-moving machines are those machines which are used for carrying out operations that require displacement of earth or similar materials, e.g. earth modelling, generally for building or territory management purposes or for making excavations and embankments.

[0003] In this frame, and in the excavation, demolition and construction fields, the earth-moving machines currently known in the art are so designed as to comprise a base that is movable on the ground, a platform coupled to the base, and an operating arm, one end of which is articulated to the platform about a first horizontal axis, in particular under the action of at least one linear actuator (usually an oleodynamic one).

[0004] When the earth-moving machine is an excavator, the platform is hinged to the base so that it can rotate about a vertical axis; for example, the elements that provide the coupling between the base and the platform may comprise a slewing ring.

[0005] Said operating arm consists of an articulated-arm kinematic mechanism, so constructed as to comprise at least two elongate elements arranged in series and mutually hinged about a second axis parallel to said first horizontal axis. Moreover, the operating arm is so realized as to comprise a terminal portion, or free end, that carries a work tool or attachment hinged about a third axis parallel to said first horizontal axis.

[0006] In particular, said work attachment may consist of a bucket, shears, a hydraulically controlled hammer, a gripping and lifting polyp-grab, and so on. In this context, the market often offers little choice to users of known earth-moving machines, in that such machines can hardly be used for different and multiple operations and functions.

[0007] In order to remedy this problem and exploit earth-moving machines for different operations and functions, thus broadening their application range, the operating arm can be modified to make it configurable, i.e. to obtain an operating arm that can be used for different operations and functions; in particular, according to the solutions currently known in the art, different work tools or attachments can be constrained to the free end of the operating arm.

[0008] In this respect, however, it must be pointed out that the solutions known in the art are not very flexible, in that they only permit using one tool at a time, i.e. only that tool which is each time constrained to the free end of the operating arm. Furthermore, the solutions currently known in the art turn out to be poorly adaptable when the tools come from different manufacturers; in this regard, it should be noted that, in fact, tools of the same type and substantially of the same size, but produced by different manufacturers, may have (for example) different center-to-center distances between the elements that permit constraining the tool to the free end of the operating arm.

[0009] It is clear that such a problem prevents constraining a tool to said free end, or makes such task very difficult, if the tool and the operating arm come from different manufacturers.

[0010] According to another known solution, a connection element is welded to an intermediate portion of the operating arm, so that it is possible to constrain to said connection element a tool that is different from and/or additional to the one constrained to the free end of the operating arm.

[0011] Nevertheless, this solution has some drawbacks as well, in that welding the connection element to the operating arm causes a structural modification, typically irreversible, to said operating arm.

[0012] In this frame, it is the main object of the present invention to provide an earth-moving machine comprising a configurable operating arm, as well as a related adapter assembly for configuring said operating arm, which are so constructed as to overcome the drawbacks of prior-art solutions.

[0013] In particular, it is one object of the present invention to provide an earth-moving machine comprising a configurable operating arm, as well as a related adapter assembly for configuring said operating arm, which are so conceived as to broaden the choice currently available to users of prior-art earth-moving machines and to allow using one machine for many different operations and functions.

[0014] It is another object of the present invention to provide an earth-moving machine, as well as a related operating arm and a related adapter assembly for configuring said operating arm, so constructed as to provide a highly flexible solution allowing for simultaneous use of different tools even when the tool and the operating arm come from different manufacturers.

[0015] It is a further object of the present invention to provide an earth-moving machine, as well as a related operating arm and a related adapter assembly for configuring said operating arm, so conceived as to permit associating different tools to the operating arm without requiring any structural and/or irreversible modifications to said operating arm.

[0016] Further objects, features and advantages of the present invention will become apparent in the light of the following detailed description and the annexed drawings, which are provided herein merely by way of non-limiting explanatory example, wherein:

- Fig. 1 shows a side view of a prior-art earth-moving machine;
- Fig. 2 shows an exploded perspective view of a portion of an operating arm of an earth-moving machine and of an adapter assembly according to the present

invention, wherein the adapter assembly is adapted to configure said operating arm;

- Fig. 3A and Fig. 3B are, respectively, a perspective view and a side view of the adapter assembly according to the present invention;
- Fig. 4 is a perspective view of a portion of the operating arm according to the present invention.

[0017] With reference to the annexed drawings, in Fig. 1 reference numeral 1 designates as a whole an earth-moving machine according to the prior art.

[0018] The machine 1 comprises a base 10, in particular of the mobile type, a platform 20 coupled to the base 10, and an operating arm 30.

[0019] In the embodiment shown in Fig. 1, the machine 1 is an excavator; in such an embodiment, the platform 20 is preferably hinged to the base 10, so that it can rotate about a vertical axis AV (shown in Fig. 1 by a dashed-dotted line), in particular a slewing ring 11 being mounted on said base 10 to support the platform 20.

[0020] It is however clear that the machine 1 may also be different from the one shown in Fig. 1; for example, it may be a machine 1 commonly known as "backhoe loader", i.e. a machine 1 characterized by the combined presence of a bucket at the front and an operating arm at the rear.

[0021] It should also be noted that, unlike shown in Fig. 1, the base 10 and the platform 20 may also be made substantially as one piece and/or in such a way as to show no discontinuity causing and defining a clearly discernible separation between such components.

[0022] The machine 1 comprises driving means 12 associated with the base 10, in particular said driving means 12 comprising tracks (as in the embodiment shown in Fig. 1) and/or wheels (not shown); moreover, said machine 1 comprises a driver's cabin 21 associated with the platform 20.

[0023] The machine 1 may then comprise supporting means (not shown) adapted to allow widening the track of said machine 1, in particular while working.

[0024] The operating arm 30 comprises a first arm 31 rotatably articulated to the platform 20 about a first horizontal axis 30A supported by the platform 20 and under the action of a first actuator device 41, which is articulated to the platform 20 about a first horizontal pivot pin 41A, said first actuator device 41 being also articulated to the first arm 31 about a second horizontal pivot pin 41B.

[0025] As known in the art, the first arm 31 can be rotatably driven about the first axis 30A between a first extreme position, in which said first arm 31 faces upwards (as shown in Fig. 1), and a second extreme position, in which the first arm 31 is substantially horizontal or facing downwards.

[0026] The operating arm 30 comprises a second arm 32 rotatably articulated to the first arm 31 about a second horizontal axis 30B supported by the first arm 31 and under the action of a second actuator device 42, which is articulated to the first arm 31 about a third horizontal pivot pin 42A, said second actuator device 42 being also articulated to the second arm 32 about a fourth pivot pin 42B.

[0027] As known in the art, the second arm 32 can be rotatably driven about the second axis 30B between a first extreme position, in which said second arm 32 is substantially an extension of the first arm 31, and a second extreme position, in which the second arm 32 substantially faces downwards (as shown in Fig. 1) at an angle relative to the first arm 31.

[0028] The operating arm 30 further comprises an attachment 33 rotatably articulated to the free end of the second arm 32 about a third horizontal axis 30C supported by the second arm 32, wherein the movement (or angular displacement) of said attachment 33 is controlled through a third actuator device 43 articulated to the second arm 32 about a fifth horizontal pivot pin 43A, said third actuator device 43 being also articulated (whether directly or indirectly, e.g. via connecting means) to the attachment 33 about a sixth horizontal pivot pin 43B.

[0029] In the embodiment shown in Fig. 1, the attachment 33 consists of a bucket; however, it should be noted that said attachment 33 may also consist of a different work element or tool, or an additional arm (not shown in the annexed drawings) adapted to extend the operating arm 30, to which attachment 33 a work tool can then be articulated.

[0030] In a preferred embodiment, the first actuator device 41 and/or the second actuator device 42 and/or the third actuator device 43 comprise each a hydraulic cylinder, in particular of the oleodynamic type. In this context, each one of said cylinders is driven by a system (not shown in the annexed drawings), in particular of the oleodynamic type, of the machine 1 for rotating the first arm 31 relative to the platform 20, rotating the second arm 32 relative to the first arm 31, and causing the activation of the attachment 33 and/or moving (or angularly displacing) the attachment 33 relative to the second arm 32.

[0031] It should be noted that the pivot pins 41A, 41B, 42A, 42B, 43A and 43B are substantially parallel to the first axis 30A; as a consequence, they are also substantially parallel to the second axis 30B and third axis 30C.

[0032] In accordance with the present invention, the machine 1 comprises an adapter assembly (designated as a whole by reference numeral 50 in Figures 2 to 4) constrained to the operating arm 30 for configuring said operating arm 30.

[0033] The adapter assembly 50 comprises:

- a first tie bracket 51 and a second tie bracket 52 vertically facing each other so as to be substantially parallel, and positioned on opposite side walls 32L of the second arm 32 of said operating arm 30;
- a plate 53 integrally connected, in a substantially perpendicular manner, to a lower portion 511 of the first tie bracket 51 and to a lower portion 521 of the second tie bracket 52, said plate 53 comprising a mount 53A apt to connect a tool to the adapter assembly 50,

wherein each one of said tie brackets 51, 52 comprises a respective seat 51A, 51B apt to receive the fifth horizontal pivot pin 43A, so as to couple the adapter assembly 50 to said second arm 32 of the operating arm 30.

[0034] In this regard, it must be pointed out that said mount 53A may be used for connecting to the second arm 32 an auxiliary hydraulic cylinder (which may control a grab, as shown in Fig. 4, or another work tool), or may be used for connecting to said second arm 32 a different work tool (e.g. a hook, a winch, etc.), which may be added to (or replace) the attachment 33.

[0035] It is therefore apparent that the teachings of the solution proposed by the present invention make it possible to overcome the drawbacks suffered by the solutions currently known in the art; in particular, the solution of the present invention makes it possible to provide a machine 1 comprising a configurable operating arm 30 and a related adapter assembly 50 for configuring said operating arm 30, so conceived as to broaden the choice available to users of known machines and to allow using one machine 1 for many different operations and functions. Furthermore, the provisions of the present invention make it possible to provide a machine 1 that is highly flexible and suitable for using different tools at the same time, even when the tool and the operating arm come from different manufacturers.

[0036] It is likewise clear that the solution of the present invention makes it possible to realize the machine 1 in such a way that different tools can be associated with the operating arm 30 without requiring any structural and/or irreversible modifications to said operating arm 30.

[0037] In a preferred embodiment, the connection between the plate 53 and the lower portions 511, 521 of the tie brackets 51, 52 is effected via coupling means, designated as a whole by reference numeral 54 in Figures 2 to 4; in such preferred embodiment (and as shown in said Figures 2 to 4), the coupling means 54 may comprise through bolts apt to be inserted into suitable holes provided in said lower portions 511, 521 of the tie brackets 51, 52 and provided in the plate 53. In this context, the lower portions 511, 521 of the tie brackets 51, 52 are preferably made as flanges extending substantially perpendicularly from said tie brackets 51, 52.

[0038] It is nevertheless apparent that the connection between the plate 53 and the lower portions 511, 521 of the tie brackets 51, 52 may also be effected otherwise, e.g. by welding the plate 53 to said lower portions 511, 521 of the tie brackets 51, 52; it should be noted that such welding is also feasible when the lower portions 511, 521 of the tie brackets 51, 52 do not include the above-described flanges.

[0039] In a preferred embodiment, the adapter assembly 50 comprises at least one damping element 55 interposed between the plate 53 and a bottom wall 321 of the second arm 32; preferably, said at least one damping element 55 comprises at least one pad made of elastic material, in particular rubber.

[0040] Furthermore, the adapter assembly 50 may comprise a spacer 56, in particular made of metallic material, adapted to be associated with said at least one damping element 55 in order to increase its protrusion from the plate 53 and apply a higher preload on said damping element 55.

[0041] In accordance with the present invention (and as particularly visible in Figures 2, 3a and 3b), each seat 51A, 51B of the tie brackets 51, 52 is located at a first distance D1 from the plate 53, wherein said first distance D1 substantially corresponds to a second distance D2 existing between a housing 32A of the second arm 32, apt to receive the fifth pivot pin 43A, and the bottom wall 321 of the second arm 32. Preferably, the seats 51A, 52A of the tie brackets 51, 52 and the mount 53A of the plate 53 lie on one same straight line R (designated by a dashed-dotted line in Fig. 3b) substantially perpendicular to the lower portions 511, 521 of the tie brackets 51, 52 (and also to the plate 53).

[0042] In accordance with a preferred embodiment, the seats 51A, 52A and the lower portions 511, 521 of the tie brackets 51, 52 are mutually positioned in such a way as to define a triangle, wherein the seats 51A, 52A are a vertex of said triangle and the lower portions 511, 521 are the sides opposite said vertex. In this preferred embodiment, the tie brackets 51, 52 have a substantially triangular shape (particularly in a front view of said tie brackets 51 and 52, as shown, for example, in Fig. 3B), wherein the seats 51A, 52A are located in proximity to a vertex of the triangular tie brackets 51, 52 and the lower portions 511, 521 constitute the sides opposite said vertex.

[0043] It is therefore clear that the adapter assembly 50 according to the present invention is so realized as to partially envelop the second arm 32 of the operating arm 30, since the tie brackets 51, 52 are positioned in contact with the side walls 32L of the second arm 32 and the plate 53 is positioned in contact with the bottom wall 321 of said second arm 32, in particular through the interposition of at least one damping element 55 (and possibly through the further interposition of at least one spacer 56) between the plate 53 and the bottom wall 321 of the second arm 32; in this context, by adequately tightening the coupling means 54, in particular comprising through holes, it is possible to compress the adapter assembly 50 against the second arm 32.

[0044] Such features, combined with the particular mutual positioning of the seats 51A, 52A, the lower portions 511, 521 and the mount 53A according to the present invention (and, preferably, with the triangular shape of the tie brackets 51, 52), permit eliminating the mechanical plays between the second arm 32 and the adapter assembly 50. In fact, said adapter assembly 50 works on three areas, i.e. the seat 51A, 52A and the two free ends of the plate 53 (i.e. those sides of the plate 53 which are not connected to the lower portions 511, 521 of the tie brackets 51, 52). If a hydraulic cylinder were coupled to the mount 53A, the force would be exerted along a vector

parallel to the lower portion 511, 521 of the tie brackets 51, 52, and a reaction force would act upon the seat 51A, 52A acting as a rotation fulcrum, compressing a first free end of the plate 53 and pulling the other free end of said plate 53. In this context, the provisions of the present invention prevent the adapter assembly 50 from rotating about the rotation fulcrum (corresponding to the seats 51A, 52A) thanks to the opposition created by the contact between said free ends of the plate 53 and the bottom wall 321 of the second arm 32, and thanks to the arrangement along the same straight line R of the seats 51A, 52A of the tie brackets 51, 52 and of the mount 53A of the plate 53. The following will describe a method for configuring an operating arm 30 of a machine 1 of the earth-moving type according to the present invention, wherein said operating arm 30 comprises:

- a first arm 31 rotatably articulated to the platform 20 about a first horizontal axis 30A supported by the platform 20 and under the action of a first actuator device 41,

wherein said first actuator device 41 is articulated to the platform 20 about a first horizontal pivot pin 41A and is articulated to the first arm 31 about a second horizontal pivot pin 41B;

- a second arm 32 rotatably articulated to the first arm 31 about a second horizontal axis 30B supported by the first arm 31 and under the action of a second actuator device 42,

wherein said second actuator device 42 is articulated to the first arm 31 about a third horizontal pivot pin 42A and is articulated to the second arm 32 about a fourth pivot pin 42B;

- an attachment 33 rotatably articulated to the free end of the second arm 32 about a third horizontal axis 30C supported by the second arm 32, wherein the movement of said attachment 33 is controlled through a third actuator device 43 articulated to the second arm 32 about a fifth horizontal pivot pin 43A, said third actuator device 43 being articulated, whether directly or indirectly, to the attachment 33 about a sixth horizontal pivot pin 43B,

and wherein said method comprises the step of associating an adapter assembly 50 with the operating arm 30 for configuring said operating arm 30.

[0045] The method according to the present invention is characterized in that said step of associating an adapter assembly 50 with the operating arm 30 comprises the following steps:

a) positioning a first tie bracket 51 and a second tie bracket 52 on opposite side walls 32L of the second arm 32 of said operating arm 30 so that said tie brackets 51, 52 face each other vertically and are substantially parallel;

b) inserting said fifth horizontal pivot pin 43A into a respective seat 51A, 51B of said tie brackets 51, 52;

c) connecting a plate 53 integrally and in a substantially perpendicular manner to a lower portion 511 of the first tie bracket 51 and to a lower portion 521 of the second tie bracket 52, said plate 53 comprising a mount 53A apt to connect a tool to the adapter assembly 50.

[0046] In a preferred embodiment, said step c) is carried out by interposing at least one damping element 55 between the plate 53 and a bottom wall 321 of the second arm 32.

[0047] Moreover, said step c) is preferably carried out by using coupling means 54, in particular comprising through bolts apt to be inserted into holes provided in said lower portions 511, 521 of the tie brackets 51, 52 and provided in the plate 53. Preferably, said step c) is carried out in such a way that the seats 51A, 52A of the tie brackets 51, 52 and the mount 53A of the plate 53 are so positioned as to lie on a same straight line R substantially perpendicular to the lower portions 511, 521 of the tie brackets 51, 52.

[0048] Furthermore, said step a) is preceded by a step a-1) of realizing the seats 51A, 52A and the lower portions 511, 521 of the tie brackets 51, 52 in such a way that they are so positioned relative to each other as to define a triangle, wherein the seats 51A, 52A are a vertex of said triangle and the lower portions 511, 521 are the sides opposite said vertex.

[0049] In particular, said step a-1) is accomplished by realizing said tie brackets 51, 52 in such a way that they have a substantially triangular shape, wherein the seats 51A, 52A are positioned in proximity to a vertex of the triangle and the lower portions 511, 521 constitute the sides opposite said vertex of the triangle.

[0050] The features of the machine 1, operating arm 30 and adapter assembly 50 according to the present invention, as well as the advantages thereof, are apparent from the above description.

[0051] In particular the peculiar features of the present invention make it possible to overcome the drawbacks suffered by the solutions currently known in the art; in particular, the solution of the present invention makes it possible to provide a machine 1 comprising a configurable operating arm 30 and a related adapter assembly 50 for configuring said operating arm 30, so conceived as to broaden the choice available to users of known machines and to allow using one machine 1 for many different operations and functions.

[0052] Furthermore, the provisions of the present invention make it possible to provide a machine 1 that is highly flexible and suitable for using different tools at the same time, even when the tool and the operating arm come from different manufacturers.

[0053] It is likewise clear that the solution of the present

invention makes it possible to realize the machine 1 in such a way that different tools can be associated with the operating arm 30 without requiring any structural and/or irreversible modifications to said operating arm 30.

[0054] It should also be noted that the peculiar teachings of the present invention allow the adapter assembly 50 to partially envelop the second arm 32 of the operating arm 30 while at the same time compressing the adapter assembly 50 against the second arm 32.

[0055] Such features, combined with the particular mutual positioning of the seats 51A, 52A, the lower portions 511, 521 and the mount 53A (and, preferably, with the triangular shape of the tie brackets 51, 52), permit eliminating the mechanical plays between the second arm 32 and the adapter assembly 50.

[0056] It is therefore apparent that the provisions of the present invention prevent the adapter assembly 50 from rotating about the rotation fulcrum (corresponding to the seats 51A, 52A) when an attachment or a tool is associated with the mount 53A of the adapter assembly 50, and that this is due to the opposition created by the contact between the free ends of the plate 53 and the bottom wall 321 of the second arm 32 and to the arrangement along the same straight line R of the seats 51A, 52A of the tie brackets 51, 52 and of the mount 53A of the plate 53.

[0057] The machine 1, operating arm 30 and adapter assembly 50 described herein by way of example may be subject to many possible variations without departing from the novelty spirit of the inventive idea; it is also clear that in the practical implementation of the invention the illustrated details may have different shapes or be replaced with other technically equivalent elements.

[0058] It can therefore be easily understood that the present invention is not limited to the above-described machine 1, operating arm 30 and adapter assembly 50, but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

Claims

1. Machine (1) of the earth-moving type comprising a platform (20) and an operating arm (30), said operating arm (30) comprising:

- a first arm (31) rotatably articulated to the platform (20) about a first horizontal axis (30A) supported by the platform (20) and under the action of a first actuator device (41),
wherein said first actuator device (41) is articulated to the platform (20) about a first horizontal pivot pin (41A) and is articulated to the first arm (31) about a second horizontal pivot pin (41B);
- a second arm (32) rotatably articulated to the first arm (31) about a second horizontal axis (30B) supported by the first arm (31) and under the action of a second actuator device (42),
wherein said second actuator device (42) is articulated to the first arm (31) about a third horizontal pivot pin (42A) and is articulated to the second arm (32) about a fourth pivot pin (42B);
- an attachment (33) rotatably articulated to the free end of the second arm (32) about a third horizontal axis (30C) supported by the second arm (32), wherein the movement of said attachment (33) is controlled through a third actuator device (43) articulated to the second arm (32) about a fifth horizontal pivot pin (43A), said third actuator device (43) being articulated to the attachment (33) about a sixth horizontal pivot pin (43B);

wherein the machine (1) comprises an adapter assembly (50) constrained to the operating arm (30) for configuring said operating arm (30),
said machine (1) being **characterized in that** said adapter assembly (50) comprises:

- a first tie bracket (51) and a second tie bracket (52) vertically facing each other so as to be substantially parallel, wherein said tie brackets (51, 52) are positioned on opposite side walls (32L) of the second arm (32) of said operating arm (30);
- a plate (53) integrally connected, in a substantially perpendicular manner, to a lower portion (511) of the first tie bracket (51) and to a lower portion (521) of the second tie bracket (52), said plate (53) comprising a mount (53A) apt to connect a tool to the adapter assembly (50),

wherein each one of said tie brackets (51, 52) comprises a respective seat (51A, 51B) apt to receive the fifth horizontal pivot pin (43A), so as to couple the adapter assembly (50) to said second arm (32) of the operating arm (30).

2. Machine (1) according to claim 1, **characterized in that** said adapter assembly (50) comprises at least one damping element (55) interposed between the plate (53) and a bottom wall (321) of the second arm (32).

3. Machine (1) according to claim 2, **characterized in that** said at least one damping element (55) comprises at least one pad made of elastic material, in particular rubber.

4. Machine (1) according to one or more of the preceding claims, **characterized in that** the connection between the plate (53) and the lower portions (511, 521) of the tie brackets (51, 52) is effected via cou-

pling means (54), in particular comprising through bolts apt to be inserted into holes provided in said lower portions (511, 521) of the tie brackets (51, 52) and provided in the plate (53).

5. Machine (1) according to claim 4, **characterized in that** the lower portions (511, 521) of the tie brackets (51, 52) are realized as flanges extending substantially perpendicularly from said tie brackets (51, 52).

6. Machine (1) according to one or more of the preceding claims, **characterized in that** each seat (51A, 51B) of the tie brackets (51, 52) is located at a first distance (D1) from the plate (53), wherein said first distance (D1) substantially corresponds to a second distance (D2) existing between a housing (32A) of the second arm (32), apt to receive the fifth pivot pin (43A), and the bottom wall (321) of the second arm (32).

7. Machine (1) according to one or more of the preceding claims, **characterized in that** the seats (51A, 52A) of the tie brackets (51, 52) and the mount (53A) of the plate (53) lie on a same straight line (R) substantially perpendicular to the lower portions (511, 521) of the tie brackets (51, 52).

8. Machine (1) according to one or more of the preceding claims, **characterized in that** the seats (51A, 52A) and the lower portions (511, 521) of the tie brackets (51, 52) are mutually positioned in such a way as to define a triangle, wherein the seats (51A, 52A) are a vertex of said triangle and the lower portions (511, 521) are the sides opposite said vertex.

9. Operating arm (30) of a machine (1), in particular of the earth-moving type, according to one or more of claims 1 to 8.

10. Adapter assembly (50) for configuring an operating arm (30) of a machine (1), in particular of the earth-moving type, according to one or more of claims 1 to 8.

11. Method for configuring an operating arm (30) of a machine (1) of the earth-moving type, wherein said operating arm (30) comprises:

- a first arm (31) rotatably articulated to the platform (20) about a first horizontal axis (30A) supported by the platform (20) and under the action of a first actuator device (41),
wherein said first actuator device (41) is articulated to the platform (20) about a first horizontal pivot pin (41A) and is articulated to the first arm (31) about a second horizontal pivot pin (41B);
- a second arm (32) rotatably articulated to the first arm (31) about a second horizontal axis (30B) supported by the first arm (31) and under the action of a second actuator device (42), wherein said second actuator device (42) is articulated to the first arm (31) about a third horizontal pivot pin (42A) and is articulated to the second arm (32) about a fourth pivot pin (42B);
- an attachment (33) rotatably articulated to the free end of the second arm (32) about a third horizontal axis (30C) supported by the second arm (32), wherein the movement of said attachment (33) is controlled through a third actuator device (43) articulated to the second arm (32) about a fifth horizontal pivot pin (43A), said third actuator device (43) being articulated to the attachment (33) about a sixth horizontal pivot pin (43B),

wherein said method comprises a step of constraining an adapter assembly (50) to the operating arm (30) for configuring said operating arm (30),
said method being **characterized in that** it comprises the following steps:

a) positioning a first tie bracket (51) and a second tie bracket (52) on opposite side walls (32L) of the second arm (32) of said operating arm (30) so that said tie brackets (51, 52) face each other vertically and are substantially parallel;
b) inserting said fifth horizontal pivot pin (43A) into a respective seat (51A, 51B) of said tie brackets (51, 52);
c) connecting a plate (53) integrally and in a substantially perpendicular manner to a lower portion (511) of the first tie bracket (51) and a lower portion (521) of the second tie bracket (52), said plate (53) comprising a mount (53A) apt to connect a tool to the adapter assembly (50).

12. Method according to claim 11, **characterized in that** said step c) is carried out by interposing at least one damping element (55) between the plate (53) and a bottom wall (321) of the second arm (32).

13. Method according to one or more of the preceding claims 11 and 12, **characterized in that** said step c) is carried out by using coupling means (54), in particular comprising through bolts apt to be inserted into holes provided in said lower portions (511, 521) of the tie brackets (51, 52) and provided in the plate (53).

14. Method according to one or more of the preceding claims from 11 to 13, **characterized in that** said step c) is carried out in such a way that the seats (51A, 52A) of the tie brackets (51, 52) and the mount (53A) of the plate (53) are so positioned as to lie on a same straight line (R) substantially perpendicular to the lower portions (51I, 52I) of the tie brackets (51, 52).

15. Method according to one or more of the preceding claims from 11 to 14, **characterized in that** said step a) is preceded by a step a-1) of realizing the seats (51A, 52A) and the lower portions (51I, 521) of said tie brackets (51, 52) in such a way that they are so positioned relative to each other as to define a triangle, wherein the seats (51A, 52A) are a vertex of said triangle and the lower portions (51I, 521) are the sides opposite said vertex.

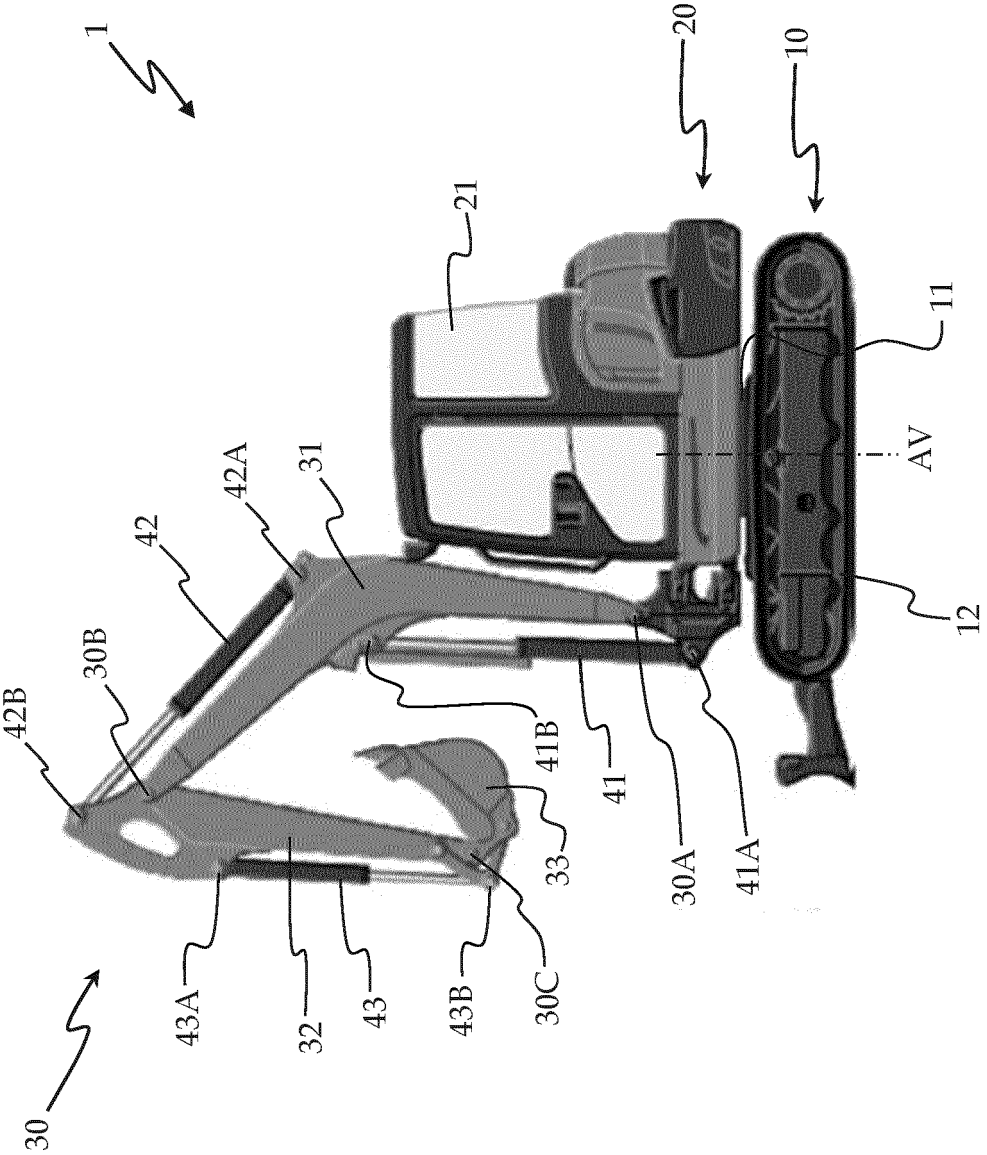
1
20
10
21
11
AV
12
42A
31
42
30B
42B
41B
41
33
30A
41A
43A
32
43
43B
30C
30

Fig. 1

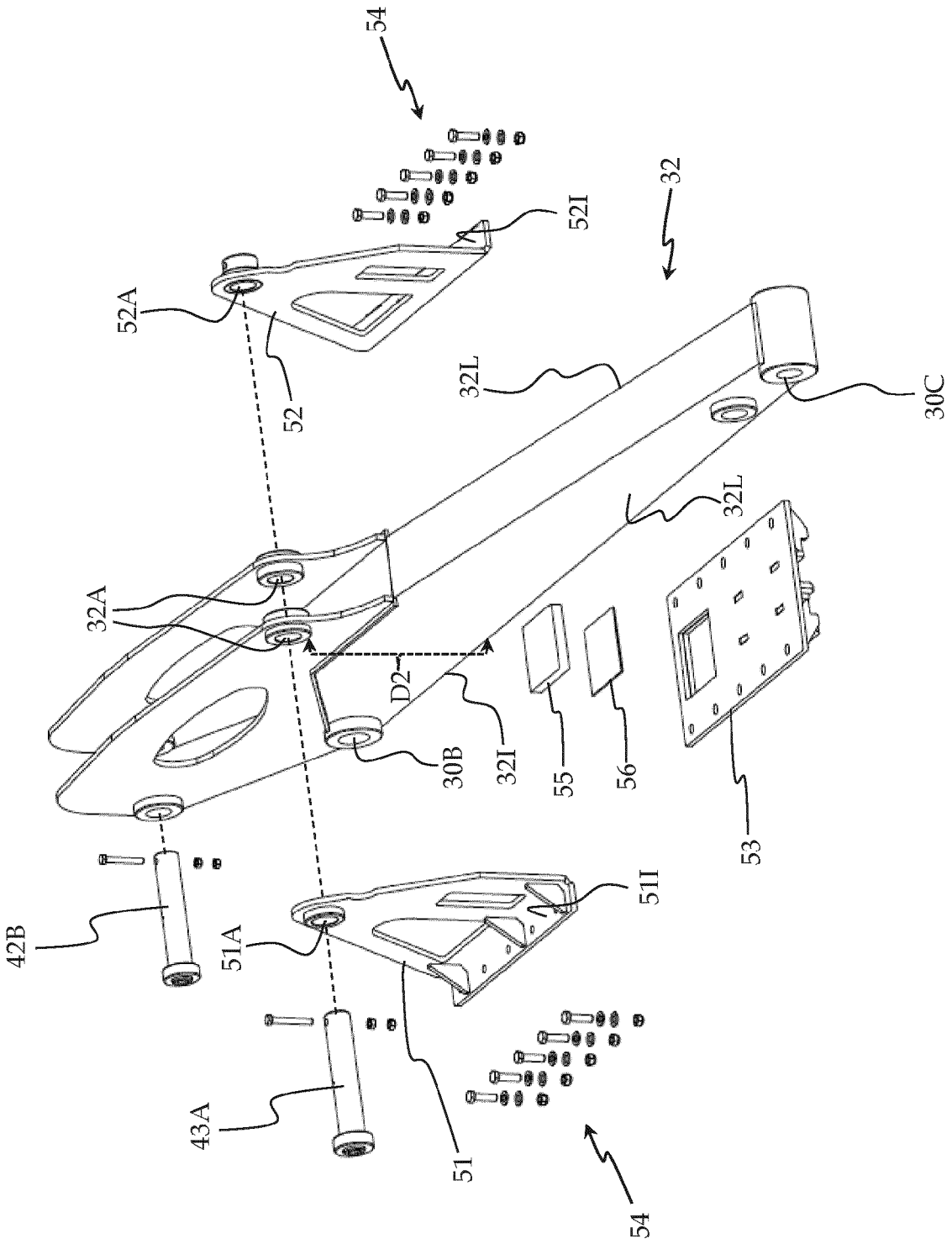
54
52I
32
52A
52
32L
30C
32L
32A
D2
30B
32I
55
56
53
42B
51A
51I
43A
51
54

Fig. 2

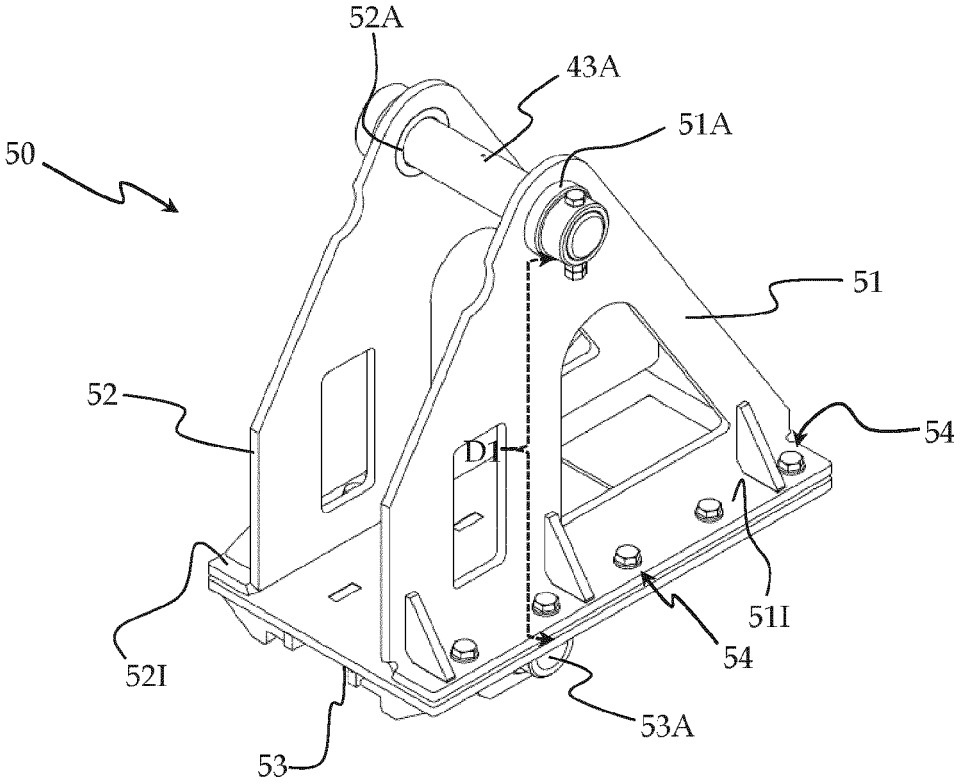
52A
43A
51A
50
51
52
54
D1
51I
52I
54
53A
53

Fig. 3A

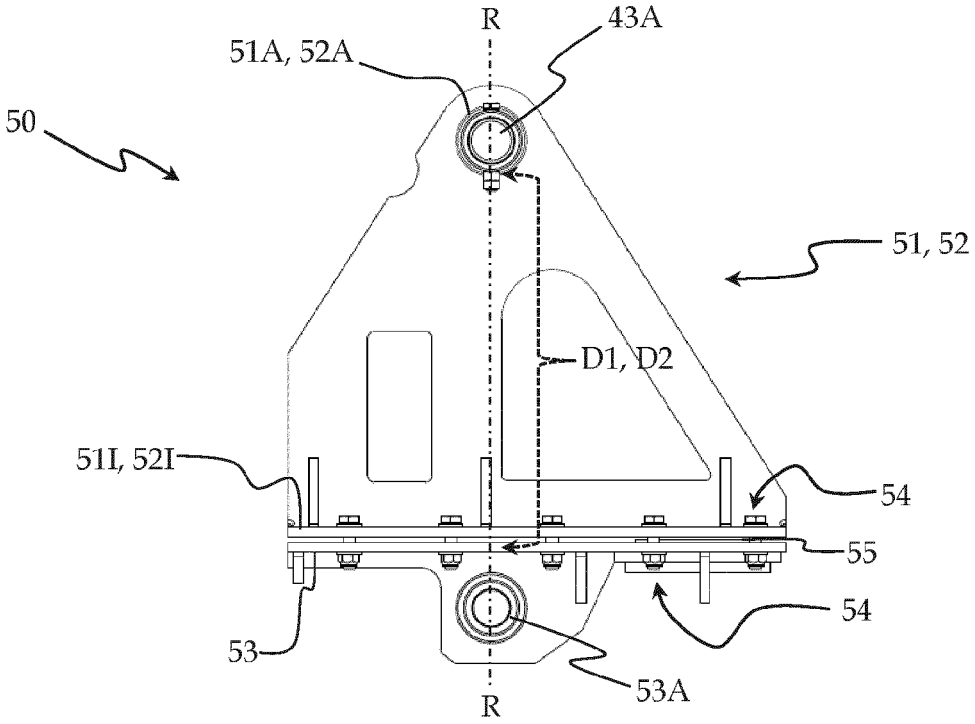
R
43A
51A, 52A
50
51, 52
D1, D2
51I, 52I
54
55
54
53
53A
R

Fig. 3B

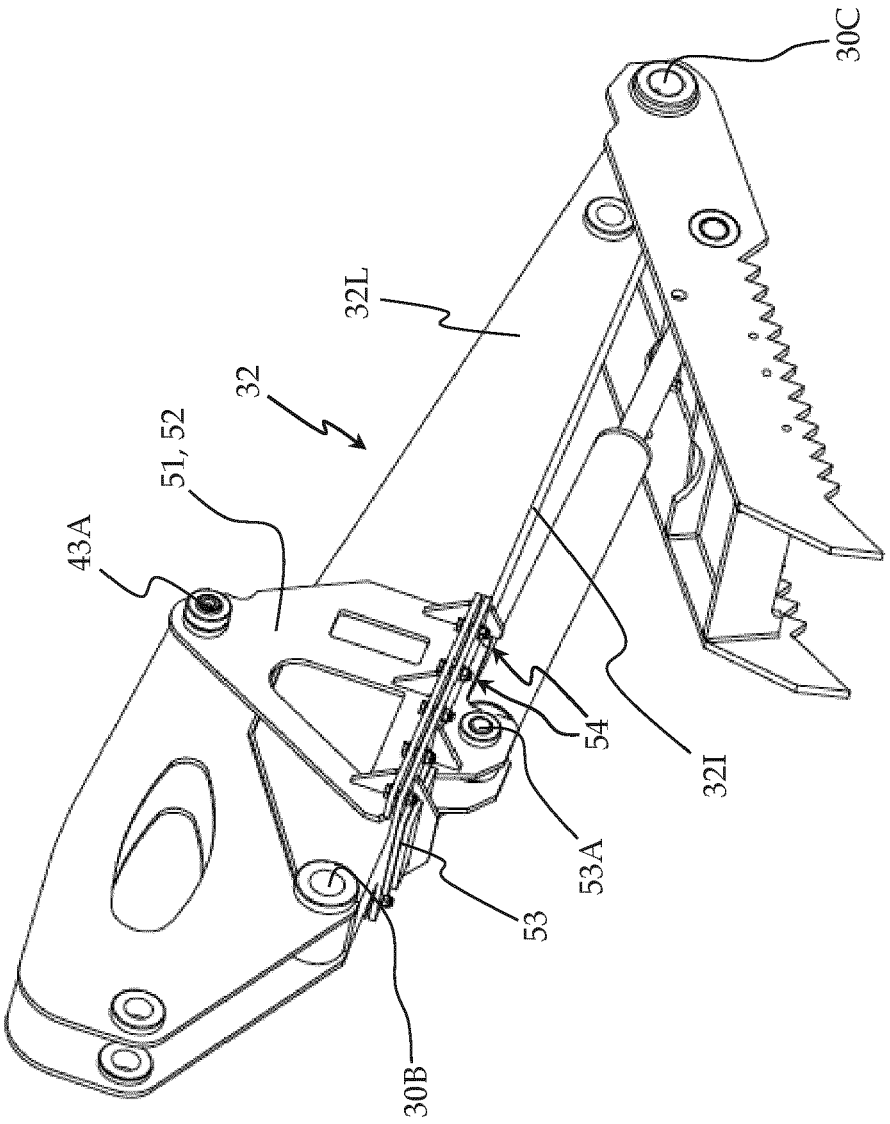

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 2365

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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
Munich	19 May 2022	Clarke, Alister

CATEGORY OF CITED DOCUMENTS

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