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(54) Apparatus for opening and closing a pair of load lifters

(57) The present invention provides an apparatus for opening and closing a pair of load lifters pivotably mountable on a support frame comprising a ram assembly pivotably connectable to each of said pair of load lifters; a pivot arm pivotably mountable on the support frame and disposed between said pair of load lifters; a first link pivotably connectable between one of said pair of load lifters and a first location on the pivot arm; and a second link pivotably connectable between the other one of said pair of load lifters and a second location on the pivot arm; wherein actuation of the ram assembly causes said pair of load lifters to open and close.

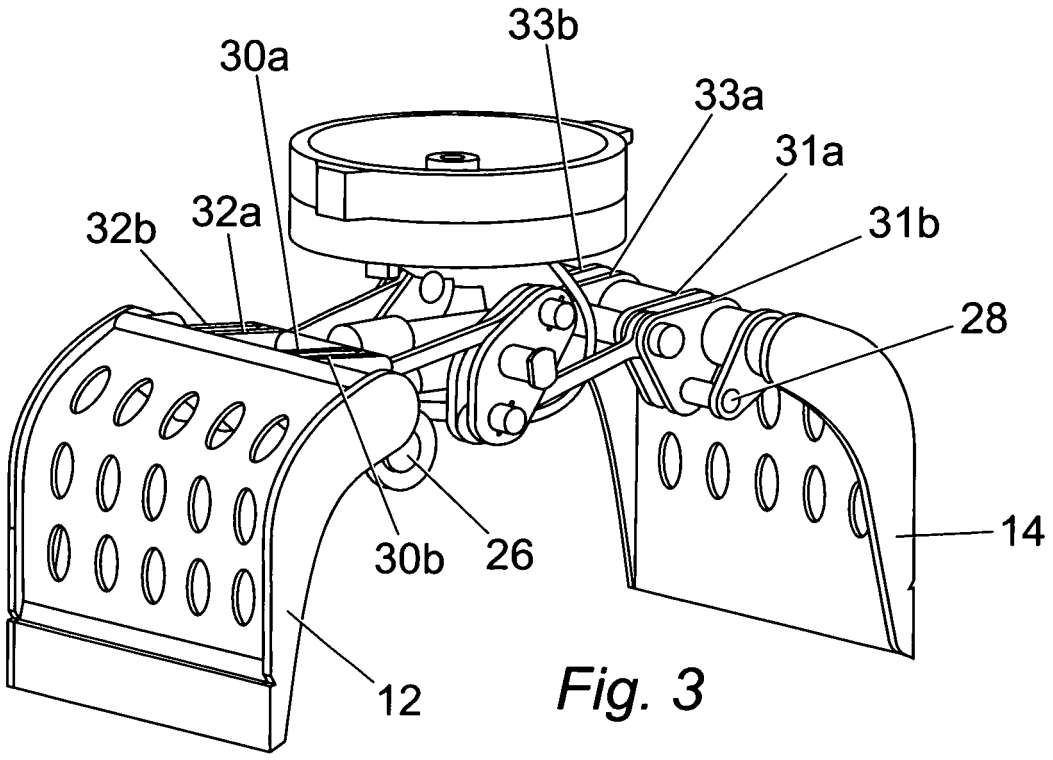

Fig. 3

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Description

Technical Field of the Invention

[0001] The present invention relates to apparatus for opening and closing a pair of load lifters. In particular, but not exclusively, the present invention relates to apparatus for opening and closing shells of a clamshell grab, simultaneously.

Background of the Invention

[0002] A conventional clamshell grab has a pair of shells pivotably connected at pivot points to a housing of apparatus for opening and closing the shells. One shell has lever arms which protrude from the top edge of the shell above and below its pivot point. The other shell only has lever arms which protrude above the pivot points. The apparatus for opening and closing the shells includes a hydraulic cylinder which is mounted between lever arms that extend above the pivot points of the shells. The hydraulic cylinder has a piston rod which actuates to rotate one of the shells to an open or closed position. The apparatus also includes a pushbar which is used to correspondingly rotate the other shell as the piston rod is actuated. The pushbar is connected diagonally between bottom lever arms on one shell, and top lever arms on the other shell.

[0003] The bottom lever arms on one of the shells, and that part of the pushbar connected thereto, extend into the volume defined by the shells which can interfere with a load being lifted and emptied by the clamshell grab. Furthermore, the headroom, i.e. volumetric capacity, of the shells is reduced because the bottom lever arms and that part of the pushbar connected thereto extend into the headroom of the shells. Further still, due to the positioning of the pushbar on the bottom lever arms on one of the shells, it is difficult to enclose this within the housing to fully protect it and the hydraulic cylinder from damage and excess wear caused by a load, which can then lead to early failure of the apparatus.

[0004] It is an object of the present invention to mitigate or obviate one or more of the above-mentioned drawbacks.

Summary of the Invention

[0005] According to a first aspect of the present invention there is provided an apparatus for opening and closing a pair of load lifters pivotably mountable on a support frame, the apparatus comprising a ram assembly pivotably connectable to each of said pair of load lifters; a pivot arm pivotably mountable on the support frame and disposed between said pair of load lifters; a first link pivotably connectable between one of said pair of load lifters and a first location on the pivot arm; and a second link pivotably connectable between the other one of said pair of load lifters and a second location on the pivot arm; wherein actuation of the ram assembly causes said pair of load lifters to open and close.

Brief Description of the Drawings

[0006] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figs. 1a to 1d are side schematic views illustrating the closing of a work implement using apparatus for opening and closing a pair of load lifters in accordance with a first embodiment of the present invention;

Fig. 2 is a perspective view of part of a work implement having the apparatus for opening and closing a pair of load lifters in accordance with the first embodiment of the present invention;

Fig. 3 is a perspective view of the apparatus of Fig. 2 with an additional load lifter attached;

Fig. 4 is a perspective view of the apparatus of Fig. 3 having a support frame and part of a housing attached;

Fig. 5 is a side schematic view of the apparatus of Fig. 4;

Fig. 6 is a plan view of the apparatus of Fig. 4 with a top portion removed;

Fig. 7 is a perspective view of the apparatus of Fig. 4 with a complete housing attached; and

Figs. 8a to 8d are side schematic views illustrating the closing of a work implement using apparatus for opening and closing a pair of load lifters in accordance with a second embodiment of the present invention.

Detailed Description

[0007] The present invention will now be described with reference to a work implement arranged vertically, as shown in the figures, such that relative terms "top", "above", "below", "bottom", "underneath", etc, can be readily used to more easily understand the invention. However, it is to be appreciated that the work implement may equally well be arranged horizontally and so the relative terms should in no way be taken to be limiting.

[0008] In accordance with a first embodiment of the present invention, as shown in Figs. 1a to 1d, there is provided a work implement 10 comprising a pair of load lifters 12, 14, apparatus 50 for opening and closing said pair of load lifters 12, 14, and a housing 100.

[0009] The work implement 10 is in the form of a clam-

shell grab but may be of other forms as will be appreciated by a person skilled in the art. The work implement 10 is connected to a work machine (not shown) by connection means 16, and is operated from the work machine.

[0010] In this specific example, the load lifters 12, 14 are shells, but they may be of other forms, for example, buckets, pincers, jaws, claws, etc. The load lifters 12, 14 are made of a suitable material as known in the art.

[0011] Teeth 18 (Fig. 1c) may be located along a bottom edge 20 of the load lifters 12, 14 to scoop and dig a load. A pair of hinges 22 (Figs. 4 and 6) extend from a top edge 24 of the load lifters 12, 14 and are pivotably connected at pivot points 26, 28 to the housing 100.

[0012] In one embodiment referring to Figs. 2 and 3, the load lifters 12, 14 each have two pairs of lever arms 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b which project from the top edge 24 of each load lifter 12, 14 for connection to the apparatus 50 for opening and closing the load lifters 12, 14.

[0013] As can be seen from Fig. 3, these lever arms 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b project above the pivot points 26, 28 of the load lifters 12, 14.

[0014] Each lever arm of the pair 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b is separated by a small distance on the top edge 24 of the load lifters 12, 14 to receive respective ends 62a, 64a of a first and second link 62, 64 as detailed below.

[0015] A relatively larger distance between lever arms 30a, 32a and 31a, 33a is provided to receive a ram assembly 52 as detailed below. The lever arm pairs 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b are situated on the top edges 24 of each load lifter 12, 14 such that the ram assembly 52 is located substantially at a midpoint of each top edge 24 of the load lifters 12, 14 to prevent torsion in the load lifters 12, 14.

[0016] Referring to Fig. 2, the apparatus 50 for opening and closing the load lifters 12, 14 includes the ram assembly 52, and two link assemblies 54, 56 disposed either side of the ram assembly 52. It is to be appreciated that whilst two link assemblies 54, 56 are provided at either side of one ram assembly 52, the number of ram assemblies 52 and link assemblies 54, 56, and their location, can be varied to be application specific, for example, one link assembly 54, 56 may be located at a midpoint between the load lifters 12, 14, with a ram assembly 52 disposed either side. Other combinations are anticipated.

[0017] The ram assembly 52 is in the form of a hydraulic cylinder having a cylinder 58 and a slidable piston rod 60, but may be of other forms, for example a pneumatic cylinder.

[0018] The link assemblies 54, 56 each include a first link 62, a second link 64, and a pivot arm 66, where the first link 62 is pivotably connected between lever arms 30a, 30b and 32a, 32b on one load lifter 12, and the pivot arm 66, and the second link 64 is connected between lever arms 31a, 31b and 33a, 33b on the other load lifter 14, and the pivot arm 66.

[0019] Referring to Figs. 4 and 5, the pivot arm 66 is substantially of the form of two triangular plates 68, which are parallel and separated apart by a hollow tubular member 70 connected to inwardly facing surfaces 68a of the plates 68 at an apex corner 72.

A pin 74 is inserted through the plates 68 at the apex corner 72, and through the tubular member 70, to pivotably mount the pivot arm 66 to a support frame 90 to provide a fixed pivot point 67.

[0020] Apertures 76, 78 are also located at corners 80, 82 furthest apart on the plates 68 to receive a pin 84, 86, onto which the other ends 62b, 64b of each of the first and second links 62, 64 is pivotably connected. The plates 68 are separated by a distance which accommodates the width of the first and second links 62, 64.

[0021] It is to be appreciated that the first and second links 62, 64 may be connected to the pivot arm 66 at any location along their lengths.

[0022] The first and second links 62, 64 are of the form of rectangular bars having eyes at either longitudinal end for pivotable connection.

[0023] The dimensions of the first and second links 62, 64, the location of the apertures 72, 76, 78 and pins 74, 84, 86 on the pivot arm 66, and the mounting location of the pivot arm 66 on the support frame 90 are such that the first and second links 62, 64 can pivot from a load lifter open position to a load lifter closed position without interfering with the tubular member 70, whilst at the same time, keeping the length of the pivot arm 66 to a minimum. The longitudinal length of the first and second links 62, 64, the location of the pivot arm 66 on the support frame 90, the angles of the links 62, 64 to the pivot arm 66, and the dimensions of the pivot arm 66 may all be varied to obtain optimum conditions for load capacity, and minimum height of the apparatus 50. It should be appreciated that if the angles of the links 62, 64 to the pivot arm 66 are too great, the apparatus 50 may experience relatively high torsional forces.

[0024] As best seen from Figs. 1a to 1d, the fixed pivot point 67 of the pivot arm 66 is arranged offset to one side of an axis (Y) located midway between the load lifters 12, 14, and below the height of a central longitudinal axis (X) of the ram assembly 52. It is to be appreciated that the fixed pivot point 67 may also be above the axis (X) of the ram assembly 52.

[0025] The support frame 90 (Figs. 4 to 6) is made up of two parallel support plates 92 vertically slotted at either side of the ram assembly 52 and connected to the housing 100. The support plates 92 have apertures 94 to allow pivoting of the lever arms 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b.

[0026] Referring now to Fig. 7, the housing 100 has a base 102 which may enclose the ram assembly 52, the link assemblies 54, 56, the support plate 90 and part of the lever arms 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b.

[0027] Sides 104, 106 of the housing 100 adjacent the load lifters 12, 14 have apertures 108 to allow the lever arms 30a, 30b; 31a, 31b; 32a, 32b; 33a, 33b, and hence

the load lifters 12, 14, to pivot in and out of the housing 100.

[0028] The other sides 110, 112 of the housing 100 have an aperture 114 to receive the pin 74 of the fixed pivot point 67 of the pivot arm 66, thus securing the pivot arm 66 in place between the support frame 90 and housing 100.

[0029] In accordance with a second embodiment of the present invention, as shown in Figs. 8a to 8d, there is provided a work implement 10, apparatus 50 for opening and closing a pair of load lifters 12, 14, simultaneously, and a housing 100 substantially the same as the first embodiment, with the exception of the pivot arm.

[0030] In this second embodiment, the pivot arm 166 has elongate plates 168, as oppose to the triangular plates 68 of the first embodiment. Fixed pivot point 167 of the pivot arm 166 is located intermediate corners 180, 182 of the plates 168, such that all three apertures 176, 178, 179 and pins 184, 186, 189 are located substantially along a central longitudinal axis (Z) of the pivot arm 166.

[0031] As can be seen from Figs. 8a to 8d, the fixed pivot point 167 of the pivot arm 166 is arranged substantially along an axis (Y) midway between the load lifters 12, 14, and substantially along the same height as a central longitudinal axis (X) of the ram assembly 52. The fixed pivot point 167 of the pivot arm 166 may also be arranged offset to one side of axis (Y).

Industrial Applicability

[0032] As illustrated in Figs. 1a to 1d, to close the load lifters 12, 14, the piston rod 60 of the ram assembly 52 is caused to extend, which in turn forces the lever arms 31a, 31b; 33a, 33b of load lifter 14 to rotate clockwise about the pivot point 28, causing the load lifter 14 to rotate clockwise towards the closed position; meanwhile the second link 64 of each link assembly 54, 56 causes the bottom corners 80 of the pivot arms 66 to rotate counter-clockwise about the fixed pivot point 67. As a result, the top corners 82 of the pivot arms 66 are driven in a counter-clockwise rotation, driving the lever arms 30a, 30b; 32a, 32b of the other load lifter 12 in a similar counter-clockwise direction by virtue of the first links 62. Consequently, the other load lifter 12 is driven counter-clockwise to close with the first-mentioned load lifter 14.

[0033] It is to be appreciated that the rotation of load lifter 14 will be mirrored by load lifter 12 as a result of the link assemblies 54, 56 and, in particular: (i) to the extent that the lengths of the first links 62 are identical to the length of the second links; and (ii) to the extent that the pins 84, 86, of the pivot arms 66, are equidistant from the fixed pivot points 67.

[0034] The load lifters 12, 14 are opened in a similar manner, but it is to be appreciated that the direction of rotation of the various parts will be reversed, upon retraction of the piston rod 60.

[0035] The second embodiment of the present invention, as shown in Figs. 8a to 8d, operates in substantially the same way as the first embodiment of the present invention.

[0036] It is to be appreciated that, in one embodiment, no component parts of the apparatus 50 extend below the base 102 of the housing 100 into the headroom defined by the volumetric capacity of the load lifters 12, 14; and that this is not at the expense of the volumetric capacity for a given size of load lifters 12, 14, i.e. the base 102 of the housing 100 can be located higher up for a given size of load lifters 12, 14. Thus, there are no interfering parts within the headroom of the load lifters 12, 14 to affect a load, and a relatively larger headroom is obtained for a given size of load lifters 12, 14.

[0037] It is also to be appreciated that, in one embodiment, the base 102 of the housing 100 spans completely underneath the apparatus 50 to protect it from damage and excess wear caused by a load.

[0038] Due to the offset fixed pivot point 67, 167, a relatively smaller angle of rotation is required to fully close and open the load lifters 12, 14. It is also to be appreciated that offsetting the fixed pivot point 67, 167 allows for a relatively shorter height of pivot arm 66, 166, which reduces the overall height of the apparatus 50, allowing for a relatively larger headroom for a given size of load lifters 12, 14.

[0039] The overall height of the apparatus 50 is relatively small compared with the prior art, by virtue of the horizontal ram assembly 52, and shallow link assemblies 54, 56.

[0040] The base 102 of the housing 100 also prevents ingress of dust or particles into the apparatus 50 from directly below.

[0041] The second embodiment has all the advantages of the first embodiment. However, the first embodiment may be slightly smaller in height, and require slightly less rotation of the pivot arm to close the shells compared with this embodiment by virtue of the triangular plates 68; although having said this, both embodiment still have significant advantages over the

prior art.

[0042] Modifications and improvements may be made to the above without departing from the scope of the present invention.

Claims

1. Apparatus for opening and closing a pair of load lifters pivotably mountable on a support frame, the apparatus comprising:

   a ram assembly pivotably connectable to each of said pair of load lifters;
   a pivot arm pivotably mountable on the support frame and disposed between said pair of load lifters;

a first link pivotably connectable between one of said pair of load lifters and a first location on the pivot arm; and
a second link pivotably connectable between the other one of said pair of load lifters and a second location on the pivot arm;

wherein actuation of the ram assembly causes said pair of load lifters to open and close.

2. Apparatus according to claim 1, wherein the pivot arm is arranged to pivot about a point on the support frame substantially at a midpoint between said pair of load lifters.

3. Apparatus according to claim 1, wherein the pivot arm is arranged to pivot about a point on the support frame offset to one side of the midpoint between said pair of load lifters.

4. Apparatus according to any preceding claim, wherein the pivot arm is mounted to the support frame at substantially the same height as a longitudinal centre-line of the ram assembly.

5. Apparatus according to any of claims 1 to 3, wherein the pivot arm is mounted to the support frame offset to one side of the height of the longitudinal centre-line of the ram assembly.

6. Apparatus according to any of claims 2 to 5, wherein the length of the first link between the one of said pair of load lifters and the first location is substantially the same length as the length of the second link between the other one of said pair of load lifters and the second location, and the first and second locations on the pivot arm are substantially equidistant from the pivot point of the pivot arm.

7. Apparatus according to any preceding claim, including a housing which substantially houses at least one of: the support frame; the ram assembly; the pivot arm; the first link; the second link.

8. Apparatus according to claim 7, wherein a base of the housing spans completely underneath the ram assembly, the first and second links, and the pivot arm, to protect the apparatus from damage.

9. A work machine comprising the apparatus of any of claims 1 to 8.

10. The work machine of claim 9, including a pair of load lifters.

11. A work implement comprising the apparatus according to any of claims 1 to 8 and a pair of load lifters pivotably mounted on a support frame.

12. A work machine comprising the work implement according to claim 11.

13. A clamshell grapple comprising a work implement according to claim 11, wherein said pair of load lifters are shells.

14. A work machine comprising the clamshell grapple of claim 13.

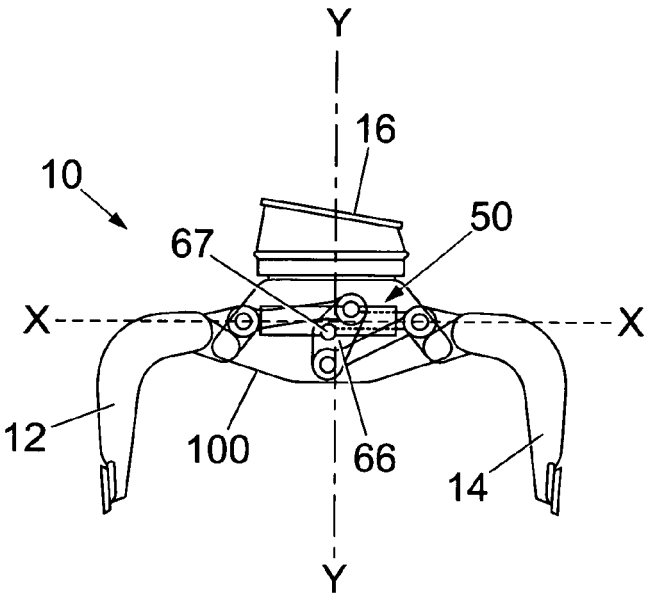


Fig. 1a

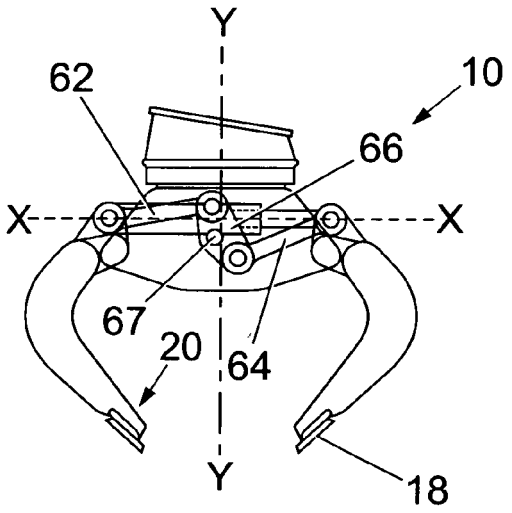


Fig. 1c

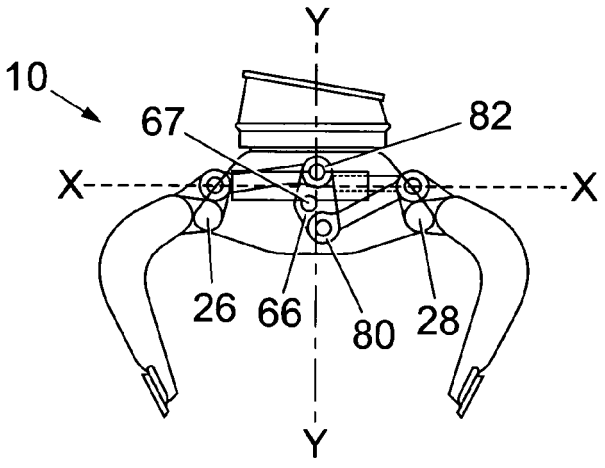


Fig. 1b

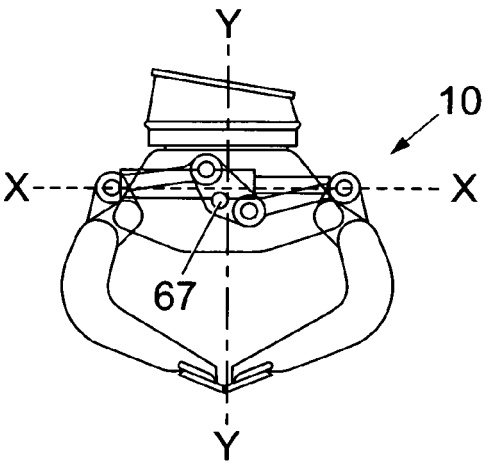
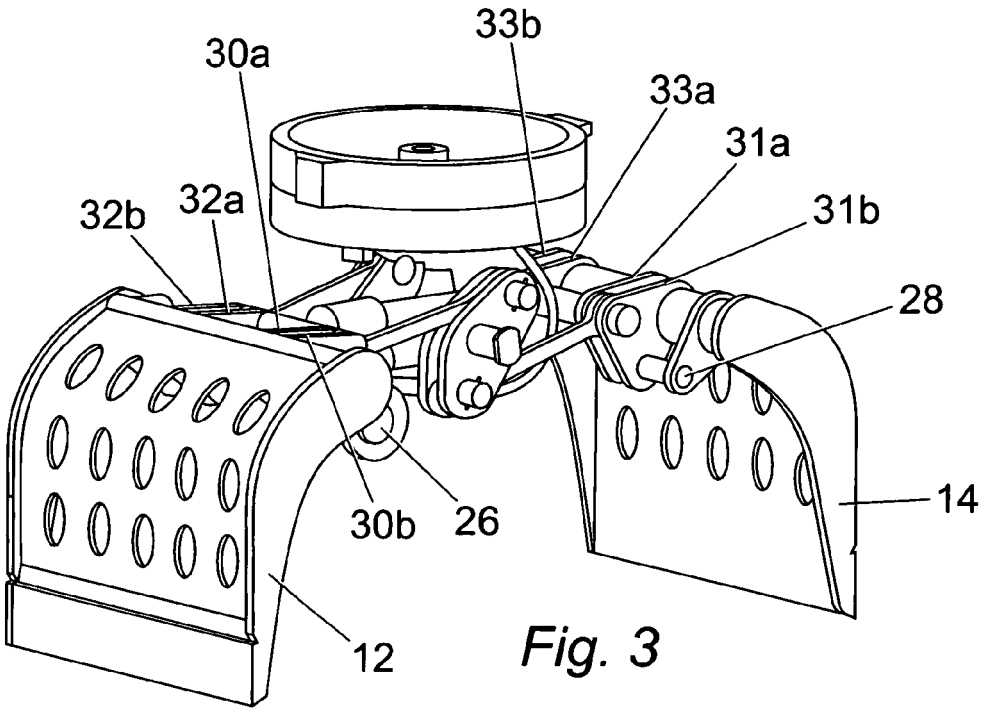


Fig. 1d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14
30b
26
12

Fig. 3

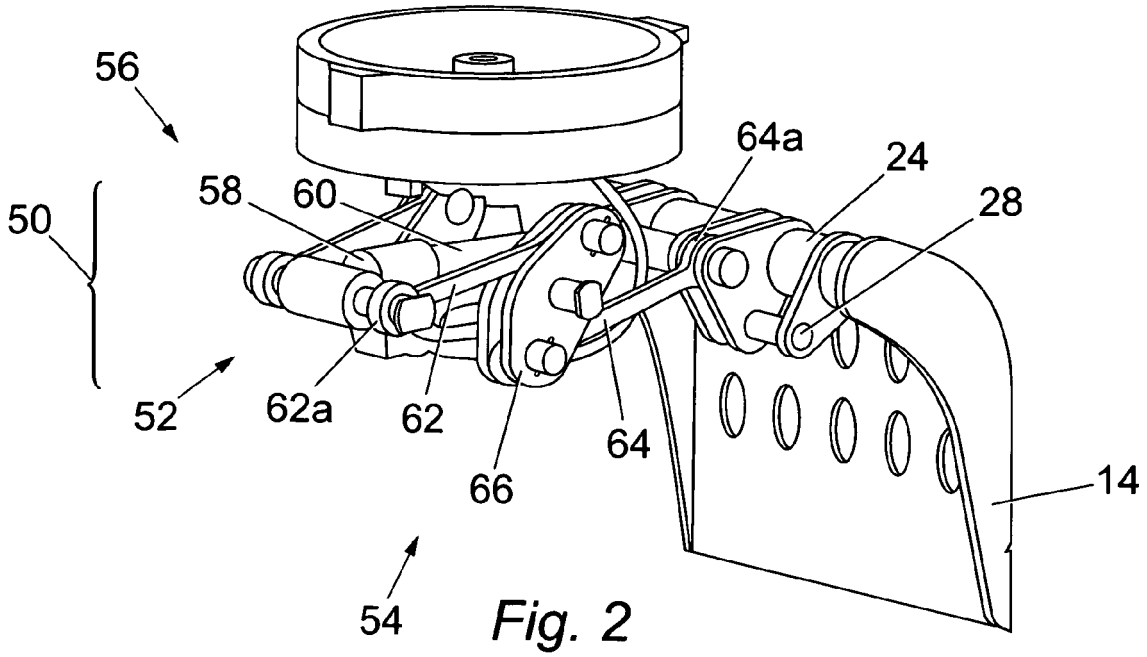
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Fig. 2

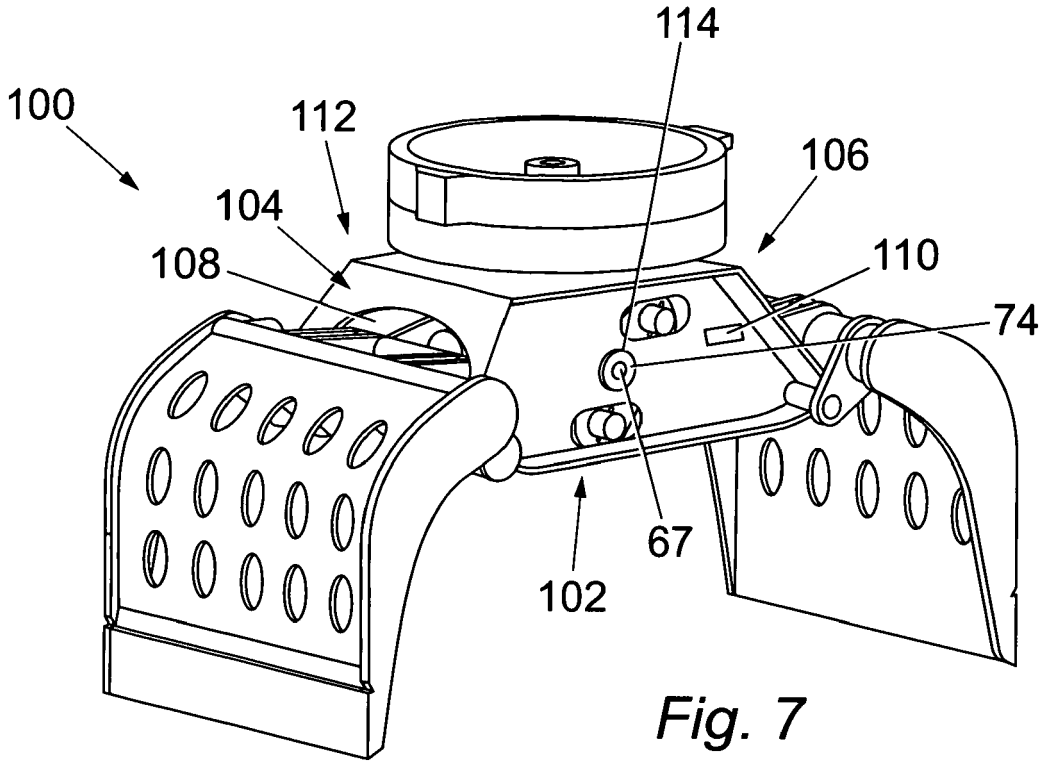
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Fig. 7

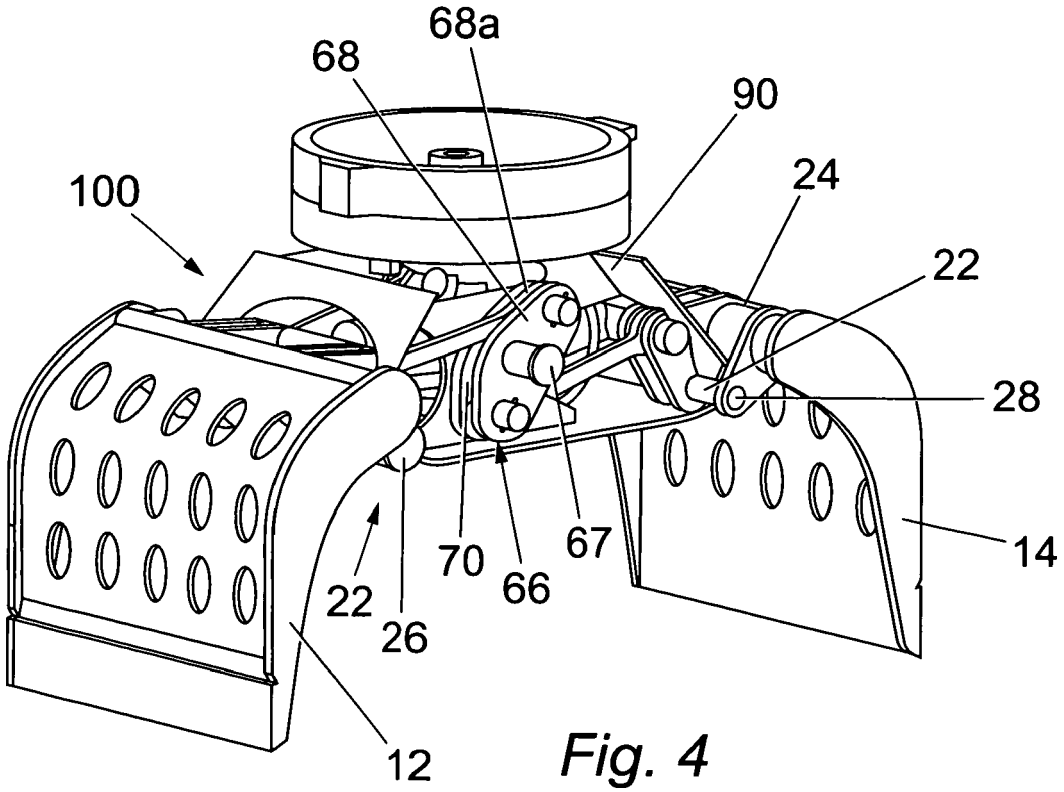
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Fig. 4

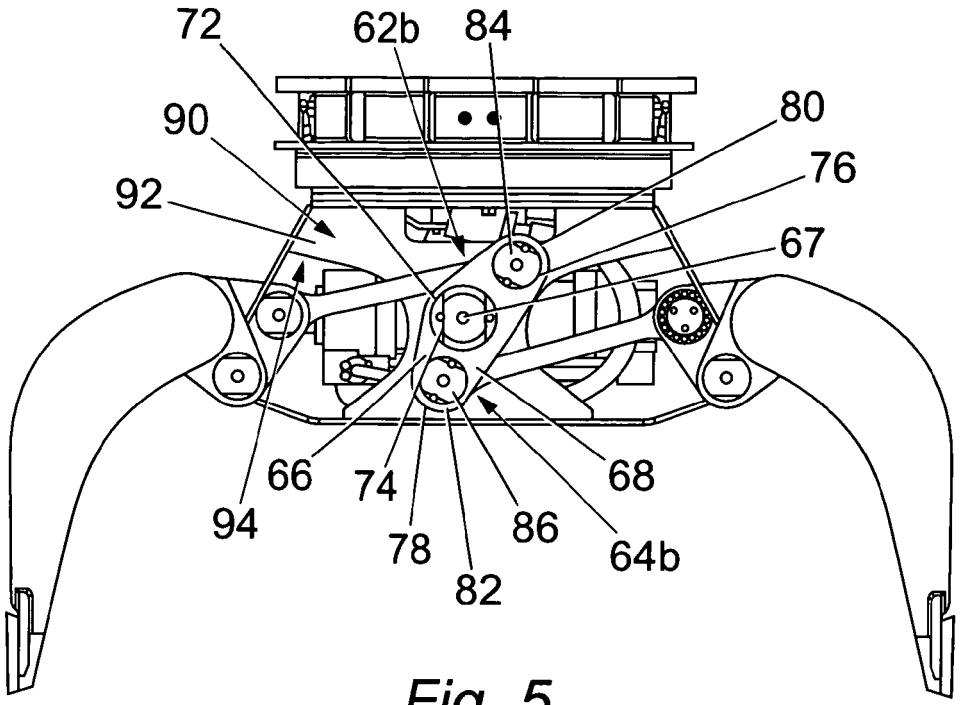

Fig. 5

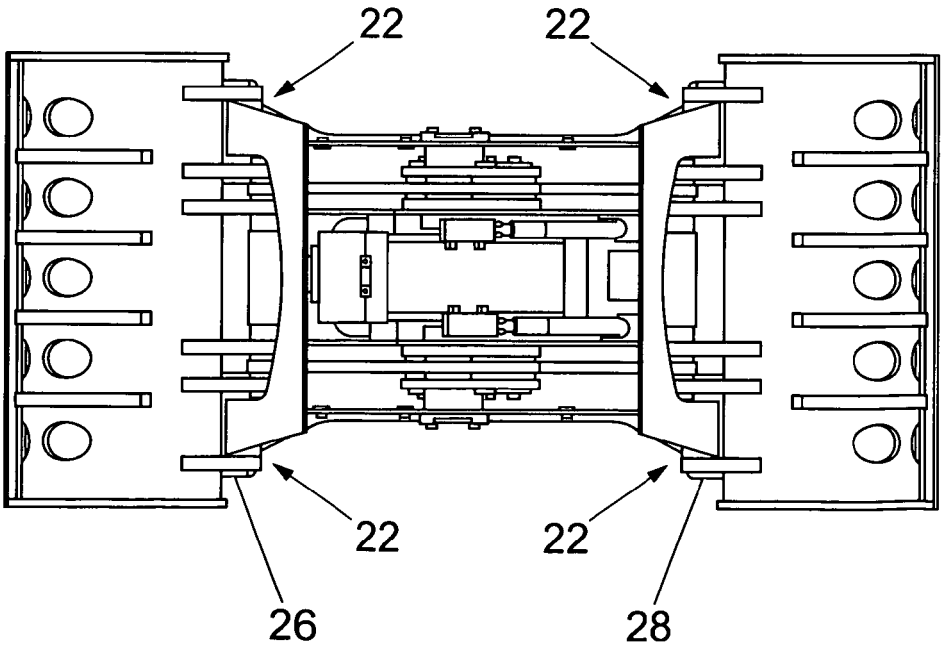

Fig. 6

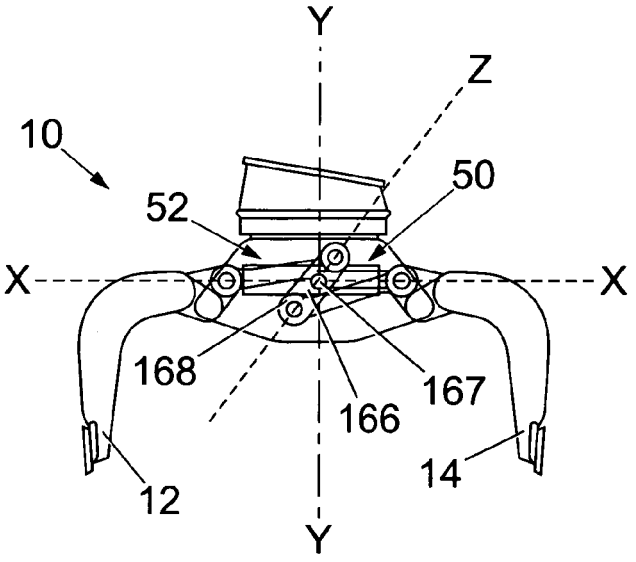

Fig. 8a

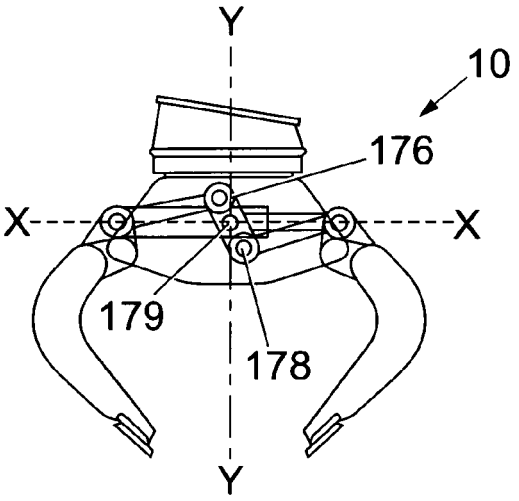

Fig. 8c

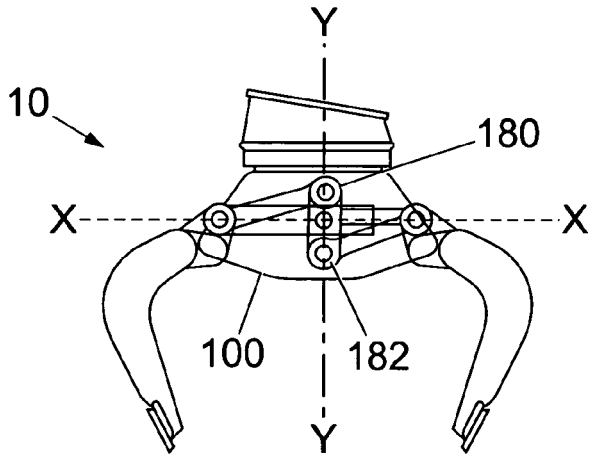

Fig. 8b

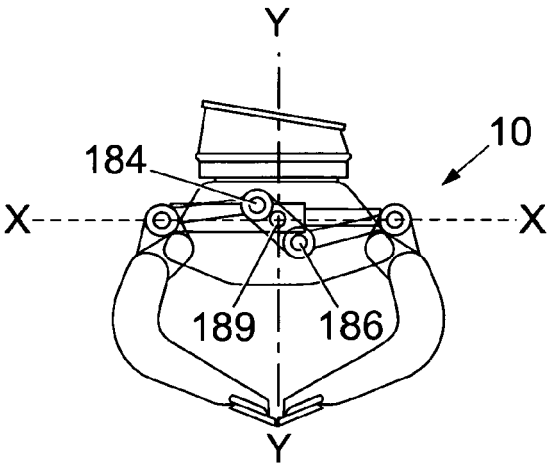

Fig. 8d

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 25 2326

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	WO 89/03800 A (HIAB-FOCO AB) 5 May 1989 (1989-05-05) * abstract *	1-14	B66C1/42 B66C1/28
A	FR 2 463 091 A (CATERPILLAR TRACTOR CO) 20 February 1981 (1981-02-20) * page 1, line 36 - page 5, line 8; figures 2-4 *	1-14	
A	SU 770 996 A1 (VOLZHSKO-KAMSKIJ NI KT I VODNOGO LESOTRANSPORTA) 15 October 1980 (1980-10-15) * figure 1 *	1-14	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 October 2005	Blumenberg, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 25 2326

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-10-2005

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82