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(54) LIFTING EYE ATTACHMENT FOR AN EXCAVATOR

(57) A dedicated lifting eye attachment (100) for an excavator (10), which has a main body (101) comprising a set of substantially parallel bars or tubes (112) that enable it to be detachably engaged with the claws (52) of a quick coupler-type device (50) mounted to the end of the excavator arm (20). The main body (101) also comprises a lifting eye (102) or D-ring (114) which is used in lieu of a lifting eye (56) forming part of the quick coupler-type connector (50). The configuration of the lifting eye attachment (100) places the lifting eye (102) or D-ring (114) in the line-of-sight (34) of an operator of the excavator (10), helps to ensure that the excavator (10) is kept within its load limits, reduces or avoids fouling of lifting stops/chains (16) with the quick coupler-type connector (50) and helps to avoid unsafe working practices.

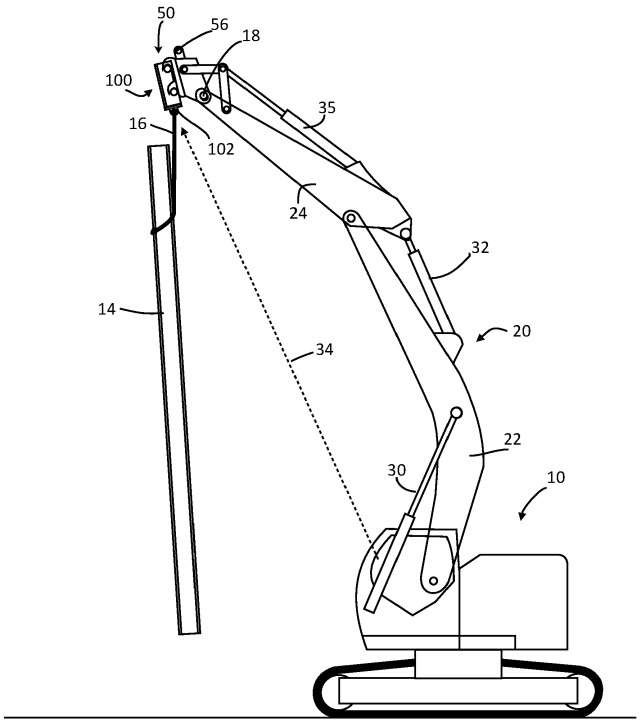

FIGURE 13

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Description

[0001] This invention relates to lifting eyes, and in particular, but without limitation, to lifting eyes suitable for use with excavators and other similar types of site plant/machinery.

[0002] When using an excavator on a building site, it is sometimes necessary or desirable to lift items and this can be done by using the excavator as a makeshift crane or hoisting device. The excavator typically has an articulated arm, which comprises two limb portions that are separately driven by hydraulic rams. The limb portions are pivotally connected to one another so that the reach and height of the distal end of the arm relative to the root end can be controlled by the operator of the excavator using a set of levers or other controls inside the cab.

[0003] Various tools can be fitted to the distal or free end of the excavator arm, for example, a digger bucket, a pile driver, a concrete nibbler, etc. To facilitate changing the tools at the end of the excavator arm, it is commonplace to use a mounting system, which is affixed to the end of the excavator arm, and which comprises a mechanism for detachably connecting different tools to it. In this way, the mounting system remains connected to the end of the excavator arm, but can be used to attach different tools to it, so that the versatility of the excavator is increased.

[0004] One of the most common mounting mechanisms is generically known as a "quick coupler", which has a set of spaced-apart hooks, which engage, in use, with appropriately spaced-apart bars of a tool, such as a digger bucket. A hydraulically-actuated claw mechanism of the quick coupler is used to retain the bars of the tool in engagement with the hooks of the mounting system.

[0005] Attachment of a quick coupler-compatible tool to a quick coupler involves opening the claws of the quick coupler to expose the hooks; engaging the hooks with the bars of the quick coupler compatible tool; and then closing the claws to grip the bars of the quick coupler compatible tool against the hooks. Engaging both sets of hooks with both bars can sometimes be achieved simultaneously, but is it also possible to engage one hook with one bar, lift the tool so that it swings into position and thus engage the second bar with the second hook, and then close the claws. Removal of the quick coupler compatible tool from the quick coupler can be accomplished using a reverse procedure of the above.

[0006] When it is desired to use an excavator as a hoisting device or makeshift crane, the manufacturers typically recommend removing all accessories and tools (including the quick coupler) from the end of the excavator arm, threading a lifting strop through the eye at the end of the excavator arm (to which tools are typically connected), and suspending the load from the end of the excavator arm. This configuration ensures that the load is transmitted through the calibrated lead point for the excavator thereby ensuring that the load being lifted or moved can be accurately assessed against the weight limits for the excavator itself, which are typically tabulated in a user/operator's manual.

[0007] That being said, removing all of the tools and accessories from the end of the excavator arm can be a difficult, fiddly and/or time-consuming process. Therefore, where the excavator is to be used to lift only a few items at a time, it is not unknown to attach the lifting strop to an existing tool (e.g. the tines of a digger bucket) - a practice which is generally frowned upon; or to attach the lifting strop a dedicated lifting eye, which is typically prewelded onto most quick couplers.

[0008] The lifting eye of the quick coupler is located on the far side of the quick coupler, i.e. the side facing away from the operator of the excavator, which means that it is out of direct line-of-sight of the operator of the excavator throughout most of the excavator's range of motion. This can be problematic insofar the operator cannot directly see the entire load at all times, but more importantly, there is a risk that the lifting strop or chain will become fouled by the quick coupler and/or any tool fitted thereto. Specifically, allowing the lifting strop or chain to wrap around another object can place excessive strain on the lifting strop/chain, and/or create a "pinch point" where the loads are amplified - which can lead to failure. This arrangement can also damage the excavator and any accessories fitted to it.

[0009] Moreover, because the lifting eye of the quick coupler is not aligned horizontally with the distal end of the excavator arm (the latter being the reference point for the excavator's weight limits), it is easy to over-load the excavator when using it in this manner because the loading point is located further away, in practice, than the free end of the excavator arm. This effectively means that the "reach", i.e. the horizontal distance between the root end of the excavator arm and the load point, is greater than the horizontal distance between the root point of the excavator arm and the free end of the excavator arm. This increased "lever arm" or moment can easily cause the excavator to be overloaded or become unbalanced, in use.

[0010] Moreover, when using an excavator in this way, the quick coupler effectively reduces the maximum lifting height of the excavator, so there can be a tendency for the operator to tilt the quick coupler away from the cab to gain some additional height, which simply serves to rotate it further out of view and laterally away from the calibrated lifting point of the excavator arm. Not only does that increase the likelihood of the lifting strop/chain fouling, but it also potentially takes the loading of the excavator yet further beyond of the permitted operating envelope specified in the operator's handbook.

[0011] A need therefore exists for a solution to one or more of the above problems, which the present invention aims to provide.

[0012] Aspects of the invention are set forth in the appended independent claims. Preferred and/or optional features of the invention are set for the in the appended dependent claims.

[0013] According to an aspect of the invention, there is provided a lifting eye attachment for an excavator comprising a main body portion and a lifting eye; the main body portion comprising: a plurality of spaced-apart sidewalls; a plurality of spaced-apart, substantially parallel bars or tubes extending between the sidewall portions and together forming a set of quick coupler-compatible engagements for connecting, in use, with a quick coupler affixed to an excavator arm; a base wall extending between the sidewall portions; and an end wall extending between the sidewall portions, wherein the lifting eye is affixed to the end wall.

[0014] The lifting eye attachment of the invention suitably provides a lifting eye, which can be readily attached to, or detached from, a quick coupler-type connector of an excavator arm. Thus, a dedicated lifting eye, which converts an excavator into a makeshift crane, is readily obtainable by virtue of the invention in a reliable and reproducible manner, and can be obtained as easily as a conventional bucket change procedure.

[0015] Additionally, a known lifting eye, which is welded onto a tool or quick coupler is susceptible to damage during use. For example, if a quick coupler is used to attach a digger bucket to an excavator arm, and is used to dig a deep hole in rocky ground, then quite often the lifting eye welded onto the quick coupler and/or the digger bucket becomes damaged by abrasion and knocks in use. This means that the lifting eye needs to be certified on a regular basis, say every 6 months, as it is subjected to wear and tear even when it is not being used as such. However, the invention, by stark contrast, provides a lifting eye attachment that is only subject to wear and tear during actual use, and which can be safely stowed when not in use. This not only extends the useful duty cycle of the lifting eye, as well as potentially extending its service/certification interval from say 6-months to say, 12-months, but gives greater confidence to the user that the lifting eye has not been damaged and/or is within design limits.

[0016] Preferably, the lifting eye attachment has no other tools associated with it, such as a bucket, such that a load can be suspended from, or attached to, the lifting eye without obstruction or impediment.

[0017] Preferably, the relationship between the a plurality of spaced-apart, substantially parallel bars or tubes and the end wall is such that the outer surface of end wall (i.e. the surface that faces away from the main body of the lifting eye attachment and to which outer surface the lifting eye is affixed), faces towards the operator of the excavator when the lifting eye attachment is correctly affixed to a quick coupler of an excavator arm. This configuration means that there is a direct line-of-sight between the lifting eye and the operator of the excavator throughout all, or at least a majority of, the excavator arm's full range of motion. This means that the operator of the excavator can properly observe the lifting eye and any attached load for all, or most, of the time.

[0018] Suitably, the sidewall portions, the base wall and/or the end wall are manufactured from plate steel pieces (e.g. rectangles), which can be welded together to form the requisite configuration. Alternatively, the sidewall portions, the base wall and/or the end wall can be integrally formed from a net of plate steel, which is folded to bring the sidewall portions, the base wall and/or the end wall into the requisite configuration. The unitary nature of the folded-net configuration can improve the durability and/or strength of the lifting eye attachment.

[0019] The plurality of spaced-apart, substantially parallel bars or tubes are suitably also made from steel tube or rod, and may be affixed to the sidewalls by being welded onto the inner surfaces of the sidewalls, or into blind- or through-holes cut, machined or drilled into the sidewalls. The plurality of spaced-apart, substantially parallel bars or tubes together form a set of quick coupler-compatible engagements, which enables the lifting eye attachment to be easily connected to, and detached from, a quick coupler of an excavator arm. By being easily connectable and detachable, this configuration suitably promotes the use of a dedicated and/or specially-designed lifting eye attachment, rather than attaching a lifting stop or chain to a bucket or other tool, which can be dangerous. Thus, the lifting eye attachment can easily be conveniently used even for relatively small jobs, or larger jobs can be carried out without having to remove the quick coupler from the excavator arm.

[0020] In preferred embodiments of the invention, the lifting eye comprises a steel ring, which is welded or otherwise securely affixed to the outer surface of the end wall. Providing a continuous ring enables a shackle or other device to be securely connected to it - without risk of it becoming disengaged as the orientation of the lifting eye attachment is changed, in use. The use of a continuous ring is preferred over, say, a hook, which could cause an attached load to disconnect as the lifting eye attachment is rotated to certain angles. In other embodiments of the invention, the lifting eye comprises a D-ring, which is suitably formed from a length of bent steel bar folded through 90-degrees twice - with its free ends welded or otherwise securely affixed to the outer surface of the end wall. A D-ring may be preferred where a webbing lifting strop is used, whereas a ring may be preferred where a shackle, carabiner, chain or rope is being used to connect the load to the lifting eye attachment.

[0021] In one possible embodiment of the invention, there are two end walls each having an outer surface. On one of the end walls in this configuration, a continuous ring is provided, whereas on the other end wall, a D-ring is provided. Provided the quick coupler bars/tubes are "reversible", the lifting eye attachment can be affixed to the quick coupler in one of two configurations, that is to say, with the continuous ring facing towards the operator of the excavator, or with the D-ring facing towards the operator of the excavator.

[0022] The main body has a base wall and this provides stability for the lifting eye attachment when it is placed on the floor. This may be particularly advantageous when

attaching or detaching the lifting eye attachment to/from the quick coupler. Inevitably, when fitting the lifting eye attachment to the quick coupler, a certain amount of down force will be experienced by the lifting eye attachment. Because the lifting eye attachment is likely to be used on soft ground/mud, there is a likelihood that it could be depressed into the ground during attachment/detachment procedures. However, by providing a base wall, the surface area of the lifting attachment in contact with the floor is much greater, and therefore the likelihood of depressing the lifting eye attachment into the floor surface is reduced and/or removed. A further advantage of providing the base wall is that it reduces the ingress of mud/stones and other debris into the interior part of the main body portion - where the tubes/bars are, which might interfere with the correct attachment of the quick coupler to the lifting eye attachment.

[0023] The or each end wall has a lifting eye (be that a continuous steel ring, or a D-ring), which is welded, or otherwise affixed, to its outer surface. The height of the lifting eye is suitably configured such that there is a certain amount of clearance between the lifting eye and the floor when the lifting eye attachment is placed on the floor with its base wall in contact with the floor. By raising the lifting eye above floor level, this means that the shackle or carabiner can be left in-situ, required. Additionally, it also means that the lifting eye itself is kept clear of the ground, and therefore reduces the likelihood of it becoming soiled or blocked by mud, stones or other contamination on site.

[0024] Embodiments in the invention shall now be described, by way of example only, with reference to the accompanying drawings in which:

Figures 1 and 2 are schematic side views of a known excavator being used as a lifting device in accordance with the manufacturer's recommendation;

Figures 3 and 4 are schematic side views of a known excavator fitted with a quick coupler device incorporating a lifting eye being used to lift a load;

Figures 5 and 6 are front and rear perspective views, respectively, of a lifting eye attachment in accordance with the invention;

Figure 7 is a schematic front perspective view of an alternate embodiment of a lifting eye attachment in accordance with the invention;

Figure 7A shows a different type of D-ring to that shown in Figure 7;

Figures 8, 9 and 10 are schematic cross-sectional, net and perspective exploded views, respectively, of a further embodiment of a lifting eye attachment in accordance with the invention;

Figures 11 and 12 are schematic side views of an excavator fitted with a lifting eye tool in accordance with the invention;

Figure 13 is a further schematic side view of an excavator fitted with a lifting eye tool in accordance with the invention being used to lift a girder; and

Figures 14 and 15 show an equivalent set-up to that shown in Figure 13, albeit using the lifting eye of a known quick coupler.

[0025] Referring to Figures 1 and 2 of the drawings, an excavator 10 is sitting on the ground 12 and is being used to lift a load 14. The load 14 is suspended from a lifting strop or chain 16, which is fed through a through-hole 18 located at the distal end of the excavator's arm 20.

[0026] The excavator arm 20 comprises a first limb 22 and a second limb 24, which are pivotally connected to one another about a pivot point 26. The root of the first limb 22 is pivotally connected 28 to a part of the main body of the excavator 10 and the first limb 22 can be pivoted about the pivot point 28 using a hydraulic ram 30. The angle between the first limb 22 and the second limb 24 is adjusted using a second hydraulic ram 32 in a manner that will be well-understood to the skilled reader. As such, the excavator arm 20 can be moved between different positions by adjusting the extension of the rams 30, 32 so as to put the through-hole 18 at the distal end of the second limb 24 into an appropriate position relative to the excavator 10. As can be seen from Figures 1 and 2 of the drawings, no matter where the load 14 is positioned, it hangs directly below the hole 18 at the end of the second limb 24, and is in direct line of sight 34 of the operator of the plant 10.

[0027] In many situations, however, a quick coupler attachment 50 is fitted to the eye 18 at the distal end of the second limb 24. A yet further hydraulic ram 35 connects to the quick coupler 50 and enables the quick coupler 50 to be pivoted about point 18.

[0028] The quick coupler 50 has a set of hooks 52, which enable a bucket 54 or other tool (as shown in Figure 4) to be detachably fitted to it. The quick coupler 50 also has a dedicated lifting eye 56 welded onto it from which a load 14 can be suspended using a lifting strop or chain 16.

[0029] As can be seen from Figure 3 of the drawings, when the position of the excavator arm 20 is relatively low down, the load 14 hangs freely from the dedicated lifting eye 56. However, it is out of the line-of-sight 34 of the operator of the plant because the eye 56 is located on the opposite side of the eye 18 at the end of the second limb 24 of the excavator arm 20 to where the operator is usually seated.

[0030] As can be seen from Figure 4 of the drawings, when the excavator arm 20 is raised further, the strop or lifting chain 16 fouls against the bucket 54 or quick lock connector 50 causing it to kink or bend thereby placing additional load onto the strop/chain 16, as well as the lifting eye 56. Moreover, when a bucket 54 is fitted, the view 34 of the load 14 can be greatly impeded.

[0031] Some of these problems can be alleviated by extending the ram 35 so as to pivot the quick coupler 50 downwardly about point 18, but that reduces the height of the load 14, which means that the excavator arm 20 needs to be cranked up yet further to achieve a given

amount of elevation of the load 14 above the floor 12.

[0032] A first embodiment of the invention is shown in Figures 5 and 6 of the drawings, which show a lifting eye attachment 100, which detachably affixes, in use, to the quick coupler 50 already at the end of the excavator arm 20 - as shown in Figures 11, 12 and 13. The lifting eye attachment 100 has a main body 101, which is formed by welding together plate steel rectangles which are the end wall 106, the side walls 108, and a base wall 110. A pair of steel tubes or bars 112 are welded, or otherwise securely affixed, to and span the side walls 108 and form connection points for the quick coupler 50 of an excavator 10.

[0033] The end wall 106 has an outer surface 104, which faces, in use, towards the operator of the excavator 10. Welded or otherwise securely affixed to the outer surface 104 of the end wall 106 is a lifting eye 102 formed from a continuous steel ring with a flat ground on one side that abuts, and which is welded to, the outer surface 104 of the end wall 106.

[0034] A variation of the lifting eye attachment 100 shown in Figures 5 and 6 is shown in Figure 7 of the drawings, which is otherwise identical save for the fact that the lifting eye 102 has been replaced by a D-ring 114 formed from a length of steel bar bent through 90-degrees twice with its free ends welded to the outer surface 104 of the end wall 106. Figure 7A shows a yet further type of lifting eye, which can be used with the invention, namely an articulated D-ring 114, which pivots in a clevis 115 that is welded to the outer surface 104 of the end wall 106. Other types of lifting eye suitable for the invention can readily be envisaged.

[0035] A further embodiment of the invention is shown in Figures 8, 9 and 10 of the drawings, which is more of a unitary configuration formed by folding a net as shown in Figure 9 of the drawings. The net shown in Figure 9 is cut from a sheet of plate steel and is folded along the dashed fold lines 116 so that the side walls are angled at 90-degrees to the base wall 110. The end wall 106 is then folded up so that its side edges meet the ends 118 of the side walls and a weld 120 is used to secure the assembly as shown in Figure 10. The side walls 108 have circular through-holes 122 drilled or cut therein, which receive the steel tubes or bars 112 to complete the main body. Finally, as can be seen in Figure 8 of the drawings, the lifting eye (or alternatively, the D-ring 114) can be welded onto the outer surface 104 of the end wall 106 to complete the lifting eye attachment 100. As can be seen in particular, from Figure 8 of the drawings, the lifting eye 112 is raised 124 slightly above the base wall 110/floor level 12. This means that the lifting eye (of D-ring) is clear of the floor 12 when the lifting eye attachment 100 is placed on the floor 12.

[0036] As can be seen from Figures 11 and 12 of the drawings, the lifting eye attachment 100 has a main body 101 with a lifting eye 102 on the side nearest the operator of the plant 10. This means now that the plant operator has direct line-of-sight 34 to the lifting eye attachment 100, the load 14 as well as the lifting strop/chain 16.

[0037] As can be seen by comparing Figures 11 and 12, which show the excavator arm 20 in the same positions as they were in in Figures 3 and 4, respectively: there is no interference now between the excavator arm 20 or any accessory and the lifting chain/strop in any excavator arm 20 position. Even if ram 35 is extended or retracted, it simply pivots the lifting accessory 100 about pivot point 18, but due to the fact that the lifting eye 102 is facing towards the cab operator, it remains within line-of-sight 34 of the operator at all times.

[0038] An in-use situation is illustrated, schematically, in Figure 13 of the drawings, in which the excavator arm 20 has been raised to full-height by extending ram 30 and retracting rams 32 and 35. The quick coupler 50 has been pivoted up about point 18 so that the lifting eye 102 is at its maximum possible elevation. However, because the lifting eye 102 is mounted on the end wall of the lifting eye attachment 100 facing towards the operator of the excavator 10, remains in clear line-of-sight 34 of the operator at all times. The lifting strop 16, in this case, is used to hoist a girder 14, which now hands freely from the lifting eye 102 of the lifting eye attachment 100.

[0039] Compare the situation shown in Figure 13 with an equivalent situation as would be in the prior art. Figure 14 shows how, with the lifting arm 20 in an identical configuration, if the lifting strop 16 were affixed to the lifting eye 56 of the quick coupler 50, then it would foul and/or create a pinch point 130 where the lifting strop/chain passes around the hooks of the quick coupler 50. The situation shown in Figure 15 of the drawings shows a similar configuration to that in Figure 14, albeit this time with a digger bucket 54 attached to the quick coupler also. Here, it can be seen that the length of the lifting strop/chain 16 needs to be much greater to ensure that the load 14 hangs free, but in addition, there is a pinch point 130 where the lifting strop/chain 16 wraps around the outer surface of the bucket 54.

[0040] It will be appreciated from the foregoing that the invention provides a marked improvement over the known system or systems and thereby addresses one or more of the problems set out in the preamble of this description of the invention.

Claims

1. A lifting eye attachment (100) for an excavator (10) comprising a main body portion (101) **characterised by**:

   the main body portion comprising a lifting eye (102);
   a plurality of spaced-apart sidewalls (108);
   a plurality of spaced-apart, substantially parallel bars or tubes (112) extending between the sidewall portions (108) and together forming a set of quick coupler-compatible engagements for

connecting, in use, with a quick coupler (50) affixed to an excavator arm (20) of the excavator (10);
a base wall (110) extending between the sidewall portions (108); and
an end wall (106) extending between the sidewall portions (108), wherein
the lifting eye (102) is affixed to the end wall (106).

2. The lifting eye attachment (100) of claim 1, wherein the relationship between the plurality of spaced-apart, substantially parallel bars or tubes (112) and the end wall (106) is such that an outer surface (104) of the end wall (106) faces towards (34) an operator of the excavator (10) when the lifting eye attachment (100) is correctly affixed to a quick coupler (50) of an excavator arm (20) of the excavator (10).

3. The lifting eye attachment (100) of claim 1 or claim 2, wherein any one or more of: the sidewall portions (108); the base wall (110); and the end wall (106) are manufactured from plate steel pieces, which are welded together to form the requisite configuration.

4. The lifting eye attachment (100) of claim 1 or claim 2, wherein any two or more of: the sidewall portions (108); the base wall (110); and the end wall (106) are integrally formed from a foldable net of plate steel, which is folded (116) to bring the sidewall portions (108), the base wall (110) and/or the end wall (106) into the requisite configuration.

5. The lifting eye attachment (100) of any preceding claim, wherein the plurality of spaced-apart, substantially parallel bars or tubes (112) are made from steel tube or rod and are affixed to the sidewalls (108) by being welded between inner surfaces of the sidewalls (108), or into blind- or through-holes (122) in the sidewalls (108).

6. The lifting eye attachment (100) of any preceding claim, wherein the lifting eye comprises a continuous steel ring (102), which is welded or otherwise securely affixed to an outer surface (104) of the end wall (106).

7. The lifting eye attachment (100) of claims 1 to 5, wherein the lifting eye comprises a D-ring (114), which is formed from a length of bent steel bar whose free ends are welded or otherwise securely affixed to an outer surface (104) of the end wall (106).

8. The lifting eye attachment (100) of any of claims 1 to 5, wherein the main body (101) comprises two end walls (106) each having an outer surface (104), and wherein on one of the end walls (106), a continuous ring (102) is affixed, whereas on the other end wall (106), a D-ring (114) is affixed, and wherein the lifting eye attachment (100) is reversibly connectable to the quick coupler (50) such that, in use, the lifting eye attachment (100) can be affixed to the quick coupler (50) in one of two configurations, namely with the ring (102) facing (34) towards the operator of the excavator (10), or with the D-ring (114) facing (34) towards the operator of the excavator (10).

9. The lifting eye attachment (100) of any preceding claim, wherein the position of the lifting eye (102) on the end wall (106) is such that there is a clearance (124) between the lifting eye (102) and the floor (12) when the lifting eye attachment (100) is placed on the floor (12) with its base wall (100) in contact with the floor (12).

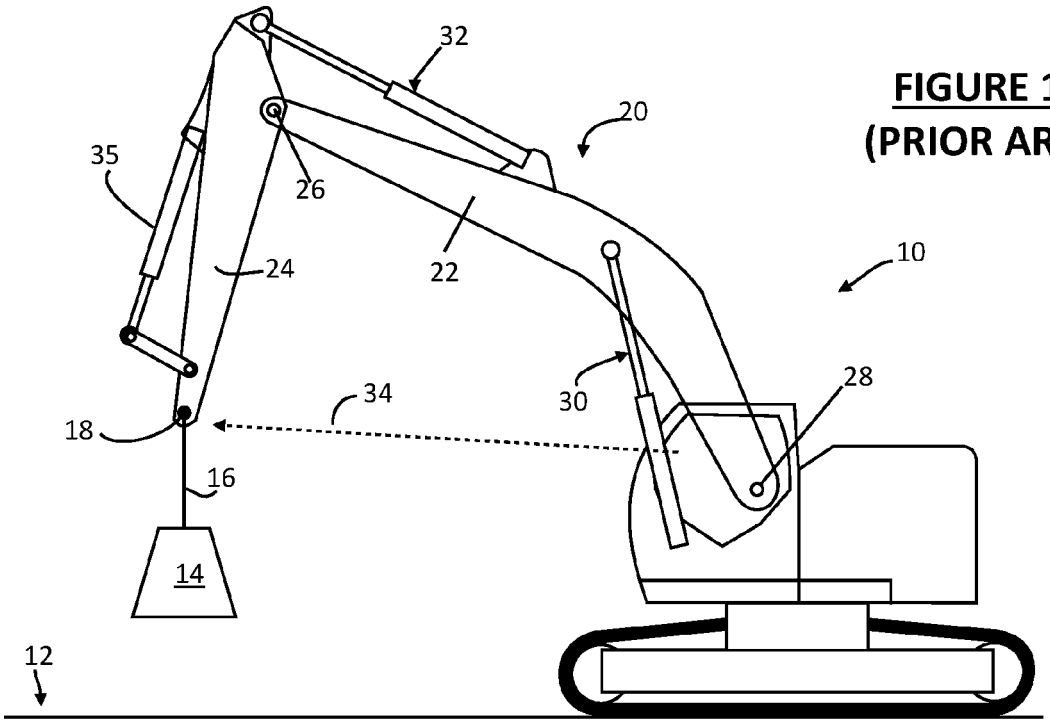

FIGURE 1
(PRIOR ART)

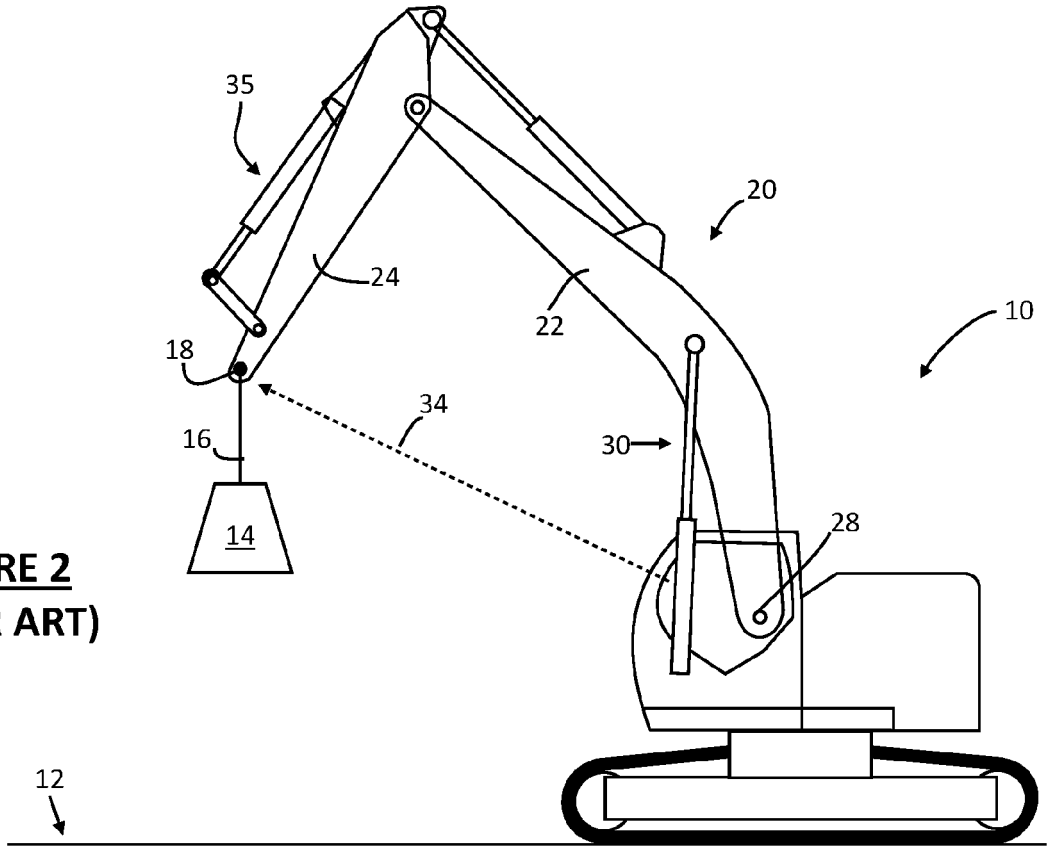

FIGURE 2
(PRIOR ART)

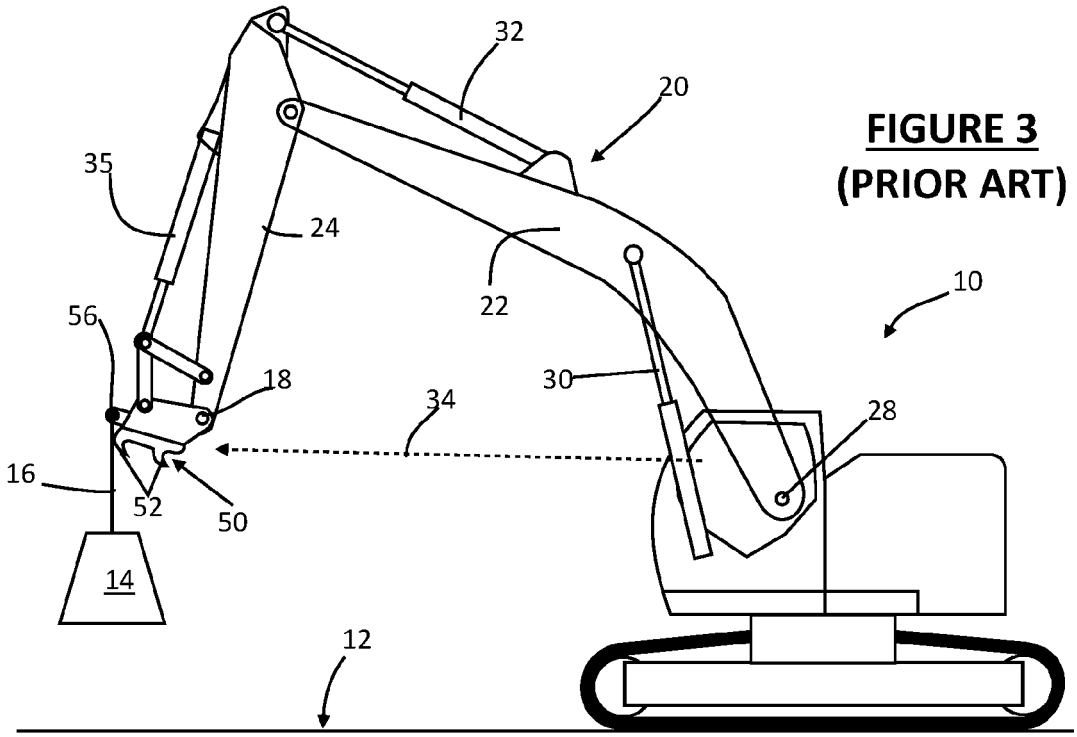

FIGURE 3
(PRIOR ART)

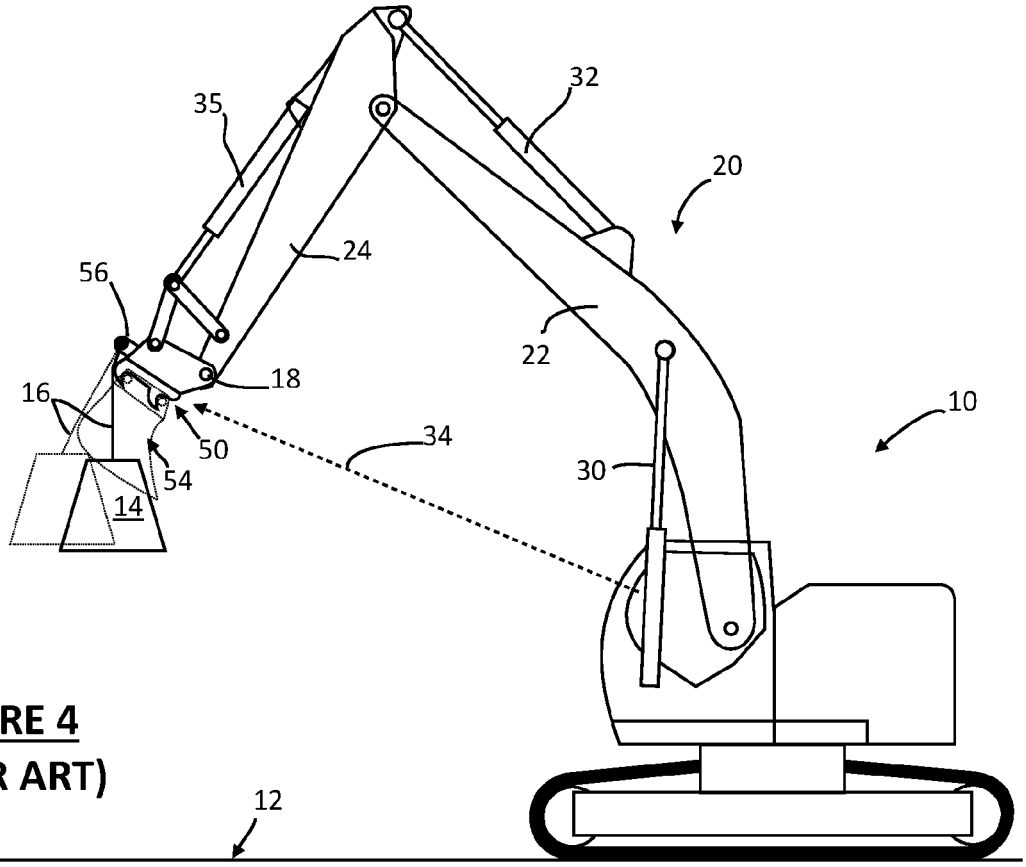

FIGURE 4
(PRIOR ART)

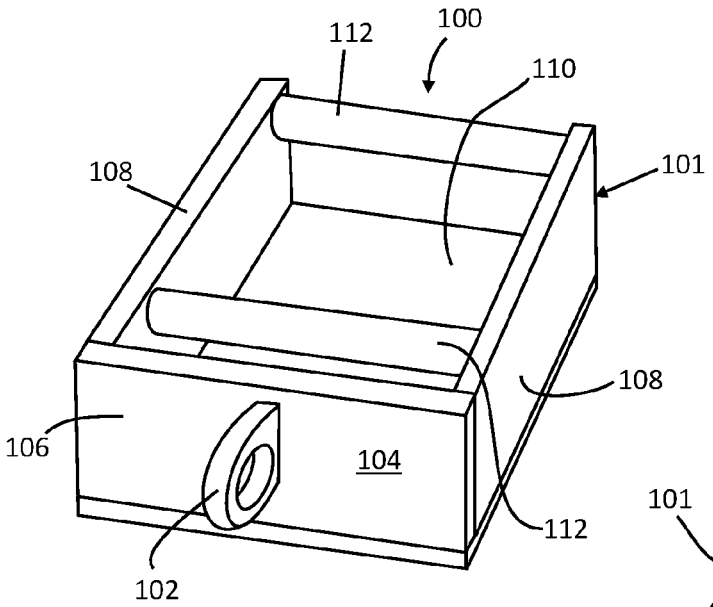

FIGURE 5

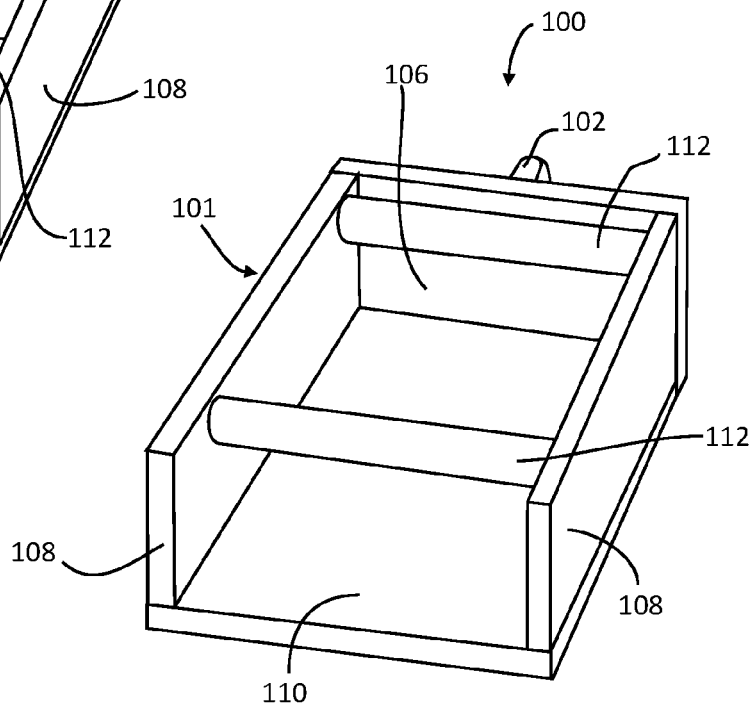

FIGURE 6

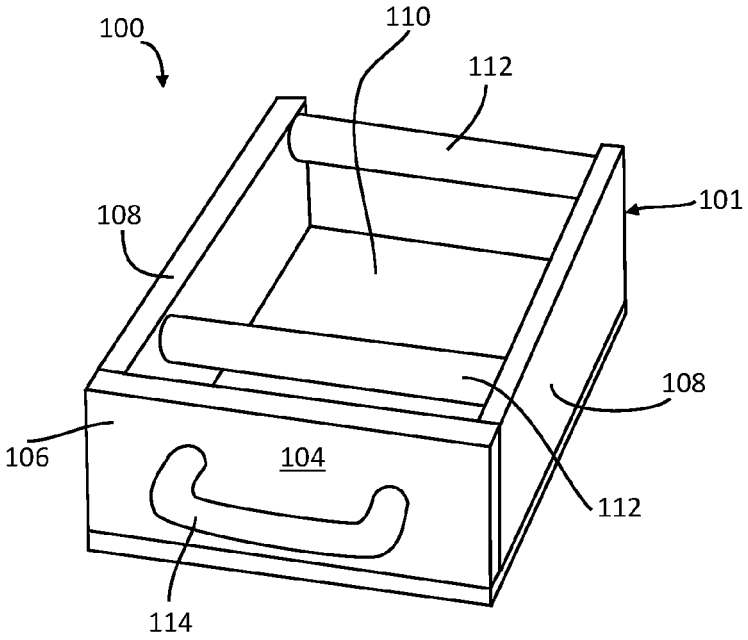

FIGURE 7

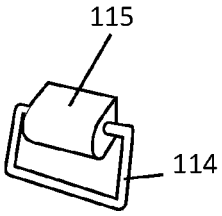

FIGURE 7A

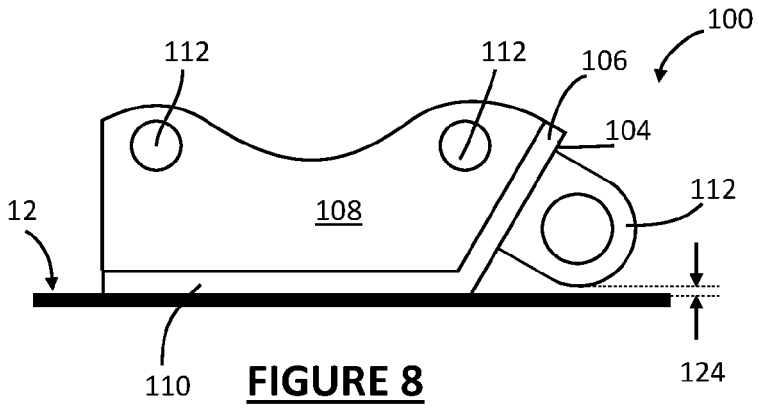

FIGURE 8

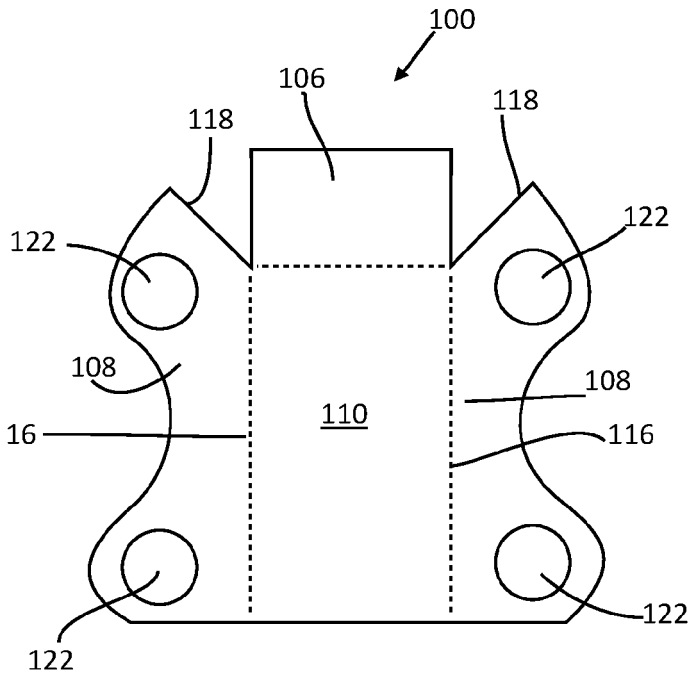

FIGURE 9

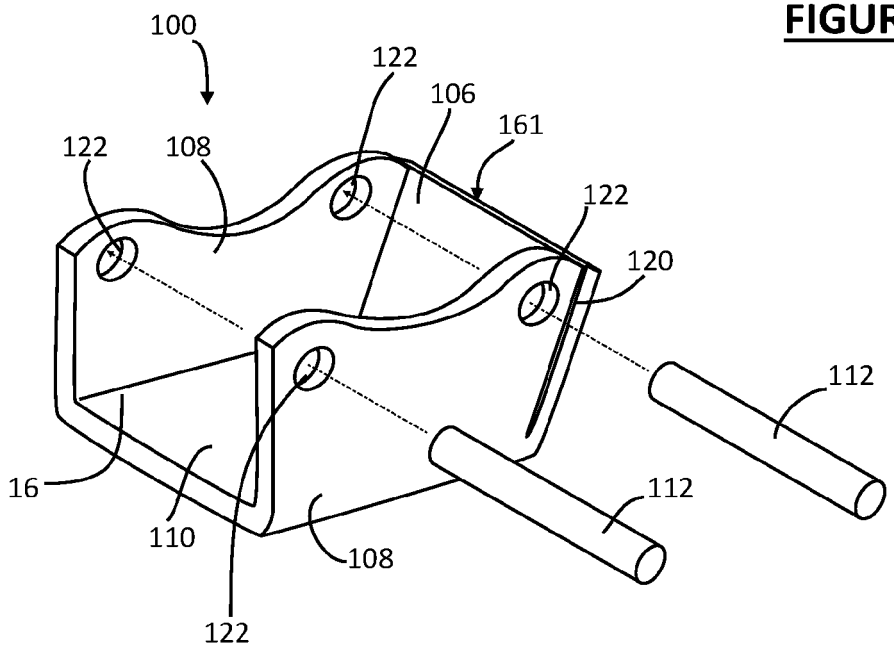

FIGURE 10

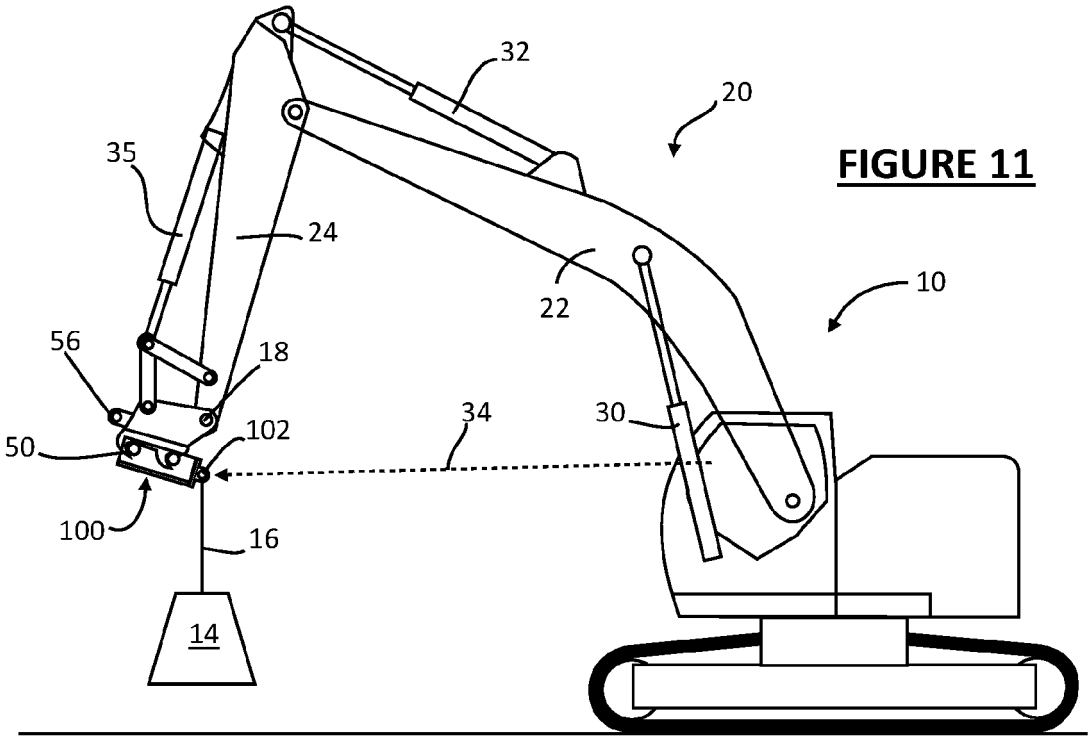

FIGURE 11

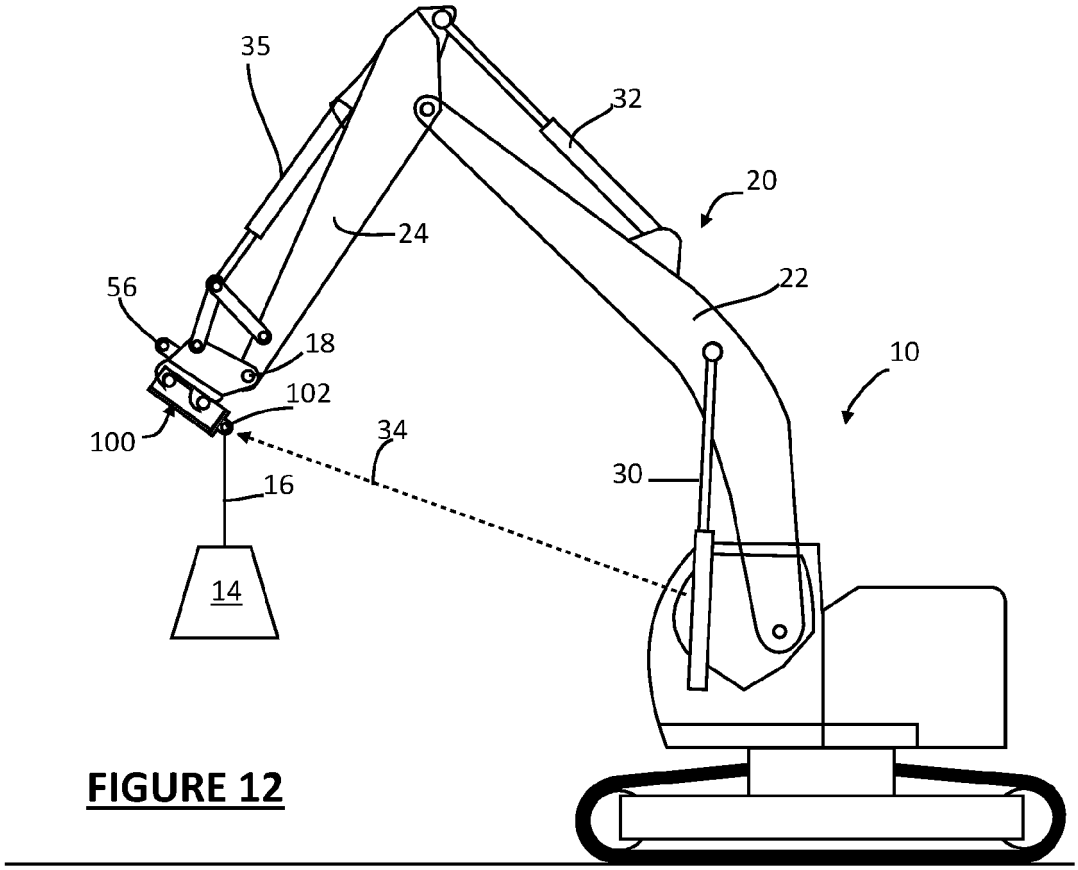

FIGURE 12

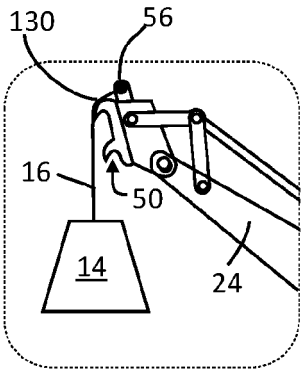

FIGURE 14
(PRIOR ART)

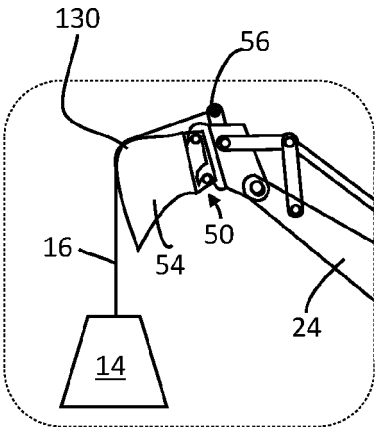

FIGURE 15
(PRIOR ART)

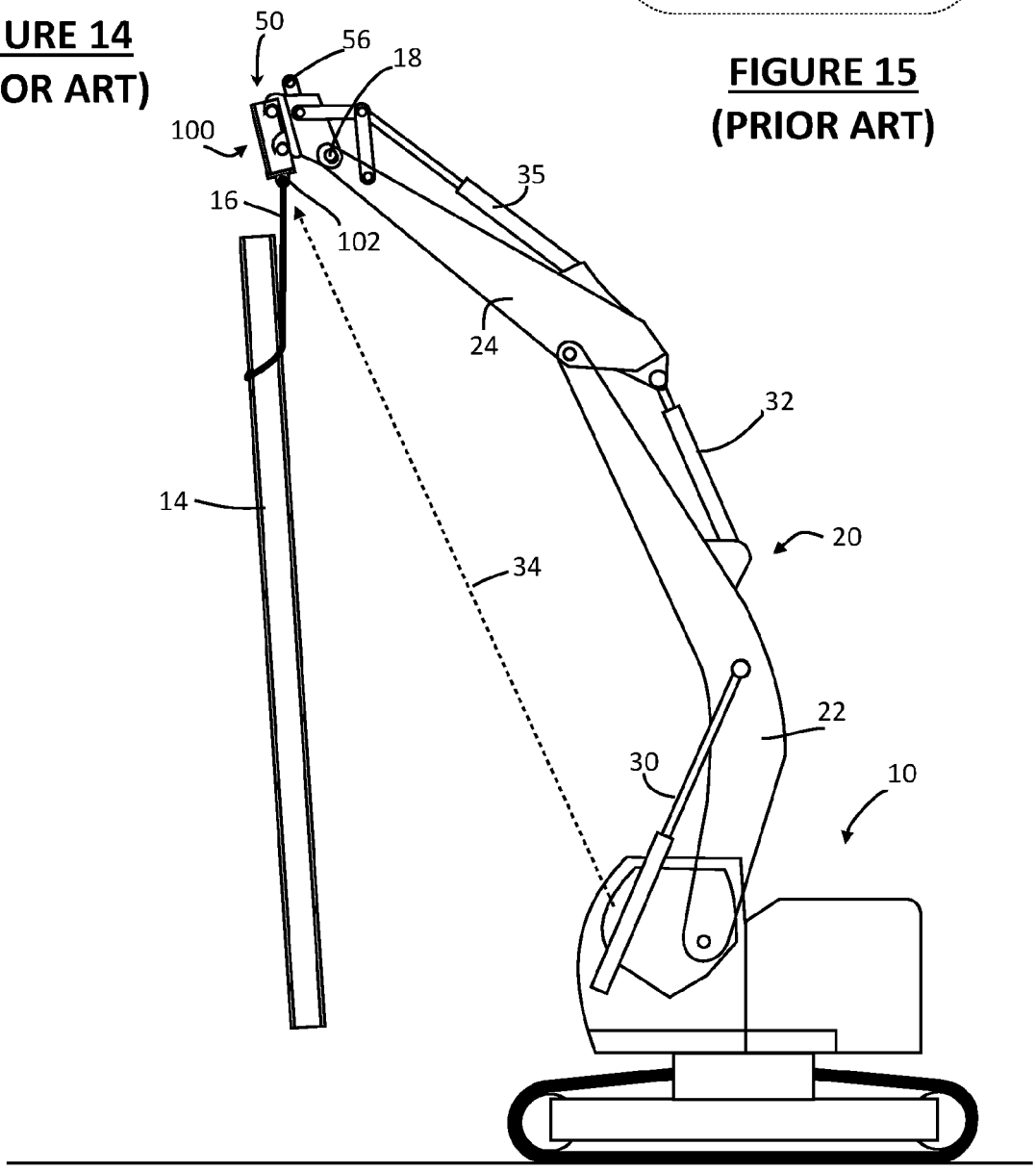

FIGURE 13

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 5397

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 101 928 795 B1 (DAEHAN HEAVY IND LLC [KR]) 13 December 2018 (2018-12-13)	1-3,5-9	INV.
Y	* abstract; figures 1-8 *	6	E02F3/36
A		4	E02F3/96
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Y	* figures 1-4 *	6	
A		4	

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A	* abstract; figures 3-7 *	1-5,7-9	

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E02F
B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 August 2020	Ferrien, Yann

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31-08-2020

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