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(54) COUPLING ASSEMBLY FOR ATTACHING A TOOL TO A HYDRAULIC EXCAVATOR OR OTHER WORK MACHINE

(57) A tool 1 is coupled to a work machine 3 by an assembly comprising a tool mounting body 110 connected to the tool 1 and a machine mounting body 130 connected to the work machine 3. The machine mounting body 130 comprises one or more first connectors 33, 34 which releasably engage the tool mounting body in a mounted position relative to the machine mounting body, and one or more second connectors 50. Each second connector is movable relative to the machine mounting body in a first stage of movement in a first direction D1 from a release position to an engaged position, in which the tool mounting body 110 may be retained in the mounted position on the machine mounting body 130, and then in a second stage of movement in a second, different direction D2 from the engaged position to a lock position in which the tool mounting body 110 is locked in the mounted position in fixed relation to the machine mounting body 130 to transfer forces between the work machine 3 and the tool 1.

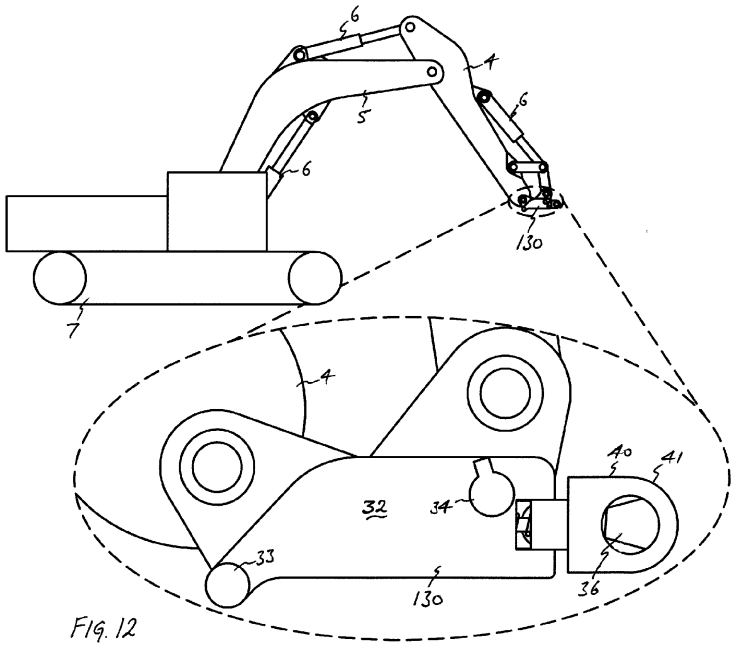

FIG. 12

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Description

Technical Field

[0001] This disclosure relates to systems for attaching a tool to a work machine.

Background

[0002] In this specification, a work machine means a vehicle which is configured to manipulate and operate a tool mounted on the vehicle. In particular, a work machine includes a vehicle having at least one arm and an arrangement of actuators for moving the arm, wherein the tool is connected at a distal end of the arm. Usually the actuators are hydraulic.

[0003] Wheeled or tracked work machines such as excavators and backhoe loaders are commonly configured to operate a variety of interchangeable tools, for example, for digging and shifting loose materials, crushing or breaking concrete, handling shaped loads, compacting surfacing materials and other specialist functions. Each tool is releasably coupled to the machine by a coupling assembly which connects a tool mounting body of the tool in fixed relation to a machine mounting body of the machine to as to transmit forces between the tool and the machine in use.

[0004] Different types of work machine tend to have different coupling systems.

[0005] For example, tractors or other work machines intended for agricultural use may have a coupling system such as disclosed by US7562718 (B1) which teaches to connect a plough to a vehicle by means of a pair of collinear pins retracted and extended by a pivoting linkage.

[0006] Work machines intended principally for use in building construction and the like tend to employ a relatively more compact attachment system which can transmit high bending moments through relatively closely spaced connection points, so that a tool can be mounted for example at the distal end of a hydraulically operated arm, often referred to as the stick and mounted in turn at the distal end of another arm known as the boom, so that the tool can be manipulated with multiple degrees of freedom in a confined workspace.

[0007] By way of example, Figs. 1 - 8 illustrate a known type of tool coupling system commonly used in attaching a tool 1 such as a hydraulic or pneumatic breaker to a machine mounting body 30, which is connected via pins 31 to the distal end of the arm or stick 4 of a work machine such as a hydraulic excavator. It should be understood that the elements of the known system as described herein are common also to embodiments of the novel assembly and tool mounting body, except for the points of difference which will become evident from the further description below.

[0008] In the known system of Figs. 1 - 8 the tool 1 is mounted on a tool mounting body 10 so that when the tool mounting body is mounted in a mounted position on the machine mounting body 30, the work machine can manipulate and apply force to the tool 1 and can operate the tool 1 via electric, hydraulic or pneumatic power lines 2 which connect the tool to the electric, hydraulic or pneumatic power and control systems of the work machine.

[0009] The tool mounting body comprises two steel plates or side walls 11 arranged in parallel spaced relation, each side wall 11 having a pivot recess 12, a reaction recess 13, and a locking recess 14.

[0010] The locking recesses 14 are open on the inwardly facing sides of the two side walls 11 and covered on their outwardly facing sides by cover plates 15. Each locking recess 14 extends along a central axis X2. The opposed, upper and lower surfaces 16 of each locking recess are arranged on either side of the axis X2 and converge (which is to say, they approach one another although they may not meet) in the direction of the axis X2 towards (which is to say, in a direction more towards than away from) the reaction recess 13.

[0011] The machine mounting body 30 may be fabricated, forged or cast as a rigid steel part with two side walls 32 arranged in parallel spaced relation to transfer large bending moments and other forces from the work machine via the tool mounting body to the tool.

[0012] Each side wall 32 comprises a pair of first connectors 33, 34, which may be fixed in relation to the machine mounting body 30, for example, as welded or integrally forged parts. The first connectors of each pair will be referred to herein, respectively as a pivot connector 33 and a reaction connector 34, reflecting their respective functions as explained below. The reaction connectors 34 are aligned in collinear relation, and similarly, the pivot connectors 33 are aligned in collinear relation to define a pivot axis X1 of the machine mounting body.

[0013] The machine mounting body is also provided with a connector body 35 which has sidewardly projecting, wedge shaped blocks 36 at its forward end and which is slidably extendable and retractable from the machine mounting body between a release position and a lock position, as shown respectively in Figs. 5 and 6 and Fig. 7.

[0014] In use, with the tool resting in a convenient position on the ground, the machine mounting body is manipulated on the arm of the work machine to engage the pivot connectors 33 in the pivot recesses 12 as shown in Fig. 5, taking care to avoid damage to the connector body 35 which remains in the extended, release position during this procedure. The machine mounting body is then rotated relative to the tool mounting body about the pivot axis X1 to engage the reaction connectors 34 in the respective reaction recesses 13 so that the tool mounting body is located in its mounted, use position on the machine mounting body as shown in Fig. 6.

[0015] The extended connector body 35 is then retracted to the lock position so that each of the wedge shaped blocks 36 engages in the respective locking recess 14 to retain the tool mounting body in the mounted position in fixed relation to the machine mounting body, as shown in Fig. 7. Each block 36 may be arranged so that only

one surface of the block is engaged with the corresponding surface of the locking recess 14, the contact surfaces of the block being symmetrically arranged on either side of a plane of symmetry with the block being rotatable in a service procedure to transpose its contact surfaces when the active surface becomes worn.

[0016] The machine mounting body will usually be connected to a distal end of the arm of the work machine so that it somewhat extends the overall length of the arm, which is further extended by the tool and tool mounting body in their use position, so that the complete assembly occupies a part of the range of movement of the arm. In order to maximise the range of movement which remains for manipulation of the tool, it is desirable for the machine mounting body and tool mounting body to be as compact as possible.

[0017] Typically, the connector body is operated by a hydraulic actuator arranged within the machine mounting body, which has a stroke sufficient to move the connector body between its release position and lock position, and a force sufficient to retain the connector body in the lock position in normal operation of the tool, during which large bending moments may be transferred between the tool and the work machine.

Summary

[0018] In accordance with a first aspect of the present disclosure there is provided an assembly for releasably coupling a tool to a work machine, as defined in the claims.

[0019] The tool is connected or connectable to a tool mounting body, which may be of generally conventional form as described above. The assembly comprises a machine mounting body which is connected or connectable to the work machine, at least one first connector, and at least one second connector. Each of the first and second connectors is releasably engageable with the tool mounting body so that the first and second connectors together connect the tool mounting body in a mounted position in fixed relation to the machine mounting body.

[0020] The second connector is movable relative to the machine mounting body between a release position and a lock position. In the release position the second connector is configured to release the tool mounting body to allow the tool mounting body to be dismounted from the machine mounting body, while in the lock position the second connector is configured to retain the tool mounting body in the mounted position in fixed relation to the machine mounting body.

[0021] The second connector is reversibly movable in a first stage of movement in a first direction from the release position to an engaged position, and in a second stage of movement in a second, different direction from the engaged position to the lock position.

[0022] Optionally, the second connector may be configured in the engaged position to retain the tool mounting body to the machine mounting body.

[0023] In a second aspect, a method for releasably coupling a tool to a work machine comprises: releasably engaging the at least one first connector with the tool mounting body to connect the tool mounting body to the machine mounting body; and then reversibly moving the second connector relative to the machine mounting body, in a first stage of movement in a first direction from the release position to the engaged position, and then in a second stage of movement in a second, different direction from the engaged position to the lock position.

Brief Description of the Drawings

[0024] Further features and advantages will become evident from the following illustrative embodiment which will now be described, purely by way of example and without limitation to the scope of the claims, and with reference to the accompanying drawings, in which:

Figs. 1 - 8 show a tool coupling system of a type known in the art, wherein:

- Figs. 1 and 2 show the tool mounting body respectively in side and front view;
- Figs. 3 and 4 show the machine mounting body respectively in side and front view;
- Figs. 5, 6 and 7 are side views showing consecutive stages in the connection of the tool mounting body to the machine mounting body; and
- Fig. 8 is a front view of the assembly in the fully connected condition as shown in Fig. 7; and

Figs. 9 - 19 show a tool coupling assembly in accordance with a first embodiment of the disclosure, wherein:

- Figs. 9, 10 and 11 show the tool coupling body respectively in side, front, and top view;
- Fig. 12 shows the machine mounting body in side view and mounted on a work machine, with the carrier in the extended position;
- Fig. 13 shows the machine mounting body in side view with the carrier in the retracted position;
- Fig. 14 is a top view of the machine mounting body with the carrier extended and the second connectors in the release position;
- Fig. 15 is a top view of the machine mounting body with the carrier extended and the second connectors in the engaged position;
- Fig. 16 is a top view of the machine mounting body with the carrier retracted to move the second connectors from the engaged position to the lock position; and
- Figs. 17, 18 and 19 are side views showing consecutive steps in the connection of the tool mounting body to the machine mounting body.

[0025] Reference numerals and characters appearing in more than one of the figures indicate the same or corresponding parts in each of them.

Detailed Description

[0026] Referring to Figs. 9 - 19, the tool coupling assembly of the first embodiment comprises a tool mounting body 110 and a machine mounting body 130. Many of the features of the tool mounting body and machine mounting body are similar to those of the known system described above, and so will not be described again in detail. The machine mounting body may thus be used to releasably couple a tool with a generally conventional tool mounting body to the work machine 3.

[0027] Referring to Fig. 12, a work machine 3 comprises a steerable land vehicle with a gross weight of at least 2 tonnes, mounted on wheels or tracks 7 and including at least two arms 4, 5. The arms are pivotably connected together and movable in rotation by hydraulic actuators 6. The machine mounting body 130 is connected to a distal end of a respective one of the arms, either in fixed relation to the arm or, as shown, for pivotable motion relative to the arm. The work machine 3 is configured to operate a tool 1 connected to the tool mounting body 110, for example, a hydraulic or pneumatic breaker as shown in Fig. 9, when the machine mounting body 130 is connected to the work machine 3 and the tool mounting body 110 is connected in the mounted position in fixed relation to the machine mounting body 130, with the power and control lines 2 from the tool being connected to the machine as previously described. In the mounted position of the tool mounting body, the machine mounting body may be configured to transmit a bending moment of not less than 5kNm between the tool and the machine.

[0028] By way of example, the work machine may have a gross weight in excess of 5 tonnes, 10 tonnes, or 20 tonnes, up to as much as 100 tonnes or more, and the machine mounting body may be configured to transmit a bending moment in excess of 10kNm, 20kNm, or 100kNm, up to as much as 500kNm or more.

[0029] In order to transmit substantial forces between the tool and the machine, the machine mounting body 130 may be made as a heavy forging or casting or otherwise as a heavy steel fabrication, with two pairs of fixed, first connectors 33, 34 extending from its side walls, each pair comprising a pivot connector 33 and a reaction connector 34 as previously described, the pivot connectors being arranged in axial alignment to define a pivot axis X1. The pivot connectors are engaged in the pivot recesses 12 of the tool mounting body as shown in Fig. 17 before pivoting the machine mounting body about the pivot axis X1 to engage each reaction connector 34 in the respective reaction recess 13 of the tool mounting body as shown in Fig. 18, as described above with reference to the known system.

[0030] Unlike the known system, a carrier 40 is mounted at the forward end of the machine mounting body. The carrier 40 may be a heavy steel fabrication, forging or casting and defines two housings 41 in each of which is received a respective one of a pair of second connectors 50.

[0031] Each second connector 50 may comprise at least one contact surface oblique to the second direction D2, the contact surface being arranged to engage a corresponding surface of the tool mounting body in use. In the illustrated embodiment each second connector 50 terminates in a wedge shaped block 36 with a pair of oblique contact surfaces 37, similar to those of the known system. It will be noted that in the mounted position the direction D2 is aligned with the axis X2 of the locking recess 14, so that as the second connector 50 moves to the lock position one or both of the surfaces 37 engage the corresponding surface or surfaces 16 of a respective one of the locking recesses 14 of the tool mounting body 110 as previously described.

[0032] The second connectors are mounted on the carrier for reversible movement relative to the carrier in a first direction D1, while the carrier is mounted on the machine mounting body 130 for reversible movement relative to the machine mounting body in a second direction D2 different from the first direction, optionally substantially normal the first direction as illustrated. In this way the second connectors are movable in a first stage of movement in the first direction D1 from a release position to an engaged position, and then in a second stage of movement in the second, different direction D2 from the engaged position to a lock position, as will now be described.

[0033] The carrier 40 is guided to slide with a single degree of freedom through a short stroke in the second direction D2, as shown by the arrow as shown in Fig. 17, between the extended position of Fig. 12 and the retracted position of Fig. 13 against the restoring force of springs 42 which urge the carrier to the extended position. As the carrier moves in the second direction, the second connectors move with it.

[0034] The second connectors 50 are connected by a crank arrangement 52 so that they are movable together by sliding translation with a single degree of freedom in the first direction D1, relative to the carrier. The second connectors can thus be extended together from the carrier 40 from the release position to the engaged position as shown in Fig. 15, and retracted together to the carrier from the engaged position to the release position, as shown in Fig. 14. In the retracted, release position the carrier protects the second connectors from damage.

[0035] The movement of the second connectors 50 relative to the carrier, and of the carrier 40 relative to the machine mounting body 130, may be accomplished by an actuator 60 which has a linear stroke and which is reversibly operable through a first portion of its stroke to urge each of the second connectors 50 in the first direction D1 from the release position (Fig. 14) to the engaged position (Fig. 15). By continuing to operate the actuator through a second portion of its stroke, it urges the carrier

40 in the second direction D2 to move the second connectors 50 relative to the machine mounting body from the engaged position (Fig. 15) to the lock position (Fig. 16).

[0036] Referring particularly to Fig. 16, it can be seen that the actuator 60 comprises a hydraulic cylinder 61 which is mounted in trunnions 62 between the first ends of a pair of first cranked arms 63 (only one of which can be seen). Each first arm is pivoted at 64 on the carrier 40 and pivotably connected at its second end to a first end of a second arm 65, which is pivotably mounted 66 at its second end to the machine mounting body 130.

[0037] The piston 67 is connected to a bar 51 which extends through a recess in the carrier from the inward end of one of the second connectors 50. The first portion of the stroke moves the bar, hence the second connectors from the release position to the engaged position. When the second connectors reach the engaged position, the end of the piston meets an abutment 43 which forms a fixed part of the carrier (Fig. 15).

[0038] Further movement of the piston is then accommodated by rotation of the arms 63, 65 which causes pivot point 64 to approach pivot point 66, pulling the carrier 40 in the second direction D2 against the restoring force of the springs 42.

[0039] When the tool mounting body is received in the mounted position on the machine mounting body as shown in Fig. 18, with the second connectors 50 in the release position as shown in Fig. 14, the second connectors 50 are configured to release the tool mounting body 110 to allow the tool mounting body to be dismounted from the machine mounting body 130 by rotation in the mounting/dismounting direction D3.

[0040] It will be noted that in the mounted position, the tool mounting body 110 is constrained against movement relative to the machine mounting body 130, other than in the rotational direction D3 about the pivot axis X1 to release the reaction connectors 34 from the reaction recesses 13. With the second connectors in the release position, the tool mounting body can therefore be dismounted only by relative movement in the direction D3, which is substantially normal to the first direction D1 and the second direction D2.

[0041] In the mounted position of the tool mounting body, the movement of the second connectors 50 in the first direction D1 from the retracted, release position of Fig. 14 to the extended, engaged position of Fig. 15 loosely engages the wedge shaped blocks 36 in the locking recesses 14. In this configuration, the assembly may be configured to retain the tool mounting body to the machine mounting body, so that although the tool mounting body may be movable relative to the machine mounting body, it cannot be detached.

[0042] From this engaged position, only a short movement of the carrier 40 in the second direction D2 is required to move the second connectors 50 to the lock position to retain the tool mounting body in the mounted position in fixed relation to the machine mounting body, as shown in Fig. 19. The movement in the second direction from the position of Fig. 15 to the position of Fig. 16 engages one or both of the oblique contact surfaces of the blocks 36 with one or both of the upper and lower surfaces 16 of the locking recesses 14 so as to lock the tool mounting body tightly in rigid, fixed relation to the machine mounting body to transfer bending moments and other forces between them. For example, each block 36 may be arranged so that only the upper one of its two oblique contact surfaces engages the corresponding upper surface 16 of the respective locking recess. The oblique contact surfaces of the block may be arranged on either side of a plane of symmetry which bisects the block, with the block being arranged as known in the art so that it can be rotated in a service procedure so as to transpose the two oblique contact surfaces when the upper one becomes worn.

[0043] As in the known system previously described, when the second connector reaches the lock position it clamps a portion 111 of the tool mounting body 110 between the second connector 50 and the respective reaction connector 34 as shown in Fig. 19 to lock the tool mounting body to the machine mounting body in the mounted position. In this position the first and second connectors 33, 34, 50 together connect the tool mounting body 110 in fixed relation to the machine mounting body 130.

[0044] In summary, a tool is coupled to a work machine by an assembly comprising a tool mounting body connected to the tool and a machine mounting body connected to the work machine. The machine mounting body comprises one or more first connectors which releasably engage the tool mounting body in a mounted position relative to the machine mounting body, and one or more second connectors. Each second connector is movable relative to the machine mounting body in a first stage of movement in a first direction D1 from a release position to an engaged position, in which the tool mounting body may be retained in the mounted position on the machine mounting body, and then in a second stage of movement in a second, different direction D2 from the engaged position to a lock position in which the tool mounting body is locked in the mounted position in fixed relation to the machine mounting body to transfer forces between the work machine and the tool.

Industrial applicability

[0045] The novel assembly may be employed to couple a tool having a generally conventional tool mounting body to a work machine. By arranging the second connector to move in different directions in first and second stages of movement, it is possible to provide an effective locking action as the second connector moves through the second stage from the engaged position to the lock position, optionally in the conventional direction towards a reaction connector, while better protecting it from damage when in the release position.

[0046] Advantageously, the second connector may be retractable into a carrier in the release position so that it can be extended only after the machine mounting body has engaged the tool mounting body in the mounted position of the tool mounting body. This protects the second connector from damage throughout the mounting and dismounting procedure.

[0047] The engaged position may be selected to require only a small movement in the second direction to fully engage the second connector in the lock position. For example, where the second connector comprises an oblique contact surface, the overall length of the stroke required to move the second connector from the engaged position to the lock position may be much shorter than would be required to move the oblique contact surface between the lock position and an extended, release position as known in the art.

[0048] This relatively shorter movement may be accomplished using a more compact actuator assembly and hence a more compact machine mounting body. The movement in the first direction, which is not required to exert a clamping pressure on the machine mounting body, may be longer but may be accomplished with lower force and so, again, with a more compact actuator assembly. The actuator assembly may be arranged to accomplish both movements in a single stroke of an actuator which is suitably articulated, optionally to provide mechanical advantage for the second stage.

[0049] The first and second connectors may be arranged so that in the engaged position the second connector retains the tool mounting body to the machine mounting body. In this case the tool will be retained to the machine (e.g. with some freedom of movement, hence not in fixed relation) even if the force applied in the second direction to hold the tool mounting body in fixed relation to the machine mounting body should be relaxed. This ensures that even if for example hydraulic pressure is lost, the tool cannot inadvertently detach unless the first stage of movement is also reversed to return the second connector to the release position.

[0050] Advantageously, when the second connector is in the release position, the tool mounting body may be movable relative to the machine mounting body in a direction substantially normal to the first direction, optionally also substantially normal to the second direction, to dismount the tool mounting body from the machine mounting body. This helps to ensure that the second connector is not urged from the engaged position to the release position, optionally also from the lock position to the engaged position, by forces applied by the tool.

[0051] In alternative embodiments, the first connectors need not be formed as pins, but could have any shape defining one or more surfaces to engage corresponding parts of the tool mounting body. One or more of the first connectors may be active rather than passive, so that it is movable relative to the machine mounting body to engage and disengage the tool mounting body.

[0052] In further alternative embodiments, the second connectors could be movable in different, first and second directions, for example, by suitable guiding or articulation arrangements, without being mounted on a carrier.

[0053] In the illustrated embodiments, each of the first and second connectors comprises a pair of like connectors arranged on either side of the central plane of symmetry of the machine mounting body. This helps to react forces, particularly bending moments between the two mounting bodies, irrespective of the direction of the force. In alternative embodiments however it is conceivable that only one first connector (e.g. one pivot connector and/or one reaction connector) and/or one second connector might be provided and arranged to act, for example at a central plane of symmetry of the assembly, with forces out of the plane being reacted via further abutting surfaces of the respective mounting bodies.

[0054] The tool may comprise for example a pneumatic or hydraulic breaker as illustrated for example in Figs. 1 and 2 and Fig. 9, a grab, a bucket, a concrete crusher, a compactor, or any other tool which is operable by the work machine. Typically, the tool will comprise an actuator or drive means which is coupled (e.g. via fluid or electrical power lines as shown in Figs. 1 and 2 and Fig. 9) to the power and control systems of the work machine, but it could also be a passive tool in the sense that in its mounted position it forms a fixed appendage to the arm or stick of the work machine, for example, as a bucket without moving parts for use in digging or shifting loose material.

[0055] Many further adaptations are possible within the scope of the claims.

[0056] In the claims, reference numerals and characters in parentheses are provided purely for ease of reference and are not to be construed as limiting features.

Claims

1. An assembly for releasably coupling a tool (1) to a work machine (3), the tool being connected or connectable to a tool mounting body (110), the assembly including:

a machine mounting body (130) connected or connectable to the work machine,
at least one first connector (33, 34), and
at least one second connector (50);

each of the first and second connectors being releasably engageable with the tool mounting body (110) so that the first (33, 34) and second (50) connectors together connect the tool mounting body in a mounted position in fixed relation to the machine mounting body;
the second connector (50) being movable relative to the machine mounting body between a release position and a lock position, wherein

in the release position the second connector (50) is configured to release the tool mounting body (110) to allow the tool mounting body to be dismounted from the machine mounting body (130), and
in the lock position the second connector (50) is configured to retain the tool mounting body (110) in the mounted position in fixed relation to the machine mounting body (130);

wherein the second connector is reversibly movable:

in a first stage of movement in a first direction (D1) from the release position to an engaged position, and
in a second stage of movement in a second, different direction (D2) from the engaged position to the lock position.

2. An assembly according to claim 1, wherein the second connector (50) is configured in the engaged position to retain the tool mounting body (110) to the machine mounting body (130).

3. An assembly according to claim 2, wherein in the release position of the second connector (50) the tool mounting body (110) is movable relative to the machine mounting body (130) in a direction (D3) substantially normal to the first direction to dismount the tool mounting body (110) from the machine mounting body (130).

4. An assembly according to claim 1, further including a carrier (40);
the second connector (50) being mounted on the carrier (40) for reversible movement relative to the carrier in the first direction (D1);
the carrier (40) being mounted on the machine mounting body (130) for reversible movement relative to the machine mounting body (130) in the second direction (D2).

5. An assembly according to claim 4, wherein the second connector (50) is extendable from the carrier (40) from the release position to the engaged position and retractable to the carrier (40) from the engaged position to the release position.

6. An assembly according to claim 4, wherein the assembly further comprises an actuator (60), the actuator (60) having a linear stroke and being reversibly operable:

through a first portion of its stroke to urge the second connector (50) in the first direction (D1) from the release position to the engaged position, and
through a second portion of its stroke to urge the carrier (40) in the second direction (D2) to move the second connector (50) from the engaged position to the lock position.

7. An assembly according to claim 1, wherein the second connector (50) comprises at least one contact surface (37) oblique to the second direction (D2), the contact surface arranged to engage a corresponding surface (16) of the tool mounting body (110) in use.

8. An assembly according to claim 1, wherein the at least one first connector comprises at least one pivot connector (33) and at least one reaction connector (34);
the pivot connector (33) defining a pivot axis (X1) and being engageable with the tool mounting body (110);
the machine mounting body (130) being pivotable about the pivot axis (X1) when the pivot connector (33) is engaged with the tool mounting body (110) to engage the reaction connector (34) with the tool mounting body (110);
the second connector (50) being configured in the lock position to clamp a portion (111) of the tool mounting body (110) between the second connector (50) and the reaction connector (34).

9. An assembly according to claim 1 and further including said tool mounting body (110) and a tool (1), the tool being connected to the tool mounting body and operable by a work machine (3) when the machine mounting body (130) is connected to the work machine and the tool mounting body (110) is connected in the mounted position in fixed relation to the machine mounting body (130).

10. A work machine (3), the work machine being a steerable land vehicle with a gross weight of at least 2 tonnes, mounted on wheels or tracks (7) and including at least two arms (4, 5), the arms pivotably connected together and movable in rotation by hydraulic actuators (6), and an assembly according to claim 1, the machine mounting body (130) being connected to a distal end of a respective one of the arms (4), the work machine being configured to operate a tool (1) connected to a tool mounting body (110) when the tool mounting body is connected in the mounted position in fixed relation to the machine mounting body (130).

11. A method for releasably coupling a tool (1) to a work machine (3), the tool being connected to a tool mounting body (110), the method comprising:

providing an assembly including:

a machine mounting body (130) connected to the work machine,

at least one first connector (33, 34), and
at least one second connector (50),

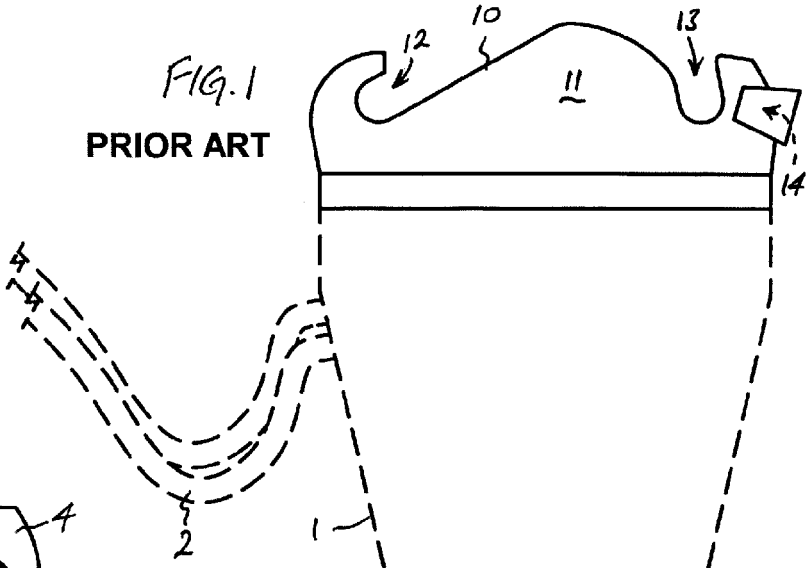
each of the first and second connectors being releasably engageable with the tool mounting body (110) so that the first (33, 34) and second (50) connectors together connect the tool mounting body in a mounted position in fixed relation to the machine mounting body;
releasably engaging the at least one first connector (33, 34) with the tool mounting body to connect the tool mounting body to the machine mounting body; and then reversibly moving the second connector (50) relative to the machine mounting body:

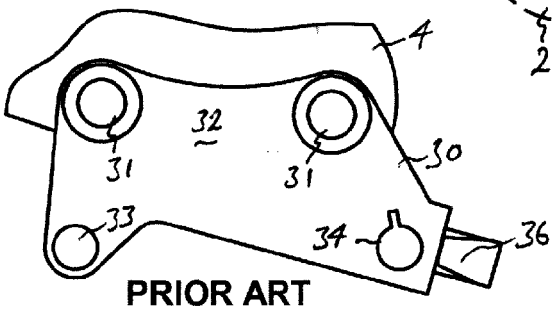
in a first stage of movement in a first direction (D1) from a release position to an engaged position, and then
in a second stage of movement in a second, different direction (D2) from the engaged position to a lock position,

wherein

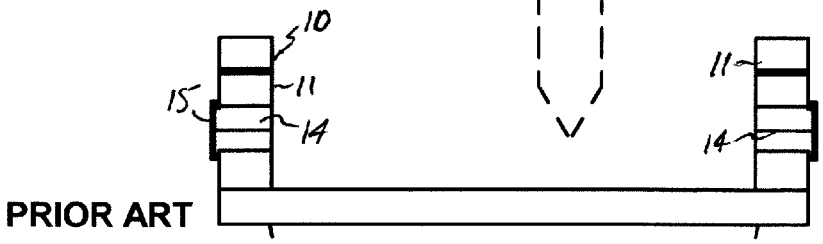
in the release position the second connector (50) is configured to release the tool mounting body (110) to allow the tool mounting body to be dismounted from the machine mounting body (130), and
in the lock position the second connector (50) is configured to retain the tool mounting body (110) in the mounted position in fixed relation to the machine mounting body (130).

FIG. 1
PRIOR ART





PRIOR ART
FIG. 3



PRIOR ART
FIG. 2

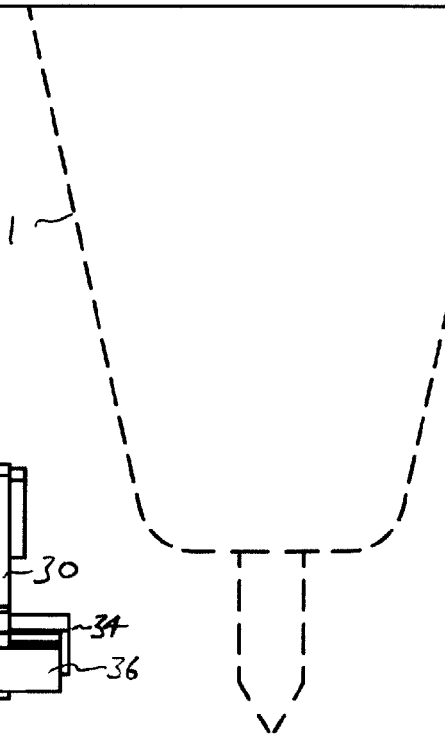
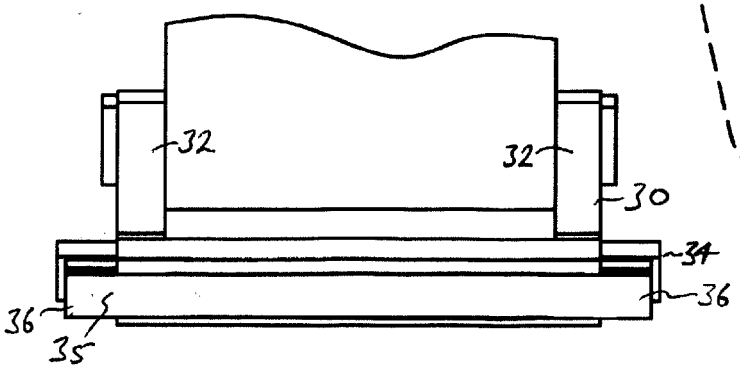


FIG. 4
PRIOR ART



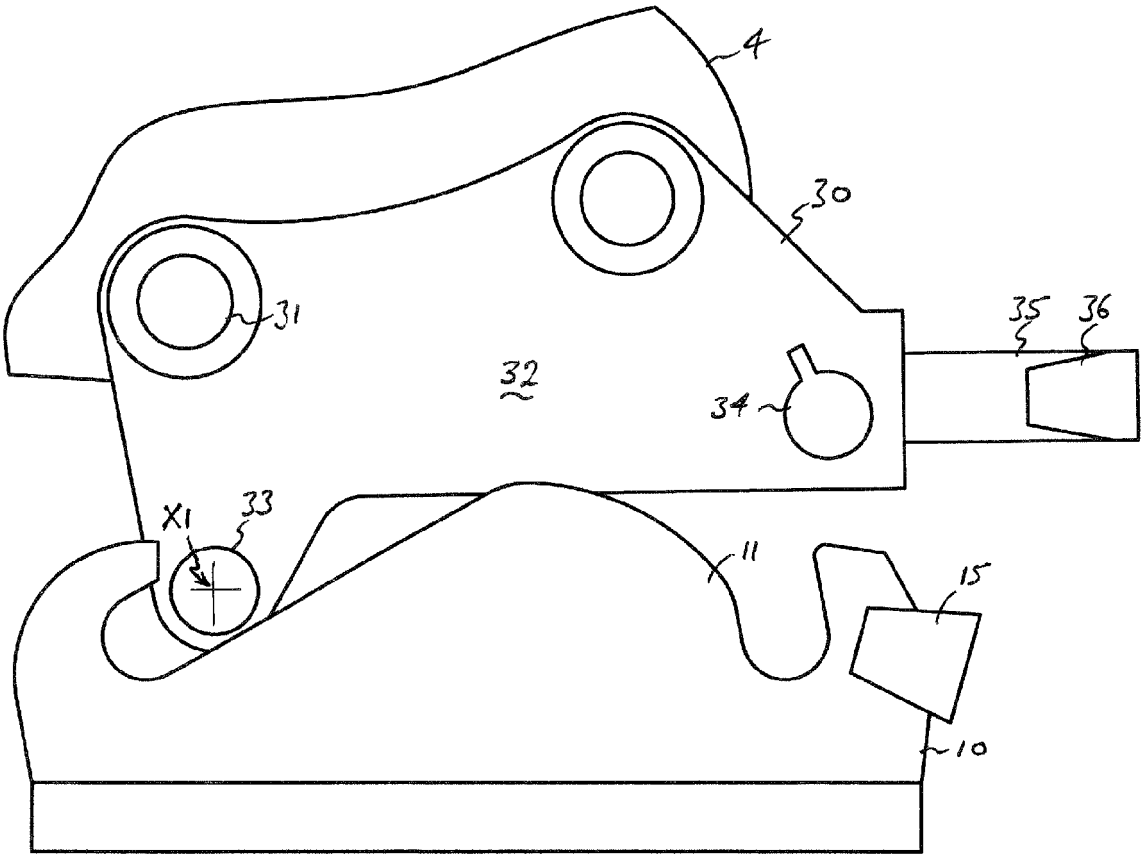
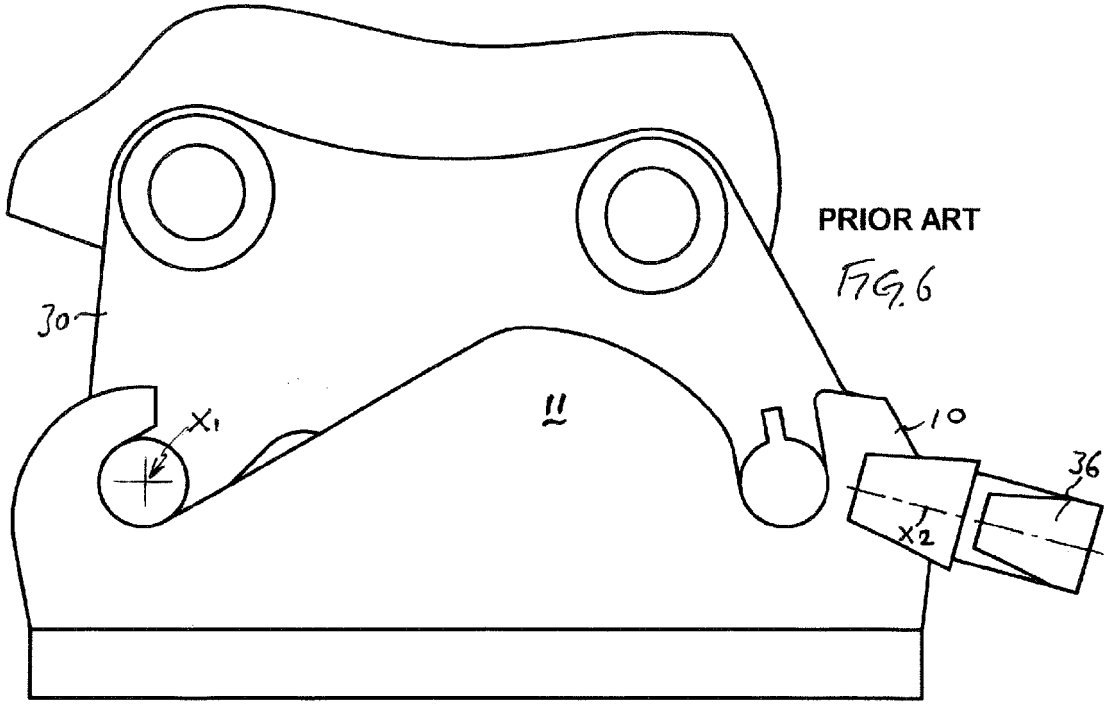


FIG. 5 PRIOR ART



PRIOR ART

FIG. 6

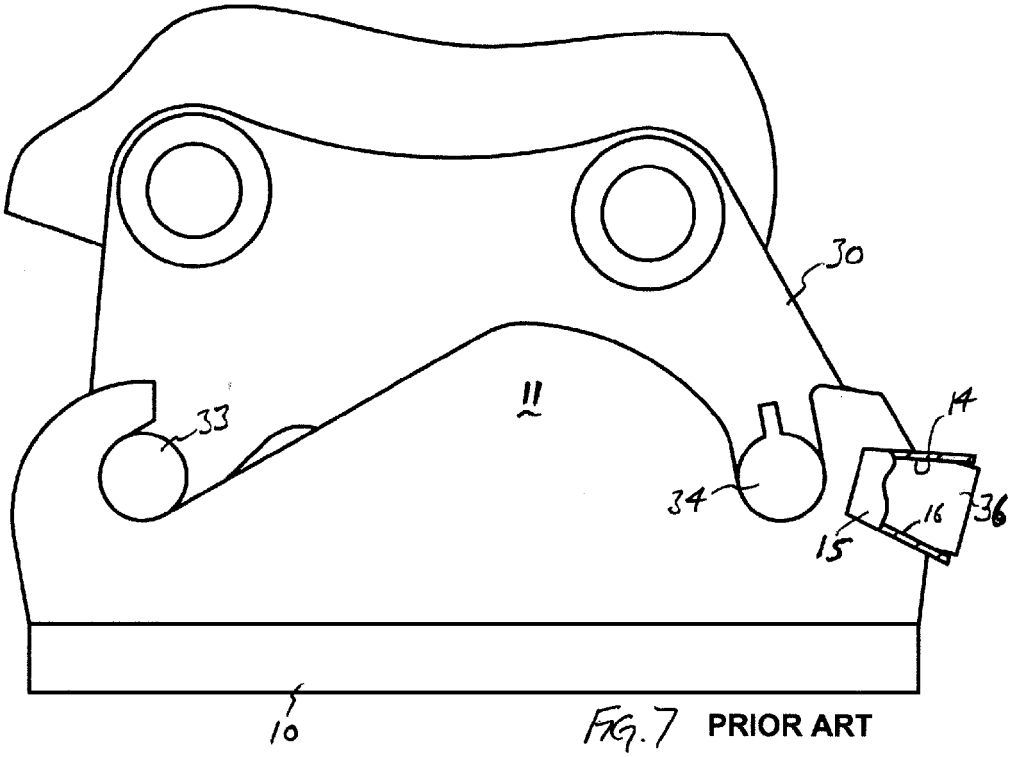
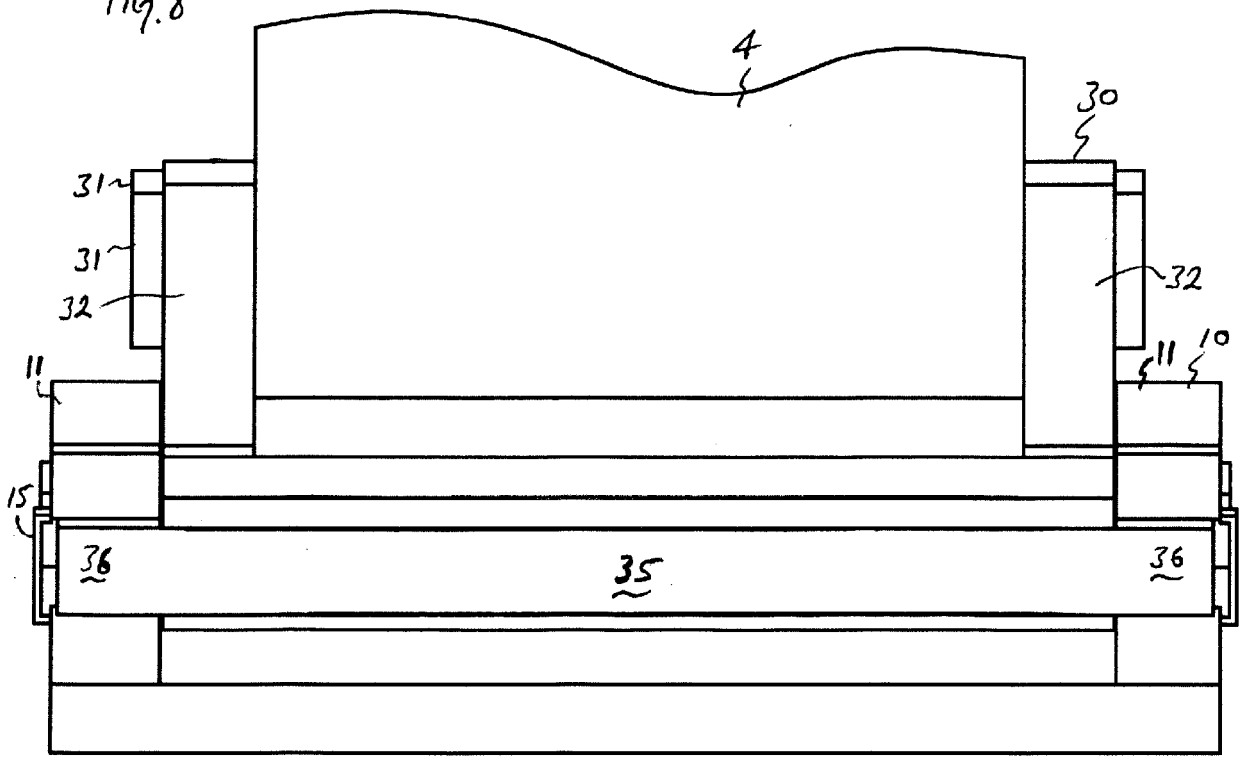


FIG. 7 PRIOR ART

FIG. 8 PRIOR ART



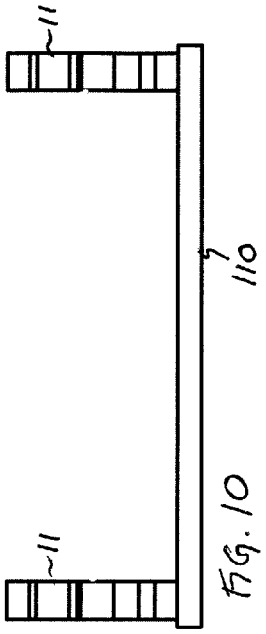


FIG. 10

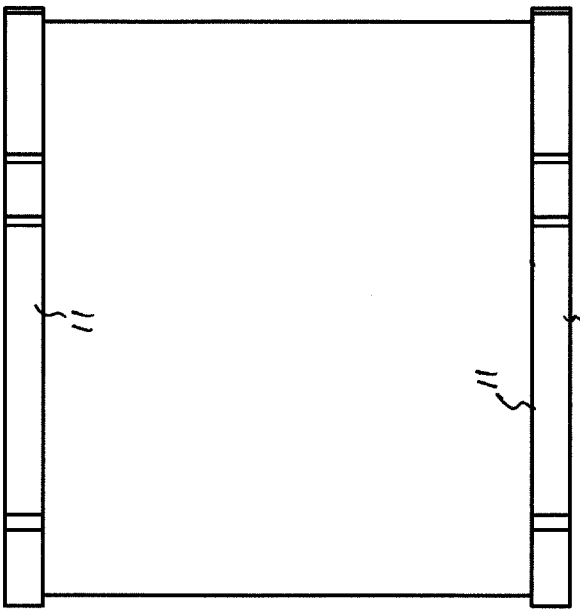


FIG. 11

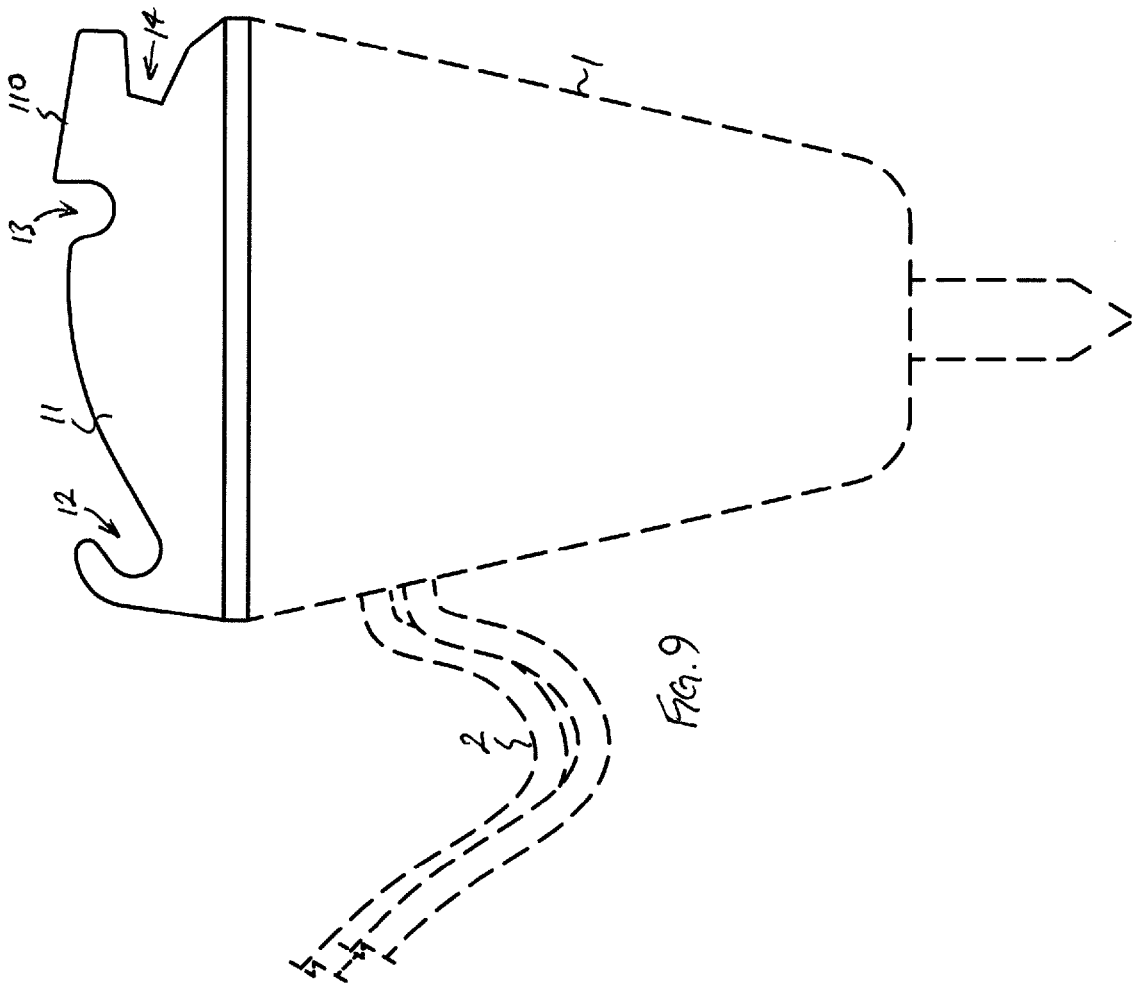


FIG. 9

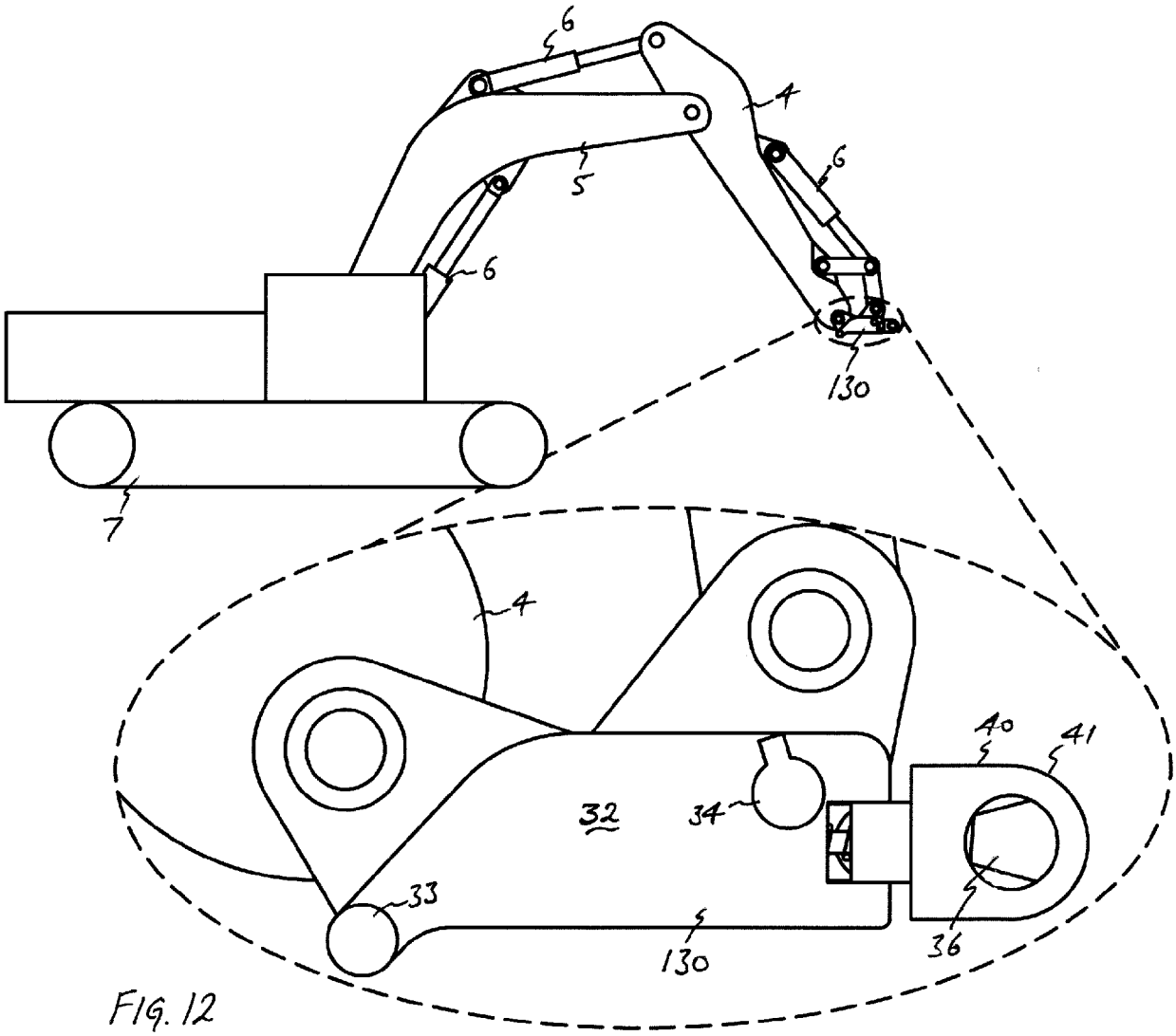


FIG. 12

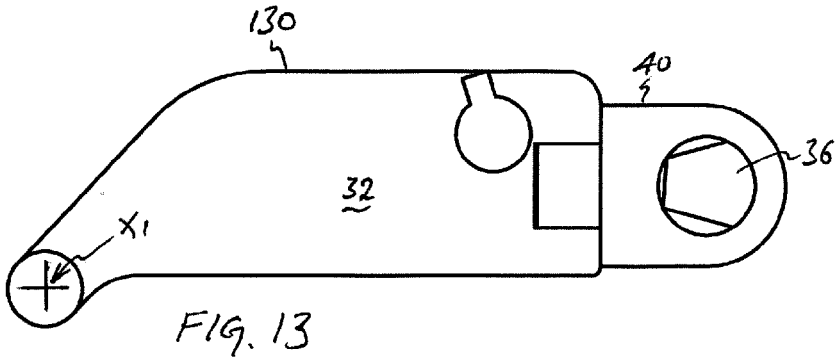


FIG. 13

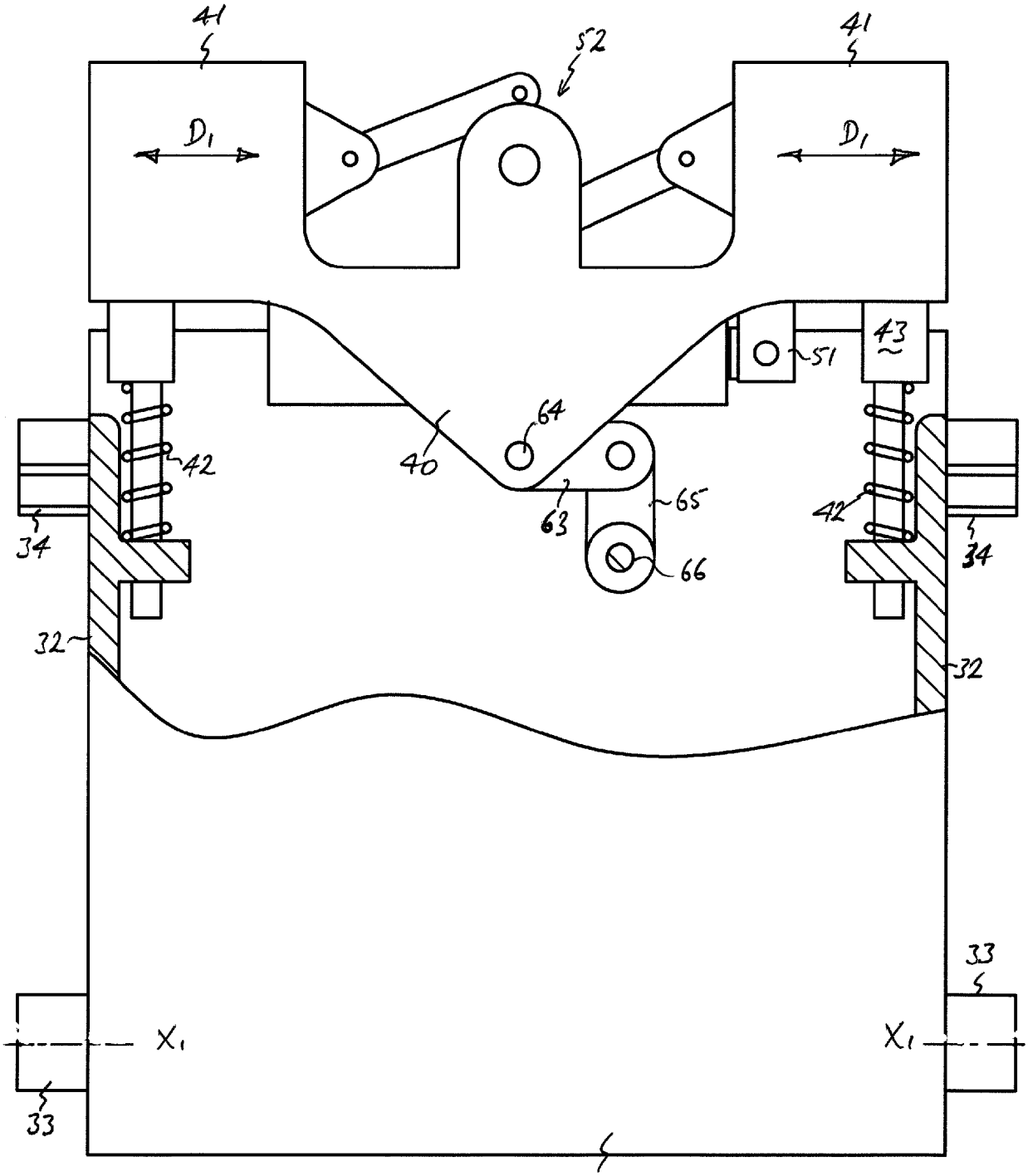


FIG. 14

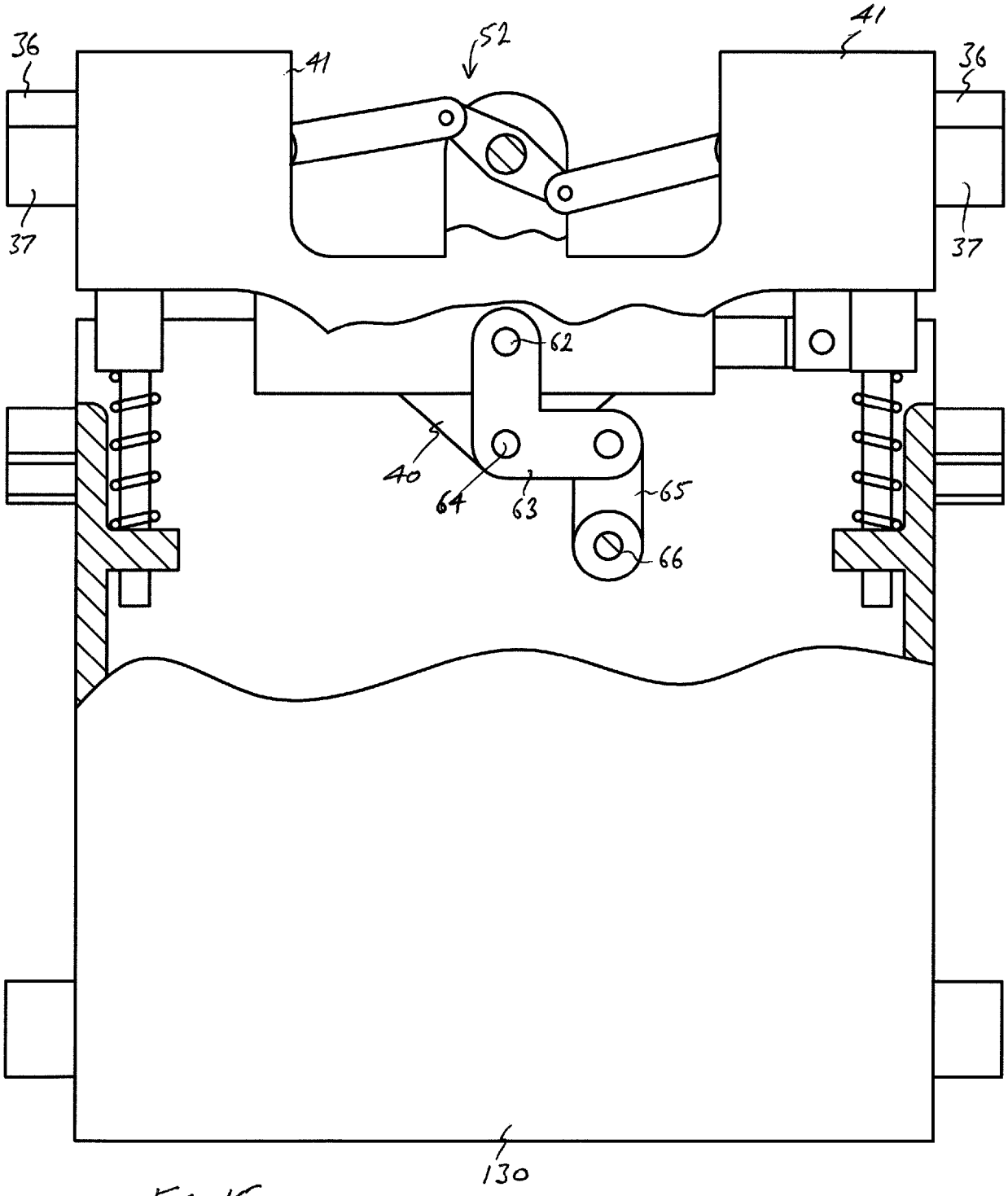


FIG. 15

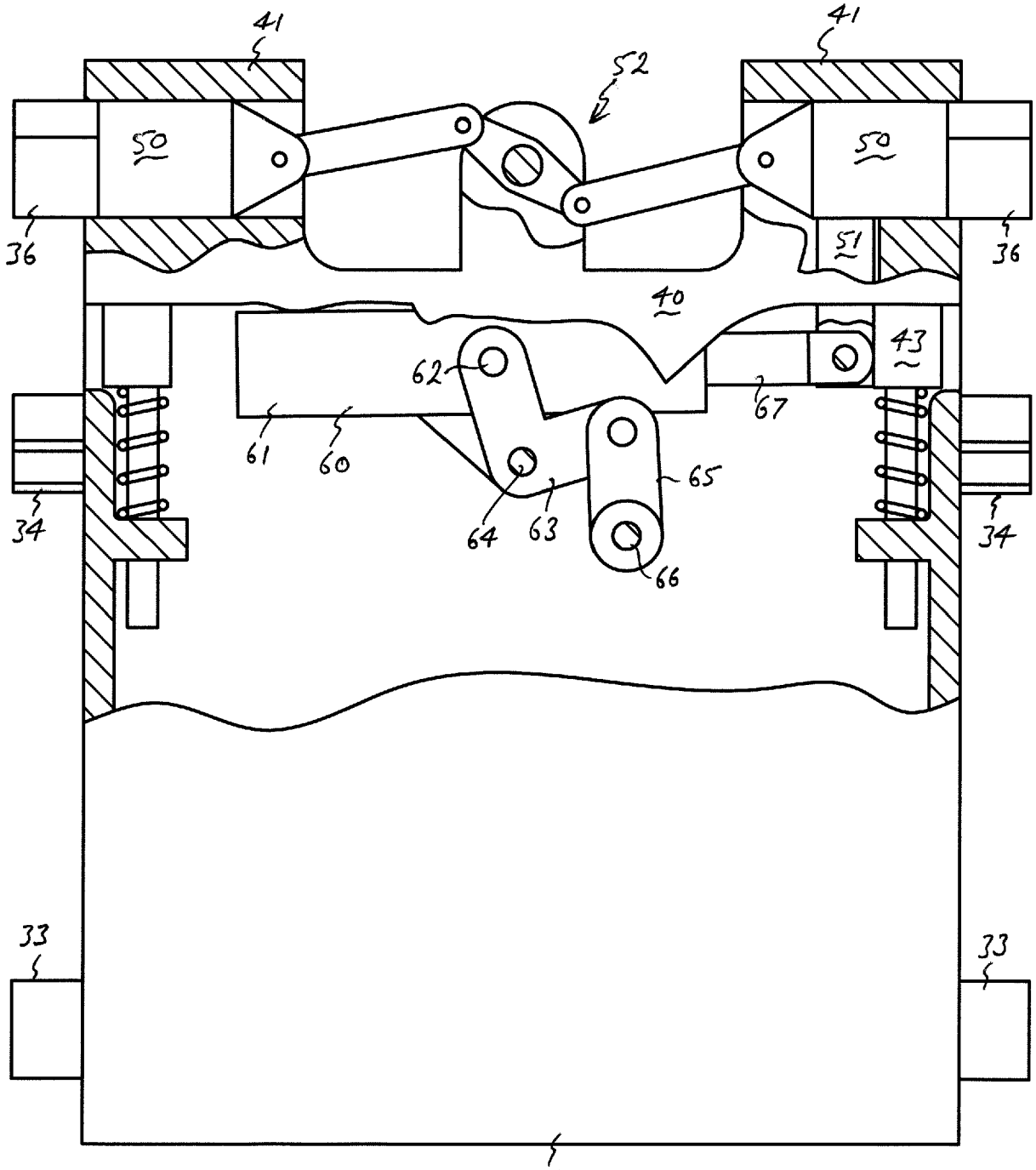


FIG. 16

FIG. 17

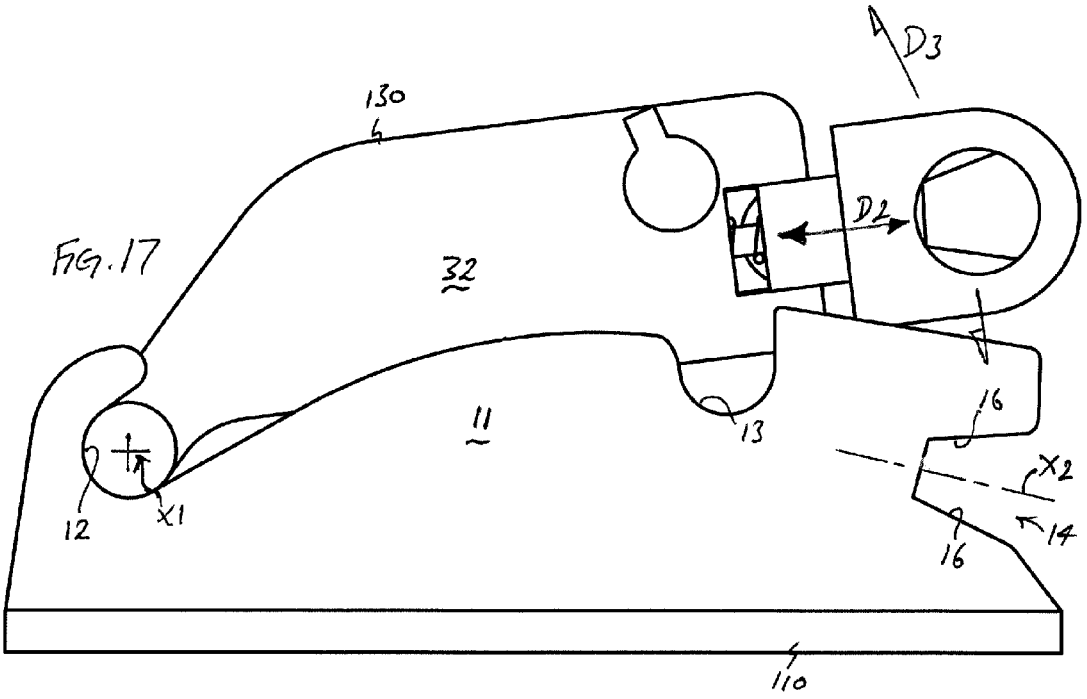


FIG. 18

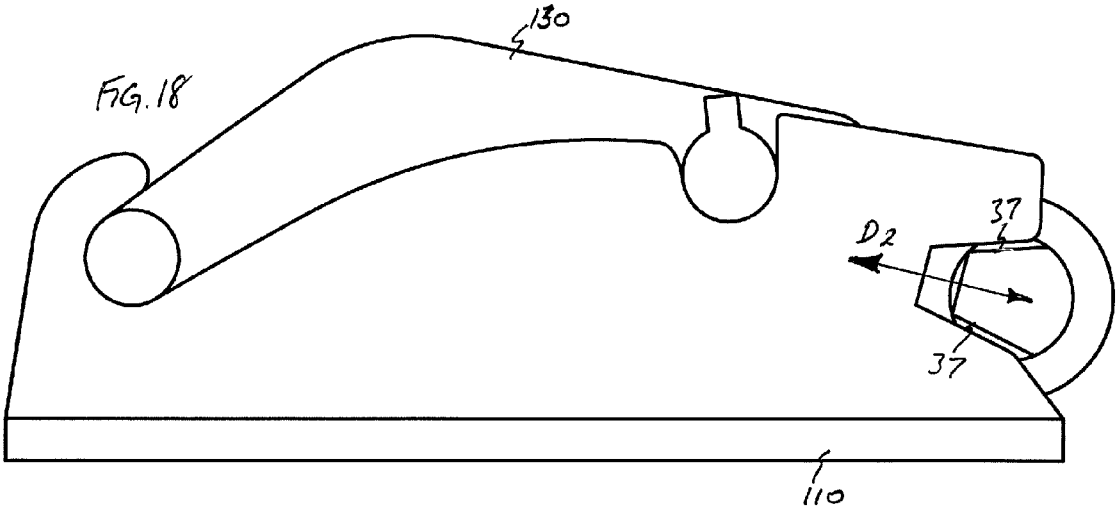
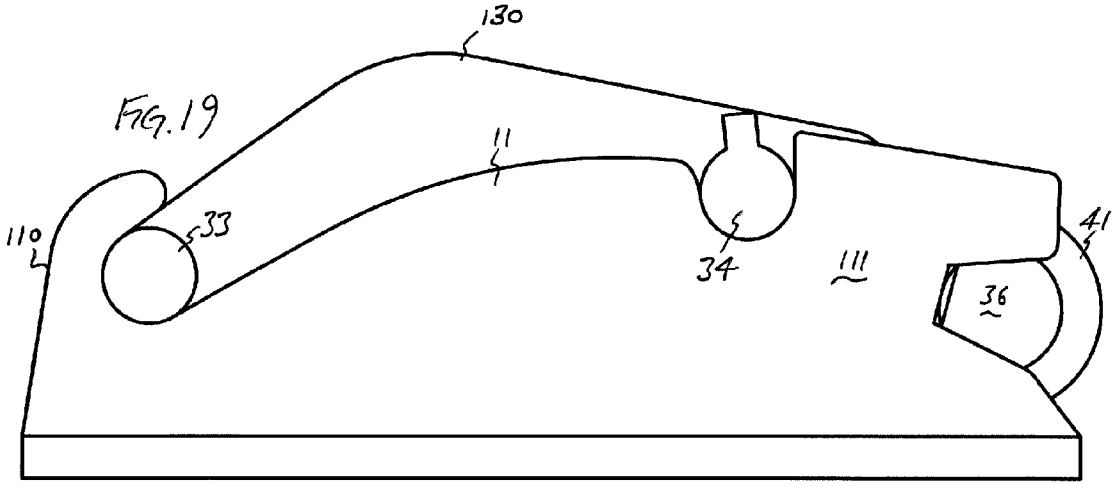


FIG. 19



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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 6322

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/296031 A1 (YEAGER MURRAY [CA] ET AL) 4 December 2008 (2008-12-04) * paragraph [0029] - paragraph [0036]; figures 6-9 *	1-11	INV. E02F3/36
X	CA 2 815 032 A1 (AMI ATTACHMENTS INC [CA]) 30 October 2014 (2014-10-30) * paragraph [0026] - paragraph [0032]; figures 1,2,3,5,10a,10b *	1-11	
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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	25 October 2019	Clarke, Alister

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