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(54) ARTICULATED MECHANICAL ARM

GELENKIGER MECHANISCHER ARM

BRAS MÉCANIQUE ARTICULÉ

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**EP-A- 1 770 050 WO-A-92/04270
DE-A1- 3 609 512 DE-B- 1 102 366
FR-A- 2 600 634 US-A- 4 461 369**

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Description

[0001] This invention relates to an articulated mechanical arm according to the preamble of claim 1. Such an arm is known from DE 1 102 366 B.

[0002] Mechanical arms are seen in wide use provided by a number of manufacturers for applications including digging. Typically, such mechanical arms utilise rigid beam sections connected to each other at pivot points. Typically, the rigid sections pivot in a vertical plane within an angular range less than a reflex angle. Such limited angular freedom of motion suits the application of such a mechanical arm for low level work such as digging. However, the use of such an arm for overhead work is limited due to restrictions placed upon the angular freedom of articulation of the arm by the design of the arm and the pivot points.

[0003] A lifting crane is an example of a device that uses a mechanical arm. DE 3 609 512, EP 1 770 050 and FR 2 600 634 each describe examples of a crane using a mechanical articulated arm. In DE 3 609 512 the crane includes a columnar stanchion with a main jib that is pivotably attached to the stanchion and is connected to a swivel arm by means of a joint. A single hydraulic cylinder/piston mechanism is operable to swivel the arm in relation to the main jib by means of an articulation system that includes two interacting articulation pieces. The hydraulic cylinder/piston mechanism is attached to the top of the main jib to allow the arm to swivel between two end positions; a first position in which the swivel arm is located substantially parallel to the underside of the main jib and a second position where the arm projects upwards from the free end of the main jib at a certain angle, for example 50 degrees.

[0004] In EP 1 770 050 a foldable crane is described, where the crane includes a crane support and a pivotal arm system that includes a lift arm and a telescopic articulated arm rotatably hinged to the lift arm. A lift cylinder operates between the support and the lift arm and an articulation cylinder operates between the lift arm and the telescopic arm. In the stowed condition the crane is arranged with the arms and the support forming a Z shape. To move to operation mode the lift arm rotates about a pivot in a one direction and the telescopic arm rotates about the pivot point on the lift arm in an opposite direction to unfold the arm mechanism. Further rotation of both the lift arm and the telescopic arm moves the arm to the operating position as a lifting crane.

[0005] In FR 2 600 634 a device that is suitable for use with a lifting machine such as a crane jib is described. The device controls the articulation movement of two arms; where one arm is fixed and the other arm is movable relative to the first. The movement of the second arm is by rotation about a pivot point where the two arms join together at one end. Rotation of the moving arm is controlled by two cylinder/pistons that are joined together at one end and are pivotally attached to a lever arm connected to the pivot point. The other end of the first cylinder

is connected to the fixed arm and the other end of the second piston is connected to the moving arm.

[0006] Discrete pieces of equipment, for example "cherry pickers", are used for overhead, high level working. In such a "cherry picker" a platform is elevated, typically using a scissor-like mechanism, or with rigid sections which pivot in a vertical plane with an angular range less than a reflex angle in order to provide a base from which work can be conducted.

[0007] Such "cherry pickers" are not suitable for use in underhead operations such as digging. This is because the raising mechanisms are inherently not suitable for movement below the horizontal plane of the base of the "cherry picker".

[0008] According to the present invention, there is provided an articulated mechanical arm according to claim 1.

[0009] Such an articulated mechanical arm allows for operation both as a digger arm and as a "cherry picker" due to the range of movement of the first rigid section relative to the second rigid section. The arm can thus function as a mechanical digger or as a cherry picker with little more effort than swapping the digger bucket for a cherry picker platform. For example, when used on a vertical plane, the mechanical arm would be suitable for both higher level (eg overhead) work as well as for lower level work (eg below head height).

[0010] The angular range of the first and second rigid sections may range from an acute angle through an obtuse angle to a reflex angle.

[0011] The ability of the rigid sections to pivot in relation to each other on a plane through an angle greater than 180 degrees in either direction gives a greater freedom of operating angle than is currently available.

[0012] The working angle of operation between the adjacent first and second rigid sections may range from being an acute through an obtuse to a reflex angle in either direction.

[0013] The articulated mechanical arm may comprise one or more hydraulic or pneumatic cylinders, the cylinders having a fulcrum centre which is arranged to load and/or move at least one of the plurality of a rigid sections to which it is pivotally connected relative to another of the plurality of rigid sections.

[0014] The articulated mechanical arm may comprise a pivotal motion assistance mechanism, for example a ratchet clamp. The pivotal motion assistance mechanism may be arranged to assist relative pivotal movement of rigid sections independently of any other external object, for example the ground.

[0015] The articulated mechanical arm may comprise actuators such as hydraulic cylinders or angular actuators such as hydraulic motors.

[0016] The articulated mechanical arm may comprise fittings arranged to receive at least one attachment. The articulated mechanical arm may comprise a control mechanism arranged to control the orientation of the at least one attachment. The attachment may comprise at least one of the following: cherry picker platform, bucket,

pneumatic or hydraulic drill, pneumatic or hydraulic hammer, pallet lifting forks, or a hedge or bush cutter.

[0017] The articulated mechanical arm may comprise a mechanism for temporarily moving the fulcrum of a cylinder which would otherwise obstruct the movement of the rigid sections to a configuration suitable for overhead operation.

[0018] The articulated arm may comprise a damping mechanism arranged to dampen gravity assisted movement of pivotally connected adjacent rigid sections.

[0019] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings:

Figure 1 is a schematic representation of an articulated mechanical arm according to an aspect of the present invention shows a typical digging application comprising two rigid sections where the superior angle of operation Θ_s and the inferior angle of operation Θ_i are both defined by the relative angles of the axis 21 of the first rigid section 2 and the axis 22 of the second rigid section 3;

Figure 2 is a plan view of a pivot region of the articulated mechanical arm of Figure 1;

Figures 3 to 6 are representations of two rigid sections of the articulated mechanical arm of Figure 1 being configured for an overhead application;

Figures 7 to 9 are representations illustrating the introduction into the articulated mechanical arm of a further rigid section so as to allow work at higher levels and at positions more distant to the support base;

Figures 10 to 14 are cross-sectional side elevations of the pivot region of a second embodiment of an articulated arm according to an aspect of the present invention.

Figure 15 is a schematic diagram showing the first section 2 and second section 3 of the arm 1 in figure 1, in alternate configurations.

[0020] Referring now to Figures 1 and 2, an articulated mechanical arm 1 comprises first rigid section 2 and second rigid section 3, a pivot 4, a hydraulic ram 5 and a base 6;. Typically, the base 6 comprises a mechanical digger, a tractor, or any suitable vehicle, for example a four wheel drive, all terrain vehicle. The present embodiment comprises an attachment in the form of bucket 7 for digging purposes.

When operated as a digger the inferior angle of operation Θ_i is less than 180 degrees and the articulated mechanical arm 1 operates in the manner of a standard digger arm where the fulcrum 20 of the ram 5 operates exclusively within the superior angle of operation Θ_s and does

not intersect the axis 21 of the first rigid section 2.

[0021] The first rigid section 2 has a recess 8 extending partway along its longitudinal axis from the pivot 4 so as to define a substantially U-shaped channel therein. The recess 8 allows part, or all of, the ram 5 to pass from one side of the first rigid section 2 to the other. This, changes the point of action of the fulcrum 20 of the ram 5 from the superior angle Θ_s of operation to the inferior angle of operation Θ_i . The second rigid section 3 pivots with respect to the first rigid section such that the inferior angle of operation Θ_i can be a reflex angle. This allows the use of the arm 1 for high level applications for example as a "cherry picker", with the fitting of a suitable platform 9.

[0022] The drawings represent the sequence of events to raise the cherry picker platform from ground level upwards.

[0023] Referring now to Figures 3 and 4, in order to raise the free end 10 of the arm 1 above the longitudinal axis of the first rigid section 2, the ram 5 is retracted fully and the platform 9 is lowered to the ground. In a typical digger arm arrangement, the ram 5 reaches its full retractive limit when the inferior angle of operation is less than 180 degrees, this places a limitation on the inferior angle of operation. In order to remove this limitation on the inferior angle of operation a mechanism is provided to selectively and temporarily free the ram 5 from fulcrum point 15 on the first rigid section 2. A downward load is maintained to cause the longitudinal axis of the second rigid section 3 to rotate about the pivot such that the longitudinal axes of the first and second rigid sections 2,3 are aligned. The downward load is maintained such that the longitudinal axis of the second rigid section 3 passes overcentre of the pivot 4. The longitudinal axis of the second rigid section 3 crosses or intersects the longitudinal axis of the first rigid section 2 so that the fulcrum 20 now operates in the inferior angle of operation Θ_i . Once the second rigid section 3 has passed overcentre, flipped upwards, the arm 1 is suitable for use in higher level applications.

[0024] Referring now to Figure 5 and 6, the ram 5 extends further such that second rigid section 3 rotates further about the pivot 4 and the superior angle of operation Θ_s reduces accordingly, such that it may become an acute angle.

[0025] Referring now to Figures 7 to 9, the use of an additional rigid section 11 allows operation of the arm 1 such that the platform 9 can be at even a higher level or at a position more distant from the support base 6. The extra section allows the platform 9 to remain upright even at ground level and a control mechanism 12 maintains the platform 9 level in operation.

[0026] It will be appreciated that although described with reference to a cherry picker platform the use of an additional rigid section also allows the operation of a digger bucket or other attachment at an increased distance from the base 6. Also, it will be appreciated that the labels first rigid section 2 and second rigid section 3 are used for the convenience of describing their relationship to one

another and do not reflect their positions in a plurality of rigid sections.

[0027] Figures 10 to 14 show a second embodiment of an articulated arm subsection that is substantially the same as that of Figure 1. Accordingly, similar parts are accorded the same reference numerals.

[0028] The arm 1 comprises an additional ram 13 and a cam 14. The cam 14 is rotatably linked to the additional ram 13, the pivot 15, the first rigid section 2 and the ram 5.

[0029] Extension of additional ram 13 changes the position of the pivot 15 of the ram 5 from its position within the superior angle of operation Θ_s to a position within the inferior angle of Θ_i through actuating rotation of the cam 14.

[0030] Retraction of the additional ram 13 exerts a force on the second rigid section 3 at an operating pivot 15 which causes the second rigid section 3 to rotate about the pivot point 4. The longitudinal axis of the second rigid section 3 crosses or intersects the longitudinal axis of the first rigid section 2. Once the second rigid section 3 has passed overcentre the arm 1 is suitable for use in higher level applications with the fulcrum 20 now operating within the inferior angle of Θ_i .

[0031] A ratchet 16 maintains the second rigid section 3 in the overcentre position until released. The additional ram 13 retracts to reverse the rotation of the cam 14 to return the anchor pivot 15 of the ram 5 to its original position within the superior angle of operation Θ_s .

[0032] Extension of the ram 5 now rotates the second rigid section 3 in a direction to further reduce the superior angle Θ_s while the ratchet 16 offers minimal resistance.

[0033] When this mechanism in its original position it can be used to prevent either unwanted downward or unwanted upward overcentring of the second rigid section 3. The prevention of unwanted downward overcentring of the arm 1 is important when the arm 1 is operating in the superior angle of operations, for example as a cherry picker. The prevention of unwanted upward overcentring of the arm 1 is important when the arm is operating in the inferior angle of operation, for example digging, where the mechanism limits the inferior angle of operation to less than 180 degrees.

[0034] Such an arrangement allows the overcentring of the second rigid section 3 with respect to the first rigid section 2 without the use of the ground or other external body as a counterload.

[0035] It will be appreciated that any suitable mechanism may be employed in order to limit either of the superior, or the inferior, angles of operation to less than 180 degrees.

[0036] While various embodiments of the invention have been described, it will be apparent to those skilled in the art once given this disclosure that various modifications, changes, improvements and variations may be made without departing from the scope of the invention, as defined by the claims.

Claims

1. An articulated mechanical arm (1) comprising:

a first rigid section (2) connected to a base (6);
a second rigid section (3) pivotably connected to the first rigid section (2) about a first pivot point (4);

and a cylinder (5) operatively connected at a first end via a second pivot point (15) to the first rigid section (2) and at a second end via a third pivot point (20) to a first end of the second rigid section (3), the third pivot point (20), and thus the first end of the second rigid section (3), being proximal to the first rigid section (2), such that advancing and retracting the cylinder causes the second rigid section (3) to pivot about the first pivot point (4) relative to the first rigid section (2); wherein the angular position of the second rigid section (3) relative to the first rigid section (2) is such that the arm (1) is configured to selectively perform underhead or overhead work, wherein exerting a load on the second rigid section (3) causes pivotal rotation of the second rigid section (3) about the first pivot point (4) such that the third pivot point (20) crosses the longitudinal axis of the first rigid section (2) to adopt the overhead or underhead working position; **characterised in that**

the first rigid section (2) includes a recess (8) arranged to allow passage of the first end of the second rigid section (3) and of the third pivot point (20) when the longitudinal axis of the second rigid section when the cylinder crosses the longitudinal axis of the first rigid section.

2. An arm according to claim 1, further comprising an additional cylinder (13) and a cam (14), wherein the cam is rotatably linked to the additional cylinder (13), the second pivot point (15), the cylinder (5) and the first rigid section (2), wherein actuating rotation of the cam (14) is operable to change the angular position of operation of the second pivot point.

3. An arm according to claim 1, further comprising a ratchet (16) operable to maintain the second rigid section (3) in an overhead position.

4. An arm according to any preceding claim comprising fittings arranged to receive at least one attachment and a control mechanism arranged to control the orientation of the at least one attachment, wherein the attachment comprises at least one of the following: a cherry picker platform, a bucket, an hydraulic/pneumatic drill or hammer, pallet lifting prongs or a hedge cutter.

Patentansprüche

1. Ein mechanischer Gelenkarm (1) umfassend:

einen ersten starren Abschnitt (2) verbunden mit einer Basis (6);
 einen zweiten starren Abschnitt (3) drehbar mit dem ersten starren Abschnitt (2) um einen ersten Drehpunkt (4);
 und einen Zylinder (5), operativ an einem ersten Ende über einen zweiten Drehpunkt verbunden (15) mit dem ersten starren Abschnitt (2) und an einem zweiten Ende über einen dritten Drehpunkt (20) an ein erstes Ende des zweiten starren Abschnitts (3), dem dritten Drehpunkt (20) und damit das erste Ende des zweiten starren Abschnitts (3), sie proximal zu dem ersten starren Abschnitt (2) ist, so daß Vorwärts- und Rückwärts des Zylinders bewirkt, daß das zweite starre Teil (3) drehbar um den ersten Drehpunkt zu sein (4) relativ zu dem ersten starren Abschnitt (2); wobei die Winkelposition des zweiten starren Abschnitts (3) relativ zu dem ersten starren Abschnitt (2) so ist, daß der Arm (1) so konfiguriert ist, um Arbeit entweder auf einem niedrigen Pegel oder Arbeiten in der Höhe selektiv durchzuführen, wenn eine Last auf die zweite starre Abschnitt (3) bewirkt eine Schwenkdrehung des zweiten starren Abschnitts (3) um den ersten Drehpunkt (4) derart, dass der dritte Drehpunkt (20) durchquert, die die Längsachse des ersten starren Abschnitt (2) um Arbeit zu verrichten niedrigen Niveau oder in der Höhe zu ermöglichen;
 wobei der erste starre Abschnitt (2) eine Ausnehmung (8) angeordnet ist, um Durchgang von dem ersten Ende des zweiten starren Abschnitt erlauben (3) und der dritte Drehpunkt (20), wenn die Längsachse des zweiten starren Abschnitt, wenn der Zylinder kreuzt die Längsachse des ersten starren Abschnitt.

2. Ein Arm nach Anspruch 1, welcher weiterhin einen zusätzlichen Zylinder (13) und einen Nocken (14) enthält, wobei der Nocken drehbar mit dem zusätzlichen Zylinder (13), dem zweiten Drehpunkt (15), dem Zylinder (5) und dem ersten starren Abschnitt (2) verbunden ist und die Betätigung der Drehung des Nockens (14) bedienbar ist, um die Winkel der Betriebsposition des zweiten Drehpunktes zu ändern.

3. Ein Arm nach Anspruch 1, welcher weiterhin einen Sperrklinke (16) enthält, die so bedienbar ist, dass sie den zweiten starren Abschnitt (3) in einer Überkopfposition hält.

4. Ein Arm nach der vorhergehenden Ansprüche, mit Armaturen und einen Steuermechanismus, um die Ausrichtung ein zusätzliches Element, welches folgendes umfaßt steuern: eine Arbeitsplattform, einen Eimer, eine hydraulische / pneumatische Bohrmaschine oder Hammer, eine Palettenhubeinrichtung oder eine Heckenschere.

Revendications

1. Un bras mécanique articulé (1) comprenant :

une première partie rigide (2), connectée à une base (6) ;
 une deuxième partie rigide (3), connectée de manière pivotante à la première section rigide (2) par le premier point de pivot (4) ; et un cylindre (5), relié effectivement en une première extrémité par le deuxième point de pivot (15) à la première section rigide (2), et en une deuxième extrémité par un troisième point de pivot (20) à une première extrémité de la deuxième section rigide (3), le troisième point de pivot (20), afin que la première extrémité de la deuxième section rigide (3) soit proximale de la première section rigide (2) de façon que l'avance et le retour du cylindre fait pivoter la deuxième section rigide (3) autour du premier point de pivot (4) par rapport à la première section rigide (2) ;
 ainsi, la position angulaire de la deuxième section rigide (3) par rapport à la première section rigide (2) est telle que le bras (1) est configuré pour exécuter sélectivement travail ci-dessus ou en dessous du niveau de la tête.

De cette manière, sa pression sur la deuxième section rigide (3) provoque la rotation pivotale de la deuxième section rigide (3) autour du premier point de pivot (4) de telle sorte que le troisième point de pivotement (20) croise l'axe longitudinal de la première section rigide (2) pour exécuter sélectivement travail ci-dessus ou en dessous du niveau de la tête; dans lequel la première section rigide (2) comporte un évidement (8) agencé pour permettre le passage de la première extrémité de la deuxième section rigide (3) et du troisième point de pivot (20) lorsque l'axe longitudinal de la deuxième section rigide lorsque le cylindre croise l'axe longitudinal de la première section rigide.

2. Un bras selon la revendication 1, comprenant en outre un cylindre supplémentaire (13) et une came (14) reliée de manière rotative sur ledit autre cylindre supplémentaire (13), le second point de pivotement (15), le cylindre (5) et le première section rigide (2), dans lequel la came d'actionnement de rotation (14) de façon que la rotation de la came (14) est utilisable

pour modifier la position angulaire du fonctionnement du deuxième point de pivot.

3. Un bras selon la revendication 1, comprenant en outre un cliquet (16) pouvant fonctionner pour maintenir la seconde partie rigide (3) dans la position au-dessus du niveau de la tête. 5
4. Un bras selon une revendication précédente quelconque, comprenant les raccords disposés de façon à recevoir au moins une attache et un mécanisme agencé pour commander l'orientation de la au moins une pièce jointe, dans lequel la fixation comprend au moins un des éléments suivants: une plate-forme élévatrice, un seau, une perceuse pneumatique / hydraulique ou marteau, palettes griffes de levage ou un taille-haie. 10 15

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Fig 1

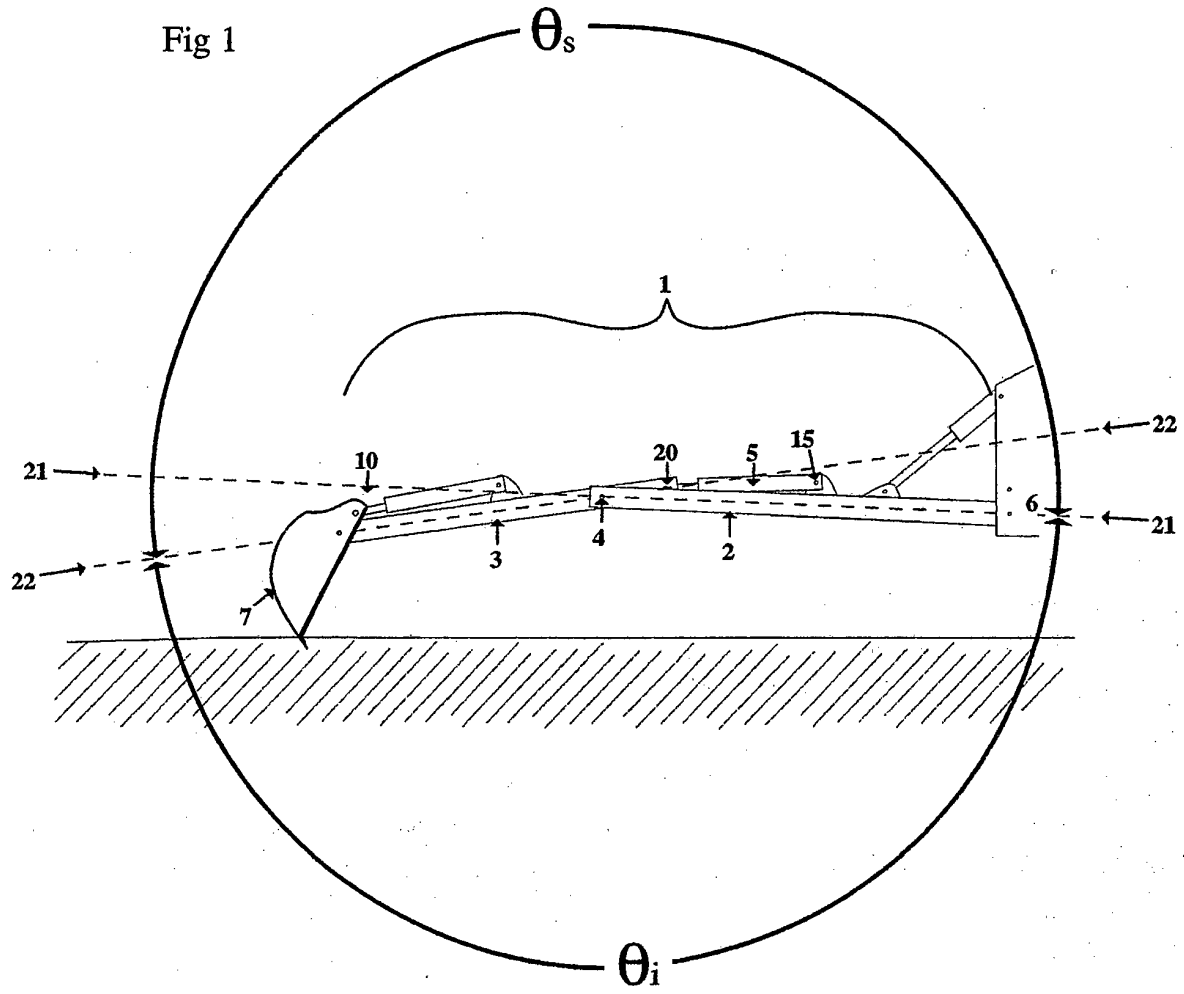


Fig 2

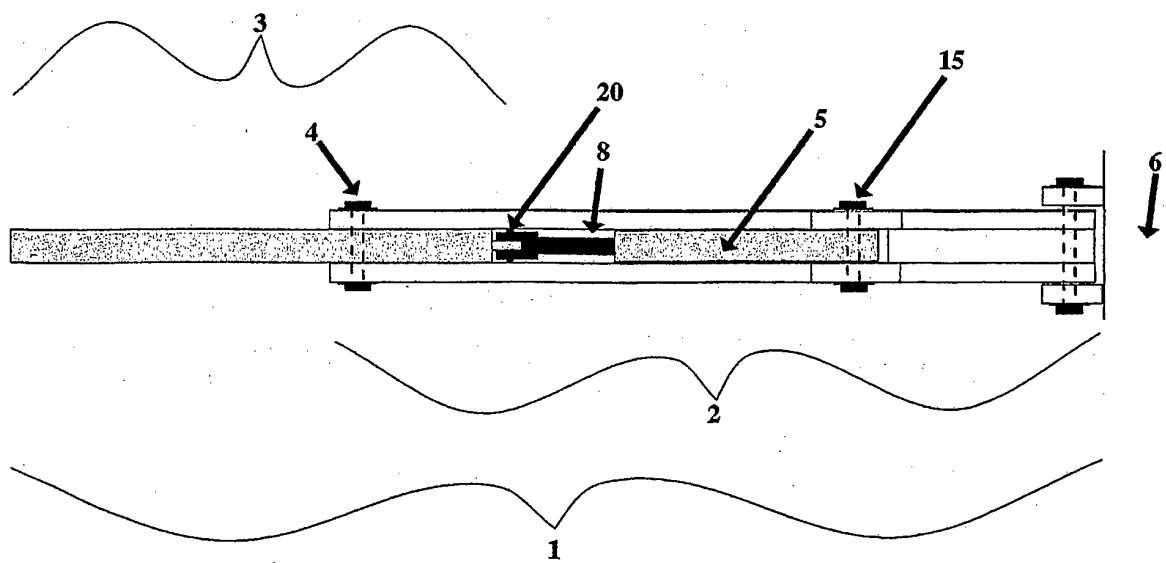


Fig 3

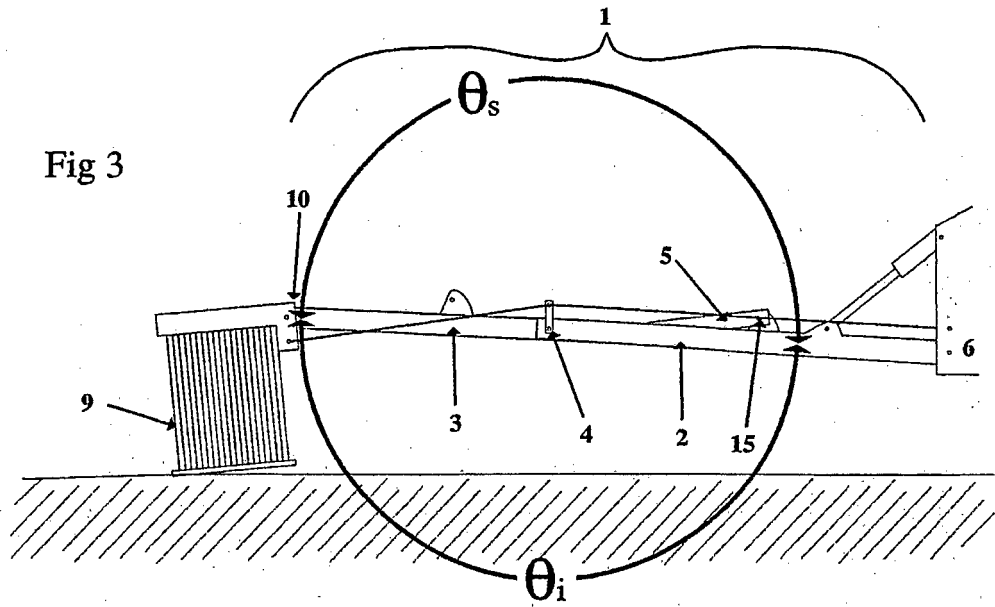


Fig 4

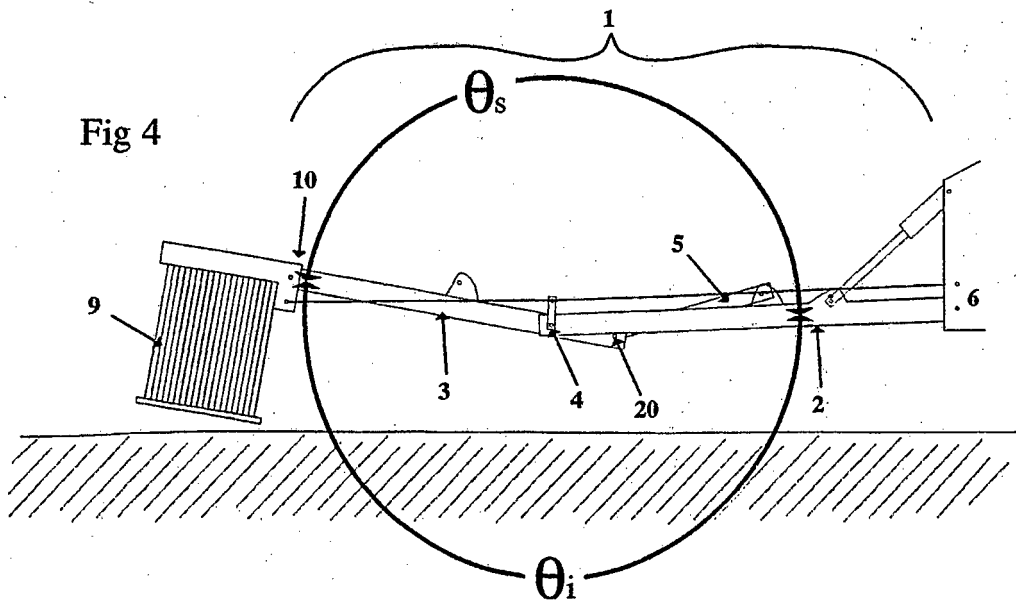


Fig 5

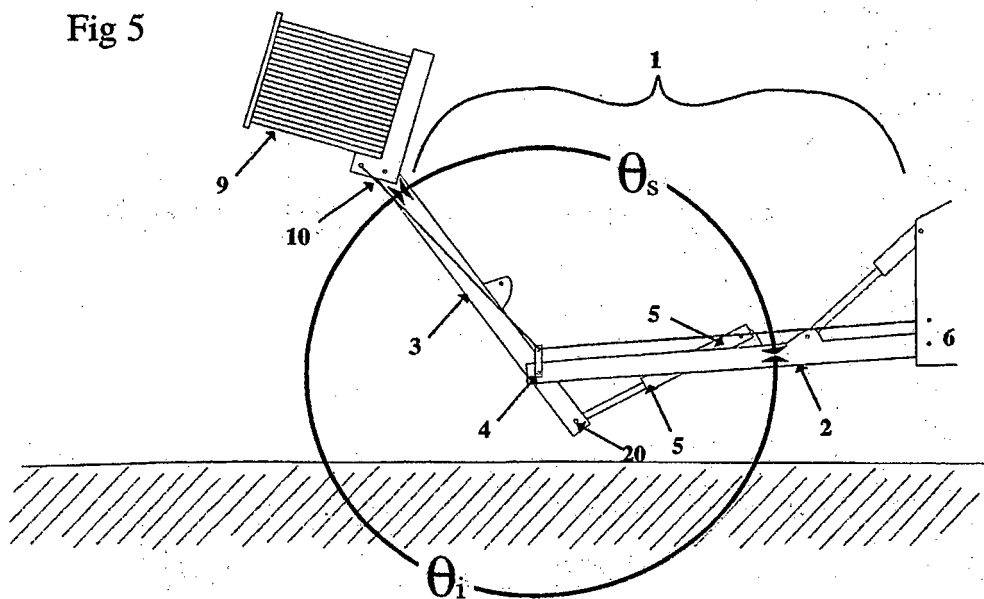


Fig 6

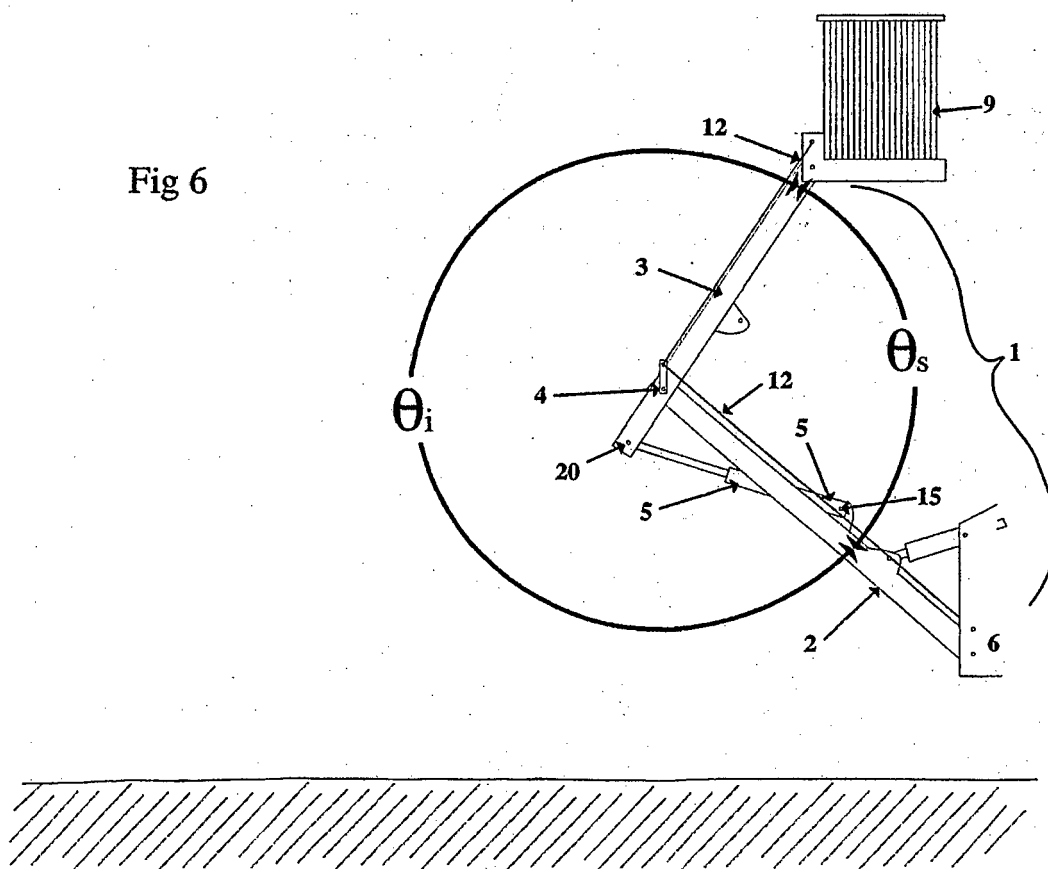


Fig 7

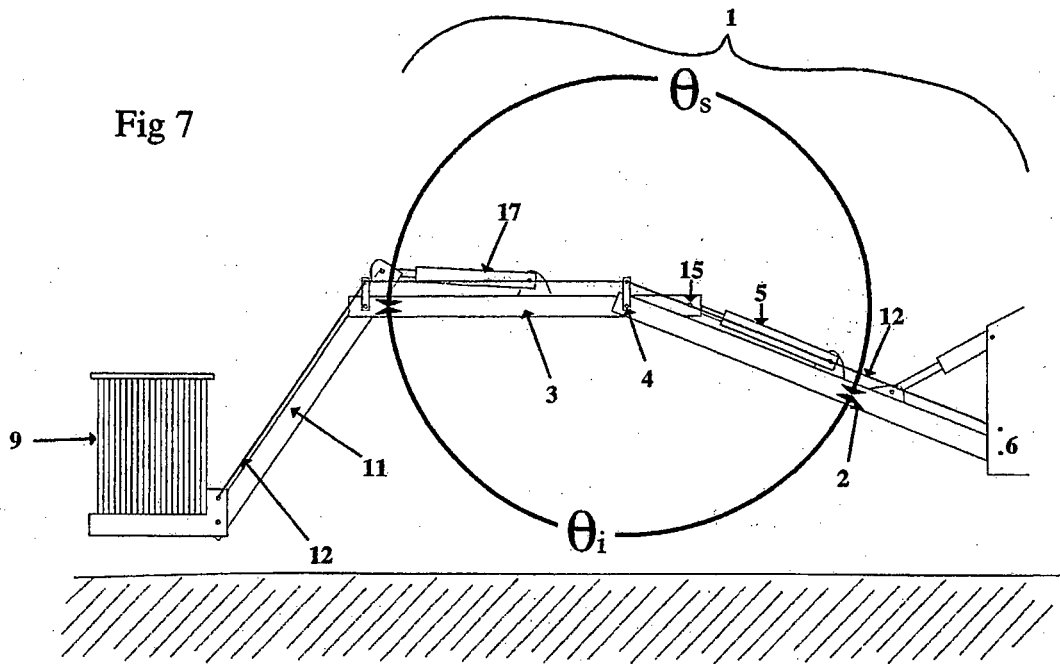


Fig 8

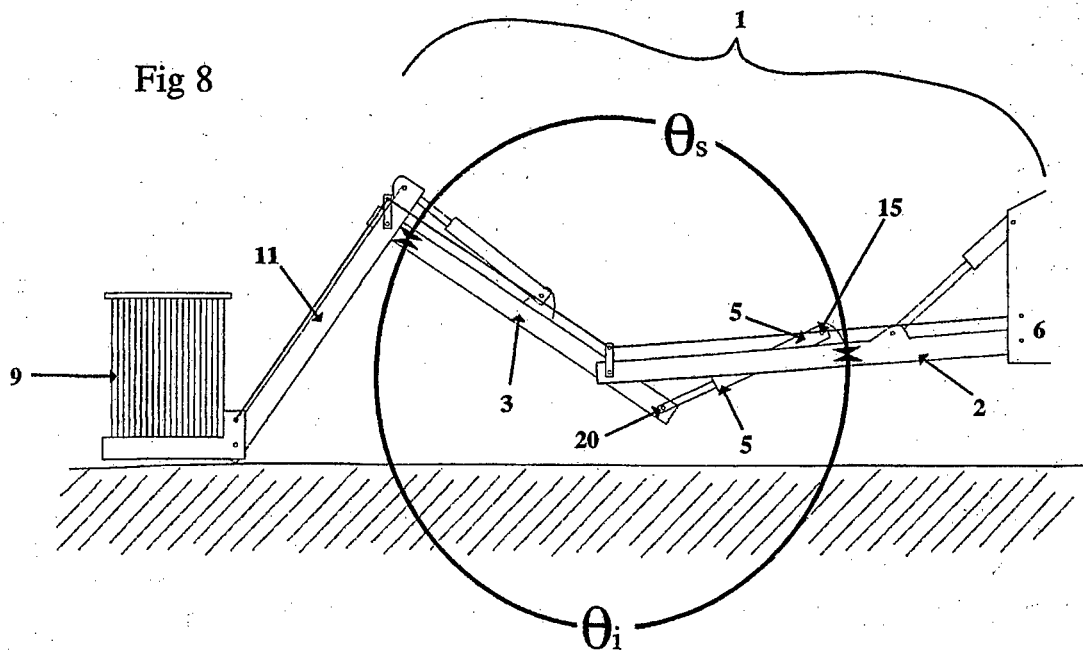


Fig 9

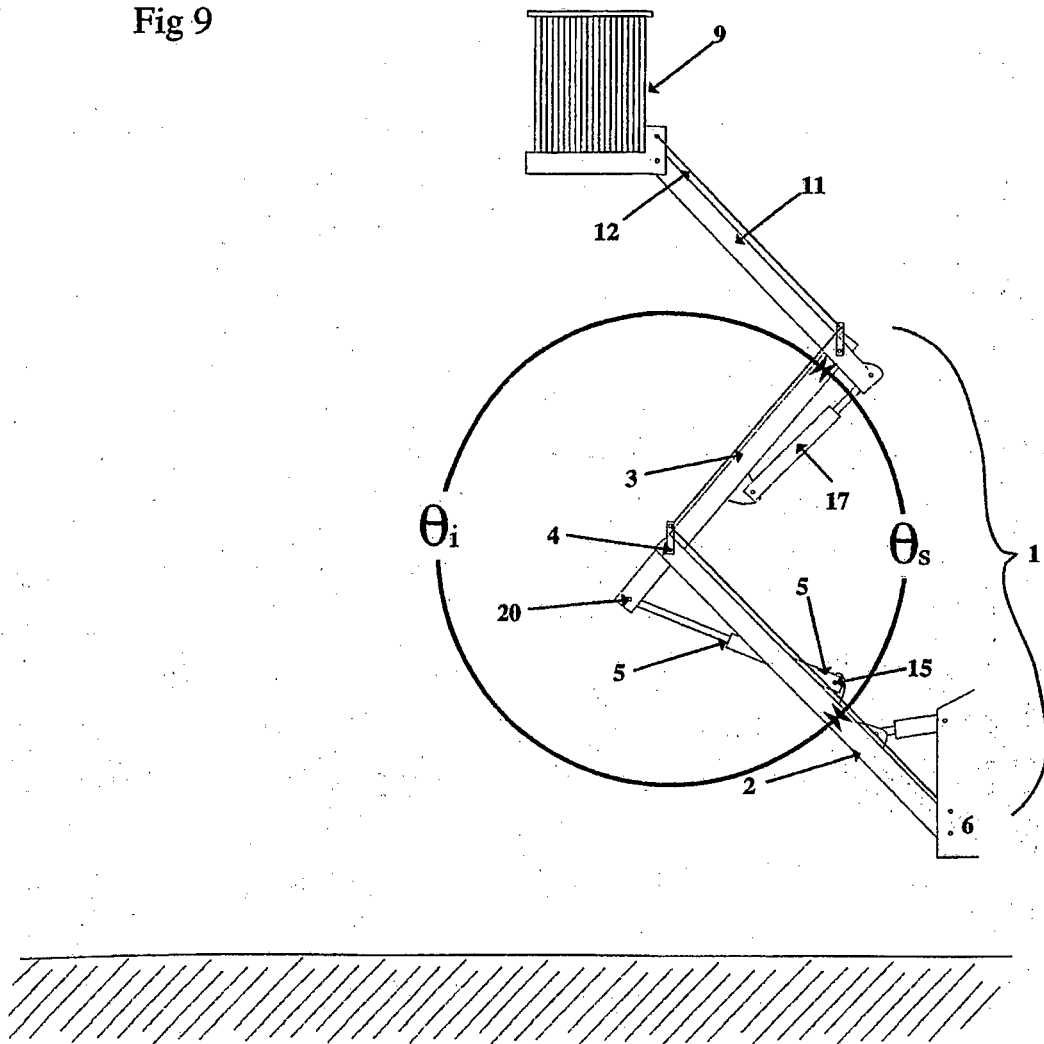


Fig 10

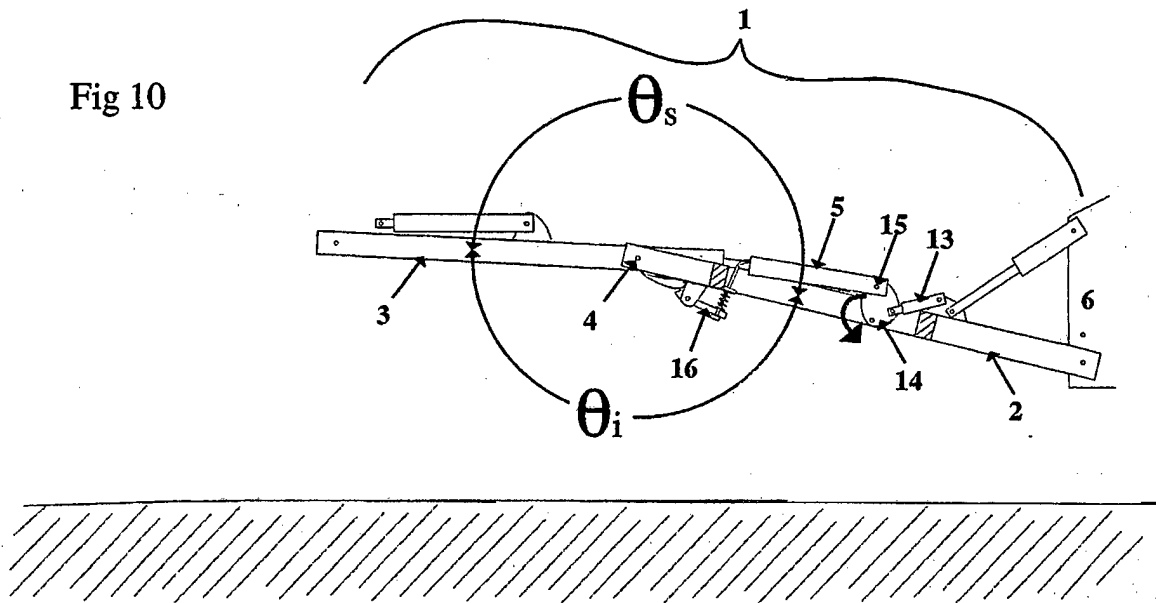


Fig 11

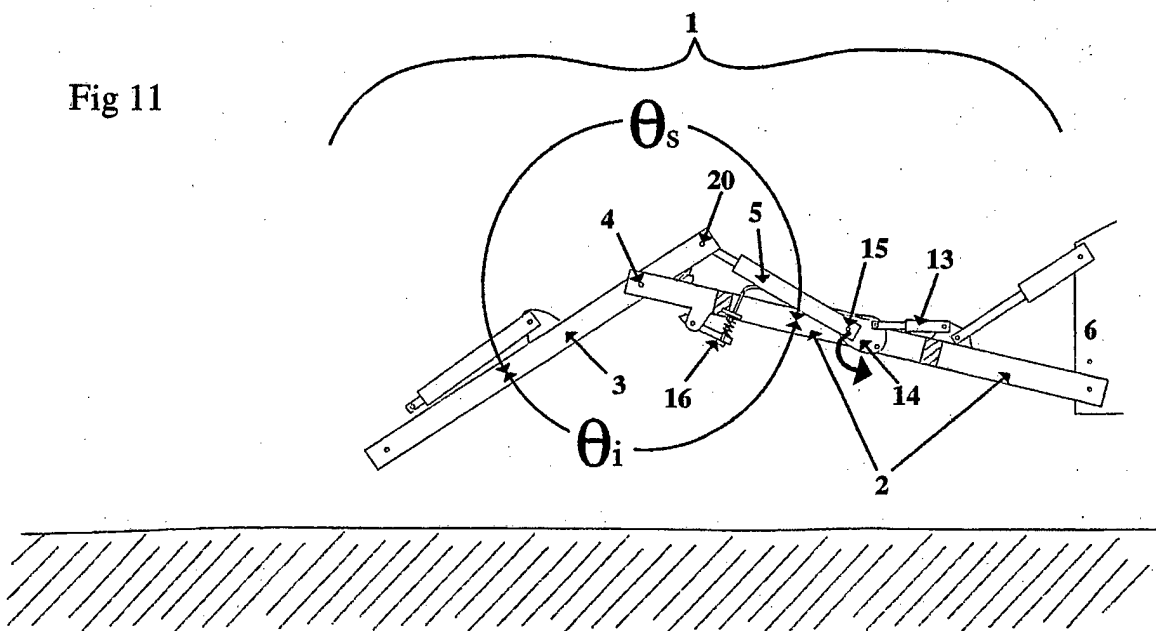


Fig 12

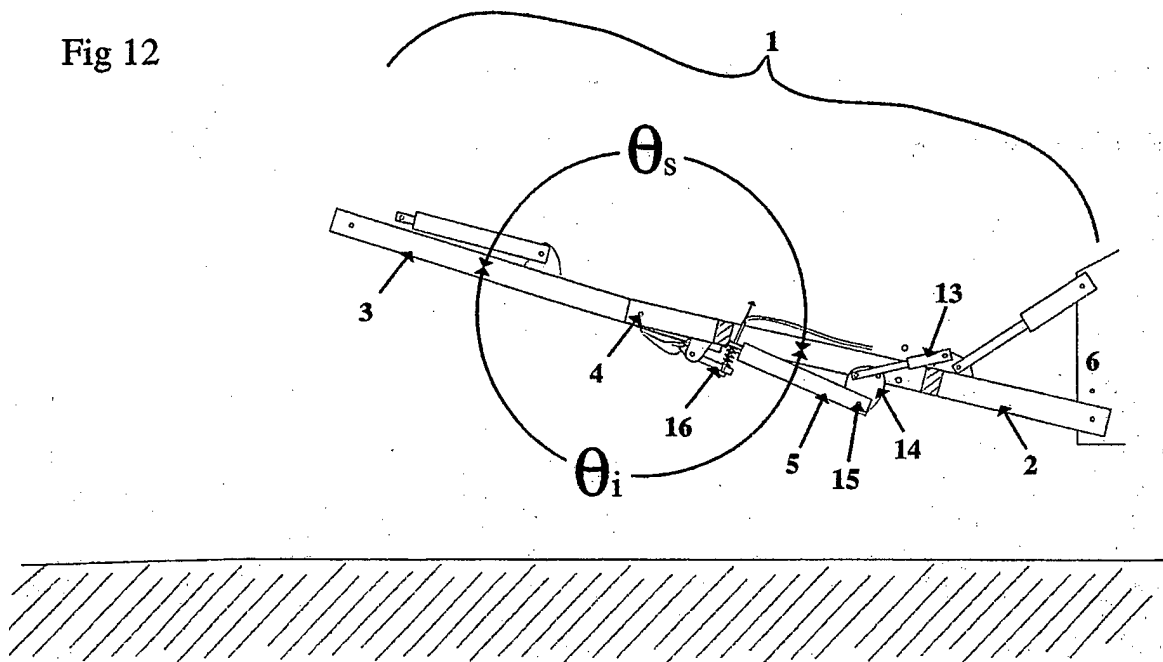


Fig 13

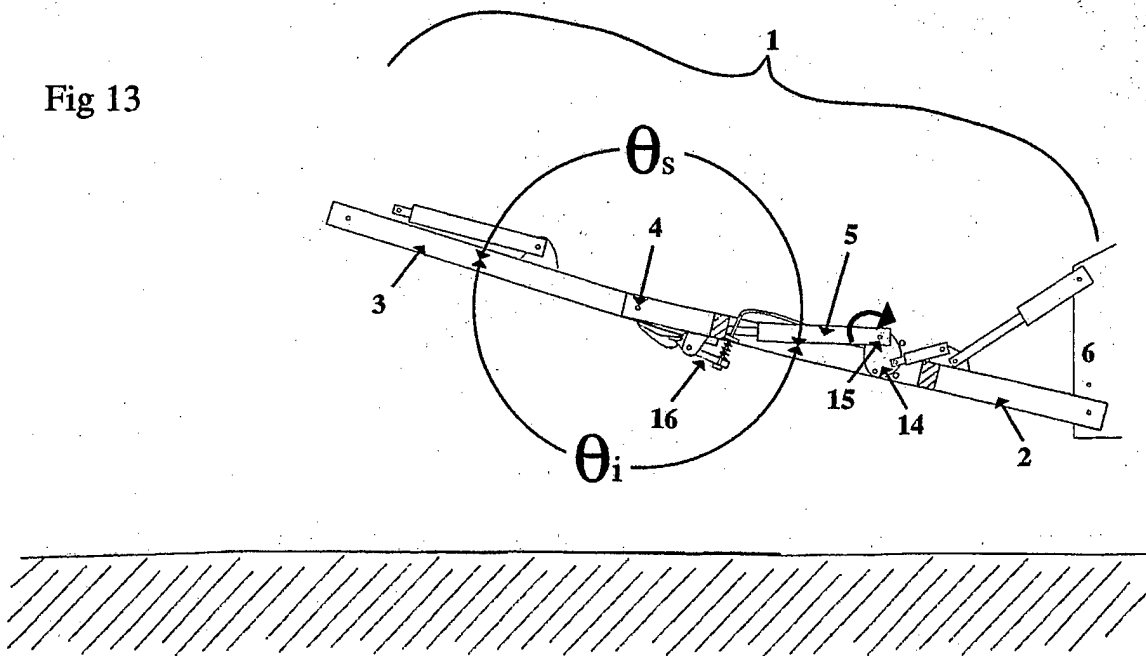


Fig 14

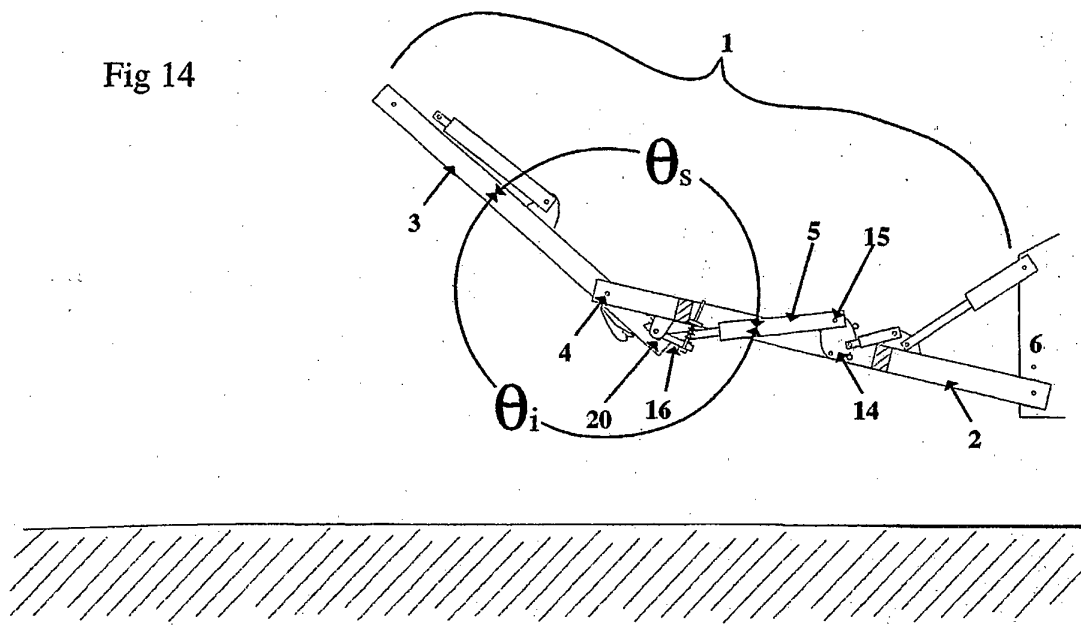
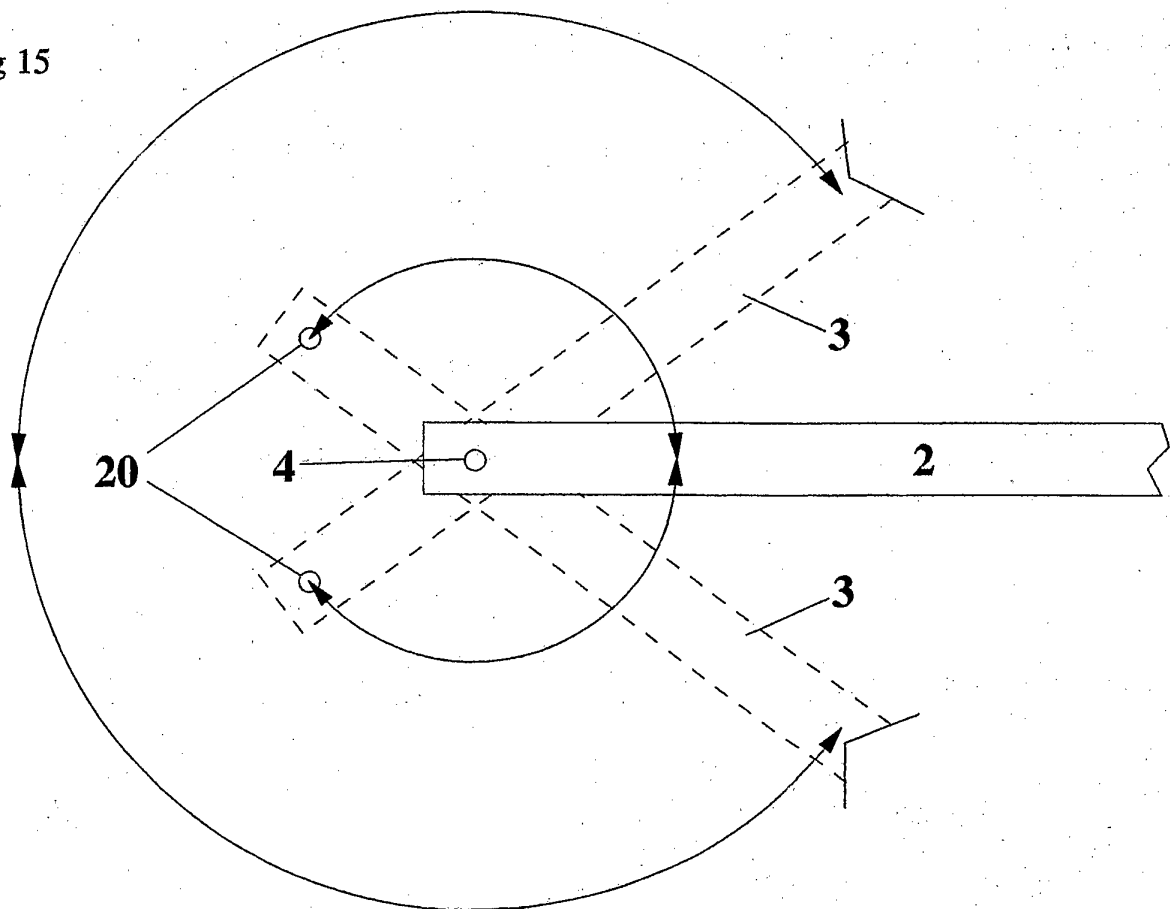


Fig 15



REFERENCES CITED IN THE DESCRIPTION

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