



PATENT SPECIFICATION

(11) S85699

(21) Application No. S2007/0639

(22) Date of Filing of Application: 07/09/2007

(45) Specification Published: 16 February 2011

(51) Int. Cl. (2009)
B66F 11/00
E02F 3/04

(54) Title: Articulated mechanical arm

(72) Inventor: VINCENT SOUTHALL

(73) Patent Granted to: VINCENT SOUTHALL, British, Greagh Loughmourne Castleblaney, Co. Monaghan, Ireland

ARTICULATED MECHANICAL ARM

This invention relates to an articulated mechanical arm. More particularly but not exclusively, it relates to an articulated mechanical arm having a
5 large angular range of articulation. Even more particularly but not exclusively it relates to an articulated mechanical arm having an angular range of articulation suitable for use in underhead and overhead work.

Mechanical arms are seen in wide use provided by a number of
10 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
15 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.

Discrete pieces of equipment, for example "cherry pickers", are used for
20 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.

25 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".

According to the present invention, there is an articulated mechanical arm comprising:

- a plurality of rigid sections;
- at least two of the rigid sections being pivotable relative to each other,
- 5 about a pivot point such that a fulcrum located at a proximal end of a second of the at least two rigid sections, adjacent the pivot point, can cross a longitudinal axis of a first of the at least two rigid sections.

Such an articulated mechanical arm allows for operation both as a digger
10 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
15 both higher level (eg overhead) work as well as for lower level work (eg below head height).

The angular range of the first and second rigid sections may range from an acute angle through an obtuse angle to a reflex angle.
20

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.

25 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.

30 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.

5 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.

10 The articulated mechanical arm may comprise actuators such as hydraulic cylinders or angular actuators such as hydraulic motors.

15 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.

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

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

30 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 comprising shows a typical
5 two rigid sections in a digging application;

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

10 Figures 3 to 6 are representations of two rigid sections of the articulated mechanical arm of Figure 1 in 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
15 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; and
20

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

Referring now to Figures 1, 2 and 15, an articulated mechanical arm 1
25 comprises first and second rigid sections 2,3, 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.

- 5 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 ram 5 from the superior angle Θ_s of operation to the inferior
- 10 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.
- 15 The drawings represent the sequence of events to raise the cherry picker platform from ground level upwards.

- 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
- 20 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
 - 25 temporarily free the ram 5 from fulcrum point 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
- 30 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. Once the second rigid section 3 has passed overcentre, flipped upwards, the arm 1 is suitable for use in higher level applications.

5

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.

10

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.

15

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.

20

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.

25

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 4, the first rigid section 2 and the ram 5.

30

Extension of additional ram 13 changes the position of the pivot 4 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.

5

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

10

2. Once the second rigid section 3 has passed overcentre the arm 1 is suitable for use in higher level applications.

15

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 of the ram 5 to its original position within the superior angle of operation Θ_s .

20

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.

25

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.

30

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.

5

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.

10

It will be further appreciated that in an alternative embodiment, the second rigid section of the arm may be mounted alongside, externally, of the first rigid section. This obviates the requirement for the provision of a recess in the first rigid section to allow passage of the proximal end and fulcrum of the second rigid section overcentre.

15

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.

20

CLAIMS

1. An articulated mechanical arm comprising:
a plurality of rigid sections;
5 at least two of the rigid sections being pivotable relative to each other,
about a pivot point such that a fulcrum located at a proximal end of a
second of the at least two the rigid sections, adjacent the pivot point, can
cross a longitudinal axis of the first of the at least two rigid sections.
- 10 2. An arm according to claim 1 wherein, the first of the two rigid
sections comprises a recess extending from the pivot point and arranged
so as to allow passage of a proximal end of the second of the at least two
rigid sections, adjacent the pivot point over a longitudinal axis of the first of
the at least two rigid sections.
- 15 3. An arm according to either claim 1 or claim 2 comprising 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
20 the plurality of rigid sections.
4. An arm according to any preceding claim comprising a mechanism
arranged to allow a variation in the position of either fulcrum of the
cylinder.
- 25 5. 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: cherry picker

platform, bucket, hydraulic/pneumatic drill or hammer, pallet lifting prongs or hedge cutter.

Fig 1

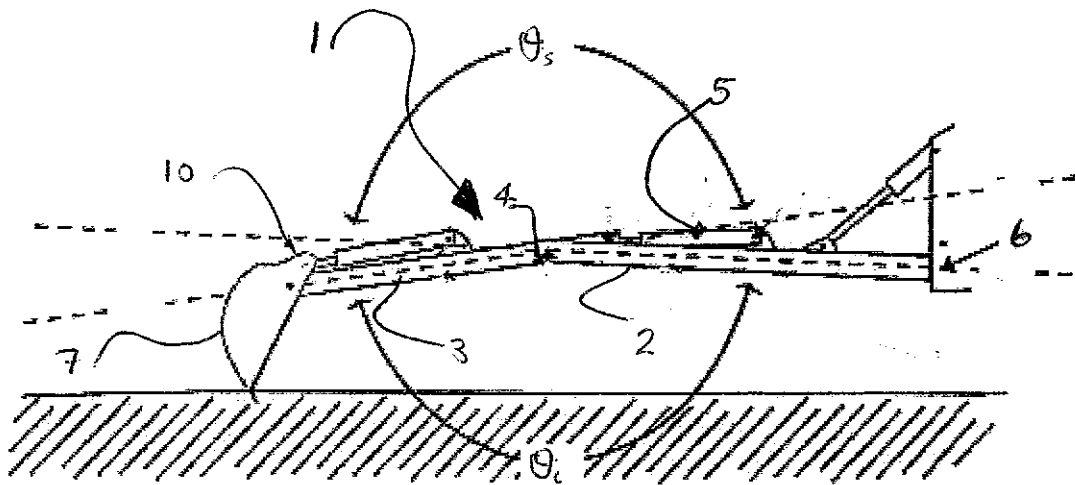
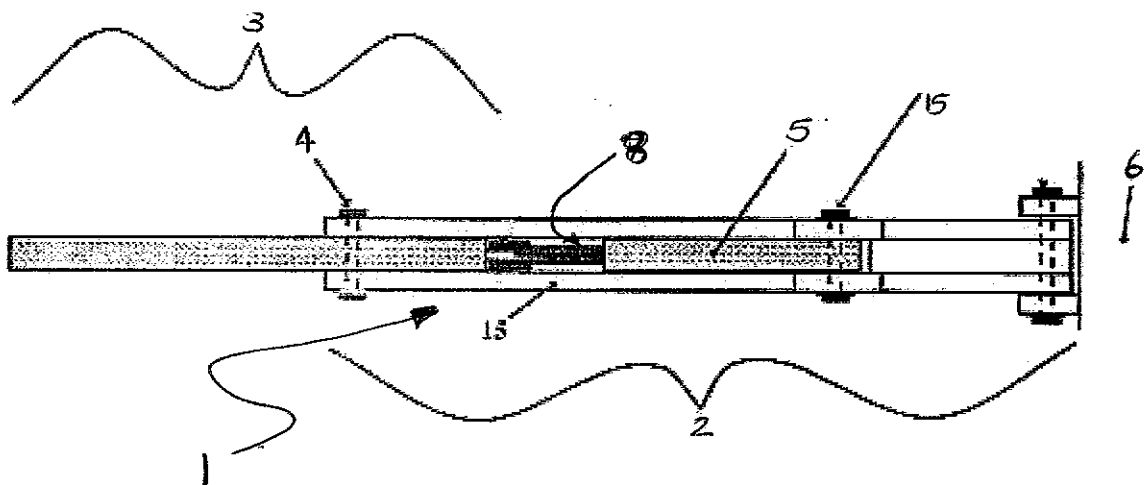


Fig 2



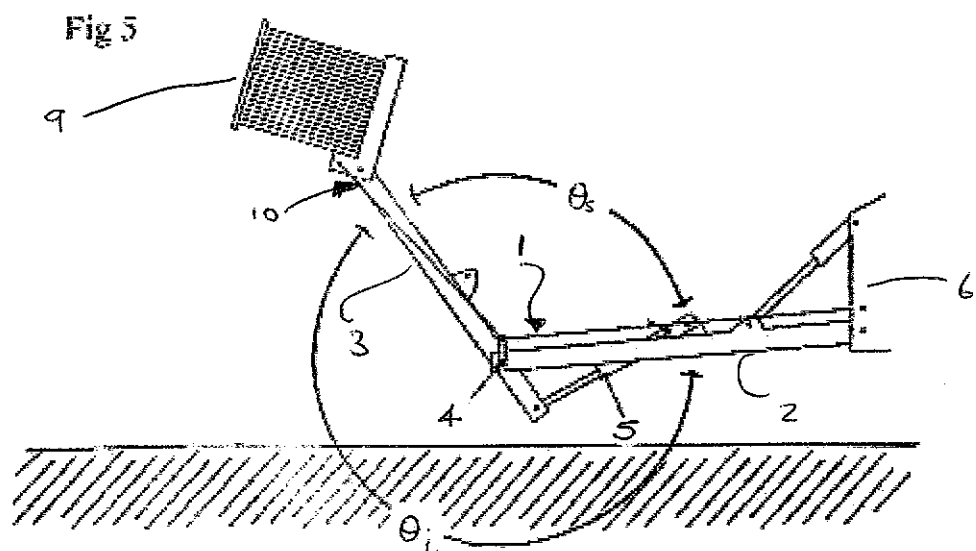
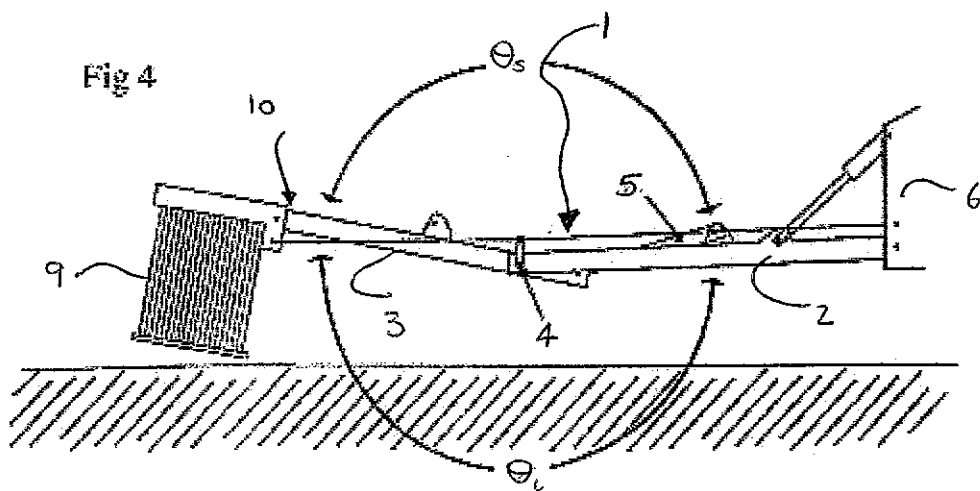
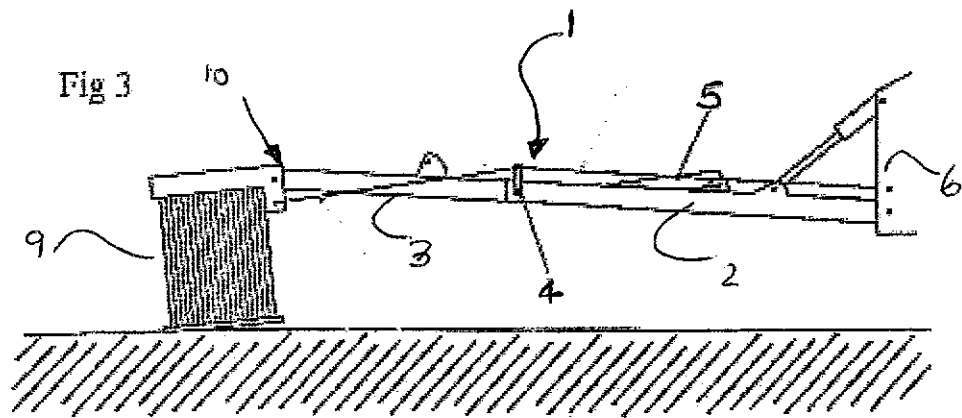


Fig 6

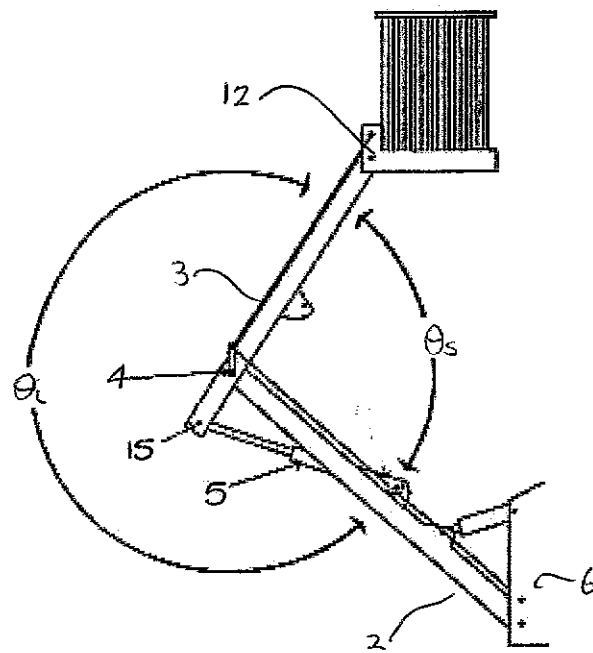


Fig 7

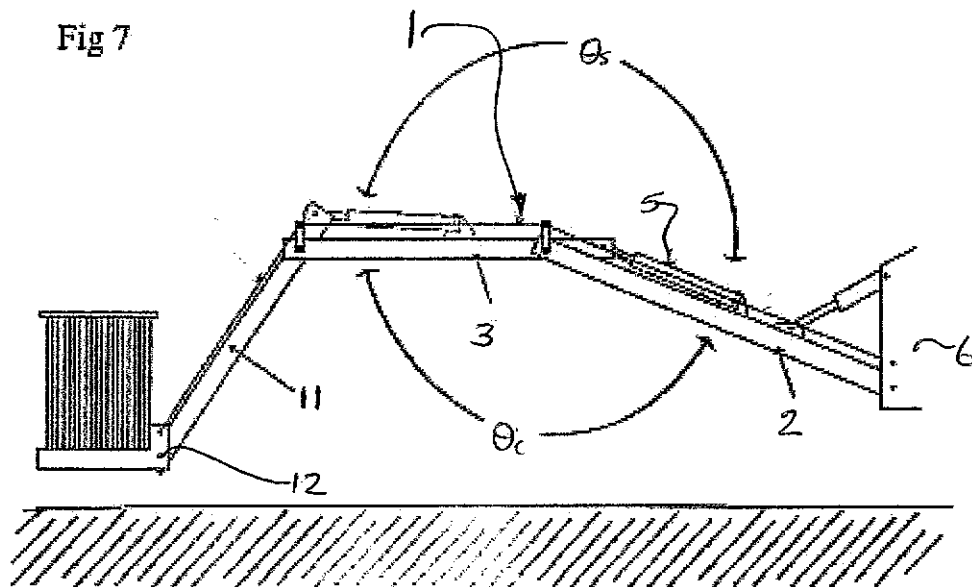


Fig 8

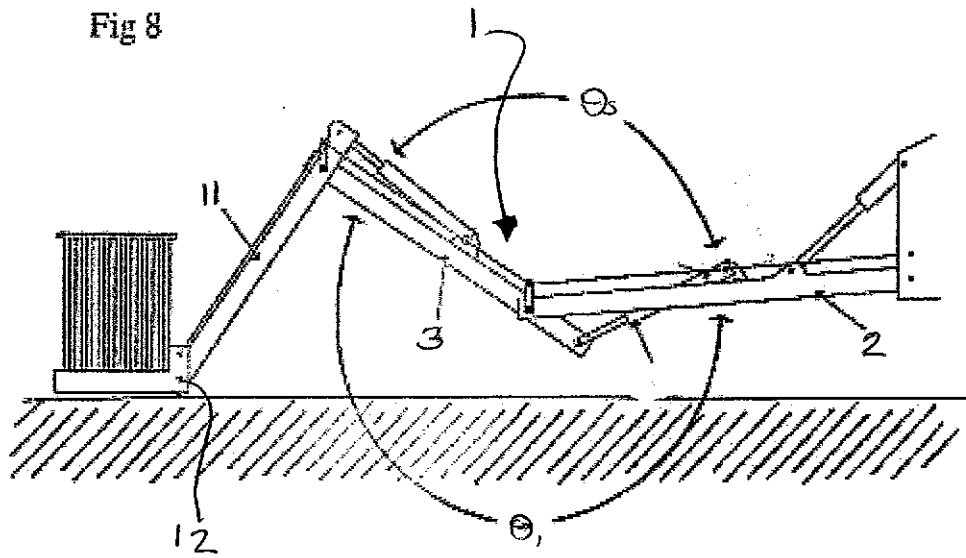


Fig 9

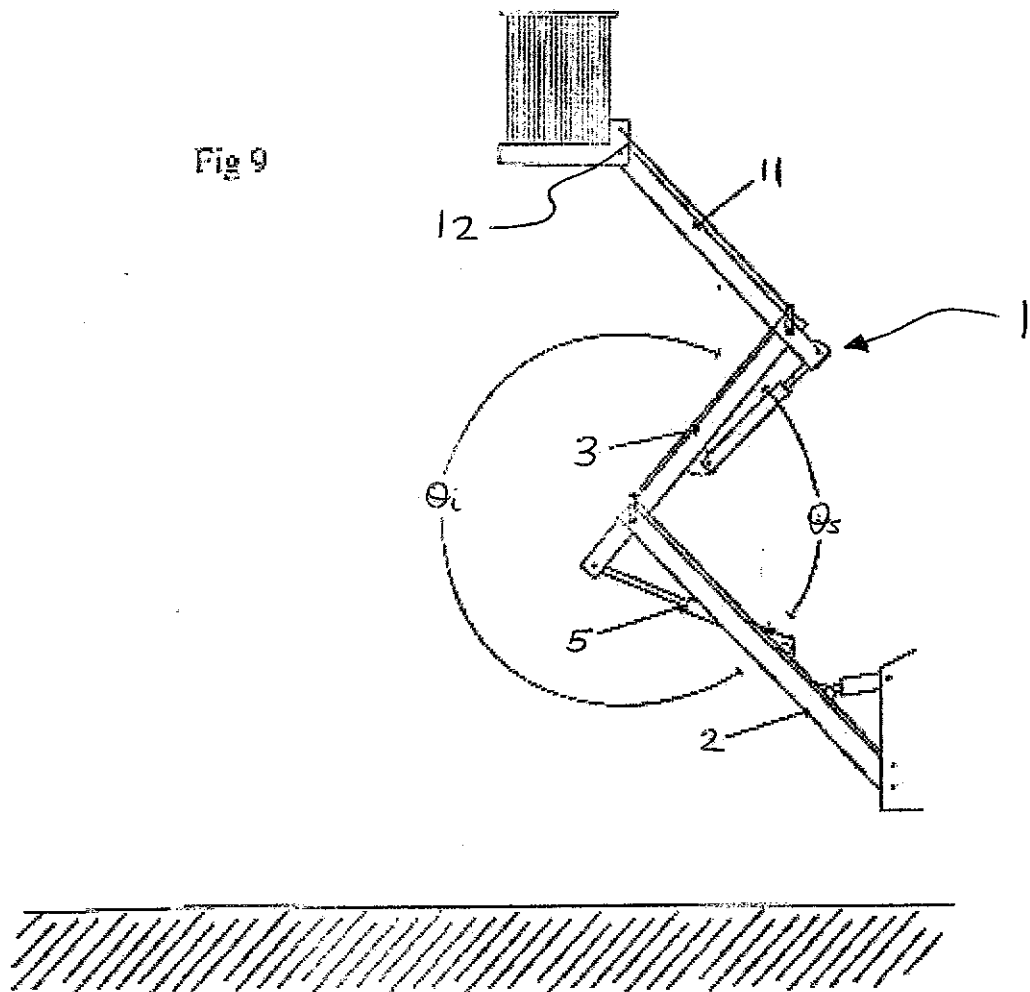


Fig 10

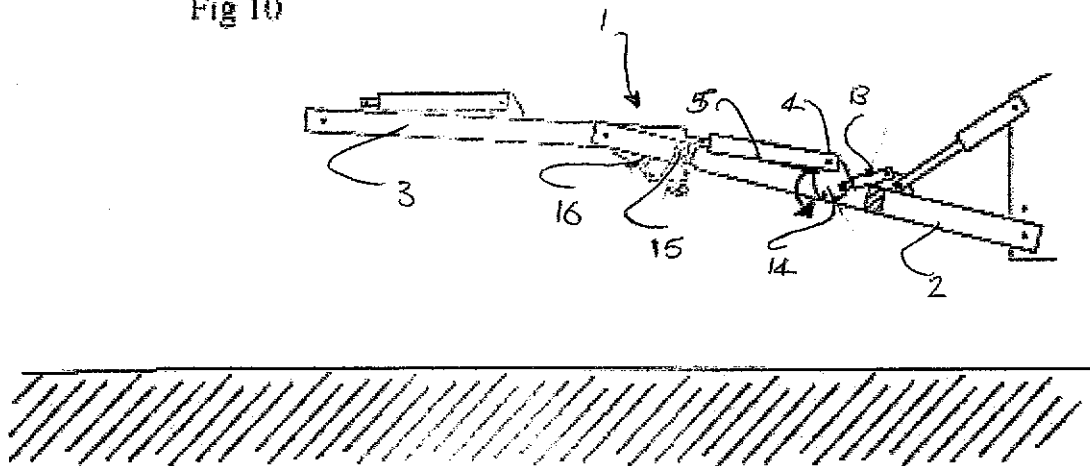


Fig 1i

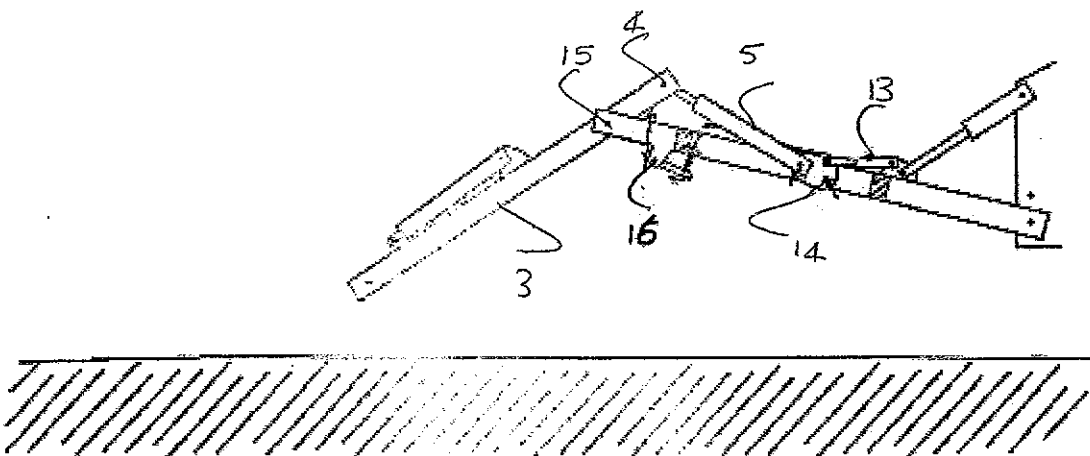


Fig 12

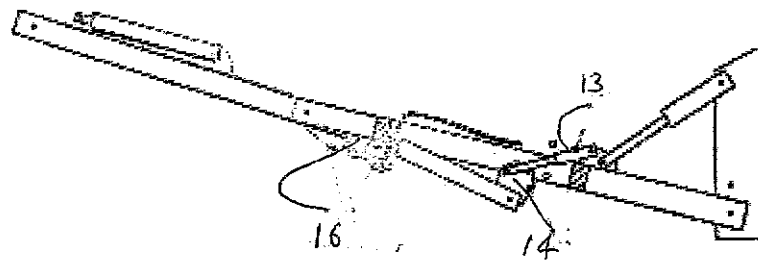


Fig 13

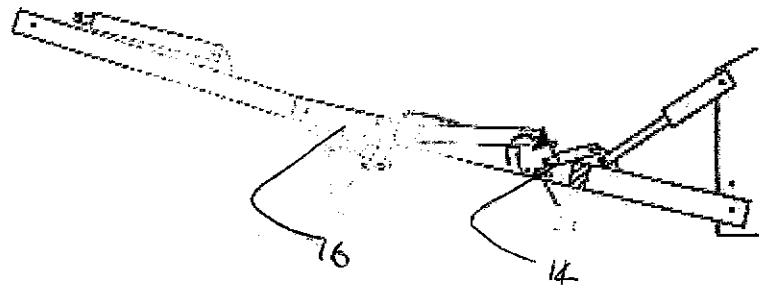


Fig 14

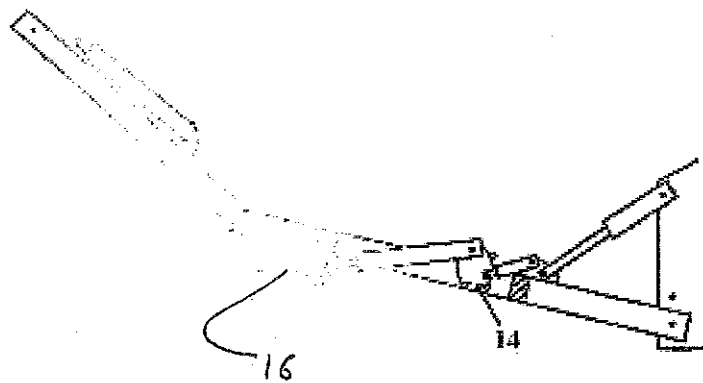


Fig 15