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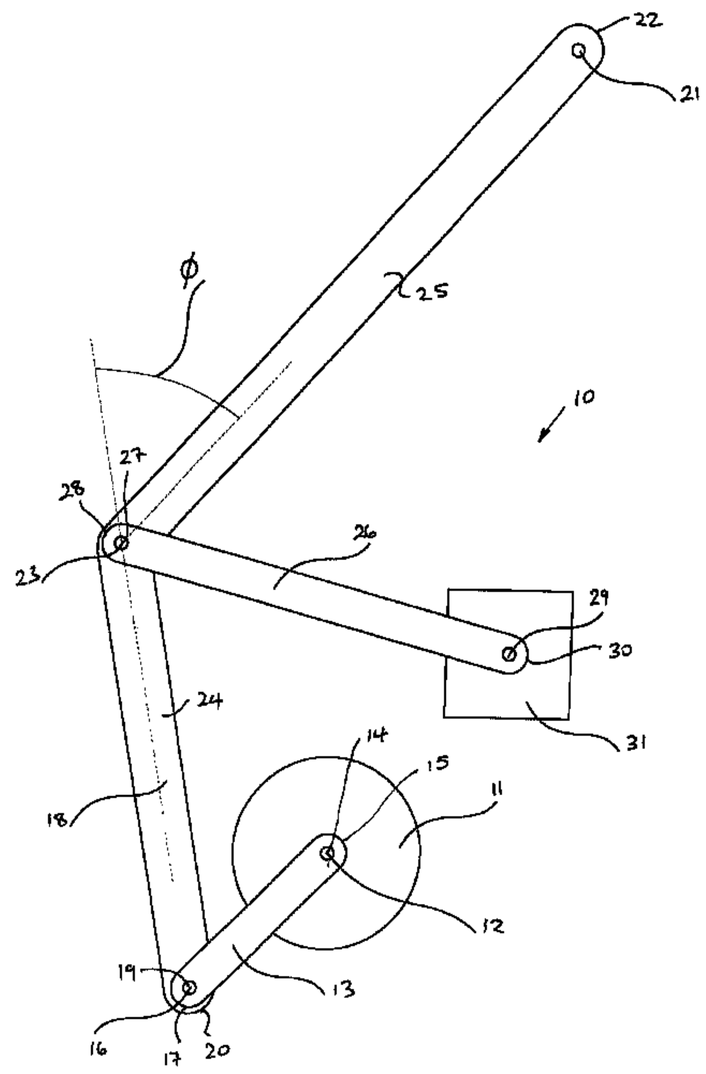
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(54) **AMELIORATIONS AUX TRINGLERIES DE MOTEUR**

(54) **IMPROVEMENTS IN OR RELATING TO MOTOR LINKAGES**



(57) An articulated linkage mechanism 10 comprises a motor 11 arranged to produce a torque force on a drive shaft 12. A crank 13 is mounted to the drive shaft 12 at a first mounting position 14 located at a first end 15 of the crank 13. A second mounting position 16 at a second end 17 of the crank 13 is attached to a link 18 at a first end 20 of the link 18. At a second mounting position 21 on the link 18 at a second end 22, which is remote from the first end 20, a load, not illustrated, is attached. At an intermediate pivot mounting position 23 of the link 18, an arm 26 is attached and a remote end 30 of the arm 26 is fixed to an anchorage position 31. The motor 11 is fixed and the second mounting position 29 of the arm 26 is fixed with respect to the first mounting position 14 of the crank 13. The movement of the link 18 is constrained by the arm 26 such that the crank 13 is able to rotate through a range of angles greater than + 270°.

ABSTRACT

IMPROVEMENTS IN OR RELATING TO MOTOR LINKAGES

An articulated linkage mechanism 10 comprises a motor 11 arranged to produce a torque force on a drive shaft 12. A crank 13 is mounted to the drive shaft 12 at a first mounting position 14 located at a first end 15 of the crank 13. A second mounting position 16 at a second end 17 of the crank 13 is attached to a link 18 at a first end 20 of the link 18. At a second mounting position 21 on the link 18 at a second end 22, which is remote from the first end 20, a load, not illustrated, is attached. At an intermediate pivot mounting position 23 of the link 18, an arm 26 is attached and a remote end 30 of the arm 26 is fixed to an anchorage position 31. The motor 11 is fixed and the second mounting position 29 of the arm 26 is fixed with respect to the first mounting position 14 of the crank 13. The movement of the link 18 is constrained by the arm 26 such that the crank 13 is able to rotate through a range of angles greater than ± 270°.

IMPROVEMENTS IN OR RELATING TO MOTOR LINKAGES

The present invention relates to an articulated linkage mechanism for coupling a load to a motor.

Typically a motor can be directly coupled to a load that is able to rotate directly in response to torque generated by the motor. Alternatively, the motor can be linked to the load using a simple crank and link arrangement, such that the motor and load are not required to be in close proximity to one another and other mechanisms and sensors can be installed between the motor and load within the crank and link arrangement. Another benefit of the crank and link arrangement is that some mechanical advantage can be gained between the motor and the load by providing a short crank attached to the motor and a longer link between the load and the crank. However, a disadvantage of the simple crank and link arrangement is that it is only able to operate over a limited angle of rotation, for example up to ±60°. That is the angle of rotation of the motor or the load can never ±90°. This is in contrast with a directly coupled motor and load which are able to rotate continuously, that is the motor or load can rotate through ±360°.

Therefore, in order to provide an improved mechanical advantage than can be achieved by a directly coupled arrangement, whilst still allowing continuous rotation of the motor and load, it is normal to provide an appropriate gear train system between the motor and load. However, in safety critical applications, for example in an aerospace application, the use of a gear train system is unacceptable as it can result in jamming or physical malfunction

of the gear train itself. Therefore, although a gear train system may be the most appropriate means of coupling a motor to a load, its use can be prohibited due to safety considerations.

According to the invention an articulated linkage mechanism comprises a motor arranged to produce a torque force on its drive shaft, a crank mounted to the drive shaft at a first mounting position, a link pivotally attached at a first mounting position to a second mounting position of the crank and at a second mounting position attachable to a load, the link having an intermediate pivot mounting position between its first and second mounting positions, and an arm pivotally attached at a first mounting position to the intermediate pivot mounting position and pivotally attached at a second mounting position to a anchorage position fixed relative to the first mounting position of the crank.

In this manner, a motor can be coupled to a load without the use of a gear train system and the linkage mechanism has an improved mechanical advantage over that provided by a conventional crank and link arrangement or direct coupling arrangement between the motor and load. Furthermore, the linkage mechanism can provide a greater angle of rotation than that achievable by a crank and link arrangement, that is the motor can produce an angle of rotation greater than ±270°.

The link may be constituted by first and second limbs either side of the intermediate pivot mounting position and the first and second limbs may be disposed angularly with respect to one another.

The dimensions of the crank, the link, the arm and the respective mounting positions of the

crank, the link and the arm may be arranged such that the second mounting position of the link that is attachable to the load describes a substantially straight line during movement of the drive shaft of the motor.

In this manner, the second mounting position of the link describes a substantially straight line such that an attached load to the second mounting position also moves in a substantially straight line when the second mounting position is caused to travel between two predetermined limits of the articulated linkage mechanism by the rotation of the drive shaft of the motor.

Preferably, the motor may be a torque motor.

The articulated linkage mechanism may be arranged to form part of an active stick controller. The active stick controller may be arranged for use in an aircraft cockpit.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a linkage mechanism in side elevation according to the present invention;

Figure 2 illustrates a first position of the linkage mechanism shown in Figure 1;

Figure 3 illustrates a second position of the linkage mechanism shown in Figure 1;

Figure 4 illustrates a third position of the linkage mechanism shown in Figure 1, and

Figure 5 illustrates the first, second and third positions shown in Figures 2 to 4 overlaid on one another.

Referring to Figure 1, an articulated linkage mechanism 10 comprises a motor 11 arranged to produce a torque force, on its drive shaft 12. The motor 11 can be a torque motor which is arranged to achieve a high level of torque, particularly when its drive shaft 12 is stationary.

A crank 13 is mounted to the drive shaft 12 at a first mounting position 14 located at a first end 15 of the crank 13. There is provided a second mounting position 16 at a second end 17 arranged remotely to the first end 15. A link 18 is pivotally attached at a first mounting position 19 located at a first end 20 of the link 18 to the second mounting position 16 of the crank 13. There is provided a second mounting position 21 on the link 18 at a second end 22 arranged remotely to the first end 20. A load, not illustrated, is attached to the link 18 via the second mounting position 21 of the link 18.

The link 18 is arranged to have an intermediate pivot mounting position 23 located between the first and second mounting positions 19 and 21. The link 18 is constituted by a first limb 24 and a second limb 25 arranged either side of the intermediate pivot mounting position 23. The first and second limbs 24 and 25 are disposed angularly with respect to one another by an angle ϕ. The first limb 24 carries the first mounting position 19 and the second limb

25 carries the second mounting position 21.

An arm 26 is pivotally attached at a first mounting position 27, located at a first end 28 of the arm 26, to the intermediate pivot mounting position 23 and is pivotally attached at a second mounting position 29, located at a second end 30 remote 30 the first end 28, to a fixed anchorage position 31. It will be understood that the motor 11 is fixed and that the second mounting position 29 of the arm 26 is fixed with respect to the first mounting position 14 of the crank 13.

Referring to Figures 2 to 4, in which like references have been used to indicate similar integers to those illustrated in Figure 1, in operation, the motor 11 generates a torque force at its drive shaft 12 that controls the angular position of the crank 13 attached to the drive shaft at the first mounting position 14 of the crank 13. The second end 17 of the crank 13 describes a circular movement about the first mounting position 14 which in turn causes the link 18, attached to the second mounting position 16 of the crank 13 by its first mounting position 19, to swivel.

The movement of link 18 is constrained by the arm 26 attached between the intermediate pivot mounting position 23 and the fixed anchorage position 31, respectively the first mounting position 27 and second mounting position 29 of the arm 26.

As the drive shaft 12 rotates, the crank 13 rotates and causes the link 18 to move in a manner which is constrained by the positions of the crank 13 and the arm 26. The various positions of the link 18 are illustrated in Figures 2 to 4 for various angular displacements

of the crank 13 caused by either clockwise or anticlockwise rotation, indicated by double headed arrow 32 of the drive shaft 12. It also follows that the position of the load attached to the second mounting position of the 21 of the link 18 is also determined by the position of the crank 13.

Figure 2 illustrates the mechanism 10 in a mid-position, that is the crank 13 can be rotated either clockwise or anticlockwise, indicated by double headed arrow 32. Referring to Figure 3, if the crank 13 is rotated anticlockwise, as indicated by arrow 33, then the second mounting position 21 of the link 18 will move backwardly, as indicated by arrow 34, that is from the left to the right of Figure 3, to a backward position. Referring to Figure 4, if the crank 13 is rotated clockwise, as indicated by arrow 35, then the second mounting position 21 of the link 18 will move forwardly, as indicated by arrow 36, that is from the right to the left of Figure 4, to a forward position.

As can be determined from Figures 3 and 4, the crank 13 is able to rotate through a range of angles greater than ±270°. This angular movement represents a substantial improvement in terms of that achievable using a crank and link arrangement according to the prior art. The improvement in angular movement also provides a greater mechanical advantage between the motor and load.

In Figure 5, wherein like references have been used to indicate similar integers to those illustrated in Figures 1 to 4, there is illustrated a forward position 37, in solid line, a mid-position 38, in dotted line and a backward position 39, in chained line. It should also be noted that the spatial location of the second mounting position 21, and hence the load, not

illustrated, attached thereto, moves approximately horizontally during angular rotation, indicated by arrows 34 and 35, of the crank 13, that is rotational movement between the forward position 37 and the backward position 39. However, this feature is dependent on the choice of the relative dimensions of the crank 13, the link 18 and the arm 26 and also the respective spacing of the mounting positions 14 and 16 of the crank 13, the mounting positions 19, 21 and 23 of the link 18, whose position in turn determines the angle ϕ between the two limbs 24, 25 of the link 18, and the mounting positions 27 and 29 of the arm 26.

A mechanism 10, as described, can be used as part of an active stick controller for use in an aircraft. Whereas, conventional aircraft utilise one or more control sticks with mechanical linkages to operate various control surfaces of the aircraft, in a fly by wire aircraft the mechanical linkages are implemented electronically using wire connections and actuators. An active stick controller not only provides a suitable electrical interface with the wire connections of a fly by wire aircraft, it also embodies a means of controlling the force and position characteristics using the motor 11 of the mechanism 10. That is force, generated by the motor 11, can be used to provide a user with feedback.

When the mechanism 10 is to be used as an active stick controller then the user, usually the pilot, will apply a load at the second mounting position 21 of the link 18. This load is sensed by one or more force sensors, not illustrate, installed at appropriate positions between a stick, attached to the link 18 at mounting position 21, and the link 18. The motor 11 is controlled in such a manner to position the link 18 between the forward and backward positions 37, 39, indicated in Figures 4 and 3 respectively, to provide the desired force feel

characteristic thereby providing the pilot with a feeling of the movement of the aircraft.

It will be noted that proper control of the force feel characteristic of the active stick controller via the motor 10, according to one or more sensors monitoring the motion of the aircraft, will provide the pilot with feedback via the stick which will feel substantially the same as that provided by a conventional stick.

Although the invention has been described and is predominantly intended for use part of an active stick controller, it will be understood that such an active stick controller can also be utilised in other environments, for example manual controls provided for trains, ships, space craft and other applications requiring the manipulation of a load by a user such as cranes, chemical or other engineering control systems. It will be understood that the incorporation of the invention allows a high level of integrity to be achieved by removal of the need for a geartrain system.

CLAIMS

1. An articulated linkage mechanism, comprising

a motor arranged to produce a torque force on its drive shaft,

a crank mounted to the drive shaft at a first mounting position,

a link pivotally attached at a first mounting position to a second mounting position of the crank and at a second mounting position attachable to a load, the link having an intermediate pivot mounting position between its first and second mounting positions, and

an arm pivotally attached at a first mounting position to the intermediate pivot mounting position and pivotally attached at a second mounting position to an anchorage position fixed relative to the first mounting position of the crank.

2. An articulated linkage mechanism, as in Claim 1, wherein the link is constituted by first and second limbs either side of the intermediate pivot mounting position and the first and second limbs are disposed angularly with respect to one another.

3. An articulated linkage mechanism, as in Claims 1 or 2, wherein the dimensions of the crank, the link, the arm and the respective mounting positions of the crank, the link and the arm are arranged such that the second mounting position of the link that is attachable to the load describes a substantially straight line during movement of the drive shaft of the motor.

4. An articulated linkage mechanism, as in any preceding claim, wherein the motor is

a torque motor.

5. An articulated linkage mechanism, as in any preceding claim, arranged to form part of an active stick controller.

6. An articulated linkage mechanism, as in Claim 5, wherein the active stick controller is arranged for use in an aircraft cockpit.

7. An articulated linkage mechanism substantially as illustrated in and/or described with reference to the accompanying drawings.

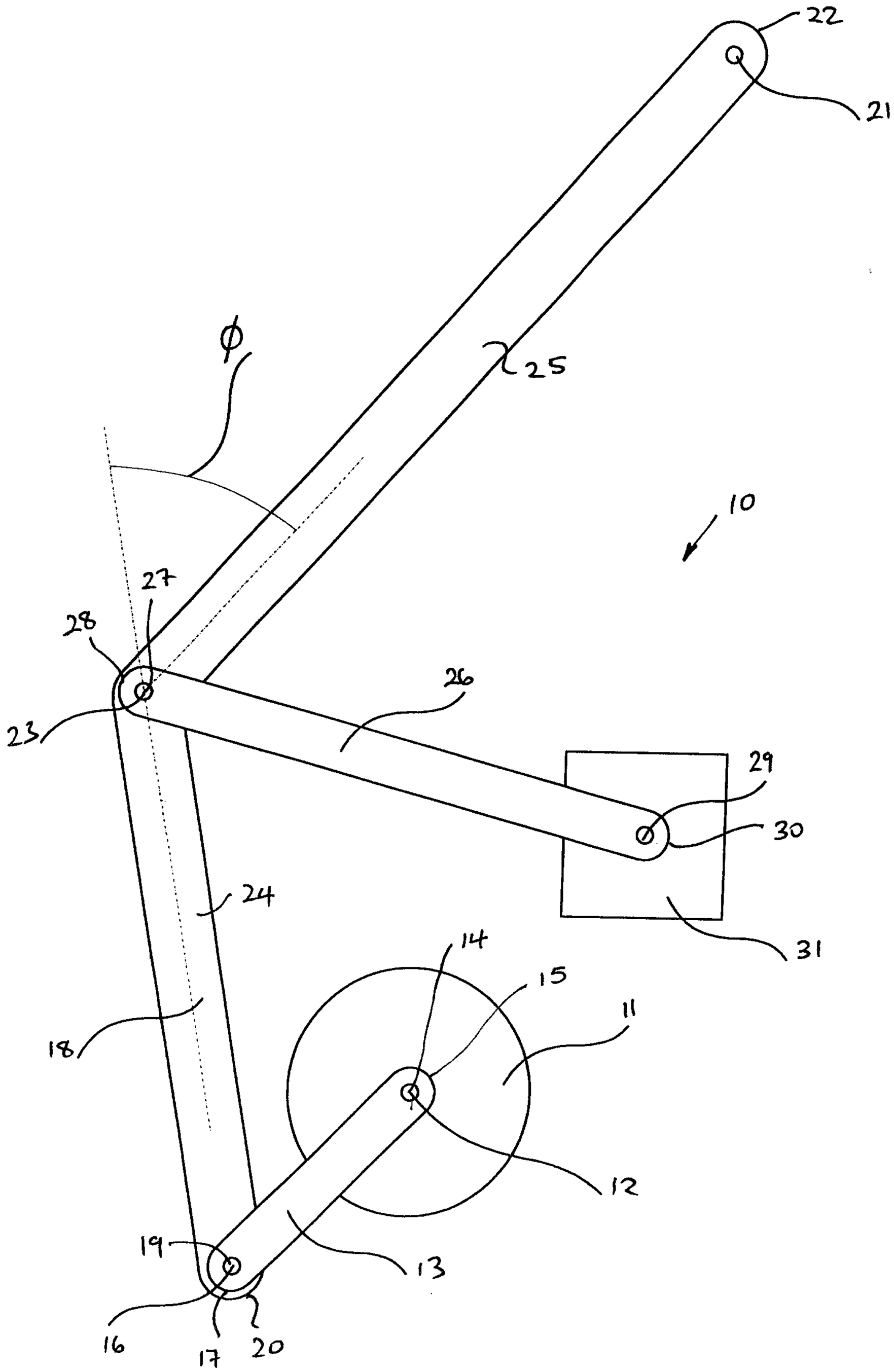


Fig.1.

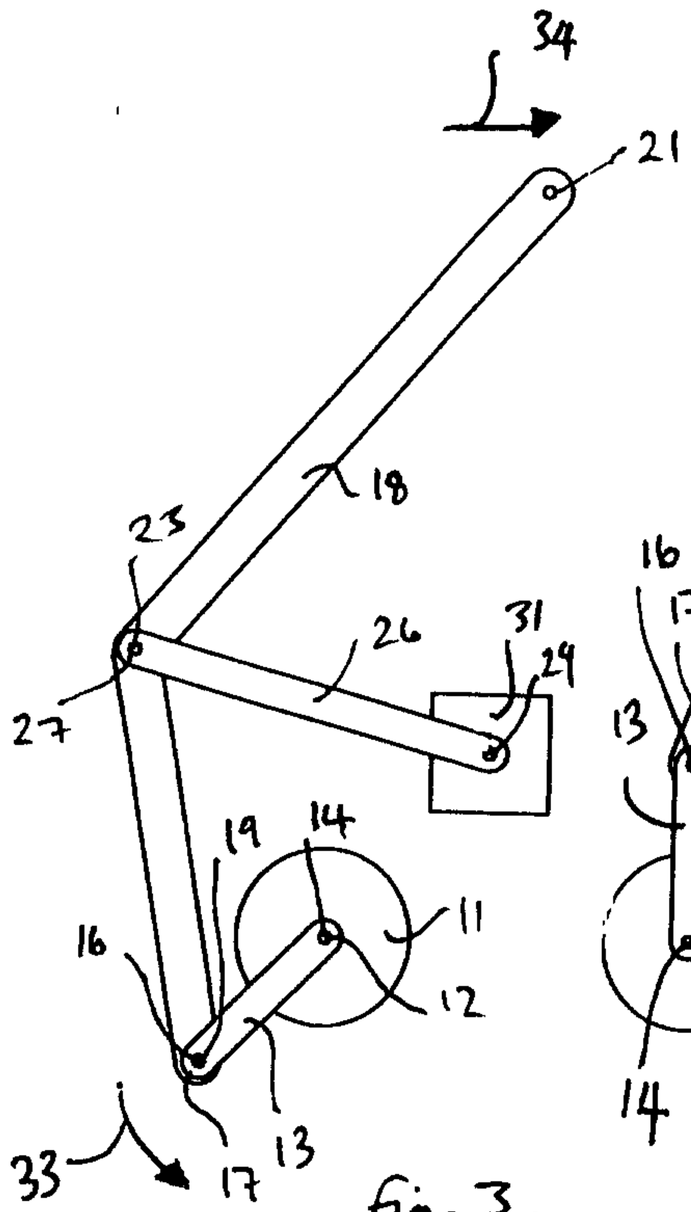


Fig. 3.

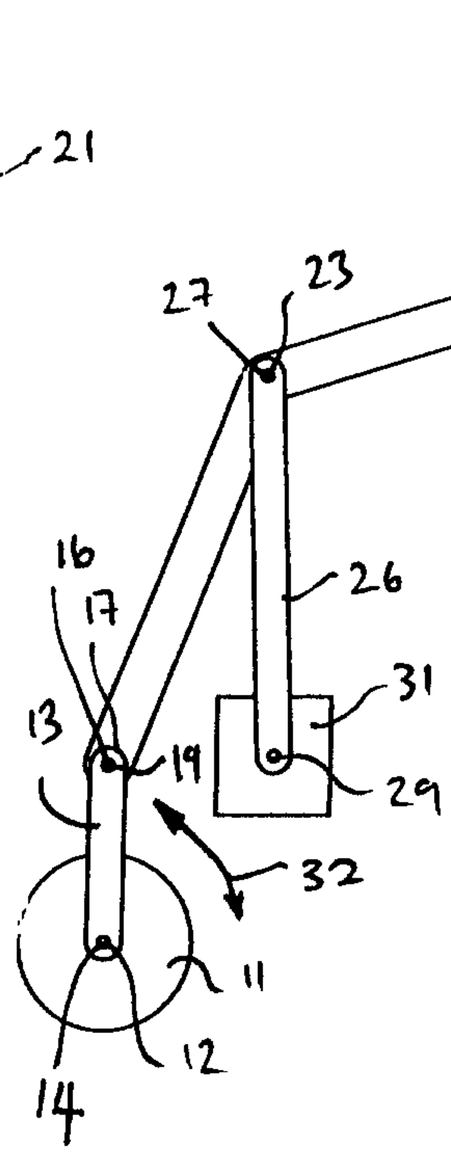


Fig. 2.

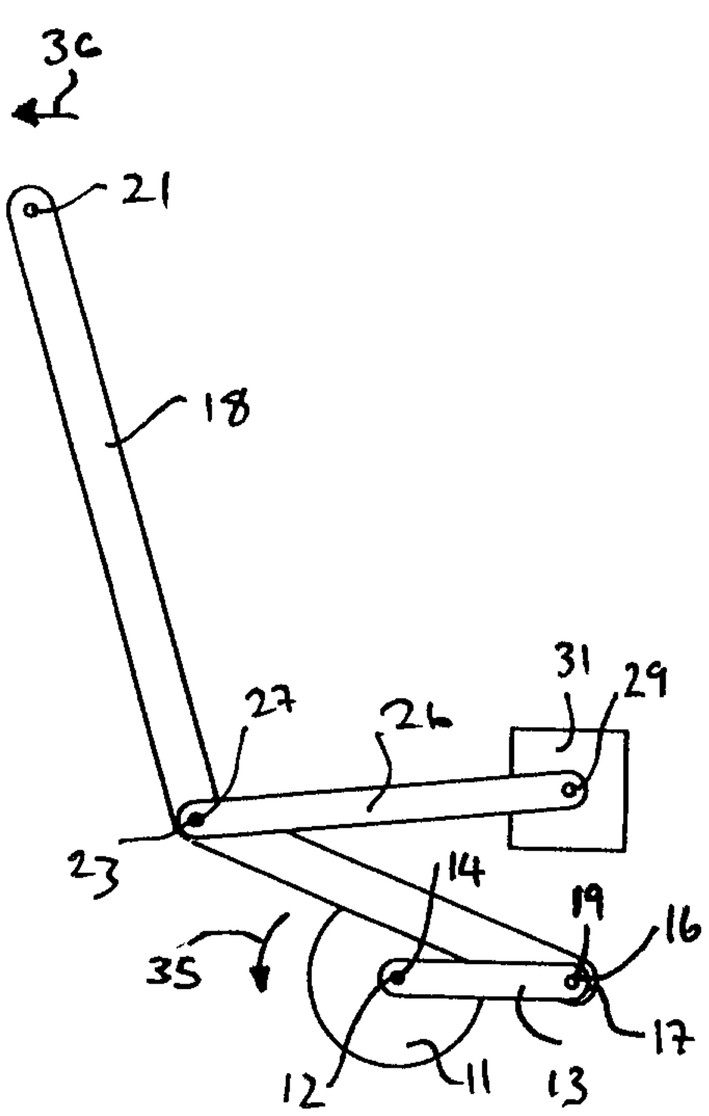


Fig. 4

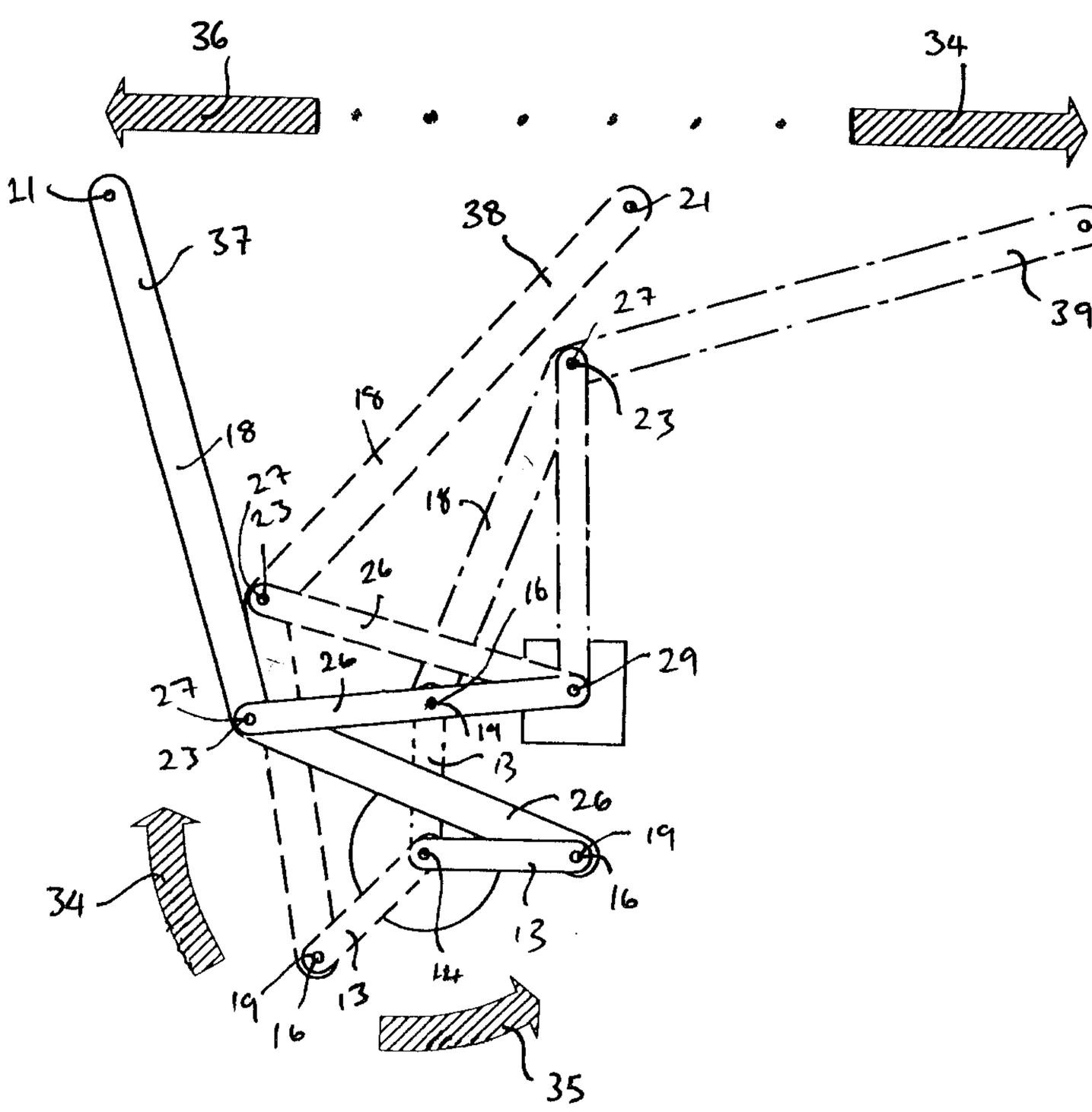
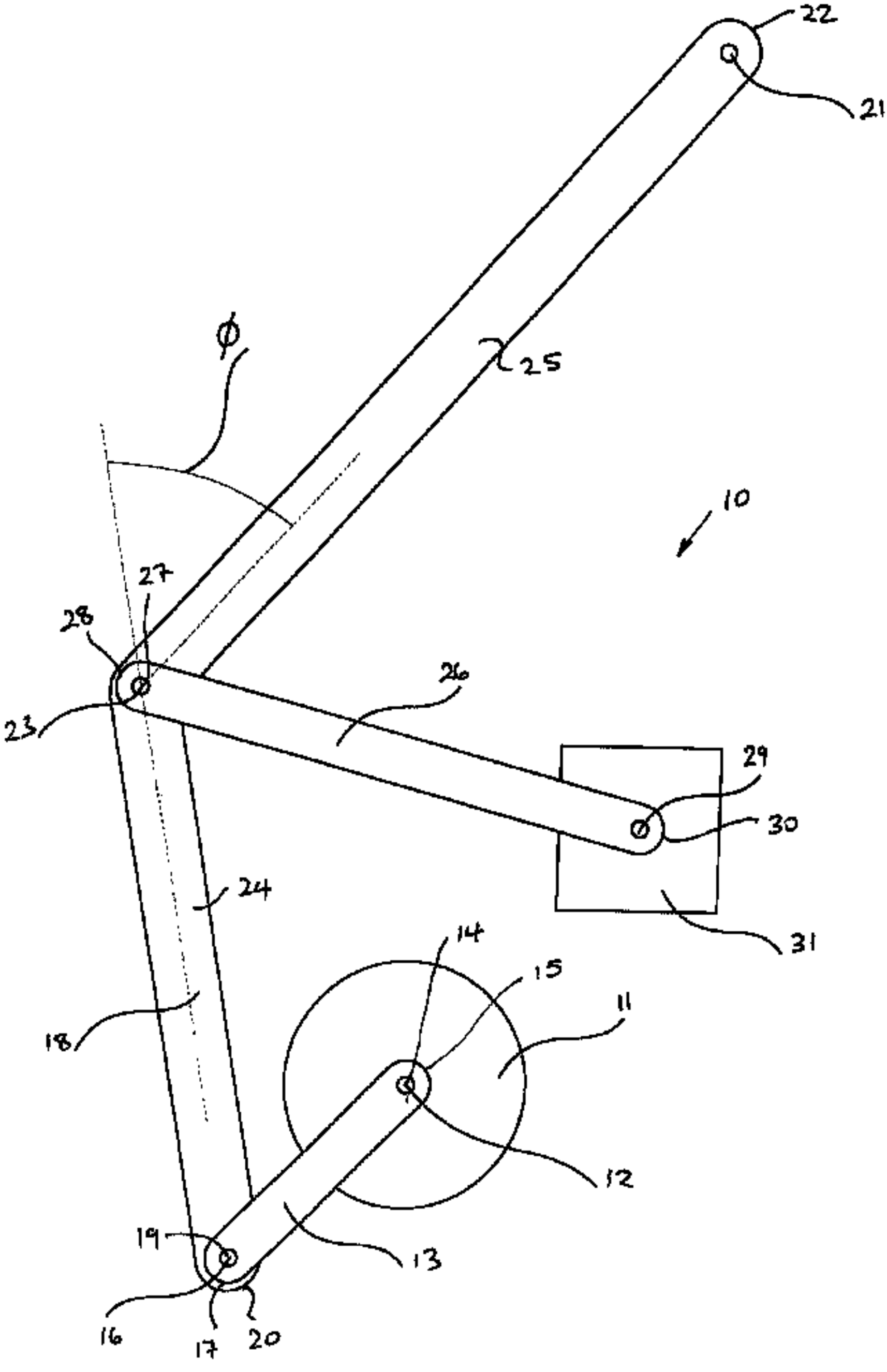


Fig.5.


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