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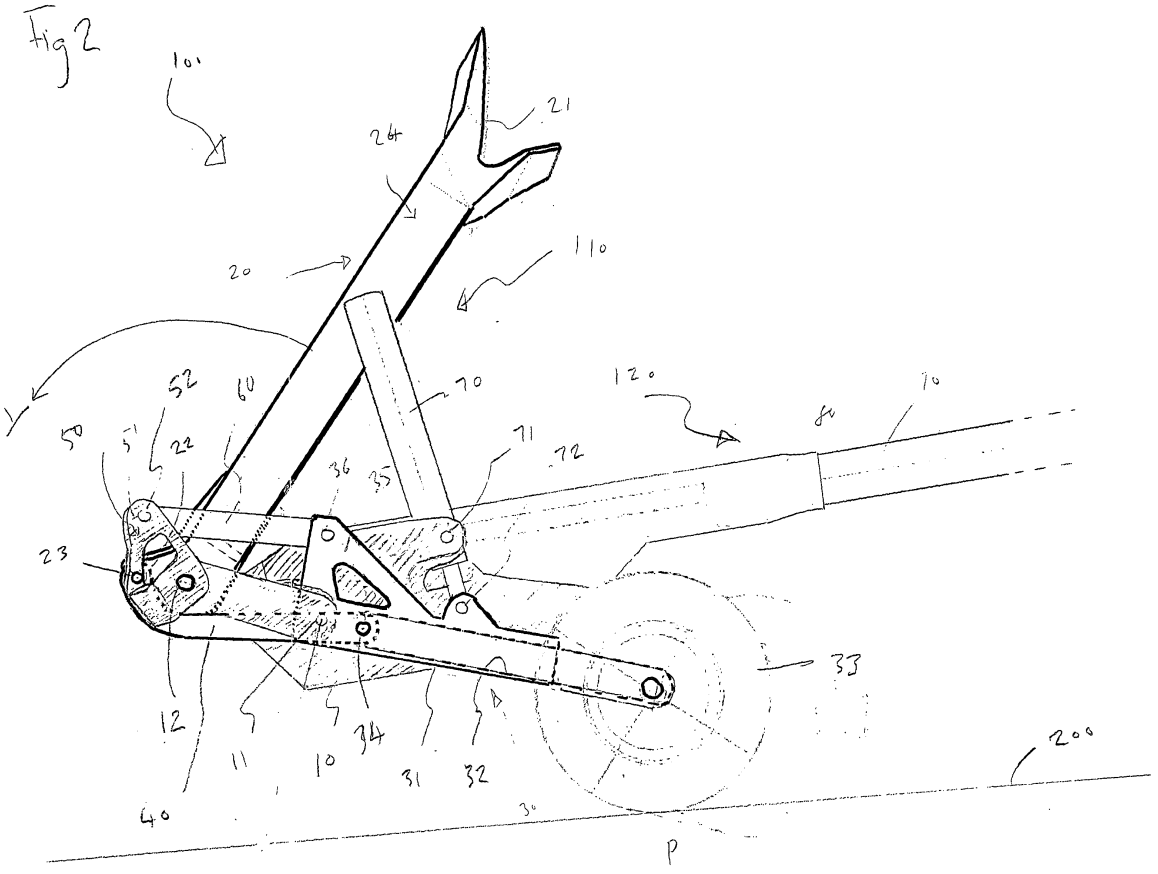
(54) Field gun carriage

(57) There is disclosed a field gun (100) that may be converted between a firing condition and a travelling condition. In the firing condition, front legs (30) and back legs (20) rest on the ground and support the gun. In the travelling condition, the back legs (20) are out of contact with the ground and the front legs (30) are retracted towards the gun chassis. To facilitate conversion, a link (40,60) joins a front leg (30) to a back leg (20) so that as the back leg (30) is lifted off the ground, the front leg (20) is retracted.



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Description

[0001] The following invention relates to a carriage for a field gun, the field gun being convertible between a travelling condition and a firing condition.

[0002] In a firing condition, a field gun generally has a structure that should withstand the forces encountered during the firing of a projectile from the gun barrel. Such forces include: the recoil force which is exerted on the gun as the gun reacts against the firing of the projectile; and the counter-recoil force which succeeds the recoil force, occurring as the elastic strain energy, stored by the gun over the course of the recoil force, is released. The gun should also be capable of counteracting any tipping moments whilst in the firing position. In order to withstand the forces and counteract the moments, field guns in firing conditions are generally securely engaged with the ground.

[0003] In a travelling condition, a field gun should be easy to tow by a propulsion device, for example a truck. Therefore, in the travelling condition, the field gun should be able to move freely relative to the ground.

[0004] Thus, in general, the requirements for a firing structure and a travelling structure are in conflict and so a single condition of the field gun does not tend to be satisfactory in providing a stable base for firing and a freely moving platform for towing.

[0005] It is known to have a field gun carriage that has both a firing condition and a travelling condition.

[0006] 155mm calibre field guns such as the M777 lightweight howitzer and the FH-70 howitzer have therefore been provided with components which can be relocated between a firing configuration and a travelling configuration.

[0007] By manipulating each and every one of these components between their firing configuration and travelling configuration the field gun as a whole can be converted between a firing condition and a travelling condition. Manipulation is generally undertaken manually by a field gun crew.

[0008] However, the process of manipulating the components can be time consuming because in general each component must be individually manipulated so as to effect its relocation.

[0009] Further, the manipulation of some components requires considerable manpower and so crews for manning the gun must be carefully selected and/or sufficiently large.

[0010] Still further, the manipulation of some components can be dangerous to the crew, particularly if the component is heavy and able to fall undamped under its own weight as it relocates between the firing and travelling configuration.

[0011] Each of these factors tends to contribute to the time it takes to convert the gun between conditions. It is desirable to minimise this conversion time so that the gun can be deployed into action as quickly as possible. In the situation where the gun is to be fired and moved and fired again, for example for strategic battlefield reasons, a gun that tends to be quick to deploy is implicitly a gun that can achieve a higher firing rate.

[0012] It is an object of the present invention to provide a field gun carriage that tends to be easily deployable and/or mitigates the above disadvantages of known convertible field guns.

[0013] Accordingly there is provided a carriage for a field gun, the field gun being convertible between a travelling condition and a firing condition, the carriage comprising:

a first component for occupying a first traveiiing configuration when the gun is in the travelling condition, and for occupying a first firing configuration when the gun is in the firing condition;

a second component for occupying a second travelling configuration when the gun is in the travelling condition, and for occupying a second firing configuration when the gun is in the firing condition; and

a link connecting the first and second component,

wherein a manipulation of the first component from the first travelling configuration to the first firing configuration actuates a relocation of the second component between the second travelling configuration and the second firing configuration.

[0014] Advantageously, such a carriage can be converted between conditions quicker than a carriage having only independently manipulated components. This means that the gun can be redeployed, so as to be ready to fire, in less time. This increases the rate at which the field gun can fire from a plurality of positions and thus offers a tactical advantage on the battlefield

[0015] Preferably the first component is rotatable about a pivot axis and the manipulation of the first component is a rotation about the pivot axis. It is further preferable that the first component has an elongate form so as to present a substantial moment arm extending from the pivot axis.

[0016] Beneficially, the rotatable elongate form allows an operator to apply a greater force to the second component for the same amount of work done to the back leg. Thus, if the second component requires a substantial force to relocate it, it can be more easily relocated.

[0017] Preferably the second component is extensible and the relocation of the second component is a linear extension or retraction

such a relocation will require a substantial force if the extension lifts the gun and beneficially, the use of the moment arm will facilitate this mode of relocation.

[0018] Preferably the first component is a structural member suitable for resting on a ground plane in the firing condition, the first component resting on the ground plane at a back ground contact point. In further preference, the second component is a structural member suitable for

forming a base whereby the field gun may rest on a ground plane in the firing condition, the second component resting on the ground plane at a front ground contact point.

[0019] Forces from the firing of the projectile will therefore be transmitted through the components if they rest on the ground. For a component to be suitable for resting on the ground, it must therefore be sufficiently strong so as to avoid failing under the firing forces.

[0020] Preferably the carriage defines a pitch, the pitch being a distance between the forward ground contact point and the back ground contact point when the gun is in the firing condition, the carriage further comprising:

a central body for mounting a gun cradle on;
a back joint connecting the central body to the back leg, such that as the central body rotates about the pivot axis at the back joint, the elevation of the gun cradle varies;
a front joint connecting the central body to the second component,

wherein the link connects the first component and second component such that as the elevation of the gun varies, the second component relocates to tend to maintain the pitch.

[0021] Beneficially this prevents the pitch from reducing and so the counter topple performance of the gun does not deteriorate with differing aim elevations. Further, because this happens automatically, no time need be spent by the crew maintaining the pitch through manual adjustments.

[0022] Preferably the first component is a back leg which in the first travelling configuration is disengaged from the ground plane

[0023] Since it is generally a necessary stage in the conversion of a field gun to disengage a back leg from the ground (e.g. because the back end of the back leg has become embedded in the ground), the back leg will be a focus of attention for the operating crew's manpower. By saving the operating crew from attending to other parts of the field gun (e.g. the front leg), the gun can be converted quicker.

[0024] Preferably the second component is a retractable front leg comprising a wheel for contacting the ground plane at a forward ground contact point such that when the front leg is retracted into the carriage, the retractable front leg is in the second travelling configuration

[0025] Advantageously, when converting from the travelling condition to the firing condition, the front leg extends. Therefore the pitch is increased relative to an unextended equivalent front leg. Thus the gun is better suited to withstanding toppling moments.

[0026] It is likely that the manipulation of the first component is effected in part by the gravitational potential of the first component in which case it is preferable that the link is damped so as to dissipate the gravitational potential and effect a controlled manipulation.

[0027] For example, the back leg of a field gun that is pivoted at one end and rotated through approximately 180 degrees will tend to fall in all situations other than when the centre of gravity of the leg is held vertically over the pivot. If such a back leg were dropped from a position just off vertical, then it could cause considerable damage to any operator who was positioned between the leg and the ground if its motion was not damped. Damping, e.g. of the rotation of the back leg, makes the gun safer to convert because it reduces the speed at which the back leg rotates.

[0028] Optionally, the carriage is provided with a third component for occupying a third travelling configuration when the gun is in the travelling condition, and for occupying a third firing configuration when the gun is in the firing condition,
wherein the actuator is connected to the third component such that a manipulation of the first component from the first travelling configuration to the first firing configuration actuates a relocation of the third component between the third travelling configuration and the third firing configuration. In particular, it is preferable that the third component is an additional front leg.

[0029] Such an arrangement allows both the second and third components can be actuated by a single manipulation of the first component. This can be beneficial where the components are light enough to be manipulated by the manpower which is able to access the component. Thus the conversion is accelerated.

[0030] In an alternative option there is provided a third component for occupying a third travelling configuration when the gun is in the travelling condition, and for occupying a third firing configuration when the gun is in the firing condition, and a fourth component for occupying a fourth travelling configuration when the gun is in the travelling condition, and for occupying a fourth firing configuration when the gun is in the firing condition wherein the link is connected to the fourth component such that a manipulation of the fourth component from the first travelling configuration to the fourth firing configuration actuates a relocation of the third component between the third travelling configuration and the third firing configuration. It is particularly preferred that the fourth component is an additional back leg and the third component is an additional second front leg.

[0031] This allows actuation by simultaneous movement of two components; in particular two back legs are moved to actuate two front legs. This type of actuation can be beneficial in situations where there is likely to be an abundance of manpower but limited space for the manpower to access a single component.

[0032] An embodiment of the carriage, as incorporated into a field gun, will now be described by way of example and with reference to the following figures of which:

Figure 1 shows a field gun in the firing condition; and

Figure 2 shows a field gun in the travelling condition.

[0033] Throughout the specification, references to 'front' or 'back' or 'forwards' or 'backwards' are to be interpreted in the accepted meaning of the art. For example, when the gun is in the firing condition, a component that is generally closer to the muzzle of the barrel than another component, is construed as being forwards of the other component.

[0034] Throughout the specification, references to 'up' or 'down' or 'upwards' or 'downwards' are to be interpreted in the accepted meaning of the art. For example, when the gun is in the firing condition and deployed on a ground plane, a component that is generally closer to the ground plane than another component, is construed as being downwards of the other component.

[0035] Referring to the figures, a field gun 100 comprises a carriage 110 and a cannon 120. The carriage 100 rests on a ground plane 200 and supports the cannon 120.

[0036] The cannon 120 comprises a cradle 80 and a barrel 90. The barrel 90 is able to slide within the cradle 80, along the axis of the barrel, so that it may react to recoil forces and counter-recoil forces in a manner that tends to reduce the stress on components. The cradle 80 also provides the interface between the cannon 120 and the carriage 110: a bearing (not shown) connects a lower portion of the cradle 80 to a central body 10 of the carriage 110.

[0037] The carriage 110 comprises the central body 10, a back leg 20, a front leg 30, a link 40, an ear 50, a pantograph link 60 and a linear actuator 70.

[0038] The central body 10 is pivotally connected to the back leg 20 at a back joint 12 that allows the back leg 20 to rotate (e.g. X or Y) relative to the central body 10 about a pivot axis (which is not shown, but extends from the back joint 12 in a direction generally perpendicular to the page). The ear comprises an ear lug 51 that extends upwards from the back joint 12.

[0039] The back leg 20 extends from the back joint 12 in two generally opposite directions. The substantial majority of the back leg 20 extends in a first direction and has a portion 24 with elongate form. This elongate form terminates at the back end of the back leg 20 where the back leg 20 has the form of a spade 21. The spade 21 contacts the ground at a back contact point Q when the gun is in the firing condition.

[0040] A lesser portion of the back leg 20 extends in a second direction to form a lever 22 that has formed in it an arcuate recess. Further, the lever 22 is pivotally connected at a lever pivot 23 to the back end of the link 40.

[0041] Back leg 20 also comprises a tenon (not shown) that interlocks with a mortise (not shown) formed in the ear 50 when the back leg 20 is fully relocated to its firing configuration. Thus the back leg 20 and the ear 50 are rigidly connected when the gun 100 is in the firing condition.

[0042] The ear 50 is pivotally mounted at back joint 12 and extends upwards to form an ear lug 51 which is pivotally connected to the pantograph 60 at ear lug pivot 52.

[0043] When in the firing condition the lever joint 23 is forwards of the back joint 12 but when in the travelling position the lever joint 23 is backwards of the back joint 12.

[0044] Also pivotally connected to the central body 10 is the front leg 30. The pivotal connection between the central body 10 and the front leg 30 occurs at a front joint 11 and allows relative rotation between body 10 and leg 30. The front joint 11 is positioned on the central body 10 and forwards of the back joint 12.

[0045] The front leg 30 comprises a sleeve 31, an arm 32 and a wheel 33. The arm 32 slides within the sleeve 31 thereby allowing the front arm 30 to retract or extend. The wheel 33 is for contacting the ground at a front contact point P, and is rotatably mounted on a bearing 37at the front end of the arm 32.

[0046] The sleeve 31 forms, at a front joint 11, the connection between the central body 10 and the front leg 30. The sleeve 31 comprises a lug 35 that extends upwards from the front joint 11, and comprises at sleeve pivot 72 a connection to the linear actuator 70. The sleeve pivot 72 is forward of the front joint 11.

[0047] The arm 32 is connected at is back end to a front end of the link 40 by way of an arm pivot 34. A slot (not shown) is provided in the sleeve 31 so that the link 40 can extend from the arm pivot 34, out of the sleeve 31 and towards the back leg 20.

[0048] The back end of the link 40 is curved: firstly so as to fit into the reciprocal arcuate recess in the back leg lever 22 when the gun is in the travelling configuration; and secondly to avoid obstruction of the front joint 11 when in the firing configuration.

[0049] The pantograph link 60 connects the ear lug 51 and the sleeve lug 35 at the respective pivot joints 52 and 36.

[0050] The linear actuator 70 is pivotally connected at one end of the sleeve 31 by means of the sleeve pivot 72, and also pivotally connected to the central body 10 by means of pivot joint 71.

[0051] For the sake of clarity the figures show only one side of the carriage 110, for example only a single back leg 20 and a single front leg 30 are visible. However, the field gun 100 has a far side which is provided with equivalent carriage components to those described and illustrated (excepting the central body 10 of which there is only one).

[0052] Thus the field gun carriage 110 is generally symmetrical, having a front leg and back leg pair each having a distinct link for connecting the front leg to the respective back leg

[0053] In operation, the aforementioned arrangement of components allows the front leg 30 of the field gun 100 to be converted from the firing condition to the travelling condition by manipulating the back leg 20.

[0054] When the gun 100 is in the firing condition as shown in Figure 1, a conversion can be effected by rotating the back leg 20 about the back joint 12 so as to relocate the front leg 30.

[0055] This rotation can be undertaken manually by a crew of operators. The back leg is particularly suitable for such manipulation because it is arranged in a readily accessible position and moreover because the proportions of the leg 20 (especially the elongate portion 24) mean that there is a considerable moment arm from the back end of the leg 20 to the back joint 12.

[0056] Prior to converting the gun from the firing condition to the travelling condition it may be necessary to extract the spade 21 from an embedded position in the ground. If it is not possible for the crew alone to extract the spade, then the extraction may be done by pulling the gun 100 at the muzzle of the barrel 90 with a propulsion means. Once the spade 21 is sufficiently detached from the ground so that crew members may lift the back leg 20, the conversion may commence.

[0057] During the conversion from the firing arrangement of figure 1, as the back leg 20 is rotated in a clockwise direction X about pivot joint 12, the back end of the link 40 also rotates clockwise about pivot joint 12 because it is connected to the lever 22 of leg 20 at lever joint 23.

[0058] As the back end of the link 40 rotates clockwise about joint 12, link 40 is drawn generally backwards.

[0059] As the link 40 is drawn backwards, the arm 32 which is connected at the joint 34 to the front end of the link 40 is retracted into the sleeve 31. The link 40 is generally in tension throughout this operation.

[0060] As the back leg 20 is fully rotated to reach the travelling configuration, occupying a position over the central body 10, the arm 32 simultaneously reaches the fully retracted position and thus the gun 100 is in the travelling condition, as depicted in Figure 2.

[0061] Conversely, when the gun 100 is in the travelling condition as shown in figure 2, it can be converted to the firing condition by rotating the back leg 20 about back joint 12 in an anticlockwise direction Y.

[0062] As back leg 20 is rotated from its travelling configuration to its firing configuration, the actuator 40 is placed under a generally compressive load which tends to push arm 32 out of sleeve 31 thus extending front leg 30 and thereby relocating the front leg 30 between the travelling and firing condition.

[0063] In order to push arm 32 out of sleeve 31, any associated resistance forces at the interface of these components (e.g. friction) must be overcome.

[0064] When the back leg 20 reaches a point where it may fall under its own weight (which is generally the case whenever the back leg is neither resting nor vertical) these resistance forces can advantageously tend to dampen the motion of the back leg 20 left to rotate under its own weight.

[0065] Thus, the sleeve 31 and arm 32 are interfaced so as to provide damping to back leg 20.

[0066] Without such damping forces, the back leg 20 might fall into the firing configuration at a speed that was dangerous to nearby crew.

[0067] In the firing condition, a further operational effect of the carriage 110 is as follows.

[0068] When the cannon 120 is being elevated so as to aim the gun 100, the aim being effected by the extension of the linear actuator 70, the arrangement of the ear lug 51, pantograph 60 and sleeve lug 35 is such that in the absence of the link 40, there is a tendency for the pitch, i.e. the distance between front and back ground contact points P and Q, to reduce. This is disadvantageous because the reduced pitch is less stable particularly with regard to counteracting counter recoil tipping moments.

[0069] However, the link 40 connecting the lever 22 of the back leg 20 to the arm 32 of the front leg 30, automatically extends the front leg 30 as the body 10 rotates. This automatic extension as a result of barrel elevation tends to maintain the pitch.

[0070] In general, the muzzle of the gun barrel 90 will need to be supported for both conversion operations. Otherwise the central body 10 would tend to fall to the ground as back leg 20 was rotated in direction X. However, because the gun may be towed from the muzzle, this support can be easily provided by a towing pintle (or other towing attachment means) of a propulsion vehicle such as a truck. In the absence of a propulsion vehicle, should the need to convert the gun arise, some of the operating crew may provide the required support at the muzzle.

[0071] A variant form of the field gun 100 occurs if a single link connects a single back leg to two front legs and accordingly effects the relocation of said front legs.

[0072] In the above embodiment, the link 40 is a generally rigid member made from a single piece of material having suitable properties in compression and tension.

[0073] As an alternative to the above embodiment, the link 40 may comprise a an actuator such as a hydraulic piston. The provision of an actuator within the link could enable a greater force to be applied to rotate the back leg 20 and effect the conversion. This would be likely to allow the back leg 20 to be extracted from the ground 200 more easily as might be required if the spade is otherwise held fast in the ground.

[0074] The field gun may be made out of any materials known in the art to be suitable. Various steel alloys, titanium alloys and composite materials may be suitable depending on the in service requirement.

[0075] Whilst the example described above may relate to a 155 mm calibre field gun, the invention is not intended to be limited to a particular calibre. The invention could, for example, be embodied in a 105 mm calibre field gun.

Claims

1. A carriage for a field gun, the field gun being convertible between a travelling condition and a firing condition, the carriage comprising:

   a first component for occupying a first travelling configuration when the gun is in the travelling

condition, and for occupying a first firing configuration when the gun is in the firing condition;
a second component for occupying a second travelling configuration when the gun is in the travelling condition, and for occupying a second firing configuration when the gun is in the firing condition; and
a link connecting the first and second component,

wherein a manipulation of the first component from the first travelling configuration to the first firing configuration actuates a relocation of the second component between the second travelling configuration and the second firing configuration.

2. A carriage according to claim 1 wherein the first component is rotatable about a pivot axis and the manipulation of the first component is a rotation about the pivot axis.

3. a carriage according to claim 2 wherein the first component has an elongate form so as to present a substantial moment arm extending from the pivot axis.

4. A carriage according to any one of the preceding claims wherein the second component is extensible and the relocation of the second component is a linear extension or retraction.

5. A carriage according to any one of the preceding claims wherein the first component is a structural member suitable for resting on a ground plane in the firing condition, the first component resting on the ground plane at a back ground contact point.

6. A carriage according to claim 5 wherein the second component is a structural member suitable for forming a base whereby the field gun may rest on a ground plane in the firing condition, the second component resting on the ground plane at a front ground contact point.

7. A carriage according to claim 6, the carriage defining a pitch, the pitch being a distance between the forward ground contact point and the back ground contact point when the gun is in the firing condition, the carriage further comprising:

a central body for mounting a gun cradle on;
a back joint connecting the central body to the back leg, such that as the central body rotates about the pivot axis at the back joint, the elevation of the gun cradle varies; and
a front joint connecting the central body to the second component,

wherein the link connects the first component and second component such that as the elevation of the gun varies, the second component relocates to tend to maintain the pitch.

8. A carriage according to any one of the preceding claims wherein the first component is a back leg which in the first travelling configuration is disengaged from the ground plane.

9. A carriage according to any one of the preceding claims wherein the second component is a retractable front leg comprising a wheel for contacting the ground plane at a forward ground contact point, such that when the front leg is retracted into the carriage, the retractable front leg is in the second travelling configuration.

10. A carriage according to any one of the preceding claims wherein the manipulation of the first component is effected in part by the gravitational potential of the first component and wherein the link is damped so as to dissipate the gravitational potential and effect a controlled manipulation.

11. A carriage according to any one of the preceding claims further comprising:

a third component for occupying a third travelling configuration when the gun is in the travelling condition, and for occupying a third firing configuration when the gun is in the firing condition,

wherein the link is connected to the third component such that a manipulation of the first component from the first travelling configuration to the first firing configuration actuates a relocation of the third component between the third travelling configuration and the third firing configuration.

12. A carriage according to claim 11 wherein the third component is an additional front leg.

13. A carriage according to any one of claims 1-9 further comprising:

a third component for occupying a third travelling configuration when the gun is in the travelling condition, and for occupying a third firing configuration when the gun is in the firing condition; and
a fourth component for occupying a fourth travelling configuration when the gun is in the travelling condition, and for occupying a fourth firing configuration when the gun is in the firing condition,

wherein the link is connected to the fourth component such that a manipulation of the fourth compo-

nent from the first travelling configuration to the fourth firing configuration actuates a relocation of the third component between the third travelling configuration and the third firing configuration.

14. A carriage according to claim 13 wherein the fourth component is an additional back leg and the third component is an additional second front leg.

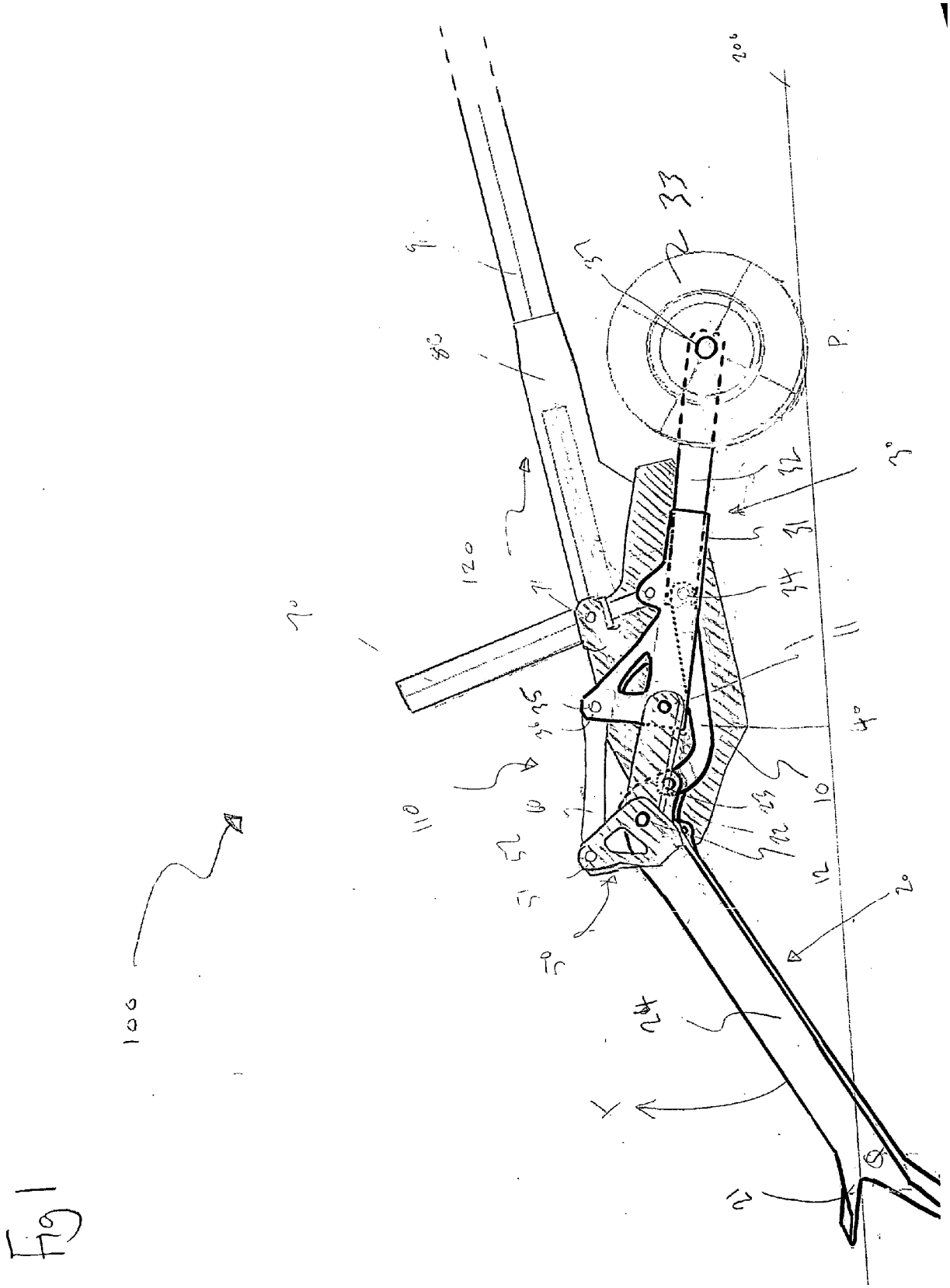

FIG 1

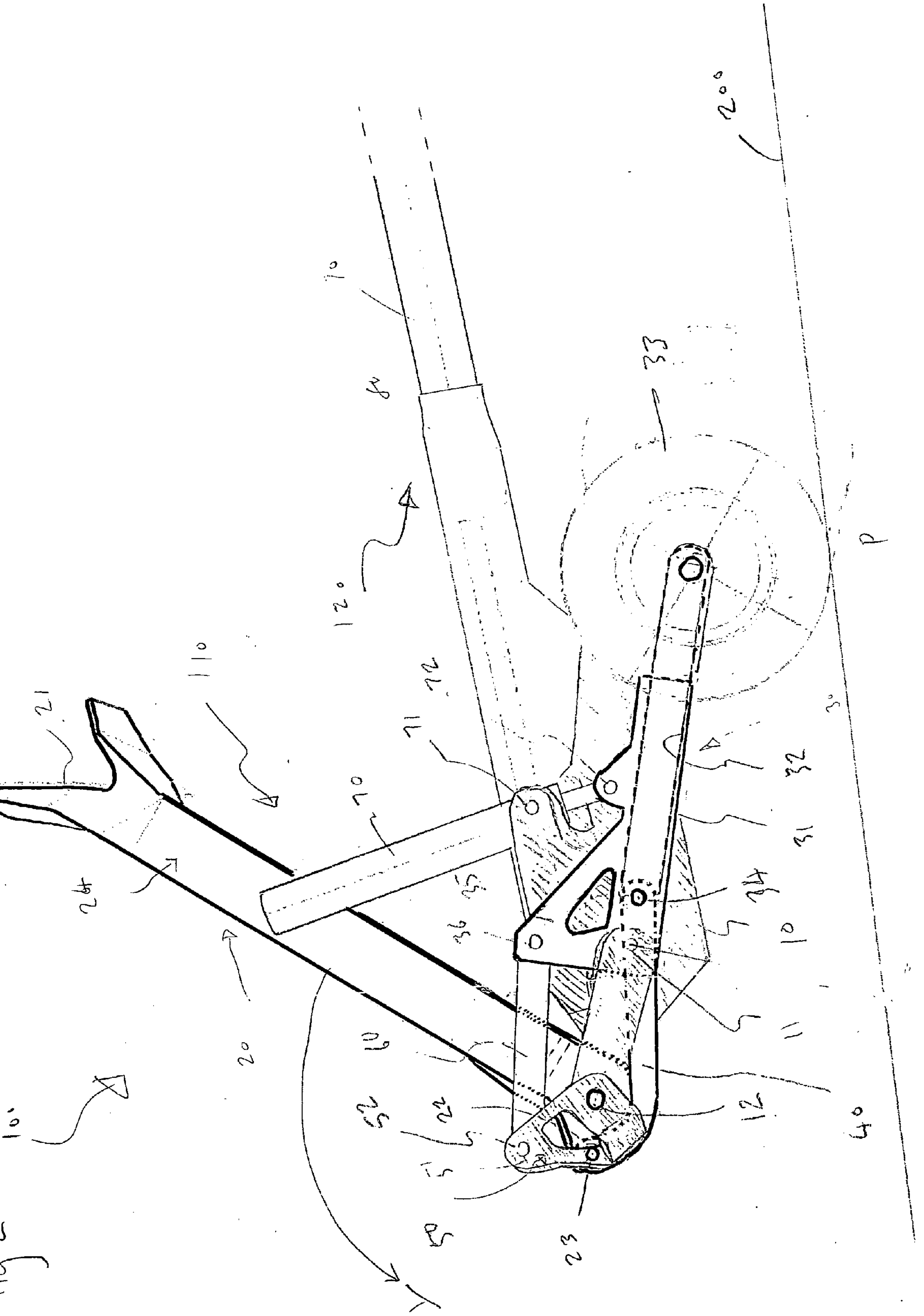

Fig 2

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EUROPEAN SEARCH REPORT

Application Number
EP 08 25 2202

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

F41A

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 December 2008	Schwingel, Dirk

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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1

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 25 2202

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-12-2008

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82