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AIRCRAFT-WHEEL LIFTING DEVICE

The present invention relates to a device for lifting a wheel assembly of an aircraft, particularly but not exclusively a twin nosewheel assembly, for aircraft ground handling purposes.

The present invention particularly aims to provide a device for lifting the nosewheel assembly of an aircraft, which is suitable for use in confined areas, but not exclusively.

In a first aspect, the present invention provides a device for lifting a wheel assembly of an aircraft, particularly but not exclusively a twin nosewheel assembly, for aircraft ground handling purposes, the device comprising first and second wheel support means which are rotatable relative to each other between a first configuration in which a first portion of the circumference of the aircraft wheel can be located against the first support means and a second configuration in which the second support means is brought against a second portion of the circumference of the wheel, opposite the first portion, to cradle the wheel, said first and second wheel support means being raisable and lowerable in the second configuration.

Although the device may be embodied as a self-propelled towing dolly or the like, it is envisaged that the device will constitute part of an aircraft ground handling machine. In a preferred embodiment, therefore, the device also comprises means connectible to a bearing structure or chassis of an aircraft ground handling machine to enable the raising and lowering of the wheel support means and wheel cradled thereby.

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In a second aspect, the present invention provides an aircraft ground handling machine, such as a towing dolly or a tractor, having a device according to the first aspect.

The wheel support means may be constituted by wheel-engaging surfaces and may comprise a fixed support means which defines the first support surface and movable support means which defines the second support surface and is rotatable relative to the fixed support means. The wheel support means may, however, each comprise laterally-disposed and vertically spaced-apart pins which define notional wheel-engaging surfaces but which have the advantages that they have utility irrespective of the diameter of the wheel. The support means may be rotatable relative to each other about an axis which is substantially vertical in the normal condition of use, so that the support means close around the wheel laterally in the manner of a jaw.

In a preferred embodiment, the movable wheel support means rotate relative to the fixed wheel support means about a transverse axis which is substantially horizontal in the normal condition of use, the movable support means being disposed on the same side of the wheel as the fixed support means (that is, adjacent the first portion of the circumference of the wheel) in the first configuration and being swung over the wheel into the second configuration so that, in the second configuration, the movable support means are disposed on the opposite side of the wheel from the fixed support means. Where the wheel support means comprise wheel-engaging surfaces, they are preferably curved surfaces which are concentric or substantially concentric about the said transverse axis, although the wheel support means may as indicated

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above comprise pins; the pins may be carried by side plates for location and rotation purposes relative to the wheel and may be themselves rotatable or may carry rotatable sleeves.

In the preferred embodiment for the lifting of a twin nosewheel assembly, the first support surface of the fixed wheel support means corresponds substantially in width to the overall width of the twin nosewheel and is engageable by the two wheels thereof, and the movable wheel support means comprise two members which are rotatable in unison over respective wheels of the twin nosewheel assembly, on either side of the central nosewheel strut, commonly known as an oleo leg, and each of which defines a respective second support surface portion engageable with the respective wheel in the second configuration.

Preferably, on the first support surface, there are two pressure switches operable by the two wheels of the twin nosewheel to enable the rotation of the movable wheel support means, the pressure switches being in positions such that they can both be operated to enable the rotation of the movable support means only when the twin nosewheel is correctly located against the first support surface. This prevents the movable wheel support means from operating in a misaligned condition of the nosewheel and hence from fouling the nosewheel.

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

Figure 1 is a partially exploded plan view of a device for lifting a wheel of an aircraft, according to one

embodiment of the present invention;

Figure 2 is a side view of the device of Figure 1;

Figure 3 is a plan view of the device in an initial operating condition;

Figures 4 and 5 are a plan view and a side view, respectively, of the device in a subsequent operating condition;

Figures 6 and 7 are a plan view and a side view, respectively, of the device in a further operating condition;

Figure 8 is a side view of the device in yet another operating condition;

Figure 9 is a side view, corresponding to Figure 8, of a variant of the device and

Figure 10 is a plan view, corresponding to Figure 1, of another variant.

With reference now to the drawings, a device for lifting a twin nosewheel of an aircraft comprises a structure, generally indicated 1, which is mounted on chassis members 11 of an aircraft ground handling vehicle (not shown in its entirety) for rotation about a transverse axis X-X which is substantially horizontal in the normal condition of use of the device and which is defined by two main supporting trunnions 2 located within bearing housings 10 on the chassis members 11. A shaft 21 extends coaxially between the two trunnions and two sleeves or collars 6 are fixed to the shaft 21 adjacent

its opposite ends.

One end of a respective side member 7 is fixed to the outer end of each collar 6 and one end of a respective support arm 8 is fixed to the inner end of each collar 6. The side members 7 and the support arms 8 project in the same direction away from the axis X-X and, being fast with the collars 6 which are themselves fixed to the shaft 21, are rotatable together about that axis.

At their free ends, that is, the ends opposite the collars 6, each side member 7 and the two support arms 8 carry respective wheel supports 13, 9. The two support arms 8 together carry a fixed wheel support 9 which extends transversely over a substantial part of the distance between the two side members 7. The side members 7 carry respective movable wheel supports 13 which are attached to support plates 3 which are rotatable, by means of trunnions 5, in respective bearing housings 4 aligned on a common transverse axis Y-Y adjacent the free ends of the side members 7. This latter axis Y-Y is parallel to the axis X-X. The fixed wheel support 9 and the rotatable wheel supports 13 define respective curved support surfaces which are concentric with the axis of rotation Y-Y of the rotatable supports 13.

In use of the device, the device is first aligned with a twin nosewheel unit 12 of an aircraft, as shown in Figure 3, by the manoeuvring of the aircraft ground handling vehicle and the device is then moved towards the nosewheel unit 12 until the two wheels 12A thereof are located in the bifurcated structure formed by the two side members 7 and rest firmly against the curved surface of the fixed wheel support 9, as shown in Figures 4 and

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5. In this condition, the rotatable wheel supports 13 are disposed in a position in which they overlies the fixed wheel support 9, radially outwardly thereof with slight clearance, to permit the support 9 to be placed firmly against the wheels 12A.

When the nosewheel unit 12 is properly positioned against the fixed wheel support 9, the two wheels 12A operate respective pressure sensitive switches or pads 16 on the surface of the fixed wheel support 9 to enable the rotation of the rotatable wheel supports 13, without their interfering with the tyres of the wheels 12A. As shown in broken outline in Figure 4 and in Figures 6 and 7, the wheel supports 13 rotate through an obtuse angle, preferably of about 180°, relative to the fixed wheel support 9, swinging over the wheels 12A on either side of the central strut of the nosewheel unit 12. The rotatable wheel supports 13 thus move from the configuration of Figures 3, 4 and 5, in which the fixed and rotatable wheel supports 9, 13 are disposed on the same side of the nosewheel unit 12, to the configuration of Figure 6 and 7 where the supports 9, 13 are disposed on opposite sides of the wheels, with the curved surfaces of the rotatable supports 13 in engagement with portions of the circumferences of the wheels 12A opposite the portions of the circumferences located against the fixed support 9. In this configuration, the wheels 12A are cradled by the supports 13, 9.

Once the configuration of Figures 6 and 7 has been reached, the device is raised relative to the aircraft handling machine, as shown in Figure 8, to lift the nosewheel unit 12 clear of the ground so that the aircraft, for example a helicopter, can be manoeuvred by the ground handling vehicle. With the nosewheel unit 12

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in the raised position, some of the weight of the aircraft bears on the ground handling vehicle, increasing the friction between the drive wheels of the vehicle and the ground and helping to prevent slippage of those wheels on the ground.

The rotatable wheel supports 13 are rotated by rotary actuators 14, for example of the rack-and-pinion type in which the rack is constituted by the rod of the actuator and the pinion is connected to or formed on the trunnion 5 of the support plate 3. The raising and lowering of the device relative to the ground handling vehicle may be effected by actuators acting, for example, between the chassis members 11 and the shaft 21 but, in an alternative arrangement shown in Figure 9, this raising and lowering may be effected by an actuator 15 attached at A to one of the side members 7 and attached at B to an extension (not shown) of one of the chassis members 11. In order to prevent the device from being raised until the rotatable wheel supports 13 are safely in the configuration of Figures 6 and 7, a microswitch (not shown) or the like, which, when open, disables the actuators for raising the device, may be provided in a position where it can be closed by the supports 13 to enable those actuators only when the supports 13 are in the proper position.

The inner supports 8 may be variable in length by means of hydraulic cylinders so that the fixed wheel support 9 can be moved in a horizontal plane (in the normal condition of use) to compensate for any variation in the diameters of different aircraft nosewheels. Alternatively or in addition, the fixed wheel support 9 may be slidable on the inner supports 8, for example by means of an hydraulic actuator, so that the support 9 can

be moved towards the wheels 12A if necessary to compensate for the gap which may open at the top of the fixed support 9, as shown in Figure 8, and thus to prevent the wheel from dropping slightly when the device is raised. Alternatively or additionally, the supports 13 may be movable relative to plates 3, or the bearing housings 4 may be longitudinally adjustable in the side members 7, in order to maintain the axis Y-Y substantially in common with the axis of the wheels.

In order to provide for greater flexibility of use with aircraft wheels of different diameters, particularly with the ability to vary the spacing between the wheel supports referred to in the preceding paragraph, the curved support surfaces 9, 13 may be replaced with laterally-extending pins or dowels 22, 23, as shown in Figure 10. The pins may be rotatably mounted or may carry rotatable sleeves to prevent any undue chafing against the tyre surface in use.



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CLAIMS

1. A device for lifting a wheel assembly of an aircraft, particularly but not exclusively a twin nosewheel assembly, the device comprising first and second wheel support means which are rotatable relative to each other between a first configuration in which a first portion of the circumference of the aircraft wheel can be located against the first support means and a second configuration in which the second support means is brought against a second portion of the circumference of the wheel, said first and second wheel support means being raisable and lowerable in the second configuration.

2. A device according to claim 1, in which the second portion of the circumference of the wheel is opposite to the first portion of the circumference of the aircraft wheel and which, in use, cradles the wheel.

3. A device according to claim 1 or claim 2 further comprising means connectible to a bearing structure or chassis of an aircraft ground handling machine to enable the raising or lowering of the wheel support means and wheel cradled thereby.

4. A device according to claim 1 or claim 2, in which the device is embodied as a self-propelled towing dolly, a ground handling machine, or the like.

5. An aircraft ground handling machine comprising a device according to claim 1 or claim 2.

6. A device according to any preceding claim, in which the wheel support means are constituted by wheel-engaging surfaces and comprise a fixed support means which defines the first support surface and movable support means which defines the second support surface and is rotatable relative to the fixed support means.

7. A device according to any one claims 1 to 5, in which the wheel support means each comprise laterally-

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disposed and vertically spaced-apart pins or dowels which define notional wheel-engaging surfaces.

8. A device according to any preceding claim, in which the support means are rotatable relative to each other about an axis which is substantially vertical in the normal condition of use so that, in use, the support means close around the wheel laterally in the manner of a jaw.

9. A device according to claim 6, in which the movable wheel support means rotate relative to the fixed wheel support means about a transverse axis which is substantially horizontal in the normal condition of use.

10. A device according to claim 7, in which the wheel support means comprise wheel-engaging surfaces having curved surfaces which are concentric or substantially concentric about said transverse axis.

11. A device according to claim 10, in which the wheel support means comprise pins.

12. A device according to claim 11, in which the pins are carried by side plates for location and rotation purposes relative to the wheel and are themselves rotatable.

13. A device according to claim 11, in which the pins carry rotatable sleeves.

14. A device according to any preceding claim, in which the first support surface of the fixed wheel support means corresponds substantially in width to the overall width of the twin nosewheel and is engagable by the two wheels thereof, and in which the movable wheel support means comprise two members which are rotatable in unison over respective wheels of the twin nosewheel assembly, on either side of the central nosewheel strut, each of which defines a respective second support surface portion engagable with the respective wheel in the second configuration.

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15. A device according to any one of claims 6 to 14, in which on the first support surface there are two pressure switches operable by the two wheels of the twin nosewheel to enable the rotation of the movable wheel support means, the pressure switch is being in position such that they are operable to enable the rotation of the moveable support means only when the twin nosewheel is correctly located against the first support surface.

16. A device according to any preceding claim, in which the two wheels thereof are located in a bifurcated structure formed by two side members of the device.

17. A device according to claim 8 in which the rotatable wheel support means are rotated by rotary actuators.

18. A device according to claim 17, in which the rotary actuators are of the rack-and-pinion type.

19. A device according to any preceding claim, the raising and lowering of the device relative to the ground handling vehicle is effected by actuators between the chassis members and the shaft.

20. A device according to any one of claims 1 to 18, in which the device is raised and lowered by means of at least one actuator, each actuator being attached to one side member and to an extension of one of the chassis members.

21. A device according to claim 20, in which the actuators comprise fluid-operated cylinders.

22. A device according to any one of claims 17 to 21, in which a microswitch disables the actuators for raising the device and enables those actuators to operate only when the supports are in the correct position.

23. A device according to any preceding claim, in which the device further comprises inner supports which are variable in length and moveable in a horizontal plane which, in use, compensate for any variation in the





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diameters of different aircraft nosewheels.

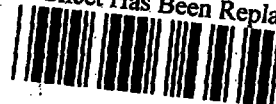
24. A device according to claim 23, in which the inner supports comprise hydraulic cylinders.

25. A device according to claim 23, in which the fixed wheel support is slidable on the inner supports so that, in use, the support can be moved towards the wheels to compensate for any gap which may arise at the top of the fixed support.

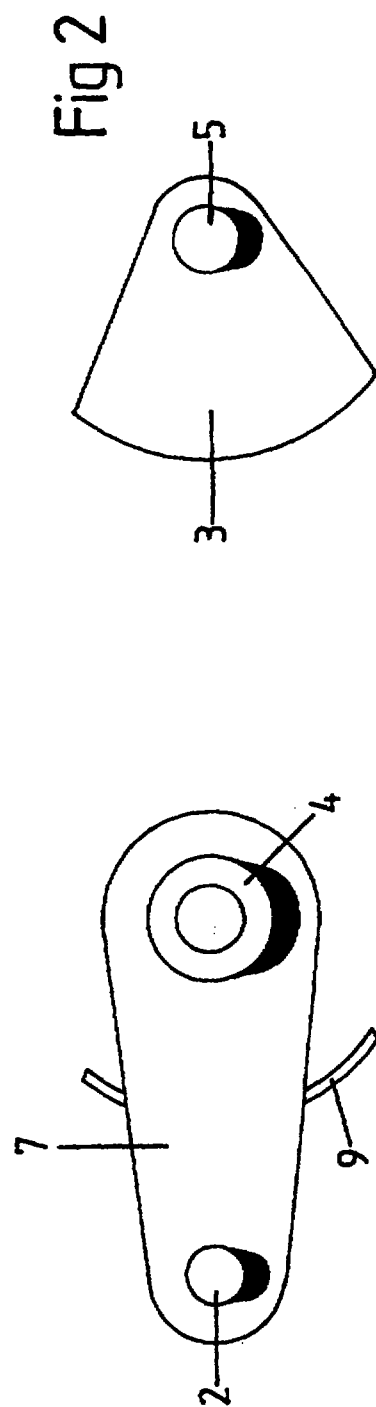
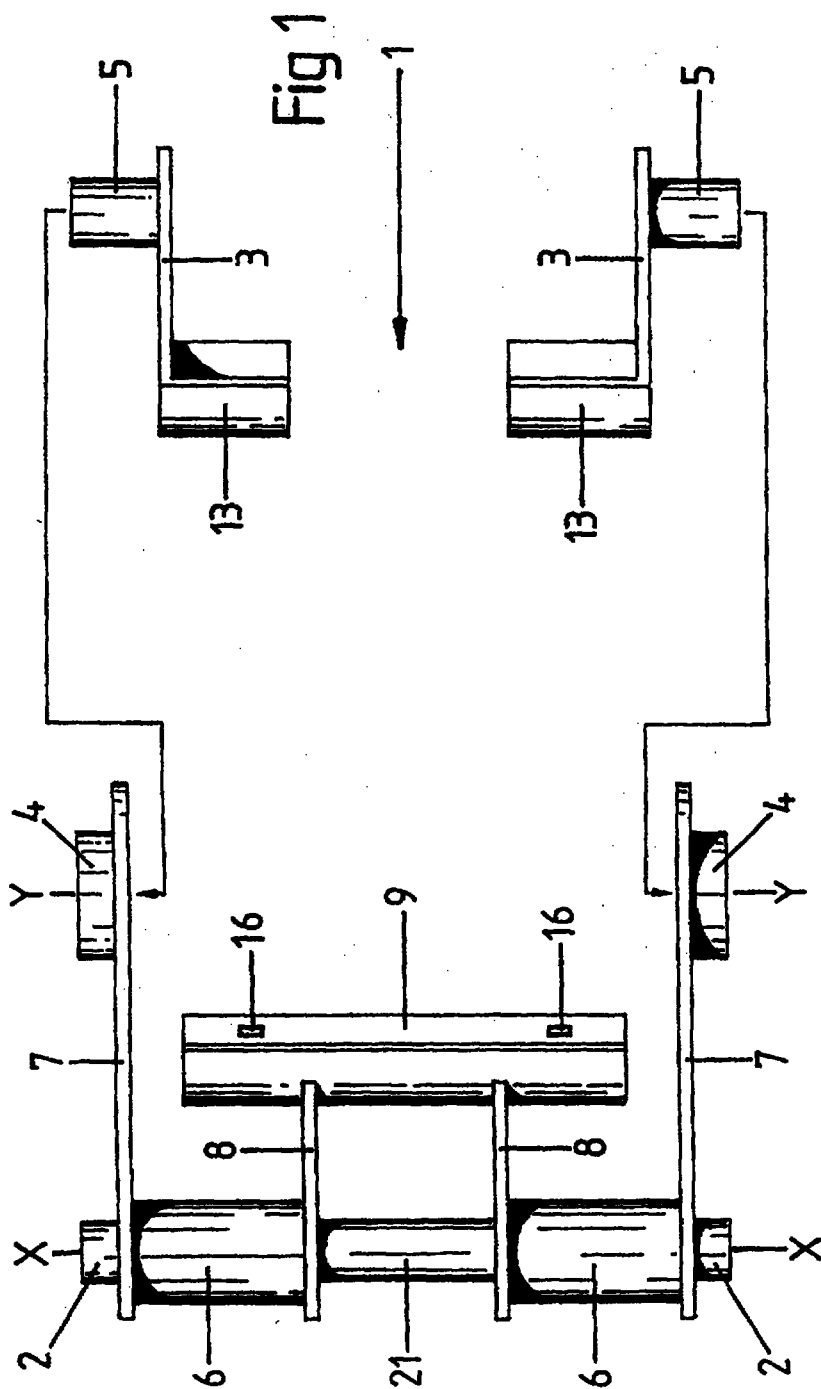
26. A device according to any one of claims 23 to 25, in which the supports are movable relative to plates which are rotatable in respect of bearing housing aligned on a common transverse axis adjacent the ends of the side members.

27. A device according to any one of claims 23 to 25, in which the bearing housings are longitudinally adjustable in the side members.

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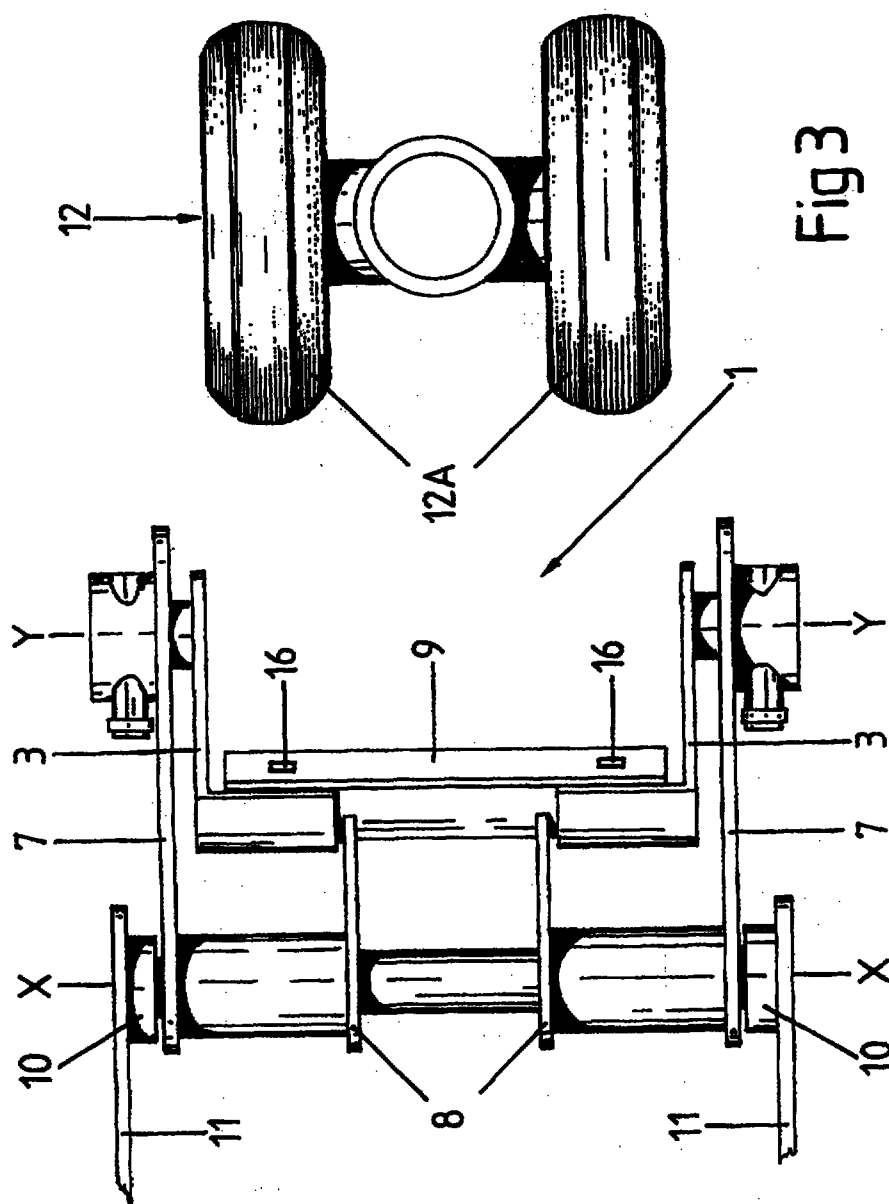
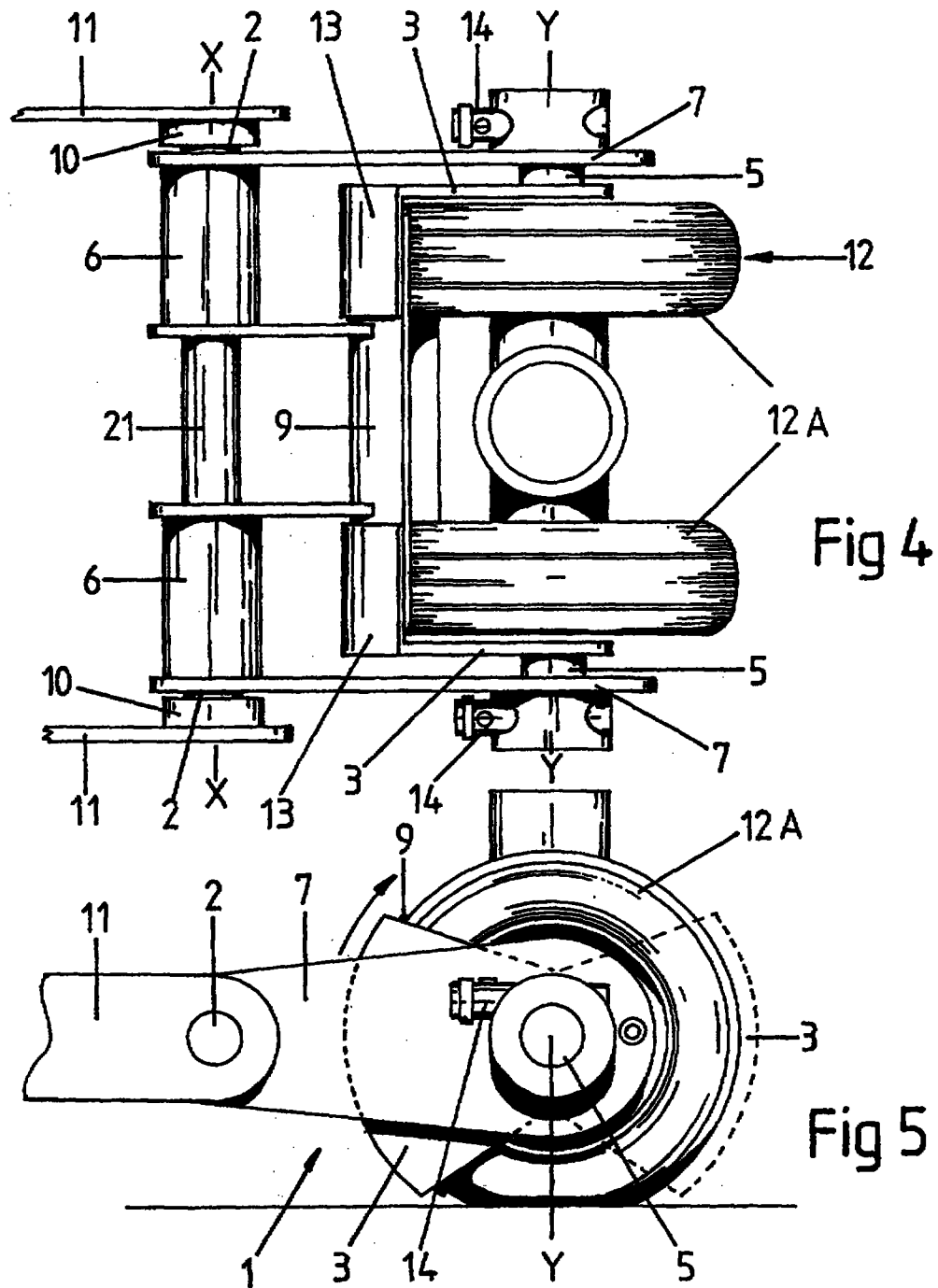


Fig 3

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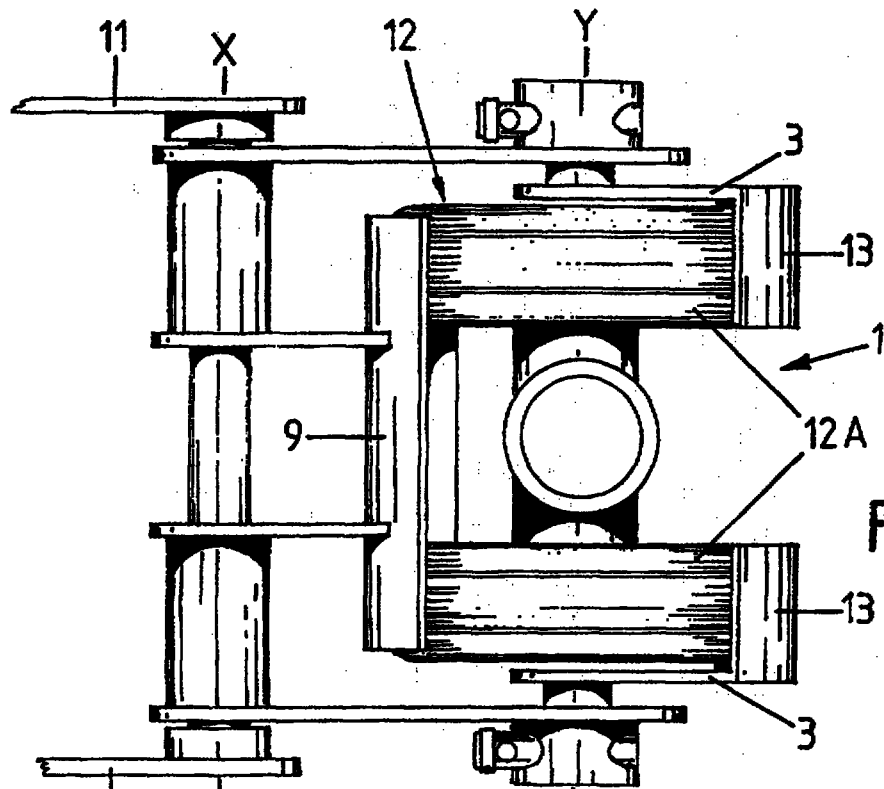


Fig 6

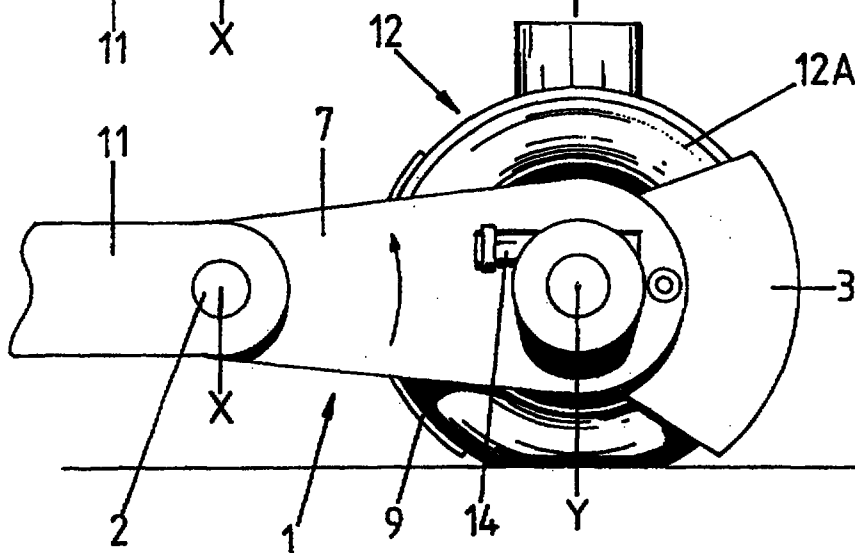
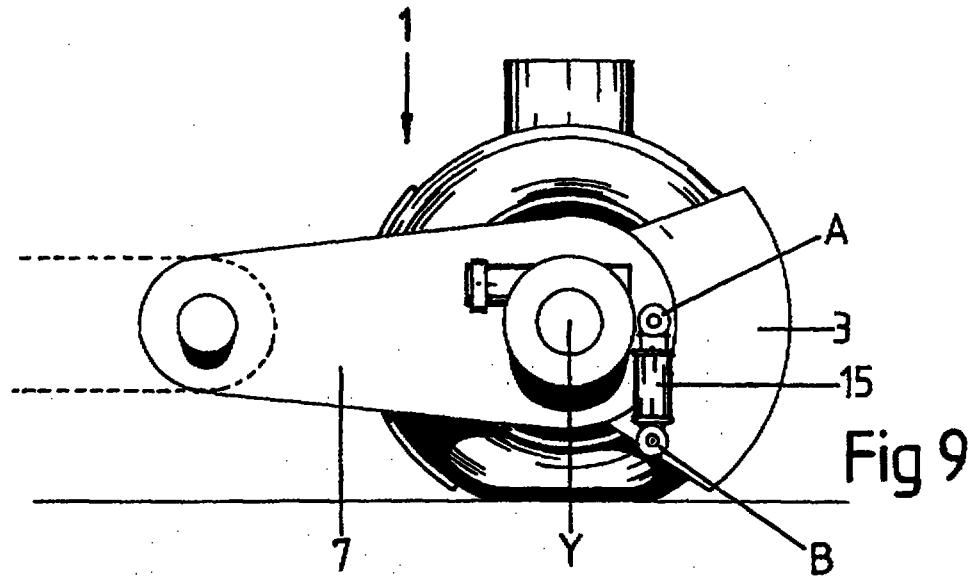
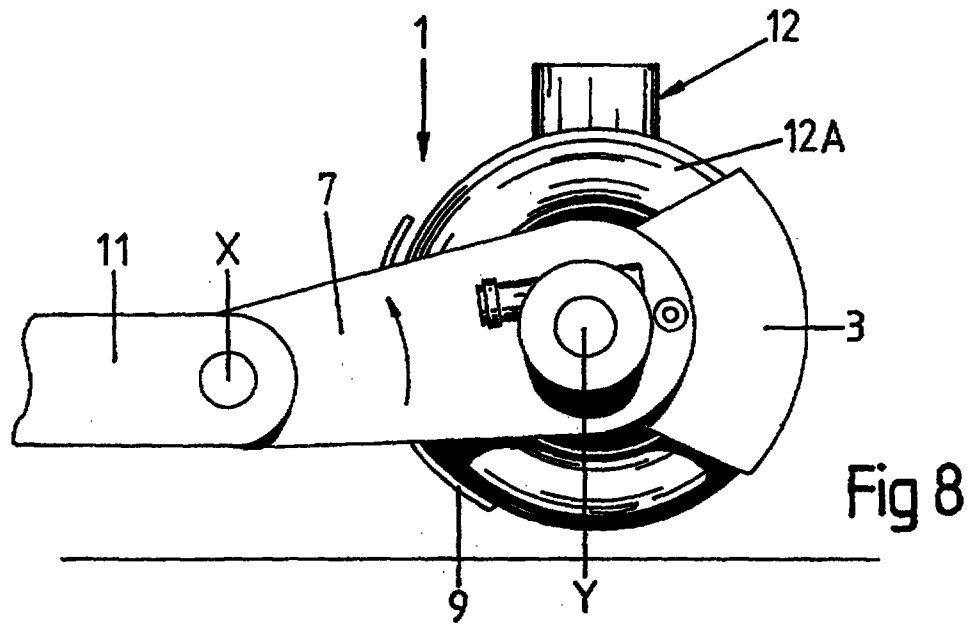


Fig 7

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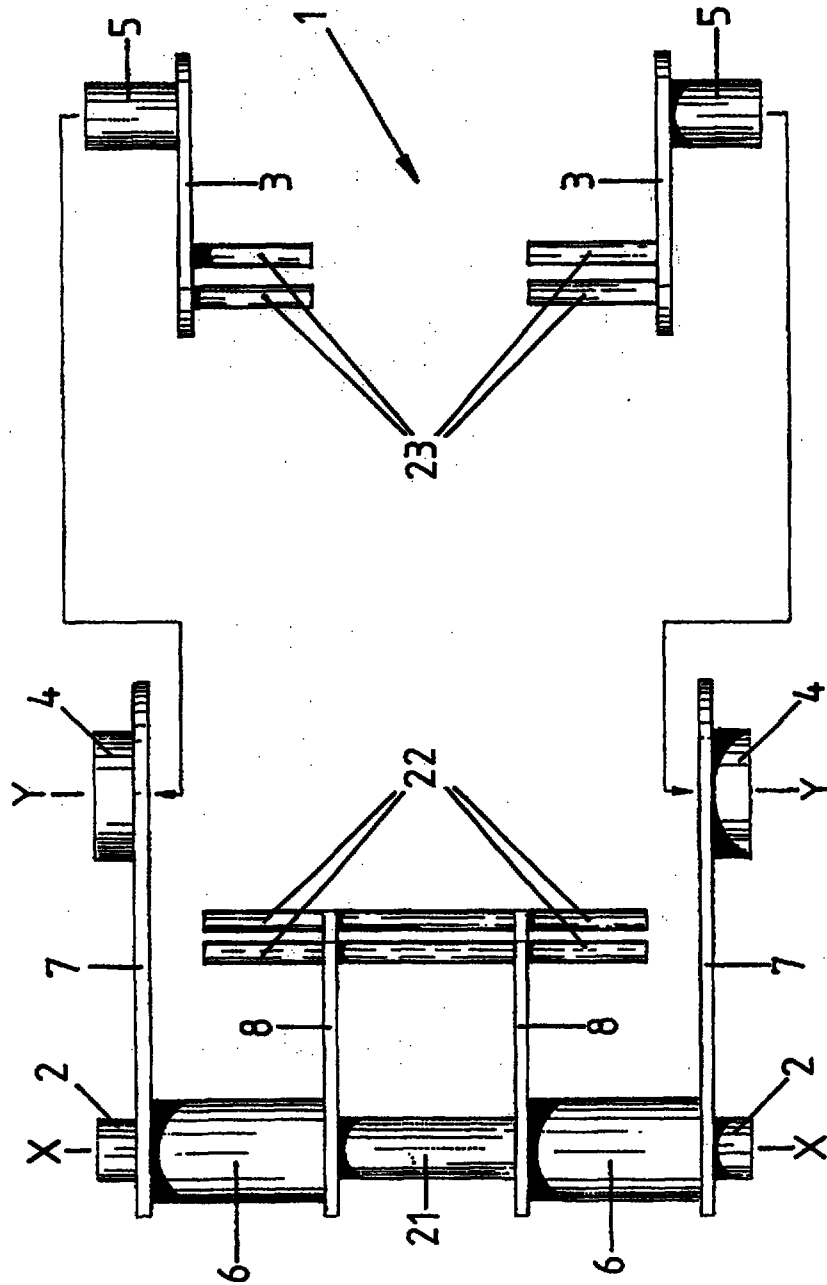


Fig 10

CLAIMS

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1. A device for lifting a wheel assembly (12) of an aircraft and including first (9) and second (13) wheel-engaging support means which are connectable to a bearing structure (11) of an aircraft ground handling machine and in use are rotatable relative to each other between open and wheel-cradling configurations, characterised in that the device includes means (15) connected to the bearing structure to enable the raising or lowering of the support means relative to the ground when in the wheel-cradling configuration.

2. A device according to claim 1 in which the support means (9,13) are pivotably attached to the bearing structure (11) about a transverse horizontally-disposed axis (X-X).

3. A device according to claim 1 or claim 2, in which the second wheel support means (13) are rotatably attached to the first support means about a transverse horizontally-disposed axis (Y-Y).

4. A device according to any preceding claim, in which the wheel-engaging support means (9, 13) comprise wheel support surfaces.

5. A device according to any preceeding claim, in which the wheel-engineering support means comprise laterally-disposed and vertically spaced-apart pins (22, 23) which optionally carry rotatable sleeves.

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6. A device according to claim 4 as dependent on claim 3, in which the wheel support surfaces are curved about an axis which substantially corresponds with the axis of the second wheel support means (Y-Y).

7. A device according to any preceding claim, in which the second wheel support means comprise two laterally spaced-apart supports (13; 23) carried on a common axis of rotation (Y-Y) for rotational movement in unison between said open and wheel cradling configurations.

8. A device according to claim 7, in which the first wheel support means (9; 22) are attached to inner support arms (8) which extend forwardly from a pivotable shaft (21) carried by the bearing structure (11) and the second wheel support means (13; 23) are attached to outer support arms (7) which also extend forwardly from the pivotable shaft (21), the outer support arms (7) defining a bifurcated twin-wheel receiving space and the first wheel support means (9; 22) extending transversely over a substantial part of the distance between the outer support arms (7), whereby in use the first wheel support means supports both wheels of a twin wheel unit (12) and each support of the second wheel support means supports a respective one of said twin wheels.

9. A device according to claim 8, in which said second wheel support means (13; 23) overlies radially said

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first wheel support means (9; 22) in the open configuration.

10. A device according to any preceding claim including pressure-sensitive switch means (16) carried by the first wheel support means (9; 22) and operatively connected to the second wheel support means (13; 23) to actuate rotation thereof when an aircraft wheel (12A) is in position against said first wheel support means.

11. A device according to claim 10, including two pressure-sensitive switch means (16) positioned laterally spaced apart on said first wheel support means to be actuated by respective wheels (12A) of an aircraft twin wheel unit (12) to enable rotation of said second wheel support means only when the twin wheel unit (12) is correctly located against said first wheel support means.

12. A device according to any preceding claim, in which the first (9) and/or second (13) wheel-engaging support means are horizontally adjustable on their respective support arms (8, 3) to vary their distance from the axis of rotation (Y-Y) of the second support means, whereby to compensate for aircraft wheels of different diameter.

13. An aircraft ground handling machine including a device for lifting a wheel assembly of an aircraft as claimed in any of claims 1 to 12.

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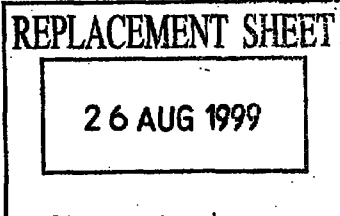
AIRCRAFT-WHEEL LIFTING DEVICE

The present invention relates to a device for lifting a wheel assembly of an aircraft, particularly but not exclusively a twin nosewheel assembly, for aircraft ground handling purposes.

The present invention particularly aims to provide a device for lifting the nosewheel assembly of an aircraft, which is suitable for use in confined areas, but not exclusively.

Document DE-A-3327629 discloses a device for lifting a wheel assembly of an aircraft according to the preamble of claim 1. The present invention provides a device for lifting a wheel assembly of an aircraft, particularly but not exclusively a twin nosewheel assembly, for aircraft ground handling purposes, the device comprising first and second wheel support means which are rotatable relative to each other between a first configuration in which a first portion of the circumference of the aircraft wheel can be located against the first support means and a second configuration in which the second support means is brought against a second portion of the circumference of the wheel, opposite the first portion, to cradle the wheel, said first and second wheel support means being raisable and lowerable in the second configuration.

Although the device may be embodied as a self-propelled towing dolly or the like, it is envisaged that the device will constitute part of an aircraft ground handling machine. In a preferred embodiment, therefore, the device also comprises means connectable to a bearing structure or chassis of an aircraft ground handling machine to enable the raising and lowering of the wheel support means and wheel cradled thereby.



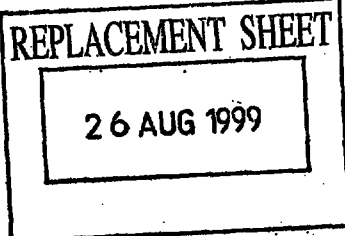
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The present invention also provides an aircraft ground handling machine, such as a towing dolly or a tractor, having a device according to claim 1.

The wheel support means may be constituted by wheel-engaging surfaces and may comprise a fixed support means which defines the first support surface and movable support means which defines the second support surface and is rotatable relative to the fixed support means. The wheel support means may, however, each comprise laterally-disposed and vertically spaced-apart pins which define notional wheel-engaging surfaces but which have the advantages that they have utility irrespective of the diameter of the wheel. The support means may be rotatable relative to each other about an axis which is substantially vertical in the normal condition of use, so that the support means close around the wheel laterally in the manner of a jaw.

In a preferred embodiment, the movable wheel support means rotate relative to the fixed wheel support means about a transverse axis which is substantially horizontal in the normal condition of use, the movable support means being disposed on the same side of the wheel as the fixed support means (that is, adjacent the first portion of the circumference of the wheel) in the first configuration and being swung over the wheel into the second configuration so that, in the second configuration, the movable support means are disposed on the opposite side of the wheel from the fixed support means. Where the wheel support means comprise wheel-engaging surfaces, they are preferably curved surfaces which are concentric or substantially concentric about the said transverse axis, although the wheel support means may as indicated



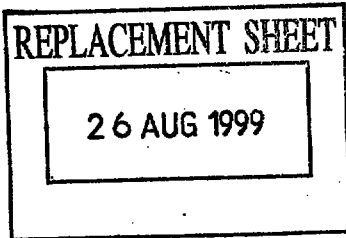
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5. In this condition, the rotatable wheel supports 13 are disposed in a position in which they overlies the fixed wheel support 9, radially outwardly thereof with slight clearance, to permit the support 9 to be placed firmly against the wheels 12A.

When the nosewheel unit 12 is properly positioned against the fixed wheel support 9, the two wheels 12A operate respective pressure sensitive switches or pads 16 on the surface of the fixed wheel support 9 to enable the rotation of the rotatable wheel supports 13, without their interfering with the tyres of the wheels 12A. As shown in broken outline in Figure ~~4~~⁵ and in Figures 6 and ~~7~~, the wheel supports 13 rotate through an obtuse angle, preferably of about 180°, relative to the fixed wheel support 9, swinging over the wheels 12A on either side of the central strut of the nosewheel unit 12. The rotatable wheel supports 13 thus move from the configuration of Figures 3, 4 and 5, in which the fixed and rotatable wheel supports 9, 13 are disposed on the same side of the nosewheel unit 12, to the configuration of Figure 6 and 7 where the supports 9, 13 are disposed on opposite sides of the wheels, with the curved surfaces of the rotatable supports 13 in engagement with portions of the circumferences of the wheels 12A opposite the portions of the circumferences located against the fixed support 9. In this configuration, the wheels 12A are cradled by the supports 13, 9.

Once the configuration of Figures 6 and 7 has been reached, the device is raised relative to the aircraft handling machine, as shown in Figure 8, to lift the nosewheel unit 12 clear of the ground so that the aircraft, for example a helicopter, can be manoeuvred by the ground handling vehicle. With the nosewheel unit 12



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CLAIMS

1. A device for lifting a wheel assembly (12) of an aircraft and including first (9) and second (13) wheel-engaging support means which are connectable to a bearing structure (11) of an aircraft ground handling machine and in use are rotatable relative to each other between open and wheel-cradling configurations, characterised in that the device includes means (15) connectable to the bearing structure to enable the raising or lowering of the support means relative to the ground when in the wheel-cradling configuration.

2. A device according to claim 1 in which the support means (9,13) are pivotably attachable to the bearing structure (11) about a transverse horizontally-disposed axis (X-X).

3. A device according to claim 1 or claim 2, in which the second wheel support means (13) are rotatably attached to the first support means about a transverse horizontally-disposed axis (Y-Y).

4. A device according to any preceding claim, in which the wheel-engaging support means (9, 13) comprise wheel support surfaces.

5. A device according to any preceeding claim, in which the wheel-engaging support means comprise laterally-disposed and vertically spaced-apart pins (22, 23) which optionally carry rotatable sleeves.

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6. A device according to claim 4 as dependent on claim 3, in which the wheel support surfaces are curved about an axis which substantially corresponds with the axis of the second wheel support means (Y-Y).

7. A device according to any preceding claim, in which the second wheel support means comprise two laterally spaced-apart supports (13; 23) carried on a common axis of rotation (Y-Y) for rotational movement in unison between said open and wheel cradling configurations.

8. A device according to claim 7, in which the first wheel support means (9; 22) are attached to inner support arms (8) which extend forwardly from a pivotable shaft (21) adapted to be carried by the bearing structure (11) and the second wheel support means (13; 23) are attached to outer support arms (7) which also extend forwardly from the pivotable shaft (21), the outer support arms (7) defining a bifurcated twin-wheel receiving space and the first wheel support means (9; 22) extending transversely over a substantial part of the distance between the outer support arms (7), whereby in use the first wheel support means supports both wheels of a twin wheel unit (12) and each support of the second wheel support means supports a respective one of said twin wheels.

a respective one of said twin wheels.

9. A device according to claim 8, in which said second wheel support means (13; 23) overlie radially said



