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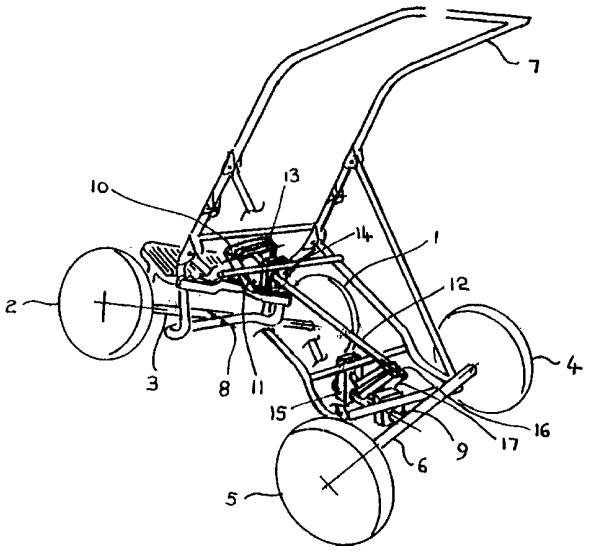
(54) Title: IMPROVEMENTS RELATING TO SUPPORT SYSTEMS



(57) Abstract: In order to render a wheeled vehicle, particularly an infant's pushchair, more stable on uneven ground, front and rear pairs of wheels are mounted on pivotal axes and a mechanical connection between the two axles translates pivotal movement of the front axis into opposite pivotal movement of the rear axis. If, for example, the left-hand front wheel rides-up over a bump as compared to the right-hand front wheel, then the right-hand ear wheel is causes to ride-up and the left-hand rear wheel is driven down which compensates the tendency of the pushchair to tilt in response to the riding-up of the left-hand front wheel. Various different mechanical connections are disclosed including linkages of different kinds and interconnecting gears. Application to lawnmowers, hand carts, supermarket trolleys, wheelbarrows etc is disclosed, and also to tables and the like where compensation for uneven ground is required.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

IMPROVEMENTS RELATING TO SUPPORT SYSTEMS

Field of the Invention:

The present invention concerns improvements relating to support systems and, more particularly, is concerned with the automatic and stable support of a platform or other structure via at least four feet or wheels even when on an uneven surface. The invention is particularly, but not exclusively, applicable to baby carriages, infant's pushchairs, wheelchairs, lawnmowers, supermarket trolleys and the like.

Summary of the Invention:

The present invention is applicable to both stationary structures and moving vehicles and, whilst the following description mainly concerns wheeled vehicle applications, it is to be appreciated that castors or feet can be readily substituted for wheels to suit other applications.

According to the invention, pairs of vertically movable feet or wheels are mechanically interconnected so that they support a platform or other structure in such a manner as to minimise or at least reduce the effect of uneven surfaces on the disposition of the platform, the platform being supported in such a manner that its disposition is uniquely related to the positions of the pairs of feet or wheels.

Alternatively stated, the present invention provides a quadripedal support structure having four vertically movable support members and

wherein means are provided whereby movement of any support member in one direction provokes compensatory movement of the adjacent support members in the opposite direction and movement of the diagonally opposite support member in the same direction.

Preferably, in a four wheeled or four footed arrangement, the interconnection is effected both from side-to-side and from front-to-rear.

A device may be included which can be selectively or automatically operated to lock the platform or other structure to one or both pairs of feet or wheels to suit particular conditions.

The above and further features of the invention are set forth in the appended claims and will be well understood from consideration of the following description of exemplary embodiments which is given with reference to the accompanying drawings.

Description of the Drawings:

Fig 1 is a schematic end view of a first exemplary embodiment in the form of a wheeled vehicle;

Fig 2 is a schematic side view of a second exemplary wheeled vehicle embodiment;

Fig 3 is a perspective view of a third exemplary wheeled vehicle embodiment;

Fig 4 is a pictorial view of a modification of the vehicle of Fig 3;

Fig 5 is a side view of a fourth exemplary wheeled vehicle embodiment;

Fig 6 is an end view of a fifth exemplary wheeled vehicle embodiment;

Fig 7 is an end view showing a disc brake addition to the embodiment shown in Fig 6;

Fig 8 is a schematic side view of an exemplary embodiment in the form of a pushchair;

Fig 9 is a schematic end view of the pushchair of Fig 8;

Fig 10 is a schematic end view of the pushchair of Fig 8 showing axles at the extremes of their travel;

Fig 11 is a schematic plan view of the pushchair of Fig 8 showing one exemplary means to lock the axle linkage to the main pushchair frame;

Fig 12 is a pictorial view of the pushchair of Fig 8;

Fig 13 is an enlarged side view of the linkage connecting the two wheel axles of the pushchair of Fig 8;

Fig 14 is a side view of the pushchair in Fig 8, shown folded for transportation;

Fig 15 is a schematic side view of a modification of the pushchair of Fig 8 wherein the structure is simplified;

Fig 16 is a schematic front end view of yet another modification of the pushchair of Fig 8 wherein the front and/or rear wheels are mounted on self-adjusting, pivotal, stub shafts; and

Fig 17 is a view similar to that of Fig 16 showing the arrangement of Fig 16 in a different condition.

Detailed Description of the Embodiments:

In the following, various schematic arrangements embodying the present invention will first be described, and then there will be described a pushchair embodying the present invention and several modifications of that pushchair.

Fig 1 shows a first embodiment having one pair of wheels 1, 2 mounted on transverse axle 3 and a second pair of wheels 4, 5 mounted on transverse axle 6. Axles 3 and 6 are pivoted to a platform 7 by a further axle 8 disposed in a fore-aft direction so that the wheels are all vertically movable relative to the platform. Link 9 connects to axle 3 at joint 10, and is connected to slide 11 at joint 12. Slide 11 moves on part of platform 7. Link 13 connects to axle 6 at joint 14, and is connected to slide 11 at joint 15. In operation, when wheel 5 rides up as compared to wheel 4, for example, the linkage 13, 11, 9 causes the diagonally opposite wheel 1 to ride up and the same side rear wheel 2 to be driven down which compensates the tendency of platform 7 to tilt in response to the riding up of wheel 5, and similarly for all the other wheels.

Fig 2 shows a second embodiment having one pair of wheels 16, 17 mounted on stub axles on a link 18 and a second pair of wheels 19, 20 mounted on stub axles on a link 21. Links 18 and 21 are pivoted to a platform

22 on a transverse axle 23 so that again the wheels are all vertically movable relative to the platform. Link 24 connects to link 21 at joint 25 and is connected to slide 26 at joint 27. Slide 26 moves on part of platform 22. Link 28 connects to link 18 at joint 29 and is connected to slide 26 at joint 30. As with the first embodiment, if a wheel rides up or drops down, the same side other wheel moves oppositely and the other side wheels move diagonally oppositely. Again this compensates for the tendency of platform 22 to tilt.

Fig. 3 shows a third embodiment having one pair of wheels 31, 32 mounted on an axle 33 and a second pair of wheels 34, 35 mounted on an axle 36. Axles 33 and 36 are pivoted to a platform 37 at joints 38 and 39 respectively. Again, all the wheels are vertically movable relative to the platform. Axles 33 and 36 are connected to links 40 and 41 respectively, which are pivoted to platform 37 at joints 42 and 43. As with the previously described embodiments, vertical movement of any wheel causes opposite movement in the other same side and opposite side wheels and the same movement in the diagonally opposite wheel which serves to reduce tilting of the platform.

Fig 4 shows a modification of the Fig 3 embodiment having one pair of wheels 44, 45 mounted on stub axles on a link 46 and second pair of wheels 47, 48 mounted on stub axles on a link 49. Links 46 and 49 are pivoted to a platform 50 at joints 51 and 52 respectively. So that, again, all the wheels are vertically movable relative to the platform. Link 53 is connected to links 46 and 49 at resilient joints 54 and 55 and to platform 50 at

joint 56. Link 57 is connected to links 46 and 49 at resilient joints 58 and 59 and to platform 50 at joint 60. Other than for the displacements between the wheel axles and the connections between the longitudinal and transverse links and the provision of resilience in some of the connections, this arrangement is the same as that of Fig 3 and operates similarly.

Fig 5 shows a similar arrangement to the embodiment of Fig 1 but with the axles connected to the platform by gears instead of links. Transverse axle 61 is carried on a first frame 62 which is pivoted to platform 63 in bearings at 64 and transverse axle 65 is carried on a second frame 66 which is pivoted to platform 63 in bearings at 67, the pivoting of frames 62 and 66 to platform 63 being achieved by means of short longitudinal axles which extend from frames 62 and 66 through bearings at 64 and 67. These longitudinal axles carry bevel gears 68, 69 on their inner ends and these gears mate with other bevel gears 70, 71 rotating in journals in platform 63. The overall effect of this embodiment is the same as for the previous embodiments.

Fig 6 shows a similar arrangement to the embodiment of Fig 2 but with the links connected to the platform by gears instead of links. One pair of wheels 73, 74 is mounted on stub axles on a link 75 and a second pair of wheels 76, 77 is mounted on a link 78. Links 75 and 78 are pivoted to a platform 79 on axles 80, 81 rotating in bearings at 82 and 83. The inner ends of axles 80 and 81 carry bevel gears 84 and 85 which mate with other gears 86 and 87 rotating in journals in platform 79. Again, the overall effect of this embodiment is the same as for the previous embodiments.

Fig 7 shows an addition to the embodiment of Fig 6 whereby a disc brake assembly 89 is capable of selectively locking axle 88 and thus preventing relative movement between links 75 and 78 and platform 79.

The embodiments of the present invention hereinbefore described are schematic and illustrative more of the principles underlying the present invention than of the way that the invention might actually be applied in practice, and corresponding changes to the embodiment described might be made. One of the hereinbefore described embodiments incorporates resilience in its linkage connections and resilience might be incorporated into the other embodiments hereinbefore and hereinafter described by use of springs, elastomeric bushes, additional links etc as are well known per se. Links 46 and 49 in the Fig 4 embodiment may for example be mounted higher than axles 53 and 57 so that short vertical links mounted in elastomeric bushes might be used to connect links 46 and 49 to axles 53 and 57 at points 54, 55, 58 and 59. Furthermore, whilst mechanical linkages have been shown in the particular embodiments, it is to be appreciated that other positive means could be used to achieve the same aims, particularly the use of equivalent hydraulic systems appropriate to certain classes of vehicle. Furthermore, the locking means of Fig 7, or any suitable alternative locking means, could also be applied to the embodiments of Figs 1-5 and to the hereinafter described embodiments.

The invention is contemplated to be particularly useful in pushchairs or baby carriages, where its anti-tipping features are clearly advantageous,

especially for use of the baby carriage on rough and uneven ground. Hereinafter a pushchair embodiment will be described in detail. Other applications might be in the field of lawnmowers, wheelchairs, supermarket trolleys, hand carts, wheelbarrows and towed trailers, and even in the field of powered vehicles, especially for use on rough and uneven ground, such as earth-moving equipment. The invention could also be used on tables and other articles of furniture and support structures where compensation for uneven ground is required, the wheels in the described embodiments being replaced by feet.

Figures 8 to 14 of the accompanying drawings show an exemplary infant's pushchair embodying the present invention and this embodiment will now be described. Thereafter some modifications of this embodiment will be described.

Figs 8-14 show an exemplary pushchair having one pair of front wheels 1,2 rotatably mounted on transverse axle 3 and a second pair of rear wheels 4,5 rotatably mounted on transverse axle 6. The mid-point of front axle 3 is pivoted to a front part of pushchair frame 7 by a further axle 8 disposed in a fore-aft direction. Similarly, the mid-point of rear axle 6 is pivoted to a rear part of frame 7 by a further axle 9 fixed to axle 6 and disposed in a fore-aft direction. This is best seen in Fig 12. By this means, all the wheels are vertically movable relative to the frame. As best shown in Figs 8 and 13, link 10 is pivotally connected to an upwards extension from the front axle 3 at joint 11 and is fixedly connected to a shaft 12 at joint 13. Shaft

12 is retained laterally in bearings 14 and 15 mounted on frame 7 and connects fixedly to rear axle 9 at 16 by way of a rigid projection 17 extending from axle 9. This arrangement forms a simple universal joint connecting shaft 12 to rear axle 9.

In operation, when wheel 2 for example rides up as compared to wheel 1, the linkage 10,12,17 causes the diagonally opposite wheel 4 to ride up and the same side rear wheel 5 to be driven down which compensates the tendency of frame 7 to tilt in response to the riding up of wheel 2.

The particular means used to connect axles 3 and 6 enables the pushchair to be folded for transportation. As shown in Fig 8, frame 7 is comprised of four elements 18,19,20,21 pivotally connected at joints 22,23,24,25. Elements 18 and 19 are locked together in normal operation creating a rigid frame for supporting a child in a seat (not shown). When elements 18 and 19 are unlocked the frame may be folded as shown in Fig 14. Pivot 24 is collinear with pivot 13 connecting link 10 to shaft 12 so there is no conflict when the pushchair is folded.

A footrest 27 (Fig 11) is rigidly fixed to front axle 3 and is in close proximity to vertical elements of frame part 19. A transverse member 28 with serrations at its outer ends is rigidly fixed to front axle 3 and passes behind vertical elements of frame part 19. Member 28 normally moves freely behind frame part 19, but if the pushchair is tilted backwards to negotiate a kerb, so that the front wheels are lifted off the ground, the front axle assembly tips forward slightly because of the weight distribution and the serrations in

member 28 engage the frame parts 19 thereby automatically locking the linkage connecting the front and rear axles. Downwards forces on footrest 27 are resisted directly by upward forces through wheels 1 and 2 and the pushchair will not tip sideways even if an infant/child stands on one side of the footrest.

Fig 15 shows a modification of the abovedescribed pushchair in which shaft 12 is directly connected to rear axle 6 and is pivoted in bearing 26. The operation of the thus modified pushchair is similar to that of the embodiment previously described, except that the rear axle 6 moves in a plane 27 at right angles to the axis of shaft 12, causing wheels 4,5 to move fore-aft slightly relative to frame 7 when travelling over uneven surfaces. This has little adverse effect in practice.

Fig 16 shows yet another modification of the Fig 8 embodiment in which the front wheels are mounted on stub axles 29,30 on carriers 31,32 which are themselves movable to provide an additional degree of movement of the front wheels relative to the frame for the purpose hereinafter described. The carriers rotate in brackets 33,34 about vertical axes 35,36. Axes 35 and 36 are forward of the stub axles 29,30 to give some natural castor action. Brackets 33 and 34 are pivoted to the footrest 27 at 37 and 38. Footrest 27 rotates on frame 7 at axle 8. Brackets 33 and 34 normally move with footrest 27 when the wheels 1,2 are in contact with the ground and are loaded. However, if wheel 1, say, becomes unloaded, carrier 33 rotates relative to footrest 27 and peg 39 engages one of the serrations in rack 40. Similarly, if

wheel 2 becomes unloaded, carrier 34 rotates relative to footrest 27, and peg 41 engages one of the serrations in rack 42. This is illustrated in Fig 17 which shows peg 41 engaging one of the serrations in rack 42. Either action locks the linkage connecting the wheels, making it easier to negotiate kerbs and other large obstacles. The same modification has a similarly beneficial effect in other extreme conditions when one wheel is unloaded, improving stability. A similar modification could be made to the other embodiments described herein.

Having described the present invention in the foregoing by reference to particular embodiments, it is to be appreciated that the described embodiments are in all respects exemplary and that modifications and variations thereto are possible without departure from the spirit and scope of the invention.

For the avoidance of doubt, it is to be well understood that reference to vertically movable support members in the following claims and hereinbefore does not mean that the movement should be exclusively vertical without any other components, rather the intention is to embrace any movement having a vertical component.

Claims:

1. A quadripedal support structure having four vertically movable support members and wherein means are provided whereby movement of any support member in one direction provokes compensatory movement of the adjacent support members in the opposite direction and movement of the diagonally opposite support member in the same direction.

2. A structure as claimed in claim 1 wherein said support members comprise wheels.

3. A structure as claimed in claim 2 wherein said wheels comprise two forward wheels and two rearward wheels, the two forward wheels being mounted on a first transverse axle which is pivotal with respect to a body part of the structure, the two rearward wheels being mounted on a second such transverse axle, and means being provided interconnecting said axles whereby pivotal movement of one axle in one direction causes oppositely directed pivotal movement of the other axle.

4. A structure as claimed in claim 3 wherein one or both of said axles comprises pivotally mounted stub axles.

5. A structure as claimed in claim 4 wherein means are provided for locking said stub axles against pivotal movement.

6. A structure as claimed in claim 3 or 4 or 5 wherein said axles are interconnected by means of mechanical linkages.

7. A structure as claimed in claim 6 wherein said mechanical linkages include components pivotally mounted to said body part for pivotal movement generally transverse to the pivotal movement of said axles.

8. A structure as claimed in claim 6 wherein said mechanical linkages comprise a connection between the first axle adjacent to one of the forward wheels and the second axle adjacent to the opposite one of the rearward wheels.

9. A structure as claimed in claim 8 wherein said connection is made between a slidable element on said body part and said first and second axles.

10. A structure as claimed in claim 3 or 4 or 5 wherein said axles are interconnected by means of a gear arrangement.

11. A structure as claimed in claim 10 wherein the first and second transverse axles are coupled to respective longitudinal axles journalled in a gearbox comprising intermeshing bevel gears.

12. A structure as claimed in any of the preceding claims incorporating resilient support means or supplementary links associated with said support members.

13. A structure as claimed in any of the preceding claims including means operable to lock the structure against compensatory movement.

14. A structure as claimed in any of the preceding claims configured as a baby carriage or infant's pushchair.

15. A structure as claimed in any of claims 1 to 13 configured as a hand cart, wheelbarrow, tow-trailer or the like.

16. A structure as claimed in any of the preceding claims which is configured to be foldable.

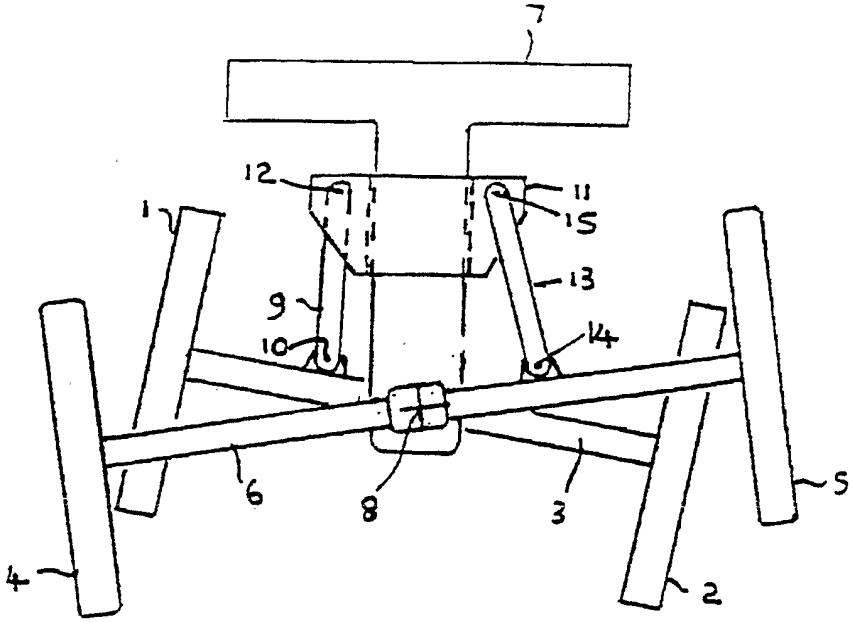
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Fig 1

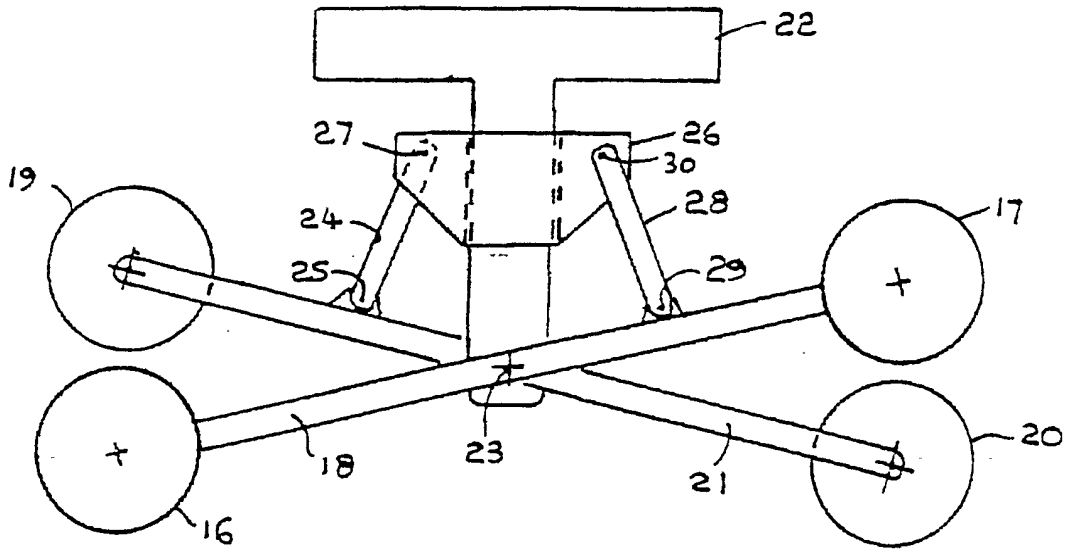
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Fig 2

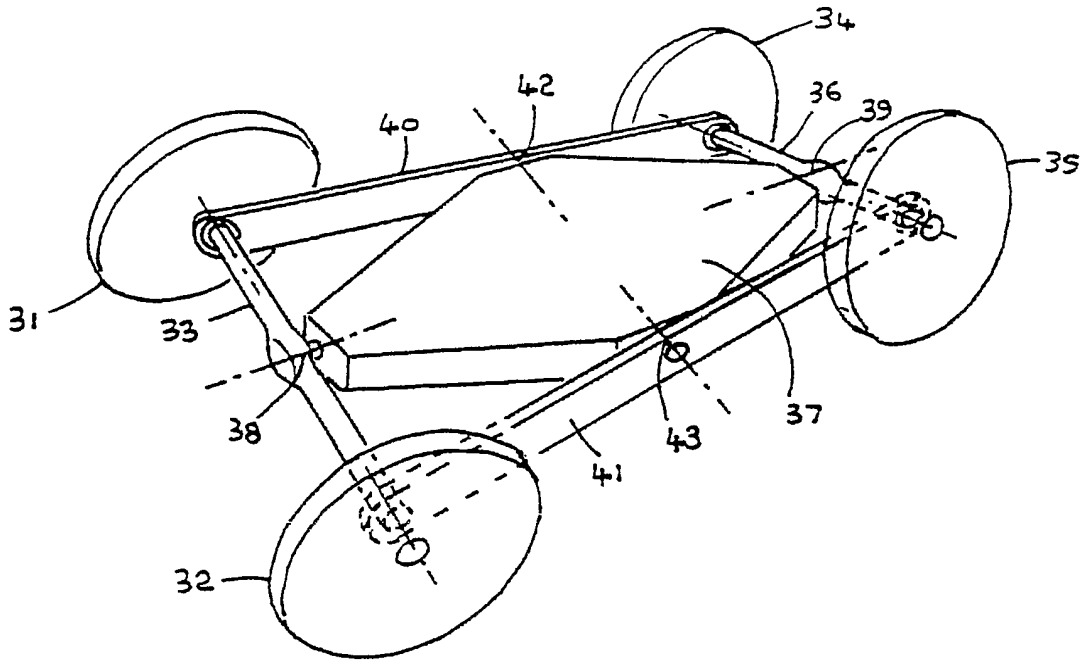
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Fig 3

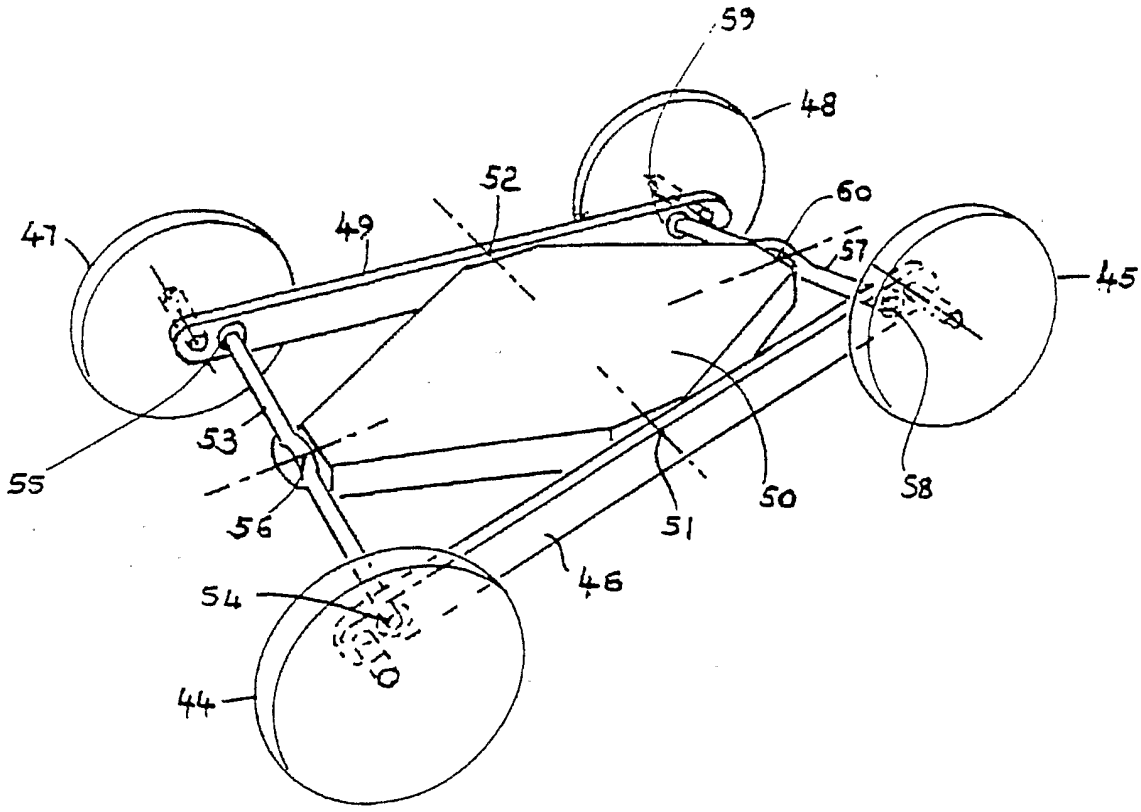
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Fig 4

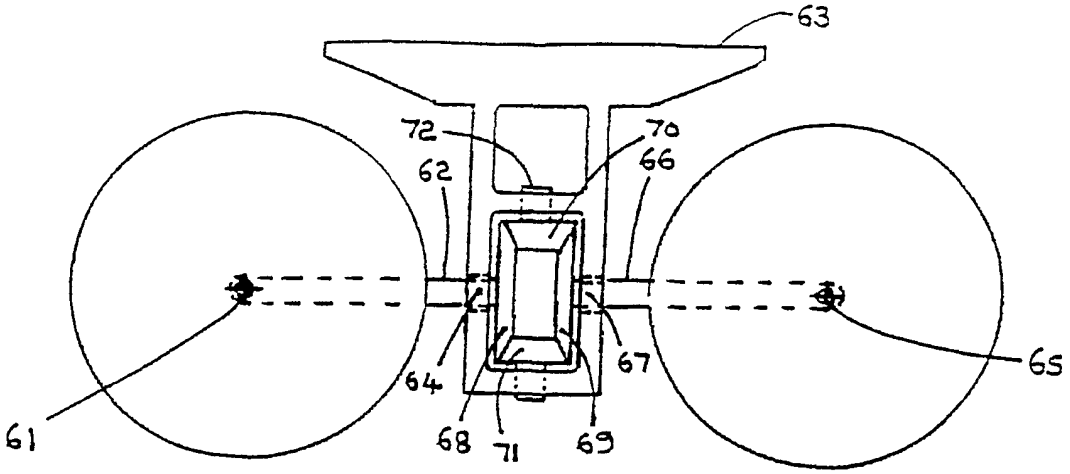

Fig 5

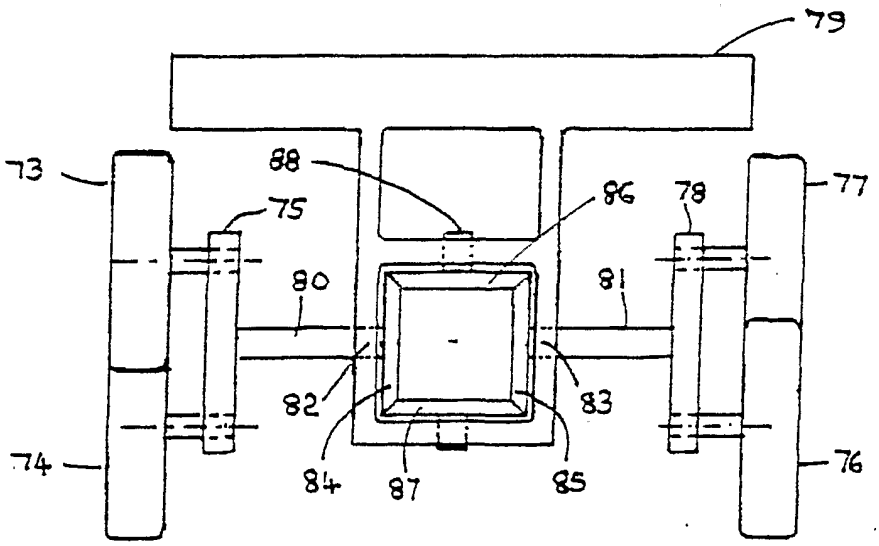

Fig 6

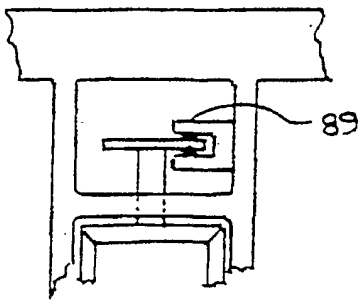

Fig 7

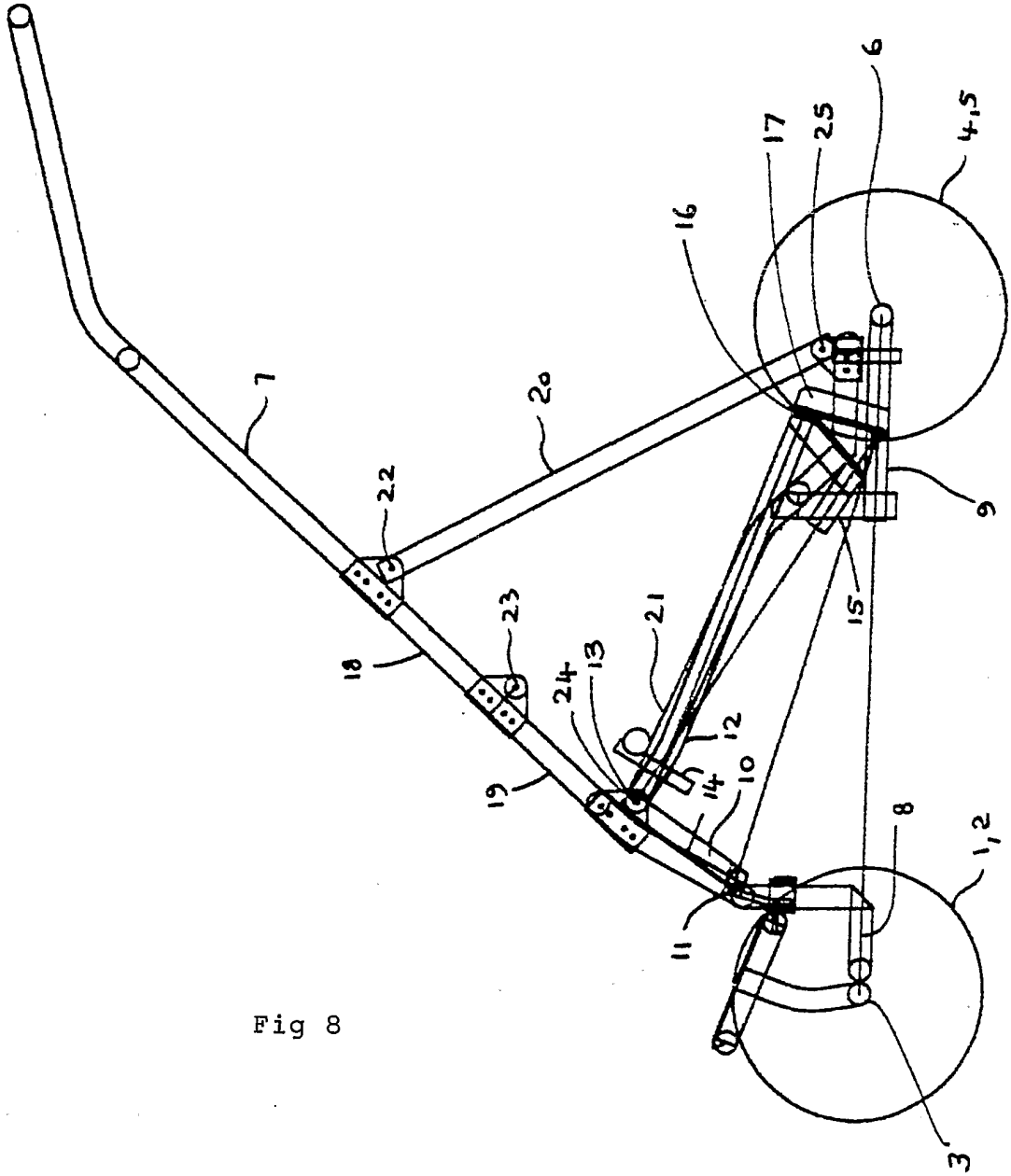

Fig 8

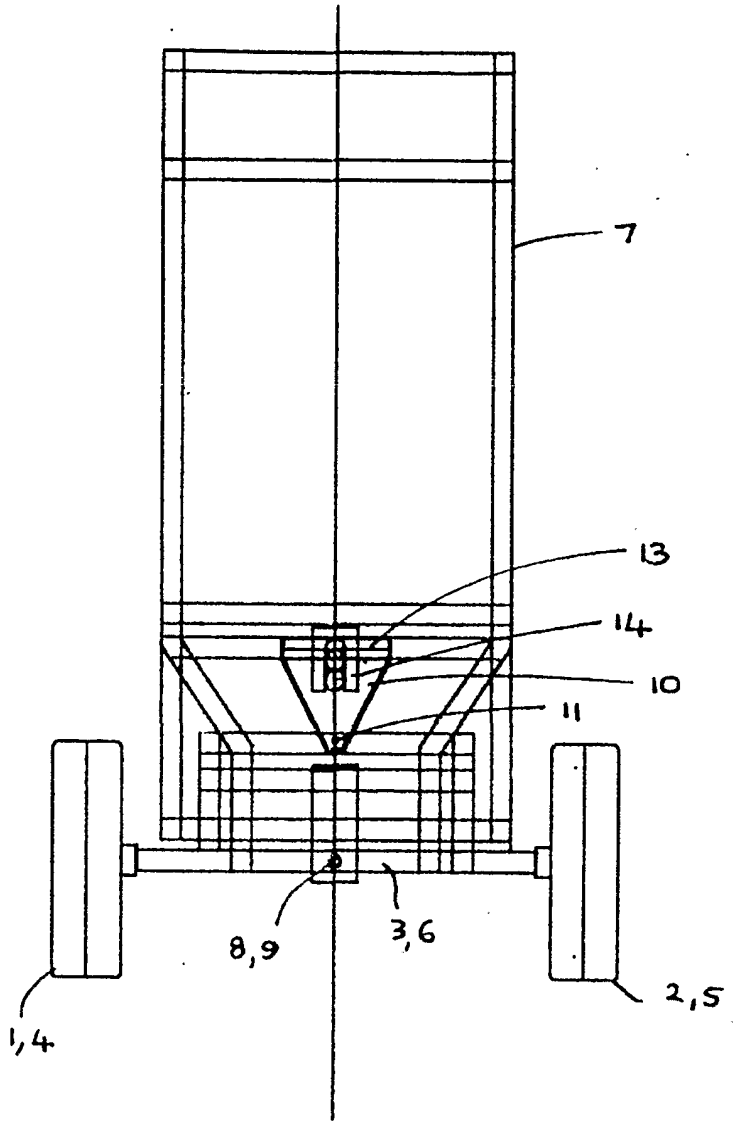

Fig 9

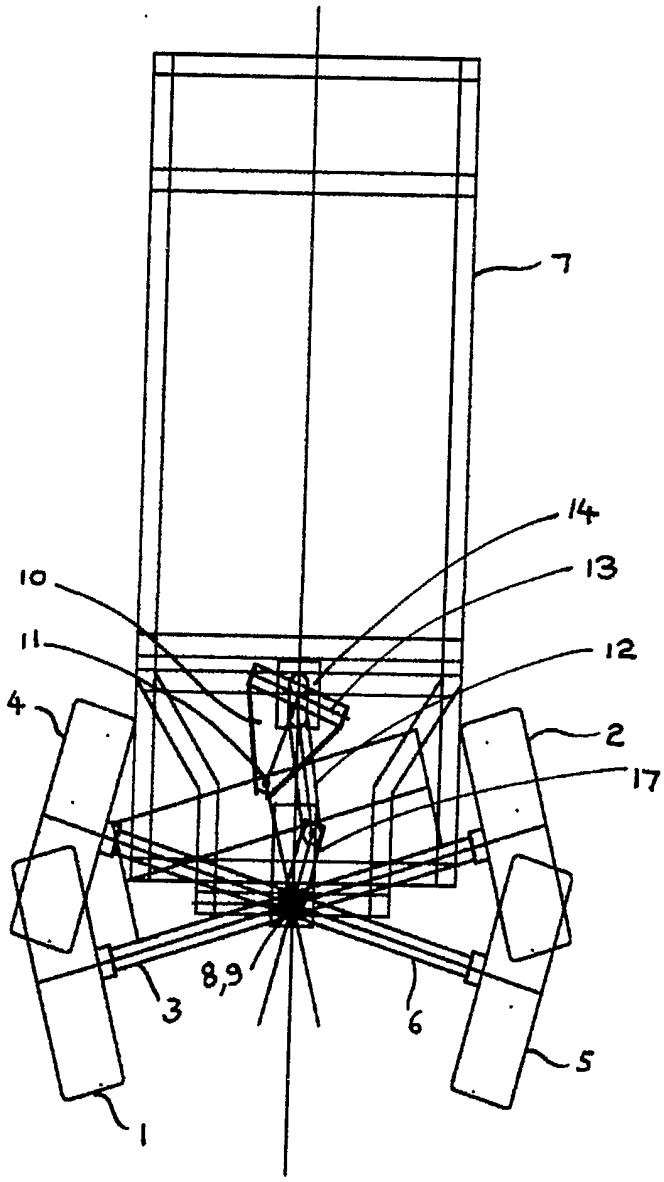

FIG 10

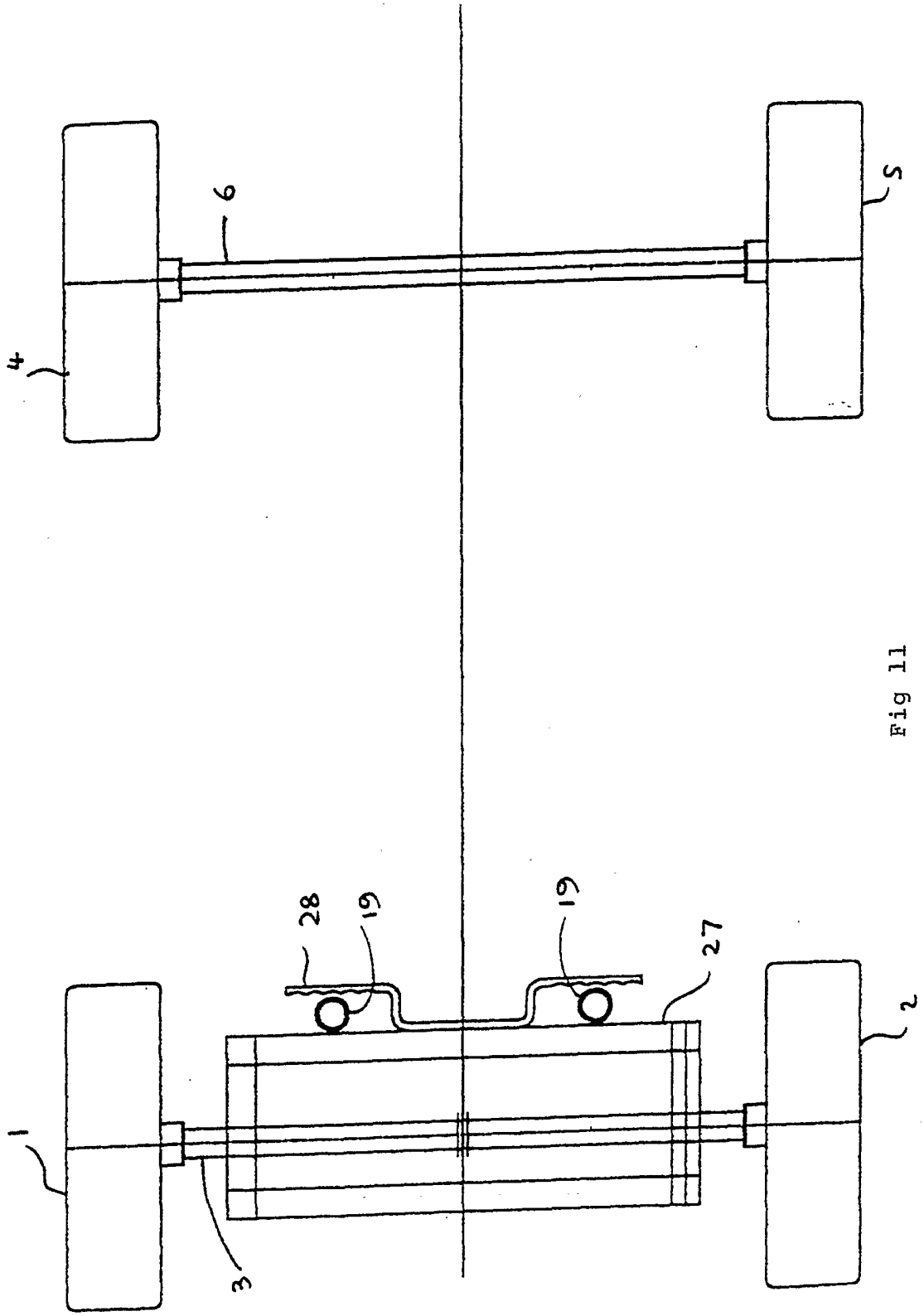

Fig 11

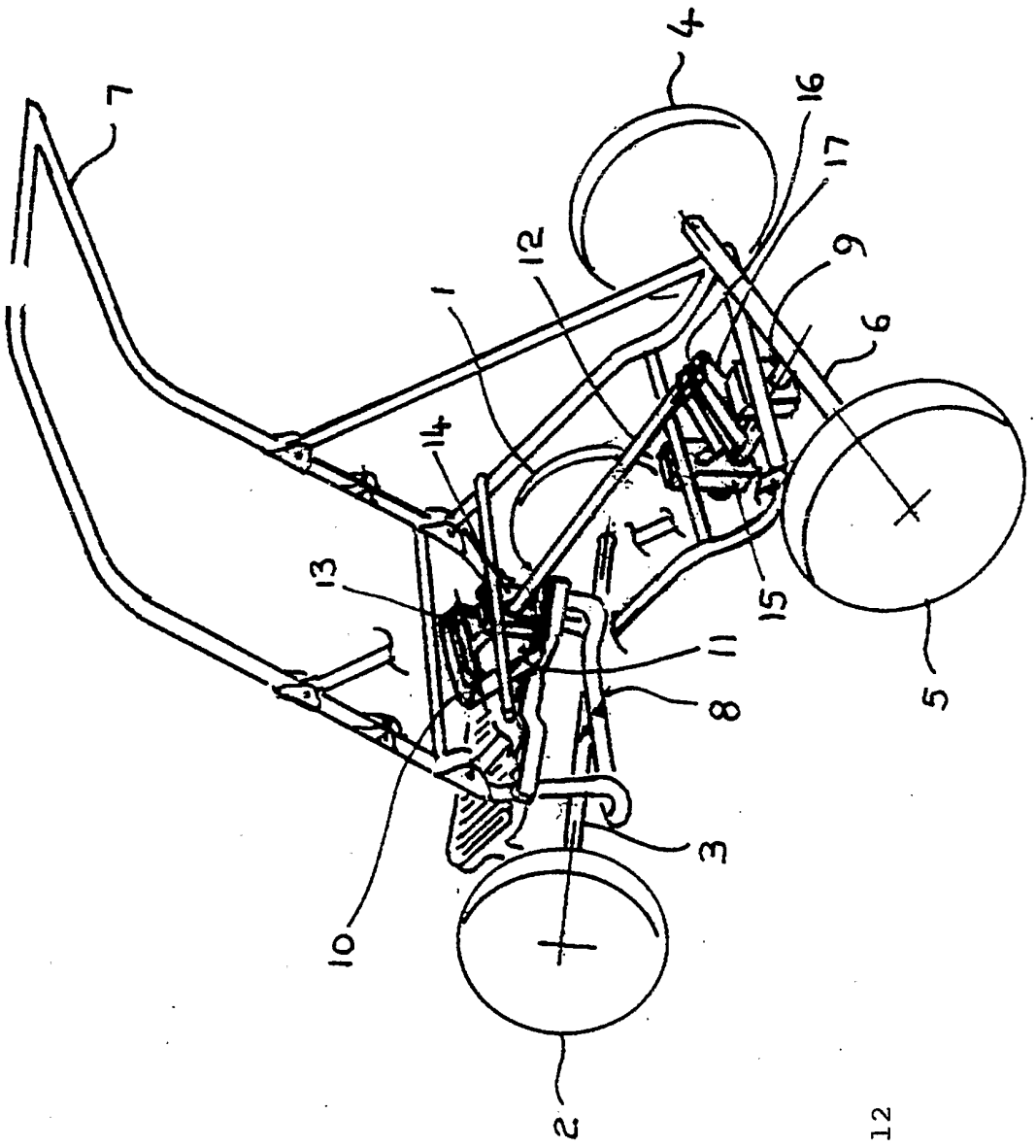

Fig 12

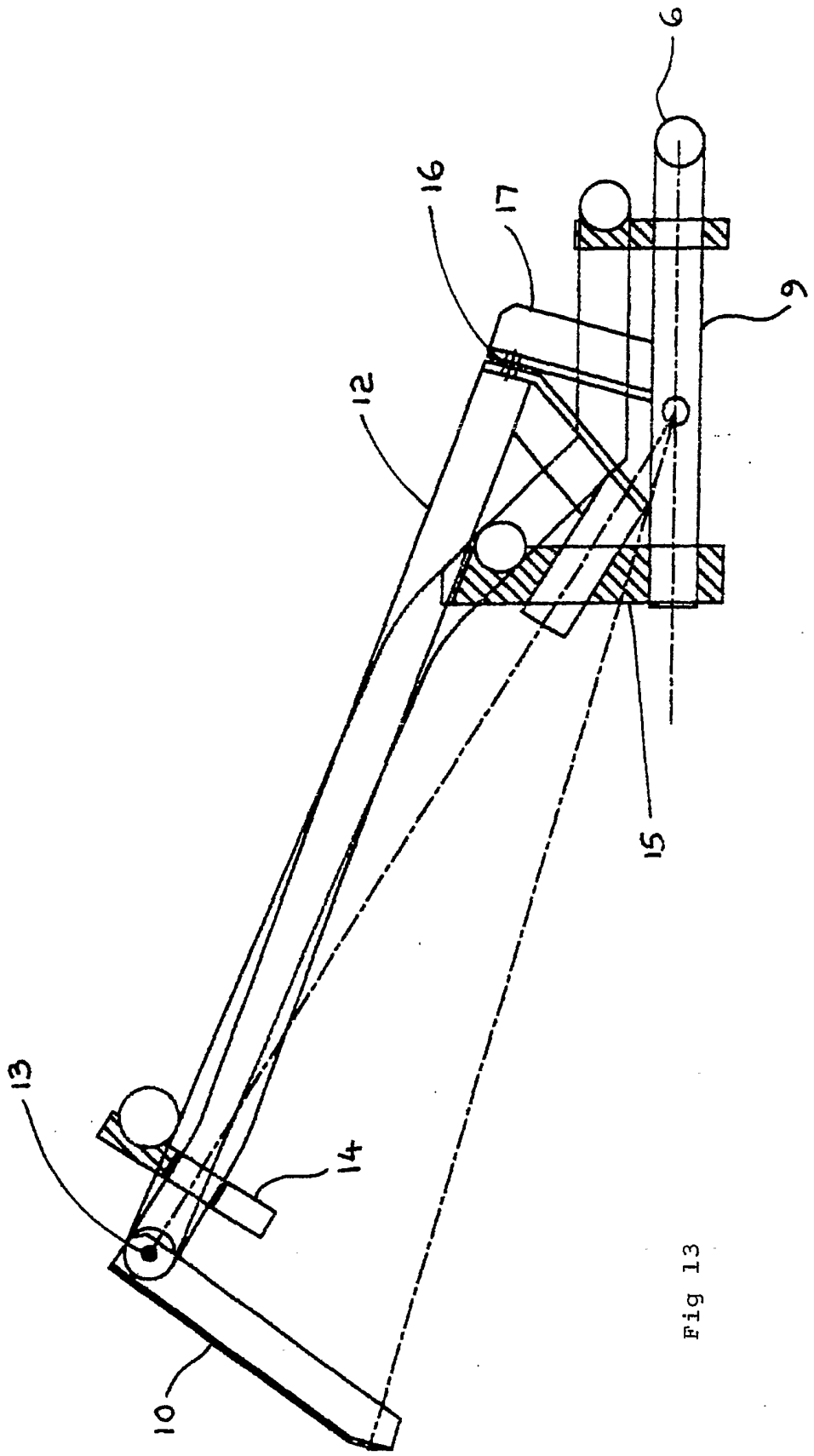

Fig 13

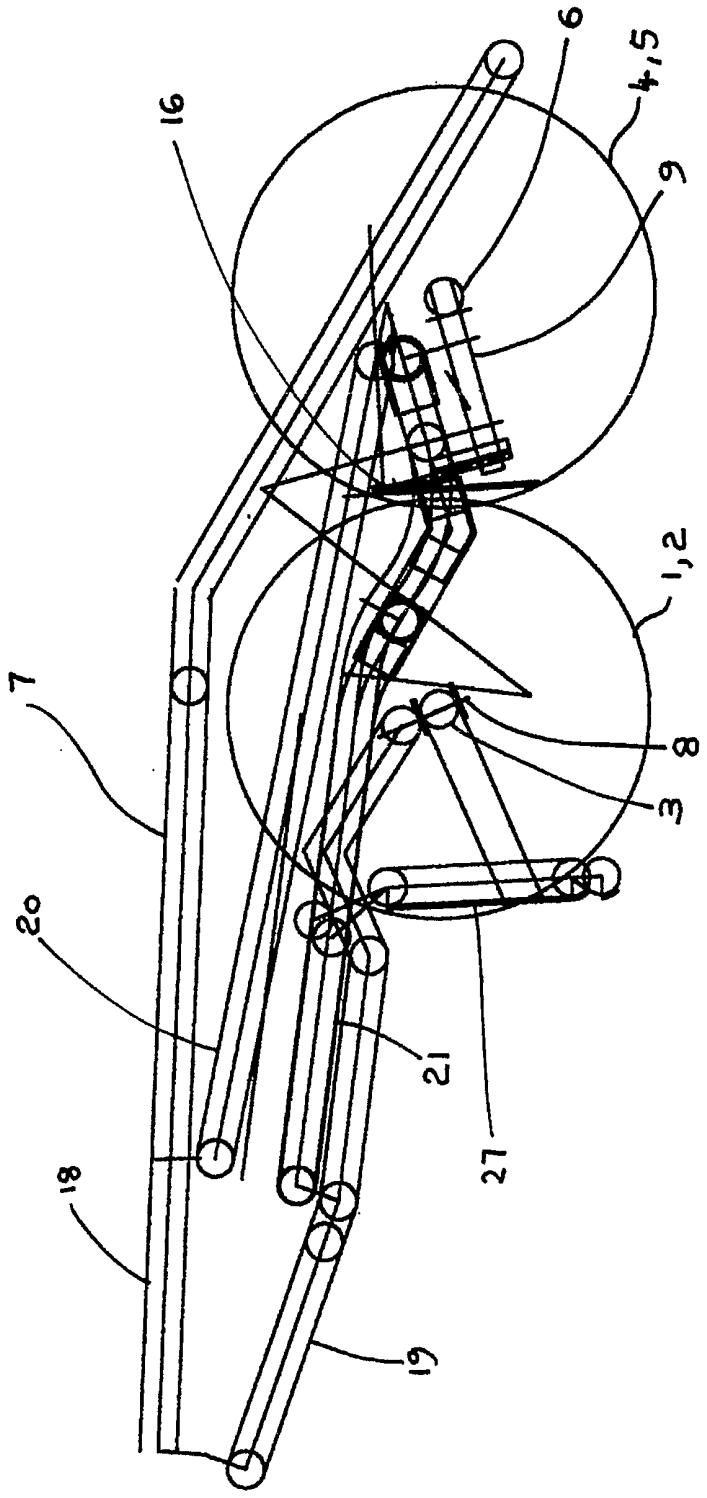

FIG 14

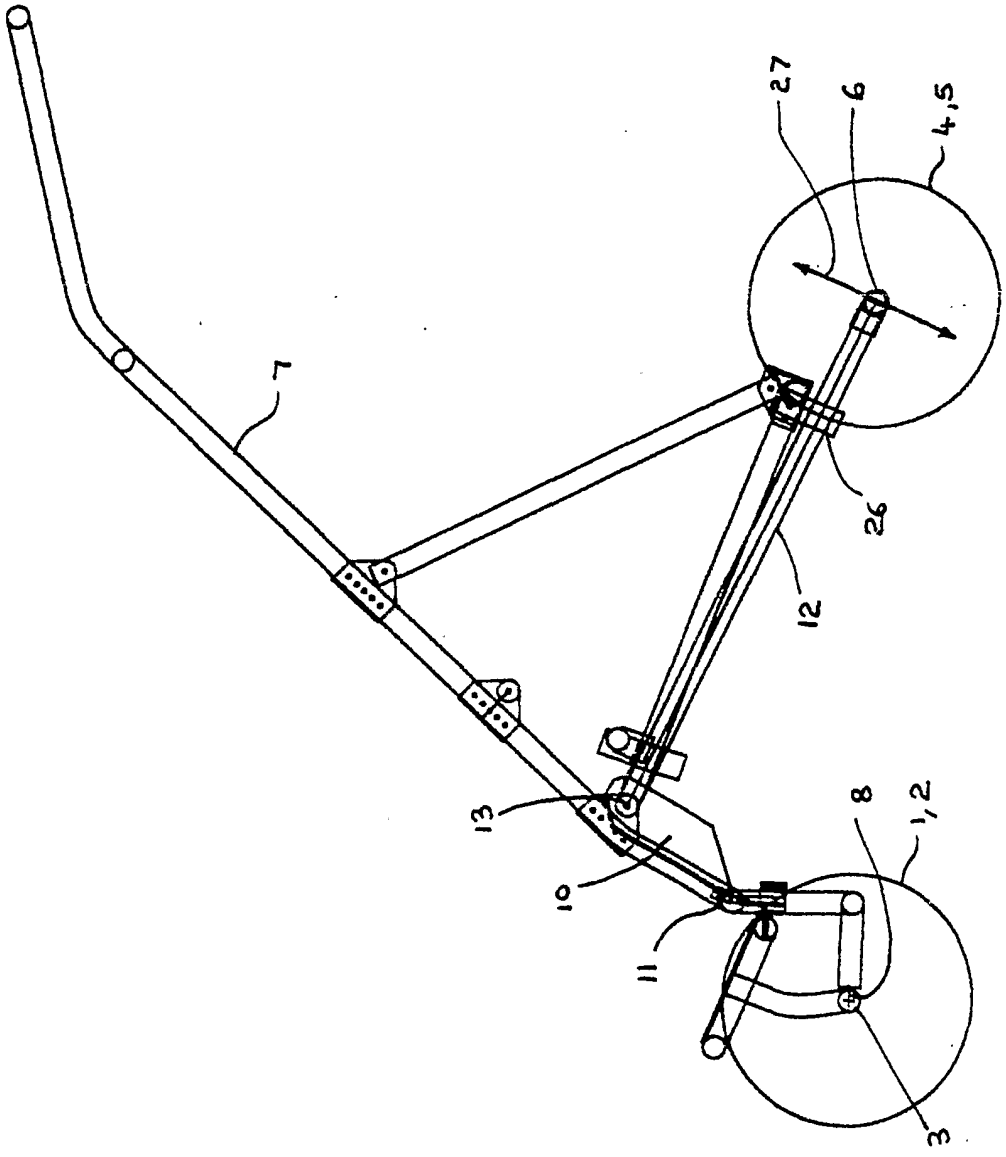

FIG 15

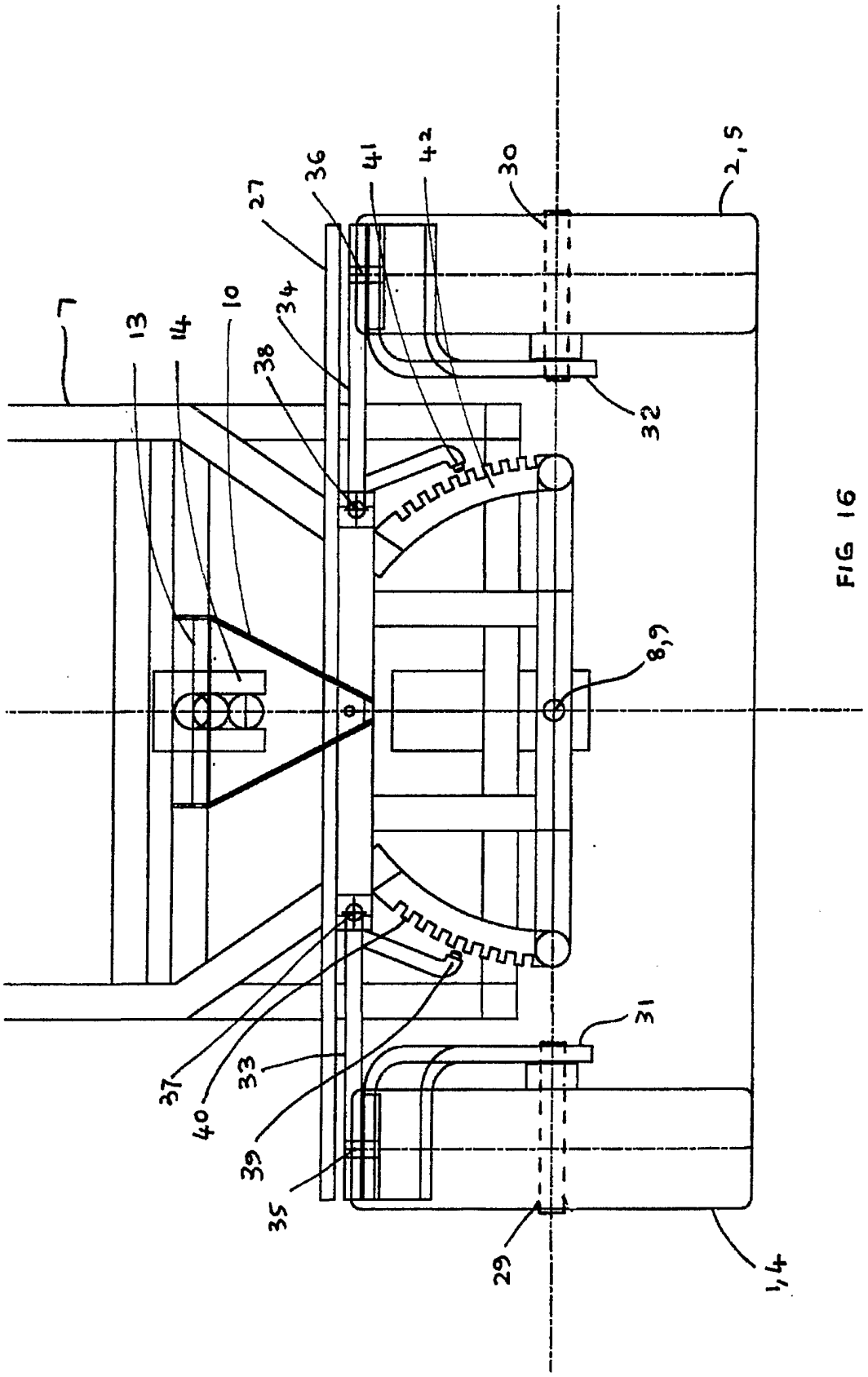

FIG 16

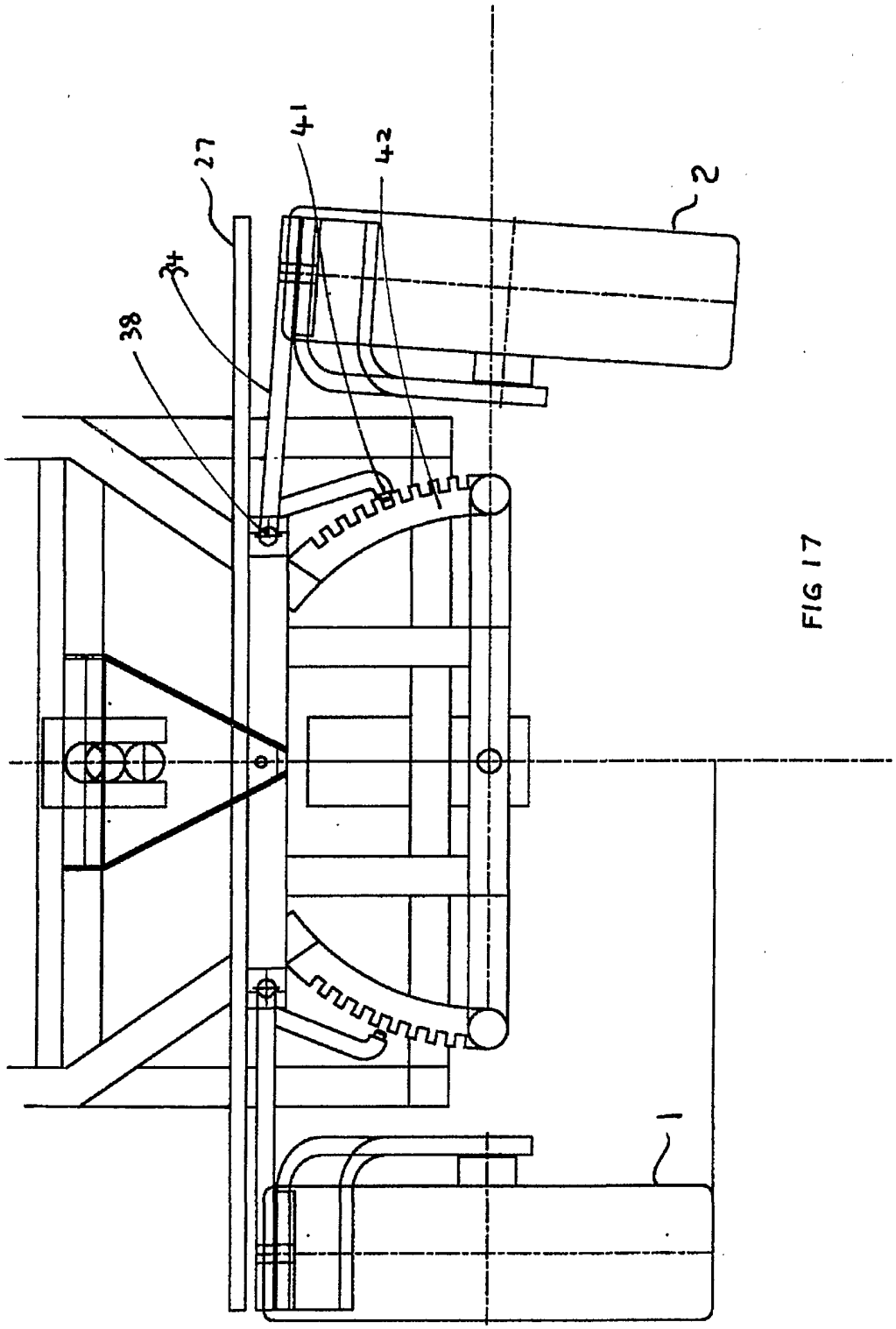

FIG 17

INTERNATIONAL SEARCH REPORT

	ıtional Application No
	PCT/GB 01/03961

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60G21/04 F16M11/12 B62B9/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60G F16M B62B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 5 927 736 A (SALFINGER BRIAN JOHN ET AL) 27 July 1999 (1999-07-27) column 1, line 56 -column 2, line 31; figures	1-4,14, 15 5,6,10, 12-16
X A	FR 1 337 204 A (LABURTHE ROBERT CHARLES) 13 September 1963 (1963-09-13) the whole document	1-7, 10-13 8,14-16
X A	FR 2 161 017 A (SMALLFRY LTD) 6 July 1973 (1973-07-06) the whole document	1-4,6,7 5,8,10, 12-16
X A	FR 1 155 319 A (CONTANT CLAUDE) 25 April 1958 (1958-04-25) the whole document	1-4 5,6,10, 12-16

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 February 2002	14/02/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Cauderlier, F

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 01/03961

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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