



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ :

B60G 3/14, 7/02, 9/02

B60P 1/28, 9/00, B62D 33/02

A1

(11) International Publication Number:

WO 92/04196

(43) International Publication Date:

19 March 1992 (19.03.92)

(21) International Application Number: PCT/AU91/00389

(22) International Filing Date: 26 August 1991 (26.08.91)

(30) Priority data:

PK 2104

3 September 1990 (03.09.90) AU

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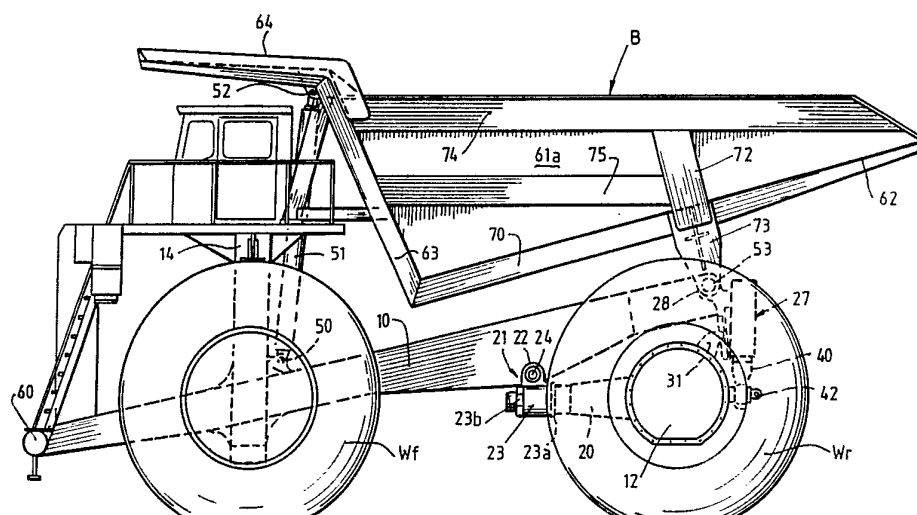
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(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, ML (OAPI patent), MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, SD, SE, SE (European patent), SN (OAPI patent), SU⁺, TD (OAPI patent), TG (OAPI patent), US.

Published

With international search report.

(54) Title: SUSPENSION SYSTEM AND BODY FOR LARGE DUMP TRUCKS



(57) Abstract

A suspension system for the main frame of a large dump truck having laterally spaced frame members (10) each associated with a wheel mounting hub (12) the system comprising, for each hub (12), a hollow forward attachment arm (20) supported by a bearing block (21) having a longitudinal journal (23) and a transverse journal (22), the longitudinal journal (23) receiving the attachment arm (20) and the transverse journal (22) receiving the ends of a shaft rigidly secured to the frame members (10) and extending therebetween to define a cross member and a vertically compliant suspension strut comprising a cylinder (41) rigidly attached to a support (28) secured to the frame member (10) and receiving a piston (40) attached to a rear extension (42) from the hub (12) via a bearing which allows each hub (12) to rotate about longitudinal and transverse axes relative to the respective frame member (10). Also disclosed is dump truck body (B) having side walls (61), a floor (62) and an end wall (63), the floor (62) being reinforced by longitudinal reinforcing beams and by only one transverse beam (72). The side walls (61) slope inwardly, the floor (62) slopes downwardly and forwardly and the width of the floor (62) increases towards the rear of the body (B).

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Suspension system and body for large dump trucks

Field of the Invention:

5 This invention relates to suspension systems and configurations for the main structural components of very large trucks of the type used in mining operations.

Background of the Invention:

10 There is much commonality between currently available large mining trucks made by different manufacturers and the following observations are generally applicable regardless of the truck manufacturer:

- 15 - The empty vehicle weight is a high proportion of the maximum gross vehicle weight. Typically the ratio of payload to empty vehicle weight is only about 1.4:1. This means that much of the cost of operating such trucks is related to moving the empty vehicle weight rather than the payload.
- 20 - The total width of the four rear tyres is large compared to the total width of the truck. Typically 65% of the total width of a truck is taken up by the four rear tyres. With present designs of truck this leads to a very narrow main frame for the truck and very high bending loads on the rear axle and rear wheel support systems. The narrow main
25 frame causes shortage of space for maintenance of some components, high stress changes during cornering manoeuvres, the need for vertically stiff rear suspension springs and design restrictions on the body. The nett effect is high weight and cost for the main frame, the rear axle, the rear wheel
30 support assemblies and the body.
- The travel of the rear suspension system of a fully loaded truck is very limited compared to the scale of the truck. Typically the maximum travel in the
35 compression direction of the rear axle relative to the main frame is only of the order of 50 mm when loaded. This limited travel is a result of the need to achieve adequate roll stiffeners from the two

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narrowly spaced rear spring units.

- 5 - The main frames of these trucks are complex welded steel structures that are heavy (e.g. 16.5 tonnes for the main frame of a truck with a payload rating of 172 tonnes), expensive to design, develop and manufacture, and prone to fatigue cracking.
- 10 - The main load carrying member (the body) of the trucks is a very strong and generally stiff member. This strength and stiffness is a consequence of the need for the body to withstand the shock loads applied during loading of large rocks by large excavators.
- 15 - The body is generally supported from the main frame of the truck at numerous points. For example at the rear pivot points, at two, four, six or eight points along the underside of the body and in some trucks also at forward extensions of the body which contact the main frame at points which are close to being above the line of the front wheels. This system of supporting the stiff body causes high variation of stress levels in the main frame of the truck and the body as the truck traverses over uneven ground. This feature causes fatigue problems, high design and fabricating costs and the need for considerable expenditure to limit the unevenness of the ground on which the trucks travel.
- 20 - The body is tipped (hoisted) by hydraulic cylinders which react against the main frame of the truck at points near to midway between the front and rear wheels. This causes very large bending loads to be applied to the main frame of the truck and requires that the main frame be very massive at the mid sections. It can also cause large stress changes in the body.
- 25 - The dual rear tyres are rotationally locked together. During short radius turning manoeuvres (frequent occurrences in typical mining
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operations), this causes severe scrubbing type wear of the tyres due to the differential travel distance effect. Relative scrubbing between the two tyres of a dual set is considered to contribute significantly to total wear of rear tyres on large mining trucks.

- The combination of four wide tyres on a solid beam axle type rear axle causes large variations in individual tyre loads as the trucks traverse uneven ground conditions. This arrangement also means that it is necessary to take considerable care in matching tyre outside diameters and inflation pressures to minimise the unevenness in tyre loads on level ground conditions.

- In general with currently available truck designs, the transfer of forces between the body and the ground is through a very indirect path which involves high bending loads in the body, the main frame of the truck, the rear axle housing and the rear wheel support systems (the final drives or the wheel motor housings). Furthermore these bending loads fluctuate greatly as the truck travels over uneven ground and during cornering.

A typical very large mining truck is shown in Figure 1 of the drawings of our co-pending International Patent Application No. PCT/AU90/00084, and it will be noted that the frame structure is quite substantial and this results from the frame being required to bear the load supported by the body of the truck by contact between the body and the upper surfaces of the frame, and by virtue of the body hoisting rams being connected to the frames as shown. The substantial size of the rear axle is also apparent.

While many truck frame design improvements have been suggested over the years, no one design has successfully addressed more than a few of the difficulties which have been outlined above. For example, United States Patent No. 3,704,040 Davis et al

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discloses a frame arrangement in which the front and rear wheel pairs are centrally supported, the independent frame members arrangement which is described as addressing many of the problems created by uneven terrain is extremely complex and consequently expensive and heavy. This patent and the related United States Patent No. 3,773,348 also disclose a rear suspension arrangement suitable for use with centrally supported rear wheel pairs. Centrally supported rear wheel pairs provide the potential to overcome some of the problems inherent in currently available large mining trucks, but to date no successful method of exploiting this potential has been established.

In addition to the above, most truck body designs have remained essentially unchanged for many years, being characterized by extremely heavy structures reinforced by means of relatively closely spaced transverse beams assisted by limited longitudinal beams, thereby resulting in a body structure of extremely high weight.

Similarly, most conventional truck bodies have a sloping floor and vertical longitudinal sides arranged at a constant width spacing. In one departure from this approach, a body having a flat floor and vertical sides which are wider apart at the rear of the body than at the front of the body was designed. Although in this arrangement, the wear on the sides of the body is reduced, the flat body floor is not compatible with most truck main frame designs and it increases the height of the centre of gravity of the truck unless the overall width and/or length of the truck is increased.

Summary of Invention and Objects:

It is an object of the present invention to provide an improved configuration for a very large vehicle in which at least some of the problems outlined above are ameliorated.

In one aspect, the invention provides a suspension system for a main frame of a very large vehicle, the

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main frame having a forward section and a rear section, said rear section including spaced frame members each associated with a wheel mounting hub, each hub supporting a pair of rear wheels one either side of the hub, said suspension system comprising a forward attachment means for said hub pivotally mounted on said frame members to allow limited rotation of said hub about a longitudinal and transverse axis relative to each frame member, and a vertically compliant suspension means controlling and limiting the rotation of said hub about said transverse axis, said vertically compliant suspension means being rigidly attached to said frame member to prevent lateral movement of said hub in the transverse plane relative to said frame member and being actively coupled to said hub in a manner which allows longitudinal movement of said hub relative to said vertically compliant suspension means as the hub rotates about said transverse axis and to permit rotation of said hub about said longitudinal axis.

In a preferred form, the vertically compliant suspension means is actively coupled by a rearward extension from said hub received within a slidable bearing means.

The forward attachment means is preferably an elongate forward attachment member and may be formed integral with the wheel mounting hub.

The forward attachment member may be substantially tubular and the pivotal mounting may have a passage through it to convey cooling air to electric traction motors supported by the rear wheel mounting hub.

In another aspect of the invention there is provided a large substantially rigid vehicle frame comprising a main frame having a front section and a rear section, said front section carrying forward frame means for supporting at least two front wheels, said rear section including spaced frame members each having a vertically compliant suspension means including a wheel mounting hub, each hub supporting a pair of rear

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wheels one on either side of said hub, a substantially rigid load supporting body, means for pivotally mounting said body with respect to said frame, means for maintaining transverse spacing between said rear wheel
5 pairs, the suspension system having a forward attachment member for said hub, pivotally mounted on said frame member to allow rotation of said hub about a longitudinal and a transverse axis of each frame member and a vertically compliant suspension means actively
10 coupled to said hub limiting its rotation relative to said frame member.

By providing the principal reinforcement of the body by means of longitudinally extending strengthening beams, the necessary body strength can be achieved with
15 significant reductions in the weight and the manufacturing cost of the body.

The body is preferably pivotally mounted on the main frame of the truck such that pivotal movement of said body is about an axis which lies within the profile
20 of the rear wheel pairs. The body is preferably supported only at the pivot points and at one or two points near the front of the body, these forward support(s) lying close to above the line between the centres of the front wheels of the truck. The hydraulic
25 cylinder(s) used for tipping the body about its pivot points preferably react onto the main frame of the truck at one or two points which are also close to above the line between the centres of the front wheels of the truck. By these means the body is prevented from
30 exerting large bending moments in the main longitudinal members of the main frame of the truck. The forward body supports may include a positive location system between the body and the main frame of the truck so that the body can provide a significant proportion of the
35 strength that is required between the front and rear wheels when it is in the 'down' position.

The use of rear wheel mounting hubs positioned between each pair of wheels suits the use of electric

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5 motor systems to drive the rear wheels. The use of such
motors has the inherent advantage of enabling the
problems associated with a solid rear axle to be easily
overcome thereby reducing the weight of the rear wheel
supporting systems, improving load sharing between the
rear tyres and reducing the rear tyre wear effects of
such axles. However, mechanical drive systems may be
utilized with acceptable results. Advantages may be
taken of the rear wheel mounting arrangement to incline
10 one or both of the wheels which are mounted on the hub
at an angle other than vertical so as to improve the
stability of the vehicle during cornering manoeuvres and
when operating on cross (transverse) slopes. The
location of the rear wheel mounting hubs between each
15 pair of wheels allows independent rotation of each wheel
thereby avoiding tyre wear caused by short radius
turning.

In another aspect, the invention provides a load
carrying body for a large vehicle comprising a floor
20 reinforced by strengthening beams, side walls and an end
wall defining a load carrying region, characterized in
that a substantial majority of said strengthening beams
extend longitudinally of said body.

In a preferred form of this aspect of the
25 invention, the body is reinforced by only one
substantial strengthening beam extending transversely of
the vehicle, preferably in the region of a pivot
attachment means for pivoting the body with respect to
a truck. The body preferably also has longitudinal
30 strengthening beams in the side walls, and the traverse
beam also preferably extends into said side walls.

In another aspect of the invention, there is
provided a load carrying body for a large vehicle,
comprising a floor, side walls and an end wall defining
35 a load carrying region, said floor sloping downwardly in
the forward longitudinal direction of said body, said
side walls sloping inwardly towards said floor, and said
floor increasing in width towards the rear longitudinal

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direction of said body.

5 A truck body having the above combination of features has the necessary low centre of gravity and the sloping side walls and the increasing width of the body floor facilitates easier discharge of a load while minimizing wear on the sides of the body.

Brief Description of the Drawings:

10 The foregoing and other features, objects and advantages of the present invention will become more apparent from the following description of the preferred embodiment and the accompanying drawings in which:

Figure 1 is a side elevation of a truck incorporating an embodiment of the invention;

15 Figure 2 is a side elevation similar to Figure 1 with the truck body elevated;

Figure 3 is a rear end elevation of the truck of Figure 1 showing details of the rear suspension and partly illustrating the improved truck body construction;

20 Figure 4 is a fragmentary sectional end elevation with parts removed to show the extent of transverse rotation of one of the two rear wheel mounting hubs in one direction;

25 Figure 5 is a fragmentary plan view of the truck frame with the body removed;

Figure 6 is an enlarged sectional side elevation of one rear wheel mounting and suspension, and

Figure 7 is a plan view of the truck body showing its improved construction.

30 Description of Preferred Embodiment:

Referring to Figures 1 to 5 of the drawings, the truck frame comprises a pair of relatively light longitudinal members 10 and 11 suspending rear wheel mounting hubs 12 and 13 towards their rear ends. The longitudinal members 10 and 11 are connected at their forward ends by a substantial cross member 14, such as a mounting collar which generally includes mounting points for the front suspension (not shown) for the

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front wheels W_r , at the front by a bumper 60 and at the rear, forwarding of the rear wheels, by a cross member 61, which forms part of the support means for the rear wheel mounting hubs 12 and 13, as will be described further below. The front suspension may take the form described in greater detail in our co-pending International Patent Application No. PCT/AU90/00084, or in any other suitable form.

As shown in Figures 3, 4 and 5, the wheel mounting hubs 12 and 13 support drive means for the rear wheels W_r , such as electric traction motors 16, 17, 18 and 19, which are in turn connected to the rear wheels W_r , with each wheel being mounted one on either side of the hubs 12 and 13. The location of the rear wheel mounting hubs 12 and 13 between each pair of rear wheels W_r allows independent rotation of each wheel thereby avoiding tyre wear caused by short radius turning.

The rear suspension system includes rear wheel mounting hubs 12 and 13 mounted to the longitudinal frame members 10 and 11 by means of hollow forwarding extending attachment members 20 which are attached to pivotal mountings 21 which are in turn pivotally secured to a cross member 61 which is rigidly secured to the frame members 10 and 11. The attachment members 20 and the rear wheel mounting hubs 12 and 13 may be formed separately or as an integral unit, and the hollow attachment members 20 operate to convey cooling air to the motors 16 to 19 attached to the hubs 12 and 13.

Each pivotal mounting 21 includes a top transverse journal 22 and a bottom longitudinal journal 23 which allow two rotational degrees of freedom for the hubs 12 and 13. The transverse journal 22 engages spindle sections on the ends of a shaft 24 (Fig. 5) which forms part of the rear cross member 61 for the frame members 10 and 11, which, as shown in Figures 1 and 2, are of increased depth in this region to allow the cross member 61 to penetrate the side plates of the frame members 10 and 11, to which the cross member 61 is rigidly secured

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in some suitable manner. Each lower journal 23 receives the end portion of one of the attachment members 20, within which journal 23 this end portion is free to rotate, the end portion of the attachment member 20 being restrained within the journal by a flange 23a formed on the attachment member 20 and a nut 23b engaging the end portion of the attachment member 20, as shown most clearly in Figure 6 of the drawings.

The frame members 10 and 11 also carry a mounting member 26 for vertically compliant suspension means or spring unit 27, the mounting member 26 also having an integrally formed journal 28 which receives pivot pins 29 about which the body B of the truck pivots. The spring unit 27 includes a cylinder housing 41 rigidly attached to the mounting means 26 and receiving a piston unit 40 which is fixed to the mounting hubs 12,13 by a rearward extension 42. The spring effect may be obtained by the compression of a gas within the cylinder or by other suitable means.

The mounting means 26 has downwardly extending rigid flanges 30 which are adapted to be engaged by a projection 31 extending from each hub 12,13 at a position closely adjacent the flanges 30 whereby transverse rotation of the hubs 12 and 13 is limited.

Rotation of the attachment member 20 and its connected hub 12,13 in the other direction is confined by the cylinder of the spring means 27 to be along the axis of the cylinder 27, and the attachment point of the piston 40 to the rearward extension 41 is allowed by a spherical sliding bearing 45 between the piston 40 and the rearward extension 42.

The above described coupling and spring unit for the rear wheel mounting hubs 12 and 13 allows the hubs 12 and 13 to pivot about both longitudinal and transverse axes to facilitate greater flexibility in the movement of each hub 12,13 with respect to the frame and truck body B. One such movement is illustrated in Figure 4 of the drawings.

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While the above described suspension system is suitable for trucks having frames of the type described above, or of the type otherwise described in our co-pending International Patent Application No. PCT/AU90/00084, it should be appreciated that the suspension system is equally applicable to other forms of truck having independent rear axles supported in a different manner to that described above.

Referring additionally to Figure 7 of the drawings, the truck body B according to a particularly preferred embodiment comprises side walls 60 and 61, a floor 62, a front wall 63 and a forwardly extending cabin-protecting extension 64. The truck body B has a number of novel features, including that the main reinforcing beams under the floor 62, front wall 63 and extension 64 extend longitudinally of the body, as shown at 65 to 70, and only one transverse reinforcing beam 72, located close to or on a line between brackets 73 formed to receive the pivot pin 29 engaging the journals 28, as previously described. Two additional beams 74, 75 and 76, 77 extend along each side 60 and 61 as shown most clearly in Figure 3 of the drawings. Similarly, the cabin cover 64 will be seen to have the smallest strengthening beams as shown in Figure 3. The transverse beam 72 extends the full width of the floor 62, and preferably extends up the sides 60, 61 of the body as shown.

As mentioned earlier in this specification, conventional truck body designs rely on numerous transverse beams, and generally only two longitudinal beams running above the main frame of the truck or along the sides of the body floor. The principal advantages of the new body design described above include a significant reduction in the body weight, and a significant reduction in the manufacturing cost of the body, the body still having sufficient strength to allow it to be supported only at the front and at the body pivots, thereby allowing the weight and cost of the main

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frame of the truck to be reduced as described in greater detail in our co-pending International Patent Application No. PCT/AU90/00084.

5 In additional to the above, the floor 62 and the sides 60 and 61 are sloped in the manner shown in Figures 1, 3, 4 and 7 of the drawings whereby the width of the floor 62 of the body B increases from the front of the body to the rear of the body, as shown most clearly in Figure 7 of the drawings. The advantage of this design feature is that wear on the sides of the body is reduced, because when the body is raised to the tipping position as shown in Figure 2, the load slides into a widening space, rather than being confined to a constant width as for a conventional body design. 10 Furthermore, the weight of the body can be reduced and there is no increase of the overall width of the truck. 15

As described in our earlier International patent application referred to above, the body is elevated by a pair of extendible rams 51 carried by mounting points 50 on the frame cross member 14 and at 52 on the truck body B. 20

It will be appreciated that the truck body features described in greater detail above are equally applicable to trucks of designs other than the design described in greater detail above. 25

Details of the attachment of the traction motors 16 to 19, the front wheel assemblies, the engine and the construction of the truck ancillaries including the driver's cab has not been included in this specification since each of these items can be of relatively standard construction and is within the existing knowledge of a person of skill in the art. It will, however, be noted that the rear axles are independent short axles with one tyre on either side. Whilst the three cross members 14, 60 and 61 provide substantial strength and rigidity between the two main longitudinal members of the main frame, the transverse spacing of the frame members 10 and 11 is also maintained to a significant extent by the 30 35

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direct attachment of the body B to the longitudinal frame members at the pivot mounts 73. This use of the inherent strength of the body B enables a further reduction in the frame strength, weight and cost.

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Claims:

1. A suspension system for a main frame of a very large vehicle, the main frame having a forward section and a rear section, said rear section including spaced frame members each associated with a wheel mounting hub, each hub supporting a pair of rear wheels one either side of the hub, said suspension system comprising a forward attachment means for said hub pivotally mounted on said frame members to allow limited rotation of said hub about a longitudinal and a transverse axis relative to each frame member, and a vertically compliant suspension means limiting rotation of said hub about said transverse axis, said suspension means being rigidly attached to said frame member to prevent lateral movement of said hub in the transverse plane relative to said frame member and being actively coupled to said hub in a manner which allows longitudinal movement of said hub relative to said suspension means as the hub rotates about said transverse axis and to permit rotation of said hub about said longitudinal axis.
2. The system of claim 1, wherein said suspension means is actively coupled to said hub by a rearward extension from said hub received within a slidable bearing means carried by said suspension means, said slidable bearing means allowing said longitudinal movement of said hub and rotation of said hub about said longitudinal axis.
3. The system of claim 1 or 2, wherein said forward attachment member is substantially hollow to convey cooling air to drive motors supported by said rear wheel mounting hub.
4. The system of any one of claims 1 to 3, wherein said forward attachment member is received within one journal of a bearing block having a further journal extending transversely to said one journal, said transverse journal receiving a shaft rigidly secured to the frame member.
5. The system of claim 4, wherein said shaft extends

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between said spaced frame members to define a rear cross member for said spaced frame members.

5 6. The system of any preceding claim, wherein said suspension means is carried by a rigid support member which is rigidly attached to said frame member, said support member having downwardly extending flange means positioned to be engaged by an abutment formed on said hub to limit transverse rotation of said hubs.

10 7. A large substantially rigid vehicle frame comprising a main frame having a front section and a rear section, said front section carrying forward frame means for supporting at least two front wheels, said rear section including spaced frame members each having a suspension system carrying a wheel mounting hub, each
15 hub supporting a pair of rear wheels one on either side of said hub, a substantially rigid load supporting body, means for pivotally mounting said body with respect to said frame, means for maintaining transverse spacing between said rear wheel pairs, said suspension system
20 being as defined in any one of the preceding claims.

8. The vehicle frame according to claim 7, wherein said body is pivotally mounted on said main frame such that pivotal movement of said body is about an axis which lies within the profile of the rear wheel pairs,
25 said body being supported only at said pivot points and at not more than two points near the front of the body and lying close to a line between the centres of the front wheels of the frame.

9. The frame of claim 7 or 8, further comprising
30 hydraulic cylinders used to tip the body about its pivot points, said hydraulic cylinders being mounted at points which are close to the line between the centres of the front wheels of the vehicle.

10. A load carrying body for a large vehicle comprising
35 a floor reinforced by strengthening beams, side walls and an end wall defining a load carrying region, characterized in that a substantial majority of said strengthening beams extend longitudinally of said body.

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11. The body of claim 10, wherein said body is reinforced by only one substantial strengthening beam extending transversely of the vehicle.

5 12. The body of claim 10 or 11, wherein said transverse strengthening beam is located in the region of a pivot attachment means for pivoting the body with respect to a truck.

10 13. The body of claim 10, 11 or 12, further comprising longitudinal strengthening beams in the side walls, said traverse beam also extending into said side walls.

15 14. A load carrying body for a large vehicle, comprising a floor, side walls and an end wall defining a load carrying region, said floor sloping downwardly in the forward longitudinal direction of said body, said side walls sloping inwardly towards said floor, and said floor increasing in width towards the rear longitudinal direction of said body.

20 15. A load carrying body according to claim 14 further comprising reinforcing beams as defined in claim 10 or 11.

16. A very large vehicle comprising a frame and suspension system as defined in claim 7, 8 or 9, and a load carrying body as defined in claim 10, 11, 14 or 15.

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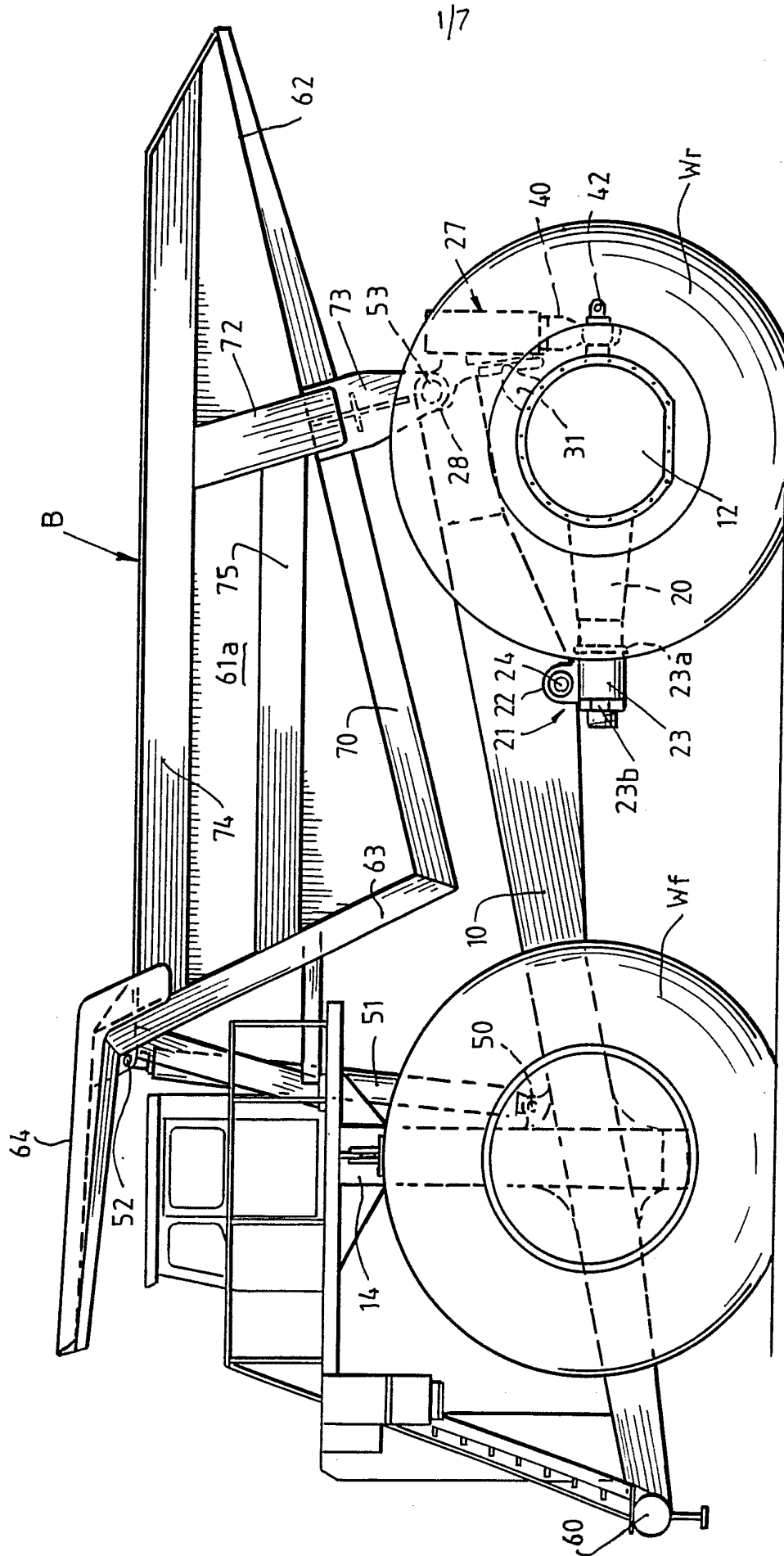


Fig. 1.

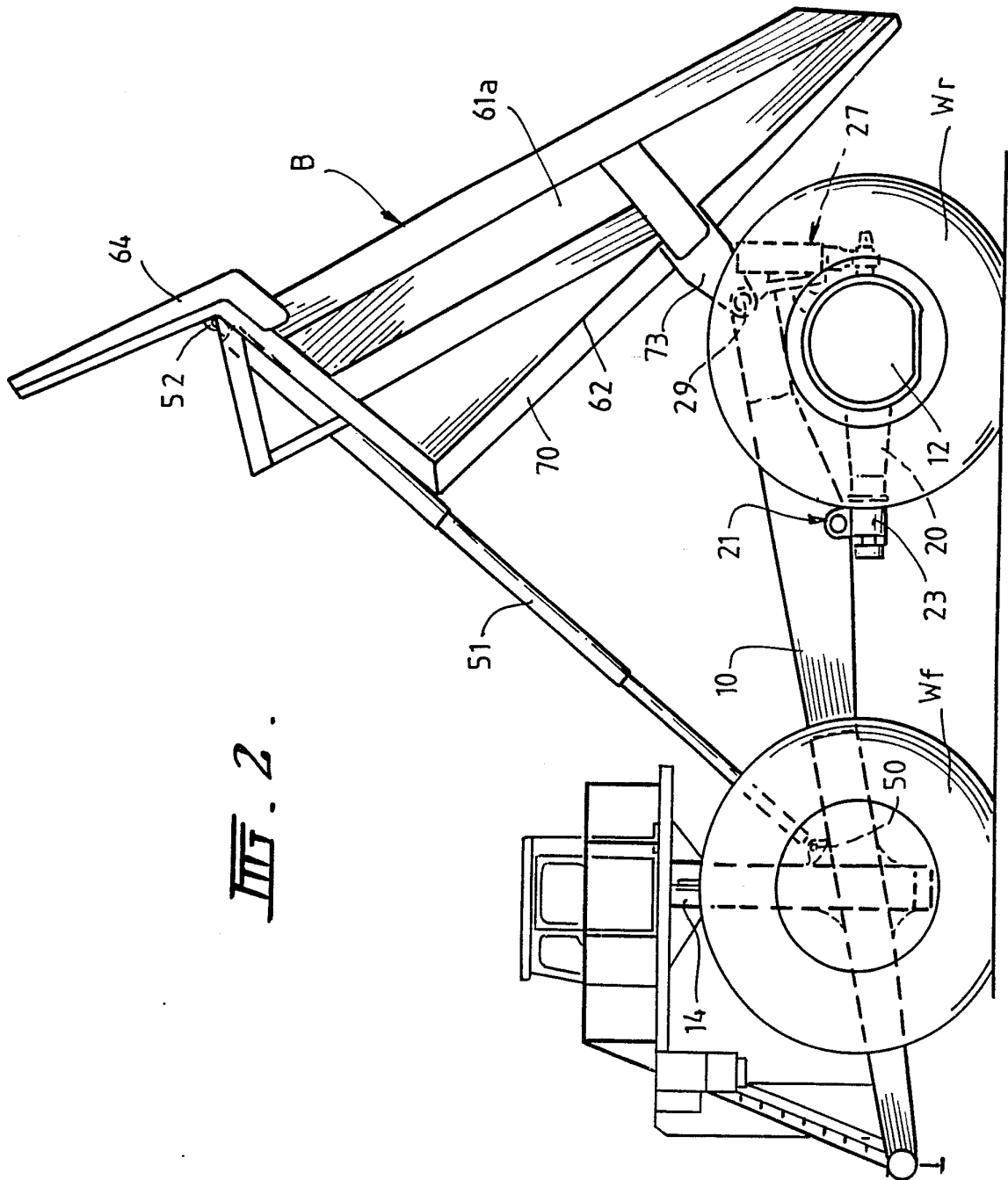
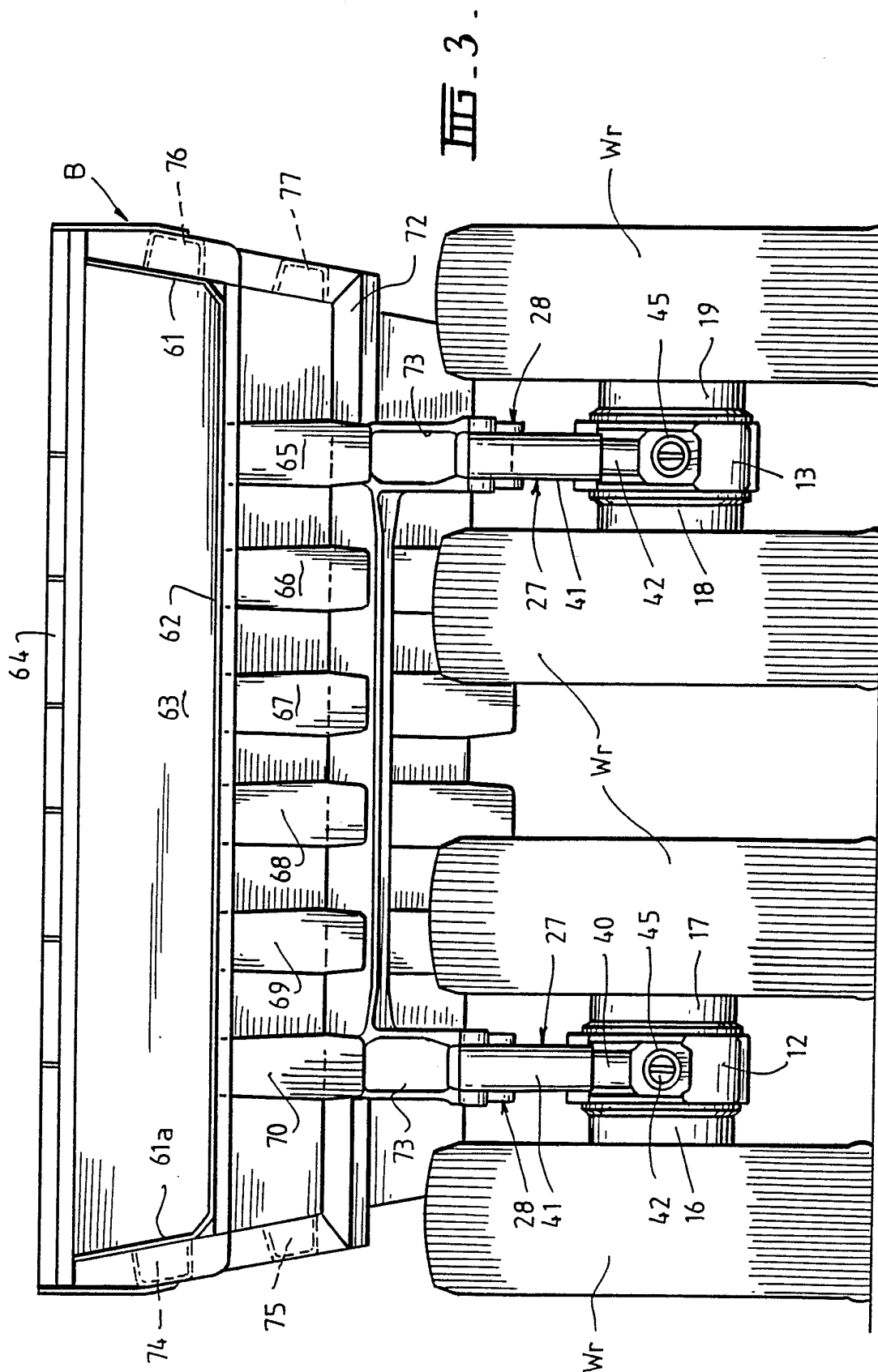


Fig. 2.

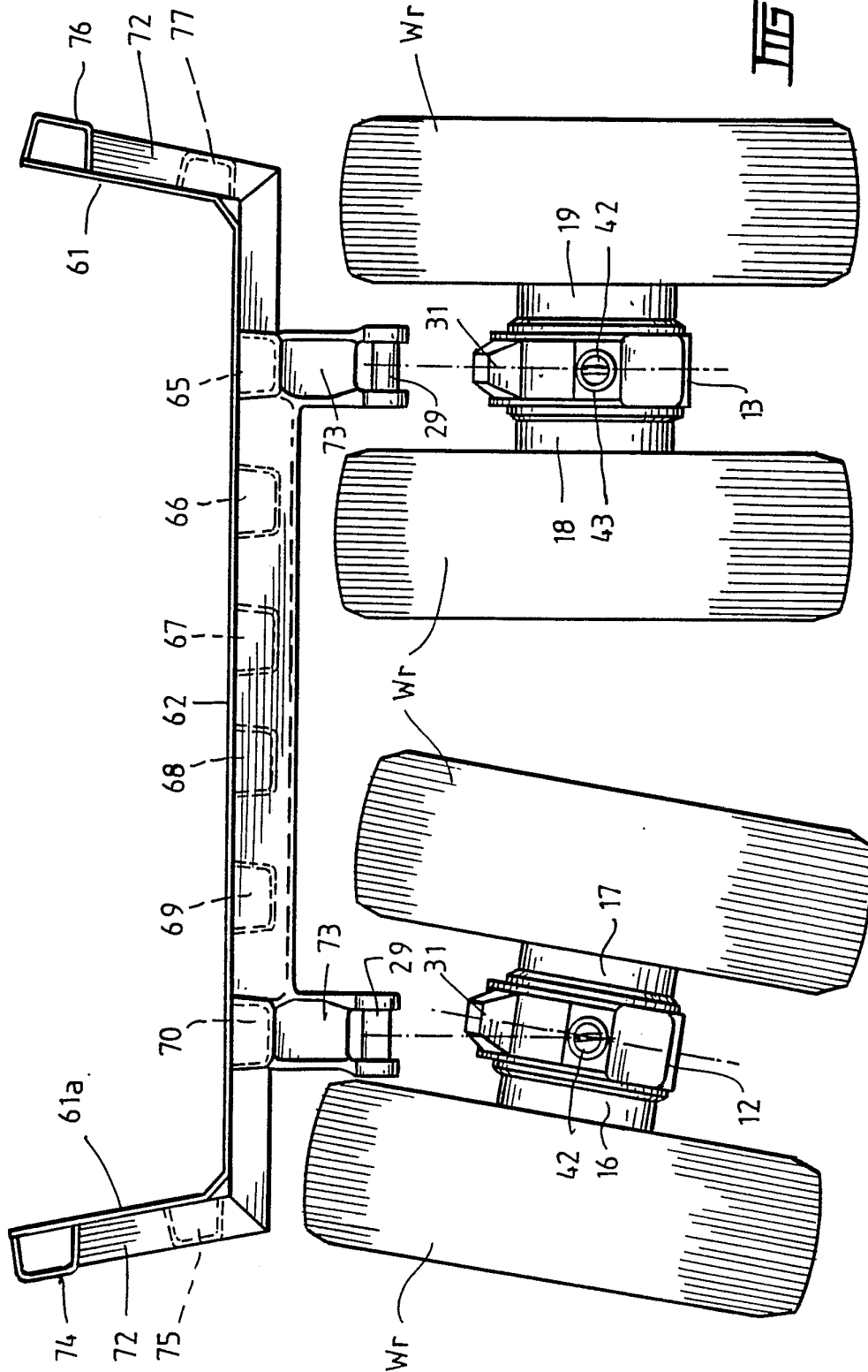
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Fig. 4.



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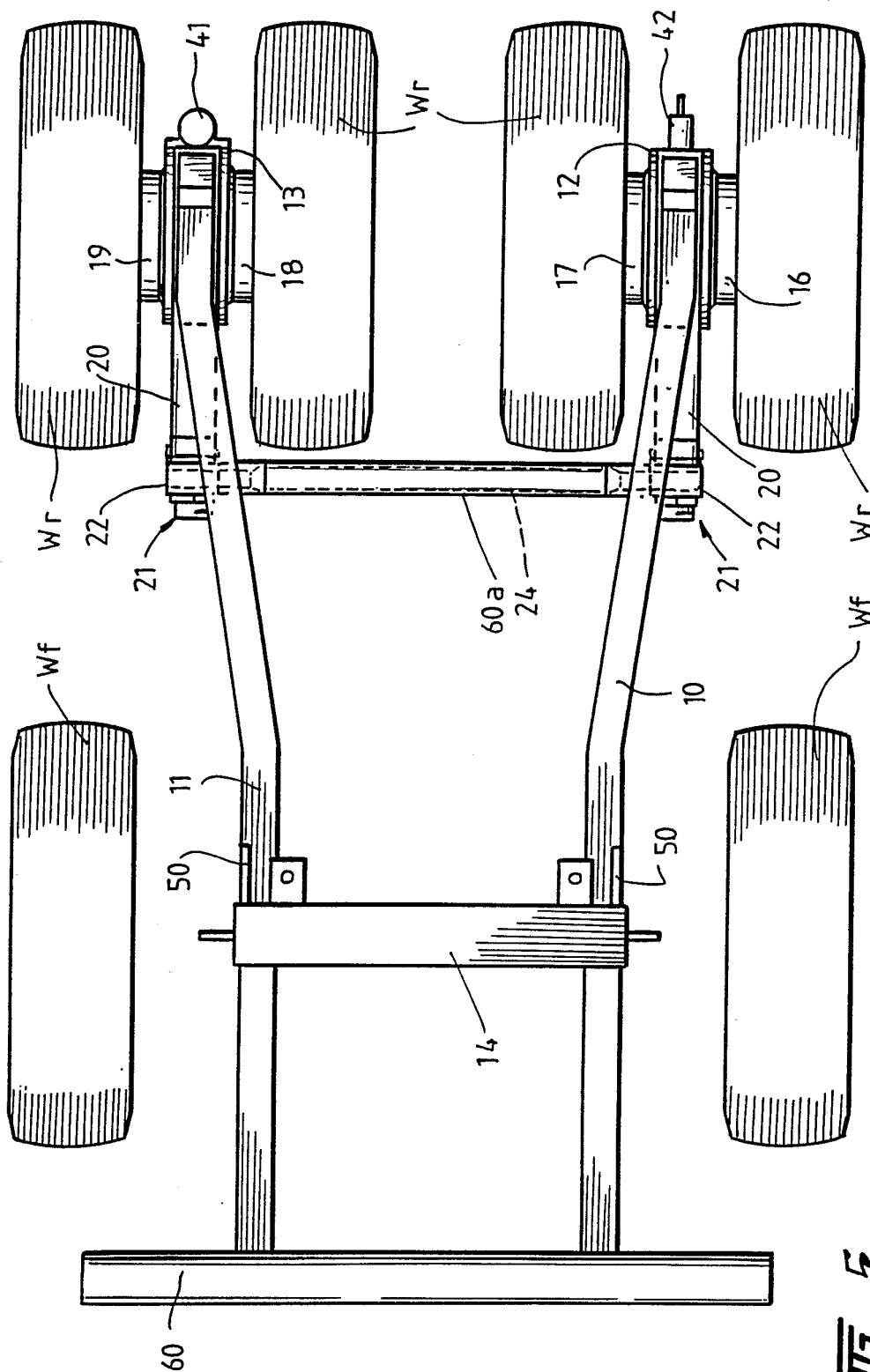
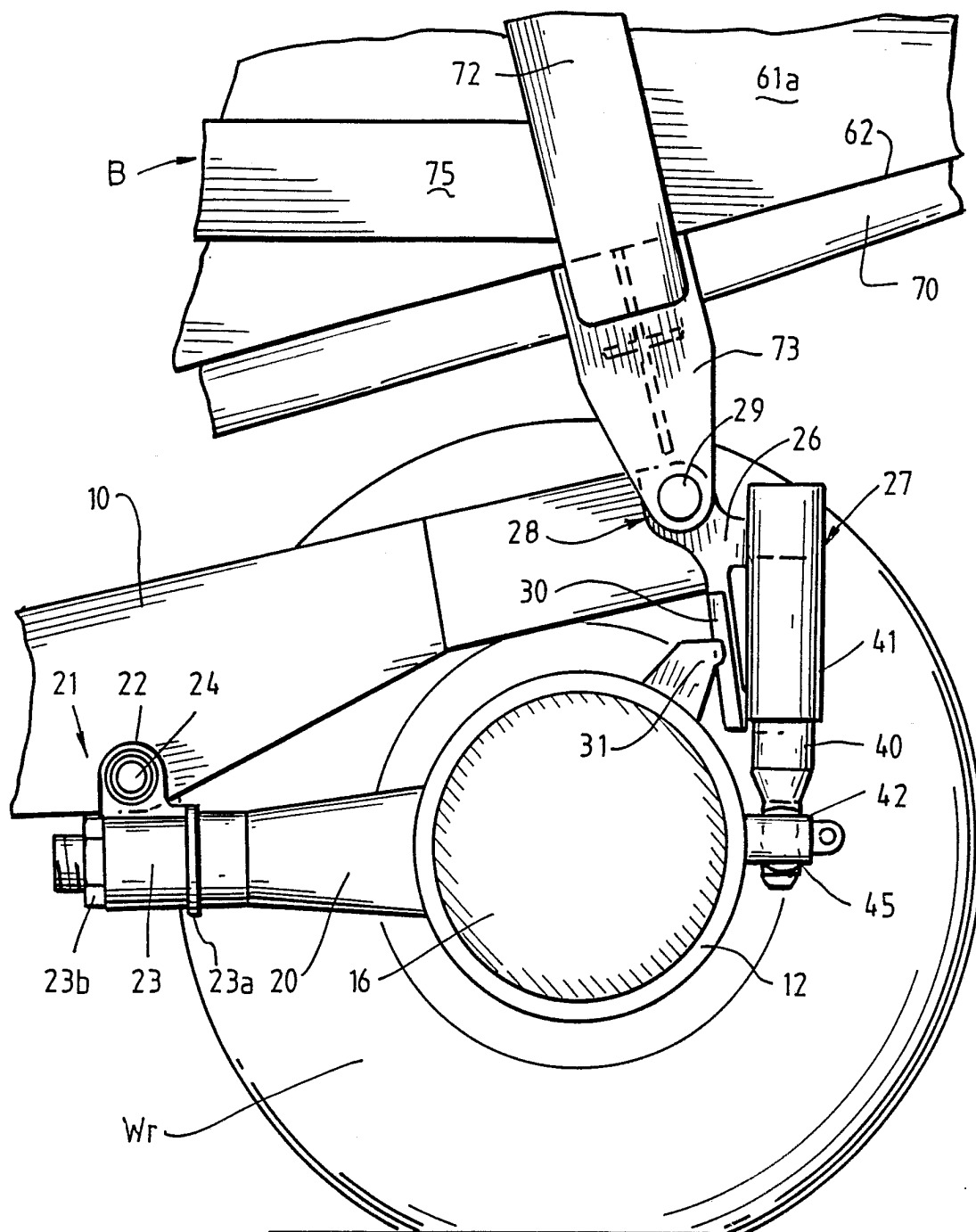
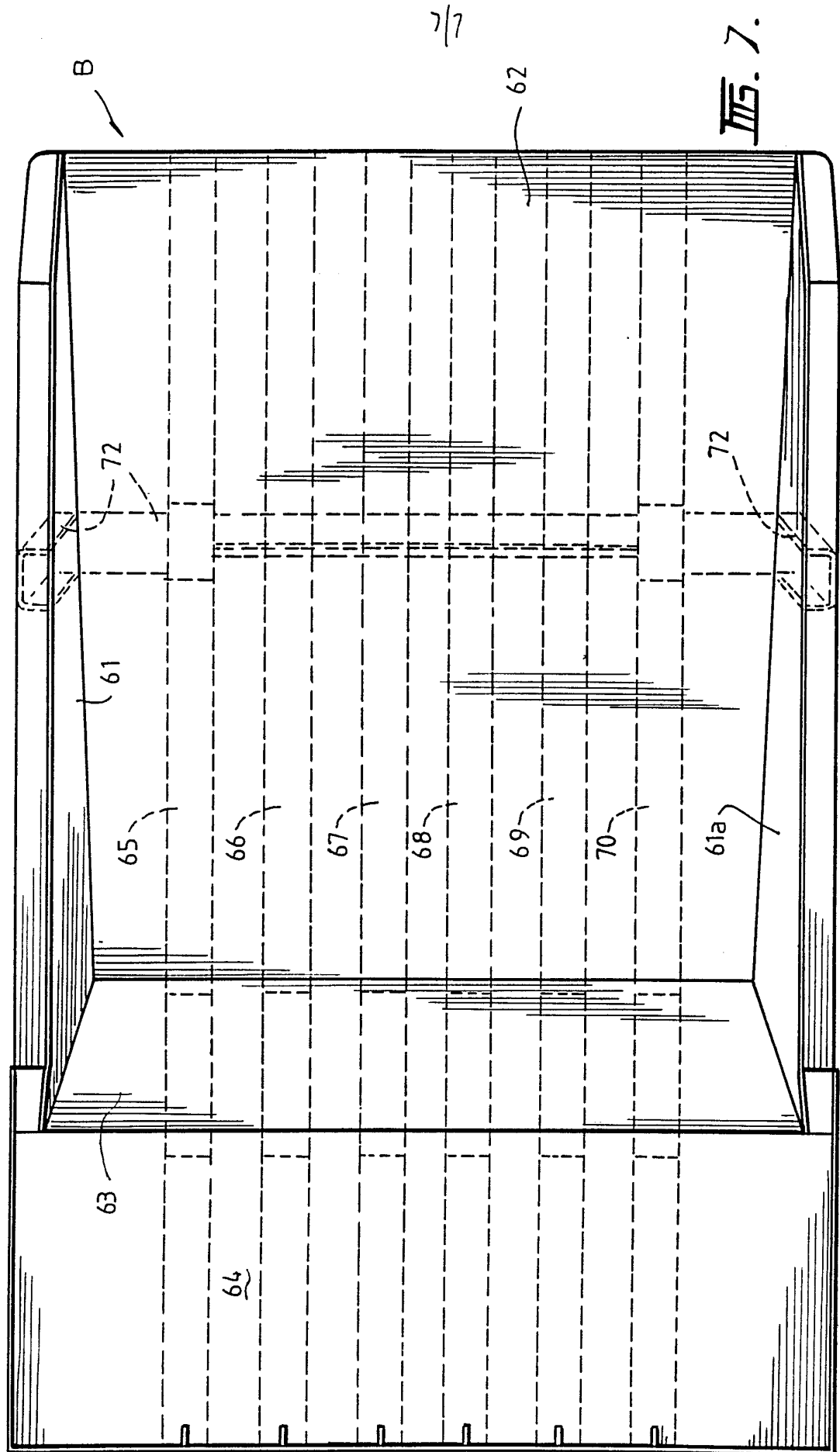


Fig. 5.

FIG. 6.



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INTERNATIONAL SEARCH REPORT

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)⁶

According to International Patent classification (IPC) or to both National Classification and IPC
Int. Cl.⁵ B60G 3/14, 7/02, 9/02, B60P 1/28, 9/00, B62D 33/02

II. FIELDS SEARCHEDMinimum Documentation Searched⁷

Classification System

Classification Symbols

IPC

B60G 3/14, 7/02, 9/02, B60P 1/28, B62D 33/02

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched⁸

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹

Category [*]	Citation of Document, ¹¹ with indication, where appropriate of the relevant passages ¹²	Relevant to Claim No ¹³
X	US,A, 3940163 (DAVIS et al) 24 February 1976 (24.02.76). See the abstract; column 3, line 53 to column 6, line 53 and the drawings.	(1-2, 4)
X	US,A, 3773348 (DAVIS) 20 November 1973 (20.11.73). See the abstract; column 2, line 23 to column 3, line 68 and Figs. 1, 2 & 4.	(1-2, 4)
A	DE,A, 3434297 (MAYER) 27 March 1986 (27.03.86). See the abstract and the drawings.	(1)
(continued)		

* Special categories of cited documents : ¹⁰

"A" Document defining the general state of the art which is
not considered to be of particular relevance
"E" earlier document but published on or after the
international filing date
"L" document which may throw doubts on priority claim(s)
or which is cited to establish the publication date of
another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use,
exhibition or other means
"P" document published prior to the international filing date
but later than the priority date claimed

"T"

Later document published after the international
filing date or priority date and not in conflict
with the application but cited to understand the
principle or theory underlying the invention
"X" document of particular relevance; the claimed
invention cannot be considered novel or cannot be
considered to involve an inventive step
"Y" document of particular relevance; the claimed
invention cannot be considered to involve an
inventive step when the document is combined
with one or more other such documents, such
combination being obvious to a person skilled in
the art
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search
5 December 1991 (05.12.91)

Date of Mailing of this International Search Report

11 December 91

International Searching Authority

AUSTRALIAN PATENT OFFICE

Signature of Authorized Officer.

C.M. WYATT

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category*	Citation of Document, ¹¹ with indication, where appropriate of the relevant passages ¹²	Relevant to Claim No ¹³
A	DE,A, 2830450 (S.A. AUTOMOBILES CITROEN et al) 15 February 1979 (15.02.79). See claim 1 and the drawings.	(3)
A	GB,A, 963370 (SCAMMELL LORRIES LIMITED) 8 July 1964. See page 1, line 19 to page 2, line 21 and the drawings.	(1)
X	US,A, 3897972 (LOGUE) 5 August 1975 (05.08.75). See the abstract and the drawings.	(10-11, 13)
X	CH,A, 416346 (SCHAEFF) 31 January 1967 (31.01.67). See page 1, line 41 to page 2, line 56 and the drawings.	(10-11, 13)
X	GB,A, 954178 (SWISS ALUMINIUM LIMITED) 2 April 1964 (02.04.64). See page 1, lines 28 to 37 and the drawings.	(10-11)
X	DERWENT ABSTRACT ACCESSION NO. B7994D/09, Class Q15 Q22, SU,A, (RUMSHEVICHIN) 25 May 1980 (25.05.80). See the abstract.	(10)
X	PATENTS ABSTRACTS OF JAPAN, M-72, page 132, JP,A, 56-34574 (SHINMEIWA KOGYO K.K.) 4 June 1981 (04.06.81). See the abstract.	(10)
X	CH,A, 374556 (NENCKI) 28 February 1964 (28.02.64). See Figs. 1 & 2.	(14)
X	CH,A, 383791 (RIESEN) 15 January 1965 (15.01.65). See Figs. 1 & 2.	(14)
A	FR,A, 1145351 (ATHEY PRODUCTS CORPORATION) 25 October 1957 (25.10.57). See Figs. 1 to 4.	(14)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers ..., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4a

VI. ☒ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

Claims 1 to 9 define a suspension system and a vehicle frame which includes the suspension system; claims 10 to 13 define a load carrying body with reinforcing beams and claim 14 defines a load carrying body with a particular shape. The three sets of claims do not possess a common novel feature.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 91/00389**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	3940163	CA	965123		
US	3773348	AU	53184/73	CA	977380 JP 49061820
DE	2830450	FR	2397298		