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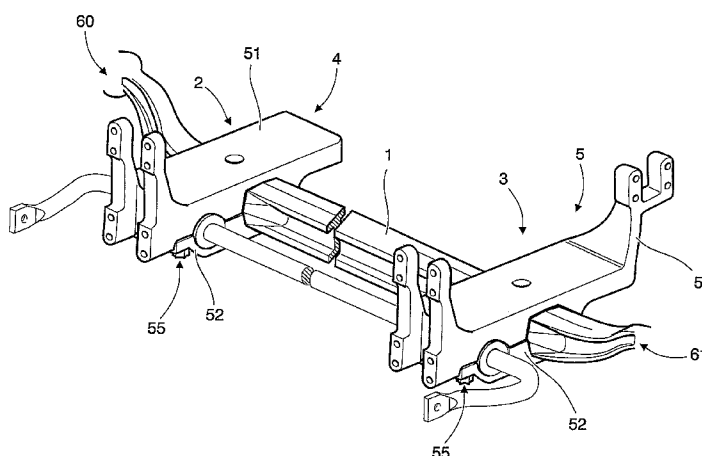
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(54) Title: AN AXLE SUSPENSION ASSEMBLY FOR A HEAVY VEHICLE



(57) Abstract: An axle suspension assembly for a heavy vehicle, which assembly comprises an axle (1) having a first receiving portion (2) and second receiving portion (3) which first and second receiving portions (2, 3) are situated adjacent to the respective distal end of said axle (1). The assembly further comprises a first mounting bracket (4) attached to the axle (1) at the first receiving portion (2) and a second mounting bracket (5) attached to the axle (1) at the second receiving portion (3), for mounting the axle (1) on a vehicle chassis. Each of the first and second mounting brackets (4, 5) comprises a first mounting member (51) and a second mounting member (52), wherein the first mounting member (51) and the second mounting member (52) are arranged on opposite sides of the axle (1) at the first/second receiving portion (2; 3), and are attached to the axle (1) by a fastening means (55) interconnecting the first mounting member (51) and the second mounting member (52) to each other.



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An axle suspension assembly for a heavy vehicle

TECHNICAL FIELD

- 5 The present invention relates to an axle suspension assembly for a heavy vehicle, such as a truck or the like, according to the preamble of claim 1.

PRIOR ART

- 10 A front axle suspension assembly of this kind is a well-known design in relation to heavy vehicle, where the suspension mounting brackets are positioned onto the receiving portions and bolted to the axle.

BACKGROUND AND SUMMARY OF THE INVENTION

- 15 The majority of heavy vehicles such as trucks have their front wheels suspended on a rigid front axle and steering knuckles. The front axle is typically an integral unit made of heat-treated, drop-forged special steel. The steering knuckles are flexibly attached to the front axle by king pins, which are rotatably mounted at both ends. The upper bearing mounting
20 consists of taper roller bearings, which absorb the front axle pressure and the lateral movement of the vehicle. The lower king pin bearings consists of bushings, which only absorb the load from the lateral movement. The front axle is attached to the vehicle frame with the aid of suspension members adjacent each front wheel. These suspension members may be in the form of springs, e.g. leaf springs, or air springs e.g. air bags or air bellows, to
25 absorb the unevenness of the road.

- The use of air suspension as the means for suspending the vehicle chassis on all axles has become more and more popular for heavy vehicles for use in many areas of transportation, mainly within distribution long-distance transport. Air spring suspension has several
30 advantages. Air suspension increases the ride comfort and reduces the risk of goods being damaged. An air suspension system allows for automatic level control of the vehicle and thereby contributing to good road properties for the vehicle as well as extra comfort.

- In later developments of heavy vehicle, the air spring suspension system is equipped with an
35 electronic controlled air suspension system (ECS: Electronic Controlled Suspension). By this ECS system the height may be regulated by an electronic unit that is integrated in the vehicle electronic system. The control unit cooperates with a level sensor which constantly

measures the spring level during driving. The control unit then regulates solenoid valves, which in turn, regulate the amount of air in the air bellows of the air suspension system.

5 By an air suspension system, it is also possible to provide a manual level control system with pre-programmed loading dock heights to facilitate the handling of goods to be loaded and unloaded from the vehicle. Accordingly, by using air suspension it is possible to lifting the vehicle level even when the engine is off.

10 The limits to the height that the vehicle can be raised or lowered to are defined by the structural design of the chassis elements. Therefore, it is an object of the present invention to provide an axle suspension assembly, in particular a front axle suspension assembly that allows for an increase in the highest and lowest level.

15 The invention is based on the insight that by redesigning an axle such as a rigid front axle, and mounting brackets for suspension of the axle, an increase in the range in chassis heights can be achieved.

20 By the provision of an axle suspension assembly according to claim 1, the mounting brackets do not need to be bolted to the axle, rather the mounting brackets can be mounted around the axle. Hereby, the installation height of the mounting bracket on the axle can be significantly reduced. It is found that by the axle suspension assembly for a heavy vehicle according to the invention, the installation height can in some cases be reduced with as much as 30 mm, which in turn means that the available lifting height of the chassis on air suspended trucks may be increased with double this installation height reduction. This
25 means that a heavy vehicle may be provided where the performance of the air suspension system is increased without reducing the clearance height of the truck. Thanks to the invention, the axle suspension assembly can be made more compact without decreasing the strength of the axle suspension assembly.

30 The first mounting member is preferably provided with a downwardly open cavity having a shape corresponding to the upper section of the current receiving portion, and the second mounting member is preferably provided with an upwardly open cavity having a shape corresponding to the lower section of the current receiving portion. The shape of the cavity of the upper mounting member and the shape of the cavity of the lower mounting member are
35 matching the geometric shapes of the upper section and the lower section, respectively, of the receiving portion of the front axle. Thus, the axle is designed to receive the mounting members which are clamped on the axle at the respective receiving portion. The cross-section of the axle at the receiving portion is preferably designed substantially rectangular

with an upper surface and a lower surface, and sloping side walls. On each side of the axle a cavity extending in the longitudinal direction of the axle can be arranged approximately on half the height of the axle. The mounting members are provided with cavities corresponding to the shape of the receiving portion of the axle, but preferably a bit smaller in size, so that
5 the mounting members are pressed onto the axle during the mounting.

The cross-section of the first/second receiving portion of the axle preferably exhibits an upper section which is tapered. Preferably, the cross-section of the first/second receiving portion exhibits a lower section which is also tapered. This means the axle can have double-
10 conic shape where the axle dimension is increased in the direction from the upper surface towards the centre of the axle and in the direction from the bottom surface towards the centre of the axle. As regards both the upper and the lower section of the axle at the first/second receiving portion, the side surfaces of the current section can slope relative to the top/bottom surface with various angles, preferably with an angle in the interval 3-15°, and
15 more preferably in the interval 5-12°. An angle of approx. 8° has been found to give a geometric shape of the axle suitable for receiving a mounting member to be clamped around the axle.

By the provision of such a conical cross section, mounting members having a corresponding
20 geometric shape can be clamped on the axle to achieve a strong and compact suspension of the axle.

The upper mounting member and the lower mounting member are clamped around the axle and thereby providing a preloaded mounting around the receiving portion of the axle. The
25 upper mounting member and lower mounting member are preferably interconnected by a plurality of bolts, and the bolts are pretensioned for preloading the mounting bracket when clamped around the current receiving portion of the axle. Suitably about half of the force used during mounting is absorbed in deforming the mounting members (and possibly the axle) to put the mounting members into the right position relative to the axle, and the
30 remaining force is absorbed as preloading the fastening means, which implies that when using bolts, the bolts are preloaded in the axial direction.

The axle can be manufactured by a drop-forge process. By means of a subsequent heat treatment in calibrating tools the final cross-section shape having sloping side surfaces can
35 be achieved. During this treatment surplus material is pressed out beneath the sloping side walls and into the longitudinal cavity along the axle.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples:

5

In the drawings:

- Fig. 1 is a perspective view of the frontal portion of a heavy vehicle,
Fig. 2 is a perspective view of a rigid front axle according to prior art,
10 Fig. 3 is a perspective view of a front axle suspension assembly according to prior art,
Fig. 4 is a perspective view of a front axle suspension assembly according to the invention,
Fig. 5 is an exploded view of the axle suspension assembly illustrated in Fig. 4, and
Fig. 6 is a cross-section lateral view of the axle suspension assembly illustrated in Fig.
15 4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

With reference to the figures 1-3, a conventional front axle suspension assembly for a heavy
20 vehicle is shown. A rigid front axle 1 is suspended from a vehicle chassis frame having two longitudinal beams 6, 7 extending in the driving direction. The axle 1 is mounted via left and right mounting brackets 4, 5 arranged at left and right receiving portions 2, 3 on the axle 1. As shown in figure 3, the axle 1 is designed for both shock absorber and air suspension means 8. In figure 3 an air bellow 8 is mounted between the respective mounting bracket 4,
25 5 and the longitudinal chassis frame beams 6, 7. Although the features described with reference to Figs. 1-3 belong to prior art, of course at least some of these features can be used together with the invention. In the following same reference numerals will be used for same or corresponding components when the components specific to the invention are discussed.

30

In the conventional design of the front axle 1 shown in figures 1-3, the axle is provided with bore holes and the mounting brackets 4, 5 are bolted onto the top of the axle 1.

In figures 4-6 an axle suspension assembly according to the invention is illustrated. The
35 assembly comprises an axle 1 having a first receiving portion 2 and second receiving portion 3 which first and second receiving portions 2, 3 are situated adjacent to the respective distal end 60, 61 of said axle 1. A first mounting bracket 4 is attached to the axle 1 at the first

receiving portion 2 and a second mounting bracket 5 is in the same way attached to the axle 1 at the second receiving portion 3, for mounting the axle 1 on a vehicle chassis.

Each of the first and second mounting brackets 4, 5 comprises a first mounting member 51 and a second mounting member 52. The first mounting member 51 and the second mounting member 52 are arranged on opposite sides of the axle 1 at the first/second receiving portion 2; 3, and are attached to the axle 1 by a fastening means 55 interconnecting the first mounting member 51 and the second mounting member 52 to each other. Thus, according to the invention and in contrary to the prior art, the mounting brackets 4, 5 are not bolted to the axle, but instead the first mounting member 51 and the second mounting member 52 of the respective mounting bracket are attached to the axle by for example bolts, which bolts interconnect the first and second mounting member. In this way, the two-part mounting bracket can be clamped around the axle 1 and mounted to the axle without making any holes in the axle. By arranging the mounting brackets 4, 5 around the axle 1 rather than on top of the axle 1, a more compact suspension assembly is achieved where the suspension assembly height may be reduced without reducing the strength of the axle suspension assembly or reducing the ground clearance.

In the embodiment illustrated in figs. 4-6, see for example figure 6, the first mounting member 51 is provided with a shape corresponding to a first section 63 of the cross-section of the first/second receiving portion 2; 3 of the axle 1, and the second mounting member 52 is provided with a shape corresponding to a second section 64 of the cross-section of the first/second receiving portion 2; 3 of the axle 1.

As appears from figures 5 and 6, the first mounting member 51 can be provided with a downwardly open cavity 53 having a shape corresponding to the upper section 63 of the first/second receiving portion 2; 3, and the downwardly open cavity 53 is preferably slightly smaller than said corresponding upper section 63 of the first/second receiving portion 2; 3 so as to obtain a preloaded mounting when the first mounting member 51 is arranged on the axle 1. In a similar way, the second mounting member 52 can be provided with an upwardly open cavity 54 having a shape corresponding to the lower section 64 of the first/second receiving portion 2; 3, and the upwardly open cavity 54 is preferably slightly smaller than said corresponding lower section 64 of the first/second receiving portion 2; 3 so as to obtain a preloaded mounting when the second mounting member 52 is arranged on the axle 1.

Thus, the axle 1 is provided with a predetermined cross-sectional shape in the receiving portions 2; 3, for receiving the first and second mounting members 51, 52.

Although other fastening means are possible, one or more bolts 55 can preferably be used for interconnection of the first and second mounting member. The bolts 55 can be positioned in through holes 56 in one of the first mounting member 51 and the second mounting member 52 (in the lower mounting member 52 in the illustrated example) and positioned in threaded holes 57 in the other of the first mounting member 51 and the second mounting member 52 (in the upper mounting member 51 in the illustrated example). The bolts 55 can be pretensioned for preloading the first/second mounting bracket 4; 5 when being arranged on the first/second receiving portion 2; 3. Thus, the lower mounting member 52 is preferably provided with a series of bolt through holes 56, and the mating upper mounting member 51 is provided with corresponding bolt holes 57 having an internal threading.

The upper or first section 63 of the axle 1 is preferably tapered in a direction radially outwardly from the axle. The upper section can have the shape of a truncated cone. Then the first section 63 has a top surface 65 and at least one side surface 11, 12 sloping relative to the top surface 65 with an angle θ in the interval 3-15°, and more preferably in the interval 5-12°. In the illustrated embodiment both side surfaces 11, 12 slope with substantially the same angle of approximately 8° relative to the top surface 65.

In the same way the lower or second section 64 of the axle 1 is preferably tapered in a direction radially outwardly from the axle. The lower section can have the shape of a truncated cone. Then the second section 64 has a bottom surface 66 and at least one side surface 13, 14 sloping relative to the bottom surface 66 with an angle θ in the interval 3-15°, and more preferably in the interval 5-12°. In the illustrated embodiment both side surfaces 13, 14 slope with substantially the same angle of approximately 8° relative to the bottom surface 66.

As appears from Fig. 6, in the illustrated embodiment the cross-section of the receiving portion 3 of the axle 1 exhibits said tapered upper section 63 and said tapered lower section 64. On each side of the axle 1 between the upper and the lower section the axle 1 is provided with a cavity 15. The cavity 15 extends in the longitudinal direction of the axle 1 on each side of the axle. In the example, the tapered upper portion is provided with said top surface 65 with tapered side portions 11, 12 sloping towards the top surface at approx. 8° and the tapered lower portion is provided with said bottom surface 66 and with tapered side portions 13, 14 sloping towards the bottom surface at approx. 8°.

The shape of the cavity 53 of the upper mounting member 51 and the shape of the cavity 54 of the lower mounting member 52 are matching the geometric shapes of the upper section and the lower section, respectively, of the receiving portion 3 of the front axle 1. As shown in

fig. 6, the cross-section of the axle 1 may be designed substantially rectangular with sloping side walls at the current positions and with said longitudinal cavity 15 arranged on the middle, i.e. on approximately half the height of the axle, of each side of the axle 1. By forming the axle 1 in special steel using drop-forge manufacturing, a high-strength rigid front
5 axle can be achieved. After the drop-forge process, a heat treatment in calibrating tools is performed, whereby surplus material is pressed out beneath the sloping side walls 11, 12 and above the sloping side walls 13, 14, and into the longitudinal cavities 15 along the sides of the axle 1.

10 The mounting members 51, 52 are provided with said cavities 53, 54 corresponding to the shape of the receiving portion 2; 3 of the axle 1, but preferably a bit smaller in size, so that the bracket members 51, 52 are pressed onto the axle 1 towards each other during the mounting. In a preferred embodiment, the suspension assembly parts are dimensioned in such a manner that about half of the tension force created in the bolts 55 is absorbed in
15 deforming the mounting members and the remaining bolt tension force is absorb as axial preloading in the screws.

It is to be understood that the present invention is not limited to the embodiments described above and illustrated in the drawings; rather, the skilled person will recognize that many
20 changes and modifications may be made within the scope of the appended claims.

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Claims

1. An axle suspension assembly for a heavy vehicle, said assembly comprising an axle (1)
5 having a first receiving portion (2) and second receiving portion (3) which first and second receiving portions (2, 3) are situated adjacent to the respective distal end of said axle (1), and a first mounting bracket (4) attached to the axle (1) at the first receiving portion (2) and a second mounting bracket (5) attached to the axle (1) at the second receiving portion (3), for mounting the axle (1) on a vehicle chassis, **characterised in that** each of the first and
10 second mounting brackets (4, 5) comprises a first mounting member (51) and a second mounting member (52), wherein the first mounting member (51) and the second mounting member (52) are arranged on opposite sides of the axle (1) at the first/second receiving portion (2; 3), and are attached to the axle (1) by a fastening means (55) interconnecting the first mounting member (51) and the second mounting member (52) to each other.
15
2. An axle suspension assembly according to claim 1, wherein the first mounting member (51) is provided with a shape corresponding to a first section (63) of the cross-section of the first/second receiving portion (2; 3), and the second mounting member (52) is provided with a shape corresponding to a second section (64) of the cross-section of the first/second
20 receiving portion (2; 3).
3. An axle suspension assembly according to claim 2, wherein said shape of the first mounting member (51) is an open cavity (53).
- 25 4. An axle suspension assembly according to claim 3, wherein the open cavity (53) is slightly smaller than said first section (63) so as to obtain a preloaded mounting when the first mounting member (51) is arranged on the axle (1).
5. An axle suspension assembly according to claim 3 or 4, wherein the open cavity (53) of
30 the first mounting member (51) is directed substantially downwardly when the first mounting member is arranged on the axle.
6. An axle suspension assembly according to any of claims 2-5, wherein the first section (63) is an upper section of the first/second receiving portion (2; 3).
35
7. An axle suspension assembly according to any of claims 2-6, wherein said shape of the second mounting member (52) is an open cavity (54).

8. An axle suspension assembly according to claim 7, wherein the open cavity (54) is slightly smaller than said second section (64) so as to obtain a preloaded mounting when the second mounting member (52) is arranged on the axle (1).
- 5 9. An axle suspension assembly according to claim 7 or 8, wherein the open cavity (54) of the second mounting member (52) is directed substantially upwardly when the second mounting member is arranged on the axle.
- 10 10. An axle suspension assembly according to any of claims 2-9, wherein the second section (64) is a lower section of the first/second receiving portion (2; 3).
11. An axle suspension assembly according to any preceding claim, wherein the first/second mounting bracket (4; 5) is connectable to air suspension means (8).
- 15 12. An axle suspension assembly according to claim 11, wherein the first/second mounting bracket (4; 5) is provided with air bellow means (8).
13. An axle suspension assembly according to any preceding claim, wherein the fastening means comprises one or more bolts (55).
- 20 14. An axle suspension assembly according to claim 13, wherein the bolts (55) are positioned in through holes (56) in one of the first mounting member (51) and the second mounting member (52), and positioned in threaded holes (57) in the other of the first mounting member (51) and the second mounting member (52), whereby the bolts (55) are
- 25 pretensioned for preloading the first/second mounting bracket (4; 5) when being arranged on the first/second receiving portion (2; 3).
15. An axle suspension assembly according to any preceding claim, wherein said first section (63) is tapered.
- 30 16. An axle suspension assembly according to claim 15, wherein said first section (63) has a top surface (65) and at least one side surface (11, 12) sloping relative to the top surface (65) with an angle θ in the interval 3-15°.
- 35 17. An axle suspension assembly according to claim 15, wherein said first section (63) has a top surface (65) and at least one side surface (11, 12) sloping relative to the top surface (65) with an angle θ in the interval 5-12°.

18. An axle suspension assembly according to claim 15, wherein said first section (63) has a top surface (65) and at least one side surface (11, 12) sloping relative to the top surface (65) with an angle θ of approximately 8° .
- 5 19. An axle suspension assembly according to any preceding claim, wherein said second section (64) is tapered.
20. An axle suspension assembly according to claim 19, wherein said second section (64) has a bottom surface (66) and at least one side surface (13, 14) sloping relative to the
10 bottom surface (66) with an angle θ in the interval $3\text{-}15^\circ$.
21. An axle suspension assembly according to claim 19, wherein said second section (64) has a bottom surface (66) and at least one side surface (13, 14) sloping relative to the top bottom surface (66) with an angle θ in the interval $5\text{-}12^\circ$.
- 15 22. An axle suspension assembly according to claim 19, wherein said second section (64) has a bottom surface (66) and at least one side surface (13, 14) sloping relative to the bottom surface (66) with an angle θ of approximately 8° .
- 20 23. An axle suspension assembly according to any preceding claim, wherein the axle (1) is a front axle.
24. A truck comprising an axle suspension assembly according to any of claims 1-23.

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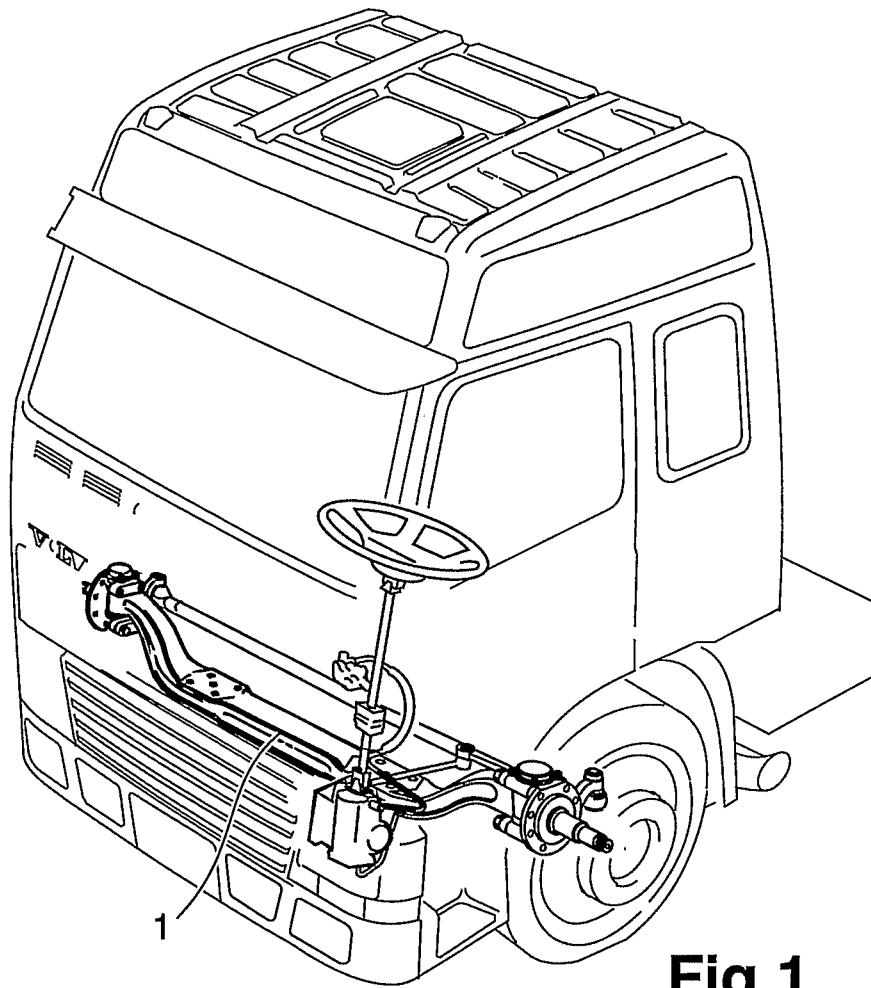


Fig.1

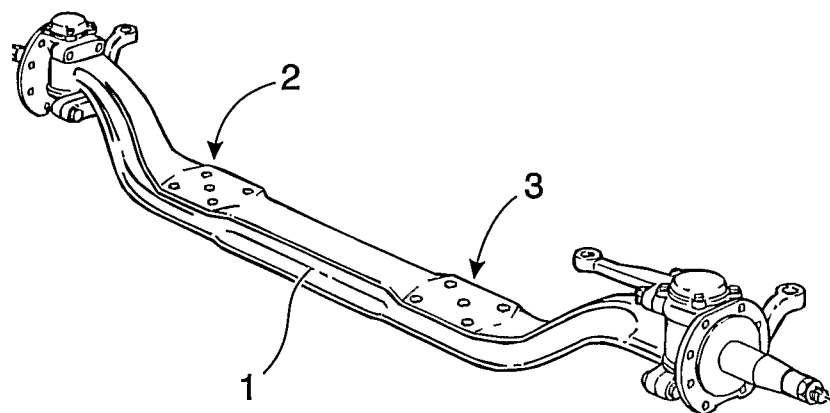


Fig.2

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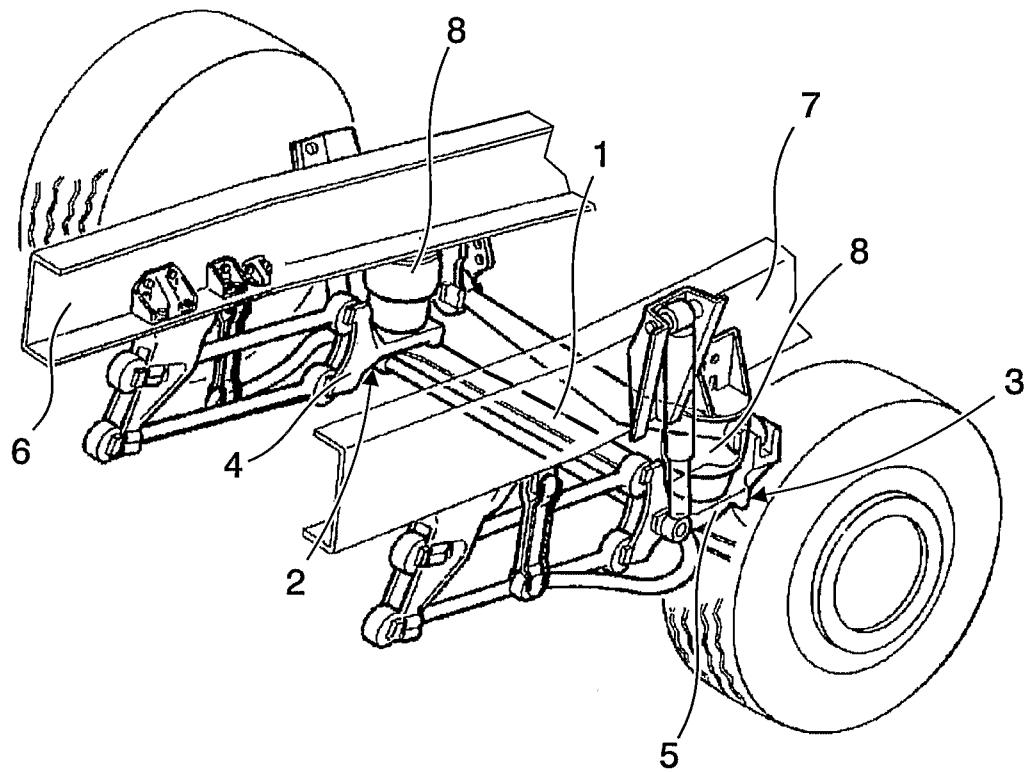


Fig.3

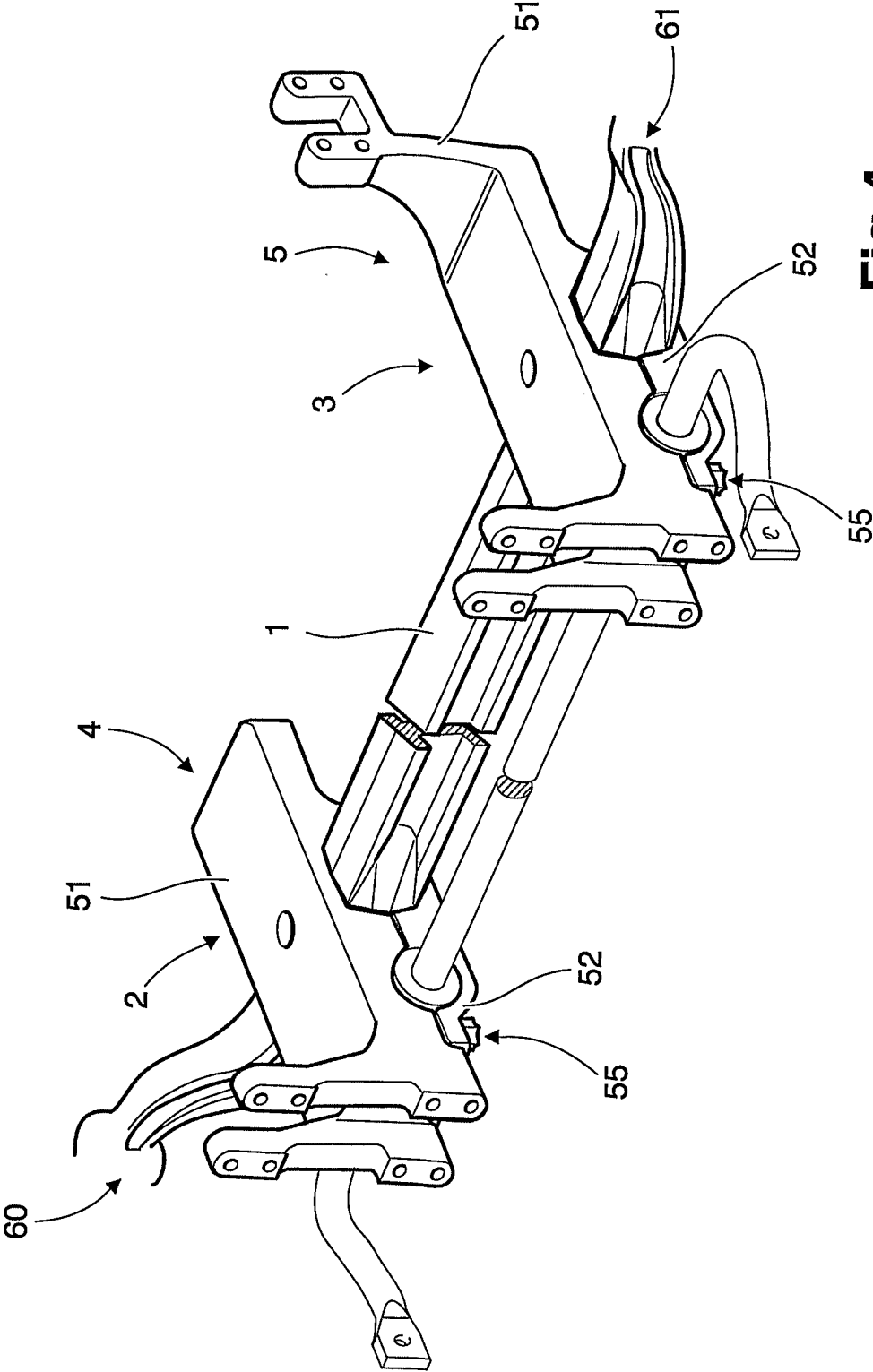


Fig.4

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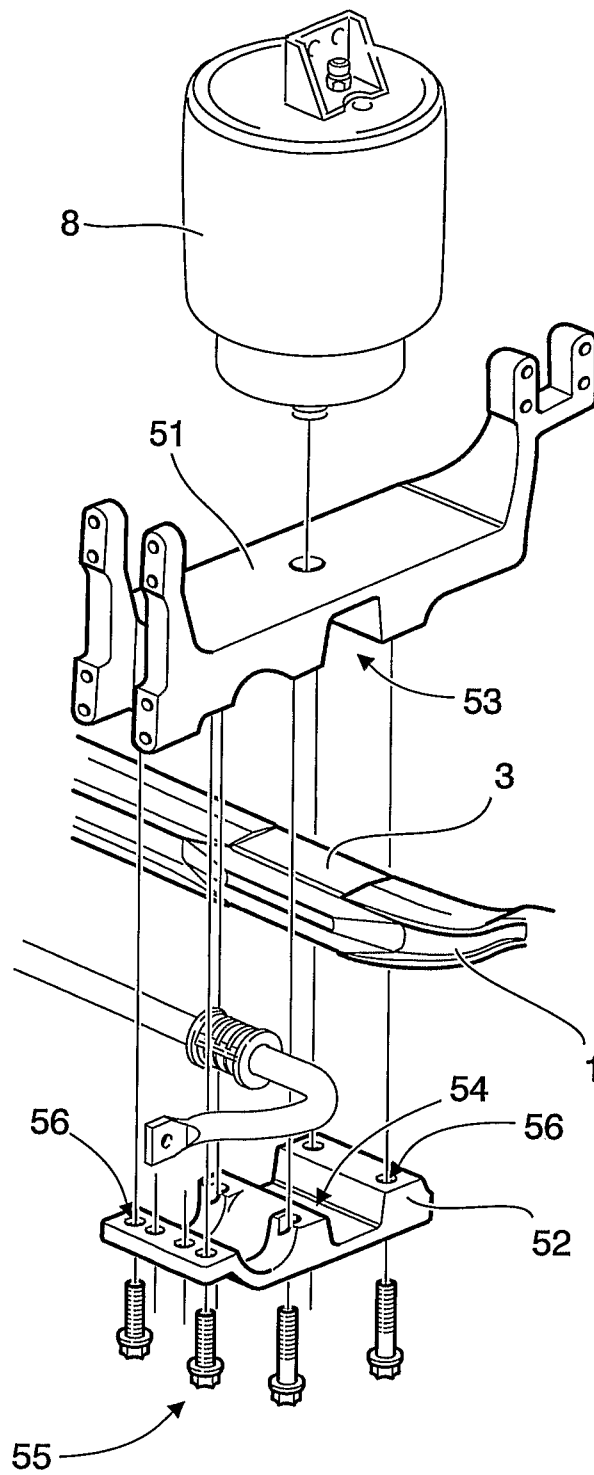


Fig.5

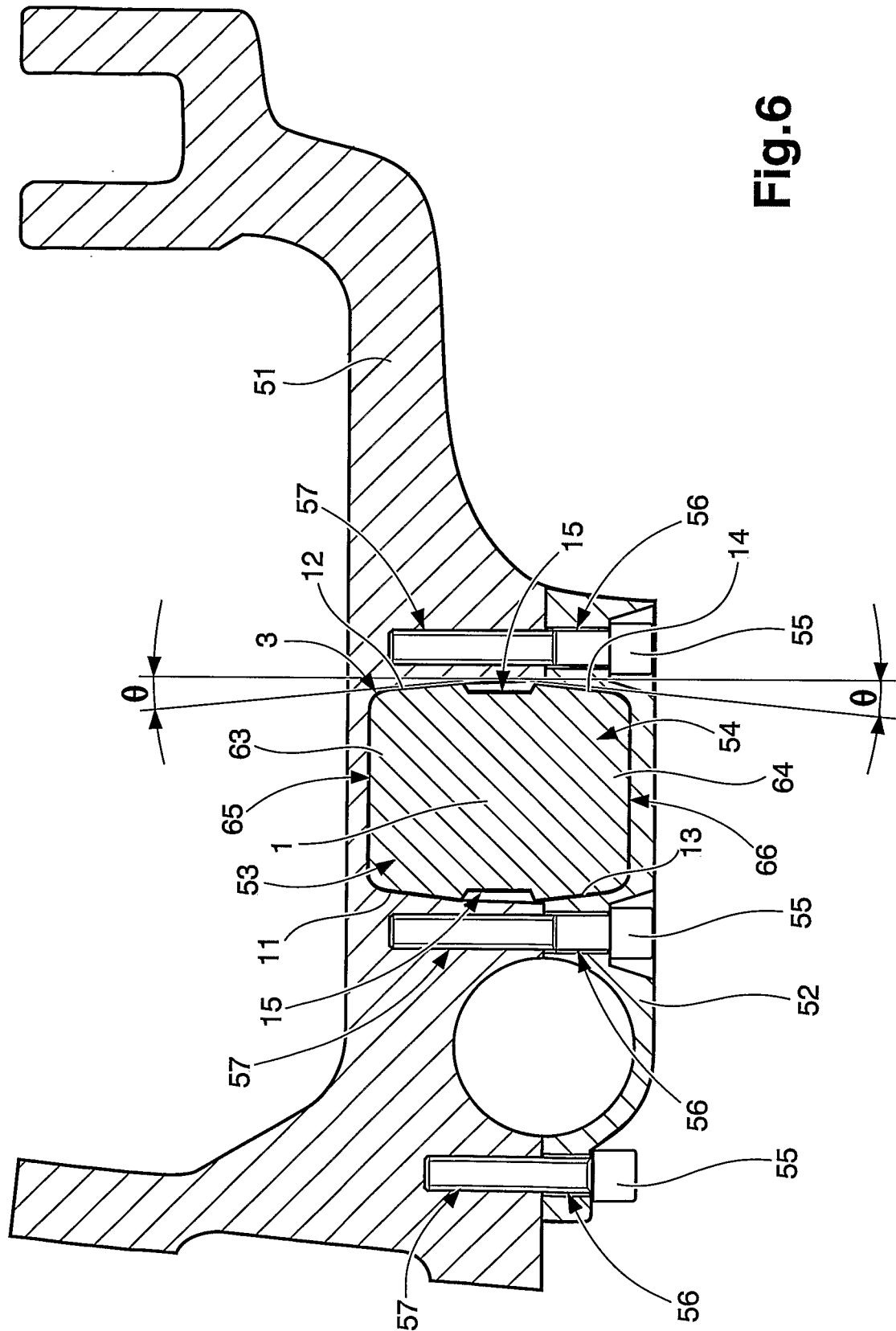


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/001235

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
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: B60G, B62D

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20040041463 A1 (GABELLA ET AL), 4 March 2004 (04.03.2004), figures 1,5, abstract, paragraphs (0018),(0023) --	1-24
X	US 3811700 A (MOORE), 21 May 1974 (21.05.1974), figures 2,4, abstract --	1-24
X	US 20040232646 A1 (PETERS ET AL), 25 November 2004 (25.11.2004), figure 1, abstract --	1-24
A	DE 19624242 A1 (DAIMLER-BENZ AKTIENGESellschaft), 18 Sept 1997 (18.09.1997), whole document -- -----	1-24

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

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B60G 9/02 (2006.01)

B60G 11/28 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT
Information on patent family members

31/03/2007

International application No.
PCT/SE2006/001235

US	20040041463	A1	04/03/2004	BR	0113705 A	08/07/2003
				DE	10043802 A	14/03/2002
				DE	50104332 D	00/00/0000
				EP	1370433 A,B	17/12/2003
				US	7025428 B	11/04/2006
				WO	0220290 A	14/03/2002

US	3811700	A	21/05/1974	NONE		
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US	20040232646	A1	25/11/2004	AU	3047702 A	03/06/2002
				US	7077411 B	18/07/2006
				US	20050275185 A	15/12/2005
				WO	0242097 A	30/05/2002

DE	19624242	A1	18/09/1997	NONE		
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