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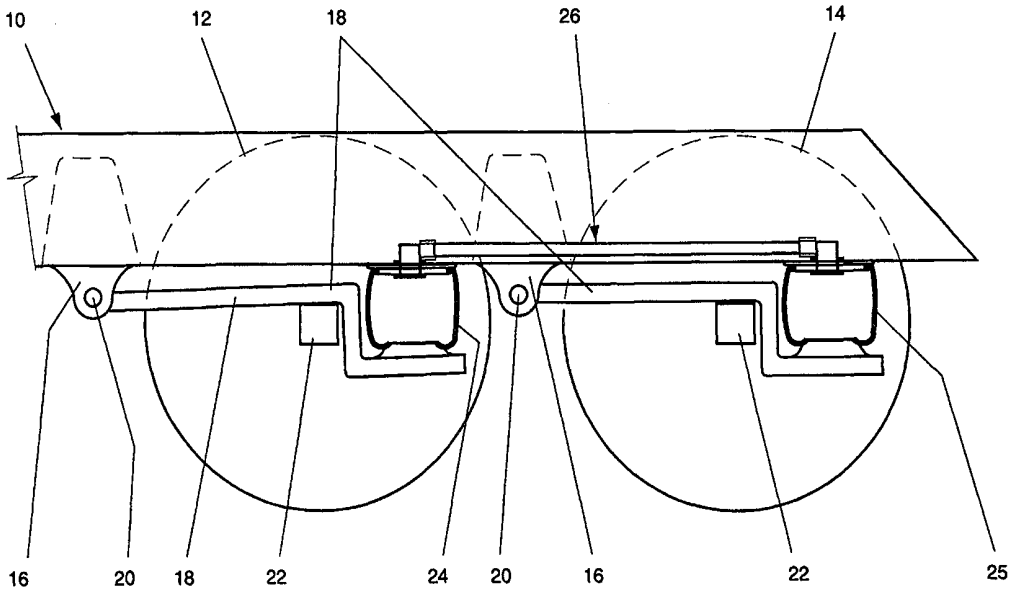

(57) Abstract

A suspension system for use with a vehicle having at least one wheel (12); the suspension system including: at least two airbags (24, 25) arranged as a forward air bag (24) and a rear air bag (25), the forward air bag (24) and the rear air bag (25) being operatively connected to enable high flow-rates of air between them. A vehicle suspension wherein a front differential and a rear differential have extending therebetween a height valve rocker and a link extending from the midpoint of the length of the height valve rocker to a height valve is also disclosed.

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VEHICLE SUSPENSION WITH LINKED AIR BAGS

Field of the invention

This invention relates to improvements in vehicle suspension and refers particularly to improvements in vehicle suspension wherein air bags (sometimes referred to as air springs) are used as an integral component in the vehicle suspension.

Definitions

Throughout this specification reference to a vehicle is to be taken as including reference to a bus, coach, truck, trailer, prime mover, tractor, or any other suitably wheeled vehicle.

Background to the invention

Air bags have been used in the suspension system of vehicles for some time. For example, they have been used on trucks, trailers, buses, coaches, and the like, for many years. They generally provide an improved ride over highway surfaces, particularly on relatively smooth surfaces.

In multi-axle air bag systems, or single-axle, multi-air bag systems, the air bags are joined by a small diameter, low flow-rate tube so that the air bags can be inflated relatively equally to provide an even height of the suspension of the vehicle above the ground.

However, they have shown to have great difficulty over rough terrain, particularly when multi-wheeled drives are used. For example, for a coach passing over a kerb, fallen log or the like, quite often the forward of the rear wheels will rise on the kerb lifting the rear wheels off the ground surface. Naturally, all drive is provided to the rear wheels thus stranding the coach. Similar problems can arise with trucks or other vehicles with lazy axles when travelling over uneven roads, or when traversing natural terrain. This quite often occurs with livestock carriers in attempting to collect livestock, collecting and/or delivering large quantities of hay,

straw, earth-moving equipment, farming equipment, and the like.

The air bags are supplied with air from an air tank, but again a small-diameter low flow-rate air tube is used. Its sole purpose is to allow the air bags to be inflated and deflated to vary the height of the vehicle above the ground.

The low flow-rate air tubes cannot cope with sudden changes in pressure within an air bag and cannot quickly equalise the pressure within and between the air bags.

Furthermore, with air bag suspension in multi-axle vehicles it can be difficult to drive on a ramp or the like as the height valve will attempt to inflate all air bags, thus lifting one set of wheels off the ramp to prevent further progress along the ramp.

A further problem with air bag suspensions is that when encountering a roughened or uneven road surface such as a railway crossing, the vehicle suspension will continue to oscillate (tramp) for some distance after the encounter. This can cause damage to the road surface.

There have been a number of proposals for overcoming these problems with air bag suspensions. For example, in Australian patent 567, 664 there is disclosed an air bag suspension whereby there is an air tank mounted in the vehicle chassis directly above the air bags, and short large diameter air ducts connect each air bag to the air tank. This had as its aim the maintaining of the air pressure in each air bag relatively constant irrespective of the axle position to thus reduce excessive movement of the vehicle body. There is also proposed the elimination of restricting flow lines connecting the air bags to the airtank. Each side of the vehicle has its own air tank, with the air tanks optionally being connected.

This system did not solve the problems identified above as when the axle moved upwardly due to an irregularity in the road surface, the air inside the air bag and the air tank was compressed under load. When the irregularity in the road surface was passed, the pressure in the air tank would force the axle down without load.

As there was no restriction in the air duct, this would happen at great speed, thus forcing the tyre onto the road surface with great impact.

Due to the resilience of a pneumatic tyre, the rebound would be sufficient to again compress the air in the air bag and air tank under load. As a result, the cycle continued - an effect called tramping. Shock absorbers, more correctly called dampers, were required to overcome the tramping.

Australian patent application 69220/87 is also directed at some of the problems mentioned above, but in particular at the damping of shock loads on the suspension system. There the air bags are in direct communication with a large air tank which supplies air under pressure to the air bags. This is the same as for Australian patent 567, 664. With this latter proposal, there is a secondary air tank mounted within the air tank and in operative communication therewith through a restricted opening. The secondary air tank and the restricted opening combine to assist in the dampening of shock loads on the suspension. However, with the speed of operation, the large volume of air in the air tank and the large size of the openings from the air bags to the air tank meant that there was no effective dampening of tramping, and the system could not cope with uneven loads due to uneven terrain.

It is therefore the principal object of the present invention to provide improvements in suspension for vehicles wherein these problems are addressed.

Brief description of the invention

With the above and other objects in mind the present invention provides improvements in suspension for a vehicle, the vehicle having at least one wheel, the suspension system including at least two air bags arranged as a forward air bag and a rear air bag, the forward air bag being operatively connected to the rear air bag to enable high flow-rates of air between them.

There may be at least two wheels arranged as a forward wheel on a forward axle, and a rear wheel on a rear axle; the forward air bag being operatively connected

to the forward axle and the rear air bag being operatively connected to the rear axle.

The wheels may be located on either side of the vehicle and there may be an air bag on either side of the vehicle. Preferably the air bags on each side of the vehicle are also operatively joined.

The front axle and/or the rear axle may have two air bags, one on either side of the respective axle. In that case, it is preferred that the air bags of each axle are operatively joined to each other, as well as to the air bags of the other axle.

Preferably, the operative connection is by means of a high flow-rate, large diameter air tube. More preferably, the rate air tube has a forward end with a forward fitting, and a rear end with a rear fitting. Advantageously, the forward fitting and/or the rear fitting has a controlling orifice therein to control the high rate of air flow in the air tube.

The air tube may also function as an air manifold. Alternatively or additionally, a separate but integral manifold may be provided on one or more of the forward fitting, rear fitting, and the air tube.

The invention also provides an improved suspension for a vehicle having a single axle with an air bag suspension, air being supplied to the air bag from an air tank, the air bag and the air tank being connected by a low flow-rate tube, preferably with a height control valve.

The invention also provides a vehicle suspension wherein a front differential and a rear differential have extending therebetween a height valve rocker, there being a link extending from a height valve to a location approximate the mid-point of the length of the height valve rocker. This can be controlled by either pneumatic or hydraulic means.

Brief description of the drawings

In order that the invention may be fully understood there shall now be described

by way of non-limitative example only preferred constructions of improvements in vehicle suspension incorporating the principal features of the present invention, the description being with reference to the accompanying illustrative drawings in which:

Figure 1 is a schematic side view of a first embodiment;

Figure 2 is a schematic side view of a second embodiment;

Figure 3 is a schematic side view of a third embodiment being a modification suitable for use with the embodiments of Figures 1 and 2;

Figure 4 is a side view of a fourth embodiment as fitted to a steering axle of a vehicle;

Figure 5 is a top plan view of the fourth embodiment and;

Figure 6 is an underneath view of the fourth embodiment.

Description of preferred embodiment

To refer to the drawings, like reference numerals receive like components with a prefix number denoting the relevant embodiment. For example, for the second embodiment of Figure 2, a prefix number 2 is used.

The vehicle in each instance may be any one of the vehicles defined above.

The vehicle has a chassis 10, a front set of driving wheels 12 and a rear set of driving wheels 14. In each instance, there are wheels on either side of the vehicle and the wheels on each side may be single or dual wheels.

For each set of wheels 12, 14, on each side of the vehicle there is a suspension arm mounting bracket 16 and a suspension arm 18 pivotally attached thereto by a pivot pin 20. The suspension arm 18 is somewhat "S"-shaped and passes over, and has attached thereto, the axle 22 of the wheel set. Mounted to the chassis 10

as well as to suspension arms 18 is a front air bag 24 and a rear air bag 25. The nature and operation of air bags in vehicle suspensions is known and will not be described further.

In the present instance, a high flow-rate air tube 26 passes between and is operatively connected to the air bags 24, 25. In this way if the front air bag 24 acts due to the axle 22 moving downwardly, and the rear air bag 25 acts due to the axle 22 thereof moving upwardly, air can be transferred very quickly from the rear air bag 25 to the front air bag 24 thus providing for appropriate downward pressure on suspension arm 18, and thus front axle 22, to enable the front wheel set 12 to have good traction on the ground. In this way it is possible for both wheel sets 12, 14 to retain positive traction on the ground. The air tube 26 is a high flow-rate tube capable of controlling the transfer of a large volume of air at low pressure very quickly, thus decreasing the load on the vehicle's shock absorbers.

Naturally, the tube 26 is capable of having air at appropriate pressure pass therethrough and has appropriate pressure resistant connections. The passage of air through the tube 26 can be in both directions. This therefore provides a more stable ride for the wheel sets 12, 14 as the controlled transfer of air lessens the transmission of forces, caused by uneven surfaces from the vehicle's tyres to the chassis.

To now refer to Figure 2, the chassis 210 is as before and the axles and wheel sets 212, 214, 222, are also as before. However, in this instance there is a suspension saddle 218 for each wheel set 212, 214 and there are two air bags provided for each wheel set 212, 214 - an air bag on each side of each axle 222 and acting between the chassis 210 and suspension saddles 218. As can be seen, the high flow-rate air tube 226 is operatively connected to all four of the air bags 224, 225 by controlling orifices (not shown) in respective air fittings 215 and 217. Therefore, the air bags 224 of the front wheel set 212 are connected by a high flow-rate tube 228, and the air bags 225 of the rear wheel set 214 are connected by a high flow-rate tube 230. The high flow-rate tubes 228, 230 are connected by a high flow-rate tube 232. Naturally, the high flow-rate tubes 228, 230 and 232 may be separate tubes operatively connected, or may be the one

tube with operative connections to the air bags 224, 225 depending therefrom.

If desired, the high flow-rate tubes 26 on one side of the vehicle may be connected to the tubes 26 on the other side of the vehicle. Also, the tubes 226 on one side of the vehicle may be connected to the tubes 226 on the other side of the vehicle. Furthermore, there may be independent connection of the tubes 228 and/or 230 and/or 232 from one side of the vehicle to the other side of the vehicle.

If desired, there may be provided an appropriate valve or control mechanism in high flow-rate tubes 26, 226 (and even tubes 228, 230) to control the rate of airflow. This may be desired in certain circumstances. Such a device may also be able to completely close the tube so that, for example, for a coach travelling on major interstate highways the valves can be closed to enable the air bags to work in a normal manner. However, when encountering uneven terrain, or proceeding off road, the driver can merely release the valves or alter their settings to allow for appropriate air transfer from the air bags in accordance with the above description. Any such valves may be able to be controlled from within the cabin of the vehicle, or may be controlled externally.

The air bags 24, 25, 224, 225 are supplied with air from an air supply (not shown). The air supply may, if desired, include an air tank. If an air tank is used it is preferred that the tube from the air tank to the air bags (either directly or via tubes 26, 226) is a low flow-rate tube with above-mentioned controlling orifices in air line fittings 215 and 217 to enable the air tank to act as an accumulator, in much the same way as an accumulator in a hydraulic system. There may, if desired, be a manifold (not shown) between the tubes 26, 226 and each air bag 24, 25, 224, 225.

In Figure 3, there is shown a modification suitable for use with the embodiments of Figures 1 and 2. Here, there is a chassis 310 which has two generally-parallel rails 311, and a cross member 313. A front differential 319 drives front wheels 312, and a rear differential 321 drives rear wheels 314, with drive shafts 323 and 327 being used. Pivotally mounted to and extending between the rear 329 of front differential 319 and the front 331 of rear differential 314 is a height valve rocker 333.

Mounted on cross member 313 approximate the centre thereof is a height valve 334 which serves to automatically control the inflation of both front and rear air bags. This is connected to the height valve rocker 333 at approximately the centre thereof by a link 336. Therefore, if the wheels 312, 314 pass along a sloping ramp in a reversing mode rear wheels 314 lift but front wheels 312 lower. Therefore, there is little or no movement of the centre of rocker 333. What movement there is of rocker 333 may cause movement of link 336 but by an insufficient amount to automatically operate valve 334 so as to cause valve 334 to effect inflation of all air bags. The inflation of all air bags would make the passing along the ramp impossible. By preventing this, the vehicle could then pass along the ramp by transferring air from one bag to another. However, if both differentials 319, 321 move up or down in relative unison, the rocker 333 will cause valve 334 to operate as required and desired. Valve 334 is in the main supply air tube from the air supply to the air bags.

The embodiment of Figures 4 to 6 shows an air bag suspension of the present invention fitted to a steering axle of a vehicle where, although it may be used with any form of axle.

Here there is a rail 411 having a plate 435 depending therefrom. Springs 437 are mounted to plate 435 by a pin 438. Mounted between springs 437 and rail 411 is a left air bag 424 and a right air bag 425. The springs 437 are somewhat wedge shaped, being at their greatest width where they are attached to beam or axle 440. In this way, the springs 437 absorb a significant amount of tension, thereby eliminating the need for a stabiliser bar.

Air under pressure is supplied to and received from air bags 424, 425 by a large diameter air tube 426 extending therebetween, and being connected to left air bag 424 by left fitting 415, and to right air bag 425 by right fitting 417. The fittings 415, 417 are of reduced diameter when compared to the tube 426 so as to provide a constriction. For example, tube 426 may be a 2 inch diameter tube, with fittings 415, 417 being 3/4 of an inch in diameter, thus providing or being the controlling orrifice.

Air under pressure is supplied to tube 426 from a standard air hose 446 via a connector 441 at approximately the mid-point of tube 426. The connector 441 is in-line of tube 426 and has a reduced diameter of the order of ¼ of an inch - to provide a constriction in tube 426 between air bags 424, 425.

By having air tube 426 of a much larger diameter than connector 441 and fittings 415, 417 air tube 426 also acts as a manifold.

A low-flow, height control valve 442 in air hose 446 also acts to constrict air hose 446.

By virtue of the constrictions of connectors 415, 417 air under pressure due to compression of either or both air bags 424, 425 will be forced into tube 426 - tube 426 acting as a manifold/accumulator. If the compression in air bags 424, 425 is different, connector 441 will allow air flow therebetween at a controlled rate so as to equalise the pressure, the controlled rate of air flow acting to dampen any oscillations and minimise or eliminate tramping.

The constriction provided by fittings 415, 417 slows the return of air into air bags 424, 425 thus significantly reducing, or eliminating, tramping as the wheel is not driven into the road surface by a rapid supply of air under pressure. The air is returned to air bags 424, 425 at a reduced rate.

With the present invention, it may be possible to use an air bag suspension without the usual shock absorbers. Alternatively, shock absorbers may be used but may be of reduced rating or capacity. Further alternatively, regularly rated shock absorbers may be used but should have an increased working life due to the reduced load applied to them. This is due to the dampening effect the present invention has on any oscillations (particularly tramping) in the suspension, the dampening effect being due to a number of factors including, but not limited to, one or more of: the controlling orifices in the air fittings, the manifold effect created by the air fittings and/or the air hose, any separate manifold, the inherent nature of the air bags themselves and them being operatively connected, and frictional losses.

Whilst there has been described in the foregoing description preferred embodiments improvements in vehicle suspension incorporating the principal features of the present invention, it will be realised by those skilled in the technology concerned that many variations or modifications and details of design or construction may be made without departing from the essential features of the present invention. In particular, it is noted pneumatic and hydraulic embodiments are both possible.

It will be understood that the invention disclosed and defined in this specification extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

It will also be understood that the term "comprises" (or its grammatical variants) as used in this specification is equivalent to the term "includes" and should not be taken as excluding the presence of other elements or features.

CLAIMS

1. A suspension system for use with a vehicle having at least one wheel; the suspension system including: at least two air bags arranged as a first air bag and a second air bag, the first air bag and the second air bag being operatively connected to enable controlled flow-rates of air between them.

2. A suspension system as claimed in claim 1, wherein there are at least two wheels arranged as a forward wheel on a forward axle, and a rear wheel on a rear axle, the first air bag being a forward air bag operatively connected to the forward axle and the second air bag being a rear air bag being operatively connected to the rear axle.

3. A suspension system as claimed in claim 2, wherein there are two air bags for the forward axle, and two air bags for the rear axle, each of the pair of air bags being located on opposite sides of the relevant axle.

4. A suspension system as claimed in any one of claims 1 to 3, wherein the air bags are operatively connected by means of a high flow-rate air tube.

5. A suspension system as claimed in claim 4, wherein the high flow-rate air tube is of large diameter.

6. A suspension system as claimed in claim 4 or claim 5, wherein the high flow-rate air tube has a first end with a first fitting, and a second end with a second fitting.

7. A suspension system as claimed in claim 6, wherein the first fitting and/or the second fitting has a controlling orifice therein to control the rate of air flow between the air tube and the respective air bags.

8. A suspension system as claimed in any one of claims 4 to 7, wherein the air tube also functions as an air manifold.

9. A suspension system as claimed in any one of claims 4 to 8, further including a separate but integral air manifold on any one or more of the high flow-rate air tube, the first fitting and the second fitting.

10. A suspension system as claimed in any one of claims 4 to 9, wherein there is provided a low flow-rate air tube for supplying air under pressure to the high flow-rate air tube.

11. A suspension system as claimed in claim 10, wherein the low flow-rate air tube is connected to the high flow-rate air tube by an air fitting in-line of the high flow-rate air tube.

12. A suspension system as claimed in claim 11, wherein the air fitting has a constriction therein.

13. A suspension system as claimed in any one of claims 1 to 12, further including a height valve controlling the operative connection between the at least two air bags.

14. A suspension system as claimed in claim 13 when appended to any one of claims 10 to 12, wherein the height control valve is in the low flow-rate air tube.

15. A suspension system as claimed in claim 13 or claim 14, wherein the height valve is controllable by a height valve rocker located between the first air bag and the second air bag.

16. A suspension system as claimed in any one of claims 7 to 15, wherein the controlling orifice is a reduction in diameter to provide a restriction.

17. A suspension system as claimed in claims 11, wherein the air fitting is located at approximately the mid-point of the high flow-rate air tube.

18. A suspension system as claimed in claim 17, wherein the high flow-rate air

tube has a diameter of 2 inches; the first and second fittings are each of a diameter of ¾ inch; and the air fitting constriction is of a diameter of ¼ inch.

19. A suspension system for a vehicle having a front differential and a rear differential, and wherein extending between the front and rear differentials is a height valve rocker, there being a link extending from a height valve to a location approximate the mid-point of the length of the height valve rocker.

20. A suspension system as claimed in claim 19, wherein the height valve can be controlled by either pneumatic or hydraulic means.

21. A suspension system as claimed in any one of claims 1 to 18, in combination with the suspension system of either of claims 19 or 20.

22. A vehicle having a suspension system as claimed in any one of claims 1 to 21.

23. A suspension system for use with a vehicle having at least one wheel, the suspension system incuding at least two air bags arranged as a first air bag and a second air bag, the first air bag having a first air fitting of reduced diameter and the second air bag having a second air fitting of reduced diameter, the first air fitting and the second fitting being connected by a high flow-rate air tube of large diameter and being capable of acting as an air manifold; air under pressure being able to supplied to the high flow-rate air tube by a low flow-rate air tube connected to the high flow-rate air tube by an air fitting in-line of the high flow-rate air tube, the air fitting having a constriction therein.

Figure 1

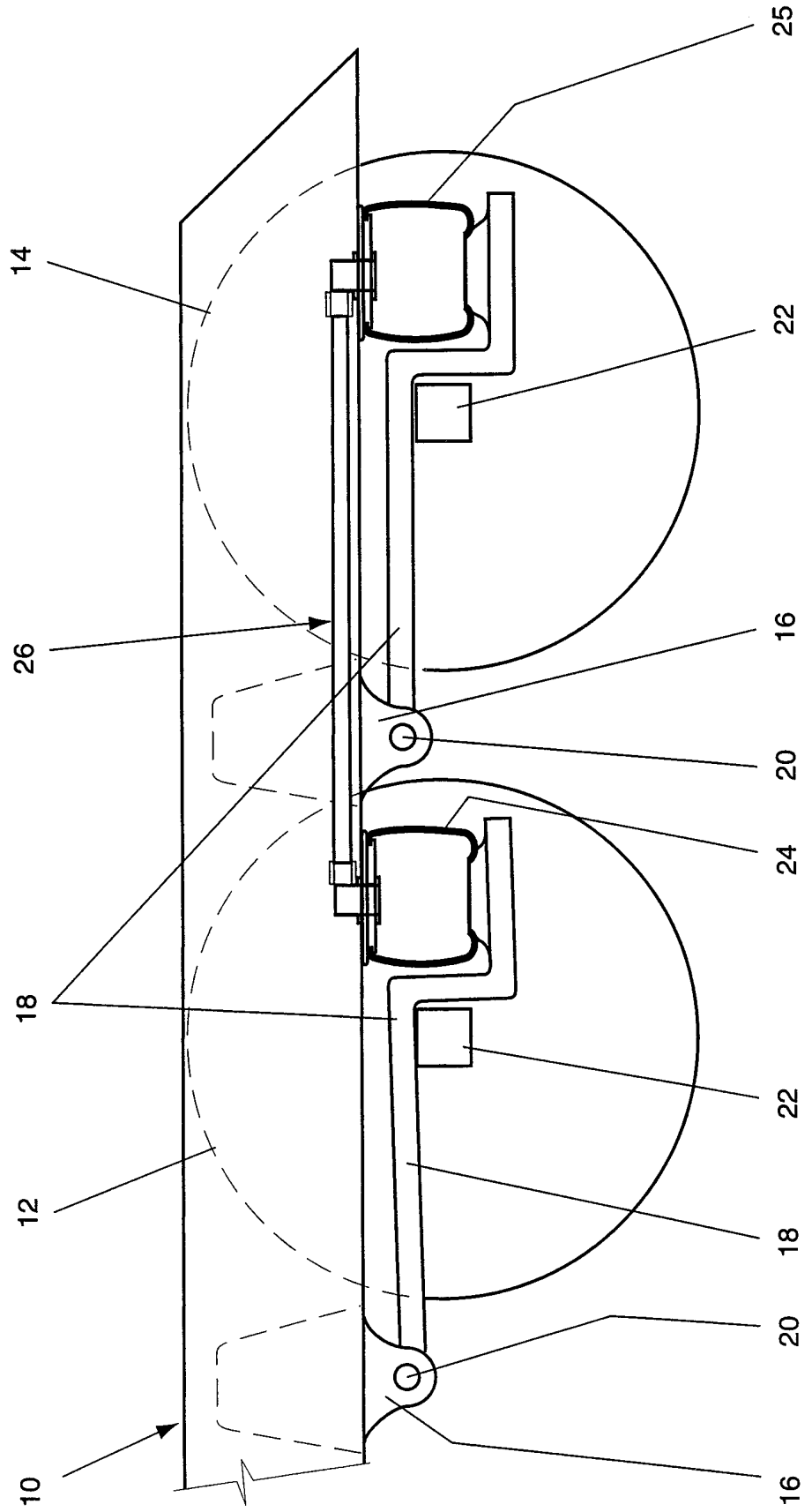

Figure 2

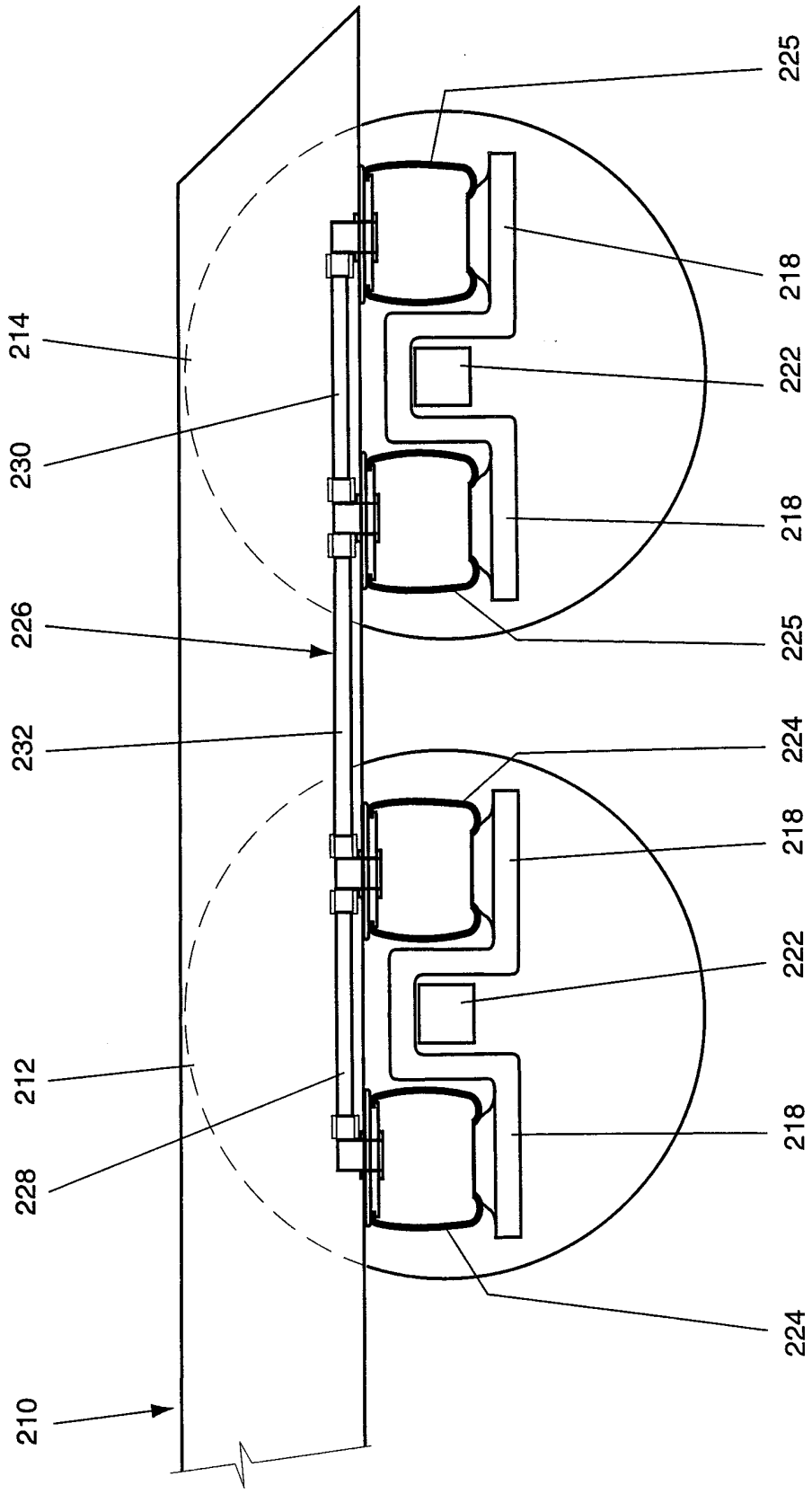
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Figure 3

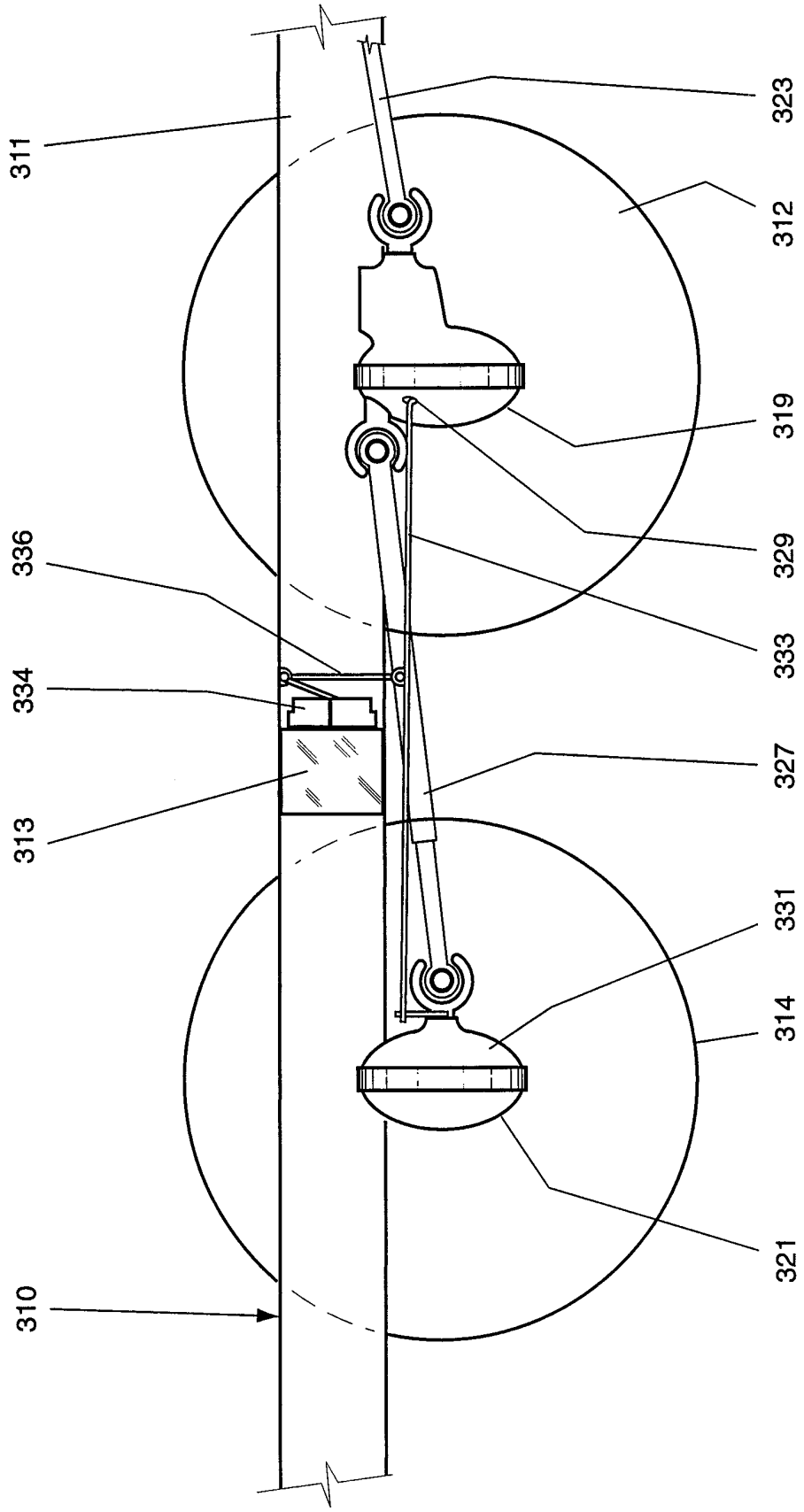


Figure 4

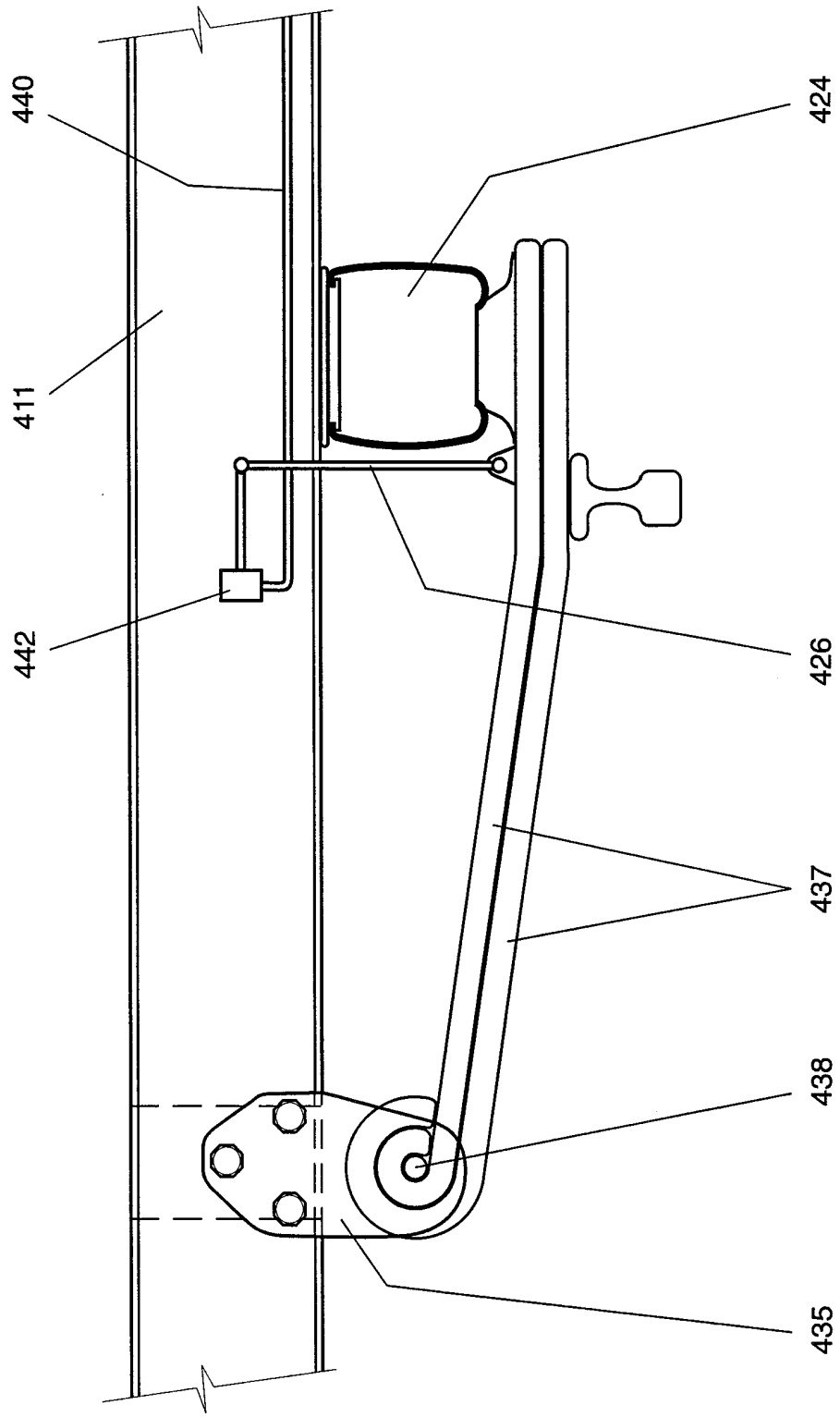


Figure 5

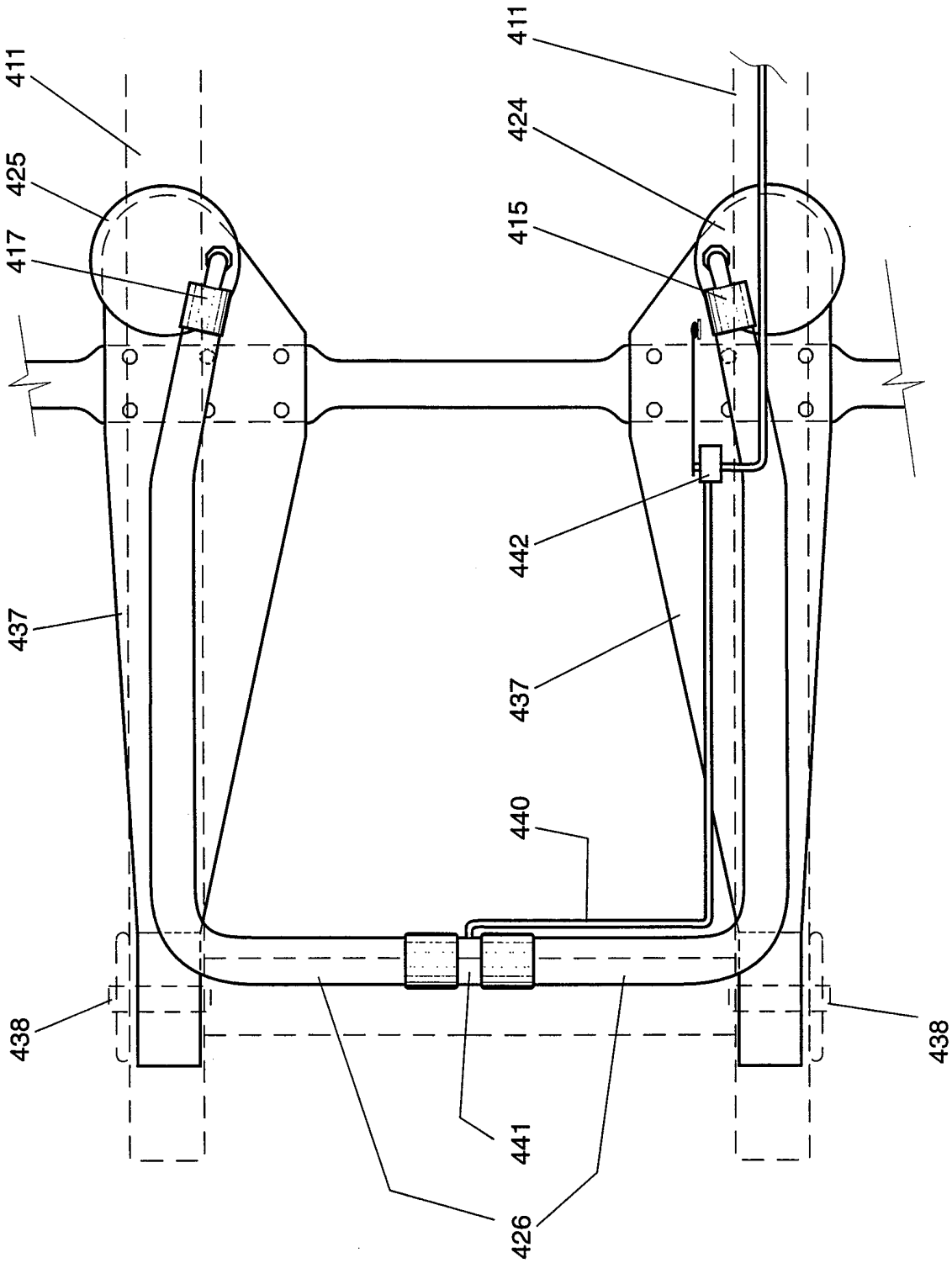
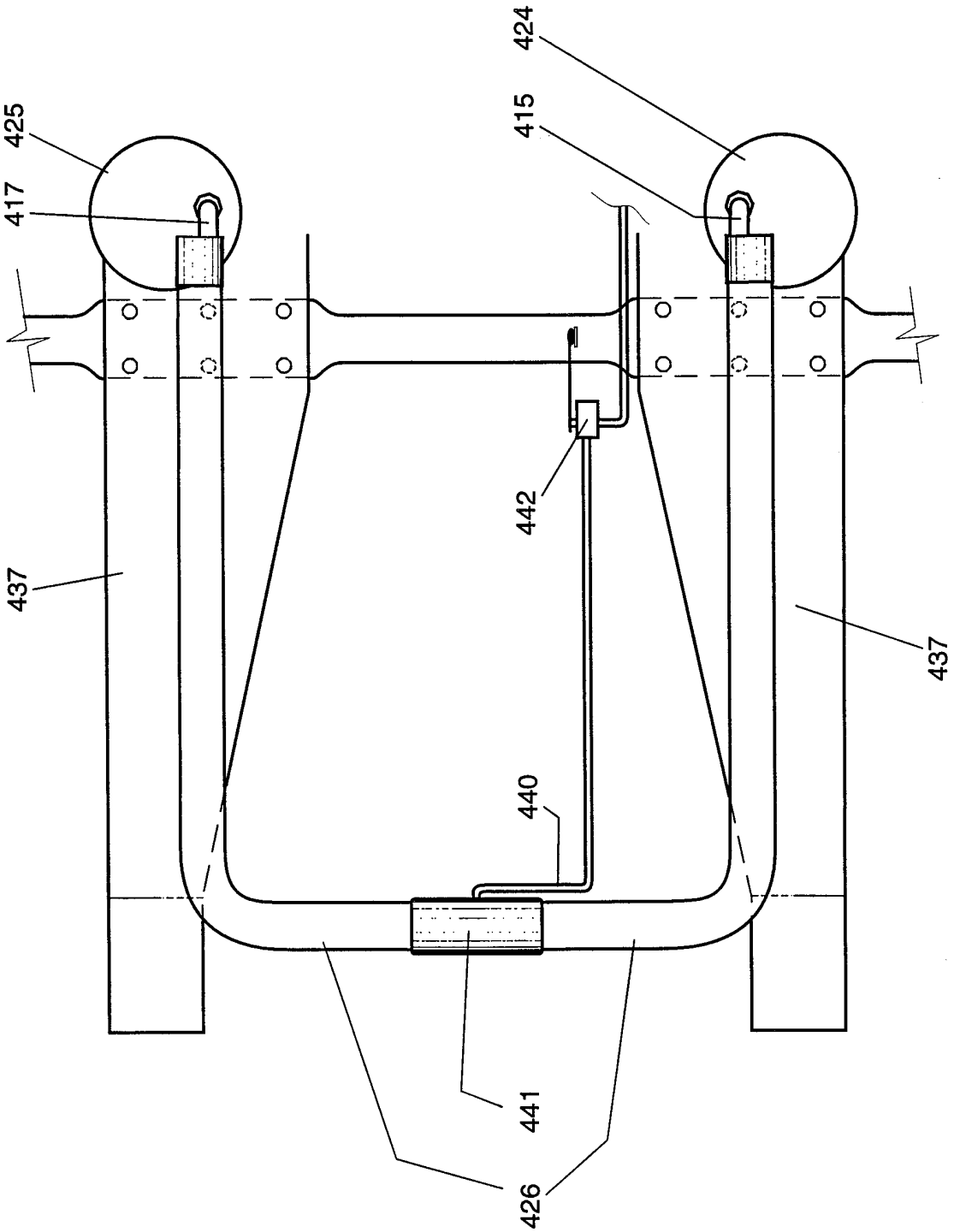


Figure 6



INTERNATIONAL SEARCH REPORT

international application No.
PCT/AU 99/00605

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: B60G 5/04, 11/27, 13/10, 17/056

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

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPTO, ESP@CE, WPAT with keywords

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5374077 (PENZOTTI et al) 20 December 1994 column 5, line 5 - column 8, line 35; figures 6-10	1-12, 16-18, 22, 23
X	US 5046752 (STEPHENS et al) 10 September 1991 column 3, line 32 - column 4, line 56, figures 1, 4	1, 4-12, 16-18, 22, 23
X	US 3782753 (SWEET et al) 1 January 1974 whole document	1, 4-12, 16-18, 22, 23

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

[X] See patent family annex

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"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 when the document is taken alone

"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

Date of the actual completion of the international search	Date of mailing of the international search report
15 October 1999	28 OCT 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **ZBIGNIEW BIELAWSKI** Telephone No.: (02) 6283 2218

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00605

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3499662 (PAUL) 10 March 1970 whole document	1, 4-12, 16-18, 22, 23
X	US 3201141 (BERNSTEIN et al) 17 August 1965 whole document	1-12, 16-18, 22, 23
X	US 3063732 (HARBERS et al) 13 November 1962 whole document	1-12, 16-18, 22, 23
X	US 2998261 (BARTLETT) 29 August 1961 column 1, line 10 - line 42; column 3, line 58 to column 4, line 39; figures	1, 4-12, 16-18, 22, 23
X	Derwent Abstract Accession No. 96-318124/32, Class Q12, JP 08-142631A (HINO MOTORS LTD) 4 June 1996 Whole abstract	1-6,8-11,13-15,17,18,22
A	Derwent Abstract Accession No.84-150279/24, Class Q12, SU1043041A (KLUSHIN V P) 23 September 1983	

INTERNATIONAL SEARCH REPORT

Ii national Application No.
PCT/AU 99/00605

Box 1 Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

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

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

2. ☐ Claims Nos.:
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. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
see extra sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ 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 claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00605

Box II continued

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are different inventions as follows

1. Claims 1 to 18 and 22 to 23 are directed to a suspension system for use with a vehicle, the suspension system including at least two air bags connected to enable flow of air between them.
   It is considered that said connected air bags comprises a first "special technical feature".

2. Claims 19-21 are directed to a suspension system for a vehicle, the suspension system having a height valve rocker connected to a height valve.
   It is considered that said rocker and height valve arrangement comprises a second "special technical feature".

   Since the abovementioned groups of claims do not share any of the technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept, a priori.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU 99/00605

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	5374077	CA	2112715	GB	2274144	GB	2294667
US	5046752	US	4906415	EP	413318	US	4776987
		CA	1267129	DE	3511048	EP	203286
		JP	61220740	DE	3511050		

END OF ANNEX