



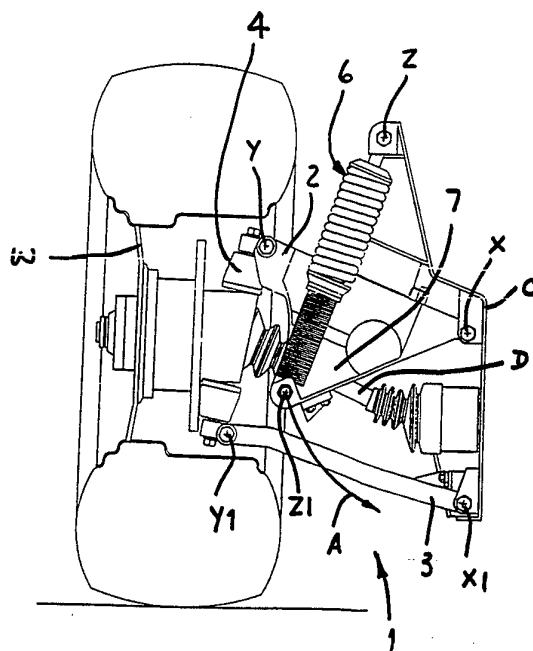
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁵ : B60G 15/06, 11/14, 7/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 94/05520</p> <p>(43) International Publication Date: 17 March 1994 (17.03.94)</p>
<p>(21) International Application Number: PCT/GB93/01101</p> <p>(22) International Filing Date: 27 May 1993 (27.05.93)</p> <p>(30) Priority data: 9218588.3 2 September 1992 (02.09.92) GB</p> <p>(71) Applicant (for all designated States except US): TOTAL MOBILITY VEHICLES LIMITED [GB/GB]; Bellinster Factory, Berners Cross, Winkleigh, Devon EX19 8DH (GB).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only) : VICKERY, Melvin, Douglas, Albert [GB/GB]; 20 Park Road, Tiverton, Devon EX16 6BA (GB).</p> <p>(74) Agent: ELLIOTT, Michael, Harry; Withers & Rogers, 4 Dyer's Buildings, Holborn, London EC1N 2JT (GB).</p>		<p>(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, KZ, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i> <i>With amended claims.</i></p>

(54) Title: INDEPENDENT WHEEL SUSPENSION

(57) Abstract

An independent wheel suspension (1) for all-terrain vehicles has upper and lower wishbones (2, 3) pivoted at one of their ends on the structure (C) of the vehicle about respective axes (X, X1) which are parallel to each other and to a longitudinal axis of the vehicle, a wheel support (4) which is pivotably connected to the wishbones at their other ends about respective axes (Y, Y1) parallel to the other axes, and two telescopic spring/shock-absorber struts (5, 6) pivotably connected at opposite ends to the structure (C) of the vehicle and to the upper wishbone (2), intermediate the ends of the latter, about respective axes (Z, Z1) parallel to the other axes (X, X1; Y, Y1) so that the struts can pivot about their respective axes (Z, Z1) as they contract and extend with oscillations of the wishbones (2, 3) in use, with the lower ends of the struts describing a transverse arcuate path about the axis (Z) of the upper ends. The ability of the struts (5, 6) to pivot about the two axes (Z, Z1) as they are compressed or extended results in their progressive loading or unloading and leads to a smooth ride.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NE	Niger
BE	Belgium	GN	Guinea	NL	Netherlands
BF	Burkina Faso	GR	Greece	NO	Norway
BG	Bulgaria	HU	Hungary	NZ	New Zealand
BJ	Benin	IE	Ireland	PL	Poland
BR	Brazil	IT	Italy	PT	Portugal
BY	Belarus	JP	Japan	RO	Romania
CA	Canada	KP	Democratic People's Republic of Korea	RU	Russian Federation
CF	Central African Republic	KR	Republic of Korea	SD	Sudan
CG	Congo	KZ	Kazakhstan	SE	Sweden
CH	Switzerland	LI	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovak Republic
CM	Cameroon	LU	Luxembourg	SN	Senegal
CN	China	LV	Latvia	TD	Chad
CS	Czechoslovakia	MC	Monaco	TG	Togo
CZ	Czech Republic	MG	Madagascar	UA	Ukraine
DE	Germany	ML	Mali	US	United States of America
DK	Denmark	MN	Mongolia	UZ	Uzbekistan
ES	Spain			VN	Viet Nam
FI	Finland				

Independent Wheel Suspension

The present invention relates to an independent wheel suspension for vehicles, particularly but not exclusively for all-terrain vehicles.

Independent wheel suspensions for all-terrain vehicles must allow a large degree of travel to cope with rough terrain but this is usually achieved at the expense of ride comfort. The present invention aims to provide an independent wheel suspension suitable for all-terrain vehicles, which affords better ride comfort than conventional suspensions while still permitting a large degree of travel.

According to the present invention, there is provided an independent wheel suspension comprising upper and lower wishbones, each of which is pivoted at one end on the structure of the vehicle about a respective axis, the axes being parallel to each other and to a longitudinal axis of the vehicle, a wheel support which is pivotably connected to the wishbones at their other ends about respective axes parallel to the other axes, and resilient shock-absorbing means pivotably connected at opposite ends to the structure of the vehicle and to one of the wishbones, intermediate the ends of the latter, about respective axes parallel to the other axes so that the resilient shock-absorbing means can pivot about their respective axes as they contract and extend with oscillations of the wishbones in use, with the lower end of the said means describing a transverse arcuate path about the axis of the upper end. This ability of the resilient shock-absorbing means to pivot about the two longitudinal axes as they are compressed or extended results in their progressive loading or

unloading and leads to a smooth ride.

The resilient shock-absorbing means preferably comprise a shock-absorber and an associated spring. Although the shock-absorber and the spring may be separate from each other and be pivotably connected to the vehicle structure and the wishbone about separate axes, for example, transversely spaced-apart axes, they are preferably in the form of a telescopic spring/shock-absorber strut.

The pivot mounting for the lower end of the telescopic strut preferably comprises a bracket projecting from the wishbone and the wishbone to which the lower end of the strut is connected is preferably the upper wishbone. In this latter case, the bracket is preferably dependent from the upper wishbone so that the lower pivot axis of the strut lies between the two wishbones, below a line joining the pivot axes of the upper wishbone on the vehicle and of the wheel support on the upper wishbone.

The suspension of the invention may be used equally well with a driven wheel or a non-driven wheel.

The suspension may have two telescopic struts and the lower ends of these struts may be pivoted about a common axis on respective brackets dependent from opposite sides of the upper wishbone so as to leave space for the passage of a drive shaft if the suspension is to be used with a driven wheel. Alternatively, if the spring and the shock-absorber are separate from each other, the lower end of the spring may be pivoted on one of the brackets and the lower end shock-absorber may be pivoted on the other bracket,

again about a common axis.

The two struts or the separate spring and shock-absorber may be parallel to each other or they may diverge or converge towards their common axis of pivoting on the vehicle structure.

The present invention also provides a suspension wishbone for use with independent wheel suspensions, having mountings at opposite ends for the pivotable connection of the wishbone to the structure of a vehicle and for the pivotable connection of a wheel support to the wishbone respectively, and a further mounting intermediate its ends for the pivotable connection of one end of resilient shock-absorbing means, preferably a suspension strut, the mountings defining parallel pivot axes transverse, and preferably perpendicular or substantially perpendicular to, the longitudinal median axis of the wishbone. The further mounting preferably comprises a bracket which projects from the wishbone and the wishbone is preferably intended for use as an upper wishbone with the bracket extending downwardly in use.

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

Figure 1 is a perspective view of an independent wheel suspension according to one embodiment of the present invention, and

Figures 2, 3 and 4 are frontal views of the suspension of Figure 1 at the top of its travel, at its normal ride height and at the bottom of its travel,

respectively.

With reference to the drawings, an independent wheel suspension according to the invention, generally indicated 1, for an all-terrain vehicle has upper and lower wishbones 2, 3, each of which is pivoted at one end on a chassis member C of the vehicle about a respective axis X, X1 (see Figures 2, 3 and 4). The axes X, X1 are parallel to each other and to the longitudinal axis (not shown) of the vehicle. A wheel support 4 is pivotably connected to the other ends of the wishbones 2, 3 about respective axes Y, Y1 which are parallel to each other and to the axes X, X1. In a conventional manner, the wheel support 4 carries a wheel W which, in the embodiment illustrated, is a driven wheel, the drive shaft of which is indicated D. The wheel support 4, the wheel W and the drive shaft D are omitted from Figure 1 for the sake of clarity.

As shown in Figure 1, the wishbones 2, 3 have bifurcated ends with respective bushes which constitute the pivot mountings defining the axes X, X1, Y and Y1.

The suspension 1 also includes two telescopic spring/shock-absorber struts 5, 6 which are spaced-apart longitudinally of the vehicle and are pivotably connected at their upper ends to the chassis member C about a common axis Z and at their lower ends to the wishbone 2 about a common axis Z1 intermediate the ends of the wishbone, that is, intermediate the axes X and Y. The axes Z, Z1 are parallel to each other and to the axes X, X1, Y and Y1. The pivot mountings for the lower ends of the telescopic struts 5, 6 are formed by respective brackets 7 which project downwardly from opposite sides of the wishbone 2 so

that the axis Z1 is between the two wishbones 2, 3, that is, is offset downwardly relative to a line joining the axes X and Y. In the embodiment illustrated, the axis Z1 is closer to a line joining the axes X1, Y1 of the lower wishbone 3 than to the line joining the axes X, Y of the upper wishbone 2.

As illustrated, the two struts 5, 6 converge towards their common axis Z but, in other embodiments, they may diverge towards the axis Z or they may be parallel to each other.

The brackets 7 are spaced apart by a distance sufficient to allow room for the drive shaft D to pass between them, as shown in Figures 2, 3 and 4. The brackets 7 are preferably integral with the upper wishbone 2 but they may be formed separately and, for example, welded to the wishbone 2.

By virtue of the pivoted connections of the upper and lower ends of the struts 5, 6, the struts can pivot about the longitudinal axes Z, Z1 as they contract and extend between the top and bottom of the travel of the suspension 1. With this pivoting, the lower ends of the struts 5, 6 describe a transverse arcuate path about the upper axis Z, as indicated by the arrows A in Figures 2, 3 and 4, so that, when the suspension is at the top of its travel, the lower ends are located outwardly of the vehicle with respect to the upper ends and with respect to the positions of the lower ends when the suspension is at the bottom of its travel.

The particular geometry of the suspension 1 of the invention, whereby the struts 5 pivot through the path A as they contract and extend with oscillations of the

wishbones 2, 3 between the top and bottom of the suspension travel, gives progressive loading and unloading of the springs of the struts 5, 6 and thus results in the smoother ride than with conventional suspensions in which pivoting of the struts is not permitted.

CLAIMS

1. An independent wheel suspension (1) comprising upper and lower wishbones (2, 3), each of which is pivoted at one end on the structure (C) of the vehicle about a respective axis (X, X1), the axes (X, X1) being parallel to each other and to a longitudinal axis of the vehicle, a wheel support (4) which is pivotably connected to the wishbones (2, 3) at their other ends about respective axes (Y, Y1) parallel to the other said axes (X, X1), and resilient shock-absorbing means (5, 6) pivotably connected at opposite ends to the structure (C) of the vehicle and to one (2) of the wishbones, intermediate the ends of the latter, about respective axis (Z, Z1) parallel to the other said axes (X, X1, Y, Y1) so that the resilient shock-absorbing means (5, 6) can pivot about their respective axes (Z, Z1) as they contract and extend with oscillations of the wishbones (2, 3) in use, with the lower end of the said means describing a transverse arcuate path (A) about the axis (Z) of the upper end.
2. A suspension according to Claim 1, characterised in that the resilient shock-absorbing means (5, 6) comprise a shock-absorber and an associated spring.
3. A suspension according to Claim 2, characterised in that the resilient shock-absorbing means comprise a telescopic spring/shock-absorber strut (5, 6).
4. A suspension according to Claim 3, characterised in that the lower end of the telescopic strut (5, 6) is pivotably connected to a bracket (7) projecting from the said one wishbone (2).
5. A suspension according to Claim 3 or Claim 4,

characterised in that the wishbone to which the lower end of the strut (5, 6) is connected is the upper wishbone (2).

6. A suspension according to Claim 4 or Claim 5, characterised in that the bracket (7) is dependent from the upper wishbone (2) so that the lower pivot axis (Z1) of the strut (5, 6) lies between the two wishbones (2, 3), below a line joining the pivot axes (X, Y) of the upper wishbone (2) on the vehicle and of the wheel support (4) on the upper wishbone.

7. A suspension according to any one of Claims 3 to 6, characterised in that it has two telescopic spring/shock-absorber struts (5, 6) the lower ends of which are pivoted about a common axis (Z1) on respective brackets (7) dependent from opposite sides of the upper wishbone (2).

8. A suspension wishbone (2) for use with independent wheel suspensions, the wishbone having mountings at opposite ends for the pivotable connection of the wishbone to the structure of a vehicle and for the pivotable connection of a wheel support to the wishbone respectively, and a further mounting (7) intermediate its ends for the pivotable connection of one end of resilient shock-absorbing means, the mountings defining parallel pivot axes (X, Y, Z1) transverse the longitudinal median axis of the wishbone.

9. A wishbone according to Claim 8, characterised in that the pivot axes (X, Y, Z1) are perpendicular or substantially perpendicular to the longitudinal median axis of the wishbone (2).

10. A wishbone according to Claim 8 or Claim 9, characterised in that the further mounting comprises a bracket (7) which projects from the wishbone and the wishbone is intended for use as an upper wishbone with the bracket (7) extending downwardly in use.

AMENDED CLAIMS

[received by the International Bureau on 21 December 1993 (21.12.93); claims 8-10 cancelled, original claims 1 and 6 replaced by amended claim 1; new claims 2 and 3 added; claims 2 and 3 renumbered as claims 4 and 5; claim 7 replaced by amended claim 6 (2 pages)]

1. An independent wheel suspension (1) comprising upper and lower wishbones (2, 3), each of which is pivoted at one end on the structure (C) of the vehicle about a respective axis (X, X1), the axes (X, X1) being parallel to each other and to a longitudinal axis of the vehicle, a wheel support (4) which is pivotably connected to the wishbones (2, 3) at their other ends about respective axes (Y, Y1) parallel to the other said axes (X, X1), and resilient shock-absorbing means (5, 6) pivotably connected at their upper and lower ends respectively to the structure (C) of the vehicle and to one of the wishbones (2, 3), about respective axes (Z, Z1) parallel to the other said axes (X, X1, Y, Y1), so that the resilient shock-absorbing means (5, 6) can pivot about their respective axes (Z, Z1) as they contract and extend with oscillations of the wishbones (2, 3) in use, characterised in that the lower end of the resilient shock-absorbing means (5, 6) is pivotably connected to the upper wishbone (2), intermediate its ends, by means of a pivot mounting (7) which is fast with the wishbone (2) and projects downwardly therefrom so that the axis (Z1) of the lower end of the said means (5, 6) lies between the two wishbones (2, 3), below a line joining the pivot axes (X, Y) at the ends of the upper wishbone (2), whereby the lower end of the resilient shock-absorbing means (5, 6) describes a transverse arcuate path (A) about the axis (X) of the upper wishbone (2) during pivoting of the said means (5, 6) and moves outwardly of the vehicle when the suspension moves towards the top of its travel (Fig. 2) in use.

2. A suspension according to Claim 1, characterised in that the axis (Z1) of the lower end of the resilient

shock-absorbing means (5, 6) is closer to a line joining the axes (X1, Y1) of the lower wishbone (3) than to the line joining the axes (X, Y) of the upper wishbone (2).

3. A suspension according to Claim 1 or Claim 2, characterised in that the pivot mounting for the lower end of the resilient shock-absorbing means (5,6) comprises a bracket (7) integral with the upper wishbone (2).

4. A suspension according to any one of the preceding claims, characterised in that the resilient shock-absorbing means (5, 6) comprise a shock-absorber and an associated spring.

5. A suspension according to Claim 4, characterised in that the resilient shock-absorbing means comprise a telescopic spring/shock-absorber strut (5, 6).

6. A suspension according to Claim 5, characterised in that it has two telescopic spring/shock-absorber struts (5, 6) the lower ends of which are pivoted about a common axis (Z1) on respective pivot mountings or brackets (7) projecting downwardly from opposite sides of the upper wishbone (2).

1/4

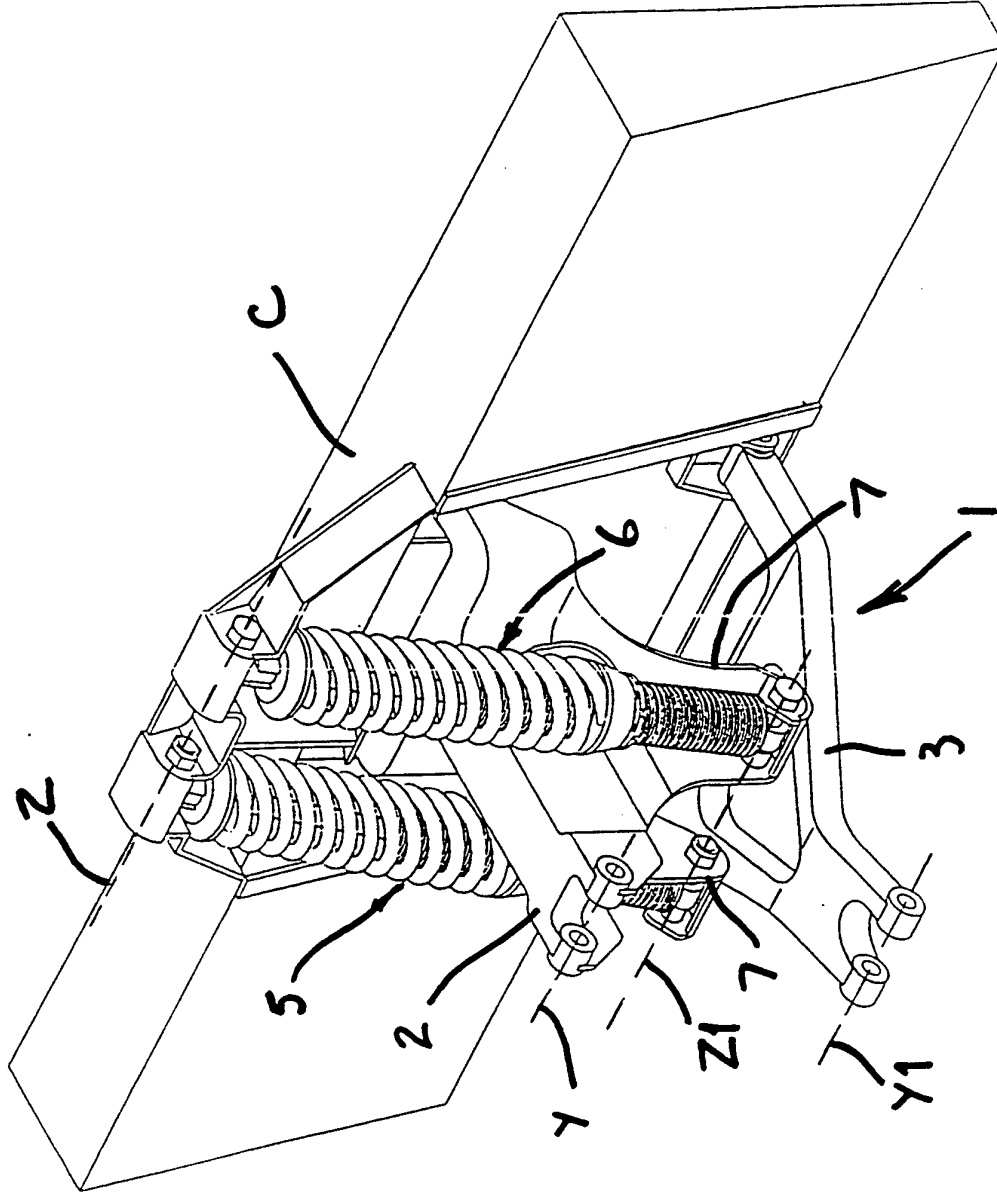
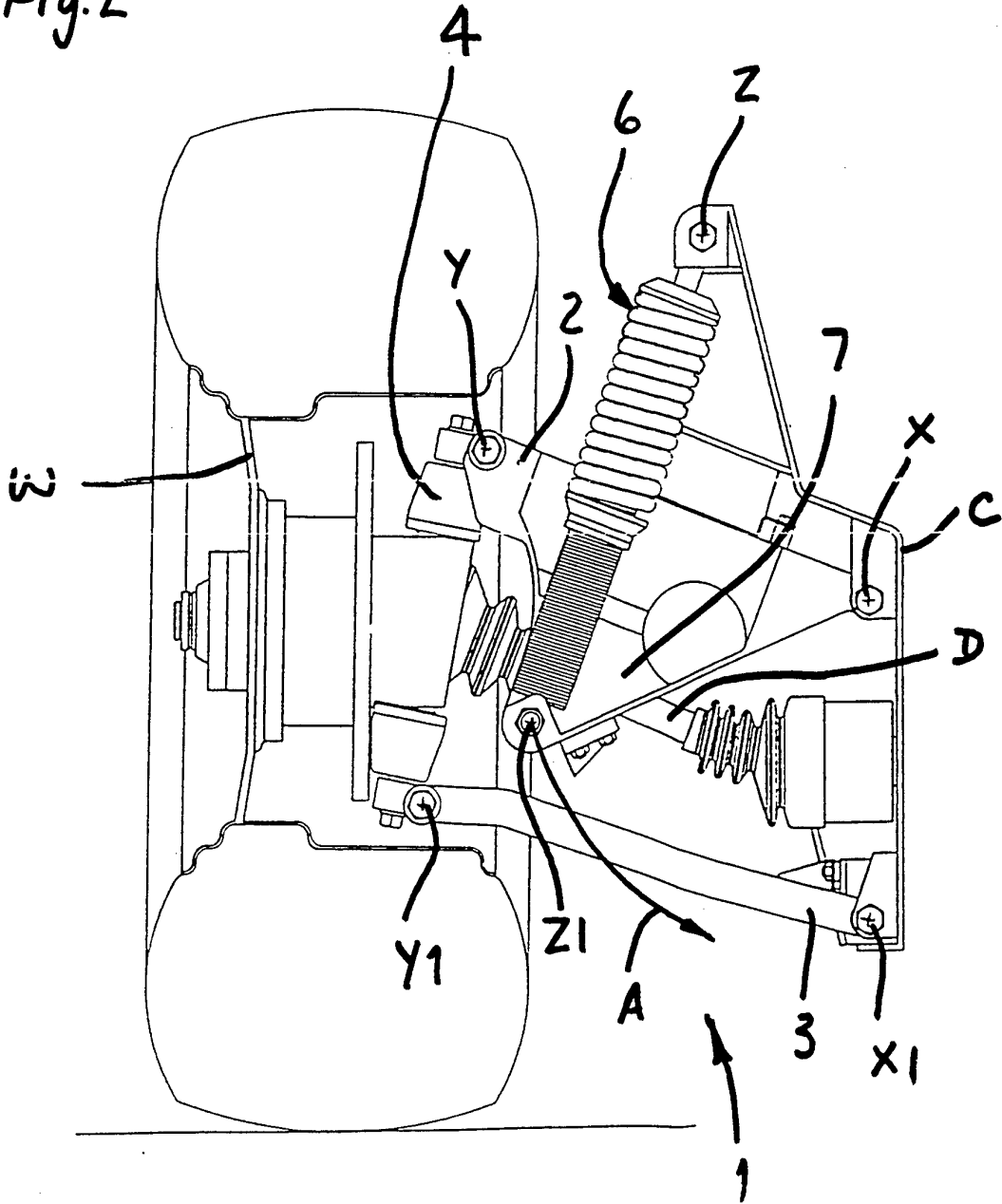


Fig.1

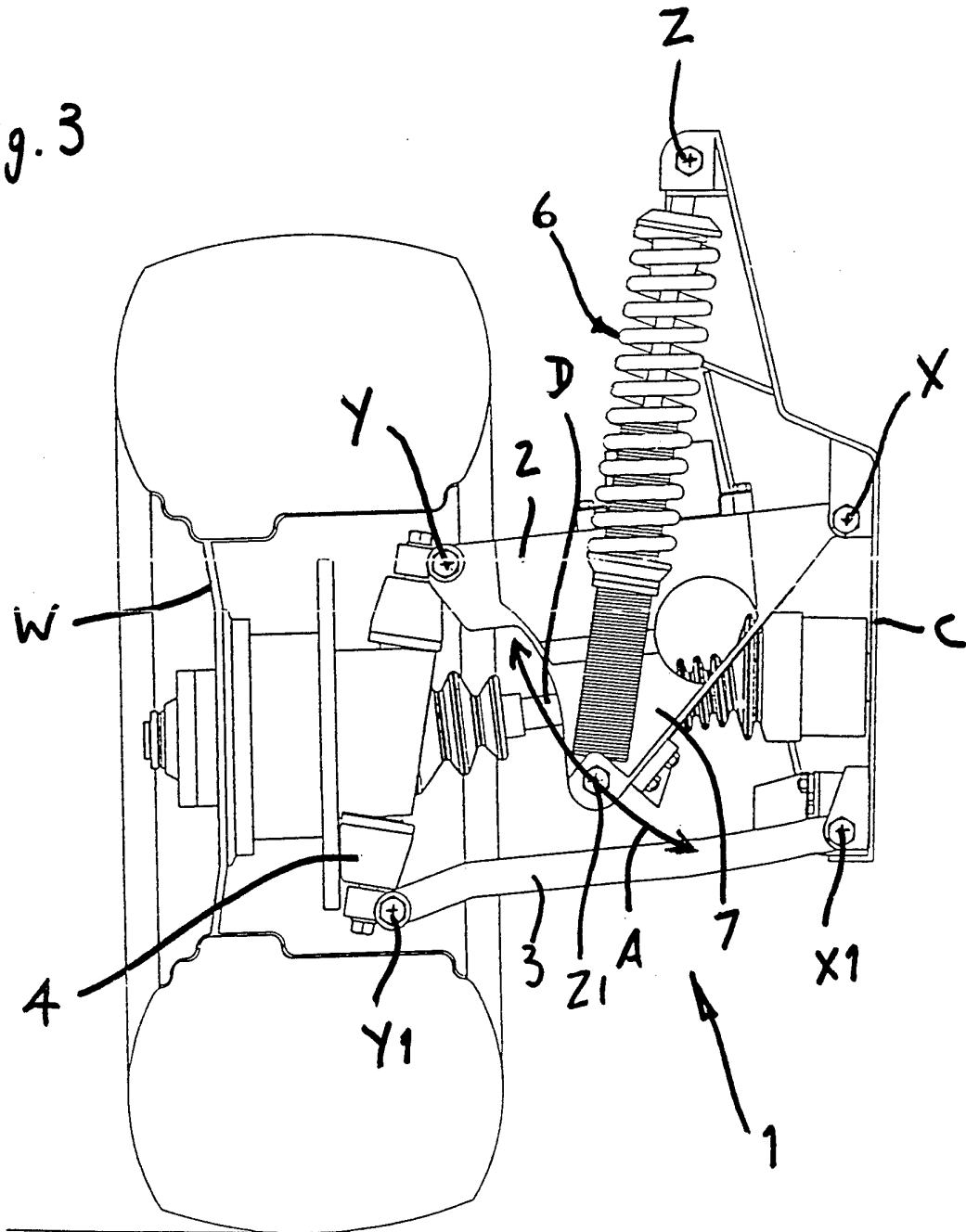
2/4

Fig.2



3/4

Fig. 3



INTERNATIONAL SEARCH REPORT

PCT/GB 93/01101

International Application No

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 B60G15/06; B60G11/14; B60G7/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B60G	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	GB,A,411 824 (SCHRÖTER) 12 June 1933	1,8,9
Y	see page 1, line 40 - line 50; figures 1,2 see page 1, line 93 - page 2, line 22 ---	2-7,10
X	EP,A,0 389 685 (PORSCHE) 3 October 1990	8,9
Y	see figures 1,3 ---	2-6,10
Y	EP,A,0 287 278 (TECHNOLOGY INVESTMENTS) 19 October 1988 see figures 1,3 ---	7
X	US,A,2 154 569 (HICKS) 18 April 1939	1-4,8-10
Y	see page 3, left column, line 41 - right column, line 9; figures 1-3 ---	5-7
		-/--
<p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
27 AUGUST 1993	07.09.93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	TORSIUS A.	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	FR,A,1 043 096 (BASTOW AND MORGAN) 5 November 1953	8-10
Y	see figures 1-3 ---	5,6
Y	US,A,2 052 064 (WHISENAND) 25 August 1936	7
A	see figures ---	1,4,8-10
X	REIMPELL 'Fahrwerktechnik: Fahrzeugmechanik' 1989, VOGEL, WÜRZBURG	1,8,9
A	see page 199 - page 203; figure 5.10 ---	5
X	GB,A,978 608 (DAIMLER-BENZ) 23 December 1964 see page 1, line 77 - page 2, line 40; figures 1-3	8,9
A	US,A,3 209 851 (COLLINS) 5 October 1965 see figure 1 ---	1
A	US,A,2 816 616 (HILL) 17 December 1957 see column 10, line 12 - line 54; figures 10-12 ---	1,6,8,9
A	FR,A,931 104 (GRÉGOIRE) 13 February 1948 ---	
A	DE,C,931 872 (BITTEL) 18 August 1955 -----	

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.

GB 9301101
SA 74412

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 27/08/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A-411824		BE-A- 392913 DE-C- 611685 DE-C- 621685 FR-A- 747011	
EP-A-0389685	03-10-90	DE-A- 3909942 US-A- 5048858	27-09-90 17-09-91
EP-A-0287278	19-10-88	AU-A- 1434288 US-A- 4848789	13-10-88 18-07-89
US-A-2154569		None	
FR-A-1043096		None	
US-A-2052064		None	
GB-A-978608		DE-B- 1233281 FR-A- 1361769	
US-A-3209851		None	
US-A-2816616		BE-A- 534174 FR-A- 1083291 GB-A- 773672	
FR-A-931104		GB-A- 666852	
DE-C-931872		None	