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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

[Continued on next page]

(54) Title: AUXILIARY AXLE AND SUSPENSION ASSEMBLY

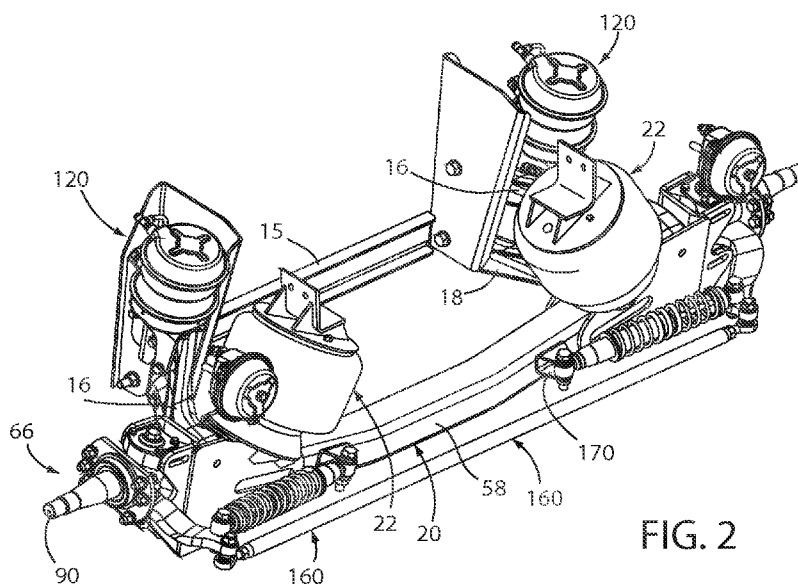


FIG. 2

(57) Abstract: A vehicle suspension assembly includes first and second mounting brackets each adapted to couple to a vehicle frame assembly, first and second trailing arms each having a first end pivotably coupled to the mounting brackets, and a second end located outboard of the first end of the associated trailing arm; an axle member having a first end and a second end; an integrated first mounting arrangement and an integrated second mounting arrangement coupled to the associated ends of the axle member, wherein the mounting arrangements pivotably couple the second end of the associated trailing arm to one of the ends of the axle member, and wherein the mounting arrangements couple one of the ends of the axle member to the spindle assembly.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/12234

Box No. II 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.: 4, 7-14, 19, 21-28, 32-35, 39, 43-46
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III 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 supplemental box ---

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 additional fees, this Authority did not invite payment of additional fees.
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.:
1-2, 3/(1, 2), 5/(1, 2), 6/(1,2)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/12234

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B60G 7/00 (2014.01)

USPC - 280/124.116, 124.128

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(8) - B60G 7/00 (2014.01)

USPC - 280/124.116, 124.128

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

USPC - 280/81.6, 86.5, 86.751, 89.11, 93.51, 124.125, 124.153, 124.157

IPC(8) - B60G 9/00, 9/02, 11/27, 11/28, 11/46, 21/05 (2014.01)

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

Patbase; Google Patents; Google Scholar; Google Web; Search Terms: additional, air*, angl*, arm*, attach*, automobile*, axle*, bracket*, car, cars, connect*, coupl*, frame*, further, inch*, max*, mount*, outboard*, second*, spindle*, spring*, suspension*, trailing*, truck*, vehicle*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,062,578 A (Richardson) 16 May 2000 (16.05.2000), entire document, especially Figs. 7-13, col. 7, ln. 40-49, col. 9, ln. 8-21	1-2, 3/(1, 2), 5/(1, 2), 6/(1,2)
A	US 2011/0163514 A1 (Saieg et al.) 07 July 2011 (07.07.2011), Figs. 1, 11-12, para [0028]-[0032]	1-2, 3/(1, 2), 5/(1, 2), 6/(1,2)
A	US 2011/0115184 A1 (Johnson et al.) 19 May 2011 (19.05.2011), para [0008], [0037]-[0039]	1-2, 3/(1, 2), 5/(1, 2), 6/(1,2)
A	US 7,618,049 B2 (Varela et al.) 17 November 2009 (17.11.2009), col. 2, ln. 43-67	1-2, 3/(1, 2), 5/(1, 2), 6/(1,2)

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent 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 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

20 July 2014 (20.07.2014)

Date of mailing of the international search report

07 AUG 2014

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

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Authorized officer:

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PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/12234

Continuation of Box No. III - Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-3, 5-6, directed to a vehicle suspension assembly comprising two brackets coupled to a vehicle frame; an axle member; a trailing arm pivotably coupled to each bracket at one end and the other end located outboard of the first end; two spindle assemblies; and two mounting arrangements that each connect one end of the axle member with corresponding trailing arm ends and spindle assemblies.

Group II: Claims 15-18, 20, directed to a vehicle suspension assembly comprising two brackets coupled to a vehicle frame; an axle member; a trailing arm pivotably coupled to each bracket at one end and opposite ends of the axle member at the other end; two spindle assemblies; two air spring assemblies; and two mounting arrangements that each connect one end of the axle member with corresponding spindle assemblies and air spring assemblies.

Group III: Claims 29-31, directed to a vehicle suspension assembly comprising two brackets coupled to a vehicle frame; an axle member; a trailing arm pivotably coupled to each bracket at one end and opposite ends of the axle member at the other end; and a lift arrangement configured to move the axle from a first position where a tire coupled to the axle touches the ground and a second position where a tire coupled to the axle is spaced from the ground.

Group IV: Claims 36-38, directed to a method of assembling a vehicle suspension assembly comprising an axle member; a mounting structure on the first end of the axle; two bearing blocks with apertures attached to the mounting structure; a spindle assembly coupled to the mounting structure by two spherical bearings in the bearing block apertures and a kingpin connecting the bearings.

Group V: Claims 40-42, directed to a vehicle suspension assembly comprising two brackets coupled to a vehicle frame; an axle member; a trailing arm pivotably coupled to each bracket at one end and opposite ends of the axle member at the other end; two air spring assemblies, each coupled to an end of the axle and inclined inwardly; the suspension assembly having a natural frequency less than or equal to 3Hz.

The inventions listed as Groups I-V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

The invention of Group I includes the special technical feature of each trailing arm having a second end located outboard of the first end and each mounting arm being attached to a mounting arrangement. These features are not required in Groups II-V

The invention of Group II includes the special technical feature of two integrated mounting arrangements that each connect one end of the axle member with corresponding air spring assemblies. These features are not required in Groups I, III-V

The invention of Group III includes the special technical feature of a lift arrangement configured to move the axle from a first position where a tire coupled to the axle touches the ground and a second position where a tire coupled to the axle is spaced from the ground. These features are not required in Groups I-II, IV-V.

The invention of Group IV includes the special technical feature of two bearing blocks with apertures attached to the mounting structure; a spindle assembly coupled to the mounting structure by two spherical bearings in the bearing block apertures and a kingpin connecting the bearings. These features are not required in Groups I-III, V.

The invention of Group V includes the special technical feature of the air spring assemblies inclining inwardly from the ends of the axle assembly; a natural frequency of the suspension assembly is less than or equal to about 3Hz.

Common Technical Features

Groups I-V all share the common features of an axle assembly having a first end and a second end.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson discloses an axle (244, Fig. 7) assembly (216, Fig. 7) having a first end and a second end (Fig. 7; col 7, ln 50-62).

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INTERNATIONAL SEARCH REPORT

International application No.

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Continuation of Box No. III - Observations where unity of invention is lacking

Groups I-II, IV all share the common features of an axle assembly having a first end including a first mounting structure and a second end;
a first spindle assembly coupled to the first mounting structure.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson discloses an axle (244, Fig. 10) assembly (216, Fig. 10) having a first end including a first mounting structure (at knuckle 278, Fig. 10) and a second end (Fig. 10-13; col 9, ln 8-21);
a first spindle (280, Fig. 10) assembly coupled to the first mounting structure (Fig. 10-13; col 9, ln 8-21).

Groups I-III, V all share the common features of an axle member having a first end and a second end,
a first mounting bracket adapted to couple to a vehicle frame assembly;
a first trailing arm having a first end pivotably coupled to the first mounting bracket, and a second end;
a second mounting bracket adapted to couple to a vehicle frame assembly;
a second trailing arm having a first end pivotably coupled to the second mounting bracket, and a second end.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson discloses an axle member (244, Fig. 7) having a first end and a second end (Fig. 7-9; col 9, ln 8-21);
a first mounting bracket (226, Fig. 7) adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
a first trailing arm (218, Fig. 7) having a first end pivotably coupled to the first mounting bracket (at 224, Fig. 7), and a second end (at 222, Fig. 7) (Fig. 7-9; col 7, ln 40-62);
a second mounting bracket (226 on opposite side of vehicle, Fig. 7) adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
a second trailing arm (218 on opposite side of vehicle, Fig. 7) having a first end pivotably coupled to the second mounting bracket (at 224 on opposite side of vehicle, Fig. 7), and a second end (at 222 on opposite side of vehicle, Fig. 7) (Fig. 7-9; col 7, ln 40-62).

Groups I-II all share the common features of an axle member having a first end and a second end;
a first mounting bracket adapted to couple to a vehicle frame assembly;
a first trailing arm having a first end pivotably coupled to the first mounting bracket, and a second end;
a second mounting bracket adapted to couple to the vehicle frame assembly;
a second trailing arm having a first end pivotably coupled to the second mounting bracket, and a second end;
an integrated first mounting arrangement coupled to the first end of the axle member,
and wherein the first mounting arrangement couples the first end of the axle member to the a first spindle assembly;
and an integrated second mounting arrangement coupled to the second end of the axle member,
wherein the second mounting arrangement couples the second end of the axle member to the a second spindle assembly.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson teaches an axle member (244, Fig. 7, 10) having a first end and a second end (Fig. 7-13; col 9, ln 8-21 - col 8, ln 57-65 provides that the fourth and third embodiments may be freely combined);
a first mounting bracket (226, Fig. 7) adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
a first trailing arm (218, Fig. 7) having a first end pivotably coupled to the first mounting bracket (at 224, Fig. 7), and a second end (at 222, Fig. 7) (Fig. 7-9; col 7, ln 40-49);
a second mounting bracket (226 on opposite side of vehicle, Fig. 7) adapted to couple to the vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
a second trailing arm (218 on opposite side of vehicle, Fig. 7) having a first end pivotably coupled to the second mounting bracket (at 224 on opposite side of vehicle, Fig. 7), and a second end (at 222 on opposite side of vehicle, Fig. 7) (Fig. 7-9; col 7, ln 40-49);
an integrated first mounting arrangement (at knuckle 278, Fig. 10) coupled to the first end of the axle member (Fig. 10-13; col 9, ln 8-21),
and wherein the first mounting arrangement couples the first end of the axle member to the a first spindle (280, Fig. 10) assembly (Fig. 10-13; col 9, ln 8-21);
and an integrated second mounting arrangement (at knuckle 278 on opposite side of vehicle, Fig. 10) coupled to the second end of the axle member (Fig. 10-13; col 9, ln 8-21),
wherein the second mounting arrangement couples the second end of the axle member to the a second spindle (280 on opposite side of vehicle, Fig. 10) assembly (Fig. 10-13; col 9, ln 8-21).

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INTERNATIONAL SEARCH REPORT

International application No.

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Continuation of Box No. III - Observations where unity of invention is lacking

Groups II-III, V all share the common features of an axle assembly having a first end and a second end;
 a first mounting bracket and a second mounting bracket each adapted to couple to a vehicle frame assembly;
 a first trailing arm having a first end pivotably coupled to the first mounting bracket, and a second end pivotably coupled to the first end of the axle assembly;
 a second mounting bracket adapted to couple to a vehicle frame assembly;
 a second trailing arm having a first end pivotably coupled to the second mounting bracket, and a second end pivotably coupled to the second end of the axle assembly.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson teaches an axle (244, Fig. 7) assembly (216, Fig. 7) having a first end and a second end (Fig. 7-9; col 9, ln 8-21);
 a first mounting bracket (226, Fig. 7) adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
 a first trailing arm (218, Fig. 7) having a first end pivotably coupled to the first mounting bracket (at 224, Fig. 7), and a second end pivotably coupled to the first end of the axle assembly (at 222 via 231, Fig. 7) (Fig. 7-9; col 7; ln 40-62);
 a second mounting bracket (226 on opposite side of vehicle, Fig. 7) adapted to couple to the vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
 a second trailing arm (218 on opposite side of vehicle, Fig. 7) having a first end pivotably coupled to the second mounting bracket (at 224 on opposite side of vehicle, Fig. 7), and a second end pivotably coupled to the second end of the axle assembly (at 222 via 231 on opposite side of vehicle, Fig. 7) (Fig. 7-9; col 7, ln 40-62).

Groups II, V all share the common features of an axle assembly having a first end and a second end;
 a first mounting bracket and a second mounting bracket each adapted to couple to a vehicle frame assembly;
 a first trailing arm having a first end pivotably coupled to the first mounting bracket, and a second end pivotably coupled to the first end of the axle assembly;
 a second mounting bracket adapted to couple to a vehicle frame assembly;
 a second trailing arm having a first end pivotably coupled to the second mounting bracket, and a second end pivotably coupled to the second end of the axle assembly;
 a first air spring assembly coupled to a first end of the axle assembly such that a longitudinal axis of the first air spring assembly inclines inwardly from the first end of the axle assembly;
 a second air spring assembly coupled to the second end of the axle assembly such that a longitudinal axis of the second air spring assembly inclines inwardly from the second end of the axle assembly.

However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 6,062,578 A (Richardson).

Richardson teaches an axle (244, Fig. 7) assembly (216, Fig. 7) having a first end and a second end (Fig. 7-9; col 9, ln 8-21);
 a first mounting bracket (226, Fig. 7) and a second mounting bracket (226 on opposite side of vehicle, Fig. 7) each adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
 a first trailing arm (218, Fig. 7) having a first end pivotably coupled to the first mounting bracket (at 224, Fig. 7), and a second end pivotably coupled to the first end of the axle assembly (at 222 via 231, Fig. 7) (Fig. 7-9; col 7, ln 40-62);
 a second mounting bracket (226 on opposite side of vehicle, Fig. 7) adapted to couple to a vehicle frame assembly (Fig. 7-9; col 7, ln 40-49);
 a second trailing arm (218 on opposite side of vehicle, Fig. 7) having a first end pivotably coupled to the second mounting bracket (at 224 on opposite side of vehicle, Fig. 7), and a second end pivotably coupled to the second end of the axle assembly (at 222 via 231 on opposite side of vehicle, Fig. 7) (Fig. 7-9; col 7, ln 40-62);
 a first air spring (unlabeled 242 mounted above 234, Fig. 7) assembly coupled to a first end of the axle assembly such that a longitudinal axis of the first air spring assembly inclines inwardly from the first end of the axle assembly (Fig. 7-9; col 7, ln 50-62);
 a second air spring (unlabeled 242 mounted above 234 on opposite side of vehicle, Fig. 7) assembly coupled to the second end of the axle assembly such that a longitudinal axis of the second air spring assembly inclines inwardly from the second end of the axle assembly (Fig. 7-9; col 7, ln 50-62).

As these are known in the art at the time of the invention, they cannot be considered a common technical feature that would otherwise unify the groups. Therefore, Groups I-V lack unity under PCT Rule 13.

NOTE: Claims 4, 7-14, 19, 21-28, 32-35, 39, 43-47 are unsearchable because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).