Abstract: A rolling chassis assembly (1) has a chassis frame (2) with a plurality of vehicle body mounting brackets (8) at a top of the chassis frame (2). Spaced-apart on the chassis frame (2) are a number of rigid rectangular wheel support frames (21) each of which has wheel stations (10) at opposite sides of the wheel support frame (21) for mounting an independent suspension assembly (49). A demountable support module comprising a pair of support module cross members (27, 28) support an axle housing (62) within the wheel support frame (21). This support module and axle housing (62) can be dropped out of the wheel support frame (21) without removing the associated independent suspension assemblies (49). Also each independent suspension assembly (49) can be removed from the chassis frame (2) without detaching the axle housing (62) from the chassis frame (2).
"A Rolling Chassis Assembly for a Vehicle"

Introduction

This invention relates to a rolling chassis assembly for a vehicle.

Various examples of vehicle chassis assemblies are disclosed in US 4,930,809, US 6,398,262, DE 10201001791, US 2005/0087971, CN 2913123Y and CN 203958307U.

The present invention is particularly concerned with heavy vehicles of the type incorporating independent suspension systems, and to this type of heavy vehicle for use in both motorway and off-road conditions.

It is an object of the invention to provide an improved chassis construction for such heavy vehicles which facilitates efficient and cost effective manufacture whilst allowing flexibility in the chassis design such that it is readily adaptable to a number of configurations to suit a range of different vehicles.

It is also an object of the invention to provide a chassis which facilitates access to drive transmission and suspension elements mounted thereon for maintenance and/or repair in use.

Summary of the Invention

According to the invention there is provided a rolling chassis assembly for a vehicle, including:

- a chassis frame having a pair of substantially parallel spaced-apart longitudinal chassis members interconnected by two or more spaced-apart transverse chassis members extending between the longitudinal chassis members,
- a plurality of spaced-apart vehicle body mounting brackets on the chassis frame,
- a plurality of spaced-apart wheel stations on the chassis frame, the wheel
stations arranged in associated pairs of wheel stations, each pair of wheel stations comprising two aligned wheel stations on opposite sides of the longitudinal chassis members interconnected by a pair of spaced-apart transverse chassis members extending between said longitudinal chassis members to form a rigid wheel support frame on the chassis frame,

each wheel station comprising means for mounting a wheel on the chassis by an independent suspension assembly,

at least one demountable support module associated with a pair of wheel stations, said demountable support module nestably engaged within the longitudinal chassis members and extending between and demountably secured to said longitudinal chassis members between said wheel stations.

In one embodiment of the invention, the demountable support module comprises a complementary pair of spaced-apart support module cross members each of which is bolted to the longitudinal chassis members.

In another embodiment at least one of the support module cross members is mounted at or adjacent a transverse chassis member. In another arrangement, both of the support module cross members are mounted at or adjacent transverse chassis members.

In another embodiment, each support module cross member is movable downwardly out of engagement with the longitudinal chassis members for disengagement therefrom.

In a further embodiment of the invention outer ends of each support module cross member are bolted to inside faces of the longitudinal chassis members.

In another embodiment of the invention one or more shims are mounted between an outer end of each support module cross member and the inside face of the longitudinal chassis member with which it engages.

In another embodiment of the invention, each longitudinal chassis member defines an
inwardly facing channel, a mounting block retained in said channel and projecting inwardly of the channel, each support module cross member having an outer end wall at each end, said outer end walls being bolted to the mounting blocks.

In another embodiment one or both of the support module cross members form the transverse chassis members at each wheel support frame.

In one embodiment, the chassis frame comprises a composite chassis frame comprising two or more interconnected chassis subframes, each chassis subframe having a pair of spaced-apart longitudinal side frame members interconnected by two or more spaced-apart transverse cross members.

In another embodiment of the invention, the chassis subframes are interconnected by longitudinal load bearing members.

In another embodiment of the invention, each longitudinal load bearing member comprises an elongate tubular body having flanged ends for abutting and engaging an outer face of the subframe transverse cross members.

In another embodiment of the invention, each longitudinal load bearing member comprises an elongate rail which engages and extends alongside the longitudinal side frame members.

In another embodiment of the invention, steering stops are mounted on the longitudinal load bearing members for cooperation with a steering system mounted on the rolling chassis assembly.

In another embodiment, the independent suspension assembly comprises an upper suspension arm and an associated lower suspension arm supporting a wheel by means of a wheel hub mounted between outer ends of the suspension arms, inner ends of the suspension arms being pivotally mounted at an outer side of the longitudinal chassis members.

In another embodiment, inner ends of the suspension arms are mounted on the chassis by spherical bearings.
In another embodiment, the rolling chassis assembly includes a driveline mounted on the chassis frame and drivably connected to wheels at an associated pair of wheel stations.

In another embodiment, the rolling chassis assembly includes a steering system mounted on the chassis frame and operably connected to at least one pair of steerable wheels mounted on a chassis frame.

In a further embodiment, the rolling chassis assembly includes a power pack which is drivably connected by an associated driveline to at least one pair of wheels mounted on a chassis frame.

**Brief Description of the Drawings**

The invention will be more clearly understood by the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a composite rolling chassis assembly for a vehicle according to the invention;

Fig. 2 is a plan view of the rolling chassis assembly;

Fig. 3 is an elevation view of the rolling chassis;

Fig. 4 is an end elevation view showing a front end of the rolling chassis assembly;

Fig. 5 is a detail exploded perspective view of the front end of the rolling chassis assembly;

Fig. 6 is a detail perspective view showing a chassis frame of the rolling chassis assembly;
Fig. 7 is a plan view of the chassis frame;

Fig. 8 is an elevational view of the chassis frame;

Fig. 9 is an end elevational view showing a front end of the chassis frame;

Fig. 10 is an end elevational view showing the rear end of the chassis frame;

Fig. 11 is an enlarged detail partially sectioned elevational view showing portion of the chassis frame;

Fig. 12 is an enlarged detail partially sectioned view of portion of the chassis frame;

Fig. 13 is a perspective view of another chassis frame according to the invention;

Fig. 14 is a plan view of the chassis frame shown in Fig. 13;

Fig. 15 is an elevational view of the chassis frame shown in Fig. 13;

Fig. 16 is an end elevational view showing a front end of the chassis frame shown in Fig. 13;

Fig. 17 is an end elevational view showing a rear end of the chassis frame shown in Fig. 13;

Fig. 18 is a perspective view of another chassis frame according to the invention;

Fig. 19 is a plan view of the chassis frame shown in Fig. 18;

Fig. 20 is an elevational view of the chassis frame shown in Fig. 18;

Fig. 21 is an end elevational view showing a front end of the chassis frame.
shown in Fig. 18;

Fig. 22 is an end elevational view showing a rear end of the chassis frame shown in Fig. 18;

Fig. 23 is a perspective view of another chassis frame according to the invention;

Fig. 24 is a plan view of the chassis frame shown in Fig. 23;

Fig. 25 is an elevational view of the chassis frame shown in Fig. 23;

Fig. 26 is an end elevational view showing a front end of the chassis frame shown in Fig. 23;

Fig. 27 is an end elevational view showing a rear end of the chassis frame shown in Fig. 23;

Fig. 28 is a perspective view of another chassis frame according to the invention;

Fig. 29 is a plan view of the chassis frame shown in Fig. 28;

Fig. 30 is an elevational view of the chassis frame shown in Fig. 28;

Fig. 31 is an end elevational view showing a front end of the chassis frame shown in Fig. 28;

Fig. 32 is an end elevational view showing a rear end of the chassis frame shown in Fig. 28;

Fig. 33 is a perspective view of another chassis frame according to the invention;

Fig. 34 is an elevational view of the chassis frame shown in Fig. 33;
Fig. 35 is an enlarged plan view of the chassis frame shown in Fig. 33; and

Fig. 36 is a sectional view taken along the line A-A of Fig. 35,

**Detailed Description of Preferred Embodiments**

Referring to the drawings, and initially to Figs. 1 to 12 thereof, there is illustrated a composite rolling chassis assembly for a vehicle according to the invention, indicated generally by the reference numeral 1. The composite rolling chassis assembly 1 comprises a chassis frame 2 mounted on wheels 3. The chassis frame 2 is of composite construction and includes a number of chassis subframes which are bolted together. In this case, the chassis subframes comprise a front chassis subframe 5, a central chassis subframe 8 and a rear chassis subframe 7, the front chassis subframe 5 and rear chassis subframe 7 being similar. A number of vehicle body mounting brackets 8 are mounted spaced-apart on the chassis frame 2, each subframe 5, 6, 7 having a number of said vehicle body mounting brackets 8 thereon.

At least one wheel station, indicated generally by the reference numeral 10, is provided at each side of each subframe 5, 6, 7 for mounting the wheels 3 on the chassis frame 2. Thus the embodiment shown has eight wheel stations 10, that is two on each of the front chassis subframe 5 and rear chassis subframe 7 and four on the central chassis subframe 6.

A driveline, indicated generally by the reference numeral 12, is mounted on the chassis frame 2 for delivering power from a powerpack (not shown) to the wheels 3. The driveline 12 includes a number of drive axles, described later, mounted on the subframes 5, 8, 7.

A steering system, indicated generally by the reference numeral 14, is mounted on the chassis frame 2 and connects between a steering wheel 15 and each wheel 3 for steering the wheels 3 on the chassis frame 2. Whilst this is an all-wheel steer arrangement, it will be appreciated that in some other embodiments of the invention only some of the wheels 3 are steerable, sufficient to manoeuvre the vehicle.
Referring in particular to Figs. 6 to 10, the chassis subframe 5 has a pair of substantially parallel spaced-apart longitudinal side frame members 20 interconnected at each end by a pair of spaced-apart transverse cross-members 22 to form a rigid rectangular wheel support frame 21 on the chassis frame 2 associated with the wheel stations 10.

Vehicle body mounting brackets 8 are mounted at a front and at a rear end of the longitudinal side frame members 20 at a top 23 and at an outer side 24 of the longitudinal side frame members 20. The vehicle body mounting brackets 8 may extend above the top 23 and may be angled.

Referring in particular to Fig. 7, on the outer side 24 of each longitudinal side frame member 20, there is mounted a pair of spaced-apart upper suspension pivot mounts 25 and a pair of spaced-apart tower suspension pivot mounts 28 forming portion of a wheel mounting station 10. Each pivot mount 25, 26 is formed by a straddle bearing or spherical bearing.

A demountable support module associated with the wheel stations 10 of the front subframe 5 comprises a complementary pair of spaced-apart support module cross members, namely an outer support module cross member 27 and an inner support module cross member 28, each of which is bolted to the longitudinal side frame members 20. Thus, the support module cross members 27, 28 nestably engage within the wheel support frame 21, extending between and demountably attached to the longitudinal side frame members 20. In this case the support module cross members 27, 28 are mounted adjacent the transverse chassis members 22. The rigidity of the wheel support frame 21 is thus enhanced by the support module cross members 27, 28.

Each support module cross member 27, 28 is movable downwardly out of engagement with the longitudinal side frame members 20 for disengagement therefrom as shown in Fig. 5. Thus the support module cross members 27, 28 and axle housing 62 can be dropped out of the vehicle without removing an independent suspension assembly 49 mounted at each wheel station 10. Also, each suspension assembly 49 can be removed from the vehicle without detaching the axle housing 62 from the vehicle.
The rear chassis subframe 7 is of similar construction to the chassis subframe 5 and like parts have been assigned the same reference numerals. The chassis subframe 6 has a pair of substantially parallel spaced-apart longitudinal side frame members 30. In this case, a transverse chassis member 32 is provided at each end of the longitudinal side frame members 30 to form a rigid rectangular central chassis subframe 6.

An outer support module cross member 33 and an associated inner support module cross member 34 nestably engage within the central chassis subframe 6 at front and rear ends thereof defining wheel support frames 21 associated with the wheel stations 10. The support module cross members 33, 34 extend between and are demountably attached to the longitudinal side frame members 30. The outer support module cross members 33 are located adjacent the transverse chassis members 32. Thus in this case it will be noted that the transverse chassis members 32 and the support module cross members 33, 34 co-operate with the longitudinal side frame members 30 to form rigid rectangular wheel support frames 21 at the front and rear ends of the central chassis subframe 8.

It will be noted also that preferably the vehicle body mounting brackets 8 are located at these wheel support frames 21 on the chassis frame 2, and most preferably in alignment with the support module cross members 27, 28, 33, 34.

Additional transverse chassis members 29, which may or may not be demountable, are mounted on the central chassis subframe 6, extending between the longitudinal side frame members 30 and located between the wheel support frames 21.

The chassis subframes 5, 6, 7 are interconnected by longitudinal load bearing members 35. Each longitudinal load bearing member 35 comprises an elongate tubular body 36 having flanged ends 37 which abut and engage and are bolted to outer faces 38 of the subframe cross members 22, 32 to align the subframes 5, 8, 7 and join them together to form a rigid composite chassis frame 2. It will be noted that the length of the load bearing member body 36 may be chosen to provide any desirable wheelbase spacing between drive axles mounted at each end of the central chassis subframe 6 and drive axles mounted on the front chassis subframe 5 and rear
chassis subframe 7. Steering stops 39 associated with the steering system 14 may be incorporated in the longitudinal load bearing members 35.

Referring in particular to Figs. 5, 11 and 12, on the front chassis subframe 5, each support module cross member 27, 28 is mounted between the longitudinal side frame members 20 for supporting a drive axle 62 between the longitudinal side frame members 20. Each support module cross member 27, 28 is secured in similar fashion to the longitudinal side frame members 20. The support module cross member 27, 28 extends between the longitudinal side frame members 20. Outer end walls 41 of the support module cross member 28 are bolted by means of bolts 42 to inside faces of the longitudinal side frame members 20. Each longitudinal side frame member 20 defines an inwardly facing channel 44 with a mounting block 45 retained in the channel 44 and projecting inwardly of the channel 44. The outer end walls 41 of the support module cross member 28 are bolted to the mounting blocks 45. Shims 46 may be mounted between the outer end wall 41 of the support module cross member 28 and an inside face of the mounting block 45 on the longitudinal side frame member 20.

Mounting bolts 47 are engageable through holes in a side wall of the longitudinal side frame members 20 with complementary threaded sockets 48 in the mounting blocks 45 for mounting the lower suspension pivot mounts 26 on the side frame members 20 at each side of the front chassis subframe 5.

It will be noted that releasing the bolts 42 allows the support module cross member 27, 28 to drop down out of engagement with the longitudinal side frame members 20 (as shown in Fig. 5) to facilitate access to, or removal of, the drive axle which is supported in use by the support module cross members 27, 28 between the longitudinal side frame members 20. This conveniently allows access to the drive axle 62 without interfering with the wheel stations 10. Similar mounting arrangements are provided for the support module cross members 27, 28 on the rear chassis subframe 7 and the support module cross members 33, 34 on the central chassis subframe 6.

As can be seen particularly in Fig. 1, Fig. 2 and Fig. 6, the vehicle body mounting brackets 8, together at the top of the chassis frame 2, provide a platform for mounting one of a number of different vehicle body types as required on the composite rolling chassis assembly 1. The locations of the vehicle body mounting brackets 8 on the chassis frame 2 may be varied for different vehicle body types.
As best seen in Figs. 3 to 5, each wheel station 10 provides an independent suspension assembly 49 having an upper suspension arm 50 and an associated lower suspension arm 51 supporting a wheel 3 by means of a wheel hub 52 mounted between outer ends of the suspension arms 50, 51. An inner end of the upper suspension arm 50 is mounted between the upper suspension pivot mounts 25 (Fig. 8) and an inner end of the lower suspension arm 51 is pivotally mounted on the lower suspension pivot mounts 26 on the outer side of the longitudinal side frame member 20, 30.

The driveline 12 shown is of similar configuration to that described in our previous Patent No. EP1231093 and comprises a through drive axle with transfer case 60 mounted on the central chassis subframe 6 which drivably connects forwardly through a first propshaft 61 with a front final drive axle 62 mounted on the front chassis subframe 5 and rearwardly drivably connects through a second propshaft 63 with a through drive axle 64 mounted at a rear end of the central chassis subframe 6 which in turn drivably connects through a third propshaft 66 with a rear final drive axle 67 on the rear chassis subframe 7.

Each drive axle 60, 62, 64, 87 is supported between the longitudinal side frame members 20, 30 of the chassis subframe 5, 6, 7 on which is mounted by the support module cross members 27, 28, 33, 34 for driveable connection via drive shafts 89 (Figs. 4 and 5) with the hubs 52 on which the wheels 3 are mounted. Openings 70 in the longitudinal side frame members 20, 30 allow through passage of the drive shafts 69. These openings 70 may not be required if a hybrid drive option is chosen for the vehicle.

The chassis subframes 5, 6, 7 are welded structures which are bolted together to form the rigid chassis frame 2. This is convenient for manufacture and varying vehicle width and wheelbase configurations are readily possible. Each chassis subframe 5, 6, 7 forms a rigid welded structure for mounting suspension, driveline and steering assemblies. The chassis subframes 5, 8, 7 are then bolted together using longitudinal load bearing members 35 as required to provide a rolling chassis 1. The rolling chassis 1 provides a common platform for a number of vehicle body designs.
Referring now to Figs. 13 to 17 there is shown a chassis frame indicated generally by the reference numeral 72 of another composite rolling chassis assembly for a vehicle according to the invention. Parts similar to those described previously are assigned the same reference numerals. In this case the chassis frame 72 is formed by the front chassis subframe 5 and the central chassis subframe 6 interconnected by longitudinal load bearing members 35 to form a composite chassis frame 72 with six wheel stations 10, that is, with three wheel stations 10 on each side of the chassis frame 72 of the composite rolling chassis assembly.

Referring now to Figs. 18 to 22 there is shown a chassis frame indicated generally by the reference numeral 75 of another composite rolling chassis assembly for a vehicle. Parts similar to those described previously are assigned the same reference numerals. In this case the front chassis subframe 5 and the rear chassis subframe 7 are interconnected by longitudinal load bearing members 35 to form the chassis frame 75 with four wheel stations 10, that is, two wheel stations 10 on each side of the chassis frame 75 of the composite rolling chassis assembly.

Referring now to Figs. 23 to 27 there is shown another chassis frame according to the invention indicated generally by the reference numeral 80. Parts similar to those described previously are assigned the same reference numerals. In this case the central chassis subframe 6 can be used to form a chassis frame 80 having four wheel stations 10.

Referring now to Figs. 28 to 32 there is shown a further chassis frame according to the invention indicated generally by the reference numeral 90. Parts similar to those described previously are assigned to the same reference numerals. In this case the chassis frame 90 has a pair of spaced-apart substantially parallel longitudinal chassis members 92. At spaced locations on the chassis frame 90 pairs of demountable support module cross members 93, 94 are provided to define with the longitudinal chassis members 92 a number of spaced-apart wheel support frames 21 for supporting three pairs of wheel stations 10 on the chassis frame 90. It will be noted that a number of the vehicle mounting brackets 8 are mounted on an outside of the chassis frame 90 in alignment with the support module cross members 93, 94 located between the longitudinal chassis members 92.
Referring now to Figs. 33 to 36, there is shown another chassis frame according to the invention indicated generally by the reference numeral 100. Parts similar to those described previously are assigned the same reference numerals. This arrangement shows four spaced-apart wheel support frames 21 with two wheel stations 10 on each wheel support frame 21, that is four wheel stations 10 at each side of the chassis frame 100.

An advantage of the rolling chassis assembly of the present invention is that no post-welding machining of the chassis is required.

Further, the provision of spherical bearings at inner ends of the upper and lower suspension arms accommodates some misalignment without adversely affecting the performance of the chassis in use.

While the vehicle body mounting brackets could be mounted at any suitable locations on the chassis for supporting a vehicle body on the chassis, it is preferred that they be mounted adjacent the wheel stations at which locations increased stiffening of the chassis is provided by the transverse structural members and drive axle support members. The vehicle body may be bolted or welded to the mounting brackets.

It will be appreciated that a hybrid drive vehicle might not have a drive axle. For example, if in-wheel motors were to be used to drive the vehicle, then power cables would be connected to the motors in the wheel hubs.

Regarding steering, the steering system may provide steering to a single axle or to multiple axles depending on requirements.

It will also be appreciated that while each of the embodiments described relate to a wheeled chassis, it is envisaged that for some applications it may be desirable to mount tracks rather than wheels on the chassis and the present invention encompasses such a construction also and the terms wheel and wheel station as used herein are intended to embrace such a tracked construction also. When tracks are provided skid steering might be employed rather than the mechanical steering systems associated with wheels.
Whilst typically building such heavy vehicles depends upon collaboration between different specialists - chassis builders, axle manufacturers, suspension builders etc., the present invention proposes an integrated chassis construction providing chassis, drive line, steering and suspension systems in a rolling chassis assembly as described herein. By adding a power pack conveniently the chassis and associated drive line, steering and suspension systems can be tested and approved, or any required adjustments easily carried out, prior to mounting a vehicle body on the rolling chassis assembly.

In this specification the terms "comprise, comprises, comprised and comprising" and the terms "include, includes, included and including" are all deemed totally interchangeable and should be afforded the widest possible interpretation.

The invention is not limited to the embodiments hereinbefore described which may be varied in both construction and detail within the scope of the appended claims.
CLAIMS

1. A roiling chassis assembly (1) for a vehicle, including:
   a chassis frame (2) having a pair of substantially parallel spaced-apart longitudinal chassis members (20, 30) interconnected by two or more spaced-apart transverse chassis members (22, 32) extending between the longitudinal chassis members (20, 30),
   a plurality of spaced-apart vehicle body mounting brackets (8) on the chassis frame (2),
   a plurality of spaced-apart wheel stations (10) on the chassis frame (2), the wheel stations (10) arranged in associated pairs of wheel stations (10), each pair of wheel stations (10) comprising two aligned wheel stations (10) on opposite sides of the longitudinal chassis members (20, 30) interconnected by a pair of spaced-apart transverse chassis members (22, 32, 34) extending between said longitudinal chassis members (20, 30) to form a rigid wheel support frame (21) on the chassis frame (2),
   each wheel station (10) comprising means for mounting a wheel (3) on the chassis (2) by an independent suspension assembly (49),
   at least one demountable support module (27, 29) associated with a pair of wheel stations (10), said demountable support module (27, 28) nestably engaged within the longitudinal chassis members (20) and extending between and demountably secured to said longitudinal chassis members (20) between said wheel stations (10).

2. The rolling chassis assembly (1) as claimed in Claim 1, wherein the demountable support module comprises a complementary pair of spaced-apart support module cross members (27, 28), each of which is bolted to the longitudinal chassis members (20).

3. The rolling chassis assembly (1) as claimed in Claim 2 wherein at least one of
the support module cross members (27, 28) is mounted at or adjacent a transverse chassis member (22).

4. The rolling chassis assembly (1) as claimed in claim 3, wherein both of the support module cross members (27, 28) are mounted at or adjacent transverse chassis members (22).

5. The rolling chassis assembly (1) as claimed in any one of Claims 2 to 4, wherein each support module cross member (27, 28) is movable downwardly out of engagement with the longitudinal chassis members (20) for disengagement therefrom.

6. The rolling chassis assembly (1) as claimed in any preceding claim wherein outer ends (41) of each support module cross member (27, 28) are bolted to inside faces of the longitudinal chassis members (20, 45).

7. The rolling chassis assembly (1) as claimed in claim 6 wherein one or more shims (46) are mounted between an outer end (41) of each support module cross member (27, 28) and the inside face of the longitudinal chassis member (20, 45) with which it engages.

8. The rolling chassis assembly (1) as claimed in claim 6 or claim 7 wherein each longitudinal chassis member (27, 28) defines an inwardly facing channel (44) a mounting block (45) retained in said channel (44) and projecting inwardly of the channel (44), each support module cross member (27, 28) having an outer end wall (41) at each end, said outer end walls (41) being bolted to the mounting blocks (45).

9. The rolling chassis assembly (1) as claimed in any one of Claims 2 to 8, wherein one or both of the support module cross members (27, 28) form the transverse chassis members at each wheel support frame (21).

10. The rolling chassis assembly (1) as claimed in any preceding claim wherein the chassis frame (2) comprises a composite chassis frame (2) comprising two or more interconnected chassis subframes (5, 8, 7), each chassis subframe (5, 8,
having a pair of spaced-apart longitudinal side frame members (20, 30) interconnected by two or more spaced-apart transverse cross members (22, 32).

11. The rolling chassis assembly (1) as claimed in claim 10 wherein the chassis subframes (5, 6, 7) are interconnected by longitudinal load bearing members (35).

12. The rolling chassis assembly (1) as claimed in claim 10 or claim 11 wherein each longitudinal load bearing member (35) comprises an elongate tubular body (36) having flanged ends (37) for abutting and engaging an outer face of the subframe (5, 6, 7) cross members (22, 32).

13. The rolling chassis assembly (1) as claimed in claim 11 or claim 12 wherein each longitudinal load bearing member (35) comprises an elongate rail which engages and extends alongside the longitudinal side frame members.

14. The rolling chassis assembly (1) as claimed in any one of claims 11 to 13, wherein steering stops (39) are mounted on the longitudinal load bearing members (35) for cooperation with a steering system mounted on the rolling chassis assembly.

15. The rolling chassis assembly (1) as claimed in any preceding claim, wherein the independent suspension assembly (49) comprises an upper suspension arm (50) and an associated lower suspension arm (51) supporting a wheel (3) by means of a wheel hub (52) mounted between outer ends of the suspension arms (50, 51), inner ends of the suspension arms (50, 51) being pivotally mounted at an outer side of the longitudinal chassis members (20, 30).

16. The rolling chassis assembly (1) as claimed in Claim 15, wherein inner ends of the suspension arms (50, 51) are mounted on the chassis (2) by spherical bearings.

17. The rolling chassis assembly as claimed in any preceding claim, which includes a driveline mounted on the chassis frame (2) and drivably connected to wheels.
(3) at an associated pair of wheel stations (10).

18. The rolling chassis assembly (1) as claimed in any preceding claim, which includes a steering system mounted on the chassis frame (2) and operably connected to at least one pair of steerable wheels (3) mounted on the chassis frame (2).

19. The rolling chassis assembly (1) as claimed in claim 17 or claim 18, which includes a power pack drivably connected by an associated driveline to at least one pair of wheels (3) mounted on the chassis frame (2).

20. A vehicle incorporating the rolling chassis assembly as claimed in any preceding claim.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. B60G7/02 B60G3/20 B62D21/02 B62D21/12

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)

B60G B62D

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

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

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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

* 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
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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

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Date of the actual completion of the international search

2 March 2017

Date of mailing of the international search report

13/03/2017

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Fax. (+31-70) 340-3016

Authorized officer

Cavalli, Frederic

Form PCT/ISA/210 (second sheet) (April 2005)
### DOCUMENTS CONSIDERED TO BE RELEVANT

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