(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2013 (16.05.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/070155 A1

(51) International Patent Classification:
*G01M 17/007* (2006.01) *G09B 9/042* (2006.01)
*G08G 1/16* (2006.01)

(21) International Application Number:
PCT/SE2012/051203

(22) International Filing Date:
5 November 2012 (05.11.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1119575.7 11 November 2011 (11.11.2011) GB

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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, IS, JP, KE, KG, KM, 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, 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.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published**:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: A DUMMY TEST VEHICLE

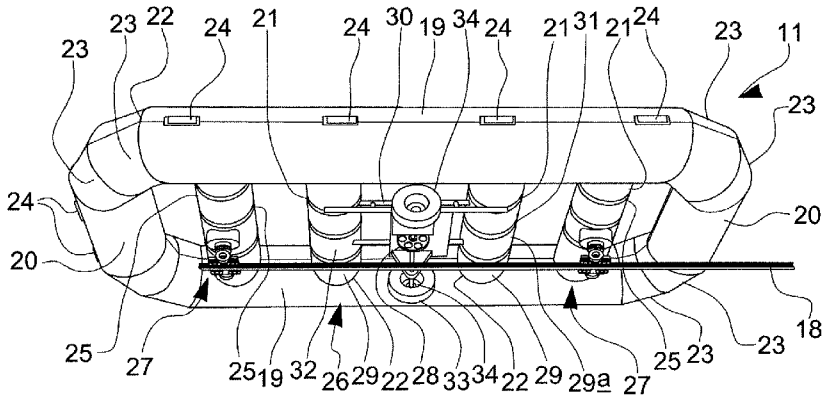



FIG 4

(57) Abstract: There is disclosed a dummy test vehicle (10). The test vehicle has running gear configured to permit the vehicle to run along the ground (17), and the running gear comprises: a guide arrangement (27) configured for connection to a track (18) secured to the ground (17)so as to vertically secure the vehicle to the track for movement along to the track; and a drive arrangement (26) having a motor arranged to drive the vehicle. The guide arrangement and the drive arrangement are interconnected via a biasing arrangement (19) which is configured to bias the drive arrangement (26) downwardly towards the ground (17). In a preferred arrangement, said biasing arrangement comprises at least one resiliently deformable biasing member (19).The resiliently deformable biasing member (19) may be provided in the form of an inflatable member forming part of an inflatable structure (14) of the vehicle chassis (11).

WO 2013/070155 A1

# A DUMMY TEST VEHICLE

The present invention relates to a dummy test vehicle. More particularly, the invention relates to a dummy test vehicle of a type which is intended approximately to resemble a conventional motor vehicle and which may be used for the development and testing of active safety systems for motor vehicles.

The provision of so-called active safety systems in motor vehicles is becoming more common, and now represents a quickly developing area of motor vehicle safety. The term "active safety" is used in the field of automotive safety to refer to technology which is designed to assist in the prevention of a crash, and can thus be contrasted with the term "passive safety" which is used to refer to systems and devices (such as airbags, seatbelts etc.) which are designed to help protect the occupants of a vehicle in the event of a crash actually occurring. Modern active safety systems thus typically comprise a number of sensors, including cameras and other optical sensors configured to monitor the environment in which the vehicle is driving and, for example, to detect and track the position and movement of other vehicles in that environment. Such active safety systems can be designed to issue warnings to the driver in the event of a likely crash being predicted, and can even be configured to intervene in the event that a driver's inputs are deemed likely to result in a crash, for example by applying the vehicle's brakes or applying inputs to the vehicle's steering system in order to take evasive action.

As will be appreciated, the successful development of modern active safety systems of this type involves extensive testing and calibration of proposed systems and equipment. In order to reduce unnecessary and expensive damage to real motor vehicles arising from impacts during such testing, it has therefore been proposed to use dummy test vehicles to represent vehicles driving or parked in the environment of a real test vehicle equipped with an active safety system. Important characteristics for such dummy test vehicles include i) a requirement for the dummy vehicles to resemble actual real motor vehicles (at least approximately) so that active safety systems can reliably "see" and detect the dummy vehicles, and ii) a requirement that the dummy vehicles are resistant to impact with the real test vehicle in the sense that such an impact should not cause significant damage either to the real test vehicle or the dummy test vehicle.

It has therefore been proposed previously to provide a dummy test vehicle in the form of inflatable "balloon car", as illustrated in figure 1. Such a dummy vehicle 1 typically comprises a chassis structure having running gear 2 such that the vehicle can be driven by following a track 3 provided on the ground, and an inflatable body 4 in the form of a balloon supported by the chassis and which is sized and shaped so as to resemble a conventional vehicle. Typically such dummy test vehicles 1 are driven or pulled along tracks 3 through a simulated street environment 5, which may include buildings and street intersections, through which a real test vehicle 6 equipped with active safety equipment can be driven in order to test and/or calibrate different systems or components of the active safety arrangements.

It has been found that previously proposed dummy test vehicles of the general type described above can suffer from several disadvantages.

One problem associated with the type of conventional dummy test vehicle described above concerns how to ensure reliable and consistent movement of the vehicle along the ground. One proposal has been to provide the dummy test vehicle with a drive arrangement comprising one or more driven wheels or gears provided in engagement with the track, in order to drive the vehicle along the track. However, such arrangements typically require the provision of a relatively large and rigid track, which does not lend itself well to being laid around corners at street intersections in a simulated street environment. Also, tracks suitable for driven engagement with the vehicle typically have a relatively high vertical profile and thus project significantly above the surface of the road, thereby representing a significant obstruction to the smooth running of the real test vehicle, which can typically include very sensitive test equipment susceptible to impact interference.

It has therefore been proposed instead to configure the drive arrangement of a dummy test vehicle to drive a wheel in engagement with the ground. Such an arrangement has the benefit of requiring the track only to define the trajectory of its movement, which means that the track can be smaller and made from more flexible material. However, it can be difficult to configure such a drive arrangement to ensure reliable and consistent contact between the drive wheel and the ground, particularly in windy conditions given the inflatable nature of the dummy vehicle.

It is a preferred object of the present invention to provide an improved dummy test vehicle.

According to the present invention, there is provided a dummy test vehicle having running gear configured to permit the vehicle to run along the ground, said running gear comprising: a guide arrangement configured for connection to a track secured to the ground so as to vertically secure the vehicle to the track for movement along the track; and a drive arrangement having a motor arranged to drive the vehicle, wherein said guide arrangement and said drive arrangement are interconnected via a biasing arrangement configured to bias the drive arrangement downwardly towards the ground.

Preferably, said drive arrangement comprises a drive wheel arranged to be driven by said motor and urged against the ground by said biasing arrangement.

Advantageously, said biasing arrangement comprises at least one resiliently deformable biasing member.

Conveniently, said drive arrangement comprises a drive unit, and said guide arrangement comprises at least one guide unit, the or each guide unit being spaced from the drive unit (preferably in the longitudinal direction of the vehicle) and being connected to the drive unit via at least one resiliently deformable biasing member.

Preferably, said drive unit is arranged at a generally central position along to the length of the vehicle, the vehicle having a front guide unit spaced in front of the drive unit, and a rear guide unit spaced behind the drive unit.

Conveniently, said front and rear guide units are substantially equi-spaced from the drive unit.

Advantageously, the or each said resiliently deformable biasing member is provided in the form of an inflatable member.

Conveniently, the test vehicle comprises a chassis incorporating said running gear and an inflatable structure, wherein the or each said inflatable member forms part of said inflatable structure.

Preferably, the inflatable structure is provided in the form a tubular framework comprising a plurality of interconnected inflatable members.

Advantageously, said tubular framework comprises a pair of longitudinal inflatable side members, said side members being spaced-apart from one another across the width of the vehicle and defining respective said biasing members.

Conveniently, said tubular framework comprises a plurality of transverse inflatable cross-members, said cross-members being spaced apart from one another along the length of the vehicle.

Preferably, each said cross-member extends between said side members and is provided in fluid communication with the side members.

Advantageously, each said unit of the running gear is fixed to at least one said cross-member.

Conveniently, said running gear is strapped to the inflatable structure of the chassis with a plurality of flexible straps.

Advantageously, said inflatable structure is configured for inflation to a pressure in the range of 1 to 60 kPa., and preferably to a pressure of at least 10 kPa. In a preferred embodiment, the inflatable structure is inflated to a pressure in the range of 25 to 30 kPa.

Advantageously, the test vehicle further comprises a body supported by the chassis.

The body is preferably shaped and configured to resemble the bodywork of a conventional motor vehicle, and may also be printed with images resembling the windows, doors, lights and other features of a conventional motor vehicle.

Preferably, the body is inflatable and configured for inflation to a pressure which is lower than the pressure to which the inflatable structure of the chassis is inflated. The inflatable body may be inflated to a pressure in the range of 0.1 to 1 kPa, and preferably approximately 0.5 kPa.

Preferably, said running gear is arranged to support the inflatable structure of the chassis above the ground.

Advantageously, the inflatable structure is spaced above the ground by a height equivalent to the height of a conventional vehicle bumper or fender.

Conveniently, said running gear is arranged to support the inflatable structure of the chassis between 0.1m and 0.6m above the ground.

Preferably, each said inflatable member is substantially circular in cross-section when inflated to said second pressure.

Advantageously, said inflatable structure is formed from a material comprising at least one component selected from the group consisting of: chlorosulfonated polyethylene; polychloroprene; polyvinylchloride; and polyurethane.

Conveniently, the guide arrangement comprises a carriage configured for connection to the track in a manner effective to vertically secure it to the track for movement along the track, and a support associated with the structure of the vehicle, wherein the carriage and the support are releasably connectable to one another.

The carriage may be provided in the form of a trolley, or a slider.

Conveniently, said carriage and said support are magnetically connectable to one another.

Preferably, said carriage and said support are releasably connectable to one another via at least one permanent magnet.

Advantageously, one of said carriage and said support comprises a permanent magnet, and the other of said carriage and said support comprises a ferromagnetic material for magnetic attraction to said permanent magnet.

In a preferred arrangement, the carriage comprises said permanent magnet, and the support comprises said ferromagnetic material.

Conveniently, one of said carriage and said support comprises a socket and the other of said carriage and said support comprises a connection element configured for releasable engagement within the socket.

Preferably, said support comprises said socket, and said carriage comprises said connection element. However, in an alternative arrangement the support comprises the connection element and the carriage comprises the socket.

Advantageously, said socket is rotatably mounted to said support for rotation about a substantially vertical axis. Alternatively, the socket may be rotatably mounted to the carriage for rotation about a substantially vertical axis.

Conveniently, said connection element is rotatably mounted to said carriage for rotation about a substantially vertical axis. Alternatively, the connection element may be rotatably mounted to the support for rotation about a substantially vertical axis.

Preferably, said socket and said connection element are substantially circular.

Advantageously, said socket comprises a substantially planar base with a peripheral lip.

Conveniently, said peripheral lip defines an inner surface, at least a region of which is substantially orthogonal to the surface of said planar base.

Optionally, said peripheral lip defines an inner surface, at least a region of which makes an obtuse angle to the surface of said planar base.

Preferably, a chamfer is provided between the inner surface of said peripheral lip and the surface of said planar base.

Advantageously, said guide arrangement comprises a pair of guide units, each guide unit comprising a respective said carriage and a respective said support.

Conveniently, the test vehicle comprises a chassis incorporating said running gear and an inflatable structure, wherein the or each said support is fixed to the inflatable structure to support the inflatable structure above the ground.

Preferably, the dummy test vehicle comprises a flexible peripheral skirt releasably connected to the chassis. The skirt may be printed with an image resembling the wheels and/or bumpers or fenders of a conventional motor vehicle.

So that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 (discussed above) is a schematic illustration showing a dummy test vehicle in use in a simulated street environment;

Figure 2 is an exploded perspective view of a dummy test vehicle in accordance with an embodiment of the present invention;

Figure 3 is a perspective view of the assembled dummy test vehicle;

Figure 4 is an perspective view from below, showing the chassis of the dummy test vehicle of the invention, engaged with a length of track along which the dummy test vehicle is designed to run;

Figure 5 is a perspective view of part of a guide arrangement of the dummy test vehicle, showing a carriage and a support disengaged from one another;

Figure 6 is a front elevational view showing the carriage of figure 6 in engagement with the track; and

Figure 7 is a perspective view similar to that of figure 5, but which shows the carriage and the support in engagement.

Referring now to the drawings in more detail, figure 2 shows an exploded view of a dummy test vehicle 10 in accordance with the present invention. The dummy vehicle comprises a chassis 11, a body part 12, and a lower flexible skirt 13.

As will be described in more detail below, the chassis 11 comprises a main inflatable structure 14 and running gear (not shown in figure 2). The running gear is configured to support the inflatable structure of the chassis a small distance above the ground, and to permit the vehicle to run along the ground.

The body part 12 is inflatable, and as such is provided in the form of a large envelope or balloon formed of flexible material and configured so as to resemble the shape of the upper part of a conventional motor vehicle when the body 12 is inflated. In the arrangement illustrated schematically in figure 2, the body 12 is shaped to resemble a small family hatchback car, although of course other types of motor vehicle can be represented with different shapes of body 12. The body 12 may also be printed with images resembling the windows, doors, external lights and other features of a conventional motor vehicle in order to represent a motor vehicle more accurately.

The body 12 is preferably configured as a single large inflatable chamber, although it is to be appreciated that in other embodiments of the invention the body can have a multi-chamber

configuration. It is also considered preferable to form the inflatable body 12 from a relatively lightweight flexible material. Suitable materials for the construction of the body include synthetic fabrics such as rip-stop nylon or Dacron.

The body 12 is configured for inflation to a relatively low pressure, and most preferably to a pressure in the range of 1 to 10 kPa. When inflated, the body 12 is supported on top of the chassis and is tethered to the chassis, as described in more detail below.

The flexible skirt 13 is provided for releasable attachment around the periphery of the chassis, in order to depend downwardly from the chassis towards the ground, thereby bridging the gap between the inflatable structure 14 of the chassis 11 and the ground. The skirt 13 may be formed from any suitable flexible material, and is preferably formed of similar material to the inflatable body 12; for example synthetic fabrics such as rip-stop nylon or Dacron. The flexible skirt can be releasably attached around the periphery of the inflatable structure 14 in any convenient manner, but in a preferred arrangement it is releasably secured via lengths of conventional hood-and-loop fasteners 15 such as the type commonly known by the trade mark Velcro.

The flexible skirt 13 may be printed with images resembling the wheels, tyres, bumpers or fenders, and other external features of the lower part of a conventional motor vehicle in order to represent a motor vehicle more accurately.

Figure 3 illustrates the inflatable body 12 and the skirt 13 both connected to the chassis 11 in order to form the assembled dummy test vehicle 10. The inflated body 12 is positioned on top of the inflatable structure 14 of the chassis, and is tethered to the inflatable structure via one or more rope tethers or the like in order to secure it in position relative to the chassis 11. The skirt 13 is wrapped around the periphery of the inflatable structure 14 and is secured to the inflatable structure 14 (for example via the above-mentioned hook-and-loop type fasteners 15 ) so as to hang downwardly from the inflatable structure of the chassis, terminating at a lower edge 16 which is spaced slightly above the ground 17. As will be appreciated, the height of the skirt 13 is thus determined by the height at which the running gear (described below) of the chassis 14 supports the inflatable structure 14 above the ground 17.

It is proposed that one or more of the inflatable body 12, the inflatable structure 14 and the flexible skirt 13 could comprise radar reflecting material, such as metal foil or metal threads,

in order to improve the radar signature of the dummy test vehicle 10, and hence improve its characteristics in resembling a real motor vehicle during the testing or active safety equipment incorporating radar devices.

As will be appreciated, the dummy test vehicle 10 is thus configured to be very light in overall weight. As will be described in more detail below, the inflatable structure 14 of the chassis is configured to be relatively stiff when inflated and thus represents the main load-carrying part of the vehicle 10, whilst the inflatable body 12 is configured to be relatively soft when inflated and is provided primarily to provide an appropriate shape to the vehicle 10 in order to ensure that it reasonably represents the shape and size of a real motor vehicle.

Turning now to consider figure 4, the structure of the chassis 11 is shown in more detail, as viewed from below and in combination with a length of track 18 which it is proposed will be secured to the ground 17 so as to project upwardly from the ground and to define a predetermined path along which the dummy vehicle may move.

The inflatable structure 14 of the chassis 11 is provided in the form of a generally rectangular-shaped tubular framework comprising a plurality of fluidly interconnected inflatable members 19, 20, 21. The inflatable structure 14 is shown in figure 4 in its inflated condition, in which the inflatable members 19, 20, 21 each have a substantially circular transverse cross-section.

The inflatable structure 14 is configured for inflation to an internal pressure which is higher than the internal pressure to which the inflatable body 12 is inflated. It is proposed to inflate the inflatable structure to between 1 and 60 kPa overpressure, and preferably to at least 10kPa overpressure. In the preferred embodiment, the inflatable structure is inflated to 25 – 30 kPA overpressure. In order to withstand this level of pressure, the tubular framework of the inflatable structure 14 is made from relatively heavy duty material in comparison to the inflatable body 12. It is therefore proposed to fabricate the tubular framework from inflatable members 19, 20, 21 having a similar construction to the inflatable tubes used in modern high performance rigid-inflatable-boats. Accordingly, it is proposed to make the inflatable members 19, 20, 21 from materials such as chlorosulfonated polyethylene; polychloroprene; polyvinylchloride; and polyurethane. The inflatable members 19, 20, 21 may have a laminated construction formed from a number of layers of such materials. The inflatable members 19, 20, 21 are preferably bonded to one another via taped adhesive bonds 22 to ensure substantially hermetic interconnection of the members.

As illustrated in figure 4, the inflatable structure 14 of the chassis comprises a pair of substantially parallel longitudinal inflatable side-members 19, which are spaced from one another across the width of the chassis 11, and hence effectively across the width of the dummy vehicle 10. Extending between the two side-members 19, there are provided a plurality of transverse inflatable cross-members 20, 21 which are spaced apart from one another along the length of the chassis 11, and hence effectively along the length of the dummy vehicle. The plurality of cross-members 20, 21 includes a pair of end-members 20 defining respective ends of the chassis 11, and a number of central brace-members 21. The central brace-members 21 are each fluidly connected at their ends directly to respective side-members 19. The two end-members 20 are fluidly connected to the ends of the side-members 19 via corner members 23 which define slightly chamfered corners to the generally rectangular framework.

Around the periphery of the inflatable structure 14, there are provided a plurality of spaced apart grab-handles 24, which are sized and configured to be conveniently grasped by a technician to permit the chassis 11 to be manoeuvred; for example on to or off the track 18. In the arrangement illustrated, four grab-handles 24 are provided along the outer sides of the two side-members 19, and two grab-handles 24 are provided along the outer sides of the end-members 20.

Additionally, a plurality of eyelets 25 are affixed to the underside of the tubular framework. The eyelets are configured to allow the passage of a fixing cord or rope (not shown), in order to tether the inflatable body 12 to the chassis 11. It is therefore proposed to provide similar eyelets underneath the inflatable body 12 (not shown). In the particular arrangement illustrated in figure 4 the eyelets provided on the chassis 11 are provided on the central brace-members 21, although it is to be appreciated that such eyelets could be provided anywhere on the inflatable structure 14 of the chassis 11. The eyelets can be seen more clearly in figure 5.

Figure 4 also clearly shows the running gear 26, 27 of the chassis 11. More particularly, it is to be noted that the running gear includes a drive arrangement 26 and a guide arrangement 27. In the particular arrangement illustrated, the drive arrangement comprises a single drive unit 26 provided at a generally central position along the length of the chassis 11, and the guide arrangement comprises a pair of discrete guide units 27. The guide units 27 are spaced apart from one another, and also from the drive unit 26, in the longitudinal direction of

the chassis and thus define respectively a front guide unit spaced in front of the drive unit 26, and a rear guide unit spaced behind the drive unit 26.

Considering firstly the drive unit 26, it is to be noted that the drive unit 26 comprises a central structure or housing 28 which is spaced between a pair of supports 29. An arrangement of longitudinal beams 30 rigidly and structurally interconnects the central housing 28 and the spaced apart supports 29.

The supports 29 of the drive unit 26 each have a respective upwardly concave support plate 29a arranged to present an upwardly directed concavity and configured to have a radius of curvature substantially equal to the radius of the outer surfaces of the brace-members 21 of the inflatable structure 14 when in their inflated condition as illustrated in figure 4. Furthermore, the two support plates 29a are spaced-apart by a distance generally corresponding to the spacing between the two centremost brace-members 21. The support plates 29a are thus arranged to receive and engage respective said brace-members 21 in their concavities in order to support the central region of the inflatable structure 14.

As illustrated in figure 4, the two support plates 29a are actually set at an angle to one another such that their concavities are directed slightly away from one another. This arrangement means that support plates 29a extend slightly further around the inwardly facing sides of the brace-members 21 than they do around the oppositely directed sides of the brace-members 21. This arrangement helps to prevent longitudinal slippage of the inflatable structure 14 relative to the drive unit 26

In order to securely connect the inflatable structure 14 of the chassis 11 to the drive unit 26, a plurality of flexible straps 31 are provided (for example webbing straps as commonly used to lash down cargo). The straps are used to strap the brace-members 21 to the support plates 29a as shown in figure 4.

As can also be seen in figure 4, the support plates are provided with an array of apertures 32 which are configured to fit over the eyelets 25 on the central brace-members 21 in order to permit access to the eyelets in order to tie down the inflatable body 12.

As will be noted, with the support plates 29a engaged with and strapped to the two centremost brace-members 21 of the inflatable structure, the housing 28 of the drive unit is

positioned approximately mid-way between the two brace-members 21, and hence centrally along the length of the chassis 11, and also the vehicle 10.

The housing 28 of the drive unit 26 houses an electric motor (not shown), which is mechanically connected (for example via a chain 33) to at least one drive wheel 34. In the particular arrangement illustrated in figure 4, two wheels 34 are provided at opposite ends of a common axle, and both wheels are arranged to be driven by the motor. The wheels are preferably provided with tyres and are arranged for engagement with the ground 17. In a preferred arrangement, the drive wheels are provided with a rudimentary suspension arrangement and are biased downwardly, away from the housing 28.

Figures 5 to 7 illustrate in more detail the configuration of one of the two guide units 27. Both of the guide units 27 are substantially identical. The purpose of the two guide units 27 is to releasably connect the chassis 11 to the track 18 and to guide the chassis in its movement along the track. Each guide unit 27 comprises two main parts; namely a carriage 35 and a support 36. The carriage 35 is configured for connection to the track 18, and the support 36 is connected to the inflatable structure 14 of the chassis 11.

The carriage 35 can take any convenient form, provided it is configured for connection to the track 18 in a manner effective to vertically secure it to the track for movement along the track. The embodiment illustrated in the drawings uses carriages 35 which are each provided in the form of a trolley for rolling movement along the track 18. However, in alternative embodiments, it is envisaged that the carriages could take the form of sliders configured for sliding movement along the track 18.

Figure 6 illustrates a carriage 35 in more detail, as viewed from the front and showing the carriage 35 connected to the track 18 (the track being shown in transverse cross-section). The track 18 is preferably formed from rubber or a similar resilient and easily deformable material, so that the track can easily be laid out on the ground 17 in a desired path, incorporating bends and curves as required. The track is proposed to be adhesively bonded to the ground 17. As will be noted in figure 6, the transverse cross-sectional profile of the track 18 is configured so as to define a pair of upwardly and outwardly directed spaced apart ribs 37. A longitudinal recess 38 is thus defined along each side edge of the track.

The carriage 35 comprises a main body 39, to which are mounted a pair of rollers 40. Figures 5 to 7 show only one of the rollers 40, as provided at one end of the body 39, but it is

to be appreciated that a substantially identical roller 40 is provided at the opposite end of the body 39. The rollers 40 are both mounted for rotation relative to the body 39 about respective horizontal axes (in the orientation of the carriage illustrated in figure 6) and are arranged to engage and roll along the top of the track 18, and more particularly along the top surfaces of the two ribs 37, as illustrated most clearly in figure 6.

The carriage 35 is also provided with an arrangement of four guide wheels 42. The guide wheels 42 are arranged in a square array comprising a front pair and a rear pair. The guide wheels 42 are all mounted for rotation relative to the body 39 about respective vertical axes 43 (again, in the orientation of the carriage illustrated in figure 6). As illustrated most clearly in figure 6, the guide wheels of each said pair are spaced apart from one another across the track 18, such that each guide wheel engages an outer edge of the track 18. More particularly, it will be noted that the guide wheels 42 have a recessed profile in radial cross-section comprising a pair of vertically spaced apart peripheral lips 44, the recessed profile being complimentary to the outer profile of the projecting ribs 37 of the track. As illustrated in figure 6, the upper peripheral lips 44 of the guide wheels 42 thus engage an upper surface of the ribs 37 of the track, and the lower peripheral lips 44 fit into the recesses 38 along the side edges of the track, and engage the under-surface of the ribs 37. The recessed profile of the guide wheels thus engage the ribs 37 of the track in a manner which is effective to prevent vertical movement of the carriage 35 relative to the track once the carriage has been engaged with the track from one end. The carriage 35 is thus configured for connection to the track in a manner effective to vertically secure it to the track for movement along the track, thereby preventing the carriage from being lifted upwards off the track, as might otherwise occur for example in windy conditions given the relatively low overall density of the dummy vehicle.

The carriage 35 also preferably includes a pair of support wheels 45, mounted for rotation relative to the body 39 about a common horizontal axis 46. Each guide wheel 45 is provided on a respective side of the carriage 35 and has a diameter which is sized so that the wheel extends downwardly below the bottom of the body 39, and also a small distance below the guide wheels 44. Figure 6 shows the carriage 35 in a horizontal orientation in which the two support wheels 45 are both spaced a small distance above the ground 17. The support wheels 45 are intended to provide support to the carriage 35 in the event that the carriage, under the weight of the dummy vehicle 10, is caused to tilt about its longitudinal axis out of the horizontal orientation illustrated, as might occur during movement of the dummy vehicle

along a tightly curved length of the track 18, or if caught by a gust of wind. In such a scenario one of the support wheels 45 (and in particular the support wheel 45 located on the outside of a bend in the track) will engage and bear against the ground 17, thereby limiting the degree of tilt imparted to the carriage 35, and preventing damage to the rollers 40, the guide wheels 42 and the track 18.

The carriage 35 also has a connection element 47 which is mounted above the body 39, and generally centrally between both the rollers 40 and the guide wheels 45. The connection element 47 of the embodiment illustrated is provided in the form of a circular disc having a diameter which extends across a major extent of the width of the body 39, between the guide wheels 45. The connection element 47 preferably takes the form of a permanent magnet. In the embodiment illustrated in the drawings, the connection element 47 is fixedly connected to the carriage.

Turning now to consider figures 5 and 7, the support 36 of one of the guide units 27 is shown in more detail. The support 36 comprises a generally cylindrical body 48 which extends downwardly from an upwardly concave support plate 49 arranged to present an upwardly directed concavity and configured to have a radius of curvature substantially equal to the radius of the outer surfaces of the brace-members 21 of the inflatable structure 14 when in their inflated condition as illustrated in figure 4. As will thus be appreciated, the support plate 49 of the support 36 has a similar configuration to the support plates 29a of the drive unit 26, and is thus similarly configured to receive and engage a respective brace-member 21 in its concavity in order to support the front region (in the case of the front guide unit 27) or the rear region (in the case of the rear guide unit 27) of the inflatable structure 14.

In order to connect the inflatable structure 14 of the chassis 11 securely to the guide units 27, a plurality of flexible straps 31 are again used to strap the brace-members 21 to the support plates 49 of the guide units 27 as shown in figure 4.

As can also be seen in figure 5, the support plates 49 of the guide units 27 are provided with an array of apertures 32 which are configured to fit over the eyelets 25 on the front and rear brace-members 21 in order to permit access to the eyelets in order to tie down the inflatable body 12.

Mounted below the body 48 of each support 36, there is provided a respective socket 50. In the preferred arrangement illustrated, the socket is rotatably mounted to the body 48 for

rotation about a vertical axis 51 (in the orientation of the chassis 11 illustrated). The socket 50 illustrated in the drawings is circular in configuration and comprises a substantially planar base 52 from which depends a small peripheral lip 53. The socket 50 is sized and configured to receive the connection element 47 of the carriage 35, such that the inner surface of the peripheral lip 53 engages the outer surface of the connection element 47. In such an arrangement, it is therefore envisaged that the inner surface of the peripheral lip 53 will be substantially orthogonal to the surface of the planar base 52 of the socket 50.

Furthermore, it is to be appreciated that the socket 50 is made from a ferromagnetic material for magnetic attraction to the permanent magnet of the connection element 47. As will therefore be appreciated, the carriage 35 and the support 36 are thus configured to be magnetically connected to one another via the connection element 47 and the socket 50.

The above-described guide arrangement, comprising discrete guide units 27 to the front and rear of the central drive unit 26 is thus configured to ensure reliable connection of the dummy vehicle 10 to the track 18, ensuring that the vehicle remains vertically secured to the track 18 for movement along the track 18 during normal use of the dummy test vehicle, for example in a simulated street environment. The permanent magnets of the connection elements 47 are configured so as to be sufficiently strong to remain magnetically connected to the respective sockets 50 during such normal use of the test vehicle, and in particular to resist any tendency for the supports 36 and the carriages 35 to become disconnected in high wind conditions, or as the dummy vehicle negotiates bends or curves in the track 18 (for example at street intersections). However, the strength of the permanent magnets are carefully selected to permit disengagement of the connection elements 47 from the sockets 50, and hence disconnection of the supports 36 from the carriages 35, in the event that the dummy vehicle is struck by a real test vehicle. In such an impact, the attractive force between the permanent magnets of the connection elements 47 and the ferromagnetic material of the sockets 50 will be overcome, thereby enabling disconnection of the supports 36 and the carriages 35 so that the dummy vehicle 10 can detach from the track 18 and bounce off the real test vehicle, thereby avoiding significant damage to either vehicle.

As will be appreciated, the height of the peripheral lips 53 below the planar bases 52 of the sockets 50 is an important factor in how easily the supports 36 become disengaged from the carriages 35 in a generally horizontal impact between the dummy vehicle 10 and a real test vehicle. The lips 53 are therefore arranged to depend only a few millimetres below the

planar bases 52 of the sockets, to ensure that they do not interfere with the disconnection of the sockets 50 and the connection elements 47 in the event of an impact. The main function of the lips 53 is to ensure positive and properly aligned connection between the supports 36 and the carriages 35. In an alternative configuration of the sockets 50 (not shown), it is proposed that the peripheral lips 53 will be outwardly directed, such that their inner surfaces make an obtuse angle to the respective planar bases 52 of the sockets. There may thus be formed a chamfer between the inner surface of each lip 53 and the respective base 52 which will further assist in reliable disconnection of the connection elements 47 from the sockets 50 in the event of impact with a real test vehicle.

As will also be appreciated, the rotational mounting of the sockets 50 to their respective support bodies 48 ensures that the guide units 27 will reliably guide the dummy test vehicle 10 around curves in the track 18. However, it is to be appreciated that in variants of the embodiment described, the sockets 50 could be fixedly mounted and the connection elements 47 of the carriages 35 could instead be rotatably mounted relative to the bodies 39 of the carriages 35. In other embodiments, the sockets 50 and the connection elements 47 could both be mounted for rotation.

Furthermore, whilst the invention has been described above with reference to an embodiment in which the connection element 47 of each carriage is provided in the form of a permanent magnet, they could instead be provided in the form of magnetised ferromagnetic material. In such an arrangement, it is envisaged that the sockets 50 of the supports 36 would instead be formed as permanent magnets.

As illustrated in figures 4 to 7, the running gear of the chassis 11, comprising the drive unit 26 and the guide units 27 is configured to support the inflatable structure 14 of the chassis 11 in spaced relation to the ground 17 when the dummy vehicle 10 is engaged with the track 18 as described above. More particularly, it is proposed that the running gear will be configured to support the inflatable structure 14 above the ground 17 by distance equivalent to the normal spacing of a conventional motor car's bumper or fender above the ground. In preferred embodiments, it is therefore proposed to support the inflatable structure 14 between 0.1m and 0.6m above the ground. In such an arrangement, the inflatable structure 14 will thus be provided at a height for direct impact with a real test vehicle, thereby ensuring that the inflatable structure 14 will thus take the main force of the impact. Because the structure 14 is inflatable, and inflated to a relatively high pressure in comparison to the

inflatable body 12, the inflatable structure 14 is sufficiently robust to survive most anticipated impacts with real test vehicles, without significant damage occurring either to the dummy vehicle 10 or the real test vehicle. In particular, the relatively soft inflatable body 12 is supported by the inflatable structure 14 so as to be above the part of the real test vehicle most likely to impact with the dummy vehicle, and is thus unlikely to be damaged in such an impact.

The inflatable structure 14 represents the major load carrying part of the chassis 11. The tubular framework construction of the inflatable structure 14 has been found to be particularly advantageous in absorbing and distributing the impact forces arising from a collision with a real test vehicle. For example, the spaced-apart configuration of the two side members 19 gives good energy absorption characteristics in the event of a side impact, whilst the spaced-apart configuration of the cross-members 20, 21 gives good energy absorption characteristics in the event of a rear or frontal impact.

However, the inflatable structure 14 of the chassis, combines with the spaced-apart configuration of the central drive unit 26 from the front and rear guide units 27 to provide another significant advantage. As can be seen in figure 4 in particular, the two guide units 27 are each effectively connected to the drive unit 26 by a length of the two inflatable side members 19 of the inflatable structure 14. In a preferred embodiment, the guide units 27 are configured to be slightly reduced in height above the ground 17 in comparison to the central drive unit 26, such that when the supports 36 of each guide unit 27 are magnetically connected to their respective carriages 35 on the track 18, the front and rear ends of the inflatable structure 14 are pulled slightly downwardly. This slight downward pulling of the front and rear ends of the inflatable structure 14 serves to impart a downward biasing force to the drive unit 26, effective to urge its drive wheels 24 against the ground, thereby ensuring that they will have sufficient traction against the ground to provide a reliable driving force to the dummy vehicle. In such an arrangement, the inflatable side members 19 of the inflatable structure thus represent resilient deformable biasing members of a biasing arrangement configured to bias the drive unit 26 downwardly towards the ground.

Furthermore, the division of the running gear of the chassis 11 into separate units 26, 27 permits relative movement between the units 26, 27, through flexure of the inflatable structure 14 during movement of the vehicle along the track 18. This helps to ensure reliable

movement of the vehicle, and its continued connection to the track 18 despite possible kinks and undulations in the track 18.

Also, because the running gear comprises discrete units 26, 27, in the event of damage being sustained to a particular unit, that unit can be easily and relatively inexpensively replaced, without necessitating replacement of the entire running gear arrangement.

The central location of the drive unit 26 in the longitudinal direction of the chassis, and the symmetrical arrangement of the two guide units 27 to the front and the rear of the chassis enables the dummy vehicle to be driven either forwards or backwards along the track 18 with similar dynamic characteristics.

Although the invention has been described above with reference to particular embodiments in which the body 12 of the vehicle, supported by the inflatable structure 14 of the chassis, is configured to be inflatable, other variants of the vehicle body 12 are also envisaged. For example, it is proposed that instead of the body 12 being inflatable, it could instead be formed from lightweight flexible material stretched over a lightweight frame (i.e. in the manner of a tent). Alternatively, the body 12 could be formed from foam, or any other convenient lightweight material.

When used in this specification and claims, the terms “comprises” and “comprising” and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or integers.

The features disclosed in the foregoing description, or in the following claims, or in the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for obtaining the disclosed results, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

While the invention has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the invention set forth above are considered to be illustrative and not limiting. Various changes to the described embodiments may be made without departing from the spirit and scope of the invention.

CLAIMS

1. A dummy test vehicle (10) having running gear (26, 27) configured to permit the vehicle to run along the ground (17), said running gear comprising: a guide arrangement (27) configured for connection to a track (18) secured to the ground (17) so as to vertically secure the vehicle (10) to the track (18) for movement along the track; and a drive arrangement (26) having a motor arranged to drive the vehicle, wherein said guide arrangement (27) and said drive arrangement (26) are interconnected via a biasing arrangement (19) configured to bias the drive arrangement (26) downwardly towards the ground (17).

2. A dummy test vehicle according to claim 1, wherein said drive arrangement (26) comprises a drive wheel (34) arranged to be driven by said motor and urged against the ground (17) by said biasing arrangement (19).

3. A dummy test vehicle according to claim 1 or claim 2, wherein said biasing arrangement comprises at least one resiliently deformable biasing member (19).

4. A dummy vehicle according to claim 1 or claim 2, wherein said drive arrangement comprises a drive unit (26), and said guide arrangement comprises at least one guide unit (27), the or each guide unit (27) being spaced from the drive unit (26) and being connected to the drive unit (26) via at least one resiliently deformable biasing member (19).

5. A dummy test vehicle according to claim 4, wherein said drive unit (26) is arranged at a generally central position along to the length of the vehicle (10), the vehicle having a front guide unit (27) spaced in front of the drive unit (26), and a rear guide unit (27) spaced behind the drive unit (26).

6. A dummy test vehicle according to any one of claims 3 to 5, wherein the or each said resiliently deformable biasing member is provided in the form of an inflatable member (19).

7. A dummy test vehicle according to claim 6, comprising a chassis (11) incorporating said running gear (26, 27) and an inflatable structure (14), wherein the or each said inflatable member (19) forms part of said inflatable structure (14).

8. A dummy test vehicle according to claim 7, wherein the inflatable structure (14) is provided in the form a tubular framework comprising a plurality of interconnected inflatable members (19, 20, 21).

9. A dummy test vehicle according to claim 8, wherein said tubular framework comprises a pair of longitudinal inflatable side members (19), said side members (19) being spaced-apart from one another across the width of the vehicle and defining respective said biasing members.

10. A dummy test vehicle according to claim 8 or claim 9, wherein said tubular framework comprises a plurality of transverse inflatable cross-members (20, 21), said cross-members (20, 21) being spaced apart from one another along the length of the vehicle.

11. A dummy test vehicle according to claim 10 as dependent upon claim 9, wherein each said cross-member (20, 21) extends between said side members (19) and is provided in fluid communication with the side members (19).

12. A dummy test vehicle according to claim 10 or claim 11, as dependent upon claim 4 or claim 5, wherein each said unit (26, 27) of the running gear is fixed to at least one said cross-member (21).

13. A dummy test vehicle according to anyone of claims 7 to 12, wherein said running gear (26, 27) is strapped to the inflatable structure (14) of the chassis (11) with a plurality of flexible straps (31).

14. A dummy test vehicle according to any one of claims 7 to 13, wherein said inflatable structure (14) is configured for inflation to a pressure in the range of 1 to 60 kPa.

15. A dummy test vehicle according to any one of claims 7 to 14, further comprising an inflatable body (12) supported by the chassis (11).

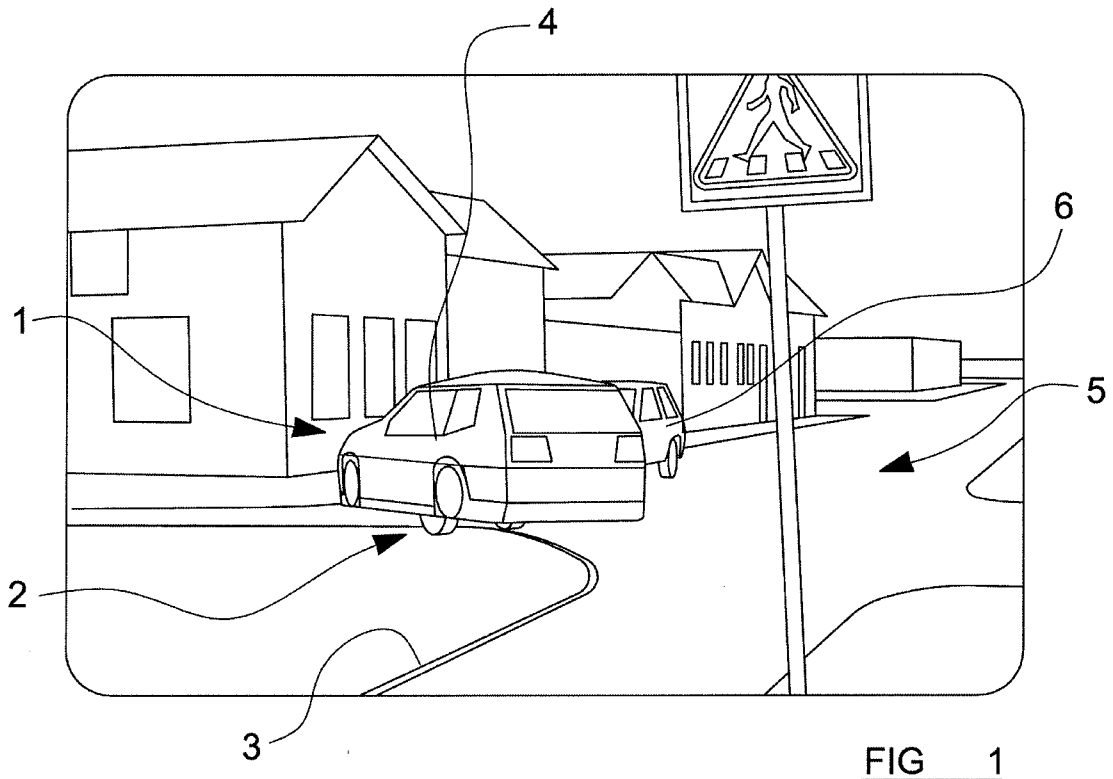



FIG 1

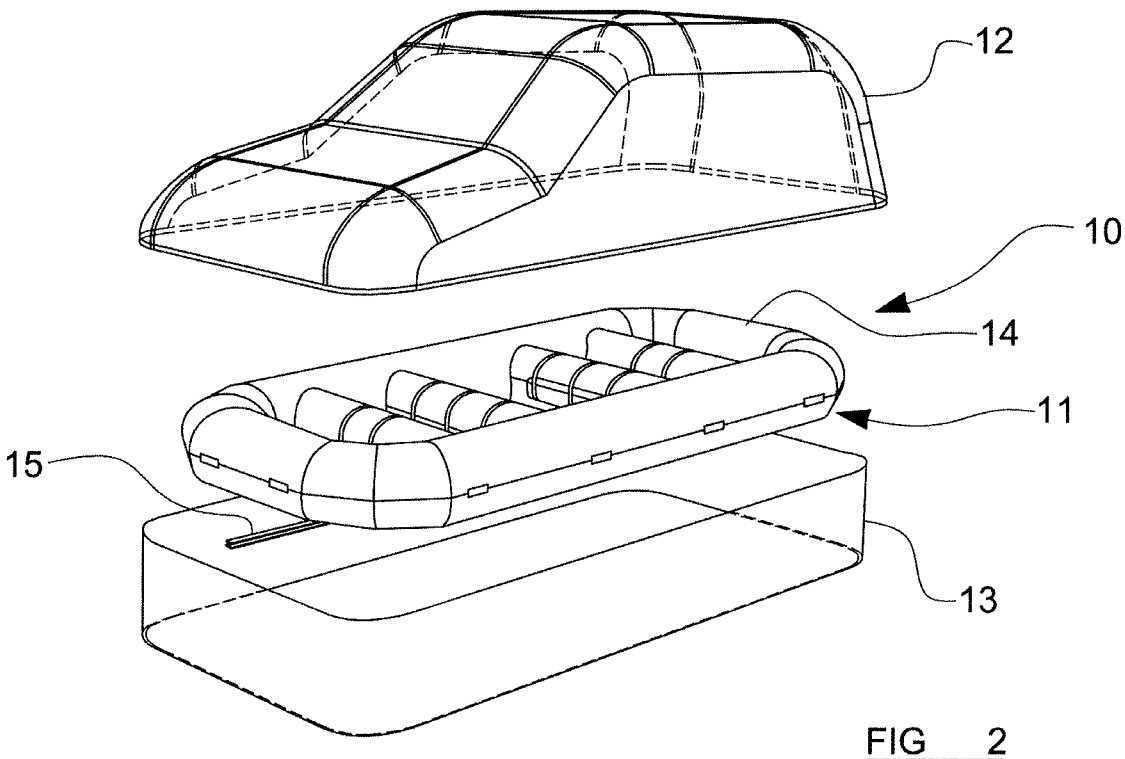



FIG 2

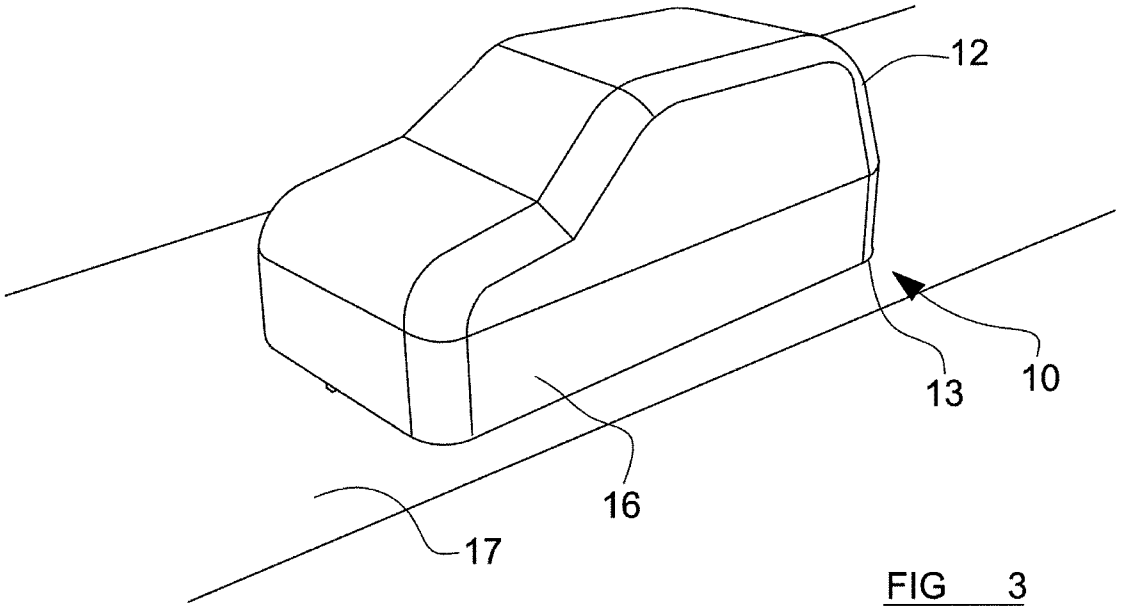

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FIG 3

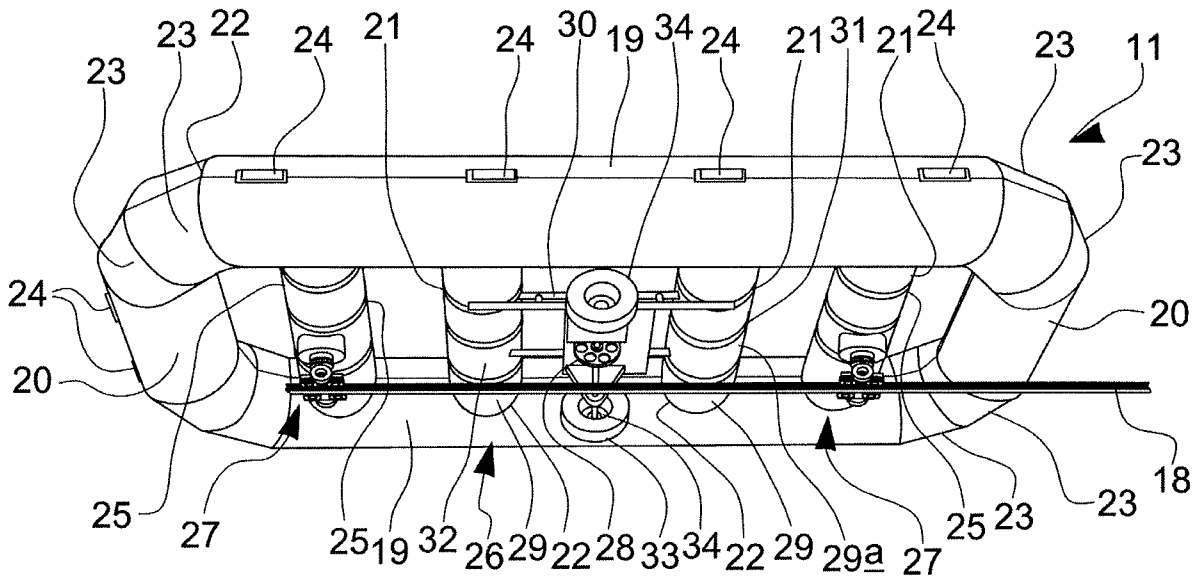

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FIG 4

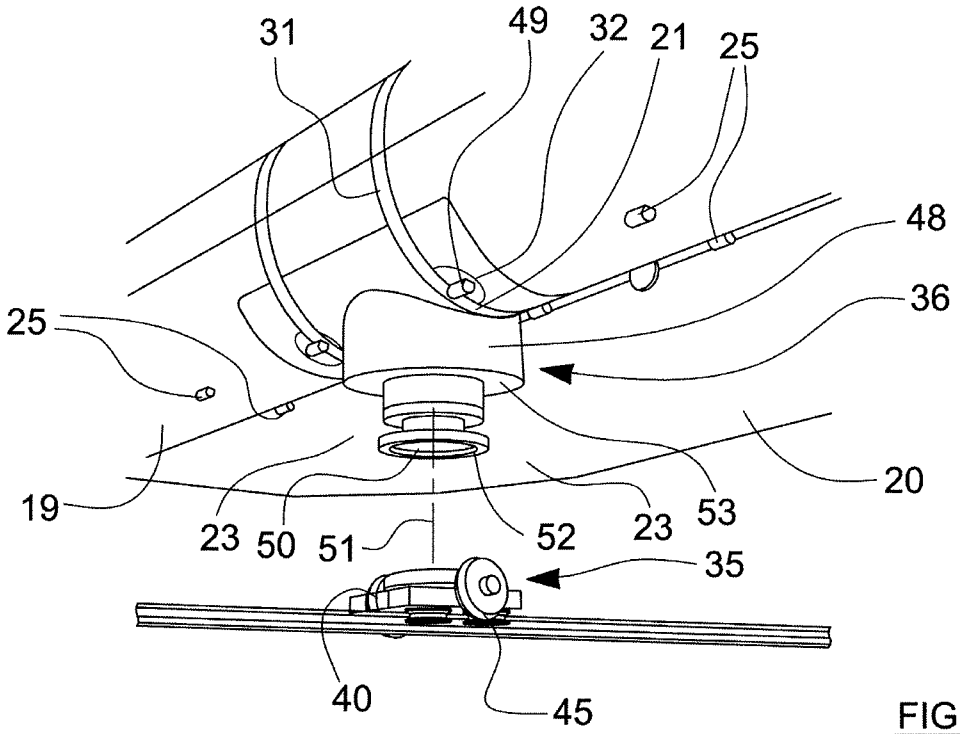



FIG 5

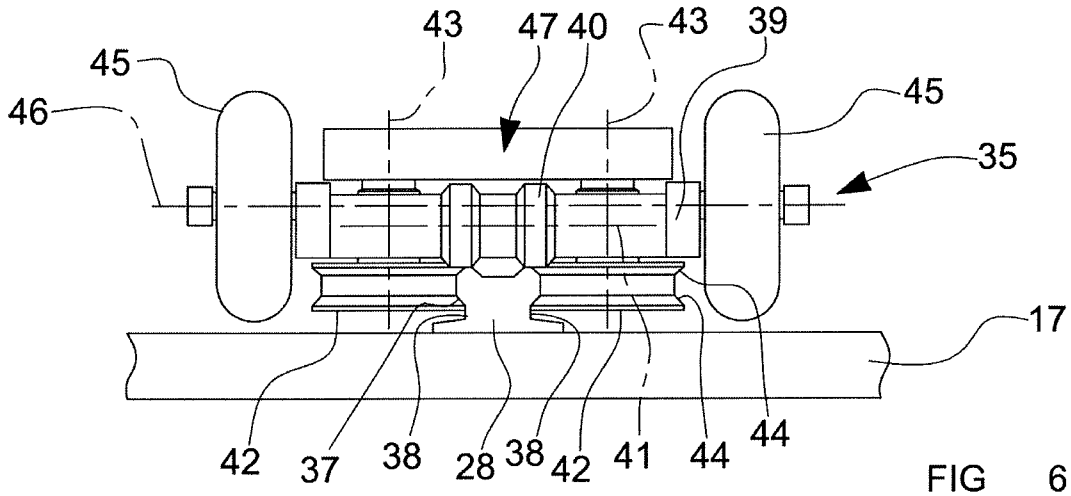



FIG 6

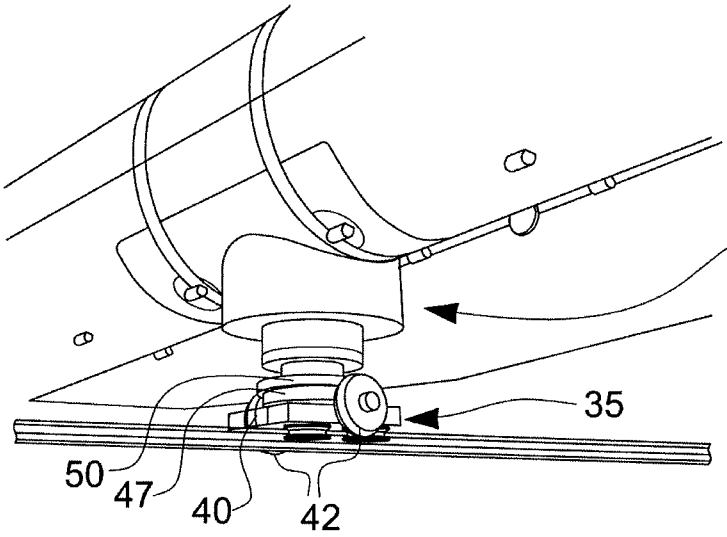



FIG 7

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/SE2012/051203

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G01M, G08G, G09B

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 4126312 A (KREUZER JOHN A ET AL), 21 November 1978 (1978-11-21); abstract; figure 1 -- | 1-15 |
| A | GB 2350824 A (CONNER JOHN JOSEPH O), 13 December 2000 (2000-12-13); abstract; page 1, line 9 - line 12; page 2, line 7 - line 11; figure 1 -- | 1-15 |
| A | WO 2009103384 A (DAIMLER AG ET AL), 27 August 2009 (2009-08-27); abstract; figure 5 -- ------- | 1-15 |

☐ 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

"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 | Date of mailing of the international search report |
|---|---|
| 22-03-2013 | 22-03-2013 |


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International application No.
PCT/SE2012/051203

**Continuation of:** second sheet

**International Patent Classification (IPC)**

***G01M 17/007*** (2006.01)
***G08G 1/16*** (2006.01)
***G09B 9/042*** (2006.01)

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|---|---|---|---|---|---|---|---|
| US | 4126312 | A | 21/11/1978 | NONE | | | |
| GB | 2350824 | A | 13/12/2000 | NONE | | | |
| WO | 2009103384 | A | 27/08/2009 | DE | 102008010630 | A1 | 03/09/2009 |