



(51) International Patent Classification:
B60R 21/231 (2011.01)

(21) International Application Number:
PCT/EP2021/082648

(22) International Filing Date:
23 November 2021 (23.11.2021)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
DE 10 2020 131 316.0
26 November 2020 (26.11.2020) DE

(71) Applicant: **AUTOLIV DEVELOPMENT AB** [SE/SE];
Wallentinsvägen 22, 44783 Vargarda (SE).

(72) Inventors: **KNUTSSON, Stefan**; Hedåsgatan 7, 44735
Vargarda (SE). **RYDSMO, Erik**; Molla Smedstorp 1,
52495 Ljung (SE). **BACKMAN, Kenneth**; Nybrogatan 26,

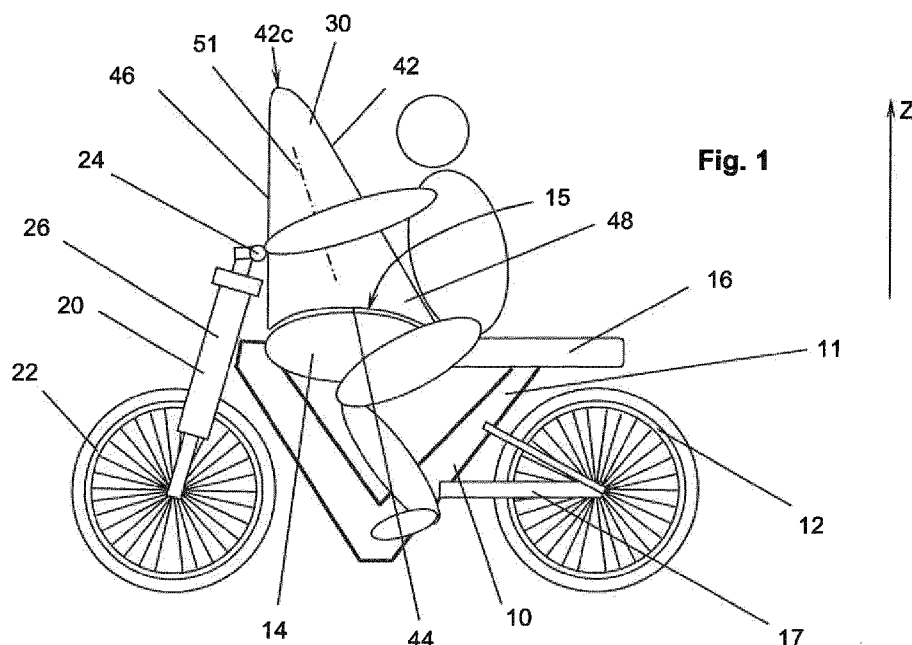
66230 Amal (SE). **ANDERSSON, Mikael**; Nordenskiöldsgatan 1b, 44134 Alingsås (SE).

(74) Agent: **KOCH, Henning**; Autoliv B.V. & Co. KG, Otto-Hahn-Strasse 4, 25337 Elmshorn (DE).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,

(54) Title: VEHICLE AND AIRBAG ADAPTED FOR BEING USED AS A PART OF SUCH A VEHICLE



(57) Abstract: The present invention relates to a vehicle comprising a first part (10) carrying at least one rear wheel (12) at least indirectly, said first part (10) comprising at least one seat element (16) and a component in front of the at least one seat element (16), a second part (20) being attached to the first part (10) at the front end of the first part (10) in a swiveling manner and carrying at least one front wheel (22), said second part (20) comprising at least one handlebar (24), and an airbag device comprising an airbag (30) being attached to the first part (10), said airbag (30) having an outer skin (40) comprising an impact wall (42) being located in front of the seat element (16) when the airbag (30) is fully deployed. The present invention also relates to an airbag (30) adapted for being used in said vehicle.

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, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

Vehicle and Airbag adapted for being used as a Part of such a Vehicle

5 Description

The invention relates to a vehicle according to the preamble of claim 1 as well as to an airbag adapted for being used as a part of such a vehicle according to claim 12.

10

Frontal airbag devices are widespread in today's automotive technology and such a frontal airbag device is part of almost every modern passenger car and similar vehicles. Such a frontal airbag device (hereinafter also simply referred to as 'airbag device') comprises an airbag having an outer skin and an inflator for filling this
15 airbag. The outer skin of such an airbag device always comprises an impact wall facing the person to be protected when the airbag is fully deployed. Most often the outer skin also comprises a front wall which supports the airbag at a rigid part of the vehicle, for example the steering wheel or the instrument panel. The outer surface of the front wall thus forms the supported surface of the outer skin of the air-
20 bag. In order to reduce the depth of the fully deployed airbag it is known to provide at least one tethering element between the front wall and the rear wall, wherein this tethering element is under tension when the airbag is fully deployed. Such frontal airbag devices contribute to the safety of the occupant of a passenger car to a large extent.

25

It is a known fact that motorcycle riders are even more endangered during an accident than the occupants of a passenger car. Consequently it has been proposed to adapt the concept of a frontal airbag device to motorcycles. A motorcycle with such a frontal airbag device is described for example in JP2015-067148A.

30

Starting from this prior art it is the task of the invention to improve a generic vehicle.

- 2 -

This task is solved by a vehicle having the features of claim 1. An airbag adapted for being used as a part of such a vehicle as defined in claim 12.

- 5 The invention relates to motor cycles in the first place but can also be applied to similar vehicles like trikes and quads or other types of two wheelers, quads, ATVs and other types of four wheelers without a car body. These vehicles have in common that they comprise a first part having a seat element (often in form of a bench) and a second part being held at the front end of the first part in a swiveling
10 manner and comprising a handlebar, wherein the first element comprises a component which is located between the seat element and the second element. This component often is a tank.

The basic idea is to use at least a part of the upper surface of the component as a
15 support surface for the deployed airbag and to choose the shape of the outer skin of the airbag accordingly. It was found that the matching shape of the airbag skin is a wedge-shape such that it has a base wall and slanted impact wall, a front wall and two substantially triangular side walls.

- 20 By means of the wedge-shape, the upper surface of the component of the first part of the vehicle in front of the seat element can be used as a support surface (as has already been mentioned), and an early coupling of the abdominal region of the rider to the impact wall of the outer skin of the airbag can be reached without exercising too much force to the head and neck of the rider. Further, the vol-
25 ume enclosed by the outer skin when the airbag is fully deployed is minimized.

In order to limit the total width of the airbag such that the outer skin has the shape of a classic wedge, it is preferred to provide at least one transverse tethering element connecting the side walls.

30

In order to create the wedge-shape, it can be preferred that the airbag comprises at least one longitudinal tethering element being connected to the impact wall and to the front wall. Like the transverse tethering element, this at least one longitudi-

- 3 -

nal tethering element is under tension when the airbag is fully deployed. In this case it can be advantageous that the at least one longitudinal tethering element is also connected to the base wall. This helps to shape the base wall such that it can properly be supported by the upper surface of the component of the first part. In
5 other embodiments however, the at least one longitudinal tethering element is not connected to the base wall. This can improve an even gas distribution within the gas space enclosed by the outer skin.

The transverse tethering element and the longitudinal tethering element can be
10 combined to a combined transverse and longitudinal tethering element being connected to the side walls as well as at least to the impact wall and preferably also to the front wall. Especially in this case it can be preferred that the edge of the combined tethering element being connected to the impact wall is concave leading to an impact wall that is concave at least in sections.

15

It is possible to use such a combined transverse and longitudinal tethering element alone or in combination with at least one distinct transverse tethering element and/ or in combination with at least one distinct longitudinal tethering element. Of course more than one combined transverse and longitudinal tethering
20 element can be used.

If at least one distinct transverse tethering element and at least one distinct longitudinal tethering element are present, they of course cross each other in some way. In one preferred embodiment, the at least one transverse tethering element
25 extends through the at least one longitudinal tethering element or that the at least one longitudinal tethering element extends through the at least one transverse tethering element. In another preferred embodiment, the transverse tethering element comprises at least two sections with two adjacent sections being connected to the longitudinal tethering element, or the longitudinal tethering element
30 comprises at least two sections with two adjacent sections being connected to the transverse tethering element.

- 4 -

Especially in order to shape the impact wall such that the rider's head is hindered from slipping off laterally, it can be advantageous to provide at least two longitudinal tethering elements.

- 5 As has already been mentioned, the base wall extends along at least a section of the upper surface of the component being located in front of the at least one seat element. It is preferred that the base wall extends at least along half of the length of the upper surface component, more preferably along substantially the entire length of the upper surface of the component. It is often ideal if the base wall extends essentially to the rear end of this component next to the seat element.
- 10

Of course, the airbag device of the vehicle comprises an inflator for inflating the airbag.

- 15 The invention will now be described by means of preferred embodiments in view of the figures. The figures show:

- Figure 1 a first embodiment of an inventive vehicle, namely a motorcycle with the airbag of this vehicle being fully deployed,
- 20
- Figure 2 the airbag of the vehicle shown in Figure 1 in a perspective view with some hidden elements being shown in broken lines,
- Figure 2a a second embodiment of the airbag in a representation according to Figure 2,
- 25
- Figure 3 a third embodiment of the airbag in a representation according to Figure 2, but with no hidden elements being shown,
- 30
- Figure 4 the tethering elements of the airbag of Figure 3,
- Figure 5 a variation to what is shown in Figure 4,

- 5 -

Figure 6 a sectional view taken along plane A-A in Figure 5,

Figure 7 the motorcycle of Figure 1 during deployment of the airbag,

5 Figure 8 what is shown in Figure 7 after the airbag is fully deployed (same as in Figure 1),

Figure 9 another embodiment of the motorcycle in a representation according to Figure 7 (meaning during deployment of the airbag), and

10

Figure 10 the motorcycle of Figure 9 after complete deployment of the airbag.

The invention will now be described by means of embodiments in which the inventive vehicles are motorcycles. According to current knowledge this is the most
15 important application of the invention, but it should be noted that the invention can also be applied to similar vehicles especially to vehicles which have a longitudinal bench on which the rider is seated, and a fork or fork-like part having a handle bar. In any case it is necessary that a component of the vehicle extends between the seat element (seating bench) and the handle bar. Currently, this component
20 usually is a tank. Usually, the legs of the rider are positioned left and right of the longitudinal axis of the vehicle, and most often left and right of the component and outside the vehicle.

First, the structure of the motorcycle shown in Figure 1 is briefly described: The
25 motorcycle can be looked at as comprising two parts, namely a first part 10 and a second part 20. The first part 10 is basically the "rear part" and usually comprises a frame 11, a tank 14, attached to the frame, a seat element (seat bench) 16 attached to the frame 11 and a swing arm 17 being attached to the frame 11 in a rocking manner. This swing arm 17 holds a rear wheel 12. A second part is at-
30 tached to the first part, namely to the front end of the frame 11 in a swiveling manner. As is usual with motorcycles, this second part 20 comprises a fork 26, and a handle bar 24 attached to the fork 26. A front wheel 22 is held by the fork. The wheels 12, 22 are of course also parts of the vehicle.

An airbag device is provided and the airbag 30 of this airbag device is shown in Figure 1 in its fully deployed state. The airbag device further comprises an inflator, but this inflator is not shown in the drawings. The airbag 30 is again shown in Figure 2 in more detail and its structure and position relative to the first part and the second part of the motorcycle is described now:

As every airbag, the airbag 30 comprises an outer skin 40. This outer skin 40 comprises an impact wall 42, a front wall 46 and a base wall 44. The base wall 44 extends from a front end 44a to a rear end 44b, the impact wall 42 extends from the rear end 44b of the base wall to a top end 42c and the front wall 46 extends from the top end 42c of the impact wall 42 to the front end 44a of the base wall 44. The impact wall 42 is slanted to the vertical direction Z, for example at an angle between 20° and 40°. When viewed at from the side, these three walls essentially form a triangle, wherein especially the base wall 44 can be curved, especially concavely curved, in order to conform to the upper surface 15 of the tank 14. Laterally the outer skin 40 is closed by substantially triangular side walls 48 and 49.

The base wall 44 extends substantial along the whole length of the upper surface 15 of the tank 14, meaning of the component in front of the seat element 16. As is shown, and this is preferred, the rear end 44b of the base wall 44, which is also the rear and lower end of the impact wall 42 is located at or near the rear end of the tank 14, such that it is located close to the driver of the motorcycle, especially close to his/ her abdominal region. It is further preferred and shown that the base wall 44 extends essentially to the front end of the tank 14 such that the whole upper surface 15 of the tank 14 (more general: the component of the first part) or at least a large part of this surface can be used as a support surface.

As has been mentioned, it is essential that the outer skin 40 of the airbag 30 is wedge-shaped wherein it is preferred that the base wall 44 conforms to the upper surface of the tank 14. In order to achieve this wedge shape, the side walls 48, 49 are of course substantially triangular-shaped and it is further necessary to provide

- 7 -

at least one tethering element. Especially good results can be achieved if at least two tethering elements are provided, namely a transverse tethering element 50 and a longitudinal tethering element 60. The transverse tethering element 50 is attached to the first side wall 48 by means of a first lateral wall connection 51
5 (usually a seam) and to the second side wall 49 by means of a second lateral wall connection 52 (usually also a seam). It is preferred that the transverse tethering element 50 extends along a substantial part of the height of the side walls 48, 49.

The longitudinal tethering element 60 is attached to the impact wall 42 by means
10 of an impact wall connection 62 (usually a seam) and to the front wall 46 by means of a front wall connection 66 (usually also a seam). In the embodiment shown in Figure 2, the longitudinal tethering element 60 is also connected to the base wall 44 namely by the base wall connection 64 (usually also a seam). This can help to shape the base wall, but is not mandatory. In the case that the impact
15 wall connection 62 extends along the complete height of the impact wall, the front wall connection 66 extends along the complete height of the front wall 46 and the base wall connection 64 extends along the complete length of the base wall 44, these connections 62, 64 and 66 can be sections of a single connection. In other embodiments, the longitudinal tethering element 60 does not extend to the base
20 wall, such that the two chambers that are separated by the longitudinal tethering element 60 are connected at the bottom. This has the advantage that only one central gas inlet is needed or the inflator can be located inside the gas space.

Because of the structure and shape of the tethering elements 50, 60 they need to
25 cross each other. In the embodiment shown, the longitudinal tethering element 60 shows an opening 68 for this purpose. Of course it would also be possible to provide such an opening in the transverse tethering element 50 instead. In case that the tethering elements are traditional belt-like tethers, these of course can just pass each other.

30

The longitudinal tethering element 60 divides the gas space enclosed by the outer skin into two sections. In order to ensure a substantially symmetric deployment, one inflator opening 45, 45' is provided for each section. In the case that the longi-

tudinal tethering element does not extend to the base wall, one central inflator opening is sufficient.

The tethering elements 50, 60 help to keep the fully deployed outer skin 40 in its wedge-shape. This-wedge shape has the following advantages: The rear lower end of the outer skin 40 can be located close to the motorcycle rider, especially to his/ her abdominal region such that an early coupling between rider and the airbag, namely its impact wall 42, takes place. Further, a large supported surface can be provided; essentially the whole outer surface of the base wall 44 serves as a supported surface. Preferably, the width of the base wall 44 in Y-direction is at least the width of the tank 14, such that a maximum support can be provided, but the overall volume of the airbag is not higher than necessary. Because of the transverse tethering element 50, the maximum width (in Y-direction) of the completely deployed outer skin 40 does not exceed substantially the width of the base wall 44 or is at least limited to a defined value. Besides the volume reduction this has the further advantage that the deployed airbag does not interfere with the arms of the rider such that usually the driver's hands still hold the handle bar 24 when the airbag is fully deployed. The longitudinal tethering element 60 and especially its connection to the impact wall 42 has the further advantage that the impact wall 42 is flat or even slightly concave such that the driver's head and torso are hindered from slipping off laterally.

Figure 2a shows an embodiment with a combined transverse and longitudinal tethering element 55, which is both, a transverse tethering element and a longitudinal tethering element. It can be preferred that the edge of the combined transverse and longitudinal tethering element 55 being connected to the impact wall 42 is concave such that also the outer surface of the impact wall (the impact surface) is concave. This can help to hinder the rider from slipping off the impact surface. Of course, at least two such combined transverse and longitudinal tethering elements 55 being spaced from one another in Z-direction could be used.

Figures 3 and 4 show a third embodiment of the airbag 30, wherein Figure 3 is a perspective view according to Figure 2 but without showing hidden elements and

Figure 4 shows only the tethering elements. The difference to the first embodiment is that two longitudinal tether elements 60, 60' are provided. For this reason of course also two connections to the impact wall, the base wall (if such a connection exists) and the front wall are provided; the impact wall connections 62, 62' are
5 shown in Figure 3. By providing two longitudinal tethering elements 60, 60', an essentially flat area of the impact wall 42 can be generated. This can especially help to keep the driver's head centered at the impact wall 42.

In this case it is for example possible to provide the gas feeding only in the middle
10 between the two longitudinal tethering elements 60, 60' even if the longitudinal tethering elements extend to the bottom wall. In this case it can be necessary to provide overflow openings 69, 69' in the longitudinal tethering elements 60, 60'.

Figures 5 and 6 show an alternative to the structure shown in Figures 3 and 4.
15 Here, the transverse tethering element 50 has three sections 50a, 50b and 50c, wherein the outer sections 50a, 50c are each connected to one side wall and to one longitudinal tethering element, and wherein the middle section 50b is connected to both longitudinal tethering elements 60, 60'. This concept can of course also be applied to the case that only one longitudinal tethering element is used.

20

The tethering elements shown in the embodiments have a rather planar, two-dimensional structure. This can have advantages, but it needs to be noticed that the tethering elements could also be "classic" belt-shaped tethers. In this case, it might be necessary to use several tethers for each direction (meaning the longitu-
25 dinal and the transverse direction).

As is shown in Figures 7 and 8, it is for example possible to locate the airbag device (meaning the un-deployed airbag and the inflator) at the rear end of the tank 14 or the front end of the seat element 16, such that the airbag deploys basically
30 to the front and upwards. This has the advantage that the impact wall 42 is located in front of the driver at an early stage.

- 10 -

As an alternative (shown in Figures 9 and 10), the airbag device could also be located essentially at the front of tank 14 such that the airbag deploys more like a traditional frontal airbag, namely towards the rider.

- 5 It would of course also be possible (but not shown in the drawings) to locate the airbag device essentially in the middle of the tank such that it deploys to the front and to the rear.

- 10 One sees that the wedge-shape of the outer skin of the airbag provides numerous advantages over the motorbike airbags known in the prior art.

List of reference numbers

	10	first part of vehicle
	11	frame
5	12	rear wheel
	14	tank
	15	upper surface of tank
	16	seat element
	17	swing arm
10	20	second part
	22	front wheel
	24	handlebar
	26	fork
	30	airbag
15	40	outer skin of airbag
	42	impact wall
	42c	top end
	44	base wall
	44a	front end
20	44b	rear end
	45, 45'	inflator opening
	46	front wall
	48, 49	side wall
	50	transverse tethering element
25	51	first lateral wall connection
	52	second lateral wall connection
	55	combined transverse and longitudinal tethering element
	59	overflow opening
	60, 60'	longitudinal tethering element
30	62, 62'	impact wall connection
	64	base wall connection
	66	front wall connection
	68	opening for transverse tethering element
	69, 69'	overflow opening

Claims

1. Vehicle comprising
- 5 a first part (10) carrying at least one rear wheel (12) at least indirectly, said first part (10) comprising at least one seat element (16) and a component in front of the at least one seat element (16),
- a second part (20) being attached to the first part (10) at the front end of the first part (10) in a swiveling manner and carrying at least one front wheel (22), said second part (20) comprising at least one handlebar (24),
- 10 and
- an airbag device comprising an airbag (30) being attached to the first part (10), said airbag (30) having an outer skin (40) comprising an impact wall (42) being located in front of the seat element (16) when the airbag (30) is fully deployed,
- 15 characterized in that
- the outer skin (40) of the fully deployed airbag (30) is wedge-shaped and comprises:
- a base wall (44) extending from a front end (44a) to a rear end (44b), the impact wall (42) extending from the rear end (44b) of the base wall (44) to a top end (42c),
- 20 a front wall (46) extending from the top end (42c) of the impact wall (44) to the front end (44a) of the base wall (44), and
- a substantially triangular first side wall (48) and a substantially triangular second side wall (49), said side walls (48, 49) connecting the lateral edges of the base wall (44), the impact wall (42) and the front wall (46).
- 25
2. Vehicle according to claim 1, characterized in that the airbag (30) further comprises at least one transverse tethering element (50) being connected
- 30 to the first side wall (48) by means of a first lateral connection (51) and to the second side wall (49) by means of a second lateral connection (52), said transverse tethering element (50) being under tension when the airbag

(30) is fully deployed such that it limits the width of the outer skin of the airbag.

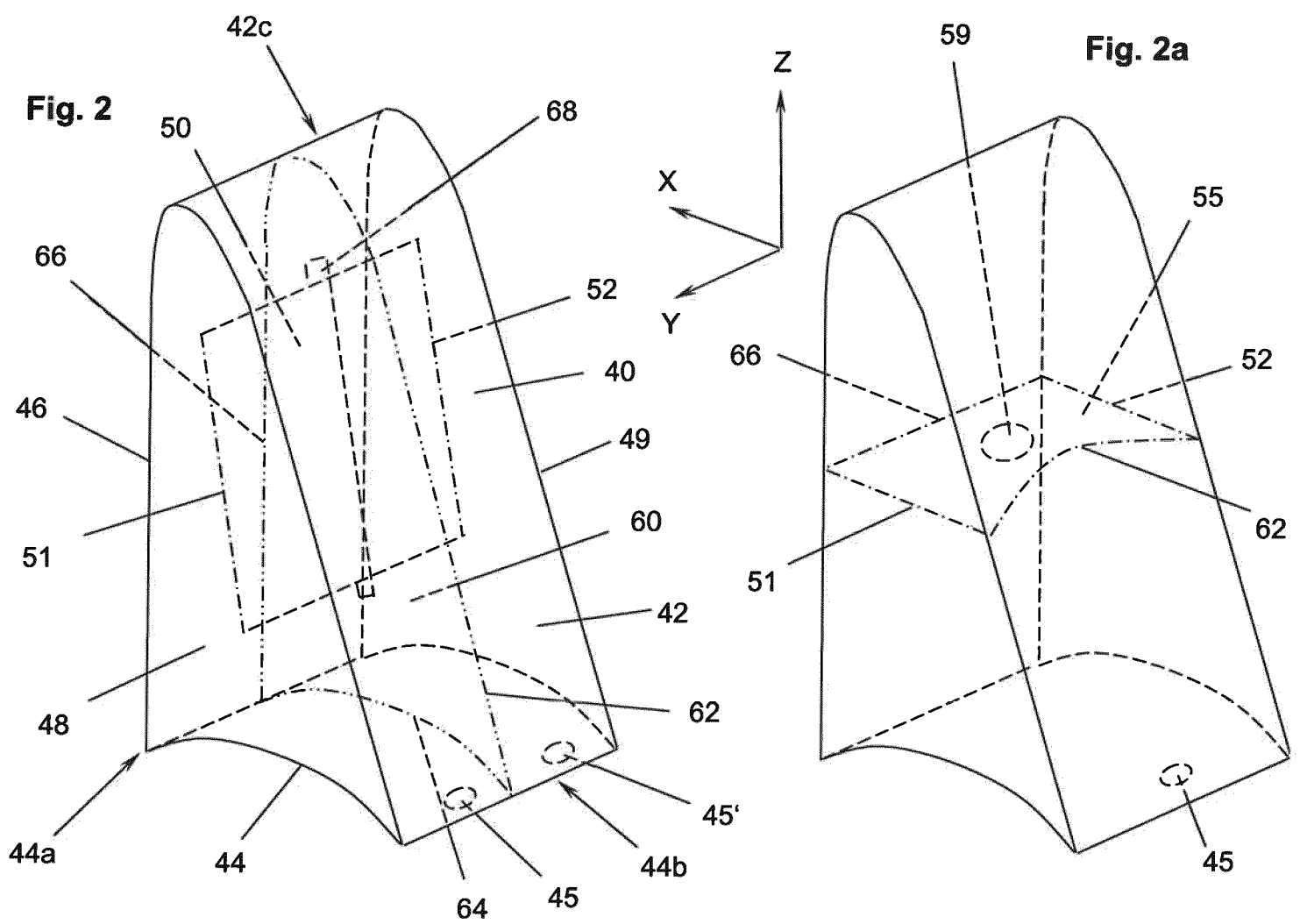
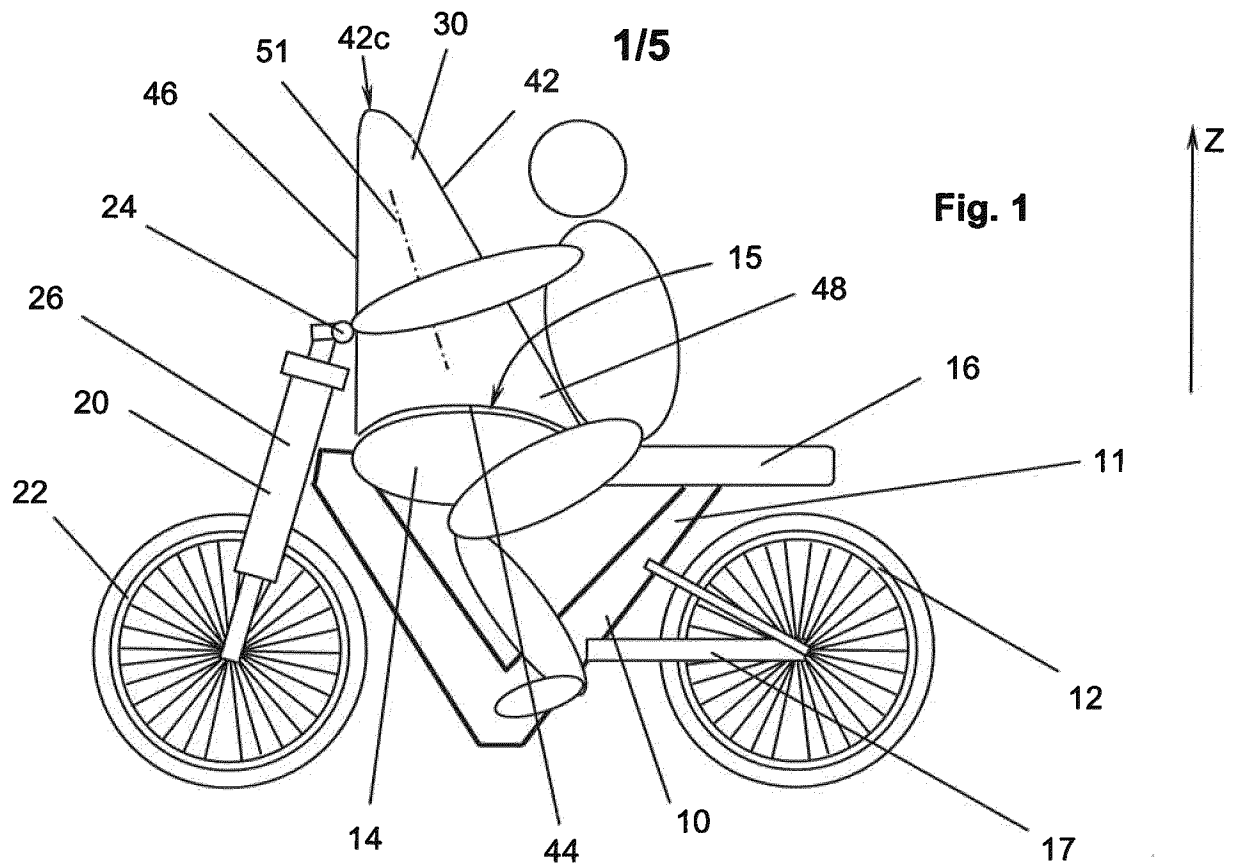
3. Vehicle according to claim 1 or to claim 2, characterized in that the airbag
5 (30) further comprises at least one longitudinal tethering element (60, 60') being connected to the impact wall (42) by means of an impact wall connection (62) and to the front wall (46) by means of a front wall connection (66), said at least one longitudinal tethering element (60, 60') being under tension when the airbag (30) is fully deployed.
- 10 4. Vehicle according to claim 3, characterized in that the at least one longitudinal tethering element (60, 60') is further connected to the base wall (44).
- 15 5. Vehicle according to claim 2 and claim 3 or claim 4, characterized in that the at least one transverse tethering element (50) extends through the at least one longitudinal tethering element (60, 60') or that the at least one longitudinal tethering element (60, 60') extends through the at least one transverse tethering element (50).
- 20 6. Vehicle according to claim 2 and claim 3 or claim 4, characterized in that the transverse tethering element (50) comprises at least two sections with two adjacent sections being connected to the same longitudinal tethering element (60, 60'), or that the at least one longitudinal tethering element (60, 60') comprises at least two sections with two adjacent sections being connected to the same transversal tethering element (50).
- 25 7. Vehicle according to any one of the claims 3 to 6, characterized in that the airbag (30) comprises at least two longitudinal tethering elements (60, 60').
- 30 8. Vehicle according to any one of the claims 1 to 7, characterized that the airbag further comprises at least one combined transverse and longitudinal tethering element (55) being connected to the first side wall (48) by means of a first lateral connection (51), to the second side wall (49) by means of a

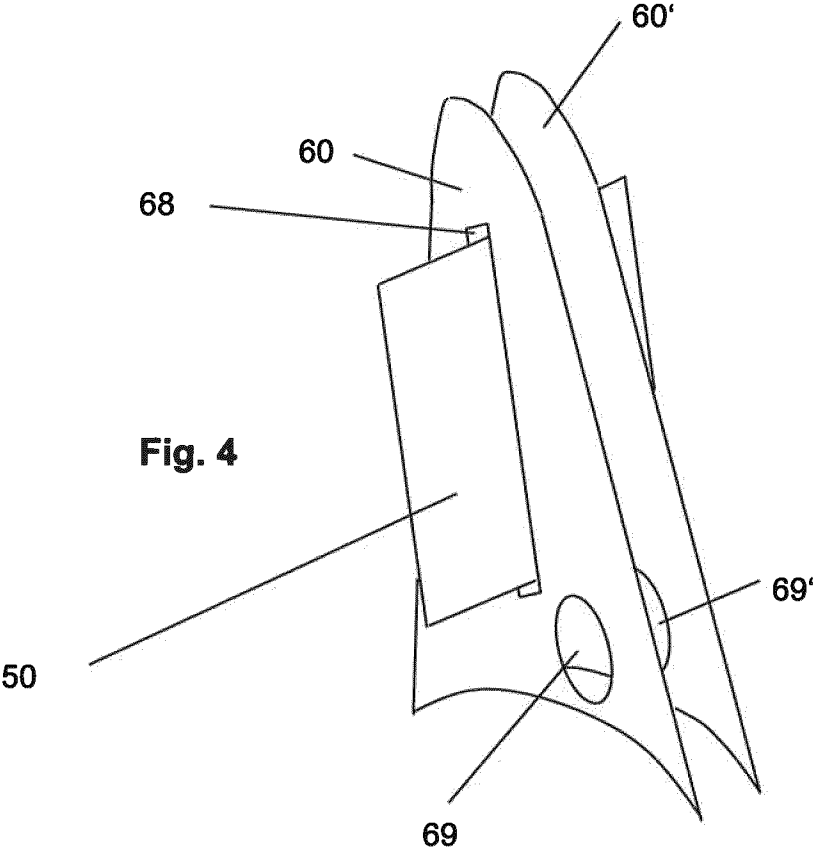
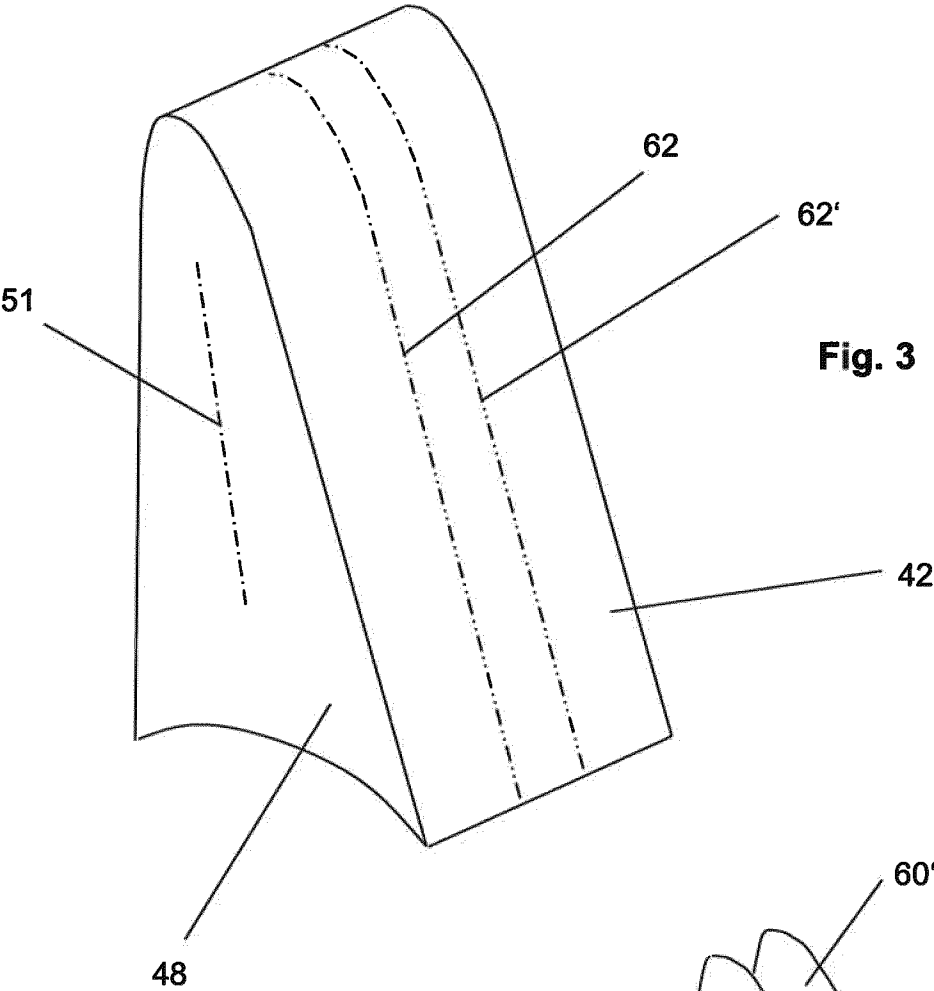
second lateral connection (52), to the impact wall (42) by means of an impact wall connection (62) and preferably to the front wall (46) by means of a front wall connection (66), said combined transverse and longitudinal tethering element (55) being under tension when the airbag (30) is fully deployed such that it limits the width of the outer skin of the airbag.

9. Vehicle according to any one of the claims 1 to 8, characterized in that the base wall (44) extends along at least a section of the upper surface (15) of the component being located in front of the at least one seat element (16), wherein it is preferred that the base wall (44) extends at least along half of the length of the upper surface (15) of the component, more preferably along substantially the entire length of the upper surface (15) of the component.
10. Vehicle according to any one of the claims 1 to 9, characterized in that the component in front of the at least one seat element is a tank (14).
11. Vehicle according to any one of claims 1 to 9, characterized in that it lacks a car body.
12. Airbag (30) adapted for being used in a vehicle according to one of the claims 1 to 11, said airbag comprising an outer skin (40) being wedge-shaped when the airbag (30) is fully deployed and comprising:
an impact wall (42) having a top end (42c),
a base wall (44) extending from a front end (44a) to a rear end (44b),
a front wall (46) extending from the top end (42c) of the impact wall (44) to the front end (44a) of the base wall (44),
a substantially triangular first side wall (48) and a substantially triangular second side wall (49), said side walls (48, 49) connecting the lateral edges of the base wall (44), the impact wall (42) and the front wall (46),
wherein the airbag (30) further comprises:
at least one transverse tethering element (50) being connected to the first side wall (48) by means of a first lateral connection (51) and to the second

side wall (49) by means of a second lateral connection (52), said transverse tethering element (50) being under tension when the airbag (30) is fully deployed such that it limits the width of the outer skin of the airbag, and/ or

- 5 at least one longitudinal tethering element (60, 60') being connected to the impact wall (42) and to the front wall (46), said at least one longitudinal tethering element (60, 60') being under tension when the airbag (30) is fully deployed.





3/5

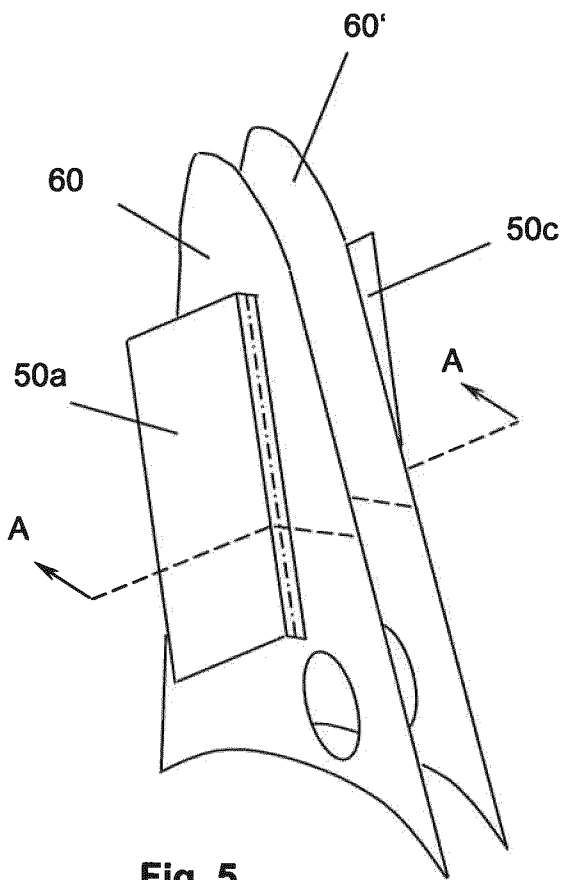


Fig. 5

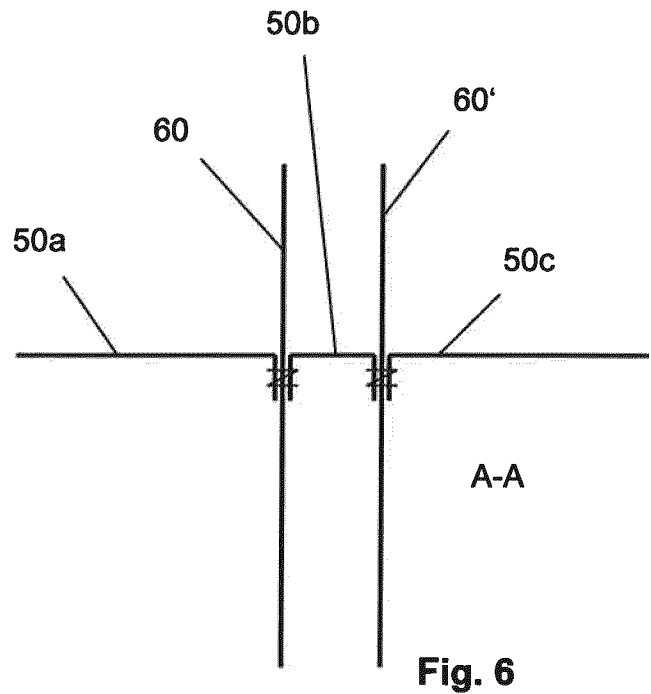


Fig. 6

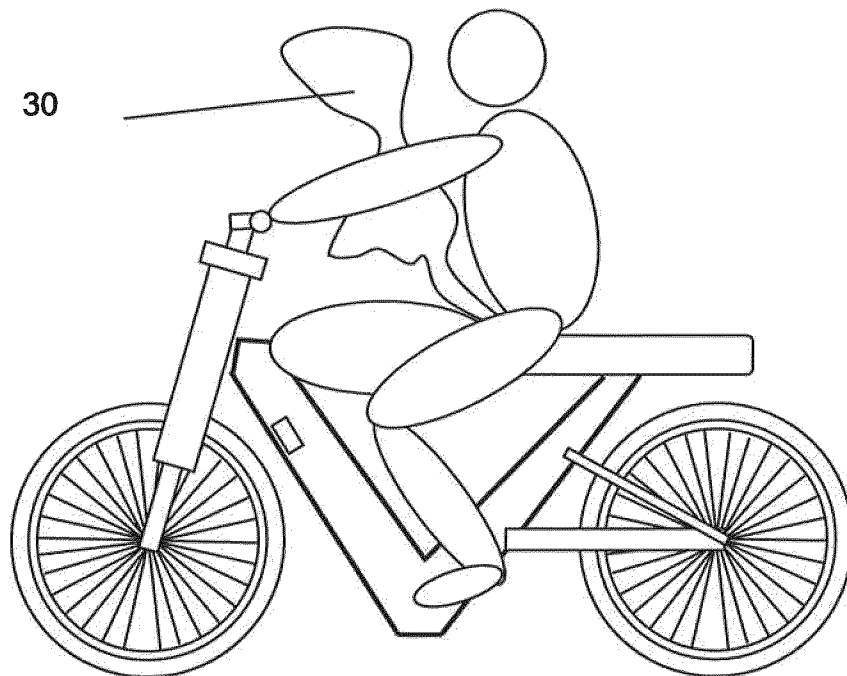


Fig. 7

4/5

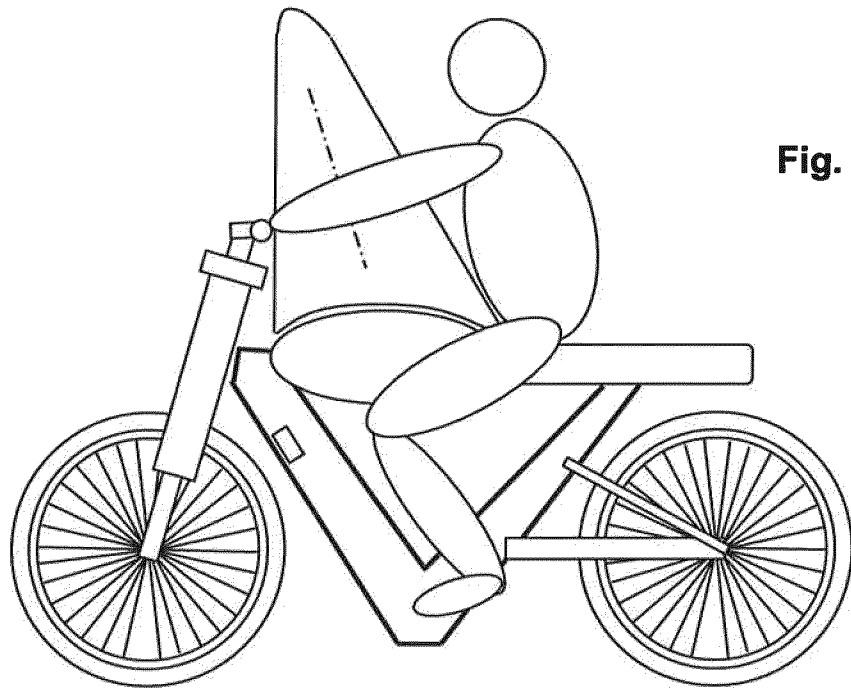


Fig. 8

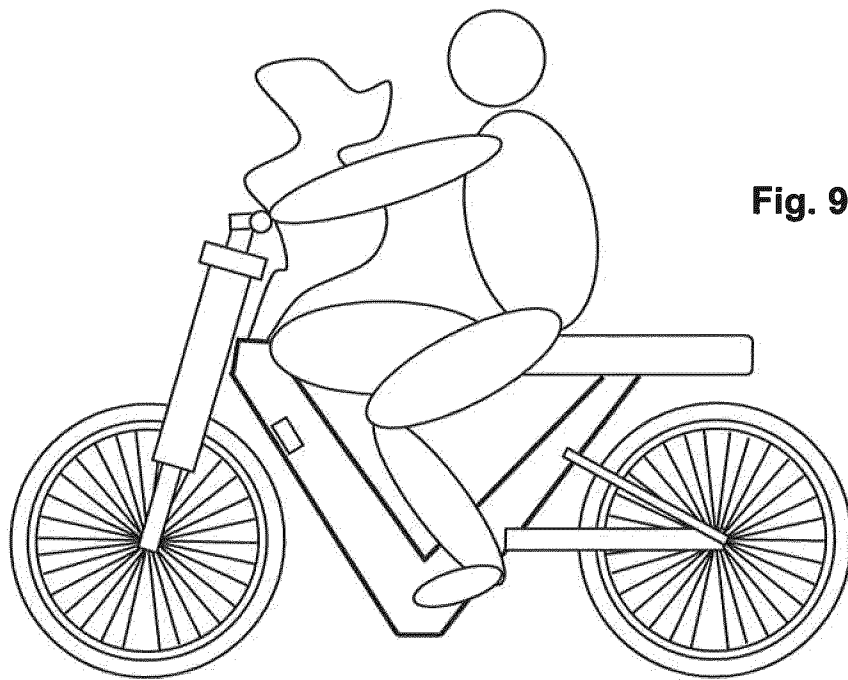


Fig. 9

5/5

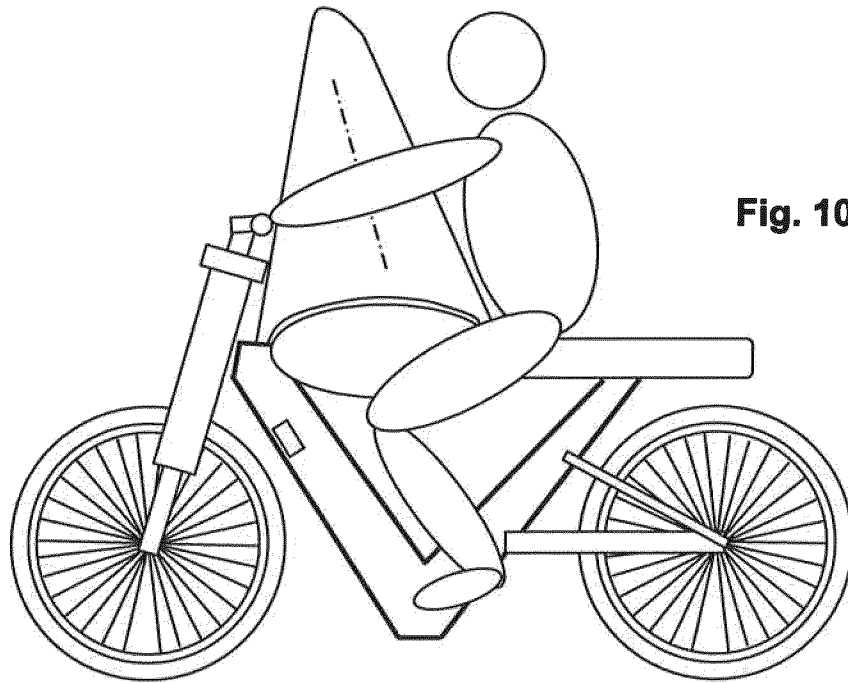


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/082648

A. CLASSIFICATION OF SUBJECT MATTER**INV. B60R21/231****ADD.**

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)

B60R B62J

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**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/256848 A1 (MIYATA YASUHIRO [JP] ET AL) 23 December 2004 (2004-12-23) paragraphs [0044] - [0046], [0061], [0062]; figures 1, 6, 9, 10, 11 -----	1-12
X	JP 2018 052285 A (TOYODA GOSEI KK) 5 April 2018 (2018-04-05)	1
A	paragraphs [0036] - [0038]; figures 1, 6, 7, 9 -----	2-12
A	US 2007/063492 A1 (IGAWA TADAHIRO [JP]) 22 March 2007 (2007-03-22) paragraphs [0018] - [0019]; figure 1 -----	1-12



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

19 January 2022

Date of mailing of the international search report

28/01/2022

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

Huber, Florian

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/082648

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004256848 A1	23-12-2004	CN 1572641 A	02-02-2005
		JP 4388313 B2	24-12-2009
		JP 2005008055 A	13-01-2005
		US 2004256848 A1	23-12-2004
JP 2018052285 A	05-04-2018	JP 6759935 B2	23-09-2020
		JP 2018052285 A	05-04-2018
US 2007063492 A1	22-03-2007	NONE	