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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 January 2019 (31.01.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/022675 A1

(51) International Patent Classification:
A42B 3/04 (2006.01)

(21) International Application Number:
PCT/SG2018/050384

(22) International Filing Date:
27 July 2018 (27.07.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10201706129U 27 July 2017 (27.07.2017) SG

(71) Applicant: **HOLLAND STORY DESIGN & INNOVATION** [SG/SG]; Block 620 Ang Mo Kio Avenue 9 #03-04, Singapore 560620 (SG).

(72) Inventor; and
(71) Applicant: **LI, Jin** [SG/SG]; Block 620 Ang Mo Kio Avenue 9 #03-04, Singapore 560620 (SG).

(74) Agent: **CHINA SINDA INTELLECTUAL PROPERTY PTE LTD**; 133 Cecil Street, #12-01A, Keck Seng Tower, Singapore 069535 (SG).

(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, 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, 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, ST, 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, KM, 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))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

(54) Title: WEARABLE APPARATUS, METHOD AND CONTROLLER THEREOF

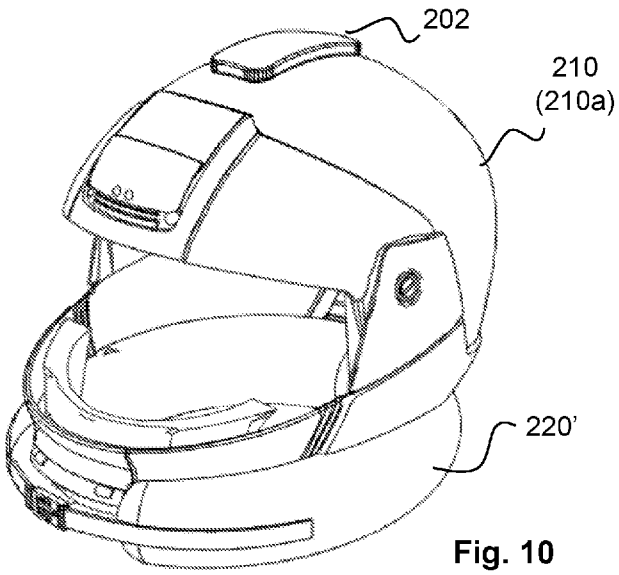


Fig. 10

(57) Abstract: A wearable apparatus includes a helmet and an airbag attached to a bottom rim of the helmet. In the event of an accident, for example when ta motorcyclist riding a motorcycle collides with an object, the airbag is triggered by the accident event and activated to inflate surrounding the lower rim of the helmet, to form a cushion surrounding the neck portion of the motorcyclist. The airbag is inflated within a very short time e.g. 10 several tenths of a second, before the motorcyclists is thrown off the motorcycle and hit a surrounding object that may cause injury to the motorcyclist. The inflated airbag therefore form a protection to the neck portion of the motorcyclist, to greatly reduce the level of injury.

WO 2019/022675 A1

WEARABLE APPARATUS, METHOD AND CONTROLLER THEREOF

TECHNICAL FIELD

The present invention relates to a wearable apparatus, a controller for the wearable apparatus and a method of operating a wearable apparatus. In particular, the present invention relates to a wearable apparatus and a controller configured to reduce injury to a human body in case of accident.

BACKGROUND

Safety devices such as airbags are equipped in motorized vehicles as a protection means for the driver and passengers of the vehicle in case of accidents. The efficacy of these safety devices is limited according to the placement of these devices within the vehicle and the method of deployment of such devices. In some circumstances, it may be impractical to equip motorized vehicles with safety devices of same type due to the fact that motorcyclists are riding in an open environment and the complexity of the accident situations of motorcycles.

SUMMARY OF INVENTION

A wearable apparatus includes a helmet and an airbag attached to a bottom rim of the helmet. In the event of an accident, for example when ta motorcyclist riding a motorcycle collides with an object, the airbag is triggered by the accident event and activated to inflate surrounding the lower rim of the helmet, to form a cushion surrounding the neck portion of the motorcyclist. The airbag is inflated within a very short time e.g. 10 several tenths of a second, before the motorcyclists is thrown off the motorcycle and hit a surrounding object that may cause injury to the motorcyclist. The inflated airbag therefore form a protection to the neck portion of the motorcyclist, to greatly reduce the level of injury.

In one embodiment, a wearable apparatus comprises a base; a control unit mounted to the base; a folded airbag mounted to the base; and an ignitor disposed in the folded airbag and coupled to the control unit. The control unit is configured to detect an impact signal of the base and upon the impact signal reaching a predetermined threshold, the control unit activates the ignitor to inflate the folded airbag.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are disclosed hereinafter with reference to the drawings, in which:

Fig. 1 is a schematic view showing a riding and accident situation that a motorcyclist encountered;

Fig. 2 is a perspective top view of a wearable apparatus according to one embodiment of the present invention;

Fig. 3 is a perspective bottom view of a wearable safety device of Fig. 2;

Fig.4 is a cross-sectional perspective view of Fig. 2;

Fig. 5 is a perspective view showing the wearable apparatus of Fig. 2 when the airbag is inflated;

Fig. 6 is a schematic diagram and an x-y-z coordinate system showing the terms used in line with the acceleration and inertia data acquired by the wearable apparatus of Fig. 2;

Fig. 7 is a schematic diagram showing an x-y-z coordinate system referred to in the context with respect to a motorcyclist;

Fig. 8 is a block diagram showing a safety assembly for use in the wearable apparatus of Fig. 2.

Fig. 9 is a perspective view of a wearable apparatus according to another embodiment;

Fig. 10 shows the apparatus of Fig. 9 upon inflation of the airbag;

Fig. 11 is a cross sectional view of Fig. 9 along A-A;

Fig. 12 is an enlarged view of portion 11a of Fig. 11;

Fig. 13 is an enlarged view of portion 11b of Fig. 11;

Fig. 14 is an exploded view of Fig. 9;

Fig. 15 is a perspective view showing the folded airbag of the apparatus shown in Fig. 8;

Fig. 16 is an exploded view of Fig. 10;

Fig. 17A, 17B and 18 show a wearable apparatus according to a further embodiment;

Fig. 19 is a flowchart showing an operation process of a wearable apparatus.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in the Figs. 1 to 5, a wearable apparatus 100 is provided to a motorcyclist 10 for use while riding a motorcycle 20. According to one embodiment of the present invention, wearable apparatus 100 includes a helmet 110 and a folded airbag 120 attached to a bottom rim 112 of the helmet 110. In the event of an accident, for example when the motorcyclist 10 riding the motorcycle 20 collides with an object 30, the folded airbag 120 is triggered by the accident event and activated to inflate surrounding the lower rim 112 of the helmet 110, to form an inflated airbag 120' surrounding the neck portion of the motorcyclist 10. The airbag 120 is inflated within a very short time upon occurrence of an accident, e.g. within several tenths of a second, before the motorcyclist 10 is thrown off the motorcycle 20. Inflated airbag 120' is shaped and dimensioned to surround the neck portion 12 of the motorcyclist 10. The inflated airbag 120' therefore forms a means of protection to the neck portion of the motorcyclist 10, to greatly reduce the level of injury.

Wearable apparatus 100 comprises an accelerometer 130, a controller 140, an ignitor / inflator 150 and a power source 160 fixed to helmet 110. Power source 160 may be one that is used in the motorcycle and supplied via a power supply cable, or a separate battery unit assembled into the helmet 110, which maybe an alkaline battery, a rechargeable battery, a solar battery, etc. Wearable apparatus 100 may further include a communication module such as a GPS module to wirelessly connect to a backend, for example a traffic control center 190, via cloud 50.

Helmet 110 has a rigid external shell 122 made of structurally strong material such as carbon fiber, polyethylene terephthalate or fiber-reinforced plastic or the like, etc., and a lining 124 made of soft material e.g. fabric or plastic foam inside the external shell. The accelerometer 130, controller 140, ignitor / inflator 150, battery 160 and GPS module 180 of the wearable safety device 100 may be fixed to the helmet 110 between the external shell 122 and lining 124, and electrically connected by cables 170. When the helmet 110 is worn by a user e.g. a motorcyclist and used during riding, the accelerator 130 detects the movement status of the motorcyclist by measuring the acceleration and/or speed of the

helmet 110 to which the accelerator 130 is fixed, and transmits the measurement results to the controller 140 for processing and determination.

Accelerometer 130 is electrically connected to controller 140 via cable 170 which can be imbedded into the space between the external shell 122 and the lining 124 of the helmet 110. Accelerometer 130, controller 140, ignitor 150, battery 160 and GPS module 180 are electrically connected via cables 170. Ignitor 150 is connected to airbag 120 via tube 172. Cables 170 and tube 172 can be imbedded into the space between the external shell 122 and lining 124 of the helmet 110.

Accelerometer 130 detects the movement status of the motorcyclist wearing the helmet 110, while the motorcyclist riding a motorcycle. The movement status may be determined by one or more data e.g. linear acceleration / speed, angular acceleration / speed that can be detected and measured by the accelerometer 130.

In an event of accident, the motorcyclist's movement status is suddenly changed as compared to the normal riding situation. Such changes / impact are captured by the accelerometer as acceleration data, and processed by the controller to derive a Movement Index. The Movement Index is compared with a pre-determined threshold value. Upon the Movement Index exceeds the threshold value, the controller 140 determines the occurrence of an accident, and triggers the ignitor / inflator that in turn releases a fluid into tube 172 and inflates the folded airbag 120.

The accident situation may be further verified prior to the controller 140 triggering the ignitor / inflator 150, by making use of the speed data. For example, the controller 140 may be configured to trigger the ignitor / inflator 150 upon the average speed in a certain time period (e.g. 2 seconds) prior to the accident exceeds a predetermined speed limit. Making use of the speed data has the advantage of preventing fault triggering of the ignitor / inflator 150 in situations where the wearable apparatus is not in actual use.

In one embodiment, the Movement Index includes a Collision Index that is defined and derived based on the linear and/or angular acceleration / speed measured by the

accelerometer 130, before and after the accident. The measurement results are transmitted to and processed by the controller 140.

In one embodiment, as illustrated herein in conjunction with Figs. 6 and 7, the accelerometer 130 is a 3-dimensional motion sensor capable of detecting the 3-dimensional (X-Y-Z directions) linear acceleration a_x (t), a_y (t) and a_z (t), and 3-dimensional angular acceleration α_x(t), α_y(t) and α_z (t), at predetermined time intervals. The controller 140 receives the measurement data from the accelerometer 130 and processes calculations to derive the Collision Index based on the linear acceleration in X, Y and Z directions, angular acceleration in X, Y and Z directions, critical linear acceleration in X, Y and Z directions and critical angular accelerations in X, Y and Z directions.

The accelerometer 130 maybe positioned within or on top of the helmet along the z-axis as defined by the longitudinal axis of the neck of motor cyclist (as shown in Fig. 7) in an upright position, and as far away from the neck as possible so that the accelerometer is most sensitive to motion of the motorcyclist's head about the neck.

According to another embodiment, a wearable safety device 100 includes an inertia sensor 132 affixed to the helmet 110, and coupled to the controller 140. Independent from the accelerometer 130, inertia sensor 132 is a 3-axis linear pressure sensor capable of measuring the X-Y-Z axes inertia data of the motorcyclist 10 during riding and in case of any accident, measurements result of the inertia sensor 132 is transmitted to the controller 140 for processing.

In another embodiment, the Movement Index may include an Injury Index that is defined and derived based on tensile and/or compression force along longitudinal direction of the neck spiral, the bending moment applied to the upper neck portion in X direction and Y directions, the critical force bearing capacity and critical moment bearing capacity in X direction and Y directions.

In a preferred embodiment, the Movement Index comprises both the Collision Index and Injury Index.

Fig. 8 is a block diagram showing the controller 140 for use in a wearable apparatus 100 of Fig. 2 and connections with other components. Controller 140 may be in the form of an integrated device including a Collision Index calculator 141 and an Injury Index calculator 142 connected to the accelerometer 130 and inertia sensor 132, to acquire and process the acceleration data and the inertia data. A bios module 143, a memory module e.g. RAM 144 and a logic module 145 are coupled to the Collision Index calculator 141 and the Injury Index calculator 142 to store the calculation results and determine criteria for triggering the ignitor / inflator 150 to activate the air bag 120. GPS module 180, in the form of either a standalone component or integrated in the accelerometer 130, is coupled to the controller for transmitting the motorcyclist's physical location information to a back end for tracking and further data analysis.

Wearable apparatus 100 may further include a communication port 182 such as USB port coupled to the controller 140, for charging the battery 160 and/or retrieving data from the controller 140 for analysis. Additionally, wearable apparatus 100 may include a test port 184 to verify that the parts and modules are under normal working condition each time before the device 100 is used. Wearable apparatus 100 may further include a switch to control the operation of device 100 and indicator lights to indicate the operation state of device 100. Solar panel may be included to power the wearable apparatus 100.

In yet another embodiment, as shown in Figs. 9 to 16, a wearable apparatus 200 includes a base such as a helmet 210, a control unit 202 mounted to the helmet 210, a folded airbag 220 mounted to the helmet 210, and an ignitor 250 disposed in the folded airbag 220. The control unit 202 is configured to detect an impact signal of the helmet 210 and upon the impact signal reaching a predetermined threshold, the control unit 202 activates the ignitor 250 to inflate the folded airbag 220.

The helmet 220 has a rigid shell 210a, and the folded airbag 220 is mounted to a bottom rim 212 (Fig. 13) of the shell 210a. The Wearable apparatus 200 may include a

holder 206 in which the folded airbag 220 is disposed. The holder 206 is detachably mounted to the bottom rim 212 of the shell 210a. Upon the folded airbag 220 being inflated, the holder 206 is detached from the helmet 210 such that the inflated airbag 220' remains attached to and support the neck portion of a user, to provide protection support to the user to reduce the risk of injury to the neck portion.

The control unit 202 is mounted to an external top surface of the rigid shell 210a and having an electrical cable 204 imbedded in the shell 210a to electrically coupling the control unit 202 and the ignitor 250.

The ignitor 250 maybe detachably coupled to the cable 204 and upon inflation of the folded airbag 220, the ignitor 250 is detached from the cable 204, such that the cable 204 and the control unit 202 are prevented from causing possible injury to the user.

The folded airbag 220 maybe formed of an open loop (Figs. 14, 15) to better fit the neck portion of a human body. The folded airbag 220 has a first end 220a and a second end 220b disposed adjacent to each other, the wearable apparatus 200 further comprises a first fastening member, e.g. a first belt 228a mounted to the first end 220a and a second fastening member e.g. a second belt 228b mounted to the second end 220b and lockable to the first belt 228a, to prevent the first and the second ends 220a, 220b from separating away from each other which may result in failure protection by the inflated airbag 220' to the user's neck portion.

The control unit 202 includes an accelerometer 230 for detecting the impact signal of the helmet 220, which corresponds to the movement status of a user riding a motorcycle, a processor 240 coupled to the accelerometer 230 for determining the impact signal with respect to the predetermined threshold.

The wearable apparatus may include a housing 201 into which the control unit 202, the accelerometer 230, the processor 240 and other components such as battery 260, GPS module 280 are disposed. The housing 201 may be mounted to the helmet 210 in a detachable manner, by screw for example, or a non-detachable matter by e.g. an adhesive.

The folded airbag 220 is shaped and dimensioned to conform to a body part of a user wearing the apparatus upon inflation.

The wearable apparatus 200 may include a one-way safety valve 292 mounted on the folded airbag 220. In the event that the air pressure of the inflated airbag 220' exceeds a predetermined pressure limit, the one-way safety valve 292 is opened to release the air pressure. An advantage of having a one-way safety valve 292 is to prevent the likelihood of reduction of protection by an over-pressured inflated airbag 220'.

While the invention has been described in the preceding paragraphs in the form of a safety helmet, it should not be interpreted as limiting to the scope of the current invention. For instance, the wearable apparatus may assume the forms of other headwear or apparel like a vest for use by workers to mitigate the risk of e.g. falling from heights. The airbag may be inflated in response to a falling motion and aids in lessening the impact of the fall to vital organs of the wearer.

Figs. 17A, 17B and 18 show an embodiment of a wearable apparatus 300 in the form of a vest 301. Vest 301 may comprise a zip 303 that is secured at the top end by a button 302 to facilitate wearing and removal of the vest 301. A module housing 390 may take the form of a belt and houses a controller 340, accelerometer 330, battery 360, a plurality of ignitors 350 electrically connected to the controller 340 by cables 370. A plurality of folded airbags 320 that may be inflated by the plurality of ignitors 150 are positioned at the collar, front and back of the vest 301. The wearable apparatus 300 functions similarly to the wearable apparatus 100. The controller 340 measures and transmits acceleration/speed data acquired from the accelerometer 330 for deriving a Movement Index. In the event of a wearer falling from certain height, if the Movement Index exceeds a pre-determined threshold, the controller 340 triggers the ignitors 350 which in turn inflate the folded airbags 320 as shown in Fig. 18. The inflated airbags 320' surround a wearer's neck and also form protective cushions on the front and back of the wearer to reduce the impact from the fall.

The predetermined threshold may be determined based on whether the acceleration in vertical direction is equal to or greater than one time of the gravitational acceleration (1g), and whether the falling height is greater than a limit that may cause injury to a human body under typical situations, e.g. 2 meters. It is therefore understandable that by adopting the predetermined threshold based on criteria dedicated to a particular application, a wearable apparatus can be configured to be suitable for use in such application.

The wearable apparatus 300 may further comprise an altimeter 380 for measuring the height of the apparatus relative to a ground surface, to provide additional information for the determination of the threshold and provide efficient and reliable effect of triggering the airbags in case of need.

In another aspect of the invention, a method 900 of operating a wearable apparatus is shown in Fig. 19. The method starts with a self-test at block 902. In the event that an error is detected at block 904, for example a part / component failure, insufficient battery voltage, etc, the selftest will fail and an alarm is triggered at block 906 to prompt the user to remedy the problem/error. If the selftest is successful, the apparatus will start acceleration/inertia data acquisition at block 908, to obtain and accumulate the acceleration / inertia data of the device. Thereafter, the apparatus determines, at block 910, based on the acceleration / inertia signal acquired, whether a Collision Index exceeds a predetermined threshold. If not, the process loops back to block 908 to continue the acceleration / inertia data acquisition for next determining cycle. If the Collision Index exceeds the threshold, the apparatus determines that an abnormal event takes place, for example an accident happened, and proceed to block 914 to activate the ignitor to inflate the airbag.

Parallel to the Collision Index determination, the apparatus determines at block 912, based on the acceleration / inertia date/signal acquired, whether the Injury Index exceeds a predetermined threshold. If not, the process loops back to block 908 to continue the acceleration / inertia data acquisition for next determining cycle. If the Injury Index exceeds the threshold, the device determines that an abnormal event takes place, for

example an accident happened, and proceed to further checking at block 413 whether the speed of the wearable apparatus exceeds a predetermined limit. If so, the method proceed to block 914 to activate the ignitor to inflate the airbag. If not, the method looks back to block 908 to continue the acceleration / inertia data acquisition for next determining cycle.

Although embodiments of the present invention have been illustrated in conjunction with the accompanying drawings and described in the foregoing detailed description, it should be appreciated that the present invention is not limited to the embodiments disclosed. Therefore, the present invention should be understood to be capable of numerous rearrangements, modifications, alternatives and substitutions without departing from the spirit of the invention as set forth and recited by the following claims.

CLAIMS

1. A wearable apparatus comprising:
   a base;
   a control unit mounted to the base;
   a folded airbag mounted to the base;
   an ignitor disposed in the folded airbag and coupled to the control unit;
   wherein the control unit is configured to detect an impact signal of the base and upon the impact signal reaching a predetermined threshold, the control unit activates the ignitor to inflate the folded airbag to form an inflated airbag.

2. The apparatus of claim 1, wherein the base is a helmet having a rigid shell, and the folded airbag is mounted to a bottom rim of the rigid shell.

3. The apparatus of claim 2, further comprising a holder in which the folded airbag is disposed, wherein the holder is detachably mounted to the bottom rim of the shell.

4. The apparatus of claim 3, wherein upon the folded airbag being inflated, the holder is detached from the helmet.

5. The apparatus of claim 2, wherein the control unit is mounted to an external top surface of the rigid shell and having an electrical cable embedded in the shell to electrically coupling the controller and the ignitor.

6. The apparatus of claim 5, wherein the ignitor is detachably coupled to the cable and upon inflation of the folded airbag, the ignitor is detached from the cable.

7. The apparatus of claim 2, wherein the folded airbag is formed of an open loop having a first end and a second end disposed adjacent to each other, the apparatus further comprises a first fastening member mounted to the first end and a second fastening member mounted to the second end and lockable to the first fastening

member to prevent the first and the second ends from separating from each other from the inflated airbag.

8. The apparatus of claim 1, wherein the control unit includes an accelerometer for detecting the impact signal, a processor coupled to the accelerometer for determining the impact signal with respect to the predetermined threshold.

9. The apparatus of claim 1, further comprising a housing into which the control unit is disposed, wherein the housing is detachably mounted to the base.

10. The apparatus of claim 1, wherein the folded airbag is shaped and dimensioned to conform to a body part of a user wearing the apparatus upon inflation.

11. The apparatus of claim 1, wherein the base is a cloth having a collar portion, a front portion and a back portion, and the folded airbag is mounted to each of the collar portion, the front portion and the back portion.

12. The apparatus of claim 1, further comprising a one-way safety valve coupled to the folded airbag and in fluid communication with an interior of the folded airbag, wherein upon an air pressure of the inflated airbag exceeds a predetermined pressure limit, the one-way safety valve is opened to release the air pressure.

13. A method of operating a wearable apparatus, the method comprising:

executing a loop comprising:

acquiring a movement data of the wearable apparatus;

determining a Movement Index based on the movement data;

determining if the Movement Index exceeds a predetermined Movement Index threshold; and

exiting the loop and inflating a folded airbag coupled to the wearable apparatus if the Movement Index exceeds the predetermined Movement Index threshold.

14. The method of claim 13, wherein the movement data includes an acceleration of the wearable apparatus.

15. The method of claim 14, wherein the movement data includes a speed of the wearable apparatus.

16. The method of claim 13, wherein the loop further comprises acquiring an inertia data of the wearable apparatus, wherein said inertia data is used to determine the Movement Index.

17. The method of claim 13, wherein the Movement Index includes a Collision Index based on an acceleration the wearable apparatus.

18. The method of claim 17, wherein the Collision Index is derived based on a speed of the wearable apparatus.

19. The method of claim 13, wherein the Movement Index includes an Injury Index based on the inertia data.

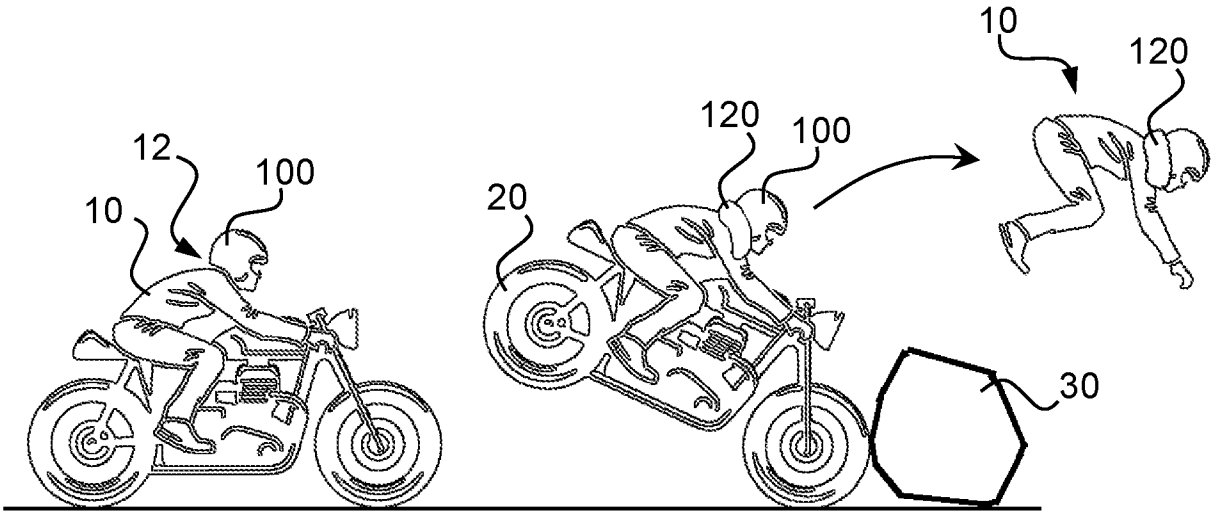


Fig. 1

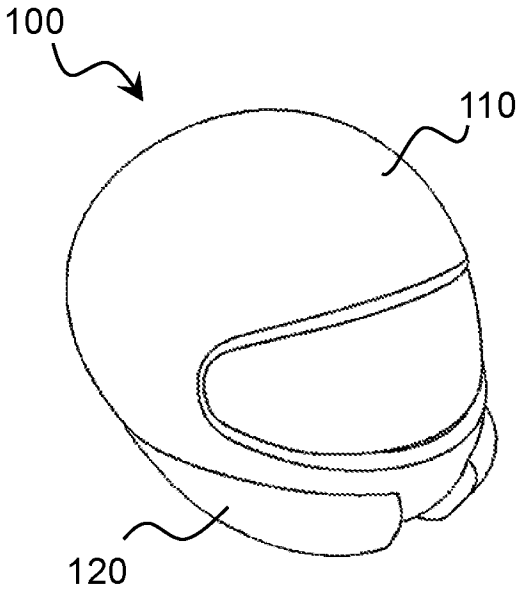


Fig. 2

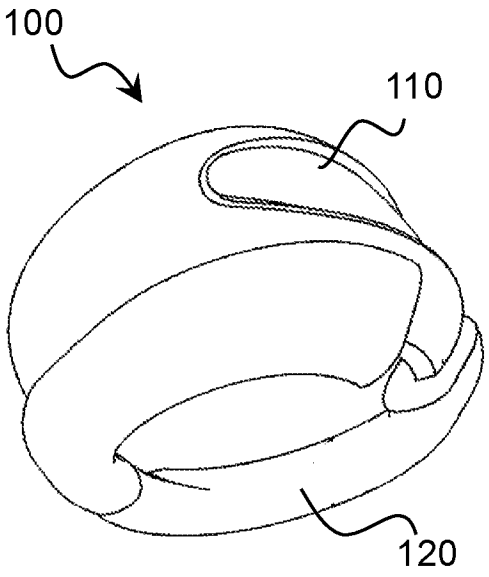


Fig. 3

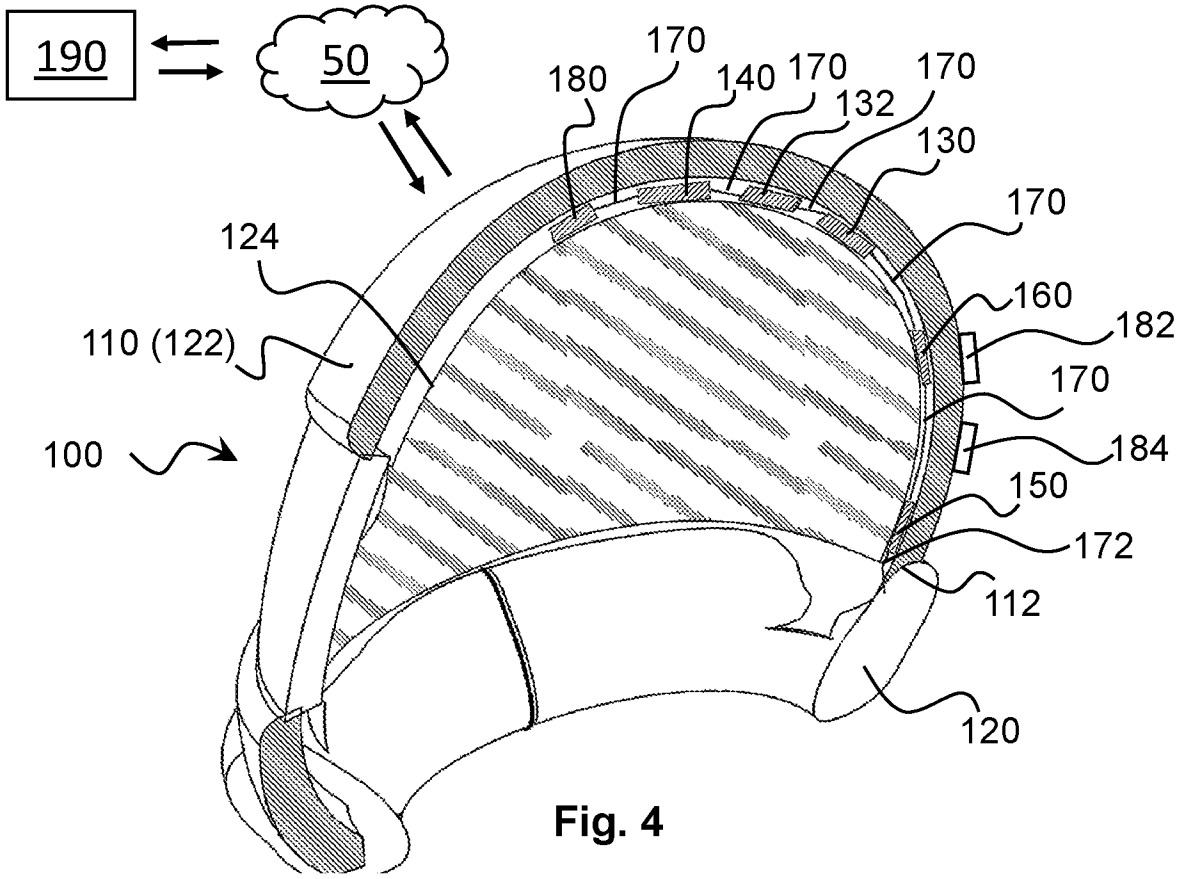

190
50
180
170
140
170
132
170
130
170
124
160
110 (122)
182
170
100
184
150
172
112
120

Fig. 4

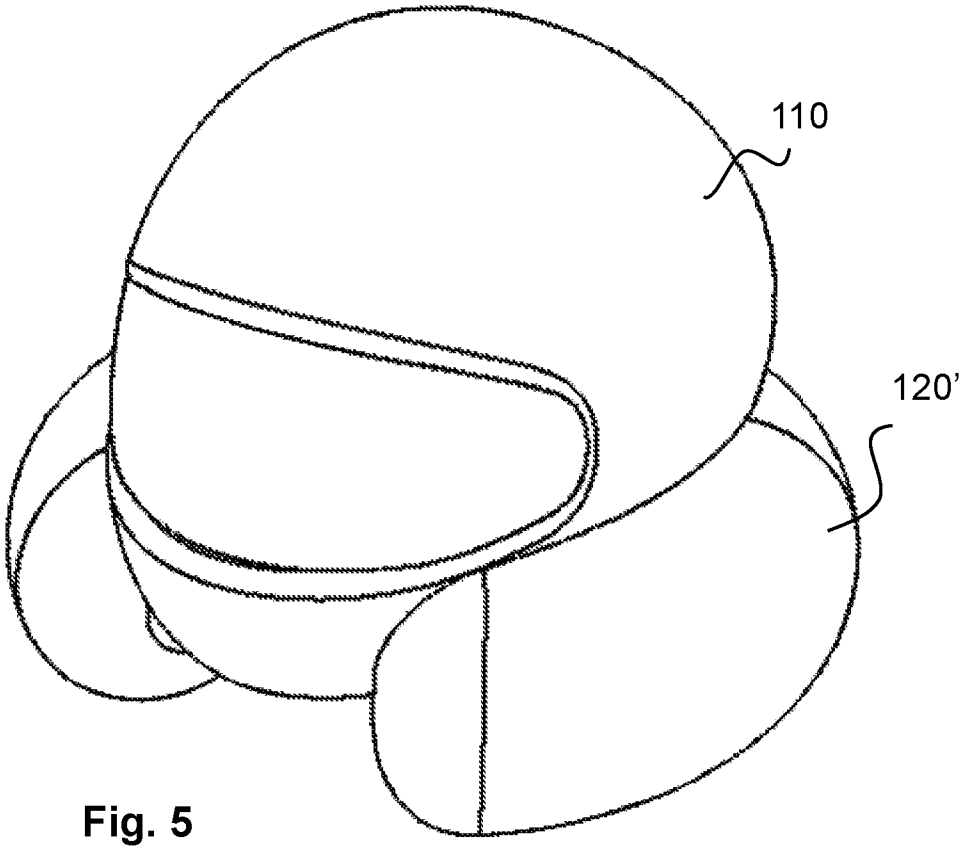

110
120'

Fig. 5

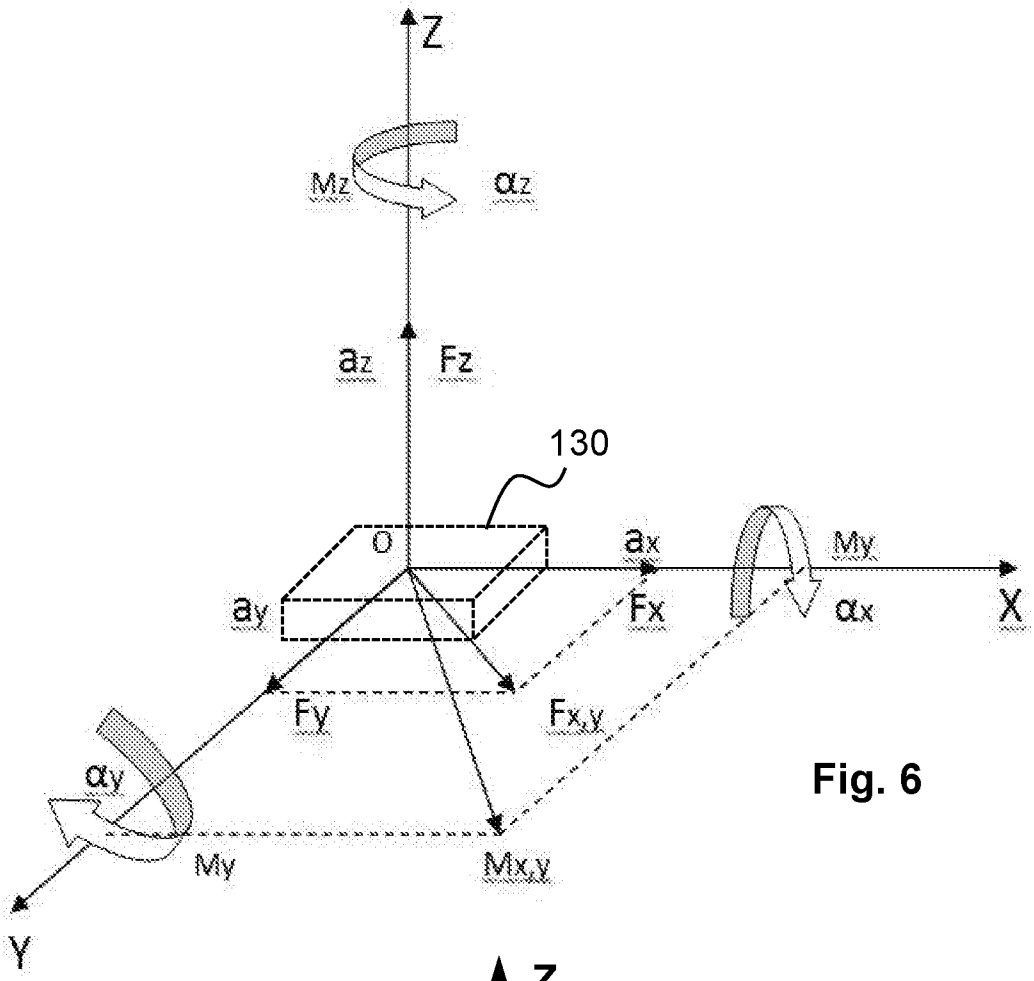


Fig. 6

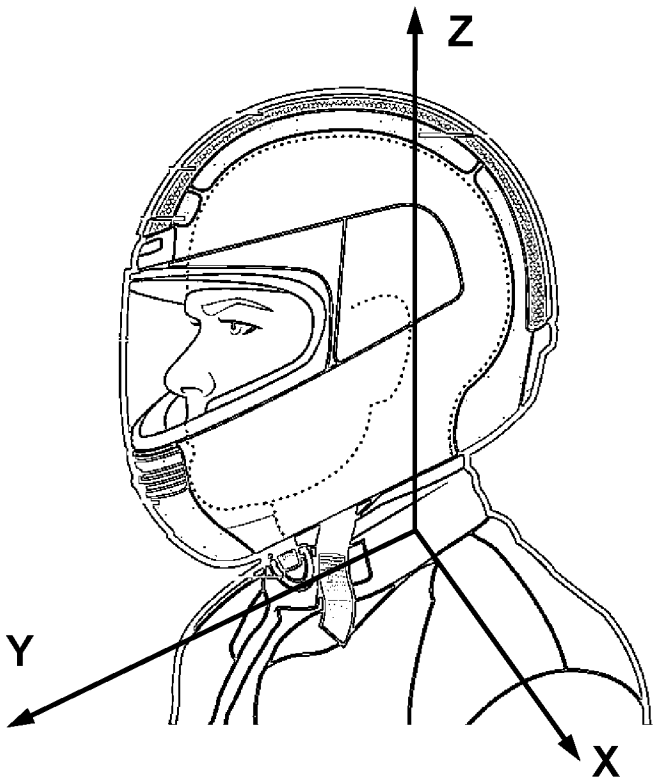


Fig. 7

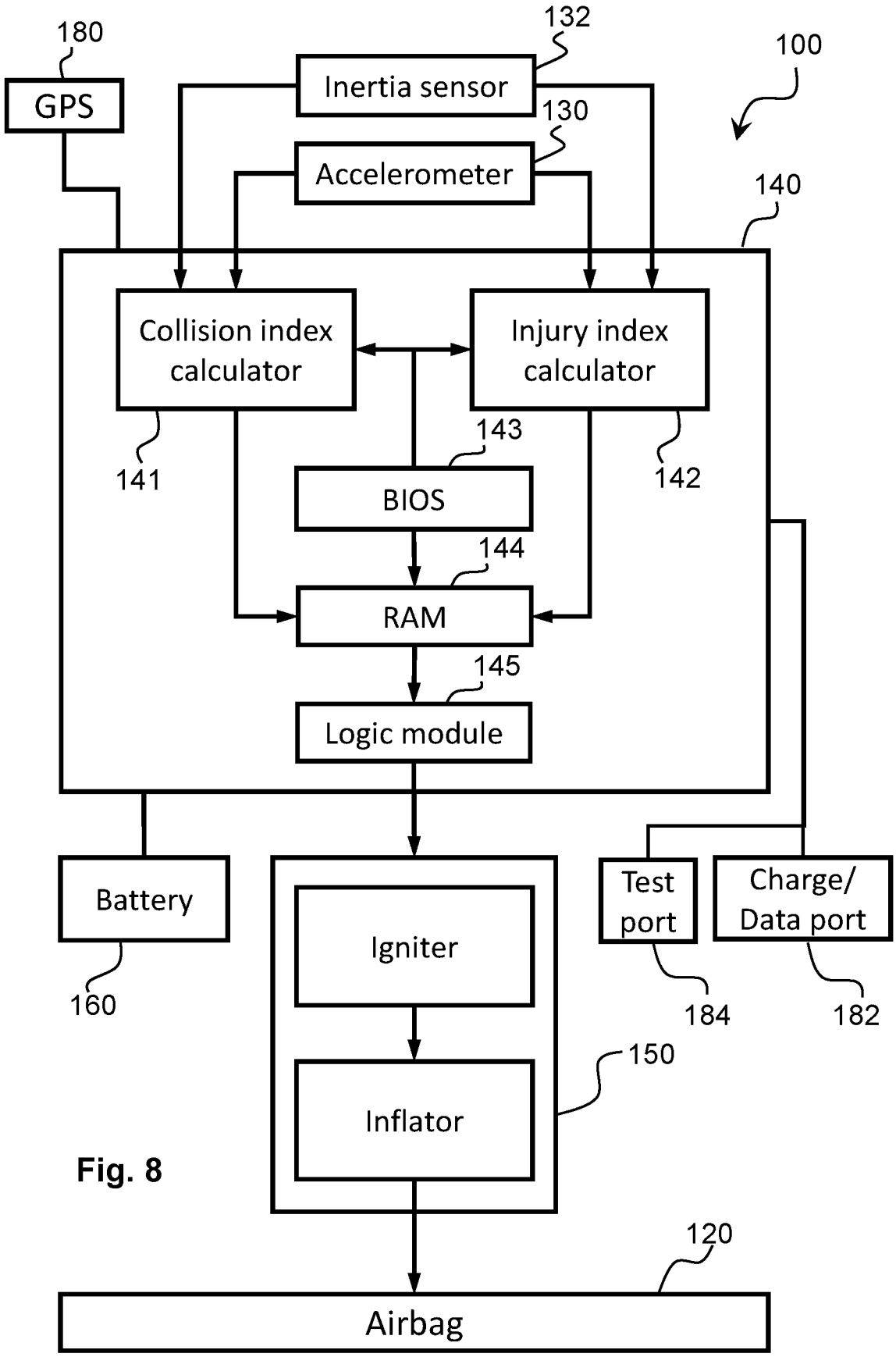

180
GPS
132
Inertia sensor
130
Accelerometer
100
140
Collision index calculator
Injury index calculator
141
143
BIOS
142
144
RAM
145
Logic module
Battery
160
Igniter
Inflator
150
Test port
Charge/ Data port
184
182
120
Airbag

Fig. 8

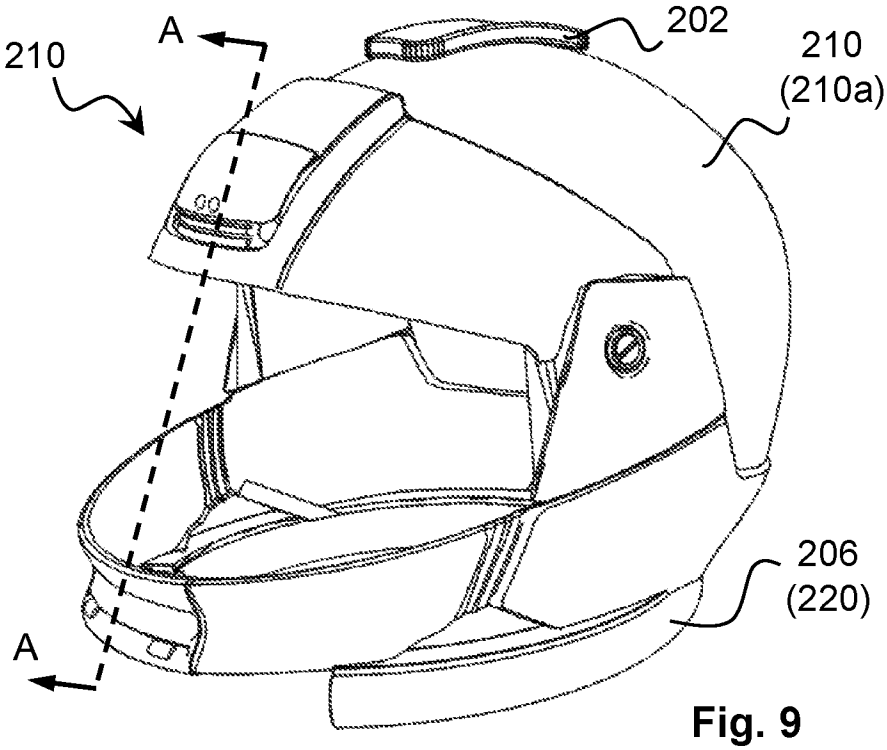


Fig. 9

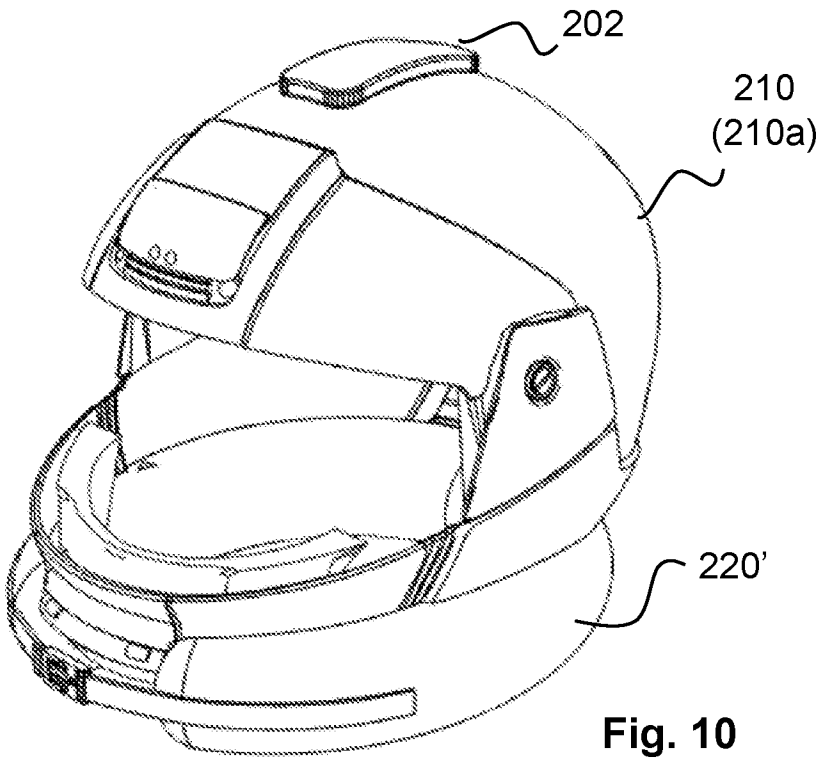
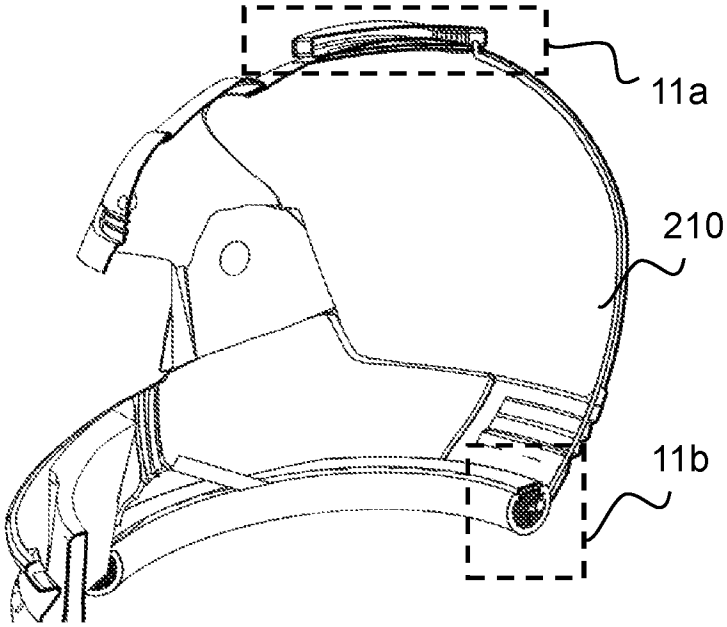


Fig. 10

Fig. 11
A-A



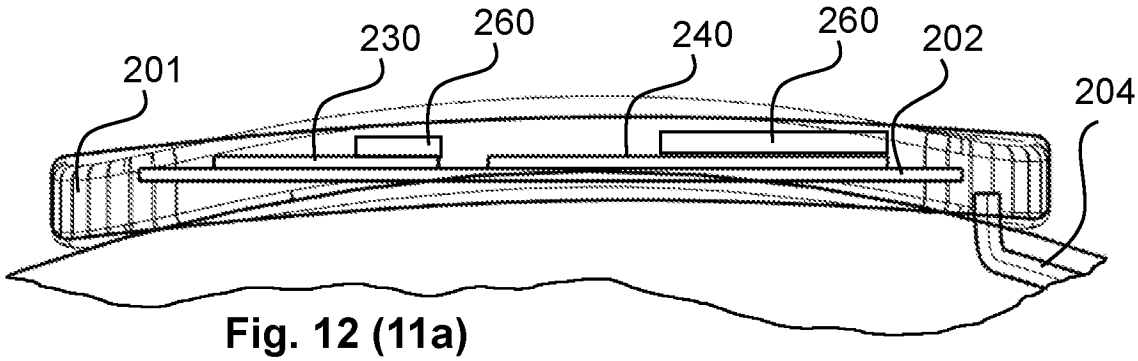


Fig. 12 (11a)

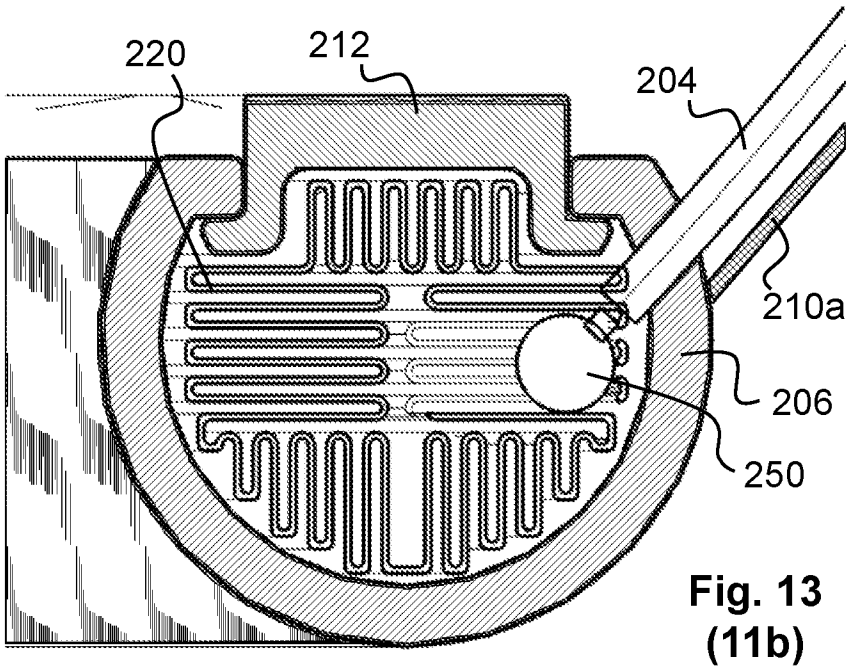


Fig. 13
(11b)

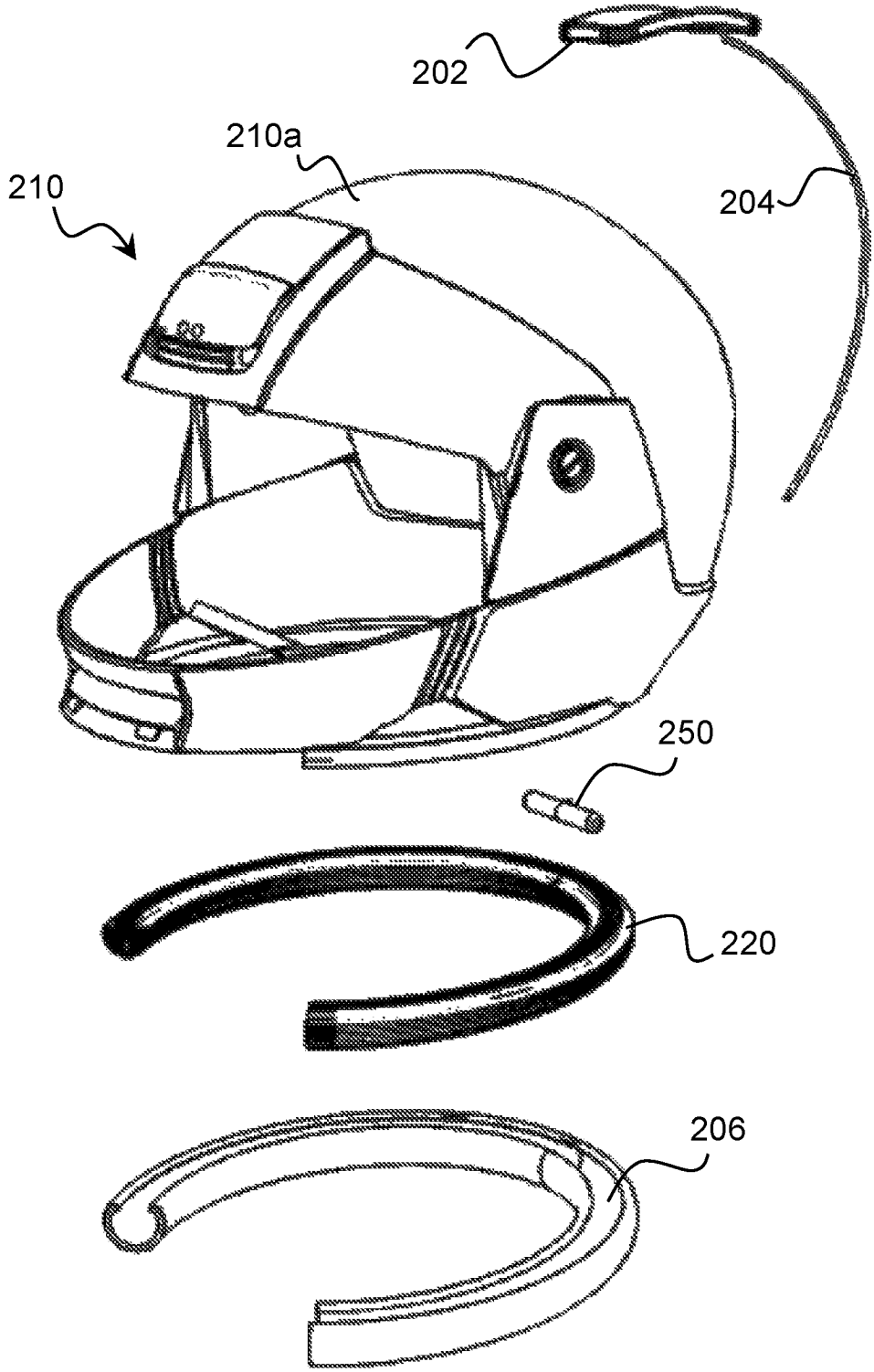


Fig. 14

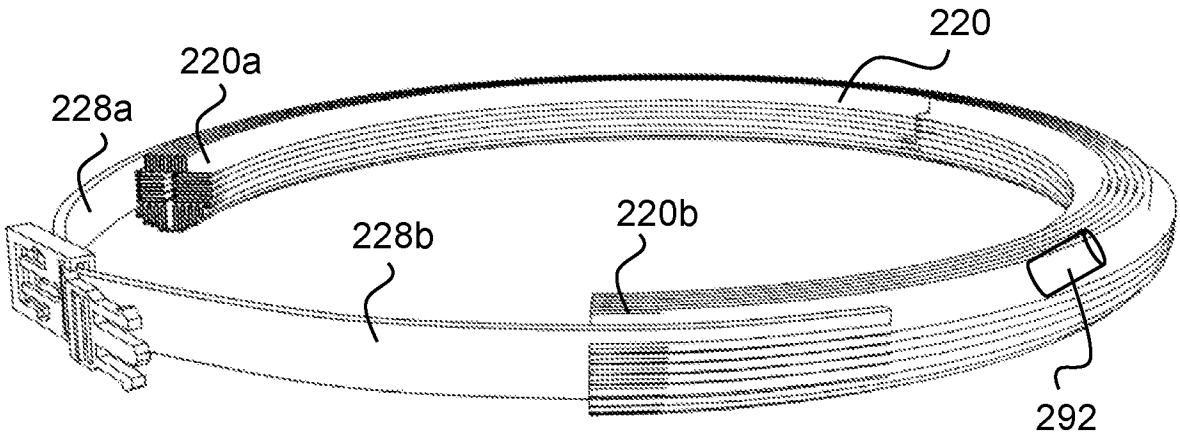


Fig. 15

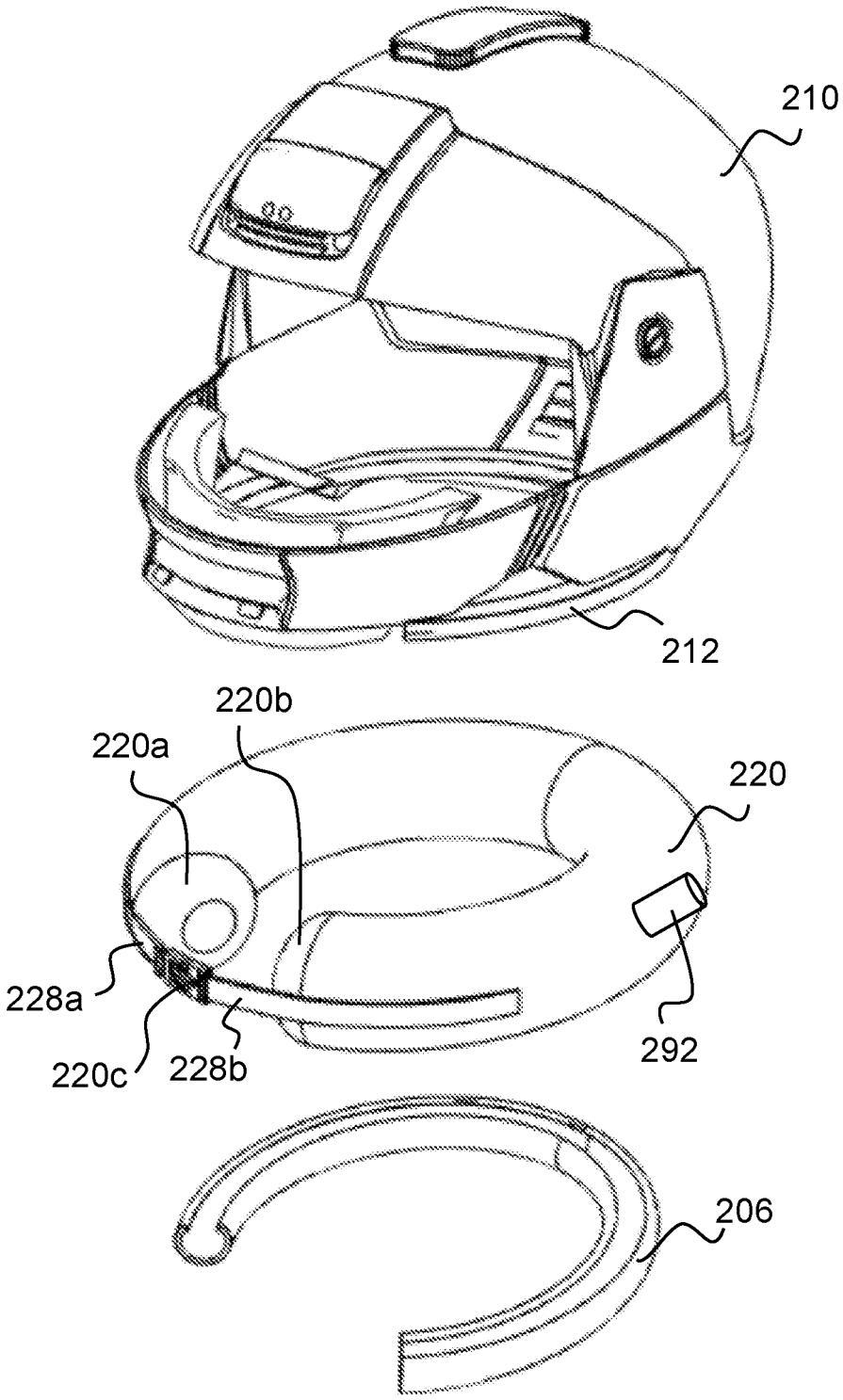


Fig. 16

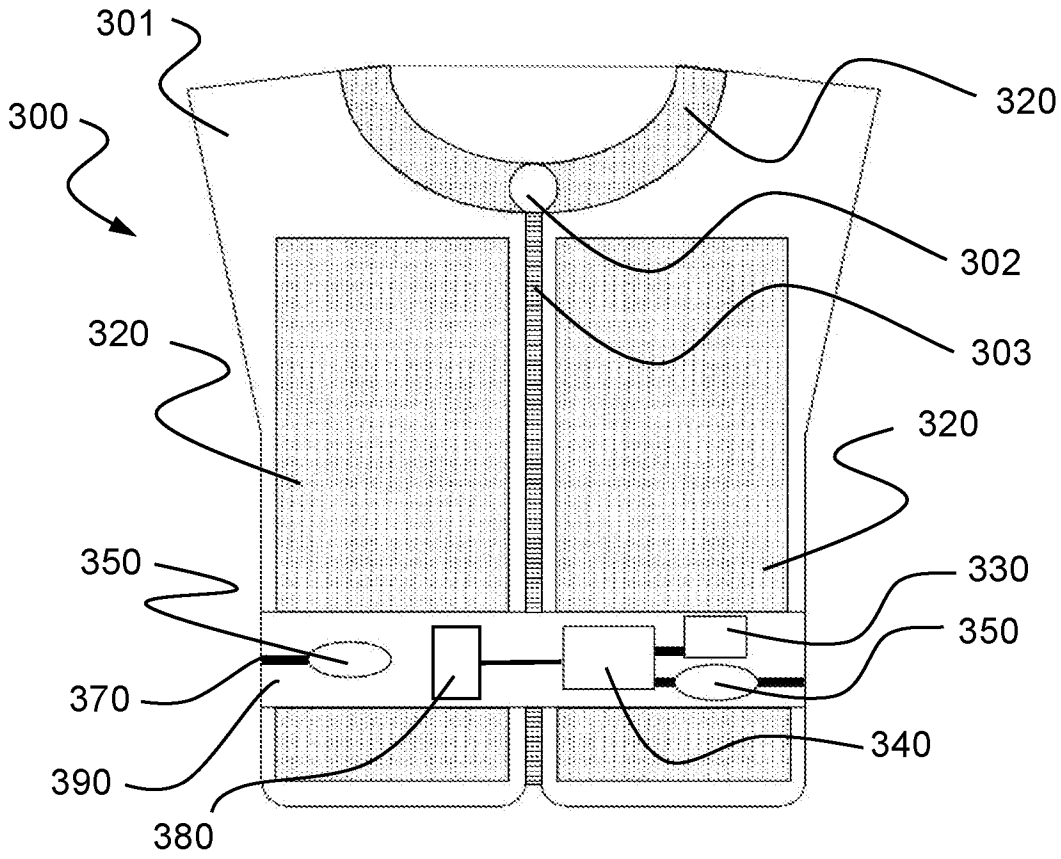


Fig. 17A

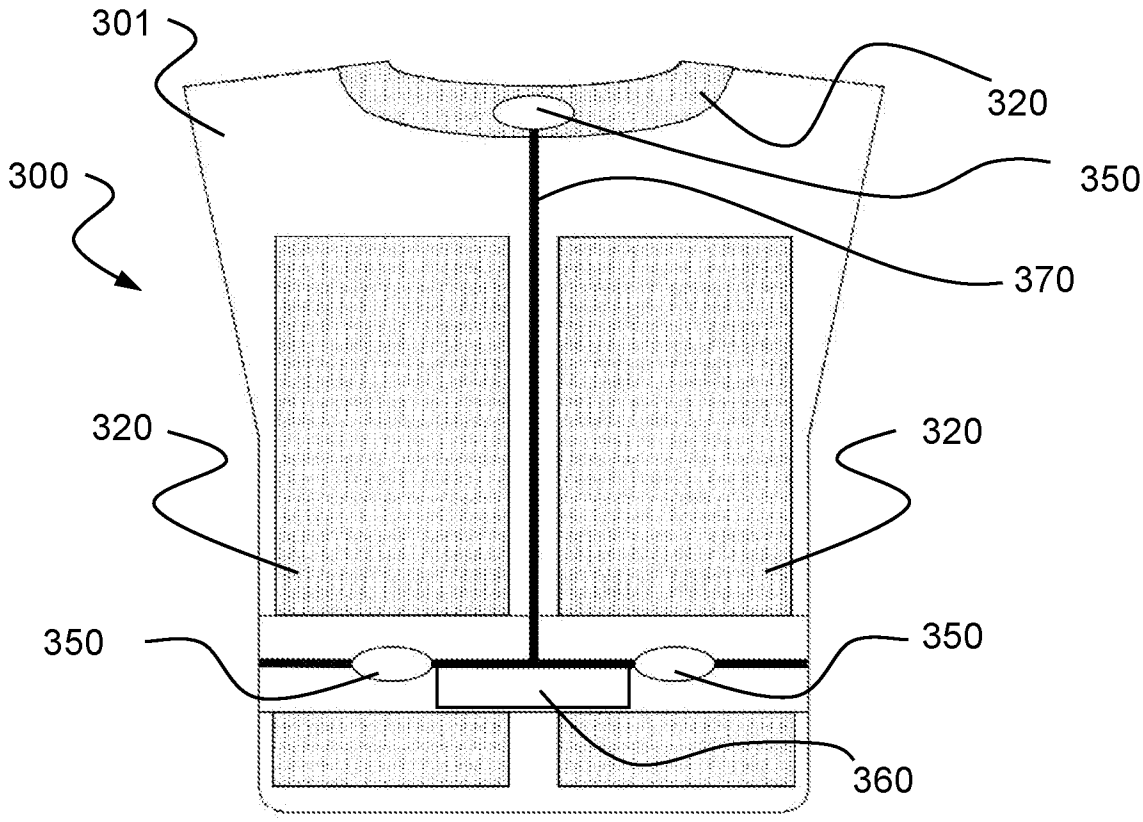


Fig. 17B

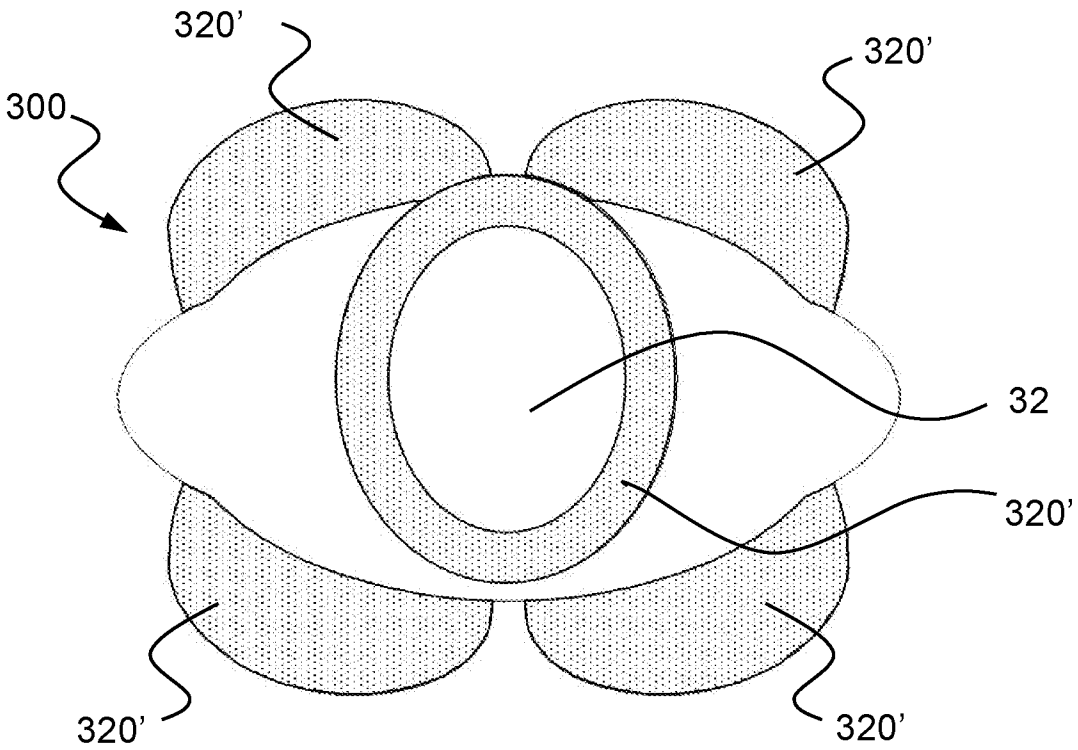


Fig. 18

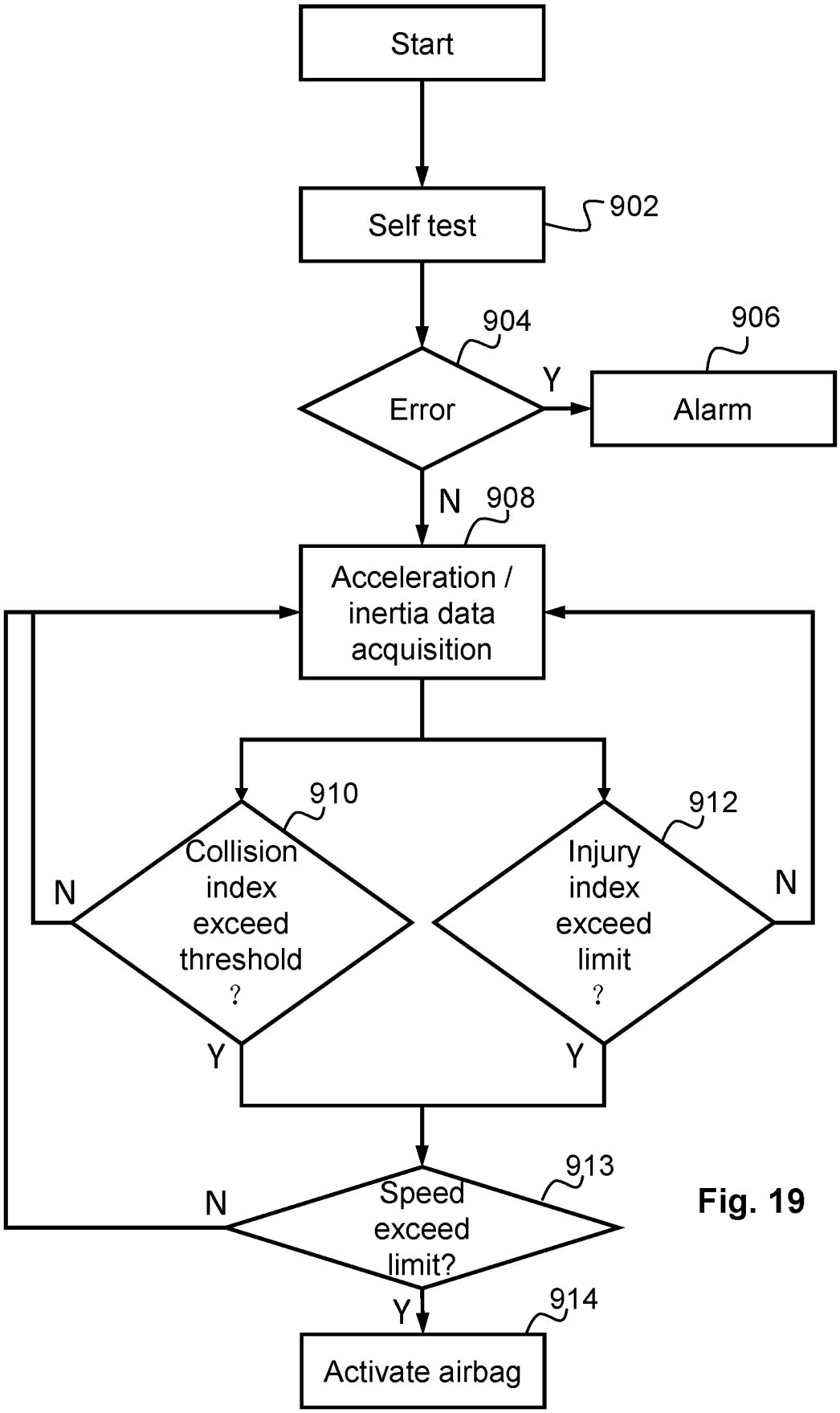

Start
Self test
902
904
Error
Y
906
Alarm
N
908
Acceleration / inertia data acquisition
910
Collision index exceed threshold ?
N
Y
912
Injury index exceed limit ?
N
Y
913
Speed exceed limit?
N
Y
914
Activate airbag

Fig. 19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2018/050384

A. CLASSIFICATION OF SUBJECT MATTER

A42B 3/04(2006.01)i

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)
A42B 3/04; A41D 13/018; A41F 9/00; A42B 3/00; A42B 3/06; A42B 3/12; A63B 71/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: helmet, cloth, wearable, ignitor, folded airbag, predetermined threshold, impact signal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2017-0143055 A1 (ELWHA LLC) 25 May 2017 See paragraphs [0007], [0023], [0025], [0027], [0035], [0038], [0040]; claims 1, 4; and figures 1-7, 9.	13-19
Y		1-12
Y	KR 10-1996-0005946 B1 (HONG JIN CROWN CO., LTD.) 06 May 1996 See pages 2-3; claims 1-2, 4; and figures 1, 3-5.	1-12
A	US 2016-0270472 A1 (ELWHA LLC) 22 September 2016 See paragraphs [0022]-[0062]; claims 1-5; and figures 1-9.	1-19
A	US 2017-0181485 A1 (XIN JIN) 29 June 2017 See paragraphs [0024]-[0042]; claims 1-4; and figures 1-9.	1-19
A	KR 10-2010-0060458 A (TAK, SEUNG HO) 07 June 2010 See paragraphs [0038]-[0052]; and figure 1.	1-19

☐ 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
27 November 2018 (27.11.2018)	**28 November 2018 (28.11.2018)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
MIN, In Gyou
Telephone No. +82-42-481-3326

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SG2018/050384

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017-0143055 A1	25/05/2017	US 2016-0120238 A1 US 9648914 B2	05/05/2016 16/05/2017
KR 10-1996-0005946 B1	06/05/1996	KR 10-1995-0010805 A	15/05/1995
US 2016-0270472 A1	22/09/2016	US 2017-0325533 A1 US 9788588 B2	16/11/2017 17/10/2017
US 2017-0181485 A1	29/06/2017	None	
KR 10-2010-0060458 A	07/06/2010	None	