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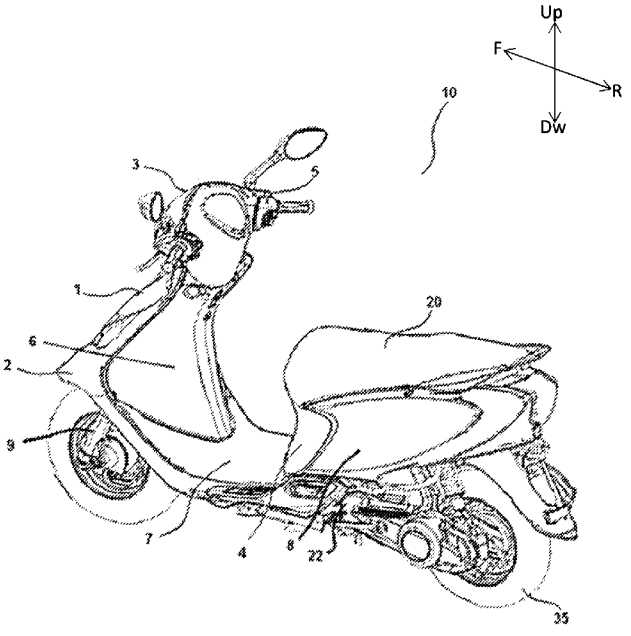

Fig.1

(57) Abstract: The present subject matter described herein relates to a body frame (11) for a vehicle including a scooter-type vehicle. The body frame (11) includes a main frame (13) and a pair of side frames (14) extending rearwardly from a front portion of the body frame (11). As per an aspect of the present subject matter said body frame (11) includes a composite sandwich bridge panel (15) with at least two slots to accommodate and support at least a portion of the body frame (11) including the main frame (13) and the pair of side frames (14). The composite sandwich bridge panel is made of composite material for contributing to light wightness of the body frame (11).

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BODY FRAME FOR A VEHICLE

FIELD OF INVENTION

[0001] The present subject matter described herein generally relates to a body frame for a vehicle.

BACKGROUND OF INVENTION

[0002] Conventional two wheeled vehicles make use of metal tubes or tubes composed of metal alloys such as steel for forming a body frame thereof. Said tubes typically form a closed framework to interconnect various parts such as body covers, seat, engine etc. Besides, said tubes act as load bearing members and are connected by a plurality of bridges which serve to take the impact during a vehicle crash.

[0003] However, metal tubes are relatively heavy due to their specific strength properties. Additionally, conventional body frames are prone to having weak joints between respective tubes and bridges, said joints acting as points of stress.

[0004] In light of the above circumstances, there is a need to provide lighter frames with optimized load and weight distribution. Vehicle body frames are being increasingly replaced with light weight body frames made of composite materials such as fibre reinforced resin. Particularly, in light weight body frames it is important to optimize load and weight distribution since certain parts of the body frame are subject to greater stress and load and it is necessary to reinforce such parts optimally without leading to significant increase in weight of the body frame.

[0005] It is therefore desirable to address the problems encountered in the background as discussed above.

BRIEF DESCRIPTION OF DRAWINGS

[0006] The detailed description of the present subject matter is described with reference to the accompanying figures.

[0007] Figure **1** illustrates a side view of a two wheeled vehicle in accordance with an embodiment of the present invention.

[0008] Figure **2** illustrates a perspective view of a body frame of said two wheeled vehicle in accordance with a first embodiment of the present invention.

[0009] Figure **3** illustrates a detailed enlarged view of a front portion of the body frame in accordance with an embodiment of the present invention.

[00010] Figure **4** illustrates an exploded view depicting parts of a composite sandwich bridge panel in accordance with an embodiment of the present invention.

[00011] Figure **5** illustrates a perspective view of the composite sandwich bridge panel in accordance with an embodiment of the present invention.

[00012] Figure **6** illustrates the body frame including the composite sandwich bridge panel as per a second embodiment of the present invention.

[00013] Figure **7** illustrates the body frame including the composite sandwich bridge panel as per a third embodiment of the present invention.

DETAILED DESCRIPTION

[00014] The present invention has been devised in view of the above stated problems.

[00015] It is an object of the present invention to provide a body frame for a vehicle which is light in weight yet whose strength is uncompromised.

[00016] It is another object of the present invention to provide a body frame including at least one composite sandwich bridge panel for bridging different frame members of the body frame.

[00017] It is yet another object of the present invention to provide a body frame including at least one composite sandwich bridge panel which serves to improve overall stiffness/rigidity of the body frame without leading to significant increase in weight of the body frame.

[00018] It is one more object of the present invention to provide a body frame including at least one composite sandwich bridge panel which serves to support at least two frame members of said body frame structure.

[00019] It is still another object of the present invention to provide a body frame including at least one composite sandwich bridge panel which serves to provide increased contact surface area for effectively bridging at least two frame members of the body frame of a vehicle.

[00020] With the above and other objects in view, the present invention provides a body frame including a head tube, a main frame extending rearwardly from said head tube and a pair of side frames extending rearwardly from a front portion of said body frame, particularly from said main frame. The body frame exemplified in the present invention is a composite frame made of fibre reinforced resin such as carbon fibre or glass fibre. As per an aspect of the present invention, the body frame includes at least one composite sandwich bridge panel adapted to bridge at least the pair of side frames. As per another aspect of the present invention and as per one embodiment, said at least one composite sandwich bridge panel bridges the pair of side frames and the main frame. Particularly, as per an embodiment, one composite sandwich bridge panel of the at least one composite sandwich bridge panel is a first composite sandwich bridge panel, and another composite sandwich bridge panel of the at least one composite sandwich bridge panel is a second composite sandwich bridge panel. As per the present embodiment, the first composite sandwich bridge panel and the second composite

sandwich bridge panel are disposed in the front portion of the body frame and serve to bridge the pair of side frames to the main frame. Further, as per the present embodiment, the first composite sandwich bridge panel and the second composite sandwich bridge panel serve to accommodate at least a portion of the main frame and the pair of side frames and locally reinforce the main frame and the pair of side frames.

[00021] As per an aspect of the present invention, said at least one composite sandwich bridge panel comprises at least one inner layer member sandwiched between at least a pair of outer layer members. Particularly, while said at least one inner layer member is made of light weight material such as foam, said at least a pair of outer layer members is made of a fibre reinforced resin, for example carbon fibre, glass fibre etc. More particularly, since said at least a pair of outer layer members is made of fibre reinforced resin, it aids in enhancing overall strength and rigidity of said at least one composite sandwich bridge panel. Further, said at least one composite sandwich bridge panel is formed by placing said at least one inner layer member between said at least a pair of outer layer members and baking said inner layer member together with said pair of outer layer members.

[00022] Furthermore, said at least one composite sandwich bridge panel is formed in a manner such that each of said at least one inner layer member and said at least a pair of outer layer members integrally includes at least a slot each for accommodating at least a portion of the body frame including the pair of side frames. Particularly, in the present embodiment, said at least a slot on said at least a pair of outer layer members is formed in manner such that a flange extends from an outer periphery thereof. The flange which is integrally formed along each slot on each outer layer member of said pair of outer layer members, and disposed on either sides of said at least one inner layer member serves to support the pair of side frames reliably. Providing the flange along the outer periphery of said at least a slot enables in ensuring availability of higher contact surface area for supporting the pair of side frames, thereby ensuring better support.

[00023] Thus, said at least one composite sandwich bridge panel as per the present invention serves to reliably support a portion of the body frame such as the pair of side

frames. Further, since said at least one composite sandwich bridge panel is composed of fibre reinforced resin, sufficient rigidity is also ensured for the body frame while ensuring low body weight. Thus, use of said at least one composite sandwich bridge panel serves to improve strength of joints between different frame members of a body frame made of composite material, ensuring that rigidity of the body frame is not compromised even when the body frame is made of light weight composite material. Moreover, presence of said at least one inner layer member made of foam helps in reducing vibrations and noise. Owing to the above features, said at least one composite sandwich bridge panel may be used in multiple locations of the body frame as a stiffener member. Further, said at least one composite sandwich bridge panel may also be used in conventional frames made of metal tubes, eliminating the need for additional parts such as gussets and other heavy support structures and thereby contributing to weight reduction in conventional body frames. In one embodiment of the present invention, one composite sandwich bridge panel may also be used to support a single frame member of the body frame in order to locally reinforce said frame member.

[00024] Summary provided above explains the basic features of the invention and does not limit the scope of the invention. The nature and further characteristic features of the present invention will be made clearer from the following descriptions made with reference to the accompanying drawings.

[00025] Exemplary embodiments detailing features of the body frame, in accordance with the present invention will be described hereunder with reference to the accompanying drawings. Particularly, although the present invention has been exemplified for a body frame of a two-wheeled vehicle such as a scooter-type vehicle, the invention is also applicable to body frames of other two-wheeled vehicles including motorcycles. Various aspects of different embodiments of the present invention will become discernible from the following description set out hereunder. Rather, the following description provides a convenient illustration for implementing exemplary embodiments of the invention. Further, it is to be noted that terms "upper", "lower", "right", "left", "front", "forward", "rearward", "downward", "upward", "top", "bottom"

and like terms are used herein based on the illustrated state or in a standing state of said vehicle with a driver sitting thereon unless otherwise elaborated. Furthermore, a longitudinal axis refers to a front to rear axis relative to said vehicle, defining a vehicle longitudinal direction; while a lateral axis refers to a side to side, or left to right axis relative to said vehicle, defining a vehicle lateral direction. Although, the present invention has been exemplified for a two wheeled vehicle, the same is applicable for three wheeled vehicles, four wheeled and other heavy vehicles. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. Further, although the present invention has been exemplified for a two-wheeled vehicle having a body frame made of fibre reinforced resin, the present invention is also applicable for two-wheeled vehicles having metallic body frame.

[00026] Arrows provided in the top right corner of each figure depicts direction with respect to the vehicle, wherein an arrow F denotes front direction, an arrow R indicates rear direction, an arrow Up denotes upward direction, an arrow Dw denoted downward direction, an arrow Rh denotes right side, an arrow Lh denoted left side, as and where applicable.

[00027] Firstly, a description is made of an entire schematic structure of a vehicle **10** including a body frame comprising a main frame member, and side frame members; say for example a two wheeled vehicle, with reference to **FIG.1**.

[00028] **FIG.1** is a side view of the vehicle **10**. The invention disclosed herein has been exemplified for a two wheeled vehicle such as a scooter type motorcycle. As shown in **FIG.1**, the vehicle **10** includes a body frame **11** (shown in **FIG.2**), for example an underbone body frame, made of a composite material such as glass fibre or carbon fibre.

[00029] Said body frame **11** which forms a skeleton of the vehicle **10**, is covered by different body covers. A front cover **1** is provided to cover a forward facing side of the body frame **11** and is disposed above a front fender **2**. A headlamp cover **3** is disposed

above the front cover **1** to encompass a headlamp (not shown) and a handle bar **5** at least partially.

[00030] Further, a leg shield **6** is disposed on a rear side of the front cover **1**, which serves to protect a rider's legs from running wind. From a lower portion of the leg shield **6**, a floorboard **7** extends in a vehicle longitudinal direction towards a central cover member **4** of the vehicle **10**.

[00031] Left and right side covers **8** are disposed to cover left and right side surfaces of a rear portion of the body frame **11**.

[00032] A seat **20** is disposed above the left and right side covers **8**. A fuel tank (not shown) is arranged in the rear portion of the body frame **11** with its sides covered by the left and right side covers **8**. Further, a utility box (not shown) supported between a pair of side frames **14** (shown in **FIG.2**) of the body frame **11**, is disposed in front of the fuel tank and above a power unit **22**. The vehicle **10** is powered by the power unit **22** including at least one of an internal combustion engine or a traction motor. Power from the power unit **22** is transmitted through a transmission system to a rear wheel **35**. The transmission system may include a fixed gear chain drive or continuously variable transmission (CVT) or an automatic manual transmission (AMT) or the like.

[00033] In case of an internal combustion engine, power is supplied with an air fuel mixture sent in by a throttle body (not shown) to a combustion chamber thereof. In the present embodiment the throttle body is a carburettor. However, in another embodiment, the throttle body can be an electronic fuel injection device.

[00034] Further, combustion gases generated by the engine are let out as exhaust from a muffler (not shown).

[00035] A toggle link (not shown) is supported swingably to a portion of the body frame and is disposed on a lower side of the left and right side covers **8**. The rear wheel **35** is connected to the toggle link via the power unit **22**, said power unit **22** being an internal combustion engine.

[00036] Further the vehicle **10** comprises a power source (not shown) that may include a battery or a fuel cell or the like. For example, the power source may be used for propulsion of the vehicle and for powering lighting systems or other electrical and electronic parts of the vehicle such as a vehicle control unit, an anti-lock braking system, or a synchronous braking system.

[00037] **FIG.2** illustrates a perspective view of the body frame **11** of said vehicle **10** in accordance with an embodiment of the present invention.

[00038] As may be seen in **FIG.2**, the body frame **11** includes a head tube **12**, a main frame **13** extending downwardly and rearwardly from said head tube **12**, the pair of side frames **14** extending from a front portion **11a** (shown in **FIG.3**) of said body frame **11** up to a rear portion of said body frame **11**, and on either sides of said main frame **13**. In the present embodiment, the pair of side frames **14** serves to support the floorboard **7** (shown in **FIG.1**) of the vehicle **10**. The body frame **11** further includes at least one composite sandwich bridge panel **15**. In the present embodiment, the at least one composite sandwich bridge panel **15** serves to bridge the main frame **13** and the pair of side frames **14** in the front portion **11a** of the body frame **11**. For example, in the present embodiment one of said at least one composite sandwich bridge panel **15** is a first composite sandwich bridge panel **15a** and another of said at least one composite sandwich bridge panel **15** is a second composite sandwich bridge panel **15b**. While the first composite sandwich bridge panel **15a** serves to bridge the main frame **13** and the pair of side frames **14** at a front end portion of the pair of side frames **14**, the second composite sandwich bridge panel **15b** serves to bridge the main frame **13** and the pair of side frames **14** at a rear end portion of the main frame **13**.

[00039] Particularly, as may be seen in **FIG.3**, the first composite sandwich bridge panel **15a** and the second composite sandwich bridge panel **15b** are provided in a manner so as to accommodate at least a portion of the main frame **13** and the pair of side frames **14**. Thus, the first composite sandwich bridge panel **15a** and the second composite sandwich bridge panel **15b** hold between them the pair of side frames **14** and

the main frame **13**. Thus, the front portion **11a** of the body frame **11** including the first composite sandwich bridge panel **15a**, the second composite sandwich bridge panel **15b**, and portions of the pair of side frames **14** and the main frame **13** sandwiched between the first composite sandwich bridge panel **15a** and the second composite sandwich bridge panel **15b** serves to form a support structure for the floorboard **7**.

[00040] As may be seen in **FIG.3** and as per an embodiment of the present invention, the main frame **13** and the pair of side frames **14** are made of regular geometrical shape, and are preferably square shaped. However, the main frame **13** and the pair of side frames **14** may have other shapes including a rectangular shape or a tubular shape. Further, the main frame **13** and the pair of side frames **14** comprise of at least two inner core members **16** that extend along their respective lengths. Particularly, the at least two inner core members **16** are composed of composite material such as fibre reinforced resin. Further, the at least two inner core members **16** are secured together by an outer core member also made of a composite material such fibre reinforced resin. In order to obtain a solid structure, the at least two inner core members **16** and the outer core member are baked. Therefore, since the body frame **11**, including the main frame **13** and the pair of side frames **14** is made of composite material, there is a need to ensure reliable support for the same, without leading to a significant increase in the overall weight of the body frame **11**. As per an aspect of the present invention, the first composite sandwich bridge panel **15a** and the second composite sandwich bridge panel **15b** are not only adapted to bridge the pair of side frames **14** to the main frame **13** but also adapted to support and locally reinforce the main frame **13** and the pair of side frames **14**. A structure and composition of the first composite sandwich bridge panel **15a** and the second composite sandwich bridge panel **15b** as per the present invention enables to reliably support the main frame and the pair of side frames.

[00041] With reference to **FIG.4-FIG.6**, the structure and composition of the at least one composite sandwich bridge panel **15** is elaborated.

[00042] **FIG.4** is an exploded view of the at least one composite sandwich bridge panel **15** in accordance with an embodiment of the present invention. The at least one

composite sandwich bridge panel **15** comprises at least one inner layer member **15i** and at least a pair of outer layer members **15o**. For example, the first composite sandwich bridge panel **15a**, the second composite sandwich bridge panel **15b**, a third sandwich bridge panel **15c** (shown in **FIG.6**), a fourth sandwich bridge panel **15d** and a fifth sandwich bridge panel **15e** (shown in **FIG.6**) comprise of said at least one inner layer member **15i** and said at least a pair of outer layer members **15o**. Particularly, said at least one inner layer member **15i** is sandwiched between said at least a pair of outer layer members **15o**. Further, while said at least one inner layer member **15i** is made of a light weight material such as foam, said at least a pair of outer layer members **15o** is made of fibre reinforced resin. Said at least one inner layer member **15i** and said at least a pair of outer layer members **15o** are baked together to form said at least one composite sandwich bridge panel **15**. In another embodiment, said at least one inner layer member **15i** and said at least a pair of outer layer members **15o** may be attached together using adhesive.

[00043] Further, as may be seen in **FIG.4** and **FIG.5**, said at least one composite bridge panel **15** comprises at least a slot **15s** including two slots **15s** for receiving the pair of side frames **14**. As per the first embodiment, since said at least one composite sandwich bridge panel **15** is adapted to bridge the pair of side frames **14** and the main frame **13**, said composite sandwich bridge panel **15** including said first composite sandwich bridge panel **15a** and said second composite sandwich bridge panel **15b** is provided with three slots **15s** to accommodate the main frame **13** in the centre and the pair of side frames **14** on either sides of said main frame **13**. In other words, each of said inner layer member of said at least one inner layer member **15i** and each outer layer member of at least a pair of outer members **15o** is formed to include at least two slots **15s** to accommodate the main frame **13** and the pair of side frames **14**. Further, size and shape of said at least two slots **15s** may vary based on the corresponding size and shape of parts of the frame members that have to be accommodated therewithin. In other words, each slot **15s** is provided with a shape complimentary to that of the portion of the body frame being accommodated in said slot.

[00044] Particularly, in order to provide adequate support to the main frame **13** and the pair of side frames **14**, a flange **15f** each is integrally formed along an outer periphery **15p** of each slot **15s**. The flange **15f** protrudes outwardly away from a central portion of each slot of each outer layer member of said at least a pair of outer layer members **15o**. Provision of the flange **15f** which is enmoulded along the outer periphery **15p** of each slot **15s**, enables in ensuring increased contact surface area with the pair of side frames **14** and the main frame **13**, thereby ensuring good support for the same.

[00045] In the present embodiment and as may be seen in **FIG.3**, the first composite sandwich bridge panel **15a** is inserted through the main frame **13**. Thereafter, the pair of side frames **14** is inserted into two of said at least a slot **15s** formed in said first composite sandwich bridge panel **15a**. Further, the second composite sandwich bridge panel **15b** is disposed over the pair of side frames **14** and the main frame **13** bridging the same. Particularly, slots **15s** in the second composite sandwich bridge panel **15b** are formed in a manner such that they enable supporting the pair of side frames **14** and the main frame **13** on three sides.

[00046] Further, as may be seen in **FIG.4**, said at least one composite sandwich bridge panel **15** including the first composite sandwich bridge panel **15a**, and the second composite sandwich bridge panel **15b** is oriented in a manner such that one outer layer member of said pair of outer layer members **15o** is visible when viewed from a vehicle front direction, and said inner layer member **15i** and the pair of outer layer members **15o** is visible when viewed from a vehicle top direction. However, in another embodiment, said at least one composite sandwich bridge panel **15** may be oriented in a manner such that the inner layer member **15i** and the pair of outer layer members **15o** is visible when viewed from the vehicle front direction, and one outer layer member of the pair of outer layer members **15o** is visible when viewed from the motorcycle top direction.

[00047] **FIG.6** denotes the use of said at least one composite sandwich bridge panel **15** in a two-wheeled vehicle such as a motorcycle and constitutes a second embodiment of the present invention. Particularly, **FIG.6** denotes a body frame **21** of said motorcycle

including a head tube **23**, a main frame **24** extending rearwardly from said head tube **23**, a pair of side frames **25** connected to said main frame **24** and extending rearwardly therefrom towards a rear portion of said body frame **21**. The body frame **21** also includes at least one sandwich bridge panel **15**, for example the third sandwich bridge panel **15c**, the fourth sandwich bridge panel **15d** and the fifth sandwich bridge panel **15e** for bridging said pair of side frames **25**, and comprises said at least one inner layer member **15i** and said at least a pair of outer layer members **15o**, as elaborated in the preceding paragraphs. For example, in the present embodiment each slot **15s** formed in each outer layer member of the pair of outer layer members15o is adapted to hug each side frame of the pair of side frames from the sides.

[00048] Use of said at least one composite sandwich bridge panel **15** as per the present invention may not be restricted to the front portion of the body frame **11** in a scooter type vehicle. As illustrated in **FIG.7** and as per a third embodiment of the present invention, the at least one composite sandwich bridge panel **15** is used to bridge the pair of side frames **14** in a rear portion of the body frame **11** and for supporting a utility box between said pair of side frames **14**. The at least one composite sandwich bridge panel **15** can also be adapted to support a pair of rear shock absorbers at a rear side of the vehicle.

[00049] In an embodiment where said at least one composite bridge panel is being used to locally reinforce at least a portion of the body frame, say for example the main frame; each inner layer member of the at least one inner layer member and each outer layer member of said at least a pair of outer layer members is provided with a slot each for allowing insertion of said composite bridge panel portion through said portion of the body frame. In another implementation, said bridge panel may be disposed locally over said portion of the body frame.

[00050] While the present invention has been shown and described with reference to the foregoing preferred embodiments, it will be apparent to those skilled in the art that changes in form, connection, and detail may be made therein without departing from the spirit and scope of the invention as defined in the appended claims:

We claim:

1. A body frame (11,21) for a vehicle, said body frame (11,21) including:
   a main frame (13,24);
   a pair of side frames (14,25) connected to said main frame (13,24) and extending towards a rear portion of said body frame (11,21); and
   at least one composite sandwich bridge panel (15), said at least one composite sandwich bridge panel (15) comprising at least one inner layer member (15i) sandwiched between at least a pair of outer layer members (15o), each of said at least one inner layer member (15i) and said at least a pair of outer layer members (15o) being formed to include at least a slot (15s) each for receiving at least a portion of the body frame (11, 21).

2. The body frame (11, 21) as claimed in claim 1, wherein said at least a portion of the body frame (11, 21) includes said main frame (13) and said pair of side frames (14).

3. The body frame (11, 21) as claimed in claim 1, wherein said at least a portion of the body frame (11, 21) includes said pair of side frames (14, 25).

4. The body frame (11,21) as claimed in claim 1, wherein said at least a slot (15s), each provided on each outer layer member of said at least a pair of outer layer members (15o) is formed to include a flange (15f), said flange (15f) extending along an outer periphery (15p) of each slot of said at least a slot (15s).

5. The body frame (11,21) as claimed in claim 1, wherein said at least a slot (15s), each provided on each outer layer member of said at least a pair of outer layer members (15o) and in said inner layer member (15i) has a shape complimentary to that of said at least a portion of the body frame (11,21), and wherein at least a portion of said body frame (11,21) has a regular geometrical shape including a rectangular shape, and a square shape.

6. The body frame (11, 21) as claimed in claim 1, wherein said at least one composite sandwich bridge panel (15) comprising at least one inner layer member

(15i) sandwiched between at least a pair of outer layer members (15o) is formed by baking said at least one inner layer member (15i) with said at least a pair of outer layer members (15o).

7. The body frame (11, 21) as claimed in claim 1, wherein said at least one composite sandwich bridge panel (15) comprising at least one inner layer member (15i) sandwiched between at least a pair of outer layer members (15o) is formed by attaching said at least one inner layer member (15i) to said at least a pair of outer layer members (15o) using adhesive.

8. The body frame (11, 21) as claimed in claim 1, wherein said at least one inner layer member (15i) is made of a light weight material including foam.

9. The body frame (11, 21) as claimed in claim 1, wherein said at least a pair of outer layer members (15o) is made of composite material including fibre reinforced resin.

10. The body frame (11, 21) as claimed in claim 1, wherein said at least one composite sandwich bridge panel (15) is adapted to bridge said pair of side frames (14, 25).
11. The body frame (11,21) as claimed in claim 1, wherein said at least one composite bridge panel (15) is adapted to bridge said main frame (13) with said pair of side frames (14).
12. A vehicle (10) including said body frame (11, 21) as claimed in claims 1-11.

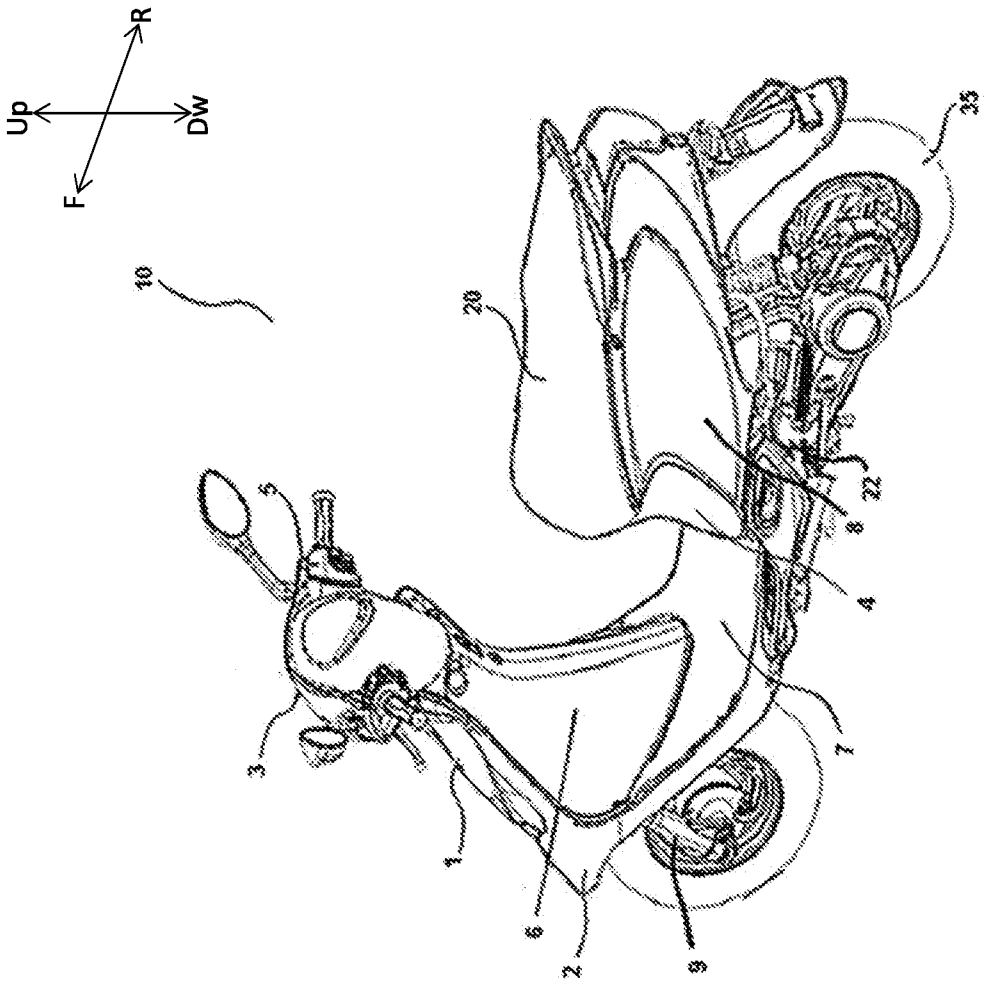


Fig.1

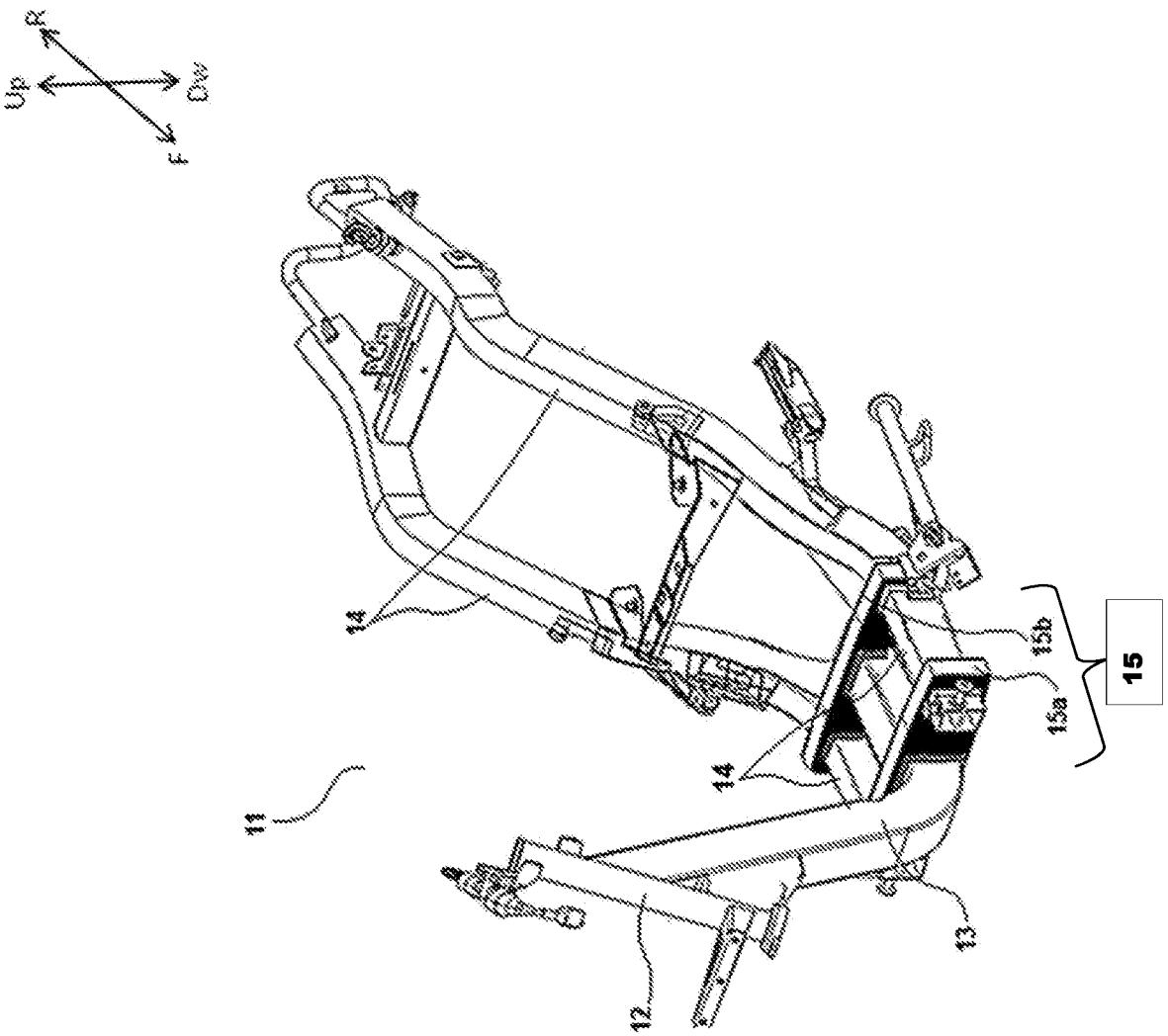


Fig.2

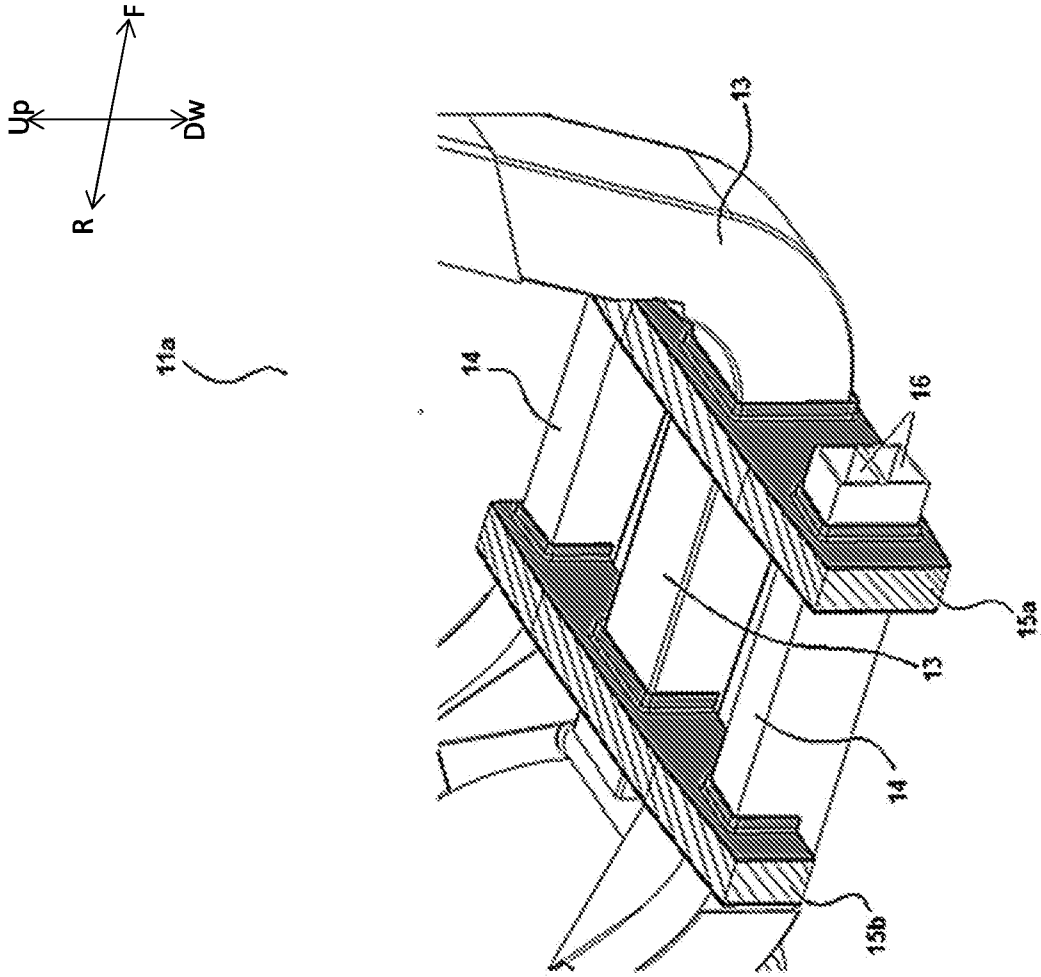


Fig.3

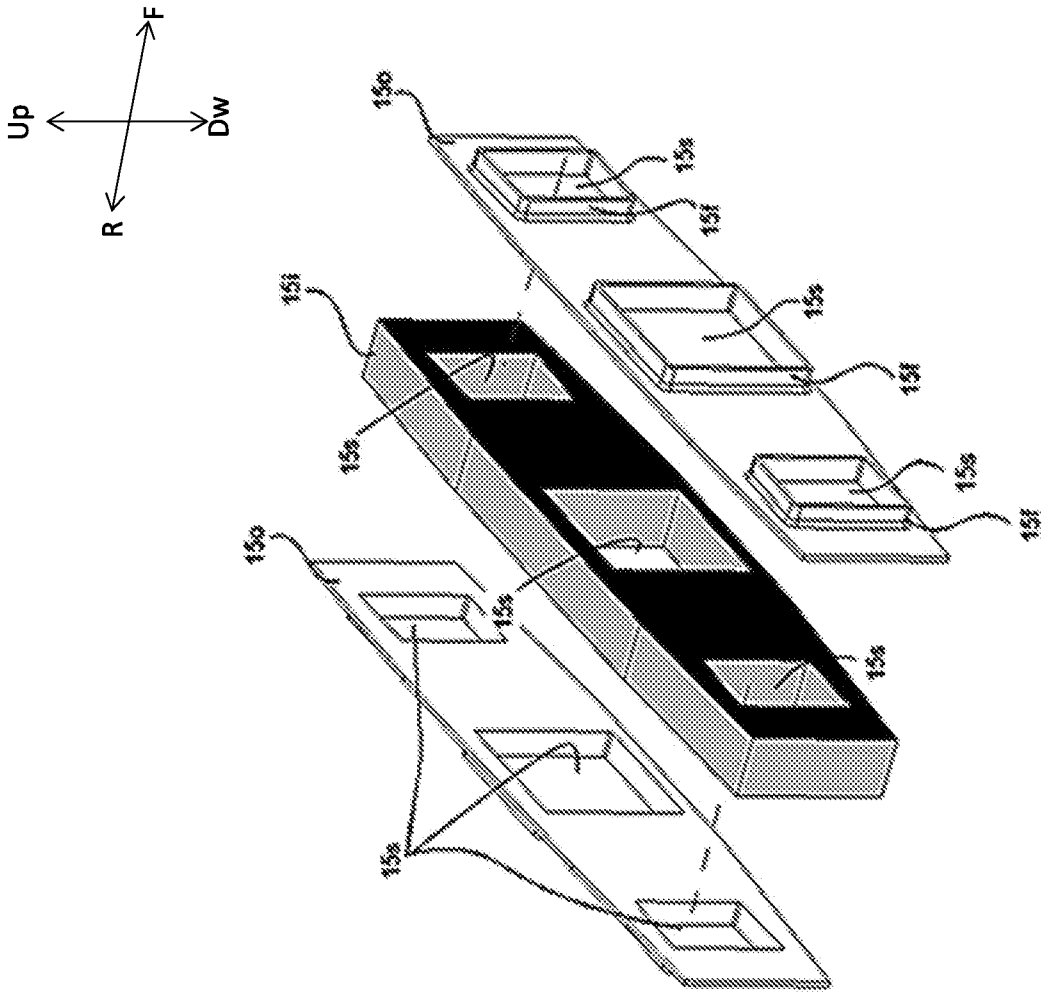
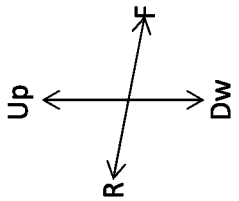


Fig.4



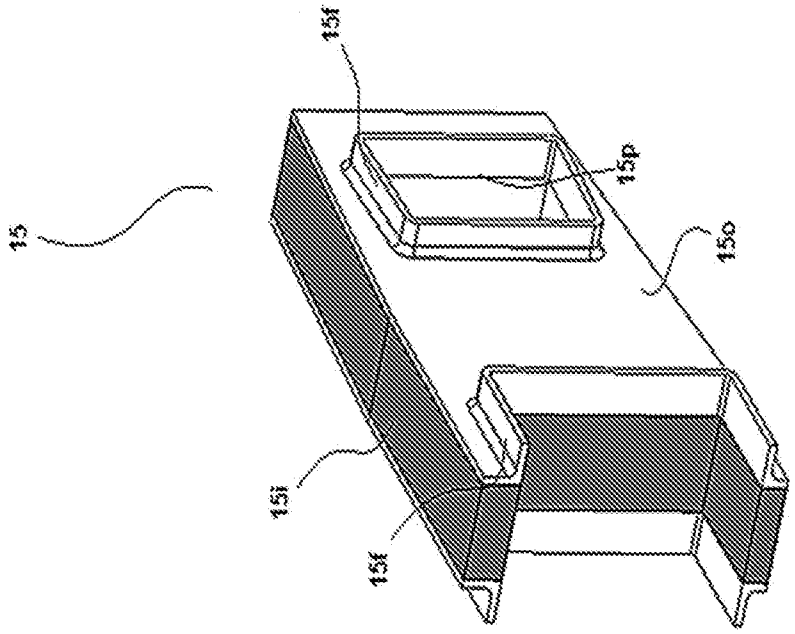


Fig.5

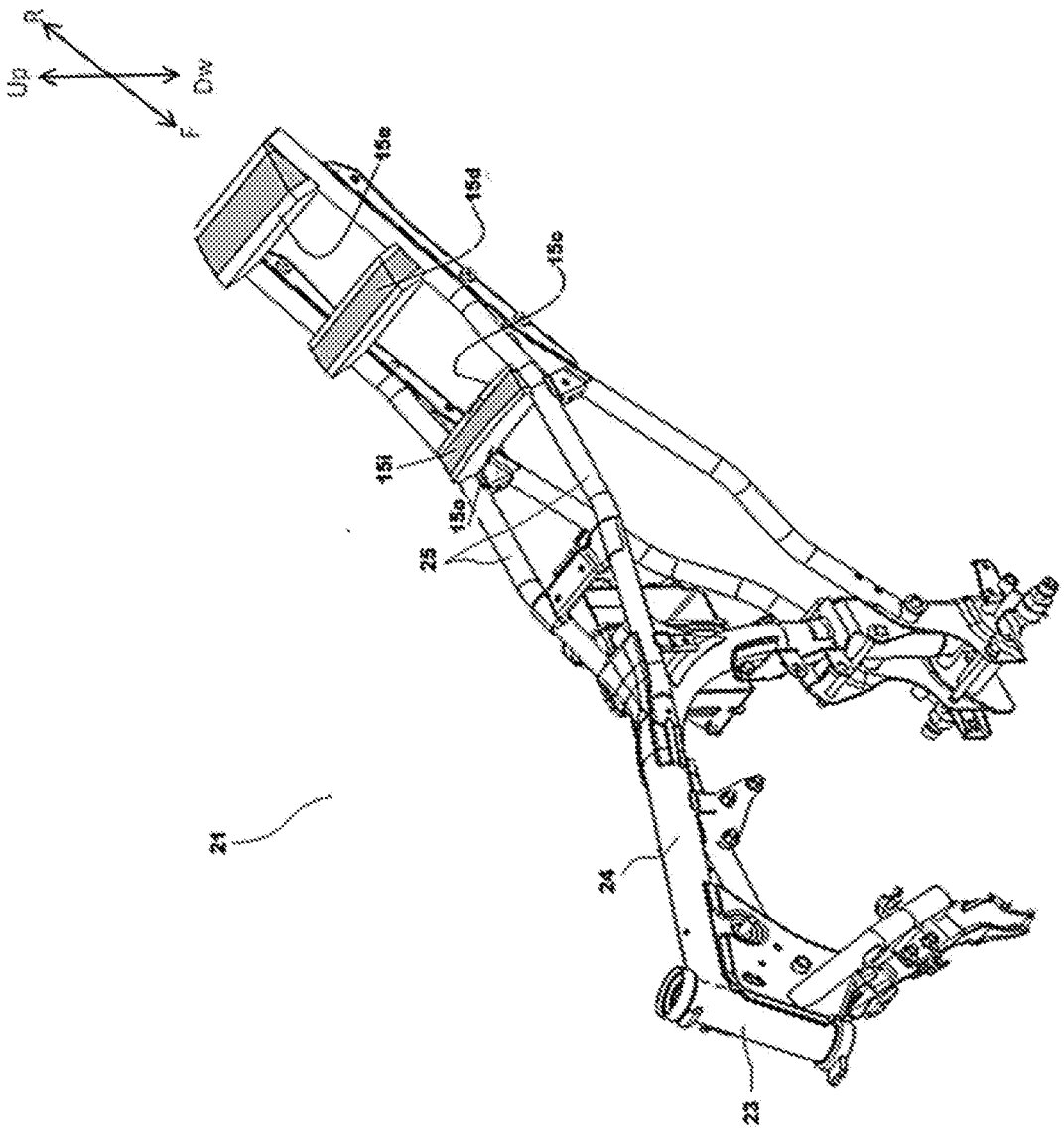


Fig.6

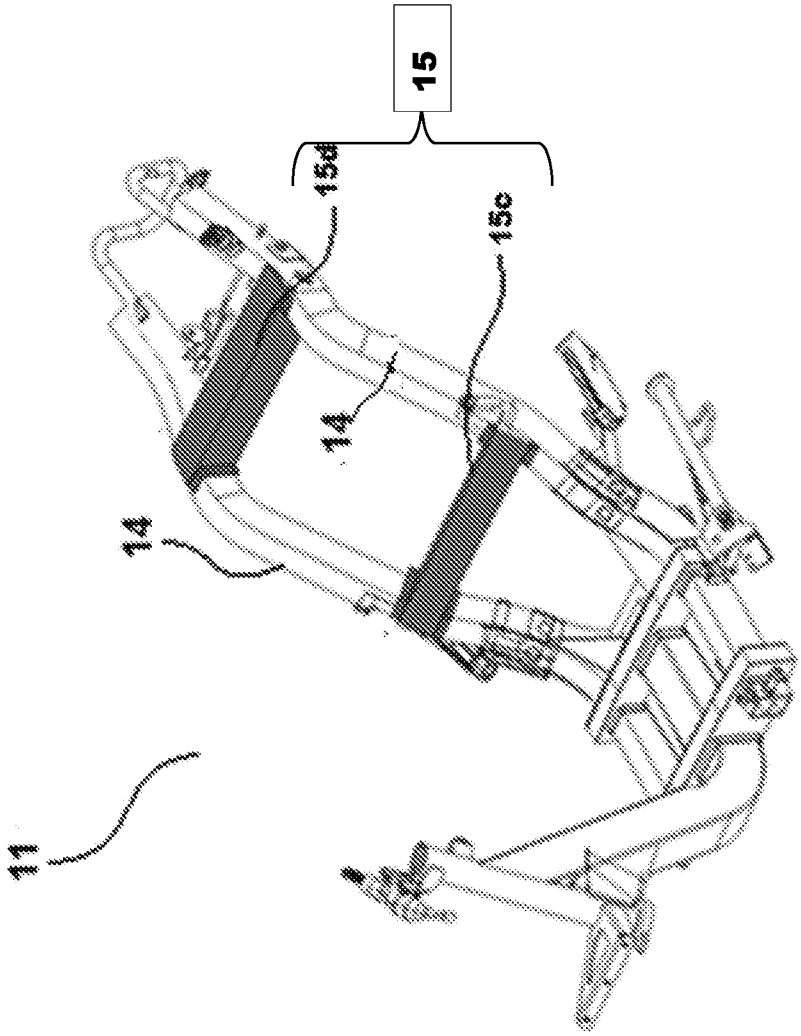


Fig.7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2017/055231

A. CLASSIFICATION OF SUBJECT MATTER
B62K11/02,B62D21/15 Version=2017.01

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)

B62K, B62D

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

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

Patseer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE102014222297A1, BAYERISCHE MOTOREN WERKE AG, 04 May 2016 (04/05/2016) paragraphs-(3-18)	1-12
A	US20130032424 A1, FASTER FASTER INC., 7 February 2013 (07/02/2013) Fig. 1, claims-(1-23)	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
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"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
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"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
20-11-2017	20-11-2017

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Nanda Theja Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2017/055231

Citation	Pub.Date	Family	Pub.Date
US 20130032424 A1	07-02-2013	EP 2739522 A2	11-06-2014
		EP 2739522 B1	06-09-2017
		US 20140209402 A1	31-07-2014
		US 8672077 B2	18-03-2014
		WO 2013019727 A2	07-02-2013
		WO 2013019727 A3	08-05-2014