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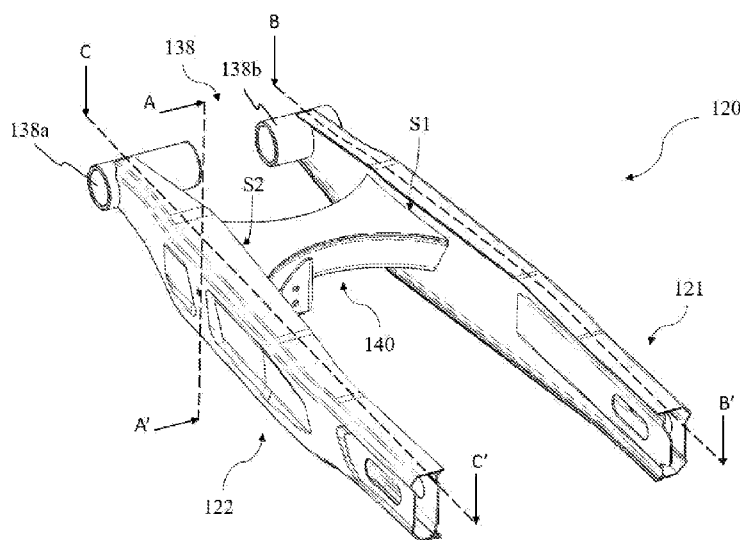


Figure 3

(57) **Abstract:** A vehicle (100) having a body frame (102), a sheet metal swing arm (120) pivotally coupled to the body frame (102), and a rear ground engaging member (111) rotatably coupled to the sheet metal swing arm (120). The sheet metal swing arm (120) includes a pivot section (138). The pivot section (138) swingably supporting the sheet metal swing arm (120) to the body frame (102). The sheet metal swing arm (120) further includes a right arm (121) extending rearwardly from the pivot section (138), a left arm (122) extending rearwardly from the pivot section (138), and a bridge member (140) extending in vehicle width direction between the right arm (121) and the left arm (122) and attached to the right arm (121) and the left arm (122), wherein at least one reinforcement member (R1) is joined to the right arm (121) and at least one reinforcement member (R2) is joined to the left arm (122).

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## “SWING ARM OF VEHICLE”

### FIELD OF INVENTION

**[0001]** The present invention relates to a vehicle, and more particularly, to a swing arm of the vehicle.

### BACKGROUND

5 **[0002]** Vehicles such as motorcycles, scooters, etc. are often provided with a swing arm that rotatably supports a rear wheel. Further, the swing arm acts as a support member to one or more rear suspensions and other vehicle components. The swing arm is generally formed by left and right arms to which a wheel axle of the rear wheel is attached to a rear side, and front side of the swing arm is hingably supported to a vehicle body frame. A cross member  
10 is coupled to the left and right arms of the swing arm. The cross member is provided with a bracket member extending upwards from the cross member, the bracket member supports a lower portion of the rear suspension of the vehicle.

**[0003]** It is always desired to keep the swing arm light weighted yet withstand different loads. In order to make the swing arm light it is formed of sheet material. Conventional swing  
15 arms made of sheet material generally involves several joints. Load bearing portions of the swing arm, for example, the joints of the cross member, the left arm and the right arm experiences maximum loading conditions and are prone to failure due to load acting on them. These load bearing portions are designed with higher sheet metal thickness to avoid the failure of the swing arm. However, to achieve higher sheet metal thickness at the load bearing  
20 portions, the sheet metal thickness of the entire arm (left or right or both) of the swing arm needs to be maintained same as that of the load bearing portion's thickness for ease of manufacturing, which leads to heavier structure of the swing arm.

**[0004]** One such swing arm entitled: “Tapered swing arm for a motorcycle” is disclosed in Patent Document JP 3125259 B2 (herein after referred to as ‘259 patent). The  
25 patent discloses forming a tapered swing arm of a motorcycle of plate material in such a way that the length of weld parts need not be long. The patent discloses forming arm parts of a swing arm of plate material. The rear tapered parts are formed into angular pipe shape by

bending, and the plate ends are connected by one longitudinal weld part. Front tapered parts are vertically provided with inward flanges, and both ends of a cross member are overlapped and welded at weld parts. However, the disclosed method of forming the swing arm of '259 patent increases the overall manufacturing cost of the swing arm, which is not desirable.

5

## SUMMARY OF INVENTION

**[0005]** In one aspect of the present invention, a vehicle is provided. A vehicle having a body frame, a sheet metal swing arm pivotally coupled to the body frame and a rear ground engaging member rotatably coupled to the sheet metal swing arm. The sheet metal swing arm has a pivot section that includes a right end portion and a left end portion, the pivot section swingably supporting the swing arm to the body frame. The sheet metal swing arm has a right arm extending rearwardly from the right end portion of the pivot section. The sheet metal swing arm has a left arm extending rearwardly from the left end portion of the pivot section. The sheet metal swing arm further has a bridge member extending in vehicle width direction between the right arm and the left arm and attached to the right arm and the left arm. The swing arm has at least one reinforcement member is joined to the right arm and at least one reinforcement member is joined to the left arm.

**[0006]** In one aspect of the present invention, the at least one reinforcement member is joined at a portion of the right arm where the bridge member is attached to the right arm, and the at least one reinforcement member is joined at a portion of the left arm where the bridge member is attached to the left arm (122).

**[0007]** In one aspect of the present invention, the bridge member is seam welded to the right arm forming a seam weld line on the right arm, at least portion of the at least one reinforcement member overlaps the seam weld line and the bridge member is seam welded to the left arm forming a seam weld line on the left arm, at least portion of the at least one reinforcement member overlaps the seam weld line.

**[0008]** In one aspect of the present invention, the at least one reinforcement member has an outer edge and an inner edge, the outer edge and the inner edge lie on opposite sides of the seam weld line and the at least one reinforcement member has an outer edge and an inner edge, the outer edge and the inner edge lie on opposite sides of the seam weld line.

**[0009]** In one aspect of the present invention, the at least one reinforcement member is spot welded to the right arm and the at least one reinforcement member is spot welded to the left arm.

5 **[00010]** In one aspect of the present invention, the right arm and the left arm each having at least one outer member and at least one inner member made up of sheet metal.

**[00011]** In one aspect of the present invention, one of the atleast outer member and the atleast one inner member is “C” shaped member.

**[00012]** In one aspect of the present invention, one of the at least one outer member (142) and the at least one inner member (144) is flat plate shaped member.

10 **[00013]** In one aspect of the present invention, the bridge member is made up of joining at least two sheet metal pieces together.

**[00014]** In one aspect of the present invention, the bridge member is attached to the atleast one inner member of the right arm and the at least one reinforcement member is joint to the atleast one inner member at the opposite side of the bridge member is attached to the inner member of the right arm.

15 **[00015]** In one aspect of the present invention, the bridge member is attached to the atleast one inner member of the left arm and the at least one reinforcement member is joint to the atleast one inner member at the opposite side of the bridge member is attached to the atleast one inner member of the left arm.

20 **[00016]** In one aspect of the present invention, the at least one reinforcement member is joint to a top portion and a bottom portion of the “C” shaped member of the right arm.

**[00017]** In one aspect of the present invention, the at least one reinforcement member is joint to the top portion and the bottom portion of the “C” shaped member of the left arm.

25 **[00018]** In one aspect of the present invention, a sheet metal swing arm has a pivot section includes a right end portion and a left end portion, the pivot section swingably supporting the sheet metal swing arm to a body frame of a vehicle. The sheet metal swing arm

has a right arm extending rearwardly from the right end portion of the pivot section. The sheet metal swing arm has a left arm extending rearwardly from the left end portion of the pivot section. The sheet metal swing arm further has a bridge member extending in vehicle width direction between the right arm and the left arm and attached to the right arm and the left arm.

5 The sheet metal swing arm has at least one reinforcement member is joined to the right arm and at least one reinforcement member is joined to the left arm.

**[00019]** In one aspect of the present invention, a vehicle having a body frame, the body frame includes a head tube, a lower frame member extending downward and rearward in the longitudinal direction of the vehicle from the head tube, an upper frame member extending

10 downward and rearward in a longitudinal direction of the vehicle from the head tube, a pivot plate disposed on a rear portion of the upper frame member, a pair of seat rail members extending rearward from the upper frame member, a pair of sub frame member extending upward and rearward from the pivot plate and supports the pair of seat rail members. The vehicle further having a sheet metal swing arm pivotally coupled to the body frame and a rear

15 ground engaging member rotatably coupled to the sheet metal swing arm. The sheet metal swing arm has a pivot section that includes a right end portion and a left end portion, the pivot section swingably supporting the swing arm to the body frame. The sheet metal swing arm has a right arm extending rearwardly from the right end portion of the pivot section. The sheet metal swing arm has a left arm extending rearwardly from the left end portion of the pivot

20 section. The sheet metal swing arm further has a bridge member extending in vehicle width direction between the right arm and the left arm and attached to the right arm and the left arm. The swing arm has at least one reinforcement member is joined to the right arm and at least one reinforcement member is joined to the left arm.

**[00020]** In the aforementioned aspects at least one reinforcement member joined to at

25 least one of the right arm and the left arm to provide the necessary stiffness and thickness required at the load bearing portion/s for example, the joint of the bridge member and the left arm, the left arm and the right arm may be made from sheet metal having lower thickness, thereby reducing the overall weight of the swing arm. The disclosed swing arm made of stamped sheet material is lightweight as compared to the conventional swing arms. The lighter

30 weight of the swing arm reduces the un-sprung mass and results in comfortable riding of the

vehicle. The plurality of reinforcement members eliminate/reduce the failures that occur at the load bearing portions.

### BRIEF DESCRIPTION OF DRAWINGS

5      **[00021]**      The invention itself, together with further features and attended advantages, will become apparent from consideration of the following detailed description, taken in conjunction with the accompanying drawings. One or more embodiments of the present invention are now described, by way of example only wherein like reference numerals represent like elements and in which:

10      **[00022]**      Figure 1 illustrates a side view of an exemplary vehicle, according to an embodiment of the present invention;

**[00023]**      Figure 2 illustrates a view of a body frame of the vehicle, according to an embodiment of the present invention;

**[00024]**      Figure 3 illustrates a view of a swing arm of the vehicle, according to an embodiment of the present invention;

15      **[00025]**      Figure 4 illustrates an exploded view of the swing arm, according to an embodiment of the present invention;

**[00026]**      Figure 5 illustrates an exploded view of a left arm of the swing arm, according to an embodiment of the present invention;

20      **[00027]**      Figure 6 illustrates a sectional view taken along line A-A' of the left arm of Figure 3, according to an embodiment of the present invention;

**[00028]**      Figure 7 illustrates a sectional view taken along line B-B' of the right arm of Figure 3, according to an embodiment of the present invention; and

**[00029]**      Figure 8 illustrates a sectional view taken along line C-C' of the left arm of Figure 3, according to an embodiment of the present invention.

**[00030]** The drawings referred to in this description are not to be understood as being drawn to scale except if specifically noted, and such drawings are only exemplary in nature.

### DETAILED DESCRIPTION

5 **[00031]** While the invention is susceptible to various modifications and alternative forms, an embodiment thereof has been shown by way of example in the drawings and will be described here below. It should be understood, however that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the invention is to cover all modifications, equivalents, and alternative falling within the spirit and the scope of the  
10 invention.

**[00032]** The term “comprises”, comprising, or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a setup, structure or method that comprises a list of components or steps does not include only those components or steps but may include other components or steps not expressly listed or inherent to such setup or structure or method. In  
15 other words, one or more elements in a system or apparatus proceeded by “comprises... a” does not, without more constraints, preclude the existence of other elements or additional elements in the system or apparatus.

**[00033]** For better understanding of this invention, reference would now be made to the embodiment illustrated in the accompanying Figures and description here below, further, in  
20 the following Figures, the same reference numerals are used to identify the same components in various views.

**[00034]** While the present invention is illustrated in the context of a vehicle, however, swing arm and aspects and features thereof can be used with other type of vehicles as well. The terms “vehicle”, “two wheeled vehicle” and “motorcycle” have been interchangeably  
25 used throughout the description. The term “vehicle” comprises vehicles such as motorcycles, scooters, bicycles, mopeds, scooter type vehicle, all-terrain vehicles (ATV) and the like.

**[00035]** The terms “front / forward”, “rear / rearward / back / backward”, “up / upper / top”, “down / lower / lower ward / downward, bottom”, “left / leftward”, “right / rightward”

used therein represents the directions as seen from a vehicle driver sitting astride and these directions are referred by arrows Fr, Rr, U, Lr, L, R in the drawing Figures.

**[00036]** Referring to Figure 1, an exemplary vehicle (100) according to an embodiment of the present invention is depicted. The vehicle (100) referred to herein, embodies a motorcycle. Alternatively, the vehicle (100) may embody any other ridden vehicle such as scooter, three-wheeled vehicle, all-terrain vehicle (ATV) etc. without limiting the scope of the invention.

**[00037]** The vehicle (100) comprises a body frame (102), a steering assembly (104), and a front ground engaging member (106). The body frame (102) supports the steering assembly (104), and the front ground engaging member (106) in front portion of the vehicle (100). The steering assembly (104) is pivotally mounted on the body frame (102). The front ground engaging member (106) is operatively connected to the steering assembly (104). The steering assembly (104) comprises a handle bar (108). The handle bar (108) is configured to be rotated by a rider to steer the vehicle (100). The steering assembly (104) comprises a steering shaft (not shown) and a pair of front forks (117). The handle bar (108) is mounted on an upper end portion of the steering shaft. The handle bar (108) is integrally rotated with the steering shaft (not shown) in response to a steering manipulation by the rider. The front forks (117) are disposed on the lower end portion of the steering shaft (not shown). The front forks (117) are rod-shaped members that rotatably support the front ground engaging member (106).

**[00038]** The vehicle (100) comprises a head light unit (109) and a pair of turn signal lamp units (not shown). The head lamp unit (109) and the turn signal lamp units are provided for safety of the rider and in conformance with the traffic regulations. Further, front portion of the vehicle (100) may comprise front fender, dash assembly, mirrors etc. without limiting the scope of the invention.

**[00039]** Further, the vehicle (100) comprises a power unit (110), and a rear ground engaging member (111). In the illustrated example, the power unit (110) provides necessary power required to drive the rear ground engaging member (111) of the vehicle (100). Alternatively, the power unit (110) may provide necessary power to drive the front ground engaging member (106), or both the front ground engaging member (106) and the rear ground engaging member (111) simultaneously, without limiting the scope of the disclosure.

**[00040]** The body frame (102) supports the power unit (110) in middle portion of the vehicle (100). The power unit (110) comprises an engine (112) and a transmission unit (not shown). The engine (112) generates power required by the vehicle (100). The transmission unit transmits the generated power to the rear ground engaging member (111). Alternatively, the transmission unit may transmit the generated power to both the front ground engaging member (106) and the rear ground engaging member (111), without any limitations.

**[00041]** Referring further to Figure 1, the vehicle (100) comprises a fuel tank (114), and a seat (116). The fuel tank (114) is configured to store fuel required by the engine (112) to power the vehicle (100). The fuel tank (114) extends from front portion to middle portion of the body frame (102). Further, the body frame (102) supports the seat (116) which extends from middle portion to rear portion of the vehicle (100). The rear ground engaging member (111) is supported by the body frame (102) at rear portion of the vehicle (100). The fuel tank (114) provides necessary fuel to the engine (112) to generate power to propel the vehicle (100). The seat (116) provides seating for a rider and a passenger of the vehicle (100). Further, the seat (116) comprises a rider's seat (118), and a passenger seat (119). The rider's seat (118) provides seating for the rider, and the passenger seat (119) provides seating for the passenger of the vehicle (100).

**[00042]** The vehicle (100) comprises a sheet metal swing arm (120). The sheet metal swing arm (120) is operatively coupled to body frame (102). The sheet metal swing arm (120) rotatably supports rear ground engaging member (111). The sheet metal swing arm (120) comprises a left arm (122) (shown in Figure 3) and a right arm (121) (shown in Figure 3). The rear ground engaging member (111) is pivotally supported between the left arm (122) and the right arm (121) of the sheet metal swing arm (120). The vehicle (100) comprises a speed deceleration system (not shown). The speed deceleration system provides braking forces to the front ground engaging member (106) and the rear ground engaging member (111), for slowing or stopping the vehicle (100). Further, rear portion of the vehicle (100) may comprise tail light/s, suspension system/s, rear grip/s etc. without limiting the scope of the invention.

**[00043]** Referring to Figure 2, the vehicle (100) comprises the body frame (102). The body frame (102) is formed by integrally joining number of steel members and the like, by welding or the like. In the illustrated example, the body frame (102) having a specific

construction is disclosed. Alternatively, the body frame (102) may have different body frame constructions generally associated with motorcycles, without limiting the scope of the invention.

5       **[00044]**     The body frame (102) comprises a head tube (124), a lower frame member (125) and an upper frame member (126). The upper frame member (126) extends downward and rearward in the longitudinal direction of the vehicle (100) from the head tube (124). A pivot plate (129) is disposed on rear portion of the upper frame member (126). The upper frame member (126) supports the fuel tank (114). The lower frame member (125) extends downward and rearward in the longitudinal direction of the vehicle (100) from the head tube (124), and is disposed below the upper frame member (126). The lower frame member (125) supports the power unit (110) (shown in Figure 1). The head tube (124) is a cylindrical member which supports the steering assembly (104) and the front ground engaging member (106). The steering shaft (not shown) is rotatably supported on the head tube (124). The front fork (117) is inclined at an inclination angle substantially similar to that of the head tube (124).

15       **[00045]**     The body frame (102) having a left seat rail member (123) and a right seat rail member (127). The left seat rail member (123) and the right seat rail member (127) extending rearward from the upper frame member (126). The left seat rail member (123) and the right seat rail member (127) support the seat (116) of the vehicle (100). The pivot plate (129) provided on the rear portion of the upper frame member (126). The lower frame member (125) and the pivot plate (129) support the engine (112) of the vehicle (100). The body frame (102) comprises a left sub frame member (131) and a right sub frame member (133). The left sub frame member (131) extending between the left seat rail member (123) and the pivot plate (129). The right sub frame member (133) extending between the right seat rail member (127) and the pivot plate (129). The left sub frame member (131) and the right sub frame member (133) provides support for the left seat rail member (123) and the right seat rail member (127) respectively.

30       **[00046]**     Further, the body frame (102) having a plurality of swing arm mounting provisions (136). The swing arm mounting provisions (136) are provided on the pivot plate (129). The swing arm mounting provisions (136) extends in vehicle width direction away from the pivot plate (129). The swing arm mounting provisions (136) rotatably support the sheet metal swing arm (120) about the body frame (102).

**[00047]** Referring to Figures 3 and 4, the sheet metal swing arm (120) comprises a pivot section (138), a right arm (121), a left arm (122) and a bridge member (140). The pivot section (138) includes a right end portion (138a) and a left end portion (138b), the pivot section (138) swingably supporting the sheet metal swing arm (120) to the body frame (102). The right arm (121) extends from right end portion (138a) of the pivot section (138) towards rear in longitudinal direction of the vehicle (100). The left arm (122) extends from left end portion (138b) of the pivot section (138) towards rear in longitudinal direction of the vehicle (100). The right arm (121) and the left arm (122) support an axle (not shown) of the rear ground engaging member (111). In the illustrated example, the sheet metal swing arm (120) is double supported type swing arm in which the axle of the rear ground engaging member (111) is supported from both left and right sides. The sheet metal swing arm (120) is capable of mounting one or more than one shock absorbers (not shown). The pivot section (138) of the sheet metal swing arm (120) is a split type pivot section as shown in Figure 3 and 4. In another embodiment the pivot section (138) is a single piece member to swingably supporting the sheet metal swing arm (120) to the body frame (102), without limiting the scope of the invention.

**[00048]** The sheet metal swing arm (120) comprises a bridge member (140). The bridge member extending in vehicle width direction between the right arm (121) and the left arm (122) and attached to the right arm (121) and the left arm (122). The bridge member (140) is a hollow member provided between the left arm (122) and the right arm (121) connecting the two arms together in a side-by-side relation to each other. In an embodiment the bridge member (140) made of joining two sheet metal piece together. In one example, the bridge member (140) comprises bracket member (not shown) which supports lower end portion of the shock absorber.

**[00049]** In the illustrated example, the right arm (121) and the left arm (122) are made up of joining two sheet metal pieces together. The left arm (122) of the sheet metal swing arm (120) is explained in detail herein. However, it should be noted that the description is equally applicable to the right arm (121) of the sheet metal swing arm (120) without limiting the scope of the invention.

**[00050]** Referring to Figures 3, 4 and 5, the right arm (121) and the left arm (122) both having at least one outer member (142) and at least one inner member (144). The at least one outer member (142) and the at least one inner member (144) are sheet metal pieces which are stamped to desired shapes to form the right arm (121) and the left arm (122) with a sufficient stiffness in particular, under bending. In the illustrated example, the at least one outer member (142) and the at least one inner member (144) are made of high strength steel, i.e. steel having high yield strength. Alternatively, the at least one outer member (142) and the at least one inner member (144) may be made from other materials such as low-alloy steels, boron steels, and vanadium steels etc. which are suitable for cold-stamping or hot-stamping, without limiting the scope of the invention.

**[00051]** In the illustrated example, the at least one outer member (142) comprises a outer member tapered front end portion (146), an outer member first straight portion (148), an outer member tapered rear end portion (150), an outer member second straight portion (152). The outer member tapered front end portion (146) extends between the pivot section (138) and the outer member first straight portion (148), and is tapered with height thereof progressively increasing towards rear in the longitudinal direction of the vehicle (100).

**[00052]** The outer member first straight portion (148) extends between the outer member tapered front end portion (146) and the outer member tapered rear end portion (150). The outer member tapered rear end portion (150) extends between the outer member first straight portion (148) and the outer member second straight portion (152), and is tapered with height thereof progressively decreasing towards rear longitudinal direction of the vehicle (100).

**[00053]** The outer member second straight portion (152) extends from the outer member tapered rear portion (150) to the rear end thereof. Further, the at least one outer member (142) comprises an outer member top portion (156), an outer member middle portion (158) and an outer member bottom portion (160) (Shown in Figure 6). The outer member top portion (156) and the outer member bottom portion (160) extend in the vehicle width direction from the outer member middle portion (158). Further, the at least one outer member (142) may comprises aperture/s, flange/s etc. without limiting the scope of the invention.

**[00054]** In the illustrated example, the at least one inner member (144) comprises an inner member tapered front end portion (170), an inner member first straight portion (172), an inner member tapered rear end portion (174), an inner member second straight portion (176). The inner member tapered front end portion (170) extends between the pivot section (138) and the inner member first straight portion (172), and is tapered with height thereof progressively increasing towards rear longitudinal direction of the vehicle (100).

**[00055]** The inner member first straight portion (172) extends between the inner member tapered front end portion (170) and the inner member tapered rear end portion (174). The inner member tapered rear end portion (174) extends between the inner member first straight portion (172) and the inner member second straight portion (176), and is tapered with height thereof progressively decreasing towards rear longitudinal direction of the vehicle (100). The inner member second straight portion (176) extends from the inner member tapered rear portion (174) to the rear end thereof. Further, the at least one inner member (144) may comprises aperture/s, flange/s etc. without limiting the scope of the invention.

**[00056]** In the illustrated example, the at least one inner member (144) comprises an inner member inner surface (162) and an inner member outer surface (164). The inner member outer surface (164) faces inner surface of the at least one outer member (142). The bridge member (140) is welded to the inner member inner surface (162).

**[00057]** In an embodiment, the sheet metal swing arm (120) includes the right arm (121) and the left arm (122) each comprises at least one outer member (142) and at least one inner member (144) made up of sheet metal. The at least one of the at least one outer member (142) and the at least one inner member (144) is "C" shaped member.

**[00058]** In an embodiment, the sheet metal swing arm (120) includes the right arm (121) and the left arm (122) each comprises at least one outer member (142) and at least one inner member (144) made up of sheet metal. The at least one outer member (142) and the at least one inner member (144) is flat plate shaped member, without limiting the scope of the invention.

**[00059]** Referring to Figures 4, 5, and 6, the sheet metal swing arm (120) comprises at least one reinforcement members (R1 & R2) such as a first reinforcement member (180), a

second reinforcement member (182) and a third reinforcement member (184). The plurality of reinforcement members provide necessary reinforcement required for the load bearing portions of the sheet metal swing arm (120).

5       **[00060]**     The first reinforcement member (180) abuts the outer member top portion (156) and is welded to it. In the illustrated example, the first reinforcement member (180) is spot welded to the outer member top portion (156). Width of the first reinforcement member (180) is substantially similar to width of the outer member top portion (156). In the illustrated example, the first reinforcement member (180) extends along at least portion of the outer member tapered front end portion (146) and at least portion of the outer member first straight  
10       portion (148).

**[00061]**     The second reinforcement member (182) abuts the outer member bottom portion (160) and is welded to it. In the illustrated example, the second reinforcement member (182) is spot welded to the outer member bottom portion (160). Width of the second reinforcement (182) is substantially similar to the width of the outer member bottom portion  
15       (160). In the illustrated example, the second reinforcement member (182) extends along at least portion of the outer member tapered front end portion (146) and at least portion of the outer member first straight portion (148).

**[00062]**     The third reinforcement member (184) is provided on the inner member outer surface (164) of the at least one inner member (144) and is welded to it. In the illustrated  
20       example, the third reinforcement member (184) is spot welded to the inner member outer surface (164) of the at least one inner member (144). Height of the third reinforcement member (184) is substantially similar to the height of the inner member first straight portion (172). The shape of the third reinforcement member (184) is preferably selected so as to provide reinforcement to the locations where the bridge member (140) is welded to the inner  
25       member inner surface (162) of the at least one inner member (144).

**[00063]**     In present embodiment, the at least one reinforcement member (R1) is joined at a portion of the right arm (121) where the bridge member (140) is attached to the right arm (121), and the at least one reinforcement member (R2) is joined at a portion of the left arm (122) where the bridge member (140) is attached to the left arm (122).

**[00064]** In the present embodiment, the bridge member (140) is attached to the at least one inner member (144) of the right arm (121) and the at least one reinforcement member (R1) is joint to the at least one inner member (144) at the opposite side of the bridge member (140) is attached to the at least one inner member (144) of the right arm (121).

5 **[00065]** In present embodiment, the bridge member (140) is attached to the at least one inner member (144) of the left arm (122) and the at least one reinforcement member (R2) is joint to the at least one inner member (144) at the opposite side of the bridge member (140) is attached to the at least one inner member (144) of the left arm (122).

10 **[00066]** During assembly of the sheet metal swing arm (120), the third reinforcement member (184) is spot welded to the at least one inner member (144). The first reinforcement member (180) is welded to the outer member top portion (156). The second reinforcement member (182) is welded to the outer member bottom portion (160). The at least one outer member (142) and the at least one inner member (144) are seam welded along the edges, thereby forming the right arm (121) and the left arm (122). The bridge member (140) is welded  
15 to the left arm (122) and the right arm (121), forming a sub assembly, the sub-assembly is then coupled to the pivot section (138) forming the sheet metal swing arm (120).

**[00067]** Referring to Figures 7, illustrates a sectional view taken along line B-B' of the right arm of Figure 3, wherein at least one reinforcement member (R1) i.e. third reinforcement member (184) attached to the at least one inner member (144) of the right arm (121) at the  
20 opposite side of the bridge member (140) is attached to the at least one inner member (144) of the right arm (121).

**[00068]** Referring to Figures 8, illustrates a sectional view taken along line C-C' of the left arm of Figure 3, wherein, at least one reinforcement member (R2) i.e. third reinforcement member (184) attached to the at least one inner member (144) of the left arm (122) at the  
25 opposite side of the bridge member (140) is attached to the at least one inner member (144) of the left arm (122).

**[00069]** In present embodiment the third reinforcement member (184) is spot welded to the right arm (121) and the left arm (122). The bridge member (140) is seam welded to the right arm (121) forming a seam weld line (S1) on the right arm (121), wherein at least portion

of the at least one reinforcement member (R1) i.e. the third reinforcement member (184) overlaps the seam weld line (S1) and the bridge member (140) is seam welded to the left arm (122) forming a seam weld line (S2) on the left arm (122), wherein at least portion of the at least one reinforcement member (R2) i.e. the third reinforcement member (184) overlaps the seam weld line (S2).

**[00070]** As illustrated in Figure 7 & Figure 8, in the present embodiment, the at least one reinforcement member (R1) provided on right arm (121) has an outer edge (E1) and an inner edge (E2), the outer edge (E1) and the inner edge (E2) lie on opposite sides of the seam weld line (S1) and the at least one reinforcement member (R2) provided on left arm (122) has an outer edge (E3) and an inner edge (E4), the outer edge (E3) and the inner edge (E4) lie on opposite sides of the seam weld line (S2).

**[00071]** The present invention discloses the sheet metal swing arm (120) comprising the left arm (122), the right arm (121), the bridge member (140) and a plurality of reinforcement members (R1 & R2) such as the first reinforcement member (180), the second reinforcement member (182) and the third reinforcement member (184). As load bearing portions of the swing arm (120), for example, the joints of the bridge member (140), the left arm (122) and the right arm (121) experiences maximum loading conditions and are prone to failure due to load acting on them. These load bearing portions are designed with higher sheet metal thickness to avoid the failure of the swing arm. However, to achieve higher sheet metal thickness at the load bearing portions, the sheet metal thickness of the entire arm (left or right or both) of the swing arm needs to be maintained same as that of the load bearing portion's thickness for ease of manufacturing, which leads to heavier structure of the swing arm, which is not desirable thus in present invention the reinforcement members provide the necessary stiffness and thickness required at the load bearing portion/s for example, the joint of the bridge member (140) and the left arm (122), the left arm (122) and the right arm (121) may be made from sheet metal having lower thickness, thereby reducing the overall weight of the sheet metal swing arm (120). The disclosed sheet metal swing arm (120) made of stamped sheet material is lightweight as compared to the conventional swing arms. The lighter weight of the sheet metal swing arm (120) reduces the un-sprung mass and results in comfortable riding of the vehicle (100). The plurality of reinforcement members eliminate/reduce the failures that occur at the load bearing portions.

**[00072]** While few embodiments of the present invention have been described above, it is to be understood that the invention is not limited to the above embodiments and modifications may be appropriately made thereto within the spirit and scope of the invention.

5 **[00073]** While considerable emphasis has been placed herein on the particular features of this invention, it will be appreciated that various modifications can be made, and that many changes can be made in the preferred embodiments without departing from the principles of the invention. These and other modifications in the nature of the invention or the preferred  
10 embodiments will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation.

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**The claims:**

1. A vehicle (100) comprising:
  - a body frame (102);
  - a sheet metal swing arm (120) pivotally coupled to the body frame (102); and
  - 5 a rear ground engaging member (111) rotatably coupled to the sheet metal swing arm (120), the sheet metal swing arm (120) comprises:
    - a pivot section (138) comprising a right end portion (138a) and a left end portion (138b), the pivot section (138) swingably supports the sheet metal swing arm (120) to the body frame (102);
    - 10 a right arm (121) extending rearwardly from the right end portion (138a) of the pivot section (138);
    - a left arm (122) extending rearwardly from the left end portion (138b) of the pivot section (138); and
    - a bridge member (140) extending in vehicle width direction between
    - 15 the right arm (121) and the left arm (122) and attached to the right arm (121) and the left arm (122);
    - wherein at least one reinforcement member (R1) is joined to the right arm (121) and at least one reinforcement member (R2) is joined to the left arm (122).
- 20 2. The vehicle (100) as claimed in claim 1, wherein the at least one reinforcement member (R1) is joined at a portion of the right arm (121) where the bridge member (140) is attached to the right arm (121), and the at least one reinforcement member (R2) is joined at a portion of the left arm (122) where the bridge member (140) is attached to the left arm (122).
- 25 3. The vehicle (100) as claimed in claim 1, wherein the bridge member (140) is seam welded to the right arm (121) forming a seam weld line (S1) on the right arm (121), wherein at least portion of the at least one reinforcement member (R1) overlaps the seam weld line (S1) and the bridge member (140) is seam welded to the left arm (122) forming a seam weld line (S2) on the left arm (122), wherein at least portion
- 30 of the at least one reinforcement member (R2) overlaps the seam weld line (S2).
- 35 4. The vehicle (100) as claimed in claim 1 and claim 3, wherein the at least one reinforcement member (R1) has an outer edge (E1) and an inner edge (E2), the outer edge (E1) and the inner edge (E2) lie on opposite sides of the seam weld line (S1) and the at least one reinforcement member (R2) has an outer edge (E3) and an inner

edge (E4), the outer edge (E3) and the inner edge (E4) lie on opposite sides of the seam weld line (S2).

- 5           5. The vehicle (100) as claimed in claim 1, wherein the at least one reinforcement member (R1) is spot welded to the right arm (121) and the at least one reinforcement member (R2) is spot welded to the left arm (122).
- 10           6. The vehicle (100) as claimed in claim 1, wherein the right arm (121) and the left arm (122) each comprises at least one outer member (142) and at least one inner member (144) made up of sheet metal.
- 15           7. The vehicle (100) as claimed in claim 6, wherein one of the at least one outer member (142) and the at least one inner member (144) is "C" shaped member.
- 20           8. The vehicle (100) as claimed in claim 6, wherein one of the at least one outer member (142) and the at least one inner member (144) is flat plate shaped member.
- 25           9. The vehicle (100) as claimed in claim 1, wherein the bridge member (140) is made up of joining at least two sheet metal pieces together.
- 30           10. The vehicle (100) as claimed in claim 1 & claim 6, wherein the bridge member (140) is attached to the at least one inner member (144) of the right arm (121) and wherein the at least one reinforcement member (R1) is joint to the at least one inner member (144) at the opposite side of the bridge member (140) is attached to the at least one inner member (144) of the right arm (121).
- 35           11. The vehicle (100) as claimed in claim 1 & claim 6, wherein the bridge member (140) is attached to the at least one inner member (144) of the left arm (122) and wherein the at least one reinforcement member (R2) is joint to the at least one inner member (144) at the opposite side of the bridge member (140) is attached to the at least one inner member (144) of the left arm (122).
- 40           12. The vehicle (100) as claimed in claim 1 & claim 7, wherein the at least one reinforcement member (R1) is joint to an outer member top portion (156) and an outer member bottom portion (160) of the "C" shaped member of the right arm (121).
13. The vehicle (100) as claimed in claim 1 & claim 7, wherein the at least one reinforcement member (R2) is joint to the outer member top portion (156) and the outer member bottom portion (160) of the "C" shaped member of the left arm (122).

14. A sheet metal swing arm (120) comprises:

a pivot section (138) comprising a right end portion (138a) and a left end portion (138b), the pivot section (138) swingably supporting the sheet metal swing arm (120) to a body frame (102) of a vehicle (100);

5 a right arm (121) extending rearwardly from the right end portion (138a) of the pivot section (138);

a left arm (122) extending rearwardly from the left end portion (138b) of the pivot section (138); and

10 a bridge member (140) extending in vehicle width direction between the right arm (121) and the left arm (122) and attached to the right arm (121) and the left arm (122);

wherein at least one reinforcement member (R1) is joined to the right arm (121) and at least one reinforcement member (R2) is joined to the left arm (122).

15 15. A vehicle (100) comprising:

a body frame (102) comprising a head tube (124), a lower frame member (125) extending downward and rearward in the longitudinal direction of the vehicle (100) from the head tube (124), an upper frame member (126) extending downward and rearward in a longitudinal direction of the vehicle (100) from the head tube (124), a pivot plate (129) disposed on a rear portion of the upper frame member (126), a pair of seat rail members (123 & 127) extend rearwards from the upper frame member (126), a pair of sub frame member (131 & 133) extending upwards and rearwards from the pivot plate (129) and supports the pair of seat rail members (123 & 127);

a sheet metal swing arm (120) pivotally coupled to the body frame (102); and

25 a rear ground engaging member (111) rotatably coupled to the sheet metal swing arm (120), the sheet metal swing arm (120) comprises:

a pivot section (138) comprising a right end portion (138a) and a left end portion (138b), the pivot section (138) swingably supporting the sheet metal swing arm (120) to the body frame (102);

30 a right arm (121) extending rearwardly from the right end portion (138a) of the pivot section (138);

a left arm (122) extending rearwardly from the left end portion (138b) of the pivot section (138); and

35 a bridge member (140) extending in vehicle width direction between the right arm (121) and the left arm (122) and attached to the right arm (121) and the left arm (122);

wherein at least one reinforcement member (R1) is joined to the right arm (121) and at least one reinforcement member (R2) is joined to the left arm (122).

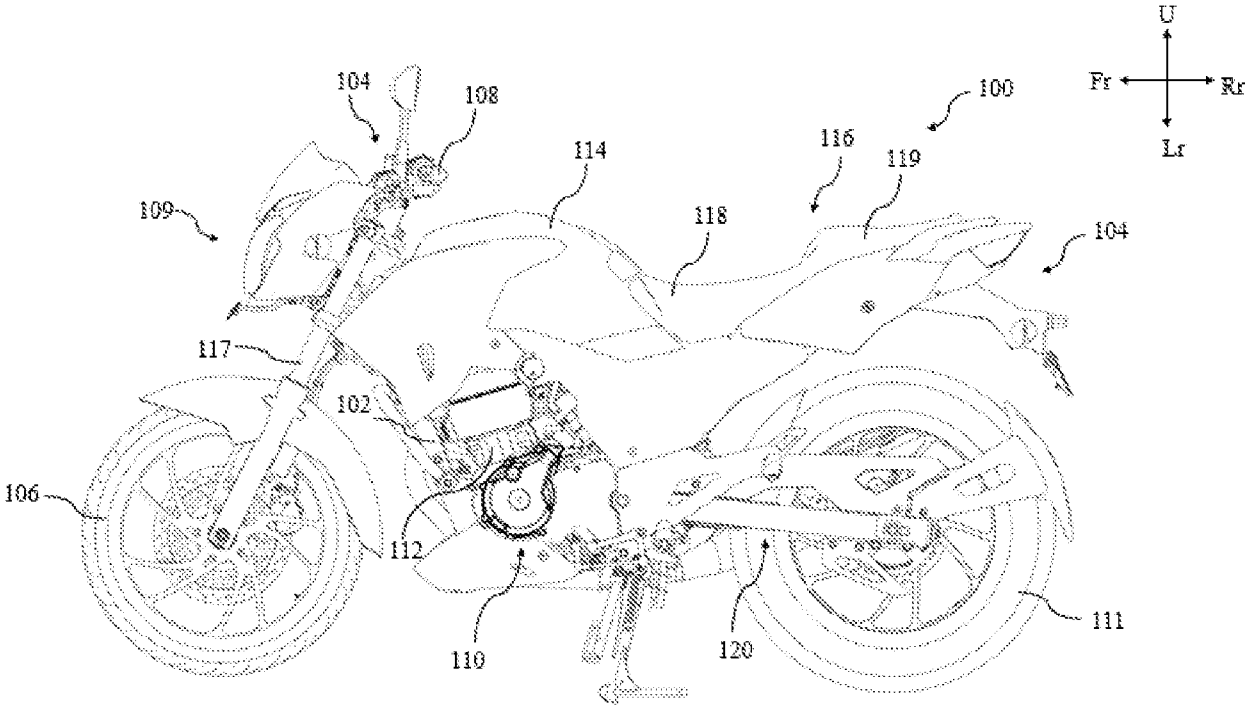


Figure 1

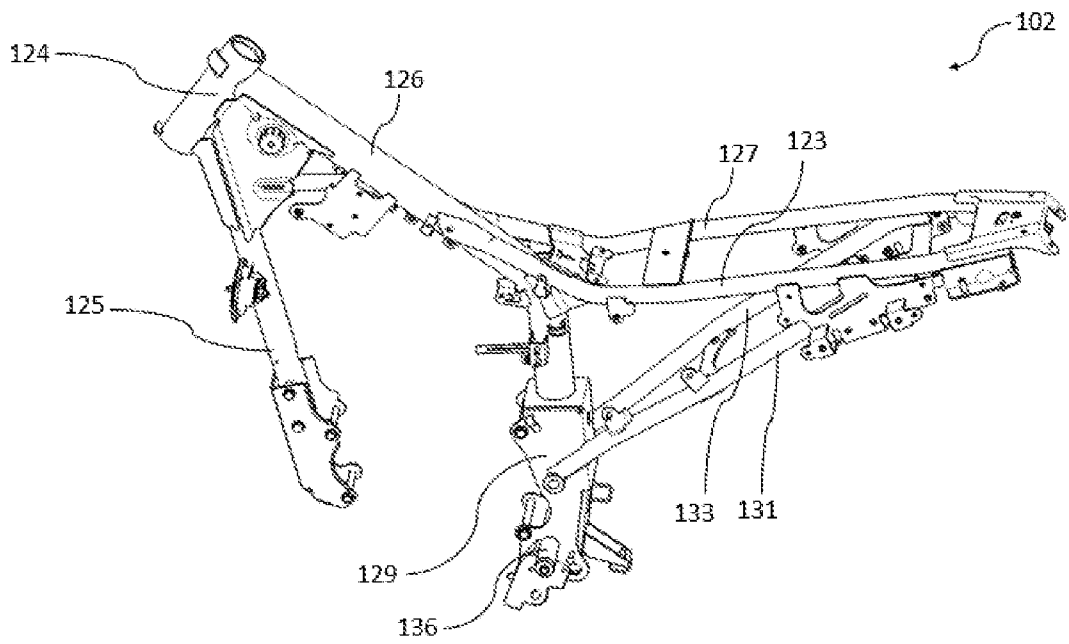


Figure 2

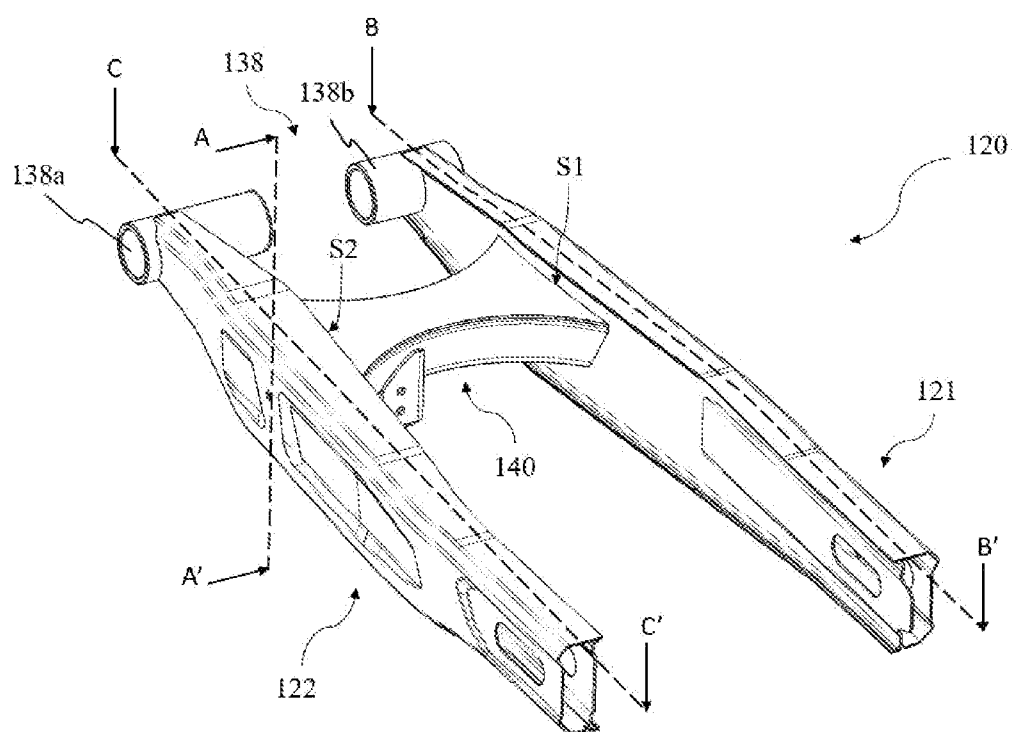


Figure 3

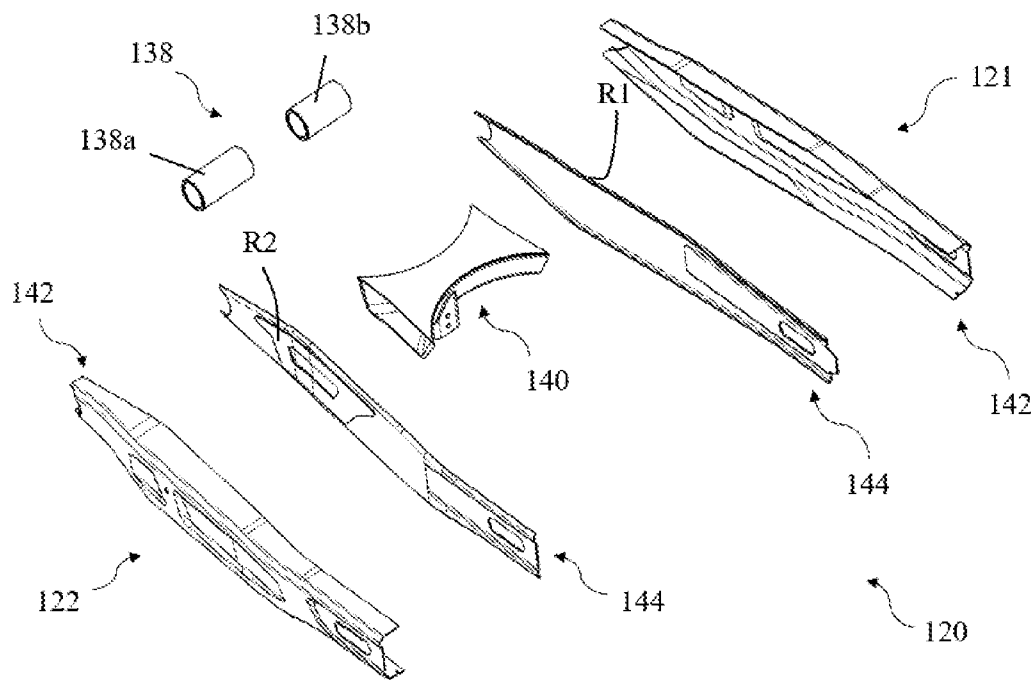


Figure 4

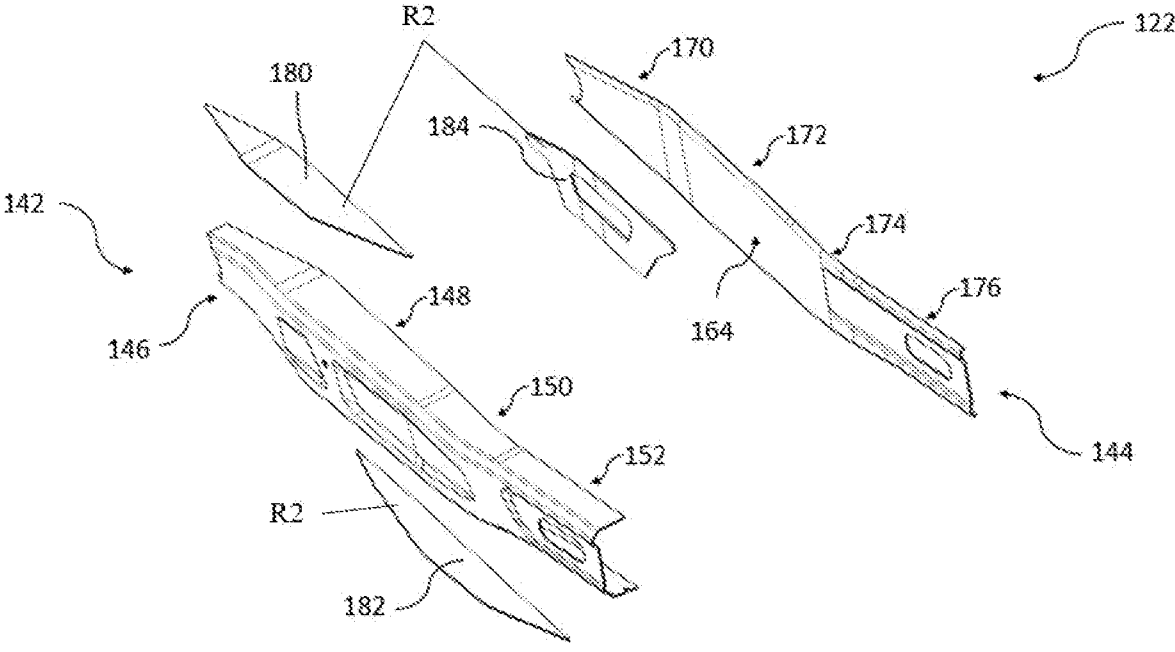


Figure 5

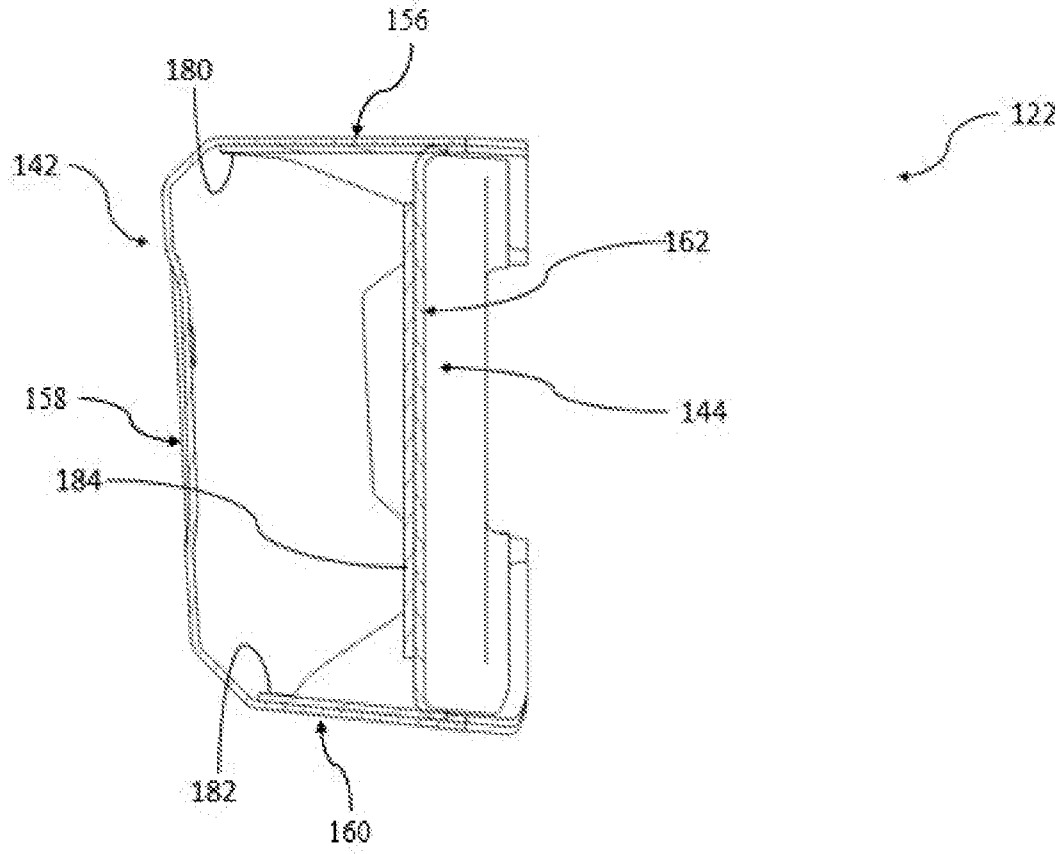


Figure 6

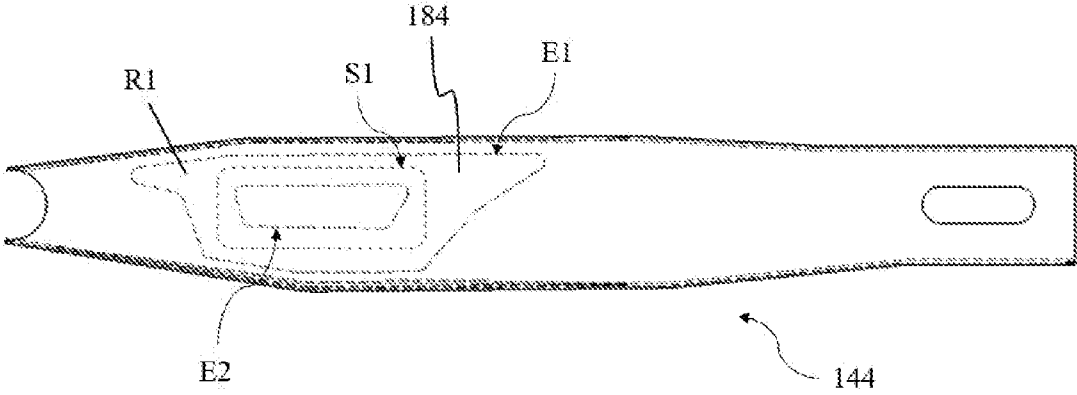


Figure 7

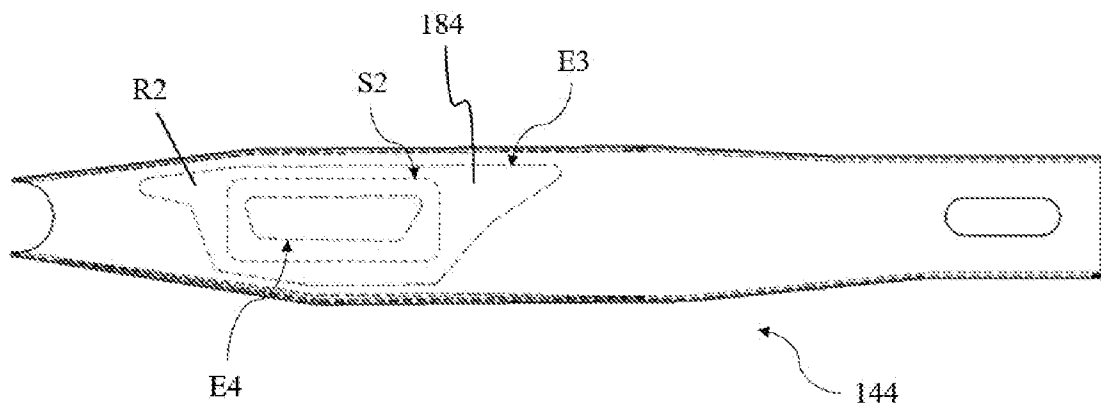


Figure 8

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IN2019/050956

A. CLASSIFICATION OF SUBJECT MATTER  
B62K11/04, B62K25/20 Version=2020.01

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

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)

TotalPatent One, IPO Internal Database, Google Patents

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                | Relevant to claim No. |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | KR20110102191A (HONDA MOTOR CO LTD; 16 SEP 2011; 16-09-2011) Paragraph-[0023] to [0026],[0036],[0044] to [0046], as per English translation referred in Espacenet Figures. 1 to 4 | 1-5, 14, 15           |
| Y         | Paragraph-[0023] to [0026],[0036],[0044] to [0046], as per English translation referred in Espacenet Figures. 1 to 4                                                              | 6-9                   |
| A         | Paragraph-[0023] to [0026],[0036],[0044] to [0046], as per English translation referred in Espacenet Figures. 1 to 4                                                              | 10-13                 |
| Y         | JPH03220079A (YAMAHA MOTOR CO LTD; 27 SEP 1991; 27-09-1991) Abstract, as per English translation referred in Espacenet Figures. 2, 4                                              | 6-9                   |



Further documents are listed in the continuation of Box C.



See patent family annex.

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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

18-05-2020

Date of mailing of the international search report

18-05-2020

Name and mailing address of the ISA/

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IN2019/050956

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| A         | Abstract, as per English translation referred in Espacenet<br>Figures. 2, 4        | 10-13                 |

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
PCT/IN2019/050956

| Citation         | Pub.Date   | Family         | Pub.Date   |
|------------------|------------|----------------|------------|
| KR 20110102191 A | 16-09-2011 | JP 5410340 B2  | 05-02-2014 |
|                  |            | ZA 201101667 B | 25-06-2014 |