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सत्यमेव जयते

**भारत सरकार
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MINISTRY OF COMMERCE & INDUSTRY
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बौद्धिक संपदा भारत

एकस्व| अभिकल्प| व्यापार चिह्न|
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**जिस किसी से संबन्धित हो
TO WHOMSOEVER IT MAY CONCERN**

में, अधोहस्ताक्षरी जो पेटेंट अधिनियम, 1970 की धारा 73(3) के तहत महानियंत्रक एकस्व, अभिकल्प एवं व्यापार चिह्न की ओर से प्रमाणपत्र हस्ताक्षर व जारी करने के लिए प्राधिकृत अधिकारी हूँ, एतद्वारा यह प्रमाणित करता(ती) हूँ कि निम्नलिखित पेटेंट आवेदन के संबंध में फाइल दस्तावेज़(जों) की सही प्रतिलिपि इसके साथ संलग्न है:

I, the undersigned, being an officer duly authorized to sign and issue the certificate on behalf of the Controller General of Patents, Designs and Trademarks in accordance with the provisions of Section 73(3) of the Patents Act, 1970, hereby certify that annexed hereto is a True Copy of the document(s) as filed in connection with the following Patent Application:

- क) आवेदन संख्या / a) Application Number: **201721046004**
ख) फाइल करने की तारीख / b) Date of Filing: **21/12/2017**
ग) अनुरोधित दस्तावेज़(जों) का नाम / C) Name of the document(s) requested:

- 1) Application for Grant of Patent (Form-1)**
2) Provisional Specification filed on 21/12/2017.

यह प्रमाणपत्र पेटेंट अधिनियम, 1970 की धारा 147(1) के अधीन मुझमें निहित शक्तियों के तहत जारी किया गया है।

This certificate is issued under the powers vested in me U/S 147(1) of The Patents Act, 1970.

दिनांक / Dated this th 10 day of Dec. 2018

(VIJAY T. DOYE)

सहायक नियंत्रक पेटेंट व डिजाइन / Assistant Controller of Patents and Designs
(प्राधिकृत हस्ताक्षरी/ Authorized Signatory)

"FORM 1 THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT (See section 7, 54 and 135 and sub-rule (1) of rule 20)				(FOR OFFICE USE ONLY)	
				Application No.	
				Filing date:	
				Amount of Fee paid:	
				CBR No:	
				Signature:	
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)					
2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]					
Ordinary (✓)		Convention ()		PCT-NP ()	
Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()	Divisional ()	Patent of Addition ()
3A. APPLICANT(S)					
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				Country	India.
				Pin code	411035.
3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]					
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		Small Entity ()		Startup ()	Others (✓)
4. INVENTOR(S) [Please tick (✓) at the appropriate category]					
Are all the inventor(s) same as the applicant(s) named above?				Yes ()	No (✓)
If "No", furnish the details of the inventor(s)					
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5. TITLE OF THE INVENTION						
"AN ELECTRIC VEHICLE"						
6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	INPA269				
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8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION						
Country	Application Number	Filing date	Name of the applicant	Title of the invention	IPC (as classified in the convention country)	
N/A	N/A	N/A	N/A	N/A	N/A	
9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)						
International application number			International filing date			
N/A			N/A			

10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION

Original (first) application No.	Date of filing of original (first) application
N/A	N/A

11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT

Main application/patent No.	Date of filing of main application
N/A	N/A

12. DECLARATIONS:**(i) Declaration by the inventor(s)**

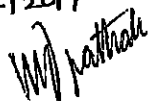
(In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

We, the above named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

i)

(a) Date : 21/12/2017

(b) Signature



(c) Name: PATHAK MAHESH DAMODAR

ii)

(a) Date : 21/12/2017

(b) Signature



(c) Name: PANDYA UDAY

iii)

(a) Date : 21/12/2017

(b) Signature



(c) Name: JOSHI SUHAS VIRUPAKSHABHATT

(ii) Declaration by the applicant(s) in the convention country

(In case the applicant in India is different than the applicant in the convention country: the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative. N/A

(a) Date

(b) Signature(s)

(c) Name(s) of the signatory

(iii) Declaration by the applicant(s) :

We the applicant(s) hereby declare(s) that: -

- ☒ We are in possession of the above-mentioned invention.
- ☐ The provisional/complete specification relating to the invention is filed with this application.
- ☐ The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by us before the grant of patent to us.
- ☒ There is no lawful ground of objection(s) to the grant of the Patent to us.
- ☐ we are the true & first inventor(s).
- ☒ we are the assignee or legal representative of true & first inventor(s).
- ☐ The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of our invention(s).
- ☐ We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by us or by any person from which We derive the title.
- ☐ Our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.
- ☐ The application is divided out of our application particulars of which is given in Paragraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.
- ☐ The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ provisional specification)#	No. of pages: 20	Rs. 10400/-	Addl. claims: N/A Addl. pgs : 3
No. of Claim(s)	No. of claims: N/A and No. of pages: N/A		
Abstract	No. of pages: N/A		
No. of Drawing(s)	No. of drawings: 17 and No. of pages: 13		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional

specification are required to be mentioned here.

(b) Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies). – N/A

(c) Sequence listing in electronic form – N/A

(d) Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies). – N/A

(e) Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS. – N/A

(f) Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability. – N/A

(g) Statement and Undertaking on Form 3

(h) Declaration of Inventorship on Form 5

(i) Power of Authority

(j).....

Total fee Rs..... in Cash/ Banker's Cheque /Bank Draft bearing No.....

Date.....onBank.

We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated on this the 21st day of December 2017

For BAJAJ AUTO LIMITED,

Authorised signatory :



Name in full : SRINIVASAN RAVIKUMAR

Designation : PRESIDENT (BD&A)

Seal :

Authorised signatory :



Name in full : R. NARASIMHAN

Designation : VICE PRESIDENT (R&D)

Seal :

To,
The Controller of Patent,
The Patent Office, at Mumbai.

FORM - 2

**THE PATENTS ACT, 1970
(39 of 1970)
&
The Patents Rules, 2003**

**PROVISIONAL SPECIFICATION
(SECTION 10 AND RULE 13)**

**TITLE
"AN ELECTRIC VEHICLE"**

A P P L I C A N T

**We, BAJAJ AUTO LIMITED, an Indian Company, having its registered office
at Akurdi, Pune - 411035, State of Maharashtra, India.**

The following specification describes the nature of this invention:-

FIELD OF THE INVENTION

This invention relates to electric vehicles.

BACKGROUND OF THE INVENTION

A strong trend to electric vehicle manufacture and use is now becoming evident as concerns with climate change and availability of fossil fuels become evident. Electric vehicles include a number of batteries including a large number of electric cells. The number of batteries required for an application is driven largely by the required vehicle range. At the present time, readily available batteries remain bulky and this may limit their use particularly where desired vehicle range conflicts with small vehicle size.

For example, small vehicles which currently operate using liquid and gaseous hydrocarbon fuels could advantageously be shifted to electric motor prime movers to reduce emissions. An initial trend to reduced emission, prime movers has involved transition from petrol operated engines to gaseous fuelled engines, for example of the LPG or CNG type. This has reduced emissions but not eliminated them completely. However, proposed changes in regulations, is driving a shift to electrically powered vehicles. The timeline for such shift is short and there are obvious difficulties in reconfiguring a vehicle fleet to operate with electric motors. Vehicle re-design and re-configuration of manufacturing plants for electric vehicle manufacture is a potentially time consuming and costly exercise. Yet such activity is desirable to meet regulations/ directives set by the Government of various countries.

A key issue in vehicle re-design is the challenge of maintaining a basic vehicle structure the same as, or at least similar to, current vehicle structure to aid the manufacturing transition and maintain customer acceptance whilst packaging the batteries. This is a particular issue for smaller vehicles and

does not need to be addressed, at least to the same extent, as for bespoke four wheeler electric cars as produced for example by Tesla.

The battery is an essential component i.e. prime mover of the vehicle which provides necessary electric power to motor to run a vehicle. Since the overall load on the 4 wheeled vehicle is more a large capacity battery needs to be provided. However; providing such a large capacity battery is challenging considering its size, weight etc. Also replacement, maintenance and accessibility of such battery becomes difficult.

It is an object of the present invention to provide an electric vehicle design which enables convenient packaging of the required batteries and other components.

SUMMARY OF THE INVENTION

With this object in view, the present invention provides an electric vehicle comprising:

- a chassis;
- a load carrying cell disposed above the chassis;
- an electric motor as prime mover;
- an electric battery module for powering the electric motor comprising at least one battery; and
- a protective frame structure for positioning the at least one battery;

wherein said electric battery module is located above the chassis and within the load carrying cell forward of a rear luggage compartment. The location is selected as being safe in terms of reducing the possibility of damage to the electrical battery module, and other associated components in case of accidents or external impact. Where the passenger cell is lockable there is also added security from theft which can be a problem for electrical batteries.

The electric battery module is desirably located towards the centre of the electric vehicle with a preferred location being under the driver or co-driver seat where the load carrying cell is a passenger cell carrying passengers. Alternatively, or additionally, the load carrying cell is a goods carrying cell for carrying goods or luggage. Batteries are one of the heaviest components of an electric vehicle so battery positioning has an impact on the efficiency of the vehicle. If the electric battery module was provided on either side of the vehicle for e.g. rear or front then it could cause an uneven weight distribution hampering efficiency. The centre positioning provides a better weight distribution of the electric battery module which helps in getting good efficiency. Another disadvantage of placing the batteries at the rear or front side is easy susceptibility of the batteries to external impacts which could lead to permanent damage of batteries and other serious safety related issues. Locating the batteries towards the centre of the vehicle is expected to avoid such susceptibility to direct external impacts and thereby minimizes the possibility of damage and related issues.

As to the battery voltage, typical voltages to be employed are above the common 12v batteries, often being 48 volts or higher. Preferred voltage range for present purposes is in the range 32 volts to 60 volts with a preferably parallel connection though series or parallel and series combination connection is possible.

Preferably, given battery sizes currently available, the at least one battery, typically a plurality of batteries are disposed horizontally inside the protective frame structure and access to the frame structure for swapping or removal of batteries for charging is from either the left or right side. Batteries may alternatively be charged on-board by charging systems including wireless charging systems. A number of vertically and horizontally disposed rows of batteries may be provided, typically a pair of rows, the rows of batteries being separated by a clearance. However vertical positioning is also possible, especially in the event that battery size reduces from current.

The protective frame structure comprises a plurality of frame members connected together to form a rigid structure (for example in the form of an open box or casing) for fixing the at least one battery, and more typically a plurality of batteries into position. In one embodiment, the protective frame structure is constructed from one or a plurality of frames for packaging batteries for protection and electrical safety. Batteries may be arranged in tiers, for example a lower tier and an upper tier. Conveniently, the protective frame structure provides an access area for removing one or more batteries from the frame structure. The frame structure and batteries may be provided with guides such as guide rails to facilitate the removal of batteries. The batteries may be horizontally disposed which helps to achieve easy removal and insertion by shifting the Center of Gravity of batteries downward on the rear side so assisting with insertion of the batteries. At least one battery may be disposed slightly offset towards the rear to minimise the issue of interference of batteries with the leg space of driver/co-driver. Where the batteries are disposed in tiers, the batteries in the upper tier may offset to the rear or all the batteries may be shifted slightly toward the rear and so away from passenger legs. This positioning also accommodates a natural leg angle range of a driver/co-driver. Vertical disposition of the batteries is also possible as an alternative with less risk of interference with either the driver/co-driver seat frame or the legs of the driver/co-driver. As a further alternative, the electric battery module could also be located below or behind a rear passenger seat. This allows the battery module to better follow a desirable seating contour of the associated seat, and also creates some foot room for any rear passenger.

Desirably, the electric battery module is evenly distributed, weigh-wise, across the width of the vehicle. A plurality of discrete battery sub-modules could be used. For example a pair of electric battery sub-modules could be used, for example being separated by space in the centre of the vehicle. Such space could accommodate components such as hand brakes.

Desirably, the protective frame structure is fixed to a front portion of the chassis by vibration isolating elements to reduce the vibrations being transmitted to the battery from chassis or vice versa. Generally, the frame structure positions the batteries in such manner as to reduce vibration and noise. The protective frame structure may typically be fixed to the front portion of the chassis below the driver and co-driver seat.

The protective frame structure may also conveniently provide a support frame for the front seat(s). Sliding rails are conveniently fixed to a mounting bracket provided on the protective frame. The seats are installed on the sliding rails such that seats can slide on the sliding rails to adjust seat and/or driving position. Therefore the protective frame structure remains fixed to a floor of the vehicle while the seats can slide along the longitudinal direction of vehicle for adjustment purposes. The batteries are advantageously positioned offset to avoid interference with legs of driver or co-driver even when the seat position is changed.

A junction box assembly is typically included as the terminal block for making connections between the at least one battery and at least the electric motor using flexible wired connections. Preferably, the junction box is located outside a volume defined by the protective frame structure being located at a back side of the protective frame structure though location on the top, front and either side of the protective frame structure is also possible. Alternatively, the junction box may also be located at other locations within vehicle such as behind or below passenger seat, near motor transmission or on the front side of vehicle. As a result, the junction box is less susceptible to damage or faults in operation due to heat generation from the batteries, especially where the junction box or terminal block is mounted on the frame structure of the batteries such that at least a substantial surface of the junction box is located outside the protective frame structure and away from direct contact with battery surfaces. Such a configuration allows easy access to the junction box or terminal block. The junction box typically comprises

both positive and negative terminals however using a single junction box with both positive and negative terminals typically makes it very bulky. Considering the consequential space limitation, two separate junction boxes may advantageously be provided instead of a single junction box. One junction box comprises all the positive terminals and the other box comprise all the negative terminals. This helps to reduce the size and weight of junction box and to package it in a compact space.

If necessary, a cover can be provided for the protective frame structure, electric battery module and junction box assembly in order to protect the batteries, junction box from dust, water, moisture or any external impacts.

The electric battery module along with its protective frame structure advantageously comprises a battery temperature control system with a view to optimising battery efficiency and battery life, such temperature control system may include a cooling box with air circulation means so that air circulating inside the cooling box flows over the battery surfaces helping to maintain desired battery temperature. The cooling box may have an outer portion including an insulating material to reduce heat transfer towards the batteries. The temperature control system is packaged in the limited space available between the electric battery module and protective frame structure. This assembly is compactly arranged below the driver and co-driver seat. The temperature control system may optionally comprise an air cooling (AC) system including compressor, condenser and evaporator. Such compressor is a noise and vibration generating component and can cause discomfort to the passengers. Therefore the compressor is placed outside the load carrying/passenger cell preferably being placed in front of the front firewall which helps to minimise the transfer of noise and vibrations to the passenger cell. Similarly, the condenser works efficiently under external cooling, such as ram air cooling, and is conveniently on the front side of the vehicle. A front cover could be supplied. Such front cover is desirably provided with perforation(s) such that the ram air can flow over the condenser surface and

achieve required cooling. Other advantage of installing the condenser and compressor on the front side is it gives easy accessibility to these components by opening the front bonnet of the vehicle. A suitable temperature control system is described in the Applicant's co-pending Application IN 201721019563, the contents of which are hereby incorporated herein by reference.

Conveniently, a space below a bonnet on the front side of the vehicle is used as a front luggage space. A suitable luggage carrier can also be mounted in the front space for placing the luggage. A suitable luggage carrier could be in the form of a box located below the front bonnet.

The vehicle desirably includes an auxiliary battery to provide electric power to vehicle control unit headlights, tail lights, dashboard and control system and other low voltage electric componentry. This reduces demand on the electric power module, improves electric motor performance and improves safety. Such auxiliary battery conveniently has a 12 volt rating. The deliverable voltage of the electric power module is the sum of the voltage capacity of the individual batteries and requires a wiring harness with rating matched to the electric battery module. Conveniently, the auxiliary battery is positioned at the rear of the vehicle, for example behind a rear passenger seat. Such positioning allows easy access to the auxiliary battery as well as making wiring routing convenient. Alternatively, and subject to space limitations, the auxiliary battery may be positioned at the front of the vehicle. The auxiliary battery is preferably fixed to the chassis by suitable mounting means.

The auxiliary battery requires a charging means supplied, though indirectly, from the electric battery module. Preferably, this is a DC-DC convertor which steps voltage down from the electric power module is conveniently located at the rear of the vehicle to provide easy access to the convertor. The charging means, conveniently the DC-DC convertor, is fixed to the chassis by suitable

mounting means. Alternatively, the DC-DC convertor may be located on the front side of vehicle behind front firewall considering the convenience of routing wire harness.

The batteries may optionally but advantageously provided with security features, such as digital codes, which are advantageously utilized for protecting the batteries from theft using a suitable electronic monitoring system.

The vehicle may be provided with a suitable display device such as a tab, mobile or TV for rear passengers. Such display device is conveniently mounted centrally behind the driver and co-driver seats on the frame of the vehicle in a manner enabling convenient viewing by the passengers. The display device may also be utilized to display navigation or any other information.

The vehicle is intended to be a compact vehicle which can be used for commuter applications, such vehicle at least including three and four wheel vehicles. Such compact vehicles would have similar manufacturing costs and design to hydrocarbon fuelled vehicles currently available to the marketplace.

BRIEF DESCRIPTION OF THE DRAWINGS

The electric vehicle of the present invention may be more fully understood from the following description of preferred embodiments thereof, made with reference to the accompanying drawings in which:

Fig. 1(a) is a side section view of an electric vehicle according to a preferred embodiment of the present invention.

Fig. 1(b) is a top orthogonal view of the electric vehicle of Fig. 1 (b).

Fig. 2 is a plan view of the electric vehicle of Figs. 1(a) and 1(b).

Fig. 3a is an orthogonal view of a protective frame structure for the electric battery module of the electric vehicle shown in Figs. 1 and 2 according to one of the embodiment of present invention.

Fig. 3b includes front and side views of the electric battery module for the electric vehicle shown in Figs. 1 and 2 according to one of the embodiment of present invention.

Fig. 4 is an orthogonal view of the front seats of the electric vehicle shown in Figs. 1 and 2.

Fig. 5(a) is a front view of the front seats of Fig. 4 and showing the electric battery module packaged into two sub-modules.

Fig. 5(b) is an orthogonal detail of the front seat of Figs. 4 and 5(a).

Fig. 5(c) is an orthogonal cutaway view showing the rear of the front seats and showing the junction boxes of the electric vehicle of Figs. 1 and 2.

Fig. 6(a) is a view of the dashboard of the electric vehicle shown in Figs. 1 and 2.

Fig. 6(b) is a detail of a central portion of the dashboard of Fig. 6(a) and showing the drive mode selection switches.

Fig. 7 is an orthogonal view of an electric battery module with battery cooling system for use in the electric vehicle shown in Figs. 1 and 2.

Fig. 8 is an orthogonal section view of the electric battery module with battery cooling system of Fig. 7.

Fig. 9 is a front section view of the electric battery module with battery cooling system of Figs. 7 and 8 and schematically illustrating operation of the cooling system.

Fig. 10 is a rear orthogonal view of the electric vehicle of Figs. 1 and 2 showing the charging point and access to the charging point with back cover open.

Fig. 11 is a detail from Fig. 10 showing the charging point and access to the charging point with charging cable plugged into charging point and back cover closed.

Fig. 12 is a further cutaway view of the electric vehicle of Figs. 1 and 2, 10 and 11 and showing a display device for passengers of the electric vehicle.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to Figs 1(a, b) and 2, there is shown an electric vehicle 10 suitable for use as a commuter vehicle with the load carrying cell being a passenger/goods carrying cell 105 and including luggage spaces 87 and 88 with luggage carrier boxes at front and rear respectively. Differences in the structure of the electric vehicle 10 are essentially dictated by the requirement that the vehicle be electrically powered. The electric vehicle is a four wheeler with the load carrying cell 105 and including rear wheels 82 and front wheels 84.

A driver sits at the front of the electric vehicle 10 on a front seat 12 and rear passenger seat 14 are available for seating of passengers within passenger cell 105. A target number of passengers is 2 or 3. A further passenger could

join the driver on the front seat 12. Both seats 12 and 14 are of individual style though other configurations such as bench style could be adopted if required. The driver steers electric vehicle 10 through steering wheel 15 and controls power output from the electric motor 20 by pedal 115.

Electric vehicle 10 has an electric motor 20 and transmission system 80 powered by an electric battery module 22 comprising four batteries 24 arranged in two rows separated by a clearance space 24a as shown in the figure 3(b). A different number of batteries 24 can be deployed according to required range. The transmission system 80 is modular and so can be used in a number of applications, here having much the same construction and mode of operation as described in the Applicant's co-pending Indian Provisional Patent Application Nos. 201721045778 and 201721045779 the contents of which are hereby incorporated herein by reference.

Electric motor 20 has a rating of 7kW to 10 kW (though this rating is dictated by application) and is controlled by vehicle control unit (VCU) 100. Batteries 24 are of conventional design each with 48 volt rating preferably connected in parallel so deliverable voltage is 48 volts. Batteries 24 are preferably rechargeable though may be made replaceable by swapping with charged batteries when required. Recharging is possible using charger units 28 and charging point 29 located backward of the charger units 28 and which may be connected to a suitable electric power source. The charger unit 28 is packaged in a transversely extending storage space available behind the rear passenger seat 14. Two charger units 28 are accommodated in this storage space. The charger units 28 are packaged such that they do not interfere with the rear luggage space 88 available behind the rear passenger seats 14. The space above the charger units 28 can be utilized as luggage space. Alternatively the charger unit(s) 28 may be located below the rear passenger seats 14 or on the front side of the vehicle 10.

The charging point 29 can be positioned on any side of the vehicle 10 but is located near a charger unit 28 as shown on the back side of vehicle with a lower height from the ground surface. This is the most convenient position considering the limitations of length of cable used for charging and the location of external charging socket (not shown) providing the necessary electrical supply.

A cover/cap 188 may be provided for charging point 29, as shown in more detail in Figs. 10 and 11. The cover 188 is lockable by suitable locking means to protect the charging point 29 from external weather conditions. The cover 188 is also advantageously utilized for anti-theft protection of charger units 28 during charging of batteries 24. Whenever there is a need for charging the batteries 24, the cover 188 is unlocked and the charging cable is plugged into charging point 29. The cover 188 is then locked such that the charging cable also gets locked inside the cover 188 and remains plugged to charging point 29. The charging point 29 and charger unit 28 are also secured to protect the charger units 28 and charging point 29 from external weather conditions as well as from theft during charging of batteries 24.

Further to anti-theft protection, electric battery module 22 may be integrated with security features as individual batteries 24, for example being provided with digital codes which enable tracking using a suitable electronic monitoring system.

Batteries 24 are not required to power low voltage components ancillary to the electric motor 20 such as headlights 18 and vehicle control unit (VCU) 100. An auxiliary battery 50 is provided for this purpose being located rearward of and below the level of rear passenger seat 14 as shown in Figs. 1(a) and 1(b). The auxiliary battery 50 is charged by a DC-DC convertor 30 which steps voltage down from the 48v electric power module 22 to the required 12 v. The DC-DC convertor 30 is conveniently located towards the

rear of the electric vehicle 10 to provide easy access and fixed to the chassis 11 by suitable mounting means.

Electric motor 20 includes a rear wheel drive transmission 80 and detail of the relationship between transmission and rear wheels 82 is provided in the Applicant's co-pending Indian Patent Application Nos. 201721045778 and 201721045779 incorporated herein by reference. The transmission 80 is mounted to chassis 11 by vibration isolating mounts 801 and 802. Electric motor 20 has a portion located below the floor 111 to enable ram air cooling during operation of the electric vehicle 10.

Electric battery module 22 is located centrally of the vehicle 10 and in load carrying cell 105 under the front seat 12 and above the vehicle floor 111 (which is fixed to chassis 11 and specifically chassis members 11a) as shown in Figs. 1, 4 and 5. Such location is a secure position as described above and the electric battery module 22 is evenly distributed weight wise across the electric vehicle 10. Electric battery module 22 includes a protective frame structure 23 made up of a number of structural members 23a formed into an open box or casing with the electric battery module 22 as shown in Fig. 3(a, b). The protective frame structure 23 acts as a support frame for front seats 12.

Structural members 23a are conveniently lightweight and made of a material such as aluminium or a suitable polymer or composite material. Frame structure 23 is fixed at its bottom to the chassis portion 11a or on the floor 111 substantially rearward of the axis of rear wheels 82 by vibration isolating elements (not shown) to reduce the vibrations being transmitted to the frame structure from chassis 11. According to another embodiment, as illustrated in Figs. 4 to 5(b), the protective frame structure 23 is constructed from a plurality of frames for packaging batteries, preferably two separate frames 122A and 122B. Frame 122B is located below the driver's seat 12 and other frame 122A below co-driver's seat 12. Both the frames 122A and 122B are

suitably covered/connected to form a single battery package. Generally, the frame structure 23 positions and fixes the batteries 24 in such manner as to reduce vibration and noise. To enable front seat position adjustment, especially for driving position, sliding rails 23b are fixed to a mounting bracket 23c provided on the protective frame structure 23. The front seats 12 are installed on the sliding rails 23b enabling them to slide longitudinally on the sliding rails 23b to adjust seat and/or driving position. However, the protective frame structure 23 remains fixed to the chassis 11 and does not move during front seat 12 longitudinal adjustment.

Batteries 24 are separated by a space 24a to allow convective heat transfer away from the electric battery module 22. Frames 122A and 122B which package batteries 24 into two sub-modules are separated at the top by a centrally located space accommodating park brake 115. Other components and storage space could be provided in this location if desired.

The electric battery module 22 could further include a cooling box structure similar in design to that described in the Applicant's co-pending Indian Provisional Patent Application No IN 201721019563, the contents of which are hereby incorporated herein by reference. Referring to Figs. 7 to 9, the cooling box structure 150 comprises at least one enclosure 153 wherein a space is formed for mounting the batteries 24 such that at least an air passage or air path A is created along the surface of batteries 24 for circulation of air. An opening 152 is formed on the cooling box structure 150 for mounting an electric fan 151 (powered, as with other electrical components other than electric motor 20, from auxiliary battery 50) to draw outside air inside the cooling box structure 150. Where the protective frame structure 23 is provided as two separate frames 122A and 122B as described above, the space between them accommodates certain components of a cooling system 150 like fan 151, evaporator 155 and air directing means in the form of duct 152 and other guiding surfaces enabling more efficient cooling system operation. Fan speed may be controlled by VCU 100 to assist

maintaining the batteries 24 in an efficient temperature range. Evaporator 155 is provided below fan 151 such that the air drawn into the cooling box structure 150 flows over the evaporator 155. Alternatively evaporator 155 is placed above the fan 151. The cool air then passes through the air directing means 152 for directing the air to flow along the air flow path A.

The temperature control system condenser 158 and compressor 157 for circulating a suitable refrigerant fluid through conduits 159 are placed at outside the cooling box structure 150 close to luggage space 87 located under vehicle bonnet 87B. A front cover 87A may be provided with perforation(s) to enable ram air cooling of the condenser 158. It will be understood that the cooling box structure 150 could be provided without evaporator, condenser and compressor and only a fan may be provided, especially in the conditions where ambient temperature is low and fan cooling is sufficient for maintaining desired battery temperature. During summer or hot weather conditions there is a possibility that the outside heat may be transferred inside the cooling box structure 150. In order to prevent the reverse flow of heat, the outer portions of the cooling box structure 150 along with battery module 22 can be provided with an insulating material which prevents any heat transfer across the cooling box structure and helps in maintaining the desired temperature inside battery module 22 using cooling box structure 150.

Access to the frame structure 23 and electric battery module 22 enables removal and swapping of batteries 24 for charging purposes. Battery 24 removal is eased further by provision of guiding rails on either the batteries or frame structure 23 as shown in Figs. 3a and 3b. Batteries 24 are removed horizontally, possibly to a trolley or other apparatus for added safety in the embodiment shown in Figs. 1 to 5. A vertically disposed arrangement of batteries 24 is also possible. Batteries 24 are allowed to slide within the protective frame structure 23 for installation and removal with guide rails 23c sized to neatly fit the batteries 24 as indicated in Fig. 3a. A guide rail 23c is

provided for each battery 24. Further fixings may be used as required. Batteries 24 may be provided with a handle to further assist installation and removal. To avoid interference of batteries 24 with the legs of the front seat occupants, the upper tier 24A of batteries 24 are slightly offset, by distance D, towards the rear of the vehicle 10. This accommodates a natural leg angle range for the driver/co-driver. Further protection for the front seat passengers and the electric battery module 22 is provided by covers 12A as shown in Fig. 4.

The batteries 24 are positioned inside the protective frame structure 23 in the manner described in the Applicant's co-pending Indian Patent Application Nos. 201721045778 and 201721045779, the contents of which are hereby incorporated herein by reference.

The electric vehicle 10 requires junction box(es) comprising both positive and negative terminals for connection to at least the electric motor 20 while protecting the terminals and connections from any external impacts, dust, water, dirt and so on. A single junction box could be used. However using a single junction box with both positive and negative terminals typically makes it very bulky. Considering the consequential space limitation, two separate junction boxes 25 may advantageously be provided instead of a single junction box. One junction box 25 comprises all the positive terminals and the other junction box comprises all the negative terminals. This helps to reduce the size and weight of the junction box component and to package it in a compact space, again with a more even weight distribution.

Junction boxes 25 are connected rearward of battery packaging frames 122A and 122B. In this position, junction boxes 25 does not require any further special supporting structure. Junction box 25 is a terminal block or housing for electrical connections connected to batteries 24 and other components. The connections are desirably flexible.

Each junction box 25 therefore acts as a safety barrier at the rear of electric vehicle 10. Being located outside and rearward of the protective frame structure 23 and its packaging frames 122A and 122B (as shown in Fig. 5(c)), and without opposed sides of its housing being located between heat generating batteries, heat transfer from the batteries 24 should not affect its operation. The junction boxes 25 are generally made of lightweight plastic. The junction boxes 25 include electric studs which connect the batteries 24 to the operating components of the electric vehicle 10, particularly its electric motor 20. Control over the operation of electric vehicle 10 is exercised by electronic vehicle control unit (VCU) 100 which is mounted to chassis 11, proximate to charger unit 28 in a secure inboard position, by a plate like bracket (not shown).

VCU 100 comprises battery monitoring unit, charge monitoring unit and transmission and load control unit. VCU 100 includes related monitoring, sensing and control circuitry of the vehicle 10. VCU 100 is small in size and is a low weight component. VCU 100 is also positioned away from the batteries 24 or other heat generating components as its performance may deteriorate if it is mounted near the electric battery module 22. Further the magnetic flux around the battery may also affect the functioning of VCU 100 commonly known as electromagnetic (commonly known as Electromagnetic Interference – EMI). The VCU 100 is conveniently located behind the rear passenger seat 14 near charger units 28. Alternatively, the VCU 100 can also be placed on any other convenient location such as below the rear passenger seats or on the front side of the vehicle near front firewall.

The electric vehicle 10 can be provided with various sizes of wheels 82, 84 for example 12 inch diameter or 8 inch diameter. A better Rolling Resistance (RR) is required on electric vehicles to get good efficiency. A lower RR value is better for efficiency. However, as wheel size increases, RR value also increases. Therefore in vehicles provided with bigger 12inch wheels, the rolling resistance is more. In order to get lower rolling resistance with bigger

12 inch tyres the conventional bias belt tyres are replaced by radial tyre which has lower RR value and thus using radial tyres improves the vehicle efficiency.

Referring to dashboard 19 as shown in Figs. 6(a) to 6(b), this includes a plastic moulded component including a recess B for accommodating an indicator 19a which serves as both a speedometer and a battery state of charge SOC indicator. SOC of the battery module 24 can be displayed using speed segments or ODO segments of the indicator 19a when the state of charge icon is turned ON. This is straightforward during charging since vehicle speed is known to be zero. Hence the speed segment of indicator 19a can be utilized to display battery SOC. This gives advantages of lesser space requirement, less number of LCD segments and compact packaging of the speedometer.

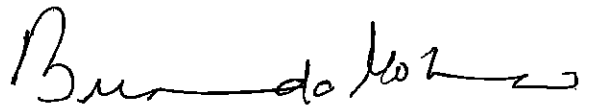
Electric vehicle 10 conveniently has three drive modes i.e. neutral mode, forward drive mode and reverse mode (D, N, R, C) to accommodate different driving conditions such as driving through the roads having upward or downward gradient. For example, a 'climb mode' C may be provided in case of negotiating an upward gradient. Switches 200 to change drive mode are located on dashboard 19 in front of the driver near steering wheel 15 (and could be integrated with the steering wheel 15) and allow easy change of driving mode without distraction of the driver during running.

As shown in Fig. 12, electric vehicle 10 may be provided with a suitable display device 400 such as a tab, mobile or TV for rear passengers. Display device 400 is conveniently mounted centrally behind the driver and co-driver seats 12 to the roof bow member 89A supporting roof 89 of the electric vehicle 10 in a manner enabling convenient viewing by the passengers. The display device 400 may also be utilized to display navigation or any other information.

Modifications and variations to the electric vehicle described in the present specification may be apparent to skilled readers of this disclosure. Such modifications and variations are deemed within the scope of the present invention.

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

A handwritten signature in black ink, appearing to read 'Brinda Mohan', with a stylized flourish at the end.

(BRINDA MOHAN)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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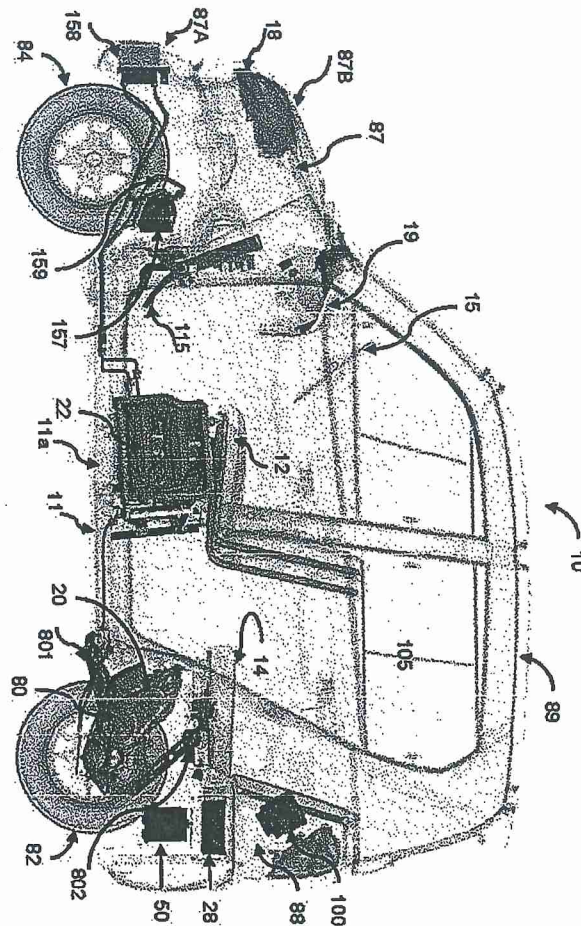


Figure 1 (a)

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan

(BRINDA MOHAN)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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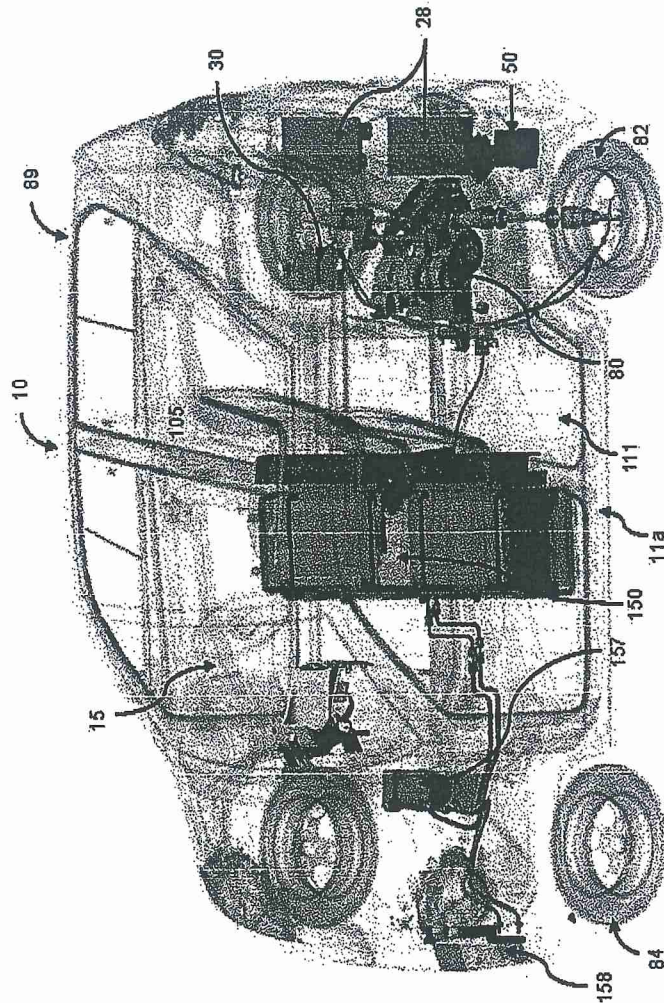


Figure 1 (b)

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan

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INPA 269

Applicant name. : BAJAJ AUTO LIMITED
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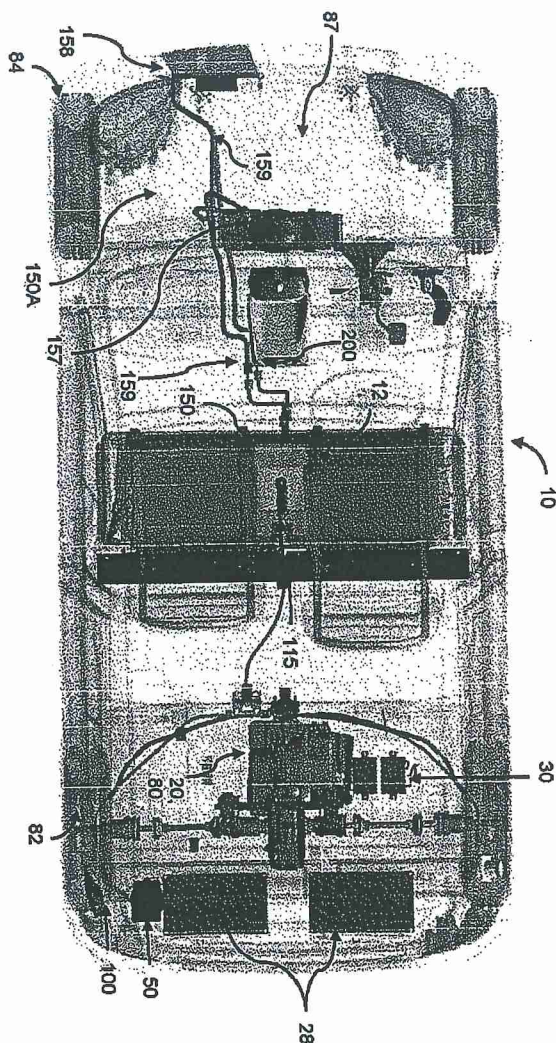


Figure 2

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

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INPA 269

Applicant name. : BAJAJ AUTO LIMITED
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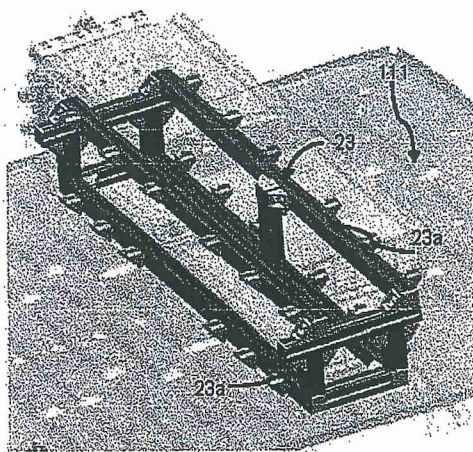


Figure 3 (a)

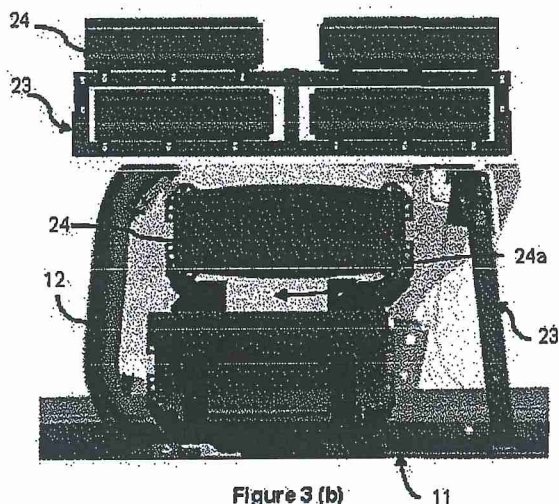


Figure 3 (b)

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan

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INPA 269

Applicant name. : **BAJAJ AUTO LIMITED**
Application No. :

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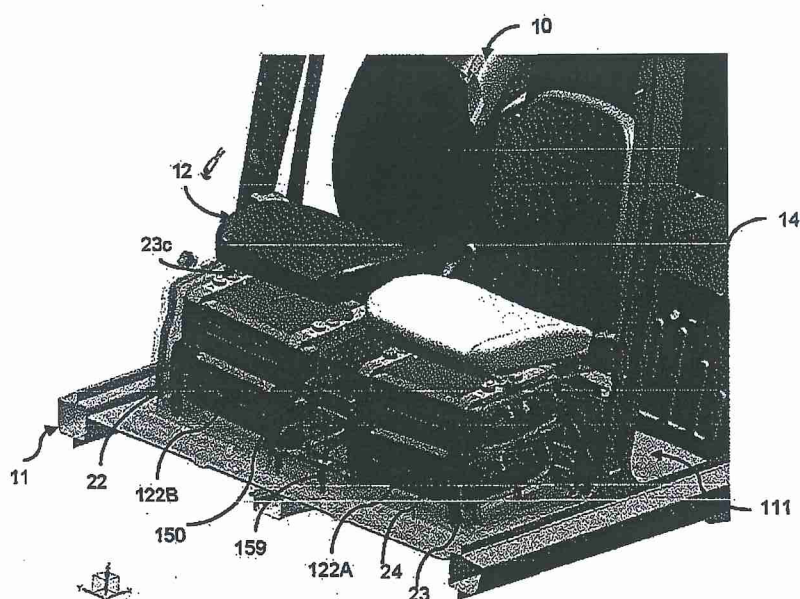


Figure 4

Dated on this 21st day of December, 2017

For **BAJAJ AUTO LIMITED**,
By its attorney,


(BRINDA MOHAN)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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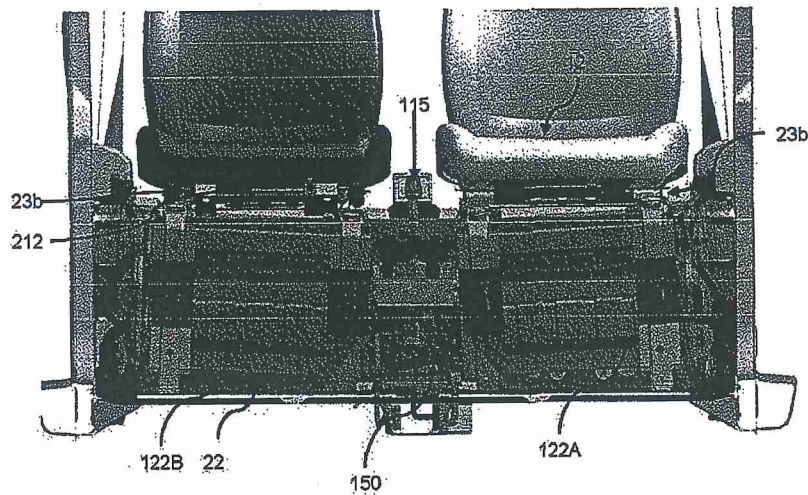


Figure 5 (a)

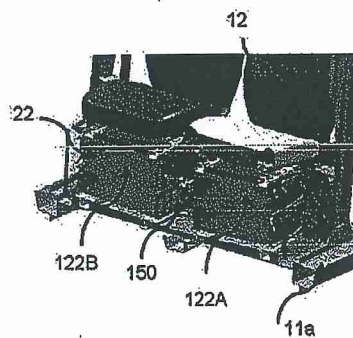


Figure 5 (b)

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan

(BRINDA MOHAN)
INPA 269

Applicant name. : **BAJAJ AUTO LIMITED**
Application No. :

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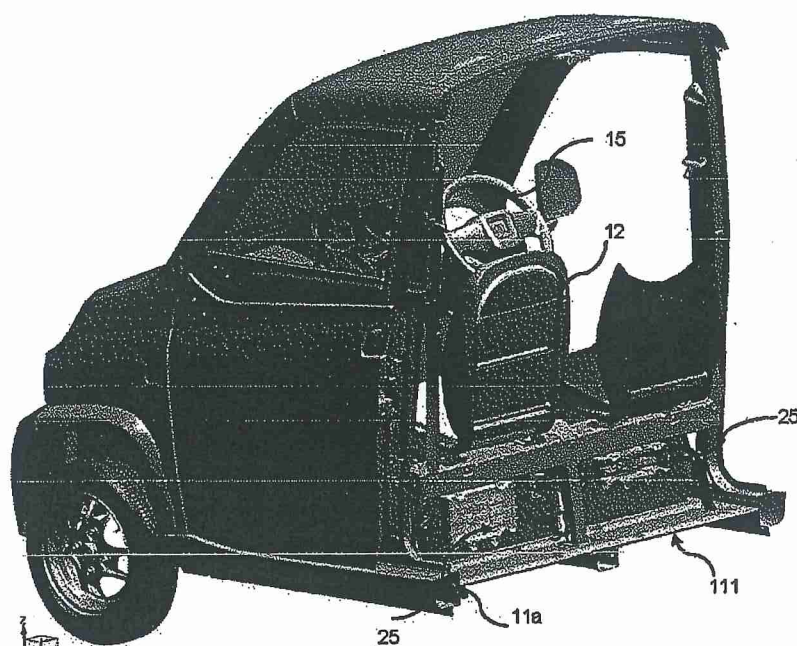


Figure 5 (c)

Dated on this 21st day of December, 2017

For **BAJAJ AUTO LIMITED**,
By its attorney,

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INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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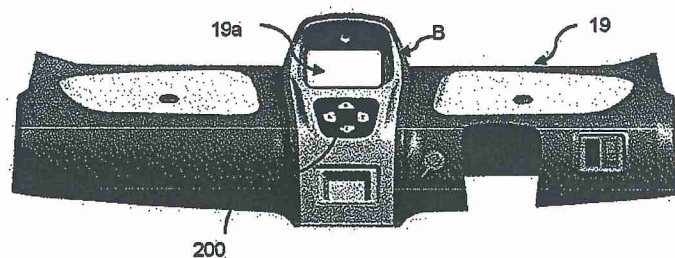


Figure 6 (a)

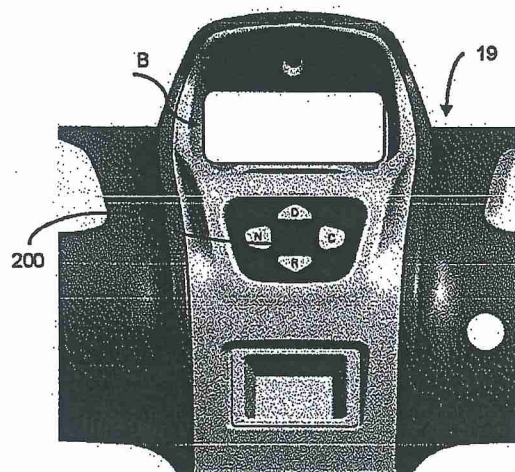


Figure 6 (b)

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

(BRINDA MOHAN)
INPA 269

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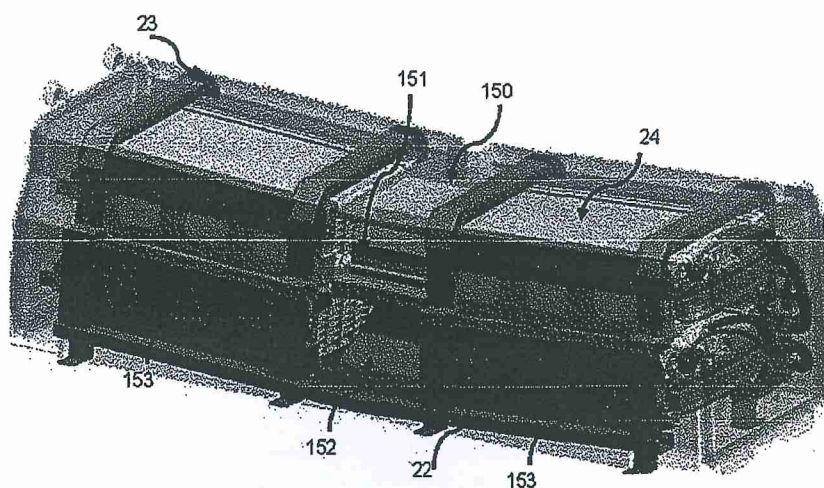


Figure 7

Dated on this 21st day of December, 2017

For **BAJAJ AUTO LIMITED**,
By its attorney,



(BRINDA MOHAN)
INPA 269

Applicant name. : **BAJAJ AUTO LIMITED**
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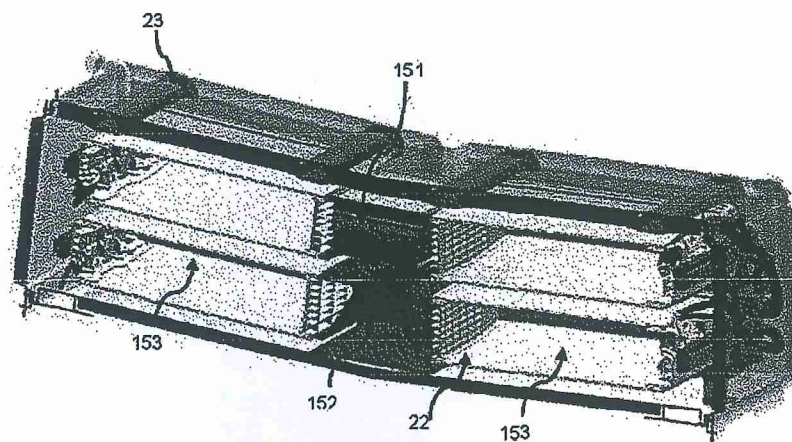
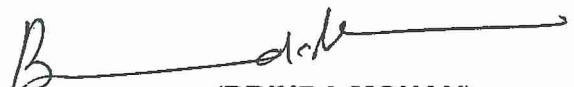


Figure 8

Dated on this 19th day of December, 2017

For **BAJAJ AUTO LIMITED**,
By its attorney,


(BRINDA MOHAN)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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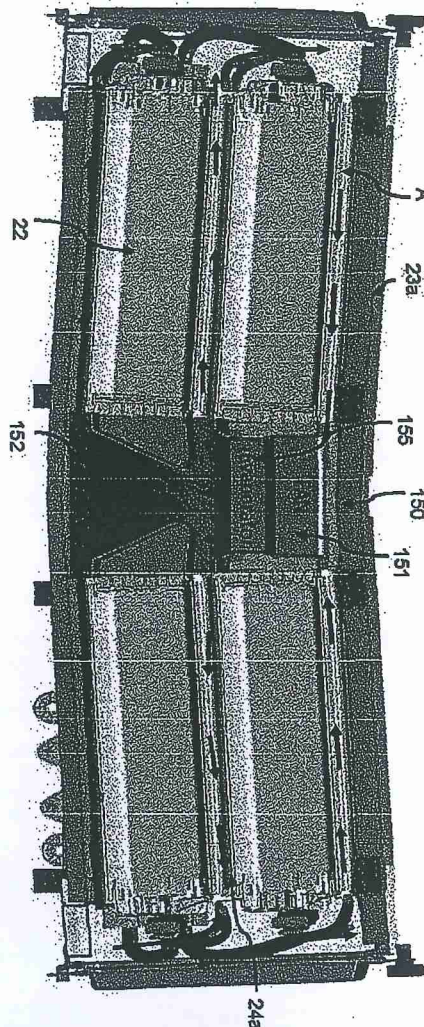


Figure 9

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

B 

(BRINDA MOHAN)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
Application No. :

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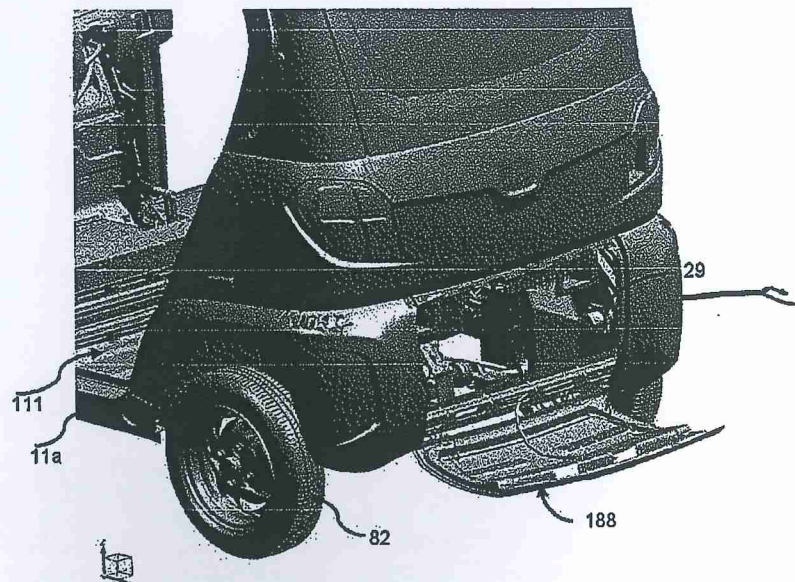


Figure 10

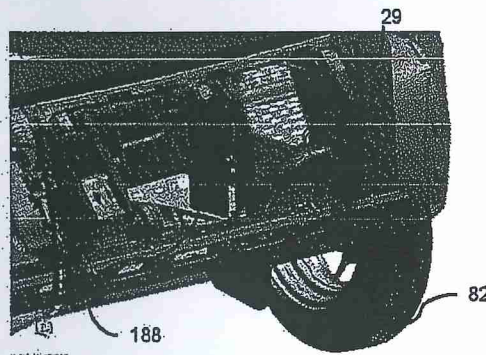


Figure 11

Dated on this 21st day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan

(BRINDA MOHAN)
INPA 269

Applicant name. : **BAJAJ AUTO LIMITED**
Application No. :

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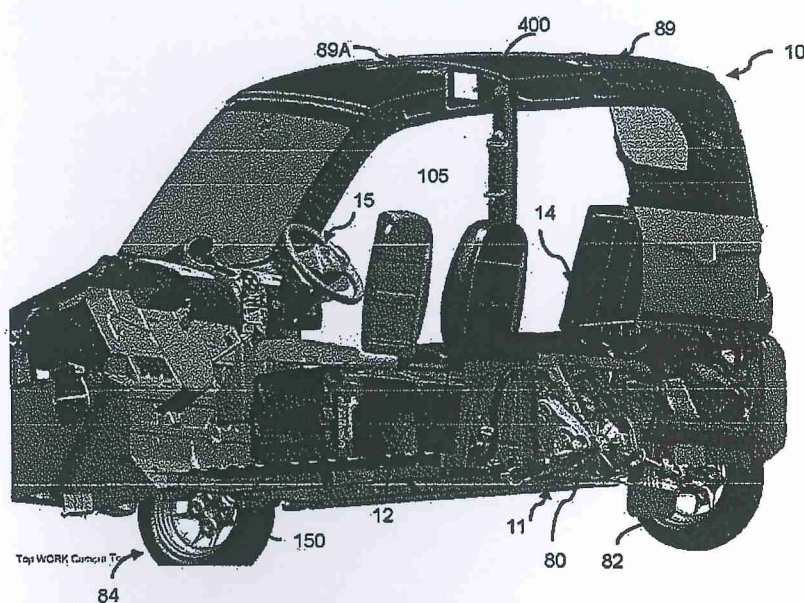


Figure 12

Dated on this 21st day of December, 2017

For **BAJAJ AUTO LIMITED**,
By its attorney,

Brinda Mohan

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