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भौगोलिक उपदर्शन

जिस किसी से संबन्धित हो
TO WHOMSOEVER IT MAY CONCERN

मैं, 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: **201721045779**
ख) फाइल करने की तारीख / b) Date of Filing: **20/12/2017**
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 20/12/2017.

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 **10th** 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)					
Name in Full		Nationality	Country of Residence	Address of the Applicant	
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				State	Maharashtra.
				Country	India.
				Pin code	411035.
3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]					
Natural Person ()		Other than Natural Person			
		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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			Country	India.	
			Pin code	411035.	
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)**

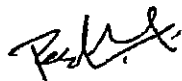
(In case the applicant is an assignee: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

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 : 19/12/2017

(b) Signature

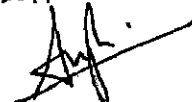


(c) Name: KHAMKAR PRITAM POPATRAO

ii)

(a) Date : 19/12/2017

(b) Signature



(c) Name: JOSHI ASHISH MOHANIRAJ

iii)

(a) Date : 19/12/2017

(b) Signature



(c) Name: DORALE NINAD VASANT

(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: 16	Rs. 11200/-	Addl. claims : N/A Addl. pgs : 4
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: 28 and No. of pages: 18		

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.....on Bank.

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

Dated on this the 19th day of December 2017

For BAJAJ AUTO LIMITED,

Authorised signatory : x



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 and more particularly to motor and transmission positioning within 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. However, proposed changes in regulations, for example in India, 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 it is desirable to meet directives/focus set by the Government of various countries.

a. 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 four

wheeler electric cars as produced for example by Tesla. Compact packaging is typically a requirement and if the compact packaging could be done in a way that allows other advantages and functionality, for example motor cooling, to be done cost effectively, this would be a useful advantage.

b. It is an object of the present invention to provide an electric vehicle design which enables convenient packaging of a motor and transmission.

SUMMARY OF THE INVENTION

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

a chassis including a rear frame portion;

an electric motor as prime mover connected to said chassis and to a rear drive transmission system;

an electric battery module for powering the electric motor comprising at least one battery and its frame structure mounted to the rear frame portion;

wherein a portion of said electric motor is disposed below the rear frame portion of the chassis, such location of the portion of the electric motor being convenient to enable cooling, conveniently ram air cooling. Ram air cooling involves cooling by a direct airflow stream (related to the velocity of the vehicle) flowing over the electric motor as well as cooling achieved by directing ram airflow towards heated part of motor.

However, such position of a portion of the electric motor below the rear frame portion of the chassis and partly in the ground clearance exposes the electric motor to external impacts; as well as water, mud or any foreign material which may clog or cause damage to the electric motor. A protective cover or guard may therefore be provided, conveniently being connected to the electric motor. Such protective cover or guard is configured to reduce/avoid obstacles to ram air flow which could cause overheating of the electric motor. The protective cover or guard may be designed to force and/or guide cooling air flow. Preferably, the hottest part of the electric motor – the upper portion in the preferred disposition of the electric motor – is left open without any

covering elements. In this case, air is allowed to flow over the surface of the upper portion of the electric motor to achieve cooling. The side portions and bottom portions of the electric motor are covered using said protective cover or guard thus protecting the bottom and the side portions of the electric motor from any external impacts or ingress of water, mud or any foreign material.

The transmission, for an electric vehicle, includes a power train assembly, for example a single speed power train assembly having belt, helical gears and differential mechanism, which provides two stage reduction as described below. In a preferred embodiment, the electric motor is mounted directly along with the transmission system on the differential mechanism, desirably with an integral casing/housing for the transmission and differential mechanism. Such a mounting of the power train assembly consumes less space and so provides the advantage of compactness.

Preferably, the transmission system comprises an intermediate shaft to which power is delivered from an output shaft of the electric motor through a suitable drive. A belt drive is preferred. A toothed belt is more preferably used for transmitting the motive power than a normal belt which has more slip and which would cause reduction in transmission efficiency and noise related problems. A toothed belt has comparatively higher efficiency and low noise. In such case, a toothed belt is used as a primary reduction. A gear mechanism is desirably used for second stage reduction. A helical gear set, conveniently a pair, is used for 2nd stage reduction with a differential assembly for the rear mounted power train. Overall size of the power train assembly is significantly less than for a comparable power output internal combustion engine and transmission assembly. Alternatively, the transmission arrangement can also be provided without a belt drive. The output shaft of the electric motor can also be directly engaged with the intermediate shaft to transmit the power to the differential mechanism using a gear drive.

In order to reduce noise and vibration and provide smooth transmission, helical gears are desirably used as a final stage of the above mentioned gear drive. Helical angle of gears may be increased and the module of gear which is a ratio of an reference circle or pitch circle of the gear to the number of gear teeth reduced maintaining the face width of the gear constant so that the gear engage smoothly and reduce noise. The contact ratio of the helical gears is also increased. Preferably, low module gears are used, each gear having module up to 1.5 with pressure angle of 17.5 deg. The gears also desirably include a damping mechanism so as to further reduce noise and vibrations.

The proposed power train assembly comprising motor, transmission and differential results in a very compact arrangement.

The differential mechanism is conveniently connected to the two rear wheels through drive shafts to transmit the power to the wheels. The motor, transmission and differential are desirably positioned such that the length of the differential drive shafts on the left side and right side of the differential mechanism are substantially equal. This allows interchangeability of shafts on the right and left side. Also it eliminates the need to manufacture two different shafts of different dimensions on right and left side thereby saving the manufacturing cost.

The motor transmission assembly is mounted to the rear frame portion of the chassis of the vehicle, desirably so that the motor is swingable. According to a preferred embodiment, the rear frame portion is made from a plurality of longitudinal members connected to each other by cross frame member/s. The rear frame is mounted on the chassis of the vehicle and fixed at suitable locations using connectors such as nuts/bolts. Alternatively, the rear frame portion may be welded to the vehicle chassis. The bottom part of the rear frame portion has a mounting arrangement for fixing one end of the motor transmission assembly to it. Preferably, a flange is provided on the integral housing of the transmission and differential which is fixed to the said mounting

arrangement of rear frame portion. The other part of the motor transmission assembly is fixed on the cross-member of the vehicle chassis using a mounting bracket. The motor transmission assembly is fixed using rubber isolators at both of the above mentioned locations to minimise the transfer of vibrations to the chassis and vice versa. The upper part of the rear frame portion is also conveniently utilized for mounting the electrical batteries along with its frame structure. Therefore, the rear frame portion is advantageously utilized for fixing both electrical batteries and the motor transmission assembly to the chassis of the vehicle which allows a compact arrangement.

As a further embodiment, the rear frame portion may be fully integrated with the vehicle chassis and may be provided with suitable mounting provisions for motor/ transmission and battery while manufacturing the chassis.

The transmission housing is desirably provided with an integral flange having a plurality of mounting options enabling mounting of the motor transmission assembly onto the chassis of various types of vehicles. The mounting provisions can be used selectively as per required orientation and packaging requirements of motor and transmission for a particular vehicle.

Advantageously, the electric power module may be configured as described in the applicant's co-pending Indian provisional application filed under the title "An Electric Vehicle" simultaneously alongwith this application, the contents of which are hereby incorporated herein by reference.

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. The motor-transmission assembly can also be made such that it acts as a single package transmission which can be easily fitted on any vehicle for example a four wheeled vehicle/ quadri-cycle.

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 partial side view of an electric vehicle according to a first embodiment of the present invention.

Fig. 1(b) is an orthogonal view cutaway view showing the relationships between the electric power module, the chassis and other elements of the electric vehicle shown in Fig. 1(a).

Fig. 2 is a detail view showing the relationship between the electric power module, motor transmission assembly and the chassis proximate the rear wheel in Fig. 1(b).

Fig. 3(a) is a schematic side view showing the relationship between a rear frame portion and other portions of the chassis of the electric vehicle shown in Figs. 1 and 2.

Fig. 3(b) is a detail front orthogonal view of the rear frame portion of Fig. 3(a) and indicating mounting of one part of the motor transmission assembly of the electric vehicle to the rear frame portion.

Fig. 3(c) is a detail further orthogonal view of the rear frame portion of Figs. 3(a) and 3(b) and indicating mounting of one part of the motor transmission assembly of the electric vehicle to the rear frame portion.

Fig 4(a) is a further orthogonal view showing the relationship between the rear frame portion, the motor transmission assembly and the rear wheels of the electric vehicle shown in Figs. 1(a) and 1(b).

Fig. 4(b) is a detail from Fig. 4(a) showing a rear mounting of the motor transmission assembly to the rear frame portion.

Fig. 5 is a plan view showing one arrangement for the rear frame portion, motor transmission assembly and rear wheels of the electric vehicle of Figs. 1(a) and 1(b).

Fig. 6 is a plan view showing a further arrangement for the rear frame portion, motor transmission assembly and rear wheels of the electric vehicle of Figs. 1(a) and 1(b).

Figs. 7(a) and 7(b) respectively show orthogonal views of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) without a protective guard for the electric motor.

Figs. 8(a) and 8(b) respectively show orthogonal views of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) with a protective guard for the electric motor.

Fig. 9(a) shows a side view of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) without a protective guard for the electric motor.

Fig. 9(b) shows a bottom view of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) without a protective guard for the electric motor.

Fig. 10(a) shows a side view of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) with a protective guard for the electric motor.

Fig. 10(b) shows a bottom view of the motor transmission assembly and its relationship to the rear frame portion of the electric vehicle of Figs. 1(a) and 1(b) with a protective guard for the electric motor.

Fig. 11(a) shows an orthogonal view of the protective guard shown in Figs. 8 and 10. Fig. 11(b) shows an orthogonal view of the protective guard shown in Figs. 8 and 10 as a separate component.

Fig. 12 shows a bottom view of the motor transmission assembly, its mounting locations and the protective guard.

Fig. 13 shows a detail of the connection of the motor transmission assembly to the protective guard.

Fig. 14 shows an orthogonal view of a power train for the electric vehicle of Figs. 1(a) and 1(b) using a first form of belt drive.

Fig. 15 shows an orthogonal view of a power train for the electric vehicle of Figs. 1(a) and 1(b) using a second form of belt drive.

Fig. 16 shows an orthogonal view of the relationship between the motor transmission assembly as shown in Figs. 1 to 10.

Fig. 17 shows a side view of the motor transmission assembly as shown in Fig. 16.

Fig. 18 is a detail view of a bottom portion of the motor transmission assembly shown in Figs. 16 and 17.

Fig. 19 is a detail orthogonal view of the center distance adjuster included in the motor transmission assembly as shown in Figs. 16 to 18.

DESCRIPTION OF PREFERRED EMBODIMENT OF THE INVENTION

Referring now to Figs 1(a) and 1(b), there is shown an electric vehicle 10 suitable for use as a commuter vehicle and having a chassis 11 with a rear frame portion 11a. The chassis 11 is essentially the same as for both electric and internal combustion engine vehicle types. Differences in the structure of the electric vehicle 10 are essentially dictated by the requirement that the vehicle be electrically powered. The electric vehicle 10 is a three wheeler including a pair of rear wheels 82 and front wheel 84. Rear wheels 82 are provided with a suspension system, including trailing arms 92 and a shock absorber 93 provided on each of the trailing arms 92 of both the rear wheels 82. An anti-roll bar 90 is fixed onto the trailing arms 92 using suitable connecting structure. Further description of the anti-roll bar 90 is provided in the applicant's co-pending Indian provisional application filed under the title "An Electric Vehicle" simultaneously alongwith this application, incorporated herein by reference.

A driver sits at the front of the electric vehicle 10 on front seat 12 and a rear seat 14 is available for seating of passengers. 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 bench style though other configurations could be adopted if required. The driver steers electric vehicle 10 through handlebar 15.

Electric vehicle 10 has an electric motor 20 and transmission system 80 powered by an electric power module 22 comprising two or three batteries 24 arranged in rows separated by a clearance space 24a as shown in Fig. 2. Electric battery module 22 is positioned to the rear of the vehicle 10 above the electric motor 20 and transmission system 80, a position which provides a convenient position for routing the wire harness.

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 connected in parallel so deliverable voltage is 48 volts.

Electric motor 20 includes a rear wheel drive transmission and detail of the relationship between transmission and rear wheels 82 is conveniently shown in Figs. 1 to 10. Electric motor 20 has a portion located below the rear frame portion 11a, and inboard, to enable ram air cooling during operation of the electric vehicle 10.

Electric battery module 22 is located below a luggage compartment 188, located under the rear roof portion 10B of the electric vehicle 10 which demonstrates compactness as space remains available even with a change from an internal combustion engine prime mover to an electric motor prime mover. Electric battery module 22 includes a protective frame structure 23. Batteries 24 are separated by a space 24a to allow convective air heat transfer away from the electric battery module 22.

Junction box 25 is connected external to and to the rear of frame structure 23 and, in this position, it does not require any further special supporting structure. Junction box 25 is a housing for electrical connections connected to batteries 24 and other components which protects the connections from any external impacts, dust, water, dirt and so on. Further description of the electric battery module 22, protective frame structure 23, charger unit and vehicle control unit (VCU) 100 are as described in the Applicant's co-pending Indian provisional patent application filed under the title "An Electric Vehicle" simultaneously alongwith this application, incorporated herein by reference.

Electric motor 20 includes a rear wheel drive transmission system for providing drive from the electric motor 20 to rear wheels 82. Electric motor 20 has a portion located below the rear frame portion 11a of chassis 11 to enable ram air cooling during operation of the electric vehicle 10. As was explained above, ram air cooling involves cooling by direct airflow over the electric motor

20 with the velocity of the cooling airflow being related to the speed of the electric vehicle 10 as well as cooling by directing the flow of air towards heated surface of motor 20 using louvers (not shown) where provided in the protective cover 95.

Electric motor 20 and the transmission system 80 are mounted together, through mounting bracket 225, to form a motor transmission assembly 208 which is fixed to chassis 11 and chassis portion 11a by suitable mounts such as rubber soft mounts 110 in order to prevent transfer of vibrations and noise to chassis portion 11a and the chassis 11 and electric vehicle 10 generally. Mounting arrangements are most conveniently illustrated in Figs. 3 to 10, 16 and 17. As the transmission system 80 could also be used in other vehicles requiring a different orientation of transmission system to chassis 11, the transmission housing 81 is provided with an integral flange 88 having a plurality of mountings (not shown) enabling mounting of the motor transmission assembly onto the chassis of various types of vehicles as provided in the Applicant's co-pending Indian provisional patent application filed under the title "An Electric Vehicle" simultaneously alongwith this application.

The motor transmission assembly 208 is mounted to the rear frame portion 11a and chassis 11 of the electric vehicle 10 in a manner that allows the electric motor 20 to be swingable. As shown, rear frame portion 11a is made from a plurality of longitudinal members 11b connected to each other by a cross frame member 11c. The rear frame portion 11a is mounted on the chassis 11 of electric vehicle and fixed at four suitable locations 11d using nuts/bolts (not shown). Alternatively, the rear frame portion may be welded to the vehicle chassis. As a further embodiment, the rear frame portion may be fully integrated with the vehicle chassis and may be provided with suitable mounting provisions for motor/ transmission and battery while manufacturing the chassis. The bottom part of the rear frame portion 11a has a first mounting arrangement 110 for fixing one end of motor transmission assembly 208. As

shown, a flange 88 is provided on the integral housing 81 of transmission system 80 and differential mechanism 86 which is fixed to the rear frame portion 11a. The other end of the motor transmission assembly 208 is fixed on the cross-member 150 of the vehicle chassis 11 using a mounting bracket 125 that includes a structural member 190 extending below electric motor 20 to provide the requisite support. The motor transmission assembly 208 is fixed using rubber isolators 110 at both of the above mentioned mounting locations to minimise the transfer of vibrations to the chassis 11 and the rest of the electric vehicle 10 and vice versa. The mounting of the motor transmission assembly 208 enables sufficient ventilation for ram air cooling yet provides acceptable protection as well.

The upper part 11aa of the rear frame portion 11a of chassis 11 is utilized for mounting, via the protective frame structure 23, the electrical batteries 24. Further description of the protective frame structure 23 and battery arrangement therein is provided in the Applicant's co-pending Indian Provisional Application (Applicant Docket 01-01.537), incorporated by reference. Therefore, the rear frame portion 11a is utilized for fixing protective frame structure 23, its electrical batteries 24 and motor transmission assembly 208 to the chassis 11 of the vehicle which allows a compact arrangement, through use of some of the ground clearance space while also assisting ram air cooling.

The rear drive transmission 80, as is typical for an electric vehicle, includes a single speed power train assembly having a drive belt 91, helical gears (not shown) and differential mechanism 86, which provides two stage reduction as described below. The electric motor 20 is mounted directly along with the transmission system 80 on the differential mechanism 86. The differential mechanism 86 is conveniently connected to the two rear wheels 82 through drive shafts 83 to transmit power to the rear wheels 82 and not front wheel 84. The transmission, integrated with differential mechanism 86, is mounted along the centre longitudinal axis C of the electric vehicle as shown in Figs. 5, 6,

9(b) and 10(b). It will be observed that left and right hand positioning of the electric motor 20 or transmission system 80 relative to longitudinal axis C is possible. Drive shafts 83 on both left and right hand side of the differential mechanism 86 have substantially equal length. This allows interchangeability of drive shafts 83 on right and left side. It eliminates the need to manufacture two drive shafts of different dimensions on right and left side thereby saving manufacturing cost.

Referring further to the position of electric motor 20 below the rear frame portion 11a of the chassis 11, such positioning in the ground clearance exposes the electric motor 20 to external impacts; as well as water, mud or any foreign material which may clog or cause damage to the electric motor 20. A protective cover or guard 95, conveniently of polymer such as polypropylene (though metals and composites could also be used subject to weight considerations), may therefore be provided as shown in Figs. 7 to 11. Such protective guard 95 is conveniently connected to the motor support member 190 with the assistance of the further bracket 95D. As shown in fig. 13 which is a sectional side view illustrating the mounting of guard 95 on the motor support member 190. Preferable the protective guard 95 is bolted using bolt 95C onto the motor support member 190. The protective guard 95 is configured to reduce obstacles to air flow which could reduce overheating of the electric motor 20. As shown in Fig. 9a and 10a, the hottest part of the electric motor 20 – the upper portion 20a – is left open without any covering elements. In this case, air is allowed to flow over the surface of the upper portion 20a of the electric motor 20 to achieve ram air cooling. Side portions and bottom portions of electric motor 20 are protected by protective guard 95 from any external impacts or ingress of water, mud or any foreign material. Additionally the protective guard 95 may include louvers (not shown) which directs the air towards the hot surface 20a of motor 20. With the help of louvers, additional cooling can be achieved. A helical gear set (not shown), conveniently a pair, is desirably used for second stage reduction with the differential mechanism 86. A helical gear set is selected in order to reduce

noise and vibration and provide smooth transmission. Overall size of this power train assembly is significantly less than for an internal combustion engine and transmission assembly. It will be understood that the transmission system 20 can also be provided without a belt drive. The output shaft 205 of the electric motor 20 could also be directly engaged with the intermediate shaft 810 to transmit the power to the differential mechanism 86 using a gear drive.

Helical angle of helical gears may be increased and the module of gear reduced maintaining the face width of the gear constant so that the gears engage smoothly and reduce noise. The contact ratio of the helical gears 117 is also increased. Preferably, low module gears are used, each gear 117 having module up to 1.5 with pressure angle of 17.5 deg. The helical gears 117 also include a damping mechanism so as to further reduce noise and vibrations. This arrangement reduces angle of the drive shafts 83 and enables a lower position for the transmission system 80 than in conventionally fuelled and internal combustion engine equipped vehicles.

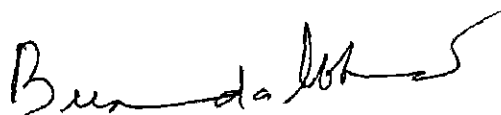
Referring further to the belt drive 91, the belt drive 91 is here advantageously provided with a Center Distance (CD) adjuster 301, as shown in Figs. 16 to 19 to maintain the drive belt 91 tension. The CD adjuster 301 provides a convenient way to adjust the center distance between the motor drive pulley 206 and driven pulley 802 of the transmission system 80. Adjustment between -1.5 and 5mm is possible here but this range may be selected differently. As described above, the electric motor 20 is swingably mounted onto the transmission housing 80 by mounting bracket 225 such that the electric motor 20 is swingably fixed at one location 208A. Mounting bracket 225 is fixed to the transmission system side 80 for holding the electric motor 20 fixed at a certain position and comprises a sleeve adjuster 302 and an adjustment bolt 303. This arrangement allows the swingable adjustment of electric motor position which in turn controls the CD for drive belt 91. Therefore, when a user wants to adjust the CD of belt drive 91, the adjustment bolt 303 can simply be

adjusted to adjust the electric motor 20 position to change the CD of the drive belt 91. If the drive belt 91 is required to be removed for any purpose such as maintenance, it is possible to first reduce the CD thereby allowing easy removal and insertion of the drive belt 91. Similarly, when more drive belt 91 tension is required, the electric motor 20 position can be adjusted such that the CD of the drive belt 91 increases which induces more tension in the drive belt 91.

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 19th 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

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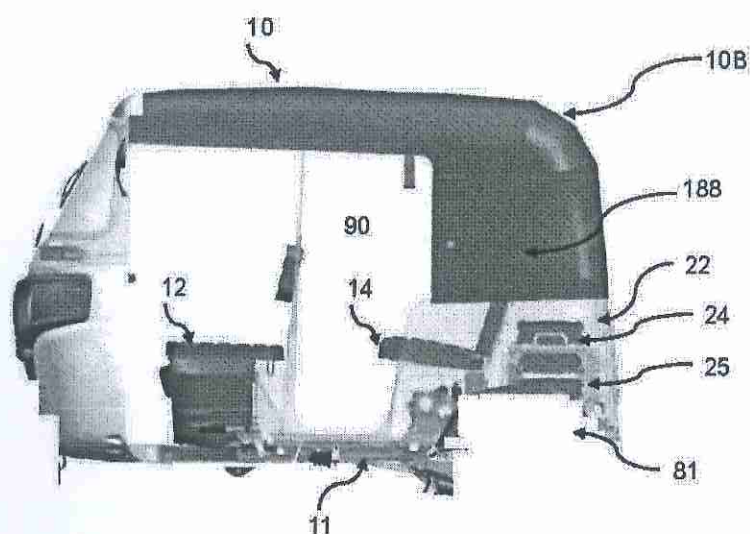


Figure 1 (a)

Dated on this 19th day of December, 2017

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

Brinda Mohan

(BRINDA MOHAN)
INPA 269

Applicant name. : **BAJAJ AUTO LIMITED**

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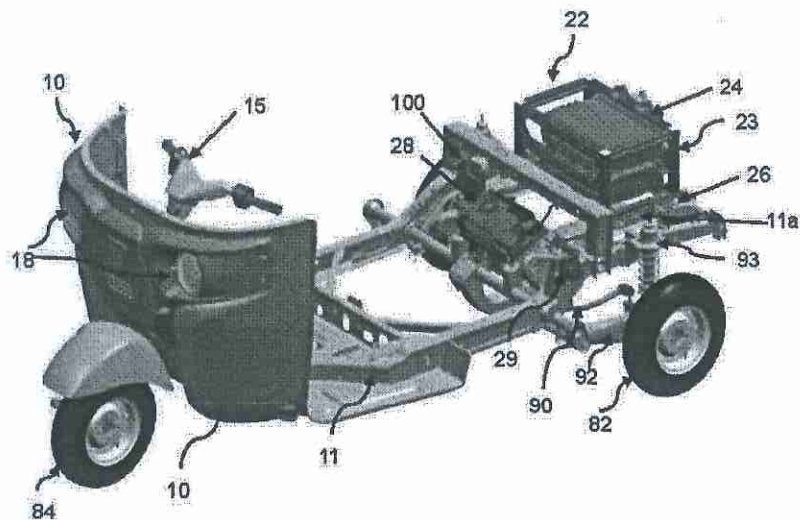


Figure 1(b)

Dated on this 19th day of December, 2017

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

Banda 104

(BRINDA MOHAN)
INPA 269

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

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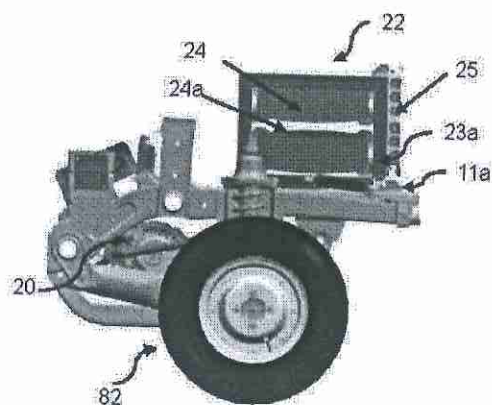


Figure 2

Dated on this 19th day of December, 2017

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

Brinda Mohan

(**BRINDA MOHAN**)
INPA 269

Applicant name. : BAJAJ AUTO LIMITED
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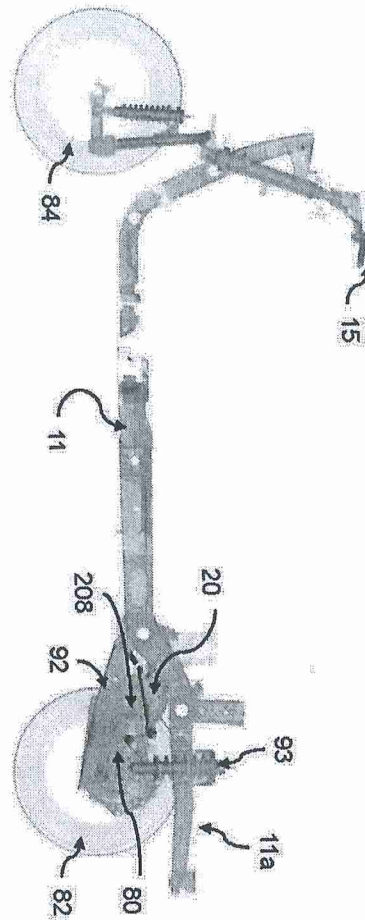


Figure 3 (a)

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

Brinda Mohan
(BRINDA MOHAN)
INPA 269

Applicant name : **BAJAJ AUTO LIMITED**
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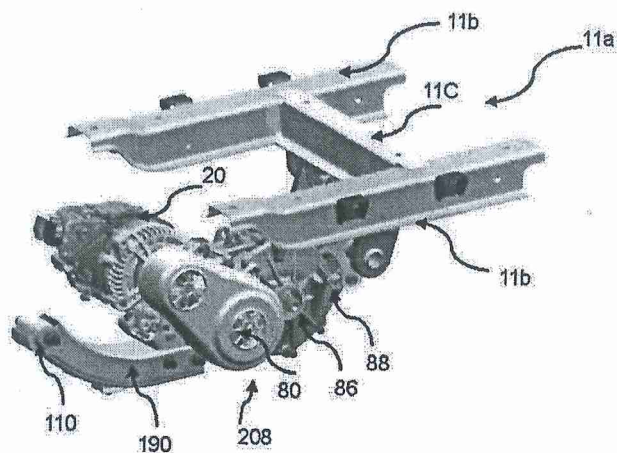


Figure 3 (b)

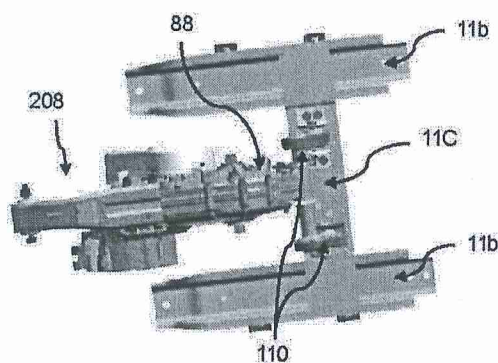
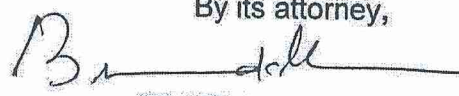


Figure 3 (c)

Dated on this 19th day of December, 2017

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


(BRINDA MOHAN)
INPA 269

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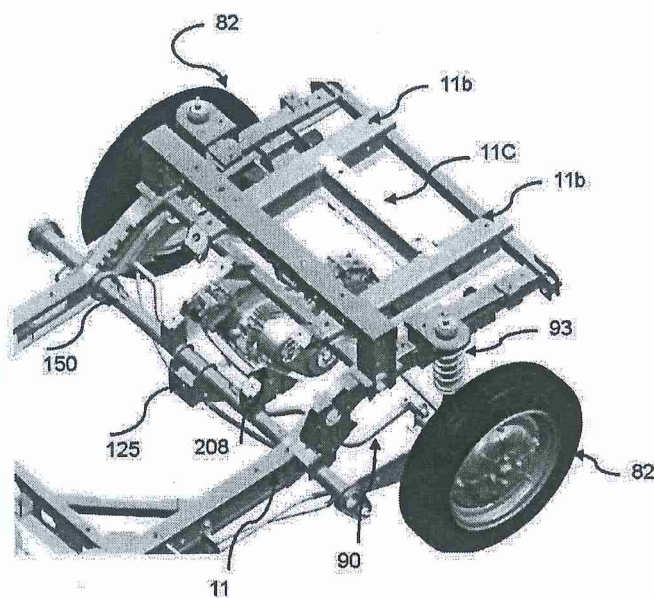
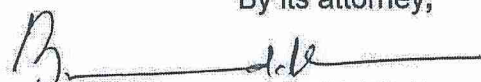


Figure 4 (a)

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,


(BRINDA MOHAN)
INPA 269

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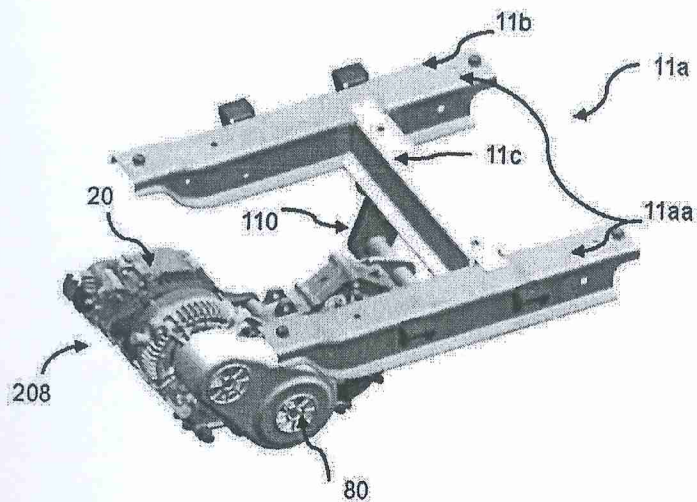
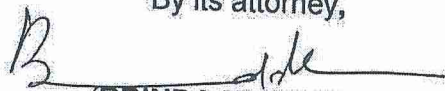


Figure 4 (b)

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,


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INPA 269

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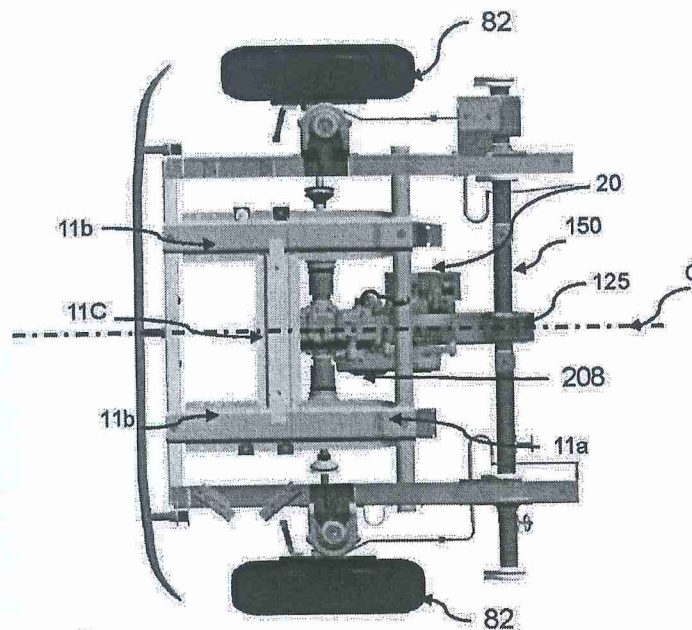


Figure 5

Dated on this 19th day of December, 2017

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

(**BRINDA MOHAN**)
INPA 269

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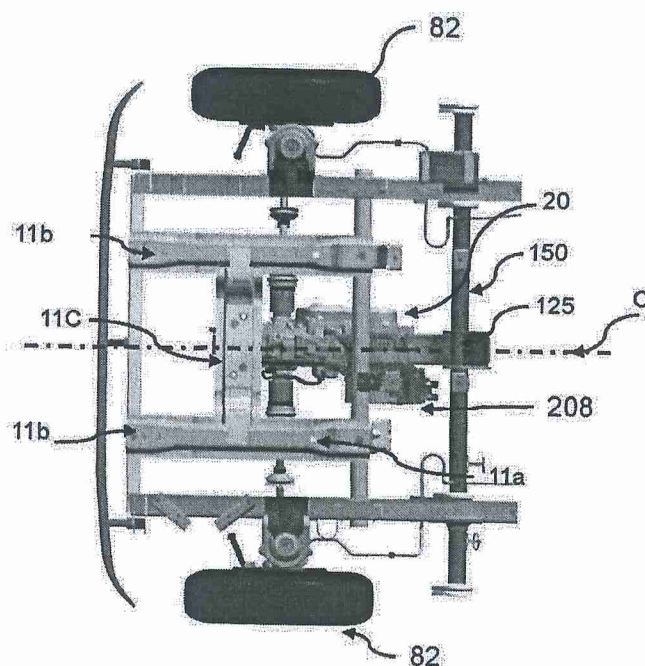


Figure 6

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,

B *Brinda Mohan*
(BRINDA MOHAN)
INPA 269

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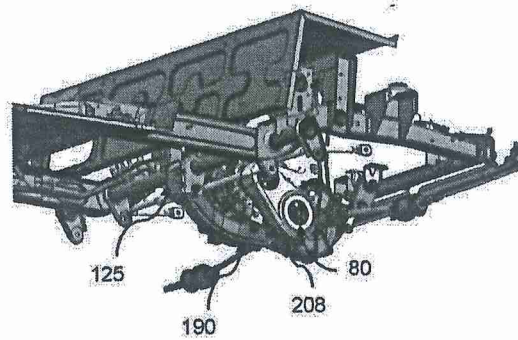


Figure 7 (a)

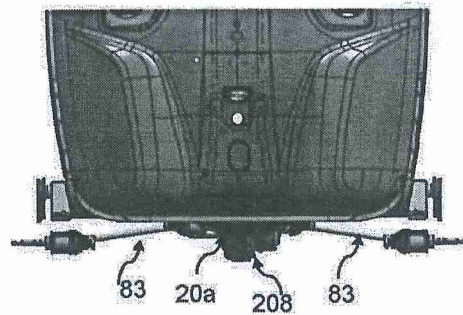


Figure 7 (b)

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
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(BRINDA MOHAN)
INPA 269

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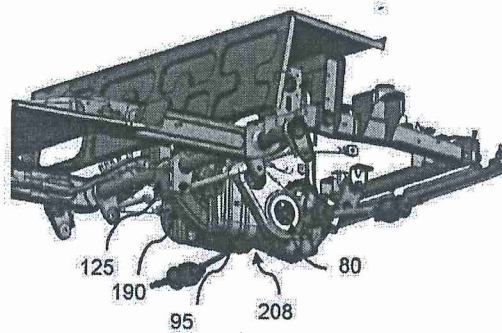


Figure 8 (a)

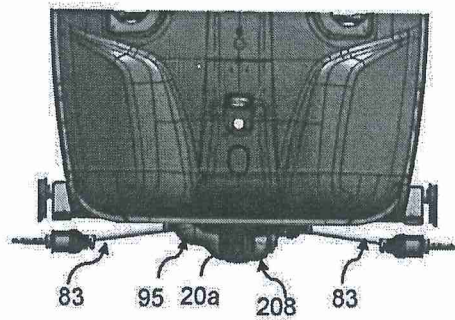


Figure 8 (b)

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


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INPA 269

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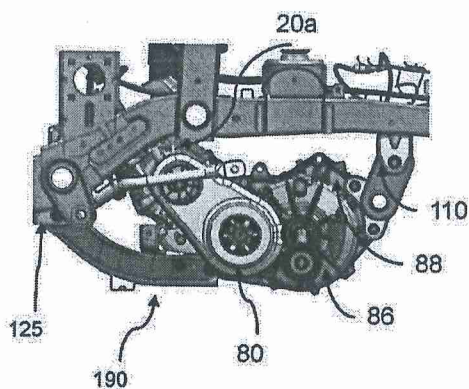


Figure 9 (a)

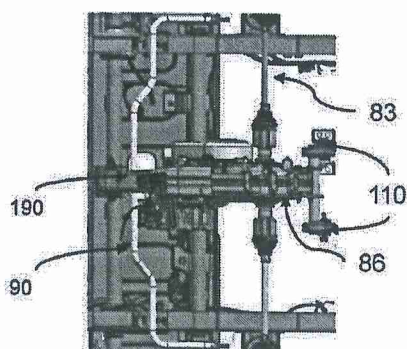


Figure 9 (b)

Dated on this 19th day of December, 2017

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INPA 269

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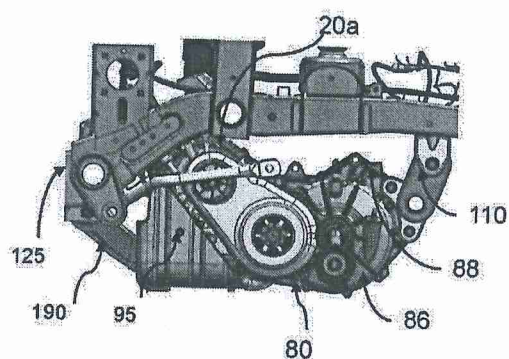


Figure 10 (a)

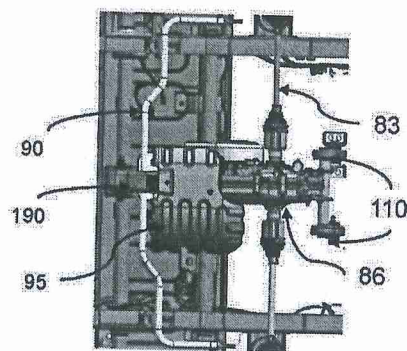
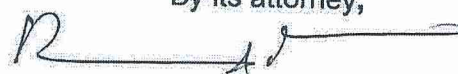


Figure 10 (b)

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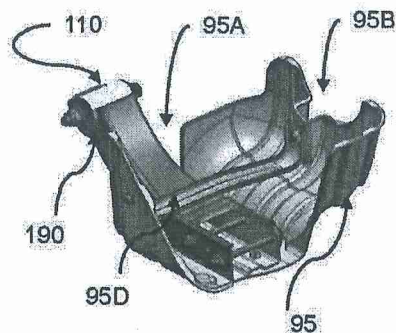


Figure 11 (a)

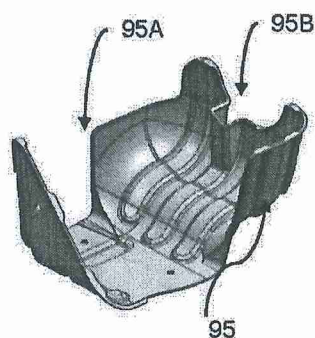


Figure 11 (b)

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By its attorney,

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INPA 269

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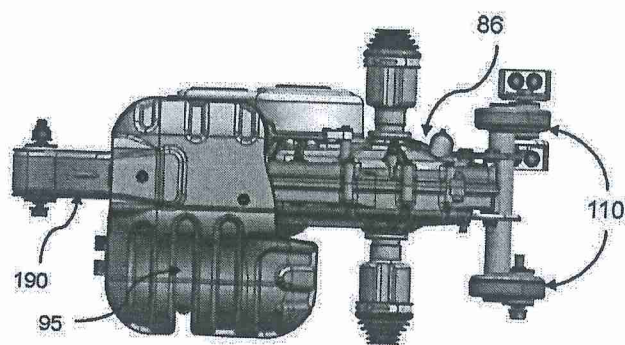


Figure 12

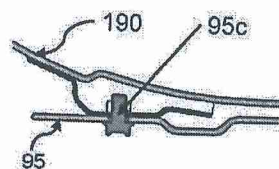


Figure 13

Dated on this 19th day of December, 2017

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

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INPA 269

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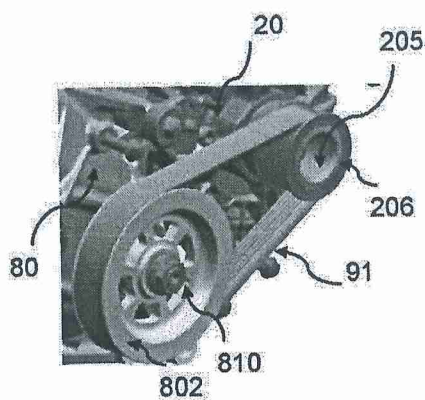


Figure 14

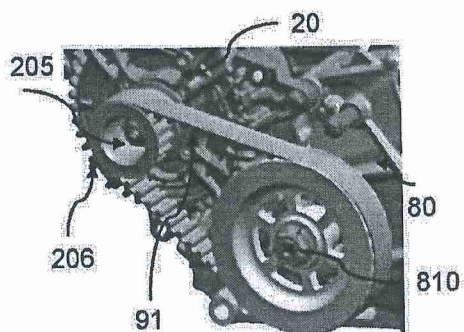


Figure 15

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(BRINDA MOHAN)
INPA 269

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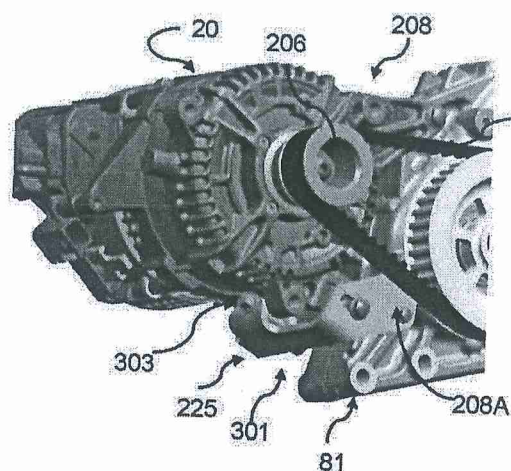


Figure 16

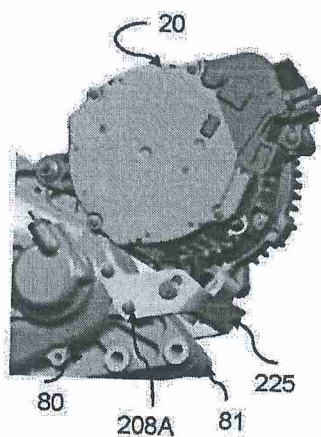
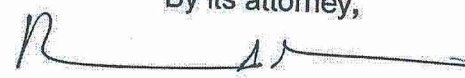


Figure 17

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INPA 269

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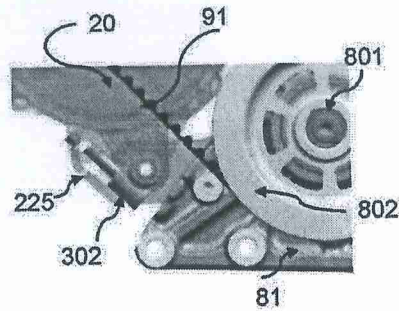


Figure 18

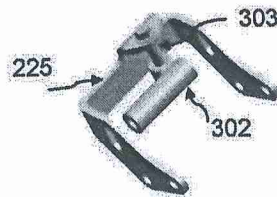


Figure 19

Dated on this 19th day of December, 2017

For BAJAJ AUTO LIMITED,
By its attorney,


(BRINDA MOHAN)
INPA 269