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G.A.R.6
[See Rule 22(1)]
RECEIPT



Docket No 23957

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PALANISAMYMANOJKUMAR

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Assistant Professor Dept of EEE Bannari
Amman Institute of technology
Sathyamangalam-638401

CBR Detail:

Sr. No.	Ref. No./Application No.	App. Number	Amount Paid	C.B.R. No.	Form Name	Remarks
1	202341015411	TEMP/E-1/18204/2023-CHE	1600	10500	FORM 1	PERFORMANCE STUDY OF AXIAL FLUX MOTOR FOR E-VEHICLE

TransactionID	Payment Mode	Challan Identification Number	Amount Paid	Head of A/C No
N-0001112292	Online Bank Transfer	0803230004391	1600.00	1475001020000001

Total Amount : ₹ 1600.00

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FORM 1
THE PATENTS ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003
APPLICATION FOR GRANT OF PATENT
[See sections 7,54 & 135 and rule 20(1)]

(FOR OFFICE USE ONLY)

Application No.:
Filing Date:
Amount of Fee Paid:
CBR No.:
Signature:

1. APPLICANT(S):

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3	DR. SENTHIL KUMAR J	India	Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu	Erode	
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			of Technology, Sathyamangalam, Erode – 638401				
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11	GOKUL R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
12	KARTHIKEYAN S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	

2. INVENTOR(S):

Sr.No.	Name	Nationality	Address	Country	State	Distict	City
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			Sathyamangalam-638401				
2	DR.S. VEERA KUMAR	India	Associate Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu	Erode	
3	DR. SENTHIL KUMAR J	India	Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu	Erode	
4	MR. BALAVIGNESH S	India	Assitant Professor level , Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
5	MR. SUNDAR S	India	Assistant Professor, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401.	India	Tamil Nadu	Erode	
6	AMEER KHAN B	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
7	BARATHWAJ S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
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9	ARUN M	India	UG Student, Department of EEE, Bannari Amman Institute of Technology,	India	Tamil Nadu	Erode	

			Sathyamangalam, Erode – 638401				
10	KIRAN AKASH S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
11	GOKUL R	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	
12	KARTHIKEYAN S	India	UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401	India	Tamil Nadu	Erode	

3. TITLE OF THE INVENTION: PERFORMANCE STUDY OF AXIAL FLUX MOTOR FOR E-VEHICLE

**4. ADDRESS FOR CORRESPONDENCE OF APPLICANT /
AUTHORISED PATENT AGENT IN INDIA:**

Assistant Professor Dept of EEE Bannari Amman Institute of
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Telephone No.:

Fax No.:

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E-mail: manojkumar@bitsathy.ac.in

5. PRIORITY PARTICULARS OF THE APPLICATION(S) FILED IN CONVENTION COUNTRY:

Sr.No.	Country	Application Number	Filing Date	Name of the Applicant	Title of the Invention
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6. PARTICULARS FOR FILING PATENT COOPERATION TREATY (PCT) NATIONAL PHASE APPLICATION:

International Application Number	International Filing Date as Allotted by the Receiving Office
PCT//	

7. PARTICULARS FOR FILING DIVISIONAL APPLICATION

Original (first) Application Number	Date of Filing of Original (first) Application
-------------------------------------	--

8. PARTICULARS FOR FILING PATENT OF ADDITION:

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

I/We ,PALANISAMYMANOJKUMAR,DR.S. VEERA KUMAR,DR. SENTHIL KUMAR J,MR. BALAVIGNESH S,MR. SUNDAR S,AMEER KHAN B,BARATHWAJ S,KALAISELVAN R,ARUN M,KIRAN AKASH S,GOKUL R,KARTHIKEYAN 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.

(a) Date: ----

(b) Signature(s) of the inventor(s):

(c) Name(s): PALANISAMYMANOJKUMAR,DR.S. VEERA KUMAR,DR. SENTHIL KUMAR J,MR. BALAVIGNESH S,MR. SUNDAR S,AMEER KHAN B,BARATHWAJ S,KALAISELVAN R,ARUN M,KIRAN AKASH S,GOKUL R,KARTHIKEYAN S

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

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

(a) Date: ----

(b) Signature(s) :

(c) Name(s) of the singnatory: PALANISAMYMANOJKUMAR,DR.S. VEERA KUMAR,DR. SENTHIL KUMAR J,MR. BALAVIGNESH S,MR. SUNDAR S,AMEER KHAN B,BARATHWAJ S,KALAISELVAN R,ARUN M,KIRAN AKASH S,GOKUL R,KARTHIKEYAN S

(iii) Declaration by the applicant(s)

- **The Complete specification relating to the invention is filed with this application.**
- **I am/We are, in the possession of the above mentioned invention.**
- **There is no lawful ground of objection to the grant of the Patent to me/us.**
- **I am/We are, the assignee or legal representative to true first inventors.**

10. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION:

Sr.	Document Description	FileName
1	COMPLETE SPECIFICATION	Complete specifications.pdf
2	DRAWINGS	diagram.pdf
3	STATEMENT OF UNDERTAKING (FORM 3)	form-3.pdf
4	DECLARATION OF INVENTORSHIP (FORM 5)	FORM 5.pdf

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

Dated this(Final Payment Date): -----

Signature:

Name: PALANISAMYMANOJKUMAR

To The Controller of Patents
The Patent office at CHENNAI

This form is electronically generated.

AXIAL FLUX MOTOR FOR E-VEHICLE

ABSTRACT

Axial flux motors, also known as disk motors or pancake motors, are a type of electric motor that has gained attention in recent years due to its potential to increase the efficiency and power density of electric vehicles (EVs). Unlike traditional radial flux motors, which have a magnetic field that is perpendicular to the axis of rotation, axial flux motors have a magnetic field that is parallel to the axis of rotation. This design results in several key advantages over radial flux motors, making it an attractive option for EV applications. One of the key advantages of axial flux motors is their compact size. The magnetic field being parallel to the axis of rotation means that the length of the stator and rotor can be reduced, resulting in a smaller overall size compared to radial flux motors of the same power output. This compact size is particularly important in EV applications, where space is limited and every inch counts. A smaller motor also reduces the weight of the vehicle, which is critical for extending the range of the vehicle and improving overall efficiency. Another advantage of axial flux motors is their high power density. The compact design of the motor allows for a higher magnetic density, which results in higher torque and power output. This increased power density means that an axial flux motor can deliver the same amount of power as a radial flux motor of much larger size, making it a more efficient option for EV applications. Axial flux motors also offer improved cooling compared to radial flux motors. The compact design of the motor means that the stator and rotor are closer together, allowing for improved heat dissipation. This improved cooling is important in EV applications, as the motor must be able to operate efficiently at high temperatures and high-power outputs. In addition to these advantages, axial flux motors also have a more favorable torque-to-weight ratio compared to radial flux motors. This improved torque-to-weight ratio means that axial flux motors can deliver high torque with a relatively low weight, which is important for improving the acceleration and overall performance of an EV. However, despite these advantages, there are also some challenges associated with axial flux motors. One of the main challenges is the difficulty in manufacturing and assembling the motor. The compact design of the motor means that components must be precisely manufactured and assembled, which can be challenging and time-consuming.

AXIAL FLUX MOTOR FOR E-VEHICLE

COMPLETE SPECIFICATION

FIELD OF THE INVENTION

However, axial flux motors pose some serious design and production challenges that have made them far more costly than their radial counterparts, despite the technological advantages. Radial motors are well-understood, and manufacturing methodologies and machinery are readily available.

One major challenge with axial machines is maintaining a uniform air gap between the rotor and the stator, as the magnetic forces are much higher than in radial machines. Dual-rotor axial machines also have thermal issues, as the windings are located deep within the stator and between the two rotor discs. That makes it difficult to dissipate the heat.

Axial flux motors have also been difficult to manufacture, and for several reasons. Dual-rotor machines with a yokeless topology (where the iron yoke of the stator is removed but the iron teeth are kept), overcome some of the problems while avoiding the need to scale the machine's diameter and magnets.

BACKGROUND OF INVENTION

A new type of motor is gaining traction in the e-mobility sector – the axial flux type. For many years they have been used in stationary applications such as elevators and agricultural machinery, but over the past decade a number of developers have been working on improving the technology to make it suitable for applications such as electric motorcycles, airport pods, delivery trucks, electric cars and even aircraft.

Traditional radial flux motors, which use permanent magnets or induction motors in an electric field, are undergoing extensive development aimed at optimizing their weight and cost. That can only go so far, however, so moving to a completely different machine type such as axial flux might be a good alternative.

Axial flux permanent magnet machines typically provide more torque for a given volume of motor than a radial motor, as the active magnetic surface area is the face of the motor's rotor rather than the outside diameter.

SUMMARY OF THE INVENTION

The invention of axial flux motors can be traced back to the 1960s, when engineers and scientists first started exploring new designs for electric motors that could deliver higher power density, efficiency, and performance. Axial flux motors differ from conventional radial flux motors in that they use a disc-shaped rotor and stator, where the magnetic flux flows in an axial direction, perpendicular to the rotor and stator.

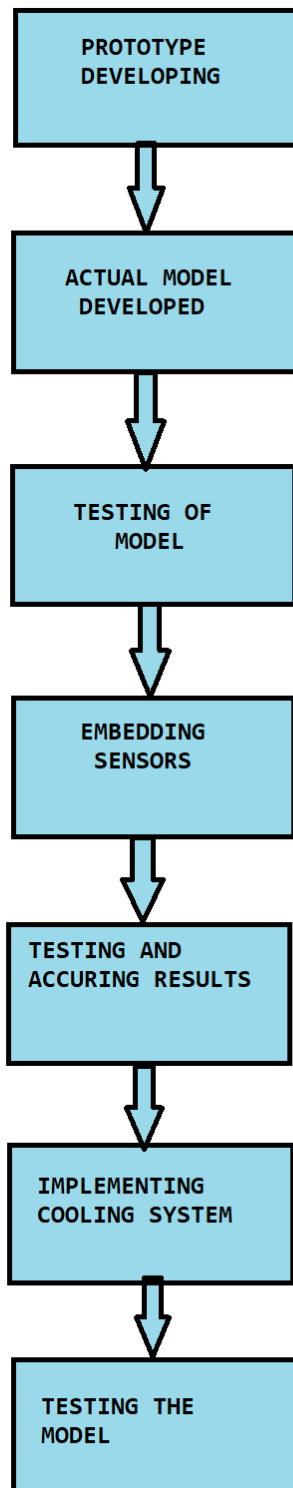
DETAILED DESCRIPTION OF THE INVENTION

The development of axial flux motors was motivated by the need for more efficient and compact electric motors for various applications, including electric vehicles, industrial drives, and renewable energy systems. The key innovations in the design of axial flux motors include the use of disc-shaped rotors and stators, the optimization of magnetic circuit and airgap, and the integration of power electronics and control systems.

Over the years, axial flux motors have attracted increasing attention from researchers, engineers, and manufacturers due to their potential to deliver high performance and efficiency. However, the development and implementation of axial flux motors face several challenges, such as the design and manufacture of high-performance components, the optimization of cooling and thermal management, and the validation of performance and reliability under real-world conditions.

Despite these challenges, the invention of axial flux motors represents a significant step forward in the development of more efficient and high-performing electric motors. Further research and development are needed to overcome the remaining challenges and realize the full potential of axial flux motors.

3D MODEL DIAGRAM OF AXIAL MOTOR



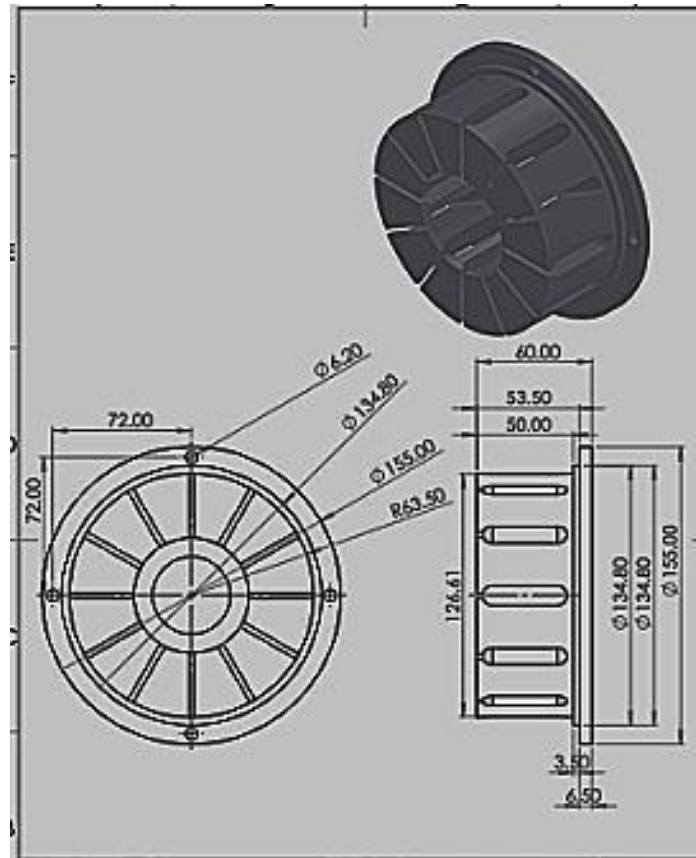


Figure.7. Stator of Original Model

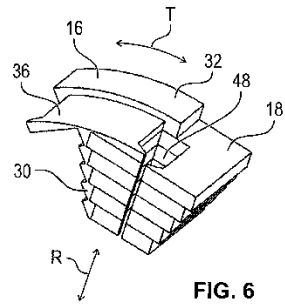


FIG. 6

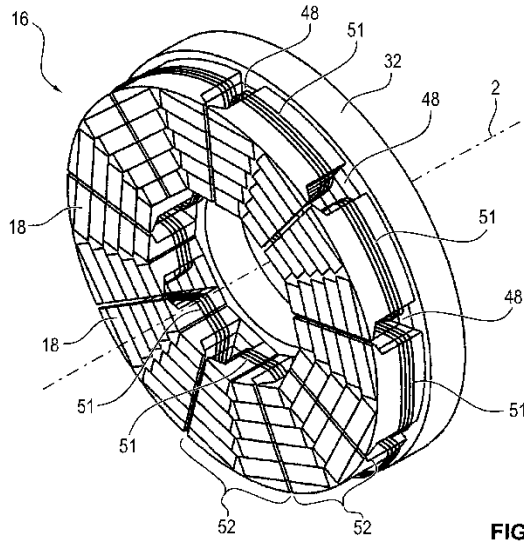


FIG. 7

Figure.1. Stator view of Axial Flux motor

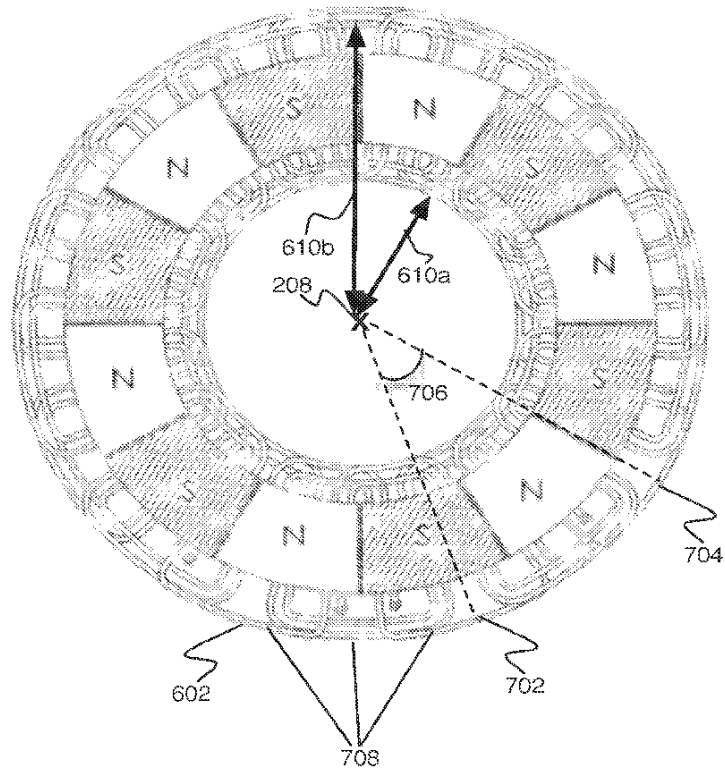


FIG. 7

Figure.2. Rotor upper View of Axial Flux motor

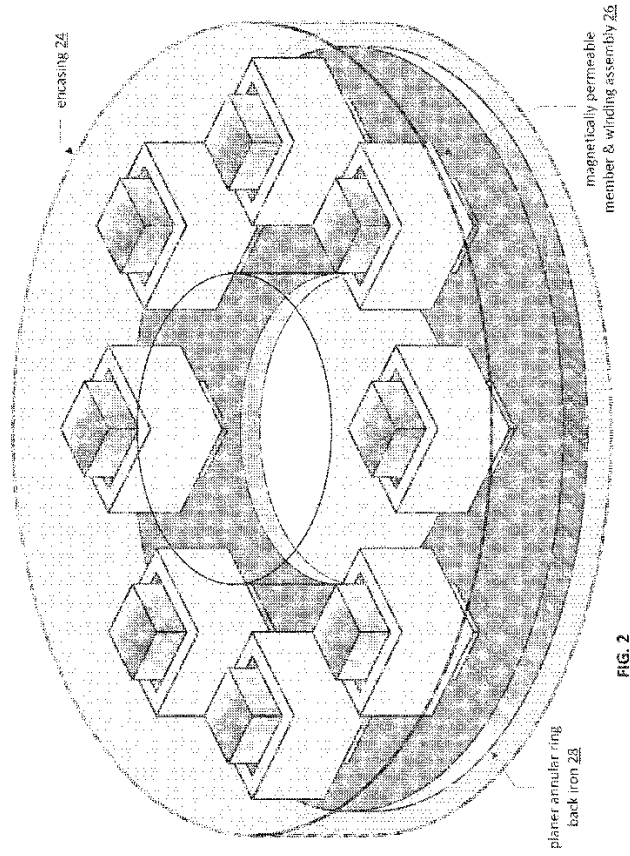


Figure.3. Side view of Outer Cover model

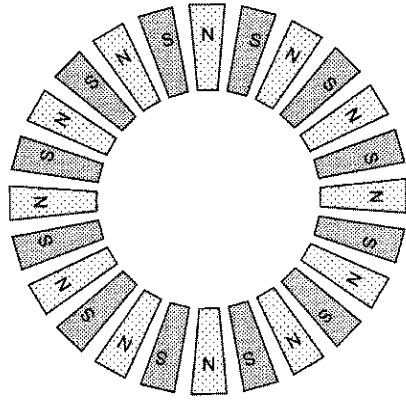


FIG. 6

Figure.3. Neodymium Magnet



Figure.4. Schematic diagram of Axial Flux motor

PERFORMANCE STUDY OF AXIAL FLUX MOTOR FOR E-VEHICLE

Claims:-

1. As per claim 1, Axial flux motors have a compact design compared to traditional radial flux motors, making them a good option for EV applications where space is limited.
2. As per claim 2 Axial flux motors have a higher power density compared to radial flux motors of the same size, which means that they can deliver more power in a smaller package.
3. As per claim 3 The compact design of axial flux motors allows for improved heat dissipation, making them more suitable for use in high-power applications.
4. As per claim 4, Axial flux motors have a better torque-to-weight ratio compared to radial flux motors, which can improve the acceleration and overall performance of an EV.
5. As per claim 5, Axial flux motors are designed to have a more efficient magnetic circuit, which can result in improved overall efficiency compared to radial flux motors.
6. As per claim 6, The compact design and improved magnetic circuit of axial flux motors can result in increased performance compared to radial flux motors, making them an attractive option for high-performance EVs.

FORM 5
THE PATENT ACT, 1970
(39 OF 1970)
&
The Patents Rules, 2003
DECLARATION AS TO INVENTORSHIP
[See section 10(6) and Rule 13(6)]

1. NAME OF APPLICANTS	DR. VEERA KUMAR S AP , Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Erode – 638401
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KARTHIKEYAN S
UG Student, Department of EEE, Bannari Amman Institute of
Technology, Sathyamangalam, Erode – 638401

hereby declare that the true and first inventor(s) of the invention disclosed in the complete specification filed
in pursuance of our application numbered _____/CHE/2021 dated _____ are

2. INVENTOR (S)

1. (a) Name DR.S. VEERA KUMAR
 - a. (b) Nationality India
 - b. (c) Address AP, Department of EEE, Bannari Amman Institute of
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12. (a) Name KARTHIKEYAN S
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Dated this 02th day of November 2022

Signature :

Name: DR. J. SENTHIL KUMAR

3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT (S) IN THE CONVENTION COUNTRY:-

-NA-

**To,
The Controller of Patent
The Patent Office, at Chennai.**

FORM 3

THE PATENTS ACT, 1970

(39 of 1970)

and

THE PATENTS RULES, 2003

STATEMENT AND UNDERTAKING UNDER SECTION 8

(See section 8; Rule 12)

1. Name of the applicant(s).	I/We hereby declare: DR. VEERA KUMAR S DR. SENTHIL KUMAR J DR. MANOJ KUMAR S MR. BALAVIGNESH S MR. SUNDAR S BARATHWAJ S AMEER KHAN B ARUN M KALAISELVAN R KIRAN AKASH S GOKUL R KARTHIKEYAN S
2. Name, address and nationality of the joint applicant.	(i) that I/We have not made any application for the same/substantially the same invention outside India Or (ii) that I/We who have made this application No.....datedalone/jointly with, made for the same/substantially same invention, application(s) for patent in the other countries, the particulars of which are given below:

Name of the country	Date of application	Applicati on No.	Status of the application	Date of publication	Date of grant
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3. Name and address of the assignee	(iii) that the rights in the application(s) has/have been assigned to BARATHWAJ S
	<p>UG Student, Department of EEE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu 638 401</p> <p>that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application.</p>
4. To be signed by the applicant or his authorized registered patent agent.	Signature.
5. Name of the natural person who has signed.	DR. J. SENTHIL KUMAR
	<p>To</p> <p>The Controller of Patents,</p> <p>The Patent Office,</p> <p>at.....</p>
Note.- Strike out whichever is not applicable;	