KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT

AND

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Centre for Engineering Research and Development

Jointly Organize

INNOVATE 2018 OF KSCSTE

Application Form

1. Mode of Participation: Individual ☐ Group ☑ (*Please tick the category*)
2. Title of the Project: MagLev Fan
3. Name of the Applicant (Group leader for team): Ameen.K.B

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4. Name and Official Address of the Mentor: Dr. Nafeesa.k
   (*Should be a faculty of the Institution*) Professor, ECE dept, MES college of Engg. Kuttippuram.

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5. Name and Address of the Institution: MES College of Engineering, Thrikkanapuram P.O, Kuttippuram, Malappuram Dist. Kerala. PIN:679573
6. In case of group participants details of group members

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7. Details of the proposed project:

i. Abstract of the Project:

Friction and noise are the root disadvantages for the traditional fan motors. After long term operation, rubs between the shaft and the inner surface of the bearings cause abrasions, in turn creating noise and sway. This drawback can be solved using the MagLev motor fan, which works under the principles of magnetic levitation. By the use of this mentioned fan, the noise and friction in the fan can be reduced considerably, while making it available at the same cost of that of conventional electric fans. Here, the stator and rotor are physically independent of each other completely. The rotation of the rotor is suspended using the magnets such that the use of ball bearings is eliminated, thereby removing friction. The independent motion of the rotor also helps to attain greater speeds under less power, reducing power consumption. The suspension of the rotor makes the motor noise proof as there are no slipping parts. The heat formation in the motor can also be thus reduced.

The design varies from conventional fans in various aspects. The number of poles required for the construction of this fan is only 8-12, whereas a conventional electric fan uses 18-22 poles. Thus the amount of steel required for construction and copper for winding is considerably reduced, reducing the weight of the stator and also mainly, the cost. There is no Aluminum housing required as the rotor runs independent of the stator. Whereas, dust caps are provides on the open parts in order to block the entry of atmospheric dust particles and to provide a good aesthetic appearance. The leaves of the fan are attached to the periphery of the rotor base, which are provided with the rotor steel sheets. The leaves of the fan can be made using fiber plastic in order to reduce the overall weight of the fan and also reducing the cost.

The same motor can also be used to implement other electrical fan devices such as bathroom exhaust, air blowers, vacuum pumps, blowers in rice fields etc. where the design of the fan is changed. The bearing and magnet position is made axial such that 360° orientation of the motor is possible. In case of a ceiling fan, full angle orientation is irrelevant.

When the supply is given to the fan, the electromagnets provided above gets magnetized and pull the rotor off the base, levitating it in a thin cushion of air, independent from any physical contact, under the influence of the magnetic field produced by the electromagnets. This leads to the rotation of the leaves of the fan with high speed, no friction, noise, and heat issues.

At open switch condition, the rotor rests on the ball bearings provided at the base of the motor under gravitational force. When the supply is given, the fan rotates as a conventional fan. As the fan picks up the speed, the electromagnets provided above the rotor gets magnetised and lifts up the rotor from the supporting ball bearing structures and rotates on a cushion of air, above the ball bearings and below the elctromagnets. The speed controlling of the fan can be brought about by using either electronic regulator of capacitive regulator. While switching off the fan, the electromagnet slowly loses the magnetisation and the rotor smoothly lands back onto the ball bearings given below, giving no posible chance for wear and tear.

A variable capacitance in series (usually few capacitors connected together with some tappings corresponding to each step) is used for speed regulation. As we turn the knob the capacitance increases and it reduces the voltage available to the fan. For example the fan rated 230V may get only 180V due to voltage division. This will reduce the fan speed. There is nearly no power loss in this method. The losses incurred are due to resistive losses inside the capacitor which is negligible. So a fan with rating 230V, 50W will consume only 25-30 Watts at low speeds. There are no heating problems and the capacitor improves the power factor of the circuit. They are less bulky than resistive controllers.

Advantages:

- Low Noise: Noise is reduced as the fan doesn't contain any slipping or sliding parts
- High speed rotation possible
- No friction with good balance
- High temperature endurance: No friction and keep a low temperature between the shaft and the bearings
- Consist of temperature resistant material
- Longer life
- Prevents dust penetration, increases lubrication and circulation
- Suitable for multiple orientation with no noise occurred
- Lower power consumption
- Cost effective
- Less maintenance required

ii. Summary of the Project:

The aim of the project is to manufacture a simple, efficient and cost effective fan which overcomes most of the drawbacks of the conventional fans available in the market. The system of MagLev fan works on the principle of magnetic levitation, which suspends the rotor of the fan in a cushion of air, such that the rotor is completely independent of the stationary parts of the fan, thus providing less chance for friction. The considerable reduction in the friction also helps to reduce other loss factors such as noise, heat etc. The independent motion of the rotor also helps to attain greater speeds under less power, reducing power consumption. The other advantages of the fan includes high temperature endurance, longer life, prevention of dust penetration, multiple orientation with no noise occurred, lower power consumption, cost effectiveness and less maintenance.

When the supply is switched on, the fan rotates as a conventional fan. As the fan picks up the speed, the electromagnets provided above the rotor gets magnetised and lifts up the rotor from the supporting ball bearing structures and rotates on a cushion of air, above the ball bearings and below the elctromagnets. The speed controlling of the fan can be brought about by using either electronic regulator of capacitive regulator. While switching off the fan, the electromagnet slowly loses the magnetisation and the rotor smoothly lands back onto the ball bearings given below, giving no posible chance for wear and tear.

iii. Methodology in detail (including drawings):

WORKING PRINCIPLE: Magnetic Levitation

Magnetic levitation, maglev, or magnetic suspension is a method by which an object is suspended with no support other than magnetic fields. Magnetic force is used to counteract the effects of the gravitational acceleration and any other acceleration.

The two primary issues involved in magnetic levitation are lifting forces: providing an upward force sufficient to counteract gravity, and stability: ensuring that the system does not spontaneously slide or flip into a configuration where the lift is neutralized.

Magnetic materials and systems are able to attract or press each other apart or together with a force dependent on the magnetic field and the area of the magnets. For example, the simplest example of lift would be a simple dipole magnet positioned in the magnetic fields of another dipole magnet, oriented with like poles facing each other, so that the force between magnets repels the two magnets.

Design:

The rough model design of the MagLev fan designed using Rhinoceros 3D software is given below. Fig. 1 and fig.2 shows the perspective view of the machine and fig.3 shows the exploded view. Here the stator or the central hub is given in white color, the electromagnetic portion is denoted red, and the rotor is given blue color. The MagLev motor fan works under the principles of magnetic levitation, where the rotor is suspended in the space with the help of electromagnets.

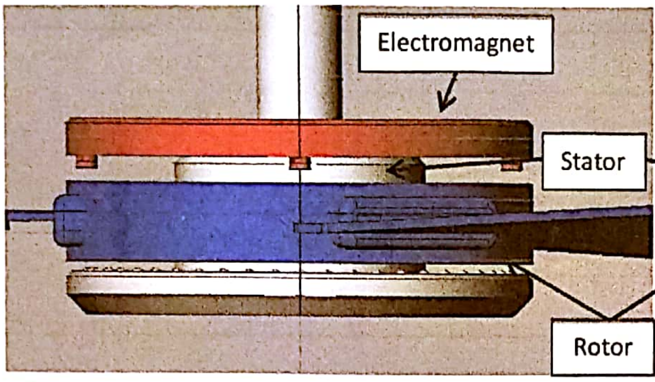


Fig. 1

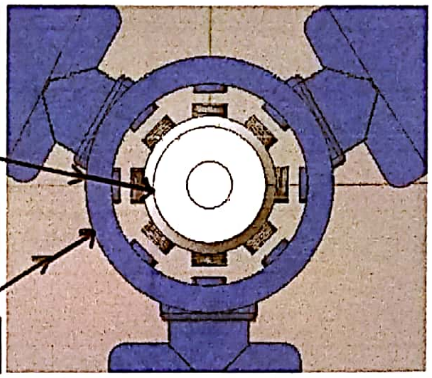


Fig. 2

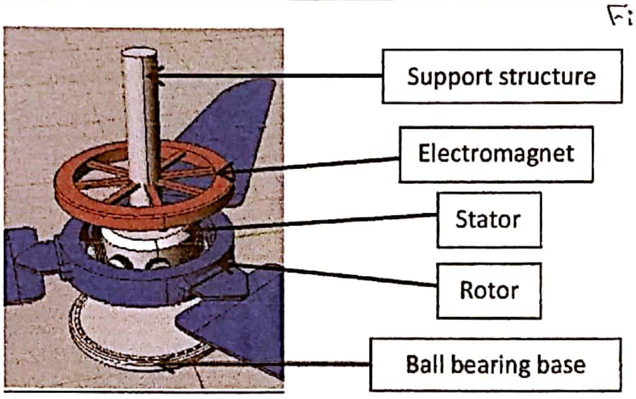


Fig. 3

The design varies from conventional fans in various aspects. The number of poles required for the construction of this fan is only 8-12, whereas a conventional electric fan uses 18-22 poles. Thus the amount of steel required for construction and copper for winding is considerably reduced, reducing the weight of the stator and also mainly, the cost. There is no Aluminum housing required as the rotor runs independent of the stator. Whereas, dust caps are provides on the open parts in order to block the entry of atmospheric dust particles and to provide a good aesthetic appearance. The leaves of the fan are attached to the periphery of the rotor base, which are provided with the rotor steel sheets. The leaves of the fan can be made using fiber plastic in order to reduce the overall weight of the fan and also reducing the cost.

The same motor can also be used to implement other electrical fan devices such as bathroom exhaust, air blowers, vacuum pumps, blowers in rice fields etc. where the design of the fan is changed. The bearing and magnet position is made axial such that 360° orientation of the motor is possible. In case of a ceiling fan, full angle orientation is irrelevant.

Components Required:

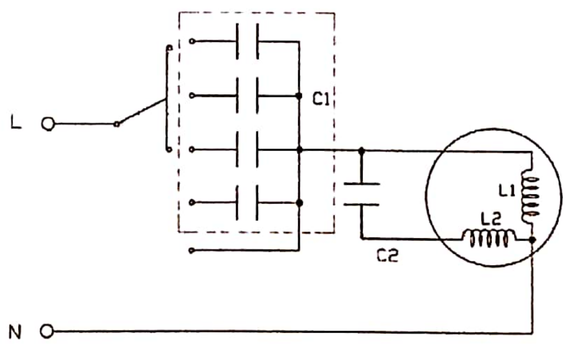
- 220v 50Hz AC Electromagnets: 4-6
- Speed control capacitors: 1uF, 1.5uF, 2uF
- AC fan capacitor: 2.5uF
- Copper wire for main and auxiliary windings
- Steel ball bearings
- Electric steel sheet for stator and rotor poles
- Non corrosive iron for rotor base
- Connection wires

Working:

When the supply is given to the fan, the electromagnets provided above gets magnetized and pull the rotor off the base, levitating it in a thin cushion of air, independent from any physical contact, under the influence of the magnetic field produced by the electromagnets. This leads to the rotation of the leaves of the fan with high speed, no friction, noise, and heat issues.

At open switch condition, the rotor rests on the ball bearings provided at the base of the motor under gravitational force. When the supply is given, the fan rotates as a conventional fan. As the fan picks up the speed, the electromagnets provided above the rotor gets magnetised and lifts up the rotor from the supporting ball bearing structures and rotates on a cushion of air, above the ball bearings and below the elctromagnets. The speed controlling of the fan can be brought about by using either electronic regulator of capacitive regulator. While switching off the fan, the electromagnet slowly loses the magnetisation and the rotor smoothly lands back onto the ball bearings given below, giving no posible chance for wear and tear.

Speed Regulator: A variable capacitance in series (usually few capacitors connected together with some tappings corresponding to each step) is used in this regulator. As we turn the knob the capacitance increases and it reduces the voltage available to the fan. For example the fan rated 230V may get only 180V due to voltage division. This will reduce the fan speed. There is nearly no power loss in this method. The losses incurred are due to resistive losses inside the capacitor which is negligible. So a fan with rating 230V, 50W will consume only 25-30 Watts at low speeds. There are no heating problems and the capacitor improves the power factor of the circuit. They are less bulky than resistive controllers.



iv. Expected social relevance/benefit of the project:

The social relevance and benefits of this project can be explained by comparing the MagLev fan with the currently available conventional electric fans.

- Loss due to friction: The main disadvantage of conventional electric fans is the frictional loss that takes place in the contact areas, shaft and the bearings. Here, in the maglev fan, friction is considerably eliminated, as there are no direct contact between stator and rotor. This in turn reduces the heat loss, noise and high power consumption due to friction.
- Cost efficient: The conventional electric fan comes in the market under the price range of INR 1000 to 5000. The number poles of the maglev fan are considerably less than the conventional fans. Thus the amount of copper (which accounts for major part of the budget) and steel sheet are very much less, considerably reducing the cost. The absence of Aluminium housing also account for low cost.
- Less power consumption: The power consumption of the machine is less compared to the conventional fans as it uses electromagnets, which consumes 2-10W along with the frictionless rotor, which sums up the overall consumption around 30-50W, whereas the conventional system consumes 35-75W.
- Less Maintenance: The main reasons for the maintenance of traditional fans are recoiling and wear and tear. The levitation of rotor helps in reducing the maintenance as the heat dissipation is reduced well.
- Unlike conventional motors, easy assembly and disassembly is possible.
- For conventional fans with no magnetic control exerted over the blade trajectory, a traditional fan tends to produce irregular shuddering and vibrations. After long-term use, the shaft will cause severe abrasion on the bearings, distorting them into a horn shape. The worn-out fan will then start to produce mechanical noises and its life will be shortened. Maglev fans overcome this issue by making multi-angle orientation possible

Advantages in short:

- Low Noise: Noise is reduced as the fan doesn't contain any slipping or sliding parts
- High speed rotation possible due to magnetic levitation
- No friction with good balance
- High temperature endurance: No friction and keep a low temperature between the shaft and the bearings
- Consist of temperature resistant material
- Longer life
- Prevents dust penetration, increases lubrication and circulation
- Suitable for multiple orientation with no noise occurred
- Lower power consumption
- Cost effective
- Less maintenance required

The social applications of the proposed project are given as below:

- Ceiling fan for household
- Exhaust fan in bathrooms
- Agricultural blowers in the rice fields
- Portable vacuum cleaners
- Most of air flow regulating motors

8. Budget details of the project:

Estimated approximate cost of the proposed project is as follows. It is to be noted that the cost of the development of prototype may be higher than the actual product in the market, as it includes experimental parts, spares, working and labor charges. If the item is to be produced in bulk, the cost can be reduced by 50%.

- Copper Wire : Rs. 1000/-
- Metal parts: Iron : Rs. 1000/-
- Metal parts: Steel : Rs. 1500/-
- Electromagnetic components : Rs. 2000/-
- Auxiliary parts : Rs. 1000/-
- Electronic components
    - Regulator : Rs. 350/-
    - Capacitor : Rs. 50/-
    - Connection wires : Rs. 100/-
- Labor charges : Rs. 500/-
- Miscellaneous costs : Rs. 500/-

- Total cost : Rs. 8000/-

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8. Budget details of the Project :

9. Whether the project has been exhibited in any National/State level contest?
   If yes please provide the details: NO

10. Whether the project won any prize in National/State level contest?
   If yes please provide the details: NO

We declare that the above statements are true to the best of our knowledge.

17/10/17 Dr. N...

Signature of the Mentor

Signature of the Applicant

Office seal

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