Design and build an electrical motor housing for an electric motor bike

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INTRODUCTION

This project required an electric motor to be designed to drive the electric bike being designed in the EPICentre at Otago Polytechnic. Electric motors are becoming more popular as a cheap and environmentally friendly way to travel (Martin, n.d.). Our issue was to create a housing for an electric motor on a bike. The motor had to be small enough to fit inside the wheel and be strong enough to handle the forces exerted on it. There are two main types of motor that could be used: the axle flux motor and the radial flux motor. The axial flux motor has an air gap between the stator and the rotor parallel to the axis of rotation, whereas the radial flux motor has an air gap between the stator and rotor on the same plane of the rotation (Moreels, n.d.). The motor type chosen was an axial flux permanent magnet with single stator and dual rotor design as shown in illustration 2. The axial flux motor was chosen for its high torque and low rpm as well as for its high power to density ratio (Moreels, n.d.). This allowed for a much smaller width of motor, enabling us to have the whole motor design being confined within the wheel width.

Figure 1: The motor mounted in the bike wheel.

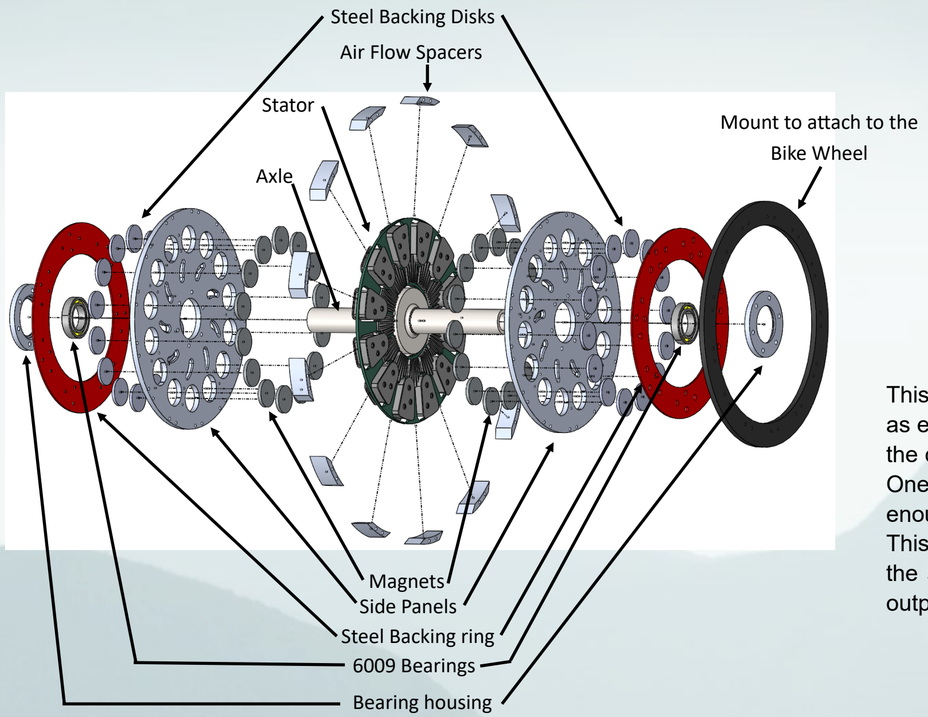

Figure 2: Exploded view of motor

Bearing Housing: A bush that attaches to the side panel to give enough space for the bearing to sit in.

6009 Bearing: stranded 6009 Bearing

Steel Backing Ring: Steel ring that bolts to the side panel so the steel backing disks have something to be bolted onto. Also adds more steel to contain the magnetic flux.

Steel Backing Disks: Sits behind the magnets to give a solid attachment for the magnets to be glued in, also acts as a containment to keep the magnetic flux from escaping.

Side Panels: The main structure of the housing. This is what holds it all together and where all the force analysis was done. It has a Factor of safety of 2.2

Magnets: These are the 50x6mm neodymium magnets, the strongest rare earth magnets.

Axle: Stationary hollow axle that the stator is attached to and the side panels rotate on. The axle is hollow to allow the wires to run from the stator to the control unit inside the bike.

Stator: Holds the coils (electro magnets) in place and acts as the driver to spin the magnets, causing the motor to spin.

Air Flow Spacers: Spacers that allow air flow though the motor and maintain the air gap between the magnets and the stator.

Mount to Attach Bike Wheel: 10mm disk that is welded to the hub of the wheel to attach the motor.

Basic costing

Item	Cost of material	Cost to build	Total Cost
Magnets	$700	-	$700
Side Panel	$300	80 mins water jet-cutter @ $8 min + 40 mins lathe @ $80 hr	$993
Air Flow Spacers	$50	30 mins water jet-cutter @$8 min 60 mins milling @ $80 hr	$370
Steel back-ers	$40	20 mins water jet-cutter @ $8 min	$210
Steel ring	$80	25 mins water jet-cutter @ $8 min	$280
Bearings	$55	-	$55
Fixtures	$50	-	$50
Wheel	$100	Welding 1 hr @ 80hr	$180
Axle	$100	45 mins lathe @ $80 hr	$160
		Total	$2998

Table 1: Costings

Conclusion

This housing design was assembled easily and seems to be functioning as expected. Unfortunately, it was unable to be tested at this time because the controller to run the motor has not yet been made available for testing. One of the main drawbacks is the stator design which was not strong enough take the force of the magnets and broke during the first test fit. This caused the stator to be misaligned when remounted, which caused the air gap to be a lot larger then desired. This would reduce the power output of the motor.

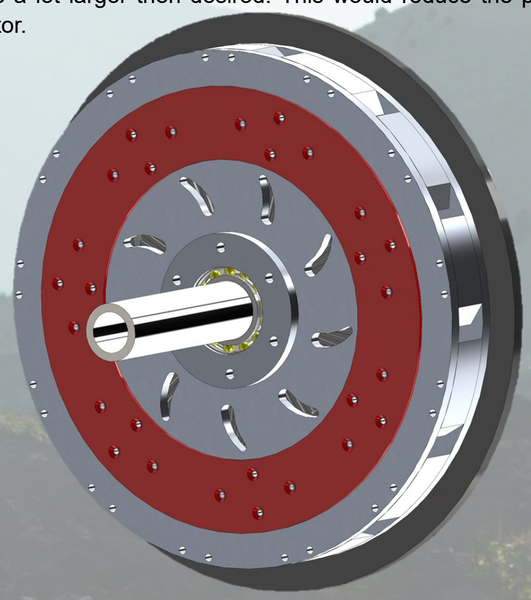

Figure 3: 3D Solid Works render of motor

Martin, K. (n.d.). *Why Electric Cars Are Becoming More Popular – All About Electric Cars and Solar Energy*. Retrieved October 21, 2020, from http://www.ebig.org/electric-cars-becoming-popular/

Moreels, D. (n.d.). *Axial Flux vs Radial Flux: 4 Reasons Why Axial Flux Machines have a Higher Power Density*. Retrieved October 10, 2020, from https://www.magnax.com/magnax-blog/axial-flux-vs-radial-flux_-4-reasons-why-does-axial-flux-machines-deliver-a-higher-power-density

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