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A REVIEW ON DESIGN AND FABRICATION OF FILAMENT WINDING MACHINE

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Abstract: Designing a filament winding machine involves two major components. First component is the designing of the mechanism which delivers appropriate winding pattern as specified by the user (i.e. the winding angle). The second component is the realization of an effective fiber tensioning system for ensuring consistent overall consolidation. However for creating axi-symetric products with constant diameter, only a 2-axis winding is sufficient. On this note a novel cost effective method for fiber winding angle control and fiber winding tension control is designed, simulated, implemented into a low cost prototype 2-axis filament winding machine, and the scope for its" further improvement has also been discussed.

1. Introduction

Filament Winding process is involves winding filaments under tension over a rotating mandrel. The mandrel rotates around the spindle while a delivery eye on a carriage traverses horizontally in line with the axis of the rotating mandrel, laying down fibers in the desired pattern or angle. The most common filaments are glass or carbon and are impregnated in a bath with resin as they are wound onto the mandrel. Once the mandrel is completely covered to the desired thickness, the resin is cured. Depending on the resin system and its cure characteristics, often the rotating mandrel is placed in an oven or placed under radiant heaters until the part is cured. Once the resin has cured, the mandrel is removed or extracted, leaving the hollow final product. This fabrication technique allows production of strong, lightweight parts, especially for components of aerospace hydrospace and military applications and structures of commercial and industrial usefulness.

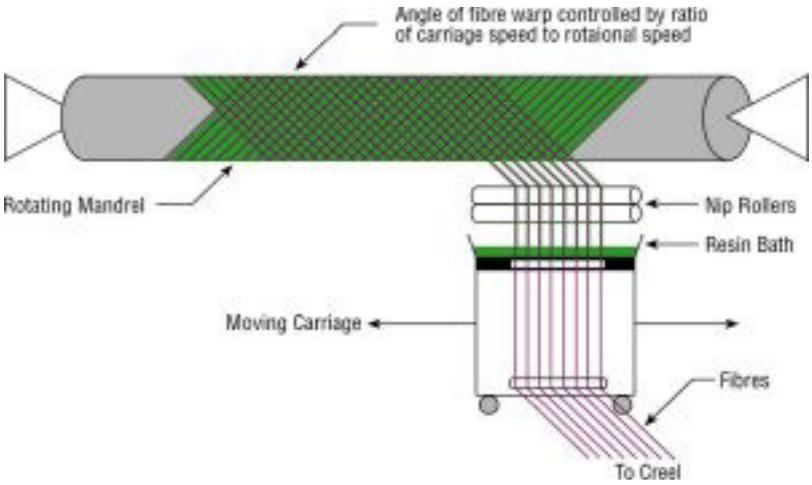

Figure 1. Representation of filament winding process

2. Materials and Methods

Filament Winding is one of the most widely used processes for manufacturing axis symmetric objects. The applications of filament winding range are very wide; it includes pressure vessels, chemical tanks, aircraft fuselages, rocket motor cases, helicopter rotor shafts, high pressure pipelines, sporting goods, wind turbine blades and other structural applications.

Components Details:

- Main Frame
- Mandrel
- Carriage Assembly
- Motor

- Bushed bearing
- Bi-directional switch

Main frame:

The mainframe is support for all the other memers of the machine. This carries the entire weight of the other parts and the load due to operation by the tight filament winding and the turning moment of the motor etc. This is made of steel plates of 3 mm thickness and an25 mm angle plates. The angle plates are cut into dimensions as per the solid works dimensions and welded in proper place.

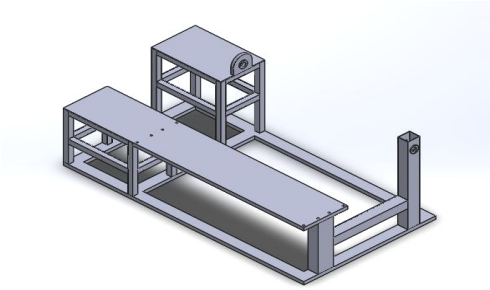

Figure 2. Main frame

Mandrel:

Mandrel having two types- wood mandrels and spider/plaster mandrels. Here using wooden mandral for low cost filament winding machine. Advantage of mandrel is low cost for small production quantities and excellent dimensional reproducibility. Mandrels of different diameters are made from wood. The ends of the mandrel are turned to 25mm to
mount on bearings. Provision is made to remove the bearing blocks to change the mandrel. The mandrel is driven using AC motor with 1440rpm, through a pulley by using a sleeve that
connects the pulley shaft and the mandrel end for positive drive. Mandrel is shown in figure 3.

Figure 3. Mandrel

Carriage Assembly:

A round nut (75mm outer diameter) is used as carriage. A sliding block is bolted to the bottom of the nut and is made to slide between the guide ways. This prevents the rotation of the nut. An aluminium lever for adjusting the center distance between the mandrel axis and the point of deviation of the fiber is mounted on the top surface of the nut.

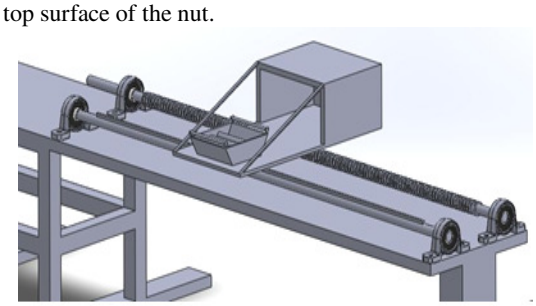

Figure 4. Carriage assembly

Motor:

Here using single phase induction motor it has 230V and 50 HZ. Single phase induction motors require just one power phase for their operation. They are commonly used in low power rating applications, in domestic as well as industrial use. This article is aimed at giving you a conceptual overview of the working of single phase motors.

Bi-Directional Switch:

Bidirectional, a roadway that carries traffic moving in opposite directions. It is a tram or train or any other vehicle that can be controlled from either end and can move forward or backward with equal ease without any need to be turned around. Bi-directional text , text containing text in both text directionalities. It is a process in computer science.

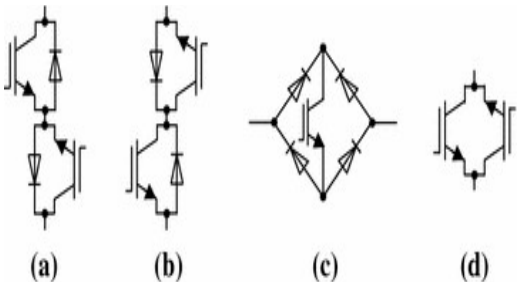

Figure 5. Bi-directional switch cell configuration

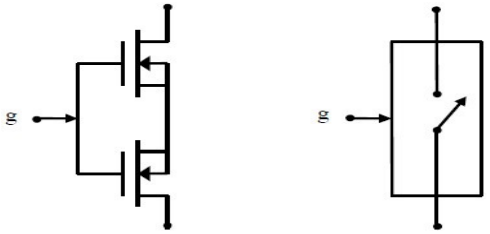

Figure 6. Bi-directional Mosfot anti series switch

Bushed Bearing:

Bush Bearing , a type of plain bearing. Bushing, an insulated device that allows a conductor to pass through a grounded conducting barrier. Bushing , a mechanical device used to reduce vibrations. Threaded bushing, a metal sleeve with screw threads

3. Experiment

The machine is fabricated as per the dimensions and assembled. The final assembly of the machine is run for checks. A product is developed using the machine on the mandrel shown in the figure.

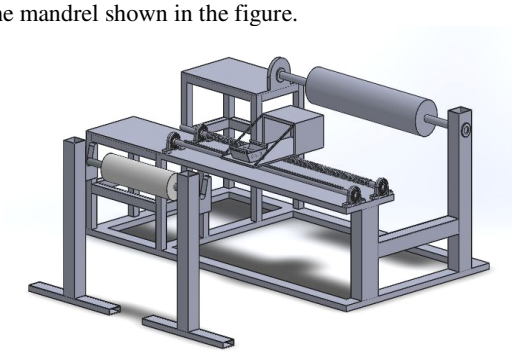

Figure 7. Assembled view filament winding machine

The material is of Nylon with a suitable binder on that. The formed tube is cured for four days in solar light and specimens were cut from it the properties of the specimens are also checked with proper standards that shows good results.

Figure 8. Finished product

Typical Applications:

1. Chemical storage tanks
2. Pipelines
3. Gas cylinders, rocket motors
4. Launch tubes
5. Pressure vessels
6. Drive shafts
7. Fishing rods
8. Missile cases.

4. Conclusion

A low cost machine was modified for filament winding and it is design and fabricated, to improve the tensile strength of the composite material. The development machine will be capable of changing the different winding angle to improve the tensile strength of the fibre.

1. The machine is capable of producing cylindrical parts of different diameters using mandrels of different sizes.
2. Different combination of fibers and resins can be used to produce cylindrical tubes.
3. The machine developed has a limitation that the length of the specimen that can be produced is limited to 600 mm.

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