Design and Modelling of Coiler Mechanism for Mini Carding Machine

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Abstract— Carding is a very important process and the quality of the final yarn that we produce is very much dependent on the quality of carding and to maintain the quality of carded slivers are packaged in the form of coils. The sliver is very weak therefore the form of package should be such that it should adequate protection during handling and it should not get entangled or stretched during packaged formation. To maintain the sliver quality, the delivery speed of carding machine slightly lower than the coiler speed. This project is the outcome of the textile Industry need to design and validate a coiling mechanism for mini carding machine, as the delivery of mini carding machine doesn't match with the existing coiling mechanism (as speed of coiling is very high). Mini carding machine needs slow speed coiling. Hence, there is a scope for designing the coiling mechanism as per the mini carding machine capacity. So that the sliver will get packaged more effectively in the sliver can. The mini-carding machine delivers 8kilograms of sliver in one hour. First the data accumulated from the existing coiler mechanism. Understood the working and design of mechanism. Mini carding machine thoroughly studied for understanding the coiler requirement. As per design data obtained and literature studied, coiler mechanism is designed and to validate the design a finite element analysis is carried out. For graphical representation 3d cad model is generated and to validate the design a finite element analysis is carried out. From the results it is observed that the design is safe for the given loading conditions.

Keywords: Carding Machine, Coiler Mechanism, CAD Modeling

I. INTRODUCTION

According to the dictionary `Card' means a wire-toothed brush or a machine fitted with rows of wire teeth, used to disentangle fibers, such as wool, prior to spinning. The word `card' was derived from the Latin word `carduus, ' meaning thistle. A pair of hand cards, consisting of thistles fixed on a wooden frame was used in the fifteenth century to comb out and clean cotton and wool fibers before spinning.

Sliver is a delicate assembly of fibers. A suitable package is needed for its storage and transportation. Being very weak, the form of package should be such that

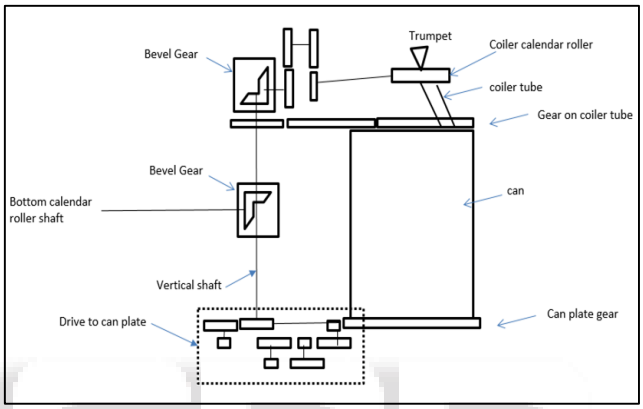
1) It provides adequate protection during handling and
2) It should not get entangled or stretched, during package formation or subsequent withdrawal

The above mentioned two requirements can be fulfilled if sliver is deposited in cycloidal fashion, i.e. in the form of spirals or coils in a container (can).

A cycloidal type deposition needs two simultaneously occurring rotary motions: one for laying the sliver in the form of coils and the other for the continues shift of the coils formed during laying so that successive coils do not form one above the other. It is also important to ensure that the gaps between successive coils are not far apart from each other leaving a large space between them.

A cycloidal deposition also results in the formation of hollow space at the center of the can(container) from bottom to top. This space avoids overlapping of sliver layer at the middle of the can and the large coils are better with small to medium size can diameter, since a lower speed of the coil laying mechanism can be used for same circumferential speed leading to reduction in force, noise and wear. The package capacity also increases by 5 to 10%.

II. WORKING OF COILER MECHANISM



The coiler gets its drive from the bottom calendar roller shaft through a gear. This drives the vertical shaft through the bevel gear. At the top of vertical shaft there is another two bevel gear through which coiler calendar roller gets the drive. The two coiler calendar rollers are being pressed together to form a nip below the coiler trumpet. The coiler calendar rollers are driven at surface speed slightly higher than that of the calendar rollers so that is a tension in the sliver. A tube wheel driven by gear. On the vertical shaft has an inclined tube with its upper end below the coiler calendar roller, so that it can collect the sliver from the nip of coiler calendar roller The lower end of the coiler tube is provided with an exit for the sliver at a point near its periphery, so that the sliver led is circular coil into the can. The can is positioned on a plate driven through reduction gearing from the bottom of the vertical shaft at a slow speed. The axis of the can is offset from that of the tube wheel.

III. DESIGN CALCULATIONS

over centre coiling: Diameter of coil is greater than radius of can

$$\frac{dc}{ds} = 1.45 \text{ approx.}$$

ds = 150 mm
Speed of coiler: 7km/hr capacity

$$v = \frac{7000m}{3600sec}$$

$$v = 2\ m/sec$$

Speed of calendar roller = 2.2 m/s
Roller diameter = 200 mm [assumed]

$$v = \frac{\pi DN}{60}$$

$$2.2 = \frac{(\pi \times 0.2 \times N)}{60}$$

$$N = 210 \text{ rpm}$$

IV. CAD MODELING

Cad model of the coiler mechanism as per the calculation.

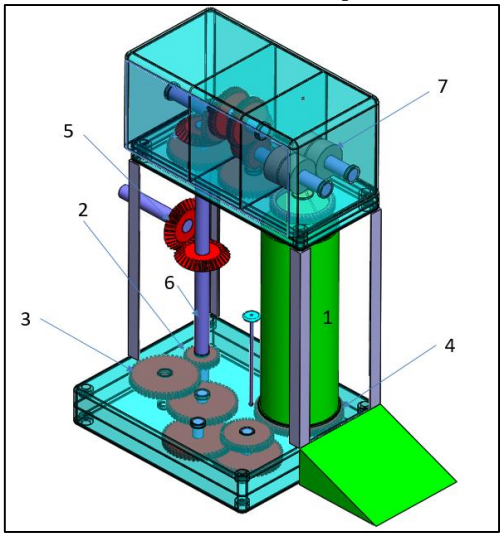


Fig. 1: Cad model of coiler mechanism

1.CAN, 2.gear 100MM dia.,3.gear 200 mm dia., 4.gear 250mm dia., 5. bevel gear 150 mm dia., 6.shaft, 7. Rollers

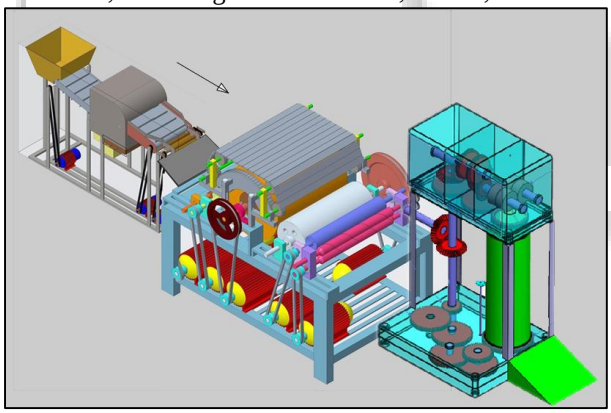


Fig. 2: synchronized model of coiler with mini carding machine

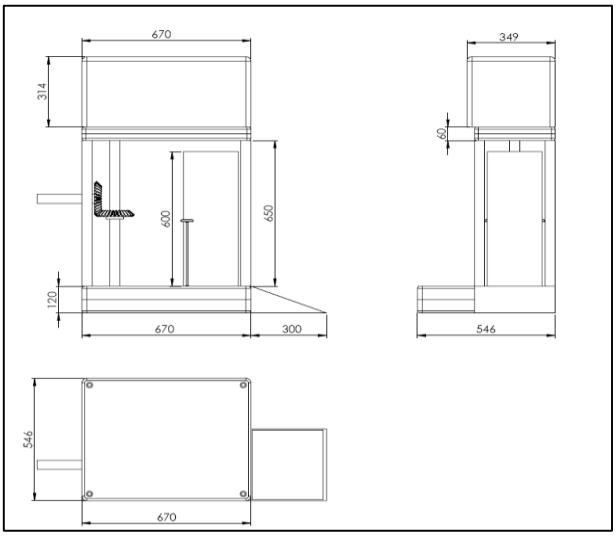
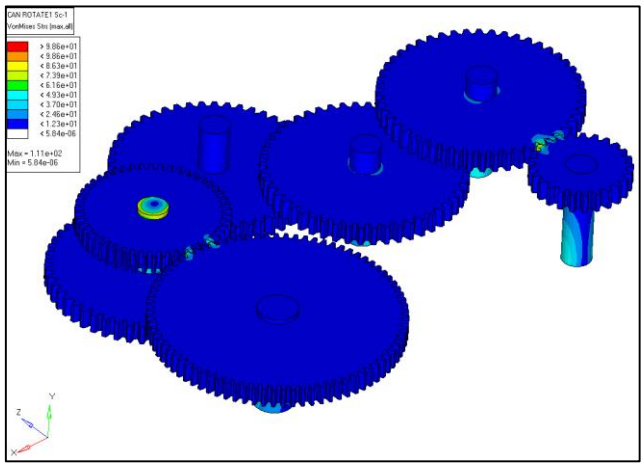


Fig. 3: Detailed view of coiler mechanism

V. FINITE ELEMENT ANALYSIS

Finite Element analysis of gears performed to understand the stresses developed in gears during operation. CAD model is converted into finite elements and boundary conditions applied to represent the actual loading.

A. Gear Train for can Rotation:



Maximum Stress = 111 MPa

VI. RESULT DISCUSSION

As per the calculation of design parameter for proposed design of carding coiler mechanism for mini-carding machine the determined parameter are as follows;

The diameter of can=217.5mm
The height of can =760mm
Calendar roller diameter = 80mm
Trumpet Size = 5.5mm
Speed of coiler = 2m/sec

Per hour capacity of mini-carding machine is 5 to 8kg/hr. The average capacity =60kg/8hr

As the outlet capacity of sliver from mini-carding machine is 5to 8 kg/hr with 2m/sec speed of coiler. We have to increase the speed of calendar roller, because of this it will not get gather. It is very important to get tension in the sliver because for the further production the strength in the sliver is necessary. Based on design calculations graphical representation 3d cad model is generated and to validate the design a finite element analysis is carried out. From the results it is observed that the design is safe for the given loading conditions.

VII. CONCLUSION

In every industry a considerable portion of investment is being made for machinery installation. So in this project we have improved the performance of mini carding machine by designing the coiling mechanism which implies that industrialist have not to pay for new machine performing tasks, since this machine will perform with improved capacity.

The project includes accumulating existing data, performing design calculations, CAD modelling and FEA of the proposed model as per the requirement. From the results of Finite element analysis, we can see the stresses, developed in the design are within the yield stress limits which results in

safe design. The performance is improved by maintaining slightly higher speed of coiler calendar roller.

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