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Eccentric Detector in Spinning Mill Spindles

R. Thiruppathi[1], S. Karthikeyan[2], A. Mano Abinesh[3], M. Kishor[4], R. Manikandan[5]
[1]*Assistant Professor, Dept. of Mechanical Engineering, Sri Eshwar College of Engineering, Coimbatore, India*
[2,3,4,5]*UG Student, Dept. of Mechanical Engineering, Sri Eshwar College of Engineering, Coimbatore, India*

***Abstract*: The quality of yarn produced in spinning mills is highly influenced by the spindles rotating in the ring frame. The faults such as eccentricity and imbalance in rotating spindle affects quality and number of end breakages in yarn. Hence, the manufacturers would manufacture the spindle-bolster assembly with high precision. Over the period of time, the running spindles might get damaged either it got wearied or eccentric with centre. Hence it would be checked and sent for rework frequently. The volume of spindles in the frame is huge, so it is tedious to check manually. It increases the man power and workers will get fatigue due to continuous checking. The current project work is to eliminate these problem by using automatic spindle eccentricity checking system. The system consists of electric motor and drive through which the spindle rotates. An Electronic Sensing Unit in the system used to detect the eccentricity. It reduces the time & fatigue of the worker to do the same by manually and also make process easy.**

***Keywords*: Motor, vibration sensor, spindle, display unit.**

1. Introduction

Spinning is the twisting of drawn-out strands of fibres to form yarn, and is a major part of the textile industry. The yarn is then used to create textiles, which are then used to make clothing and many other products. There are several industrial processes available to spin yarn, as well as hand-spinning techniques where the fibre is drawn-out, twisted, and wound onto a bobbin.

In early days, Hand spinning was an important cottage industry in medieval Europe, where the wool spinners (most often women and children) would provide enough yarn to service the needs of the men who operated the looms, or to sell on in the putting – out system. After the invention of the spinning jenny water frame the demand was greatly reduced by mechanisation. Its technology was specialised and costly, and employed water as motive power. Spinning and weaving as cottage industries were displaced by dedicated manufactories, developed by industrialists and their investors; the spinning and weaving industries, once widespread, were concentrated where the sources of water, raw materials and manpower were most readily available, particularly West Yorkshire. The British government was very protective of the technology and restricted its export. After World War I, the colonies where the cotton was grown started to purchase and manufacture significant quantities of cotton spinning machinery. The next breakthrough was with the move over to break or open-end spinning, and then the adoption of artificial fibres. By then most production had moved to Asia.

Ring spinning is a method of spinning fibres, such as cotton, flax or wool, to make a yarn. The ring spinning machine was invented in the year 1828 by the American Thorp. In 1830, another American, Jenk, contributed the traveller rotating on the ring. In more than 150 years that have passed since that time, the machine has experienced considerable modification in detail, but the basic concept has remained unchanged. The traveller, and the spindle share the same axis but rotate at different speeds.

A ring frame was constructed from cast iron, and later pressed steel. On each side of the frame are the spindles, above them are drafting rollers and on top is a creel loaded with bobbins of roving. Spindles could rotate at speeds up to 25,000 rpm, this spins the yarn.

2. Observations

The ring spinning mills have been operating at low spindle utilisation between 67 to 80% which is below the recommended standard norm of 98% resulting to yarn production loss occurring from frequent stoppages of the ring frame and increase in the number of spindles running without producing yarn [1]. Different mechanical and electrical faults produce different vibration signature [2]. The spindle speed increases, the ratio of static to dynamic friction increases, which tends to improve the imperfections. Also, at high drafting speed, there is roller vibration and the front roller nip does not remain stable, which may lead to uneven yarn. At high spindle speed, more fly is deposited on the yarn due to high air current [5]. The spindle speed increases the yarn hairiness index first and then increases with further increase in spindle speed [6].

The vibration of elements in the ring spinning machine due to the rotation of the spindle, traveller and drafting rollers causes the spinning tension to vary. Among these, the spindle rotation is the major source to cause tension fluctuations, as it is not supported at the top and rotates at a very high speed [7].

Eccentricity is one of the factors that is likely to cause whirling of the shafts thereby subjecting them to cyclic bending stresses resulting in premature failure of the shafts. Higher the shaft whirls more is the repeated bending stresses acting on the shaft [3]. A vibrating machine consumes more power than the normally running machines. i.e., consumes extra one unit than the other machines. The vibration has also had direct impact on power consumption during running of the machine [4].

3. Methodology

- The problem is identified in the spinning mill spindles.
- The design of the product is carried out and the product is verified by analysis.
- The product is fabricated with the help of design and analysis.
- The product is experimentally investigated for the verification.
- The final product is achieved after the completion of all the process.

A. Spindle

The spindle is the main part of a ring frame which helps in twisting, winding simultaneously. Sometimes, spindle referred as 'heart of spinning'. It holds the bobbin, somewhat loosely but tight enough to prevent slippage.

1) Functions of spindle

1) Twisting and winding is performed by spindle.
2) It holds the bobbin.
3) The capacity of ring frame is mainly determined by the number of spindle.

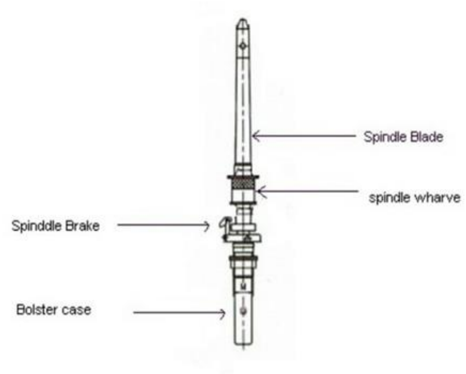

Fig. 1. Spindle

2) Effect of spindle in ring spinning

Spindles have a considerable influence on the machine's energy consumption and noise level. However, the running behaviour of the spindle, especially balancing errors and eccentricity relative to the ring, also have an impact on yarn quality and, of course, on ends down frequency. Badly running spindles have an adverse impact on almost all yarn parameters. Spinning mills must therefore always ensure the best possible centering of rings and spindles. Since the ring and the spindle are units that are independent of each other and can change position relative to each other during operation, these components must be centered from time to time. This used to be done by mobbing the spindle relative to the ring, but now usually involves adjusting the ring. Mechanical or electronic devices can be used for centering.

3) Design

The design of the experimental setup is carried out in solid works.

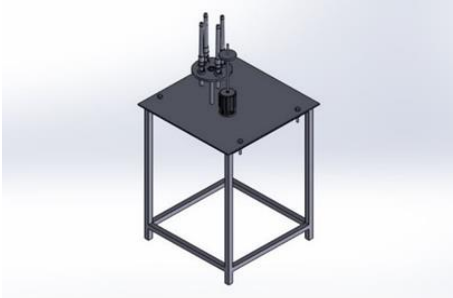
Fig. 2. Design of experimental setup

The spindle-bolster assembly is also carried out in solid works.

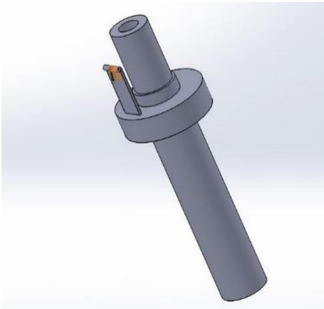
Fig. 3. Bolster


Fig. 4. Spindle

The spindle is fitted in the bolster and the bolster is fixed with the help of spindle nut.

4. Analysis

The design of the experimental setup can be verified by analysis. In analysis, the deformation and force analysis can be done.

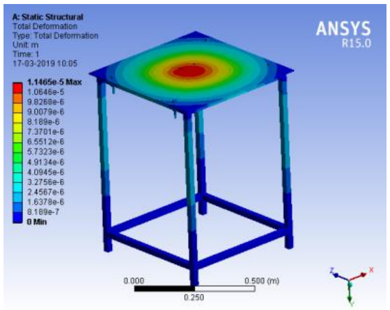

Fig. 5. Deform analysis for frame

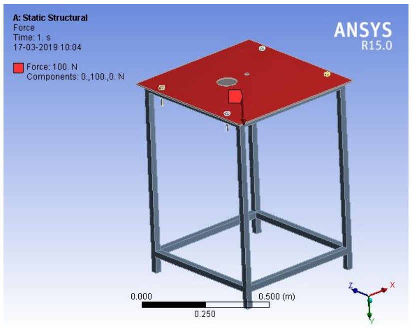

Fig. 6. Force analysis

In this analysis, the force of 100 N is given and tested.

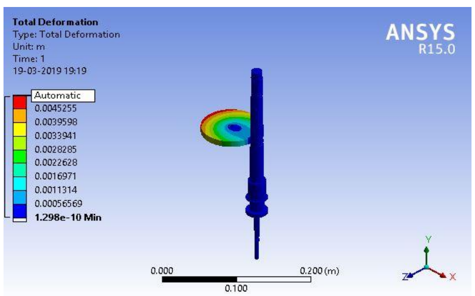

Fig. 7. Deform analysis for roller-spindle contact

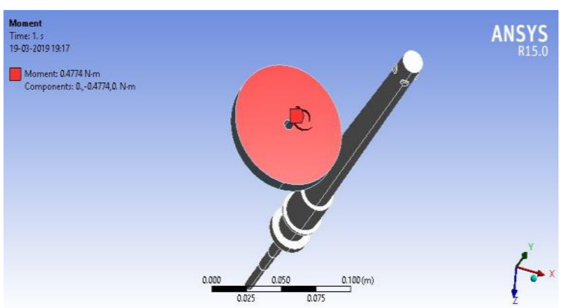

Fig. 8. Moment for the rotation of roller

The frame and roller-spindle contact is tested by analysis and the design is safe.

A. Working

In this setup, the spindles are fixed in holder by bolts and it is made to rotate by the motor. The motor is given a supply and it starts to rotate. The motor is connected to the shaft with the help of pulley and the pulley holds the shaft tight and make the perfect rotation without eccentricity. The roller which is made to rotate the spindle is connected with the shaft at a specified height to make a contact with the spindle. The roller rotates and the spindle rotates with the help of roller.

The bolster is fixed with the holder with bolts in such a way that it should not make or create any extra vibration. After the bolster is fixed with the holder, the upper part of the spindle is fixed with the bolster. Due to the rotation of the spindle at high speed, the centrifugal force is created around the spindle. The centrifugal force may release the spindle from the bolster. The spindle cap is located in the bolster which blocks the release of the spindle. The sensor is placed in the setup which is programmed to find the defective spindle with the vibration above the particular limit. By the rotation of the spindle, a small vibration is created inside the bolster and it is sensed by the vibration sensor. The vibration sensor gives the necessary output by which the defective spindle can be easily identified.

Fig. 9. Fabricated model

5. Conclusion

It is to ensure the eminence of spindle in spinning mills which is indispensable to maintain the eminence of yarn. The chief hitch of the spindle is that it is rotating in the eccentricity manner. This project is primarily done to check the eccentricity and also the rotation of the spindles. Also the structure is premeditated by Solid works, substantiated by Ansys and then it is fabricated. By using this structure, it is conceivable to check the rotation of four spindles at the same stint. The electronic sensing unit is used to sense the eccentricity and apposite rotation. So, this structure is supportive to sense eccentricity without any exertion.

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