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Development of Cone Winding Machine for School Of Technology Textile Technology Workshop: Kano State Polytechnic

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Abstract
The present economic problems and lack of low and middle scale producers of cone for the final process in textile and also the problem of lack of the machine in the practical laboratory of textile technology of the school made it of interest to provide a low costing and efficient device that will not only serve the school environment and students but also can be used as prototype to be produced and sold in the outside market for economic development. So the idea is decided to produce a conventional electric motor powered cone winding machine to support the teaching and economic problems in textile. The research is provided with the full detail of operations, construction techniques, The machine operation was up to the expected capacity which made the project a success. As all standards in colors and part assembly were observed, there were only minor adjustments that were necessary which was done, and it brought the machine into a perfect working standard and shape.

Keywords*: cone winding machine, textile, educational research, electric motor*

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I. INTRODUCTION

Winding is the process of transferring yarn or thread from one type of package to another to facilitate subsequent processing (Carl A Lawrence, 2002). The principle objective of the winding is to assemble long length of yarn onto package form suitable for subsequent operations such as warping, weaving and knitting (www.bdtextileinfo.blogspot.com). The suitability of package is adjudged by its ability to get easily unwound at the high speed and the wound yarn should be free from objectionable faults like very thick and thin places. But at the same time the number of joint ends (splices) should be minimal. The re-handling of yarn is an integral part of the fiber and textile industries. Not only must the package and the yarn itself be suitable for processing on the next machine in the production process, this machine is called 'winding machine' (Lord, 2003).

A winding machine is a machine for wrapping string, twine, chord, thread, yarn, rope, wire, ribbon, tape, on a spool, bobbin, reel, etc. The winding machine comprises three units, namely the creeling and feeding unit, the central unit and the winding unit. Creeling and feeding unit contains the elements for the material feeding of the winding unit like snarl preventer, balloon control and magazine with bobbin creeling. The Central unit contains all the elements for upper and lower yarn gripping, yarn monitoring, and yarn joining and yarn tension regulator.

1.1 *TYPE OF WINDING MACHINES*

- Computerized winding machine
- Electrically powered conventional (drum type)
- Mechanically powered conventional type

1.2 ELECTRICALLY POWERED CONVENTIONAL DRUM TYPE CONE WINDING MACHINE

The winding machine is conventional type as such, it operates using electric motor as a source of power and the yarn knotting is done manually with hand which makes it simple in operation. When the shafts carrying the drums operate; the yarn package holder is released to rest on top of the drum due to its weight and friction. The revolution of the drums is transmitted to the cheese there by winding the yarn as the patent is designed. The conventional winding is operated manually to achieve repackaging to required size by unwinding and rewinding sometimes clear fluff and other flying related particles.

It consists of twelve drums which are arranged side by side, six on each side guided by self-aligned bearing to support un even motions of the shaft. The machine is powered by two motors of two horse power

capacity which transmit its motion to a pulley by means of transmission belt linking to the frame pulley from the motor pulley.

The motor and all the other components are mounted on a frame. The yam tensioned used for tensioning the thread or yarn to a desired stiffness and avoid fat and thin portions on the yarn or thread, is mounted to the carriage and also the yarn carrier connecting unit which is also linked to the yarn carriage which accommodate the cone and support an even winding and a good rotation of the cone to give a good wrap. The disc is a component to clean, smoothen and intensify the tension of the yarn when it revolves on the smooth surface of the disc, it removes and smooth all the furs on the yarn. The machine is powered by electrical system with the components mounted on a control panel board which in cooperates the contact breaker as a safety switching device to automatically cut out supply whenever there is fluctuation in power.

The indicator light also incorporated on the board to indicate the presence of power and to indicate the status of the machine when powered of off to prevent over running of machine as a result of non-identification of, machine operation status. The switch which powered the machine either ON or OFF status.

1.3 RESEARCH METHODOLOGY

1.4 Materials and methods

1.5 MATERIALS USED AND REASONS FOR SELECTION

Shaft made from mild steel, for its rigidity and ability to withstand torsion stress. Bearing seating made from Cast iron, cast iron can absorb heat generated due to friction.

The drums are made of Aluminum/stainless steel the mixture of the two will provide less cost and standard quality to withstand the rubbings of the yarn without tearing the surface and creating a path groove. Also,

-3 x 1.5 inch x 3mm thickness mild steel (u-channel) which serves as the chassis for machine

-17mm bolt and nut for temporary joint, in the major parts.

-12mm bolt and nut, in the minor parts.

-10mm bolt and nut in the fittings of attachments.

-Mild steel (Angle Iron 3inches x 3mm thickness) for carriage and umbrella. For its strength to withstand load.

Ball bearing. It is used to transfer high speed of the motor, without any significant loss.

Mild steel (bar). It is used for construction of package carrier (handle), and its selected due to its strength to withstand load. Mild steel pipes for the construction of umbrella/angle iron, foundation bolt anchor type and adjustable for machine balancing and alignment.

1.6 REASONS FOR MATERIAL SELECTION

The reason for selection of the above mentioned materials, is due to their individual mechanical properties and reliability as stated above; considering the procedure followed in determining the diameter of the shaft from its strength, this prove the reason for selection of the shaft. There is also availability of the shaft. There is also availability of the material at our disposal at affordable price.

1.7 TOOLS AND MACHINES USED ARE AS FOLLOWS; -

- Welding machine
- Lathe machine
- Hand cutting machine
- Electrode
- Filler rod
- Sand paper
- kerosene
- Waste cleaner (rag)
- spanners
- Drilling machine
- Measuring instruments (tape, Vanier caliper)

1.8 RESEARCH METHODOLOGY

It begins with the design of three units, namely the creasing and feeding unit, the central unit and the winding unit. Creating and winding unit contain the element for the material feeding of the winding unit like snarl preventer, balloon control and magazine with bobbin creating the central unit contain all the element for upper and lower yarn gripping, yarn monitoring and yarn joining. The winding unit executes its main function i.e. Package winding.

1.9 CALCULATIONS

The shaft that from integral part of machine was selected based on the following parameters.

T/J= T/r

Moreover, the machine is made up of different material with different mechanical properties to serve different operational requirement. The machine consists of patient drums fixed on a shaft driven by pulleys linked to an electric motor of 3hpvia a v- volt, a both sides.

Where T= twisting moment on torque acting on the shaft

J= polar moment of inertia of shaft about the axis of rotation

T= tensional shear stress

R= Distance from the natural axis to the outermost fiber

= D/2 where d= diameter of the shaft

For round solid shaft, polar movement of inertia

$J= /32 \times d^2$

equation one now be written as

$\underline{T/} \times d^4 = \underline{/2}$ or $T/16 \times xd^3$

32 d

But $=\underline{2NxT}$

60

or T= x60

2N

Where T= Twisting moment on Nm

N= speed of the shaft on RPM

Expected speed of the main driven shaft= 1300 rpm power to be transmitted = 30kw

$=42$ MPa$= 42N/mm^2$

American society of Mechanical Engineering (ASME) code for the design of transmission shaft.

Then if T= px60

2N

T= 50x103x60=367.2N/m

2 1300

$= 367.2x10^3$Nmm

Torque transmitted by the shaft T

$367.2x10^3=/16xtxd^3$

$= /16x42xd^2$

Thus $d^3=44.51393x10^3$

Add d=35.44mm

Therefore, the shaft diameter to the used is 35.44mm

From the above equation, the diameter of solid shaft to be used in driving the drums and allowance for attachment in future is determined.

Capacity of the machine

Drum diameter = 4 inch

Motor speed =1430rpm

Motor pulley=3 inch

Frame pulley = 6 inch

Drum speed= moor speed x motor pulley diameter

Frame pulley diameter

= 3 inch x 1430

6 inch

Therefore drum speed= 715rpm

Weights

Weight of angle iron …… 25.68kg

Weight of u- channel…… 48kg

Motor weight 25x2……..50kg

Drum 4kg x 2 …… 48kg

Bearing and housing ……4.5kg

Shaft ……..45kg

Cover ……5kg

Disc and weight of package……15kg

Other accessories weight ……..10kg

II. CONSTRUCTIONS PROCEDURE

The construction of the machine began after testing and confirm that meet all the designed standard, length of the "U" channel is cut in to the accurate size to form the main structure, or the chassis by welding the ends together.

Three stands were formed and cross members from the same material.

The cross members are bolted to the frames using 17 mm bolt and nut and this is to enable easer transportation of the machine and allow better leveling and alignment, while installing it on unsmooth and poor leveled foundation flow.

Yam tension bracket is then constructed and bolted to the frame then head and tailstock of the machine is decided at that instance motor base is constructed welded to headstock. On the topside of frame holes were made to accommodate 17mmbolt and nut to tighten the bearing housing that the drums Carrier shaft or main driven shaft rest upon or revolved on freely. The cutting is done after measuring the length needed using either hacksaw blade or cutting disc driven by hand-grinding machine

After construction of the above mention component the umbrella is made using angle iron of 3 mm by 2 feet size. The purpose of the umbrella is to serve as carrier for empty cones ready for doffing.

Safety guide were not left behind on the driven side to prevent accident by operating personnel.

2.1 Testing of the machine

Greasing of the bearing was carried out before test and cleaning all the area where the machine is to be tested and the machine component.

The machine was first tested manually by turning the drums with hands in hand gloves, to ensure the shaft is properly aligned on the bearing setting even though the bearings are self-aligned, there is a limitation for its alignment.

Pulleys attached to the shaft were connected to the motor pulleys, via the v-belt.

The motors are connected to contactors on the control panel that has indicator light which indicated the mains is connect and ready to be use.

Then after ensuring that all guide covers are in place one motor is started and clamp to know its loading at the same time the machine speed and noise are monitored not to exceed acceptable limit.

The drum direction of rotation is checked and ensures that it runs at the right direction, then filament yarn of 150 deniers is use to test the first production from just a drum.

The machine is the stopped and checked the bolt and nut that were used in tighten most of the component of the machine. After that the machine is run fully on production.

2.2 Safety: -

The machine should never be started with guide covers open to avoid endangering the operator and ensure his safety.

While on production knitter knives should not be used to remove rapping,

The machine should be stopped and seizures should be use to cutaway the rap gently not to damage the drums. Hand should not be allowed to touch the drums while on motion to avoid injury.

DRUMS

There would be 12 drums to be arranged side by side, six on each side to be guided by self-aligned bearing to support uneven motion of the shaft.

2.3 ELECTRIC MOTORS

Two electric motor of 3 horse power would be used to power the machine by transmitting its motion by mean of transmission belt linking to the frame pulley from the motor pulley. The motor and all other component are mounted on a frame. The yarn tension carrier use for tensioning the thread or yarn to a desired stiffness and avoid fat and thin portion on the yarn or thread would be mounted on a carriages.

2.4 CONTROL BOARD

The machine is powered by electrical system with the component mounted on a control panel board which incorporate a contact breaker as a safety switching device to automatically cut out supply whenever there is fluctuation in power. An indicator light on the board will indicate the presence of power and to indicate the status of the machine.

2.5 RESULTS

2.6 DISCUSSION OF RESULTS

When the machine was tested there was a problem of in effective overlapping of the cone on the drum as a result insufficient weight of the arm to give it density upon the drum which result to partial vibration, so here was a

need for damper spring to absorb the vibration, the tension of the spring was negligible since the vibration was very minimal but was effective as a result of the sensitivity of the process.
Also there was a problem with the settings of the yarn guide, as it has been tampered with, there was no alignment so the yarn overlapping on the cone and the ' weaving across the cone was not guided accordingly. The yarn guide has to be adjusted to a certain angle 90° to the centre.
Initially the tensioner was not for the specific yarn size as such the yarn was braking and cutting, the yarn type was 24 counts and the tensioner size is 9g (0.09kg)
When all the problems encountered were resolved, there was no any failure during test.

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