

Research Article

Design and Development of Manual Hank Reeling Machine

Fitsum Etefa

Leather Engineering Department, Ethiopian Institute of Textile and Fashion Technology (EiTEX),
Bahir Dar University, Bahir Dar, Ethiopia.

*Corresponding author's e-mail: oneday790@gmail.com

Abstract

In today's textile product processing, customers are demanding lower prices, the best quality product and service. An effective cost reduction and higher productivity with short processing time is the main objective for textile manufacturer to be a strong competitor by having high market share with profitability and to compete successfully in the world market by keeping benefits of stake holders including customers. Nowadays there is different manual and automatic hank reeling machine. Hank reeling machine used to reel cone yarn to hank yarn form. Automatic hank reeling machine works by use of electric power system and has motor for hank reeling. This machine can wind a maximum number of hanks within one reeling cycle of machine. It's less time consuming, but expensive. Hand hank reeling machine can wind single hank per reeling cycle and its time consuming than automatic reeling machine. Based on data analysis, the researcher designed and fabricated manual hank reeling machine which can be driven easily by using foot. This machine can wind up to 12 hanks within single hank reeling cycle.

Keywords: Yarn; Hank yarn; Manual hank reeling, Automatic hank reeling.

Introduction

The interest of producing textile and related product are increasing in the world. The abundance in nature combined with the ease of Textile processing was an attractive feature, which makes it an important income for the development of a given country. Nowadays different latest textile machineries are developed by different manufacturers. In production of Yarn, the main input fiber is changed into yarn by passing through different yarn production sequence. Winding is one of the most important operation, which is mainly occurred in spinning section. In fabric manufacturing, winding as well as rewinding is so important. The creation of large yarn packages that can be easily wound and unwound, is called winding. In textile industry, a hank is a coiled or wrapped unit of yarn. This is often the best form for use with handlooms, compared to the cone form needed for powerlooms. Hanks come in varying lengths depending on the type of material and the manufacturer. For instance, a hank of linen is often 300 yards (270 m), and a hank of cotton or silk is 840 yards (770 m). While hanks may differ by manufacturer and by

product, a skein is usually considered 1/6th of a hank (either by weight or by length) [1-5].

In yarns for handcrafts such as knitting or crochet, hanks are not a fixed length but are sold in units by weight, most commonly 50 grams. Depending on the thickness of the strand as well as the inherent density of the material, hanks can range widely in yardage per 50 gram unit. Knitters and crocheters rewind the hanks into balls or centre-pull skeins prior to use, in order to prevent the yarn from becoming tangled. Hank reeling machine is used to change cone or cop packed yarn into a hank form by winding a yarn into a circular or round shaped reel. To produce these fabrics, hank is used as main input. [2-4]. Automatic hank reeling machine works by use of electric power system and has motor for hank reeling. This machine can wind a maximum number of hanks within one reeling cycle of machine. It's less time consuming, but expensive [6-11].

In Ethiopia, Textile product manufacturing is one of a key sector that identified by the government since 2010. The Ethiopia industrialization strategy has given top

priority to textile product processing. The several opportunity and suitability of the general atmosphere for the growth of textile industries in the country some local and foreign investors are investing their knowledge and capital in textile industry. In Ethiopia there are large number of small scale knitted and woven fabric producers. To produce these fabrics the main input they using is hank yarn [12-15]. Local knitted and woven fabric producers can purchase a cop packed yarn from market and they change into hank form by using small manual hand driven hank reeling machine. However, the amount of hank produced by manual reeling machine does not satisfy the need of small scale knitted and woven fabric producers and it leads to very high hank cost. Therefore, this problem was a notable hindrance limiting the industrial growth of the country. The present work aims at fabricating a manual reeling machine that can be operated easily, with less manufacturing cost, rotates by using foot and capable of winding more number of hanks per cycle.

Materials and methods

Materials

Hollow Structural Sections of circular (CHS) pipe, Rectangular (RHS), Tubular steel, Sheet Metal, Bearing, pulley, Worm Gear etc., were used in fabrication work.

Methods

The main aim of designing and fabricating a manual hank reeling machine which winds more hank per reeling cycle, was achieved by changing some mechanism of hand reeling machine. In manual hank reeling the operator uses his hand to wind hank yarn and can wind single hank per cycle. This is now changed in the present design by changing the driving unit from hand to foot and by extending the width of reel in order to wind up to 12 hanks per reeling cycle. This allows comfort for the operator, because the operator got a possibility to drive the reel by his foot like fabric sewing machine, by sitting on a chair.

Design of manual hank reeling machine parts

As indicated in Fig 1, the reeling part used to wind hank yarn and worm gear and worm shafts are used to push yarn traverse rod. Yarn traverse used to distribute the yarn uniformly throughout the width of hank.

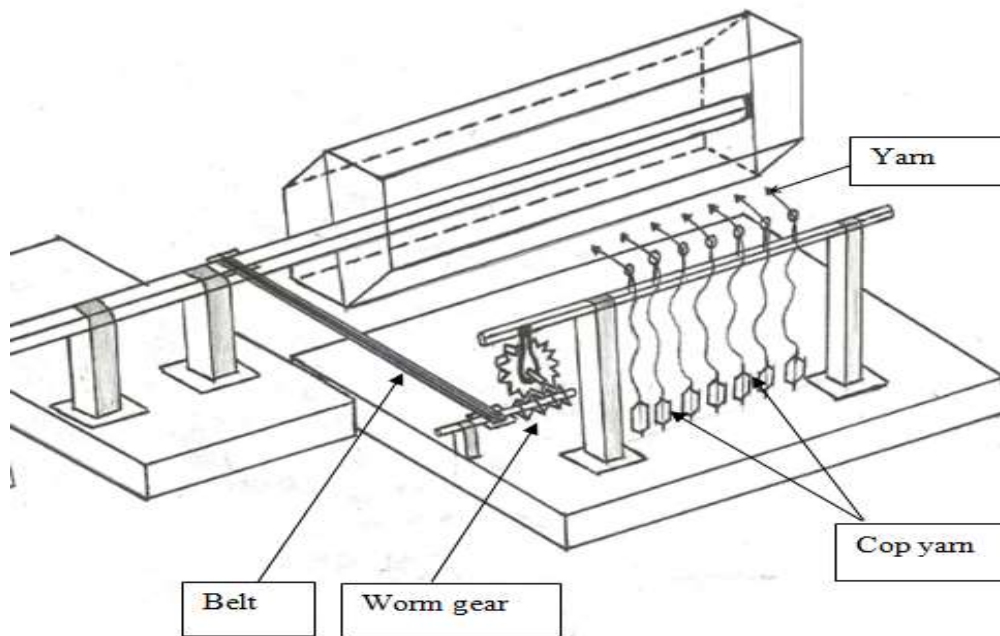


Fig. 1. Manual hank reeling machine design

As shown in Table 1, the machine has a 160 cm long 25*1.25 hollow structural sections of circular (CHS) pipe main shaft, on which 20 cm length 6 round bars are welded at one end of the shaft and 20 cm length 6 round bars are welded at 90 cm end of the shaft in opposite

direction. A 90 cm Length 6 round bar reel parts are welded with 20cm Length round bars in both edge of reel parts.

The main shaft is supported by two 50cm long 50*2 hollow structural sections of circular (CHS) pipe vertically welded on machine frame

with having two 25*52 ball bearing and bearing house at the edge of shaft support. The one edge of main shaft is welded with the driving unit Pit man rod and foot treadle part which is taken from fabric sewing machine. When the foot treadle driving unit rotates, the reel which is fixed on the shaft starts reeling the cone or cop yarn into the reel and forms a hank yarn.

The machine has a feeding unit to feed cone or cop packed yarn to the reeling unit. There is 110 cm long yarn traverse round bar used to distribute the yarn throughout the hank width. The machine has worm gear with 100 teeth number. The worm gear is connected with

main shaft by belt. A small length rod is welded on the worm gear there is a small length rod. In yarn traverse rod a small key like tongue is connected. During reeling, when the shaft rotates one cycle, one of the worm gear teeth forward and a small rod on the worm gear pushes the key like tongue welded on yarn traverse rod. Yarn feed welded on yarn feed Yarn traverse distribute the hank yarn uniformly throughout the width of hank. A 1.25 mm thickness sheet metal is welded on machine frame in order to hold yarn cones and cops.

Table 1. Manual hank reeling machine specification

S. No.	Machine parts	Dimension	Material Type
1	Reel length	Reel length 90 cm, Reel circumference 80 cm	10 mm round bar
2	Reel support	Length 50 cm	Hollow structural sections of circular (CHS) pipe 50*2
3	Yarn Traverse support	Length 65 cm	CHS Pipe 25*1.25
4	Yarn traverse	Length 110 cm	10 mm round bar
5	Reel frame	60*40 cm	RHS tubular steel
6	Feeding frame	110*60 cm	RHS tubular steel
7	Shaft	Length 160 cm	Hollow structural sections of circular (CHS) pipe 25*1.25
8	Ball bearing	25*52	-
9	Worm gear	100 Teeth number	-
10	Sheet metal	1.25 mm Thickness	-

Result and discussion

Table 2 shows, fabricated manual hank reeling machine description. The machine has 1.8 m length, 1.1 m width and 1 m height. It used to convert cone or cope yarn to hank yarn. It

requires one operator and requires simple maintenance. It can wind 12 hanks with one reeling cycle. As indicated in Fig. 2, fabricated manual hank reeling machine can be driven easily by foot like sewing machine treadle. The machine has 80 circumference reels.



Fig. 2. Front and side view of fabricated manual hank reeling machine

In one rotation, the reel can wind 80 cm hank. The author recorded reel rotation of 5 people in min. Each person rotates 10 times and the average reel rotation is 120 rpm (revolution per min). Machine can wind 96 m in a min. The Length of one hank of cotton is 760 m and machine wind full hank within 7.91 min per reeling cycle. The new fabricated Manual hank reeling machine can reel 12 hanks within one reeling cycle or within 7.91 min. The produced hank yarn is distributed uniformly throughout the width of hank. The cost to fabricate this machine is very cheap compared to Automatic Electrical hank reeling machine. To fabricate this machine, it costs only around 530\$ as compared to 4000\$ in case of an automatic electrical hank reeling machine.

Table 2. Fabricated manual hank reeling machine description

S. No.	Description	Description
1	Type of machine	Manual hank reeling machine
2	Number of hank produced per cycle	12
3	Working condition	Manual
4	Required Number of operator	Single
5	Spinning method	Winding
6	Material input	Cone or cop packed yarn
7	Material output	Hank yarn
8	Maintenance system used	Oiling and cleaning
9	Swift circumference	1.2 m
10	Length of machine	1.8 m
11	Width of machine	1.1 m
12	Height of machine	1 m

Conclusions

In Ethiopia, Textile sector plays a very important role in the Economic growth of the Country. Different domestic and foreign companies are investing their capital in this sector. In the country there are a large number of Small scale enterprises working in producing woven and knitted related fabrics. Most of the enterprises use a hank yarn to produce a woven fabric. To convert Cone yarn to hank yarn, they use hand

driven manual single hank reeling machine. This machine is tedious and less productive. The aim to design manual foot driven hank reeling winding machine is that to reduce the time for the reeling of hank. The job of reeling single hank is very tiresome. Also the time required for the reeling hank varies largely from worker to worker, thus making process is time unpredictable. This work lead to develop easily controlled manual hank reeling machine. This will make hank reeling process convenient for woven fabric production. It is proposed to fabricate the hank reeling machine to distribute to the small scale woven fabric producers in this part of the country.

Conflicts of Interest

Authors declare no conflict of interest.

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