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Design of Refill Band Spiral Winding Attachment on Lathe Machine

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***Abstract:** Now-a-days in this competitive era it is essential to complete jobs in smallest cycle time in order to achieve maximum profit at minimum wastage.*
Some leading, printing machine manufacturers outsource some parts from vendors. Currently, one of the roller sub-assembly is being outsourced from outer vendors.
During the visit, we observed that the existing process of manufacturing of such sub-assembly is very lengthy & of manual nature.
As to find an alternative solution to the existing problem, we decided to semi-automate the process which will also result in better productivity and which will reduce wastage also. For achieving this, we designed and manufacture an attachment which can be used on a simple lathe machine.
Using attachment made the whole process semi-automated, results of which are compared with the previous manual process. It is observed that using attachment reduces cycle time, reduces man power, and also decreases wastage than the manual process.

***Keywords:** Refill Band Spiral Winding, Lathe Machine, Cast Iron.*

1. INTRODUCTION

The Proposed design relates to an attachment for winding of metal strip on Lathe machine. The company which sponsored this project has a pipe like component in which they wound metal strip, these metal strips are made from low mild steel and strips have sharp punches on it. Currently, the company is using the manual method to wound strip on aluminium pipe which is time consuming as well as costly. In order to solve this problem we have made attachment and made the lathe semi-automatic by giving an automatic feed with the help of which only one worker can do the whole operation in less time. We have made roller attachment which will be on opposite side of the tool holder. Roller attachment will guide metal strip and will provide tension which is necessary to wound metal strip on aluminium pipe. Bobbin will hold metal strip and will be on the same side of roller attachment.

2. LITERATURE REVIEW

For design and manufacturing references we have used reference book of Workshop Technology by Hajra choudhary in which we came to know about the setting of the pitch, how the half nut mechanism works, and spindle and carriage moments. In order to finalize design aspects and manufacturing process, we referred to book on manufacturing technology by M. Adinath.

3. MATERIAL SELECTION

In the selection of materials, a systematic approach is necessary to select the best materials for a particular application. Proper technique needs to be followed; first, it is required to carefully define the application requirements in terms of mechanical, thermal, environmental, electrical, and chemical properties. Then the choices are narrowed down by the method of elimination. Production techniques also have a major importance in selecting the best material.

By carefully studying the available materials in the market, we narrowed down our choices to two materials, namely, cast iron and mild steel. The selection of one material from these two is explained in detail in the following section.

3.1 CAST IRON

Cast iron is a group of iron-carbon alloys with a carbon content greater than 2%.Its usefulness derives from its relatively low melting temperature. The alloy constituents affect its colour when fractured: white cast iron has carbide impurities which allow cracks to pass straight through; grey cast iron has graphite flakes which deflect a passing crack and initiate countless new cracks as the material breaks; ductile cast iron has spherical graphite "nodules" which stop the crack from further progressing.

Carbon ranging from 1.8–4 wt. % and silicon (Si) 1–3 wt. % is the main alloying elements of cast iron. Iron alloys with less carbon content are known as steel. While this technically makes the Fe–C–Si system ternary, the principle of cast iron solidification can be understood from the simpler binary iron–carbon phase diagram. Since the compositions of most cast irons are around the eutectic point (lowest liquid point) of the iron–carbon system, the melting temperatures usually range from 1,150 to 1,200 °C (2,100 to 2,190 °F), which is about 300 °C (540 °F) lower than the melting point of pure iron.

Cast iron tends to be brittle, except for malleable cast irons. It has a relatively low melting point, good fluidity, castability, excellent machinability, resistance to deformation and wear resistance. It is resistant to destruction and weakening by oxidation.

3.2 MILD STEEL

Mild steel is the most widely used steel which is not brittle and cheap in price. Mild steel is not readily tempered or hardened but possesses enough strength.

Mild steel contains:

- Carbon 0.16 to 0.18 % (maximum 0.25% is allowable)
- Manganese 0.70 to 0.90 %
- Silicon maximum 0.40%
- Sulfur maximum 0.04%
- Phosphorous maximum 0.04%

3.2.1 PROPERTIES OF MILD STEEL

Hardness, Brinell	126
Tensile Strength, Ultimate	440 MPa
Tensile Strength, Yield	370 MPa
Elongation at Break (In 50 mm)	15.0 %
Modulus of Elasticity	205 GPa

4. DESIGN CALCULATIONS

4.1 FRICTON CALCULATIONS

The friction force is the force exerted by a surface when an object moves across it or makes an effort to move across it. The frictional force can be expressed as

$F_f = \mu N$ (1)

Where

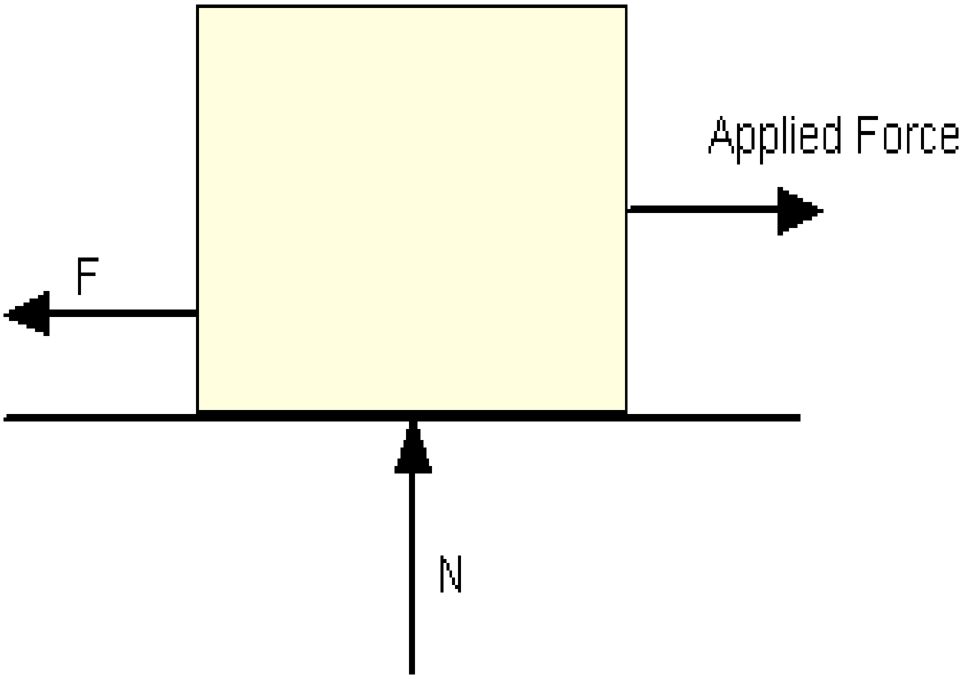
F_f = frictional force (N)

μ = static (μ_s) or kinetic (μ_k) frictional coefficient

N = normal force (N)

There are at least two types of friction forces

- Kinetic (sliding) friction force- when an object moves
- Static friction force - when an object makes an effort to move



For an object pulled or pushed horizontally the normal force N is simply the gravity force or weight:

$N = F_g$

$= m g$ (2)

Where,

F_g = gravity force or weight (N)

m = mass of the object (kg)

g = acceleration of gravity (9.81 m/s^2)

The friction force (1) can with (2) be modified to

$F_f = \mu m g$ (3)

4.2 FRICTION BETWEEN STRIP AND ROLLER

Mass of rolling strip on roller= 0.200kg

∴ Weight of transverse travelling plate= mass * 9.81

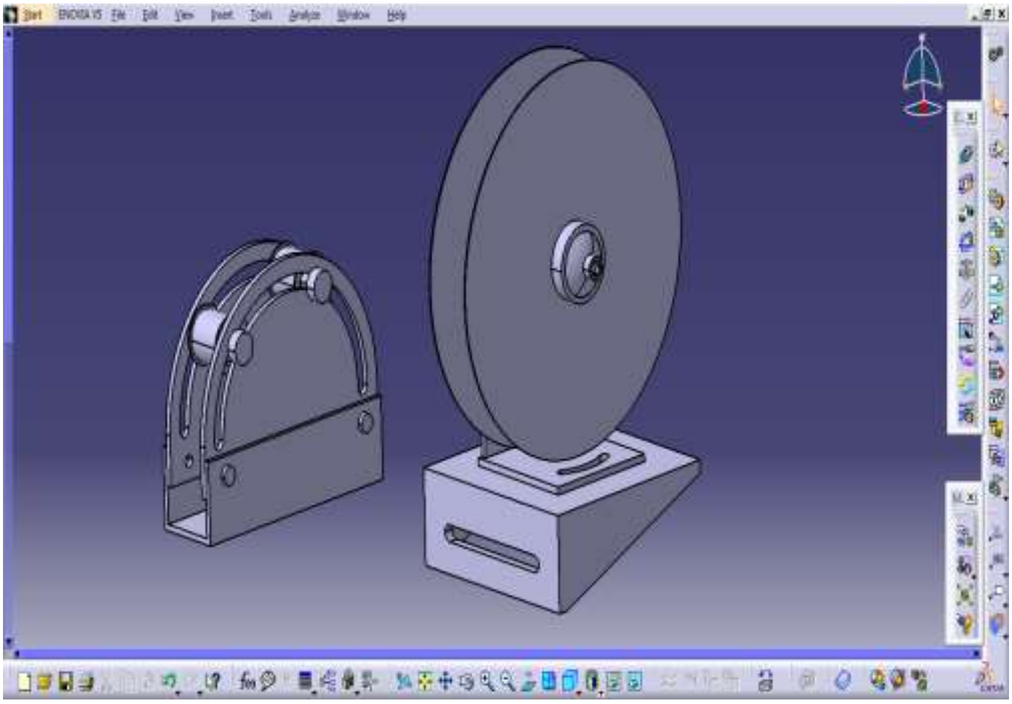
= 200*9.81

= 1.962N

Then,

Force of friction = μN = 5*1.962= 9.81N

5. FINAL DESIGN OF ATTACHMENT



6. RESULTS AND DISCUSSION

TIME STUDY							
	HEADS						
METHODS (In Min)	STRIP CUTTING	STRIP WOUNDING	STRIP WOUNDING ON ROLLER	TIGHTENIN G	BRUSHI NG	MISLLENI OUS	TOTAL TIME
MANUAL (In Min)	2.10	1.80	5.58	3.25	0.5	1.80	15.03
WITH ATTACHMENT (In Min)	NA	NA	3.20	NA	NA	1.80	5

TOTAL TIME REQUIRED (In Min)	
MANUAL	15.03
WITH ATTACHMENT	5
TOTAL TIME SAVE	10.03

PRODUCTION RATE (Job)			
HEADS	PER 1 HOUR	EXPECTED OUTPUT AFTER 8 Hr.	ACTUAL OUTPUT PER 8 Hr.
MANUAL	4	32	28-30
WITH ATTACHMENT	12	96	90-92
TOTAL DIFFERENCE	8	64	62

MAN POWAR REQUIRED		
HEADS	MANUALLY	WITH ATTACHMENT
STRIP CUTTING AND WOUNDING	1	NA
STRIP WOUNDING ON BAR	2	1
TOTAL MANPOWAR REQD.	3	1
LABOUR REDUCED	-	2

7. CONCLUSION

By using this attachment for this particular product, we have reduced the cycle time of manufacturing of the product by 10 minutes and manpower required is also minimized.

By the use of attachment, wastage is reduced by 80% and this semi-automatic process is very much user friendly.