e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

REVIEW ON DESIGN & MANUFACTURING OF PAPER TUBE CUTTING MACHINE

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ABSTRACT

This Project is dedicated to Paper tube cutting machines play a vital role in various industries, facilitating the precise and efficient cutting of paper tubes, a fundamental component in many products. This literature survey provides an in-depth exploration of the research and developments in this field, covering the latest advancements, challenges, and trends Now a days, there is lot of competition in the market. So there is need of developing a new method or process for effective manufacturing.

Keywords: Pneumatic, Paper Tube, Foot Lever, Bearing.

I. INTRODUCTION

In the dynamic landscape of manufacturing and packaging industries, efficiency and precision are paramount. One indispensable tool addressing the unique needs of these sectors is the Paper Tube Cutting Machine. This specialized equipment is designed with the purpose of precisely cutting paper tubes to specific lengths, playing a crucial role in various applications such as packaging, textile, and manufacturing [1]. Paper tube cutting machines are engineered to handle a diverse range of tube sizes, accommodating the industry's varied demands. These machines are equipped with advanced mechanical structures, featuring cutting-edge components like precision cutting blades and automated feeding systems. The incorporation of sophisticated control systems ensures accuracy and repeatability in the cutting process [2] .The primary purpose of a paper tube cutting machine is to streamline production processes by providing a reliable and efficient means of achieving precise cuts [3].

Whether it is cutting tubes for packaging materials, textiles, or other cylindrical items, this machine significantly enhances workflow efficiency, contributing to cost-effectiveness and product quality. The design of a paper tube cutting machine involves careful consideration of various factors, including the size range of tubes it can handle, the required level of precision, and safety features to protect operators. The mechanical design focuses on stability during the cutting process, with attention to materials that balance durability and cost-effectiveness [4].

Modern paper tube cutting machines integrate automation and control systems, allowing for efficient and precise operation. Sensors and feedback mechanisms contribute to the accuracy of cuts, while user-friendly interfaces enhance ease of use. These features not only improve productivity but also contribute to the overall safety of the machine

PROBLEM STATEMENT

- Existing paper tube cutting machines often face challenges related to efficiency, precision, and adaptability to diverse production requirements.
- In order to increase productivity and efficiency and also assure safety of operator we are provideautomation to manual paper tube cutting machinein lowest possible cost.
- Cutting, crushed, pilled into or stuck by objects thrown by manual machines.

OBJECTIVES

1. To increase Productivity:

Increasing productivity is a multifaceted endeavor that involves optimizing processes, enhancing efficiency,

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and fostering a conducive work environment.

2. To Reduce Unsafe Incidents:

Reducing unsafe incidents requires a comprehensive approach that prioritizes safety at every level of the organization. First and foremost, establishing clear safety protocols and procedures is essential. These guidelines should be regularly reviewed and updated to reflect best practices and address emerging risks.

3. To Reduce Rework:

Reducing rework is essential for improving efficiency and maximizing productivity. One effective strategy is to establish clear project objectives and requirements upfront, ensuring that all stakeholders have a shared understanding of expectations. This helps minimize misunderstandings and reduces the need for revisions later on.

4. To Reduce time and cost of rework:

Reducing the time and cost of rework requires a targeted and systematic approach aimed at addressing the root causes of rework while optimizing processes for efficiency.

5. To Deliver part to customer at time:

Delivering parts to customers on time is critical for maintaining customer satisfaction and fostering long-term relationship Establish clear communication channels with customers to understand their deliver. Regular updates on order status and potential delays can help manage customer expectations and build trust.

II. LITERATURE REVIEW

Paper cutting is an art with a long history, cutting paper began long before the making of the book of bound leaves and the necessity of making a number of sheets of the same e called for some mechanical means of cutting and trimming Shah Vipul ...(1)The earliest cutting machine was no doubt a sharp stone or a stick then a piece of metal, dragged across the parchment, with a guide to keep the cut in a straight line Mistry Nishant .....(2) The sheet was simply held by the hand, and later tie straight edge formed a clamp also its first origins date back to the 4th century after the invention of the paper by the Chinese Some of their earnest uses for paper cutting wren for religious decorations or stencils used for patterns in embroiders For a long time this art form was popular among high , Patel Neel ....(3) Society women but it soon spread to other classes About the fifth century the important step of folding the vellum to leaves became the practice The instrument What we know w-day as sensors or shears probably had a large part to do in these early operations Surya Yadav....(4)

With the invention of postal the multiplication of books larger and stronger as were necessary to cut the sheets Although the other untrimmed sheets was the rule of this earlier time and of a later time, for the smaller books and for divine a cutter was necessary he sheets The lever is a movable bar that pivots on a fulcrum attached to a fixed point. The lever operates by applying forces at different distances from the fulcrum, or a pivot. For your arm, leg or any body part to move the appropriate muscles and bones must work together as a series of levers. A lever amplifies an input force to provide a greater output force, which is said to provide leverage. The ratio of the output force to the input force is the mechanical advantage of the lever. Anatomical leverage system can be used to gain a mechanical advantage. Improve simple or complex physical movements. Some habitually use human levers properly. Some develop habits of improperly using human levers. The mechanical advantage of a lever can be determined by considering the balance of mo- ments or torque. Torque is the turning effect of an eccentric force. Eccentric force is the force applied in a direction not in line with the center of rotation of an object with a fixed axis. In objects without a fixed axis it is an applied force that is not in line with object's center of gravity. For rotation to occur an eccentric force must be applied. Class 1 lever built for equilibrium, class 2 lever for saving effort and class 3 lever.

III. DESIGN OF VARIOUS PARTS

1. **Frame:** The structural support that houses all the components of the machine The frame of a paper tube cutting machine is typically constructed from durable materials such as steel or aluminum. Its primary function is to provide a sturdy and stable platform to which all other components are mounted. The frame is designed to withstand the forces generated during the cutting process, ensuring accuracy and reliability in operation.

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Fig 1: Frame

2. **Cutting Mechanism:** The system responsible for slicing through paper tubes, typically consisting of blades, cutting wheels, or lasers. The cutting mechanism of a paper tube cutting machine is designed to perform accurate and efficient cuts on paper tubes. It typically consists of various components that work together to achieve clean and precise cuts.

Fig 2: Cutter Blade

3. **Blades:** Rotary blades or guillotine-style blades are commonly used in paper tube cutting machines. These blades are made from high-quality materials such as hardened steel or tungsten carbide, ensuring durability and sharpness. The blades are mounted on the machine in a configuration that allows them to slice through the paper tubes with precision.

Design of Parts and Calculation:

- **Shaft**
- **Foot lever**
- **Belt drive pulley (B46)**
- **Bearing (UCP 210)**
- **Pneumatic**

1. Shaft

A shaft is a long, cylindrical mechanical component that rotates to transmit power or motion between different machine components. It typically has a circular cross-section and is used to support and align rotating elements such as gears, pulleys, and wheels within a machine or mechanical system. Shafts can be made of various materials such as steel, aluminum, or composite materials, and they play a critical role in the operation of engines, motors, and other rotating equipment.

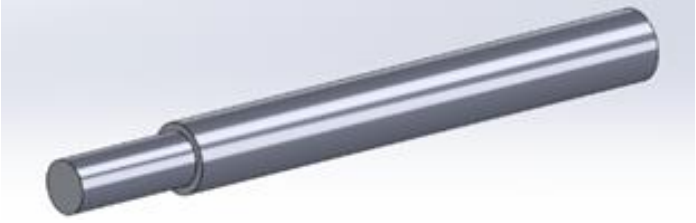

Fig 3: Shaft

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CALCULATION:

We know that yield strength of iron is 49.98Mpa and we have assumed that factor safety is 2.5

1. Calculation of permissible stress

Max. shear stress =0.5xSyt/fos

2 To calculate the total torque (mt) we the following input parameters.

Power = 1.5kw

(Mt)=Px60x10^6/2Πn

3. To calculate bending moment:

Weight of pulley = mass of pulley x gravitational force

4. Calculating diameter of shaft:

We have used the following relation

Tmax =16/πd^3x = √(Mb)2+(Mt)^2

2. Foot Lever

A foot lever is a simple mechanical device operated by foot pressure, typically used to activate or control various mechanisms or functions. It consists of a lever or pedal that is pressed down or depressed by the foot to initiate a specific action, such as braking in a vehicle, operating machinery, or controlling musical instruments. Foot levers are commonly found in a wide range of applications, providing a convenient and ergonomic means of control.

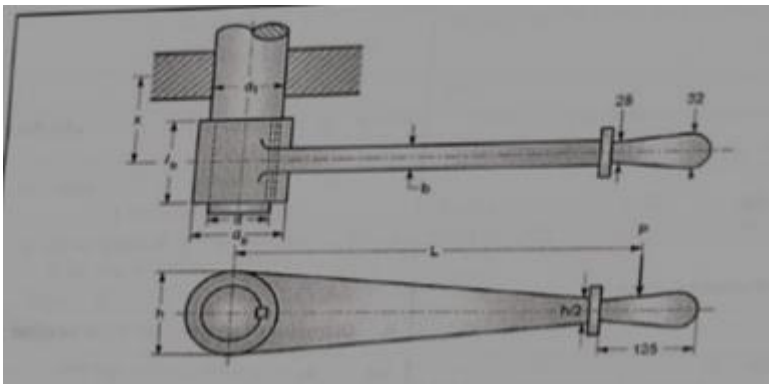

Fig 4: Foot lover

CALCULATION:

The effective length of foot lever is 800mm, the foot lever and shaft are made of iron for which tensile yield strength is 276 N/mm^2 and safety factor is 2.

We have parameters to calculate

To determine:

1. Manual effort

2. Diameter of shaft

3. Width

4. Thickness

5. Dimension of boss

Effective length (L) = Torque/Manual effort =T/P

Manual effort = torque/effective length

1. Diameter of shaft (d): τ =16xT/πxd^3

2. Width (W) = d/4

3. Thickness (t) =2/3xw

4. Dimension of boss:

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- Diameter of boss (db) =1.6xd
- Length of boss (lb) = 1.5xd

3. Belt Drive Pulley (B46)

A Belt Drive Pulley (B46) is a mechanical component used in belt drive systems to transmit power between shafts. It consists of a grooved wheel, called a pulley, which is attached to a shaft and wrapped with a belt. As the pulley rotates, it drives the motion of the belt, which in turn transfers power to another pulley connected to a different shaft. Belt drive pulleys are commonly used in various applications such as machinery, vehicles, and industrial equipment for efficient power transmission.

Fig 5: Belt Drive Pulley

CALCULATION:

Assuming that we have rpm at 2nd pulley or shaft at 540 rpm we have shaft velocity as 5.74 m/s. Intial motors rpm is 1440 and power input is 1.5kw

- **Calculating length of Belt (L)**

$$L=2C+[\pi(D1+D2)/2]\ldots\ldots\ldots\text{(V.B.Bhandari)}$$

Now we have assumed that center to center distance between pulleys is twice of dia of bigger pulley

- **Calculation of width of belt (W)of (b)**

In order to calculate width of belt we need to calculate tensions of belt or belt tension for that following are some relation reff.of V.B.Bhandari.

$$P1\text{-}Mv^2/P2\text{-}Mv^2 = e^{\mu x \alpha}$$

Where, P1 and P2 are tension of belt.

M=mass of belt

V =velocity μ=coefficient of friction (0.1-0.2)

α=wrap angle or angle of wrap.

4. Bearing (UPC 210)

A Bearing (UPC 210) is a mechanical component used to reduce friction between moving parts and support rotational or linear movement. UPC 210 is a specific classification or identifier for a type of bearing, though the exact details may vary depending on the manufacturer or industry standards. Bearings typically consist of inner and outer races with rolling elements (such as balls or rollers) between them, allowing smooth movement while minimizing wear and friction. They are crucial components in various machinery, vehicles, and equipment, enabling efficient motion and load handling.

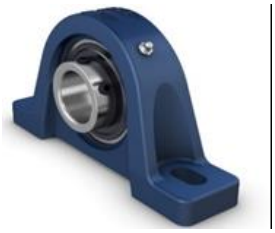

Fig 6: Bearing (UPC 210)

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CALCULATION:

We have assumed that life of bearing is 50000 and shape factor 3 at rpm of 540... (Design of machine by S. S. sabharval)

Therefore

L10h=50000 rev.hrs

Ka=3

N=540rpm

We know that,

L10=L10hxNx60/10^6

Therefore ,we have the relation of dynamic loading.

P=w(L10)^1/3xKa

For Max.for (w) we need to calculate radial and axial force.

Tangential force (ft)=Torque/radius

Therefore Radial force (fr) = ftxtanα

For contact angle (α) it ranges between (15-20)

Therefore,

SKF CATALOG

We have selected UCP210 bearing which comes with pillow block housing which is perfectly suitable for our system

5. Pneumatic

Pneumatics is a branch of engineering that deals with the study and application of pressurized gas (typically air) to produce mechanical motion. It involves the use of compressed air to generate force and control mechanisms, often used in various industrial, automotive, and manufacturing applications for tasks such as actuation, lifting, and automation.

Fig 7: Pneumatic Cylinder

CALCULATION:

In order to lift the cutter by a pneumatic cyclinder we need to find the force as load of the cutter. We know that total cutting load to 53kg

Total load = 53x1.5(fos)

We know that Pressure =force/area Usually in pneumatic system pressure range is (2-12) Bar

Area =force/pressure

Bore diameter of pneumatic cyclinder Area = π/4(d^2)

IV. ROLES OF PNEUMATIC AUTOMATION

Pneumatic actuators play a significant role in automation systems across various industries. They are devices that use compressed air to produce mechanical motion, and they are essential components in many automated . Pneumatic actuators are known for their rapid response times and high-speed operation. In the context of a paper tube cutting machine, quick and precise motion is essential for maintaining high production throughput and reducing cutting cycle times.The paper tube cutting machinate requires six basic actions the cutting action and the conveying action are the must import manufacturing process overall he device is mainly compound of a feeding mechanic unloading and collection, in the clear protest, although each meted.Through the research on

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the and the three dimensional simulation diagram of the cutting mechanism, and the cylinders 7, 8, 12 under the sand unloading mechanic switch oft control of the control valve switch make the feeding mess hafnium, convey The mechanism, positioning mechanism, and cutting frame mechanism work together.

The long paper tube is placed on the rack of the feeding mechanizing, clamped by Misshaped and t-shaped (lamps 20, and controls the transportation pipe reaches the conveying mechanize eleven, and the claw-toped parts on the conveying mechanism fix the long paper tube to prevent it frons swinging. The long napped tube minutes back and forth linearly with the slide tail It of the conveying metonym.

When the long paper tube is sleeved on the shaft of the machine foot When it stops moving for the positioning mechanism fires the paper tube under the action of the cylinder to prevent it from scraping.

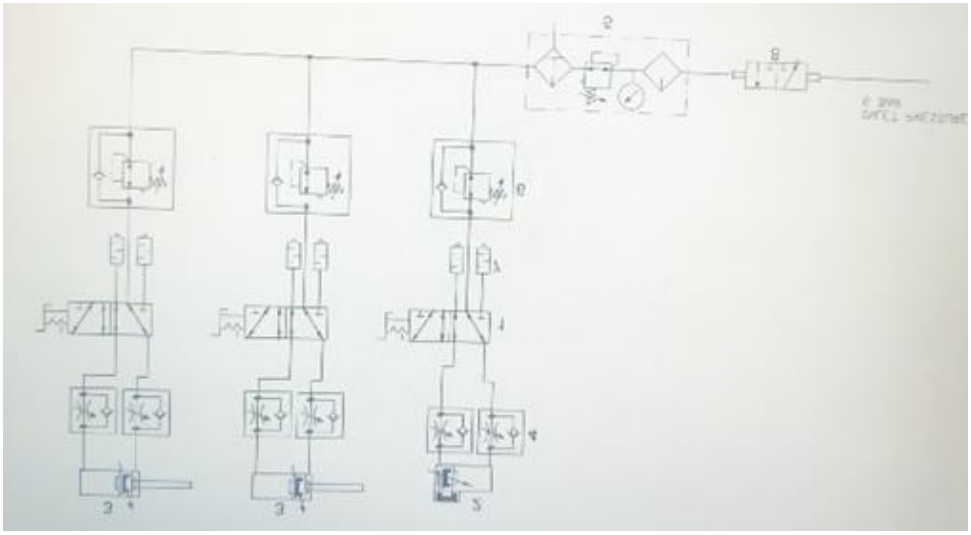

Fig 8: Pneumatic Circuit Diagram

1. VHEF-ES-B52-G18 (hand operated 5/2 valve)
4106816
2. DGO-25-1100-PPV-A-B (rodless magnetic cylinder)
15224
3. DSBC-50-100-PPVA-N3 (Cylinder 50mm bore stroke-100mm)
1366952
4. GRLA-1/4-QS-8-RS-D (one way flow control valve)
534339
5. FRC-1/4-D-MINI (FRL unit)
159605
6. LR-1/4-DB-7-MINI (Pressure Regulator)
539682
7. U-1/4 (Silencer)
2316
8. Inline Slide valve

V. CONCLUSION

- A Paper tube Cutting Machine with an increased Torque Capacity. It increases the Pressure Capacity of Air, which comes out from the Compressor and with the help of Silencer, we can reduce the noise produced by these Pneumatic Paper Cutting Machines.
- The existing Pneumatic Crushing Machines take a lot of time for cutting the paper as well as they are very much noisy during their operation.
- In the project the main aim is to increase productivity and efficiency and also assure safetyof operator we are

provide automation to manualpaper tube cutting machine in lowest possible cost.

ACKNOWLEDGEMENT

It gives us great pleasure to present this work on **"Design and Manufacturing Paper Cutting Machine"**. In preparing this project number of hands helped us directly and indirectly. Therefore it becomes our duty to express our gratitude towards them. We are very much obliged to Project guide **Prof.L.B.Mali** of Mechanical Engineering Department, for helping and giving proper guidance. There timely suggestions made it possible to complete this work. All efforts might have gone in vain without his valuable guidance.

VI. REFERENCES

[1] Sunil H. V, Ankit Yadav, May 2007. Automatic Paper Cutting Machine using Geneva mechanism.

[2] Maryam Hashemitaheri, Sai Manish Reddy Mekarthy, Harish Cherukuri, 2020. Prediction of Specific cutting forces and maximum tool temperatures in orthogonal machining by Support Vector and Gausan process Regression Methods.

[3] Ke Xu, Jiarui Wang, Chih-Hsing Chu, Kai Tang, 2017. Cutting force and machine kinematics constrained cutter location planning for five –axis flank milling of ruled surfaces. Journal of Computational Design and Engineering.

[4] Tim Rostek, Werner Homberg,2017. Locally Graded Steel Materials for Self- sharpening Cutting Blades. International conference on the technology of Plastcity,ICTP2017, 17-22 September 2017, Cambridge, United Kingdom.

[5] Runqing Liu, Tao Tao, Xuesong Mei, Xinping Xu, Xiaochao Sheng, Motion mechanism of rotating transverse paper cutting machine and its parameter optimization. 11th CIRP Conference on Intelligent Computation in Manufacturing Engineering.

[6] Vipul Shah, Feb 2019, Universal Paper Cutting Machine

[7] Rakesh Prajapati, Jan 2018. Design and development of machine to perform stamping and cutting operation.

[8] Mohit S. Kalamkar, march 2019. Design and Fabrication of Paper cutting machine by using Geneva mechanism.