



IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 Issue: V Month of publication: May 2019 DOI: https://doi.org/10.22214/ijraset.2019.5212

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CAD Modelling and Analysis of Round Ring Cloth Peg Assembly Machine

Darshan D. Bapat¹, Dr. S.K. Choudhary², Ms. S.P. Bhorkar³

¹M. Tech Student, ²Professor, ³Assistant Professor, Department of Mechanical Engineering, K.D.K. College of Engineering, Nagpur, Maharashtra, India

Abstract: Cloth pegs are used for holding clothes especially when kept for drying. There are different types of cloth pegs available in the market, made from different materials like plastic, metal or wood. The two pieces of the cloth peg are held together either by a metal ring, U-pin, or spring. The plastic parts and the metal ring are manufactured separately and then assembled together. Assembly of the plastic parts and the ring is done manually. This is a very tedious and troublesome process. So, the researcher has designed a machine to reduce the human efforts and time. Keywords: Cloth peg, Clothes, Plastic parts, Metal ring, Assembly machine

I. INTRODUCTION

A cloth peg is a fastener used to hang up clothes for drying, usually on a clothes line. They are made from plastic, metal or wood. A ring, spring or U-pin is inserted between the two parts of the cloth peg. The assembly of the cloth peg (two plastic pieces and ring) can be done manually by workers, or by semiautomatic or fully automatic machines.



Fig.1 Cloth peg assembly

II. NEED OF THE PROJECT

Inserting the ring in the two parts is very tedious and troublesome job for the workers. So, by developing the machine for the same will reduce the manual efforts of the workers which will ultimately benefit the company.



Fig.2 Cloth peg assembly parts



International Journal for Research in Applied Science & Engineering Technology (IJRASET)

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177 Volume 7 Issue V, May 2019- Available at www.ijraset.com

III. MACHINE DESCRIPTION

The major component of the machine is a grooved lever with a knob, mounted on a round up table. The round up table is mounted on a stand. The stand is made by welding two cross MS plates with a central rod. The dimensions of the plates are $250 \times 45 \times 10$ mm. Bolted holes of diameter 16mm are provided on the two cross plates for foundation and mounting of the whole setup on to a platform. The diameter of the central rod is 24mm. The round up table exactly fits in the central rod. The dimensions of the round up table are 350×50 mm. At the two ends of the table two sockets having the shape of the cloth peg are made. The fulcrum of the lever is at the center of the round up table. The diameter of the fulcrum pin is 5mm. The dimensions of the cross-section of the lever are 13.4×6.7 mm. A groove of 1mm thickness is made on one side of the lever to hold the ring. A knob is provided on the other side of the lever. The knob restricts the horizontal and vertical motion of the ring. A plier is used for stretching the ring for inserting it into the rectangular and circular grooves of the cloth peg.

IV. DESIGN CALCULATIONS



Fig.3 Lever



Fig.4 Free body Diagram of Forces acting on Lever

Where, F- Force to be applied on the knob to hold the ring in the groove

- P- Effort required to produce that force
- R- Reaction at the fulcrum pin
- l₁- Effort arm
- l₂- Load arm
- Step 1: Force Analysis

1)

Taking moments about the fulcrum, we get, $F \times l_2 + P \times l_1 = 0$ $P \times l_1 = -F \times l_2$ $P = -F \times (l_2/l_1)$ = -0.5*9.81*(0.138/0.353)

P = -1.917 N

R=F+P

= (0.5*9.81) + (-1.917)<u>R= 2.988 N</u>

2) Step 2: Design Of Lever Arm Bending moment, $M_b = P^* (l_1 - d_1)$ Where, d_1 -Diameter of pin We have $d_1=0.5 \text{ cm}=0.005 \text{ m}$ $M_b=-1.917^*(0.353-0.005)$ $\underline{M_b=-0.667 \text{ N-m}}$ Bending stress, $\sigma_b = \frac{M_b * y}{I}$ Where, I- Moment of Inertia y- Distance from neutral axis to the outer-most fibre. We have, I=bd³/12 and y = d/2 Where, b- Distance parallel to the neutral axis d - Distance perpendicular to the neutral axis We have, $\sigma_b = \frac{Force}{Area} = \frac{F+P}{d*b} = \frac{2.988}{d*b}$ Equating equations (1) and (2)

2.988 _	$0.667 * \frac{10}{2}$			
d*b	bd^3			
	12			
Generally, d=2b				
2.988_0	.667 * $\frac{2b}{2}$			
2b * b 1	$b * (2b)^3$			
-	12			
<u>b=0.67 cm</u>				
Therefore, d=1.34 cm				

(2)

(1)

V. CAD MODEL OF ROUND RING CLOTH PEG ASSEMBLY MACHINE





Fig.5 Round Ring Cloth Peg Assembly Machine



Fig.6 Exploded view of the machine

VI. CAD MODEL OF DIFFERENT PARTS OF THE ASSEMBLY MACHINE



Fig.7 Stand





ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177 Volume 7 Issue V, May 2019- Available at www.ijraset.com

Fig.8 Round Table



Fig.9 Grooved Lever with knob



Fig.10 Bolt



Fig.11 Nut





Fig.12 Meshing of lever





Fig.13 Boundary conditions of forces acting on the lever





Fig.14 Stress due to the forces acting on lever



Fig.16 Force reaction

TABLE I:	Force	Reaction
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Time [s]	Force Reaction (X) [N]	Force Reaction (Y) [N]	Force Reaction (Z) [N]	Force Reaction (Total) [N]
1.	1.541e-008	6.822	-1.0049e-008	6.822

Fig.17 Bending Moment acting on lever

Fig.18 Stress due to the Bending Moment acting on lever

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Fig.20 Moment reaction

TABLE III: Moment Reaction

Time	Moment Reaction (X)	Moment Reaction (Y)	Moment Reaction (Z)	Moment Reaction (Total)
[s]	[N·mm]	[N·mm]	[N·mm]	[N·mm]
1.	667.00	3.8881e-003	1.9895e-002	667.00

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VIII. CONCLUSION

As per the machine description and design, the CAD model of the Round Ring Cloth Peg Assembly Machine is prepared and its analysis is done using Ansys Workbench-16.2.

IX.ACKNOWLEDGMENT

I express my sincere gratitude to my guide Dr. S.K. Choudhary (Professor) and Co-Guide Ms. S.P. Bhorkar (Assistant Professor), Mechanical Engineering Department, K.D.K. College of Engineering, Nagpur for their valuable guidance, proper advice and moral support during the course of my work on this paper.

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