DESIGN AND DEVELOPMENT OF TUMBLING MACHINE

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ABSTRACT:

Every good manufactured in an industry is passing through different processes. Finally a product is salable in market if finishing carried out over the product is effective. For small products it is very difficult to provide finishing with human and hence a machine is necessary to smooth finish a product. Finishing not only provides better look to the product but it also processes the product through removal of rust and polishing of product. Authors have designed and developed the tumbling machine for finishing of the small products in mechanical manufacturing companies. The detail calculations of design and model developed in CAD is presented in this paper.

KEYWORDS: Tumbling, Tumbling Machine, finishing, smoothening, CAD.

INTRODUCTION:

A finished product had been always appreciated by the customer than the one without proper finishing. The process deals with removal of unwanted pieces, sharp edges and other corners those are hazardous for safe use of any product. Tumbling is very important process as any product is finally ready after finishing it. The process of finishing the products by removing the hard corners and other unwanted minute pieces of material is very important.

When those processes are completed by human being it is very difficult to complete it with accuracy level needed for the products. The machine is needed to carry out this task in manufacturing cycle. Cost of such machines should be less so that every small scale industry can purchase it and utilize it to improve the quality of product. Authors have designed the tumbling machine for Indian industries where the products need to be manufactured at low cost with high precision.

SYSTEM REQUIREMENT:

Table.1: Details of main components

Sr. No.	Component Details	Picture of Purchased Component
1	Shaft carbon steel of grades 40C8, 45C8, 50C4 and 50C12	
2	Media (Abrasive Material)	
3	Bearing (Ball)	
4	Spring spring rate 10 N/mm	
5	Vibrating Motor 1HP, Single Phase, 3000 RPM, 220V	
6	MS Base (Rigid frame)	

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OBJECTIVES OF WORK:

The work is carried out with following objectives accomplishment.

- Designing the tumbling machine for small industries in India.
- Developing the machine for goods finishing.
- Using the machine for product finishing in industries.

SYSTEM DESIGN:

Design of Shaft

The following is the design procedure for shaft
P=20KW
N=400RPM
Shock factor (Kb)= 1.25
Fatigue factor (Ka) = 1.5
Ultimate tensile stress = 400 Nmm2
Yield tensile stress = 240 Nmm2
Pulley is apart 500 mm

Step 1: Applying ASME code to find Ʈ permissible
Ʈper=0.3 × Syt = 0.3 × 240 = 72 Nmm2
Ʈper=0.18 × Sut=0.18 × 400 = 72 Nmm2
Pulley are key to shaft reducing smaller values by 25 %
Ʈper = 0.75 × 72 = 54 Nmm2
Ʈper = 54 Nmm2

Step 2: Calculate Torque Transmitted
P=2πNT60 T=P×602πN
=20×10^3×602×π×400
T= 477464.829 N-mm
Torque is transmitted by belt drive
Torque= (T1-T2)×R
47746.829=(T1-T2)×150
(T1-T2) =3183.09886
Also $T1T2$=2.5
(2.5T2-T2) =3183.09886
T2=2122.065907 N-mm
T1=5305.1647 N-mm
Shear force calculations
Ma=0
7427.2306×500−Rb×600=0
Rb=6189.35883 N-mm
Ra=1237.87177 N-mm

Step 3: Bending moment calculations
Bm at A=0
Bm at B=0
Bm at C= 6189.35883×500
C=1594679.415 N-mm

Step 4: To find diameter of shaft
$\sqrt{}(Ka\times T)2+(Kb\times M)2=\pi 16\times d3\times \tau per$
D=50.49 mm
Diameter if solid shaft is 50 mm

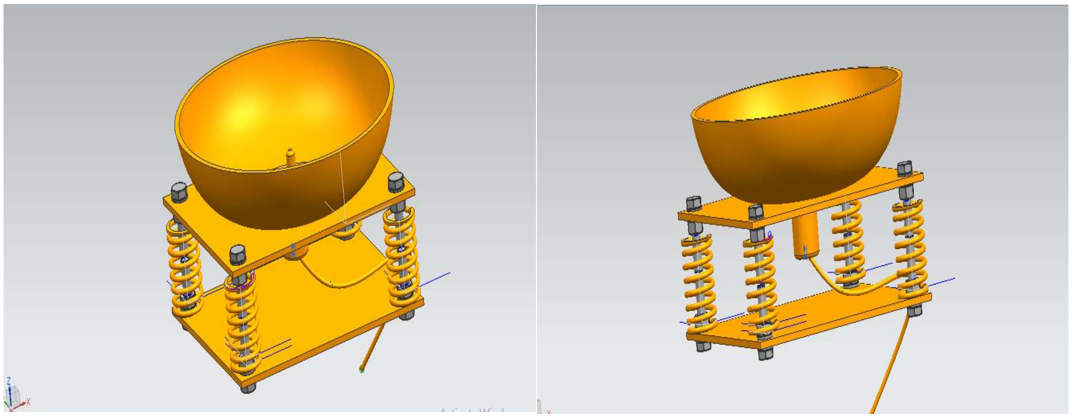
Design of Ball Bearing
The following is the Procedure of Ball Bearing
Type of Bearing = Single Row deep groove Ball Bearing
Pmax=1500 N
N= 720 rpm
Step 1: Equivalent Dynamic Radial Load
Pe= $[1N\int P3.dN]21$
$=[12\pi\int P3max.(1-\cos\theta)\text{^}38d\theta]\text{^}132\pi 0$
After solving the above equation
= $Pmax2[52]\text{^}13$
= $15002\times[52]\text{^}13$
Pe= 1017.9066 N

Step 2: Basic Dynamic load capacity
L10 = $[CPe]\text{^}a$
345.6 = $[C1017.91]\text{^}3$
C= 7143.3285 N
The dynamic load capacity in bearing is 7143.3285.

Calculation of the Life of Bearing
In shaft use deep groove ball bearing, to find life of bearing most be determine ideal load -P- by radial factor X- thrust factor-Y- radial load-Pr- and thrust load-Pa when. [X=1, Y=0] not axial load.

1- Find Life of Bearing (A)
Pr = _/‾‾((FAv)2 + (FAh)2 (26))
Pr = = _/‾‾((73.6)2 + (63139.555)2)
Pr = 63139.598N
P = X. Pr + Y.Pa (27)
P = 1 ∗ 63139.598+ Y ∗ 0,
P = 63139.589N
To find life of bearing (A) use ideal load (P=63139.589N) speed factor (Fn=0.41) and temperature factor (Ft=1) and load capacity of bearing (C=405000N)
Fl = Fn. Ft. C/P (28) Fl = 0.41 ∗ 1 ∗ (405000)/63139.589,
Fl = 2.62 Lh = 8000h = operational hour 2-
Find Life of Bearing (B)
Pr = = _/‾‾((FBv)2 + (FBh)2),
Pr = = _/‾‾((73.6)2 + (61467.582)2)
Pr = 61467.626N,
P = X. Pr+ Y. Pa P = 1 ∗ 61467.626+ Y ∗ 0, P = 61467.626N
To find life of bearing (B) use ideal load (P=61467.626N) speed factor (Fn=0.41) and temperature factor (Ft=1) and load capacity of bearing (C=405000N) from table (4.1)
Fl = Fn. Ft. C/P
Fl = 0.41 ∗ 1 ∗ (405000)/61467.626 ,
Fl = 2.7 Lh = 8500h = operational hour

CAD MODEL DEVELOPED:



SIDE VIEWS

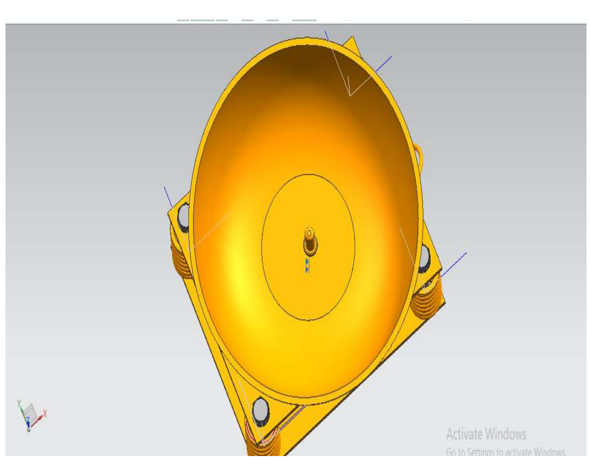


Fig.1: Various views of Tumbling Machine Designed in CAD

FUTURE SCOPE:

The machines must be developed at large scale for Indian industries to carry out finishing task of product. The design is validated and found suitable for production of machine. This is a basic model of such machines where mechanical components are connected. In future interfacing of such machines with computers and control of operation with freeware's like Arduino is possible. The control of operations with different types of products is possible in same machine with interfacing of microcontroller.

CONCLUSION:

The machine for tumbling operation of product needs to be designed with cost consideration from perspective of small workshops in India. Authors have designed the tumbling machine with effective solution with respect to cost consideration. The machine is capable of carrying out the operations in tumbling process where a raw product is converted to final finished good. This is specially designed to handle the small products in large number. A cost effective machine designed specifically for the surface finishing of the components for use in particular applications was developed. It is efficient, cost effective, simple to use and cheap to maintain. These features make it particularly suitable for the informal sector where there is little or no technical knowledge. Its cost effectiveness when compared to existing machinery also makes it competitive. It removes the restrictions posed to recycling by the high cost of existing machinery, consequently increasing recycling activities.

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