Material Handling Equipment Operated by Job Weight

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Abstract— Material handling is process of movement of material or job from one place to another i.e. from one machine to another store room to machine shop or from machine shop to store. In many industries material handling is automated but it requires more electricity and it is main contribution of price of the product. Some small scale industries material handling is manually material handling is risk full or harm full to worker. This may lead to muscular pain or back pain. This device eliminates the manual material for short distance between two machine stations. These devices also reduce the pries of the product by minimizing material handling cost. These also reduce the cost of power. In this device potential energy of the job is used to transfer of the job.

Key words: Job Weight, Material Handling Equipment

I. Introduction

Material handling device eliminates the manual material for short distance between two machine stations. These material handling devices also reduce the pries of the product by minimizing material handling cost. These also reduce the cost of power. In this device potential energy of the job is used to transfer of the job. Nowadays, major, medium as well as small local automotive manufacturing industries are experiencing rapid development in concept of technology and system applied, resulted by stronger domestic and global market demands. As the companies grow, the need for efficient material handling system also arises especially in the manufacturing area.

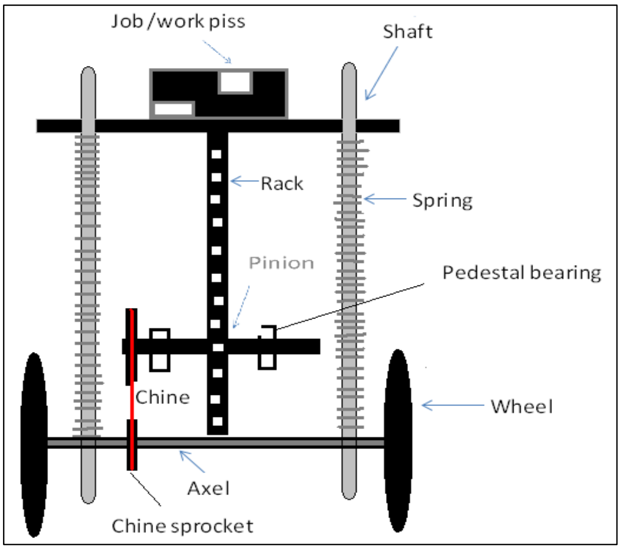
II. Working principle

A. Methodology

- Chain and Sprocket- Chain and sprocket are used and both are ¼ inch.
- Rack and pinion- Rack and pinion mechanism is used. Rack height is 1 feet. Pitch is 5 mm and number of teeth 20 to 22 teeth on this rack.

B. Working

Material handling equipment is all equipment that relates to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. Material handling equipment is the mechanical equipment involved in the complete system. Material handling equipment is generally separated into four main categories: storage and handling equipment, engineered systems, industrial trucks, and bulk material handling.



The pin is press fitted to two outer link plates while the bush is press to inner link plates. The bush and the pin form a swivel joint and the outer link are freely fitted on bushes and during engagement, turn with the teeth of the sprocket wheels. This result is rolling friction instead of sliding friction between the roller and sprocket teeth and reduces wear. The pins bushes and rollers are made of alloy Steel.

III. Design

A. Design of Chain

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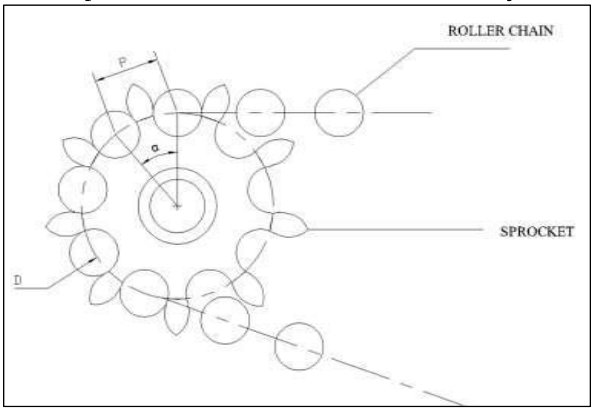

Fig. 2.1: Geomentry of Chain

Where,
P = pitch
D = pitch circle diameter of sprocket
A = the pitch angel
A = 360/z i.e. 360/13= 27.7
Z = number of teeth on sprocket.

Sin α /2 =
The velocity ratio of chain is given by
I = nl/n2 = z1 /z2
N1, N2 = speeds of driving and driven shafts (r.p.m.)
Z1, Z2 = number of teeth on driving and driven shaft the average velocity of the chain is given by
V= π x d x n/60 x 103
V = z x p x n/60 x 103
V = average velocity in meter/sec.
The length of chain is always expressed in terms of numbers of clanks.
L= ln x p
Where, l = length of chain in mm
Ln = number of link in the chain
The numbers of links in the chain are determined by the following relations
Ln = 2(a/p) + (Z1 + Z2 / 2) + (Zn- Z1 / 2xπ) x p/a
Where
A = center distance between axis of driving and driven Sprocket.
Zl = Number of teeth on Smaller sprocket.
Z2 = Number of teeth on larger Sprocket.
A = P/4{[Ln -(Z1 – Z2 / 2)] + ([Ln - (Z1 + Z2 /2)]2 - 8 [Z2-Z1/2Xπ]2)A1/2}

B. *Design of Shaft*

The shaft is subjected to fluctuating Loads, so shaft is under combined Bending and torsion.
Therefore, the equivalent Twisting Moment.
Te = [(km× M) 2 + (kt × T) 2] l/2
The equivalent Bending Moment.
Me= ½ [km × M + {(km x m) 2 + (kt X T) 2} l/2]
Where,
Km = Combined Shock and Fatigue factor for bending.
Kt = Combined Shock and Fatigue factor for torsion.

C. *Calculation of Torque Indused on Shaft*

In our project load is applied at shaft end by leaver. Manual load applied by is 20 kg.
Length of lever is 500mm. So Torque transmitted
T = F x L
T = 20 x 9.81 x 500
T = 98100 N-mm
For applied torque we first design dia of lever shaft
SAE 1040 SAE (SOCIETY OF AUTOMOBILE ENGENEERING)
10 =Plain carbon steel
40 = 0.4 % of carbon
Following stresses are normally adopted in shaft design
Max shear stress = 170 N/mm2
Max bending stress = 200 N/mm2
The lever is subject to pure bending moment
We know,
M = 3.14 / 32 x fb x D3
98100 = 3.14 / 32 x 200 x D3
D = 8.40 mm
The same torque is transmitted to big gear shaft, as number of teeth on both gears is same. So we selected shaft dia 10mm with factor of safty.

D. *Design Of Gear Shaft*

T = 3.14/16 x fs x Ds3
98100 = 3.14/16 x 170 x Ds3
Ds = 7.36 mm
Taking bigger diameter from above solution and check for induced stress.
Ra + rb = 200 + 491 = 691 n
Ra = (691 – rb)
m (rb) = 0
Ra *200 + 491 * 60 - 200 * 100 = 0
Ra = 47.3n
Rb =643.7 n
Maximum bending moment = 98200 n-mm
Maximum torque = 98100 n-mm
Equalent torque = 249351 N – mm
Using tortion formula
Te = π/16 x ds3 x fs
249351 = π /16 x 203 x fs induced
Fs induced =158 N / mm2 < 200 N / mm2
As induced stress is very less in torsion design of shaft is safe.

E. *Design Of Spri*

The spring is mounted on rack to make initial position of rack. The outer Diameter of spring is restricted due to size of rack, which is 20mm. We take the outer diameter of
Spring considering the clearance between rack and spring to avoid jam of spring.
D = 20 + clearance between spring & rack
= 20 + 2mm
D = 22 mm
For avg service life 422N/mm².
Wire diameter range is 4.5 to 8 mm
We get wire diameter d = 5 mm from range
Calculating the load bearing capacity of spring
Spring index = C = D/d = 22/5= 4.4
C = 4.4
K = [4c – 1 / 4c-4] - 0.615 / c
For c =4.4 k= 1.08
We know
8 k p d
Shear stress = 3.14 d3
P = 422 x 3.14 x 53
= 8 x 1.08 x 22
P = 870.74 n
Applied load is limited to 200n
So the design of spring is safe.-
As we required deflection of spring in the range of 125 to 150 mm
Spring rate = P/δ = 870.74 / 150 = 5.8 N /mm
K = 5.8 N/mm.
Calculation of number of turn of Spring.
We know
8 P Do3N
Δ = G d4
8 x 870.74 x 223x N
150 = 0.007845 x 10^6 x 54
N = 10.68 Turns
N = 11 turns
Solid length of spring ls = n x d
= 11 x 5
= 55 mm

Free length of spring = ls + δmax + 0.015 x δ
= 55 + 150 + 0.15 x 150
Lf = 227.5 mm
Pitch of spring = free length
Pitch = 20 mm
Summary of spring
Wire dia d = 5 mm
Coil dia d = 22mm
Solid length = ls = 55 mm
Free length = lf = 227.5 mm
Pitch = p = 20 mm
No of turns = 11
Deflection δ = 150 n / mm

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