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Design of Smart Conveyor System of Inlet Air Manifold

D.D.Patil[1], V.V.Nikam[2],P.G.Mali[3], A.A.Chamansheikh[4] , S.R.Sathe[5] ,S.V.Yadav[6]

[1,2,3,4,5]*U.G.Student, ADCET Ashta*

[6]*Research Supervisor, ADCET Ashta*

ABSTRACT

Conveyors are essential to quarrying, mining, and mineral processing operations to transfer the material from one place to another place. It is very difficult to transfer the material very quickly or efficiently and the whole undertaking would be a lot more dangerous. The ciritcal components of the conveyor is analyzed and checked within the permissible limit. The maximum stress developed at the point of application as shown in fig above. The advantage of our system over the conveyor system is that the system has a time delay between moving jobs and this delay used to introduce any alterations in the package or move the package for any other purpose and likewise. While in conveyor system such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which basically is less costly. The prototype design requires electric motor, shafts and the frame of which the frame and platform on which the packages are moved is fabricated.

The result of optimization show that the reduction of weight of is also under safe zone. The stresses developed in the component is within safe zone so that we accept the optimize results.

Keywords: Conveyor, electric motor,shaft,Cost.

INTRODUCTION

Different methods such as fork lifting, use of bucket elevators, conveyors systems, crane, etc. has been identified for lifting or transporting bulk materials or products from one place to another in the manufacturing industries depending on the speed of handling, height of transportation, nature, quantity, size and weight of materials to be transported. However, occasional halt or fatalities encountered while loading and unloading in the industry are source of concern. The objective of this research work is to provide design data base for the development of a reliable and efficient belt conveyor system that will reduce cost and enhance productivity while simultaneously reducing dangers to workers operating them. Conveyor system is a mechanical system used in moving materials from one place to another and finds application in most processing and manufacturing industries such as: chemical, mechanical, automotive, mineral, pharmaceutical, electronics etc.

It is easier, safer, faster, more efficient and cheaper to transport materials from one processing stage to another with the aid of material handling equipment devoid of manual handling. Handling of materials which is an important factor in manufacturing is an integral part of facilities design and the efficiency of material handling equipment add to the performance level of a firm [1]. Conveyor systems are durable and reliable in materials transportation and warehousing. Based on different principles of operation, there are different conveyor systems namely: gravity, belt, screw, bucket, vibrating, pneumatic/hydraulic [2], chain, spiral, grain conveyor systems etc. The choice however depends on the volume to be transported, speed of transportation, size and weight of materials to be transported, height or distance of transportation, nature of material, method of production employed. Material handling equipment ranges from those that are operated manually to semi-automatic systems and to the ones with high degree of automation. The degree of automation however depends on handling requirements.

There has been a serious demand for intermittent movement of packages in the industries right from the start. Though the continuous movement is more or less important in the same field the sporadic motion has become essential .The objective of our project is to produce a mechanism that delivers this stop and move motion using mechanical linkages. The advantage of our system over the conveyor system is that the system has a time delay between moving jobs and this delay can be used to introduce any alterations in the package or move the package for any other purpose and likewise. While in conveyor system such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which basically is less costly.The prototype design requires electric motor, shafts and the frame of which the frame and platform on which the packages are moved is fabricated.

Material handling involves movement of material in a manufacturing section. It includes loading, moving and unloading of materials from one stage of manufacturing process to another. A belt conveyor consists of an endless and flexible belt of high strength with two end pulleys (driver and driven) at fixed positions supported by rollers. In this work, 3 roll idlers are required for adequate support of materials transported and protection of the belt along its length. Pulleys are used for providing the drive to the belt through a drive unit gear box powered by an electric motor. It also helps in maintaining the proper tension to the belt. The drive imparts power to one or more pulleys to move the belt and its loads. Materials are transported over the required distance as a result of friction generated between the roller surface and the moving belt set in motion by a rotating pulley (drive pulley). The other pulley (driven or idler pulley) acts as a wheel around which the material rotates and returns in a continuous process. Continuous processes are characterized by non-stop motion of bulk or unit loads along a path without halt for loading and unloading [3].

The peculiarities of a belt conveyor is that it is easy and cheap to maintain, it has high loading and unloading capacity and can transport dense materials economically and at very high efficiency over long distance allowing relative movement of material [4].

DESIGN CONSIDERATIONS

According to [1], the design of an effective and efficient material handling system which will increase productivity and minimize cost, the guidelines normally followed are:

1. Designing the system for continuous flow of material (idle time should be zero);

2. Going in for standard equipment which ensures low investment and flexibility;

3. Incorporating gravity flow in material flow system; and

4. Ensuring that the ratio of the dead weight to the payload of material handling equipment is minimum.

Manufacturers Data:-

1. Length of conveyor from centre to centre.:- approx. 3meter

2. Either degree of inclination, ior distance to belifted ior lowered.i:- Horizontal orientation

3. Average capacity per hour.:- 20 to 25 manifolds

4. Maximum capacity per hour.i:- 25 inumbers

5. Material to be conveyed, and weight per piece:-
   Automobile manifolds (weight approx. 3-4 Kg)

6. Average size of material.:- Length 300 to 400mm and height 200mm and width 250mm

7. Size of largest pieces :- Length 300 to 400mm and height 200mm and width 250mm

8. Nature of material – Automobile components.

9. Component feeding to belt conveyor:- Manually.

10. Components to be discharged from the belt: Manually.

11. General indication of supporting structure.:- MS fabricated

12. Power available for driving.:- AC 3 phase 230V

But to drive the PMDC motor we will use adaptor and the motor input supply is 12 V 5 amp current

Capacity of Belt Conveyor

The rate at which material is carriediby the conveyor is known as capacity of the conveyor.

the capacity can be either volume flow rate (i) or mass flow rate (i)

Let, B = width of the belt, m

b = width of the material storage on belt, m

= (0.9B-0.05), m

v = belt speed, m/s

B = capacity of conveyor in)

M = capacity of conveyor in(i)

ρ = mass density of bulk material, kg/m3

Capacity of Horizontal Belt Conveyor:

The volumetric capacity of horizontal belt conveyor is giveniby,

M = ρQ

Where,

C = surcharge factor

Selection iof imotor-

as per the given data from the sponsored company we can select the suitable motor.

motor selection depends upon the power required and capacity of the motor.

Power requirement of belt conveyor consist of two parts:

1. Power required for lifting load through height 'h'(pl)

2.Power required for overcoming frictional iresistance at various points while moving the load (Pf).

Let, Q = Capacity of conveyor, m3/s

p = mass density of material, kg/m3

h = height through which material is to be lifted, m

L =belt length, m

Co = specific friction factor (It is the frictional resistance at dlers, pulleys, loading section and unloading section per Newton load per meter belt length).

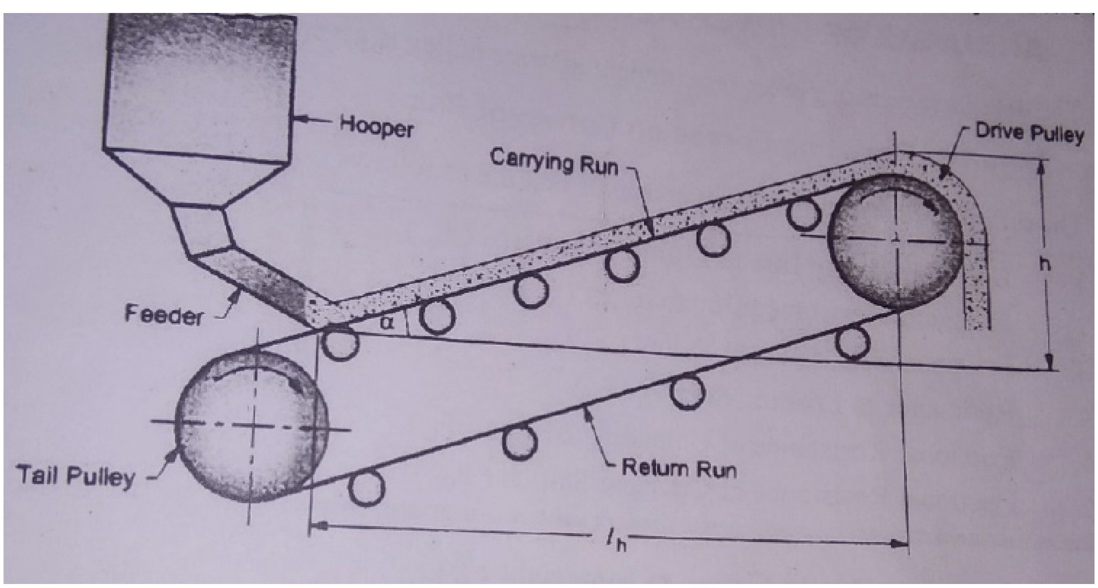


Fig. No.1 power requirement of Belt Conveyor

1. Power required for lifting load through height 'h' (Pl)

For the horizontal belt iconveyor height 'h' will become zero so that the power required to lift the load become zero.

2.Power required for overcoming frictional resistance at various points while moving the load (Pf):

1.Load Resistance Due to Lifting of Material (Fm):

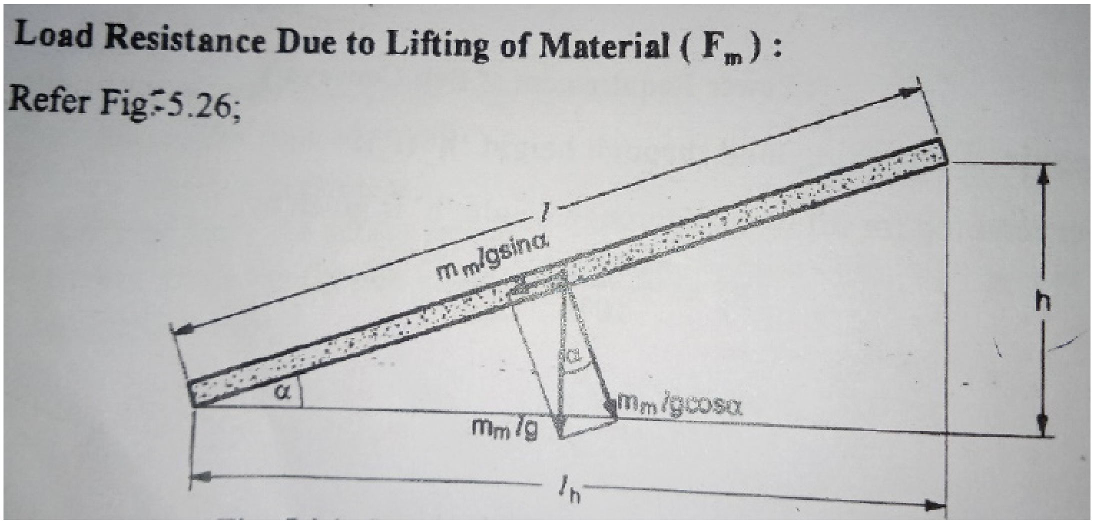


Fig. No.2 Load Resistance due to Lifting of Material.

Let, M = capacity of conveyor or mass of material carriediby conveyor, kg/s

mm= material carried by conveyor per unit belt length, kg/m

v = belt ispeed, im/s

l = length of load carrying run of belt, m

lr = length of return run of belt, m (l = lr)

h = height through which the material is lifted, m

Ø = angle of inclination of belti(Ø = 0, horizontal belt)

Now,

M = mmV

mm = M/V

from the fig.

Total material load acting on the load carryingirun of the belt is,

Wm = mm.l.g

Total material load 'Wm' can be resolved into two components:

(i)Wm cosØ = mm l gcosØ

The component is normal to the belt.It acts as a normal reaction on idlers and produces frictional resistance at idlers.

For horizontal belt conveyor cosØ = 1(Ø = 0)

Wm cosØ = mm.g

Total load W= 37.5 x 10 (max weight considered is 37.5kg)

=375N……………………………………………………………………………..(1)

(i)Wm sinØ = mm l g sinØ

This component is along the belt but in a direction opposite to the belt motion. This omponent is known as Load resistance.for the horizontal belt sinØ = 0, so that this component will not be there.

Wm sinØ = 0

2.Frictional Resistance at Pulley (Fp):

The frictional resistance at pulley is due to pulley bearings and belt stiffness. It is determined as follow:

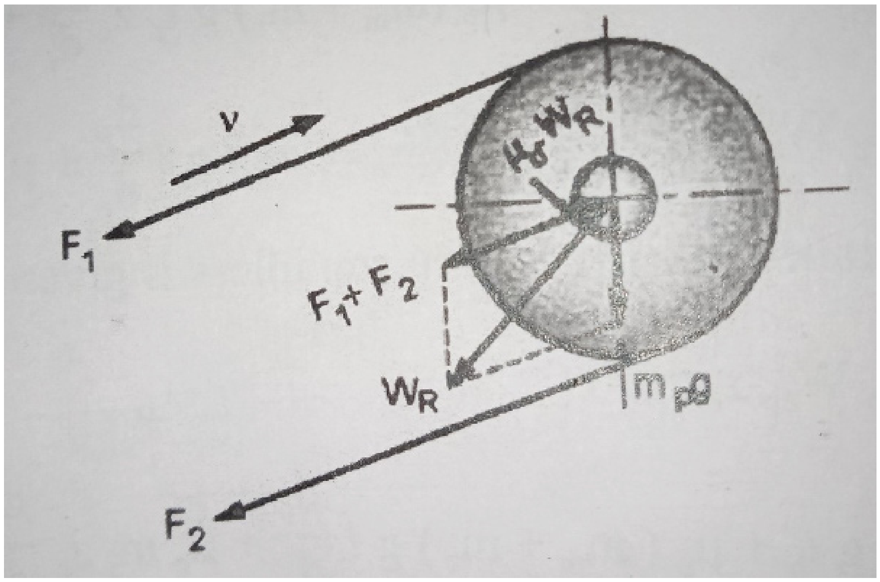


Fig. No.3 Frictional Resistance at Pulley

Let, F1 = effective tension in tight side of pulley belt, N

F2 = effective tension in slack side of pulley belt, N

mp = mass of pulley

db = diameter of pulley bearing, m

Dp = diameter of pulley, m

Wr = resultant load acting on pulley bearing, N

μd = coefficient of friction at pulley bearings

The resultant load acting on the pulley bearings Wr is the vector sum of belt tensions

(F1 and F2) and pulley weight mp.g

Wr =(F1+ iF2) + mp.g

Friction resistance at the pulley bearings = μd.Wr

Equivalent frictional resistance at pulley is,

$$Fp = \mu_d . \text{Wr}. \frac{d_b}{D_p}, \text{ N}$$

The total frictional resistance at pulley due to pulley bearings and belt stiffness is giveniby following empirical relation.

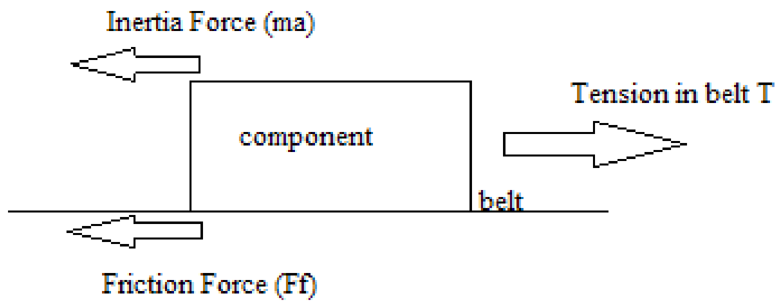
Fp = ϵ F1

where, ϵ = angle of lap(or snub) factor for pulley

= 0.02-0.03 for ϴ≤ 90o

= 0.03-0.04 for 90o ≤ Θ ≤ 180o

= 0.05-0.06 for 180o ≤ Θ



V= 0.209 m/s……………….. (where N = 40rpm and Dia.=0.1m)

Initial velocity of component is considered as zero so u = 0 m/s

We know that,

Where,

V = velocity of belt

u = initial velocity of component

a = acceleration of belt

s = distance of belt

a = 0.0218 m/s2

so that to achieve desire speed of belt acceleration should be 0.0218 m/s2

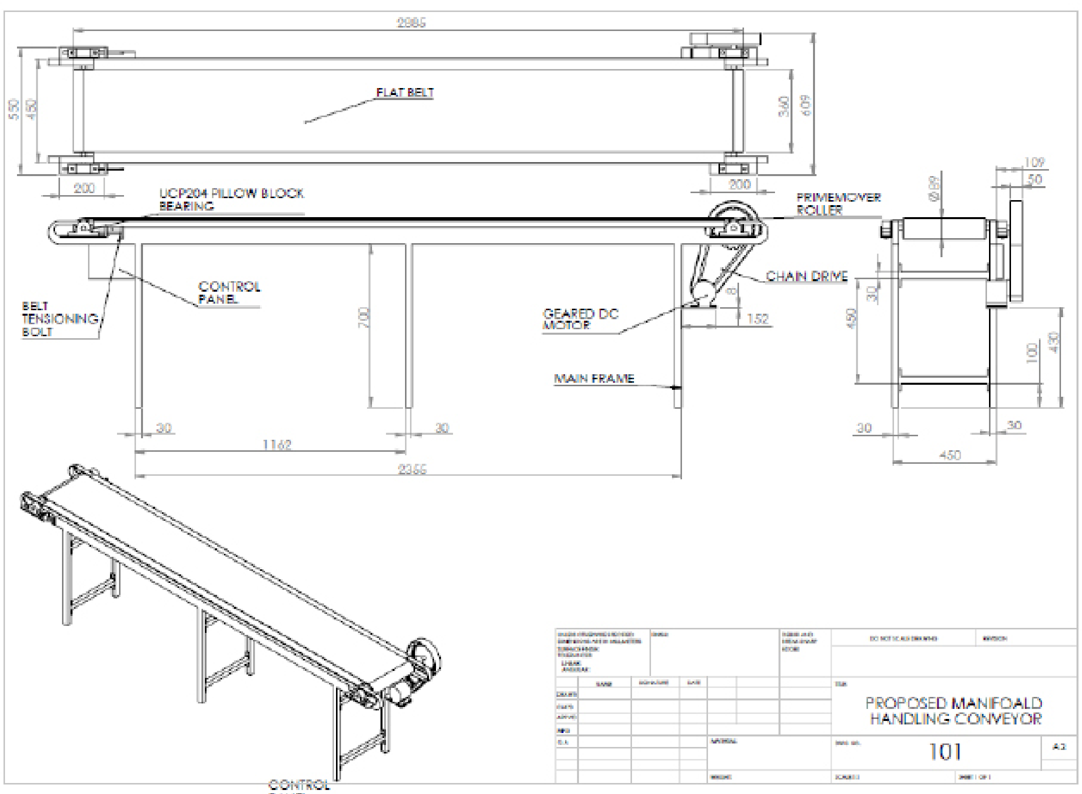


Fig. No.4 Detailed outline drawing for proposed conveyor

CONCLUSION

Using the designed values above, a belt conveyor system with 3 roll idlers can be developed for conveying coating material efficiently without belt spillage and fatalities. A PN 450 double weave standard rubber belt with the specifications above will sufficiently convey the coating material. The belt conveyor system is designed with high degree of automation, loading, movement and unloading efficiency. It is also very flexible, safe, with low initial, operational and maintenance cost while eliminating repetitive short distance movement in the manufacturing industry.

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