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Modeling of Simplified Vertical Conveyor System

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ABSTRACT

This work is related to transferring goods from a first horizontal to second horizontal conveyor comprising a substantially upright extending frame-endless drive arranged on the frame and drivable by a motor; at least one support member which is connected to endless drive and which is drivable in a circuit by means of the endless drive.

The parts used in the design including bearing, chain, sprocket, motor etc. are easily available in the market. The chain drive ensures a continuous and safe operation. The number of boxes to be delivered varies upon the number of carts connected and the gearbox & motor specifications.

So, it is basically a vertical conveyor with a carriage which is mounted on endless chain and it lift boxes in vertical direction and dispatch them on another horizontal conveyor synchronized with it.

Keywords : Fork assembly guider, Bucket chain , Fork assembly , case.

I. INTRODUCTION

A vertical conveyor is a machine which can be used to move products automatically from one level to another. In internal logistics, there are various ways for getting product flows up or down. A solution which is often used is the deployment of incline or lowering belts. When placed at an angle in order to bridge a height difference, such belt conveyors also have the advantage of covering a certain distance. A disadvantage is the loss of much useful floor space as a result of the presence of the necessary supports for the belt conveyor.

1.1 Type of Conveyors

1.Inclined Conveyor 2. Screw Conveyor
3. Spiral Conveyor 4. Platform vertical conveyor

1.2 Above mentioned conveyors cannot fulfill following requirements

1. It should have Continuous operation .
2. It should occupy minimum surface area.
3. Constant operational speed.
4. Must carry and deliver fragile material safely without vibration or shocks.
5. Minimum travel distance and time.
6. Cost should be minimum.
7. Easy to assemble and disassemble.

II. DESIGN OUTLOOK

A detailed design has been made with an integrated set of parts which works collectively to obtain desired results.

It consist of roller chain, sprocket , fork , fork guider , casing ,Triangular solid link , Motor and two horizontal roller conveyor.

This integrated set of parts give goods smooth , vibration free , stable and continuous motion.

The most common applications of vertical conveyors are for reducing floor space, tying multiple floors together, vertical accumulation systems, pick-up and drop-off points for vehicles, and many more specific use cases. They find applications in airports, automotive manufacturing, chemical processing, food packaging, recycling, warehouse distribution, and other industries. The next section will show some specific examples of these conveyors to show how they succeed in so many different settings.

This design is made in **Autodesk Fusion 360** (student version).

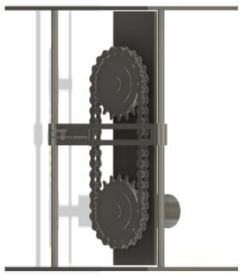

Figure-1 : Final Assembly-(a)

Table-1 : Parts of vertical conveyor

S. No.	Parts	Material	Quantity
1.	Sprocket	Cast iron	2
2.	Roller chain	-	Length
3.	Fork Assembly	Steel	1
4.	Motor	Manufacture	1
5.	Base Rectangular plate	Cast iron	1
6.	Top Rectangular plate	Wood	1
7.	Circular Column	Stainless Steel	1
8.	Rectangular Vertical support	Mild Steel	1
9.	Bearing	-	2
10.	Fork assembly guider	Steel	1
11.	Horizontal roller conveyor	-	2
12.	Triangular link	Steel	1
13.	Bearing	Steel	2

III. METHODOLOGY

3.1 Selection of Chain

Weight on the chain = weight of lifted material + weight of fork + weight of fork guider.

Assume max. lifted weight = 2kg

weight of fork = 2 kg

weight of fork guider = 2 kg

Hence weight on the chain = 6 kg

Maximum tension in chain = 6*10= 60N

Pitch=8mm
Tensile strength=4400N

Tensile strength considering factor of safety=4400/9 =488.8N

Taking the distance between the two sprockets= 1.5meter

Hence, Chain Length= 2*150+ 2(Semi circumference of Sprocket) =
300+2(3.14*7.5) = 347 cm

Number of links = Chain length/Pitch = 3470/8= 433 links

Figure-2 : Roller Chain

Table-2 : Selection of Chain

Table 14.1 *Dimensions and breaking loads of roller chains*

ISO chain number	*Pitch p (mm)*	*Roller diameter d_1 (mm) (max.)*	*Width b_1 (mm) (min.)*	*Transverse pitch p_t (mm)*	*Breaking load (min) N*		
					Simple	*Duplex*	*Triplex*
05B	8.00	5.00	3.00	5.64	4 400	7 800	11 100
06B	9.525	6.35	5.72	10.24	8 900	16 900	24 900
08A (ANSI-40)	12.70	7.95	7.85	14.38	13 800	27 600	41 400
08B	12.70	8.51	7.75	13.92	17 800	31 100	44 500
10A (ANSI-50)	15.875	10.16	9.4	18.11	21 800	43 600	65 400
10B	15.875	10.16	9.65	16.59	22 200	44 500	66 700
12A (ANSI-60)	19.05	11.91	12.57	22.78	31 100	62 300	93 400

The chain which we are using here is 05B-1

3.2 DETERMINING THE SPROCKET DIAMETER

Considering the size of the fork assembly and fork guide It was necessary for us to keep some distance .

Thus, Diameter=15cm

Figure-3 : Sprocket(Fusion 360 student version)

3.3 CHAIN LUBRICATION

The frictional losses in chain drive consists of the following factors:

(i) Loss due to friction between the rollers and the bushes

(ii) Loss due to friction between bushes and pins

(iii) Loss due to friction between the sprocket teeth and the rollers.

The efficiency of a well lubricated chain drive is from 96% to 98%.

The objectives of chain lubrication are as follows:

(i) To reduce the wear of chain components

(ii) To protect the chain against rust and corrosion

(iii) To carry away the frictional heat

(iv) To prevent seizure of pins and bushes

(v) To cushion shock loads and protect the chain

There are three basic methods for the lubrication of chains.

They are designated as Type-A, Type-B and Type-C.

The type depends upon the power rating and the velocity of chain. The ANSI standard as well as the chain manufacturers recommend a particular type of lubrication depending upon these two factors

Here, We have low power rating as well as low velocity of roller chain so we will prefer **Type- A** lubrication method i.e. manual lubrication. In manual lubrication, the lubricating oil is applied to the chain links with a brush or an oil can after every eight hours of operation. The frequency of applying the oil should be adjusted so as to prevent overheating of the chain or discoloration of the chain joints.

3.4 FORK

It basically carries the material over the entire travel distance. The design has been made such that it can be dismantled easily. It gets its motion from roller chain through triangular solid link. It bears all the load of goods which are meant to transport at some vertical distance.

Fork motion should be smooth so that we can even transport fragile materials.

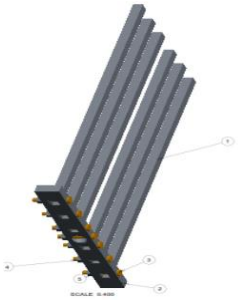

Figure-4 : Fork

Table- 3 : Parts of Fork

S.no	Parts	Material	Quantity
1.	Part 1	Mild steel	6
2.	Part 2	Mild steel	1
3.	Bolt	steel	7
4.	Nut	steel	7
5.	washer	steel	7

3.5 FORK ASSEMBLY GUIDER

Being in direct contact with the fork, it makes sure that the fork's orientation does not change over the entire travel distance. The interface between the path and the fork guider helps the fork to stay steady irrespective of the triangular link position.

Table-4 : Parts of fork assembly guider

S. No.	Parts	Material	Quantity
1.	Fork guider	Mild Steel	1

Figure-5 : Fork Assembly Guider

3.6 TRIANGULAR SOLID LINK

This Link is used to join roller chain with fork assembly. It is rigid on the chain but rotate freely with the bolt connecting fork and triangular link.

Figure-6 : Triangular solid link

3.7 CASING

The case not only provides a strong support to the entire assembly but also has the "paths" as the integrated parts of the case.

Table-5 : Parts of Casing

S. No.	Parts	Material	Quantity
1.	Circular column	Stainless steel	2
2.	Rectangular Plates	Cast iron/ wood	1-1
3.	Rectangular vertical support	Mild steel	1

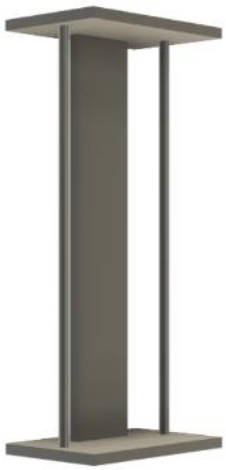

Figure-7 : Casing

3.8 BALL BEARING

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and

races. However, they can tolerate some misalignment of the inner and outer races.

Figure-8 : Ball Bearing

4 CHAIN DRIVE

Chain drive is used to transferring motion one end to another end. This chain drive gets its power from motor for rotation.

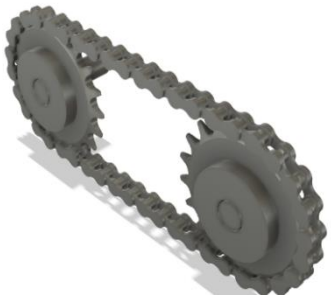

Figure-9 : Chain Drive

4.1 Sprocket and Chain with Fork assembly

Figure-10 **:** Sprocket and chain with fork assembly

4.2 FORK ASSEMBLY WITH GUIDER

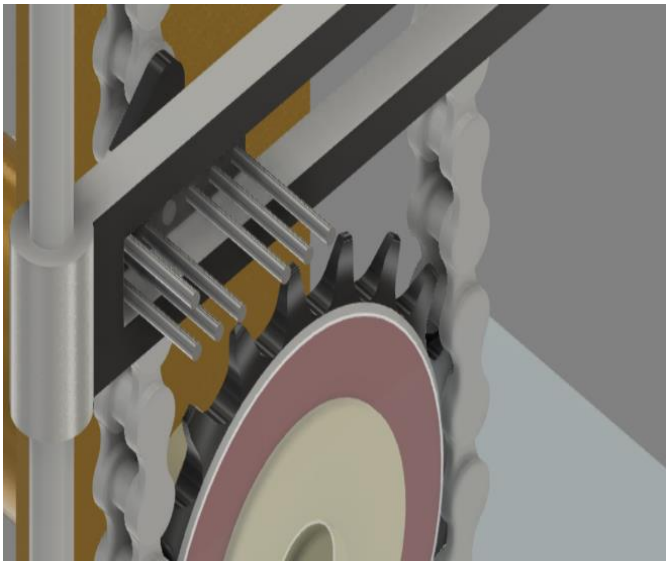

Figure-11: Fork assembly with guider

5 FINAL ASSEMBLY

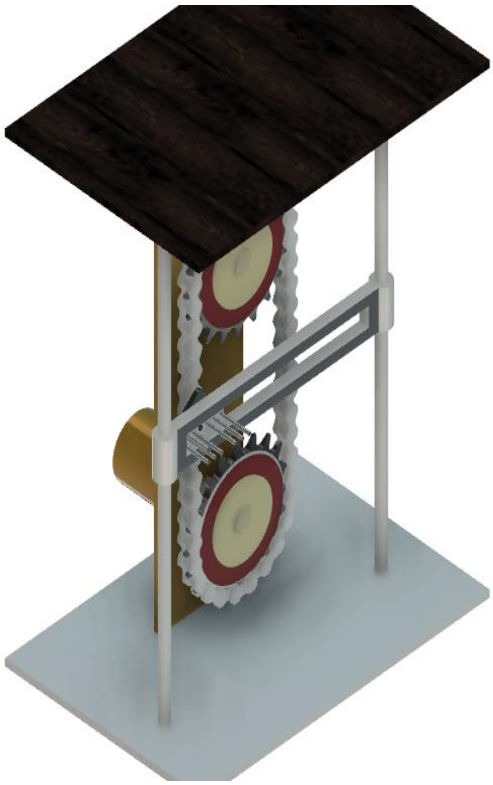

Figure- 12 : Final assembly-(b)

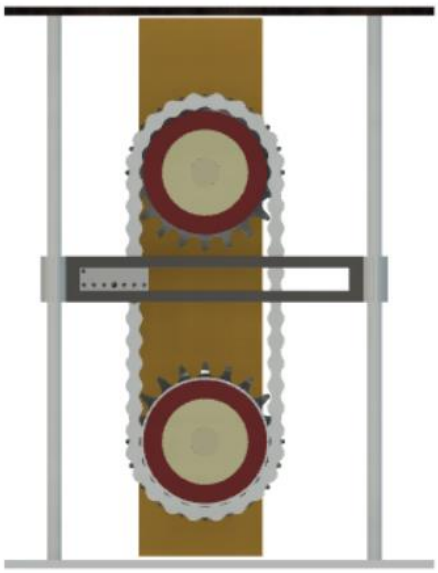

Figure-13 : Final assembly-(c)

IV. CONCLUSION

Hence, it can be concluded that the above detailed design is relatively simple as compared to the ones available in the market. Thus, it is easier for the local manufacturers with very basic machine tools to manufacture this product. Also, design is compact and simple. The parts used in the design including bearing, chain, sprocket, motor etc. are easily available in the market. The chain drive ensures a continuous and safe operation.

The conveyor is a material handling system capable of moving products from one place to the next and is an integral part of modern manufacturing. There are many kinds of conveyor systems, each designed to move material or product from inlet to outlet, and they find uses in almost every industry thanks to their capabilities. Read our article on understanding conveyor systems for a basic understanding of conveyor technology.

V. REFERENCES

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