# Automatic Pallet Carrier for Small Workshop

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*Abstract*— In small workshops there are workstations which are at distance of 5 meter and large time is spent on transmission of product from one workstation to another workstation. To transfer product the conventional transfer medium such as conveyor belt, automated guided vehicle (AGV) are used. These methods consume electricity as well as they are costlier. So this paper is important for transmission of product from one workstation to another without use of any electricity. The project is operating on weight of the product. There are arrangement such as Lever, gears, spring and wheels which operates this machine, there is arrangement such as when lever is pressed then gears rotates and there motion is transmitted to the wheels and machine moves from one workstation to another workstation. Spring arrangement is used so that when weight is lifted then spring gets contracted and wheel moves in reverse direction.
***Key words:*** Pallet Carrier, Lever, Spring, Propulsion

## I. INTRODUCTION

Material handling is movement and storing of goods. Material handling activity includes packing up material, transporting material and setting down material. Out of total production time 20% time is spent on actual process. Remaining time is spent in movement, waiting etc. Thus proper arrangement of material handling system can improve means of faster production, higher plant capacity, lower stock is process and less damage to product in all stages. Proper arrangement of material handling system can achieve faster production, Utilizes higher plant capacity, and lower work in process. The working principle of this project is ‘‘Propulsion of pallet carrier using self weight of the object”. The weight ‘w’ is kept on lever, due to its gravitational force, the upper shaft gets rotated & gear also be rotated which is keyed on shaft. By increasing gear ratio, power is transmitted to wheel & pallet carrier can run from one station to other station.

When the weight is removed, the lever comes back to its initial position, due to the spring tension and due to which pallet carrier also comes back to its initial position. By this process we can transport work in progress from one place to other at fixed distance by means of Mechanical Energy.

## II. PROBLEM STATEMENT

In general all industry has time is main factor so if it proper consumes any condition it help to the increase the overall efficiency industry so in industry overall production only 20% time is only for actual working on that object and remaining time is spend in transportation of material from one work station to another work station. So any how we can properly consume the time of production it help to overall output of that company.

So to minimizing the drawback of this we can use the various transportation device. In our project we have used automatic pallet carrier that are used for transportation of object. In this project we have used input self weight of the object which is to be placed on the pallet carrier and due to the gravity it works automatically without any human interferens.

## III. OBJECTIVES

1) To achieve a travel up to ‘8.5’ meter due to weight (gravitational force).
2) To give definite path to the pallet carrier by means of using guide ways.
3) Automatic stopper mechanism after travelling particular distance by using stoppers in guide ways.
4) To increase travelling distance by increasing gear ratio.
5) To Design Pallet carrier for Weight carrying capacity of about 35 kg.
6) Pallet carrier requires less space compared with other conveyors.
7) Use the Pallet carrier wherever the space limitations.
8) Noiseless and smooth in operation.

## IV. LITERATURE REVIEW

*A. The Current State and Future Trends in the use of Pallets in Distribution Systems by Javad Mokhlesi Saman Lohrasebi (University of Borås School of Engineeringse-50190boråstelephone +46 033 435 4640)*

The main idea behind developing such a research is to demonstrate the situation of pallet utilization in industries and related affecting factors. Pallet plays a very important role in Logistics chains or Distribution systems. Regardless of the application purposes of pallets there are a lot of other factors in pallet usage that draw a great attention for the users and also producers of pallet. These factors can be considered from so many different aspects. Pallet is a part of a cargo carrier concept. This concept is broadly taken into account since individual transportation and handling of materials is costly. It can also reduce the speed of handling process to a very low level. It also decreases the efficiency of the desired logistics chain (Stjernman & Torstensson, 2006).

To overcome the stated obstacles creating a desired large unit configuration is of interest. When it comes to larger scales then mechanical handling becomes vital (Stjernman & Torstensson, 2006).One of the most important aspects that brought a lot of heat on pallet industries in the recent years is Environmental issues along with the strict associated policies and regulations. Due to the limited number of natural resources for instance Forrest and water there have been a lot of debate around roles and regulations regarding resource conservation and so forth.

These factors directly or indirectly affect the pallet utilization in any kinds of business sectors which leads this industry to a new futuristic trends and changes. These trends can be classified in many different ways and from several points of views. Many experts believe that, these likely changes and trends have been started quite a while ago and

 

they are just in the process of evolving for the predicted needs of the future. Some of the argued trends are about the recycling, repairing and also the re-using of pallets. As mentioned earlier these facts demonstrate the importance of the pallet in distribution systems and related industries. Such characteristic of this device talk for the other dimensions of importance. This attitude is widely discussed in this report and will be explained in details in the provided chapters. The focus in this thesis report is mostly around the current situation of pallets and the used raw materials for producing them also create guideline for possible future trends and changes both in structure, design and used materials.

*B. Gear (terminology of spur gear) by S. Mahendran, K.M.Eazhil, L.Senthil Kumar51(2): 55-62.*

Gears are machine elements used to transmit rotary motion between two shafts, normally with a constant ratio. The pinion is the smallest gear and the larger gear is called the gear wheel.

The gear stress analysis, the transmission errors, and the prediction of gear dynamic loads, gear noise, and the optimal design for gear sets are always major concerns in gear design. The polymer gear wear rate will be increased, when the load reaches a critical value for a specific geometry. The gear surface will wear slowly with a low specific wear rate if the gear is loaded below the critical one. The possible reason of the sudden increase in wear rate is due to the gear operating temperature reaching the material melting point under the critical load condition.

Actual gear performance was found to be entirely dependent on load. A sudden transition to high wear rates was noted as the transmitted torque was increased to a critical value. This is to be associated with the gear surface temperature of the material reaching its melting point. That is for a given geometry of actual gear, a critical torque can be decided from its surface temperature calculation. [K. Mao, 2006]

Load carrying capacity and occurring damages of gears which are made of PC/ABS blends were investigated. PC is hard material and ABS is soft material. The usage of materials limits these drawbacks.

## V. METHODOLOGY

The working principle of this project is ‘‘Propulsion of pallet carrier using self weight of the object”.

The weight ‘w’ is kept on lever. Due to which the upper shaft gets rotated due to weight. The shaft is keyed with gear which is meshing with other gear. By increasing gear ratio power is transmitted to wheel.

Wheel rotate up to ‘8.5’m in a length. When lever goes at final position, weight is removed and the weight gets displaced from one place to another place. The tension spring is attached on lever. As soon as the weight is removed the lever moves to initial position due to which conveyor comes back to initial position. When lever goes down due to weight the energy stored in tension spring. The energy is used to return the pallet carrier to its original position.

## VI. CONSTRUCTION

1) First of all we make complete statement of the problem; indicate the need of aim or purpose for which machine is to be designed.
2) Selection of a proper mechanism (gears and levers), which will give a desired motion.
3) Selection of a proper material.
4) Search and find the forces acting on each member. i.e. Design of separate elements.
5) Manufacturing of Separate parts like gears, shafts, levers, structure/frame etc.
6) Assembly of all manufactured parts and available standard parts like as bearings, nut & bolts, washers, spring, wheels, gears etc. Then all accessories assemble from bottom to top.

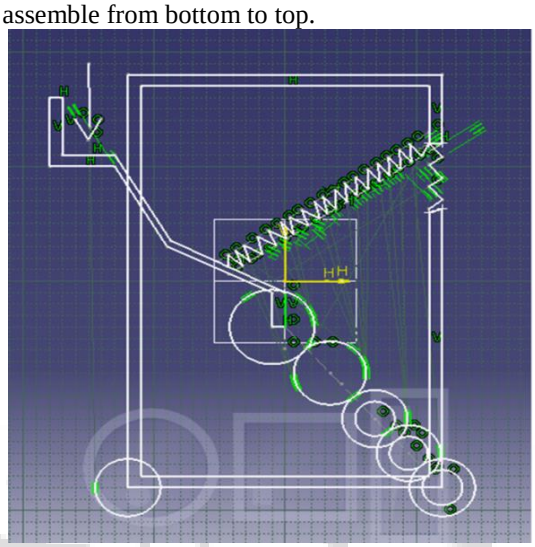

Fig. 1: Layout sketch of Automatic Pallet carrier For Small Workshop

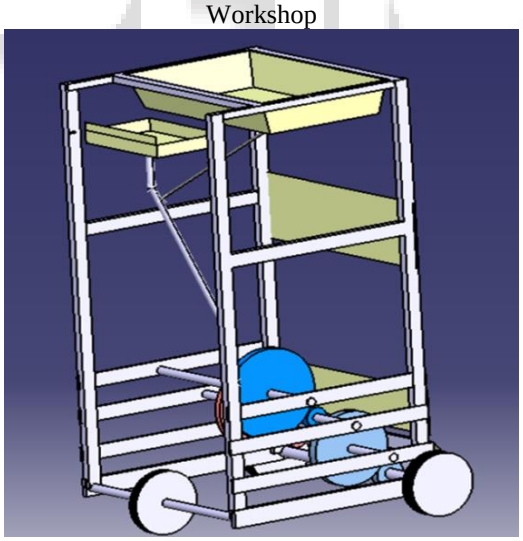

Fig. 2: 3-D View of Automatic Pallet Carrier for Small Workshop

## VII. DESIGN OF SPUR GEAR

While the designing of spur gear first of all we have to determine the torque on that system

$$torque = F \times r$$
$$= 30 \times 9.81 \times 590$$
$$= 173.637\ N.m$$

Thus, power developed by arm on the shaft is calculated as follows-

We know that,

$$P = \frac{2\pi NT}{60}$$
$$= \frac{2\pi \times 1.01 \times 173.637}{60}$$
$$= 18.36 \text{ watt}$$

Effective load on gear tooth (mt), therefor,
Thus check for Design

$$mt = \frac{60 \times 10\text{^}6 \times (kw)}{2\pi N}$$
$$= \frac{60 \times 10^6 \times 18.36}{1000 \times 2\pi \times 1.01}$$
$$= 173589.19\ Nmm$$

Y factor to be calculated by interpolation method

The gear has 127 no. of teeth. So, Lewis form factor to be calculated by interpolation method.

| No of teeth | Y |
|---|---|
| 100 | 0.466 |
| 150 | 0.458 |

Table 1: Lewis form factor

By Interpolation,

$$Y = 0.446 + \frac{(0.458 - 0.445) \times (150 - 127)}{(150 - 100)}$$
$$Y = 0.4515$$

The tangential component is given by (Pt),

$$Pt = \frac{2mt}{dp}$$
$$= \frac{2 \times 17384.19}{47.9}$$
$$= \frac{2 \times 17384.19}{47.9}$$

Diametral pitch (Dp),

$$dp = m \times Zp$$
$$= 1.58 \times 30$$
$$= 47.4$$

Where, v is the pitch line velocity in m/s
Pitch Line Velocity is given by,

$$v = \frac{\pi . dp . np}{60 \times 10^3}$$
$$= \frac{\pi \times 47.4 \times 4.29}{60 \times 10^3}$$
$$= 0.01064$$

For ordinary and commercially cut gears made with cutters and width (v<10 m/s),

$$Cv = \frac{3}{3 + v}$$
$$= \frac{3}{3 + 0.01064}$$
$$= 0.9963$$

The effective load between two meshing teeth is given by,

$$Peff = \frac{Cs}{Cv} \times Pt$$
$$= \frac{1.5}{0.9964} \times 7324.43$$
$$= 11026.33\ N$$

Beam Strength (Sb),

$$Sb = Mb . \sigma b . y$$

Where,
Sb=Beam Strength of gear tooth (N)
σb=Permissible bending stress (N/mm2)
y=Lewis form factor

For gray cast iron FG 200(Sut=20 n/mm^2)

$$\sigma b = \frac{Sut}{3}$$
$$= \frac{410}{3}$$
$$= 136.67 \frac{N}{mm^2}$$
$$Sb = Mb . \sigma b . y$$
$$= 1.58 \times 16 \times 136.67 \times 0.4515$$
$$= 1559.94\ N$$

The beam strength is lower than wear strength therefor,
Factor of Safety,

$$F.O.S = \frac{Sb}{Peff}$$
$$= \frac{1559.94}{11026.33}$$
$$= 0.14147$$

Hence the design is satisfactory & the module should be 1.58 mm.

## VIII. CONCLUSION

By this work we can transport a material while work in progress and from one place to other at fixed distance by means of Mechanical Energy. As well asIt has high amount of power saving. It saves the money and time. It reduces labor work in workshop. Less human intervention is required.

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