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PNEUMATIC STOPPER FOR ENGINE PALLET

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ABSTRACT

The main focus of his project was to design and fabricate the pneumatic stopper to guide and stop the engine pallet on the conveyor line. Pneumatic stopper designed by us has the main function to up-lift and down-lift the stopper plate and which on further the engine pallet strikes on. And it allows the transfer of pallets not only to the existing conveyor but also to new conveyor extraction. This operation is achieved by using Pneumatic Cylinder which is further controlled by the valves.
On the first day when we get the project first thing we have done is that we observe everything and we come to know that the hard stopper can't transfer the engine pallet to the new conveyor extraction. As per the requirement, the existing conveyor stopper was not able to transfer the engine pallet to the new testing conveyor line, so we cut the safety metal sheet next to the dead stopper for installing the new stopper.

Keywords: Stopper, Pneumatic Cylinder, Conveyor, Radio Frequency Identifier and Metal plates

1. INTRODUCTION

Now a days, due to the workload in workstations and to increase the productivity rate manufacturing process of any product, of any company within less time, less manpower and automation they prefer most efficient ways, in which conveyor plays vital role. So, the Conveyor systems can carry different weighs and move materials through all phases of processing and packaging with work space, minimizing educated and trained employees and the need for manual handling, work flow of bulk materials.
However, as conveyor carry the product through manufacturing, assembling and further more processes to working units/sections, we need to stop the product at that point, for going through that process. So, here we require a stopper to stop the product.
The ultimate purpose of life is to more productive professionally and personally. While it might be under stable as to why organizations are constantly trying to push productivity levels within its population. When us look at the top rung of the company's, the race is unbelievable so due to the work load in workstations and to increase the productivity rate manufacturing process of any producing any company as organization. Within less time, less man power and automation, they prefer many ways, in which conveyer play victual role, in terms of carrying the different weights and move material through all phases of processing and packaging with work once so it uses the minimize the educated and trained employees and it also used to material handling work flow of bulk materials.
However, the conveyor transfer the components of engine pallet for our particular project, at need to be stopped with particular workstations for processing like assembling, testing and further more. So are they require the stopper to stop the pallet. It has different types as per the applications. So according the company's requirements, as they have to increase the testing conveyor line, so the stopper they using currently dead stopper is basically unmovable(fixed). So here we need to replace that which allow engine pallet go forward at new conveyer line testing.

2. PROBLEM STATEMENT

2.1 Problem Definition:

Currently, the stopper used in conveyor to stop the engine pallet they uses dead Stopper which stops the any further horizontal movement of the engine pallets.

Hard stopper available at station to guide pallet, while it transfer only to existing conveyor not to new conveyor extraction. So, in the cause production rate is decreases. While transferring to the existing conveyor, the pallet arrangement gets disturbed. Due to the striking of the pallet on it. it produces noise and further more damage.

2.2. Problem Analyzing:

Collecting all data from the site workers and the project guide we come to know about the problem, that as they wanted to increase another one conveyor line (testing). So the existing stopper does not fulfil any requirement of the company's plan. So they need to replace that one, to install another one for this particular task. In this analysis, they basically want the stopper which would have pop-up and pop-down directional movement.
Meanwhile, even after installing the new stopper, we need to take care of the engine pallet's side guideways, because it is very expensive.

As pallet misaligns when it strikes the stopper of the conveyor line. We need to achieve a proper standing position.

3. OBJECTIVES

1. To install new pneumatic Stopper for provide support to the engine pallet.
2. To transfer pallet not only to the existing conveyor but also to new conveyor extraction.

4. METHODOLOGY

1) Get the title of the project
2) Literature review and study of research papers
3) Problem Statement
4) Objectives
5) Design of the project
6) Material preparation
7) Assembly and installation of the project
8) Testing and results
9) Report and presentation

5. REQUIRED SOFTWARES AND COMPONENTS

5.1 CATIA V 5 :

Catia is a multi-platform software suite for computer-aided design, computer-aided manufacturing, computer-aided engineering, 3Dmodeling and Product lifecycle management, developed by the French company Dassault Systems.

5.2 Required Components:

List of the components:

1. Double acting Pneumatic stopper
2. Piston
3. Cylinder mounting plate
4. Sliding plate
5. Stopper plate
6. Stopper L-plate
7. Sliding supporting plate
8. Allen bolts
9. Hexagonal bolts
10. Washer
11. Hose pipes
12. Solenoidal valve

5.2.1 Double Acting Pneumatic Cylinder-

The basic functions of a pneumatic cylinder is to generate. To generate the pressure to stop and guide engine pallet on the conveyor line. Basically the main function is to just pop-up and pop-down.

6. PNEUMATIC CYLINDER

Stroke Length	50 mm
Piston Rod Thread	M12
Operating Pressure	4-6 bar
Mode of Operation	Double-acting
Piston diameter	80 mm
Material Cover	Die-Cast Aluminium, coated
Material Piston Rod	High alloy steel

Pneumatic cylinder

7. WORKING

As per the requirement of the company, the existing conveyor line allows only one line testing line for the testing, they want to start a new testing line to increase the production with less amount of time, without manpower and with proper alignment.

On the first day, we observe testing the conveyor line of the engine pallet and how it transferred to another testing conveyor line for further process. The project guide told us that the company requires to start a new testing conveyor line beside the existing conveyor, So the engine pallet can go to the new line. And they also told us the main problem, that the engine pallet is unable to transfer to the new conveyer line because of the dead stopper. The existing stopper is dead and cannot pop up and pop down, So, we decide with each other what shall we can do to overcome this problem then after the proper decision,

we told our guide that we can replace the existing dead stopper with a new stopper which can pop up and pop-down according to our requirement.

While observing we come to know that the engine pallet coming through the existing shift and roll conveyer allows transferring to only one testing conveyor line with the dead existing stopper. Because of hard stopper engine pallet causes wear and stress rate of production is also decreasing

After analyzing all the problems we have to make a structure which has to fulfill all their requirements and it also sustains whenever pallet strikes on it too by discussing with all the members and project guide from the college we have the idea of that structure based on the provided data by the project guide in Cummins India Limited like flow load speed and impact of the engine pallet on the stopper.

As they have also told about the quotation of the project which has been provided to them by regular maintenance partners working in the company. So we need to prepare such a model which has makes strength and sustainability and also a cost-effective structure stopper model.

We get the idea of the structure and having design analysis of the stopper we want to company and provided idea with them and having discussed with a supervisor they agree to the concept as it's was working and fulfilling their requirements.After getting a green signal from the company, we need to decide the place of the structure to be installed in the conveyor. When installing the product we cut the safety metal sheet concerning the dimensions of our product.

Our next aim was to design and fabricate the components of the structure and we need to platform various act manufacturing projects on the components such as hardening, bending and so on.

From the first day when we get project first thing we have done is that we observe everything and we come to know that the hard stopper can't transfer engine pallet to the new conveyor extraction. So, we firstly cut metal sheet beside the hard stopper. Then we understood that we can replace existing to pneumatic stopper. Then we told to supervisor and guide, they told it is better option to start new conveyor extraction. From getting green signal, we studied all the possibility designs which can stop plate properly, we done work on it. So, the main planned working will be occurs like this. Engine pallet will come through the conveyor line (shift and roller conveyor) before it, sensor will be detect the engine pallet and after detecting the pallet RFID amplify the frequency and it will decide that where should pallet, basically it will be acts as our decision maker.

After taking decision, the stopper will start working. Suppose, both the line are busy with pallets then stopper will stop upcoming pallet, if only one line is busy with pallet then it will allow to the line which is free. Working of the stopper will be to pop-up and pop-down depends on the RFID.

Basically, we are grounding pneumatic cylinder mounting on the L-plate in such way that we have to achieve the stroke length of 50mm. And the Piston rod is assembled to another one L-plate which has different dimensions that first one. It will act as the stopper and restrict the pallet accordingly.

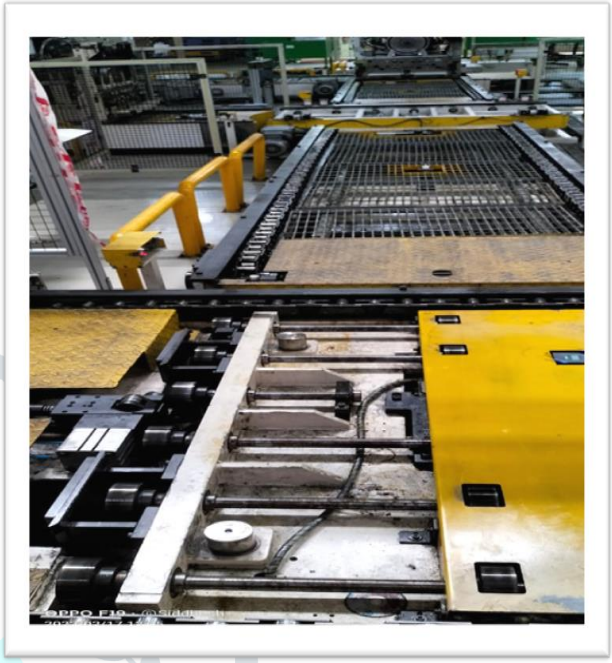

Image: Conveyor before installing stopper

Image: Conveyor after installing stopper

8. PNEUMATIC SYSTEM

8.1 Pneumatic Flow Diagram:

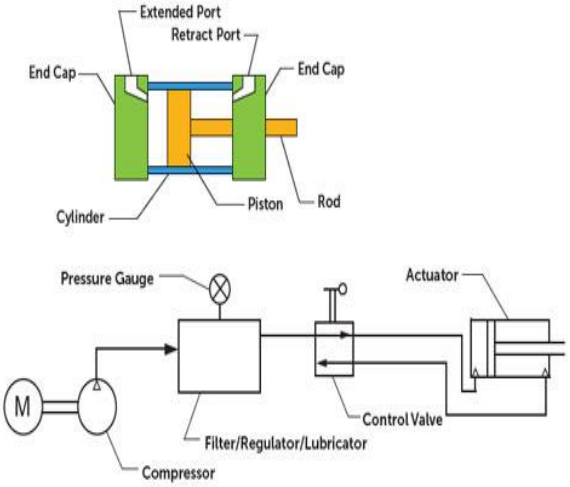

Fig. 8.1 Pneumatic flow system

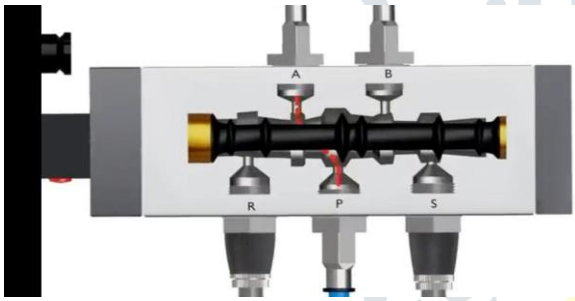

Fig. 8.2 Solenoidal valve

The compressed air supplied through inlet port P of the valve directs air to a particular direction which we can observe in the figure 7.2. in this case the air is directed to port A. This high pressure gas is then transferred to the cap end of cylinder through the pneumatic hose. This creates high pressure and the cap end of cylinder which therefore pushes a piston towards the head end. This also pushes gas from the head end. This exhaust gas travels through other hose and reaches the valve. The valve directs the gas port S and allows it escape through the pneumatic muffler. The gas muffler helps to reduce any noise produced during exhaust. This process is just extension stroke of cylinder. During the retraction stroke the valve directs compressed air to the head end of the cylinder. This causes the piston to return an air to the other chamber escape in the exhaust port. The theoretical force of the actuator is relative pressure on the piston multiplied by effective area of piston on which pressure is exerted.

Force = Relative Pressure (p) * Effective Area,

Relative pressure= [P(in)-P(atm)],

Effective area=Partial area= Piston area(A) – Rod area(a)

Frictional losses on the interface of the different surfaces also needs to be considered while designing the pneumatic cylinder. The diameter of the rod and the length of stroke also a determining factor for capacity of actuator.

9. CALCULATION

a. Force Analysis:

Pneumatic Cylinder Force Calculation:

Total piston force (F) = P A - R
where,
A = Area of Cylinder,
P = Pressure of air (bar),
R = Small frictional force
F= P X A - R

Here,
we consider the small friction force is 10% of the total piston force(F),
$F = p *(\pi/4) * d^2 * (1/10) – 10 \%$ of F
As we know,
1 bar = 10^5 N/m² = $10^5 /10^4$ N/mm² = 1/10 N/mm²
$F = p * (\pi/4) * d^2 * (1/10) – 0.1 * F$

$1.1 F = p * (\pi/4) * d^2 * (1/10)$

When operating pressure is 4 bar piston diameter (d) is 80 mm piston rod diameter (dr) is 20 mm.

$1.1F= 4 * (\pi/4) * d^2 * (1/10)$

F = 1827.8 N

Now,

Air Consumption Calculations:

I. During forward stroke:

'Q' is denoted as Air Consumption Rate –

Q = Area * stroke length * 10^-⁶ * Compression Ratio factor

$Q = \pi/4* d^2h * 10^{-6} * ((Patm + P) / Patm)$

Here, '(Patm+P)/Patm' Convert the given operating conditions into free air conditions or atm. Conditions.

$Q = \pi/4 * d^2 * 'h * 10^{-6} * (1 + P)/1$

$Q = \pi/4 * d^2h * 10^{-6} * (1+P)$

Now, At the pressure of 4 bar having piston diameter 80 mm, the air consumption in forward stroke is,

$Q = \pi/4 * (80)^2 * 50 *10^{-6} * (1+4)$

Q = 1.26 litre at 4 bar.

Now, At the operating pressure of 4 bar having piston diameter 80 mm and the air consumption in return stroke of having 20 mm piston rod diameter is,

$Q = \pi/4 * (d^2 - dr^2) * h* 10^{-6} [(Patm + P)/Patm]$

$Q = \pi/4 * (80^2 - 20^2) * 50 * 10^{-6} [1+P]$

Q = 0.94 litre at 4 bar.

10. FINAL ASSEMBLY

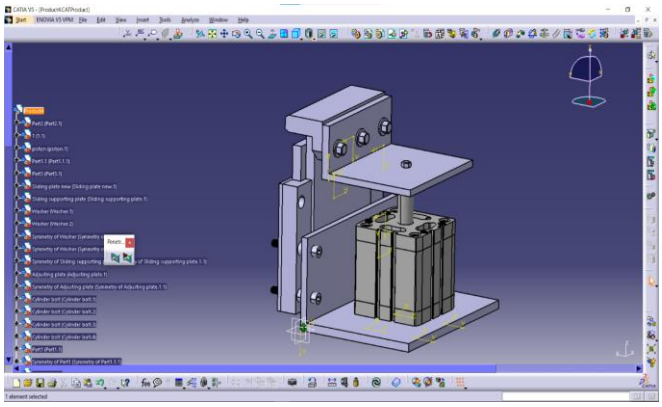

Fig. Final assembly

11. TESTING AND RESULT

11.1 Testing:

The pneumatic stopper we fabricated for the engine pallet is installed and bolted to the existing plate of the conveyor itself. After installing the Stopper we need to perform testing experiments on it such as the load-carrying capacity of the product, and impact loading on the plate by striking of engine pallet on it. So, we did all required design analyses and the force analysis concerning provided data from the industry.

The main function of the Stopper we made has to move upward and downward the stopper plate, so we need to test the properties like operating pressure of the cylinder and also valve setting of the pneumatic cylinder. We also desirable stroke length of the piston as it needs to strike on the proper point of the engine pallet and in our observations it was working properly.

11.2 Results:

i. At the operating pressure of 6 bar having piston diameter (d) 80 mm and

piston rod diameter (dr) 20 mm the total force is 2741.75 N.

ii. At the operating pressure of 4 bar having piston diameter (d) 80 mm and
   a. piston rod diameter (dr) 20 mm the total piston force is 182 7.8 N.

iii. Air consumption rate at operating pressure of 6 bar is,
   a. For forward stroke = 1.76 litre and
   b. For return stroke = 1.65 litre.

iv. Air consumption rate at operating pressure of 4 bar is,
   a. For forward stroke = 1.26 litre
   b. For return stroke = 0.94l litre.

12. PROJECT SCOPE

By using pneumatic system we can improve the performs of pneumatic stopper particularly designed for the purpose of guiding or stop the engine pallet.

By using proper pneumatic balancing weight of parts we can use pneumatic guiding stopper for stop or guide heavy loaded engine pallet.

13. CONCLUSION

1.As per the requirement, the existing conveyor stopper was not able to transfer the engine pallet to the new testing conveyor line, so we cut the safety metal sheet next to the dead stopper for installing the new stopper.
2.While observing the problem we come to know that, the pallet strikes on the existing stopper, and the arrangement gets disturbed.
3.From it, we understood that, while doing any physical work on the conveyor line, the line must be off. However, the productivity rate of any company will be decreased.
4.Meanwhile in the work, we decided to work based on logic and designing of the components, so it will also not affect the productivity rate.

14. REFERANCE

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