C7 Flipper at OP10

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Abstract. In this paper we present a new design for flipping a 250 pounds cylinder head 90 degrees. The device was designed in response to a safety hazard where workers were flipping large cylinder heads manually. The design uses the force of gravity to flip the part around a pivot point. In this design the worker no longer needs to put physical effort into the actual flipping of the cylinder head. The worker will only need to place the part on the device using the overhead crane that is already provided at that station, then release the latch whereby potential gravity is utilized to turn the part smoothly onto the conveyer.

Key words: Rotation, Assembly line, Ergonomics

1 Introduction

Linamars Camtac plant requires an improved method of flipping large cylinder heads to specific orientations for certain machining processes. Ergonomic related issues were arising; these involved the awkward postures [1] combined with the high forces generated when flipping parts manually with hands/bar at the C7 assembly line op 20. The repetitive movements of flipping heavy engines using a short bar over a short period of time can cause severe shoulder and back pain. The solution is to flip the part 90 degrees to correct orientation safely within the given workspace. It also had to eliminate the excessive ergonomic stresses on the worker and stay within safety guidelines. Simplicity and minimal cost were important criteria.

2 Conceptual Design

This device is basically formed of 2 general components as illustrated in figure 1:

1) The L-Shaped metal pieces which will act as a support for the engine to rest on during the flipping movement.

2) The Mounting device: The L-shaped metal pieces will attach to a bar with hinges that will be restricted using any type of stoppers. This bar will be attached at both ends (elevated a distance above the conveyer belt). These components will then be attached to a metal frame with metal poles extending to the floor where it will be firmly attached.

Further safety features were added to decrease the speed of the L-shaped metal arms to a safe level.

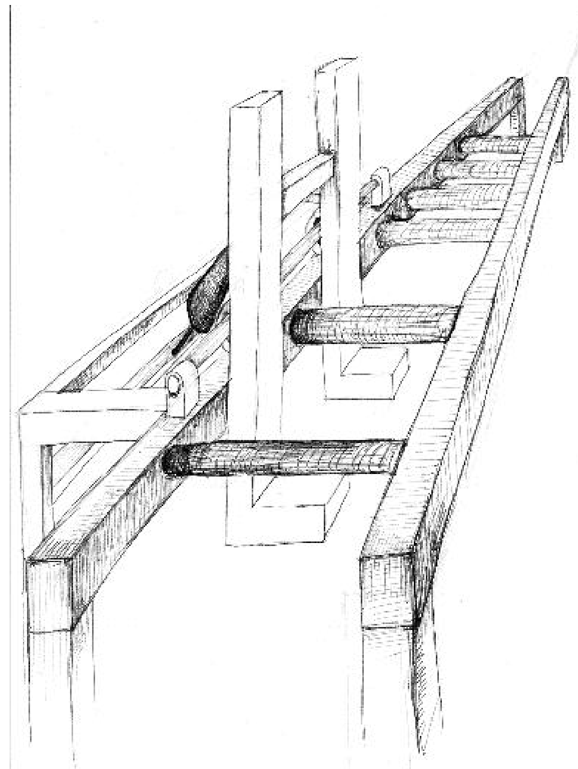

Fig. 1. Sketch of the Design.

3 Discussion

In the development of the design, the avaliable space and the method of transportation of the complete design was considered. The crane that currently picks up the part and the conveyer that moves it from station to station both already have motors in them that will be sufficient to move the design to the place of implementation. It was decided that if at all possible one or both of these two motors should be utilized to flip the part. After performing mechanical analysis on the part, forces that are currently used in flipping were calculated. With this information, forces were calculated using different fulcrum locations and different bar lengths. By moving the pivot to a point along the bottom directly below the centre of gravity, very little force is needed to begin to turn the part.

After the part begins to turn the centre of gravity is shifted so that it is no longer directly above the pivot. This creates a moment around the pivot and the system will continue to rotate freely 180 degrees unless impeded. By placing the conveyer into this system, the part is allowed only to rotate 90 degrees before landing on the conveyer bars. However, as the part turns the moment increases, and so does the momentum. The moment around the pivot was analyzed for varying points in the cycle. Using one directional pneumatic (air) dampers, the system process can be controlled so that unnecessary speed and force will not pose safety hazards or damage the conveyer.

To make the design easy and safe to operate, the system starts with the cylinder placed on the device in such a way that there is already a moment around the pivot in the desired flip direction. The process is then released by a latch and the flip is done completely by use of gravitational potential. The Latch in the design was therefore integral to the success and overall safety of the design. The latch system designed combined two main features, it is easy to operate and it is safe. The latch system had to be designed in a way to allow the unlatching from a safe clearance, while being extremely reliable so that it would never release at an improper time. A pin and ring latch was decided to be most appropriate as it is simple, reliable and user friendly.

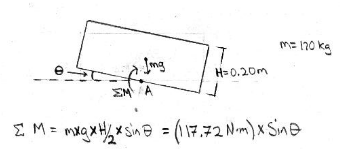

Fig. 2. Biomechanical Anaylsis.

4 Assembly

As mentioned above this device consists mainly of 2 components:

The L-Shaped Arms: Three-quarter inch thick mild steel will be used to form the arms. Each arm will have a length of 38 cm. At the end of each arm , the supporting L-shaped ends will have a minimum length of 12 cm , this dimension could be changed as the increase of material on it will provide extra moment in the desired direction. At the back of each L-shaped arms, pillow ball bearings will be bolted at 15 cm from the L-shaped ends. The pillow ball bearings that are going to be used have circular hole diameter of 2.5 cm and a raised height of 3.65 cm from the bottom of the pillow ball bearings(For further information regarding the bearings please see NSK motion Control Ball Bearing Units, Model UCP205 with a bolt size of M10[2]). A rod of diamter 2.5 cm with be used as the hinge on which the L-shaped Arms rotate around. All of these components will be raised above the conveyer edge by 11 cm to allow the free rotation of the L-shaped arm ends that will place the engine on the rollers.

The Table frame: Thick mild steel wil be used to form the table on which the design is supported and the linear dampers are attached to. The thickness of the table frame could be of any dimensions. This is completely due to the metal poles that extend from the table frame to the ground where its fixed strongly to ensure stability and reliability of the design.

Linear Dampers and Latch System: The Linear Dampers used are from Deschner Corp., after talking with Uli Gebhard(Engineer at Deschner) , specifications of the avaliable linear dampers were provided along with CAD drawings. The model that suited our application and forces was Super K 5001-37-6 [3] with a stroke length of 6 inches and can support up to 1200 lbs. The dampers were picked with a high force capacity to increase the safety factor of the design and its long term reliability. The Dampers will be attached from the arm to the table frame with a hinge mechanism , similar to that on screen doors. As for the latch system , two circular rings of a strong material with strong fixations will be firmly attached; one to the table frame , and the other to the closer L-shaped arm. Using a strongly enforced bar of diameter 3cm to to be placed through those 2 rings to keep the flipper in its initial position.

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