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# Fabrication and Testing of Tilting Head Industrial Pipe, Plate and Angle Handling Vehicle

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***Abstract:*** Mild steel and Carbon Steel Pipes, Plates and Angles are major raw materials used in several fabrication industries. As of over-head travelling magnetic crane and Hook-Cranes are used in shifting these materials from one place to other. Over-head magnetic cranes available in some industries can handle these materials within the closed manufacturing area limits and they cannot handle the materials placed in open- yards. Hook-Cranes need additional man power to lift and sling these materials to hook.It clearly indicates need for a specific machine which can perform handling operation of plates, pipes and angles without any additional workers inside and as well as outsidethe closed manufacturing areas. The tilting head pipe, plate and angle handling vehicle is fabricate and test with fallowing features (1) uses magnetic force to hold the Carbon Steel and Mild Steel Pipes, Plate and Angles (2) Motor Powered screw lift to elevate materials to various levels (3) Mechanism to place plates in vertical position (4) Transporting materials to various places. The paper mainly involves study of industrial handling machines, materials and mechanisms, preparation of drawings, fabrication of components, assembly of machine and testing.

***Index Terms* - Magnetic crane, Hook cranes, Tilting head pipe, Magnetic force.**

## I. INTRODUCTION

As we see in the many industries that the movement of heavy equipment or metals sheet is very tedious task and a huge labour and a lot of time is required to movefrom one place to desire place. So, it's complicated, uneconomical and also risky. To overcome this problem a machine is used which is called Tilting Head Industrial Pipe,Plate and Angle Handling Vehicle. Crane is a mechanical device in which lever, pulley,rope, hook & engine are used like as magnetic plate crane, electromagnetic crane etc. By the help of electromagnetic crane, we can move heavy metals (mainly metal scrap)from one place to another place very easily, it reduce working time, force and money. It can be operated by a single person so it reduces the need of labours. Yogi Ravel [1] in "Design analysis and improvement of EOT crane", analyzed thecrane wheel for optimum size. Using FE as an optimization tool, the optimization of the crane wheel size is carried out. Abhinav Surakarta and Vishal Shukla, [2] "3D Modeling and finite element analysis of EOT crane" made a comparison between the analytical calculations and FE analysis. As a result of study, they have proposed the design optimization method for overhead crane. Patil P. and Nirav K. [3] in "Design and analysis of major components of 120T capacity of EOT crane" analyzed various components of crane like wheels, pulleys, rope drum and girder. They have done the manual calculations using Indian standards and on the basis of these calculations 3D modeling and analysis has been carried out. For modeling they have used Creo softwareand ANSYS as analysis software. Rudenko N [4], in the book of Material Handling Equipment briefed the structure of overhead travelling crane. The structure of an overhead travelling crane with a plate girder is composed of two main longitudinal girders assembled with the two end carriages which accommodate the travellingwheels. The main factors in the solution of plate girders are the safe unit bending stressand the permissible girder deflection. The vertical loads on the girders are dead weights and the force exerted by the wheel of the trolley carrying the maximum load. In IS: 4137- 1985 [5] various factors are mentioned which are helpful in the design of crane components. The preferred wheel diameters and the formula for obtaining the wheel sizes are also stated in this Indian standard. IS 13834 [6] provides a general classificationof cranes based on the number of operating cycles to be carried out and a load spectrumfactor. In IS: 807. [7] [2006] Design, erection and testing (structural portion) of crane and hoistcode of practice, various design parameters for structure of overhead cranesare mentioned. In IS: 3177-1999 [8], various factors like drive efficiency, average acceleration, friction factors for anti-friction bearings etc. are mentioned which is veryimportant in calculating the required mechanical power. The comparative study by Mr. A Gopichand. Et al. [9] has shown that Taguchimethod can be used for optimization of crane hook. In his work optimization of designparameters is carried out using Taguchi method. He considered total three parameters and made mixed levels a L16 orthogonal array. The optimum combination of input parameters for minimum Vanishes stresses Are determined. From that array he found optimum combination of area radius for minimum Vanishes stress. Ram Krishna Rathor. et al. [10] has worked on a general approach for the multiple responses. He started optimization with the regression models to calculate thecorrelation between response function and control function. An objective function is generated with the help of system for collecting various response functions together. By using artificial neural network (ANN) to find out the response function. He used multiple objective genetic algorithms (MOGA) to optimize shape function of the cranehook for same capacity by considering combination of objective function to find out the optimize shape of crane hook. The result shows that the reduction in mass as well as safety of factor is not disturbed.

## II. METHODOLOGY

### *2.1 Calculation of Lifting Power*

Mass of the material to be handled ($m_1$) = 1Kg

Mass of each magnet $m_m$ = 0.05 KgMass of magnets ($m_2$) = 4 x mm =4 x 0.05 = **m2 = 0.2Kg**

Mass of the plate that holds magnets ($m_3$) = 0.4 KgMass of lifting arrangement ($m_4$) = 0.9Kg

Total Mass to be lifted (mu) = m1+m2+m3+m4 = 1 + 0.2 + 0.4 + 0.9 = **mu = 2.5 Kg**

Mean Thread Diameter (dm) = 7mm = **dm= 0.007m**

Lead (L) = 8mm = L= 0.008m

Gravity (g) = 9.81 m/s$^2$

Load to be lifted (Fu) = mu x g = 2.5 x 9.81 = **Fu = 24.525 N**

Table 1. Coefficient of Friction (μ)

| Screw Metal | Nut Metal | | | |
|---|---|---|---|---|
| | Steel | Bronze | Brass | Cast iron |
| Dry Steel | 0.15-0.25 | 0.15-0.23 | 0.15-0.19 | 0.15-0.25 |
| Machine oiled Steel | 0.11-0.17 | 0.10-0-16 | 1.10-0.15 | 0.11-0.17 |
| Bronze | 0.08-0-12 | 0.04-0.06 | not available | 0.06-0.09 |

(a) Lifting Torque (T) = (Fu x dm/2) x ((L+Л x μ x dm) / (Л x dm - μ x L)

= (24.525 x 0.007/2) x ((0.008+3.14 x 0.19x0.007) / (3.14x0.007-0.19x0.008))

**T = 0.051 N-m**

Speed of the motor (N) = 10 rpm

(b) Power required for Lifting (PL) = 2 Л N TRu / 60

= 2 x 3.14 x 10 x 0.051/60

**PL = 0.0534 Watts**

(c) Magnetic Holding Power Calculation Power required by each magnet (Pm) = 6 WattsNumber of Magnets (n) = 4

(d) Total Power required for magnetic holding (P) = Pm x n = 6 x 4 = **(P) = 24 Watt**

### *2.2 Fabricated Model*

This is the Tilting Head industrial Pipe Plate, And Angle Handling vehicle as shown in figure 1. It consists of plate attached with four electro magnets which will be use to lift the object for transporting from one place to another. It will be controlled byremote controller and the plate will move in to-and-fro direction. When positioned in the same direction, produce magnetic flux that reaches the metallic objects to be lifted.

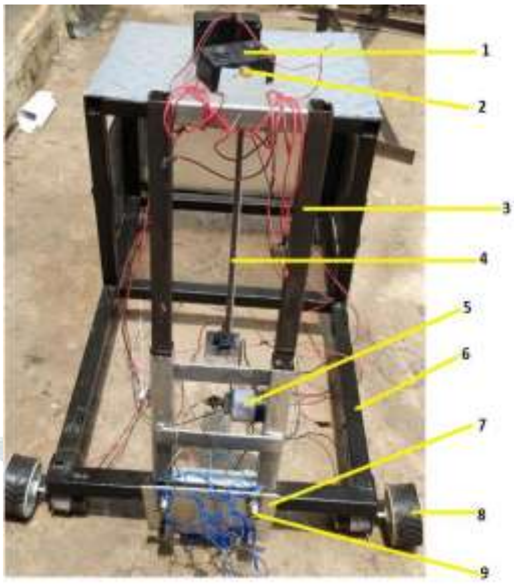


Figure 1. Tilting Head industrial Pipe Plate, And Angle Handling vehicle.

### *2.3 List of Components*

1. Switch Boxes
2. Coupler
3. Guide Column for Lifting
4. Lead Screw
5. Motor
6. Frame
7. Tilting Plate
8. Wheel
9. Electromagnet

#### *2.3.1 Switch boxes*

Figure 2 show the Switch boxes. A switch box is commonly used to mount aswitch. Switch boxes are used interior work and they are characterized by device- mounting tabs located on the outside off box.

Figure 2. Switch Boxes

### *2.3.2 Coupler*

Figure 3 show the coupler. A link or road transmitting power between two rotating mechanisms or a rotating part and a reciprocating part so that both may be played at once. The diameter is 20mm and length is 40mm.

Figure.3 coupler

### *2.3.3 Guide Column for Lifting*

Figure 4 shows the guide column for lifting. Lifting columns, also known as telescopic lifting devices, consist of linear actuators fitted with guides to provide stablevertical movement. A motor unit concealed within the column controls the devices. Lifting columns integrate linear drive and guidance systems to deliver enhancedmechanical stability in partial and fully extended positions.

Figure 4. Guide Column for Lifting

### *2.3.4 Lead Screw*

Figure 5 shows the lead screw. A lead screw is sometimes referred to as a "power screw" or a "translation screw". They are used motion within motion control devices to transform rotary or turning movement into linear movement. Material used is stainless steel 304 grade of pitch 1cm and diameter is 8mm.

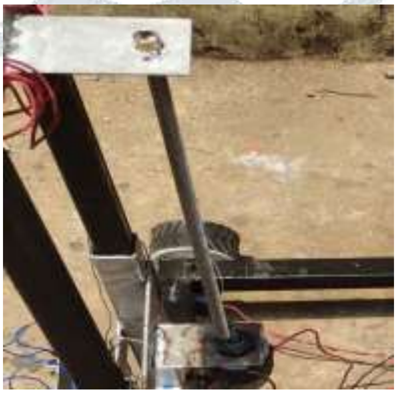

Figure 5. Lead Screw

**2.3.5 Motors**

Figure 6 shows the motors. A gear motor is a motor designed with anintegrated gear box. It functions as torque multipliers and speed reduces. The capacityand voltage are 12 watts respectively and motor speed is 10 rpm.

Figure 6. Motors

***2.3.6 Frame***

Figure 7 shows the fabricated frame of Tilting Head Industrial pipe, plate AndAngle Handling Vehicle. The frame is made of Mild steel square pipe. It is the base frame of car, carriage or other wheeled vehicles. Material is used mild steel square pipe and the dimensions is 25mm x 25mm on which the body will besupported.

Figure 7. Fabricated Frame

***2.3.7 Tilting Plate***

Figure 8 shows the tilting plate. Tilt plates are metal plate that can be attachedto an existing structure. They have protruding knobs that allow for engineer to take readings on the degree to which the plate diverges from vertical or horizontal in two directions. The thickness of plate is 2mm and dimension is 150mm x 150mm.

Figure 8. Tilting Plate

***2.3.8 Wheel***

Figure 9 shows the wheel. 4 x small wheel 7cmX2cm with good rubber gripsuitable for your all-terrain and other robotic applications. The wheel has a metal bush with M3 bolt for firm grip on the motors shaft.

Figure 9.Wheel

### 2.3.9 Electromagnets

Figure 10 shows the electromagnet. An Electromagnet is a kind of magnet where the magnetic field is created by an electric current. Electromagnets can be considered as a temporary magnet that function with the help of an electric current. The capacity of electromagnets is 27 Newton's and its dimension are 20mm in diameter and15mm in length.

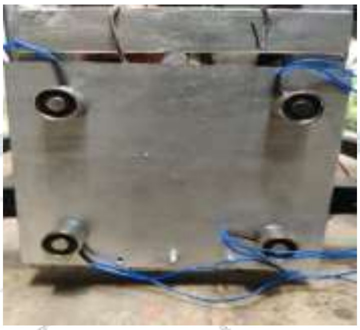

Figure 10. Electromagnets

## III. Results and discussion

Figure 11. A Very powerful magnet used in cranes: could be electromagnets or electro-permanent magnet. Get a custom designed lifting magnet from a professionaland experienced magnetic lifter manufacturer equip the magnet system below the hookof overhead crane or on the hook of your moving crane.

Figure 11. Model with Lifted Metal

Cranes using magnets lift and carry their cargo of varying weights of magneticor ferrous based metals or objects, of course within the safe permissible limit, to the dropping point then release and place, pile or stack the cargo, as need be, when magneticforce is switched off by the operator of the crane. Just as mentioned in last question, magnet cranes can be used to handle and move metals like steel and iron. So, they can be found mostly in recycling plants and scrap yards. They operate using a magnetic field that is formed by an electric current passing through windings around the magnet.

## IV. CONCLUSIONS

Tilting Head Industrial pipe, Plate and Angle Handling Vehicle is successfully completed. Our goal to build a system that can handle by metallic scrap in a specific area in industry achieved. We demonstrated the working of this system by lifting and lowering the metallic plate. Finally, this modular system can be extended to handle different types of weights. Magnet wire performs better since it is light and many coils are present. The soft iron creates the magnet function good. Electromagnetic crane is utilized to make eye-pleasing structure. It confirms the magnet switches to be on and off. It confirms final procedure accurately to manage the crane. Lifting and lowering mechanisms are functioning and able to achieve 350mm lifting / lowering. Electro Magnetic Crane is able to lift MS Plates weighing 2.5Kg.

## V. ACKNOWLEDGMENT

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