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Design and Implementation of Centrifugal Casting Locking Plate

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Abstract— This paper refer to the centrifugal casting process,in a situation when the molten metal is poured into the mold, the other end of the mould from where the pipe is taken out remains open .This end requires to be closed tightly so that due to centrifugal force, the molten metal does not sprinkle out. The other end of the mould which remains open is closed by a metal covering. This is fixed tightly to the frame by nut and bolt arrangement. The fixation of this covering is done manually. Workers need to tight each and every nut before the starting of casting process and again unlock these nut and bolts before liberating the casted pipe for further processing. This whole locking and unlocking of covering takes 5 – 6 min manually. This time is considered extra, which we can consider as wastage time. So in manufacturing of one pipe if 5-6 min is wasted at the end of the day, and at the end of the financial year we can calculate a loss in productivity by 20-30% to be approximate.

Index Terms— Accidents in Casting industry, Centrifugal casting machine, Locking arrangement, CAD.

1 INTRODUCTION

Centrifugal casting machine is used to mould cast iron pipes which are of great demand in the market. These pipes are used in great extent in various needs of our daily life like water supply pipes, sewage pipes etc. The two companies in MIDC Nagpur where identified for the study which make Cast Iron Pipes by Centrifugal Casting Process. These companies are Jaiswal Neco Pipe Casting Industry situated at MIDC, Higna and Kapila Dhatu & Sons situated in Kamptee Road. So in this tough market every company is trying to reduce their manufacturing lead time, increase the rate of production, reducing cost of labour-in short they are adopting the policy of cost cutting in every possible ways to maximize their profit. Henceforth to fulfill the needs of the companies author have made this attempt which will help them to a great extent to achieve their goals.

1.1 BRIEF IDEA OF THE PROJECT

As mentioned earlier Centrifugal Pipe Casting Machine is used to manufacture cast iron pipes which we use in our daily life. In Centrifugal Pipe Casting machine, hot molten metal is injected from one end and the other end remains closed by a covering plate having standard dimension. This covering plate is locked by a worker with the help of a spanner. This covering plate again needs to be opened after completion of casting process for the extraction of the pipe from the mould. The locking and unlocking process of this plate requires continuous human interference due to which it consumes almost 4-5minutes of the total manufacturing lead time. The paper discuss mainly in reducing this time of locking and unlocking of the plate and eventually eliminate human worker. Thus considerable amount of time can be saved which in turn will increase the productivity of the plant and at the same it will reduce the cost of labor bared by the industry. –

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1.2 RECOGNITION OF NEED

In today's world the competition in the market is going on increasing day by day. At the same time new companies are entering the market with new technology, result of which is cheaper price of the products than the existing price. Hence the old companies have to carry out their research and development process to meet the market competition. So these companies have to constantly go on upgrading their technology and shift more towards automation. This in turn helps to reduce the cost of production and increase the productivity of the plant.

Thus Cost Cutting and Automation helps the company to meet the market standards, compete with the new players of the market. So the Research & Development team constantly goes on inspecting the flaws and cause of the existing machine and develop new ideas to rectify them.

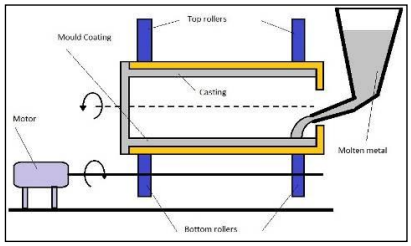

Fig: General Arrangement of centrifugal casting machine (Horizontal Type)

Such was the case with Jaiswal Neco Company and Mahesh Casting whose R&D team was working hard to upgrade their Centrifugal Casting Machine which they use for manufacturing cast iron pipes. They inspected that locking and unlocking

of the covering is consuming more time which is increasing the manufacturing lead time and constant human interference is also increasing their fixed cost. Hence they are not able to compete with the present market scenario.
The R&D team of Jaiswal Neco has assigned this project out of the gates of their industry so that their problem gets solved at optimum cost. Their main aim is to increase their productivity by reducing the time consumed in locking and unlocking of covering plate with minimum cost of modifying the plate. At the same time they will be benefited if human interference can be avoided by a suitable mechanism so that their cost of wages of workers can be saved.

2 Concept of Project

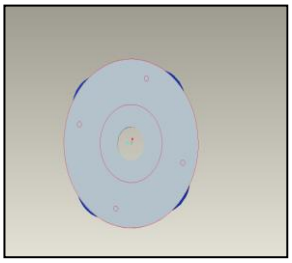

Fig 2.1 Conceptual Position of Brake Shoes

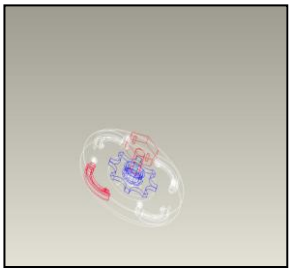

Fig 2.2 Conceptual Modification of Plate

3 Standard Dimensions Available From Industry

Specifications for max 6 inch Diameter Pipe,
Internal Diameter of mould = 252 mm;
Outer diameter of covering plate = 249 mm;
Thickness of Covering plate = 15 mm;
Bore diameter = 60 mm;
Max speed = 1300 rpm;
Average speed = 1000 rpm;
Contact surface thickness = 11 mm;
Temp. Of the molten metal = 1300°C;
Temp. Of the covering plate = 500°C.

4. Design of Parts

4.1 Brake Shoe

Thickness of the brake shoe, t = 10 mm,
Width of the brake shoe, w = 3 mm,
Outer Radius of the brake shoe = 50 mm,
Inner Radius of the brake shoe = 30 mm,
Aluminum with Asbestos Coating.

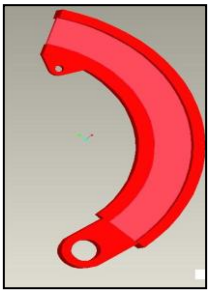

Fig 4.1 Brake Shoe

4.2 Covering Plate

Outer diameter of plate = 249mm;
Material of plate= Mild Steel;
Thickness of plate = 15mm;
Bore Diameter of plate = 60 mm;
Central plate diameter = 118 mm;
Thickness of base = 5mm;
Depth of groove= 10mm;
Distance of slots=3mm (from outer diameter);
Number of slots=4.

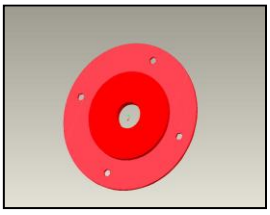

Fig 4.2 Covering Plate

4.3 Spring

Type of spring used = Round wire Helical Spring,
Sut = 913 MPa,
Syt = 463 MPa,
Sys = 273 MPa,
Seb = 477 MPa
E = 202,
G = 78,
e = 16,
BHN = 300
Shear Stress Of multiplication factor, Ks = 1.125
Wahl's Correction Factor, K = 1.40
Shear stress on spring, fs = 17.86 MPa

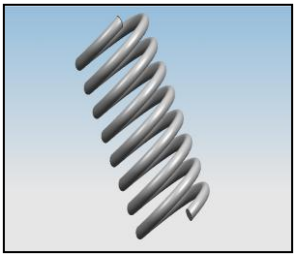

Fig 4.3 Springs

4.4 Bearing

Bearing used= Standard 6304ZZ Bearing;
Type of Bearing= Ball Bearing;
Outer Diameter of Bearing = 50 mm;
Inner Diameter of Bearing = 22 mm;
Lubrication used=Oil Base Lubrication

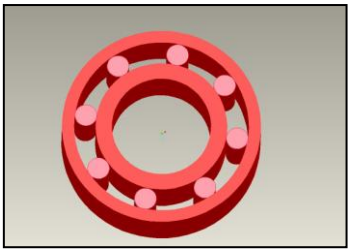

Fig 4.4 6304 ZZ Ball Bearing

4.5 Hexagonal Handle

Quantity required: 1
Material: Cast Iron
Outer Dia of Nut: 70mm
Inner Dia of Nut: 65mm
Depth of Nut: 30mm
Diameter of the arm: 22 mm
Length of the arm: 30 mm

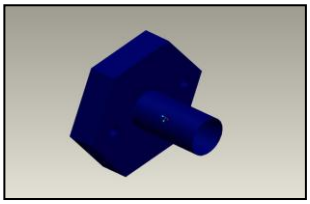

Fig 4.5 Hexagonal Handle

5. Calculations and Material Chart

- **Centrifugal Force**

Thickness of pipe =10 mm,
Diameter of pipe =152 mm,
Therefore, r = 76 mm,
Mass of Molten metal =15 kg,
Velocity of the molten metal =1200rpm
Centrifugal Force = m.v2 / r
= (15 X 202) / 76
= 45 N
Keeping tolerance of 50%, for our design safety,
Centrifugal force = 70 N

- **Spring**

Type of spring used = Round wire Helical Spring,
Force exerted on each spring is 5 N,
Therefore,
Deflection of spring = 5 mm,
Wire diameter, d = 2 mm,
Mean diameter, Dm = 8 mm (STD.),
So, Spring Index,
C =Dm / d = 8 / 2 = 4 mm,
Torque maximum = 14.32 MPa
Given Force = 5 N on spring,
Material of spring = SAE 1095…… (From data book)

Serial No.	Name of the Components	Material
1	Covering plate	SAE 1030
2	Brake Shoes	ALUMINIUM, ASBESTOS COATED
3	Nuts	MILD STEEL
4	Springs	TUNGSTEN
5	Twisting lever mechanism	ALUMINIUM
6	Bolts	MILD STEEL
7	Bearings	STEEL ALLOY
8	Sprocket	MILD STEEL
9	Handle	MILD STEEL
11	Wire rope	MS HIGH TENSION
12	Twining	MILD STEEL

Table 5.1 Material Table

6. Future Scope

The modifications in the covering plate are done such that it can be easily assembled and disassembled with ease. Hence a robotic arm type mechanism can be designed in future which will work automatically and no human labour will be required by the company. Thus the cost of wages of workers can be saved. Also automation by using some hydraulic cylinders and slider arrangements.

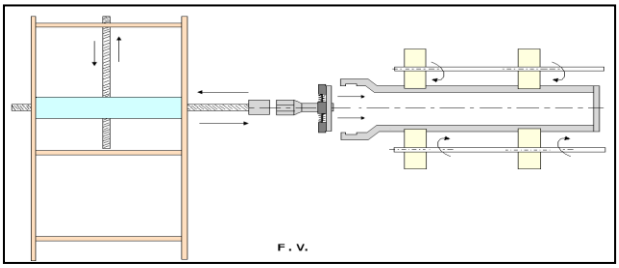

Fig 6.1 Future Model

7. Benefits to the Company

- Mechanism can be designed which will automate the locking and the unlocking mechanism.
- No manual interference will be required thus cost of wages of labour will be saved.
- It will provide safe working environment.
- The hazards to worker due to molten metal out from machine is reduced totally.

8. Conclusion

Thus the design and fabrication of the mechanism of automated locking and unlocking of the covering plate in centrifugal casting machine, used for pipe manufacturing has been tried.
The cover plate has been tried in actual machine and results were satisfactrory.

Fig 8.1. Covering Plate

Fig 8.2 Brake Shoes

Fig. 8.3 Springs

Fig. 8.4 Sprocket & Bearing Arrangement

Fig 8.5 Locks of Wire Rope (Twining)

Fig 8.6 Final image of locking Plate with all Attachments

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