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SEMI AUTOMATIC POURING SYSTEM

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Abstract- *The paper is focused on the research of mechanical semi automatic pouring system. research is aimed at to reduce human intervention ,minimize pouring time, shrinkage ,sand inclusion in order to achieve higher quality casting. Our research is focused on foundry having capacity of near about 1000 metric tons. Theoretical information and overall concept of research are also presented.*

Key Words- *Human hazardless, cost effectives, higher productivity, quality casting*.

1.INTRODUCTION

Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together.The overall goal of this project is to develop and evaluate the performance of a molten metal pouring system intended for power operated mechanism in casting in industry(foundry). The specific objective of this project is to introduce the automated (semi) molten metal pouring machine rather then manual pouring to reduce time, decrease work effort of labour and eliminate the hazards to employee. the control is self compensating and utilizes automatic learning schemes to repeatedly and accurately fill the molds. The filling of cavity in casting is determine by load cel. The difference is ten used to drive a bell crank lever which maintains the flow of molten metal in tundish. The control calculated the flow of molten metal into the molds to learn the gating system characteristics. In case of a flask less mold line, the pour tundish is automatically positioned over the sprue cup. The rising cost of material and labour has focused today's foundry to automate the various aspect of their operation to increase efficiency and productivity. The molten delivery system and high speed moulding machine has necessitated the need for an automatic pouring system, to produce high quality casting and high through put, while eliminating costly over pour.

The plc operated closed loop, self compensating automatic pouring system increase the productivity and reliability of casting process by eliminating the costly over pour and short pour. The utilization of sensor which determines the position of sprue cup, eliminate the need of oversize sprue cup design which may hold more moltem metal then needed.

1.1 RESEARCH CONCEPT

Now a day the actual process is , they use to pour the molten metal from furnace into small ladle of capacity 150-200 kg. then two worker used to carry ladle to mold or max two[if capacity of casting is less]. This work is not on actual task. Molten metal has an temperature near about 1600°c. being pouring manual handling process, this has many disadvantages, such as much more human intervention, hazardous to human due to high temperature of molten metal, short pour, over pour, which all this increase defects in casting and finally less quality product. Looking for more deep into other pouring practices, a mono rail system is also used in foundry's having production capacity of about 500-1500 metric tones. In this process the molten metal from furnace is pouring into tundish having capacity of 600 kg. and later this tundish on mono rail system is pushed by worker to mold track and later by tilting the tundish manually, metal is poured into mold's. even this process have disadvantages such as.

- Heavy work load to worker
- Hazardous to worker due high temperature of metal
- Carrying tundish to molds
- Tilting heavy tundish manually leads to short pour which may have defect in casting, and costly over pour.
- Moreover manualpouring leads to defect sand inclusion.
- Metal from furnace has to be pouring with in few sec into molds which is not on that easy task.

So to overcome disadvantages from both pouring practices, we have researched on such method where we have tried to overcome maximum disadvantages from the above two pouring system more economical to foundries having capacity of 200- 1000 metric ton.

Maximum intension on this research is to reduce human intervention, reduce defect in casting and achieve high quality product.

1.2 ELEMENTS

1.Programmable Logic Controller : EH-150

2.Proximity sensor:- A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

3.load cell:- A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured due to load applied because of molten metal filled in tundish.

4. Servo motor(SEW Germany AC Servo : AD Series : Servo Motors [ADMA] :100V)

2. WORKING PRINCIPAL

Item		Specification
Power Voltage	AC receiving power	100/110/120V AC (50/60Hz), 200/220/240V AC (50/60Hz)
	DC receiving power	24 V DC
Power voltage fluctuation range		85 to 264 V AC wide range
		to 26.4 V DC

This process would have fabrication unit, where it carries tundish near about 3 feet 11 inches above from ground level. This tundish will move in X and Y direction to achieve exact center of sprue cup, which will be operated by servo motor. This tundish at bottom has a load cell which will tell the weight carried by molten metal in it. This system will have a proximity sensor below tundish which will detect location of sprue cup and servo motor will move tundish according to it in x & y direction.

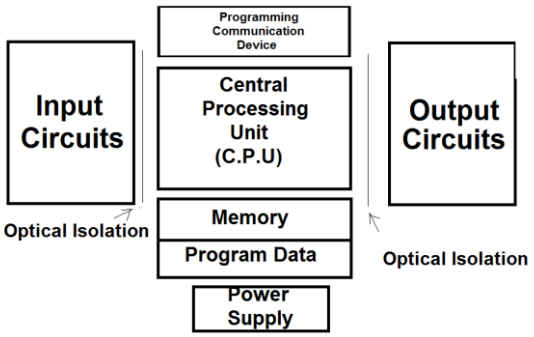


Fig. block diag. of PLC.

The above mentioned elements such as sensors, load cell, servo motor are inter connected with plc in this system. Where specific input are given to processing unit. After fetching the corrective operation, this signal is then given to output connection where operation is performed. Where inputs signal are provided by sensor and load cell and output

Items		Unit	Specification			
Basic Specifications	Rated Output *	W	50	100	200	400
	Rated Torque *	Nm	0.16	0.32	0.64	1.27
	Instantaneous Peak Torque *	Nm	0.48	0.96	1.91	3.82
	Rated Speed *	min^{-1}	3000			
	Max Speed *	min^{-1}	4500			
	Moment of Inertia *	$kg\text{-}m^2\times10^{-4}$	0.014	0.023	0.12	0.22
	Load Inertia	$kg\text{-}m^2\times10^{-4}$	Up to 30 times Motor Inertia			
	Rated Power Rate *	kW/sec	18.1	44.0	33.8	73.3
	Speed Positioning Detector	Standard	17bit/rev incremental encoder (Serial Output)			
		Optional	17bit/rev absolutel encoder (Serial Output)			

function is performed by servo motor and required operation is done. When the required cavity of casting is filled, it is carry forwarded to cooling system and preceding mold box is brought under pouring system and process and process is repeated.

The pouring system consist of 3 axis moment

X-axis moment along the rails

Y-axis left/right moment of ladle

The pouring system

The pouring ladle fills the moulds with variable speed, in term of kg/sec,set by the operator
Casting is most often used for making of complex shape. In this proposed system the tundish is filled with molten metal, and the sensor which is placed just below that will sense the proper position of gate what sensor's output will be received in PLC. When the proper position is captured then the PLC send command to servo motor and servo motor actuate accordingly. When the tundish came at the proper position the the sensor will again send a feedback to PLC and the bell crank lever will open the gate and filling starts.
For short pouring and over pouring, load cell is used which is placed below the tundish and the actual weight of tundish is recorded and on predetermined stage that load cell will close the bell crank lever.

3. Designing & fabrication

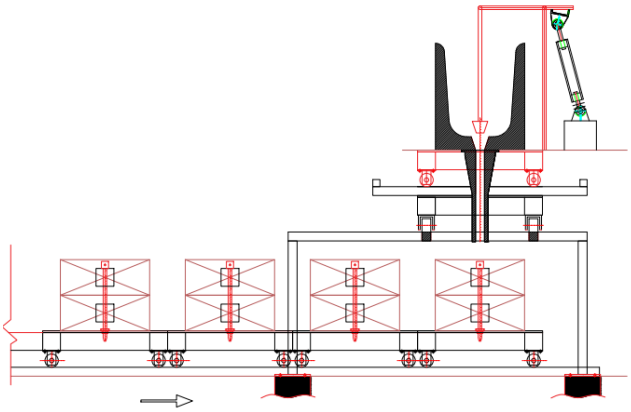
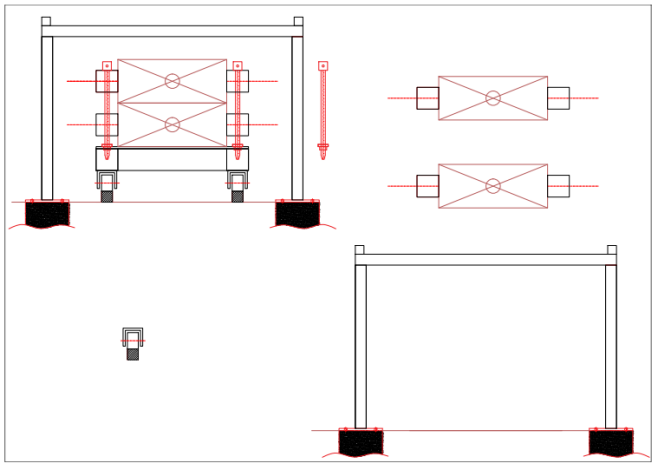


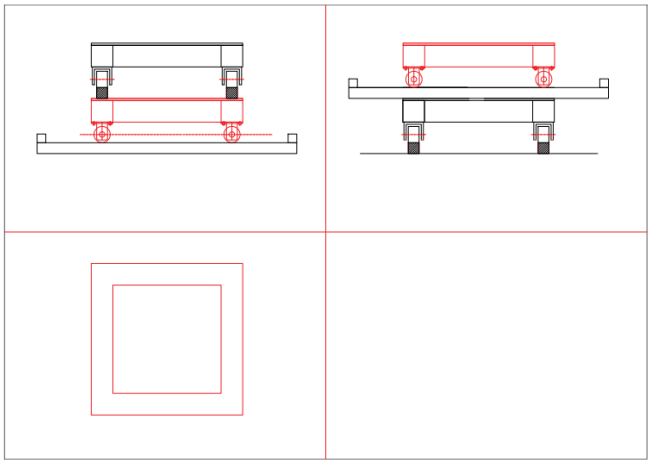
Fig- 1: assembly drawing

- mold box & track line fabrication



Mold box:-500(W) 500(L) 200(H)
Fabrication:-1200(W) 840(H)
Thickness 50

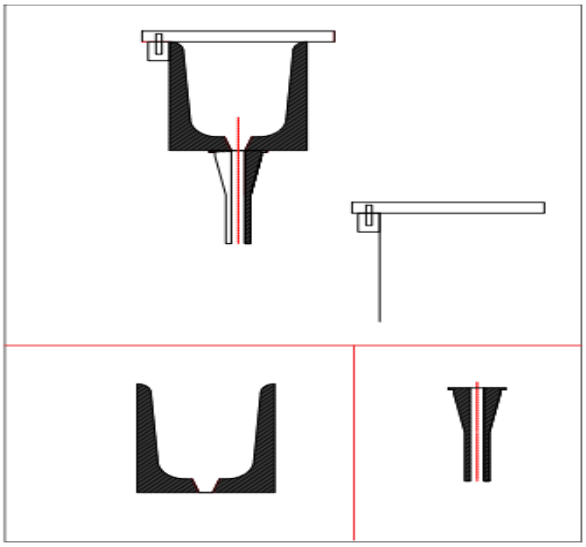
- Track line fabrication



Track line:-1200(L) 1574(W)
Thickness 50

Pallet:- (above fabrication)
Wheel:- R38
End to end distance :- 700
700(W) 700(L) 110(H)

- Tundish ladle:-



Dimension:-500(W) 600(H)
Nozzle:- 90(W)
Thickness of wall:-20

4. CONCLUSIONS

Before implementation of the semi automatic molten metal pouring machine, the process of transferring the molten metal from the electrical furnace to the die casting was made

manually which is difficult to handle the molten metal and it takes more time for transferring the molten metal. It is also hazardous for the worker to carry the molten metal nearer to him. The present work minimizes the manual work in the process of pouring the molten metal from the electrical furnace to the die casting .It also minimizes the travelling time for mould shifting from electrical furnace to the die casting mould. The present work also reduces the hazardous to the workers.

So we can easily conclude that, this process (present work) is affordable solution for approx 1000 metric ton manufacturing company.

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