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Fabrication of Semi-Automatic Molten Metal Pouring System in Casting Industries.

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ABSTRACT

In India there are many foundry have followed conventional and manual operations. Today's competitive environment has lower manufacturing cost, more productivity in less time, high quality product, defect free operation are required to follow to every foundry man. Mould shifting, Crushing, Lower Surface finish, Shrinkage, Porosity, Cold shut and Extra material are common casting defects due to these manual operations. These defects directly affect on productivity, profitability and quality level of organization. In the current global competitive environment there is a need for the casting units and foundries to develop the components in short lead time. Defect free castings with minimum production cost have become the need of foundry. In any casting industry the leading problem taking place is Mould shifting from electrical furnace to the die casting. In the present work an attempt was made to fabricate the pneumatic system for pouring the molten metal in to the cavity semi automatically. The system was tested for carrying the metal which reduces the manual work for mould shifting from electrical furnace to die casting and the results are compared with manual working which improves the quality, productivity and defect free product.

Keywords- Casting Industry- Molten metal pouring- Pneumatic System- Productivity.

I. INTRODUCTION

Casting is perhaps the oldest method of manufacturing and invariably the first step in the sequence of manufacturing a product. In this process the raw material is melted, heated to the desired temperature and poured into the mould cavity where it takes the desired shape. After the molten metal solidifies in the mould cavity the product is taken out to get the casting. Casting has various processes like Pre casting Processes, pattern making, core making, moulding and mould assembly making, Casting Processes, furnace charging, melting, holding and pouring, and Post casting Processes, shakeout, inspection and dispatch etc.

Automatic mold transferring from the furnace to the die is made easily in the large scale industries by the use of conveyors. But in small scale industries have low space and unbearable cost for such industries; many engineers are trying to build a new design for automatic molten metal pouring process. This reduces the manual work for transferring the molten metal.

II. PROCESS IN CASTING:

There are many steps to follow the process of casting; it will vary from company to company.

The company follows the below steps of casting process:

- Loading raw materials in skellener
- Shifting aluminum liquid in electrical furnace
- Alloy mixture
- Alloy treatment
- Die casting the molten metal
- riser cutting machine
- Head grinding

III. PNEUMATIC SYSTEM:

A pneumatic system is a system that uses compressed air to transmit and control energy. Pneumatic systems are used in controlling train doors, automatic production lines, clamps, etc

The air cylinder is a simple and efficient device for providing linear thrust or straight line motions with a rapid speed of response. Friction losses are low, seldom exceeds 5 % with a cylinder in good condition, and cylinders are particularly suitable for single purpose applications and /or where rapid movement is required. They are also suitable for use under conditions which preclude the employment of hydraulic cylinders that is at high ambient temperature of up to 200 to 250

Their chief limitation is that the elastic nature of the compressed air makes them unsuitable for powering movement where absolutely steady

forces or motions are required applied against a fluctuating load, or where extreme accuracy of feed is necessary. The air cylinder is also inherently limited in thrust output by the relatively low supply pressure so that production of high output forces can only be achieved by a large size of the cylinders.

Pneumatic control systems are widely used in our society, especially in the industrial sectors for the driving of automatic machines. Pneumatic systems have a lot of advantages.

Advantages of pneumatic systems

Pneumatic control systems are widely used in our society, especially in the industrial sectors for the driving of automatic machines. Pneumatic systems have a lot of advantages.

- ❖ High effectiveness
- ❖ High durability and reliability
- ❖ Simple in design
- ❖ High adaptability to harsh environment
- ❖ Safety
- ❖ Easy selection of speed and pressure
- ❖ Economical

Limitations of pneumatic systems

Although pneumatic system posses a lot of advantages, they are also subjected to many limitations.

- ❖ Relatively low accuracy
- ❖ Low loading
- ❖ Processing required before use
- ❖ Uneven moving speed
- ❖ Noise

IV. PROBLEM DESCRIPTION AIM OF PROJECT

The overall goal of this project was to develop and evaluate the performance of a Molten metal pouring system intended for power operated mechanism in casting industries. The specific objective of this project is to introduce the automated (semi) pneumatic molten metal pouring machine rather than manual pouring to reduce time increase work effort of labor and eliminate the hazards to employees.

V. EXPERIMENTAL SETUP

For designing the new technique for transferring the molten metal from the electrical furnace to the die casting there is no model for modifying the preformed work, hence this project work results in the experimental setup like air compressor, pneumatic cylinder etc, are used.

VI. MAJOR COMPONENTS OF THE SYSTEM:

The components used in fabrication of Semi-Automatic Molten Metal Pouring Process are:

a. Air Compressor
b. Pneumatic Cylinder
c. Flow control Valves
d. Hand level Valve
e. Hoses
f. Motion Transfer Mechanism
g. Trolley

a. Air Compressor

A compressor is a machine capable of compressing and delivering the air at a desired pressure. It is driven by a prime mover. Air compressor takes in atmospheric air, compresses it and delivers the high pressure to a receiver from which it may be conveyed pipe line to where it is required.

b. Pneumatic Cylinder

Pneumatic cylinders are mechanical devices which use the power of compressed gas to produce a force in reciprocating linear motion.

Like hydraulic cylinders, something forces a piston to move in desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amount of space for fluid storage.

Because the operating fluid is a gas, leakage from pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki room, pneumatics are used to prevent fluid from dripping onto people below the puppets.

Once actuated, compressed air enters into the tube at one end of piston and, hence, imparts force on piston as shown in fig. 1. Consequently, the piston becomes displaced.

Fig: 1. Pneumatic Cylinder

c. Flow control valves

Flow controls control the speed of a pneumatic cylinder. The exhaust air flow is controlled by the adjustable needle. The inlet flow is unrestricted depending upon the model, flow control may be lifted on cylinder or in the compressed air line. Flow regulation is more precise and constant when positioning the cylinder- a direct mounting of flow control on cylinder is therefore the optimum solution. Flow controls are usually mounted in pairs on cylinders. Except in case of single acting spring return cylinder. An external screw of manual adjustment with locking nut guarantees stability of adjustment. Many styles are available. The figure 2 shows the flow control valves placed on the pneumatic cylinder which can be controlled by adjusted by the screw on the top of the flow control valve.

Fig. 2: Flow Control Valve

d. Hand level valve

Solenoid valve with electromagnetic control industrial equipment used in industrial control systems to adjust direction of medium flow, speed and other parameters. Solenoid valves are used to control electromagnetic effect, controlled by main control relay as shown in figure 3. Thus, the solenoid valve can be used with different circuit to achieve the desired control and accuracy and flexibility are able to guarantee control. There are many solenoid valves; solenoid valve plays a different role in different position control system the most commonly used in one way valves, safety valves, and speed control valves.

Fig 3: Hand Level Valve

e. Hoses

A hose is a flexible hollow tube designed to carry fluids or air from one location to another. Hoses are also sometimes called pipes. The shape of a hose is usually cylindrical as shown in fig. 4.

Fig 4: Hoses

Hoses are made from one or a combination of many different materials. Applications mostly use nylon, polyurethane, polyethylene, PVC or synthetic or natural rubbers, based on the environment and pressure rating needed.

f. Motion Transfer mechanism

Each part of a machine, which moves relative to some other part, is known as kinematic link or element as shown in Figure 5. A link may consist of several parts, which are rigidly fastened together, so that they do not move relative to one another. A link or element needs not to be a rigid body, but it must be resistant body. A body is said to be resistant body if it is capable of transmitting the required forces with negligible deformation. Thus a link should have following two characteristics:

1. It should have relative motion, and
2. It must be a resistant body.

Fig. 5: Motion Transfer Mechanism

g. Trolley

Trolley is the main part of the experimental setup, it carries air compressor at the middle, pneumatic cylinder at the top and the links are joined to the piston. The whole trolley is made of cast iron angle because to withstand the temperature of the molten metal. All the angles are cut into the geometry and are set at a position and are fastened

through welding joints. The compressor is placed in between the space of the trolley at the middle with the help of two flat plates and is fastened with bolt and nuts at the bottom of the compressor. As it weighs nearly 20 kgs of weight, the trolley is designed to be of 16 gauge angle.

Fig. 6: Trolley

The pneumatic cylinder is placed at top of the trolley, a flat sheet is welded to the trolley and is made holes for setting the pneumatic cylinder. Two clamps are made and are fitted on the top of cylinder and are fastened to the sheet by bolts and nuts joints. The link mechanism is fitted to the end of the piston rod of the pneumatic cylinder.

At the bottom of the trolley 4 rollers are fitted, such that the trolley can move freely and can rotate to the required angle.

VII. WORKING PRINCIPLE

The lever is operated the molten metal is taken into the bowl connected to the piston of the pneumatic cylinder, then the trolley is moved and is made to fallen at the place we needed by operating the lever backwards. Hence the time molten metal is taken from the electrical furnace and is poured into the gravity die casting by using the system shown in the figure. 7

Fig.7: Molten pouring system assembled view

VIII. CONCLUSION

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.

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