



## Design and Fabrication of a Converter Ladle and Treatment Chamber

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### ABSTRACT

The main purpose of this project is to design and fabricate a Converter Ladle and a Chamber for the treatment of SG Iron that can eliminate the major disadvantages found in the Ladle that is currently being used. To reduce the human effort and difficulties identified during its operations. The Spillage of metal during pouring it into the shank is to be reduced to eliminate the molten metal wastage. The main objective is to reduce the evolution of large amount of gases into the open environment, that causes discomfort and health issues. The Converter Ladle simplifies the complex mechanisms being used in the Ladle for the opening and closing of the Ladles. The Gear arrangements were altered so that it is now easier for the operators to tilt the Ladle. The design enhances the safety of the workers operating the Ladle. Material handling has very old and vast history. In evaluation and implementation of material handling system, multiple factors should be considered, including the plant facilities, the machinery, the material handling equipment and of course people involved. In this paper the overall revive of principles of material handling systems and various material handling systems used in foundry is taken.

### INTRODUCTION

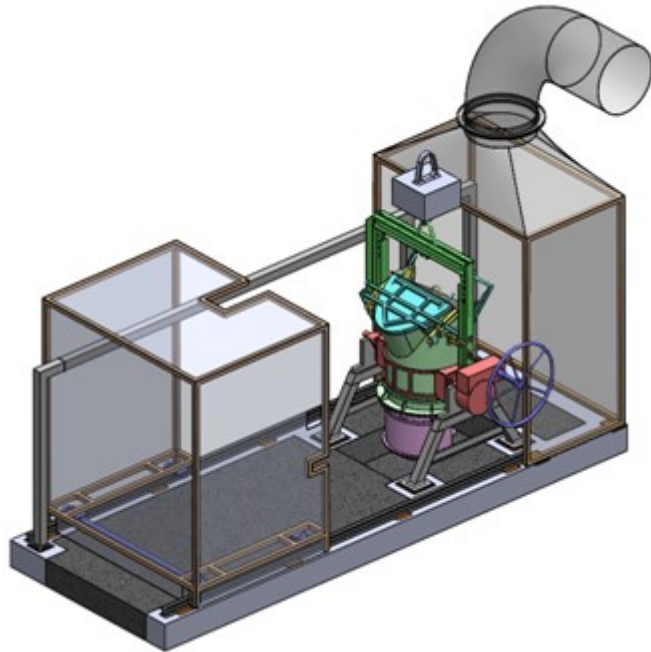
A Foundry is a factory that produces metal castings. Metals are cast into shapes by melting them into a liquid, pouring the metal in a mould, and removing the mould material or casting after the metal have been solidified as it cools. In metallurgy, a ladle is a vessel used to transport and pour molten metals. Ladles are often used in foundries.

Ladles ranges in sizes of about 0.02 to 300 Tonnes. Ladles being used are lined with refractories to avoid the loss of temperature of the molten metal to the walls of the ladle. Foundry ladles are normally rated by their working capacity rather than by their physical size. Hand-held ladles are typically known as hand shank ladles and are fitted with a long handle to keep the heat of the metal away from the person holding it. Their capacity is limited to what a man can safely handle. Larger ladles are usually referred to as geared crane ladles. Their capacity is usually determined by the ladle function. Small hand-held ladles might also be crucibles that are fitted with carrying devices. However, in most foundries, the foundry ladle refers to a steel vessel that has a lifting bail fitted so that the vessel can be carried by an overhead crane or monorail system and is also fitted with a mechanical means for rotating the vessel, usually in the form of a gearbox. The gearbox can either be manually operated or powered operation.

### PROBLEM IDENTIFICATION

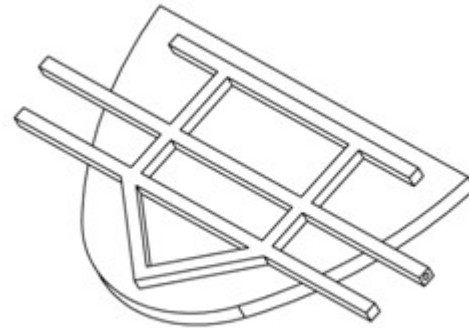
In Casting Foundries Ladles are used as handling equipment. Ladles are used to carry molten metal from the Furnace unit to the Pouring Line. In some Foundries treatment of molten iron takes place in the Ladles itself. During the treatment of SG Iron, a large amount of gases is evolved into the environment. Due to these gases the workers are affected by Low vision due to the smoke and they also experience some health issues due to inhaling the gases evolved.

**DESIGN**



**Fig 1: Isometric view of overall design**

inside the Ladle. The Lid is designed with some internal spike like structures to hold the lining material.



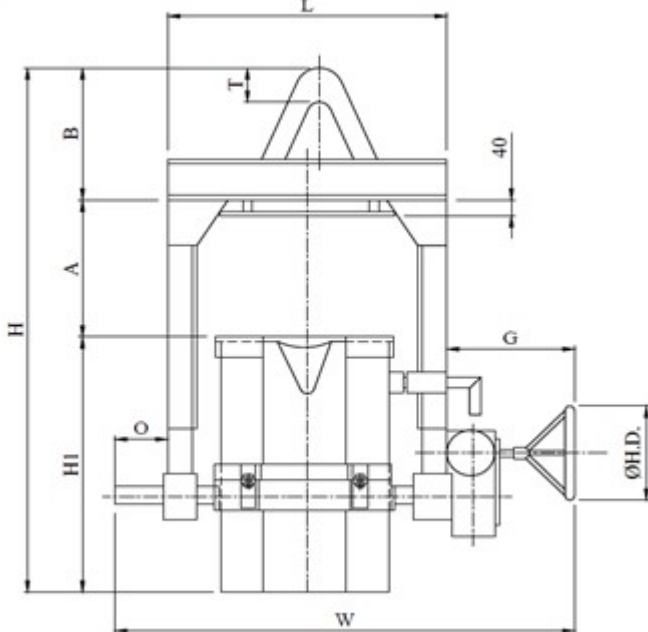
**DETAILED DRAWING OF COMPONENTS**

**Ladle:**

Ladle is equipment used for the transfer of molten metal within the foundry.

**Lid Gear Box:**

The Lid Gear Box is used to operate the Lid present on the top of the Ladle. The Lid Gear Box is present at the bottom of the Ladle at the rear side. When the Handle is rotated the drive, shaft rotates and it moves the Lid arm in the upward direction. The Drive shaft is supported by two plumber blocks. A Handle of Diameter 450mm made of hollow steel tube is provided for its operation.



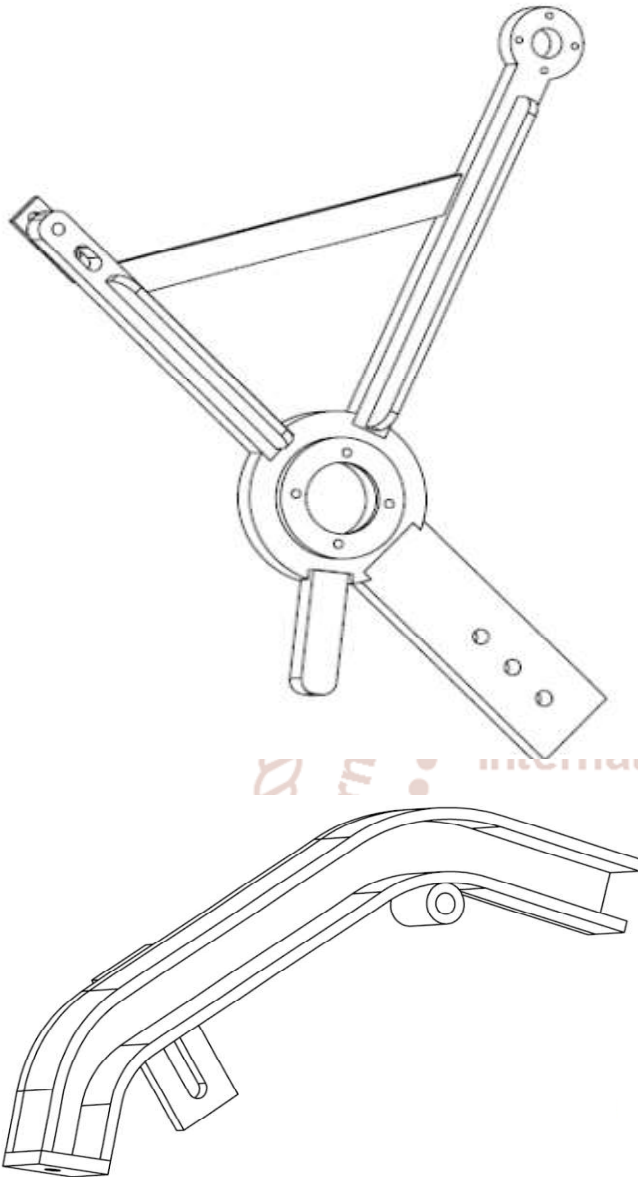
**Lid Mechanism:**

Lid mechanism consists of a gear box. The output of the gear box is coupled with a pair of internally and externally splined shafts. When the output shaft rotates the splined shaft rotates slowly. It moves the extension arms forward. The rotary motion provide at the bottom of the Ladle is converted into linear motion at the top of the Ladle. The extension arms are fitted with the Lid. The lid doors are moved with respect to the guide ways provided at the top of the Ladle. When the Handle of the Lid gearbox is rotated in the anti-clockwise direction the Lid moves forward toward the pouring lip and closes it. When the Handle of the Lid gearbox is rotated in the clockwise

**Lid:**

Lid is the door used in the Ladle for closing the pouring mouth during Treatment of magnesium. The Lid prevents the spillage of the molten metal during its explosion while it reacts with the magnesium

direction the Lid moves in the reverse direction away from the pouring lip and open it.



**Lid mechanism and Lid Guide**

#### **Centre Shell Fixed Ring:**

The Centre shell is provided as an additional support for fixing the main gear box and the Bearing housings. It is placed around the Centre shell.

#### **OPERATION**

Initially the Ladle is moved to the pre-processing region where Magnesium alloy components and minerals are being added into the alloy bucket of the Ladle present at the bottom of the Ladle. Cast Iron is converted into SG Iron by the treatment of it with the magnesium. When Magnesium comes in contact with the molten metal it starts exploding with heavy lightning. To avoid the contact of molten metal

directly with magnesium, treatment ladle is used. It consists of a bottom portion specially designed for packing of the magnesium. After adding Magnesium covering chips are being added to cover the Ferro Silicon Magnesium alloy. After the molten metal is tapped into the ladle its lid is closed and it is placed in a closed chamber and the ladle is being tilted. Now the molten metal comes into contact with the packed magnesium and explodes with heavy lightning and evolution of large amount of magnesium oxide gas. S.G Iron is a high carbon ferrous material with graphite in the spheroidal form achieved with a small amount of magnesium and therefore the name derived. To make S.G. Iron, mild steel scrap, Fe-Si, Coke etc. is melted in induction furnace. S.G. Iron possesses greater tensile strength, machinability than ordinary cast iron and also has a considerable measure of ductility, resistance to impact comparable to that of steel and low cost involved that justifies it as the metal of future. Components of S.G. Iron particularly in automobile sector is likely to increase not only for domestic consumption but also for export purpose.

#### **CONCLUSION**

Engineering or technology is all about using the power of science to make life better for people, to reduce cost, to improve comfort, to improve productivity, etc. The above research and development is being done for the requirements of JS Auto Cast Foundry India Private Limited with their financial supports. Designing a convertor Ladle that can eliminate the major disadvantages found in the Ladle that is currently being used and reducing the human effort and the difficulties of the operators are the primary functions and cost reduction techniques in developing the Ladle for the conversion of grey cast iron into Spheroidal Graphite Iron.

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