Fabrication of Manual Plastic Injection Moulding Machine

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Abstract:
Injection moulding machine is one of the most widely used method for conversion of plastics into various end products application to wide range of plastic material. The main principle is to compress the plastic material in a heating chamber (barrel) with the help of plunger and induction coil convert plastic polymer into molten (semi-solid) state. Then the plastic polymer in predetermined quantity is forced through the nozzle into the die under pressure. After completing the process, final product is obtained from the die. We can use plastics, metals or alloys for this process. In our project we are using plastics polymers for making bushes, switches, fishing hooks, mobile covers etc. This machine is a prototype for producing small plastic components. This injection moulding machine is very useful for the small scale industries because of its low manufacturing cost, low maintenance cost, no skilled worker is required. It can be recommended for small scale investors those who are willing to produce small plastic products.

Keywords: MOULDING, PLASTIC MATERIAL, INDUCTION HEATING, SMALL PLASTICS PRODUCTS, SMALL SCALE INDUSTRIES

I. INTRODUCTION

The manually operated plastic injection moulding machine, it is cheaper then hydraulic and pneumatic machine. It can solve the problem of small and medium scale industries to create small plastic components. In 1868 John Wesley Hyatt became the first to inject hot celluloid into a mould, producing Billiard balls. He and his brother Isaiah patented an injection moulding machine that used a Plunger in 1872, and the process remained more or less the same until 1946, when James Hendry built the first screw injection moulding machine, revolutionizing the plastics industry. Roughly 95% of all moulding machines now use screws to efficiently heat, mix, and inject Plastic into moulds. Injection moulding is a manufacturing process for producing parts by inserting molten or plasticized material into a mould. The injection moulding is performed on materials mainly metals, thermoplastic and thermosetting polymers. For injecting the material some equipment are required. It uses the ram or plunger to force the molten plastic material into the mould cavity. Thermoplastics polymer are preferred due to characteristics which makes them highly suitable for injection moulding such as ease to recycle, versatility allowing to used in wide range of application, and ability to soften and flow upon heating. Injection moulding machine is similar to injection with syringe and also with the screw of thrust, in which molten material is forced into the mould cavity to obtain a final product. Plastic injection moulding machine can be classified into horizontal, vertical, inclined, screw, rotary, multi-material and sandwich type based on the direction of clamping unit, axis of ram and type of ram. In vertical injection moulding machine the material is fed from the top side of the machine into the barrel which is surrounded by the heating coils. The plastic is forced into the mould cavity with the help of ram or plunger placed inside the barrel. In horizontal injection moulding machine working is same as that of vertical moulding machine except that ram or plunger is horizontal and in this type mostly screw type injection ram is used to feed the molten or plasticized material into the mould cavity to obtain a final product, in screw type injection moulding large and intricate components can be easily made.

II. LITERATURE REVIEW

- David e. Galomb invented a hand operated injection moulding machine apparatus constructed from pre-fabricated sub-assemblies, clamping means attached to a main support structure and then electrically integrated with each other.
- Lee and yun-ho invented a moulding device with hand operable mould. A moulding device includes at least two components from boards and a wedge shaped spacer board between them. An operating mechanism is associated with the form boards and the spacer, and moves them relative to one another. The operating mechanism includes at least one rack member and at least one lever connected with a pawl which swings about an axis eccentric with the axis of the lever. The pawl engages with the rack and moves the rack forward when the lever is operated.
- Yunoki and akio invented a hand operated injection moulding machine comprising a heating chamber therein is mounted on a base and has a discharge nozzle with an orifice therein a plunger being movable into the chamber toward the discharge nozzle. A mould holder is supported on the base and has a mould including first and second mould members which jointly provide a mould cavity there between. The mould holder is pivotable between a first position in which the mould is held in contact with the discharge nozzle with a sprue in one of the mould member being held in communication with the orifice and a second position in which the mould is located away from the discharge nozzle. There is a means on the base for locking the mould holder in the first position.
- M/s amrish fluid control pvt. Ltd., mumbai, is manufacturing manually operated moulding press. Authors designed a pedal operated injection moulding machine with...
compound lever system. The posture of operator changes if he operates a pedal operated machine. Effort is reduced to operate this machine and operation will be quick, thus fatigue reduces resulting improved productivity. The design of this machine is presented in this paper.

III. DESCRIPTION

The manually operated plastic injection moulding machine is fabricated by using various components. The components are heating chamber, injection ram, heating oil (induction heater), mould cavity and clamping unit which will hold the mould. The mould cavity is used to produce plastic part in moulding and mould is made from harden steel or aluminum. The induction heater working on electricity will heat the plastic and convert it into the molten state. It is fitted in the heating chamber. Plastic polymer is fed into the heating chamber and gets converted into the molten state and it is then injected into the mould cavity through the nozzle where it cools and gets solidify as per the mould cavity dimensions. The proper vent in the mould cavity is required for the removal of gasses and easy flow of molten plastic equally in all the directions. The proper flow of molten plastic inside the mould cavity depends on the viscosity of the plastic. The mould can be single cavity or multi-cavity. In multi-cavity mould each cavity is identical and forms the same parts and in single cavity mould entire part cavity is made on one side. A part line, sprue, gate marks, and ejector pin marks are generally present on the final part. Due to the nature of the process these features are unavoidable. Prior to the injection of the molten plastic into the mould, the two halves of the mould must first be securely closed by the clamping unit. When the mould is attached to the injection moulding machine, each half is fixed to a large plate, called a platen. The front half of the mould, called the mould cavity and the rare half part of the mould cavity is called as core, which slide along the tie bars.

![Manual plastic injection moulding machine](image)

**Figure.1. Manual plastic injection moulding machine**

IV. OBJECTIVES

- To have increased reliability, productivity, and uptime for injection moulding machine.
- To achieve optimal utilization of plastic injection moulding machine.
- Determine the most suitable plastic material to conduct this process and the time duration.
- To provide an Injection Moulding Machine to reduce human fatigue.
- To provide an Injection Moulding Machine to operate easily.
- To provide an Injection Moulding Machine which can be manipulates easily.
- To provide an Injection Moulding Machine at low cost.
- To provide variable height adjuster for various size of dies.
- Smooth repeatable operation.
- No skilled labour is required.
- To reduce wastage of row material.

V. WORKING PRINCIPLE

The injection – moulding machine is shown in the figure consists of feeding the compounded plastic material as granules, pellets or powder through the hopper at definite time intervals into the hot vertical cylinder where it gets softened. Pressure is applied through a manually driven ram or plunger to push the molten material through a cylinder into a mould fitted at the end of the cylinder. While moving through the hot zone of the cylinder, a device called torpedo helps spread the plastic material uniformly around the inside walls of the hot cylinder and thus ensures uniform heat distribution. The molten plastic material from the cylinder is then injected through a nozzle material from the cylinder is then injected through a nozzle into the mould cavity. The mould used, in its simplest form, is a two-part system. One is a movable part and the other stationary. The stationary part is fixed to the end of the cylinder while the movable part can be opened or locked on to the stationary part. By using a mechanical locking device (clamping unit), the mould is proper held in position as the molten plastic material is injected under high pressure. The locking device has to be very skillfully designed in order to withstand high operating pressures. Furthermore, a proper flow of the molten material to the interior regions of the mould is achieved by preheating the mould to an appropriate temperature. Usually, this temperature is slightly lower than the softening temperature of the plastic material undergoing moulding. After the mould is filled with the molten material under pressure, then it is cooled by cold water circulation or in a air and then opened so as to eject the moulded article. The whole cycle could be repeated several times manually.

VI. DISCUSSION

- The problem with the material is that it will not completely flow inside the mould cavity.
- The problem of sinks or blisters on the product after moulding because of improper flow of molten material. The sprue channel too weak or unsuitably located and the mould is insufficiently cooled.
- Also, the problem of product discolors observed may be due to the overheating of the material and the cooling rate of the material.

VII. CONCLUSION

- Due to its low cost, this working model can be successfully used in small scale moulding units and can be used to manufacture small plastic component at an acceptable cycle rate within an effective cost component.
• This machine is compatible with the operator.
• This machine is simple in design and easy to operate.
• This machine is simple in maintenance resulting low maintenance cost.

VIII. FUTURE SCOPE

• Speed up all the moulding machines. For this point we need to be sure that our machines are suitable for high speed running.
• In the project we have used manual plunger arrangement for pressing the molten plastic instead of that we can have hydraulic or pneumatic arrangement for the automatic control that will reduce production time.
• Even if our machine are high speed, but if we are in shortage of automation system in our injection moulding plants, then we need a lot of labour to pick up the moulded plastic components from the machine and we need to stack or collect them before packing. All these need labors and this will reduce the production capacity, in the same time the labour cost will be highly increased.
• It can be easily modified into hydraulic and pneumatic mechanism.

IX. REFERENCES


