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Design & Fabrication of Pneumatically Operated Plastic Injection Molding Machine

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ABSTRACT: The use of plastic is increased now days in many industries like automobile, packaging, medical, etc. The reason behind this is that the plastic made things are quiet easier to manufacture, handle and reliable to use. So the plastic goods manufacturing industries are striving hard to produce good quality products at large scale and cheaper cost. The hydraulically operated machines solve the problem, but they are too costlier for small scale and medium scale industries. This paper deals with design and fabrication of pneumatically operated injection plastic molding machine. The manually operated machine is converted into pneumatically operated machine by applying proper design procedure.

I. INTRODUCTION

The word 'pneuma' comes from Greek and means breather wind. The word pneumatics is the study of air movement and its phenomena is derived from the word pneuma. Today pneumatics is mainly understood to mean the application of air as a working medium in industry especially the driving and controlling of machines and equipment. Pneumatics has for some considerable time been used for carrying out the simplest mechanical tasks in more recent times has played a more important role in the development of pneumatic technology for automation. Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a pressure to suit the capacity of the system.

When the pneumatic system is being adopted for the first time, however it will indeed be necessary to deal with the question of compressed air supply. The key part of any facility for supply of compressed air is by means using reciprocating compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivers the air at a high pressure. Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature. The compressibility of the air was first investigated by Robert Boyle in 1662 and that found that the product of pressure and volumes of particular quantity of gas.

The usual written as

$$PV = C \quad (\text{or}) \quad P_1 V_1 = P_2 V_2$$

In this equation the pressure is the absolute pressure which for free is about 14.7Psi and is of course capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but air is the mostly used system now a days. Pneumatics is a section of technology that deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic systems used extensively in industry are commonly powered by compressed air or compressed inert gases. A centrally located and electrically powered compressor powers cylinders, air motors, and other pneumatic devices. A pneumatic system controlled through manual or automatic solenoid valves is selected when it provides a lower cost, more flexible, or safer alternative to electric motors and actuators. The increase in demand for the manufacturing products and the opening up of markets worldwide necessitates the production of goods in a mass scale. Mass production of products increases the demand for mechanization of production. Productivity increase, quick delivery of market demand and automatic of the production systems. Automatic machines controlled by the cams and lever are increasingly used in the manufacturing sector. The rigidity of such mechanical automatic machines hinders the changing patterns of consumers. The necessity for frequent changes in the design according to the medium volume production of variety of product demands a change in the manufacturing process. The pneumatic and hydraulic machines fill the void and add a boon for small and medium

scale industries. The existing machine can be converted into semi or fully automated machine with reasonable extra cost. The pneumatic system offers other advantages over hydraulic, which are explained subsequently.

II. BASIC FUNCTIONING

Working of pneumatic machine is as follows: Insert the plastic granules in the barrel from hopper. Heating coil is provided around the barrel which heats the plastic granules. The temperature of this heating coil can be controlled by dimmer of 1 amp (100°C). The stopper is provided at the bottom of the barrel from its inner side to prevent molten material from falling down. The stopper is attached in such a way that if pressure is provided due to the action of plunger, molten material gets injected smoothly into the die. Spring is used to provide a clearance between barrel and the die. Compressor is attached to cylinder through 5/2 direction control valve which operates the cylinder. The 5/2 direction control valve is hand lever type of valve. At first stroke compressed air having pressure of 3.2 bar passes into cylinder (100×160) which pushes the plunger downward into barrel and molten material gets injected into the die. At the second stroke of cylinder (100×160) plunger moves upward. Due to removal of tension from spring, clearance is produced between barrel and die. By using another cylinder (80×50) which also operates by 5/2 D.C. valve at a pressure of 1.7 bar attached horizontally at the bottom of frame. Die gets removed at first stroke. Due to this product falls down because of providing automatic feeding mechanism. Second stroke provided to close die and process continues.

III. DESCRIPTION

The pneumatically worked infusion plastic embellishment machine is created utilizing different parts. The parts are pneumatic chambers, upper cylinder (100×160mm) and lower cylinder (50×80mm), pressure controller, 5/2 bearing control valve, stream control valve, FRL unit, outline, barrel, temperature regulator, blower, mounting table, point plates, Allen bolts. The upper chamber is utilized for all over movement of the unclogged which infuses the plastic material into barrel. Lower chamber is utilized for programmed opening of the kick the bucket. In manual machine the arrangement for programmed expulsion of item is absent. In pneumatic machine

it is made accessible utilizing lower chamber. The blower gives packed air to both the chambers, which causes development of the unclogged. FRL unit is utilized for filtration, guideline, and oil of the packed. Air channel eliminates every unfamiliar material and permits dry, clean air to stream without limitation. When the blower air has been appropriately cleaned, it is important to direct it to the necessary degree of tension paying little mind to vacillations in packed air principal line. Different pneumatic frameworks work productively at various working tensions. Subsequently choice of tension controller of right reach is significant for proficient working of pneumatic framework. Pneumatic robotization parts broadly use fixing material made from elastic mixtures. For productive and inconvenience free working of these seals, they should be oiled or greased up to lessen grating and consumption. To grease up compacted air impelled gear, the most proficient and conservative strategy is to infuse the oil into the packed air that drives this hardware. 5/2 course control valve is utilized to control the bearing of the air.

IV. FUNCTIONING IN DETAIL

Working of pneumatic gadget is as follows: Insert the plastic granules within the barrel from hopper. Heating coil is supplied across the barrel which heats the plastic granules. The temperature of this heating coil may be controlled by dimmer of 1 amp (100°C). The stopper is provided at the lowest of the barrel from its internal facet to prevent molten fabric from falling in. The stopper is hooked up in one of these ways that if stress is supplied because of the motion of plunger, molten cloth receives injected easily into the die. Spring is used to offer a clearance between barrel and the die. Compressor is connected to cylinder via five/2 path control valve which performs the cylinder. The five/2 course control valve is hand lever kind of valve. At first stroke compressed air having strain of three.2 bar passes into cylinder (one hundred×160) which pushes the plunger downward into barrel and molten fabric gets injected into the die. At the second one stroke of cylinder (100×one hundred sixty) plunger moves upward. Due to elimination of hysteresis from spring, clearance is produced between barrel and die. By using any other cylinder (eighty×50) which additionally operates through five/2 D.C. Valve at a pressure of one.7 bar attached horizontally at the lowest of body. Die gets eliminated in the beginning stroke. Due to this product falls down because of supplying computerized feeding mechanism. Second stroke supplied to close die and technique keeps.



Fig 1 Functioning of a Plastic Injection Moulding Machine

In this gadget cylinders are used for plunger movement and automatic establishing of die. After the of entirety of the cycle the air movements out thru the out port of 5/2D.C. Valve. This air is launched to the environment. In future the mechanism may be evolved to use this air again for the running of cylinders.

V. COMPONENTS AND EXPLANATION

We have worked upon design of parts and drawing of plastic injection moulding. The fabrication of Plastic injection moulding requires the following components to complete the operation.

- Air Compressor
- Double acting cylinder
- Direction control valve
- Solenoid valve
- Air Tank
- Hoses
- Mounting plates
- Hexagonal nuts & bolts
- Temperature Controller
- Nichrome heat

AIR COMPRESSOR:-

An air blower is a gadget that convert power (as a rule from an electric or diesel or fuel engine) into motor energy by compressing air and packing air. Device used to pack air from a low bay strain (typically barometrical tension) to a higher wanted pressure level. Air blowers are for the most part certain dislodging units. Law of wonderful gas, the blower builds the strain of the air by diminishing its volume.

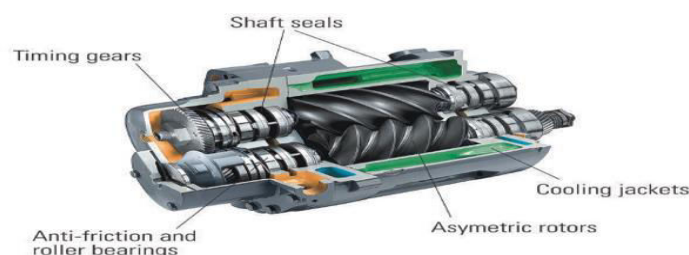


Fig:- Air Compressor

DOUBLE ACTING CYLINDER:-

Double acting cylinder utilize the power of air to move in both broadens and withdraw strokes. They have two ports to permit air in, one for outstroke and one for in stroke. Twofold acting chambers apply pneumatic strain on the two sides of the cylinder on the other hand. They perform work in the two bearings of development. These chambers don't need a return spring except if a particular rest cylinder is required at whatever point the gadget isn't fueled.



Fig: -DOUBLE ACTING CYLINDER

SOLENOID VALVE: -

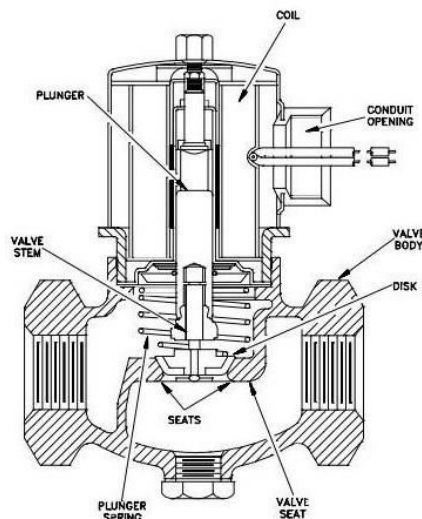


Fig: -SOLENOID VALVE

A solenoid valve is an electromechanical valve that is constrained by an electric flow. The electric flow goes through a solenoid, which is a wire loop folded over a metallic center. A solenoid makes a controlled attractive field when an electrical flow is gone through it. This attractive field influences the condition of the solenoid valve, making the valve open or close. Solenoid valves are utilized to move gases or fluids and have a wide assortment of utilizations, including water system, sprinkler frameworks and modern purposes.

AIR TANK: -

Compacted air capacity is a method for putting away energy produced at one at once at some other point utilizing packed air. At utility scale, energy produced during times of low energy request can be delivered to fulfill higher need periods. Limited scope frameworks have for some time been utilized in such applications as drive of mine trains. Huge scope applications should moderate the intensity energy related with compacting air disseminating heat brings down the energy proficiency of the stockpiling framework. In this tank the compressed air is put away to activate the hand break. Greatest strain inside the tank is 1 bar to 2 bar.



Fig :- AIR TANK

Hoses: -

Hoses used in this pneumatic device are made from polyurethane. These hose can with stand at a most strain level of $10 \times 10^5 \text{ N/m}^2$ In our gadget there are form of connectors used. One is the Hose connector and the opposite is the reducer. Hose connectors commonly include an undertake hose nipple and cap nut. These types of connectors are made of brass (or) aluminum (or) hardened pneumatic steel.



Fig: -Hoses

DESIGN AND CALCULATIONS: -

1. AREA OF CYLINDER:

$$A = \pi d^2 / 4$$

Where,

d = Diameter of cylinder = 20 mm.

$$= \pi / 4 \times (20 \times 10^{-3})^2$$

$$A = 3.142 \times 10^{-4} \text{ m}^2$$

2. FORCE EXERTED IN CYLINDER:

$$F = \text{Pressure applied} \times \text{area}$$

Where ,

pressure applied = 60 PSI

$$F = ((60/14.5) + 1.03) \times 3.142 \times 10^{-4}$$

$$= 5.138 \text{ bar} \times 3.142 \times 10^{-4}$$

$$= 5.138 \times 10^5 \times 3.142 \times 10^{-4}$$

$$F = 161.41 \text{ N}$$

VI. LITERATURE SURVEY

Design and Fabrication Of Injection Moulding Machine-Mechanical Project, Look around yourself and you will see plenty of injection molded parts. The mouse and key board that you are using browse this site were probably made through the plastic injection molding process .ever use plastic handled screwdrivers? That was made with injection molding. Injection molding is often use in mass production and prototyping this is a relatively new way to manufacture

parts. First machine were built in 1993's . So, What is injection molding? To put is basically, injection molding Is the process of forcing melted plastic in to a mold cavity .Once the plastic has cooled, the part can be ejected. It is useful when the parts are too complex are cost prohibitive to machine with this process many parts can made at the same time, out of the same mold.

Simulation and Design of a plastic injection Mold, Injection molding is one of the most important processes in the plastic manufacturing industry. More than one-third of all plastic materials are injection molded, And the mold is one of the main components in the injection molding process. The aim of this engineering thesis is to show detailed steps on how to design a complete mold and using the simulation software to analyze the material flow and defects in the product. The product design for this project is a joint credit card and USB flash drive holder. What makes this product unique from others is that it contains both functions together whereas most of the products in the market today don't contain the same dual application.

Design and development of injection moulding machine for manufacturing maboratory R A Siregar 1 , S F Khan2 and K Umurani1, This paper presented the design process and manufacturing of a benchtop and inexpensive injection moulding machine for use as learning and teaching equipment in a manufacturing laboratory. The design use a vertical plunger type of injection equipped with clamping system. The maximum volume of barrel is 290 cc combined with injection plunger 60 mm provides ideal capacity for lab. The design concept process and preliminary test result are discussed. The flow rate increases with increase of motor speed and the packing time decrease with increase of motor speed. At 2500rpm the flow rate is 0.42m/s and pack time is 15 second.

Design and Fabrication of Mini-Injection Moulding Machine for Small-to-Medium Scale Plastic Processing Nwadinobi, C.P. *1 , Ezeaku, I.I.1 and Ugwu, V.2, This paper presents the design process and manufacturing of plastic injection moulding machine that is inexpensive and for use in the production industry for producing small size plastic products. The components of the machine are the hopper, screw, the barrel assembly, and the injection nozzle. The machine is a batch processing machine and fabricated using locally sourced materials. The machine was tested with polypropylene (pp) and Acrylonitrile Butadiene Styrene (ABS) materials. Temperatures of 200oC and 300oC were used to test the rate of melting of the plastic grains and their fluidity. The performance test of the machine indicated average throughput and injection efficiency, of 261.04kg/hr and 92.2% respectively at a displacement time of 0.0353hr. Therefore, this innovation is recommended for small scale plastic industries.

Advantages &Disadvantage:-

Advantages:

- This product is an alternative for plastic cups and plates.
- Cheaper and easily available material is used.
- The pneumatic arm is more efficient in the technical field.
- Quick response is achieved
- Simple in construction.
- Easy to maintain and repair.
- Cost of the unit is less when compared other moulding machine.

Disadvantage:

- Initial cost/ setup cost of this process is very high due to design, testing and tooling of the whole equipment.
- Investment molding is generally limited to some special kind of materials like thermoplastic materials or some polymers only.
- High tooling cost i.e. the mould used is made by several processes and testing the overall cost of making a single mold is very high. For different parts different kind of molds are required.

VII. CONCLUSION

The pneumatic operated machine is most suitable for small and medium size industries. It eliminates all the drawbacks of manual machine. The productivity is increased, manual labor required is less, and problem of removal of finished product is solved because of automatic die opening mechanism. The operation is simplified. Hydraulically operated machine could solve the problem, but cost is too high to bear for small and medium sized industries. The hydraulic machine is used where large scale production is required. So pneumatic machine solves the problem very well.



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