CHAPTER 1

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 mold, and removing the mold material or casting after the metal has solidified as it cools. The most common metals processed are aluminum and cast iron. However, other metals, such as bronze, brass, steel, magnesium, and zinc, are also used to produce castings in foundries. In this process, parts of desired shapes and sizes can be formed. In metalworking, casting involves pouring liquid metal into a mold, which contains a hollow cavity of the desired shape, and then allowing it to cool and solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting is most often used for making complex shapes that would be difficult or uneconomical to make by other methods[1]. Several specialized furnaces are used to melt the metal.In the casting process a pattern is made in the shape of the desired part. Simple designs can be made in a single piece or solid pattern. More complex designs are made in two parts, called split patterns. Simple designs can be made in a single piece or solid pattern. More complex designs are made in two parts, called split patterns. A split pattern has a top or upper section, called a cope, and a bottom or lower section called a drag. Both solid and split patterns can have cores inserted to complete the final part shape. Cores are used to create hollow areas in the mold that would otherwise be impossible to achieve. Where the cope and drag separates is called the parting line. Cores are used to create hollow areas in the mold that would otherwise be impossible to achieve. Where the cope and drag separates is called the parting line.

The pattern is made out of wax, wood, plastic or metal. The molds are constructed by several different processes dependent upon the type of foundry, metal to be poured, quantity of parts to be produced, size of the casting and complexity of the casting.In a foundry, molten metal is poured into molds. Pouring can be accomplished with gravity, or it may be assisted with a vacuum or pressurized gas The solidified metal component is then removed from its mold. Where the mold is sand based, this can be done by shaking or tumbling. This frees the casting from the sand, which is still attached to the metal runners and gates - which are the channels through which the molten metal traveled to reach the component itself. Degating is the removal of the heads, runners, gates, and risers from the casting. Degating is the removal of the heads, runners, gates, and risers from the casting. Runners, gates, and risers may be removed using cutting torches, band saws or ceramic cutoff blades. For some metal types, and with some gating system designs, the sprue, runners and gates can be removed by breaking them away from the casting with a sledge hammer. The gating system required to produce castings in a mold yields leftover metal, including heads, risers and sprue, sometimes collectively called sprue, that can exceed 50% of the metal required to pour a full mold. Since this metal must be remelted as salvage, the yield of a particular gating configuration becomes an important economic consideration when designing various gating schemes, to minimize the cost of excess sprue, and thus melting costs.

PASCAL'S LAW:

The basic principle underlying all the fluid power applications is Pascal's law. In fact, it is the fundamental principal based on which all fluid power systems work. It states that "The pressure exerted on to a confined fluid is transmitted and acts equally in all the directions at the same time, and acts uniformly at right angles to the containing surfaces." Fig 1.1 Shows schematic diagram of Pascal's law.[2]

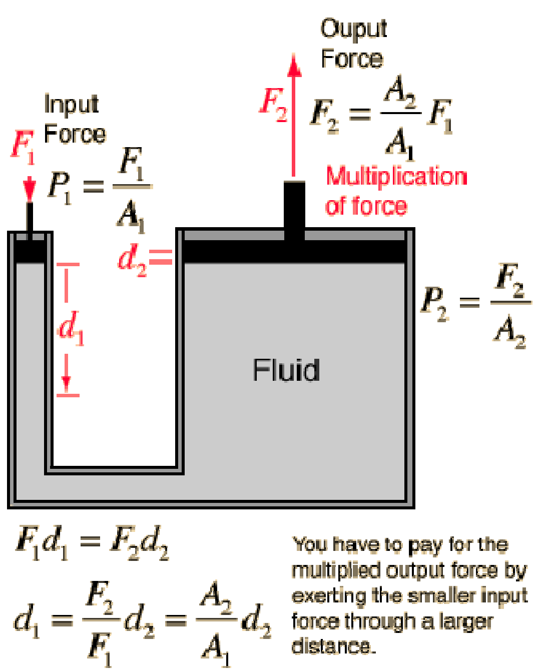

Fig 1.1 Showing Pascal's Law

Impact Gun is concerned with its application in foundry. As we all know that, any solidified casting after removing from the Cope & drag box has spruce, riser & runner attached to it. So as to get the final product we remove these components normally by hammering (ie, by providing a high impulsive force on the runner & riser) & after this process the casting is generally machined specifically at the runner, riser & spruce areas to obtain the final desired product.

The process of removing the spruce, riser & runner is done manually at most of the foundries. This manual concept is tedious job for the operator as these parts are not removed off in a single blow of a normal hammer. There has to be repetitive hammering on the part so as to drive off these parts away.

With this criteria more labor are required to complete the process, as single person can’t handle each & every casting for the whole day. Also the time required for completion of the process is more. Also working manually may lead to injury to the operator.

1.1 PNEUMATIC CYLINDERS

Pneumatic actuators, of which cylinders are the most common, are the devices providing power and movement to automated systems, machines and processes. A Pneumatic cylinder is a simple, low cost, easy to install device that is ideal for producing powerful linear movement over a wide range of velocities, and can be stalled without causing internal damage. Adverse conditions can be easily tolerated such as high humidity, dry and dusty environments and repetitive clean down with high pressure hoses[3]. The diameter or bore of a cylinder determines the maximum force that it can exert and the stroke determines the maximum linear movement that it can produce. Cylinders are designed to work at different maximum pressures. The pressure actually supplied to a cylinder will normally be reduced through a pressure regulator to control the thrust to a suitable level. As an example of cylinder power, a 40mm bore cylinder working at 6 bars could easily lift an 80kg man. The basic construction of a typical double acting single rod cylinder is shown in the cut away section, where the component parts can be identified. The main components of cylinder are as shown in figure 1.2.

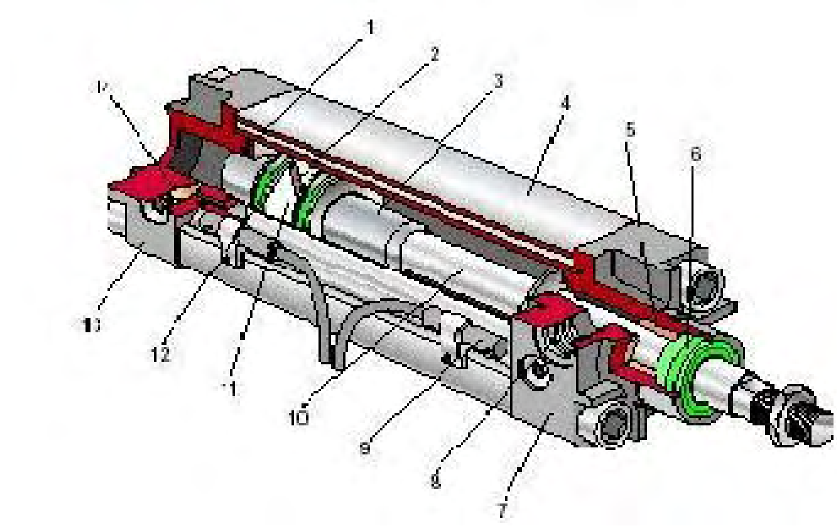

Fig. 1.2 Main components of a cylinder

1 Cushion seal	8 Front port
2 Magnet	9 Magnetically operated switch
3 Cushion sleeve	10 Piston rod
4 Barrel	11 Wear ring
5 Nose bearing	12 Piston seal
6 Rod seal and wiper	13 Rear end cover
7 Front end cover	14 Cushion adjustment screw

1.2 SINGLE ACTING CYLINDERS

Single acting cylinders use Pneumatic oil for a power stroke in one direction only. The return stroke is affected by a mechanical spring located inside the cylinder. Schematic diagram of single acting cylinder with spring return is as shown in the figure 1.3. For single acting cylinders with no spring, some external force acting on the piston rod causes its return. The schematic diagram of Single acting cylinder with no spring, push and pull is as shown in the figure 1.4. Most applications require a single acting cylinder with the spring pushing the piston and rod to the in stroked position. For other applications sprung out stroked versions can be selected.

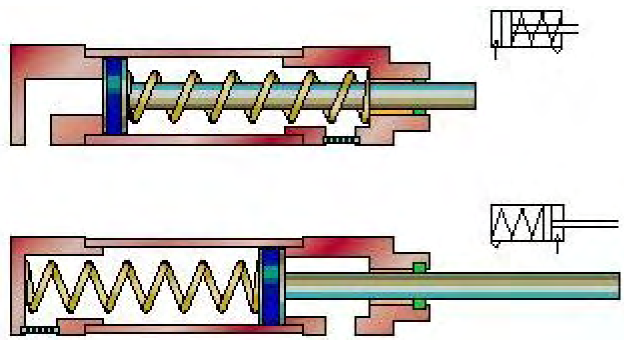

Fig.1.3 Single acting cylinder

The spring in a single acting cylinder is designed to provide sufficient force to return the piston and rod only. This allows for the optimum efficiency from the available pressure. Most single acting cylinders are in the small bore and light duty model ranges and are available in a fixed range of stroke sizes. It is not practical to have long stroke or large bore single acting cylinders because of the size and cost of the springs needed. Single acting cylinders with no spring have the full thrust or pull available for performing work[4]. These are often double acting cylinders fitted with a breather filter in the port open to atmosphere. The cylinder can be arranged to have a powered outstroke or a powered in stroke.

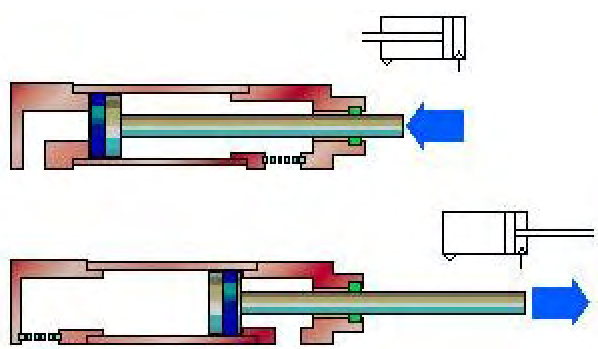

Fig.1.4 Single acting cylinder with no spring, push and pull.

1.3 DOUBLE ACTING CYLINDERS

Double acting cylinders use compressed air to power both the outstroke and in stroke. This makes them ideal for pushing and pulling within the same application. Superior speed control is possible with a double acting cylinder, achieved by controlling the exhausting back pressure. Non cushioned cylinders will make metal to metal contact between the piston and end covers at the extreme ends of stroke. They are suitable for full stroke working only at slow speeds which result in gentle contact at the ends of stroke. For faster speed, external stops with shock absorption are required. These should be positioned to prevent internal contact between the piston and end covers. The schematic diagram of Double acting non cushioned is as shown in figure 1.5.

Fig.1.5 Double acting non cushioned cylinder

Cushioned cylinders have a built in method of shock absorption. Small bore light duty cylinders have fixed cushions which are simply shock absorbing discs fixed to the piston or end cover. This type of cylinder is as shown in figure 1.6.

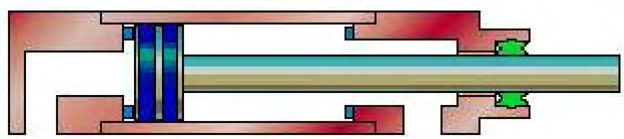

Fig.1.6 Fixed cushion cylinder.

Other cylinders have adjustable cushioning, which is shown in figure 1.7. This progressively slows the piston rod down over the last part of the stroke by controlling the escape of a trapped cushion of air.

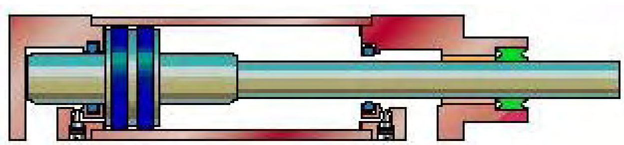

Fig.1.7 Adjustable cushion cylinder.

1.4 RODLESS CYLINDERS

For some applications it is desirable to contain the movement produced by a cylinder within the same overall length taken up by the cylinder body. For example, action across a conveyor belt or for vertical lifting in spaces with confined headroom. The novel design of a rod less cylinder is ideal in these circumstances. The object to be moved is attached to a carriage running on the side of the cylinder barrel. A slot, the full length of the barrel, allows the carriage to be connected to the piston. Long sealing strips on the inside and outside of the cylinder tube prevent loss of air and ingress of dust. The slot is unsealed only between the lip seals on the piston as it moves backwards and forwards[5]. Direction and speed control is by the same techniques as applied to conventional cylinders. The schematic diagram of Rod less cylinder is as shown in figure 1.8.

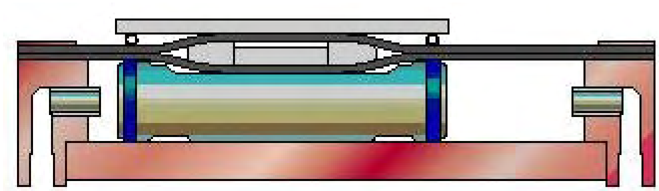

Fig.1.8 Rod less cylinder

1.5 SEALS

There are a variety of seals required within a cylinders Pneumatic single acting non cushioned cylinders use the least, double acting adjustable cushioned cylinders use the most.

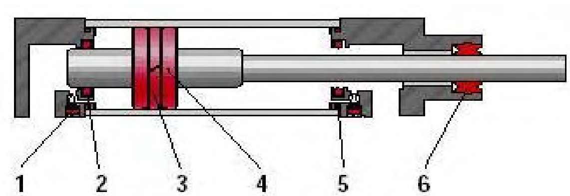

Fig.1.9 Types of seals

Key:

1) Cushion screw seal	4) Piston seal
2) Cushion seal	5) Barrel seal
3) Wear ring	6) Piston rod/wiper seal.

A sliding seal such as fitted to a piston, has to push outwards against the sliding surface with enough force to prevent compressed air from escaping, but keep that force as low as possible to minimize the frictional resistance. This is a difficult trick to perform, since the seal is expected to be pressure tight from zero pressure to 10bars or more. There is a large difference between static and dynamic friction. when the piston stops moving. Seals inherently need to exert a force radically outward to maintain a seal[6]. The schematic diagram of different seal in cylinder is as shown in figure 1.9.

1.6 PNEUMATIC VALVES

In pneumatic systems valves are essential to control parts. The efficient design of a pneumatic circuit requires the use of good pneumatic valves at suitable locations in the system. The valves uses are flow control, pressure control & direction control[7].

<u>CLASSIFICATION OF PNEUMATIC VALVES</u>

1) Directional control valve (DCV)
   (a)Poppet valves
   (b)Spool valves
2) Flow control valves
3) Pressure control valves
4) Non return valves
   (a)Check valve
   (b)Shuttle valve
   (c)Quick exhaust valve(QEV)

DIRECTIONAL CONTROL VALVES (DCV)

Certain control valves are used to direct the flow path of the air in pneumatic circuits. The valves used for this purpose are termed as Directional Control Valves(DCV). Basically, DCVs consists of a body with ports that are connected to flow passages, and these passages hence the direction of flow are controlled by movable parts like the spool or poppet.

In addition to directing the flow of air, they may also be used to allow or block the air flow: to control the speed or sequence of an operation. They are also useful to select between low or high pressure in a pneumatic system.

There are two major classes of directional control valves used in pneumatics: poppet valves and slide valves. Slide valves can be further classified as spool type and suspended seat type.

FLOW CONTROL VALVES (FCV)

In pneumatic systems, flow control valves are used to reduce the flow rate of air in the line and in turn control the speed of the actuator. In fact, a FCV act as an restriction (similar to an orifice) to the flow of air by reduced area of opening. The opening can be varied; hence the flow rate can also be varied. Most FCVs are adjustable type, so that the flow rate can be manipulated to suit the pneumatic operations. In addition, the FCV's are provided with a by-pass check valve, so that the flow is restricted in one direction only, while a free flow exists in reverse direction.

PRESSURE CONTROL VALVE (PCV)

A pressure control valve, also termed as pressure regulator, is a essential component of all pneumatic systems. Pressure regulation is important in fluid power systems to supply the fluid at the correct pressure so that there will not be any fluctuations at the actuator or electro-pneumatic devices. Pressure regulation is generally provided at two locations- at the receiver tank ans in the loading circuit. Pressure regulator is provided at the receiver tank as a safety measure, to prevent any unintentional over pressure buildup in the tank , which otherwise may lead to accidents[8]. In the loading circuits, pressure regulators are provided to control the pressure in the downstream devices.