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HYDRAULIC PAPER BOWL MAKING MACHINE

Vinayak kumbhar[1], Jagdish pathare[2], Swapnil thorat[3]

[1,2,3] *Dept. of mechanical engineering, balasaheb mhatre ploytechnic college, Maharashtra, India*

Abstract - *Hydraulic paper bowl making machine is a type of hydraulic tool which designed for production of paper bowls. This machine is better than other dish making machines, because it requires less human effort the quality of paper is good. This machine is a multipurpose useable machine. Most commonly used oil for this machine is 68number oil. Hydraulic machinery is operated by the use of hydraulics, where a liquid is the powering medium. High power can be generated by using hydraulic machine instead of pneumatic machine.*

Key Words: **Master cylinder, Piston, Hydraulic, Valves**

1. INTRODUCTION

Hydraulic paper bowl making machine is a type of hydraulic tool which designed for production of paper bowls. This machine is better than other dish making machines, because it requires less human effort the quality of paper is good. This machine is a multipurpose useable machine. Most commonly used oil for this machine is 68number oil.

The term hydraulics when used in mechanical engineering areas simply means part of applied science to transfer energy and control with oil as medium. Hydraulic machine are machinery and tools that use liquid fluid power to do simple work. E.g heavy equipments.

In this type of machine, hydraulic fluid is transmitted throughout the machine to various hydraulic motors and cylinders which becomes pressurized according to resistance present. The fluid is controlled directly by control vavles.

Hydraulic machinery is operated by the use of hydraulics, where a liquid is the powering medium. High power can be generated by using hydraulic machine instead of pneumatic machine.

In general, hydraulic machine consists of following components.

- Master cylinder
- Power pack
- Hoses
- Oil reservoir
- Pump
- Motor

2. HYDRAULIC SYSTEM

2.1 Hydraulic Cylinder

A hydraulic cylinder also called as linear hydraulic motor is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. It has many applications, notably in construction equipment, manufacturing machinery and civil engineering.

A hydraulic cylinder is the actuator or motor side of the system. The generator side of the system is the hydraulic pump which brings in a fixed or regulated flow of oil to hydraulic cylinder to move the piston. The piston pushes the oil in the other chamber back to reservoir. If we assume that the oil enters from cap end, during extension stroke and the oil pressure in the rod end is approximately zero, the force *F* on the piston rod equals the pressure *P* in the cylinder times the piston area *A. (F=P.A)*

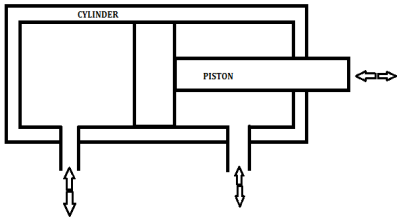

Fig -1: Symbol of Cylinder

2.2 Piston

The main function of piston is to separate pressure zone inside barrel. The piston is machined with grooves to fit metal seals and bearing elements. These seals can be single acting or double acting. The difference in pressure between two sides of piston causes the cylinder to extend and retract. Piston is attached with piston rod by means of threads, bolts, nuts to transfer the linear motion.

2.2.1 Piston rod construction

The piston rod of a hydraulic cylinder operates both inside and outside the barrel, and consequently both in and out of hydraulic fluid and surrounding temperature.

2.2.1.1 Coatings

Wear and corrosion resistance surface are desirable on the outer diameter of the piston rod. The surfaces are often applied using coating techniques such as chrome plating, laser cladding, PTA welding and thermal spraying.

2.2.1.2 Length

Piston rods are generally available in lengths which are cut to suit the application. As the common rods have soft or mild steel core, there ends can be welded or machined for screw thread.

2.3 Directional control valve

Directional control valve are one of the most fundamental parts in hydraulic machinery as well and pneumatic machinery. They allow fluid flow into different paths from one or more sources.

In this machine we have used 4/3 DC valve. This valve is placed at the right side of machine. It contains lever for operating the machine. For ease of operation to the operator, the handle is provided at right side.

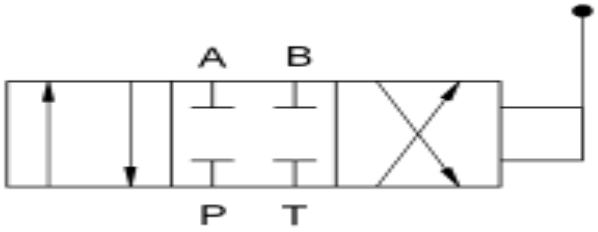

Fig -2: Symbol of DC valve

2.4 Hydraulic power pack

Hydraulic power packs are stand alone devices, as opposed to a built-in power supply for hydraulic machinery. Some power packs are large, stationary units and others are more portable. They have a hydraulic reservoir, which houses the fluid regulators that allow users to control the amount of pressure the power pack delivers to a valve, pressure supply lines and relief lines, a pump and a motor to power the pump.

2.4.1 Function

Hydraulic power packs typically offer a choice of valve connections, allowing users to connect them to a control valves to power a variety of machines. The power pack supplies hydraulic power through a control valve to run another machine.

3. DESIGN SELECTION

For this machine we have undertook various designing procedure for different parts of machines. The design consideration of different parts of machine is as follows.

3.1 Die size

As per the customer requirement size of die is selected. Hence, for this machine, we selected the sample die for paper cup. Die of our project is brought from market from die manufacturing company. 7" paper cup die is purchased from market.

For calculation of dimensions of cylinder and piston simple test on die is done which will give the load to be applied to cut the paper. From the test it is resulted that paper gets cut at a load of 400 kg. Hence we conclude that, 400 kg loading is required for cutting.

Thus, by considering factor of safety as 1.2

So the new load = 400 * 1.2

= 480 kg

Hence we selected the load of 500 kg for better performance.

Table -1: Measurement table

FORCE APPLIED (IN KG)	RESULT
100	Paper is not cut
200	Paper is not cut
300	Paper is not cut
400	Paper is cut

3.2 Cylinder bore diameter selection

Calculation of bore diameter

Force applied(f) = 500kg

Pressure of liquid (p) = 30 kg/cm^2

We know that,

Cylinder bore area is given by,

Area = force/pressure

$A = f/p$

= 500/300

A = 16.66 sq.cm

Also,

Area = A = $(\pi/4)\ d^2$

$16.66 = (\pi/4)\ d^2$

d = 4.6 cm i.e 5 cm

d = 50 mm

Thus cylinder bore diameter is selected as 50 mm.

Hence from calculation it is concluded that cylinder of 50 × 150 mm stroke is selected.

But for increasing production rate and reduce wastage of time, the stroke is kept 70 mm which does not effect on load and operation of machine.

Piston forward area = (Piston diameter)^2× π/4

= (50)^2× π/4

= 1962.5 mm^2

Piston return area = ((Piston diameter)^2 - (rod diameter)^2)× π/4

= 1347.74 mm^2

3.3 Pump and motor selection

0.5 HP, 370 W induction motor is used. The specification is given below.

Table -1: Motor specification

Frame	856
Power	370 W, 0.5 HP
Range	0.5 to 30 HP
Frame size	71 to 180 L
Syn. RPM	1500

3.4 Frame

The material used for the frame is mild steel. This is made by welding the channels of steel. The cylinder is mounted on the frame channel. 'C' channel selection is made for making frame purposefully because 'C' section provides maximum load bearing capacity.

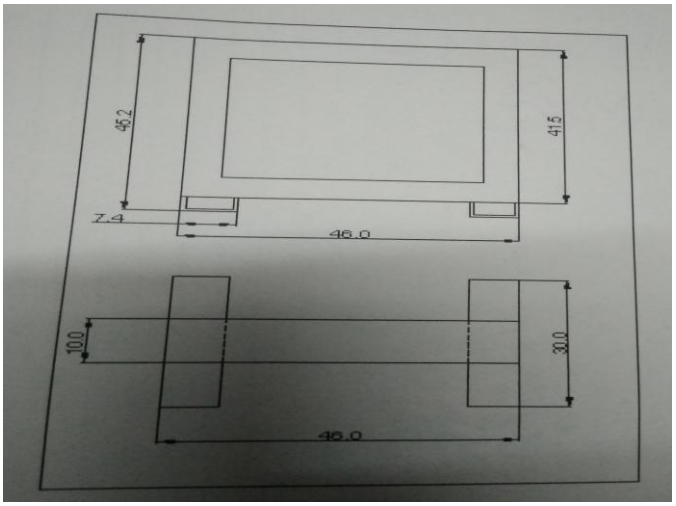

Fig -3: Frame

3.5 Adaptor

The material used for the adaptor is alloy steel bar. The function of adaptor is it holds the die at one end and couples it with the piston rod. The upper end of adaptor possesses external threads and lower end of piston having internal threads. The weight of the adaptor is 1.2 kg including bolt's weight.

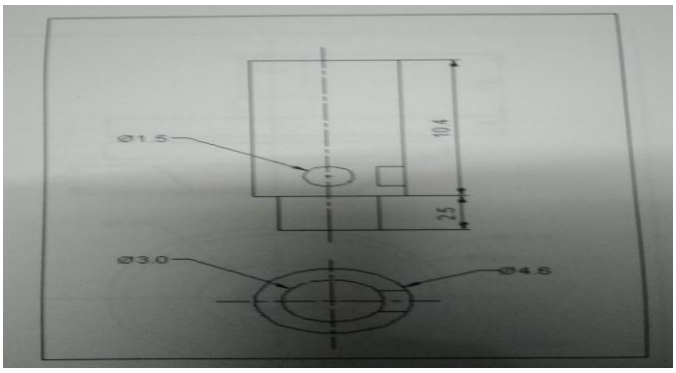

Fig -4: Adaptor

3.6 Cylinder

The machine uses double acting hydraulic cylinder. The cylinder is mounted on the top of 'C' channel frame. The bore cylinder is 50 mm and stroke length is 150 mm. the cylinder has two ports one is at top and another is at bottom for extracting and retracting process of piston and piston rod.

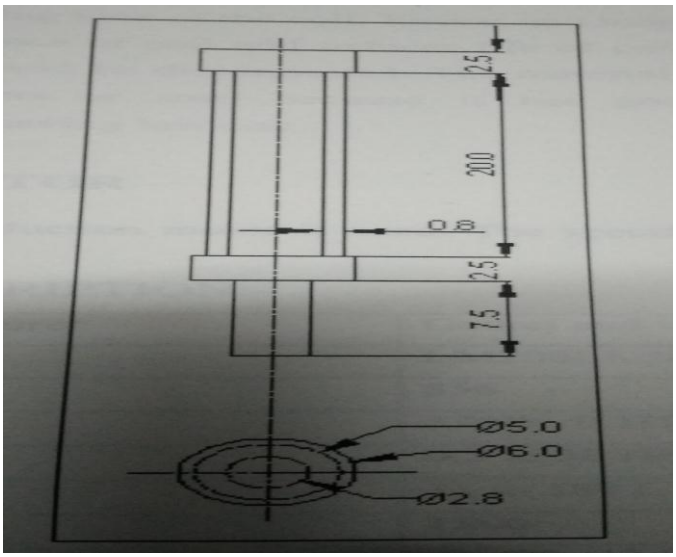

Fig -5: Cylinder

4. RESULTS

Following are the results and the observations took by testing the machine.

4.1 Time study

Table -3: Time study

Operations	Time required in secs
Initial time required for heating	30
Inserting time of paper	2.03
Time required for downward movement of die	2.33
Holding time for cutting the paper	1.04

Time required for upward movement of die	1.49
Removal time for prepared bowl	2.75
Total time	39.64

Thus, time required for completing one bowl = 10 sec

Production of bowl in one min = 60/10
= 6 bowls

Production of bowls in one hour = 6×60
=360 bowls

Production of bowl in eight hours(1 shift) = 2520 bowls

Production of bowl in one week = 15,120 bowls

Production of bowl in one month = 60,480 bowls.

5. CONCLUSION

- By using hydraulic system of paper bowl making machine instead of manual control, we can be able to increase production rate by 20%.
- Human effort is also reduced as compared to older hand operated machines.
- Due to 'C' channel type structure of frame all types of loads and stresses are eliminated
- Modification can be done very easily as we are providing nut bolt arrangement to the adaptor i.e we can change the die of bowl to the die of dish.
- Indexing of dies can also be done so that there would be no change of die for various shapes resulting in reducing time for changing die.

6. PHOTOGRAPHS

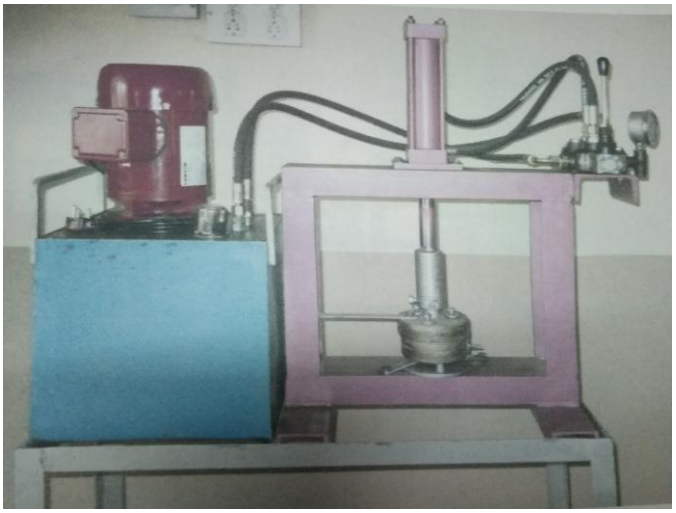

Fig -6: Front View

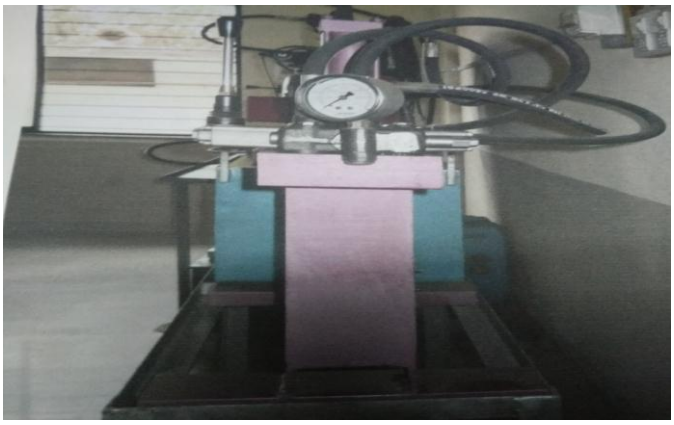

Fig -7: Right Hand Side View

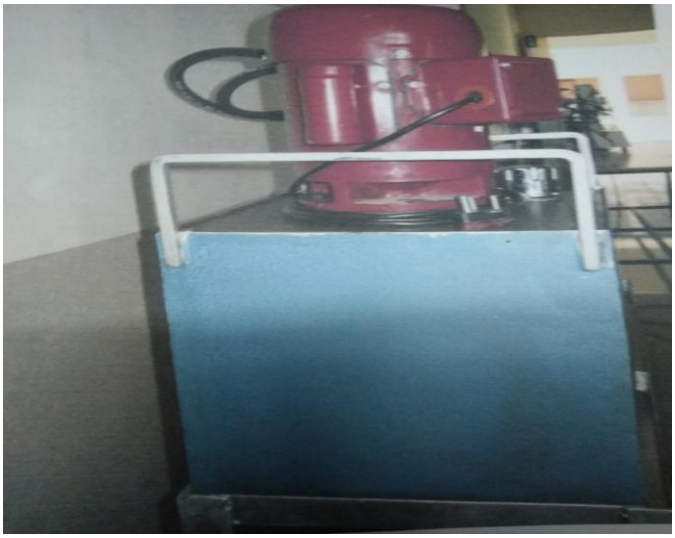

Fig -8: Left Hand Side View

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