

DESIGN AND FABRICATION OF HYDRAULIC BEARING

PULLER AND PUSHER

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Abstract

Now a day's hydraulic system plays very important role in almost all the application. As in automobile industries , small service center, aircraft industries , and used where precision is required . Traditional method of bearing removal or installation is hammering, but unnecessary hammering causes several problems. The unsafe and excessive hammering cause's damage of bearing surface or sometimes chance to failure and excessive human effort required. In order to remove or installed bearing safely, to make modification in traditional method. The modification made in easy removing and installing bearing. The purpose of modification are required less human effort , simplicity of operation , Removing and installing bearing done without damaging bearing surface , compact ,portable and well suited .The hydraulic bearing puller based on hydraulic system on the principle of Pascal's law which states that " Pressure distribution in enclosed cylinder is uniform in all direction.

Keywords: Hydraulics, Bottle jack, Bearing Puller and Pusher.

1. INTRODUCTION

The hydraulic bearing puller and pusher is a device which is used for removing as well as installing bearing on the shaft. The Hydraulic operated bearing puller is a device which is used to remove the bearing from shaft by using the puller set up from supporting device. In the machine the press fit operations are very complicated to align the assembly. For this type of operations required

heavy force for assembly & dissembling the bearing from the machines. It can widely & effectively used for removing the bearing. It can be operated by single person.

1.1 Literature and research

[1] Design of Improved hydraulic Accumulator for a Truck Loading Lift, Department of mechanical engineering, Federal University of Technology Minna, Nigeria ISSN:- 2249-9954

Pascal's law of hydrostatics for an enclosed vessel with two surfaces A1 and A2 as shown in Figure the principle states that the pressure on every surface within the enclosed vessel will be equal. Therefore given that a force F1 acts on the surface A1 then the ratio of the force F1 to the area A1 which represents the Pressure must be equal to the ratio of the force F2 to the area A2 which also represent the uniform Pressure within the same vessel.

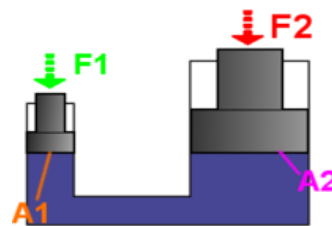


Figure 1.1 Pascal's law

The hydraulic accumulator lift machine developed in this paper operates based upon the Pascal's law of hydrostatics and is mathematically expressed as:

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

The pressure in the Hydraulic accumulator is expressed as the force by the hydraulic pump

exerted on the fluid-ward side of the hydraulic ram in the hydraulic cylinder divided by the effective area of the Hydraulic ram:

$$P = \frac{F}{A}$$

Where, P is the pressure in the hydraulic accumulator (Pa); F is the force of hydraulic pump in accumulator cylinder (N); and A is the effective area difference between the ram its shaft (m²).

2. PREVIOUS METHOD

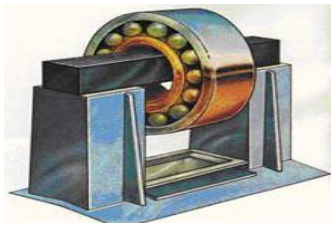


Fig 2.1: Methods of bearing remove & install

In Traditional method, bearing removal and installation is done by hammering, but such hammering causes several problems. They are

1. Excessive hammering causes damage of surface or sometimes chance to failure.
2. Excessive human effort is required which increases the labour cost.

3. THEORY

3.1 Hydraulics:

The word *hydraulics* is based on the Greek word for water, and originally covered the study of the physical behaviour of water at rest and in motion. Use has broadened its meaning to include the behaviour of all liquids, although it is primarily

concerned with the motion of liquids. Hydraulics includes the manner in which liquids act in tanks and pipes, deals with their properties, and explores ways to take advantage of these properties. Although the modern development of hydraulics is comparatively recent, the ancients were familiar with many hydraulic principles and their applications. The Egyptians and the ancient people of Persia, India, and China conveyed water along channels for irrigation and domestic purposes, using dams and sluice gates to control the flow. Daniel Bernoulli conducted experiments to study the elements of force in the discharge of water through small openings in the sides of tanks and through short pipes. During the same period, Blasé Pascal, a French scientist, discovered the fundamental law for the science of hydraulics.

Hydraulic jack is based on the **Pascal's law** which states that increase in pressure on the surface of a confined fluid is transmitted undiminished throughout the confined vessel or system.

Advantages:

1. Fluid does not absorb any of the supplied energy.
2. It is capable of moving much higher loads and providing much higher forces due to the incompressibility.
3. The hydraulic working fluid is basically incompressible, leading to a minimum of spring action. When hydraulic fluid flow is stopped, the slightest motion of the load releases the pressure on the load; there is no need to "bleed off" pressurized air to release the pressure on the load.

3.2 Bottle Jack:

BOTTLE JACKS provided an easy way for an individual to lift up a vehicle for roadside inspection or service. They range in size and weight to offer a lifting capability ranging from one hundred to several tons. Bottle jacks feature a vertical shaft, which supports a platform (called a bearing pad) that directly bears the weight of the object as it is lifted. Although they are most commonly used in the automobile industry (1.5 to 5 ton jacks are frequently used to lift cars), bottle jacks have other uses as well.

In the medical industry they can be used in hydraulic stretchers and patient lifts. In industrial applications, they can be found as pipe benders used in plumbing, as cable slicers for electrical projects, and as material lifts within warehouses. Their ability to lift heavy loads plays a big role in enabling the repair of large agricultural machinery and in many construction operations. Bottle jacks can be secured within a frame, mounted on a beam, or simply used as they are for easier jack transportation.

3.2 Hydraulic jack:

It is a short stroke hydraulic lift which is fed from hand pump. The hydraulic jack may be portable. This is extensively used for lifting automobiles usually to facilitate and repair. And for replacing the punctured wheels. The hydraulic jack is perhaps one of the simplest forms of a fluid power system. By moving the handle of a small device, an individual can lift a load weighing several tons. A small initial force exerted on the handle is transmitted by a fluid to a much larger area. The operation of hydraulic jack depends on "Pascal's law". This states that when a fluid is at rest in a closed vessel and if a certain pressure is applied at any point the pressure will be transmitted equally in all direction. Mechanical advantage is obtained by a practical application of Pascal's law of transmission of fluid pressure. Two pistons of different sizes operate inside two cylinders suitably connected with a pipe so that pressure in each is the same. If p is pressure and a_1, a_2 are the cross sectional area of cylinders, then a force F applied to the smaller plunger will make available a load W is lifted.

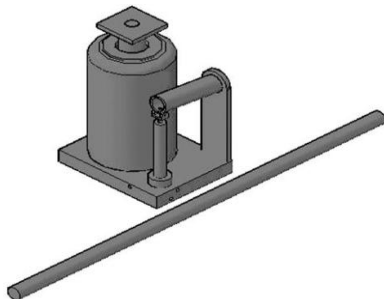


Figure 3.2 Hydraulic Jack

Where, p = pressure of the fluid,

a_1 = small cylinder area,

a_2 = larger cylinder area,

F = force acting on smaller plunger,

W = load lifted.

4. CONSTRUCTION

It consists of plunger cylinder on one side and ram cylinder on the other side. These two cylinders are mounted on base which is made of mild steel. Plunger cylinder consists of plunger which is used to build up the pressure by operating the handle. Plunger cylinder consists of two non-return valves i.e. one for suction and other for delivery. Ram cylinder consists of ram which lifts the load. The ram cylinder connected to delivery valve of plunger cylinder. It is also consists of lowering screw this is nothing but a hand operated valve used for releasing the pressure in the ram cylinder for get down the load.

5. WORKING OF HYDRAULIC JACK

Hydraulic jack works on the principle of Pascal's law. When the handle is operated, the plunger reciprocates then the oil from the reservoir is sucked into the plunger cylinder during upward stroke of the plunger through the suction valve. The oil in the plunger cylinder is delivered into the ram cylinder during the downward stroke of the plunger through the delivery valve. This pressurized oil lifts the load up, which is placed on top plate of the ram. After the work is completed the pressure in the ram cylinder is released by unscrewing the lowering screw thus the pressure releases and the ram is lowered, then the oil is rushed into the reservoir.

5.1 Application:

The inbuilt hydraulic jacks system can be incorporate in any type of motor vehicle such as:

1. In small cars
2. In heavy loading vehicle like trucks and buses
3. In heavy vehicles like crane and harvester

6. HYDRAULIC PULLING & PUSHING

Hydraulic pulling consists of mechanical jaw puller inbuilt with the hydraulic jack. When pump operated, piston comes outside. Then mechanical jaws adjusted below the bearing and again operate the pump. During operation hydraulic jack applies continuous pressure on shaft and mechanical jaw remove bearing from shaft.

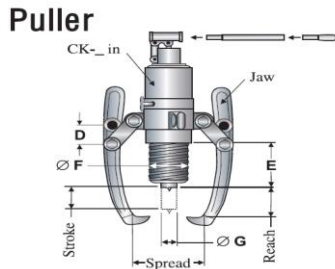
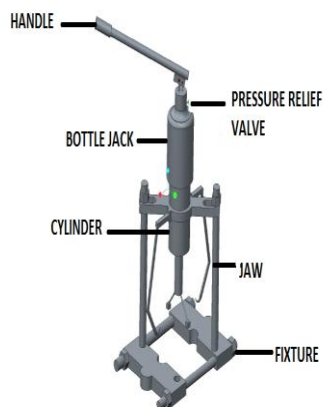


Figure 6 Hydraulic bearing puller

For pushing operation, the plunger drilled at topmost level and passed a stud rod having thread on both side and two rod bolted at both sides of stud rod. After that two loads attached permanently to the two rod ends by welding. Also provided clamping arrangement for holding bearing. When pump operated and due to movement of ram, loads acting on clamp and bearing easily installed.

7. CAD MODEL



8. DESIGN OF HYDRAULIC JACK

8.1 Design Consideration:

1. Load (W) = 2 ton (20 KN)

2. Operating Pressure (p) = 25 Mpa
3. Lift range (L) = 20 cm
4. Man effort put on handle (6t) = 120 N/mm²
5. Factor of safety = 5

8.2 Design of ram cylinder:

The ram cylinder is made up of mild steel with density 7.686 gm/cc. It is mounted on base plate.

Let

d = Inner diameter of ram cylinder

D = Outer diameter of ram cylinder

p = Pressure acting on cylinder

W = Load

T = Thickness of ram cylinder

8.3 Design of plunger cylinder:

The plunger cylinder is made up of mild steel and it is mounted on base plate. It provides slide way to the plunger in order to built up the pressure.

Let

dp = Inside diameter of plunger cylinder

Dp = Outside diameter of plunger cylinder

tp = Thickness of plunger cylinder

8.4 Design of lever:

A lever is made up of mild steel and is used to apply loads on the plunger. It is attached to the plunger with the help of pivot.

Assumption

1. Effort put on lever by man = 20 Kg
2. Load acting on plunger (W) = in Kg

8.5 Design of base:

Fix the dimensions of base plate as

$$l * b * t_b$$

Where

l = Length of base

b = Width of base

tb = Thickness of base

[7] Modelling and Simulation of Hydraulic Energy Saving System J.K. Gangwar, Madhulika Tiwari, Indian School of Mines Dhanbad (India)

9. CONCLUSION

In order to remove and installed bearing safely, to make modification in traditional method. The modification made in easy removing and installing bearing. The purposes of modification are required less human efforts and to reduce labour cost, Simplicity of operation, removing and installation of bearing done without damaging bearing surface, compact, portable, well suited, low cost, Multifunctional ,safe ,versatile and individual can lift a load weighing several ton.

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