ANALYSIS OF HYDRAULIC BEARING PULLER AND PUSHER MACHINE

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Abstract

A mounting system is disclosed for mounting a bearing assembly or other mechanical element to a shaft. The mounting system uses a tapered sleeve mechanism to secure the bearing assembly on the shaft. Specially a pressure loaded piston drives the sleeve from a preassembled position to an initial position. The initial position is determined by monitoring the pressure applied to the piston. Once the initial position has been reached, a linear indicator is used to measure the axial sleeve movement from the initial position to final position. The system remains in place after the bearing is installed on the shaft and facilitates removal of the bearing assembly from the shaft. In this project, we try to make simple and portable machine which can remove bearing from shaft with ease. The design and fabrication of hydraulic bearing machine is suitable for any type labour to use. And the bearing life is increased. The conventional bearing removal from shaft by hammering is replaced by hydraulic bearing mechanism.

Keywords: Hydraulic cylinder,Bottle jack, operating liquid, automobile sector, hydraulic system mechanism.

1. INTRODUCTION

The controlled movement of parts or a controlled application of force is a common requirement in the industries. These operations are performed mainly by using electrical machines or diesel, petrol and steam engines as a prime mover. These prime movers can provide various movements to the objects by using some mechanical attachments like screw jack, lever, rack and pinions etc. However, these are not the only prime movers. The enclosed fluids (liquids and gases) can also be used as prime movers to provide controlled motion and force to the objects or substances. The specially designed enclosed fluid systems can provide both linear as well as rotary motion. The high magnitude controlled force can also be applied by using these systems. This kind of enclosed fluid based systems using pressurized incompressible liquids as transmission media are called as hydraulic systems. The hydraulic system works on the principle of Pascal's law which says that the pressure in an enclosed fluid is uniform in all the directions. The Pascal's law is the force given by fluid is given by the multiplication of pressure and area of cross section. As the pressure is same in all the direction, the smaller piston feels a smaller force and a large piston feels a large force. Therefore, a large force can be generated with smaller force input by using hydraulic systems. In this paper the machine we are developing and design is multifunctional both pulling and pushing of bearing from shaft is possible with ease. It also improves and increased the bearing life and replace conventional bearing removal method. And the cost and time consumed is also saved.

1.1 Literature and research

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The fluid based systems using pressurized incompressible liquids as transmission media are called as hydraulic systems. The hydraulic system works on the principle of Pascal's law which says that "The pressure in an enclosed fluid is uniform in all the directions."

Force = Pressure * Cross section area

2. Conventional machine model:

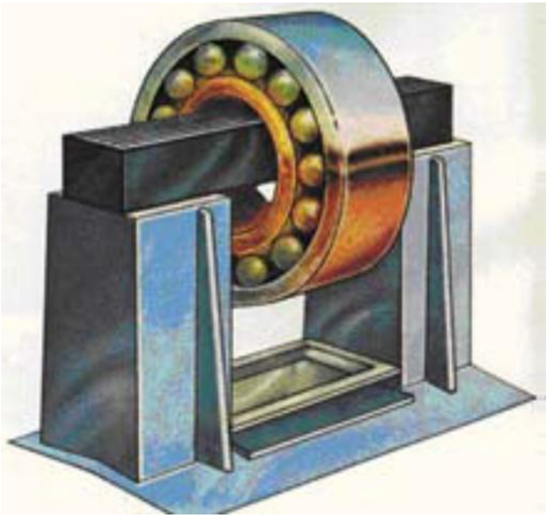


Fig 2.1: Conventional hydraulic bearing removal machine

In conventional bearing removal machine we found some problems and there is requirement of designing new modified machine which will be multifunctional in use. The problems found are as follows-

1. Excessive hammering causes damage of bearing surface or sometimes chance to failure.
2. Excessive human efforts are required which increases the labour cost.
3. More time consuming.

So we proposed to design a new machine which will overcome above problems and it will be multifunctional. It will replace conventional machine place. Pulling and pushing of bearing from shaft is with ease and quick. Bearing efficiency and life is improved.

1. DESIGN CALCULATIONS

<u>1.1Design of cylinder</u>

Bore Diameter d =60mm=0.06m

Stroke Length Ls=135mm=0.135m

Height h=150mm=0.150m

Capacity =2 tones

Pressure P=8*10^5N/m2

Area of cylinder = (3.14/4)*d^2

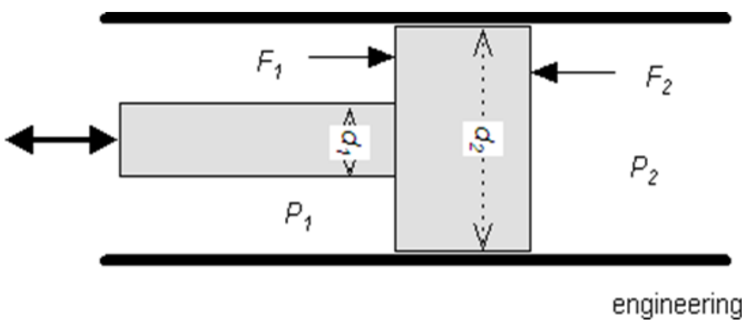
= (3.14/4)*(0.06)^2

=2.8274*10^-3 m^2

Pressure P= Force (F) /Area (A)

8*10^5=F/2.8274*10^-3

F=2262 N (Push Force)



1.2Volume of cylinder =3.14*r^2*h

=3.14*(0.03^2)*0.150

=4.2411*10^-4 m^3

Surface volume

V= (3.14*r^2*h) piston+(3.14*r^2*h)cyl

= (3.14*0.015^2*0.150)+(3.14*0.03^2*0.150)

=5.3014*10^-4 m^3

Load exerted on cylinder = 80kg.

2 Shaft design:

Torque

$$T = \frac{60 \times Pd}{2 \times \pi \times N2}$$

T = 209.23 Nm

For SAE 1030

T_{max} = 66.6 MPa

T = (π/16) ×d^3×66.6

D = 40 mm

∴ d < D

Standard Diameter

D = 40 mm

3.Bottle jack calculation:

Volume capacity=200cc=0.2m^3

Volume (m^3) =3.14*r^2*h

0.2=3.14*r^2*0.02

r=0.56 m

Stress=Axial Force/Area of bearing where force exerted

Stress= (Sut)m*2/F.O.S F.O.S=5

Stress=680 *2 /5

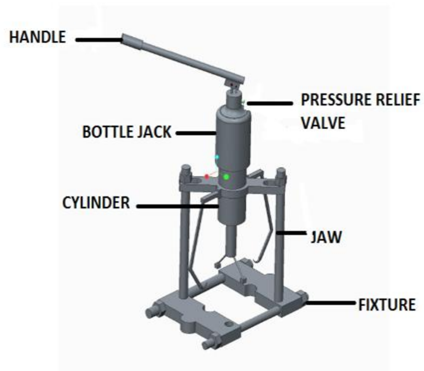
Sut=0.680N/m^2

Stress=0.272 N/m2

0.272=Axial force/7.0685*10^-4

Axial force=1922.632N (Pulling force).

4. CONCEPTUAL CAD MODEL OF DESIGN AND FABRICATION OF HYDRAULIC BEARING PULLER AND PUSHER MACHINE



4. DESIGN OF HYDRAULIC JACK

DESIGN CONSIDERATIONS

METHODOLOGY:

Load (W) = 2 ton (60 KN)

OPERATING PRESSURE (P) = 25 Mpa.

Lift range (L) = 10 cm

Man efforts put on the handle (e) = 20 kg.

Permissible tensile stresses of mild steel = 120 N/mm^2

No of strokes for lifting load (n) = 150

Factor of safety = 5

Permissible shear stress of mild steel = 20 N/mm^2

Permissible compressive stress of mild steel = 120 N/mm^2

4.1DESIGN OF PLUNGER:

Let the made up of mild steel which reciprocates in plunger cylinder to increase the pressure of the oil.

Let,

W= load acting on plunger

dp = diameter of plunger

P = pressure developed in plunger cylinder

From standard table inside diameter of plunger cylinder is fixed = 8 mm

Load acting on plunger = pressure*area

=2.5*10^5 *2827.43*10^-6

= 72.05 Kg.

We taken load acting on the plunger = 80 kg.

4.2 PLUNGER DISPLACEMENT:

We know that

Velocity ratio (V.R) =assume velocity ratio

150 = 104.49 mm

Therefore plunger displacement = 10.4 cm

4.3DESIGN OF LEVER:

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

Assumptions,

1) Effort put on lever by hand = 20 Kg.

2) Load acting on plunger = 80 Kg.

Velocity ratio of lever by man = 6.5

Required distance from fulcrum to load = 10.4 cm

Total length of lever = 6.5*10.4

67.6 cm (68 cm)

Permissible tensile strength of mild steel lever =120 N/mm^2

CONCLUSION

The purpose of developing this paper is to develop multipurpose machine to improve bearing life and efficiency , reduce cost & time required for bearing removal from shaft By using advance hydraulic bearing puller and pusher machine and advance techniques we can improve and increased bearing life & minimise cost and time.

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