

HYDRAULIC BEARING PULLER

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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 other departments where precision is required. This review focuses on study and development of concept design of Hydraulic based bearing remover. Traditional the method of bearing removal or installation is hammering, but unnecessary hammering causes several problems. The unsafe and excessive hammering cause's damaging of bearing surface or sometimes chances of failure and excessive human effort is required. While the conventional Hydraulic puller using pump are costly, huge, and high at maintenance. In order to remove bearing safely, we have to design new method by eliminating huge Hydraulic Pumps, reducing size of Cylinder, and produce large amount of force by applying minimum effort. The new design should be easy for removal of bearing or gear from the shaft. The hydraulic bearing puller is based on hydraulic system on the principle of Pascal's law which states that "pressure change occurring anywhere in a confined incompressible fluid is transmitted throughout the fluid such that the same change occurs everywhere". In this paper we have studied various existing methods for bearing removal, consisting of Mechanical Jack Screw Puller, Hydraulic bearing remover using Pump, Hydraulic bearing puller and pusher using hydraulic jack.

Keywords: Bearing remover, Hydraulic bearing puller, Hydraulic jack, mechanical puller, Pascal's law.

1 INTRODUCTION

Bearings are used to reduce friction between rotating shaft and support. Bearings have a finite operating life, it requires periodic replacement and routine maintenance to prevent failure. Several factors impact the service life is a bearing or the frequency for required maintenance. For example, bearing loads, operating temperature, exposure to external environments, contamination, lubrication and even electrical currents acting on the bearing may impact a bearing's service life or the frequency that maintenance must be conducted. The hydraulic bearing puller is a device which is used for removing bearing from the shaft. In the machine the press fit operations are very complicated to align the assembly. For this type of operations, we require heavy force for disassembly of the bearing from the machines. It can be used widely & effectively for removing the bearing. Bearings are made to exact tolerances and have very fine surface finishes. In order to maintain the geometrical precision, the surface integrity of ball, roller bearing raceways and rolling elements, it is mandatory that care in storage, handling and installation should be observed. The hydraulic bearing puller performs pulling operation of bearing safely and without damaging the bearing surface.

2 DEFINITION OF PROBLEM

Often times it is difficult to replace or service bearings due to the location, size, weight, method of coupling or type of bearing. A bearing, for example, may weigh several hundred pounds and/or be coupled to a part or shaft is through an interference fit. As a result, it is oftentimes necessary to remove the rotor or shaft assembly in its entirety to replace or repair the bearings. In some instances, the entire machine must be transported to a maintenance facility to replace the bearings. However, it is desirable to replace bearings without

- (i) Requiring removal of the rotor assembly or rotor shaft

(ii) Transporting the machine to a maintenance facility.

Traditionally, bearing removal done by hammering, but such hammering causes several problems. They are: Excessive hammering causes damage of bearing surfaces and sometimes chance to failure. More effort required to remove bearing because of hammering. Damage to the shaft edges due to wear from Jack Screw of mechanical pullers. Conventional hydraulic puller is not portable.

- a. Increase in number of valves
- b. Requires spring return mechanism
- c. Possibility of Leakage
- d. Length of cylinder increases
- e. Maintenance cost is high

3 OBJECTIVES

In order to remove bearing safely we need to make modification in traditional method. The modification to be made should allow easy removal of bearing. The purpose of modification is,

3.1 Simplicity of operation

Removal of bearing done without damaging bearing surface. Compact, portable and well suited. Low cost. Skilled as well as unskilled personnel can perform the operation. Increasing the life of bearing.

4. HEADINGS

4.1 Pullers:

Designed as a tool to make the removal and installation of bearings simple and efficient, bearing pullers often resemble a pair of scissors. In some cases, the configuration of the puller will allow the extraction of both gears and bearings, including those that are connected with a series of shafts within the mechanism. Different sizes of bearing pullers make it possible to use the device on everything from a pair of skates to complicated industrial machinery.

4.2 Hydraulic Jack:

Hydraulic Jack is perhaps one of the best examples of fluid power system. It plays very important role in automobile industries to facilitate servicing and repair. It may be portable device. By operating handle of small device and individual can lift load of several tons. Hydraulic jack works on the principle of Pascal's law. Hydraulic Jack consists of Cylinder, Plunger, and Handle, Oil reservoir, Pressure release and relief valve. 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. INDENTATIONS AND EQUATIONS

5.1 Hydraulics:

The word hydraulics' concerned with study of behavior of water at rest and at motion i.e. behavior of liquids. Hydraulics' includes properties, advantages and applications of liquids. The two main scientists give the direction to forward, one is Daniel Bernoulli and another is Blase Pascal. Bernoulli conducted an experiment on fluid flow and gives fluid flow equation to the world and at same period Pascal developed science of hydraulics.

5.2 Pascal's Hydraulic Principle:

According to Pascal's law "The fluid pressure in an enclosed vessel's is uniform in all direction". Consider a vessel having two surfaces and having area A_1 and A_2 respectively. Also F_1 and F_2 be the forces acting on area A_1 and area A_2 .

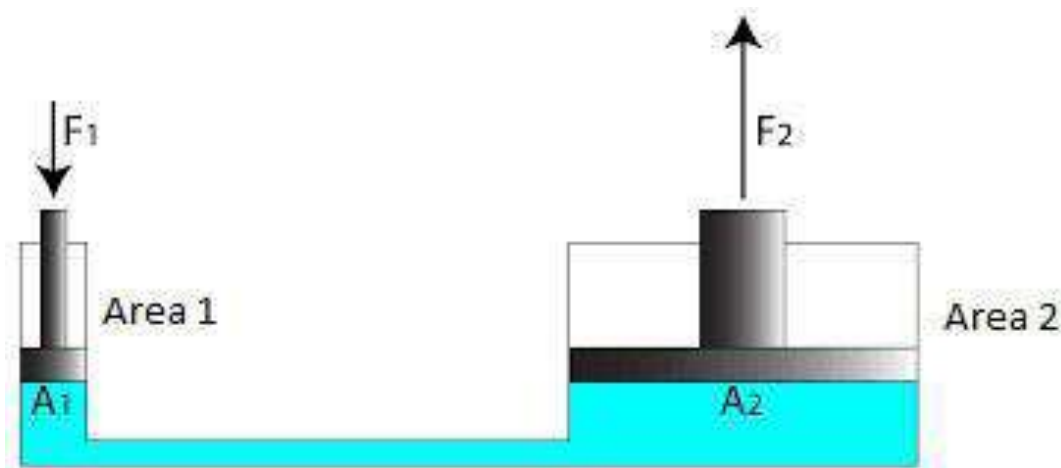


Fig-1: Pascal's Hydraulic Model

Considering surface 1 having area A_1 and force F_1 . Therefore, Pressure acting on surface 1 is given by:

$$P_1 = F_1 / A_1 \quad (1)$$

Similarly, it is given by:

$$P_2 = F_2 / A_2 \quad (2)$$

As the pressure is same in all the direction, the smaller piston feels a smaller force and a large piston feels as large force. Therefore, a large force can be generated with smaller force input by using hydraulic systems.

$$P_1 = P_2$$

$F_1 / A_1 = F_2 / A_2$ (from eqn. 1 & 2) Fluid does not absorb any kind of supplied in energy and it is capable of moving much higher load's and providing much higher forces due to the incompressibility.

6. WORKING AND MODIFICATION

6.1 Working:

Hydraulic puller performs the operation of removal of bearing. Hydraulic pulling consists of adjustable mechanical jaw puller inbuilt with the hydraulic jack. When the pump is operated, plunger comes outside. Then mechanical jaws are adjusted below the bearing and again the pump is operated. During operation, hydraulic jack applies continuous pressure on shaft and mechanical jaw remove bearing from shaft. Hydraulic Puller with External Pump to understand the model of said hydraulic puller. A skilled personnel is required for operation of such Hydraulic puller.

6.2 Need for modification:

As the cost of such hydraulic puller is high, due to the presence of external hydraulic pump, there are a lot of valves in this mechanism, namely directional control valves, pressure control valves, flow control valves, etc. use of spring return mechanism. Making the size of puller very large. This hydraulic puller requires proper handling hence the chances of leakage are high, these pullers are need to be maintained time to time for better performance, the maintenance cost is also high. Thus some modifications are need to be done so as to reduce the overall size of the system and make it easy for operation.

6.3 Concept design of Hydraulic puller:

In this concept design, the working mechanism of proposed hydraulic bearing puller is based on the principle of Pascal's law. We can design the hydraulic cylinder in such a way that it can produce huge amount of force at the plunger end by a small displacement of mechanical screw from the other end. The obtained force is used to push the shaft. The bearing is held in place by clamping arms by proper adjustments done with the help of arm clips. Thus ,bearing is removed safely without causing any casualties.

6.4 Advantages:

- a. Elimination of external pump.
- b. Reduction in length of hydraulic cylinder. Reduction number of valves.
- c. Elimination of spring return mechanism.
- d. Low cost due to elimination/reduction of above components Reduced risk of leakages.
- e. Maintenance cost is low.
- f. Skilled or unskilled personnel can operate the device.

6.5 Disadvantage:

- a. Cylinder stroke length is constant.

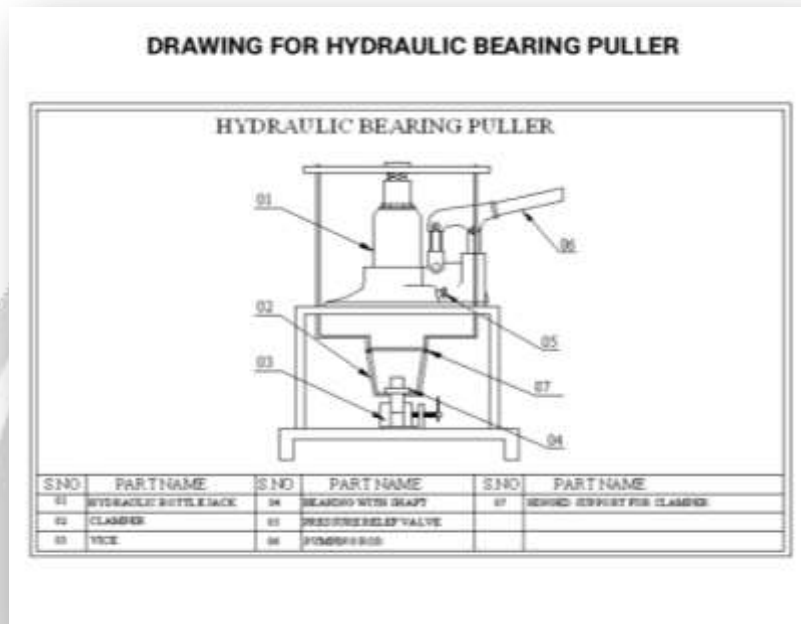


Fig.-2: Concept design of Hydraulic Puller

7. FIGURES

Following are some tools that are used today to remove bearings from shaft.



Fig-3: Mechanical Jack Screw bearing remover

8. CONCLUSION

By using Pascal's Law, we can design a compact hydraulic bearing puller. The purpose of this modification is to simplify the operation of removing the bearings without damaging the bearing surface and the shaft edges, portability of the device, low cost and safe to use. And thus, increasing the life of bearing surface.

9. REFERENCES

The following papers are being studied and are referred for the project. These papers belong to various authors, having various papers related to the Hydraulic Bearing Puller.

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