DESIGN & FABRICATION OF HYDRAULIC MACHINE WITH PULLING & BENDING OPERATIONS

M. Lava Kumar1, Sreenivasulu Bezawada2, K. Hema Mahesh Babu3 D. Krishnaiah4
Associate Professor, Dept. of ME, Siddharth Institute of Engineering & Technology, Puttur, AP, India1
Associate Professor, Dept. of ME, Siddharth Institute of Engineering & Technology, Puttur, AP, India2
Associate Professor, Dept. of ME, Siddharth Institute of Engineering & Technology, Puttur, AP, India3
Associate Professor, Dept. of ME, Siddharth Institute of Engineering & Technology, Puttur, AP, India4

ABSTRACT: *Traditional method of bearing removal from shaft is very difficult. It can remove by hammering or by applying more force. By hammering the bearing surface gets damaged. So, we can apply the hydraulics for this removal of bearing from shaft. Hydraulic system plays a very important role in almost all the applications in now a day. At present the above two are that are hydraulic bearing puller and hydraulic pipe bender are manufactured separately. The objective of this research is to combine the pulling operation and bending operation in a single machine. In this we can do both the operations that are bearing pulling and pipe bending by using hydraulics. The above research works on the principle of "pascal's law of hydraulics" that states the pressure of a fluid in a closed vessel is uniform in all directions. At present the above two are that are hydraulic bearing puller and hydraulic pipe bender are manufactured separately. The objective of this research is to combine the pulling operation and bending operation in a single machine. In this we can do both the operations that are bearing pulling and pipe bending by using hydraulics. The above research works on the principle of "pascal's law of hydraulics" that states the pressure of a fluid in a closed vessel is uniform in all directions.*

KEYWORDS: Hydraulic machine, Pulling and Bending operation.

I INTRODUCTION

The hydraulic bearing puller is a device which is used for removing bearing on the shaft. In the machine the press fit operations are very complicated to align the assembly. For this type of operations required heavy force for dissembling the bearing from the machines. It can widely & effectively have used for removing the bearing. Bearings are made to exacting tolerances and have very fine surface finishes. In order to maintain the geometrical precision and the surface integrity of ball and roller bearing raceways and rolling elements, it is mandatory that care in storage, handling be observed. The hydraulic bearing puller perform pulling operation safely and without harming bearing surfaces.

The hydraulic pipe bending press fits any small to medium-sized industry when machinery for large-scale production must necessarily make way for machinery with distinctly lower production costs. The operating procedure of hydraulic pipe bending machine is simple when compared to other pipe bending machine (Colliers Encyclopaedia, 1997). Tube bending as a process starts with loading a tube into a pipe bender and clamping it into place between two dies, the clamping block and the forming die. The tube is also loosely held by two other dies, the wiper die and the pressure die.

A.V. Vanalkar et.a l[1] In this paper 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. Bearings are made to exacting tolerances and have very fine surface finishes. In order to maintain the geometrical precision and the surface integrity of ball and roller bearing raceways and rolling elements, it is mandatory that care in storage, handling and installation be observed. The hydraulic bearing puller and pusher perform both pulling and pushing operation safely and without harming bearing surfaces.

Mohan Krishna S. A. et. A l[2]in this paper he tell how to bend the pipes, rods and bars by using hydraulics. The pipe or rod to be bent is supported between the holders and jack is actuated on pipe. It exerts force on the pipe and bends it to the angle depending on the dies used. Actuation of hydraulic jack is simple and easy to maintain. In industries, they use presses and load appliers to bending applications Hence it is better to replace conventional machines by hydraulic pipe bending machine.

Prof R.V.CHAUDHARY et.al [3]The utility model discloses a full-automatic pipe bending machine. Whole machine is supported by a base with four supporting legs which has enough strength to carry the weight and force of machine. Two parallel shaft are clamped on base by clamps which carry the lower pulley. Pulley are driven by dc motor with chain drive mechanism. Pulley gets that motion from Lead screw is working as a nut and bolt mechanism. The lead screw is get rotary motion from upper

dc motor. Guide way and lead screw are fitted between two horizontal supporting plate, which are fitted on frame by the help of the two vertical parallel supporting plate

Prof. Nilesh Nirwan et.al [4] and Prof. A.K.Mahalle, has found a portable rolling pipe bending machine is used for reliability, easy convey and good quality purpose. But there is some difficulties like not used for mass production and slow process due to hand operated device. In this machine he can use the pullies as the dies for pipe bending.

Prof. A. Pandiyan et.al [5] has found a zigzag pipe bending machine is used for making zigzag profile pipe. It is operated by hydraulic bottle jack. This bending machine is only used for zigzag profile so, not used for other bending operations. In this machine we can use the hydraulic jack has bolted arrangement is not there. This only used for zigzag bending of the pipe. It is not used for the bending of the correct angles.

Sachin throat et.al [6] found a hydraulic operated bearing puller. It is a device which is to remove the bearing from the shaft by using the puller set up from supporting device. In this machines the press fit the operations are very complicated to align the assembly. It can widely be used. It is easy to fit on the bearing and removing. This can be effectively used removing the bearings.

M. Huae et.al [7] developed in this paper, an analytical model of to study the mechanics of continuous plate edge bending mode of the four roll bending process. Solving governing differential equation for the large deflections of an elastoplastic thin plate with an arbitrary strain hardening on the material.

Mohanraj G T et. al [8]found a "hydraulic operated bearing puller" is a device which provides easy removal of bearing from shaft with less human efforts by using the puller arrangement and supporting device. The hydraulic bearing puller based on hydraulic system which is working on the principle of Pascal's law which states that "Pressure distribution in enclosed cylinder is uniform in all direction traditional method of bearing removal is hammering but unnecessary hammering causes several problems. The unsafe and excessive hammering cause's damage to bearing surface or sometimes chance to failure and excessive human effort is required. In order to remove installed bearing safely, some modifications has made in traditional method. The purpose of modifications is to reduce human efforts, simplicity in operation and removing of bearing without damaging the bearing surface.

N.Saravanan et.al [9]is found the machine is to bend the rod at the specified dimensions which is used in the building construction which called as Stirrups. Stirrup is an important reinforced element which acts as a shear reinforcement. Presently, stirrups are made manually, which suffers from many drawbacks like lack of accuracy, low productivity and resulting into severe fatigue in the operator. In manual stirrup making process, operators not only subjecting their hands to hours of repetitive motion, but in many occasions it results into several musculoskeletal disorders (MSDs). The project is designed based on the principle of Hydraulic system. The hydraulic load has more power compare to the other type of loads like pneumatic and electric. By using heavy loads we can increase the productivity of the product. The manual stirrup making process suffers from the many draw backs

II. DESIGN CONSIDERATION:

Load capacity of hydraulic jack (W)= 5ton (50kN)
Operating Pressure (p) = 25.5 MPa
Stroke (L) = 5 cm
Man effort put on handle (e) = 20Kg
Permissible tensile stress of mild steel (6t) = 120 N/mm^2
No. of stroke for lifting load (n) = 150
Factor of safety = 5
Permissible shear stress of mild steel (τ) = 20 N/mm^2
Permissible comp. stress of mild steel (6c) = 20 N/mm^2
Permissible comp. stress of cast iron (6c) = 120 N/mm^2
Permissible shear stress of cast iron (τ) = 35 N/mm^2
Dimensions of handle which operates the hydraulic jack
Length of a handle (l) = 380mm
Internal diameter of handle (d1) = 19mm
External diameter of handle (d2) = 22mm

A. Design of bearing puller:

Puller plates dimension (l x b x t) = 150 mm x 45 mm x 4mm
Diameter of hole to the bearing shaft (D) = 24mm
Internal diameter of a bushing (di) = 15.2mm
External diameter of a bushing (do) = 18mm
Length of a bushing (l) = 28mm
Diameter of rods which passes through bushings (d) = 15mm
Side of a square rods (s) = 20mm
Length of a square rods (L) = 153mm

B.Design of pipe bender:

Length of pulley = 48mm
Internal diameter of the roller = 30mm

External diameter of the roller = 40mm
Thickness of a roller= 5mm
U shaped die with an angle = 800
Design:
Diameter of thread rods = 15mm
Diameter of circular plate = 220mm
Height of circular plate = 8mm
Diameter of a centre hole on a plate = 56mm
Thickness of a hexagonal nut = 3mm
Internal diameter of a hexagonal nut = 15mm
External diameter of hexagonal nut = 18mm
Height of a hexagonal nut = 10mm
Height of the threaded rods = 330mm
Components which are used for making the hydraulic machine with bearing puller & pipe bending are: Threaded rods, Hexagonal nuts, Square blocks, Square rods, Hydraulic jack, Pulleys, Bearing plates, Bushings, Circular rods without threading and Circular plate

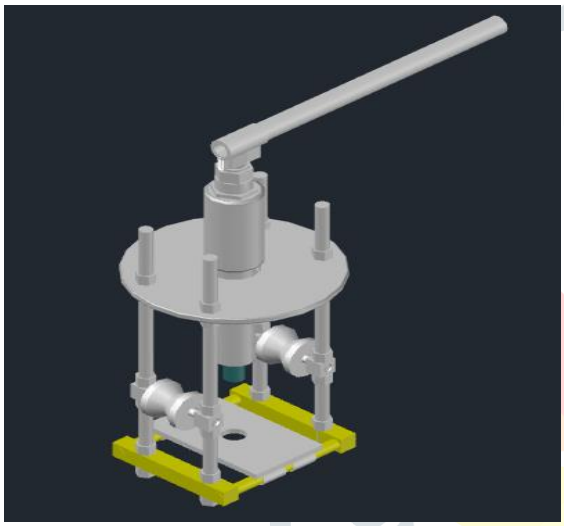

Fig.1: 3D model

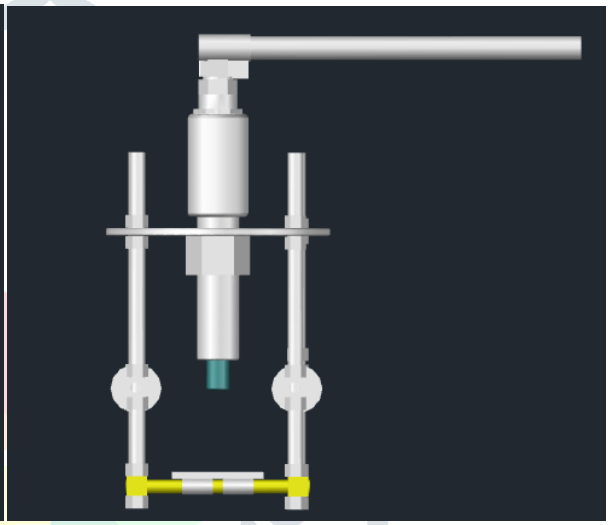

Fig.2: 2D model

III. FABRICATION

A. Bearing plates arrangement:

Fig. 3:Bearing plates arrangement

Fig. 4:Pipe bending arrangement

Fig.5:Total frame

First we can take the circular rods without threading then we can perform the turning operation at both ends of the two rods with the length of 30mm at both ends. We can remove the material about the thickness of 2.5mm. Then insert that rods in to the bushings. One rod in two bushings and another rod in another two bushings. Then place the bearing plate on two bushings which is locate on the each rod. Another bearing plate is place on another two bushings which are locate on the each rod. Then we will perform the welding operation in between the bushings and plates. Fig. 4 Take two rollers, place the bearings to both sides of the two rollers. After that take four square blocks with two holes on any two sides. Then by using small shaft we can fit the rollers the rollers in between the square blocks. One roller in between the two square blocks and another in between another two square blocks. We can fit these by using hexagonal nuts. These rollers are fit above the bearing pulling plates. Fig.5 Then we take a circular plate and make a hole on it. Because we pass the hydraulic jack from that hole. We can attach a die with internal threading that was made according to the external threading on the hydraulic jack. Then attach the die to the circular plate by using welding operation. Then fit the circular plate on the threaded rods by using hexagonal nuts. The above is the arrangement of the "Hydraulic machine with pulling & bending operations". This machine work on the principle of Pascal's law of hydraulics. In this machine we can do both the operations pull the bearing as well as bending the pipe.

B.Removal of bearing from the shaft:

At first bearing pulling operation. First we can fix the bearing in between the bearing plates. After that we place the hydraulic jack at the top of the set up. Then we can rotate the hydraulic jack until the pointer of the hydraulic jack is touched to the bearing shaft. After touching the bearing shaft we will operate the hydraulic jack by using handle. The hydraulic jack is operated by up and down motion of the handle. The handle will place at the top of the hydraulic jack. Then we can operate the hydraulic jack by pushing and pulling the handle. By apply this operation one small shaft is coming out from the hydraulic jack. The shaft which is coming out from the hydraulic jack is pushes the bearing shaft. The shaft is come out from the bearing after the application of force on it by hydraulic jack. Because the bearing is fitted with bearing plates and more force is applied on it with less effort. By applying the hydraulics we can generate more output with less effort. The above is the bearing pulling operation.

Fig.6: Pulling operations

Fig.7: Pipe bending

C. Pipe bending:

Fig.7 Pass a pipe in between the two rollers. Then adjust the hydraulic jack up to the some level. Then we attach a U shaped die with an angle of 80 degrees. Then again operate the hydraulic jack by using the pushing and pulling the handle. Then slowly the shaft is come out from the hydraulic jack and the load on the pipe then it will bent according to the angle of the die which we used.

D. Advantages of hydraulic machine with pulling and bending operations:

- We can perform two operations on a single machine.
- This machine can generate and transmit large tons of force.
- Power to weight ratio is higher in hydraulic system.
- It does not damage the surface of the bearing and shaft.
- Capital cost and maintenance costs are low.
- It can easily transfer from one place to another place.
- These operations are safe operations.

- In hydraulics, we can generate more power with less effort.
- The construction of the machine is very simple.
- We can easily assemble and disassemble the components in machine.
- We can easily operate and handle this machine.
- There is no power source for this machine.
- To increase the accuracy of the product.
- It can reduce the effort of man.
- By using this machine, we can reduce consumption of time.
- This machine can produce the uneven shaped pipes and products.
- It can remove the bearing from the shaft safely without damaging the bearing surface and shaft.

E.Disadvantages of hydraulic machine with pulling and bending operations:

- We cannot use this machine for operations are required higher force than the hydraulic jack.
- Chances of leakage is high.
- Special treatments required from corrosion, dirt etc.:
- Ageing and chemical deterioration ,cause chances of disintegration.

FApplications of the hydraulic machine with pulling and bending operations:

- The application of this machine is in both the fields of which the hydraulic bearing puller & hydraulic pipe bending machine.
- Material handling field-for shipping and maintenance departments.
- Construction field-earth moving operations & construction of buildings.
- Automobile industries use them for assembling and transferring body parts.
- Naval industry-uses them for cargo handling.
- Other prominent industries like agriculture, aviation and aerospace industries use these pullers.
- Building construction (Windows, Trusses, Interior decoration)
- Furniture's (Beds, Hospital equipment's, Wheel chairs)
- Automotive (Exhaust, Seat frames, Stabilizers)
- Chemical Plant- Petrochemical Plants.
- Dismantling transmission parts, such as bearings, couplings, bushes, gear wheels, etc.

III. CALCULATIONS

Sample calculations:

Operating pressure of hydraulic jack is

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

$$P = F/A$$

The total force excreted by hydraulic jack is 5tons.

we know that 1ton = 10KN

1KN = 1000N

Therefore 10KN = 10 x 1000N

= 10,000N

Then 5tons = 50KN

= 50*1000N

= 50,000N

The force of hydraulic jack in newtons (F) = 50,000N

Diameter of the cylinder of the hydraulic jack (d) = 50mm

Area of the cylinder of hydraulic jack is (A) = (π x d2)/4

= (π x 502)/4

= 1963.495mm2

Pressure (P) = F/A

P = F/A

= 50,000/1963.495 = 25.5 N/mm2

"The operating pressure of the hydraulic jack (P) = 25.465 N/mm2"

Pressure excreted on the bearing in the pulling operation is

$$P = F/A$$

Here area (A) = sum of the cross-section area of the cylinder in the hydraulic jack (A1) & cross section area of the pushing die on the bearing (A2)

The cylinder area (A1) = 1963.495

The area of the pusher die (A2) = (π x d22)/4
The diameter of the pusher die (d2) = 10mm
A2 = (π x 102)/4 = 78.539 mm2
A = A1+A2
= 1963.495+78.539= 2042.034 mm2
Pressure on the bearing is P = F/A
= F/(A1+A2)
= 50,000/2042.034= 24.485 N/mm2
Therefore, pressure excreted on the bearing by hydraulic jack in pulling operation is P = 24.4 N/mm2
Pressure excreted on the pipe during bending operation.
Here also we the same formula to find the pressure. P =F/A
Here also area (A) = A1+A2
Area A1 = cylinder area
Area A2 = area of the angular die
Area of the angular die (A2) = r x β
Here β is the angle of the die = 800
The above angle is in degrees (0) but we convert that in to radians by multiplying that to π/180
Radians = (80 x π)/180
= 1.396 rad
Angle β = 1.396 rad
And 'r' is the radius of the bend = 50mm
A2 = 50 x 1.396= 69.81 mm^2
Area (A) = A1+A2
= 1963.495+69.81 = 2033.305 mm^2
Pressure P = F/A
= 50000/2033.305 = 24.6 N/mm^2
Therefore the pressure excreted on the pipe from the hydraulic jack in bending operation is P = 24.6 N/mm^2

IV CONCLUSION

In order to remove bearing safely, to make modification in traditional method. The purposes of modification are Simplicity of operation, removing and installation of bearing done without damaging bearing surface. This research has provided an excellent multiple operation without damage of work members, the particular pipe bending and bearing pulling operations. Thus if perform any press operations using die and punch, than arable having a provision to hold a die can be used and corresponding punch can be fixed to the ram end

REFERENCES

[1] A.V. Vanalkar Design and Fabrication of Hydraulic Bearing Puller and Pusher IJIRST –International Journal for Innovative Research in Science & Technology| Vol 1 | Issue 11 | April 2015ISSN (online): 2349-6010..

[2] Mohan Krishna S. A. Experimental Design And Fabrication of A portable Hydraulic Pipe Bending machine, International Journal of Development Research ISSN: 2230-9926Vol. 4, Issue, 12, pp. 2681-2684, December, 2014.

[3] Prof R.V. Chaudhary Design And Development of Pipe Bending Machine. ISSN : 2249-5770..

[4] Prof. Nilesh Nirwan and Prof. A.K. Mahalle, Department of Mechanical Engineering, G.H. Raisoni college of engineering Nagpur has found a Portable Rolling Pipe Bending Machine.In april,2013..

[5] Prof. A. Pandiyan Department of Mechanical Engineering, of Saveetha School of engineering Chennai has found a Zigzag Pipe Bending Machine In Nov, 2015.

[6] Sachin throatdesign of a hydraulic operated bearing puller International Journal of innovation in Engineering and Technology,Vol.2 Issue 2 April 2013 ISSN:2319-1058..

[7] M. Huaeto study thecontinuous plate edge bending mode of the four roll bending process1997. Serope, Manufacturing Processes for Engineering Materials, Addision Wesley, USA, Edition 3..

[8] Mohanraj G Thydraulic operated bearing pullerInternational Journal for Innovative Research in Science & Technology| Volume 2 | Issue 11 | April 2015ISSN (online): 2349-6010..

[9] N. SaravananDesign and Fabrication of Hydraulic Rod Bending MachineInternational Journal of Innovative Research in Science, Engineering and Technology An I SO 3297 : 2007 Certified Organization, Vol.3 , Special Issue 2 , April 2014 Second National Conference on Trends in Automotive Part s Systems and Application s(TAPSA- 2 0 1 4) On March.