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Hydraulic Bending Machine

#1Dr.S.S.Nehe, #2Pramod Balasaheb Adsul, #3Omkar Savleram Devkar, #4Onkar Dhananjay Jagtap, #5Kirti Kashinath Kapde

2p.adsul143@gmail.com
3omkardev30@gmail.com
4onkarmech9765@gmail.com

#12345Department of Mechanical Engineering

JSPM's Bhivarabai Sawant Institute of Technology and Research, Wagholi, Pune.

ABSTRACT

The main aim of our project is to design and fabricate the hydraulic bending machine. The most important component used in this is hydraulic Jack which is used to bend the sheets or pipes. This hydraulic operated equipment is used in different fields. In Automobile industry, these hydraulic jacks are used for greasing the job. Hydraulic bending machine consists of Vice, hydraulic jack, wiper motor. Actuation of hydraulic jack is simple and reliable to maintain. These hydraulic bending machines are more reliable, portable and easy to use in Industry. Hence, we are developing hydraulic bending machine.

The 3D model will be drawn with the help of CATIA software. The components will be manufactured and then assembled together. After making the assembly of all components, the Experimental testing will be carried out. After the experimental testing, the result & conclusion will be drawn.

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I. INTRODUCTION

A **bending machine** is a forming machine tool (DIN 8586). Its purpose is to assemble a bend on a workpiece. A bends is manufactured by using a bending tool during a linear or rotating move. The detailed classification can be done with the help of the kinematics.

CNC bending machines are developed for high flexibility and low setup times. Those machines are able to bend single pieces as well as small batches with the same precision and efficiency as series-produced parts in an economical way.

Universal bending machines consists of a basic machine that can be adjusted with little effort and used for a variety of bends. A simple plug-in system supports quick and easy exchange of tools.

The basic machine consists of a CNC-operated side stop, a work bench, and software for programming and operating. Its modular construction offers an affordable entry into the bending technology, because after an initial investment the machine can be customized and extended later without any conversion. That means the basic machine delivers a bending stroke, and the tool determines the kind of bending.In the case of bending tools, they are classified by the kind of generated bends. They can be constructed to adjust the bending angle by reference, stroke measurement or angle measurement.

CNC machines usually abstain from a reference part. They grant a high bending accuracy starting with the first work piece.

Standard bends

Fig. 1 Standard bending with a universal bending machine

All bends without an extraordinary geometry belong to standard bends. The distance between a bend and the material end is quite high providing an adequate bearing area. The same with one bend to the next.

Typical tools are a so-called bending former combined with a prism with electronic angular measurement or an ordinary prism.

U-bending

For U-bends where tight and narrow bends are necessary, the bending former is replaced by a bending mandrel. A bending mandrel has a narrow geometry.

Offset bending

Offset bending tools are used to assemble two bends with a small distance between in one step.

Edgewise bending

Edge bending tools are used if the bending axis is placed parallel to the tight side of the work piece. Tools for bending on edge may include electronic angular measurement allowing a high bending accuracy.

Torsion bending

Torsion tools are able to rotate the workpiece on the longitudinal axis. Alternatives are complex assembly groups with standard bends.

Angular measurement and spring back compensation

For producing single pieces as well as small batches with the same precision and efficiency as series-produced parts, a spring back compensation is helpful. A bending accuracy of +/- 0.2° starting from the first work piece is achieved due to calculated spring back compensation and the use of electronic tools.

Operating mode angular measurement

Bending prisms with electronic angular measurement technology are equipped with two flattened bending bolds. That bold rotate while bending giving a signal to the angle measurement. The measuring accuracy is about 0.1º. The computer then calculates the required final stroke and spring back of every bend is compensated regardless of material type. A high angle accuracy of +/- 0.2º is achieved instantly with the first workpiece without adjustments. Compared to adjustment by reference, material waste amounts are decreased, because even inconsistencies within a single piece of material are automatically adjusted.

Operating mode stroke measurement

Wherever bending prisms with electronic angular measurement are not suitable, a small distance between the bends might be a reason, bending prisms without electronic angle measurement are applied. In that case the control unit can be switched from angular measurement to stroke measurement. This method allows the pre-selection of the stroke of the bending ram in mm and therefore the immersion depth of the punch into the prism. Setting accuracy is +/- 0.1 mm. A final stroke is usually not required. Further development of the stroke system enables the user to specify an angle from which the stroke is calculated by using stored stroke functions. Bending accuracy in that case is dependent on material properties such as thickness, hardness, etc. which may differ from one work piece to another.

Programming and principle of operation

Fig. 2 Graphical user interface of a bending machine

Programming is done on a PC equipped with dedicated software, which is part of the machine or connected to an external workstation. For generating a new program engineering data can be imported or pasted per mouse and keyboard. Through a graphic and menu-driven user interface previous CNC programming skill are not required. The software asks for all necessary values and checks all figures. Inputs can be corrected at any time and minimum distances are checked instantly to guard against improper inputs. The software automatically calculates the flat length of each part being bent and determines the exact position of the side stop. The part is shown on a screen.

Ideally each program is stored in one database, so it is easy to recover them by search and sort functions.

II. LITERATURE SURVEY:

Investigation methods for analysis of transient phenomena concerning design and operation of hydraulic-machine systems—A review Deyou Lia, Xiaolong Fua , Zhigang Zuob, Hongjie Wanga, Zhenggui Lic , Shuhong Liub , Xianzhu Wei

Over the past decade, the use of conventional one-dimensional numerical-simulation methods has been demonstrated to be inadequate in terms of their usefulness in investigations concerning transient processes in hydraulic machines systems—their theoretical analyses and engineering applications. Consequently, numerous three-dimensional numerical methods capable of accurately simulating transient processes in hydraulic-machine systems have been proposed and improved upon in recent years. Through use of these novel methods and strategies, many researchers have investigated transient characteristics of processes occurring within hydraulic machine systems along with corresponding formation mechanisms. This study presents a comprehensive review of related experimental studies, novel numerical methods and strategies along with transient characteristics and formation mechanisms in hydraulic-machine systems. Based on this study, suggestions have been made concerning the selection of simulation methods to be used and directions for future research have been proposed.

Experimental investigation of energy saving opportunities in tube bending machines Paolo Albertellia, Matteo Stranoa, Michele Monno

In the scenario of containing the global warming, devising energy savings strategies in industry has become a proper and urgent matter. Since manufacturing is one of the most energy demanding sectors, research and the linked industries started tackling this issue proposing new eco solutions. In this paper, an experimental investigation of the energy saving opportunities in tube bending machines is performed and critically discussed. The analysis is carried out comparing an electrical tube bender and a hydraulic machine of comparable size. The experimental measured are also used to fit energy models that are used to extend the comparison considering different working conditions of the tube bending machines. The results show that relevant energy savings can be achieved introducing the electrical drives.

Tube bending machine modelling for assessing the energy savings of electric drives technology Paolo Albertelli, Matteo Strano

The aim of the work is to carry out a comprehensive analysis of the energy saving opportunities offered by the introduction of electric drives in the rotary-draw tube bending technology. Although there is a clear industrial trend towards the replacement, especially for low tonnage forming machines, of the traditionally adopted hydraulic drives, there is a lack of scientific research that has studied its implications on energy consumption. For this purpose, an energy model for tube bending machines was developed. The parameters of the model were identified exploiting experimental power measurements performed on both a hybrid hydraulic-electric and a fully electric machine. The energy saving analysis was carried out through the updated energy models. For sake of generality, the analysis was extended considering various tube material-diameter combinations and different machine working conditions. The results showed that relevant energy savings can be obtained and that the improvements are affected by the machine throughput. It was also observed that the minimum achievable energy saving is significantly higher (at least three times) than the energy share for processing the tube. An efficiency analysis of both types of machines was also reported. The introduction of the electric drives allows increasing the machine efficiency up to 50 percentage points. This achievement slightly decreases with the increment of the rotary-draw bending machine throughput.

DESIGN AND FABRICATION OF HYDRAULIC BENDING MACHINE Pankaj Kumar Pandey, Arjun Kumar Nishad, Alok Mishra, Dinesh Kumar Gupta, Faisal Ali Ansari

The hydraulic metal bending machine is planned to do bending activity for utilizing a hydraulic power pressure. This bending machine bends a small piece of sheet metal, plates, pipes, bars, rods. The motto of this project is to develop a portable low-cost bending machine. This project comprises of a hydraulic jack, pedestal bearings, basic casing, driving and driven rollers, metal shaft, nut and bolts. The fundamental favourable position of our venture is Metal bar are twist fit as a fiddle (U-shape, circle twist) constantly and less human exertion in task.

FABRICATION OF AUTOMATIC HYDRAULIC BENDING AND BEND REMOVING MACHINE Mr. Harshad Khairkar, Mr. Dhananjay Kopre, Mr. Saurabh Kalkar, Ms. Dipali Kambe, Prof. Sarang Gulhane

The foremost aim of our project is to fabricate a hydraulic operated jack for the purpose of pipe bending and bend removing machine. Hydraulic operated equipment’s are used in different fields. In an Automobile hydraulic jack is raised for greasing job. Stepping on the brake pedal creates the hydraulic power, which stops the rotation of the four wheelers or two wheelers to stop. In order to remove the bend of pipes, rods and bars hydraulic bend removing machine is the most suitable equipment. To remove bends from pipe or rod to be supported between the die holders and jack is actuated on pipe. It exerts force on the pipe and bends it to the suitable angle depending on the dies used. Hydraulic bending machine is consisting of hydraulic jack, die holder, pulley, slider, wiper motor, and spring. Actuation of hydraulic jack is simple and reliable to maintain. In industries, Hydraulic bending and bend removing machine is portable, it is a flexible and less expensive. Hence it is better to replace conventional machines by hydraulic pipe bending and bend remove machine automatic operated bending machine requires no maintenance and power utilization. During mass production it can be converted into automated or electrically operated jack so that the rate of production can be increased. Applications of bending machines are found to be in production industries, workshop automobile etc. now a day focusing into automation. this project is aimed to bending pipe operation of by using automatically with help of wiper motor.

III. METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about Hydraulic Bending machine.

Step2: - After that the components which are required for my project will be decided.

Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of CATIA software.

Step 4: - The components will be manufactured and then assembled together.

Step 5: - The Experimental Testing will be carried out.

IV. DESIGN MODEL

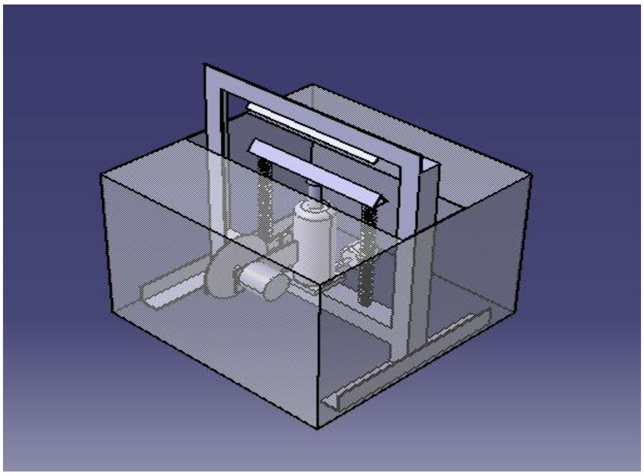

Fig. 1 CATIA Model

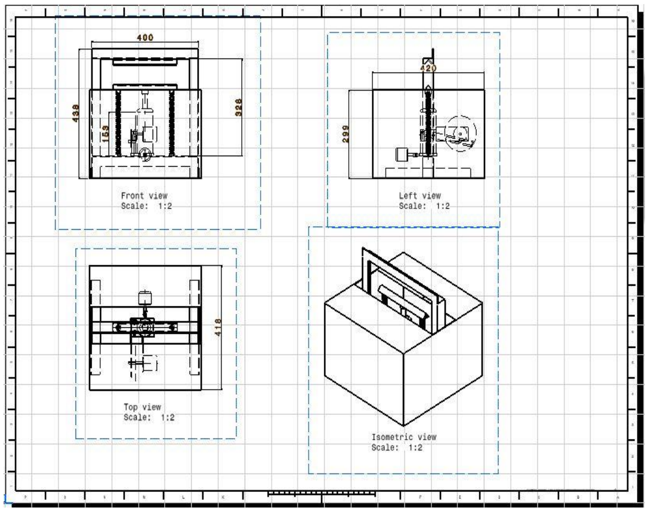

Fig. 2 Drafting of Model

V. CALCULATION

CALCULATIONS:

MOTOR SPECIFICATIONS:

Voltage = 12V,

Current = 5Amp

Speed = 10 RPM

We know that, P = V*I = 12*5 = 60Watt

$$P = \frac{2*\pi*N*T}{60}$$

$$60 = \frac{2*\pi*10*T}{60}$$

T = 57.3Nm

SPRING CALCULATIONS:

Given data: -
Material = M.S.
Load = 200 N $\tau = 0.62*400 = 248$ N
Deflection = 12 mm $G = 78 \times 10^3 \ N/mm^2$
Spring index, c = 5

(1) Stiffness of spring (k) is given by;

K = Load/deflection, $k = w/\delta$
Hence,
K = (200/12 =) K = 16.67 N/mm,

(2) Spring index is given by ;
C = D/d,
D=C×d………………………………… (1)

(3) Shear stress factor is given by ;
$K_s = 1 + 1/2C$,
$K_s = 1 + 1/(2\times8)$,
Hence,
Ks = 1.1

(4) Resultant of shear stress is given by ;
Find the value of {D & d},
$\tau = (8\times W\times D/\pi \times d^3)\times K_{S,}$
$\tau = (8\times W\times C\times d/\pi \times d^3)\times K_{S,}$
$\tau = (8\times W\times C/\pi\times d^2)\times K_{s,}$

$248 = (8\times100\times5/\pi\times d^2)\times1.1$,

$d^2 = 5.45$ mm,
d = 2.33 mm = 3 mm,
D = d×C,
D = 5*3 = 15 mm,

(5) Deflection is given by;
$\delta = (8\times W\times D^3\times n)/(G\times d^4)$,
$\delta = (8\times W\times C^3\times d^3\times n)/(G\times d^4)$,
$12 = (8\times100\times5^3\times n)/(78\times10^3\times5)$,
n = 46,
No. of active coil n = 46,
Hence,
Assuming Square & Grounded side spring;
Total No. of Coil = n+2;
Hence,
n' = 46 + 2 = 48,

(6) solid length of spring ;
$L_s = n'\times d = 48\times3 = 144$ mm,

(7) Free length of spring ;
$L_f = L_s + \delta_{max} + .15\times\delta_{max}$;
$L_f = 144+12+[0.15\times12]$,
$L_f = 158$ mm,

(8) Pitch of coil;
P= Free length /(n'-1),
P = 158/(48-1) = 3.36 mm,

HYDRAULIC JACK:

DESIGN CONSIDERATIONS& METHODOLOGY:

- Load (W) = 03 ton(30kN)
- OPERATING PRESSURE (p) = 14 M Pa
- Lift range (L) = 12 cm
- Man effort put on the handle (e) = 20 Kg
- Permissible tensile stress of mild steel (σt) = 120 N/mm2
- No. of strokes for lifting load (n) = 40
- Factor of safety = 5
- Permissible shear stress of mild steel (τ) = 20 N/mm2
- Permissible compressive stress of mild steel(σc)= 20 N/mm2
- Permissible compressive stress of cast iron (σCI) = 120 N/mm2
- Permissible shear stress of cast iron (τCI) = 35 N/mm2

DESIGN OF PLUNGER CYLINDER:

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

DESIGN OF PLUNGER CYLINDER:
Let, dp= inside dia of plunger cylinde = 8 mm
Dp = outside dia of plunger cylinder
tp = thickness of plunger cylinder
Assume the thickness of plunger cylinder (tp) = 5 mm
Tensile strength of mild steel (σt) = 120 N/mm2

By LAME 'S equation
t = 5+ 5.0625(25 - 1)
126.5625 – 5.0625 +5.0625 = 126.5625 – 25
6.0625 = 101.5625 = 16.752 N/mm2
Hence the induced tensile strength of M.S. is less than permissible value.
So, the design is safe.
By using thickness and inside diameter, we can calculate the outer diameter of plunger cylinder Dp =dp + 2t = 8+2(5) = 18 mm
Outer diameter of plunger cylinder (DP) = 18 mm

VI. CONCLUSION

The hydraulic bending machine is developed which will bends the sheets easily with the help of hydraulic jack. This will reduce the human efforts.

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