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STUDY OF PORTABLE 3 ROLLER PIPE BENDING MACHINE

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ABSTRACT

The aim of this paper is to develop a pipe bending machine which is useful to bend a pipe in workshop . This project is to design and construct a portable pipe bending machine. This machine is used to bend steel pipes into curve and the other curvature shapes. The size of machine is very convenient for portable work. It is fully made by steel. Moreover it is easy to be carry and use at any time and any place. It reduces human effort and also required low less skill to operate this machine. We are designing manually operated pipe bending machine with use of pulley, motors, gears and support (frame). The pipe bending machine is power and manually both operated. Therefore, our objective is to increase accuracy at low prize without affecting the pipe bending productivity.

This machine works on simple kinematic system instead of complicated design. This machine can bend up-to 4-5mm thickness of pipe. Due to its portability it can be used by small workshop or fabrication shop. Bending machine is a common tool in machine shop that is used to bend a metal. It is widely used in various industrial operation such as bending a pipe in required shape & size. In this project, designing a bending machine specifically for portable pipe bending machine. There is no proper small scale bending machine for bending a pipe.

Keywords; Roller attachment , chain& sprocket attachment,pipe bending,motor,gear.

I.INTRODUCTION

This study is about the work of designing a bending machine to bend a pipe. A bending is a process of bending a metal. The metal can be a sheet metal, tubes, square hollow, rod, and iron angle. This type of metal has its own thickness. The bending machine designer will take into consideration a number of factors including type of metal, type of the roller bender, power driven or manual and the size of the bending machine. Usually, the difference of these types of bending machine is only on the capacity of the bending machine that can bend a sheet metal or tube. Today, the bending machine that available in the market is for the sheet metal and tube bending machine. Many machine makers vary their products based on the capacity of the bending machine and power driven or manual. Moreover, most of the machine uses roll bending type. This type of machine has 3 rolls which is 1 roll is fixed and the other 2 are adjustable. The metal pipe needs to put in the roller and then

rolls around it until the desire shape is acquired. The products that can be produced with this machine are various curves, structural elements, automobile parts etc.

Hiroyuki goto,Ken ichiru, Hidenobu saitro, Yuu ishikura,and Yutaka tanaka[2]. This research presents a new flexible bending machine and its practical applications. The proposed machine uses a new method. When tubes are fed into the fixed and mobile dies, they are bent by shifting the relative position of the mobile die. The bending radius is controlled by the relative distance and orientation between the mobile die and the tube.

1.1 Roller for bending pipe

To give the required shape and size, roller is used. Primary function of the roller is to achieve angular shape to the pipe. This is done through screw which apply pressure on roller and also this roller achieved rolling action by using an AC motor .

1.2 Functions of Bending Machine

1. To bend a pipe having thickness upto 5 mm in required angular shape.
2. To provide curvature shape to pipe.
3. Machine is convenient for portable work.
4. The machine is power operated to achive maximum accuracy in less time.

1.3 Roller requirement

1.Roller should be very accurate and easy to handle.

2. The effort required to bend pipe should be minimal.

3. The rolling attachment should also provide directional stability. This implies that the pipe should have a tendency to move to & fro.

1.4 Pipe Bending Machine

A roll bending machine uses roller to bend a metal. The roller of bending machine can be two rollers, three rollers, or four rollers. The common product of roll bending machine are tube bending, plate bending and a coil. All modern roll bending machine is power driven and some of the bending machine equip with electronic control for more. During the roll bending process the pipe extrusion, or solid is passed through a series of roller(typically 3) that apply pressure to the pipe gradually changing the bend radius in the pipe. The pyramided style roll benders have one moving roll, usually the top roll. Double pinch type roll benders have to adjustable rolls, usually the bottom rolls, and a fixed top roll this method of bending causes very little deformation in the cross section of the pipe. This process is suited to producing pipe which is in require shape as well as long gentle bends like those use in making structure of pipe.

1.4.1 Reason To Design A Pipe Bending Machine

The reason to design a bending machine for pipe bending is because there is no proper bending machine to bend a metal pipe for small scale. The bending machines found in the market come from variety of types. There are bending machine such as press brake bending machine, roll bending machine and a folding machine. Moreover, the design for the bending machine for pipe bending is to bend a metal pipe. It produces sheet metal bending with desire degree of bending except 90°. Other reason regarding to the bending machine design, the bending machine in the market come with big size and the bending machine is expensive. The existing bending machine in the market is created for huge capacity for bending a metal pipe. With the capacity of bending machine that exists in the market, the existing bending machine is not fulfilling the requirement of the usage. The requirement of operation of bending machine is simple. Thus it is not suitable to purchase existing bending machine to be used for simple bending machine operation. Moreover, the machine is heavy and use up a lot of space. In addition, the problem will arise when to move and put the bending machine due to heavy and space.

II. MATERIALS AND CONSTRUCTION:

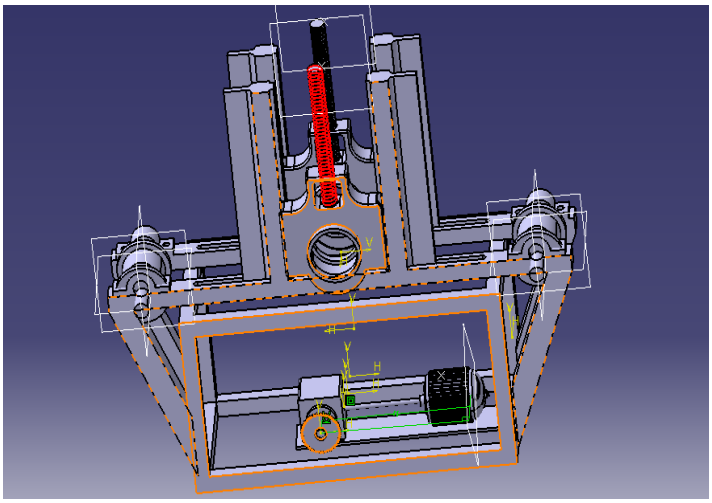

Fig.Pipe bending machine diagram

Basic components

The basic construction and main components of portable 3 roller pipe bending machine is given below,

2.1 Basic Frame

The hollow square pipes of material of mild steel are selected for the frame. The pipes are cut into required size by cutting machine. The end of the pipes cut into 45 degree(angle) to form rectangular frame. After cutting, the end of the square pipes is grinded so that it became smooth and convenient for welding. The square pipes are welded together to form a rectangular basic frame.

2.2. AC Motor:

Electric motor is machine which convert electric energy into mechanical energy. Is action is based on the principle that, when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force

whose direction is given by Fleming's Left Hand Rule. Here we use AC motor of 1 HP having speed of 1440 rpm.

2.3.Roller:

In this project the roller is used to bend a pipe in angular shape. There are 3 rollers are used to bend a pipe in curvature shape.Roller is a cylinder that rotates about a central axis and is used in various machines and devices to move, flatten or spread something. A roller always consist a bearing

2.4. Sprocket & chain:

In this project sprocket & chain are used to give rolling motion to the roller and due to it, pipe moves over the roller. One sprocket is connected at motor end and other is connected at middle roller end to give the rolling motion to middle roller.Chain drives is useful for effective power transmission choices.

2.5. Screw rods:

This attachment is used for apply a pressure on pipe which is used for bending purpose. The screw have achme threads which can sustain high torsional stresses against high load. The diameter of screw rod is designed by using formules of "Power screw".

2.6.Pedestal bearings:

Pedestal bearing are used to give easy& convenient motion to roller by using shafts which is attach to roller.

III. CALCULATIONS AND EQUATIONS:

Material of shaft having roller is Mild steel C40, whose properties are given bellow.

Yield strength(σ_{et}) = **320 Mpa**

Ultimate strength(σ_{ut}) = **620 Mpa**

Young Modulus = **200 Gpa**

Asumming that pipe to be bend is simply supported beam with load at centre as given bellow

Cross section of pipe is given bellow

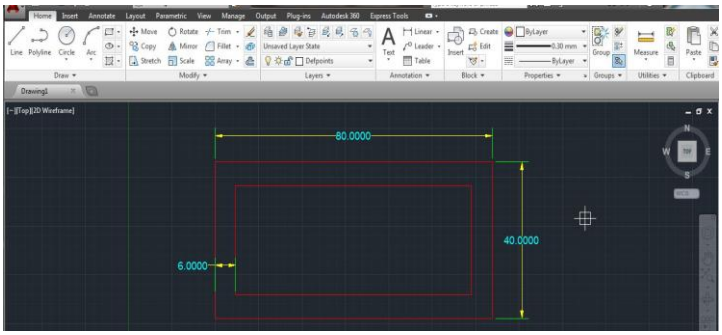

Fig. Cross section of square pipe

Force requried to deflect above beam by 10 mm at the centre, so from bellow equation we can find power requried to bend the pipe of above cross section.

$\delta(max) = P*l^3/ 48\ E*I$ or $P= 48\ E*I*\delta(max) / l^3$

From above equation we get Power, **P= 30 KN**

Now, Tension in chain of chain drive at big end can be calculated from bellow equation,

Total load on driving side= Tangential force(F_T)= Power transmited/ speed of chain drive

$F_T = P_{in}/ V$, where $V=r\omega$

From above equation we got tangential force, **F_T= 2783.58 N**

This force F_T will exert torque on shaft, $T= F_t* r$, **$T= 222.7 * 10^3$ N mm**

Now, Force bending diagram of roller shaft is given bellow,

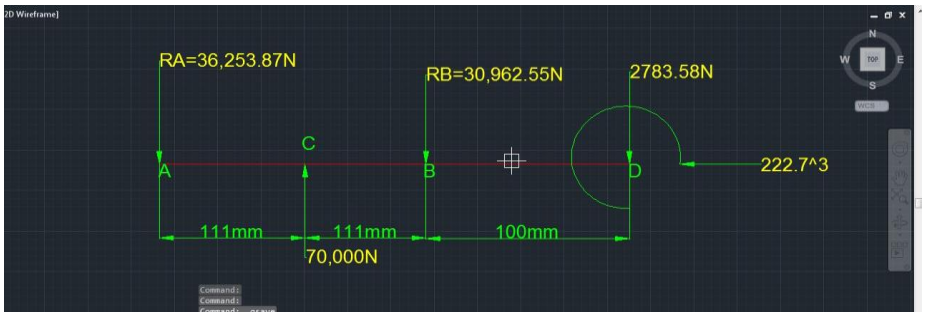

Fig. Force bending diagram for shaft on which roller is mounted

By solving above FBD using equillibrium formulae and Bending moment formulae we got Maximum bending moment which is at load point C.

So, **M_c = 278359.14 N mm**

Now, As per ASME code,

$\sigma = 0.6 * \sigma_{et} = 0.6* 320=$ **192 Mpa**

$\lambda = 0.30* \sigma_{et} = 0.3* 320=$ **96 MPa**

From equillibrium torque theory,

$T_e = \sqrt{[(M*K_m)^2 + T^2]}$

From above equation we got equillibrium torque **T_e= 2715416.93 N mm**

But it is also given as,

$T_e = \pi*\lambda*d^3 / 16$

From above equation, we got diameter of shaft, **d= 52.42 mm**

Selecting standard diameter for shaft on which middle roller is mounted is **55 mm.**

IV. WORKING

The three roll push bending is the most commonly used free form bending process to manufacture bending geometries consisting of several plane bending curves. The profile is guided between bending roll and supporting rolls, while being push through the rolls. The position of the forming roll defines the bending radius. The bending point is the tangent point between tubes and bending roll to change the bending plane, the pusher

rotate the tube around its longitudinal axis. The process is very flexible. The machine is power operated to increase accuracy at low prize without affecting the pipe bending productivity.

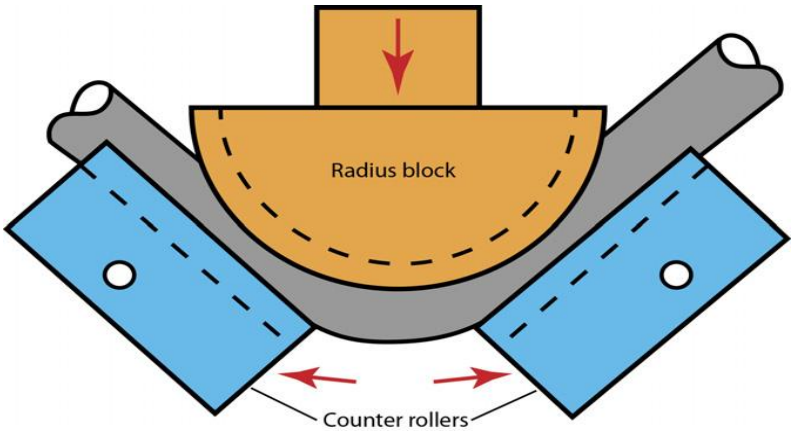

Fig.Pipe Bending

V. RESULTS

According to research of various working areas this machine is useful for bending a pipe.

VI. FUTURE SCOPE

The scopes of the study are encompasses investigation of the difficulties in portable metal pipe bending machine. The investigation is starting with stating with the problem statements. The idea of designing a bending machine can be seen clearly through the problem statements, which is a solution of designing a bending machine can be generated to encounter those problems. From this investigation, a literature review can be conducted. In the literature review, it will discuss about the reason to design a bending machine for pipe bending, the comparison of existing bending machine, classification of bending machine, working principle of bending machine, etc.

VII. CONCLUSION

Such type of bending machine more important for small scale work as well as industrial work in less cost and more precision and accuracy of different type of pipe bending. The machine capacity can be increased according to the need.

Manual bending tends to minimize wrinkles and can reduce springbuck. By its design the defects can be easily overcome. Simpler design not only reduces the defects but also contributes to fluid pressure test during bending. It should be noted the tendency to wrinkle and the cross section of tube deformation are reduced. Thus, this approach can be used for bending a thin walled tube over a small radius of the die, which can be achieved with a conventional method of bending the tube. In this paper, the problem of bending and axial stretching the internal pressure is investigated using the machine coordinate system (CMM) measurement. The objective of the study is to develop a tool that accurately predicts the change of the wall thickness and the cross-section of the tube distortion under different loading conditions.

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