DESIGN AND FABRICATION OF BENDING WITH TWISTING & CUTTING MACHINE

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ABSTRACT

Bending machine is used to bend a metal sheet, plate, rod and pipe. The aim of this project is to develop a metal bending machine. This machine is used to bend sheets into curve and the other curvature shapes and twist the plate. Circular ring are made manually, which suffers from many drawbacks like lack of accuracy, low productivity and resulting into severe fatigue in the operator. There are two different machines available in market for bending of bar, pipe and twisting of plate. There is no single machine available which bends sheet as well as pipe in a single unit and also twist plate. We develop a machine which performs bending and twisting operation on single machine. It reduces human effort and also required low less skill to operate this machine. We are designing bending with twisting machine with use of roller, motor, gear& support (frame). There are 3 roller used in bending machine. We are arrange separate attachment of die is provided, for twisting. During the roll bending process the sheet or plate or pipe is passed through consecutive rollers that gradually apply pressure on pipe. Because of this pressure the change in radius of pipe or sheet occurs.

Keyword: - *Roll Bending1, Twisting2, Motor3, and Gear4 etc….*

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1. INTRODUCTION

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis. Bending is a flexible process by which many different shapes can be produced. Standard die sets are used to produce a wide variety of shapes.
Roll forming, roll bending or plate rolling is a continuous bending operation in which a long strip of metal (typically coiled steel) is passed through   consecutive sets of rolls, or stands, each performing only an incremental part of the bend, until the desired cross-section profile is obtained. Roll forming is ideal for producing parts with long lengths or in large quantities. There are 3 main processes: 4 rollers, 3 rollers and 2 rollers, each of which has as different advantages according to the desired specifications of the output plate.

1.1 Literature review

Dhaval T. Sutar explain the design and development of automatic pipe bending machine. It is used for automobile and industrial purposes. It reduces human efforts and also require less skilled operator. This pipe design provides the precise location of work piece thereby increasing the accuracy of operations provisions are also made so as to reduce the vibrations and eliminate damage to the work piece. [1]
Akbar H. Khan gives the brief description about the design and constructions of pipe bending machine which is used to bend metal pipes into curve and other curvature shapes, the size of machine is very convenient for portable work. They designed manually operated pipe bending machine with the use of dies, gear and support (frame).Their objective is to increase accuracy at a low price without affecting the pipe bending productivity. [2]
P. N. Awachat the bar bending machine required a torque of 74.27 N-mm to bend 12 mm bar and stress is0.21 N/mm2. motor of 3 Kw power is capable of bending it saves man hour inputs for data handling, processing, programming the NC machine enabling just in time delivery due to elimination of errors and improved communication.it is a portable machine as it does not contain any compressor or storage tank.[3]

1.2 Objective

- To make the bending machine to bend metal bar and plate up to 12 mm and 2mm respectively.
- To make the machine with minimum initial investment and less maintenance cost.
- To reduce the time for operation by making with simple working principle.
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2. Construction and working principle

Roll bending machine also been called rounder and roller machine, which is universal forming equipment for rolling metal plate into cylinder, curved and other shapes. According to the principle of three-point forming circle, the relative position change and rotational motion of the working roll make the metal rod or pipe produce continuous plastic deformation to obtain the predetermined shape of the work piece. It is widely used in boiler, petroleum, metal structure, machinery manufacturing industries and automobile industries.

See below figure, 3 roller bending machine usually take two lower roller as active roll, can realize forward and reverse rotation. One upper roller is a follower roll, can move vertically up and down. When rolling bar or plate is placed between the upper and lower rollers, and the three cutting points that are exposed to the metal bar by three rolls can make the plate bend into a curved or closed circle. Therefore, the forming process of bar or plate metal can be regarded as the three-roll bending machine to make a continuous three-point bending process. During processing, one end of the metal plate or bar is feed into three-roller plate between the upper and lower roller, and then top roller bring downward displacement on the metal plate by using hydraulic jack, which make the plate or bar under it generate a certain plastic bending deformation due to compression. When the roller is rotating, there is friction between the plate and the roll, so when the roll is rotated, the plate also moves along its longitudinal direction. Lower roller under forward & reverse rotation alternately, and rolled plate move back and forth, one upper roller rotation and the friction drive plate and roller move. When stress exceeds the yield limit, it will produce plastic deformation, plate obtained the plastic bending deformation along the full length, and processed into the required shape.
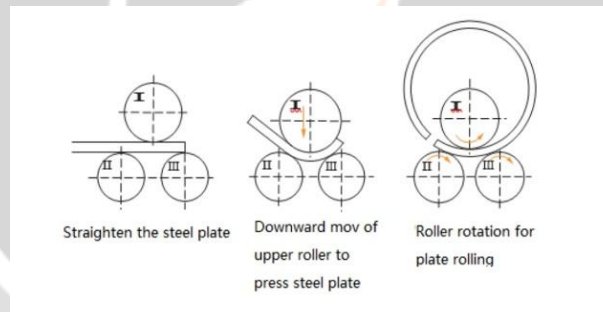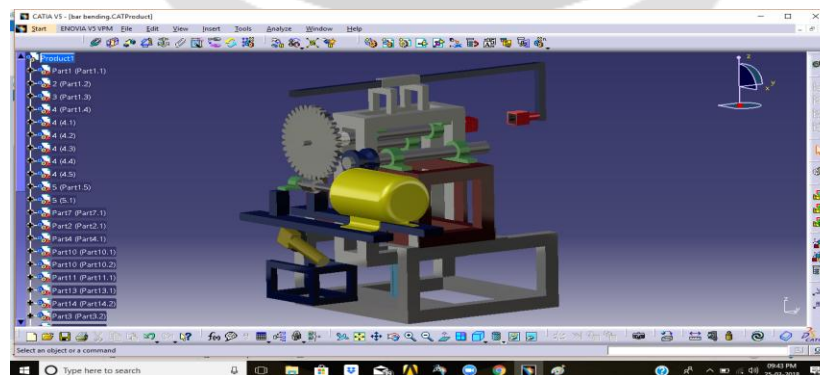

Fig -1: Three roller bending process

Fig. -2: Cad model of bending with twisting and cutting machine

2.1 Working of Twisting

For the twisting metal plate one end of plate is fixed and other end free to rotate, this rotating end is mounted on the rotating shaft. Required torque for twisting is provided by motor. But motor speed is high and torque is less. To overcome this problem we can use worm drive. Which reduce speed and increase torque. It has simple assembly in which a die and fixture is present. Die is mounted on rotating shaft and fixture is mounted on upper body of bending machine. Fixture is movable so that we can operate with different length of plates.

Fig.-3: Twisting assembly

2.2 Calculation

- Torque required to bed the bar.

For bend the mild steel having IS grade20 SAE30
S_{yt}=271 N/mm^2,   Sut= 700N/mm^2 D.D.B. Table II-3
τ < 0.3S_{yt} or τ<0.18 Sut
τ<0.3*271   or τ<0.18*700
τ<81.3 N/mm^2 or τ<126N/mm^2
Select maximum value of stress for bend the bar.
T=Π*(d)^3*τ/16   D.D.B. Table XI-1
T=Π*(12)^3*126/16
T=42750.79N-mm
T=42.75N-m
Torque require to bend the 12mmbar is 42.75 N-m

- Torque required to twist the plate

Torsion equation
τ/r =T/J =Gθ/L
Where,
τ=shear stress   r= radius
T= torque required to twist   J= Polar moment of inertia
G= shear module θ= angle of twist
L= Length of plate= 300mm   b= width of plate = 30mm
t= thickness of plate = 2mm
J= bt(b^2+t^2)/12   D.D.B Table I-1
J= 30*2(30^2+2^2)/12
J= 4520mm^2
According to Torsion equation
τ/r=T/J $\rightrightarrows$ 126/15 =T/4520
T=37968N-mm
T = 37.9 N-m
Torque required to twist the plate having width 30mm and thickness 2mm is 37.9N-m

- Assume motor of 1 HP to bend the bar and twist the plate.

Power=1HP   Power=0.746Kw
Power =746w   Speed = 1440rpm
Torque generated by the motor
P=2ΠNT/60
T= P*60/2ΠN= 746*60/2Π*1440
T=4.94 Nm
But we can required more torque and less speed, this can be achieved by worm drive.
From Torque and Speed Relation,
Where,
N1= Speed of worm   N2=Speed of gear
T1= torque motor shaft   T2= Torque after speed
N1 / N2 = T2 / T1
1440 / 36 = T2 / 4.94
T2 = 197.6N-m
Therefore torque required to bend the bar and twist the plate is 42.75N-m &37.9 N-m respectively.
Torque produce after speed reduction is 197.6N-m. Hence we can say that design is safe.

3. Components

Table: list of components with specifications

Sr. No.	Components	Specification	Quantity
1.	Motor	1 HP (3phase)	1
2.	Hydraulic jack	3 Tone	1
3.	Bearing	UCP206	6
4.	Roller	Ø48mm	3
5.	Cutter	11000 rpm	1
6.	Shaft	Ø30mm	3
7.	Worm drive	40:1(speed ratio)	1
8.	Forward revers switch	-	1
9.	Twisting die	-	1

3.1 Future scope

- We can replace cutting blade by a grinding wheel.
- It can also perform 90 degree bending operation.
- It can also be operated fully automatic with the help of programming.

4. Conclusion

As compare to the manually operated bar bending machine the power operated bar bending machine is better. The productivity of power operated bar bending machine is higher. The time required to complete bending operation is less and the requirement of extra worker's reduced. In this way we have made machine to perform basic three mechanical operation such as twisting, bending and cutting.

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