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Vice Cum Bender Machine

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Abstract - *Objective of this project is to develop a vice cum bender machine that is use to bend metal strips in workshop and hold the work piece also. The motive of this project is to design and construct a portable vice cum bending machine. This machine is used to bend metal strips into curvature and the other curve shapes and when there is need to hold, it used as vice. The machine's size is very appropriate for portable work. This machine is totally made by mild steel. Along with, it is easy to be carried and used anywhere at any time. It reduces human effort and also needed less skill to utilize this machine, that are designed manually operated vice cum bender machine with use of screw rod, bearings, slider and support (frame). This machine is manually operated &objective is to increase accuracy at cheap prize without affecting the bending productivity and also for vice with feeding specimen. This machine works on simple screw thread mechanism and roller instead of complicated design. Due to its portability, it can be used by small workshop or fabrication shop. Vice Cum Bender machine is used as common too in workshops that is used to bend a metal and hold it for cutting or other operation.*

***Key Words*: Bending, Vice, Screw Rod, Portable, Fabrication, etc.**

1.INTRODUCTION

Due to increase in globalization, it is very necessary for the manufacturer to fabricate goods having highest accuracy & integrity. In fabrication, Metal Bending and Holding is usually used as a surrogate method for casting or forging operations. Since it is associated to human being, it is compulsory to design the joint with prior attentiveness to safety of its client. There are many problems comes during bending of metallic strips. There as on that problem is arisen during this process is since the metallic pieces require a lot of pressure, strength as well as accuracy to be bent. There are many machines to be used to achieve this but it is expensive. This machine is used to bend metal strips and bar into curve and the other curvature shapes and when there is need to hold, it used as vice and feed workpiece also. This construction is more user-friendly to everyone, relatively affordable, extremely useful and it will fill with feelings of joy and satisfaction the people who want to spend their time productively.

2. LITERATURE SURVEY

Power regulated sheet bending machine & manually regulated sheet bending machine are utilized for manufacturing of pipes. It involves limitations too, of manually regulated bending machine. Productivity through power regulated bending machine is higher from the outcomes of paper **[1].** In this operation, Pipe bending mechanism has been used in fabrication and design & development of a bicycle. The utilization of bent pipes is in frames, barricades, handle of bicycle. Apart from this, bent pipes are uses in most of industries as air conditioning, boiler tubes, off-road, power generation, automotive, ship building, furniture, railroad and agricultural equipment, aircraft etc. In countries like India, the physically driven machine will impact in development & advancement of the economy and employment of nation due to competent human power. Therefore, such system has a pivotal role in countryside as a result in Asian countries people are struggling with electricity cut-off throughout most of the days. **[2].** Hydraulic tools have vast usage in different automobile fields. For adjusting the chairs in Barber's shop and in dental clinics these hydraulic equipment's are used. Further to bend pipes, strips, bars and rods Hydraulic bending machine is the appropriate equipment. The strip, bar & pipe that has to be bent is kept between the rollers. We apply force on the pipe and bend it to the desired angle rely on the roller used by using hydraulic jack. Hydraulic bending machine has less expenditure, portable and flexible in comparison to those about which we talked previously. Hence it is better to substitute the present standard machines by hydraulic pipe bending machine **[3].** Author informed in previous years that pipe bending machine is used in industry as well as in household purpose for bending the pipe under the required angles and dimensions. In the hydraulic pipe bending machine, it has a good process as compared to the heat treatment technique **[4].**

3. RESEARCH GAP

- The improvement in some fields, in this process like reduction of cost.
- High flexibility because of different types of parts can be bend.

- Uneven shaped of bar & strip can be generated by other bending m/c.
- The size of this machine is very convenient by which it is portable. Due to its portability, it can be used in small workshop or fabrication shop.

4. PROBLEM STATEMENT

- The main reason to choose this project is to simplify the operation of bending and make vice in this machine because material slips during process.
- The main problem is that the machine already available are most costly and heavy.
- The study shows bending of thick strip or bar execute higher load on center roller of machine. As the thickness of strip or bar increases the load acting on the top roller also increases.

5. OBJECTIVE OF THE WORK

The objective of our work is to fabricate, manufacture and design a Vice cum Bender Machine for light duty. The effort is to combine into a single multi-tasking machine which is effortless to manage and performs the aforementioned operations efficiently which is better of the two machines.

In few words, the objectives of the work are as follows:-

- To fabricate and design a bending machine for metal strips.
- To utilize unskilled worker.
- To reduce the duration and expenditure of the operation.
- To construct a machine competent of holding, feeding along with bending metal strips & bar, pipes and rods of various dimensions.
- To construct this m/c on a simple working principle.
- To formulate the machine comfortable & ease to operate.
- To make it convenient & transferable.

Taking these in account, the whole work was shifted further, also efforts were made to adhere to the target as rigidly as feasible.

6. METHODOLOGY

7. DESIGN

7.1 Designing Process

The process of designing is a necessary practice in applied innovation & creativity. Different design procedures came to be elucidated to help out assemble to assault over inbuilt problems description is indistinct for which numerous solutions exist. Several of this design process are beneath as you can observe.

Recognition of need: It includes identification by someone that an issue exists for which some rectifying measures ought to be taken. The problem perhaps recognizes few defects in the existing machinery or a need of new product in the market.

- *Definition of problem:* It embrace through requirement of the product to be prepared. Physical, practical or functional features, cost price, property or quality, and operable performances are involved in these specifications.
- *Synthesis:* In this phase we are developing preliminary (basic) ideas regarding the topology and configuration of the difficulty, i.e., regarding the structure & extent and association of distinct parts in the product. A prototype model is created in this stage.
- *Analysis:* In this phase a prototype model is analyzed by giving different limited situations and restrictions, subjecting the model to different conditions and loads to perform study of feasibility. The design is returned back to the synthesis phase, if the product blunder at this stage.

- *Evolution:* The final products of the inspecting period is compared with terminal stage. If they require a bit transformation, then the design is once again regressed back to the blending period.
- *Presentation:* It contains authentication of the design by signify of drawings, component specifications, charge of elements, scenes, toughness and so on.

7.2 Component

S.no.	*Name of the parts*	*Material*	*Quantity*
1.	Rectangular Hollow Bar	Mild steel	1(50x50x1200)
2.	Handle	Mild steel	1
3.	Nut & Bolt	Steel	4
4.	Pedestal Bearing	Grey cast iron	1
5.	Ball Bearing	Steel	4
6.	Screw Rod	Stainless Steel	1
7.	Slider	Mild steel	1
8.	Supporting frame	Mild steel	1

7.3 Calculations

Consequent fundamental pruning process on a metal sheet, constituents can be twisted to give it a specific structure. Curving of segments rely upon component qualities at the position of the bend. To attain bending, the functional element needs to be subjected to two considerable intensities; there is no slip because of the resistance force due to which we apply bending force through the roller, then the deflection occurs in the metal bar or in strip and the torque is generated through the handle due to which the material moves.

Where,
F = on roller force is applied;
L = gap between roller;
μ = 0.4 Nm-1 i.e., frictional force;
a = interspace from the no-slip point to departure zone (assume a = L/2);
T = torque applied to rollers;
r = rollers' radius;
ho, hf = width of the strip before and after time t.

To increase and decrease the thickness of any metal strip or bar, there should be at least two rollers are used through which its thickness is reduced by rolling process and converted it into a curvature form we should use three roller mechanisms. When a ductile material is bent then the tension occurs in its upper surface and compression in its lower surface.

A. Design of Chain drive:

Specifications:
D1: driving sprocket's diameter
D2: driven sprocket's diameter
L = chain's length
= Ln * P
Z1: Number of teeth on driving sprocket = 19
Z2: Number of teeth on driven sprocket = 19
a: center distance between driving sprocket and driven sprocket = 301mm

where,
Ln: number of links
P: Pitch = 0.25 inch = 6.35 mm
Ln= 78.30mm
L= 78.30*6.35
L= 497.205mm
D= 30mm
D=D1=D2=30mm

B. Design of power screw Specifications

μ: co-efficient of friction=0.15
do: minor diameter=6.04mm
W: weight of the roller=2.5Kg=24.525N
dc: major diameter=7.4mm
P: pitch=6.35mm
Torque required lifting the load:
Lead= pitch (single trapezoidal thread)
Torque required to lowering the load
Lead= 6.35mm
T2= 4.47N-mm
d= that is the load acting on one screw rod
d= 6.72mm
The screw is self-locking because the reducing load is +ve.

C. Force analysis

Specifications = Highest torque appropriate for a cylinder rolling
s: Output limit of material=218 N/mm2 (from data hand book)
B: Twisted shield maximum thickness= 40mm: Rolled sheet width in mm
Torque required raising the load (for 1 revolution of one screw)
Mt= y dA= 2
For thickness
When considering the distortion of the product, there
T is strengthening and to customize the equation the reinforcement co-efficient K is introduced
T1= 20.45 N-mm
It is the force acting on screw.
Mt -mm
Total torque= 20.45*54
In the above formula

K: reinforcement co-efficient=1.15
Total force= 2mm
Mt = 10028 N-mm
For thickness =3mm
Mt = 22563 N-mm
For thickness =4mm
Mt = 40112 N-mm

D. Force condition

The force position is acting while rolling steel strip. The supporting F2 on the roll strip can be acquired through the following formula, according to the force balance.
F = the angle between defined line 001 and 002
a = lower roller center distance in mm.
d min = minimum diameter of the rolling strip in mm = 388mm
d2 = lower roller diameter in mm = 62mm
R = rolling radius of neutral layers in mm
R = 0.5 d min
R = 0.5*388 = 194 mm
F2 = 115.63 N
The pressure force F1 that is developed by the upper roller, affecting on the rolling strip, according to force balance i.e.,
F1 = 2F2
F1 = 2*115.63
F1 = 206.91 N

F2 = 260.3 N
F1 = 2F2
F1 = 2*260*
F1 = 460.98 N

F2 = 462.90 N
F1 = 2*F2 = 2*462.90*
F1 = 828.31 N

E. Calculation of driving Torque:

The lower strip roller of the rolling machine is the driving roller and the driving torque is utilized to conquer the deformation torque Tn1 and friction torque Tn2 on the lower roller.
Tn1 =1601.13 N-mm [for 2mm MS strip]
which can be calculated as follows.
In the above formula,
f=co-efficient of rolling friction = 0.008*103 mm
=co-efficient sliding friction
d1, d2= upper roller and lower roller diameter (mm)
D1, D2= upper roller and lower roller neck diameter (mm)
Di=0.5di (i=1,2)
D1=0.5d1
D1=0.5*62=31 mm
D1=D2 (same size)
Tn2=0.008*103[206.91+2(115-63)]

Tn2=3508.07 N-mm

Total torque T = Tn1 + Tn2
T=1601.13+3508.07
T=5109.206 N-mm

F. Shaft analysis

Specification,
Tensile strength of the material (Sut) = 770N/mm2
Yield stress of material (Syt) = 480 N/mm2
fs = factor of safety
Shaft Material =steel (FeE480)
145 N/mm2
Calculating torque,
T = 0.18 Sut
= 0.18*770
T = 139 N/mm2
128<149 N/mm2,
Hence design is safe.

8. WORKING

Screw rod is a main component which is fixed on a top of machine frame in centre and by handle it is operated. On the bottom side of screw rod, a slider is attached. And below the slider pedestal bearing is joint in which a shaft is located and run by handle. With the help of nut bolt ball bearings are attached both side of frame on a certain height at fixed distance from centre. Two handles are used one for screw rod and other for shaft. Screw rod and nut mechanism is used to applied force on work piece which is to be bend. Work piece is hold between ball bearing and shaft of pedestal bearing. When work piece is to be bend then gradually force is applied by screw rod and work piece does to & fro motion with the help of pedestal bearing shaft by handle. Ball bearing is used as a roller mechanism for feeding the work piece if needed.

9. MODEL

Fig -1: Material Required

Fig -2: 3-D Model

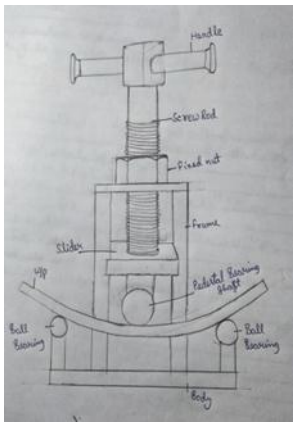

Fig -3: 2-D Design

10. SIGNIFICANCE

- Very useful in Fabrication
- Curved parts are easily made
- Supports a variety of soft metals
- Portable
- Low initial cost
- Low maintenance cost
- Simple Design

11. EXPERIMENTAL RESULTS

Results for 5mm thickness of metal strip: -

S. No.	*Material*	*Analytical*	
		Stress (N/mm2)	Deformation
1.	Aluminum Alloy	237.69	32.872 mm
2.	Copper Alloy	655.71	31.908 mm
3.	Magnesium Alloy	149.43	35.899 mm
4.	Stainless Steel	642.63	26.909 mm

Cost of project: -

S.no.	*Name of the parts*	*Material*	*Quantity*	*Cost (Rs)*
1.	Rectangular Hollow Bar	Mild steel	1(50*50*1200)	300
2.	Handle	Mild steel	1	20
3.	Nut & Bolt	Steel	4	28
4.	Pedestal Bearing	Grey cast iron	1	275
5.	Ball Bearing	Steel	4	125
6.	Screw Rod	Stainless Steel	1	200
7.	Slider	Mild steel	1	75
8.	Supporting frame	Mild steel	1	500

Total cost = 1523

12. CONCLUSIONS

- This project is to increase accuracy at low prize without affecting the bending productivity and also used as vice with feeding the workpiece.
- To fabricate machines in less possible expenditure was one of the main purposes. We preferred to utilize Screw Rod over the more expensive hydraulic jack and the rolling feed and bending pressure as well are given by human effort, that brings down the price further in our design.
- The outcome acquired by conceptual estimation and the one acquired from simulation are approximately similar with one another and this results in authentic design. This machine is completely a mechanical tool. Thus, the regarded workpiece and its measurements are sufficient and the fabricated machine can function effectively with the aforestated specifications.
- Through this machine maximum 20mm thickness of metal strip can be bended & 25mm of bar for a maximum length of 0.6m.
- When it is used as a vice then the maximum 20 feet length of strip or bar can be feed with maximum thickness 150mm.

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