International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 6 Issue 5, May - 2022, Pages: 10-15

Design and Fabrication of A Manually Operated Mechanical Press

Kotingo Kelvin, Agonga Oyinbonogha Fred, Yemi Philip Olisa

Department Of Mechanical Engineering, Niger Delta University, Wilberforce Island, Bayelsa State

Abstract: *The design and fabrication of a mechanical press for metal forming operations has been studied., in this paper, a mechanical manual press was designed and fabricated that offers the features of a sliding ram, speed and position control. The press was also designed with required accuracy and flexibility of a contemporary mechanical press which can be used in mass production of identical components during blanking and piercing operations. The parts used for the fabrication includes an angle bar of 8mm thickness, shaft, sliding ram, bearings, springs, base, guides, connecting rod, clutch wire, forming box(bolster plate) etc. The press was produced at a cost of fourty one thousand and one hundred naira (#41100) which is cheaper when compared to imported press sold at more than three thousand US dollars. The produced mechanical press has the capability to improve process conditions and metal forming productivity using locally purchased materials in the processes involved in sheet metal forming operations.*

Keywords: Sheet Metal, Mechanical Press, Bolster Plate, Springs, Bearings, Frame, Sliding Ram

INTRODUCTION

A mechanical press is a machine press that is primarily used for forming sheet metal, metal extrusion or basically used for squeezing, piercing and blanking operations. Piercing defines the operation which the hole formation is the desired result in a presswork. The punched out material during the hole forming process is discarded as waste while in blanking the punched out sheet metal part that is punched out is the needed particle of the process, the metal and the hole used for the blanking operation constitutes the waste. The study presents a designed and fabricated press machine that is driven by a shaft , bearing and clutch wire which converts rotational speed to the connecting rod to deliver strokes as the operator engages the handle of the press. The energy stored in the flywheel provides the force necessary for the stroking downwards to the bolster plate for either squeezing, piercing or blanking action in the bolster plate/forming box.

OBJECTIVES

(i)To design and fabricate a manual vertical mechanical press that is cheap and affordable
(ii)To produce a vertical press machine using indigenous technology
(iii)To produce a mechanical press that can be used for squeezing and sheet metal forming operations

METHODOLOGY

The basic parts of the manual mechanical press includes: Handle, Springs, Frame, Shaft, Connecting Rod, Bearings, Forming Box, Guards, Bottom plate, Bolts and Nuts and a Clutch Plate Wire. The description of the various parts are stated below as follows:

Frame: The frame has a dimension of 844 ×790cm made of angle bar of 8mm thickness. It is the frame that serves as housing for all the components used in the production of the manual mechanical press machine. The frame is usually mounted on a base which is bolted for rigid and easy operation during press works.

Handle: The handle is made of iron, it has a diameter of 17cm along the straight path bent at an angle of 90^o for easy rotation during operation of the press with a total handle length of 709cm. The handle is placed on the frame linked to the plunger and bearing housing component that drives the ram during piercing and blanking operations.

Plunger

The thickness of the plunger is 1mm with welded plate for the prevention of misalignment with the funnel and bolster plate. The height of the rack is 7.6mm also welded to receive inputs for delivery. Its cross sectional area is similar to that of the forming box and frame except that it is made a little smaller to enable free translational motion along the length of the frame angle bar of 8mm thickness. It is this moving plate that serves to compress the material.

Bolster Plate

The bolster plate is welded to the bottom frame, it is solid and rigid with a thickness of 2.9mm, it is designed to withstand shock, vibration, shaping and compression of sheet metals, the forming box content is steel, height 3.0m, base thickness 10mm. The removal of metal after press action is achieved by pushing the bottom plate resting on the frame.

End Plate

The end plate as the name implies is usually placed at the bottom of the forming box to keep the baling material or sheet metals in place during the compression, piercing or blanking operations.. After this it can then be removed to extract the baled material through the other end of the frame that is exposed. The thickness of the end plate is 30mm and its cross sectional area is similar to the frame, except that it is chiseled around to enable it fit into the frame. On top of the plate there is a hole through which a screw will go through to keep it in place during metal forming works. There are also guides fixed above the forming box to provide rigid supports.

Ball Bearing

Bearings provide support to shaft during power transmission, the selected bearing for the study is ball bearings made of high steel carbon chrome, this bearings possess little or no resistance due to lack of surface contact between rotating part and the bearing surface. The outer ring is 10cm and 60cm height dimension. Other parts of the ball bearings are the ball, cage, and rollers. Due to friction between the mating surfaces during shaft journal rotation in bearing which generates heat, adequate bearing lubrication is required in other to improve bearing life. Pictorial view can be seen in figure 3 of the appendix.

Springs

Spring is a mechanical component which is used in generators, car engines, as well as most machineries to store and release mechanical energy under load and applied force. Spring goes back to its original shape when the load is removed. A tension helical spring presented in figure 4 is used in this study to obtain tension when pull force externally applied up to during press work. The main purpose of a tension spring is to a facilitate tension, store the energy and use that energy to revert the spring to its original position.

Construction Procedure

The steps in the production of the manually operated mechanical press involves the design, fabrication and welding of the parts which includes the frame (angle bar), shaft, sliding ram, bearings, bearing housing, springs, base, guides connecting rod, clutch plate wire, forming box etc. the steps of construction of the press can be divided into four stages, and these are: Measuring and marking out of selected materials, Cutting, drilling and filling, Assembling of parts by either welding or using bolts and nuts and lastly Cleaning and painting.

Results and Discussions

The work done by the ram is given by the force (P) multiplied the distance travelled by the ram (D), mathematically;

$$W = PD$$

But, $P = \frac{Fx}{l}$

Therefore $W = {}^{FxD}/_{l}$

Let t be the time taken for the ram to travel through D, therefore the power of the lever arm can be given by;

$$P = Wt$$

Since the x is bigger than l the value of P becomes higher than F.

Similarly, if the force applied to the handle of the press is 250N and the ratio length of handle to the length of connecting rod is 3, therefore;

$P = Fx\ l$ P= (250×3), therefore P= 750N.

Power of the ram

The work done by the ram is given by the force (P) multiplied the distance travelled by the ram(D), mathematically; $W = PD$ But, $P = Fx\ l$ Therefore $W = FxD\ l/$ Let t be the time it takes the ram to travel through D, therefore the power of the ram can be given by; $P = Wt$

Density of material

The press was tested with sheet metals. The mass of the sheet metal was 2kg. The thickness of the sheet metal was 1.7mm (volume= length x width x height). We know that, $\rho = m\ v\,/$ where, P = mass density of material M =mass of sheet metal V =volume of sheet metal. Therefore, the density of the material: (2/1.7) kg/m3 = 1.176 kg/m3.

CONCLUSION

The performance test carried out was done by placing sheet metals on the bolster plate or forming box, from investigation, it was observed that each component performed the intended function. Blanking and piercing operations were performed successfully using sheet metals and bales, the following were checked; friction, vibration and speed of movement of the connecting rod and strokes. The test running showed the efficiency of the press machine. The following conclusions are obvious from the design; the simple design makes it possible for unskilled foundry man to operate and conduct maintenance. The minimum possible number of components were employed in the design. The production cost is economical. Precisely forty one thousand and hundred naira only (#41100) which is cheaper when compared to imported press machines. In summary, the aim of the design was achieved in terms of cost of manufacturing, maintenance, operation and servicing.

REFERENCES

Boher, D. Attaf, L. Penazziand, C. Levaillant, Wear behaviour on the radius portion of a die in deep drawing: Identiation, loallisation and evolution of the surface damage, Wear 259 (2005) 10971108.

L. Vitos, K. Larsson, B. Johansson, M. Hanson, S. Hogmark, An atom- istiapproach to the initiation mehanism of galling, Computational Materials Siene 37 (2005) 193197.

Advameg, Inc., 2019. Hay Baler. [Online] Available at: http://www.madehow.com/Volume2/Hay-Baler.html[Accessed 12 March 2019].

Carlo Ferraresi, W. F. a. G. Q., 2017. Design of human powered balers for straw bale

construction in developing countries: A case study of Haiti, Turin: Springer.

Chapman, W.A (1988): Workshop Technology, Part 1, Edward Arnold publisher, London, pp 250-309. Differient, N. (1994). Manual handling Regulations and code of practice, MIT press, Cambridge. Drury, C.G. (2003): Hand Placement in Manual Materials Handling, Human Factors, pp. 551-562 Hall, Holowenko, M. S. (1980): Theory and Problems of Machine Design, McGrew Hill, New York. Higgins, R. A. (1997). Typical Mechanical Properties of some Metals and Alloys, Engineering Metallurgy, Part 1, ELBS, London p. 68

APPENDICES

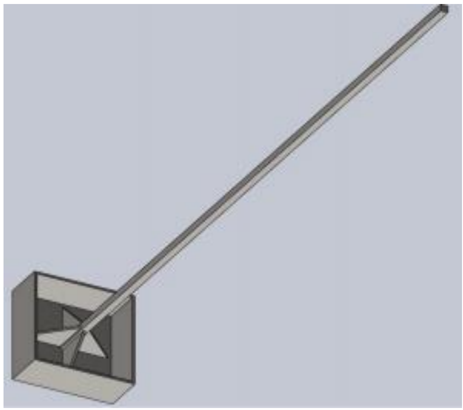

Figure 1: (Plunger mechanism)

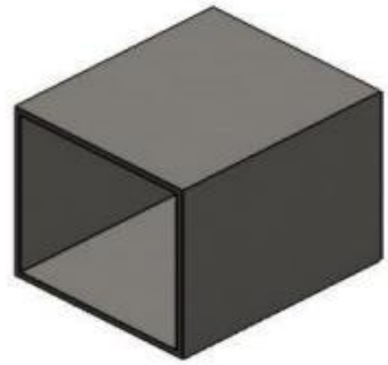

Figure 2: (Forming box)/Bolster plate

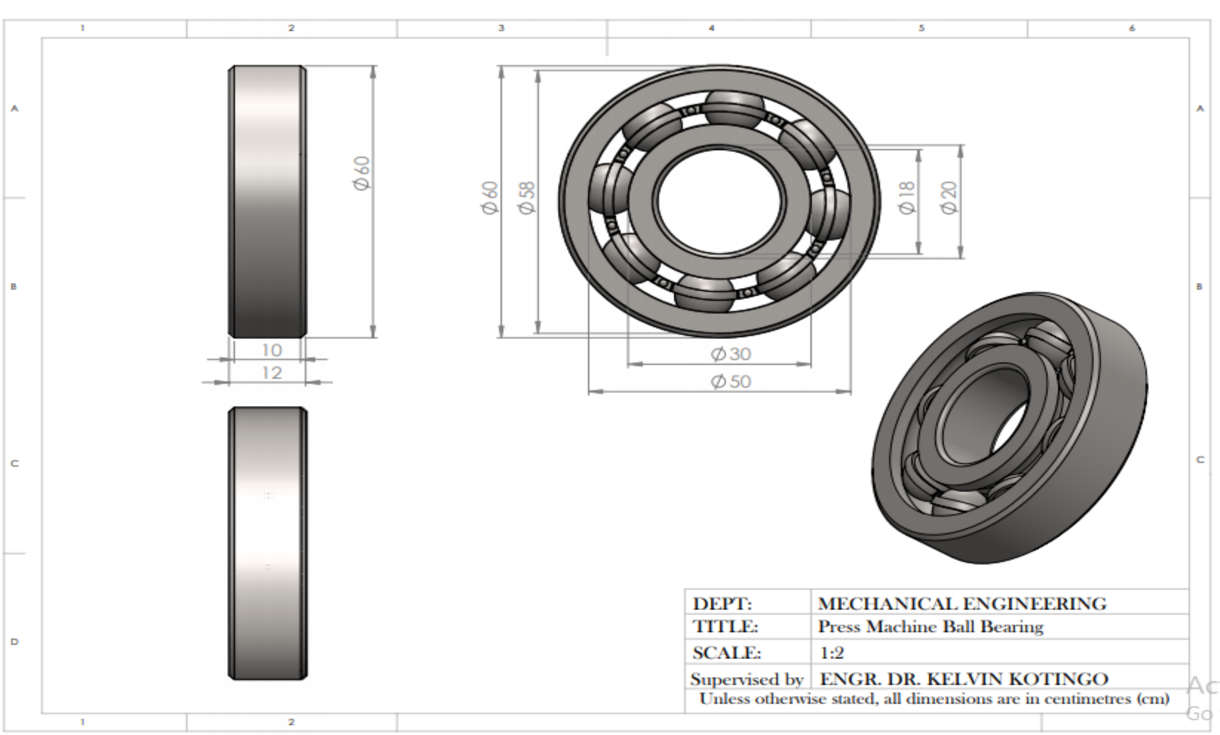

Figure 3: Ball Bearings

International Journal of Academic Engineering Research (IJAER)
ISSN: 2643-9085
Vol. 6 Issue 5, May - 2022, Pages: 10-15

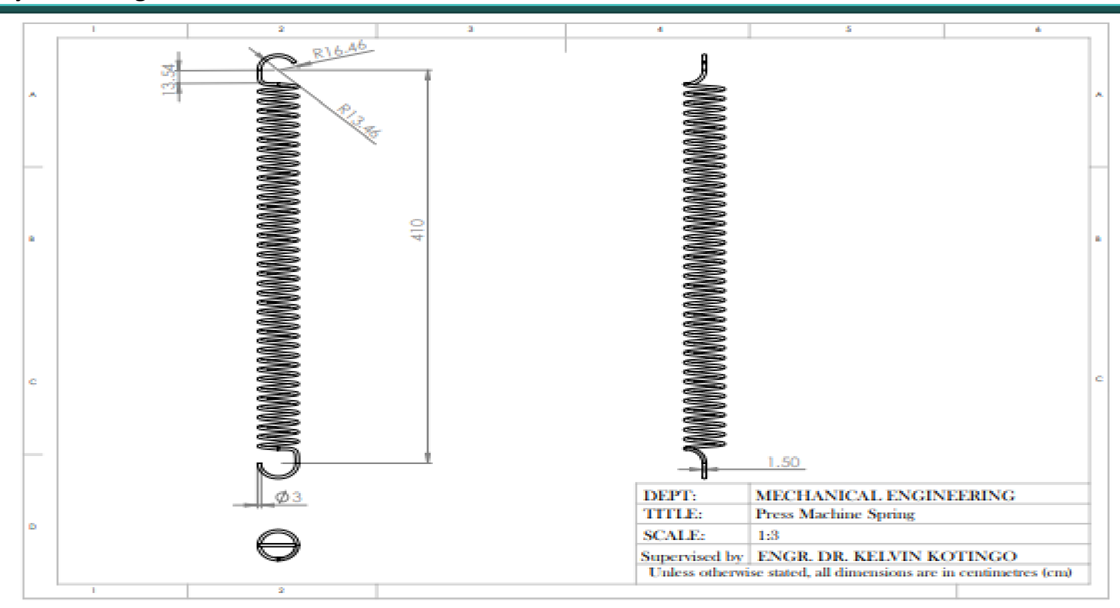

Figure 4: Press machine spring

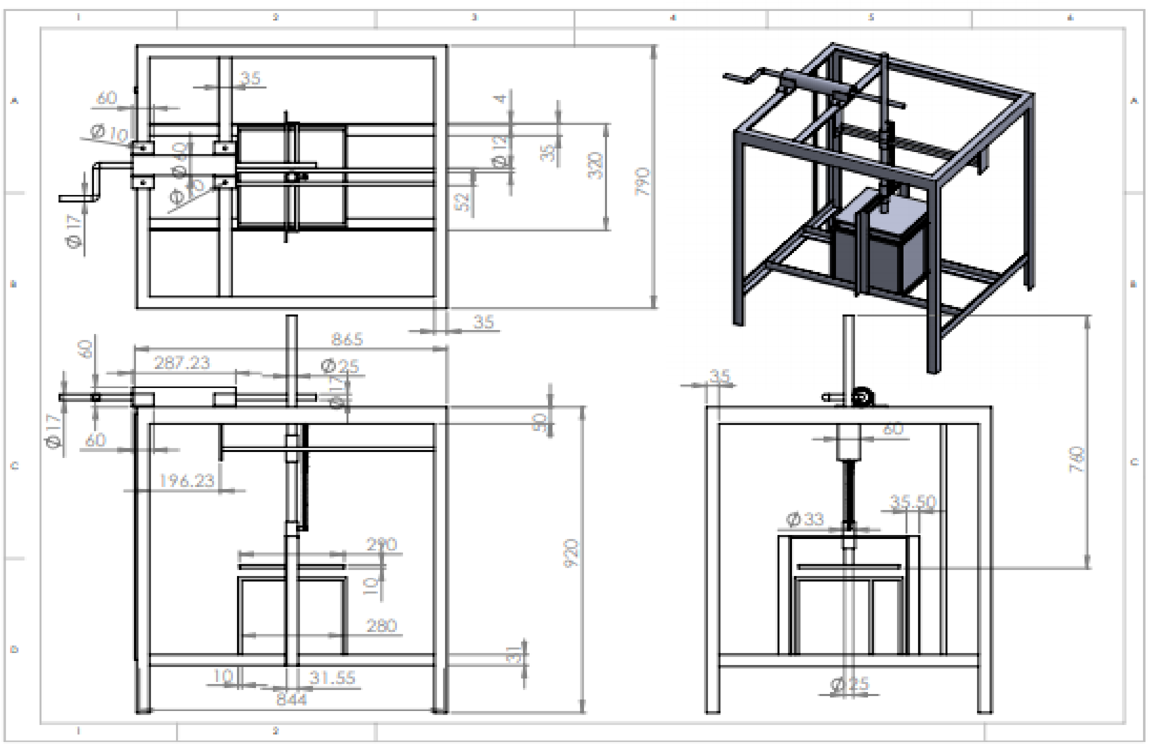

Figure 5: Press Machine Design

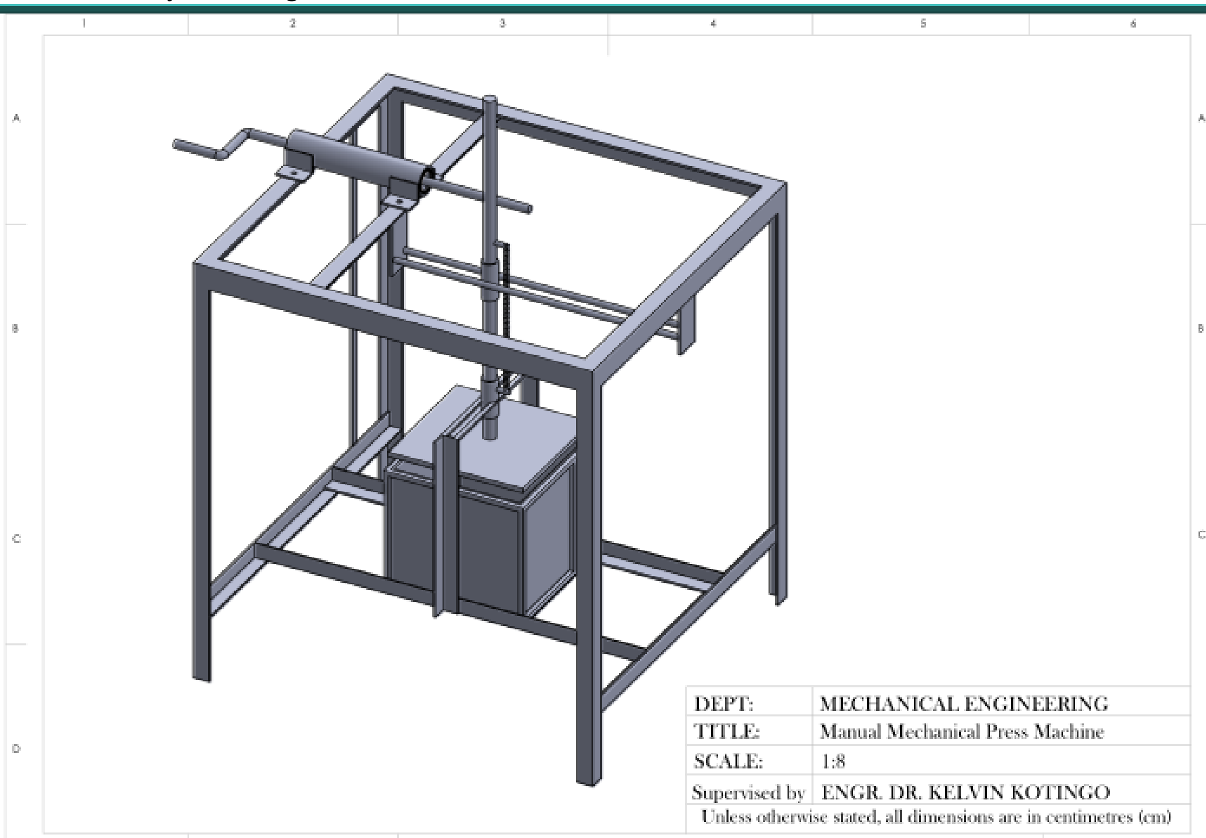

Figure 6: Pictorial View of Mechanical Press Machine

Table 1: Bill of Quantities

Component		
Angular bar		
Bolt and nut	4	150×4 = 600
Clutch wire	15 meters	2000
Iron bar	2	1250×2 = 1500
Roller bearings	2 pairs	1500×2 = 3000
Connecting rod	1	3000
Stainless steel	1 sheet	7000
Bearing housing	1 pair	2000
Shaft	1	1000
Workmanship	1	15000
Total Cost		#41,100 NGN