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A PANACEA TO ECONOMIC STABILITY
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LOCAL FABRICATION OF A COST EFFECTIVE ARBOR PRESS

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Abstract

The work was carried out at the Faculty of Engineering and Technology, Workshop, Igboora. This paper presents 'Local fabrication of a cost effective Arbor press' for small and medium scale engineering workshops. The arbor comprises of the rack and pinion, base, frame and the lever designed based on the design calculations, material selection, measuring and marking out, welding and surface finishing.

The study was carried out to fabricate an Arbor press using locally material which will performs optimally same function. Arbor Press was design for operations like stamping, installing, bearing removal and leather fittings. The use of mild steel is due to the fact that its strength, rigidity and machine ability fall within the design specification. The result revealed that with the use of mild steel the arbor press cost is cheaper compared to the imported ones where cast iron was used, which makes it expensive. The locally fabricated was N39,700 (\$88) compared to the imported ones of same capacity which ranges from \$100 to \$150 excluding cost of importation. A 1 ton arbor was achieved with an applied effort of 57 kg..

Keywords: Arbor press, fabrication, design, local materials

Introduction

An arbor is a small hand-operated press. It is typically use to perform jobs, such as staking, riveting, installing, configuring, removing bearings and other press fit work. Punches, inserters, or other tools/dies may be added to the end of the ram depending on the desired task. Presses are used in industries for a wide variety of uses, including bending, blanking, piercing and pressing and punching operations. There are many different types of presses. The most popular is the arbor press. The arbor presses are more preferable than hydraulic presses. The greatest advantage of arbor press is its speed. Arbor press is 10 times faster than other presses and it can perform many jobs faster and more efficiently. Arbor press can be mounted on a work bench, wall, or pedestal. It uses mechanical leverage to apply or generate a compressive force.

Arbor presses are usually rated by the ideal force that the leverage bar can apply. This leverage is achieved when a force is applied to the lever arm or wheel. The ram is usually driven by a rack and pinion setup to improve the mechanical advantage. Forces are usually generated by manual or hydraulic input.

Arbor presses are usually rated by the ideal force that the leverage bar can apply (McMaster-Carr)

Presses are defined as pressure exerting machine tools. It can be classified into three principal categories as; hydraulic presses that operate on the principles of hydrostatic pressure, screw presses using power screws to transmit power and mechanical presses which utilize kinematic linkage of elements to transmit power (Niebel *et al.*, 1989; Sharma 2005).

Presses are pressure exerting machine tools. These are use in industry for cold working of metallic object into a variety of shapes through operations like blanking, piercing, forming, bending and shearing. It represents an

important part of manufacturing industry use for cheap production of large quantities of components such as motor car bodies, electric motor parts and domestic electrical appliances parts (Jain 2012). The development of engineering over the years had been tailored towards the study of finding more efficient and convenient means of pushing and pulling, rotating, thrusting and controlling load, ranging from a few kilograms to thousands of tons. Presses are widely used for achieving all these aims (Sumaila 2002)

A critical look at mechanical workshops in Nigeria reveals that majority of arbor press machines are imported. This work therefore intends to produce a manually operated arbor press, with a reduced cost and equitable with imported press machine of the same designed capacity. The production of this machine will minimize high cost of purchasing and increases the profit thereby strengthen local manufacturing industries.

Materials and methods

The fabrication was carried out at Oyo State College of Agriculture and Technology Faculty of Engineering Workshop, Igboora. This work focuses on the design and fabrication of 1ton Arbor press that will be useful in the Mechanical Engineering workshops (especially small and medium scaled) to do smaller jobs such as staking, riveting, installing, and configuring and removing bearings. The fabrication was done using quality, cost-effective, and locally sourced materials.

Table 1: materials, specification and quantity used for arbor press fabrication

S/N	ITEM	SPECIFICATION	QTY
1	Mild steel	Thickness (4mm)	2 length
2	Flat metal	Thickness (4mm)	3 length
3	Carbon steel (4mm)	Thickness (4mm)	2 length
4	Bolts and Nuts	17mm 10mm	(2) pieces (4) pieces
5	Electrode	12 gauge	1 packet
6	Paint	Color blue	4litres
7	Body filler		3 packets

Design calculations

Since we are designing for 1 ton

Capacity force is 1000 kg = 9810 N

- i. Ram $1" \times 1" (25 \times 25)mm$
- ii. Pitch radius $= \frac{d}{2} = \frac{1"}{2} (\frac{25}{2} mm)$
- iii. Ram diameter $= z_r \times m$
 $= 30 \times 2 = 60$

where z_r is number of teeth of rack = 30 and m is the module = 2

iv. Linear distance = $\pi \times m \times z_r = 3.142 \times 2 \times 30 = 188.5 \text{ mm}$

v. Area $= \pi \times r^2$
 $= 3.142 \times 1.25 \times 1.25$
 $= 490.94 \text{ mm}^2$

vi. Force = *Leverage* $\times$ *Weight*
 $= 16 \times 57 \text{ kg} = 912 \text{ kg}$

Approximately 1000 kg (including safety factor)

$$= 1000 \times 9.81 \cong 9810 \text{ N}$$

vii. Pressure = $\frac{\text{force}}{\text{area}}$
 $= \frac{9810}{490.94} = 19.98 \text{ N/mm}^2$

viii. Pinion diameter, $d = z_p \times m$
 Where z_p is number of teeth of pinion gear = 20 and m is the module = 2
 $= 20 \times 2 = 40 \text{ mm}$

ix. Mechanical Advantage is the ratio of the distance the hand moves to the distance the ram travels. The lever is 400 mm (16") long and a full rotation of the lever produces a travel of 150 mm (6"). The hand would move
 $2 \times \pi \times 400 = 2513.6 \text{ mm}$
 The ratio 2513 : 150
 Reduces to 17: 1
 To achieve 1 ton of force on the Ram, 56.7 kg will be applied on the 400 mm lever.

Table 2: some designed values for the arbor press

S/N	Design Factor	Design Values
i.	Ram Length	189 mm
ii.	Pitch Radius	12.5 mm
iii.	Area	490.94 mm ²
iv.	Force	9810 N
v.	Pressure	19.98 N/mm ²
vi.	Mechanical Advantage	17: 1

Results and discussion

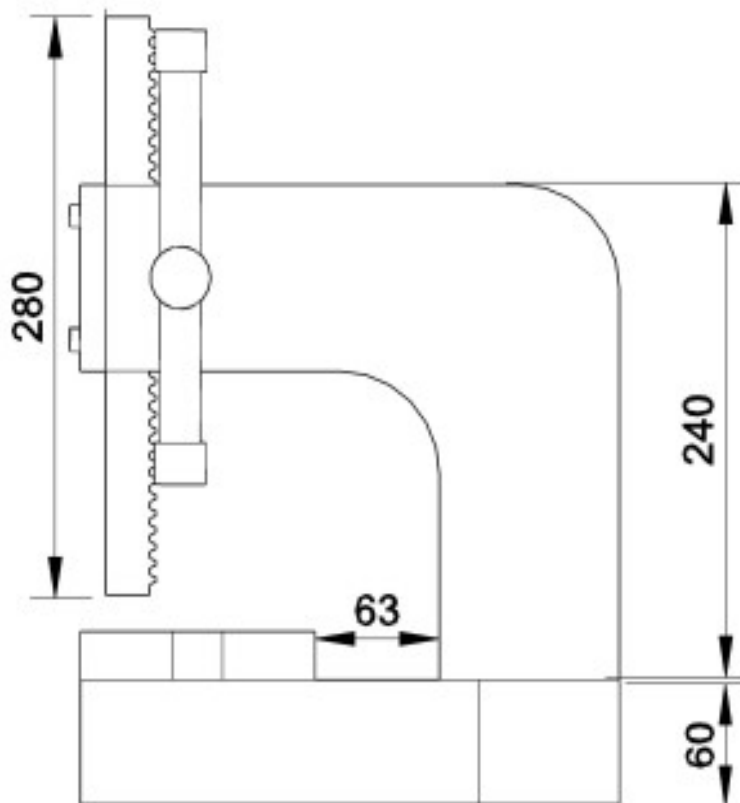
The work has contributed immensely to ease the mechanical operations performed in the workshop the cost of production is cheaper compared to the imported ones. Though this piece of equipment is fairly simple in its operation and construction, it can perform its core task without hesitation or nearly any loss of precision, the

fabricated arbor press was achieved using locally sourced materials performing the same tasks imported ones would had performed. Mild steel was used in fabricating majority of the components of the machine unlike the imported ones where cast iron is used and also costly. Tests were carried out on the press machine performing various operations such as; bending, blanking, piercing and pressing and punching. The machine worked without any challenge as there was no distortion, deformation, no weld failure.

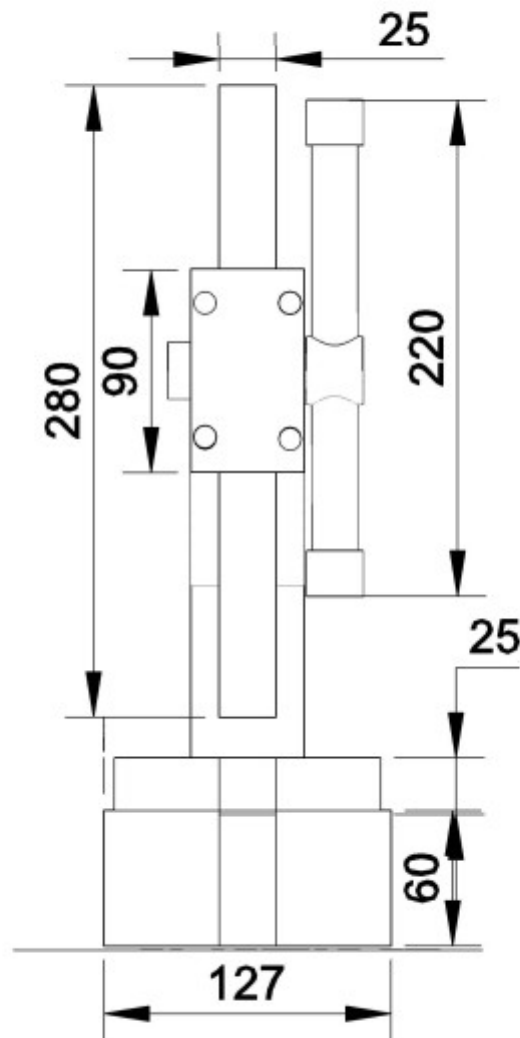


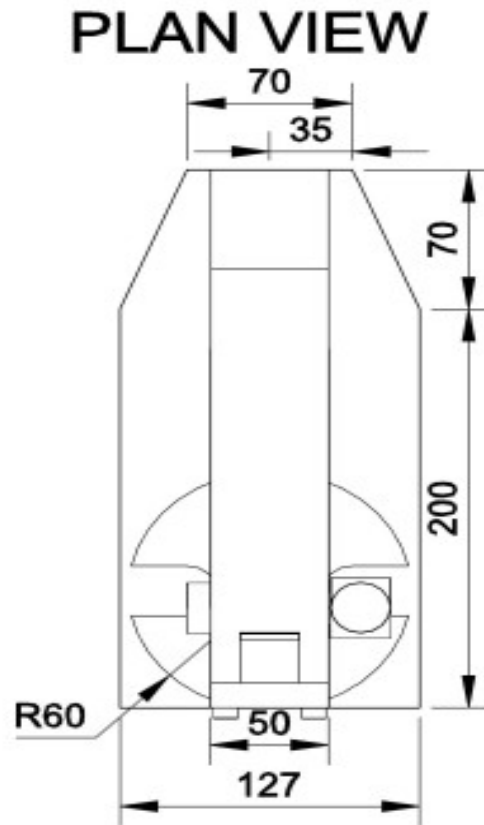
ISOMETRIC PROJECTION OF AN ARBOR PRESS

SIDE VIEW (RIGHT)



FRONT VIEW





Conclusion

An Arbor press was fabricated locally. The machine produced is capable of performing various operations such as; bending, blanking, piercing and pressing and punching. The machine perform core task without hesitation or with loss of precision.

The cost of fabricating the machine was N39,700 (\$88) compared to the imported ones of same capacity which ranges from \$100 to \$150 excluding cost of importation. The development of Arbor press will improve workshops efficiency (especially small and medium scaled) in during major mechanical engineering operation and safely.

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Appendix 1: Bill of Engineering and Measurement Evaluation

S/N	Quantity	Unit	Rate (₦)	Price(₦)
1	Mild steel (4mm)	2 length	3000	6000
2	Flat metal (4mm)	3 length	1000	3000
3	Carbon steel (4mm)	2 length	3000	6000
4	Round & Square rod metal	6 pieces	700	4200
5	Bolt	(2)17mm (4)10mm	250	500
6	Oxygen & Acetylene cutting		5000	5000
7	Electrode	1 packet	2200	2200
8	Diesel Fuel Fee	38 litre		10000
9	Painting & Metal Dental Filling	Color blue & 3 filler	800	800
10	Transport Fee		2000	2000
Total				39,700