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DEPARTMENT OF AGRICULTURAL MECHANIZATION AND IRRIGATION ENGINEERING

DESIGN AND FABRICATION OF A MANUAL SHEET METAL BENDING MACHINE

BY

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DESIGN AND FABRICATION OF A MANUAL SHEET METAL BENDING MACHINE

A RESEARCH PROJECT REPORT PRESENTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR'S DEGREE IN AGRICULTURAL MECHANIZATION AND IRRIGATION ENGINEERING

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ABSTRACT

Sheet metal bending is one of the sheet metal forming processes that is used in the industries, workshops and local artisan shops for fabrication of different parts that satisfy people's needs. Achieving curved and cylindrical patterns from metal foils, sheets and plates is a hectic process to most small scale fabricators who lack heavy industrial based rolling machines. This research project report covers the development of a small scale manually operated proper working tool for sheet metal bending. The developed sheet metal bending tool is tailored for the magnitude of work in institutional workshops and local artisan shops that are often faced with the challenge of bending sheet metal and yet their volume of work is small and covers small sheet thicknesses.

Chapter one of this report presents the challenges faced by small scale fabricators who are the immediate suppliers of simple fabricated product for use in the local communities. The problem statement, justification of the study, objectives of the study, its purpose and scope of the study are also elaborated. Chapter two presents the reviewed literature on sheet metal bending operations with more emphasis on roll bending and some of the types of existing roll bending machines in the market and their working principals are explored. In addition, the design equations which have to be put into consideration for the design of the different parts of the bending machine are also explored in the same chapter. Chapter three covers the design process that was undertaken to design the different parts of the sheet metal bending machine, fabrication of the prototype and subsequently testing of the fabricated prototype.

The designed sheet metal bending machine was found to be capable of bending sheet metal of up to 2mm thickness without fail and using less force. The maximum bending angle realized was 360^0 (measured from the centre of the formed cylinder) and after spring back, the angle was determined to be 297^0. This can be easily pressed together during welding. The sheet metal bending machine was found to be capable of performing work at the institutional workshops and local artisan shops.

DEDICATION

To my loving and caring dad, Mr.SsenfumaAdbuhSamadKitiibwa and also in remembrance of the most perfect mom in the world, Mrs. SsenfumaZainabuBiryeri (May ALLAH forgive her for what went wrong in this worldly life and grant her paradise on the day of judgment.Ameen)

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim (In the name of Allah, the Beneficent, the Merciful). All glory and thanks go to ALLAH (S.W.T), who has granted me the gift of life and a chance to reach this moment of undertaking this project and I pray that HE grants me more time to live and ascertain its contribution to the case study area…Ameen.

To my supervisors, Dr. Wandera Catherine and Mr.Kimera David, I sincerely appreciate you for all the time, support, guidance and advice that you readily provided during the execution of this project right from the proposal stages, may your prayers in life always be answered. More thanks go to the entire staff of Agricultural Mechanization and Irrigation Engineering (AMI) department especially Ms. Njuki Hope, Mr. Otim Daniel and all those who readily gave me a go ahead to work on this project with guidelines to follow.

Next to this category, is the entire staff of AEATREC_Namarele, with special thanks to Mr. Ssasa Richard who accepted me to freely utilize the available resources in the workshop while fabricating the final prototype and with gratitude, to Mr, Oluput Joseph, who has always been like a brother to me and provided all the support that he could during fabrication of the prototype. I pray that ALLAH, The Almighty finds a special way to reward you for all your endeavors.

Lastly to all my fellow students in my AMI of 2009 class who rendered all that was within their reach towards the accomplishment of this project, only ALLAH the almighty can reward you generously for only HE, knows how to reward the good work of HIS creations.

DECLARATION

I Senfuma Ibrahim, hereby declare that the work presented in this project report is my own and has not been presented to any University or higher institution of learning for any academic award.

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SENFUMA IBRAHIM

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AEATREC - Agricultural Engineering and Appropriate Technology Research Centre

AMI - Agricultural Mechanization and Irrigation Engineering

B.M - Bending Moment

Co. – Company

e.g. – for example

etc. - et cetera

N.A - Neutral Axis

SAIMMCO – Soroti Agriculture Implements and Machinery Manufacturing Company

STIL - Steel & Tube Industries Limited

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Sheet metal is metal that is formed into thin and flat pieces. It is one of the fundamental forms used in metal working and can be cut and bent into a variety of different shapes using various machines. Sheet metal forming processes are used to fabricate various parts of agricultural implements including mould boards, land wheels, hoes, hoppers and covers. Also parts of different agro-processing machines- e.g. maize hullers, rice threshers, planters, cassava chippers, metallic silos, maize threshers, etc -are made of sheet metal (Tonnet, 2012). Industries and organizations in Uganda - such as AEATREC, SAIMMCO, Tonnet, institutional workshops (e.g. Busitema University Workshop), and the local artisans - are involved in fabrication of agricultural machinery using sheet metal. Additionally, various factories in Uganda - namely Steel & Tube Industries Limited, Sembule Steel Mills Limited, Roofings Limited, Steel Rolling Mills Limited, Uganda Baati Limited etc - are involved in sheet metal production.

There are various sheet metal forming processes that used to form products of the desired shapes. The commonly used sheet metal forming processes include: cutting/shearing, punching, bending, and embossing (The University of Rhode Island, 2012). In highly skilled industries, sheet metal bending is accomplished by use of automated bending machines which can bend thin to thick sheet metal. The automated bending machines require a high initial investment and also consume a lot of electrical power for operation hence these are expensive for the operations of the small institutional workshops and artisan sheet metal fabrication shops (American machine tools Co., 2012). In Uganda, most of the sheet metal forming processes especially bending is accomplished in institutional workshops and artesian shops by use of rudimental methods and tools like hammers and anvil. Bending is done by hammering the sheet metal on the anvil until the required part geometry is achieved. This is a highly time wasting and energy consuming methods that cannot be sustainable when a large quantity of work is to be done. Additionally, hammering method produces poor quality or non- uniform parts in case many parts of the same type are to be

REFERENCES

American Machine Tools Company, 2012.*Plate bending rolls and slip roll machines* [online]. Available at: http://www.americanmachinetools.com/bending_rolls.htm [Accessed 27October 2012 at 9:34am]

Answers.com, (2012).*Sheet metal* [online]. Available at: http://www.answeres.com/topic/sheet-metal [Accessed 22nd/10/2012 at 10:25 am].

Available at: http://180.149.53.48/mfvlab/SheetMetal.php [Accessed 24th/10/2012]

Bhandari V.B., (2007), Design of Machine Elements, Second Edition, ISBN 0-07-0611416, 978-0-07-061141-2, Published by McGraw-Hill Companies.

George H. Thomas, 1976. Workshop bending rolls. *Model Engineer in Britain,*[journal]. Available at: http://www.metalwebnews.com/howto/rolls/BendingRolls.pdf [Accessed 17October 2012 at 5:44 pm].

Hearn E. J., 1997. *Mechanics of materials I:An Introduction to the Mechanics of Elastic and Plastic Deformation of Solids and Structural Materials.* 3rd Edition. United Kingdom. Scotprint, Musselburgh.

Khurmi R.S., GuptaJ.K.(2005). *A textbook of machine design(SI units).*Ram Nagar, New delhi-110 055, Eurasia publishing house (Pvt.) ltd.

The University of Rhode Island, (2012).*Sheetmetwworking* [Online].Available at: http://mcise.uri.edu/vms/ISE%20240/Sheet%20Metworking-1.pdf[Accessed: 21st/10/2012 at 12:05 pm]

Tonnet,(2012). Available at: http://www.tonnetagro.com/ [Accessed 7th/11/2012]).

Virtual lab-Dayalbagh Educational Instotute, 2012.*Sheet metal working* [online].