

DESIGN AND FABRICATION OF PROTOTYPE OF MULTIPURPOSE MACHINE FOR SHEET METAL OPERATIONS

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Abstract

Sheet metal is basically a thin sheet of metal by using several operations. Nowadays it has become one of the most important and fundamental forms in metalworking.[10] the advantage of sheet metal is that it can be bent into variety of desired shapes. Lots of everyday objects are being manufactured using sheet metal. Sheet metal is mainly used for various aerodynamically shaped car bodies, airplane wings, architecture and many other applications.[9] dent removing/rolling, cutting and v-grooving are the most widely used operations in the fabrication industry. The conventional machines could only carry out any of the above operations simultaneously. If these operations can be done on a single machine, it would not only make work quite easy and less tedious but also increases profitability .moreover, conventional machines are often hand operated for small scale industry applications. Also the time taken on these separate machines that is the overall lead time decreases by making them power operated, resulting in lower cost and higher productivity. Our project is to encompass these operations onto a single machine successfully.

Keywords: Sheet Metal, Rolling, Cutting, V-Grooving

NOMENCLATURE

$[\sigma]$	Tensile stress	N/mm^2
F_s	Shearing stress	N/mm^2
F	Force	N
P	Power	KW
T	Torque	N -mm
S.F.	Service factor	
N	speed	rpm
i	Reduction ratio	
d	diameter of driver	mm
D	diameter of driven	mm
V	speed	m/sec
μ	Co-efficient of friction	
T	tension in belt	N
z	no. of teeth	
Z	no. of starts	
a	center distance	mm
mx	module	mm
L	length	mm
da	Tip diameter	mm
df	Root diameter	mm
p	pitch	mm

1. INTRODUCTION

Today's world requires speed on each and every field. Hence rapidness and quick working are the most important factors. For achieving the same, various machines and the equipment's are manufactured by the man. The engineer is constantly conformed with the challenges of bringing ideas and design in to reality new machine and techniques are being developed continuously to manufacture various products at the cheaper rates and high quality. In the age of automation machine become an integral part of human being. In competition market, everyone strive to increase their production & reduce cost and time constraints. Sheet metal is basically a thin sheet of metal by using several operations. Nowadays it has become one of the most important and fundamental forms in metalworking. The advantage of sheet metal is that it can be bent into variety of desired shapes. Lots of everyday objects are being manufactured using sheet metal.[10] Sheet metal is mainly used for various aerodynamically shaped car bodies, airplane wings, architecture and many other applications.[9] The increased consumer demand in India from particularly the Automotive, Aerospace, construction and Electronics industry facilitated for manufacturers and suppliers of Sheet Metalworking and related services. The demand for

Automotive Industries' end product in India has increased by 50% past 3years as estimated by Bric. [7]

1.1 V-Grooving

In V- grooving operation, a pair of punch with a desired angle of bends causes the metal strip or sheet into a wedge shaped groove as it is passed through the die. The bend angle is given as per the requirement of the operation. The deformation is achieved as the contact forces by the punch causes a sufficiently large bending moment to make the desired groove. Plane strain conditions are established in the center of the sheet if it width is more than 10 times its thickness. The required die set according to the type on groove required is installed on the load bearing shaft and the nut bolts are tightened. The required gap between the two grooving dies is adjusted with the help of actuation gears. Lesser the gap thinner the sheet can be grooved. The shape of the grooves depends upon the formed shape of the male and female dies. For having grooving operation of thicker sheets, the gap between the two die is increased. When the handle is rotated the gear installed on the handle shaft linked with the grooving gear, it rotates one die gear. The male die rotates over the female die and the sheet advances through them having groove on it. [3]

1.2 Straight Cutting

Straight cutting of sheet metal with shearing can be comparatively easy and can have long life if maintained properly. A metal sheet is passed through two cutting rollers having a sharp cutting edge. For easy and comfortable cutting, the edges should be sharpened regularly. The alignment of two blades is also an important factor in order to have perfect cutting. When machine starts to give poor cuts it is likely that the cutting edges have become blunt. Shear cutters are nothing but cutting tools and like any other cutting tool the cutting angle and finishing play an important role in the performance of cutting tool. Lower blades are sharpened and kept to the same specifications as upper blades are kept. The blade should be sharpened at an angle of eight degrees and must be straight along the entire length so the clearance between it and the upper blade is uniform. A poor cut can result if proper and uniform clearance is not provided.. The extremely fine edge is ideal for producing clean, sharp cuts on soft plastics. This sharp edge tends to dull more quickly and require more frequent sharpening.[8]

1.3 Dent Removing

The Dent is physical plastic deformation on sheet metal and look like hill and valley type pattern on sheet surface. This dent creates problem while manufacturing and with the surface finish of the sheet metal. Also after completing sheet metal job if minor dents remain, it'd be visible after painting or plating due to which the complete job would be rejected. So to remove these type of dents, we made an arrangement to remove dent from sheet metal by rolling operation.

2 GENERAL PROCEDURE IN MACHINE DESIGN

The general steps to be followed in designing the machine are as follows:-

1. Preparation of a statement of the problem indicating the purpose of the machine.
2. Selection of groups of mechanism for the desire motion.
3. Calculation of the force and energy on each machine member.
4. Selection of material.
5. Determining the size of component drawing and sending for Manufacturing.
6. Preparation of component drawing and sending for manufacture.
7. Manufacturing and assembling the machine.
8. Testing of the machine and for functioning

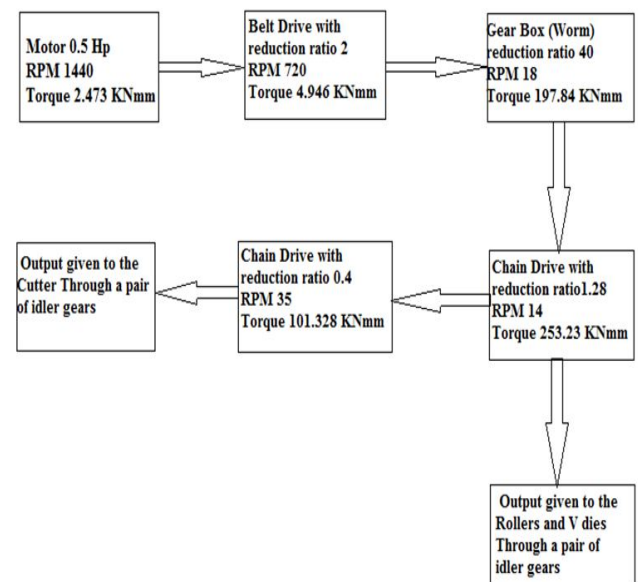


Fig.1. Flow Chart of Working of the Machine.

As seen from above, in order to obtain necessary speed and torque, speed reducers are used from the motor, a torque of 253KN is required for rolling and V-grooving for a given selection of sample sheet of Mild Steel of thickness 2 mm. Hence a worm gear drive is used for this purpose. For cutting operation torque is transmitted via chain drive.

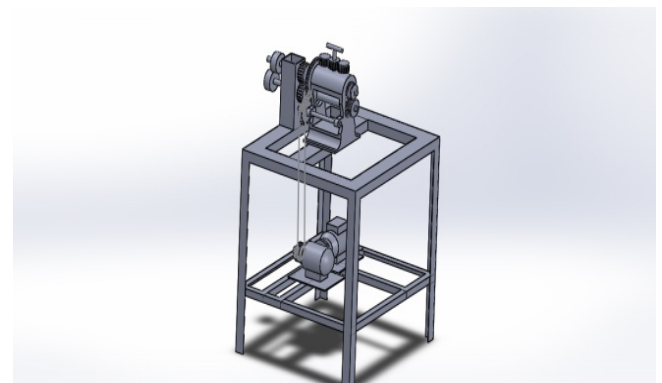


Fig.2.a. Assembly of the actual prototype.

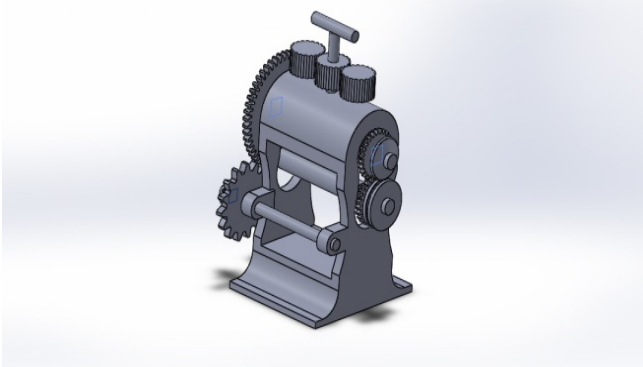


Fig.2.b. Model of the multi-operation mechanism.

3. MATERIAL SELECTION

The proper selection of material for the different part of a machine is the main objective in the fabrication of machine. For a design engineer it is must that he be familiar with the desired properties of the materials for the given purpose. For any engineering purpose, following are the factors that are ought to be taken into consideration;

1. Material Availability.
2. Suitability in service conditions.
3. Cost of the material.
4. Physical and chemical characteristics of the material.
5. Mechanical properties of the material.

Sr No.	Part Name	Material
1	Frame	Mild Steel
2	Chain Drive	Standard Component
3	0.75 hp 1200 rpm Motor	Standard Component
4	Gear Box	Mild Steel
5	Pulley	Cast Iron
6	Gear	Medium C Steel
7	Cutter	WPS
8	V-Grooving Die	Mild Steel

4. APPLICATIONS

Sheet metal operations are used in jewelry industries, texture forming industries, interior decorations and many such small scale industries. With our proposed machine these operations can be carried out on a single machine at a cost approximately equal to the conventional machines.

5. RESULTS AND DISCUSSION

For designing the system, motor is kept as primary constraint. Accordingly the design calculations for all the necessary components are done. Although we've designed the system with the necessary safety factors, these are theoretical values that we've obtained for the components. But after actual market research for the availability of the components, we may or may not be able to procure the components of our desired dimensions. In such case, standard components with approximate conformance with our desired values would be procured and corresponding modifications would be done.

5. CONCLUSION

In this project we have aimed to reduce workload, space, time, money associated with the Cutting, V-Grooving and Dent Removing operations by incorporating them in a single, multipurpose machine. As all the operations can be performed at one place and small area this machine will be very useful in small scale industries. We have used only v-grooving die in this machine, but we can attach any die as per our convenience and can perform any type grooving on this machine. Thus this machine performs all three task of Cutting, V-grooving, Dent removing properly.

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7. REFERENCES

- [1]. PSG college of technology, *Design data book*, Coimbatore, 2007
- [2]. Hajra and Choudhary, *Elements of workshop technology*, India, 2003
- [3]. Faizahmed, A., Riyajhusen, K. D., Tosif, I. K., Sawood, S. M., & Wasim, L. P. (2015)
- [4]. *Model of Multipurpose Sheet Metal Processing Machine* 3(01), 1305–1306.
- [5]. Liewald, M., Bolay, C., & Thullner, S. (2013). Shear cutting and counter shear cutting of sandwich materials. *Journal of Manufacturing Processes*. <http://doi.org/10.1016/j.jmapro.2013.03.001>
- [6]. Company. (n.d.). Optibelt Technical Manual for V belt Drive
- [7]. Punjab college of engineering and technology Research scholar, *Methods to improve mechanical properties EN31(high carbon steel)and D3(high carbon high chromium steel materials)*
- [8]. www.bricpartner.com/en/Nd/i/more/Sheet+metal+working+technology+opportunities+in+india/idn/2126
- [9]. www.antaesinc.com
- [10]. wikipedia.org
- [11]. www.spaceclaim.com