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DESIGN OF SHEET METAL PROFILE GAS CUTTING MACHINE BY USING SCRAP

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ABSTRACT

Global competitions and technological advances are forcing manufacturers, designers and engineers to regularly innovate new product manufacturing techniques in reducing product manufacturing cost and time. Contemporary manufacturers have the option of selecting optimum technologies or processes to suit their manufacturing environment. Profile cutting is a process that is used to cut steel and other metals of different thicknesses (or sometimes other materials) using a torch. In this process, a gas is blown at high speed from a nozzle; at the same time an electrical arc is formed on the surface of metal due to gas from the nozzle to the surface that is to be cut, turning some of that gas to profile. Here design of various components required for gas cutting machine is made & calculations are interpreted in the paper.

Keywords : Gas cutting ,Profile cutting

I. INTRODUCTION

An electromagnetic sheet metal profile gas cutting machine is an important instrument in a workshop. Actually many metal cutting operations in workshop needs gas cutting. This machine is aimed to reduce the efforts of workers required for gas cutting operations and also minimize the time required for operation. This project aimed to develop a gas cutting machine for sheet metal profiles in small workshops/industries within a reasonable cost than the machines which are available in the market.

1.1 PROBLEM STATEMENT

In sheet metal industry, it is required to cut different profiles with desired shapes. Previously this was done manually by the worker which had following drawbacks.

- The process was time consuming which lead to pending of the work.
- Due to repetition of the work, the process caused boredom and fatigue to the worker.
- It was difficult to apply consistent flow of gas torch in cycle manually.
- Cost of automatic profile cutting machines is more .
- Machines of this type having heavy weight.

To eliminate above limitation of manual testing it was necessary to develop mechanism.

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1.2 OBJECTIVES

This project was developed to study about the profile gas cutting machine in smooth cutting using gas cutting process .The main purposes of this project are listed below

- To study about the influence of profile gas Cutting Parameters on Mild Steel.
- To study about the best combination of solution using gas cutting, motor and tracer, template, nozzle torch.
- To reduce time required to generate the profile.
- To achieve required surface finish.

1.3 SCOPE OF STUDY

The main requirement of machine is to use in small scale workshop and for semi-skilled worker. It also helps to reduce risk of injury to worker.

- This project focuses on the optimization of cutting parameters of profile gas cutting.
- The material used to cut was mild Steel of specification AISI 1018.

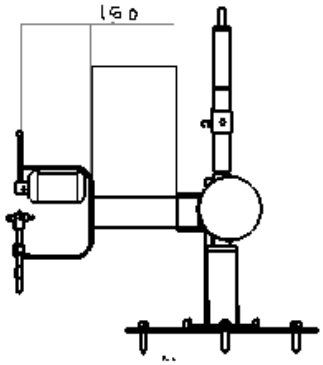
II. PRINCIPLE OF GAS CUTTING

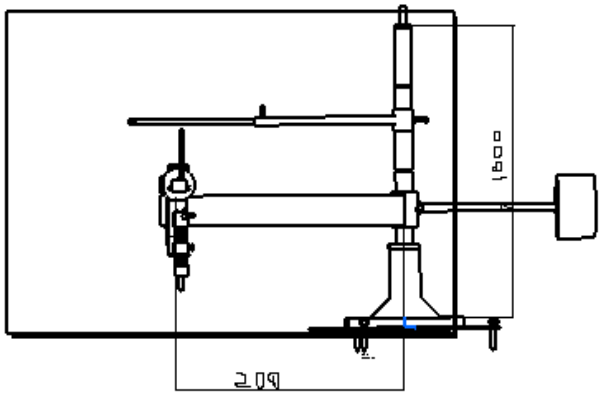
In gas cutting, the metal is first preheated with the oxy fuel flame up to the ignition temperature. When the necessary temperature is obtained, then oxygen is turned on, and the stream of pure oxygen is applied against the heated metal. This ignites the iron or steel and starts the cut. When iron or steel is heated to a temperature of 1600º F, it will burn if brought into contact with oxygen. The fuel flow is controlled by using the torch fuel valve and preheat oxygen flow is governed by the valve on the side of the cutting attachment. The cutting-oxygen jet is controlled by pressure on the lever mounted on top of the attachment. Oxygen to both the preheat oxygen valve and the cutting oxygen lever valve is supplied through the torch oxygen valve which is opened wide during cutting operations.

III. WORKING

Profile gas cutting machine is a precision, quality constructed, hard-working gas shape cutter build for high production. Compact and simple operate; this machine excels at repetitive work, flame which is continuously producing accurately cuts the required shape by following a steel template. A powerful magnetic roller smoothly guides the cutting torch around any shape, cutting steel plate up to 4 inches thick. This machine offers all the convenient features of more expensive models with all the dependability and efficiency needed for our applications. The tracing roller is magnetized by a solenoid coil or permanent magnet and driven by an electric motor follow the edge of steel template of virtually any shape guiding the cutting torch to cut the desired profile. S.C.R control ensures Table step less speed variation and smooth running. Thrust ball bearing used on rotating joints provides free and frictionless movement of arms. Efficient design of rack and pinion system ensures smooth and easy movement of cutter.

Fig.3.1. Shows 2D design of project.





IV. MANUFACTURING AND FABRICATION

Table 4.1: List of standard components

Sr. No	Name	Quantity	Material
1.	Thrust Bearing	2	M.S
2.	Ball Bearing	2	M.S
3.	Bolt (M20, M16, M10, M6, M4)	11	M.S
4.	Nut (M6, M10, M16, M8, M20)	14	M.S
5.	Nozzle	1	Bronze
6.	Electric Motor With Gear Box	1	M.S
7.	Magnetic Coil	1	Copper
8.	Magnetic Coil Holder	1	M.S

4.1. MANUFACTURING METHOD

Table 4.2 Manufacturing Method List

SR. NO	COMPONENTS	MANUFACTURING METHOD(PROCESS)
1	C-SHAPE FRAME	BENDING, CUTTING, DRILLING, WELDING
2	ARM	CUTTING, DRILLING, WELDING
3	HOLLOW PIPE	CUTTING, TURNING, FACING
4	COUNTER WEIGHT	DRILLING
5	TEMPLATE	GAS CUTTING
6	MAIN COLUMN(ROD)	CUTTING, FACING, TURNING, THREADING
7	CENTER SHAFT	CUTTING

V. DESIGN OF ASSEMBLY COMPONENTS

5.1 C-SHAPE FRAME

Material: 30C8 (Mild Steel).

S_{ut}=440MPa (Ref. Design data book).

FOS= 4(Ref. Design data book).

$\sigma_{all}=\frac{Sut}{FOS}$

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$\sigma_{all}=\frac{Sut}{FOS}$

$=\frac{440}{4}$

=110MPa

P=26.48N (Weight of motor and Nozzle)

M=P.e (e=eccentricity).

=26.48 × (90+t)N-mm

$I=(\frac{1}{12}) \times (t \times (2t)^3)$

$=(\frac{8}{12}) \times t^4$

$\sigma=(\frac{P}{A})+(\frac{M.x}{I})/(I)$ (A=cross section area)

$110 =(\frac{26.48}{(4t^2)}) + (\frac{26.48 \times (90+t)\, 8t}{\frac{8}{(12 \times t^3)}})$

$110 \times t^3 - 46.34 \times t - 3522.3 = 0$

t=3.21mm ≅5mm.

5.2MAIN COLUMN (ROD)

Material : 30C8 (Mild Steel).

Sut: 440Mpa (Ref. Design data book).

Factor of safety:4(Ref. Design data book).

Calculation for column:-

P = Load on column = 8.366 × 9.81

= 82.07 N

e =500mm

$\sigma_t=\frac{440}{4}$ = 110 N/mm

Direct Compression

$\sigma_c=\frac{P}{A} = \frac{82.07}{\frac{\pi}{4}d^2}$

$=\frac{104.40}{d^2}\frac{N}{mm^2}$

Tensile stress due to bending moment

$=\frac{P_{ey}}{I}=\frac{82 \times 500 \times 0.5d}{\frac{\pi}{4}d^2}$

$=\frac{261012.41}{d^3}$

$(\frac{261012.41}{d^3})-(\frac{104.40}{d^2}) =110$

$26101.41 - 104.40d = 110d^3$

$110d^3 + 104.4d - 26101.41 = 0$

d = 6.13mm

$\frac{417622.25}{d^3} = \frac{104.40}{d^2}=110$

$417622 - 104.4d = 110d^3$

$110d^3 - 417622.5 + 104.4d = 0$

d = 15.57mm ≅20mm.

5.3 ARM

Arm 1

H=80

B=40

$\frac{\sigma}{y}=\frac{M}{I}$

$I=\frac{BH3-bh3}{12}$

$I=bh^3-(b-2t)\times(h-2t)^3$

t=2mm

Arm 2

H=100

B=50

$\frac{\sigma}{y}=\frac{M}{I}$

$I=\frac{BH3-bh3}{12}$

$I=bh^3-(b-2t)\times(h-2t)^3$

t=3mm.

5.4 HOLLOW PIPE

Calculation for Hollow Pipe:-

P = Load on column

= 8.3×9.81N

= 82.07 N

e =500mm

$\sigma t=\frac{440}{4}$= 110 N/mm

Direct Compression

$$\frac{P}{A}=\frac{82.07}{\frac{\pi}{4}(d_o{}^2-20^2)}$$

$$=\frac{82.07}{\pi(do^2-20^2)}$$

$$=\frac{104.49}{do^2-20^2)}\frac{N}{mm^2}$$

Tensile stress due to bending moment

$$\frac{M_{ey}}{I}=\frac{82.07\times500\times0.5do}{\frac{\pi}{64}(d_o{}^4-20^4)}=\frac{41797907\,do}{(do^4-20^4)}\frac{Nmm^2}{mm^4}$$

$$\frac{d_o}{d_i}=k$$

Hollow pipe

d_i=23mm

d_o=27mm.

VI. RESULT AND DISCUSSION

Upon development of profile cutting machine work has been carried out on different template shape and material thickness. When the thickness of sheet to be cut is increasing, it's cutting speed decreases. It is found that thickness of sheet to be cut increases, pressure of oxygen gas increases almost linearly, while the pressure of LPG gas remains the same. It is also found that surface finish of manufactured profile is achieved .Time required for cutting different shapes are shown in Table6.1.

Table No 6.1. Time required for different shapes

SR.NO	PROFILE SHAPE	TIME	THICKNESS OF MATERIAL
1	CIRCULAR	80SEC	10MM
2	SQUARE	70 SEC	10MM
3	SQUARE	45 SEC	6MM

Fig 6.1 Actual profile cut by machine

VII. CONCLUSION AND FUTURE SCOPE

7.1 CONCLUSIONS

In past decades man is constantly trying to gain more and more comfortness. Man attempt has been made to develop more and more modified technique with increasing the aesthetic and economic concern. Hence there is always more scope towards whatever he might has done and also having the experience of the presently manufactured things. But being the Engineers and having the ability to think and plan. But due to some time limitations, and also due to less funds, we only have put in the report the following future modifications.

- Thickness increases time required for machining also increases.
- Surface finish obtained is good.
- After manufacturing no need of surface finish.
- Time required is less than manual gas cutting.

7.2 FUTURE SCOPE

In the future use of profile gas cutting machine would be fast and comfortable by using PLC with microcontroller. Profile templates could be loaded and unloaded automatically where various profile templates to be machined. We can use electromagnet or different sensors at place of magnetic roller, machine can be made more comfortable to user also by using new technology machine can work at any environmental conditions.

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