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# Fixture for Plasma Cutting Machine for Circular Cuts

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**Abstract:- This paper includes the design of fixture to guide the plasma cutting machine in circular cuts. An attempt has been made to gather different techniques together and design a model which increases the flexibility in the process considerably.**

***Keywords:-*** *Fixture, Plasma, CAD, ANSYS.*

## I. INTRODUCTION

Ship Building Industries and other commercial scale industries working on plasma cutters require that the processes based on plasma cutting should be completed with maximum safety and efficiently. Most of the industries have to relocate the parts to be cut from the assembly line up to the work stations which becomes too hectic. The sole aim of this fixture will be to solve the above requirements.

## II. PROBLEM DEFINITION

- Collecting information from the industries based on current scenario.
- Developing Mechanical linkages in order to cope the working of all the equipment.
- Designing the CAD model to ensure satisfactory working
- Testing the model created with providing the desired working environment
- Fabricating the designed fixture.

## III. OBJECTIVE

The main aim of the work is to replace manual plasma arc cutting process to fully automatic process. Small scale plasma cutters have manually operated torch for machining held by a worker who undertakes a lot of risk, by making the process of cutting automatic the risk factor which exists in working intensity plasma can be reduced. The change in design of any sheet metal may result in disturbance of entire assembly line-up. By the use of some electrical equipment and mechanical linkages the fixture can be attached to the walls or the roof a structure on which the cut is to be made.

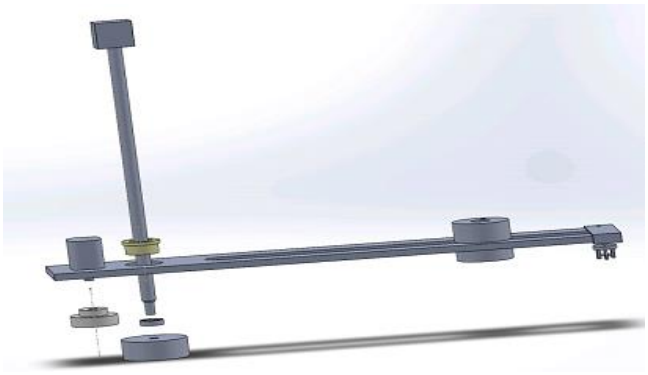

Fig 1:- CAD Model of the Fixture

## IV. DESIGN OF THE FIXTURE

The project deals with designing the fixture with the help of the CAD model created to make sure that the actual fabricated model would work the same way as expected.

The model created was supposed to show exactly the same working which was proposed by the CAD model created. The complete model of fixture included the following components

| Sr. No. | Components | Description |
|---|---|---|
| 1 | Rotating Arm | Acrylic |
| 2 | Electromagnet | Stainless Steel, 12 V DC, 0.84 A, 50 kg load carrying capacity |
| 3 | Handling Rod | Stainless Steel 304 |
| 4 | Wheel | Aluminium and Nylon |
| 5 | Bearing | SKF 6202 |
| 6 | Bush | Nylon |
| 7 | Tool Holder | Nylon |
| 8 | Motor | 12 V DC, geared, 10 rpm |
| 9 | Section Driver | Nylon |

Table 1

### *A. Fabrication of Parts*

- Rotating Arm- Slotting and drilling to provide provisions for the tool holder as well as the motor
- Electromagnet- Internal Threading to adjust the height with respect to the handling rod
- Handling Rod- Hollow Rod with press fitted hollow thread. Thread is hollow so that the connections of the electromagnet are not interrupted by the rotary motion
- Wheel- Smooth Circular motion is provided and is attached to the tool holder
- Bearing- Provide relative smooth motion of the plate around the handling rod

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- Bush- To help the motor to come in contact with circular electromagnet
- Tool Holder- To guide the cutting torch
- Motor- To provide the rotary motion of the fixture around the electromagnet
- Section driver- It also guides the motion around the electromagnet

General Specifications of the performing parts were known and then a rough sketch of assembly was developed and thus all the above mentioned components were selected in the manner to make sure that the correct choice of different mechanisms were selected.

This was followed by the detailed design of all the individual parts involved based upon their role in the fixture. Finally proper design model was generated by considering all the tolerances and other factors.

*B. Assembly*

The important aspect which was to be considered while the assembly initiated was to make the fixture strong and heat resistant because a lot of heat was supposed to be generated.

The plate was first fabricated with the desired drill holes and slot. The slot was made such that it provided the minimum as well as maximum radius cut.

Now the handling rod which is hollow is press fitted by another solid rod and thus thread is provided on the solid part of the rod.

The thread of this handling rod meshes with the internal thread of electromagnet. Thus, providing adjustments as well as the connection of the structure with the load bearing electromagnet.

This electromagnet externally meshes with the driver of the motor and thus rotates along the electromagnet.

The motor itself is attached to plate by means of bolt and is connected to the driver. Thus, the power gets transferred from the motor to the driver and finally the driver makes the entire fixture to rotate around the electromagnet.

It is made sure that the wires of the electromagnet don't wind up on the handling rod, the wires are passed internally from inside the thread through the hollow rod

The tool holder is inserted inside the slot of the plate and thus at required position id fixed by means of another bolt.

Wheel is fixed on the tool holder to make sure that the operation or we can say the circular motion of the fixture is smooth on the work piece.

C. *Working*

The switches are provided at the top of handling rod for the electromagnet as well as forward and reverse supply for motor. The centre of the electromagnet is matched with the centre of the required circular cut and is switched on. Thus, the fixture is attached at the desired location. Now the motor is switched ON and the tool holder rotates making the plasma torch rotate with it and thus cutting the workpiece.

For the desired thickness and radius, the data was obtained from a local plasma cutting shop which was the supplier of small circular sheets. Following table shows the data which was obtained.

➢ *Stainless Steel*

| PLATE THICKNESS (mm) | CUTTING SPEED (m/min) | ORIFICE DIAMETER (mm) | CURRENT (A) | POWER (kW) |
|---|---|---|---|---|
| 6 | 7.5 | 3 | 300 | 60 |
| 13 | 5 | 3 | 350 | 70 |
| 25 | 2.25 | 3 | 400 | 80 |

Table 2

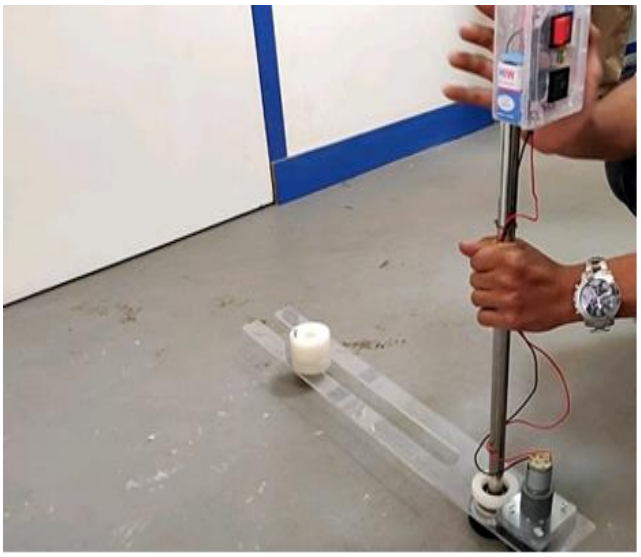

Fig 2:- Fabricated Fixture

*D. Analysis of the Fixture*

The high temperatures associated with the plasma as well as with the workpiece due to conduction of heat in the workpiece raised a concern about the ability of the fixture to resist the heat. The developed CAD model was tested against the heat loads which will be generated when the fixture is brought under actual working conditions.

Following is the result obtained by analyzing the fixture by providing heat Loads

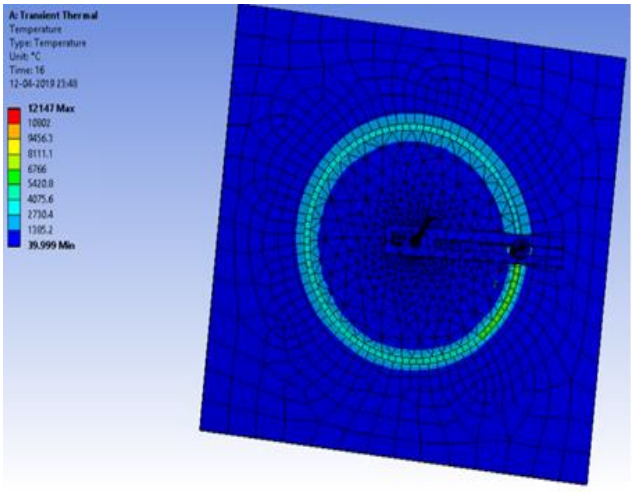


Fig 3:- Analysis of Fixture

## V. CONCLUSION

By fabricating the fixture according to the created workplan the desired objective of guiding the plasma torch was achieved. The electromagnet was able to fix the fixture at the desired location as the process of cutting took place. Most importantly the manual operation was made automatic which will reduce errors and orientation of the cut will never be a problem.

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