

# Design and Development of Special Purpose Welding Machine

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**Abstract**— In this project, we will be doing Design, Analysis & Manufacturing automation for circular parts welding with uniform weld structure using PLC. We will be designing & manufacturing the turntable, which will be rotating at specific required speed depending upon the requirement of fillet material to be added. Further, the electrode nozzle is kept stationary, which will be in contact with the surface of components to be welded. Hence, in this project, a detailed design for converting the conventional MIG welding (ARC) machine into an automated circular component-welding machine has been proposed. Along with this main modification the existing MIG welding machine – (a stationary downward ARG – HEAD which has provisions for horizontal and upward movements) is to be modified into portable robotic welding machine.

**Keywords:** PLC, HMI, Welding, Mig, Automation

## I. INTRODUCTION

In now days of mass production, it is often required data to automate the manufacturing processes that were conventionally done manually. In presence various welding technique is used for the welding purpose such as CO<sub>2</sub> welding or Electric arc welding, TIG (tungsten inert gas welding), in that various fixture is use for various welding, but in many application we use some techniques which does not work efficiently & accurately. Moving the electrode along the welding line is a skill full work and especially for circular component welding rotator. The need of a special device, which can rotate the job at a fixed rate to assist the welding process for circular component and ensure good profile and homogeneous welding. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, under water and in outer space. Regardless of location, welding remains dangerous, and precautions are taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light.

### A. General

Welding is a process in which materials of the same fundamental type or class are brought together and caused to join (and become one) through the formation of primary chemical bonds under the combined action of heat and pressure. The definition found in ISO standard is “Welding is an operation in which continuity is obtained between parts for assembly, by various means”. Hence, the welding is the fusion of two or more pieces of metal together by using the heat produced from an electric arc welding machine. Arc welding dates back to the late 1800’s, when a man was welding with a bare metal rod on iron, the sparks from the welding caught a stack of newspapers on fire near him and

while welding, he noticed that his welds started looking a lot better. The reason for this was the smoke took the oxygen out of its welding environment and decreased porosity. The arc is struck between the electrode and the metal. It then heats the metal to a melting point. The electrode is then removed, breaking the arc between the electrode and the metal. This allows the molten metal to “freeze” or solidify. The arc is like a flame of intense heat that is generated as the electrical current passes through a highly resistant air gap.

## II. PROBLEM STATEMENT

In CO<sub>2</sub> welding or sometimes electric arc welding the need often arises for welding of circular shape components, where the welding is carried out on the entire periphery or a partial arc length of the job. The electrode is thus moved along this circular path in the conventional method. However, movement of the electrode is much more difficult and it is much easier to index the job. For welding the current work piece Cycle, time is higher i.e. 45-60 sec. So need to develop such a system for easy work piece loading and & auto welding gun positioning. Auto ON/OFF the switches of welding machine to achieve the smooth working.



Fig. 1: CO<sub>2</sub> welding for pipes

## III. OBJECTIVE

The main purpose of this research is to develop this system & In order to approach this purpose, we follow.

- 1) Design the indexing table rotary motion of component to be welded
- 2) Load caring capacity up to 25 kg
- 3) Material procurement & Drawing Release for manufacturing
- 4) Fixture design for welding gun fitment for angular motion during loading & unloading of job
- 5) Utilization of Mitsubishi PLC for automation work of complete project work
- 6) Utilization of pneumatic cylinder for gripping job / locating the welding gun

Testing & complete of complete project within prescribed time

### A. Basic Objectives:

- Reduce operator effort and increase efficiency
- Multi field application that is industry, household, agriculture, etc.
- Generation of smooth & finish job piece

- Multi-purpose application that is system to be Compactable with other applications such as Sand blasting, Spray painting etc.

#### IV. NEED FOR PROJECT:

Robotic welding systems offer three main advantages: consistent weld quality, increased output, and decreased variable labour costs. Consistent weld quality the welding task associated with the magnet coils is extremely labour intensive. With most labour intensive tasks, quality tends to decrease the longer the activity is continued. Unlike a manual welder, a robotic system is not subject to fatigue and is able to sustain high quality welding for prolonged periods. Well-designed robotic systems have the capability to repeat any taught action with the same quality results. This attribute is important since there are several different magnet configurations and each configuration is used multiple times. Increased output Industrial experience suggests that the average robot can weld at least twice as fast as a skilled manual welder.

The increased speed helps avoid potential delay due to the welding operation, and a quicker turnover of magnet coils can be realized. Decreased variable labour costs due to the increased output, overall labour time is shortened and labour

#### V. LITERATURE REVIEW

- 1) "Special Purpose Machine for Linear Welding" Prof. Shendage Yogesh, Maske Dikshant, Kawachat Nivruti(NCRIME-2018 ).In today's edge of technology the demand of precision is increasing. The tradition methods are replaced by the automation to increase accuracy and precision increase the quality of welding, incorporation of the semi- automated welding machine is done for certain application. For that different parameters and methods have to be considered from different research paper for the welding machine for selection of mechanism like controller, welding process, weld angle etc. to get accuracy and quality weld. The technical constraint that has to be considered while designing and developing the machine is to achieve the stability, degree of freedom, linear and angular motion, and uniform speed of the welding torch for feed and uniform thickness of weld for quality product.
- 2) Fu-senRen Xiao-zehad developed a new type of special welding robot, which mixed design method of series and parallel and realized the integrated design of organization for robot and anchor. The robot kinematics is build and realized the real time control of welding torch position, orientation and welding speed during welding process.
- 3) A.M.Vaidya and P. M. Padole had calculated the flexibility of the links and joint stiffness.
- 4) Zhao Yang has described effect of plasma torch scanning frequency on temp. Distribution at molten pool surface. In simulation plasma torch power is 750 kW, melting rate is 300kg/hr the torch scanning frequency changes from 0.0833 Hz to 0.5 Hz.
- 5) ION Lucaciu had worked on welding head enables vertical positioning of welding wire relative to electrode position, adjusting the lead angle when entering into metal bath or turning device for bringing the welding wire in front of or behind the torch according to direction of welding
- 6) R. Xiao has worked on function of pressing wheels device is to provide the clamping force to sheet plates through a pressing wheels rolling on surface of sheet plates which is generated by compressed spring. The position sensors are used to indicate the position compressed spring. On other hand, they are necessary for connection and support for the components of clamping devices. The region of compact force of spring device is designed from 50 N to 500N, which can meet requirement in actual welding.
- 7) "Design and Manufacturing of Automatic Circular CO2 Welding Machine", A. Dhage Kalyani P., B. Chavan Harshal A , SPPU, MET's BKC IOE, Nashik, India Automatic circular CO2 machine tools are designed and manufactured for specific jobs and such never produced in bulk, such machines are finding increasing use in industries the techniques for designing such machine would obviously be quite different from those used for mass produced machine. A very keen judgment is essential for success of such machines. Circular Co2 welding process is a very critical welding which is done on cam shaft with different profile cams, to achieve the dimensional accuracy for different cam shaft welding on same platform special purpose machine is required. Using PLC and SCADA systems, we can synchronize the outcome.
- 8) Irfan Sheikh, Studied the MIG welding parameters are the most important factors affecting the quality, productivity and cost of welded joint, Weld bead size, shape and penetration depend on number of parameters. The quality of a welded joint is directly influenced by the welding input parameters.
- 9) Mithari Ranjeet, Describes the welding Positioner with auto indexing which is very important for mass production industries related with circular welding.
- 10) Bapat Prasad V. Studied the Special purpose machine tools are designed and manufactured for specific jobs and such never produced in bulk such machines are finding increasing use in industries the techniques for designing such machine would obviously be quite different from those used for mass produced machine..
- 11) Ganguly Arghya, Describes a PLC based Control System for Hardening and Tempering Furnace in Heat Treatment Plant as implemented at the Siddheshwar unit for Mahindra Automobiles Limited, which is one of India's largest vehicle manufacturing corporation. The proposed system deals with designing of a PLC based control system for Hardening and Tempering Furnace. This paper provides the description of the components implemented for the control system along with the flow of working of various required components. The system is controlled with the help of Messung PLC.
- 12) Prof. Sawant P.R, Discuss the case study and comparison of productivity of component using conventional radial drilling machine and special purpose machine(SPM) for drilling and tapping operation.

13) Patil Kunal V, Describe a novel approach of MIG (Metal Inert Gas) Welding as implemented in a control system based SPM at Gabriel which is the largest manufacturer of shock absorbers in India. The function of the SPM is to weld a knuckle bracket on the circular shaft of the shock absorber. It efficiently helps to fully automate the process of Welding. The paper provides the description of the components implemented in the control system along with the flow of working of various components. The system is controlled by means of a Messung PLC.

VI. METHODOLOGY OF DESIGN AND ANALYSIS

A parameter study is done to evaluate the most crucial parameters for FE analysis of axial ball bearings. The parameters that are evaluated are mesh density, contact stiffness, osculation, load level, geometrical nonlinearity and material nonlinearity. The studies are performed by means of the FE software ANSYS. The accuracy of finite element analysis depends on different parameters such as element type, boundary condition and how the loads are applied etc. Therefore, the FE model is nothing else but an approximate realization of the reality. The parameter study can be done by physical tests. However, it will increase the cost, time and resources consumed and therefore FE analysis is more suitable choice, at least for parameter evaluation.

A. Theoretical Aspects of the Work

In this study, the finite element method is adopted using Pro Engineer and ANSYS as a commercial CAD and FE program. The following chapter contains some fundamentals of the applied theories provided that the reader has an initial knowledge of basic structural mechanics, machine components, and fundamentals of the finite element method.

B. Proposed Block Diagram of Project:

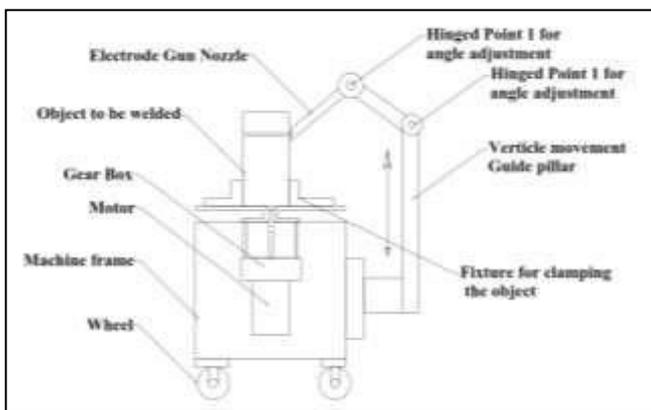


Fig. 2: 2d layout of required SPM

VII. ADVANTAGES

- Circular welding which were done using manual welding it get done by automation. Thus automation welding operation.
- As in torch rotary energy required is very high. So in job rotary there is energy saving compared to torch rotary.
- Operator fatigue get reduced

- Quality of weld joint get improve compared to manual welding.
- Saves time and improve productivity of the industry

VIII.DISADVANTAGES

1. The main disadvantages of the SPM is high initial cost.
2. Also maintenance of the machine is high.
3. High operating cost.
4. Design of the job rotary machine is complex.
5. The machine can be used only for circular welding of components and not for other type of component.

IX.BILL OF MATERIAL

| Sr. No | Component Name                  | Quantity | Cost |
|--------|---------------------------------|----------|------|
| 1.     | Axial load bearing              | 04       | 1950 |
| 2.     | Indexing plate                  | 01       | 1250 |
| 3.     | Set of spur gear with ratio 1:4 | 01       | 2150 |
| 4.     | High torque motor fwd/rev       | 01       | 7500 |
| 6.     | Speed controller ckt            | 01       | 1250 |
| 7.     | Square tube for body 25*25*2    | 02       | 1600 |
| 8.     | SMPS 12 volt 10 Amp             | 01       | 1200 |
| 9.     | PLC                             | 01       | 9750 |
| 10.    | Pneumatic Cylinder with 5/2 dcv | 03       | 2500 |

X.CONCLUSION:

Due to limitations of manual arc welding our project will leads to automation of circular welding, which can successfully achieved in the form of Job Rotary Machine with all desirable features. Also quality improvement and decrease in time consumption of welding process. Company will enjoy benefits of improved lead time, quality, customer satisfaction and increase in the number of orders. Further this SPM allots the benefits to the industry like economical benefits and status improvement among the competitors. We gained unique experience of integrating and evaluating theory and practical aspects of design. This helps us to extract valuable knowledge and data. We are sure that this valuable experience will be helpful in our future in all aspect.

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