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"Design and Development of a Automated Robotic Welding System for Circular Components"

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1.Abstract— In today's era of mass production, there is a growing need for automating manufacturing processes that were previously done manually. Welding is one such process that can be automated to improve efficiency and accuracy. The conventional method of welding circular components involves moving the electrode along a circular path, which can be difficult and time-consuming. This paper presents the design and development of a cost-effective automated robotic welding system for circular components. The system consists of an indexing table for rotary motion of the component to be welded, a fixture design for welding gun fitment for angular motion during loading and unloading of the job, and a pneumatic cylinder for gripping the job and locating the welding gun. The main objectives of this research are to reduce operator effort and increase efficiency, generate smooth and finished job pieces, and make the system compatible with other applications such as sandblasting and spray painting. The paper also reviews relevant literature on special purpose machines for linear welding and new types of special welding robots. The proposed robotic welding system offers consistent weld quality, increased output, and decreased variable labor costs, making it an attractive solution for a wide range of applications.

Keywords: Robotic welding, circular components, indexing table, fixture design, pneumatic cylinder, automation, consistent weld quality, increased output, decreased labor costs.

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 CO2 welding or Electric arc welding, TIG (tungsten inert gas welding), in that various fixture is use for various welding, but in many applications, 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 become much more difficult. To avoid such problem, we implement 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. A process in which materials of the same type are joined together by heat and pressure. Welding is commonly used in mass production to automate manufacturing processes. The article discusses different types of arc welding processes, including SMAW, GMAW, and GTAW. SMAW uses a flux-coated electrode to shield the welding area,while GMAW uses a continuous wire electrode and shielding gas.

GTAW uses a non-consumable tungsten electrode and a shielding gas for precise welding. The article also briefly touches on the history of arc welding and its industrial applications .

II .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.

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.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.

III .PROBLEM STATEMENT

The conventional method of welding circular components involves moving the electrode along a circular path, which can be difficult and time-consuming. The movement of the electrode is much more difficult, and it is much easier to index the job. For welding the current workpiece cycle, time is higher, i.e., 45-60 sec. Therefore, there is a need to develop a system for easy workpiece loading and auto-welding gun positioning. The proposed robotic welding system aims to address these challenges by automating the welding process for circular components.

I. METHODOLOGY

1. Define the problem statement: Identify the challenges in conventional welding methods, particularly for circular components, and the need for automation to improve efficiency and accuracy.

2. Establish objectives: Develop a system that reduces operator effort, increases efficiency, generates smooth and finished job pieces, and is multi-purpose for various industries.

3. Review literature: Conduct a literature review to gain insights into the latest advancements in welding technology and automation, and to determine best practices for system design.

4. Develop a conceptual design: Based on the literature review and problem statement, create a conceptual design that outlines the key features of the system, such as the indexing table rotary motion, fixture design for welding gun fitment, and utilization of pneumatic cylinder for gripping and locating the welding gun.

5. Evaluate the design: Evaluate the conceptual design using computer-aided design (CAD) software to ensure it meets the objectives and is feasible to construct.

6. Prototype construction: Build a prototype of the robotic welding system using off-the-shelf components and custom-made parts, following the design specifications.

7. Testing: Test the system for functionality and performance, including its ability to reduce operator effort, generate smooth job pieces, and operate smoothly with other applications.

8. Refine the design: Based on the test results, refine the design to improve performance and functionality.

9. Cost analysis: Conduct a cost analysis of the system to determine its cost-effectiveness and identify any areas for cost optimization.

10. Conclusion: Conclude the project by presenting the final design and performance results, and discussing potential future applications of the system.

IV. Construction and Working -

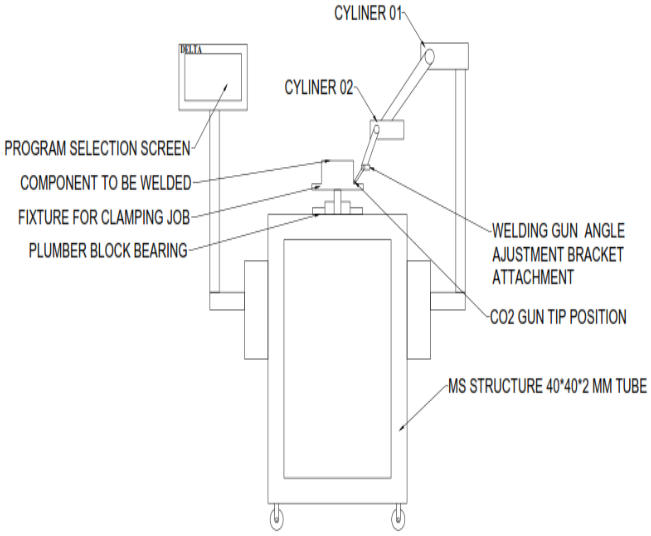

Fig. 1: Block diagram.

The job to be welded is placed on the indexer table and considering the welding process and electrode feed rate the speed regulator is adjusted to give desired table speed. The table carries indexer buttons as per no of welds and position of the same. Table is indexed to the first stop position. Now by pressing the single switch all the operation will start working simultaneously. Such as

1. Griping work piece
2. Location the welding nozzle.
3. Initiating the welding.
4. After 360 angle completion, relay off machine off the welding process .Welding gun moves to its initial position.
5. Job ready to unload.
6. Buzzer blinks for 2 sec.

Process completed.

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- Max. I/O points: 494 (14 + 480)
- Program capacity: 8k steps
- COM port: Built-in RS-232 & RS-485 ports, compatible with M

V. SOFTWARE USED-

1.Finite element analysis-

The finite element method (FEM) is a numerical technique for finding approximate solutions to boundary value problems for partial differential equations. It is also referred to as finite element analysis (FEA). It subdivides a large problem into smaller, simpler parts that are called finite elements. The simple equations that model these finite elements are then assembled into a larger system of equations that models the entire problem. FEM then uses variational methods from the calculus of variations to approximate a solution by minimizing an associated error function.

Finite element analysis (FEA) is the modeling of products and systems in a virtual environment, for the purpose of finding and solving potential (or existing) structural or performance issues. FEA is the practical application of the finite element method (FEM), which is used by engineers and scientist to mathematically model and numerically solve very complexstructural, fluid, and multiphysics problems. A finite element (FE) model comprises a system of points, called "Nodes", which form the shape of the design. Connected to these Nodes are the finite elements themselves which form the finite element mesh and contain the material and structural properties of the model, defining how it will react to certain conditions. The density of the finite element mesh may vary throughout the material, depending on the anticipated change in stress levels of a particular area. Regions that experience high changes in stress usually require a higher mesh density than those that experience little or No stress variation. Points of interest may include fracture points of previously tested material, fillets, corners, complex detail, and high-stress areas. FE models can be created using one-dimensional (1D beam), two-dimensional (2D shell) or three- dimensional (3D solid) elements. By using beams and shells instead of solid elements, a representative model can be created using fewer Nodes without compromising accuracy. Finite element analysis (FEA) is a computerized method for predicting how a product reacts to real- world forces, vibration, heat, fluid flow and other

physical effects. Finite element analysis shows

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whether a product will break, wear out or work the way it was designed. It is called analysis, but in the product development process, it is used to predict what's going to happen when the product is used. A real object is splits into a large number (thousands to hundreds of thousands) of finite elements, such as little cubes. Mathematical equations help predict the behavior of each element. A computer then adds up all the individual behaviors to predict the behavior of the actual object.

2. ANSYS- ANSYS is a commercial, general-purpose FE software, which has been on the market since 1971. It can be used in several applications for example to studythe thermal heat flow, fluid flow, magnetic fields, acoustics/vibrations and last but Not least structural mechanical problems.

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.

VI. APPLICATION-

1. Heavy industry.
2. Shipbuilding industry.
3. Multi field application that is industry, household, agriculture, etc.

VII. ADVANTAGES-

1.Greater speed.
2.Higher productivity and accuracy.
3.Fewer errors at work.
4.Greater safety.
5.It is user friendly.
6.It improves control

VIII. CONCLUSION-

1. Heavy load capacity of table is 80 kg safe load Adjustable table speed (0 to 75 rpm) Auto stop feature, to start and end process operational precise positions. Multiple indexer positions, enables to make staggered welded joints.

2.Easy operation, as table automatically stops as per indexer button position and next operation is started by merely pressing the inching switch. Compact, the entire drive assembly fitted below the table itself, and the controls are placed on the front at ergonomic positions.

3.Low power consumption (50 watt) From above report it is conclude that for the complete circular welding as well as the spray painting in required angle with perfectly and efficiently in mass production.

REFERENCS-

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