

Design & Fabrication of Automatic Welding Machine: A Review

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Abstract :

Automation in welding processes has become essential to improve productivity, consistency, and safety in modern manufacturing industries. This project focuses on the design and fabrication of an automatic welding machine in which the welding electrode remains stationary while the workpiece rotates in a circular motion about a single axis. The system also incorporates a mechanism to provide controlled forward and backward movement of the welding rod, enabling uniform weld bead formation.

The proposed machine aims to reduce human involvement, minimise welding defects, and ensure repeatability in circular welding operations. A mechanical structure integrated with DC motors, lead screw mechanisms, and a rigid frame was designed and fabricated. The developed model demonstrates the feasibility of achieving automatic circular welding with consistent motion control. This project highlights a cost-effective approach suitable for small-scale industries and educational applications.

1. INTRODUCTION

Welding is one of the most important manufacturing processes used for permanently joining metal components. It plays a vital role in industries such as automotive, shipbuilding, construction, aerospace, and heavy engineering. In conventional welding methods, the quality of the weld largely depends on the skill and experience of the operator. Factors such as improper

electrode movement, inconsistent speed, and human fatigue can lead to welding defects and non-uniform joints.

With the advancement of automation in manufacturing, there is an increasing need to reduce manual effort and improve consistency in welding operations. Automatic welding machines help achieve uniform weld quality, higher productivity, and improved safety by minimising direct human involvement. These systems are especially useful for repetitive welding operations where precision and repeatability are required.

This project focuses on the **design and fabrication of an automatic welding machine** in which the **welding rod remains stationary while the workpiece rotates in a circular direction** about a single axis. The circular motion of the job ensures continuous welding along the circumference, making the system suitable for welding cylindrical and circular components. In addition, a mechanism is developed to provide controlled forward and backward movement of the welding electrode, allowing proper adjustment of the arc length during the welding process.

The proposed system uses simple mechanical components such as a rigid frame, lead screw mechanism, threaded shafts, and DC motors, making it cost-effective and easy to fabricate. The main aim of this project is to demonstrate how basic automation can be applied to welding processes to improve weld quality, reduce human error, and enhance productivity. This

model is particularly useful for small-scale industries and educational purposes where fully automated industrial welding systems may not be economically feasible.

Key words: feasibility, demonstrate, integrated, electrode, involvement, incorporate

2. Body of Paper

a. Literature Review

Welding automation is widely used to improve weld quality, productivity, and consistency. Manual welding depends heavily on operator skill, leading to variations in weld bead and penetration. Previous studies show that **rotating the job instead of the welding torch** simplifies control and provides better stability for circular welding applications. Lead screw mechanisms are commonly used for linear motion due to their accuracy and simplicity. However, most automated systems are expensive and not suitable for small-scale use.

b. System Description

The automatic welding machine consists of a **single-axis rotating job holder** and a **stationary welding rod with controlled linear motion**. The job rotates in a circular direction while the welding rod is moved forward and backwards to maintain proper arc length and weld quality. The entire setup is mounted on a rigid steel frame.

c. Design Considerations

The following factors were considered during design:

- Structural rigidity
- Smooth and uniform job rotation
- Accurate alignment of the welding rod
- Ease of fabrication and maintenance
- Low manufacturing cost

d. Mechanical Design

1 Frame: A mild steel frame supports all components and minimises vibration during operation.

2 Job Rotation Mechanism: The workpiece is mounted on a threaded shaft supported by bearings. A DC motor drives the shaft, providing uniform rotational motion for circular welding.

3 Welding Rod Feed Mechanism: A lead screw and nut mechanism converts rotary motion into linear motion, allowing controlled forward and backward movement of the welding rod to maintain arc length.

4 Welding Rod Holder: The electrode holder is mounted on a sliding carriage and designed to maintain alignment and electrical insulation.

e. Motor Selection and Transmission

DC motors are used for both job rotation and electrode movement due to their simplicity, ease of control, and cost-effectiveness. Motion is transmitted through couplings and threaded shafts.



Fig. 1: Model of the Automatic Welding Machine

f. Fabrication and Assembly

The frame was fabricated using mild steel sections. Bearings, shafts, motors, and lead screws were mounted carefully to ensure smooth operation and proper alignment. The system was inspected after assembly.

g. Working Principle

- The workpiece is mounted on the rotating shaft
- The welding rod is positioned at the desired location
- The job rotation motor and the rod feed motor are switched ON
- The job rotates while the welding rod maintains a constant position
- A uniform circular weld is obtained

h. Testing and Observations

The machine was tested on mild steel jobs. Smooth rotation, stable arc, and uniform weld bead were observed. Minor vibration at higher speeds can be reduced by improving frame stiffness.

i. Advantages and Limitations

Advantages

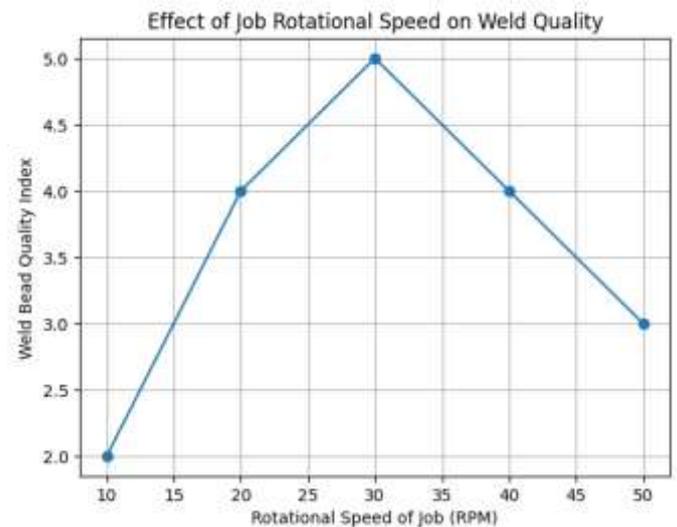
- Consistent weld quality
- Reduced human effort
- Suitable for circular welding
- Low-cost automation

Limitations

- Applicable only to circular jobs
- Manual adjustment required for different sizes

j. Future Scope

The system can be improved by adding speed control, sensors for arc length control, and microcontroller-based automation.



3. CONCLUSIONS

The design and fabrication of the automatic welding machine were completed. The developed system demonstrates effective circular welding by rotating the workpiece while maintaining controlled linear motion of the welding electrode. The machine reduces human effort, improves consistency, and provides a practical solution for automated welding applications.

This project proves that simple mechanical components combined with basic automation can significantly enhance welding efficiency. Further improvements can be made by incorporating sensors, microcontrollers, and speed control systems to make the machine fully automated.

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