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Review Article

Design and Implementation of an Innovative Torch Rotary Welding Special Purpose Machine (SPM) for Enhanced Welding Precision and Efficiency

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A B S T R A C T

Robots are frequently utilised in industrial welding processes in addition to the logical technical process. The welding process is sophisticated and not well understood, human-machine interfaces are unnatural and ineffective. Another issue with robots is that they are still in the early stages of development and challenging for regular operators to use and programme. Welding is a joining or manufacturing procedure that joins materials-usually metals or thermoplastics—by melting the base metal with the filler. The automated Torch Rotary soldering machine's design was influenced by gas metal arc welding. Automation helps to save expenses and increase system productivity. Flash welding has been done automatically. In our assignment, we must weld two circular welding spots into an automotive component. Manual welding uses more personnel and results in worse production and welding quality, among other things. By using automatic welding, all of the aforementioned issues are resolved, manual welding enhances the system as a whole. The GMAW procedure is utilised using a torch on a torch rotary machine to weld the exhaust system. For this action, the machine has a fixture. During welding, the welding torch revolves around the pipe and flange.

Keywords: GMAW, Robots, Automatic Welding System, Sensors

Introduction

Automation helps to save expenses and increase system productivity. Flash welding has been done automatically. In our assignment, we must weld two circular welding spots into an automotive component. Manual welding uses more personnel and results in worse production and welding quality, among other things. By using automatic welding, all of the aforementioned issues are resolved, manual welding enhances the system as a whole. The GMAW procedure is utilised using a torch on a torch rotary machine to weld the exhaust system. For this action, the machine has a fixture. During welding, the welding torch revolves around the pipe and flange.

Welding is a production or artistic process that unites materials by generating coalescence, typically metals or thermoplastics. This is frequently accomplished by melting the workpieces and adding a filler material, which cools and solidifies to form a weld.

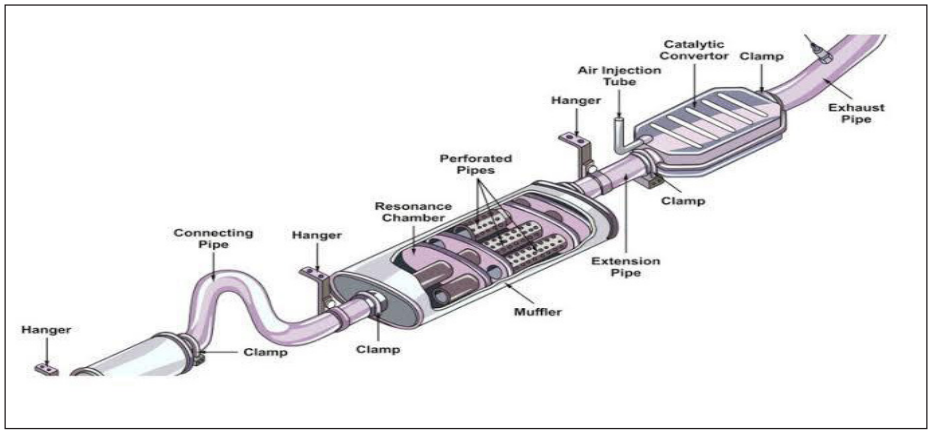

Figure 1.Muffler Assembly[1]

There has been welding for many years. Currently, more than 100 welding techniques are used in many business areas. The technology used in automated handling between machines and continuous processing at the machines can be used to describe automation. Automation has recently made extensive use of the advantages of electronic and robotic technology.

A plan for an automated TIG system Robots are frequently used in industrial welding operations to weld circular pipes and tubes, although this process is far from being streamlined. Although the robots are challenging to use and programme, they are still in the early stages of development. They have a complicated welding process that is not very well-known, abnormal and malfunctioning human-machine interactions.[1]

Welding is a structural, industrial, or assembly technique that joins base metal with a filler material, typically another metal or thermoplastic. One of the most important manual welding techniques to address the demand for automated torch rotating welding is circular welding. There are several methods of welding that can be used, including tungsten arc welding, shielding metal arc welding, tungsten inert gas welding, metallic inert gas welding.[2]

Every industry needs to adopt new technologies to remain competitive. Productivity, quality, client delivery date are the three primary areas that need to be improved for the industry to remain competitive. He has discussed in this study the potential for replacing manual Gas Tungsten Arc Welding (TIG) with automated Gas Tungsten Arc Welding. The quality and output of the production both rise with automation. Automation produces substantially higher-quality welding than manual TIG, which reduces scrap and boosts productivity.[3]

\The linear movement is more complex and significantly less labor-intensive than the conventional welding procedure by detailing the mechanism that can precisely weld both the circle and the line component. The technological constraints to accomplish stability, linear and uniform welding flash speed, consistent welding thickness for quality products were to be taken into mind during design and development in mechanics. The results of the experiments on various silencer shells are documented in the article. It can soon be fitted in the variable frequency drive (VFD) for full atomization. Nowadays, welding has a wide range of uses across practically all industries. It is extensively used in manufacturing and building steel structures in both industry and construction. Additionally, it is employed in a variety of industries, including those that produce nuclear power plants, ships, furniture, cars, aircraft.[4,6]

For the purpose of solving the issue of continuous welding of the cross-section line multi-tube radiators, an automated two-sweat torch machine has been developed. The key mechanisms of the welding machine's design are detailed. Its model was built using three-dimensional modelling software. Simulating motion and interference using interpolation is done. The welding test demonstrates that the line is accurately welded, that both production efficiency and welding quality have improved. The Y-axis synchronous drive mechanism and the Z-axis synchronous drive mechanism propel the two-welding torch to move laterally and up-and-down. Half of the seam is welded with each welding torch. As the location of the welding joints varies during the welding process, welding torches swing into the ideal position to ensure the quality of the weld.[5,7]

Problem Definition

Two circular welding spots in an automobile component were joined together in this work. Yogeshwar Industries presented this issue. The part is a Mahindra Scorpio silencer assembly. It features two points on each of the muffler's two faces. In the horizontal plane, these two points are situated at two separate locations. Its input and output pipes are attached to these two places. These two pipes must be welded to their respective places using an SPM, which must have an automated drive for consistent and accurate welding.

Methodology and Principle Parts

The design methodology is depended on the literature survey which involves the gathering of assorted industrial data, economics and choosing of the selecting feasible solution.

The Principle parts & design methodology is as follows:

- Mounting table
- Rotating disc to place the job
- Job holding stand
- Rpm controlled gear motor
- Gear motor to control auto feed of filler material
- TIG torch holding stand
- Cooling system

Mounting Table

A vise is a mechanical tool used to hold something securely so you can work on it. The screw and lever with two parallel, one fixed and the other movable jaws are used to insert and remove vises.

Rotating Disc to Place the Job

The rotating disc is used to rotate the cylindrical work piece to achieve uniform weld coat. It runs by the action of light sensors to complete one full rotation.

Job Holding Stand

To aid welding, the cylindrical work pieces are held or supported by a job holding platform. Workpieces of different lengths and diameters can be held by adjusting it.

RPM Controlled Gear Motor Connected to Rotating Disc

A gear motor is utilised to facilitate a broad range of speeds for a varying work piece dimension, resulting in a consistent weld coat. The rotating disc's speed is controlled by an RPM controller.

TIG Torch Holding Stand

The TIG torch is kept stationary using a TIG torch holding stand. It is flexible enough to change length and direction as needed for welding.

Cooling System

A cooling system is utilised to remove excess heat that could harm objects and circulate coolant through the torch.

Manual Mode Operating Sequence

Operator will select the fixture Straight Pipe or Bend

Pipe through selector switch & set the pipe locator manually.

- Operator will press the button of JOB CLAPM / JOB LIFT
- Operator will select machine mode TEST / WELD through selector switch
- Operator will press the button of Torch forward
- Operator will select the machine rotation forward through selector switch
- After completion of 01 rotation with overlap welding of torch machine & welding will stop on the spot

1. Operator will press the button of torch reverse torch assembly will go back at home position.

than by manual welding. As a result, torch rotary welding has higher productivity than manual welding.

1. A variable frequency drive (VFD) is attached to the motor during torch rotational welding. The motor speed is governed via VFD. Component rotation and melting speed become synchronous while welding. As a result, we get reliable welding. We receive perfect accuracy.

Auto Mode Operating Sequence

- Through a selector switch, the operator will choose whether the fixture is for Straight Pipe or Bend Pipe and manually configure the pipe finder.
- The JOB CLAPM/JOB LIFT button will be pressed by the operator.
- The operator will use the selection switch to choose the machine mode TEST or WELD.
- The cycle start button will be pressed by the operator.
- Torch assembly will advance, welding and torch rotation will begin right away. The torch will rotate once it has completed one rotation to weld with a 10-mm overlap.
- Welding won't take place if the machine is in test mode. The job counter in WELD mode will automatically count the job when Auto Cycle has finished.

Spm Testing and Results

Results During Welding Operation

1. For manual welding, 25–50 pieces are welded in 8 hours. 75 components are welded together using a torch in 8 hours. So, 3 times as many components are welded using a torch in rotary welding as opposed to manual welding. As a result, torch rotary welding has higher productivity than manual welding.
2. A variable frequency drive (VFD) is attached to the motor during torch rotational welding. The motor speed is governed via VFD. Component rotation and melting speed become synchronous while welding. As a result, we get reliable welding. We receive perfect accuracy.

Results & Comparison of Manual Welding With Torch Rotary Welding Machine

Table I

S. No.	Parameter	Manual Welding	Torch Rotary welding
1	Time	In 8 Hr. 25 piece	In 8 Hr. 75 piece
2	Productivity	Less as compared to torch rotary welding	3 times more than manual welding
3	Accuracy	50 %	100 %

Conclusion

This work effectively automates circular welding using a variety of "Torch Rotary Machines" that have all the desirable attributes an SPM has.

Designs and measurements made during the design cycle produced the expected results, leading to a welding cycle free of errors and susceptible failures. The goals were followed by a decrease in time spent and an increase in quality. Through this project, productivity is greatly improved. It has been determined that torch rotary welding is superior to manual welding based on cost and production time comparisons. It is observed that theory and practical aspects of design and manufacturing can be integrated and evaluated in a unique way. On the shop floor, one experiences the reality of working at ground level. These worthwhile experiences will be beneficial in all facets of life in the future.

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