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Development of automation for manual tungsten inert gas (TIG) welding

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Abstract
Using robots in industrial welding operations is common but far from being a streamlined technological process. The problems are with the robots, still in their early design stages and difficult to use and program by regular operators; the welding process, which is complex and not really well known and the human-machine interfaces, which are unnatural and not really working. In this article, these problems are discussed, and a system designed with the double objective of serving R&D efforts on welding applications and to assist industrial partners working with welding setups is presented. The use of object-oriented and distributed software to assist industrial robotic welding applications is discussed. This Article gives complete idea of design of a mechanism to automate TIG Welding of circular pipes and tubes.

Keywords: technological process, robots, regular operators

1. Introduction

In Present Robotic World Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, drilling, welding and other applications and vehicles with minimal or reduced human intervention, with some processes have been completely automated. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. The benefit of automation includes labor savings, savings in electricity costs, savings in material costs, and improvements to quality, accuracy and precision.
Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area and electrode are protected from oxidation or other atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenous welds, do not require it. A constant-current welding power supply produces electrical energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma.

2. Literature Survey

The team spent more time in literature survey studying in various commercial industries. Research institutions and other civilian sectors. The team came across various designs of projects already carried out. Data were collected and analyzed in order to find out the existing problem and bring out an innovative solution. The following were the procedures followed during the literature survey:

- Identifying the problem in present TIG welding industries.
- Comparison between the existing technologies.
- Collection and analysis of data.
- Analysis of various welding parameters.
- Selecting the best alternative.
- Analysing the effectiveness of the solution with the existing data.
- Implementing the solution.

Based on the literature survey conducted, the team has decided to fill the gap in technology by incorporating an amphibious part for industry and making it multiple platforms and multi-purpose product. It was then decided to title the project as Development of Automation for Manual Tungsten Inert Gas (Tig) Welding.

3. Methodology & Principle Parts

The design methodology is based on the literature survey which involves the collection of various industrial data, economics and choosing of the proper 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 (water Coolant).

1. Mounting Table

A vice is a mechanical apparatus used to secure an object to allow work to be performed on it. Vises have two parallel jaws, one fixed and the other movable, threaded in and out by a screw and lever.

2. 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.

3. Job Holding Stand

A Job holding stand is used to hold or support the cylindrical work pieces to facilitate welding. It can be adjusted to hold work pieces with varying lengths and diameters.

4. Rpm Controlled Gear Motor Connected To Rotating Disc

A gear motor is used to achieve uniform weld coat by facilitating varied range of speeds for varied work piece dimensions. An RPM controller is used to control rotating speed of the rotating disc.

5. Auto Feeder

Auto feeder uses set of rollers to pass the filler material to the welding area. These rollers are also actuated by RPM controlled motor.

6. Tig Torch Holding Stand

TIG torch holding stand is used to place the TIG torch stationary. It is made flexible to adjust length and direction according to welding required.

7. Cooling System

Cooling system is used to circulate the coolant through torch and to remove excess of heat which otherwise might cause damages.

5. Working

- The Gear Controlled Motor Rotates the Work piece.
- Speed of rotation varies with cylinder diameter.
- TIG Torch is fixed to a holding stand and remains fixed.
- Welding process is carried out around the circumference of the work pieces (cylinders) to be welded.
- The auto feed mechanism feeds the filler material required to obtain the weld joint.
- Uniform weld joint is obtained.

6. Testing and Performance Results

Following are the testing and performance results,

1. Specimen Diameter-50mm.
2. Specimen Material-Stainless Steel.
3. Filler Material-Stainless Steel.

Fig 1: Manual Weld Joint

Fig 2: Automated Weld Joint.

- Figures 8 shows manual weld joint and figure 9 shows weld joint obtained in automated welding machine.
- Irregularities exist in manual welding joint and it can be seen in figure 1.
- The weld joint obtained is uniform and neat in automated welding machine and it can be seen in figure 2.
- Welding speed achieved was found to be 120mm/min (in terms of filler material consumption).
- Uniform welding coat was developed.
- Welding joints in different work piece was found to be likely.
- Welding joint obtained by the concept of our automation has been approved by Caterpillar Inc.

7. Detailed View Photos

Fig 3: Mounting Table.

Fig 4: Rotating Disc to Place the Job.

Fig 5: Job Holding Stand.

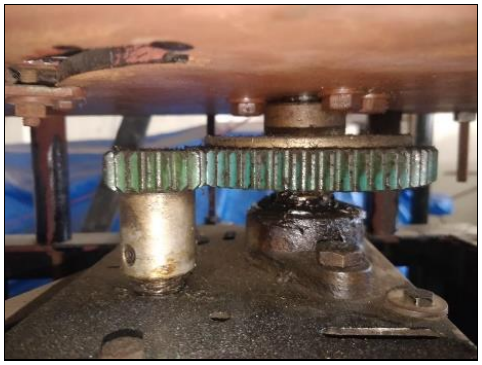

Fig 6: Rpm Controlled Gear Motor Connected To Rotating Disc.

Fig 7: Auto Feeder.

Fig 8: Tig Torch Holding Stand.

Fig 9: Weld Joint Obtained

8. Future Scope

There exists vast scope for automating any manual machining process. By the conclusion of our experiment key points that can be noted are,

- The automation concept we have adopted can be further extended to automate brazing process.
- In this model, we have used the concept of keeping the TIG torch stationary and rotating the work piece but the concept can also be reversed by making work piece stationary and rotating the TIG torch and it can be automated for pulse TIG welding process.
- The model is developed for cylindrical work pieces but it can also be used to develop linear welding joints.

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