DEVELOPMENT OF AN ARC WELDING MACHINE USING PNEUMATIC CONTROL

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Abstract

The main aim of project is to fabricate the automatic welding machine. Welding is a fabrication process that joins materials, usually metals or thermoplastics. This is often done by melting the work pieces and adding a filler material to form a pool of molten material that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. A compressor is used to compress the air and it is passed to the solenoid valve. This solenoid valve controls the direction of flow of air to the cylinder. This pressurized air is actuating the piston rod to forward and return position. At the of piston rod the welding rod is fixed. This welding rod makes forward motion and reverse motion in order to make or weld the two different plates.

Keywords – *Arc Welding, Pneumatics, welding machine*

I. INTRODUCTION

Welding is a fabrication or sculptural process that joints materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.

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, however, welding remains dangerous, and precautions must be taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light. The pneumatic operation consists of pneumatic cylinder, compressor, control unit, solenoid valve etc… which are used to actuate the piston rod. The compressor is used to compress the air and it is passed to the solenoid valve. This solenoid valve controls the direction of flow of air to the cylinder.

This pressurized air is actuating the piston rod to forward and return position. At the of piston rod the welding rod is fixed. This welding rod makes forward motion and reverse motion in order to make or weld the two different plates. The welding rod is otherwise known as electrode which is connected to the power supply terminals. The work piece also connected to the power supply. This setup requires a heavy electrical arrangement to make the welding.

II. RELATED WORK

For manual welding methods, labour costs generally make up the vast majority of the total cost. As a result, many cost-saving measures are focused on minimizing operation time. To do this, welding procedures with high deposition rates can be selected, and weld parameters can be fine-tuned to increase welding speed. Also, removal of welding spatters generated during welding process is highly labour intensive and time consuming. Implementation of Welding Anti Spatter & Flux which is safe and non-polluting is considered as a welcome change in cost cutting and weld joint quality improvement measures. Mechanization and automation are often implemented to reduce labour costs, but this frequently increases the cost of equipment and creates additional setup time. Material costs tend to increase when special properties are necessary, and energy costs normally do not amount to more than several percent of the total welding cost.

In recent years, in order to minimize labour costs in high production manufacturing, industrial welding has become increasingly more automated, most notably with the use of robots in resistance spot welding (especially in the automotive industry) and in arc welding.

III. OBJECTIVES

The main objectives of this project are

- To increase the quality of weld in components.
- To reduce the cost of automation involved in large welding machines.
- To reduce the fatalities involved in manual welding operations and to increase accuracy.
- To reduce the excessive consumption of power and electrode being used while welding.

IV. WORKING PRINCIPLE

The pneumatic operation consists of pneumatic cylinder, compressor, control unit, solenoid valve etc… which are used to actuate the piston rod. The compressor is used to compress the air and it is passed to the solenoid valve. This solenoid valve controls the direction of flow of air to the cylinder.

This pressurized air is actuating the piston rod to forward and return position. At the of piston rod the welding rod is fixed. This welding rod makes forward motion and reverse motion in order to make or weld the two different plates. The welding rod is otherwise known as electrode which is connected to the power supply terminals. The work piece also connected to the power supply. This setup requires a heavy electrical arrangement to make the welding. Two pneumatic cylinders and Solenoid valve are provided. Cylinder is used for the forward and backward movement, it moves x and y axis that's why called double axis welding machine

The automatic welding machine makes use of properly shaped MS alloy electrodes in order to apply pneumatic pressure and carry electrical current through the work pieces. Heat is generated mainly at the merging point between two sheets. This causes the material being welded to melt gradually, thereby forming a molten bath, known as the weld mass.

The molten bath is held through the pressure applied by the electrode tip and the encircling solid metal. If the compressed air goes to solenoid valve to pneumatic cylinder. welding holder connected to pneumatic cylinder which actuated by solenoid valve at the time automated welded for metal.

NEED FOR AUTOMATION

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics forms an attractive medium for low cost automation.The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production.

Nowadays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

- To achieve mass production
- To reduce man power
- To increase the efficiency of the plant
- To reduce the work load
- To reduce the production cost

V. DIAGRAM

The Figure 1 is the 2D layout of the machine which is fabricated

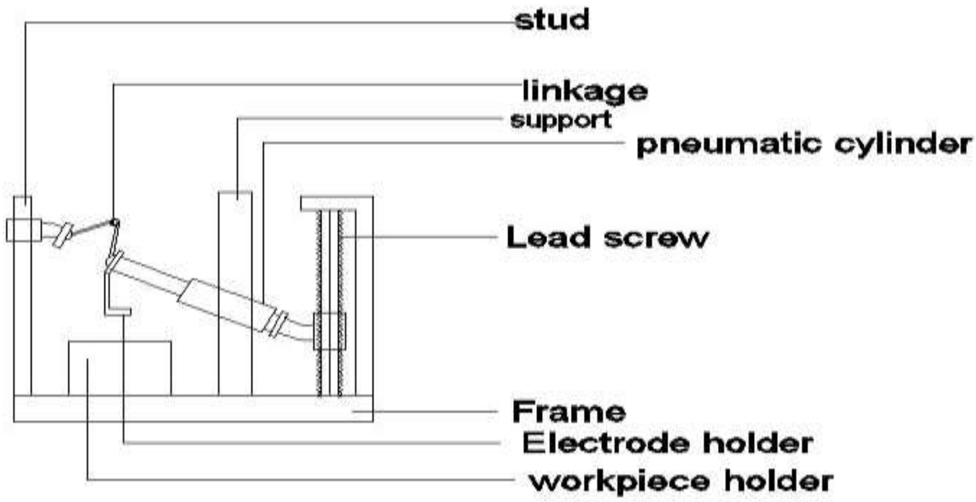

Figure 1. 2D Layout of the machine

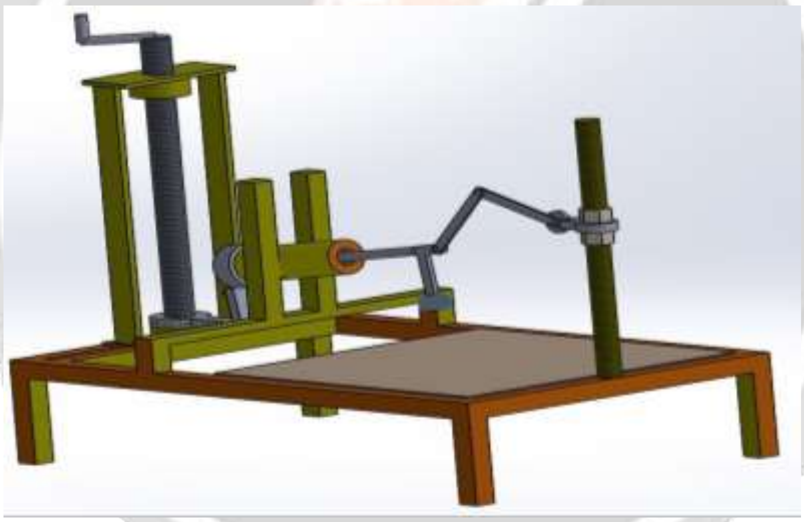

Figure 2. 3D model of the machine

VI. DESIGN CALCULATION

CALCULATION FOR PNEUMATIC CYLINDER

Operating pressure = $5 kgf/cm^2$
Maximum pressure = $13.5 kgf/cm^2$
Diameter of Cylinder = 1.6 cm
Total load in the cylinder = Pressure*area
=$13.5*3.14*(1.6)^2$
= 108.52kg
Total load in the cylinder =109kg

DESIGN OF EQUIPMENT :

PNEUMATIC COMPONENTS AND ITS SPECIFICATION :

The pneumatic cutting machine consists of the following components to full fill the requirements of complete operation of the machine.

- Double acting pneumatic cylinder
- Solenoid vale
- Flow control valve
- Connectors
- Hoses

Double acting pneumatic cylinder :

Stroke length: cylinder stroke length 100mm =0.1m
Piston rod : 10mm =10 X10^{-3}m
Quantity : 1
Seals : Nitride (Buna-N) Eastover
End cones : Cast iron
Piston : EN-8
Media : Air
Temperature: 0-80°C
Pressure Range: 8N/m^2

4.3.2 Solenoid Valve

Size : 0.635x10^{-2}m
Part size : G0.635x10^{-2}m
Maximum pressure: 0-10 x10^{5} N/m^2

4.3.3 Flow control valve :

Port size: 0.635 x 10^{-2} m
Pressure: 0-8 x10^5 N/m^2
Media : Air
Quantity: 1

4.3.4 Connectors :

Max working pressure : 10 x10^5 N/m^2
Temperature : 0-100°C
Fluid media :Air
Material :Brass

4.3.5 Hoses:

Max pressure : 10 x10^5 $_{N/m}{}^2$
Outer diameter : 6mm =6 x 10^{-3} m
Inner diameter : 3.5mm =3.5 x10^{-3}m

4.3.6 Pneumatic unit :

Type of cylinder : Double acting cylinder
Type of valve : flow control valve &solenoid valve
Max air pressure : 8 x1

4.4 DESIGN CALCULATION :

Max pressure applied in the cylinder (p) : 8N/m^2
Area of cylinder (A) : (3.14/4*(D^2)
: 80.38cm^2
: 80.38 X $10^{-4}$$m^2$
Force exerted in the piston (F) : Pressures applied X area of cylinder.

VII. CONCLUSION

In this paper " Development of an arc welding machine using pneumatic control" , we have successfully developed an adaptive pneumatic controller for an automatic alternating current SMAW system. A mathematical model of the automatic welding control system has been constructed by analyzing physical laws and utilizing a system identification technique. In the proposed approach, the adaptive sliding mode controller determines an appropriate output signal by evaluating an error signal (and its derivative) provided by a current sensor. The output signal is applied to the input terminal of an AC servomotor, which responds by driving the electrode feed rate mechanism such that the required arc length, and hence arc current, are maintained. The experimental and numerical results have demonstrated that the adaptive pneumatic controller developed in this study ensures a high quality SMAW result and enables the realization of an automatic shielded metal arc welding process.

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