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Design and Development of SPM Welding Machine

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Abstract: To decrease the required cycle time for loading and unloading of part, this alternative can be effective using the latest design softwares like CAE/CAD, considerable enhancement can be achieved. To assure the requirements of multifunction and high performance, optimum design approach is implemented. This developed fixture will significantly improve production target and increase efficiency of production. This proposed fixture ideally reduces operation time, reduces accidents, and gives high quality of operation. The motive of new SPM welding machine is to increase the weld strength, load bearing capacity, and to decrease the rejection rate of the product. The conventional machine used 4 torches which required four different machines to run welding. Thus, due to fluctuations, different current & voltages are distributed to these 4 torches which results in different quality welds. Hence these four torches are replaced by single torch in new SPM welding machine.
Keywords: Welding, efficiency, performance, quality, rejection.

I. INTRODUCTION

Welding is a material joining process in which two (or more) parts are mixed (or joined) at their contacting surfaces by suitable application of heat and/or pressure. The final part that is obtained by joining is known as 'weldment'. Weldment results in homogeneous material and usually has same compositions and characteristics as that of two parts with which joining is done.

Some welding processes require only heat while some require heat and pressure. In some other processes, external filler material is required to obtain coalescence (or mixing).various metals as well as plastics can be joined by welding methods.

The fixture is a special tool for holding a work piece in proper position during manufacturing operation. For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process is eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. Locators are used to determine the position and orientation of a work piece, whereas clamps exert clamping forces so that the workpiece is pressed firmly against locators. Clamping has to be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which require knowledge. Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts In existing design the fixture set up is done manually, so the aim of this project is to replace with hydraulic fixture to save time for loading and unloading of component. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process functionability.

II. LITERATURE SURVEY

Ajit Hooda, Ashwani Dhingra and Satpal Sharma(2012)[1] studied the process parameters such as welding voltage, current, wire speed and gas flow rate.

Sheikh Irfan and Prof. Vishal Achwal(2014)[3] says that quality, productivity and cost of welded joint depends on MIG welding characteristics also weld's size and shape depends on the same. After checking all the specimens for its depth of penetration the effects of welding such as its speed, current, voltage were investigated for the quality of depth of penetration.

Javed Kazi1, Syed Zaid, et.al.(2015)[5] says that, quality and productivity are considered to be the main points in today's manufacturing market. The main agenda of today's companies is to produce better quality products at minimum cost. Welding is known to join the two or more similar or dissimilar metals together.

OI Kenji, Murayama Masatoshi(2015)[6] described that as there is a huge competition between companies for their respective products, the demand of best quality products are required which can be generated by the parameters such as strength, hardness, ductility, tensile strength, and these parameters need to be enhanced by innovation of various welding techniques.

M. Mukherjee, J. Saha, et.al.(2015)[7] describes the effects of various shielding gases mixtures on metal's properties such as microstructure and mechanical properties like hardness, toughness, etc. the mechanical properties are affected by variations in microstructure.

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III. METHODOLOGY

A. MIG Welding

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas(MAG) welding, is a welding process in which an electric arc forms between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt and join.

Along with the wire electrode, a shielding gas feeds through the welding gun, which shields the process from contaminants in the air. The process can be semi-automatic or automatic. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations. Originally developed for welding aluminium and other non-ferrous materials in the 1940s, GMAW was soon applied to steels because it provided faster welding time compared to other welding processes. The cost of inert gas limited its use in steels until several years later, when the use of semi-inert gases such as carbon dioxide became common. Further developments during the 1950s and 1960s gave the process more versatility and as a result, it became a highly used industrial process. Today, GMAW is the most common industrial welding process, preferred for its versatility, speed and the relative ease of adapting the process to robotic automation. Unlike welding processes that do not employ a shielding gas, such as shielded metal arc welding, it is rarely used outdoors or in other areas of air volatility. A related process, flux cored arc welding, often does not use a shielding gas, but instead employs an electrode wire that is hollow and filled with flux

For most of its applications gas metal arc welding is a fairly simple welding process to learn requiring no more than a week or two to master basic welding technique. Even when welding is performed by well-trained operators weld quality can fluctuate since it depends on a number of external factors. The basic technique for GMAW is quite simple, since the electrode is fed automatically through the torch (head of tip). By contrast, in gas tungsten arc welding, the welder must handle a welding torch in one hand and a separate filler wire in the other, and in shielded metal arc welding, the operator must frequently chip off slag and change welding electrodes. GMAW requires only that the operator guide the welding gun with proper position and orientation along the area being welded. Keeping a consistent contact tip-to-work distance (the stick out distance) is important, because a long stick out distance can cause the electrode to overheat and also wastes shielding gas. Stick out distance varies for different GMAW weld processes and applications. The orientation of the gun is also important—it should be held so as to bisect the angle between the work pieces; that is, at 45 degrees for a fillet weld and 90 degrees for welding a flat surface. The travel angle, or lead angle, is the angle of the torch with respect to the direction of travel, and it should generally remain approximately vertical. However, the desirable angle changes somewhat depending on the type of shielding gas used—with pure inert gases, the bottom of the torch is often slightly in front of the upper secion, while the opposite is true when the welding atmosphere is carbon dioxide.

B. Old Four Torch Welding Machine

This machine consists of four stationary torches with CO_2 gas flow of 0.15Mpa through each torch and gas pressure of 1.4Bar. Mild steel with copper plating as wire material. As each torch has different current and voltage therefore weldment size and strength are also different on respective welds of each torch resulting in initial cracks, low load bearing capacity, fractures in weldment, etc. Below are the tests provided for current and voltage readings of the respective torches.

C. Test Results for Voltage and Current of Four Torch Welding Machine

TABLE I
TEST RESULTS FOR VOLTAGE AND CURRENT OF FOUR TORCH WELDING MACHINE

Parameters	1	2	3	4	5	6	7	8	9	10
Amp(T1)	120	120	120	130	110	120	140	120	120	130
Voltage(T1)	25	25	25	25	25	25	25	25	25	25
Amp(T2)	100	100	100	120	100	100	100	100	100	100
Voltage(T2)	27	26	26	26	26	26	26	26	26	26
Amp(T3)	120	120	140	150	120	120	130	120	140	120
Voltage(T3)	25	27	26	25	25	27	26	26	25	25
Amp(T4)	80	75	80	80	80	80	80	80	80	80
Voltage(T4)	25	25	25	25	25	27	27	27	27	27

T1= Torch no. 1, T2= Torch no. 2, T3= Torch no. 3, T4= Torch no. 4

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D. SPM Welding Machine

This is the new special purpose welding machine which consist of a single moving torch which has the gas flow rate of 0.15MPa and gas pressure of 1.4 Bar. This machine is provided with pneumatic clamps for the inclined fixture. We suggested the inclination for the fixture. We have also suggested servomotors to reduce idle time.

These changes results in reduced initial cracks of weldment, increase lead bearing capacity, etc. Below are the test results provided for voltage and current of new SPM machine

E. Test Results for Voltage and Current of New welding SPM

TABLE II
RESULTS FOR VOLTAGE AND CURRENT OF NEW WELDING SPM

Parameters	Weld No.			
	1	2	3	4
Amp	170	172	171	169
Voltage	27.9	28	27.9	28
Amp	171	173	169	168
Voltage	27.9	28	28	28
Amp	172	173	170	171
Voltage	28	28	28	28.1
Amp	172	173	169	168
Voltage	28	28	28	28
Amp	173	174	171	169
Voltage	28	28	28	28
Amp	175	175	170	171
Voltage	28	28	28	28
Amp	171	171	169	167
Voltage	28	27.9	28	28
Amp	173	172	168	170
Voltage	28.1	27.9	28	28
Amp	174	175	169	169
Voltage	28	27.9	28	28
Amp	172	171	168	168
Voltage	28.1	28	28	28

F. Test Results for Load Bearing Capacity

TABLE III
TEST RESULTS FOR LOAD BEARING CAPACITY

Sr. No.	Machine	Load Bearing Capacity (min. req. Capacity)	Remark
1	Four torch welding machine	140-160KN (150KN)	Rejection rate is higher
2	Single torch welding SPM	440-450KN (150KN)	Negligible rejections

III. CONCLUSION

According to above changes the load bearing capacity is increased thrice the minimum required capacity, various cracks have been eliminated, idle time is decreased, rework time is reduced totally, rejection rate is negligible and costumer needs are satisfied to a great extent.

Hence we conclude that the changes satisfies our various requirements.

IV. ACKNOWLEDGEMENT

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