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"DESIGN AND FABRICATION OF WELDING FIXTURES AND POSITIONERS"

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Abstract : *In recent times, manufacturing industries have shown more interest towards Automation. In other words, the industries today emerge with evolving technology. It is obvious that Industrial Automation streamlines the operations in terms of speed, reliability and product output. In this thesis, welding fixture for two wheeler steering handle is modeled using CATIA software, forces are calculated, and an analysis has been carried out in the precisions placing of one circular component over another circular component during the welding process. Welding circular rod over another circular rod, the possibility of maintaining the accuracy in placing of curved surfaces is very less in the mass production. Here the difficulty is overcome by the new design of the fixture, and the angle as well as the linear movements is maintained in the accuracy of 0.1 mm without any robots. In the field of welding engineering where a consistently good quality, low cost with a maximum productivity is a must, this accuracy canbe done by without automation. Welding fixtures are available in different size, shapes, materials and mechanisms based on their need of operations. The precision of the fixture play a major role in the manufacturing component. Batch production is the commonly used method in various small and large industries. Welding a curved surface over an another curved surface is very challenging so is positioning the components. In mass production, positioning a job takes significant amount of time due to manual process. To overcome this challenge, theoretical approach has been carried out on the fixture like design fabrication and analysis.*

Keywords *- 2 dimension, 3 dimension, American Iron and Steel Institute, Horizontal Force,Vertical Force*

I. INTRODUCTION

Welding is a process for joining different materials. The large bulk of materials that are welded are metals and their alloys, although the term welding is also applied to the joining of other materials such as thermoplastics. In order to join two or more pieces of metal together by one of the welding processes, the most essential requirement is heat. Pressure may also be employed, but this is not, in many processes essential. The term welding is used to cover a wide range of bonding techniques. Currently, a lot of welding processes has been established especially for industrial purposes. Arc welding is one of the welding processes. The welding process can be performed either manually or automatically. Usually in industries, most of the part will be produced in mass production. Therefore, in order to achieve a good outcome, implementation of automation in the process should be done. In the twenty first century, most of the process involved in the industry will be automated. In addition to that, variety of tasks such as complex assembly, part and material handling, hazardous and monotonous task can be executed repeatedly without 2 sacrificing the precision and quality, thus increasing the productivity of a company and reducing the manufacturing time and cost. With the advance technology applied to the system, such as the electronic analog or digital sensor and complex control system, the machine can cope itself in various working condition. In oil and gas pipe line welding, most of the welding process are performed by automated welding machines. The machine operate automatically based on the programs and the parameters defined by the welders and can perform dedicated movements on a weld joint that is highly repeatable in shapes such as circle, arc and longitudinal seams. As mentioned before, the machine can cope with various type of working condition and welding application. The weld equipment operations are positioned normally fixed to perform a basic geometric welding application. In

general, the main character of welding automation are the machine systems and the welding position equipment. Some of the components are welding lathes, turn tables positioners, circle welders, and longitudinal seam welders. Whether the machine is large or small, the same concept and principle for positioning are used. The applications of automatic manipulator has increased from time to time. This is due to the significant increase of the need for a precise and uniform quality part from a mass production. However, in some industries especially when there is chemical process involved, employers hiring laborers such as children to work in dangerous, hazardous and highly risky polluted environment. Machine can be employed instead of human in those harmful situations.

II. LITERATURE REVIEW

Rong et al. (1996) [5] On tolerance analysis, locating reference planes are modeled as a median layer between locator displacements and workpiece displacement. On stability analysis, 3-D stability problem is converted into 2-D problems, and "acting factor" was introduced to solve friction forces.

Chou et al. (1989) [6] used screw theory for the following fixture analysis and synthesis – deterministic locating, clamping stability, total restraint, clamping point determination, and clamping force determination.

Wu et al. (1995) [7] did both kinetics and force analysis for fixture verification. They modeled the contacts between workpiece and fixture as line and surface contacts. The stability problem is modeled and solved with screw theory and non-linear programming technique. A fixture is stable if solution exists for the non-linear system.

Trappey and Liu (1992) [8] discussed the time-variant stability problem, with considerations of fixturing force limits and directions. In a later work (Trappey, 1995), he used the FEA approach to optimize the fixture layout, which balances between minimal workpiece deformation and maximal machining accuracy.

Li et al. (1999) [9] studied the fixturing surface accessibility. He used surface discretization technique, which is commonly used in computer graphics, to assess the surface accessibility. This approach is adopted by this work, and his "surface extrusion and interference detection" algorithm is optimized with ray tracing algorithm in this work.

Irfan Sheikh et. al [10] studied the MIG welding parameters are the most important factors affecting the quality, productivity and cost of welded joint, Weld bead size, shape and penetration depend on number of parameters. The quality of a welded joint is directly influenced by the welding input parameters.

III. PROBLEM DEFINITION

There are various major problems regarding traditional vertical drilling machine, some of the problems are mentioned below:

1. Due to less flexibility of workpiece in the vertical welding fixture, designing of the welding fixture is done.

2. While attaching job on the different inclined surfaces by using a vertical machine, it takes timefor handling the workpiece by using angular vice because of its heavy weight, so the time required for cutting increases.

3. When it is required to weld on inclined surfaces of heavy workpiece and if angle vise are used then it required more human effort because of its heavyweight.

In general, welding can be the hardest and difficult in manufacturing process and in term of understanding. Due to this condition, the shortage of man power specialized in the field occur. Instead of spending a lot of money to find and train several number of welders, why not just hiring one great welders that can monitor the weldment or work quality of several welding machines. Regarding the quality, it is impossible for the human to have the same weldment quality throughout each product. A lot of factors are taking part in this condition such as the fatigue, emotions and boredom due the welds in the same spots for a many times. The possibility of the part to be damaged,

ncreasing the total time to market. Welding can be dangerous and hazardous towards the welders if no proper precautions are taken.

scrapped and being hold due to quality notification are high. Thus increasing the cost of the production and

1.Occupies small space, rugged and durable.

2. Facilities assembly of components in correct position.

3.The table top welding is done using turntable and a geared motor arrangement with a firm design to rotate the chuck.

4.This has Motorized chuck mounted on a horizontally movable arrangement so that work can be held in suitable position for the welding/cutting operations.

5.It is a completely adjustable rotating welding cutting table system.

6. Capable of handling small as well as large sized work pieces.

7. Efficiently and effectively fulfill its intended purpose.

IV. METHODOLOGY

In order to overcome problems mentioned in previous chapter, a brief study was carried out and implementation of modification of multiangle drilling machine was finalized, in order to reduce the human efforts for heavy workpiece handling. The proposed methodology makes use of both qualitative and quantitative perspectives, and includes a broad array of approaches such as expert opinions, focus groups, and content validation. It also involves sophisticated assessment of construct validity including substantive and structural aspects. Methodology may be visualized as a spectrum from a predominantly quantitative approach towards a predominantly qualitative approach. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge such that the methodologies employed from differing disciplines vary depending on their historical development. 9 4.1.1 Existing Methods We kept the ideas similar to designs and features currently on the market. The design has a main rotation axis in which the entire work surface rotates during circular welding operations. This clamping system is quite effective for operations in which the same features will be welded repeatedly, as in an assembly line configuration. Once the initial welding operation has completed, then if additional operations are required the machine operator would manually unclamp, move, and reclamp the work piece. This requires that a complex fixturing system be designed to accommodate several different shaped work pieces in customizable locations. 4.1.2 Arc Welding One of the common method in joining metals is arc welding. This is done by melting the metal with a high intense heat between two parts. This will cause them to intermix - directly, or more commonly, with an intermediate molten filler metal. A metallurgical bond will be created during the cooling and solidification process. The final might have different properties such as strength and chemically since the joining is an intermixture of metals. Figure 4.1 Arc welding circuit 10 4.1.3 Manipulator In general, manipulator is a device used to manipulate materials or object without making any physical contact. A manipulator can handle variety of jobs that is beyond the capabilities of human right from material handling and complex assembly tasks. In welding, manipulator mainly used for handling and controlling the torch movement. In welding area, the most common manipulators used are the column and boom manipulator and robotic arm manipulator. Nowadays, a lot of fabrication industries such as petrochemical, submarine manufacture, nuclear and conventional power generation plant, on shore and offshore has implemented the column and boom manipulators for their automated welding process. The columns usually will be installed on two types of base which: a steel fabricated base where the column is stationary, the other is a traversing base or bogie to allow it to move along a suitable track way. In order to enable the column to rotate 360 degree, it will be installed together with the slewing rings. The main purpose of the column and the boom is to hold the automatic welding head to carry automatic welding heads which could be TIG, Plasma, MIG or submerged arc welding heads to weld either longitudinal seams or circumferential seams with rotators. Usually, column and boom manipulators are used together with welding rotators in order to performed longitudinal and circumferential welding at the best position of down hand welding. They can also be used with welding 13 positioners for automatic circumferential welding. Arc welding using robotic manipulator was also has been massively implemented especially in automobile industry. Cartesian robotic manipulator (which can move in linear motion) which is specifically made for this single application is most usually the choice. If the part needed to be positioned and hold accurately at a certain parameters, the complex two-dimensional path can be pre-taught and no external sensors are needed. 4.1.4 Positioners Positioners are one of the main elements in the process of production. They are required in almost all of the manufacturing, assembly and inspections process. Welding positioners is an advanced implement that helps perform welding [1]. It functions by keeping the work piece in place when being welded. the work piece need to be positioned and supported in proper position and location in order to prevent the work piece from being distorted during the welding process. The work piece needs to be place carefully and the clamping need to be light in order to prevent any damage occur to the work piece but still, it is need to be firm. The placement of the clamping elements must be clear from the welding area. The positioner also need to be stable and rigid enough to withstand the welding

process. In addition, it also provide some relative, progressive, smooth movement between the torch of a fusion welding head and the joint to be welded [1]. Since the elements is moving in a simple lines, it is considered as relative movement. In conventional welding methods, a welding table is used. Although a welding table is very useful in certain ways, the limitation of no intrinsic movement has make it fall shorts on the above definition. Welding positioners is a must have tool for a highly productive mechanically assisted manual welding for those different process that supply filter filler metal continuously from a spool (GMAW,SAW) or for GTAW with thin sections if filler metal is not required [1]. Weld positioners available in a lot of design and features with the objective to help in producing the best output in the welding working area. In addition, in can reduce the risk and hazard for the welders that are working with heavy machinery. However, weld positioner are not meant to be used by only in the heavy machinery sectors, others such as automotive, heavy construction, oil and pipe, and defense industries also utilized it. In addition, it is also being applied by the agricultural industry as well. Since weld positioners has been well known as a tool that can help increase the productivity rate, many manufacturing company has established variety of design and features for welding positioners such as sliding 14 tailstock trunnions, ferris wheel positioners, five-axis positioners, L-hook positioners, and dual trunnion turntables. \ Figure 4.3 Drop center positioner A drop center positioner can handle extremely heavy and long parts. Nowadays, a drop center positioners commonly used in the agricultural industry for GMAW applications. It is also have been proven that drop center positioners are reliable for use on any kind of weld in any industry

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4.1 Motor Selection

Servo motors are self-contained electric devices that rotate or push parts of a machine with great precision [4]. A servo system made up from three main elements which is - a controlled device, an output sensor and a feedback system. Servo system is an automatic closed loop system. A dc motor will operate by applying variable input signals. Differs from DC motor, Servo motor operates by receiving feedback signal and compare it with the input and output signal. When an input signal is generated to the system, a sensor will detect it and compare the signal thus producing a third signal which is the feedback system. The third signal will acts as the input signal of controlled device. This input signal to the device presents as long as there is a logical difference between reference input signal and output signal of the system [4]. When the system already achieved the desired output, the logical difference between reference input signal and reference output signal of the system is eliminated. Later, the comparison between third signal and the above said signals will not be sufficient enough to operate the system further and to produce further output of the system until the next reference input signal or command signal is applied to the system [4]. Therefore, the main task of the servomechanism is to maintain the output of a system at the desired value in the presence of disturbances.

4.2 Modelling

The drawing and modelling for this project will be done using SolidWorks . The technique used in developing this model are sketch and extrude. Sketch is use to create basic dimension of the 2D drawing. Then, that 2D drawing is develop into 3D geometry by using extrude. In conceptual design, two designs have been develop and proposes. Solidworks Modelling SolidWorks is a solid modeler, and utilizes a parametric feature-based approach to create models and assemblies [3]. The software is written on Parasolid-kernel [3]. Parameters can be defined as the constraints value that will determine the geometric shape of the model or assembly. It can exists either in numeric parameters for example, length of a line or diameter of a circle, or geometric parameters such as tangent, parallel and concentric. Usually, geometric parameters are used in assembly drawing. Numeric parameters can be associated with each other by the use of relation, which allow them to capture design intent [3]. Design intent can be define as the design or shape that is intended to be created by the creator. For example, the creator want to extrude a cylindrical shape on the side of a box and stay at the box, regardless of the height or size of the box, even after some alterations. Solidworks will allow the user to specify the cylindrical shape at the side of a box, and will then honor their design intent no matter what height they later assign to the can [3]. Features can be refer as the building block of the part that has been created. The part is constructed by the shapes and operations programmed by the creator. Shape-based features usually started with a 2D sketch of the shapes such as holes or boxes [3]. The sketched shape will be extruded or cut forming a 3D model. Operation-based features are not sketch based. In order to use the operation based features such as fillet or chamfer, a 3D model needed to be construct first. For beginners, it is advised that they start to build a model by using 2D sketch. From the sketch, few parameters geometry need to be define such as points, lines, arc and circle. Dimension will 17 be added to the sketch using the Smart Dimension features. The location of the sketch of the sketch can also be determined. The parametric nature of SolidWorks means that the dimensions and relations drive the geometry, not the other way around [3]. The dimensions in the sketch can be controlled independently, or by relationships to other parameters inside or outside of the sketch [3]

V. CONCLUSION

By using Welding fixtures we can weld vertical as well as an inclined weld on workpiece surface at a time. Multiple operations are carried out in a single feed of the machine. Also, this machine is more advantageous than conventional welding machines. Effective operation and competitive costs can be assured in this machine.This machine is easy to operate to weld at ant position so it gives better control during the operations. This machine will reduce the human effort to a great extent.

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