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A REVIEW ON DESIGN AND DEVELOPMENT OF CIRCUMFERENTIAL WELDING MACHINE

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Abstract - *The efforts required in achieving the desired output can be effectively and economically decreased by the implementation of better designs. The benefit of automation is reduction in production time that is to produce more in regular time. Automation is delegation of human control to functions to technical equipment for better quality, reduced cost & increase safety in working conditions. For welding of components circumferentially it is a time consuming process also the quality of welding changes as number of welders work on the component so each welding quality is different from another. Example-For welding of a circular tank on both sides with caps the welder has to connect the tank to the motor for rotary motion with the help of shaft of motor directly to the tank on one side & other side is connected to a roller for rotation. The worker welds the tank on one side and then on other side which is time consuming process. Also the production output varies. For mass production and to reduce cost in operation it is required to design an automated welding machine. By the help of this project we want to reduce welding of components manually by making an automated circumferential welding machine. Making the whole process of welding automatically & aim is to increase efficiency, productivity, welding quality, & minimizing the non-value added time.*

***Key Words*: Automation, Tanks, MIG Circumferential Welding**

1. INTRODUCTION

The project is basically based on Automated Welding Machine, it is an industrial project for modification of welding from manually to automatic. The modification is carried out to overcome various problem's occurred during manufacturing. Advantages commonly attributed to automation include higher production rates and increased productivity, more efficient use of materials, better product quality, improved safety, shorter workweeks for labor, and reduced factory lead times. Worker safety is an important reason for automating an industrial operation. The Design and Development of welding machine is for circular tank of solar water system. While manufacturing of this tanks circumferential welding is carried out, during welding of this circular component (tank) with caps on both sides are done manually by workers. When workers work on the circular component for welding each and every welding finishing is different, as it is carried out by different workers. This is one of the important factor which has to be eliminated as it directly affects the quality and type of weld required. To avoid Job rejection for quality & to reduce the Non Value Added Time during production automation is required. For automation this machine is to be designed such that, the whole process should be automatic. Like from clamping of the component to welding at a same place in a sequence. For welding of this tank Gas Metal Arc Welding (MIG) is used. MIG Welding works on same principle of TIG Welding or Arc welding. It works on basic principle of heat generation due to electric arc. This heat is further used to melt consumable electrode and base plate metal which solidify together and makes a strong joint. The shielded gases are also supplied through nozzle which protect the weld zone from other reactive gases. This gives good surface finish and a stronger joint. There are various benefits of MIG welding- High quality welds can be produced much faster, the gas shield protects the arc so that there is very little loss of alloying elements. The torch used in this automated welding machine should weld the component automatically, so by this overcoming the first factor welding accuracy is eliminated as each and every weld is same. Also the time reduces for welding as compared to manual welding.

2. OBJECTIVE

The main objective of this machine is to reduce time from 30-35 minutes to 4-5 minutes for welding process i.e. reducing non value added time. Simultaneously welding is done at both side. Welding as well as holding of a tank is automated. Also the finishing of welding should be increased.

3. LITERATURE RESEARCH

D. Baharan, "Optimization of MIG welding process parameter for the hardness and strength of the welding joint using Grey relational analysis" (2018) in their brief status report to optimize the process parameters in MIG (Metal Inert gas) welding to optimize the hardness and ultimate tensile strength (UTS) of the material. The gases used in MIG welding are as carbon-di-oxide, argon and mixture of argon and helium is used. Optimization of hardness and UTS of welding speed is higher and welding voltage should be high.

S. Mehta, "An approach to reduce non value added time and improve process cycle efficiency by implementing project information system" (2017) in their report the project information system (PIS) the process will be simplified and reduce in non-value added time (NVAT) and reduction ion loss of data this overall result into increase in efficiency and output. To reduce the non-value added time (NVAT) of the improved process cycle efficiency (PCE) and to reduce the total manufacturing cycle time.

P. Gopi and team, "A review on design and development of jig and fixture for circular welding" (2017) in their report the design and development of jig and fixture for cylindrical components to design of jig and fixture holding and indexing the circular job is made easy.

S. R. Patil, "Optimization of MIG welding parameters of improving strengths of welding joints" (2016) in their brief report the welding current and welding speed are the major parameters which influence on the tensile strength of welded joint optimization method is used to define the desired output variable through developing mathematical model to the relation between the input parameter and output variable.

V. Parth, "Analysis of single row deep groove ball bearing" (2014) in their brief report the main advantage is to find the most influencing parameter for the radial stiffness of the bearing under an axial load. ANSYS software is uswed finite element analysis of single row deep groove ball bearing. The aim is to be identify the deformation and the life span of the bearing.

Y. Garud, "A study of variable frequency drive and its application" (2016) in their brief report variable frequency drive (VFD) is used in electromechanically drive system to control A/C motor speed and torque by varying motor input frequency and voltage. VFD helps to electrical consumption of motor by reducing the amount of energy they consume. VFD is used to control process temperature pressure and for flow without using any controller.

D. Gupta, "Welding: Its methodology and safety measure" (2015) in their report welding is the most economical and efficient process to join metal permanently. Welding is a method to repairing or creating metal structure by joining the piece of metal.

M. Ranwa, "Speed control of DC motor using PID controller for industrial application" (2019) in their brief report PID controller to supervise and control the speed of DC motor. PID controller are used in industrial plant because their simplicity and robustness. PID controller are used to regulate the time domain of different type of dynamic plants.

4. METHODOLOGY

The component to be welded on machine is a circular tank of solar water heater. For rotation of circular tank the torque and power is to be calculated for designing the drives and motor required.

4.1 Calculations

Given –

Weight of the tank – 25 kg

Fixture Weight – 8 kg

Factor of safety – 8 kg

Diameter of tank – 472mm

Speed (N) – 0.2 RPM

Total Weight of tank is 41 kg,

As we know,

$T = F*R$

Therefore, $F = m.g$

$41*9.81$

$F = 402.21$ N

For Torque,

$T = 402.21*236$

$T = 94.92$ N.m

Torque required to rotate the tank is 94.92 N.m

For Power,

$P = (2*(3.14)*N*T)/60$

$P = (2*(3.14)*0.2*94.92)/60$

$P = 1.98$ Kw

Therefore, required power is 1.98 Kw.

Speed Ratio = 1/2= 5

d =80mm, considering gearbox shaft diameter belt section "A"

$D/d=n_1/n_2$

$D/80=1/0.2 = 400$

D= 400mm & d = 80 mm dia. Of pulleys

Pitch length of belt,

$L = 2C + 3.14/2(D+d) + (D-d)^2/(4*700)$

$L = 2190.55$ mm

Therefore, Pitch length of Belt selected from table No-13.14, from section A is 2200

For center distance

$CD = A+\sqrt{(A^2+B)}$

$A= L/4-\pi (D+d)/8$

$= (2200/4)-\pi (400+80/8) =361.50$

$B= (D+d)^2/8= (400-80)^2/8= 12800$

$CD = A+\sqrt{(A^2+B)}$

$= 361.50+\sqrt{(361.50+12800)}$

$CD = 740.29$ mm ≅ 740mm

Correction factor for arc of contact (FD) =

$\alpha_S = 180-2\sin^{-1}(D-d)/2C$

$= 180-2\sin^{-1}(400-80)2*740$

$= 155.02^o = 154^o$

Hence, Correction factor is 0.93 (FD- form table 13.22)

By 154^o & (C-D)/C= 0.45

FD =0.93

Power rating of single V-belt =

From table 13.16 power rating of single V-belt, at 1440 & 80 dia. smaller pulley is 1.04 Kw.

No of belt = (p*Fa)/(Fr*Fc*Fd)

Fc= Belt correction factor for pitch length table 13.21

For A 2200 is 1.05

Fa = correction factor according to service from table 13.15,

For medium duty Fa =1.1

No of belt = (p*Fa)/(Fr*Fa*Fd)

= (1.93*1.1)/(1.04*1.05*0.93)

No of belts = 2.0

= 2.14≅2

The above calculations are for machine drive for rotation of tank, which contains pulley drive and gearbox calculation.

5. EXPECTED RESULT

1. Increase in production rate
2. Simultaneously welding on both side
3. Increasing welding finishing
4. Making whole process automatic

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