ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 1, Issue 3, July 2016

Design and Manufacturing of Automatic Circular CO_2 Welding Machine

[1]Kalyani P Dhage, [2] Harshal A Chavan
[1]Department of Mechanical Engineering, MET Bhujbal Knowledge City IOE , Nasik
[1]kalyanidhage8620@gmail.com,[2]chavanharshal@gmail.com

***Abstract*: Automatic circular CO_2 machine is designed and manufactured for cam shaft mechanism, this type of machine is used to increase productivity. A very keen judgment is essential for success of such machines. Welding on circular periphery is very critical to overcome this problem automatic circular CO_2 welding machine is designed. With the help of this machine dimensional accuracy and weld consistency is also improved. It helps to increase quality and reduce rejection rate of component.**

***Index Terms*—SPM, MIG welding, Programmable Logic Controller etc**

I. INTRODUCTION

Cam shaft mechanism is used in circuit breaker which can break circuit under fault condition. It is very difficult to weld cam on shaft at circular periphery. In manual welding, at a time only one cam can be weld. Which is very time consuming and rejection rate is high. To overcome this problem which is occurred in industry we designed and manufactured automatic circular CO2 welding machine. In this SPM all functions do automatically with the help of PLC.

Fig. 1: Cam Shaft Mechanism Used in Circuit Breaker

II. OBJECTIVES

- To incorporate automation system in welding process.
- To increase productivity and accuracy.
- To avoid dimensional variation and better welding strength.
- To reduce rework, scrap and defect.

III. METHODOLOGY

The methodology adopted would be studying and identifying the existing method of circular welding. Carrying out critical parameters on circular part (shaft) and designing new automated circular welding machine. Stresses generate on shaft after welding, analysis with the help of ANSYS. There is less failure in welding by automated machine compare to the manual welding. Stress analysis would be done in ANSYS static structural module. Temperature distribution is done in ANSYS steady state thermal module. Manufacturing automated machine and comparing machine parameter with previous welding results, along with the experimental results.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 1, Issue 3, July 2016

IV. DESIGN OF MACHINE

Pneumatic circuit design

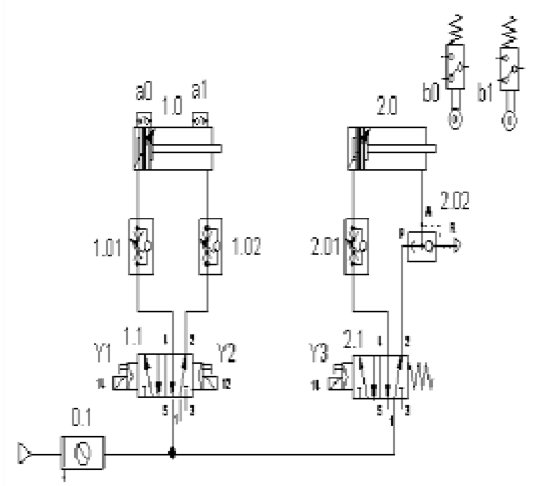

Fig. 2: Pneumatic Circuit

Components used in Pneumatic Circuit

Filter Regulator: AW 30-03 BG 1

Solenoid valve with coil: SY7220-5LZ-02

Pneumatic Cylinder: MD D1 B40-2002

Switch: D-M9PL-LUG

Mechanical component design

Structure:

Frame is made of square pipe
Width and height of pipe selected = 50 mm
Length of pipe = 2500 mm
Considering wall thickness = 3 mm
Assumption:

1. Individual pipe of length 2500mm to be simply supported
2. 5 longitudinal pipe and 2 transverse pipe welded to each other
3. assume total load on frame to be 300kg = 2943N

Now calculating the deflection of pipe when load is applied at mid of pipe i.e. 1250 mm

By Macaulay's method
Deflection of pipe is given by
$y = (W \times L3) / (48 \times E \times I)$
y= Deflection
W = Load = 2943N
L = Length of pipe = 2500 mm
E = Young's modulus = 210 Gpa
I = MI of upper frame pipe = 4267709126.66 mm^4
I (upper frame) = 5 × MI of longitudinal pipe + 2 × MI of transverse pipe
$y = (2943 \times 25003) / (48 \times 210 \times 103 \times 4267709126.66)$
y = 0.001mm
Deflection is well below specified tolerance for job hence selected pipe is safe.

Fig. 3: Structure

Rail Selection:
Assumption

1. Applied load (W = P) on rail = 50 Kg = 490.5 N
2. length of rail 2200 mm
3. External forces (F) = 25 kg = 245.25 N
4. Linear speed max V_e = 60 m/min

Selecting temporary rail from hiwin datasheet for above working condition
Rail code: HGH20CA: L = 2200 mm
For above rail
Basic dynamic load rating = C = 17.75 KN
Basic static load rating = Co = 27.76 KN

1. Calculating static safety factor (fsl)

fsl = Co / P = 56.59 > than normal load condition value i.e 3.0

2. Calculating nominal life (L)

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 1, Issue 3, July 2016

L = (C/P)3 × 50 Km = 2369452.68 km

3. Calculating Service life (Lh)

Lh = (L × 1000) / (Ve × 60) = 658181.3 hrs

4. Calculating load on blocks (P1 and P2)

P1 = P2 = (W/2) + (F/2) = 367.87 N

5. Calculating Friction (Fr)

Fr = μ × W + S μ = 0.004 for ball type block
S = 1.57 N ---------- external friction
Fr = 3.53 N
Above results are confirm the selection of rail HGH20CA.

Fig. 4: Rail

Motor:
Motor selection 85 kg-cm

Table No. 1: Load on Rail during Different Operating Pattern

Load on rail	50 kg	490.5 N
Other forces F on rail	25 kg	245.25 N
axial load during acceleration	343 N	
axial load during deceleration	324 N	
axial load at constant speed	10 N	

Torque acting on screw = r ×Total load Radius of screw in mm
Torque acting during acceleration = 343 ×12.5 = 4287.5 N-mm = 43.7 kg-cm
Torque acting during deceleration = 324 × 12.5 = 4050 N-mm = 40.5 kg-cm
Torque at constant speed = 10 × 12.5 = 125 N-mm = 1.25 kg-cm
As above torques are well below the rated torque of motor, selection of motor is correct.

V. WORKING

❖ Tagging of Cams on Shaft

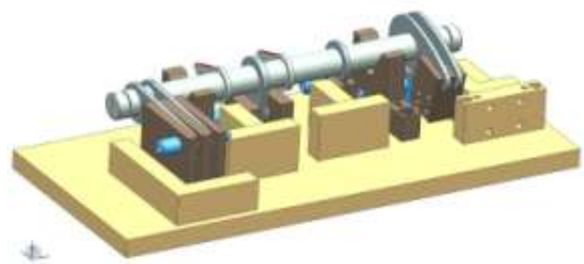

Fig. 5: Tagging

1. In this machine, two welding guns are mounted on work table to weld cams on shaft.
2. To move welding gun in Y- direction stepper motor is used and to move in X- direction cylinders are used. DC motor of 120 V with gear box 200 rpm is used to rotate the shaft in 360 degree.
3. Stepper motor of torque 85 kg-cm, 2000 rpm with drive to reduce the speed of motor.
4. In this SPM welding process of cams on shaft weld automatically with the help of PLC. Electric circuit diagram of PLC.
5. Shaft is mounted on center mounting which is fixed at one end with the help of stepper motor shaft is rotate in 360 degree at that time with the help of PLC welding gun weld the cams on that shaft. Because of automated machine time required to done the job is less and production increased.

Fig. 6: Welding Machine

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Vol 1, Issue 3, July 2016

VI. ANALYSIS OF CAMS

Table No. 2: Properties of SAE 1090

Properties	Values	Units
Elastic modulus	210000	N/mm²
Poisons ratio	0.3	
Mass density	7580	kg/mm³
Tensile strength	841	N/mm²
Compressive strength	1200	N/mm²
Yield strength	247	N/mm²
Thermal conductivity	12	μm/(m-K)
Specific heat	450	J/(kg-K)

Cams	Von Mises Stress		Bending Stress	
	Min	Max	Min	Max
1st	4.926e-005	812.39	-385.76	845.17
2nd	1.8836e-002	636.8	-460.18	689.92
3rd	0.42209	789.98	-420.14	521.54
5th	7.1142e-002	800.29	-390.72	553.99
6th	1.4554e-007	725.97	-352.09	731.5
7th	0.5113	717.34	-422.44	655.47
8th	2.9299e-007	566.1	-456.82	437.46

Table No. 3: Stress Report on Manual Welding

Cams	Von Mises Stress		Bending Stress	
	Min	Max	Min	Max
1st	3.52e-006	955.47	-450.86	967.17
2nd	2.54e-002	765.45	-515.45	811.56
3rd	0.65433	856.76	-480.98	643.78
5th	8.6544e-002	878.56	-450.87	675.34
6th	1.2456e-008	750.76	-410.89	814.67
7th	0.8764	772.67	-470.47	738.56
8th	3.1245e-007	600.01	-510.34	520.98

Table No. 4: Stress Report on Automatic Circular Machine

By comparing stress results of manual welding and automatic welding machine. We conclude that accuracy of manual welding is less so the stress generated at welding joint is more. As in case of automatic welding machine the accuracy is more so that the stress generated at joint is less. Due to that the product rejection rate is low.

VII. CONCLUTION

Project aims at automation of circular welding which is successfully achieved in the form of "CO_2 Welding Machine" with all desirable features a SPM carries. Due to design and manufacturing of automatic circular CO_2 welding machine, cyclic time/job decreases by 10 min that means in 14 min whole process is done. It helps to achieve monthly target of 1200 jobs. Quality of weld increases due to automatic welding machine. Rejection rate is low as there is accuracy in weld. Due to implementation of automatic welding machine, fatigue of operator is reduce. Productivity increases to a great extent through this project.

Future Scope:

In this CO_2 welding machine, cam mounted on shaft are of 8 nos. , in future it may increase up to 20 nos. of cam on shaft at a time and be achieved by considering different parameters.

REFERENCES

[1] Sproesser Gunther, Pittner Andreas, Rethmeier Michael, "Increasing performance and energy efficiency of Gas Metal Arc Welding by a high power tandem process", 13th Global Conference on Sustainable Manufacturing - Decoupling Growth from Resource Use, pp. 642-647, (2016).

[2] Sheikh Irfan and Prof. Achwal Vishal "An Experimental Study on the Effect of MIG Welding Parameters on the Weldability of Galvenize Steel", International Journal on Emerging Technologies, pp. 146-152, (2014).

[3] Thirugnanam A., kumar Manish, Lenin Rakesh, "Analysis of Stress in Welded Joint in Bending and in Torsion Using 'Ansys'", Middle-East Journal of Scientific Research, pp. 580-585, (2014).

[4] Ramani S., Velmurugan V., “Effect of Process Parameters on Angular Distortion of Mig Welded Ai6061 Plates”, 5th International & 26th All India Manufacturing Technology, Design and Research Conference, pp. 401-1- 401-6, (December 12th–14th, 2014).

[5] Patil Kunal V., Gadade Balaji K., Raut Parag G., Gaikwad Suvarna K., Toke Ganesh, “A Novel approach of MIG Welding using PLC”, A Novel approach of MIG Welding using PLC, Vol. 3, Issue 2, pp. 7480-7485, (February 2014).