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DESIGN, FABRICATION AND ANALYSIS OF WELDING FIXTURE HAVING HIGHER ACCURACY WITHOUT USING ROBOTS

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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 can be done by without automation.

Key words: Fabrication, Welding Fixture, CMM, Productivity.

INTRODUCTION

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[1,2], fabrication and analysis.

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Welding fixture shown in the Fig. 1 is used for the positioning a round rod over another round rod post on which a welding process is carried out[4]. It maintains the pressure applied over the two rods. The pneumatic cylinder is fixed in one end of the rod to maintain the pressure applied over another rod. The centering of the vertical rod is obtained by separate lever operated clamping[6].

Working principle

The two round rods are welded together in the location as shown in the Fig. 1. The first horizontal bend rod is clamped in the three locations: middle position by hand lever and the both the end of the rods. The V clamp is provided for easy holding of round rods. Then the second rod is vertically placed in the clamp; one end of the rod is fixed with the pneumatic cylinder to avoid the applying pressure difference in between the rods. The pneumatic cylinder moves the vertical movement of the rod towards the horizontal rod and it's maintaining the precision of the movement. Centering of the vertical rod is done by separate holding clamp as shown. This type of fixtures reduces the time cycle of the operation and increases the accuracy and production.

The part A is fixed in the clamp by using the bar stop clamp. The Part B fixed with the part A is high precisions work and it takes very long time in the mass production. Time consumption is the major problem in this case. Placing the circular components over other circular components for welding is very difficult task because the angle of the circular components and the pressure of the pressing components over other components will affect the accuracy of the welding and placing. Part B components have the rectangular guide path for arresting the angular moments. But the tolerance of the guide is + or - 0.5 mm, so there is a chance for angular moments in the part B components.

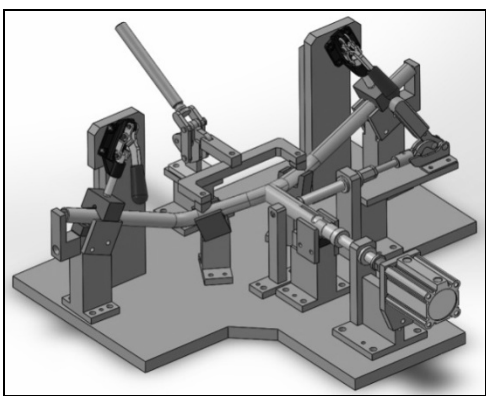

Fig. 1: Isometric view of fixture

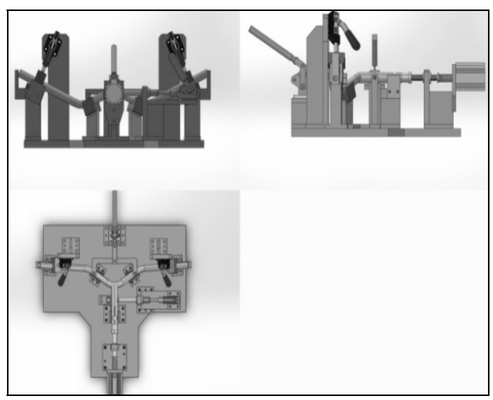

Fig. 2: Orthographic view of fixture

In the end of the part B we fixed pneumatic cylinder for maintaining the pressing pressure as 0.25 bar. While pressing the part B over part A, the pressure affects the centering of the part B over part A. For that, we fix the side lock pin. Part B is having a small hole in the component. The side lock pin is finally locking the part B as shown in Fig. 1. This will arrest both the angular and direction movements in the fraction of second, and will increase the production of the components.

CMM Readings (Loc 1, 2 & 3)

At first centering the fixture in CMM using three circle as the reference points is shown in Fig. 3[7]. The tabular column shows the output of the CMM. The result contains tolerances in plus or minus, Actual measurement, deviation out-tolerances are shown in Table 1.

CMM Readings (Loc 4, 5, 6 & Dist 1)

The same procedure has been carried out for location 4,5 and 6 and the output is tabulated in Table 2, the locations are shown in Fig. 4. Besides, the distance has also been checked in X axis from PLN5 to D.

CMM Readings (Loc 7, Dist 2,3 & Angl 1)

Here we check for location 7, DIST 2 PLN8 to E in Y axis, DIST3 PLN17 to F, and ANGL1 PLN1 to E1 is checked and the outputs are tabulatedin Table 3, the locations are shown in Fig. 5.

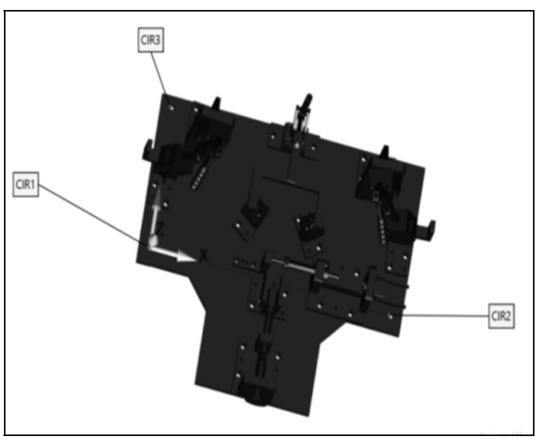

Fig. 3: CMM Measuring locations

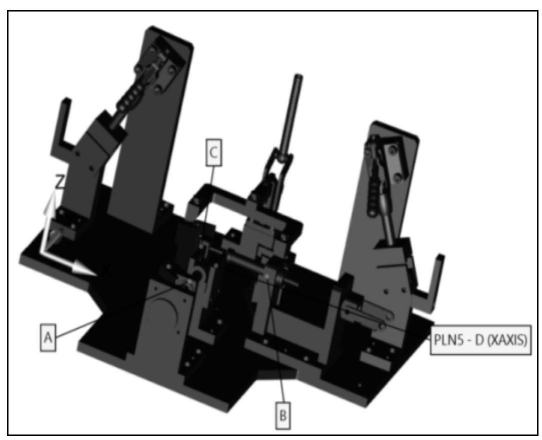

Fig. 4: CMM Measuring locations

Table 1: Reading of Loc 1, 2 & 3

LOC 1 – CIR 1						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	0.000	0.150	0.150	0.000	0.000	0.000
Y	0.000	0.150	0.150	0.000	0.000	0.000
Z	0.000	0.150	0.150	0.000	0.000	0.000
D	8.000	0.100	0.100	8.099	0.099	0.000
LOC 2 – CIR 2						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	550.000	0.150	0.150	550.114	0.114	0.000
Y	0.000	0.150	0.150	0.000	0.000	0.000
Z	0.000	0.150	0.150	0.000	0.000	0.000
D	8.000	0.100	0.100	8.095	0.095	0.000
LOC 3 – CIR 3						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	0.000	0.150	0.150	0.055	0.055	0.000
Y	0.000	0.150	0.150	250.079	0.000	0.000
Z	250.000	0.150	0.150	0.000	0.000	0.000
D	8.000	0.100	0.100	8.093	0.093	0.000

Table 2: Reading of Loc 4, 5, 6 &Dist 1

LOC 4 - A						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	276.657	0.150	0.150	276.786	0.130	0.000
Z	100.000	0.150	0.150	99.968	- 0.320	0.000
D	16.000	0.100	0.100	16.048	0.048	0.000

Cont…

LOC 5 – B						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	18.130	0.150	0.150	18.262	0.132	0.000
Z	100.000	0.150	0.150	99.896	-0.104	0.000
D	16.000	0.100	0.100	16.058	0.058	0.000
LOC 6 – C						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	18.130	0.150	0.150	18.251	0.121	0.000
Z	100.000	0.150	0.150	99.855	- 0.145	0.000
D	6.000	0.100	0.100	6.052	0.052	0.000
DIST 1 PLNS TO D (X AXIS)						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
M	27.600	0.150	0.150	27.636	0.036	0.000

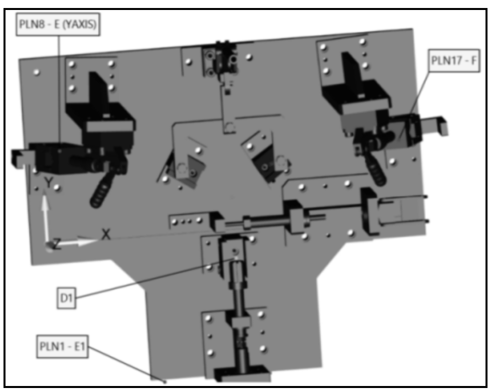

Fig. 5: CMM Measuring locations

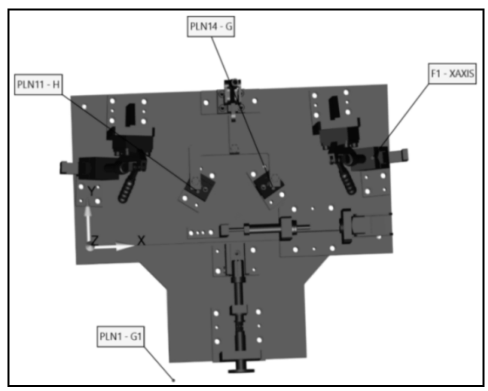

Fig. 6: CMM Measuring locations

CMM Readings (Dist 4,5 & Angl 3, 5)

DIST4 PLN14 to G, DIST5 PLN11 to H, ANGL3 F1 to X Axis and ANGL5 PLN1 to G1 were noted from CMM. Outputs are tabulated in Table 4, the locations are shown in Fig. 6.

CMM Readings (Angl 9)

The ANGL9 – PLN1 to H1 is checked and the result is tabulated in Table 5, the locations are shown in Fig. 7.

Table 3: Reading of Loc 7, Dist 2, 3 & Angl 1

LOC 7– D1						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
Z	86.400	0.150	0.150	86.315	- 0.085	0.000
DIST 2 – PLN8 TO E (Y-AXIS)						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
M	22.600	0.150	0.150	22.640	0.040	0.000
ALGN 1 – PLN 1 TO E1						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
A	23.780	1.000	1.000	23.857	0.077	0.000
DIST 3 – PLNS 17 TO F						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
M	22.600	0.150	0.150	22.808	0.208	0.058

Table 4: Reading of Dist 4, 5 & Angl 3, 5

ANGL 3 – F1 TO X-AXIS						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
X	23.780	1.000	1.000	23.800	0.020	0.000
DIST 4 – PLN 14 TO G						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
M	22.600	0.150	0.150	22.690	0.090	0.000
ALGN 5 – PLN 1 TO G1						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
A	18.090	1.000	1.000	18.143	0.053	0.000
DIST 5 – PLNS 11 TO H						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
M	22.600	0.150	0.150	22.808	0.208	0.058

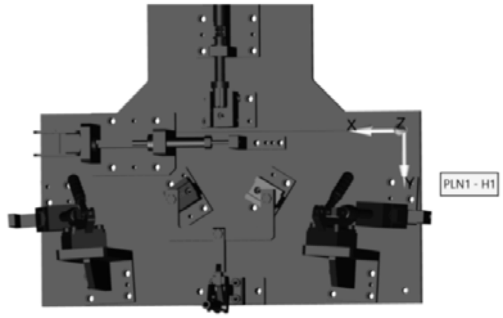

Fig. 7: CMM Measuring locations

Table 5: Reading of Angl 9

ANGL 9 – PLN 1 TO H1						
AX	**NOMINAL**	**+TOL**	**-TOL**	**MEAS**	**DEV**	**OUT TOL**
A	-18.090	1.000	1.000	-18.093	-0.003	0.000

CONCLUSION

The process of conducting operations related to welding fixtures helps in gaining a deeper understanding as well as effective alignment process. Welding fixtures closes the gap in the engineering of automated fixture mechanism. This fixture will reduce the error due to lack of labor skill, will increase higher range of accuracy, will increase the productivity and will reduce the cycle time of the operation.

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