3 DIMENSIONAL WELDING SPM / PATH TRACER

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ABSTRACT

Design and Manufacturing of 3D Welding Special Purpose Machine has been presented in this paper. Instead of using a Programmed Robot we designed and manufactured a SPM. Catia V5 has been used for designing and manufacturing of the machine with basic manufacturing processes. Conventional manual methods of welding have been replaced by automation by 3D Welding SPM. In the past path generation was for only two dimensions and no special purpose machine was invented for 3 dimensional automated welding, so we have invented a machine which will allow automated welding in 3D axis with the help of four different assemblies of basic mechanical components. Successful results have increased the accuracy and efficiency in welding process and also have cut the machining time.

Key words: 3D Welding machine, Welding SPM, 3D Path generation, automated welding.

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1. INTRODUCTION

Advanced manufacturing is an important area of focus, both as an investor and a manufacturer. We truly need to inch our all work or tasks to a certain degree of perfection which is how nature has evolved right from decades ago. This term can also be called as Robotification -‘The process by which tasks normally performed by humans are replaced with machines of some kind. These machines could be mechanical or electronic’. With the increase of industrial dependence and needs of our society, industrial production drastically increased over the last decades. In order to keep production costs low, the outsourcing of parts of the manufacturing process to emerging countries has long been an answer. But, with the development of new robotic technologies, another answer is possible. This project aims to explore the possibilities offered by scrutinizing motion to achieve a 3-Dimensional welding task. Then it will explore the Components to be utilised to build a SPM and achieve 3-dimensional spiral path to TIG weld the Bowl feeder.

2. EXPERIMENTAL PROCEDURES

In drilling machine mechanism the process of drilling machine complete the process of drilling with three motion simultaneously, one linear and two rotational. So we understand that we can achieve the 3-D path to weld the bowl feeder that is the aim of our project. To achieve the 3-D path we used the drilling machine mechanism in reverse direction like in actual drilling machine the hole is generated by downward rotational motion instead of downward rotational we reversed to it in vertical direction to rotate the bowl feeder. The main task was that the rotation and linear up and down motion of bowl feeder for that we used the rack and axle mechanism.

3. MANUFACTURING OF COMPONENTS

3.1. Timing Pulley Assembly

Timing pulley assembly consists of a pair of timing pulleys and a belt the timing pulleys are usually installed where very precise drive is required. Also the belt slip can be avoided which one can find in traditional belt driven drives. This assembly helps in giving the required rpm to the SPM. With motor output speed as 1.92 RPM, this speed further needed to be reduced to 0.25 RPM was achieved by using timing pulley Assembly. Reduction of around 4:1 was the requirement. Hence a pinion and pulley were designed accordingly.

Table 1

Parameters	Pinion	Pulley
Outer Diameter	31.8	127.2
Number Of Teeth	20	80
Pitch	6.64	6.64
Material	En8	En8
Inner diameter	25	15

3.2. Rack and Axle Assembly

A rack is a type of linear actuator that comprises a pair of gears which convert the rotational motion into linear motion. Rack is always used with pinion and a circular gear is called the “pinion” engages teeth on a linear gear bar called the “rack” rotational motion applied to pinion causes the rack to move relative to pinion, thereby translating the rotational motion of the pinion into linear motion. Rack is used to move the bowl feeder in rotation and linear up and down motion with axle.

Figure 3.2 CAD Models of Rack and Axle Assembly

3.3. Pinion Assembly

A driving system is used to drive the entire machine but every machine has a unique design, it has to follow a particular motion as per the design. In every case the driving system cannot be used directly. It has to be run via various mountings. One such mounting that suits our machine is the pinion. The pinion helps us drive the machine and generate the required motion.

Figure 3.3 CAD Model of Pinion Assembly mounting

3.4. Stepper Motor

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motors position can be commanded to move and hold at one of these steps without any feedback sensor, as long as the motor is carefully sized to the application in respect to torque and speed.

3.4.1. Selection of stepper motor

Force acting on shaft (F) = 200 N

Radius of pinion (R) = 15 mm

Torque required to grinding:-

$$T = F * R = 200 * 15$$

$$T = 3000 \text{ N-mm} = 3 \text{ N-m}$$

Stepper motor with 5 N-m is selected

$$Fos = 5 / 3 = 1.666$$

Required factor of safety is 1.66

4. MANUFACTURED COMPONENTS

Table 2 Rack

Sr. No.	Operation	Machine	Tool
1	Turning	Lathe	Turning Tool
2	Facing	Lathe	Turning Tool
3	Threading	Lathe	Thread tool
4	Groove	Lathe	Part off Tool
5	Flat	Milling m/c	Milling cutter
6	Hardening	Heat treatment	-
7	Grinding	Grinding	Grinder

Table 3 Axle

Sr. No.	Operation	Machine	Tool
1	Turning	Lathe	Turning Tool
3	Gear cutting	Hobbing m/c	hob
4	Groove	Lathe	Part off Tool
5	Key way	Milling m/c	Milling cutter
6	Hardening	Heat treatment	-
7	Grinding	Grinding	grinder

Table 4 Timing pulley

Sr. No.	Operation	Machine	Tool
1	Turning	Lathe	Turning Tool
2	Gear cutting	Hobbing m/c	hob
5	Key way	Milling m/c	Milling cutter
6	Hardening	Heat treatment	-
7	Grinding	Grinding	grinder

5. FINAL DESIGN

Figure 5 Final layout

6. RESULT

Sr.No	Parameters	Conventional Method	3D Welding Spm
1	TIME	12hours/bowl feeder	3hours/bowl feeder
2	Manufacturing cost	1500 INR	950 INR
3	Accuracy	$\pm 0.7\text{mm}$	$\pm 0.5\text{mm}$

7. CONCLUSION

Thus a solution for the problem has been successfully found which led to design of machine that can trace any 3-D profile. Moreover a special purpose machine has been developed which will be able to weld any complex axi-symmetric component just by adjusting the design parameters with respect to the given component.

The SPM for TIG Welding of bowl feeder has been designed successfully using the concept of drilling machine. Achieving primary requirements of scrutinizing motion and increasing productivity have been met to a higher extent. It has become possible for any unskilled individual to carry out the welding using the SPM. Elimination of manual errors and Welder himself from the scenario has benefited the operator from harmful argon gas causing ill effects and increasing quality of weld.

Hence, manufacturing Special Purpose Machine for TIG welding of vibratory Bowl Feeder has been an eminent solution to the prefaced problem statement considering the scope of project.

REFERENCES

- [1] Roshan W. Tulankar and Suraj S. Dehankar, "Automation in Sheet Metal Tig Welding Process: A Case Study", *International Journal of Engineering Trends and Technology (IJETT)*, Vol. 4, Issue. 7, 2013
- [2] D. R. Berkowitz and J. Canny, "Designing parts feeders using dynamic simulation," *Proceedings of IEEE International Conference on Robotics and Automation*, Minneapolis, MN, USA, 1996, pp. 1127-1132 vol.2, doi: 10.1109/ROBOT.1996.506859
- [3] N Ravinder Reddy and G Mohan Reddy, Friction Stir Welding of Aluminium Alloys - A Review, *International Journal of Mechanical Engineering and Technology (IJMET)*, 7(2), 2016, pp. 73 – 80.
- [4] D. Roymohapatra, "PART FEEDING SYSTEM FOR FMs," Rourkela, 2003. Available at: <http://ethesis.nitrkl.ac.in/291/1/10503003.pdf>
- [5] Berretty R-P, Goldberg K, Overmars MH, van der Stappen AF. Trap Design for Vibratory Bowl Feeders. *The International Journal of Robotics Research*. 2001;20(11):891-908. doi:10.1177/02783640122068173
- [6] Green, Chris and Kreul, Jeff (2009) "Vibratory Feeder Bowl Analysis," *The Journal of Undergraduate Research*: Vol. 7, Article 7. Available at: <https://openprairie.sdstate.edu/jur/vol7/iss1/7>
- [7] Chavan D K, Pawar Udayan, Tambe Niharika and Sane Abhishek, Design of Three Axis Pick and Place Mechanism for Friction Welding Machine to Reduce the Time Cycle and to Increase Productivity. *International Journal of Design and Manufacturing Technology (IJDMT)* 5(1), 2014, pp. 12–22.