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Design and Development of Automated Fixture for Seam Welding Machine

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Abstract - *The Fixtures are work piece holding devices used for fix a part which support operations on different machines. Automation reduces efforts of workers, which means that they are able to stay operating for longer time and continue generating profit. Automated fixtures are widely used for reducing human efforts. We developed automated fixture for seam welding machine for reducing human effort and for greater stability of work piece. This paper presents an approach which allows automation of fixture for seam welding machine. The solution presented consist of a fixture design concept for seam welding machine.*

***Key Words*: seam welding, fixtures, clamp, work piece, etc.**

1.INTRODUCTION

We are working on seam welding machine; this machine is used to weld the shell part of exhaust system of generator. This shell is basically of cylindrical shape. Initially this shell was worked on roll and spot welding machine where the ends of shell surface were spot welded. There are two roller of copper which are used as welding tool.

These rollers are operated by using an electrical system. This electric system supplies current to the rollers. These current then heat the rollers. These rollers are rotated in clockwise direction. An operator then put the shell on locating plate, which is place to hold the shell between hot rollers. As roller rotates, they guide the shell in forward motion. These hot rollers rolled out shell surface which is to be weld. Once the surface of shell is being weld completely, the rollers then moved away from the shell surface as pneumatic cylinder is been used for respective operation. Operator then takes the shell [art out of the locating plate. And put new shell part for same cycle. From above, it is clearly seen operator is also a main factor for the whole scenario. But what if the operator is unskilled? There are some chances of misalignment of shell while feeding to rollers. This may cause any problem to the welding quality. Automatic welding gives improved weld quality, increased productivity, high production rate, & decreased waste production. This will result in less reduction of ppm and hence sales value of industry will increase. Adding an active positioning adapting function increases the unit's degree of freedom, which further allows huge range of possible motions. Sometimes misalignment may occur while feeding the shell to the rollers. It may burn through the surface of shell, it may create noise and also it may be injurious for unskilled operator as the feeding is done manually.

Fixtures are work piece devices used to fix a part which support operations on different machining. Difficult work pieces are find through fixtures produced faster from standard parts and can then be separated when a production run is complete. Automated fixture application is mostly in manufacturing, can also utilized in assembly and analysis processes. Using automated fixtures, the flexibility and fast response capability of production systems can be raised. One of the major benefits of using automation in an assembly line is their capacity to perform a job over short period of time than that of a worker. Not only can automation perform at a high speed, they are also more accurate, which allows for less errors and wasted product, thus increasing efficiency. Automation also do not become fatigued like human effort, which means that they are able to stay operating for longer hours and continue producing profit.

Fig.1.Seam Welding Machine

1.2 Components of Seam Welding machine

Wheel Electrode: The rollers are operated using an electrical system. This electric system supplies current to these rollers. This current then heat the rollers. Out of these rollers, one is rotated in clockwise and vice versa.

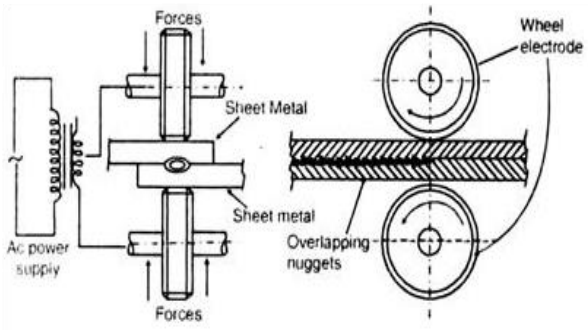

Fig.2.Wheel Electrode

Servo Motor: It controls the motion of the welding electrodes for Seam welding process. It also enables them to complete the circuit. Servo motor is controlled by electronic control unit.

Transformer: This unit is connected to the electronic unit. It also supplies current to wheel electrodes. It is water cooled of a high grade electrical steel. Primary and secondary coils of solid electrolytic copper of ample section, can withstand 140°C and offers current in 50-200kVA.

Electronic Unit: Electronic unit is the main part of Seam welding machine. All the switches are controlled by the electronic unit system. This unit contains a display from which operator can give the require commands for operation.

Reservoir: It is storage tank for the fluid which is using for the operation of seam welding machine as a coolant. This fluid is used for cooling purpose on work piece for welding operation.

Fig.3.Reservoir

Coolant: It is a fluid used to reduce the temperature of hot work piece. Water is used as a coolant for this welding operation.

1.3 Components of Fixture

For the given Seam welding machine, our automated fixture is temporary designed on solid works software have following main assembly parts-

Guideways: We are planning to design the structure in such way that the structure will hold and guide the shell with help of linear motion guideway mechanism. While guiding the shell there will be no chance for misalignment. In this manner feeding operation of shell will have done automatically. The operator will work now only for loading and unloading of the object.

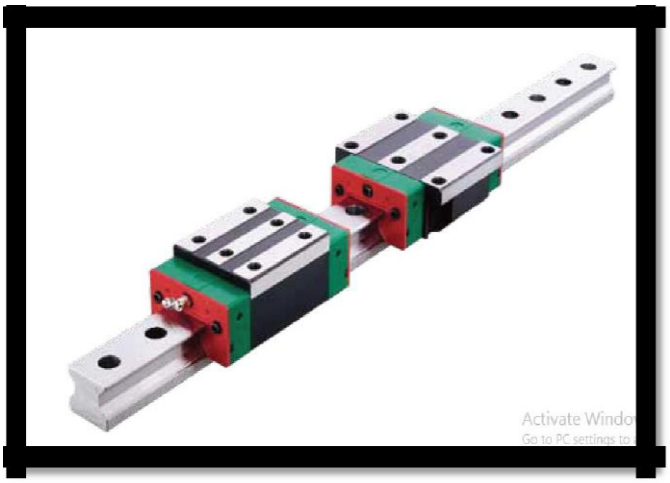

Fig.4.Guideways

Supporting Blocks: Supporting blocks are generally used for holding purpose, we are going to use this for holding the job to be welded by using seam welding machine. These blocks are placed at near about end of holding plate. The gap between two plates are maintain for different sizes of work pieces.

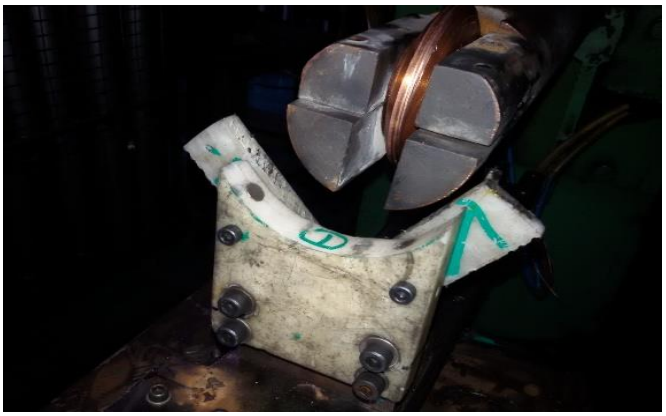

Fig.5.Supporting Block

Holding Plate: The holding plate is also a rectangular plate, made up of M.S. This plate is Allen bolted on the guide blocks, which can slide the plate with it. It is used for holding the L-block plate and block on it, for job holding purpose.

Fig.6.Holding Plate

T-Slotted Plate: The T-slotted plate is a rectangular plate, made up of material M.S. These plate is fixed with the floor stand by the Allen bolts, which is used for placing guide ways on it. The guide ways are bolted on these fixture plate for rigid support.

Stand: Floor stand made up of material M.S. The height of the stand is about 800mm. There is a tray mounted on it for connecting the fixture holding plate. The stand has great strength for withstanding the overall load of the system on it.

Fig.7.Stand

2. WORKING:

Firstly, this machine was operated manually. Seam Welding Automation is based on the Principle of pneumatic system linear slide ways in which compressed air is used to operate guide ways. Guide ways moves in Fixed Linear path. Work piece is mounted on Nylon Supporting blocks. As magnets attached in the blocks, work piece is firmly attached in between two blocks. Guide ways moves as it is pneumatically operated. It is moves in linear motion. The circular work piece moves in linearly so the work piece is passed through two copper rollers. With use of electric current, welding is to be done. As it is in the process, coolant is used for decreasing the temperature of work piece while welding. This coolant is thereafter collected in the reservoir or storage tank. Work piece is welded without use of hands. This is working as automated fixture for seam welding machine.

Fig.8. Automated Fixture for Seam Welding Machine

3.CALCULATIONS:

3.1Calculations of guide ways design-

Available data:

Welding pressure (P) = 2-4 Kg/cm^2

Speed (S) = 8 m/min

Diameter of shell (d) = 15 cm

Length of shell (L) = 56 cm

Surface area of shell (A) = πdl cm^2 = 2638.97 cm^2

Weight of shell (w) = 2 Kg

Acting load on block (P): Several factors affect the calculation of the loads acting on a linear guideway (such as the position of the center gravity of the object, the thrust position, and the inertial forces at the times of start and stop). To obtain the correct load value, each loading condition should be carefully taken into consideration.

$$P = \frac{W + F}{2}$$

Where,

P - Acting Load (N)

W - Weight of shell (N) = mg = 2×9.81 = 19.62 N

F- Force on shell (N) = Pressure × Area = 2.7 × 2638.97 = 7389.02 N

$$P = \frac{19.62 + 7389.02}{2}$$

P = 3572.37 N

Basic static load rating (C_o): Local permanent deformation will be cased between the raceway surface and the rolling

balls when a linear guide way is subjected to an excessively large load or an impact load while either at rest or in motion. If the amount of this permanent deformation exceeds a certain limit, it becomes an obstacle to the smooth operation of the linear guide way.

Static safety factor (fs): Appropriate safety factors, which depend on environmental and operating conditions, must be taken into consideration. A larger safety factor is especially important for guideways subject to impact loads.

Table.1. Static safety factor

Load Condition	Fs
Normal load	1.0 – 3.0
With impacts/vibrations	3.0 – 5.0

$$F_S = \frac{C_o}{P}$$

Here,For normal load

fs = 1.4

Therefore,

$$1.4 = \frac{C_o}{3572.37}$$

C_o = 50013.18 N

Basic dynamic load rating (C): The basic dynamic load rating is the load that does not change in direction or magnitude and results in a nominal life of 50 km of operation for a linear guide way. The values for the basic dynamic load rating of each guide way are shown in dimension tables. They can be used to predict the service life for a selected linear guide way.

Therefore,

C = 50013.18 N

3.2. Design of pneumatic cylinder-

Available data:

Pressure = 4 bar

Velocity = 8 m/minS

Force = 3572.37 N

Has the values of pressure and force on the pneumatic cylinder is available, we can calculate the area of the cylinder by equation.

$$\text{Area} = \frac{\text{Force}}{\text{Pressure}}$$

Here,

Force is the acting force P calculated before and

Pressure available as 4 bar

Therefore,

$$\text{Area} = \frac{3572.37}{4}$$

Area = 893.09 mm^2

As we have the area of the cylinder so we can calculate the bore diameter of the cylinder by area's equation.

$$\text{Area} = \frac{\pi d^2}{4}$$

Here, d = bore diameter (mm)

d = 33.72 mm

Q = V × A

Here,

Q = Discharge rate of air (m^3/sec)

V = Velocity (m/sec)

Therefore,

$$Q = \frac{(8 \times 60) \times 893.09}{1000}$$

Q = 0.119 m^3/sec

4. RESULTS:

Table.2.Permormance Characteristics

Sr. No.	Parameter	Before	After
1	Time	48 sec	38 sec
2	Welding Quality	Non-Linear and Non-Uniform	Linear and uniform
3	Safety	No safety for Operator	Safety for Operator
4	Rejection	50/day	40/day
5	Productivity	500/day	600/day
6	Cleanliness	Less Clean	More Clean
7	Wielding Thickness	2 mm	1.4 mm
8	Job Diameter	150 mm	150.03 mm

5. ADVANTAGES:

- It is safe.
- Less time consumption.
- Skill operator not required.
- To increase the Productivity.
- It reduces the hard work.
- Dimensional accuracy.
- It will reduce the rejection of work piece.
- Productivity increase.
- Reduces fatigue of worker.

6. APPLICATIONS:

- Resistance seam welding widely used automotive industry.
- Most of the metals can be welded (Except copper and some high percentage copper alloys).
- Butt welding can be done.

7.CONCLUSION

As we examined our finding, we drew conclusion based on the information collected about each aspect of our project. This conclusion led us to recommendations that we believe will, if applied, create an even better machine than we have designed.

In today's market all large manufacturers ate automating as much of their production line as possible. Automated processes have been in high demand. Robotics welding is a process that has been developed extensively in the past two decades, but there is still room for improvements. Seam welding fixture minimizes the gap between engineering of automated featuring mechanism. In spite of all the obstacles and difficulties we faced, we created very realistic final design concepts. The design of fixture fulfils all the demands.

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