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Design and Development of Semi Automated Orbital Riveting Machine

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ABSTRACT

Automation is an advanced technology by which tasks can be accomplished without human intervention or with minimal human intervention. The present work is an effort to upgrade the manual riveting by adapting semi-automated system in steering lock part riveting by using PLC controlled system, hydraulic and electro pneumatic system. The trial run was conducted to check the performance of the automated riveting process. The test results reported that a drastic reduction in cycle time with significant increase in the productivity of the riveting outcome.

Keywords: Semi Automated Riveting, Orbital Riveting, PLC Controller, Electro pneumatic system.

INTRODUCTION

Automation is an advanced technology by which more tasks of machines are completed without involvement of human or with minimal involvement of human power [1]. Industrial automation mainly uses of control systems like PLC and SCADA, ROBOT, Electro pneumatics and other Automated machines to process different machining operations and reduces the man power on the manufacturing industries and in hazardous environments.

Based on further applications many researchers like, Sachinkumar Jagtap [2] develops a new Orbital riveting machine. Special incremental motion enables smaller contact area between tool and work piece and therefore, lower forming load and friction. Moeinoddin Mahmoudi et al [3] had done Experimental and analytical comparison in orbital riveting machine and radial riveting unit in an orbital machine. Priti Nawale et al [4] had demonstrated the design and manufacturing semi- automatic machine for battery tray riveting. Prof. K.G.Sontakke et al [5] had demonstrated design and analysis of drilling cum riveting machine. The objective is to design and analyze the drilling cum riveting machine which reduces the operation as well as transportation time required for completing the job. David Römisch et al [6] have investigated Joining of CFRT-steel hybrid parts via hole forming and subsequent pin caulking. To obtain a fundamental understanding of this joining process, hole-forming and pin-caulking, are investigated in this study. Tushar A patil et al [7] had demonstrated analysis & design of drilling cum orbital riveting machine. It is found that this machine is very useful in industry as it reduces time constraint also it increases the productivity. S. H. Satbhai1 et al [8] had presented a paper on Study & Design of Multipurpose Riveting Machine. In this process two or more operation can be performed simultaneously due to this cost of a material reduces. Mr.Shubham Mogare et al [9] had demonstrated automation of Riveting Process for Aerospace Bracket Assembly. In aerospace riveting has very much important as it is very much precise process and gives beater results for the joining process.

Orbital forming is a noiseless, non-impact process of cold forming –replacing traditional riveting, staking, and crimping, pressing, welding and other fastening operations. A robust and precise process, orbital forming can be used to crown, flare roll, curl, seal and crimp material. The machine can be used for a range of jobs from freely swiveling joints to clamped, torque resisting joints. In this project, it is mainly done to reach the demand of orbital riveting mainly through automated riveting stations which is more easy to rivet the more number of parts in low production time compare to manual workstations. These riveting stations consist of moderate automated stations which require a single operator to handle the machines.

The below figure shows the conceptual drawing.

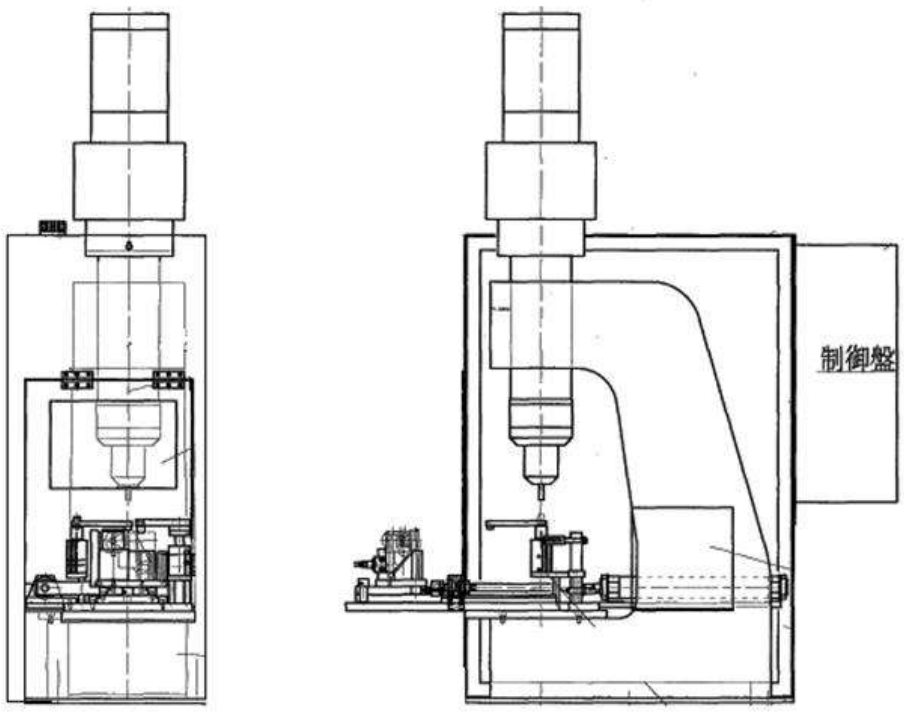

Figure 1: Conceptual drawing.

Spacer part will be pasted in to lid surface, and a protective cover assembled to the part by manually on a jig. Bracket sub assembly assembled to lock body Cp (After Protective cover assembly).

The following are the parts used in main body:

- Main body (W: 500mm x L: 800mm x H: 1400mm) or less + Control BOX (W: 500mm x D: 150mm x H: 300mm) or less.
- The work set height shall be 950 mm from the floor surface.
- The unit configuration of jig part, an operation part, an air device, hydraulic Device and a control box & Spacer & Cover assembly jig.
- Pressure controller is required -Available in Machine-Part
- Main pressure maintained: 0.3 - 0.35MPa.

METHODOLOGY

Required Machinery

1. Spacer & Protective cover assembly jig

2. Pin caulking machine

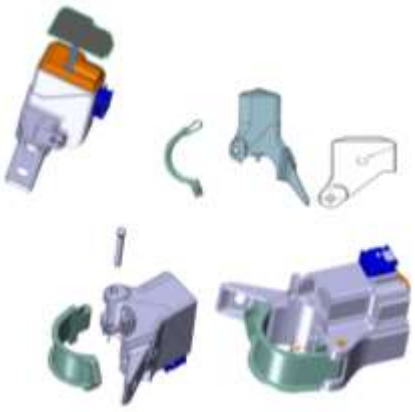

Figure 2: Work outline details

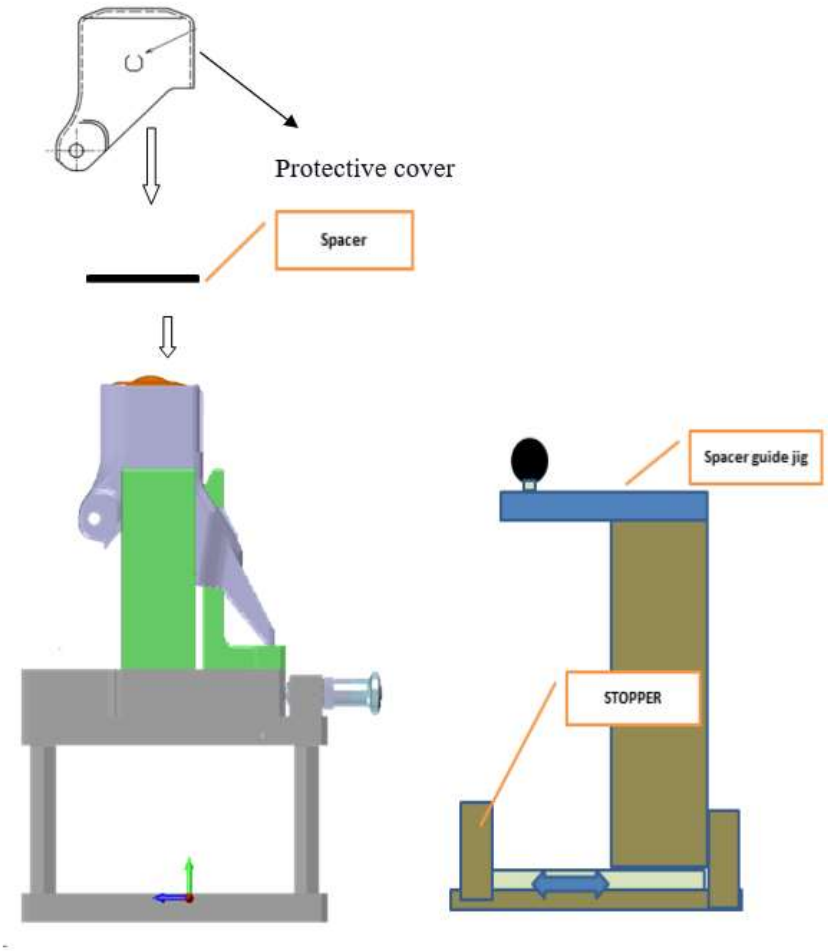

Figure 3: Rough sketch of idea of SPACER & PROTECTIVE Assembly jig.

Operation procedure

- Work set, start switches ON Confirm the existence of GO signal from the previous process In case of start without GO signal, output NG and stop.
- Receiving jig slide advance, work clamp and wrong bracket object detection at slide advance end (presence or absence of plate welding). In case of foreign object, NG output and stop.
- Pin existence confirmation unit forward, If there is no pin, output NG and stop.
- Crimping punch rotates, descends, and if the crimping descending end is not detected in an arbitrary time, punch up, NG output and stop.
- After caulking is completed, the receiving jig slides backward and the work piece is taken out.

RESULTS AND DISCUSSION

Trials are mainly carried out by two stages:

Primary Test: These are carried out at FOSTECH solutions assembly hall.

The trails were taken out at the FOSTECH solutions assembly hall once after the assembly and program of the machine were done. In this case, the assembly was done as per layout diagrams. Trials were taken to check the machine and machine process is done as per desired requirement or not.

- There was a presence of vibration in machines while taking trails, it will happen due to improper grounding of machines and machine accessories.
- The assembly of parts was done with high accuracy.
- Repeatability of machine was good.
- All the mechanical and electrical assemblies were done as per drawings.

- There was also a proper connections between the main panel to remote control panel to all the devices of machines with good communication protocol
- The cycle time of machines was 15sec were machines runs at 75% to 85% of speed.

Final Tests: These trials were carried out at customer site before handovering the project to the customer

Here trails were taken by the FOSTECH solutions team at the customer site where machine is placed at the exact locations on the shop floor according to the layout drawings.

- The average cycle time for riveting one part is 15sec where as for the same part riveting with manual riveting 40sec.
- The riveting output was about 720 parts per shift and after introducing automated machine parts output is about 1920 per shift.
- Rechability of the production is also good according to customer requirement.
- No vibrations were present.
- All the interlocking between the devices was done correctly and machine working as per the program.
- All the mechanical, Electrical, Pneumatic and Hydraulic parts were assembled as per assembly drawings on machines and working in good condition according to specified applications.
- Pin missing pokayoke checked and found ok
- Wrong bracket assembly pokayoke found ok
- Improper riveting with buzzer checked
- Tool life 100000parts- alarm will be displayed after reaching limit
- Ensured the machine should stop during abnormality
- After cycle completion while go lamp is on, press the start button. Ensured the Process NG lamp with buzzer.(Double start up prevention)
- Part load and wait for 5sec. Ensured the Process NG lamp with buzzer (Start switch not press till 5 sec)
- Part place and remove without start button pressing. Ensured the Process NG lamp with buzzer
- Without part loading to jig, press the start button. Ensured the Process NG lamp with buzzer

CONCLUSION

Manual riveting operation involves more effort and leads to the higher manufacturing time and it is hard to reach production demand. Not only riveting of parts is more important but it should be done with accuracy and safety required. Since, to overcome these challenges moderated or semi-automated machines were installed.

After successful implementation of above proposed semi-automated orbital riveting obtain some concrete improvements. The following operational improvements were reported as;

- Cycle time reduced from 40sec to 15sec.
- Production has been increased considerably and helped to reduce number of working shifts which leads to the cost reduction.
- Reduction in manual operators on the production line due to the automation of the riveting process.

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