PRODUCTIVITY ENHANCEMENT, MAN POWER AND CYCLE TIME REDUCTION AT HORN ASSEMBLY LINE IN HORN MANUFACTURING INDUSTRY USING SPECIAL FIXTURE

1.*M. Abdul Rahaman, 2*R. Girimirugan, 3*M. Vairavel, 4*S. Karthi, 5*K. Karthikeyan and 6*G. Tharma Prakash

1,2 Assistant Professor, Department of Mechanical Engineering, Nandha College of Technology, Perundurai, Tamilnadu, India
3 Assistant Professor, Department of Mechanical Engineering, Annapoorana Engineering College, Salem, Tamilnadu, India
4,5,6 JG Students-Final Year, Department of Mechanical Engineering, Nandha College of Technology, Perundurai, Tamilnadu, India

Received 25th January 2019; Accepted 20th February 2020; Published online 30th March 2020

ABSTRACT

The main aim of this study is to improve the productivity and reduce the cycle time in assembly line in a horn manufacturing industry using special fixture to combine the different processes. Existing production rates and cycle times for different processes like gasket selection, pre horn assembly, horn side screw tightening, and horn pre tuning and mounting bracket assembly are noted. New special fixture with multiple tools was designed and introduced to minimize the cycle time, manpower and maximize the productivity at horn assembly line. After this special fixture design at horn assembly line, multiple processes are combined as single process with the help of special fixture. After the successful implementation of the special fixture, again the production rates, man power utilization and cycle times for the combined processes are noted. Differences in production rate, cycle time’s for different operations and man power utilization for existing fixture and special fixtures were compared with observed numerical data’s. The comparisons reveals that the implementation of the special fixture in the horn assembly line is significantly improves the productivity, minimizes the cycle times and man power utilization.

Keywords: Horn manufacturing industry, productivity enhancement, cycle time reduction, assembly line, special fixture.

INTRODUCTION

Production is any process or procedure developed to transfer a set of input into a specified set of output in proper quality and quantity thus achieving the objectives of an industry. Production helps to create products by the transformation of raw materials. Productivity is the ratio between output of wealth and the input of resources used in the process of production. Productivity measurement turns a comparison of outputs to inputs normally by calculation of a productivity index. Productivity can be used to measure the extent to which a certain output can be extracted from a given input. Productivity measurement is the important for any kinds of industry. Increasing productivity is one of the major issues for enhancing more profit from same kinds of resources. Productivity improvement helps to satisfy customer and reduce time and cost to develop, produce and deliver products. Productivity includes effective relationship to performance for method utilization, method output, product prices, and work in process inventory levels and on time delivery. Productivity is considered to be a growth of profit. Productivity improvement can be done by sorting of elimination, repairing of ineffective process, simplifying the method, optimizing the system, reducing variation, maximizing turnover up quality or responsiveness and reducing set-up time.

Possible solutions and benefits

The horn side screw tightening and horn pre tuning stages are combined to single Stage (semi automation).
Figure 1 Process flow of horn assembly line for (a) existing fixture (b) special fixture.

Figure 2 (a) Existing fixture (b) special fixture for combining stages or processes at horn assembly line.
3. Theoretical cycle time calculation for existing fixture

The total cycle time for side screw tightening is occurred and consumes time. While this process the uneven tightening is obtained. Then the horn pre tuning and fixture side screw tightening are combined in a single stage this cause reduce the cycle time to the operation. The total cycle time for side screw tightening, horn pre tuning, mounting bracket assembly in existing fixture is shown in figure 3 (a) to 3 (f) respectively.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Using existing fixture</td>
<td>80</td>
</tr>
<tr>
<td>2.</td>
<td>Implementing new fixture</td>
<td>70</td>
</tr>
<tr>
<td>3.</td>
<td>Reduction in stages</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1 Stages description for existing and special fixture implementation

Fixture multi bit screw tightening is fastens the screws same time by using ratched mechanism it ensures the even tightness of all side screws. When the first process is completed, the next process is started to the next second due to this idea it will be reduce the half cycle time of individual process. Also increase the productivity and effectiveness of the different processes. A typical comprehensive three dimensional model of existing and special fixture is shown in figure 2 (a) and 2 (b).

3. Productivity enhancement in side screw tightening and horn pre tuning process

At assembly line of horn, disruption in productivity at side screw tightening and horn pre tuning in side screw tightening a single pneumatic gun is used and its take more time. The horn pre tuning is the simple process it also takes more time. The assembly line F1 is considered for solving the problem. In this horn assembly line the first stage involves tuning screw and coil mounting is performed. The second stage involves the assembling of plate and holder is assembled. The third stage a terminal connectors are fixed to this stage. Fourth stage involves the diaphragm plate assembly torque and height measuring. Fifth stage involves the gasket selection and pre horn placing gasket and feeding screws. Sixth stage horn side screw tightening process accomplished with single tool bit pneumatic gun. Which consumes time and uneven tight is obtained. Then the next stage horn pre tuning is the simple process but its take more time. This causes loss in productivity. The following data’s are observed at horn assembly line.

- Available time hours per day = 8 hours
- Target of the assembly line = 1710 No’s
- Average time of each component = 15.78 seconds.

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Feeding nuts on the fixture</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>Side screws--tightening</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>Horn assembly --placing, taking &amp;</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>transferring</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Cycle time’s for different process at horn assembly line

The cycle time for feeding nuts on the fixture, side screws-tightening, horn assembly - placing, taking & transferring, horn pre tuning, mounting assembly nut tightening and horn assembly - placing, taking & transferring is shown in figure 3 (a) to 3 (f) respectively.

3.3 Special fixture

The objective of this process to reduce the time consumption in this side screw tightening stage. The distinctive type of pneumatic tool bit is designed for this stage process. In this the development is occurred with gear mechanism process. The sun wheel powered from drive in which the sun wheel is meshed with required number of planet gears. Then tool bits are incorporated in the planet gears with ratched mechanism. The ratched mechanism is provided in each tool bit to avoid the uneven tight of the screws. When the horn is placed in the fixture, the screws are filled in the trumpet hole and the designed tool bit positioned above the horn fixture with guide ways. The guide ways for the tool bit is to avoid the deviation from the target position and even tightened made in the horn trumpet. Then the horn pre tuning and fixture side screw tightening are combined in a single stage this cause reduce the cycle time to the operation. The total cycle time for side screw tightening, horn pre tuning, mounting bracket assembly in existing fixture is shown in figure 4 (a). Total cycle time comparison between the existing and special fixtures is shown in figure 4 (b). Similarly, the productivity comparison between the existing and special fixtures is shown in figure 5.

![Figure 3 Cycle time for (a) feeding nuts on the existing fixture (b) side screws--tightening](image_url)
Figure 3 Cycle time for (c) horn assembly - placing, taking & transferring (d) horn pre tuning (e) mounting assembly nut tightening (f) horn assembly - placing, taking & transferring process.

Table 3 Cycle time’s for horn pre tuning and mounting bracket assembly at horn assembly line

<table>
<thead>
<tr>
<th>Cycle time (Seconds)</th>
<th>1 No</th>
<th>5 No’s</th>
<th>10 No’s</th>
<th>20 No’s</th>
<th>25 No’s</th>
<th>Average Time (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horn pre tuning</td>
<td>5.65</td>
<td>5.58</td>
<td>5.60</td>
<td>5.62</td>
<td>5.52</td>
<td>5.59</td>
</tr>
<tr>
<td>Mounting assembly nut tightening</td>
<td>2.81</td>
<td>2.78</td>
<td>2.85</td>
<td>2.70</td>
<td>2.86</td>
<td>2.80</td>
</tr>
<tr>
<td>Horn assembly - placing, taking &amp; transferring</td>
<td>4.61</td>
<td>4.59</td>
<td>4.65</td>
<td>4.65</td>
<td>4.60</td>
<td>4.61</td>
</tr>
</tbody>
</table>

3.4 Cycle time for special fixture (combined stages)

- Horn side screw tightening and pre tuning combined cycle time = fixture multi tool side screw tightening + pre tuning.
- Horn side screw tightening and pre tuning combined cycle time = 4 + 5.33 = 9.33 seconds.
- Total cycle time for both stages = 12.02 + 13.08 = 25.60 seconds.

3.5 Productivity increment for special fixture (combined stages)

- Actual cycle time = 15.78 seconds
- Analyzed cycle time = 15.78-1.19 = 14.59 seconds
- Actual target = 1710 No’s
- Analyzed target = 27000 / 14.59 = 1850 No’s
- Difference for analyzed and actual cycle time = 1850-1710 = 140 No’s.

CONCLUSION

The following outcomes are established from the observed and analyzed data by modifying the existing fixture design and combined stages at assembly line in a leading horn manufacturing industry.

- The special fixture and combined stages are significantly improves the production quantity (140 no’s) from 1710 no’s to 1850 no’s per shift for different horn assembly process like feeding nuts on the fixture, side screws –tightening, horn assembly - placing, taking & transferring, horn pre tuning, mounting assembly nut tightening, horn assembly - placing, taking & transferring respectively at assembly line in manufacturing industry.
- The special fixture and combined stages are also considerably reduces (12.98 seconds) the total cycle time for various processes from 22.31 seconds to 9.33 seconds at assembly line in horn manufacturing industry.
REFERENCES


******