Productivity Enhancement through a Development of Special Purpose Multiple Nuts Fastening Machine

[1]Purvi Chauhan, [2]Jatin Makwana, [3]Tejas Patel
[1]Assistant Professor, Production Engineering Department, BVM Engineering College, V.V.Nagar, Gujarat, India1
[2]Assistant Professor, Mechanical Engineering Department, IpcowalaInstitute of Engg. & Tech, Dharmaj, Gujarat, India
[3]Assistant professor, Mechatronics Engineering Department, G.H.Patel College of Engineering & Technology, V.V.Nagar,Gujarat, India3

***Abstract* - A nut is a type of hardware fastener with a threaded hole. Nuts are widely used to fasten a bolt for stack of parts together. The two partners are kept together by a combination of their threads friction, a slight stretch of the bolt, and compression of the parts. This paper is focused on industrial need to enhance the productivity by using the concepts of automation. The company uses several workers for assembling the manufactured nuts and bolts. The entire assembly process is carried out manually and for each assembly time depends on the sizes of stud. This paper consists of design procedure and manufacturing of the automation in the nut and bolt assembly process using a suitable automation method which increases the productivity three times more than previous process. The automation is obtained by using a motor run arrangement by making multiple nuts fastening machine. It increase productivity and also easy to operate and very fast.**

***Index Terms* - Design, Productivity Improvement, manufacturing, automatic assembly, Special Purpose Machine.**

I. INTRODUCTION

At present the nuts and bolts are manufactured in the company are assembled manually by workers. The output of one Manual Labour is 100 assemblies per hour. The Company is a leading manufacturer of various sizes of nuts and studs and other equipment. To reduce the supply time of large order they need to assemble nut and bolts quickly. This leads to automation for the assembly process. The automation in assembly process may reduce the cost and increase the productivity also. The present concept and design may increase the productivity at least 3 times then the present scenario. The automation is obtained by using a motor operated device, which is transferred through belt to the shaft which provides working motion to the die. Three dies are placed equidistance from each other on the table. Different dies can be engaged for fastening different size of nuts. The worker feeds the nut into the die to attain the necessary tightening torque; further stud will be put in the die over the turning nut for automatic assembly. [28]

Various techniques like JIT and Lean Manufacturing are used to improve the productivity [24, 25]. The productivity can be improved for instance by reducing the labor content of the process; this would help to reduce the manufacturing cost of their products [11, 12]. Nowadays the use of special purpose machine is widely adopted to increase the productivity. A stir up bending machine is developed to increase the efficiency of the stir up during construction phase [17]. A special purpose machine is proposed for manufacturing of a large turbine bearing. The modeling of the machine has been carried out by the authors [20, 26, and 27]. Welding industries are also acquainted with automation for complex shape of welding. A welding positioner is modeled with the use mechatronics approach with range of 2000 kg weight object [19]. A SPM is designed and modeled for welding of shell- diaphragm welding in conveyor pulleys. It is capable of handling various sizes of pulley [22]. Industries established earlier were using material handling systems which were time consuming, less efficient, needed more manpower, which ultimately affects productivity. To overcome these demerits, industries needed an efficient system which can be automatically controlled & guided using various sensors and image processing [13, 15, and 18]. Product assembly is generally the largest single cost element of production manufacturing. Thus with the aid of automation, the production time can be reduced as well as higher degree of accuracy can be achieved. The human efforts can be reduced with help of various controllers and PLC [14, 23]. A semi-automatic fuel filling station has been proposed using the concepts of mechatronics [21]. Same way the concept of railway track measurement has been reported using mechatronics approach [16]. By reviewing an attempt is made to propose a semi-automatic assembly system.

Fig-1 Assembly of fasteners

.

II. PROPOSED DESIGN OF MULTIPLE NUT FASTENERS MACHINE

The Proposed Design of Machine is shown in figure 2.

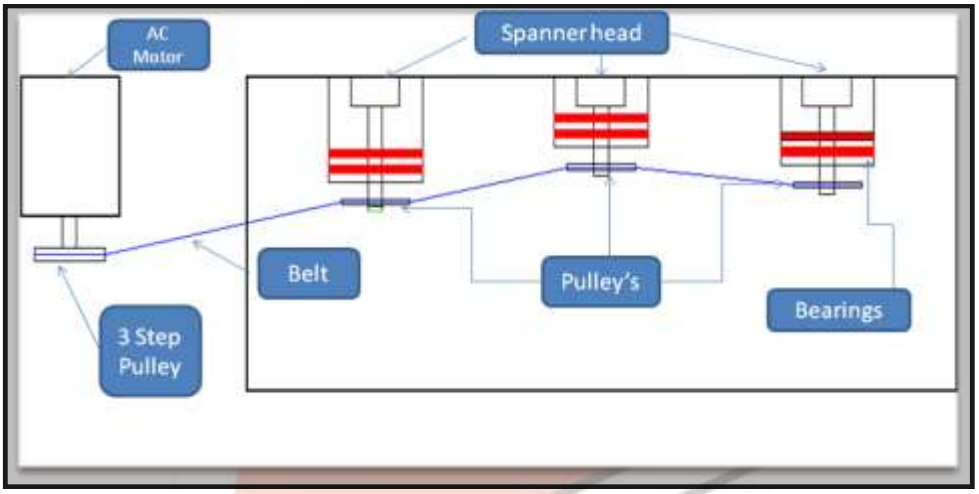

Fig 2. A Conceptual Design Of Machine[28]

In above design as shown in fig-2,we used ac motor to drive 3 step pulley which connected with spanner head mechanism via belt drive. In spanner head nut is placed which rotate and automatically assembled when bolt is pressed on nut.

III. DRAWING OF PROPOSED MACHINE AND ITS SPECIFICATIONS

Figure -3 and Figure-4 shows the front view and top view of the proposed special purpose semi-automatic machine. Its specifications are as follows: Table size: 1020 X 360 X 350 mm, Motor: ac, Rpm: 1440, Horse power: 1.5 HP and Pulley ratio: 1:2.

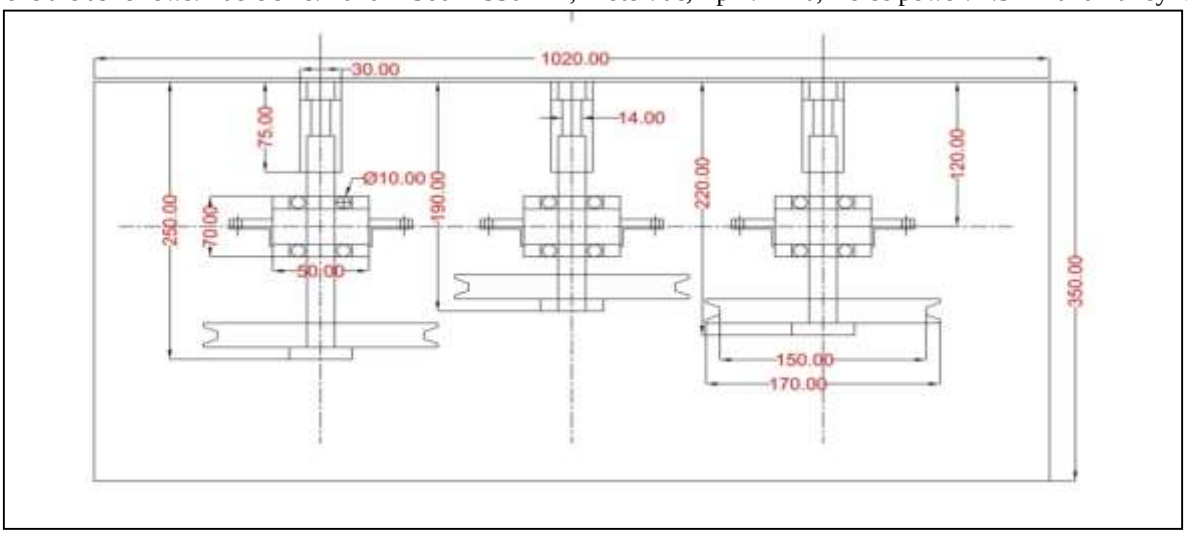

Figure 3. Front view of the proposed machine[28]

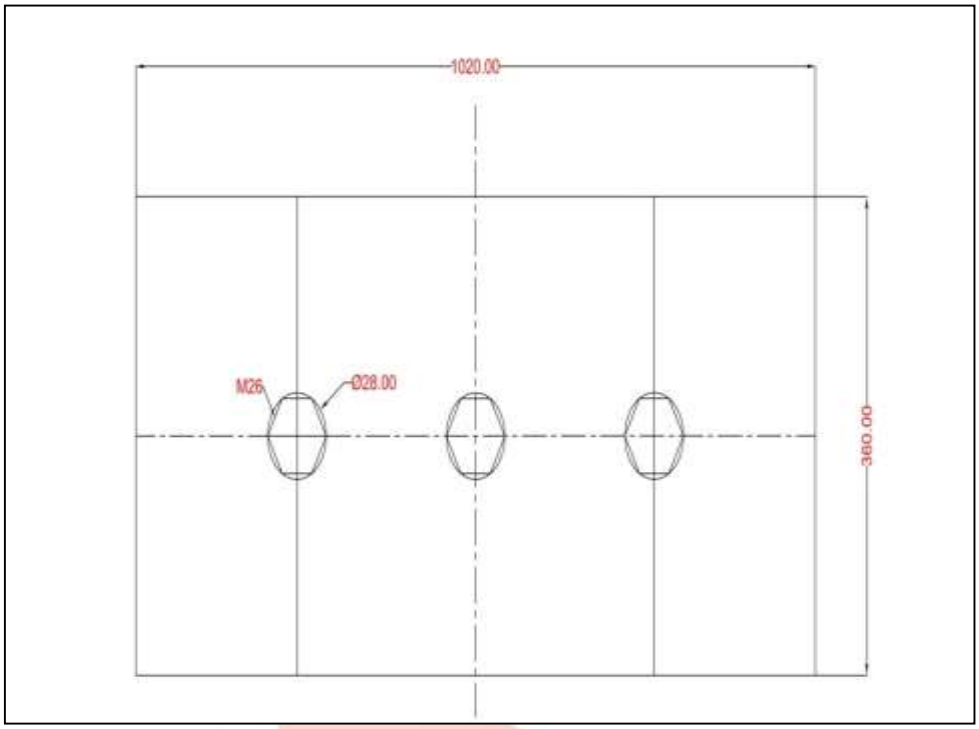

Figure 4. Top view of the proposed machine[28]

The above proposed design of multiple nut fasting machines will be useful in automatic assembly. This design of nut fastening machine is with require components with specification is given in this paper for manufacturing of machine. With the help of this design production time will be reduce and which also increase the production rate of the company. It will also indirectly minimize failure of parts in assembly. The productivity may enhance three times using such design.

IV. MANUFACTURED &WORKING OF AUTOMATIC NUT FASTING MACHINE

Fig 5. Manufactured Automated Nut Fastening Machine

All the main parts of this machine are already explained in above section and they are manufactured by standard methods. When we complete the assembly the final nut fastening machine is shown in above fig 8. Its working principle is simple; here we provide hexagonal head at top of machine which continuously rotated by 3 step pulley through spanner head. Now to prepare the nut-bolt

assembly we just need to press bolt on hexagonal head in which nut is placed which continuously rotate so which automatically assemble with nut.

V. RESULTS AND DISCUSSION

Table 1 Machine manufacturing cost

S.NO	Name of the Component	No of Component	Cost Of Component(Rs)
1	Motor (A.C)	1	7390/-
2	Pulley (1 step pulley)	3	320/- 320X3 = 960/-
3	Pulley (3 step pulley)	1	600/-
4	Bolt (plate)	6	5/- 5X6 = 30/-
5	Bolt (Die)	6	5/- 5X6 = 30/-
6	Bolt (Fitting)	12	10/- 10X12 = 120/-
7	Key	3	15/- 15X3 = 45/-
8	Key (Fitting)	3	15/- 15X3 = 45/-
9	Bolt (Motor Fitting)	4	20/- 20X4 = 80/-
10	Bolt (Motor fitting) small	4	10/- 10X4 = 40/-
11	Bearings(6004 model)	6	110/- 110X6 = 660/-
12	Spring	3	25/- 25 X 3 = 75 /-
13	Die	3	300/- 300X3 = 900/-
14	Belt	3	200/- 200X3 = 600/-
15	Channel (25X25mm)	8kg	1kg=56 56X8 = 448/-
16	Plate (100X35X4mm)	2kg	1kg=400 400X2 = 800/-
	TOTAL Material Cost		**12823/-**

The above table gives the detail cost analysis of manufactured automatic multiple nut fastening machines, which include all the details of parts use in final machine with its costs.

- Comparison between manual labour cost and multiple nut fastening machine cost for assembly work.

Monthly Labour Cost of 1 worker = 4000/- per month
No of Labour Cost in an Assembly Shop = 6 worker
Assembly Labour cost for 1 month
= No of labour per shop X Monthly cost of 1 worker
= 6 X 4000 = Rs 24000/-
So that would be Rs 24000/-
Now,
We use Multiple Nut Fastening machine which requires 3 workers to do the job which means
Assembly Labour Cost for 1 month = 3 X 4000
= Rs 12000/-
Running Cost of the Machine = Rs 1000/-
Total Cost = Rs 12000 + Rs 1000
= Rs 13000/-
Manual Assembly Cost = Rs 24000/-
Multiple Nut Fastening Machine Cost = Rs 13000/-

Company Will Save Rs 9000/ per month on Labor Cost and in two Month time cost of the machine which is Rs 16500/- will be taken out and a breakeven point would be achieved there after company will profit from the machine usage.

VI. CONCLUSION

The above automatic multiple nut fasting machines will be useful in automatic assembly. This design of nut fasting machine is with require components with specification is given in this paper for manufacturing of machine. With the help of this design production time will be reduce and which also increase the production rate of the company. It will also indirectly minimize failure of parts in assembly. It will save high amount of money of company which economically beneficial to company. The productivity may enhance three times approximately 70% using such machine. Machine manufactured by using all the above listed parts and final assembly is shown with figure in paper which consider both aspects of designing and manufacturing aspect of machine.

VII. ACKNOWLEDGMENT

Authors acknowledge the managing director of Company AEP, VallabhVidhyanagar- Gujarat for encouraging and helping.

REFERENCES

[1] www.aepindia.net
[2] AEP Company Private Limited.
[3] Manufacturing Engineering and Technology by SeropKalpakjian and Steven R. Schmid.
[4] Machine Design by R. S. Khurmi and J. K. Gupta.
[5] Workshop Technology
[6] Module 7, Screw threads and Gear Manufacturing Methods, Version 2 ME IIT Kharagpur.
[7] http://en.wikipedia.org/wiki/Pully
[8] http://en.wikipedia.org/wiki/Belt
[9] http://en.wikipedia.org/wiki/Screw
[10] http://en.wikipedia.org/wiki/List_of_manufacturing_processes
[11] B. R. Gajjar, S. Sheth, "Design and Automation in Back Plug Press Fitting Process of Ball Pen Assembly", Applied Mechanics and Materials, vol. 592, pp. 2596-2600, 2014.
[12] B. R. Gajjar, S. Sheth, "Investigation of Automation Strategy and Its effect on Assembly Cost: A Case Study on Ball Pen Assembly Line", International Journal of Current Engineering and Technology, pp. 89-92, 2014.
[13] P. A. Parikh, K. D. Joshi, S. Sheth, "Color Guided Vehicle–An Intelligent Material Handling Mechatronic System", 1st International and 16th National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, pp. 628-635,2013.
[14] T. Patel, S. Sheth, P. Patel, "Design of Semi-automatic Hydraulic Blanking Machine Using PLC", National Conference on Innovative & Emerging Technologies (NCIET- 2015), pp. 410-412. DOI: 10.13140/RG.2.1.4529.6803, 2015.
[15] S. Sheth, R. Kher, R. Shah, P. Dudhat, P. Jani, "Automatic Sorting System using Machine Vision", Multi-Disciplinary International Symposium on Control, Automation & Robotics, at DDIT, Nadiad, India, DOI: 10.13140/2.1.1432.1448,2010.
[16] K. Tamboli, S. Sheth, V. Shah, V. Modi, C. Gandhi, N. Amin, "Design and Development of a Mechatronic System for the Measurement of Railway Tracks", History 43 (200), 174-180, 2015.
[17] M. Virani, J. Vekariya, S. Sheth and K. Tamboli, "Design and Development of Automatic Stirrup Bending Mechanism", 1st International and 16th National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, pp. 598-606,2013.
[18] Chauhan V, Sheth S, Hindocha B R, Shah R, Dudhat P, Jani P, "Design and development of a machine vision system for part color detection and sorting", Proceedings of second international conference on signals, systems and Automation, ICSSA-2011. Pp 90-93. DOI: 10.13140/2.1.1628.7526,2011.
[19] Vaghasiya M, Moradia H, Nayi R, Sheth S, Hindocha B, "Modeling of an automatic positioner- A mechatronics approach", 4th National conference on recent advances in manufacturing, pp. 284-288. DOI: 10.13140/RG.2.1.1550.2888 ,2014.
[20] Desai S., Sheth S., Chauhan P., "Design and Modelling of Dual faceplate Centrifugal casting equipment for manufacturing of turbine bearing", CAD/CAM, Robotics and Factories of the Future, springer, pp. 523-534,2016.
[21] Sheth S., Patel Kavit H., Patel H., "Design of Automatic Fuel Filling system using a mechatronics approach", CAD/CAM, Robotics and Factories of the Future, springer, pp. 785- 795,2016.
[22] Gangadia H., Sheth S., Chauhan P., "Design and modeling of special Purpose Equipment for shell-diaphragm welding in conveyer pulley", Procedia Technology, 14, 497-505,2014..
[23] T. Patel, S. Sheth, B.S. Modi, P. Chauhan, "Design of Semi – automatic Slotter Machine using PLC", National Conference on Emerging Trends in Engineering, Technology & Management, At INDUS Institute of Technology & Engineering, Ahmedabad, DOI: 10.13140/2.1.4842.5761,2014,
[24] P. Chauhan, S. Rangrej, K. Samvatsar, S. Sheth, "Application of Lean Manufacturing Principles for Process Time Reduction – A case of Conveyor Pulley Manufacturing", Proceedings of 5th National Conference on Recent Advances in Manufacturing (RAM-2015), pp. 423-428, DOI: 10.13140/ RG.2.1.4412.5281,2015.
[25] P. Chauhan, S. Sheth, "Scope & Study of Just In Time – A case Study on Forging Industry", Proceedings of the 4th National Conference in Recent Advances in Manufacturing (RAM-2014), pp. 300-305, DOI: 10.13140/RG.2.1.5156.0488,2014.
[26] S. H. Desai, S. M. Sheth, "Proposed Design of Centrifugal Casting Machine for Manufacturing of Turbine Bearing", National Conference on Advances and Challenges in Engineering and Science (NCACES-2012), DOI: 10.13140/RG.2.1.4529.2645,2012.
[27] S. H. Desai, S. M. Sheth, "Study and Proposed Design of Centrifugal Casting Machine for Manufacturing of Turbine Bearing", Journal of Material Science and Mechanical Engineering(JMSME), DOI: 10.13140/RG.2.1.2503.0566,2015.

[28] P.Chauhan, J.Makwana, "Proposed Conceptual design of Special purpose Semi-Automatic Multiple Nuts Fastening machine", International Journal of Innovative Research in Science, Engineering & Technology, DOI:10.15680/IJIRSET.2016.0502126,Vol-5,Issue-2,2016.