

Proposed Conceptual Design of Special Purpose Semi-Automatic Multiple Nuts Fastening Machine

Purvi Chauhan¹, Jatin Makwana²Assistant Professor, Department of Production Engineering, BVM Engineering College, V.V.Nagar, Gujarat, India¹Assistant Professor, Department of Mechanical Engineering, Ipcowala Institute of Engineering & Technology,
Dharmaj, Gujarat, India.²

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 of the automation in the nut and bolt assembly process using a suitable automation method. 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.

KEYWORDS: Design, Productivity Improvement, Automatic assembly

I. INTRODUCTION

AEP COMPANY is one of the AEP groups of companies. Group is engaged in manufacturing and supply of Fasteners (High Tensile For High Pressure High/Low Temperature Service Application), Foundry components (investment & shell moulding casting), Forging components (closed die & open die forging) to cater various industries and industrial segments like Oil & Gas, Refinery & Petrochemicals, Equipment, Automotive, Material Handling, Engineering and many more [1,2].

At present the nuts and bolts are manufactured in the company are assembled manually by workers. At present 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. The automation in assembly process may reduce the cost and it can increase the productivity of assembly process 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.

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 labour 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 modelling 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 positioned is modelled along with the use mechatronics approach with range of 2000 kg weight object [19]. A SPM is designed and modelled for welding of shell- diaphragm

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

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.

II. PROPOSED DESIGN OF MULTIPLE NUT FASTENERS MACHINE

The Proposed Design of Machine is shown in figure 1.

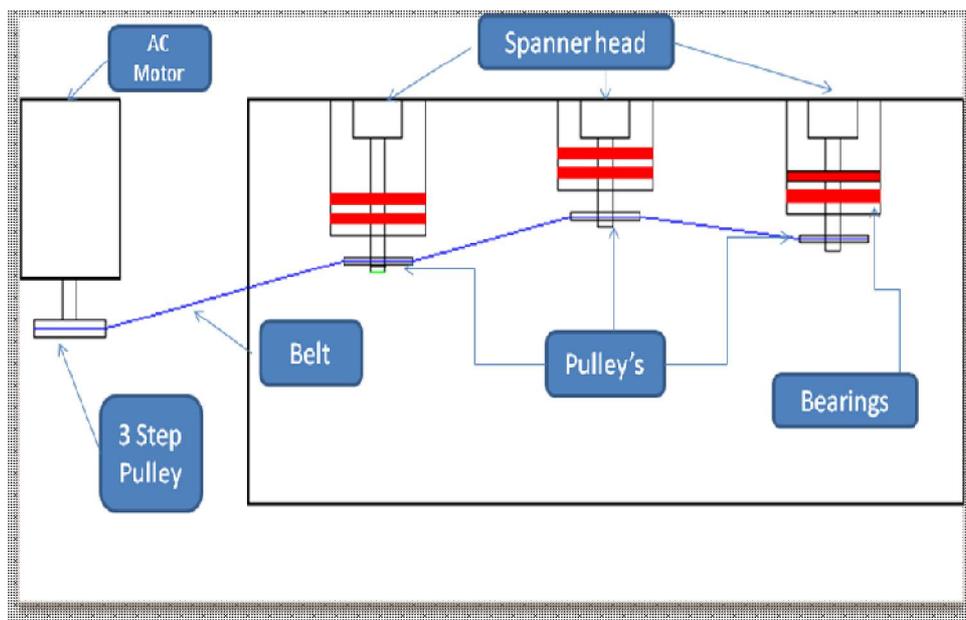


Fig 1. A Conceptual Design Of Machine

In above design as shown in fig-1, 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. All the details parts used in above assembly is explain below.

III. PARTS OF MACHINE

For the manufacturing of multiple nut fasteners machine various types of accessories are required. Their specification are described below.

a. MOTOR (AC 1.5HP, 1440 RPM.)

An AC motor is an electric motor driven by an AC current. It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field. There are two main types of AC motors, depending on the type of rotor used. The first type is the induction motor, which runs slightly slower than the supply frequency. The magnetic field on the rotor of this motor is created by an induced current. The second type is the

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

synchronous motor, which does not rely on induction and as a result, can rotate exactly at the supply frequency or a sub-multiple of the supply frequency. The magnetic field on the rotor is either generated by current delivered through slip rings or by a permanent magnet. Other types of motors include eddy current motors, and also AC/DC mechanically commutated machines in which speed is dependent on voltage and winding connection.

b. CONTROL CIRCUIT

A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.

c. BELT

A belt is a loop of flexible material used to link two or more rotating shafts mechanically. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys. In a two pulley system, the belt can either drive the pulleys in the same direction, or the belt may be crossed, so that the direction of the shafts is opposite. As a source of motion, a conveyor belt is one application where the belt is adapted to continuously carry a load between two points. The belt drive is shown in fig -2.



Fig 2. Belt drive [8]

d. PULLEYS

A pulley is a wheel on an axle or shaft that is designed to support movement of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power. The pulley is shown in fig-3.



Fig 3. Pulleyes [7]

e. SHAFT

A drive shaft, driving shaft, propeller shaft (prop shaft), or Carding shaft is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them. Drive shafts are carriers of torque: they are

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

subject to torsion and shear stress, equivalent to the difference between the input torque and the load [3, 4]. They must therefore be strong enough to bear the stress, whilst avoiding too much additional weight as that would in turn increase their inertia. To allow for variations in the alignment and distance between the driving and driven components, drive shafts frequently incorporate one or more universal joints, jaw couplings, or rag joints, and sometimes a splined joint or prismatic joint.

f. BEARINGS

A bearing is a machine element that constrains relative motion between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts. The term "bearing" is derived from the verb "to bear" a bearing being a machine element that allows one part to bear (i.e., to support) another [9, 10]. The simplest bearings are bearing surfaces, cut or formed into a part, with varying degrees of control over the form, size, roughness and location of the surface. Other bearings are separate devices installed into a machine or machine part. The most sophisticated bearings for the most demanding applications are very precise devices; their manufacture requires some of the highest standards of current technology. The bearing shows in fig 4.



Fig 4. Bearing

g. DIE/HEXAGONAL HEAD

A screw driver is the system used to turn a screw [1, 2]. At a minimum, it is a feature on the screw that allows for it to be turned. Usually it also involves a mating tool, such as a screwdriver, that is used to turn it. The following heads are categorized based on commonality, with the less common drives being classified as "tamper-resistant". Most heads come in a range of sizes, typically distinguished by a number, such as "Phillips #00" or "Torx T5". These sizes are not characterized by a linear dimension, but are arbitrary designations in the same sense as a "Size 8" shoe or dress.

A hex screw driver uses six-sided fastener heads. The fastener is known as a hex head cap screw. It can be turned with an adjustable wrench, combination wrench, and 6- or 12-point sockets. The hex drive is better than square drive for locations where surrounding obstacles limit wrenching access, because smaller wrench-swing arcs can still successfully rotate the fastener.

h. SPANNER HEAD MECHANISM

Spanner Head Mechanism is the most important Mechanism of the Machine. Spanner Head Mechanism is shown in fig- 5.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

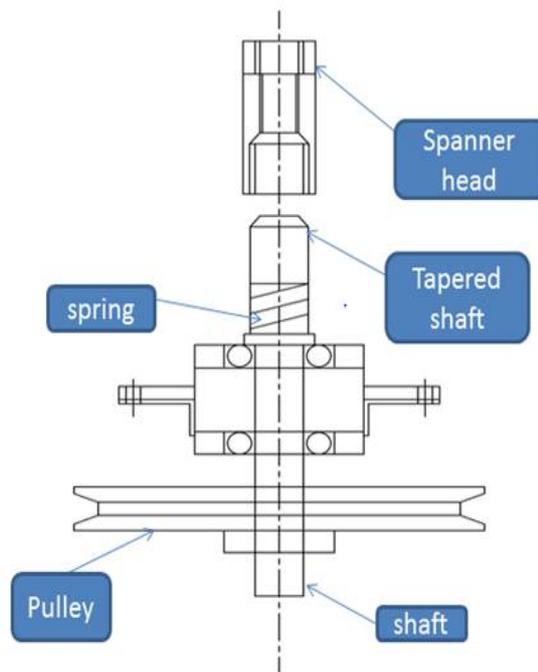


Fig 5. Spanner Head Mechanism

A hex screw driver uses six-sided fastener heads [5, 6]. The fastener is known as a hex head cap screw. It can be turned with an adjustable wrench, combination wrench, and 6- or 12-point sockets. The hex drive is better than square drive for locations where surrounding obstacles limit wrenching access, because smaller wrench-swing arcs can still successfully rotate the fastener.

IV. DRAWING OF PROPOSED MACHINE AND ITS SPECIFICATIONS

Figure -6 and Figure-7 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.

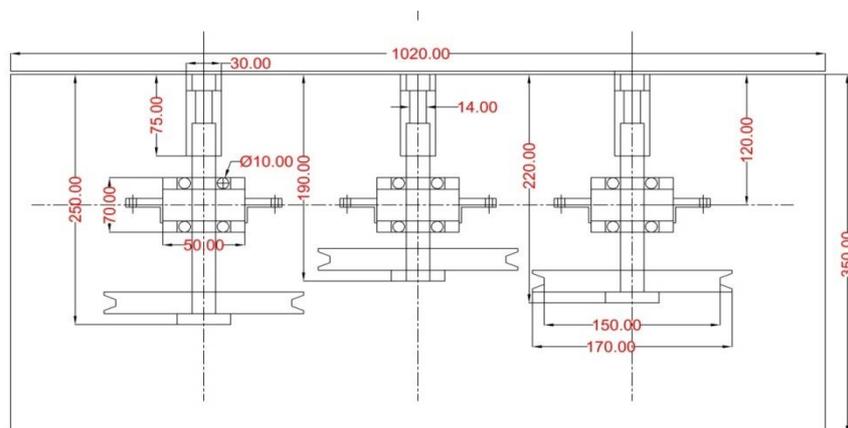


Figure 6. Front view of the proposed machine

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

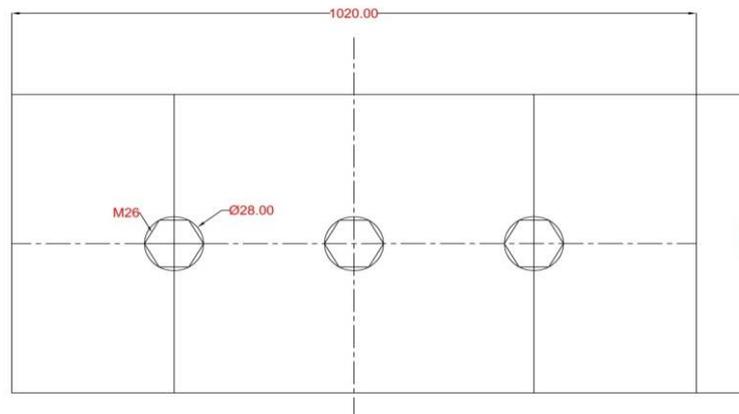


Figure 7. Top view of the proposed machine

V. CONCLUSION

The above proposed design of multiple nut fastening 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.

ACKNOWLEDGEMENT

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

REFERENCES

- [1] www.aepindia.net
- [2] AEP Company Private Limited.
- [3] Manufacturing Engineering and Technology by Serop Kalpakjian 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] Gajjar. B. R and Sheth. S, "Design and Automation in Back Plug Press Fitting Process of Ball Pen Assembly", Applied Mechanics and Materials, vol. 592, pp. 2596-2600, 2014.
- [12] Gajjar. B. R and Sheth. S, "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, Special Issue-3, pp. 89-92, 2014.
- [13] Parikh. P. A, Joshi. K. D and Sheth. S, "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] Patel. T, Sheth. S and Patel. P, "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] Tamboli. K, Sheth. S, Shah. V. Modi. V. Gandhi. C and Amin. N., "Design and Development of a Mechatronic System for the Measurement of Railway Tracks", History 43 (200), 174-180, 2015.
- [17] Virani. M, Vekariya. J, Sheth. S and Tamboli. K, "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..

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 2, February 2016

- [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 Kavir 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.