Review on Automatic Bottling Plant Controlled By PLC

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Abstract- *In Current time of global competition in market Automation has much effect in a wide range of Industries. All the industries in world are moving towards the automation. Filling is process in which any item Liquid or solid are filled into the bottle or container. Currently Filling is carried out by machine in large scale industries and by human in small scale industries. Human operated filling industries can be moved into automation industry by providing Indexing motion to the container or bottle. It may be rotary or linear. Geneva Mechanism is very useful to achieve rotary indexing motion from the continuous rotary motion. This paper present literature review on various automatic filling plant and various uses of Geneva Mechanism for indexing motion and various application of PLC Controller in Automation of industries.*

Keywords- Automation, Bottle Filling, Geneva Mechanism, PLC, Beverages Plant

I. INTRODUCTION

Current trend in all the industries in the world is to adopt new technologies to proceed towards automation. The same vision is exercised in various filling plants. To meet the customer demands and accelerate the filling of bottles & Container and to remove all the difficulties occurred by manually filling in all operations are nearly automated.

In small scale industries, Bottle & Container filling operation is done manually. The manual filling process has many shortcomings like

Wastage of water while filling it in bottle,
Same quantity of water may not be filled,
Delay due Natural & Artificial activity etc.

In bottle filling plant, they have different amount of water fill in the bottled water, like 0.1ltr, 0.5ltr, 1ltr, 10ltr, 20ltr etc. It is used for filling solid or liquid material in Plastic or glass bottle. It may be pure or impure.

Earlier, Material was filled into bottle manually but with innovation in technology large Industry use advanced machine to fill the material into bottle but it does not trend in small scale Industry because of its costly machineries.

All the Filling Industry have similar operation required to fill the bottle in required quantity like, loading of bottle, filling of bottle with some type of filler station, capping of bottle, unloading of bottle, labelling on bottle etc.

II. BACKGROUND

The first filling plant of water was started in U.K. in 1621. The demand of filling industry was increased in Europeans and Americans countries during 17^{th} and 18^{th} century. As technology was innovated in 19^{th} century, the cost of making bottle and feeling was reduced, at this time demand of automatic filling was increasing continuously due to reason that increasing demand of customer and require to reduce the cost of item and due to labour shortage.

III. LITERATURE REVIEW

Bipin Mashilkar, Pallavi Khaire and others [1] Present paper on Automated Bottle Filling System in this paper they discussed about design, fabrication and control system for automated bottle filling system. They use microcontroller to control various operation in plant. They used linear bottle filling by using conveyor with the help of sensors and electromagnetic valves, in this system entire sequence of operation is controlled by microcontroller name Arudino microcontroller with the help of c programming. In this Study they developed prototype model of filling system and take some experiment data of filling in it. They compare Input volume to output Volume by graph for optimisation of design.

Sagar T. Payghan and Rani H. Deshmukh [2] present research paper on Automation of bottle filling plant with industry 4.0. The term Industry 4.0 is define for next industrial revolution. It means highly automated industry which demand of product is entered into central computer of industry and it will control all the task of production and complete product is given at output stage. In this research paper they discussed about industry 4.0 concept into the automatic bottle filling

plant, in which all the operation Like Blow Molding, Rinsing, Filling, Capping, Packaging and unloading are carried out automatically. This study gives the information about issues of automation control system in operation development, improving management level and high efficiency process in bottle filling plant. For this research work they developed one model of automatic bottle filling plant with using PLC controller to control all the operation centrally. They conclude that it have high accuracy and precision.

Ujam, Ejeogo and Onyeneho [3] present their study on Development and application of Geneva mechanism for bottle washing. This study was developed for water beverages plant where the bottle filling operation carried out manually. They developed one test rig for bottle washing machine by Geneva Mechanism. The test rig was designed, fabricates and employed by them successfully. They used 4 slots Geneva Mechanism for Intermediately motion. In this study loading and unloading carried out manually while washing task is carried out by washer, and they also give analysis for bottle washing. This system was beneficial in reducing work, time, and cost of washing the bottle. As the speed of the Geneva mechanism increases, the cycle time, washing time and indexing time decreases while the maximum pin-slot contact force and washing efficiency increases. The washing efficiency of the test rig from 5rpm to 19 rpm increased from 81.57% to 96.89%. So, it was concluded from, the study that at 19rpm, the designed bottle washing machine had washing time of 2.434 seconds and maximum efficiency of 96.89%.

Deepak Sahu and others [4] carried research work on Design and Analysis of Paper Cutting Machine works on Geneva Mechanism. This Paper Gives the Study about a Mechanism which contain a Geneva Wheel and Gear Train to achieve intermediate motion for paper cutting operation. The Motion of Gear pair was determined by reducing jerk of Geneva wheel. The Modelling and Fabrication of a paper cutting machine using Geneva mechanism was useful to cut paper in equal and accurate dimensions. Geneva Drive was Useful for intermediate motion of a paper to be cut. In this study Paper was cut in ideal time and moves next position at indexing time. The cutter will be back to its original position by spring effect. In their study basically two types of mechanism used. 1) Indexing mechanism using Geneva and 2) cutting mechanism using 4 bar slider crank mechanism. Aim of this study was, Compact size, reduce cost, less skilled labour required, and no Electrical Inputs required, and reduced the cutting time.

Pratheep Kumar and other [5] Research on Design and Fabrication of Geneva Conveyor for Material Inspection & Noise Reduction. This Study Was Based on Geneva Conveyor design for noise reduction and material handling in various industries. It contains Motor, Belt, Rollers and IR Sensors. With the help of Geneva Mechanism, the time stoppage can be achieved well which avoids the use of stepper motor thus reduces the cost of operation and manufacturing cost. The main aim of this project is to optimization the measuring length of work piece and to reduce the noise of conveyor belt. Various gauges are used to inspect the components. Instead of using manual inspection, automatic system via pneumatic comparators is used. This study was very useful in various industries like, Sorting; pick up, Automotive, Agriculture, Bottling, Food Processing, Aerospace etc.

Chandrasekhar S. G. and Dr. K V Mahendra prashanth [6] research on Design and Implementation of automated tablet filler prototype for Pharmaceutical industry application using PLC. In this study they developed prototype of commercial tablet counting and filling machine for pharmaceutical industry application. In this main two type of operation carried out. 1) Loading, Conveying, Unloading of Tablet filling bottle by using PLC controller and sensors 2) Counting and filling of tablet in Bottle by using DC geared motor. Conclusion of this study that it was reduce the wastage of tablet, Higher production rate of tablet filling with higher efficiency.

Pallavi Vivek Shete and others [7] studied on Automatic Vessel Filling System Using Raspberry-pi microcontroller. This research is related to Automatic vessel filling system in which user manually entered the filling volume and bottle fill up automatically. For this work they used Raspberry-pi Microcontroller because it was very flexible, cost saving, Time saving and space efficient.

Ankur Prajapati and Chinmay Patel [8] research on review on Geneva mechanism and its application. In this research they discussed about different Geneva mechanism like external, internal and spherical Geneva mechanism. And also discussed about various application of Geneva mechanism. 1) Automatic filling system in which they discussed about automatic bottle filling and capping mechanism. 2) Cutting mechanism by giving feed through Geneva mechanism in this they discussed about slider crank mechanism, and belt drive. 3) Vacuum fill system using Geneva drive 4) Semi-automatic bar cutting machine.

Shantanu L. Kulkarni [9] research on Development of PLC based controller for bottle filling machine. Automation of bottle filling task can be achieved by use of PLC programming and PID controller. PLC used various sensors for the input and uses various valves for the output. He used SCADA software for PLC programming of bottle filling system, and reason of use

PID controller is to reduce the error. Human Measure Interface (HMI) is also used in this for manually entered the filling data.

Arun Kumar and others [10] present their research on A Review and Analysis of Geneva Mechanism design. In the research work they focused on converting motion achieved by conveyor to the motion achieved by Geneva mechanism because of the less spacious and less costly mechanism. In this study they designed 4sloted Geneva mechanism with curved slot and carried analysis on it, 1) force analysis of Geneva wheel and face cam with this analysis they finalised the slot of curve for perfect motion and use belt drive for rotating continuous Geneva wheel. Various type of Geneva designed can be achieved by force analysis on it.

E. Filemon [11] study on dynamic analysis of Geneva mechanisms with special consideration to reverses of pins. This study is based on change the design of pin in Geneva mechanism, because it will result into wear and failure of pin due to inadequate design. In their study firstly they find out the condition of dynamic analysis and after it they carried out kinematic and dynamic analysis on it.

IV. CONCLUSIONS

After reviewing different literature, it can be said that filling system have mainly 4 process loading, filling, capping and oading. It is necessary to convert manual bottle filling plant into automatic bottle filling plant due to higher global competiveness. Automatic bottle filling system can be achieved with 2 different types of mechanism. 1) Linear indexing motion in which different type of conveyor used 2) rotary indexing mechanism in which Geneva mechanism is used. Linear mechanism is used for larger number of operation and required large space while in rotary mechanism is mostly used for 4 to 8 operation and required less space comparatively. Controlling of automatic filling plant can be achieved with the help of PLC Controller and PID Controller or Microcontroller. Sensors and Valves also very useful in this system. Advantages of automatic bottle filling system are higher production, low cost, high precision and accuracy etc.

REFERENCES

[1] Bipin Mashilkar, Pallavi Khaire, Girish Dalvi, 2015, “Automated Bottle Filling System”, International Research Journal of Engineering and Technology Volume: 02 Issue: 07, PP: 771-776

[2] Sagar T. Payghan, Rani H. Deshmukh, 2016, “Automation of Bottle Filling Plant with Industry 4.0”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.: 5, Issue: 3, PP: 1578-1583

[3] Ujam, Ejeogo, and Onyeneho, 2015, “American Journal of Engineering Research” Volume-4, Issue-11, and PP: 63-73

[4] Deepak Sahu, Ghanshyam Kumar, 1940 “Design and Analysis of Paper Cutting Machine works on Geneva Mechanism”, IJARIIE Vol-2 Issue-2. PP: 1194-1197

[5] Pratheep Kumar, E.Sanjay, 2016 “Design and Fabrication of Geneva Conveyor for Material Inspection &Noise Reduction”, International Journal for Scientific Research & Development, Vol. 4, Issue 01, PP: 744-747

[6] Chandrasekhar S. G., Dr. K V Mahendra prashanth, 2015, “Design and Implementation of automated tablet filler prototype for Pharmaceutical application using PLC “International Journal for Scientific Research & Development, Vol. 3, Issue 03, PP:3082-3085

[7] Pallavi Vivek Shete, 2016, “Automatic Vessel Filling System Using Raspberry-pi”, International Engineering Research Journal, Vol.2, Issue 3, PP-1449-1451.

[8] Ankur Prajapati and Chinmay Patel, 2017 “Review on Geneva Mechanism and its application”, International Journal of Advance engineering and Research Development, Vol: 4, Issue: 2, PP: 425-429

[9] Shantanu L. Kulkarni, 2016 “Development of PLC based controller for bottle filling machine”, International Journal of Innovation in Engineering Research and Technology, Vol: 3, Issue: 4.

[10] Arun Kumar, 2016 “A Review on study and Analysis of Geneva Mechanism design”, International Journal of Advanced Scientific and Technical Research, Vol: 5, Issue: 6, PP:35-43

[11] E.Filemon, 1960, “dynamic analysis of Geneva mechanisms with special consideration to reverses of pins.