Automatic Washer-Feeder & Retriever Mechanism for Vehicle Assembly line

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Abstract

Using a feeder-retriever mechanism consisting of a recess, funnel and guiding channels the production line comprised of a series of workstations can be automated. The goal of fixing washers over the cylinder head of various automobile vehiclescan be achieved in a cost effective way thereby saving time of production line and increasing rate of production.

Keywords:*Automation, Feeder-Retriever mechanism, Rate of Production.*

1. Introduction:

An automated production line is comprised of a series of workstations linked by a transfer System and an electrical control system. Each station performs a specific operation and the product is processed step by step as it moves along the line in a pre-defined production sequence. The fixing of various parts of the engine as also insertion of nuts and bolts is done manually by the operators (line engineers) with the help of assistive tools and fixtures, conveyer belts etc. Our Job is to reduce effort of operator while fixing the washer on the engine head and to automate the process as much as possible in a cost effective way. Using a feeder-retriever mechanism consisting of a recess, funnel and guiding channels this goal can be achieved in a cost effective way thereby saving time of production line and increasing rate of production.

The Background and the Problem :

Whenever humans are involved in performing repetitive tasks countless number of times within a given time span errors happening due to fatigue are a high probability. On surveying and observing the assembly of a renowned 2 wheeler manufacturer from India we observed that the station where operator manually hand picked 4 washers from a storage box and placed them at 4 locations before the engine cover was bolted had a higher chance of delays due to the following factors :

1. Operator at times ended up taking 3 or 5 or an inaccurate number of washers in his hand which forced him to either end up taking extra washers needed so as to reach the precise count of 4 or he ended up putting the extra number of washers back into the storage bin.
2. In all this process operator at times ended up dropping washers around the storage bin which violates with the Seiso step of 5S methodology.
3. Operator at times was bound to get distracted due to small teething issues mentioned above which resulted in a slight delay in locking the 4 washers in the needed places.

Need of Automation:

Each of the operations on the assembly lines is usually simple involving perhaps a plain, linear or rotational motion. Around 20 to 30 operators are required a various stations at the assembly line and low cost automation to reduce effort of operator as also save time is given utmost importance by the design engineers. Our Job is to reduce effort of operator while fixing the washer on the engine head and to automate the process as much as possible in a cost effective way.

Kaizen in Production :

Kaizen states continuous small improvements in any process or rather production process compounds and leads to bigger gains over a period of time. By trying to automate the process of washer feeding and retrieval of the same we aim to reduce time for a part of the cycle which when compounded for 2-3 shifts of production during the entire day will result in a considerable amount of time being saved. For example lets consider a random 2 wheeler company XYZ running a production process involving feeding and retrieval of washers where each cycle of washer retrieval is taking 2.5 seconds and there are 500 such cycles performed in a day. If the automatic washer feeder and retriever helps to reduce the time of each cycle by a mere half a second, we are looking at a collective gain of 250 seconds during the entire span of the day which on an average is enough time for a high speed production line to assemble the engine of a bike completely or at least partially.

2. Objectives:

1) To build a system of Automatic washer-feeder mechanism for the vehicle assembly line of 2 wheelers.

2) To replace the current system, of manually inserting washer on engine which is a time consuming process.

3) To reduce time and effort of operator working on the assembly line.

4) To increase rate of engines assembled per day so as to increase output and reduce cost of operation by saving time.

3. Working Principle:

The operators (line engineers) will essentially pick a handful of washers from the main container and place them into the vibrating tray after long intervals. The tray will be given a vibrating motion using a vibrating motor and a slight inclination so that the washers fall into the recess. Further the guiding ways will guide the washer to the cylinder where it will be stacked up on each other. A retriever mechanism will make sure that the required set of washers can be conveniently acquired by the operator to further place the washers on the cylinder head of the engine.

The list of parts to be used in the design is as follows:

1. Tray
2. Vibratory Motor
3. Recess
4. Cylinder
5. Funnel
6. Lever operated spring return push button mechanism

Design of Parts:

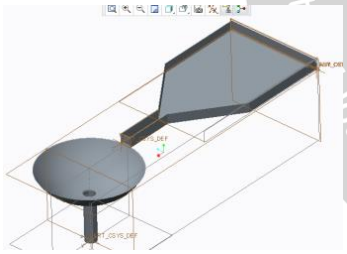

Fig. 1 Feeder Assembly

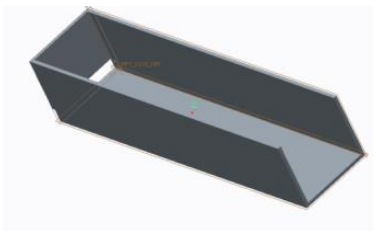

Fig. 2 Recess

Fig. 3 Funnel

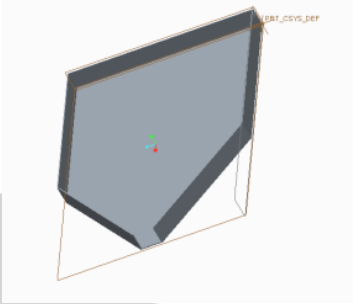

Fig. 4 Tray

All figures are images, designed in ADAMS software.

3.1 Washer Specifications:
ID: 11.2 +0.25/-0
OD: 20+0/-0.5
Thickness 2 +0.3/0
All Dimensions in MM

3.2 Software used for Simulation:

ADAMS (Automated Dynamic Analysis of Mechanical Systems) View 2014.

3.3 Materials Used:

Washers: Aluminum
Tray & Guide way: Galvanized Iron
Funnel: Aluminum

3.4 Concept used:

Vibration Frequency:$f=(\pi \times d \times N)/60$

For tray:-

a) Frequency: 418.6rad/s (3000 rpm equivalent. Considered as an input from standard motor)
b) Amplitude: 1.5mm (Started from 4 mm and tested until 0.5mm. Optimum value has been considered)

For Recess:-

a) Frequency: 100rad/s
b) Amplitude: 0.1 mm (Resultant frequency at free end)

4. Advantages of the mechanism:

1. Higher rate of production
2. Reduces Time of assembly
3. Flexible to handle
4. Reduces work of operator
5. Standard size of washer ensures better adaptability

Conclusion:

Based on standard inputs from a company having a 2 wheeler engine assembly line the duration required to put together a 150CC engine was 240 seconds i.e. 4 minutes. Considering a 7 hour shift roughly 105 engines are made per shift. The operator at the washer placement station has a time span of 3 seconds at the moment to pick the washers from the storage bin and place them on the 4 locations. Automating this process would be able to save an additional 0.5 seconds. 0.5 seconds saved per cycle X 105 cycles saves a total time of 52.5 seconds in one entire shift. Considering the same company runs 3 shifts for the engine assemblies the additional time saved would be 157.5 seconds. This would almost be equal to half the cycle time required to assemble an entire 150CC engine. Additionally the company is also saving electricity consumed if the per engine cycle time reduces which is successful Kaizen.

References

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