International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 09 | Sept - 2021 ISSN: 2582-3930

Design & Manufacturing Knuckle Hub Assembly Line

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Abstract- The assembly line is a series of workstations which is used to assemble the different parts and form it to one for efficient working. In the assembly line parts are added to the various stations in order to form a complete assembly. Each station consists of various operations which are performed while doing the assembly. Objective is to design an assembly line to reduce the manufacturing cost of itself and increase the efficiency of the production. Knuckle Hub assemblies used in automobiles consist of Hub, Knuckle, Bearings and Wheel usually integrated as unibody or part components. The materials used for these components are mainly cast iron, ductile iron, and steel spokes. Light weight hub and wheel assembly would reduce the inertia, the work done to move or stop the vehicle.

Index Terms- Knuckle + Bush assembly Trolley, Hub Trolley, Disc Trolley, LCA + Bush Assembly Trolley

INTRODUCTION

In earlier days Assembly lines were quite simpler, had more number of stages, bulky in construction, less accurate and required more time and manpower required was more in number with high skills. But with advancements in technology in today's world the assembly line grew smaller and smaller increasing its efficiency by virtue of increasing its accuracy. Now-a-days automation has been included in the assembly line no matter what type of assembly is to be done. Automations like Torque Wrenches, Pneumatic Clamping and Declamping Automatic Belt Drive, Conveyers, Magnetic Fixtures, Pneumatic Magnetic Cylinders, Etc. are used in modern Assembly Lines. The assembly lines also become highly accurate and precise by using automation and balancing techniques. Balancing techniques are used to reduce vibrations in assembly line which consequently improves the safety of assembly line.

This project consists of various automation techniques Torque wrench, Pneumatic Clamping and DE clamping technique with the implementation of POKAYOKE Principle, Programmable Logic Controller (PLC) interlinked with SCADA, Fixture and many more. Every Technique plays an important role in the assembly line increasing its reliability. Fixture being an essential part of the assembly line. of the assembled parts .In existing design the fixture set up is done manually, so the aim of this project is to replace fixture by fixture with pneumatic clamping device to save time for loading and unloading of component. Fixture provides the manufacturer for flexibility in holding forces and to optimize design for assembly operation as well as process function ability

LITERATURE REVIEW

The Assembly Line Balancing that Balancing is the main objective of line balancing is to distribute the task evenly over the work station so that idle time of man of machine can be minimized. Lime balancing aims at grouping the facilities or workers in an efficient pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes. [1]

The concept of an assembly line (AL) came to the fact when the finished product is inclined to the perception of product modularity. Usually interchangeable parts of the final product are assembled in sequence using best possibly designed logistics in an AL. [2]

Fixtures are used to hold the parts firmly which are to be machined, it is used to produce the duplicate parts accurately. In order to produce parts with required accuracy and dimensions the parts must be firmly and accurately fixed to the fixtures. To do this, a fixture is designed and built to hold, support and locate the work piece to ensure that each work piece is machined within the specified limits. [3]

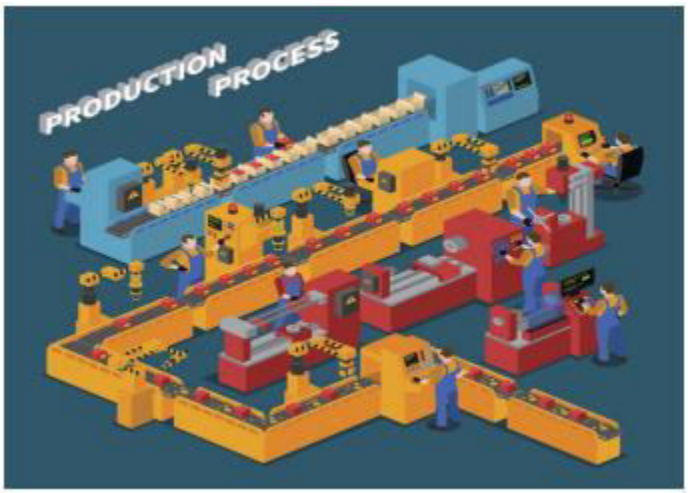
For supporting and clamping the work piece, device is provided. Frequent checking, positioning, individual marking and non-uniform quality in manufacturing process is eliminated by fixture. This increase productivity and reduce operation time. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used. A fixture consists of a set of locators and clamps. [4]

the multitude of industrial applications of natural and synthetic elastomers are seals, belts, tubes and dampers or dielectrics in soft generators and actuators. Silicone elastomers have a wide range of uses in medical devices and implants including artificial

urinary sphincter, external shell of breast implants, contact lenses and skin supports. Report are obtained that 45% of implants fracture after 3 years from implantation, possible causes for fracture initiators are small cracks created by spurs from the finger bones. [5]

WORKING

Every assembly line consists of various stages to perform a specified task. The assembly line consisting of multistage makes the assembly process simpler and efficient. In this Project of the Assembly Line is done, modelling and manufacturing of various parts, fixtures and assembly line is completed. The modelling of all the parts and fixture is done in different CAD software. The designing of roller is done on the basis of safety parameters. The modelled fixture was optimized as it was changed from closed fixture to the open fixture. Also the material Selection is to be done and selection of standard tool is done. After the theoretical and analytical work the actual manufacturing was started. Initially as per the designed dimensions the bars are made. The parted bars were welded according to model. The various parts which were manufactured were assembled according the stages designed in the assembly line. The assembled parts were tested by taking test runs trials. The errors observed in the trials were eliminated by using various optimizing techniques.

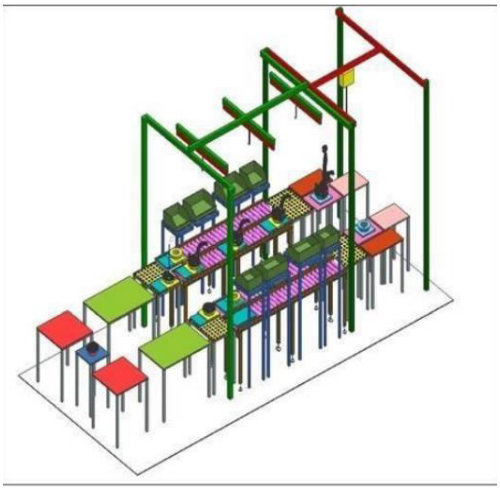


In this project the five stages of assembly line consists of following stages which are stated below as following:
Stage1: LCA assembly Stage
2: Assembly of Disc Brake and Wheel Hub Stage
3: Assembly Press Fitting and Bolt Fitting Stage
4: Calliper mounting and Bolt Fitting Stage
5: Assembly of Sensor Cable Bracket and Bolt Fitting

DESIGN OF ASSEMBLY LINE

A. Assembly line layout:

An assembly line is a manufacturing process in which interchangeable parts are added to a product in a sequential manner to create an end product. The assembly line is a series of workstations which is used to assemble the different parts and form it to one for efficient working. In the assembly line parts are added to the various stations in order to form a complete assembly. Each station consists of various operations which are performed while doing the assembly. The design of the assembly line is done on the basis of product size, accuracy required, and time required for assembly. The assembly line takes number of product which are unusable when not put together and assemble them into a single product which is then used as one product to perform certain task. The assembly line used to assemble the upright (Knuckle Hub Assembly) which is used in Four wheeler motor vehicle.



B. Part of Assembly line:

Sr No.	Part Description	Quantity
1	Knuckle + Bush assembly Trolley	02
2	Disc Trolley	01
3	Hub Trolley	01
4	Knuckle + LCA Assembly Table	02
5	Knuckle & LCA Final Assembly Trolley	02
6	LCA + Bush Assembly Trolley	02
7	Storage Bins with stand for Caliper, Nut Bolt, & Bracket	08
8	Structure with suitable Rails & Supports	01
9	Barcode Scanner with Communication Interface	03
10	Barcode Printer with Communication Interface & Table	01
11	Rolling Ball Table	04
12	Assembly Free Roller Conveyor	02
13	Empty Fixture Free Roller Conveyor	02
14	Disc + Hub Assly Table	01
15	Part Holding Fixtures	12
16	Structure for Cross Rails	01 set
17	Cross Rail Assly For Electric Hoist Sliding	01 set
18	Electronic Hoist (Cap. 75 Kg)	01
19	Control Panel with PLC.	01
20	Computer with Table	01

Table 1. Part of Assembly Line and Quantity

C. Various Stations in Assembly Line:
The Assembly consists of five stations which are to be done in Stages given below. The Assembly line consists of various stages which help in assemblage of knuckle and hub:

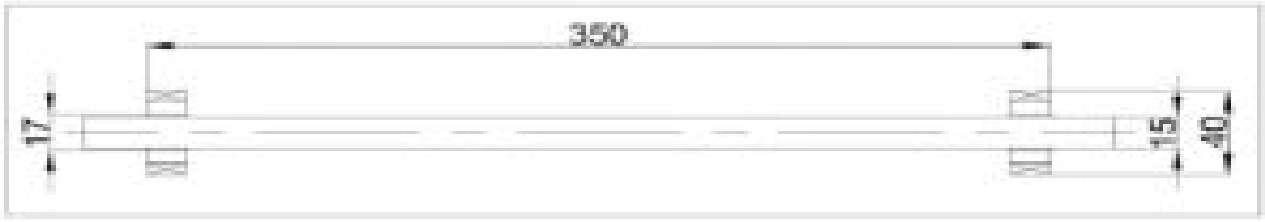
1. Stage 1: LCA assembly
2. Stage 2: Assembly of Disc Brake and Wheel Hub
3. Stage 3: Assembly Press Fitting and Bolt Fitting.
4. Stage 4: Calliper mounting and Bolt Fitting
5. Stage 5: Assembly of Sensor Cable Bracket and Bolt Fitting

D. Instruments/Components Used in Assembly Line:
The assembly line contents various components which are stated as below:
1. Torque Wrench
2. Controller
3. Fixture
4. Pneumatic cylinder
5. Roller
6. Castor Bearing assembly

Due to use of such type of automation techniques in the assembly line various problems like accuracy and precision, proper fitting, productivity are solved easily and they can be overcome ease.

DESIGN

5.1 Design of Components



Assume data:

P=0.5 kw ; N=200 Rpm; τ = 40 mpa; W= 392 N; L= 0.35 m

$$T = \frac{P \times 60}{2 \times \pi \times N}$$

$$T = \frac{500 \times 60}{2 \times \pi \times 200}$$

T=23.87 Nm

For Simply Supported shaft

$$M = \frac{W \times L}{4}$$

$$M = \frac{392 \times 0.35}{4}$$

M=34.3 Nm

$$Te = \sqrt{M^2} + \sqrt{T^2}$$

Te = 41.80 Nm

For determine Diameter of shaft

$$41.8 = \frac{\pi}{16} \times 40 \times d^3$$

D=17.3 mm

For suitable calculation we assume d= 15 mm

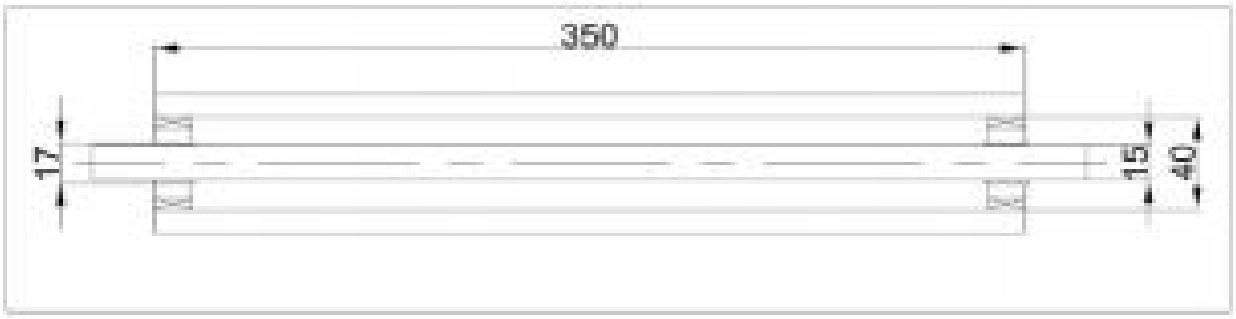
From Bearing manufacture Catalogue

internal diameter (d) =17mm

external diameter (D) = 40mm

Available bearing is 6203

5.2 Design of Roller



Initial Diam. = 40mm

Outer Diam. = 60mm

$$Thickness = \frac{D - d}{2}$$

The Material Selected for Roller is Stainless Steel

Properties of stainless steel are as follows

$Sut = 580N/mm2$

$Syt = 315N/mm2$

$\therefore \sigma t\ all = 0.18 \times Sut$

$= 0.18 \times 580$

$\sigma t\ all = 104.4N/mm2$

$\tau\ all = 0.3 \times Syt$

$= 0.3 \times 315$

$\tau\ all = 94.5N/mm2$

As $\sigma > \tau$

∴Design is Based on maximum Principle Stress Theory

For Moderate loading FOS = 2

CONCLUSION

In this project the study of various stages of assembly line components used in the assembly line and their working was done successfully. The modelling of fixture and assembly line was done. The design of roller and bearing was done. The optimization of the fixture by changing its basic design was the initial work done. Instead of making fixture a projected part of knuckle hub we have made a flat fixture with different accessories to hold different elements of knuckle and hub

The manufacturing of modelled parts was done. The manufactured parts were assembled and the completion of assembly line was done.

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6. "pneumatic clamping manipulator that Mixed sensitivity method is one of the frequency domain design methods in H control theory." Long et. al.
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