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DESIGN AND DEVELOPMENT OF SHOE SET PIN ASSEMBLY MACHINE

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Abstract- Now a day the industries are looking forward towards reducing the production cycle time and workers efforts. The industries are giving priorities to cost effective and efficient production technologies and instruments. The problem regarding assembly has required lot of worker efforts and time. Currently for some of operation done by manual method which may reduce production rate and more worker efforts. Also it consume more time due to which human fatigue increases so to overcome the above problem in assembly, machine is designed which makes assembly of shoe set pin of drum brake easily. Also reduce labor fatigue and time of operation. I am working in drum brake assembly where various assembly processes take place. Assembly machines are used to do assembly of drum brake. But shoe set pin assembly for of drum brake in our line construct manually i.e. TATA CUP (part name). In production assembly line of drum brake because of shoe set pin assembly, many times worker's finger are injure because of this production and it causes halt production for 1 to 2 hours. After the analysis of problem and implementation on line, problem gets solved and we achieved safe operation. In this work on attempt has been made to design and development an automatic shoe set pin assembly machine to make the shoe set pin assembly simpler. This project focuses on automation of shoe set pin assembly process to reduce human effort. In this machine piston cylinder are use to lead tool movement and double vane type rotary actuator for rotation of tool.

1. Introduction

Shoe set pin assembly process is done by worker with the help of tool and fixture. In the shoe set pin assembly process shoe sub assembly and back plate assembly are assemble together by shoe set pin and clips. Shoe sub assembly- this assembly also done by worker manually in which auto adjuster, hand brake liver, leading and trailing shoe, upper and lower spring assemble by standard procedure. Back plate assembly- In this assembly wheel cylinder mounting on back plate with the help of bolt. Which is done in auto torqueing assembly machine.
Following steps is followed by worker to assemble shoe set pin:

1. First of all shoe set pin put on magnetic button of fixture due to magnetic action pin become stable.
2. Put back plate on fixture through pin then locate the shoe sub assembly on back plate through shoe set pin.
3. Leading and trailing shoe are fit in wheel cylinder slot and anchor point slot.
4. Then put shoe hold down clip and fix this assembly with the help of tool and human force.

To follow this steps skilled and experienced worker is required Hence we design shoe set pin assembly machine to reduce human effort, increase production rate of shoe set pin assembly process.
Components:
Following components are used to assemble back plate and shoe sub assembly.

1. Shoe set pin :
   This pin use to hold back plate and shoe sub assembly.

2. Shoe hold down clip :
   Shoe set pin is hold assembly with the help of shoe hold down clip to avoid vibration.

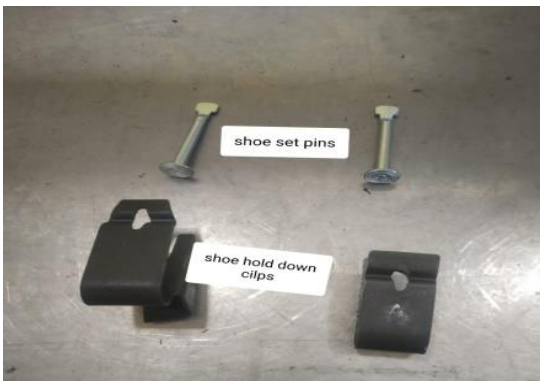

Figure 1 Shoe set pins and clips

This shoe set pin and hold down clip are use to assemble back plate and shoe sub assembly of the drum brake.

3. Fixture:
   Fixture is using to hold back plate to do assembly properly.

Figure 2 Fixture

2. Shoe set pin machine design and development

A. Problem statement
Shoe set pin assembly process is done by worker with the help of tool and fixture. Hence skilled and experienced worker are required to do assembly of shoe set pin. At the time of assembly process finger's injury of worker take place. Sometimes if that skilled

worker is not present that time target cannot be achieved. To do shoe set pin assembly process more human efforts are require.

B. Objective and project aim:

The aim of this project is to reduce the problem occurs during body assembly process and decrease the possibility that mistake could happen during work. The aim can be achieve by objective below:

1. To reduce human efforts
2. To reduce cycle time
3. To increase production rate
4. Safe to operate
5. Easy to operate
6. To increase efficiency

C. Methodology

The most important part of this project is Methodology used. It is very important because it gives me proper direction for completing the project. Thus following points is in my strategy of design.

1. Find out the problem regarding to the assembly line.
2. Make detail statement of the problems.
3. Select possible mechanism for the assembly.
4. Preparing the rough sketch or layout of selected mechanism.
5. Select components as per design calculations.
6. Design each element in solid work software.
7. Select the suitable dimension for each element of the product.

Prepare the actual drawing of each component and assembly of the component.

D. Design calculation

We require to calculate pneumatic pressure for the cylinder.

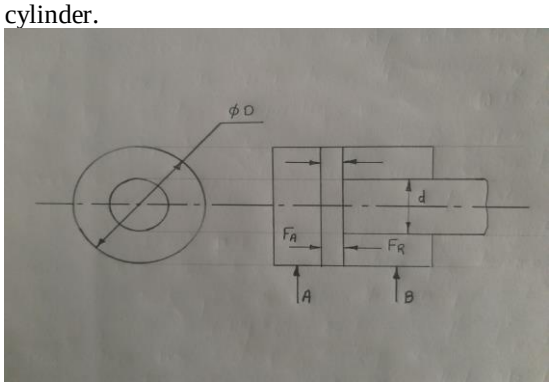

Figure 3 piston cylinder

Note that when air is supplied through port A piston will forward and when air is supplied through port B, piston will retract.

Now we will find out force with which piston will forward (F_A) and force with which piston will retract (F_R).

We know that,

Pressure = Force / Area

Force = Pressure × Area

To find force on piston in forward stroke

F_A = P × Area on which pressure is applied

To find force we assume Pressure = 6 bar and

D = 25mm, d = 10mm

$F_A = 0.6 \times (\pi \times R^2)$

$= 0.6 \times (\pi \times 12.5^2)$

$= 0.6 \times (490.87)$

$= 294.52$ N

$= 294.52 / 9.81$

$= 30.05$ kg

But Shoe hold down clip does not sustain 30.05 kg Force.

Hence we reduce Pressure.

Now Pressure = 4bar,

$F_A = 0.4 \times (490.87)$

$= 196.34$ N

$= 20.01$ kg

This Force Shoe hold down clip does not sustain.

Now Pressure = 3bar,

$F_A = 0.3 \times (490.87)$

$= 147.26$ N

$= 15.02$ kg

This Force Shoe hold down clip will be sustain so we select 3 Bar Pressure for the Pneumatic Cylinder.

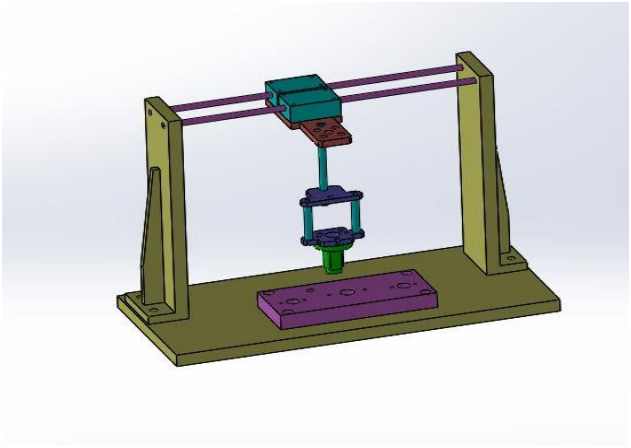

Figure 4 Design Model

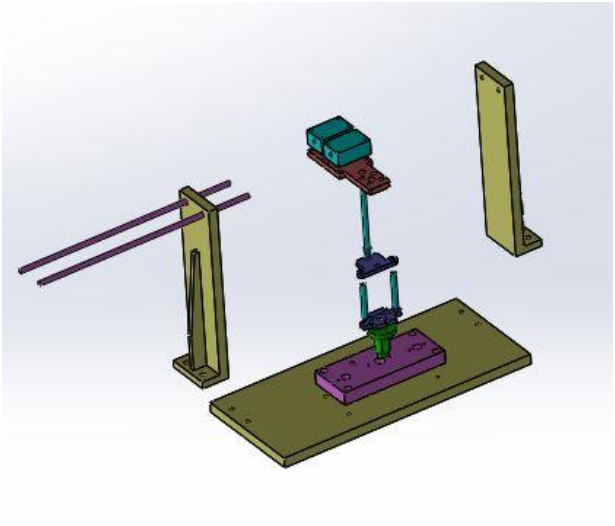

Figure 5 Detailed view of assembly

E. Parts

This device consists following parts with material description.

Sr.No.	Description	Quantity
1.	MS, Base Plate	1
2.	MS, Support pillar	2
3.	STD, Rod, Thk	2
4.	MS, Upper Plate	1
5.	EN8, Guide Rod	3
6.	MS, Middle Plate	1
7.	MS, Lower plate	1
8.	EN8, Driving Tool	1
9.	STD, Air cylinder	1
10.	STD, Rotary actuator	1

F. Assembly sequence of all parts:

1. First of all, assemble 1st support pillar to the base plate.
2. Then both rods fix in the pillar after that upper plate put in rods which slide in rods.
3. Then guide rod and cylinder are mounted to the upper plate.
4. We use two 3/2 direction control valve one of this use for cylinder and another for rotary actuator both are attached to the upper plate of the assembly machine.
5. Then middle support plate attached to the guide rod and piston rod.
6. After that two more guide rods mounted to the lower support plate.
7. Actuator and driving tool fix to the lower plate.
8. Then remaining pillar fix in the base plate and rods.

This procedure follows to done assembly

3. Working of shoe set pin assembly machine

The process of shoe set pin assembly done by pneumatic system. That convert compressed air into mechanical work. In this assembly machine assemble sub assembly into final assembly. Before going to automation this assembly done by worker manually. Now it will automation. To do automation we use pneumatic system in which various components are use such as 5/2 and 3/2 direction control valve, cylinder and rotary actuator.

First of all shoe set pin put on magnetic button of the fixture due magnetic action pin become stable. Then put back plate on fixture through pin and locate the shoe sub assembly on back plate through shoe set pin. Then fix leading and trailing shoe in wheel cylinder slot and anchor pin slot. After that 3/2 hand operated direction control valve use to on assembly machine which is connected to the cylinder due to air pressure piston moves down and because of all arrangement pressure pad also moves down and press hold down clip three mm and pin become free for rotation. Now 5/2 direction control valve open which give pressurized air to the actuator which is connected to the driving tool. Due actuator driving tool rotate pin at 90^{o}. After rotation piston move upward and pin become fit in the clip safely. Similar operation do for next clip of the assembly.

A. Advantages of design model:

1. Cycle time of shoe set pin assembly reduce
2. Production rate of line increase
3. Human efforts will be reduce
4. It is easy to operate
5. Assembly process safely done

4. Result

In survey for this product Assembly we get to known that as the assembly of this TATA CUP part is manually done. Worker require a great effort or force to lock this assembly. He has to push the clip with the help of T-Tool and with respective rotate it. He is using his whole body weight to make that clip down and while doing this again and again for 400 – 450 parts in shift. They got very tired and sometime make themselves injured (Cutting their finger due to tool slip). To overcome this problem make this locking process effortless (Pneumatic operated) and boost worker moral we suggest a design model which change their perception of worker towards working so they can work without injuring their selves. And because of this design model time required may reduce which also helps to get maximum target.

5. Acknowledgement

Chassis Brakes International Jalgaon : Practical work experiment in Chassis Brakes International Drum Brake assembly plant, Jalgaon.

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