

Design and Development of Pinning Machine for pyro block assembly

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Abstract— Furnace is used for melting and heat treating metals. So the wall of furnace requires insulation to cover the wall against high temperature. Thermal ceramics are used for protecting wall. Pyro-block is used as insulation. Block cannot attach to wall directly, for that one assembly is used called yoke-pipe. Automation is required because the manual assembly is complicated and time consuming. This work represents the design of automatic pinning machine which is automated by the pneumatic system. In this effort design of machine and its fabrication have been carried out. Model design has been carried out using Solid works 2009. The work carried out would help in increasing production rate and quality of products. It would reduce reliance upon skilled labor.

Keywords— Include at least 5 keywords or phrases

Pyro block consists of mainly three composition 40% alumina, 30% silica and 20% zirconium.

Process starts with three vessels which contains alumina, silica and zirconium in liquid form. Once furnace gives signal to proportional control valve, proportional control valve flows control proportion of each constitutes to the furnace. After reaching each constitutes to the furnace. Furnace heats the mixture at 1600C and stirrer with 300 RPM for 3 hours.

Once mixture is ready it passes to the upper spinner wheel at 12:10 dock position. Upper spinner wheel rotates at 11300 RPM and low spinner wheel rotates at 11000 RPM. Once stream fall on the upper spinner wheel it diverts stream into lower spinner wheel. Due to centrifugal action upper and lower spinner wheel has an air and at the bottom side which blow the air. Once stream contact with the air fibre ration process starts within fraction of time it completes.

Upper spinner wheel play 30% of fibre ration and lower spinner wheel play 70% of fibre ration.

In this process 10 to 15% liquid fall in between the upper and lower spinner wheel which is the waste.

Fibres generate due to the air blow it. Fibre y in the air whole area is covers by the chamber.

At the bottom of the chamber vacuum system is provided, which fall down the fibre on the conveyor. Wire mesh conveyor is provided at the bottom which passes air to the blower but not to pass fibre. So fibre fall and convey on the wire mesh conveyor spinner wheels cooled by water during the spinning process. Water is used as a lubricant. So the fibre comes out of the chamber, it contains water particles. Once fibre comes out of the chamber it is pressed in between two rollers and form sheets. This sheet passes through heating chamber to remove water particles.

When sheet comes out of the heating chamber it places one by one to make layer of sheets. Then it cut in size of block and after that it pressed in press machine which is the block.

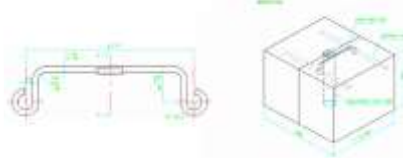


Fig.1.yoke and Pyro-block assembly [11]

After that pin and yoke assembly carried out using hand drill machine. For that first using tap bind two blocks together, after that takes yoke and drill machine than place yoke between blocks and drill block. Drill must pass through block and yoke. When drill comes out from other side pipe is placed on drill tool and inserts while taking out drill from blocks.

I. LITERATURE REVIEW

There are many researches on machine design and analysis of machine frame structure. Daniel J. Cook [2] had explained in Design and Development of an Automated Pinning Machine for the surface Mount Electronics Industry about machine development and its some points explained below, Pinning system Main focus of the project was to insert pin into Printed circuit boards (PCB). In this pins are of varying dimensions. Diameters are 0.080, 0.0062 and 0.040. Maximum pin diameter 0.040 (inches) Pin inserting operation was manual where arbour press retain the pin. Depth of insertion of pin in step by operator by testing pins until the accurate depth achieved. Pinning operation consists of two sub processes: sorting and insertion. In this both processes were decoupled by designing magazine to hold determined pins. Sorting process is required to feed pins and make aligns them in the pin magazine. Vibratory feeder used to feed the pins and then passes to a rotating wheel that grips the pins and brings them to observe in the camera to check correct position of the pin and then is sent to the magazine.

Insertion- When pins are organized in magazine, insertion process can start. In insertion process robot having end effectors are used to insert pin. The placing gantry locates the pin hole and place pin in it up to accurate depth. This procedure repeats until the magazine is depleted. Application of pin insertion process: Gripper is designed to store and feed pins in the magazine because the pins are in light weight,

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small components and stored in large amount. By which minimize downtime in spending time in feeding.

Michelle Sueway Chang [7] worked on Design of an automated sorting and Orienting Machine for Electronic Pins. In this paper sorting and orienting operation was completed before the insertion operation. So this operation is important for the automated insertion operation of pins in PCB. Ching Yuan Lin et al. [1] had explained that in this vertically linear guide is assembled with the frame and with the help of ball screw mechanism high speed spindle, so that load increases on the bearing and vibration produces. By proper calculation and selection of the bearing reduces vibration in the machine.

Eberhard Bamberg [3] had presented Rapid machine design that how to design machine and develop the machine. This paper gives guideline on the concept development of the machine. Then develop solid model using CAD system and advanced engineering tools. In this design development detailed study of every parts are carried out and set in proper position so that it represents real model. After completion of design parts were fabricated as per the drawings and parts assembled to manufacture machine. During the design of machine all calculations for the selection of parts were required for proper working of machine, like, bearing selection, cylinder selection, which mechanism reduces cost and gives proper function, etc.

Pneumatic cylinder pushes gun towards the component and drilling starts as shown in fig.3. At the other end from the hopper pipe comes in to the slot.

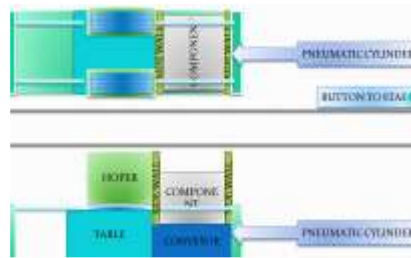


Fig.3.Drilling component

Drill stops and pipe pushed by rod at the reverse cycle of cylinder and at the completion of cycle pipe inserted into the component. Side wall unclamp component and assembly of yoke pipe is completed as shown in fig.4.

- Auto cycle of Pinning machine

As we are going to automate the operation of pinning process, so that we are going to work as follow.

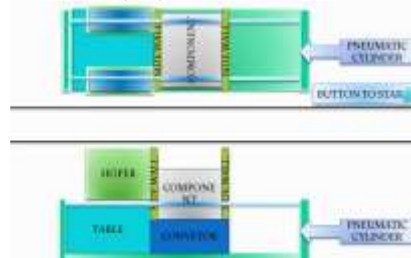


Fig.4.Pipe inserted

As shown in figures, we have to press button for every operation other than this we are going to automate this and it require for starting the process than all other operations are completed automatically. For the automation sensors are required to get the position of cylinders, clamps, pushing unit etc.

Design calculation of pinning machine

- a. Clamp Cylinder

Clamp force required to clamp PYRO Bloc = 30 Kg.

$$F = \frac{\pi}{4} \times d^2 \times XP$$

Pneumatic Pressure = 6 bar = 0.6 N/mm²

II. MOTIVATION

In assembling of Pyro-block time required is approximately 1 assembly/minute. By which production rate is low. Through applying automation in this process production may increases. Automation increases production rate and no human interference require during the assembly which increases quality of product.

III. METHODOLOGY

As shown in figure2 place components in between side wall, after that press starts button.

Side wall clamp the component and pneumatic gun starts to rotate.

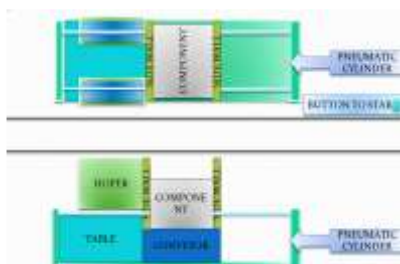


Fig.2.Component clamped

$$d = \sqrt{\frac{4 \times F}{\pi \times P}}$$

$$d = \sqrt{\frac{4 \times 300}{3.14 \times .6}}$$

$$d = 25.23 \text{ mm}$$

Consider Factor of Safety = 2
 So Required Bore of Pneumatic Cylinder = $25.23 \times 2 = 50.46 \approx 50 \text{ mm}$

Stroke Calculation:-

- 1) Original Length of Work Piece = 405 mm
 - 2) Length of Pipe = 305 mm
 - 3) Required Compression = $405 - 305 \text{ mm}$
- So Required Stroke = 100 mm

b. Double Acting (Drill Head) Cylinder

Consider Structure Weight = 90 Kg.
 Clamp force required to clamp PYRO Bloc = 90 Kg.

$$F = \frac{\pi}{4} \times d^2 \times P$$

Pneumatic Pressure = 6 bar = 0.6 N/mm^2

$$d = \sqrt{\frac{4 \times F}{\pi \times P}}$$

$$d = \sqrt{\frac{4 \times 900}{3.14 \times .6}}$$

$$d = 43.71 \text{ mm}$$

Consider Factor of Safety = 2
 So Required Bore of Pneumatic Cylinder = $43.71 \times 2 = 87.42 \approx 100 \text{ mm}$

Stroke Calculation:-

- 1) Length of Pipe = 305 mm
- 2) Length of Clamp = 405 mm

So Required Stroke = $305 + 405 = 710 \text{ mm}$

IV. DESIGN DEVELOPMENT

Pinning Machine is mainly made of three sub assembly. Material selected for Machine Frame is Mild Steel, Pneumatic cylinders and Rotors, Bearings and linear guides are bought out parts. Blocks which are connected in between the bearing and units are aluminum.

a. Pneumatic Gun Assembly
 Pneumatic Gun Assembly
 Consist of following parts

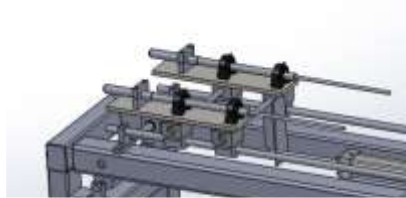


Fig.5. Pneumatic drill Assembly

Pneumatic Gun: - 2 Nos.
 Pillow Block Housing: - 4 Nos.
 Linear Bearing: - 4 Nos.
 Double Acting and Double Rod Cylinder: - 1 Nos. (Connected Between Pneumatic Gun and Pipe Inserting Assembly)
 Function of Pneumatic Gun Assembly: - To Drill in the Pyro Block which are clamped in between two jaw of Clamping Cylinder. Materials: - Drill tools are Stainless Steel Gun fitting plates are Mild steel.

b. Clamping Assembly
 Clamping Assembly Consist of following parts

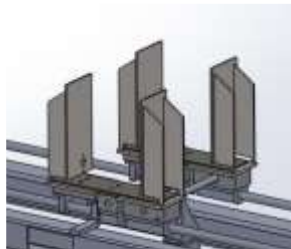


Fig.6. Clamping Assembly

Clamping Cylinder: - 1 Nos.
 Pillow Block Housing: - 4 Nos.
 Clamp Holder: - 4 Nos.
 Linear Bearing: - 2 Nos.
 Function of Clamping Assembly: - To Hold the Pyro Block for Drilling Application.
 Materials: - Clamps is Mild Steel Work piece place plate is Stainless Steel Clamp and pneumatic cylinder connecting plate is Mild Steel.

c. Pipe Inserting Assembly
 Clamping Assembly Consist of following parts

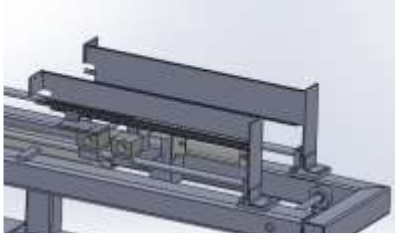


Fig.7.Pipe Inserting Assembly

Pipe inserting Cylinder: - 1 Nos.
 Pillow Block Housing: - 4 Nos.
 Pipe Magazine (to hold more no. of pipes):- 2 Nos.
 Linear Bearing: - 2 Nos.
 Double Acting and Double Rod Cylinder: - 1 Nos.(Connected Between Pneumatic Gun and Pipe Inserting Assembly)
 Materials: - pipe inserting assembly material is Stainless Steel

d. Machine Assembly

Machine Assembly Consist of all three subassembly and Width Adjustment parts for Accommodate Different Sizes of Pyro block.

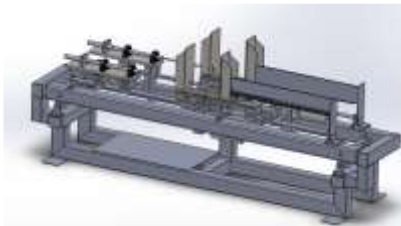


Fig.8.Machine Assembly

e. Pneumatic Circuit Diagram and Pneumatic component for Pinning operation[13]

Pneumatic Gun: -
 The Pneumatic Gun is generally known as Pneumatic Grinder. A wide range of governed die grinders are CP3109 and CP3119 series available in straight, straight extended, and angle versions. Industrial application their high durability and governed motor makes where power is needed.

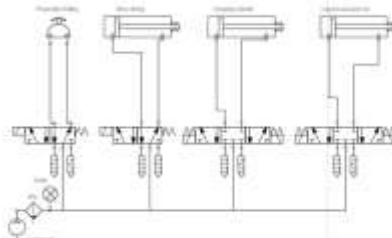


Fig.9.Pneumatic circuit of pinning machine

As shown in figure.9. Pneumatic drill and drill moving cylinder operated by 5/2 single solenoid valve. Clamping cylinder and Pipe pushing cylinder operated by 5/2 double solenoid valve. Filter regulator lubricator, Flow control valve, Pneumatic cylinders, these are the components used in manufacturing of machine.

V. Fabrication and Assembly of machine

a. Pneumatic gun subassembly



Fig.10.Pneumatic Gun Assembly

Figure.10 shows the assembly of Drilling unit. Here drill tools are made of Stainless steel and pillow blocks are used for smooth rotation of the tool.

b. Clamping subassembly

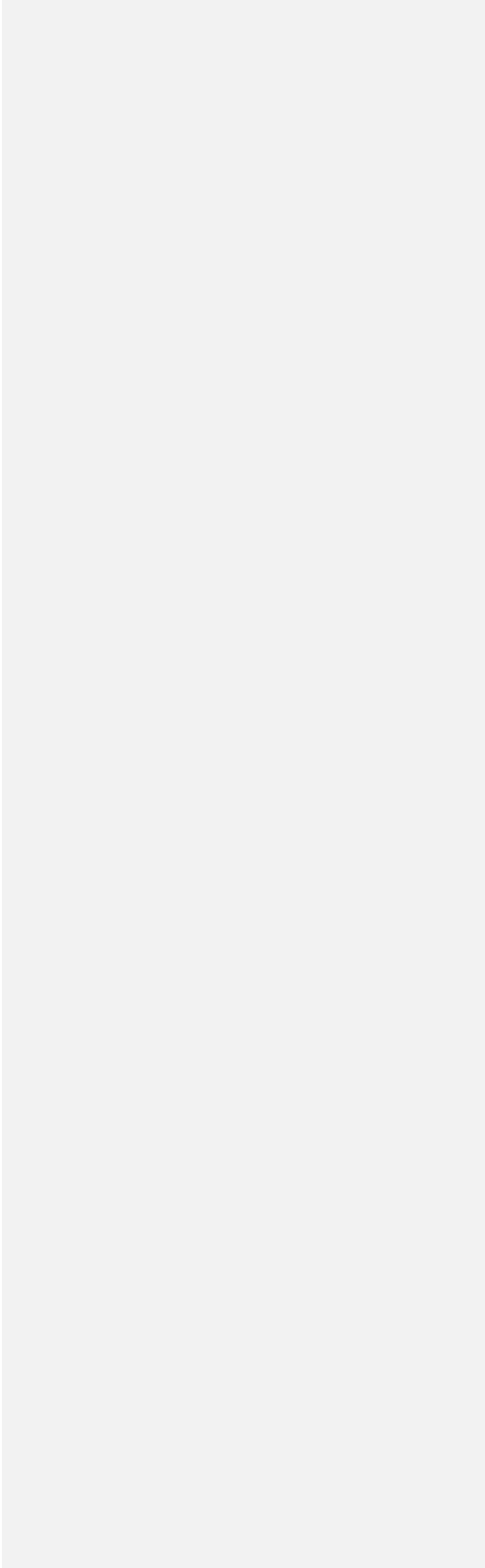




Fig.11.Clamping Assembly

Here as shown in Figure11 at the centre of block placing plate there are two blocks which are used to place yoke at perfect position.

c. Pipe inserting subassembly



Fig.12. Pipe Inserting Subassembly

In this assembly pipe place on the slot of pipe, when drilling operation completed pipe comes into the slot of pipe. After that pipe pushing cylinder pushes pipe so that pipe set on drill tool and after that pipe inserted into block by second motion of the double acting double rod cylinder.

d. Assembly of Pinning Machine



Fig.12. Assembly of Pinning Machine

e. Pneumatic circuit



Fig.13.Pneumatic circuit

VI. CONCLUSION

In this study Design and Fabrication of Pinning machine have been carried out and following conclusions have been drawn:

- When the company workers do pinning operation manually the speed of operation cycle is 1 assembly per minute but at the same time by development of pinning machine the cycle time is increased by 4 to 5 assembly per minute. The speed of the system is increased by 10%
- The accuracy of pinning of yoke is increased by using yoke holder.
- The accuracy of the pneumatic system is good only if you provide stable air supply.

VII. FUTURE SCOPE

- FE Analysis of pinning machine.
- Vibration analysis and the effect of vibration on accuracy of pinning.
- Effect of pressure stabilizer on the accuracy of pinning operation.

VIII. REFERENCES

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