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Cylinder Block Fixture for Mistake Proofing.

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ABSTRACT **:** *The project idea basically developed from trunnion tables which are one type of fixture having ability to rotate about its axis and able to fix the component at any angle, so there is no requirement of angle plate and sine plates, drilling process is also computer controlled so no guide bush is required, So robust design for extra rigidity, flexibility and simple to use. In this project task is difficult as design rotary cage type fixture for component like cylinder block, which is heavy of 76 kg. it is not possible to rotate or handle component manually and proceed on them to make this process accident proof and automated for this purpose we are designing a rotary cage which rotate 360 degree and allow indexing to process on the component. Processes are to be operated on the component are drilling tapping and air blow washing ,Since drilling don't need clamping here components self weight will enough to carry drilling force and tapping force coming through power tools. Therefore, rotary cage type fixture is critical importance.*

Keywords **-** *Poka-yoke, Mistake proofing, AISI304, UHMW*

I. INTRODUCTION

Poka-yoke (poh-kah yoh-keh) is a quality improvement concept, coined by Shigeo Shingo in Japan during the 1960s who was one of the Industrial Engineers at Toyota. The initial term was baka-yoke, which means fool proofing. Poka-yoke helps people and processes work right the first time. Poka-yoke refers to techniques that make it impossible to make mistakes. These techniques can drive defects out of products and processes and substantially improve quality and reliability. The use of simple Pokayoke ideas and methods in product and process design can eliminate both human and mechanical errors. Thus, Poka Yoke is central to the concept of Lean thinking, which aims to reduce waste and make sure that everything and every process is as efficient as possible. The concept of stopping defects or mistakes from happening is central to Poka Yoke thinking. It is not about rectifying mistakes or defects; it is about ensuring that they simply do not happen.

The Poka-Yoke entrance is promoted in the manufacturing industry as a way of improving productivity by reducing errors using often very simple modification. This research gives that, as Poka-Yoke are designed to make process mistake proof quality control. This research provides a study demonstrating the use of the Poka-Yoke approach in assembly of rotary cage fixture process highlighting how they served to improve accessibility to work by fulfilling Universal Design principles**.**

a. Poka-Yoke example from manufacturing industry

Fig 1: Sample example Poka-Yoke

A good example of Poka-Yoke design from manufacturing industry – SIM card slot in cell phones is designed in such a way that user is allowed to insert SIM card in correct way only.

b. Poka-Yoke is required to implement for cylinder block machining fixture

Fixturing is an important manufacturing activity, but there are very few hard and fast engineering principles involved in the fixture design process. Even the available limited analytical rules are not so flexible enough for the correct fixture design. Further, more, there is no exact definition as to what constitutes a good fixture design. A skilled tool designer learns his trade through apprenticeship training and many years of experience. With the current decline in the number of skilled machinists, tool and die workers, there is a clear need for an increase in the level of fixture automation. The present project describes Computer Aided Fixture Design system using the 3-2-1 Method for the design of a fixture to hold Cylinder Head components during processing on SPM. The fixturing modules, allows the user to model the component in terms of meaningful operation features and help in the selection of correct location points. The mechanical analysis of the component, which has been carried out in the project, will suggest the holding details.

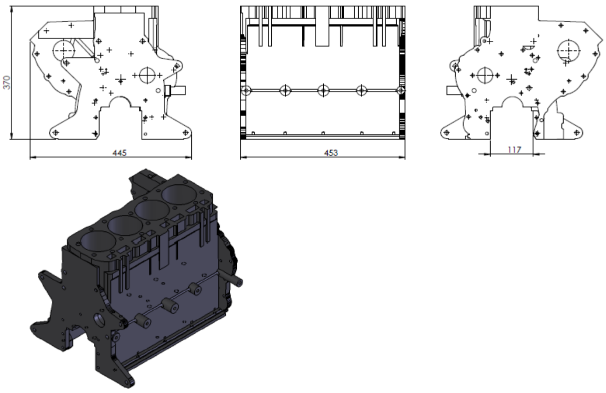


Fig 2 : Component four cylinder head

II. MATERIALS USED FOR FIXTURE

a. AISI 304 stainless steel

It is having Better corrosion resistance than Type 302. High ductility, excellent drawing, forming, and spinning properties. Stainless steels can absorb considerable impact without fracturing due to their excellent ductility and their strain-hardening characteristics. Essentially non-magnetic, becomes slightly magnetic when cold worked. Low carbon content means less carbide precipitation in the heat-affected zone during welding and a lower susceptibility to inter granular corrosion.

Grade	**Tensile strength, Yield (N/mm^2)**	**Ultimate tensile strength (N/mm^2)**	**Young's Modulus (N/mm^2)**	**Elongation (%)**
		Stainless steel		
304 (1.4301)	210	520	200000	45

Table a: Material Properties

- **Applications**

Welded and bolted fixture design, Beer kegs, bellows, chemical equipment, coal hopper linings, cooking equipment, cooling coils, cryogenic vessels, dairy equipment, evaporators, flatware utensils, feed water tubing, flexible metal hose, food processing equipment, hospital surgical equipment, hypodermic needles, kitchen sinks, marine equipment and fasteners, nuclear vessels, oil well filter screens, refrigeration equipment, paper industry, pots and pans, pressure vessels, sanitary fittings, valves, shipping drums, spinning, still tubes, textile dyeing equipment, tubing.

b. Ultra-high-molecular-weight-polyethylene

(UHMWPE, UHMW) is a subset of the thermoplastic polyethylene. Also known as high-modulus polyethylene, (HMPE), or high-performance polyethylene (HPPE), it has extremely long chains, with a molecular mass usually between 2 and 6 million u. The longer chain serves to transfer load more effectively to the polymer backbone by strengthening intermolecular interactions. This result in a very tough material, with the highest impact strength of any thermoplastic presently made.

UHMWPE is odour less, tasteless, and nontoxic. It is highly resistant to corrosive chemicals except oxidizing acids; has extremely low moisture absorption and a very low coefficient of friction; is self-lubricating; and is highly resistant to abrasion, in some forms being 15 times more resistant to abrasion than carbon steel. Its coefficient of friction is significantly lower than that of nylon and acetal, and is comparable to that of polytetrafluoroethylene used for making lock pad.

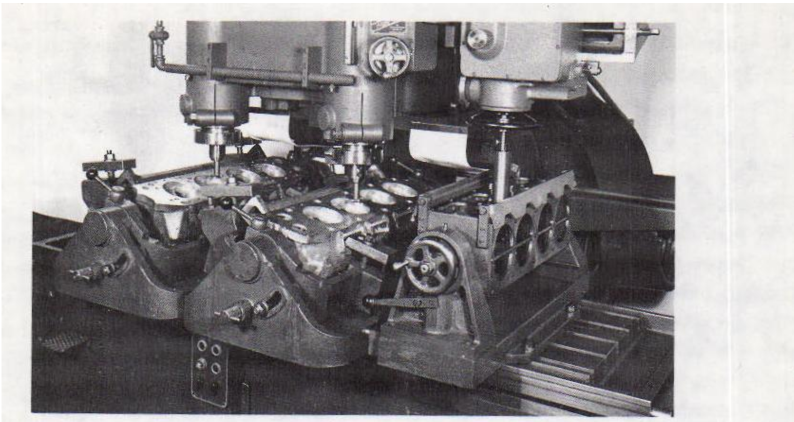
III. PROBLEM DEFINITION

Trunnion tables are used for drilling facing operation on cylinder block but it is having problem of fixing the component manually it require 3 to 4 workers for one machine. Lifting of heavy weight and locate it in correct position is time-consuming process. It also create back pain in spinal cord of the workers It is also dangerous if cylinder block fall down on worker.

IV. OBSERVATION

It is essential to have proper position of cylinder block particular machining operation. The main types of error found in trunnion tables were mis-location, and wrong insert of cylinder block. Some possible causes for these problems are workers not able to follow or are not following the standard operation procedure, from observations it was observed that human error is a major issue in this production. Since human cause is the major factor in this problem, as well as method and machine factor, Poka Yoke or a mistake proofing Problem identification technique implemented by following activities

Documents of company such as Operation standards, process flow layout, worker complaint, customer complaint, process flow chart, procedure documentation etc observed.



Courtesy of Cincinnati Milacron Inc.
Milling fixtures and template bracket for profile milling cylinder heads. Fixtures and template are trunnion mounted.

Fig 3: Trunnion tables

V. DESIGNS OF ROTARY CAGE FIXTURE FOR MISTAKE PROOFING

Poka yoke system is designed in such a way that the cylinder block insert only in correct orientation on to the trolley in direction locator pins and lock pad and it restrict the motion of cylinder block in ,+- X and + -Y axis.

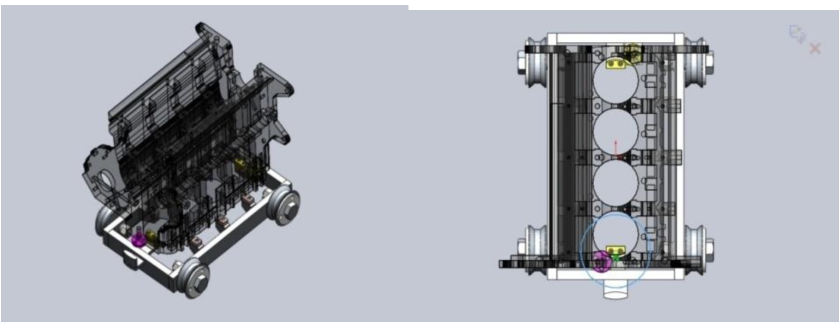


Fig 4: Transparent isometric and top view of trolley and cylinder block

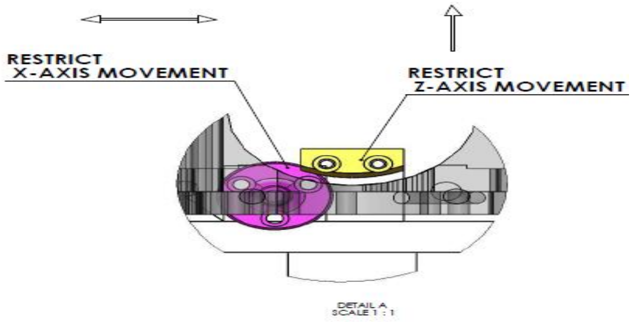


Fig 5: Transparent zoom top view of pink locator and yellow lock pad

Trolley will pass in standard defined direction into the cage for that assembly has been designed in such way that pipe is connected to the rotary cage joining plate shown in figure 7 and slots are provided on cylinder block on the in go side shown in figure 6. It allows trolley and cylinder block in only one direction as shown in figure 8. This device is mounted on conveyor before the station if off standard cylinder block along with trolley comes, it does not pass through the rotary cage fixture. Schematic views with its part names have been shown in following figure.

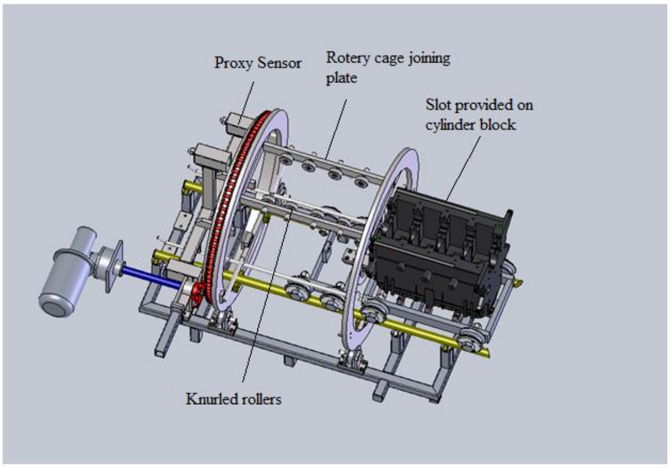


Fig 6: Isometric view showing slot on cylinder block

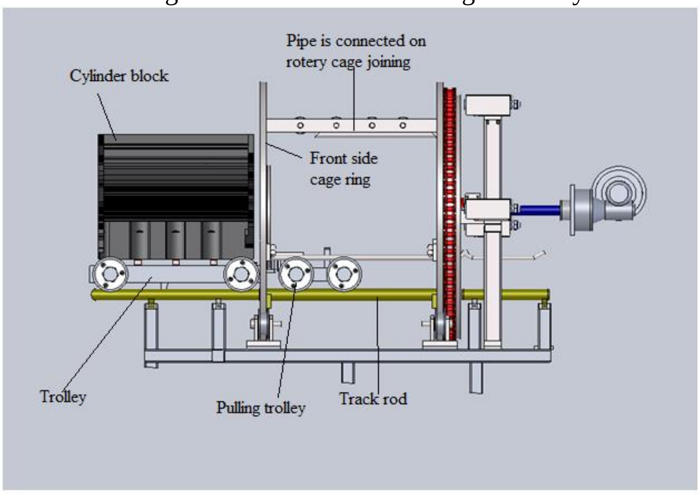


Fig 7: Front view showing pipe is connected to rotary cage joining plate

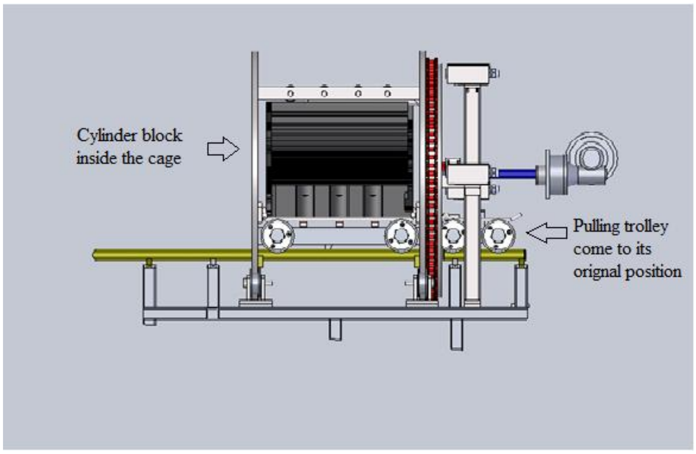


Fig 8: Front view showing complete assembly

a. Pulling trolley and its function

Pulling trolley powered by pneumatic cylinder, initially pulling trolley rest near to the loading and unloading station. When cylinder block is loaded on trolley the pulling trolley pulls the cylinder block inside the cage by pneumatic cylinder. The following figure show connection between pulling and cylinder block trolley some parts are intentionally make transparent to visualization of all the thing.

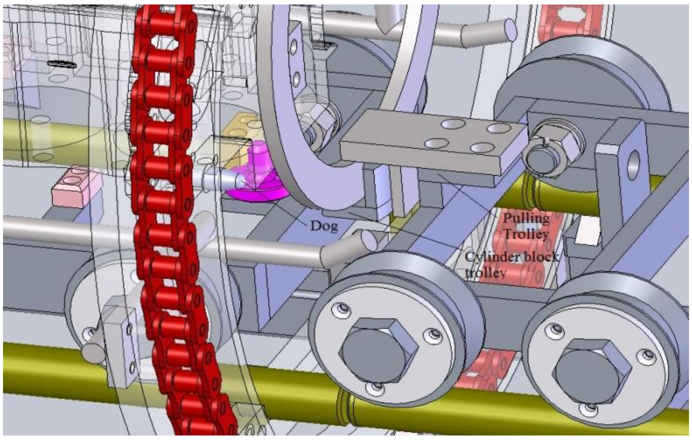


Fig 9: Pulling trolley pulls the cylinder block trolley magnified transparent view

b. Proxy sensor and dog fixed on cage:

As soon as the cylinder block and trolley come in to the cage according to the machining opera ration cage start rotating through 0, 90, 180, 360-degree cage rotation. For this purpose three proxy sensor and one dog is placed on back side of cage ring ,proxy sensor and dog comes in to the line mother control the sprocket and chain through plc circuits. Figure b shows the magnified view of proxy sensor and dog.

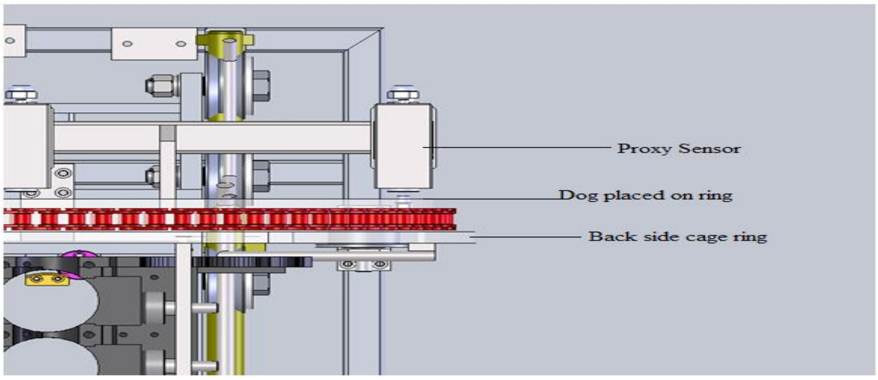


Figure 10: Transparent top view of backside cage ring

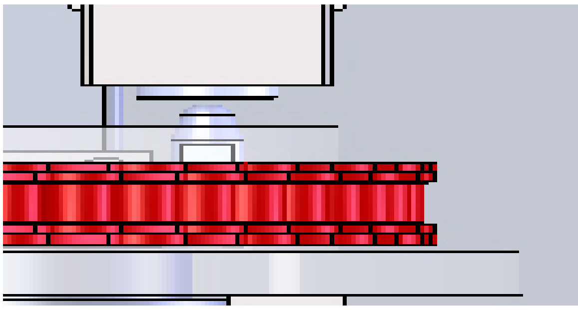


Fig 11: Magnified transparent top view of backside cage ring, Dog, and proxy Sensor

In this way system is made mistake proof and cylinder block getting hold by 3-2-1 principle. Due to mistake proof system there will be no error in system, production cost decreases and quality of product increase.

c. Fixture assembly

Figure shows actual manufactured rotary cage fixture used to hold the cylinder block. It helps for distributed load to be applied on the track rod and when it rotate load act on cage joining plate. The front side assembly photograph shown in figure.

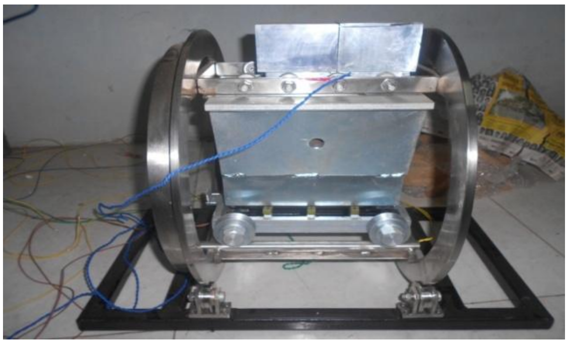


Fig 12: Actual setup manufactured for proto type cylinder block

VI. CONCLUSION

After manufacturing of rotary cage fixture, observed that it is possible to operate cage fixture successfully and scaling of model used for experimentation.

System is made mistake proof and cylinder block getting hold by 3-2-1 principle. Due to mistake proof system there will be no error in system, production cost decreases and quality of product increase.

From results and discussion, we concluded that though there are continuous changes in product design, we could arrest the defect by implementing Poka-Yokes.

We did automation to detect wrong assembly therefore any kind of operator can work to do assembly supervision.

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