RESEARCH ARTICLE OPEN ACCESS

Design of Automated Rotory Cage Type Fixture for Cylinder Block

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ABSTRACT
Project gives feasible solution to move and rotate the component with full proofing fixturing for special purpose operations like drilling, Tapping, deburring, washing, drying involve in manufacturing and assembly unit of industry. Rotary cage type fixture is made for handling the cylinder head inside the cleaning machine use for making fully ready component before assembly operation .System is useful to save time manpower and deliver perfect cleaned and dry component .system involved all the mechanical components along with the sensors used to restrict the rotating operations, stop and go operations etc.
Keywords: automated Rotary Cage, Computer Aided Fixture Design (CAFXD, The Feature Based Modeller (FBM), PLC circuit, poka-yoke, 3D CAD model, S/n ratio

I. INTRODUCTION

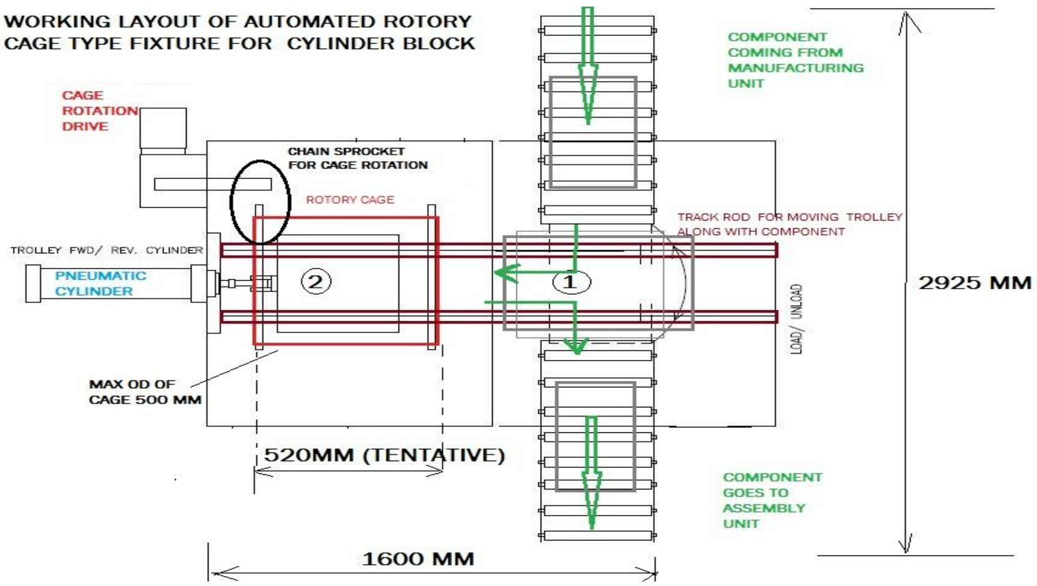
Proposed Project is to be designed for "fixturing solution". Design of automated Rotary Cage Type Fixture For Cylinder Block is taken from the special purpose machine in which component Cylinder Block is to be rotate ,drilled on face and tapping the drilled holes by robot arms ,air blow to clean the holes proceed towards assembly section in continuous production line of Automobile company The arrangement of said project will be process wise well defined sequence and Operation for the decided cycle time where the rotary Fixture along with component will be get stoppage at every angular position with the used sensors .Operation cycle will be run through PLC Programme.

II. INPUTS

3.1 Total set of Fixtures Trolley required to be mounted- 1 Nos
3.2 Total Weight Of components: 75.6 Kg
3.3 Maximum Available Area: 2Mtr x 3 Mtr
3.4 Loading Height: 1000 mm from ground.
3.5 Degree of rotation for cage -360 degree
3.6 material for construction- AISI 304, non metal - UHMW

III. PROCESS

1. Component comes from manufacturing unit by the powerised conveyor and get push on the dedicated trolley . a trolley will be having roller for moving on track provided and dedicated fixture for holding the component perfectly with full proofing .
2. Trolley will turn 90 degree to pull along with component inside the cage provided for rotory motion .The trolley get pull by the reverse stroke of pneumatic cylinder.
3. Once the certainty get by the sensor that component is present inside the rotory cage the cage start rotating along with the fixture trolley and component in 360 degree, also stoppage will be their within angular distances for operating the cavities and tapped holes at different posision as per the feasibility.
4. After cycle time over trolley will take its default position to make alignment of fixture trolley roller with track to come out side on load/unload station and move towards assembly section. By provided powerised conveyor.



IV. DETAILED DESIGN OF MECHANICAL PARTS

FIXTURE DESIGN

Fixturing is an important manufacturing activity, but there are very few hard and fast engineering principles involved in the fixture design process. The present project describes an interactive Computer Aided Fixture Design (CAFXD) system. The Feature Based Modeller (FBM), which consists of fixturing modules, allows the user to model the component in terms of meaningful operation features and help in the selection of correct location points.

i) LOCATOR PIN

Locator Pin used here to restrict DOF in linear and rotational X direction i.e. to restrict 4 DOF Viz. Linear +X,-X, and rotational clockwise X, anticlockwise X.

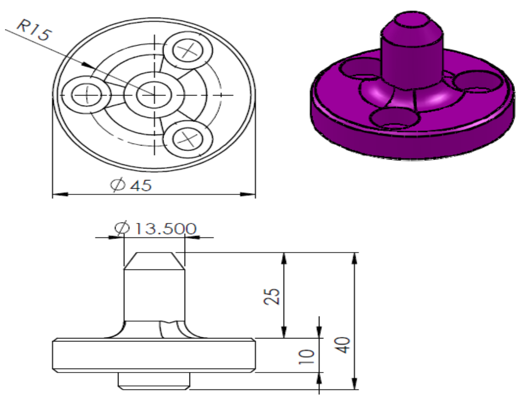
This pin plays the role for reference point also which delivers the exact position. **Material of construction is AISI 304**

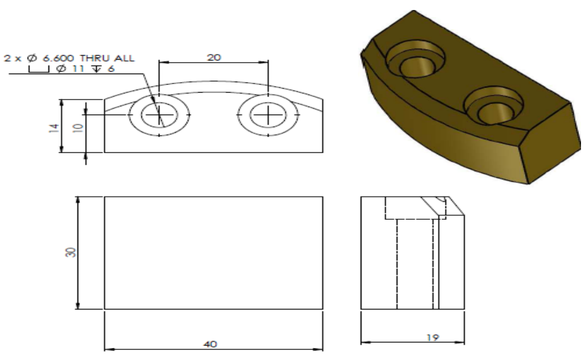
ii) LOCK PAD

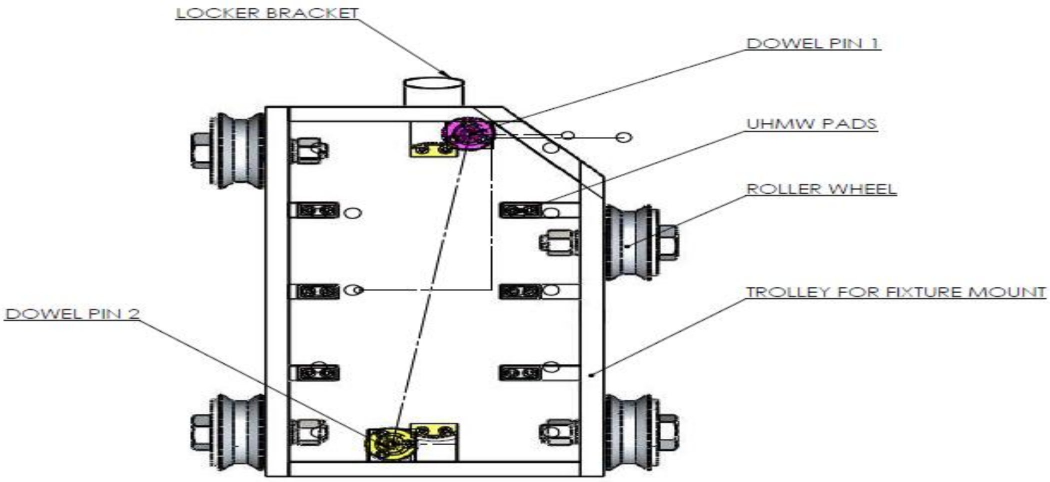
Lock Pad is used here to restrict DOF in Linear Z direction i.e., +Z, -Z, and Rotational clockwise Z, anticlockwise Z as shown in fixture arrangement. **MOC: UHMW**

iii) TROLLEY STRUCTURE

Trolley structure made up of steel flats is the platform Made for locating and Assembled the entire Fixture elements. **MOC: AISI304**

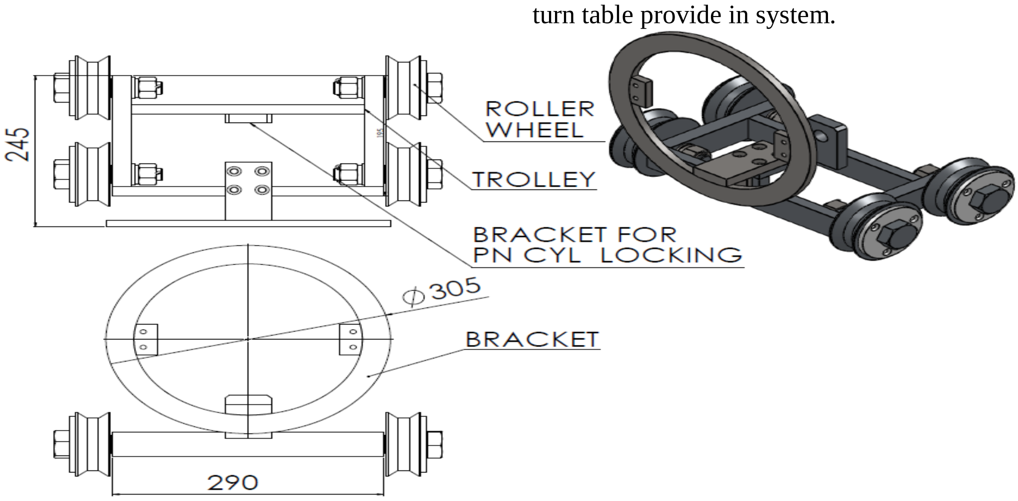






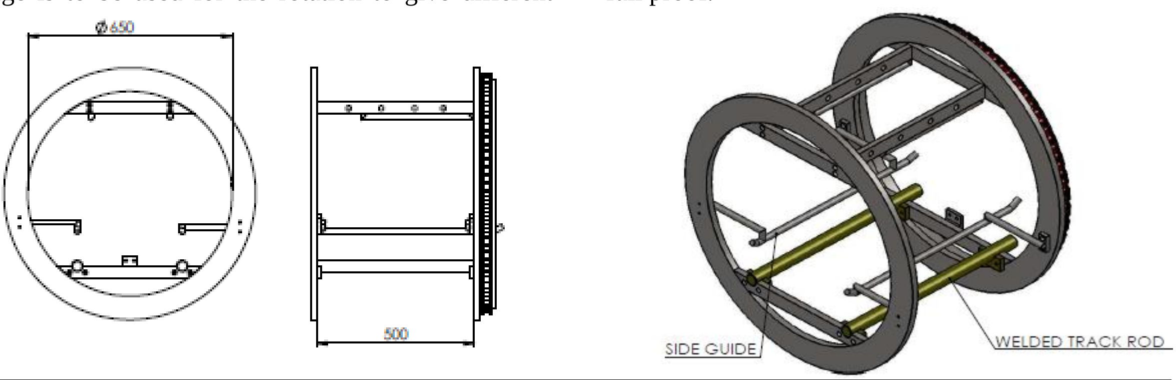
iv) <u>FIXTURE PULLING TROLLEY</u>

Small trolley pulls the main fixture trolley inside the cage by provide pneumatic cylinder stroke and make alignment with cage to travel away from station after the operation is done.
This trolley pulls the main trolley from load unload turn table provide in system.



v) <u>ROTORY CAGE</u>

Rotary cage is made up of AISI304 .since the cage is to be used for the rotation to give different faces of component operated inside SPM. Rotary cage fixes fuxture trolley along with component with full proof.



V. DRIVE UNIT DESIGN AND CALCULATIONS

Drive unit made for the transmission of rotary motion into cage which is holding fixture cum component is made by considering the input parameters like speed and cycle time require for the process inside the machine.

Calculations for selection and finalised the parameters:

Total CAGE weight = 119 kg
Per component weight = 75.44 kg
Maximum number of components at a time = 1
For rolling applications, generally preferred value the coefficient of friction is 0.2.

Total pulling Weight = Total cage weight + (per component weight × Maximum No. of components)
Hence,
1) Total pulling weight = 110 + (76×1)
= 186 kg.

Maximum Pull = Total Pulling weight × Coefficient of Friction
= 186 × 0.2
= 37.2kg
= 372 N …………………… where, consider $g=10m/s^2$

2) For **PCD of Drive sprocket**,
Chain pitch **(P)** = 25.4 mm
Number of teeth on sprockets **(z)** = 13
Time to travel pitch **(t)** = 60 sec.

Pitch Circle Diameter of Drive Sprocket, **(PCD) = Pitch (P) / sin (180/z)**

Hence,
PCD of Sprocket = 25,4 / sin (180/13)
= 106.094 mm
= 0.106 m

3) For **PCD of Driven sprocket**,
Since the driving sprocket is a ring binded by chain of pitch 25.4 mm
Ring dia d =650 mm
Perimeter of ring =2 л d **= 4084.07**
No. of teeth will be **(z) =4084.07/ 25.4 = 160.8**
Chain pitch **(P)** = 25.4 mm
Number of teeth on sprockets **(z)** = 160.8
Pitch between components **(P_c)** = 4084.07 mm (considered after every rotation fresh cycle)
Time to travel pitch **(t)** = 60 sec.

Pitch Circle Diameter of Driven Sprocket(circular ring), **(PCD) = Pitch (P) / sin (180/z)**

Hence,
PCD of Sprocket (ring) = 25.4 / sin (180/160.8)
= 1299.639 mm
= 1.29 m

4) Centre distance between two Shafts
= (PCD of Drive Sprocket + PCD of driven Ring) / 2
= (106.094+1299.639) /2
= 702.86 mm
= 0.702 m

5) **Torque Calculation for Drive unit:**

Required torque = Maximum pull × (PCD of Sprocket / 2)
= 372 × (0.106 / 2)
= 30.94 Nm

Required RPM = P_c / (t / 60) / z / P
= 4084.07 × 60 / 60 / 13 / 25.4
= 12.25
= 12.25 RPM

6) Final Result:

Consider the service factor for the conveyor chain is 1.5
Hence,

Final output Torque, (T)
= required torque × Service factor
= 30.94 × 1.5
= 46.4 Nm

Final Output RPM, (n) = 12.2 rpm 413

Final Output HP = (2 × □ × n ×T) / 45000
= (2 × л × 0.5 × 46.4) / 45000
= 0.09 HP

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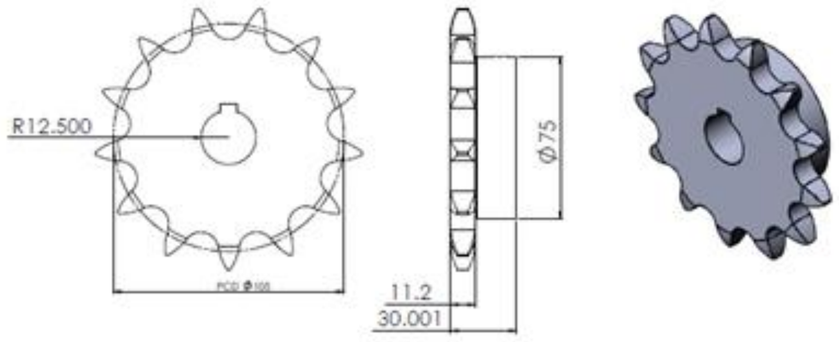

FIG: SPROCKET 13 TEETH

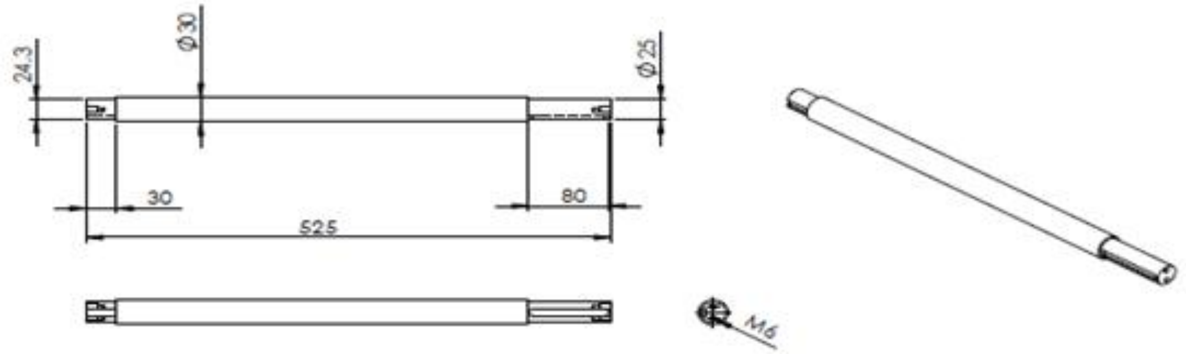

FIG: HARDENED SHAFT WITH KEYWAYS

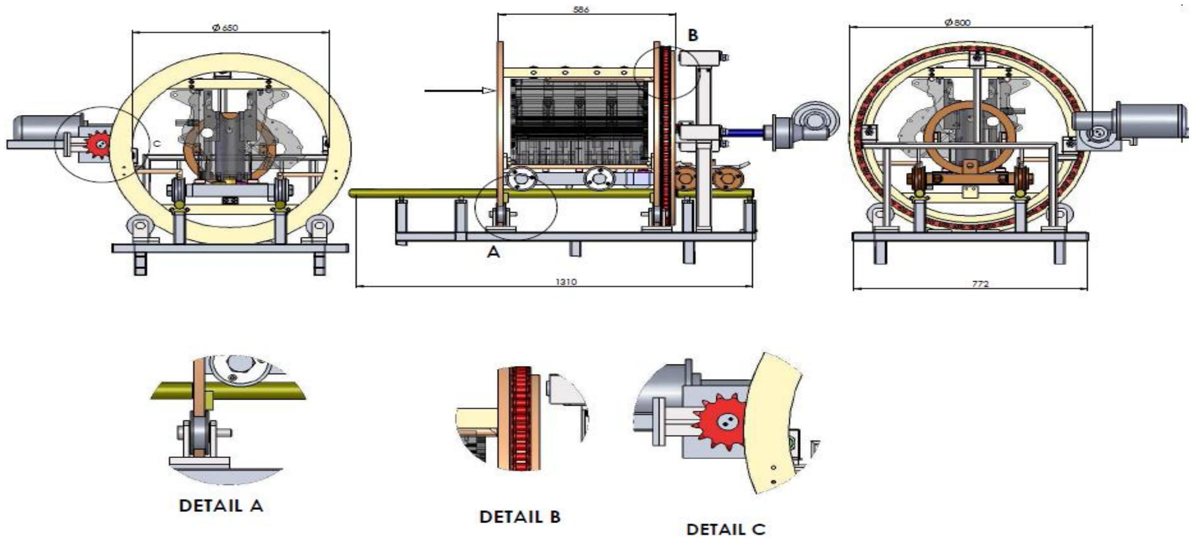

FIG: DIFFERENT VIEWS OF WHOLE WORKING SYSTEM

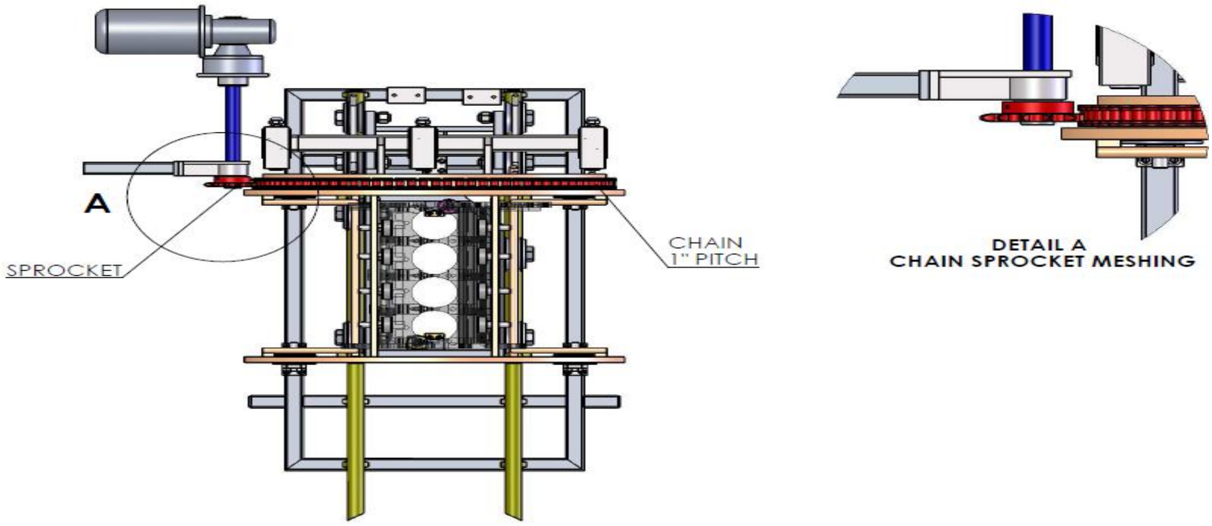

FIG: TOP VIEW (DRIVE WORKING TO START ROTATION OF THE CAGE)

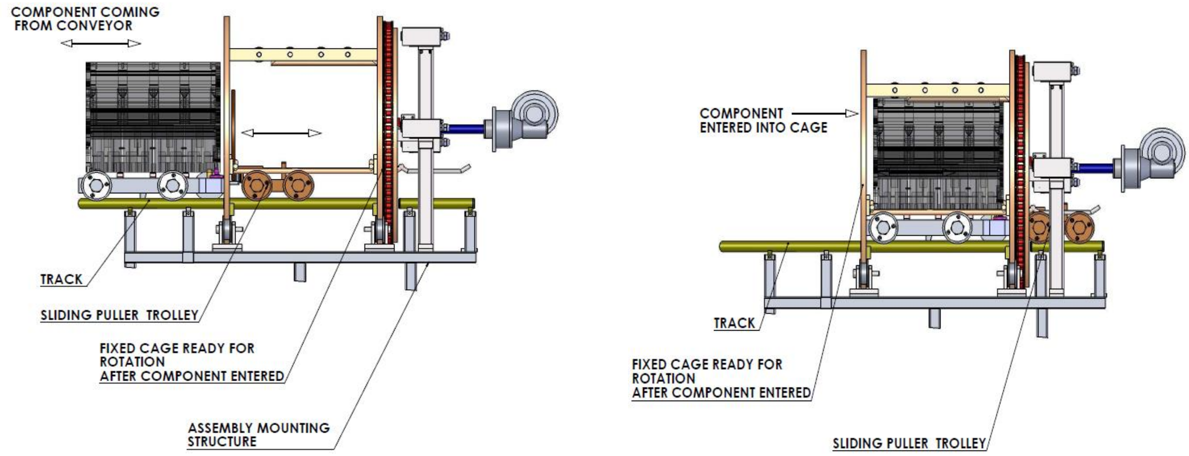

FIG: COMPONENT ENTERING INSIDE THE CAGE

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