Design & Fabrication of Top Grinding Dresser Fixture

[1]Avinash D. Mote,[2]Pravin M. Katkar,[3]Sagar P. Gund,[4]Sagar C. Gunturkar,[5]Yogesh P. Bhatt
[1234]UG Student, Mechanical Engineering Dept., Suman Ramesh Tulsiani Technical Campus Faculty of Engineering, Khamshet, Pune, MH, India.
[5]Assistant Professor, Mechanical Engineering Dept., Suman Ramesh Tulsiani Technical Campus Faculty of Engineering, Khamshet, Pune, MH, India.

Abstract:* We are moving towards more comfortable and time saving method, for this reason many engineers are contributing their innovation for several things to make Simple, Easy Handling and Save Time Consumption for Production. Grinding technologies represent a critical step in the production of high added-value and high precision parts for strategic industrial sectors such as aerospace, automotive, biomedical, and wind generation. Whilst a number of factors related to the grinding wheel are important for optimizing the grinding process, there is no doubt that the wheel surface topography is the most influential factor. Surface topography is induced not only by the nature of the wheel itself, but also, more importantly, by the dressing process. Dressing is periodically carried out in order to recover the abrasive capacity of the wheel once excessive wear of abrasive grits has occurred. This project work has a versatile range in wheel dresser, while sliding Diamond dresser can be used for tool making, for production process like surface grinding, cylindrical grinding, creep-feed grinding process. Sliding Diamond dresser is a device which is used for cleaning abrasive material surface makes them effectively ready to do grinding process again. Also, the high technology of mechanism used in sliding Diamond dresser construction ensure that they can process long lasting hours and trouble-free usage. This sliding Diamond dresser can be mounted on the table, or near the side of grinding wheel. the different models available are suitable for various machine-like surface grinding, cylindrical grinding, creep-feed grinding machine, etc.

We can use this mechanism where mass production in small scale industries with low capital cost with effective working is preferred.

Key Words–Grinding, Dressing, Jigs, fixtures, Diamond Tool, Dovetail Joint.

I. Introduction

Heavy business involves one or additional characteristics like giant and significant products; giant and significant instrumentality and facilities (such as significant instrumentality, giant machine tools, and large buildings); or complicated of various processes. attributable to those factors, significant business involves higher capital intensity than lightweight business will, and it's conjointly typically additional heavily cyclic in investment and employment. Transportation and construction alongside their upstream producing provide businesses are the majority of significant business throughout the commercial age, alongside some capital-intensive producing. Ancient examples from the mid-19th century through the first twentieth enclosed steelmaking, artillery production, locomotive erection, machine building, and also the heavier varieties of mining. From the late nineteenth century through the mid-20th, because the {chemical business industry} and electrical industry developed, they concerned elements of each significant business and light-weight business, that was before long conjointly true for the automotive business and also the craft business. fashionable building (since steel replaced wood) is taken into account significant business. [1] Giant systems square measure typically characteristic of significant business like the development of skyscrapers and huge dams throughout the post–World War II era, and also the manufacture/deployment of huge rockets and large wind turbines through the twenty first century .

Several East Asian countries have faith in significant business as a part of their overall economies. Among Japanese and Korean companies with "heavy industry" in their names, several also are makers of region merchandise and defines contractors to their several countries' governments like Japan's Fuji significant Industries and Korea's Hyundai Rotem, a joint project of Hyundai significant Industries and Daewoo significant Industries.[2]

II. Importance of the Dressing Operation

Grinding is a machining process which utilizes grinding wheels containing hard abrasive particles as the cutting medium. Grinding is one of the earliest techniques learned by human, beings, and can be traced to Neolithic times. As grinding became a precision operation, dressing techniques were developed for preparation of the working surface of the wheel. A device for dressing a sandstone grinding wheel was first patented by Altzschner in 1860. Basic principles of dressing and truing grinding wheels were laid down by Norton in 1905.

The dressing operation achieves two purposes. The first is to true the wheel surface to obtain profile accuracy and the second is to resharpen or dress the abrasive grains to improve the cutting ability. Most dressing operations combine the 'truing' and 'dressing' function as one, so the term dressing generally covers both functions. The usual reasons for redressing a wheel are:

1. slow removal rate
2. grinding vibration
3. workpiece burn
4. poor surface texture
5. loss of form-holding.

Conventional grinding wheels made from alumina and silica are almost exclusively dressed with diamond tools. This is because diamond is the only material hard enough to dress conventional abrasives without itself suffering excessive wear. Single point diamond dressing is commonly used for precision grinding and achieves the best grinding results if the diamond is sharp. Multi-point diamond dressing tools and diamond disc dressers may be used to achieve longer dressing tool life since the wear is distributed over a number of diamonds. For large batch sizes and formed profiles, diamond impregnated rolls are often used. Because the diamond roll extends the full width of the workpiece, dressing is fast. The economic advantages of a diamond roll rely on the savings in cycle time. However, diamond rolls are expensive due to the large quantity of diamond required and the careful setting required, particularly for profiled grinding wheels. There is therefore a continuing requirement to employ single point diamond dressing for precision grinding in batch production. The importance of the dressing process lies in the fact that a difference in dressing conditions leads to different grinding behaviour. The problem of current interest is to develop a methodology of achieving and maintaining optimal grinding behaviour of the grinding wheel. If the dressing operation can lead to more stable behaviour of the wheel.[3]

III. About Jigs & Fixture

The most-common jigs are drill and boring jigs. These tools are fundamentally the same. The difference lies in the size, type, and placement of the drill bushings. Boring jigs usually have larger bushings. These bushings may also have internal oil grooves to keep the boring bar lubricated. Often, boring jigs use more than one bushing to support the boring bar throughout the machining cycle. In the shop, drill jigs are the most-widely used form of jig.

Drill jigs are used for drilling, tapping, remaining, chamfering, counter-boring, countersinking, and similar operations. Occasionally, drill jigs also used to perform assembly work. In these situation, the bushing, guide pin, dowel, or other assembly elements at the jig also important to perform jig ability. Jigs are further identified by their basic construction. The two types of jigs, they are open and closed. Open jigs carry out operations on only one, or sometimes two, sides of a work-piece. Closed jigs, on the other hand, operate on two or more sides of work-piece. The most-common open jigs are

template jigs, plate jigs, table jigs, sandwich jigs, and angle plate jigs. Typical examples of closed jigs include box jigs, Channel jigs, and leaf jigs. Other forms of jigs rely more on the application of the tool than on their construction for their identity. These include indexing jigs and multi-station jigs.[4]

A jig is a special device that holds, supports, or is placed on a part to be machined. It is a production tool made so that it not only locates and holds the work-piece but also guides the cutting tool as the operation is performed. Jigs are usually fitted with hardened steel bushings for guiding drills or other cutting tools.

A fixture is a device for locating, holding and supporting a work-piece during a manufacturing operation. It is a production tool that locates, holds, and supports the work securely so the required machining operations can be performed.

Fixtures have a much-wider scope of application than jigs. These work holders are designed for applications where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, center finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixtures, and grinding fixtures. Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of a tool to a work-piece.

Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work-piece in a given orientation with respect to a cutting tool measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work-piece in that location for the particular processing operation. There are many standard work holding devices such as jaw chucks, machine vises, drill chucks, collets, etc. which are widely used in workshops and are usually kept in stock for general applications.[5]

IV. Literature Review

N. P. Maniar et al. [1] in his work in design & development of fixture for CNC explained that fixture design is one of the most important design tasks during process design for a new product development since it involves defining the locations and orientations of parts during assembly processes as well as providing physical support, which can greatly affect product dimensional variations and process yield. Generally, fixture design process can be divided into three stages.

i. Fixture planning: In the fixture planning stage, issues related to the number of fixtures needed, the type of fixtures, the orientation of fixture corresponding to orientation, and the joining or machining operations, which fixtures have to handle are identified.

ii. Fixture configuration: The fixture configuration stage determines the layout of a set of locators and clamps on a workpiece surface such that the workpiece is completely restrained.

iii. Fixture construction: Finally, the fixture construction stage involves constructing fixture components and then installing them to support the workpiece. Specifically, for complex assemblies such as an automotive body, a ship hull, and an aircraft fuselage, fixture layout design, which falls under the domain of the fixture planning and fixture configuration stages, is a primary concern and it involves adjusting the design nominal of locator positions in order to eliminate mean shifts.

fixture designing and manufacturing is considered as complex process that demands the knowledge of different are- as, such as geometry, tolerances, dimensions, procedures and manufacturing processes. While designing this review work, a good number of literature and titles written on the subject by renowned authors are referred. All findings and conclusions obtained from the literature review and the interaction with fixture designers are used as guide to develop the present re- search work.

Poonam D. Chavan et al. [2] in her study of a study of ring gear runout checking fixture explained that fixtures are widely used in industries due to their quality of increasing the accuracy and minimizing the operational time. Inspection in manufacturing includes measuring, examining, testing, or gauging one or more characteristics of a product or process and comparing the results with specified requirements to determine whether is the requirements are met for each characteristic. Inspection fixtures are used to check the quality of the workpieces, parts and components of machines. This paper presents the solution in the form of a special purpose 'Runout Checking Fixture', which can be useful for checking the runout of a component up to the desired tolerance with increased precision. The component is starter ring gear which is fitted on the periphery of flywheel of internal combustion engine.

Satyajeet sing Raijada et al. [3] in his investigation of design of a fixture of connecting rod for boring operation explained that fixtures are normally classified by the type of machine on which they are used. Fixtures can also be identified by a sub classification. For example, if a fixture is designed to be used on a milling machine, it is called a milling fixture. If the task it is intended to perform is straddle milling, it is called a straddle milling fixture. The same principle applies to a lathe fixture that is designed to machine radii. It is called a lathe-radius fixture.

Fixture Design Processes:

a) Setup planning: Determine no of setups, Determine the work piece orientation and positions determine machining datum features and locating surface.

b) Fixture planning: Determine locating positions, determine clamping surface, Determine clamping positions.

c) Unit design: Generate a unit design.

Validation: Trial manufacturing based on modifications.

G. P. Sharma et al. [4] in design related study of fixture explained that fixture is an important element in most of the manufacturing processes and related to machining errors the role of fixture is very crucial. Studies pertaining to the design of machining fixture are generally of two categories i.e. fixture analysis and fixture synthesis. While fixture analysis deals with forces and deformations, the fixture synthesis is concerned with the design of fixture configuration to completely immobilize the work part when subjected to external forces. In the fixture analysis and synthesis, a concern on the conditions for constraining a workpiece is critical. The essential requirement of fixturing is the century-old concept and the same has been extensively studied by Mishra et al (1987) and Markenscoff et al (1990) in the field of robotics with efficient algorithms to synthesize positive grips for bounded polyhedral objects. Chou et al (1989) developed a mathematical theory for automatic configuration of machining fixtures for prismatic parts. The performance of fixture has been analysed on the popular screw theory and engineering mechanics.

K.V.S. Seshendra Kumar et al. [5] in design of gear cutting fixture for CNC gear hobbing machine explained that the clamping of the work piece by using ordinary mechanical work holding devices uses single work piece for machining in each cycle. So, this increase the cycle time hence decreases the productivity. Hence there was a need to design a special work holding devices. According to the specification given by the customer, about the requirement like maximum diameter of the blank, number of teeth to be cut, module, etc. The fixture is designed based on these parameters. The customer use the machine tool for batch production i.e., why the fixture is also designed in such a way that just by changing the upper half part of the fixture, the customer can switch on to other batch production with different specification and apart from this change of speed, feed by changing the gears according the requirement. The problem was to reduce the cycle time by reducing clamping and unclamping time. Since the machining should be vibration free to accurate machining, the problem has been overcome by actuating the mechanism through hydraulic cylinder. Since the machining is carried out for multiple numbers of jobs, it reduces the machining time and hence the overall manufacturing lead time. The type of fixtures depends on the component design and type of machine used. Shaft type component require a totally different type of locating and driving arrangement compared to the disc type component with a locating bore. The type of fixture can be grouped into the following categories as:

1. Locating mandrel and face clamping for disc types of gear blanks with controlled bore for location.
2. Collet type of shaft type components having a controlled diameter for location.
3. Fixture with carrier drive for shaft type components located between center.

Sagar Kumar et al. [6] in design and fabrication of gear cutting attachment to lathe for machining spur gear in this paper it is explained that designing and fabrication of gear cutting attachment to lathe. In the present work, I made an attempt to design and fabricate an attachment for a gear cutting for a medium duty lathe. This attempt will reduce the investment for medium and small-scale industries, sub sequent reduce the manufacturing cost of gears. The attachment to lathe can perform an indexing mechanism like milling machine and carriage function, to and fro movement and sliding on a bed. The attachment was mounted on carriage, where we fixed the work piece and a mandrel was designed to hold the cutting tool. This mandrel was attached to the head stock spindle which is the main source for rotation of the cutting tool. The attachment was carefully designed after studying the proper mechanisms, power requirements and force analysis on work material and a cutting tool.

V. PURPOSE

A fixture's primary purpose is to create a secure mounting point for a workpiece, allowing for support during operation and increased accuracy, precision, reliability, and interchangeability in the finished parts. It also serves to reduce working time by allowing quick set-up, and by smoothing the transition from part to part. It frequently reduces the complexity of a process, allowing for unskilled workers to perform it and effectively transferring the skill of the tool maker to the unskilled worker. Fixtures also allow for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady.

Economically speaking the most valuable function of a fixture is to reduce labor costs. Without a fixture, operating a machine or process may require two or more operators; using a fixture can eliminate one of the operators by securing the workpiece.

We are design this Top Grinding Dresser Fixture for Dress the grinding wheel Effectively and Economically.

VI. IMPORTANT CONSIDERATIONS WHILE DESIGNING JIGS ANDFIXTURES

Designing of jigs and fixtures depends upon so many factors. These factors are analyzed to get design inputs for jigs and fixtures. The list of such factors is mentioned below:

(a) Study of work-piece and finished component size and geometry.
(b) Type and capacity of the machine, its extent of automation.
(c) Provision of locating devices in the machine.
(d) Available clamping arrangements in the machine.
(e) Available indexing devices, their accuracy.
(f) Evaluation of variability in the performance results of the machine.
(g) Rigidity and of the machine tool under consideration.
(h) Study of ejecting devices, safety devices, etc.
(i) Required level of the accuracy in the work and quality to be produced.

VII. DESIGN OF JIGS AND FIXTURES

This section explains the designing of Jigs and fixtures with a visual interface prepared to demonstrate principles. The basic difference between fixture and jig is that the former locates and holds the work piece during machining while the latter also provides tool guidance in addition to location and clamping. The jig may be or may not be fastened to the machine table whereas the fixture should be precisely fastened to the machine table the factors affecting the design decision for jigs and fixtures are further explained. As the initial cost involved in any new process or change of process is an added expense it should be justified by its returns. Setup is considered as non-value-added time. Setup time constitutes the time from the last good part of the old setup to the first good part of the ne setup. The cumulative output in terms of production units or the rate of production, manufacturing time, labour required, and ease of operation are each important for setup analysis. During the designing phase the technical points such as principle and method of location, cutter action on the work, locators and clamps used, body design, and provision for chip clearance should each be considered suitably. For instance, the suitable off-set blocks and gauges bring the cutter very close to the cutting point in a short time, which reduces the total manufacturing time during mass production. Utilizing the concept of standardization, fool proofing will reduce the manufacturing cost of the jigs and fixtures. Similarly, suitable choice of operating mechanism of the jigs and fixtures according to the working environment will also help reduce the manufacturing cost. All these points are explained in this section in the form of visual presentation. Different types of jigs used for drilling, boring, and welding are shown in the presentation. Similarly, various types of fixtures used for milling, drilling, boring, grinding, assembly, and inspection are also shown.

A complete step-by-step procedural drawing for designing a jig and a fixture is shown, which helps the user to understand the type of locators and clamps to be used and their proper placement. Other types of jigs and fixtures for different operations are also shown for the user to get familiar with design of jigs and fixtures.

VIII. Design And Development

SPECIFICATIONS OF MACHINE

Wheel diameter(D) =100mm (minimum)
Speed (N) =1350 rpm
Motor Power (P) =0.95Kw or 950W

We have design the part on above consideration.

A. CALCULATION PROCEDURE

Single point cutting tool, worked as turning operation on grinding wheel for material removal operation.

For Calculation following formulae's are required

So, we have,

$$P = V \times \text{Fc or Ft}$$

Where, F_t or F_c = Tangential cutting Force, N.

V =Velocity of Wheel, m/sec.

$$V = \frac{\pi DN}{60} \text{, m/sec}$$

For Tensile Stress calculation (σ_t),

$$\sigma_t = \frac{F}{C/s} \text{, N/mm}^2$$

Where, F = Resisting force, N.

C/s = Cross Sectional area, mm^2.

For Bending Stress calculation (σ_b),

$$\sigma_b = \frac{M \times y}{I}$$

Where, M = Bending moment

$$Y = \frac{t}{2}$$

t = thickness, mm.

But in case of grinding operation due to material hardness , the force should be taken as 30-40 times than turning force in lathe machine.

B. RESULTS AND DISCUSSION

Following parameters are required for the dressing of grinding wheel

Table 2 Design Parameters

Sr. No.	Parameter	Value	Unit
1.	Power	0.95	**kW**
3.	Motor speed	1350	**rpm**
3.	velocity	1.03	**m/Sec**
4.	Depth of Cut	0.2	**mm**
5.	Cutting Force	5400	**N**
6.	Wheel Diameter (min.)	100	**mm**

The as per our calculation & observations we have reduced dressing time upto 50 % & also reduced labour efforts.

C. COMPONENTS OF ASSEMBLY

Table 1 Component of Assembly

Sr. No.	Part Name	Material	Quantity
1.	Base Plate	M.S.	01
2.	Dovetail (Male)	GG25	01
3.	Dovetail (Female)	GG25	01
4.	Gibs Pin	M.S.	01
5.	Lever Rod	GG25	01
6.	Thimble	M.S.	01
7.	Thimble plate	M.S.	01
8.	Spring	Alloy Steel	01
9.	Rod	M.S.	01
10.	Diamond tool	M.S.	01
11.	Lever bracket	GTS35	01
12.	Fitman screw	35Mn 6Mb 3	01
13.	Fit screw	35Mn 6Mb 3	01
14.	Bolt (M10)	35Mn 6Mb 3	08
15.	Bolt (M12)	35Mn 6Mb 3	02

D. ANALYSIS OF THE FIXTURE

The analysis is performed on the fixture to analyze the stresses developed on the fixture and any deformation occurring on the fixture due to the cutting force.

- **Stress Analysis and Total Deformation**

Stress analysis on the fixture assembly was performed on ANSYS. The following constraints were given to various components of the fixture assembly.

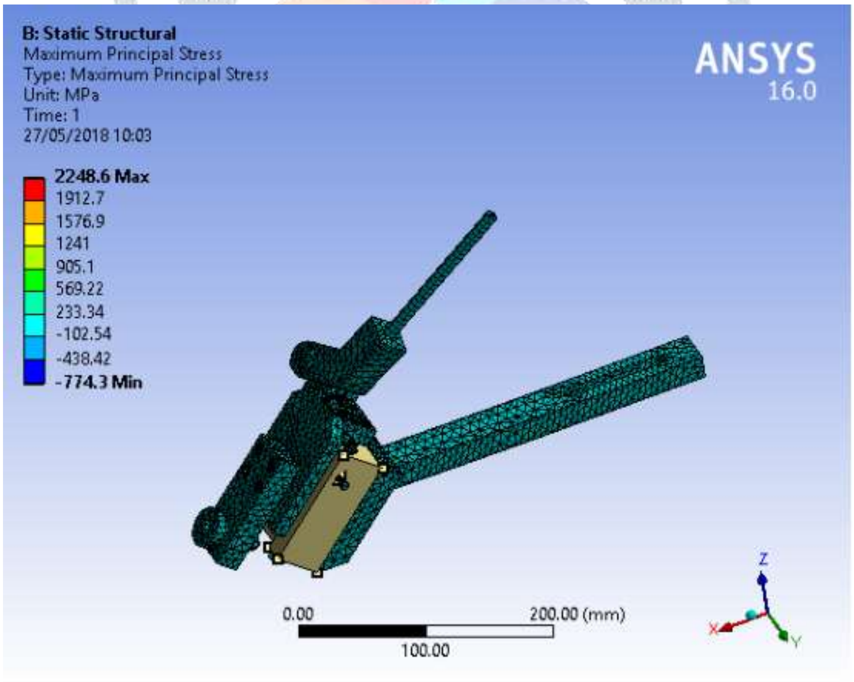

Fig. 1 Stress Analysis of assembly

As shown above fig. the total maximum stress value is 103 N/mm in compression but we have taken 40 times more load than the actual load so our design it safe and that stress is negligible.

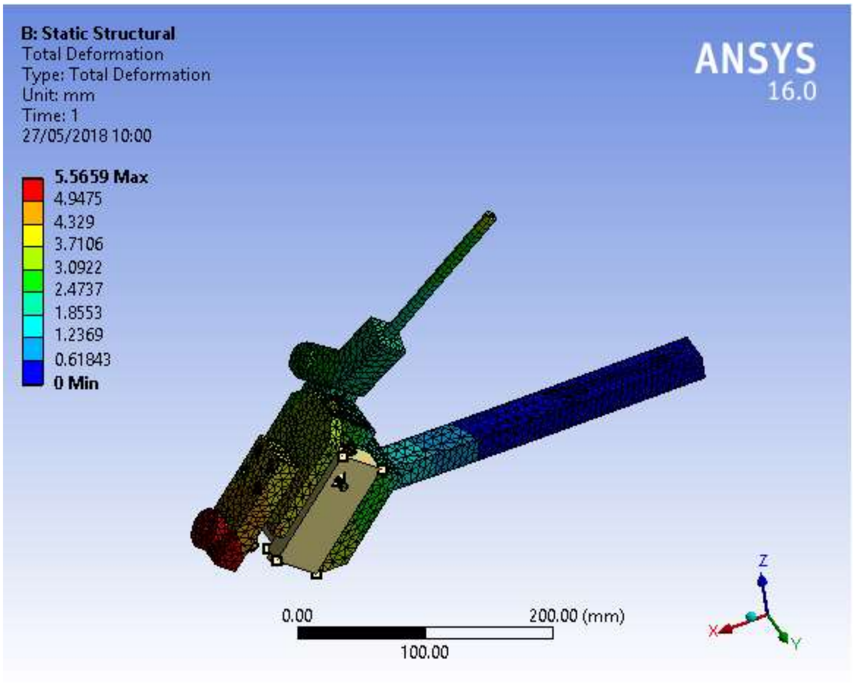

Fig. 2 Total Deformation

As Shown above fig. the maximum deformation value is 5.6 mm & it doesn't affect on our mechanism and assembly while it working.

IX. COMPONENTS AND ASSEMBLY OF REVISED DESIGN

Fig. 3 Actual model of Assembly with exploded view

X. CONCLUSION

- The entire fixture assembly can be used as an alternative in small scale workshop where the floor space available is less.
- This mechanism reduces the require time for dressing and also cost of the dressing.
- We can use this mechanism where mass production in small scale industries with low capital cost with effective working is preferred.

ACKNOWLEDEGEMENT

We sincerely acknowledge that whatever achievement we have made, was through the efforts and sincere co-operation of the entire **Sumangal Engineering Co.** Firstly, we would like to thank **Mr. Zope Sir** for giving us an opportunity to work on the topic **"Design & Fabrication of Top Grinding Dresser Fixture."** We whole-heartedly thank to Our company guide **Mr. Khare Sir.** Lastly, we would like to thank Mechanical department, SRTTC for giving us an opportunity to pursue the project at Sumangal Engg. Company.

XI. REFERENCES

[1] Avinash D. Mote, Pravin M. katkar, Sagar P. Gund, Sagar C. Gunturkar, Yogesh P. Bhatt, "A review dressing operation of grinding wheel ", JETIR, vol 5, issue 1, 116, jan 18, pp 614-616.

[2] Xue Li., Naghdy F. & Cook C., "Monitoring of wheel dressing operations for precision grinding", FIEEE International Conference on Industrial Technology, 11-14 December 2002, 2, 1296-1299.

[3] J. Kundrak, V. Fadorovich, A. P. Markopoulos. 2014 "Improvements of The Dressing Process of Super Abrasive Diamond Grinding Wheel" Manufacturing Technology, vol.14, pp.545-554.

[4] Shivaji Mengawade, Vaibhav Bankar, Pratik P Chaphale, "A Review on Design and Analysis of Work Holding Fixture", International Journal of Engineering Research and General Science Volume 4, Issue 2, March-April 2016, ISSN 2211-0616.

[5] N. P. Maniar, D. P. Vakharia, "Design &Development of Fixture for CNC – Reviews,Practices &Future Directions", International Journal for Scientific and EngineeringResearch, Vol-4, Issue 2, Feb-2013, ISSN 2229-5518.

[6] Poonam D. Chavan, Komal M. Barge, "A Study of Ring Gear Runout CheckingFixture", International Journal for Research in Applied Science & EngineeringTechnology, Vol-3, Issue V, May-2015, ISSN 2321 9653.

[7] Satyajeet Sing Raijada, Amit Dudhatra, "Design of a Fixture of Connecting Rod forBoring Operation", International Journal of Engineering Research and Development,Vol-2, Issue 09, 2014, ISSN 2321-0613.

[8] G. P. Sharma, S. C. Chadda, A. Saraf, "Design related study of fixture", InternationalJournal for Engineering and Research Vol-2, 2013, ISSN 2235-2634.