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AN INNOVATIVE APPROACH TO THE DESIGN AND FABRICATION OF FIXTURE FOR DRILLING IN A CNC MACHINE AND TO ASSEMBLE BALL AND SPRING

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ABSTRACT

Fixtures are widely used in manufacturing industries as a work-holding device in mass production. Fixtures ensure the workpieces are located securely and clamped firmly for the desired orientation. They ensure all the parts produced using them maintain conformity and interchangeability. The problem is reducing the production time for making multiple holes of the same distance and straightness. The present work is an attempt to solve this issue by developing a fixture that can be used for drilling in a CNC Machine and to assemble ball and spring in the component produced. CAD/CAM software is also used to design the fixture, including geometric analysis and assembly of the fixture in 3D. The developed device was tested and worked fine. We hope these devices will help small businesses increase their productivity.

Keywords: Assembly fixture, CNC fixture, CNC drilling.

1. INTRODUCTION

The manufacturing sector, where the accuracy of production meets the complexity of design, is a testimony to human brilliance and technical innovation. Central to this convergence is the indispensable role of fixtures, serving as the bedrock upon which the edifice of modern manufacturing is built. In essence, fixtures represent the marriage of functionality and form, offering a symphony of support and stability amidst the din of machining operations.

Fixtures in their simplest form, are work-holding devices, akin to the skilled hands of a sculptor cradling a block of marble. They serve as the conduit through which raw materials are transformed into works of art, guiding the tools of creation with unwavering precision. From the sprawling factories of industrial giants to the humble workshops of artisans, fixtures reign supreme as the silent sentinels of production, ensuring that each iteration of a product is imbued with consistency and quality.

The present work aimed to design and develop a fixture used for drilling in a CNC machine and to assemble ball and spring in the "Ball Valve Stem" component shown in Fig. 1 below, used in the petroleum and gas pipeline industries.

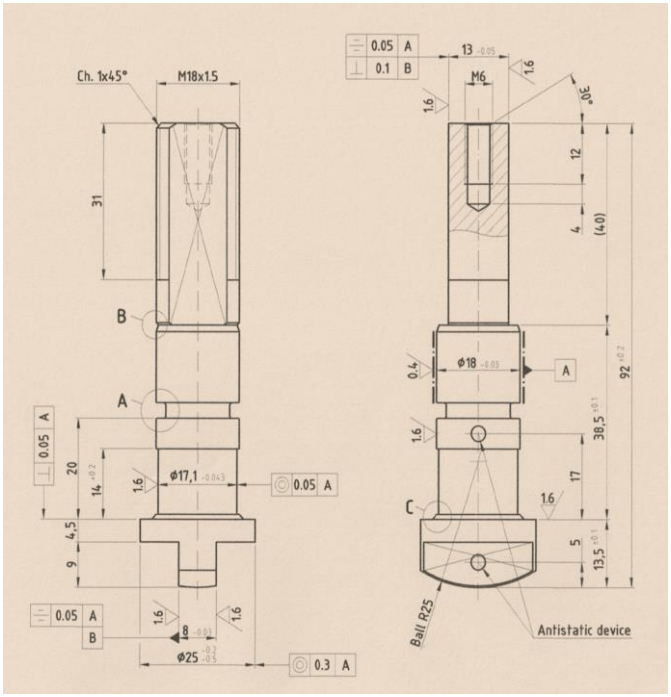

Figure 1: Ball Valve Stem Component

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The fixture is to be used for drilling holes of 2 different diameters and to assemble ball and spring in the component. The Ball Valve Stem component is to be made from F51 Duplex Stainless Steel. The Ball and Spring are made from SS316 and SS304 respectively. Then fixture is designed such that it functions correctly without causing any hardship in use. The fixture is designed such that it requires less effort to fit and operate. The fixture is easy to handle and safe too.

2. COMPONENTS AND DESIGN

At the core of the methodology lies the iterative refinement of fixture designs, a process driven by the quest for versatility, adaptability, and optimization. Fixture designs are not static entities but evolve through a series of iterations, each addressing specific challenges and constraints inherent in the manufacturing environment. The iterative refinement process begins with an initial conceptualization phase, where ideas are sketched out and basic design parameters are established. This phase serves as the foundation upon which subsequent iterations are built, providing a roadmap for the evolution of fixture designs.

Central to the methodology is the utilization of CAD/CAM software, which serves as a powerful tool for virtual prototyping and design validation. CAD/CAM software enables engineers to create detailed 3D models of fixture designs, allowing for precise visualization and analysis of component geometries and assembly configurations. One of the key advantages of CAD/CAM software is its ability to facilitate the virtual assembly of fixtures, enabling engineers to simulate the integration of individual components and assess their compatibility and functionality. This virtual assembly process allows for early detection of design flaws or interference issues, minimizing the need for costly rework during the physical prototyping phase.

AutoCAD software was used to design the Mechanical framework of the ball and spring assembly fixture. The part modeling and assembly of the fixture were done in the software before fabricating the fixture. The assembled views and isometric views of the fixture are shown in Figure 2.

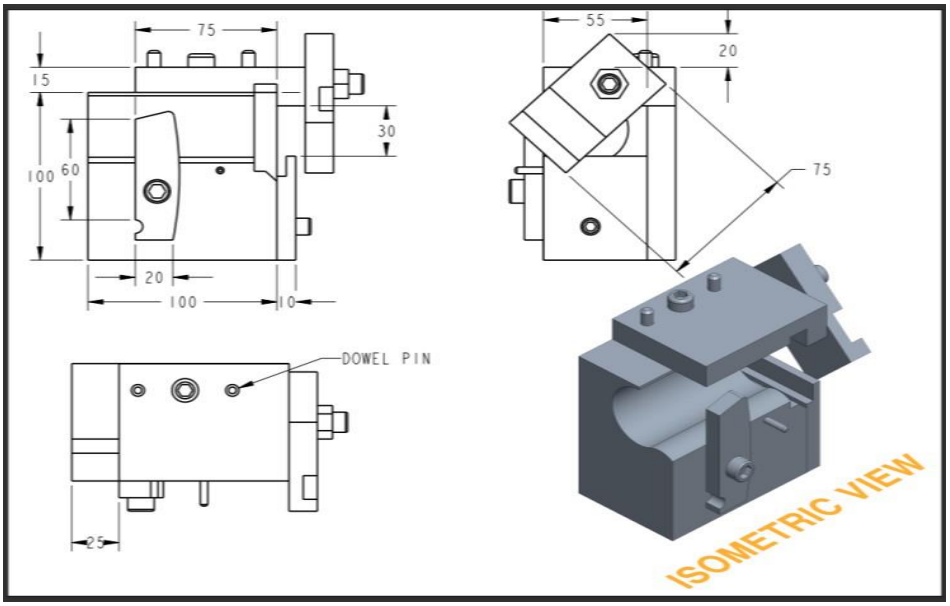

Figure 2: CAD Design of the Fixture

3. FABRICATION AND ASSEMBLY

The metal parts of the assembly were manufactured as per the designed dimensions. The machining and fabrication process begins with material preparation, where raw materials are procured and inspected for quality and suitability. Raw materials are typically sourced in the form of bars, sheets, or plates, which are then cut to size using saws, shears, or laser-cutting machines to create blanks for machining. The machining and fabrication phase of the manufacturing process for the fixture represents a crucial step where raw materials are transformed into finished components through precision machining operations and assembly. Once the material blanks are prepared, they undergo various machining operations to shape and form them into the desired fixture components. Common machining techniques employed in this phase include milling, turning, drilling, and grinding, each serving a specific purpose in the fabrication process. This phase encompasses a series of steps, each aimed at shaping, forming, and joining materials to achieve the desired fixture design. Individual parts were manufactured and finished for final assembly. The fabricated parts were assembled. The fixture for CNC drilling and ball and spring assembly is shown in Figure 3.

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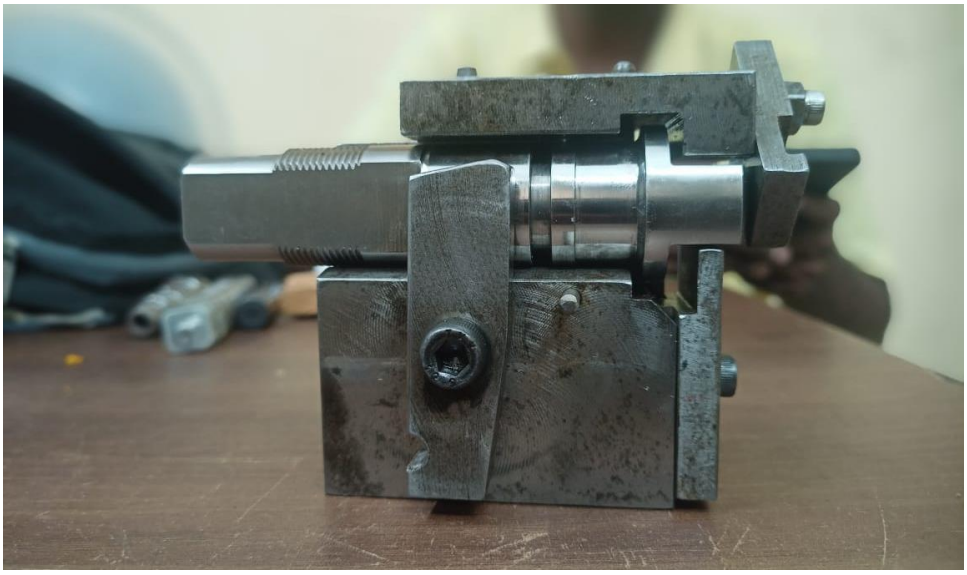

Figure 3: Fixture Assembly

4. WORKING

The functioning of the fixture was checked in actual practice. As the design of the fixture is done considering the safety factors the device was able to function properly with less effort and easiness. The fixture was tested for its functioning by using it several times and it was working fine. The fixture offers the following benefits while in use.

4.1 Elevating Manufacturing Efficiency through Specialized Fixtures and Fabrication

The journey towards heightened manufacturing efficiency culminates in the development and integration of specialized fixtures, heralding a new era of productivity and operational excellence within industrial settings. The multifaceted impact of these fixtures extends far beyond mere automation, offering a spectrum of tangible benefits that reshape the landscape of modern manufacturing.

4.2 Reducing Production Time

The specialized fixture stands as a beacon of efficiency, orchestrating a symphony of precision and speed that culminates in a substantial reduction in production time. By seamlessly orchestrating machining processes, particularly those entailing the creation of multiple holes with uniform specifications, the fixture eradicates inefficiencies inherent in traditional manual setups.

4.3 Enhancing Productivity

At the core of the specialized fixture's impact lies a profound enhancement in productivity, the lifeblood of any manufacturing enterprise. Its advent heralds a paradigm shift, ushering in an era where every machining task unfolds with unrivaled efficiency and precision.

4.4 Fostering Operational Excellence and Competitiveness

In the crucible of industrial competition, operational excellence emerges as the cornerstone of sustainable success. Here, the specialized fixture emerges as a catalyst for transformation, infusing manufacturing operations with newfound vigor and resilience.

Figure 4: Finished Component (Drilled holes of 2 different diameters)

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Figure 5: Ball and Spring components to be assembled in the Component

5. CONCLUSION

The difficulty in reducing the production time and performing repetitive machining and assembly operations in manufacturing industries was present for a long time. An effort to design and develop a fixture for drilling and ball and spring assembly is taken in the present work. The fixture was modeled in AutoCAD software, fabricated, and assembled. The developed fixture is compact and user-friendly. It is easy to handle the fixture effortlessly. The fixture was tested several times and it performed as expected without any deficiency. In conclusion, the drilling and ball and sprig assembly fixture developed fulfilled the requirements and performed the intended function with higher accuracy and precision.

6. REFERENCES

[1] Hargrove, S. K., and A. Kusiak. "Computer-aided fixture design: a review." The International Journal of Production Research, Volume 32, Issue 4, 1994, pp. 733-753.

[2] Karthikeyan, V., et al. "Design and Fabrication of Multi Operational Fixture." International Journal of Engineering and Management Research (IJEMR), Volume 6, Issue 3, 2016, pp. 413-417.

[3] Mahamani, A. "DESIGN AND FABRICATION OF FIXTURES FOR A GEAR SHIFT LEVER." Industrial Engineering Journal, Volume 11, Issue 10, 2018

[4] Aphale, S., V. Nandurdikar, and S. Desale. "Design and deployment of the fixture on the assembly line to improve productivity." Journal of Physics: Conference Series, Volume. 1803, Issue 1, 2021.

[5] Zhao, Xuesen, et al. "The design and implementation of a high-precision positioner fixture." Micromachines, Volume 12, Issue 10, 2021: 1227.

[6] Babasaheb, S. S. "Design Of Welding Fixtures And Positioners." International Journal of Innovations in Engineering Research and Technology, 2015, pp. 1-7.

[7] Pawar, Usha, et al. "Computer aided approach for case specific design of fixture for slot milling process." International Journal on Interactive Design and Manufacturing (IJIDeM), 2023: 1-11.