

Design and Development of Universal Holding Device for Bench Work Application

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Abstract— *The development of a universal Holding Device for Bench Work Application is an innovative solution for simple handling of devices that serve as multi-tasking devices, are less amount, are easy to use, and have a relatively large capacity in holding the workpieces. The study sought to determine the materials & equipment needed to develop the prototype of a universal bench vise and determine the procedures for fabricating the versatile bench vise. This study used the developmental and experimental research project. This method was more appropriate as it analyzed and described an innovative universal bench vise's functionality, reliability, accuracy, and durability. Data were analyzed using Central Tendency Measures as to average mean to evaluate the level of the versatile bench vise as functionality, reliability, accuracy, and durability to determine the level of efficiency and acceptability of the developed device. The study results revealed that the developed universal bench vise was very efficient and acceptable. The students assessed functionality, reliability, accuracy, and durability with an average mean of 95.28% percent. This versatile tool was designed for a simple universal bench vise that cost Php. 5,000.00 only. It is an affordable price for a new motivated universal bench vise.*

Keywords— *Bench Vise, Clamping, Holding Device, Innovation.*

I. INTRODUCTION

A bench vise is an indispensable tool used in machine shops and invented in 1750 by Josef Heuer from Iserloh. There are several patent documents regarding bench vise with US patent 693,811, dated February 18, 1902, of Tampa, Florida by Chandler et al., which would be very simple in its construction, strong, durable, good in its use, relatively inexpensive, to set up, and one that could adjust to horizontal and vertical angles to facilitate working with the vise.

In the prior arts, bench vises have been advanced through the years, which are provided with a fixed jaw mounted onto support to permit swiveling of the vise relative to its support [3]. Also, vises that utilize a movable jaw have a clamping feature to provide for rigid holding ability, which permits the jaw to self-align during operation [2]. Examples of patents that show the type of device with the self-aligning, clamping jaw include U.S. Pat. Nos. 2,880,638 and 3,397,880.

Moreover, bench visors come in various designs ranging from widely used vises to the most popular emerging and used visors [1].

The impressive, versatile vises are designed with the most sought-after features to fit every application, from the garage workbench to the factory floor. Whether used for cutting, screwing, drilling, planning, sanding, or just holding [10].

Therefore, the universal holding device consists of a large base supporting column whose height can be adjusted to the

height mobility of the user with the vise and can be swiveled 360 degrees. In addition, the device can tilt the column to any desired angle at work.

This device is generally used by the metal industries and machinist workers and is more applicable to job shop-type companies. The purpose of developing a universal holding device is to find an innovative solution for simple handling of machinery that serves as a multi-tasking device, is a low-cost product, easy to use, and has a relatively large capacity in holding the workpieces. Therefore, we combined the idea to create a unique universal holding device for a machinist or even in another field of fabrication using this kind of tool [5][7].

Objective of the study

The main objective of the study is to come up with a prototype of universal bench vise as an innovation. Specifically, the study sought to:

1. Design and develop a Universal Vise;
2. Determine the how much cost is the innovation;
3. Test the functionality of the device;

II. MATERIALS AND METHODS

A. Design Consideration

A.1 Functional Requirements.

The development of a universal holding device for bench work applications should meet the required performance and specifications. In addition, it should facilitate good maintenance practices, and it should withstand operational hazards.

The purpose of the reformation of a bench vise into the universal holding device for bench work application is to find innovative solutions for simple clamping and holding devices that serve as multi-purpose commoditize, are easy to operate, and have a relatively large capacity.

The device will be made easy to manipulate, safe, and prevent damage to property during holding, sawing, bending, assembling, and disassembling. Every part of the device is easy to be created, adjust, and maintain.

A.2 Efficiency in Operation

The device should be simple and safe, which includes quality design. The parts could be securely assembled and adjusted easily. It should be designed to prevent maximum holding and clamp to ensure a higher efficiency rate of components and prevent damage to the device during actual operation.

A.3 Safety Requirements

Safety of operation must be given ultimate priority to obtain the maximum level of protection. This may involve the

following factors; holding and clamping operation. The device consists of a large base supporting the column that can adjust the user's height mobility. It can swivel the vise into 360 degrees and tilt the column to any preferred angles. This device is generally used by the metal industries and machinist workers and is more applicable to job shop-type companies.

Make it safe

In designing any product, the designer is concerned with many aspects, such as function, safety, reliability, reducibility, maintainability, environmental impact, quality, unit cost, etc. Concerning safety, consideration of hazards and their elimination must start with the first concept of the product's design. The design must carry through the entire life cycle. It also includes risks that occur during the process of making the product. These hazards occur during the product's expected use, the dangers that arise during foreseeable misuse and abuse of the product, risks arising during the servicing of the product, and the hazards connected with the disposal of the product after it has worn out. Since each design is different, the designer needs to consider the safety aspects of the development, even if it is a modification of an existing product. There is no fixed, universal set of rules which tells the designer how to proceed. There are. However, some general considerations and guidelines regarding devise design are the decision-making process by which specifications for the device are created. From these specifications, materials are ordered, and machines are manufactured. The process includes;

- Inventing the concept and relationships
- Decisions on size, material, and method of manufacture
- Secondary decisions
- Adequacy assessment
- Documentation of the design
- Construction and testing of prototype(s)
- Final design

B. Design of Universal Holding Device

The figures below show that the proposed device will be made up of G.I. Pipe 3 inches in diameter x 36 inches long as a column or central casting. Steel plate 3/16-inch x 24 inches x 24 inches as a base and Angular Bar with the size of 3/8 inch x 2 inches x 92 inches as Base frame. Then, at the top is the reformation of the clamping and holding device. The proposed design is shown in figures 1-7, respectively. The Design of Prototype Universal Holding Device.

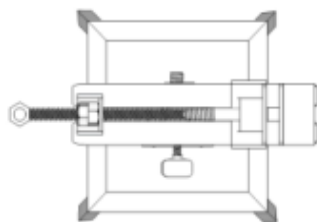


Fig. 1. Top View

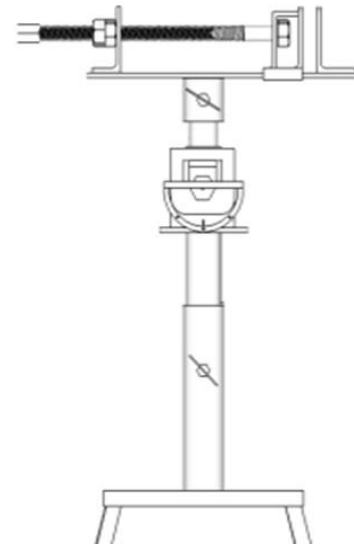


Fig. 2. Front View

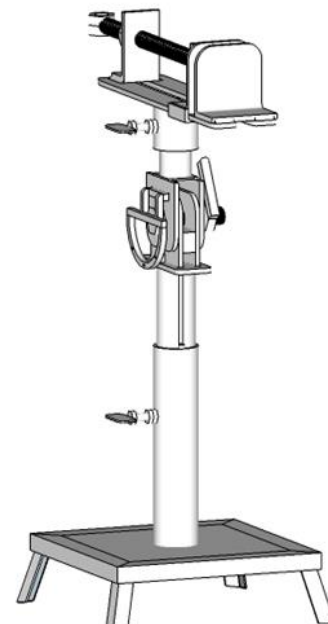


Fig. 3. Right Side View

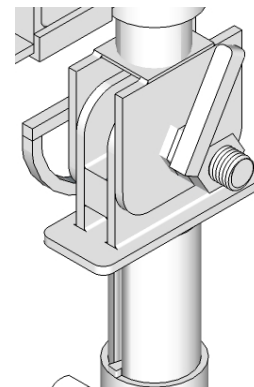


Fig. 4. Shows the pictorial drawing of the apparatus in a buttress joint

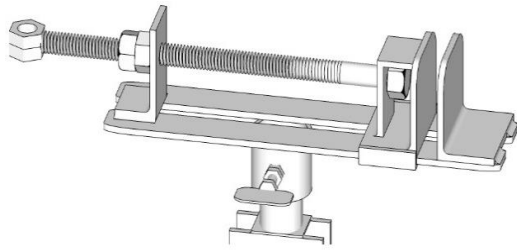


Fig. 5. Pictorial drawing pictorial of the apparatus in a head part.

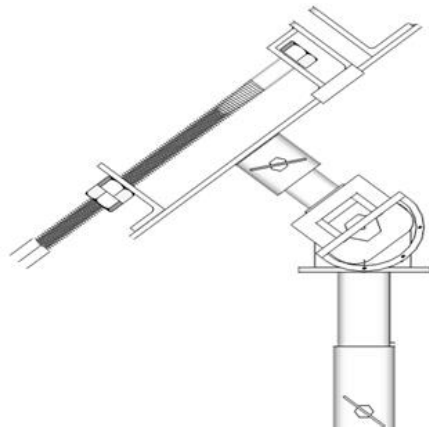


Fig. 6. The Pictorial drawing of the Apparatus in a 45-degree of head

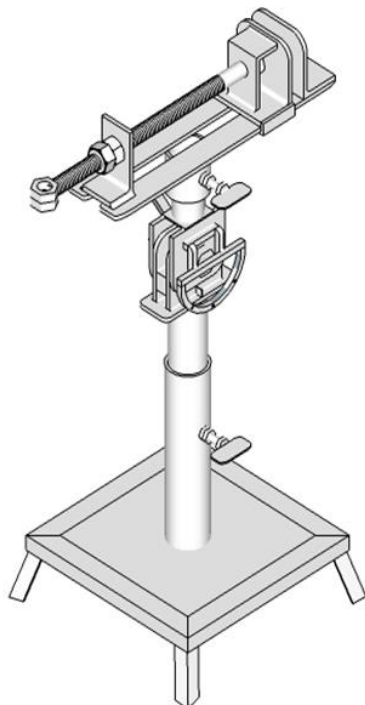


Fig. 7. Isometric view of the Universal Portable Device

Project Development

Technical Field of The Utility Model

The present utility model generally relates to mechanical devices, but more particularly to a universal holding device used for clamping and holding workpieces during cutting, filing, and other related activities in mechanical shops.

Component and Cost Analysis

TABLE 1. Material Cost for Production

Component	Unit	Value
Steel Plate	22"x18"	2,000.00
Steel Pipe	4 feet	150.00
Bearing	9 pcs.	150.00
Angle Bar	2.5"	350.00
Full Thread Shafting	(3/4)	150.00
Square Bar	2.5 inch	50.00
Electrodes	1 1/2kg.	90.00
Total Cost		2,840.00

III. RESULTS AND DISCUSSIONS

The innovation of the bench vise came from an ordinary bench vise and was reformed into a universal holding device. Therefore, it gives excellent help in the shop, especially in mechanical engineering shops and other technology shops of Surigao del Norte and Surigao City, specifically at Surigao State College of Technology. The final output of developing a universal bench vise is shown in Figure 8.



Fig. 8. Universal Portable Holding Device

Project Structure

Design and Development of Universal Bench Vise from Ordinary Bench Vise

1. Design of vise

The design of the bench vise is shown in Figure 7. Bench vise material was flat bar size of 10-inch length, 5-inch width, and 2.5inch height. This type of vise would clamp a material.



Fig. 9. Design of Vise

2. Design of rotation of the vise

The researcher welded a bearing under the vise for 360 degrees rotation of the vise. The approach has been surrounded by a pipe fitted on it to attach the lock for the course.

Project Capabilities and Limitations

The present invention relates to a bench vise which has a self-aligning, clamping fixed jaw which includes a stub support shaft that permits the fixed jaw to be mounted onto a swivel connection and it is designed efficiently such that it can perform several purpose and process especially during clamping and holding workpiece during cutting, filing, and any other related benchwork.

This Universal Holding Device is applicable to provide increased productivity and improve competitiveness among machinist and metal industries workers.

Project Evaluation

Estimated Cost of the Machine

Based on the price of the bench vise in the market before its innovation, the price was around Php. 5,000.00 depending on the size and quality of the product. But, after fabricating the vise and putting some additional parts and attachments called universal vise, it was estimated to Php. 3,500/unit, including the labor. With this price assumption, an estimate of the operating cost of the machine is shown in Table 1. Therefore, this simple portable universal vise can be used as an alternative tool based on the cost analysis.

The economy of operation of a vise is an essential factor for its adaptation by the machinist. The actual cost of operation of universal bench vise depends upon its fixed price and the variable cost. The fixed costs include the capital, depreciation of the device, interest on the money, repair, and maintenance.

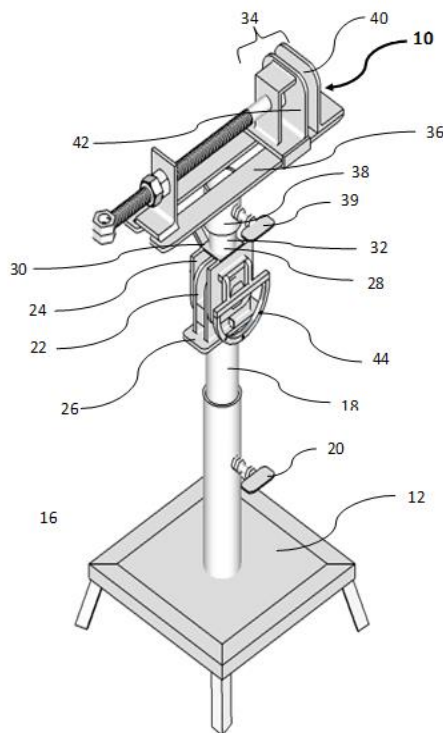


Fig. 10. Universal Holding Device

Detailed Description

Referring Figure 10, there is shown the utility model for a universal holding device 10 for holding the metal workpiece

comprises a galvanized iron plate base 12 having a plurality of leg supports 14 made of angular bars. A tubular post 16 made of GI pipe with a diameter of 3 inch attached at the central portion of said base 12 having an adjuster knob 20 screwably held to said post 16.

An elongated shaft 18 made of round shafting adjustable held inside said tubular post (16) and secured through said adjuster knob 20.

A buttress joint 22 has an upper 24 and a lower 26 member cooperatively attached at the top end of said shaft 18.

A rod 28 is made of solid round shafting integrally attached to said upper member 24 having a unitary stud 30 with a circumferential shoulder 32 and, a holding unit 34 having a plate 36 coming from flat bar and angular bar includes a bearing block 38 relatively swiveled to said stud 30 having a bolt lock 39 and seated to said shoulder 32, said plate 36 consists of a pair of opposing jaws 40 and a movable jaw 42 disposed in between said opposing jaws 40 adapted to hold the said workpiece.

Test Results

Central Tendency Measures were used as a statistical tool to analyze the weighted mean to evaluate the level of the universal bench vise as functionality, reliability, accuracy, and durability to determine the level of efficiency and acceptability of the developed versatile bench vise.

TABLE 2. Test Result made to evaluate the efficiency and acceptability of the develop Universal Bench Vise

Item	%	Self-Rating	Actual rating
A. Functionality	25%	20.77%	24.50%
B. Reliability	25%	20.15%	21.75%
C. Accuracy	20%	19.05%	19.78%
D. Durability	30%	23.88%	25.25%
Total	100%	83.85%	91.28%

A. Functionality.

It refers to the performance of the universal bench vise with innovation, and the most important is how to hold a piece of material.

B. Reliability.

It refers to the process of the developed parts attached during tilting, elevating, and changing angles of materials during rotation.

C. Accuracy.

It refers to the actual performance of the universal bench vise in holding materials during the cutting operation.

D. Durability.

The reliability and durability stay strong and in good condition depending on a long period of using the versatile tool.

Parameter	Indicator
90.00% – 100%	Very Much Efficient/Acceptable
80.00% - 89.99%	Much Efficient/Acceptable
70.00% – 79.99%	Less Efficient/Acceptable
60.00% – 69.99%	Not Efficient/Unacceptable

Evaluation Results

Based on the results from the evaluation conducted on a selected group of individuals. There were 20 students and 20 coming technical experts as respondents in the project study. Data were gathered through a researcher-made questionnaire to

determine the functionality, reliability, accuracy, and durability of developing an actual universal bench vise. In addition, data were analyzed using Central Tendency Measures as to average mean to evaluate the level of the current universal holding device in functionality, reliability, accuracy, and durability to determine the level of efficiency and acceptability of the developed versatile tools.

The self-rating comes up with a mean rating of 83.85%, which is much more efficient and acceptable. As to students, they come up with a rating of 91.28% as average means very efficient and satisfactory as to functionality, reliability, accuracy, and durability of developing a universal bench vise as an innovation.

IV. CONCLUSION

Based on the results of the investigation, the following conclusions were drawn:

1. The innovated universal holding device can easily fabricate whose materials are available in the local market.
2. The device is much more efficient and accepted in the shop.
3. It is affordable with multi-function.

Recommendation

Considering its performance test for the universal holding device, which was conducted with an average working, depends on the machinist, how the material is done, and the estimated cost of Php. 3,500.00 per unit. The device's performance to functionality, reliability, accuracy, and durability is rated at 91.28% percent, which is much more efficient and acceptable to the machinist.

1. The need for innovation in the design is necessary.
2. The device is intended for holding light materials.
3. The need for proper maintenance is essential to lengthen the life of a device.

ACKNOWLEDGEMENTS

The researcher conveys his profound gratitude and deepest appreciation to those who unselfishly and wholeheartedly extended their support to make this piece of work possible.

Most of all, he gives thanks to the merciful *Father Almighty* for his unconditional support and immeasurable source of life's full knowledge and wisdom.

To my wife, *Charity C, de la Cruz*, who was always by my side while crafting the research manuscript into a possible one.

Dr. Gregorio Z. Gamboa, Jr, our college President, for his unequivocal and generous support in making the research manuscript.

Dr. Jerry I. Teleron, one of my colleagues and friends, facilitates the publishing of this research manuscript.

His Colleagues in SSCT – COT Department, especially Dr. Marilou B. Carnicer, for their untiring support and encouragement to make this undertaking successful.

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