

# A Systematic Design, Development and Fabrication of a Safe Cam Operated Machine Vice

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**Abstract**—Reduction of human Effort and enhancing safety plays a vital role while designing and fabricating the Machine vice which is used to hold the components during heavy machining works. In an ordinary vice the human power requirement is more to tighten the heavy jobs, but in this machine vice the cam is used in order to tighten automatically. In Normal machine vice the human labour involves in turning the handle to hold the component tightly by giving more human effort which eventually results in damage on work piece due to over tightening of the handle. This may be avoided by involving cam acting machine vice in which the work piece is cannot gets damage while clamping where the operation can be monitored by the operator. An lever rotate a cam lock movable jaw their using spring type puss back ram to forward and reverse movement of the vice jaws to remove the work piece and to hold the work piece. These types of cam machine vice can be used for all type of machine. In applications such as, Drilling machine, milling machine, shaping machining which provides an effective grip to job during machining processes. This cam operated machine vice can be manufactured at optimized cost from small scale industries to larger machining works

**Index Terms**—Cam Operated, Handling Lever, Machine vice, Movable Jaw, Spring type Ram

## I. INTRODUCTION

Cam vice is one of the clamping device that are used to hold the job in rigid condition. Cam vice is operated by eccentric cam mechanism. There is a cam lever attached with it. The job is tightly held within the jaws. The job is placed in between the fixed and movable jaws, and then the movable jaw is adjusted accordingly with lead screw rod with help of cam profile attached with it. Job is fixed tightly in the fixture by operating the cam lever attached to the top of system.

These types of cam operated vice can be used to hold the same size and same size objects that were used in mass production systems. It will results in improvement of productivity, reduction in setting time of job, reduction of production cost and improved satisfaction of workers with reduced fatigue level.

## II. LITERATURE REVIEW

Manufacturing processes are the key production system involved in industries where raw materials are converted to end customer required products. The process starts with the design stage where the materials are created according to the design required. These designs of materials are then converted to required component through manufacturing processes. Process

of manufacturing includes reshaping of materials through forging, welding and cutting, heat treatment processes and sheet metal forming processes etc. The manufacturing process includes the process planning, quality assurance of materials and products manufactured even during starting and ending of manufacturing processes.

Metal cutting or machining is the manufacturing process in which the unwanted materials are removed and a required shape of product according to design standards are manufactures. These wastes are removed in forms of metal chips. The cuttings of materials are done by fracture of materials through hardened cutting tools. These types of material fractures are normally done in names of shaping, milling, grinding, facing, grinding, chiselling and broaching operations. Orthogonal cutting is the primary principle behind all these machining process, even though these tools llok different from each other basic idea behind it is causing fracture on the material. Accordingly in all processes of machining the job shape is finally changed to the required shape according to the design of product through material fracture. First step in all machining process is to hold the job firmly in a fixture and then it is exposed to high speed rotating tool to get machined. During machining process even at higher speeds and applying heavy loads in process such as forging job has to be safely held within the fixture. Commonly used fixtures are Vices, 3 jaw and 4 Jaw chucks, etc. Machining operations includes different operations for a single job such as drilling, boring grinding, reaming etc. So that job has to be removed and clamped tightly for each operation which makes the human operator tired and also to get fatigue. So that a new fixture called cam operated vice is used to tight and loosen the jobs easily to the different positions even during variety of operations in a same component.

## III. TYPES OF VISES

Vice generally describes to a bench vice with parallel jaws moving and fixed with flat, which is usually attached to a workbench.

- A woodworker's bench vice is generally integrated part which is attached to the working bench.
- An engineer's bench vice is attached to the top of bench with clamped bolts or rivets.
- hand vices (hand-held),
- Machine vices - drill vices (which lie flat on a drill press on bed). Vices of the same structured form are used also on machines such as drilling and grinding.

- Compound slide vices are manufactures with tilting arrangement which is more complex. These will allow high speed working and setting jobs precisely.
- Cross vices are used to adjust in both X and Y axis using the availed lead screws. These can be used if a job consists of many holes to be drilled using the available drilling presses.
- Off-center vices, angle vices, sine vices, are used in order to hold gauge blocks involving solving triangles with high accuracy angles involved.
- Rotary vices, table vices, pin vices and die makers' vices, (for holding cylindrical jobs at one end with thin sections)
- Jewellery maker's vices, imparted leg attached vices, and other components are attached to a bench but also supported to the ground so as acting to stable under the very heavy use imported by a blacksmith's work.

#### A. Woodworking Vises

In woodworking process, in order to avoid the marring on work piece the jaws of vice are made up of wood or plastics which does not affect the surface of work. The top jaw edges jaws are covered up with wooden faces in the top of the movable jaw made up of iron. This jaw contains a dog whole part to firmly hold a bench dog. Modern metal woodworkers' vices come up with a split nut. These nuts are used where the screw splits up into two parts so that, by means of a hand lever, it can be easily removed from the screw and the moveable jaw can easily fixed into a suitable position required. Finally the work can be fixed with the jaws firmly during the machining process without slip.

#### B. Metal Worker's Vises

In process of metalworking, the fixed jaw and movable jaws are generally made up of hardened steels in order to hold the work firmly. It contains coarse grippers with high accuracy to hold the jobs firmly. Movable jaws are made up of soft irons so that it can be easily replaced with new one, where the fixed jaws stay stronger for longer period of time. These were made stronger to avoid the damages.

Metalworking bench vices which are termed as engineers' or fitters' vices which are bolted onto the top surface of the bench consists a face of the fixed jaws in forward of the front edge of the bench. The bench height should be designed accordingly to the elbow height of the worker for easier convenience while in standing position.

The nut is used to remove the movable jaw operated by means of a screw, which can be again tightened in order to quickly set the suitable position of the job. Fitters prefer to use the maximum precision availed in from a plain screw vise. The vice consist of other features such as a small anvil in back of its body to tighten.

Vice screws are generally made up of either of an Acme thread form or a buttress thread. These arrangements will provide a quick-release nut use a buttress thread.

#### C. Metal Working Vises in Machine Shops

In high production machine work to attain higher accuracy work must be held in the same position, to achieve these CNC

Machining operations will consist of array of vices in order to show the production lines. There are several types of specific vices available to assist these types of great accuracy machining operations.

Hard and soft machine jaws play a vital difference between other metalworking vice jaws for machining process. The jaws are precision ground enough to a very flat and smooth surface for accuracy. These jaws are depended on mechanical pressure for gripping and holding of job, instead of a rough surface. An unskilled operator will often make mistake by over tightening the handle which leads too deformation dn error in work pieces. to over-tighten jaws, leading to part deformation and error in the finished work piece. The jaws themselves come in a variety of hard and soft jaw profiles, for various work needs. One can purchase machinable soft jaws, and mill the profile of the part into them to speed part set-up and eliminate measurement. This is most commonly done in gang operations, discussed below. For rectangular parts being worked at 45 degree angles, prismatic hard jaws exist with V grooves cut into them to hold the part. Some vices have a hydraulic or pneumatic screw, making setup not only faster, but more accurate as human error is reduced.

For holding larger jobs in length wise regular machines vices are arranged in parallel order in a bench so that it can be firmly held. These are arranged with help of a dial indicator in order to get common reference plane for all the vices used.

For multiple parts holding there are many alternatives where vice manufactures find different solutions in order to get optimized productivity.

Modular vices are manufactured accordingly where they are bolted to a grid. This makes a better grip to vice to hold the job. These come around with two varieties of clamps.

Tower vices are also stated as vertical vices used in applications of horizontal machining centres. Is contains one side with one vice and dual clamping options. These vices cab be used for many operations this one vice can be used without any special kind of arrangements.

## IV. DESCRIPTION OF EQUIPMENT'S

#### A. Cam

A cam is a perfectly shaped part of a rotating wheel or shaft that strikes a lever at one or more points on its axis of circular path. The cam is said to be a simple tooth, as is used to deliver the acting pulses of power to a steam hammer

Cam acts in such a manner like lever because the hole is not located exactly in centre, so that cam is just spinning on its axis. On the other hand, some cams are made with a hole exactly in the centre so that designed their sides to be act as cam which makes the springs to push back the ram.

#### B. Frame Stand

Frame stand of the cam device is made up of flat rods with welding and sheet metal forming process. The frame stand is used in order to hold the fixed jaw, the lever and moving jaw, lead screw, and handle with cam arrangements in this device.

#### C. Lever

The hand lever is used in order to load and unload the cam arrangements in the cam machine vice. These make the

equipment to be operated easily with lever which is attached to the arrangement.

#### D. Fixed Jaw and moving Jaw

The fixed jaw is stable and mounted with the frame stand of the equipment. The moving jaw is attached with lead screw arrangement makes the moving jaw to get moved easily while operating the handle lever of the mechanism. The jaw is actually fixed on the frame stand of the equipment.

### V. DESIGN PROCEDURES AND DRAWING

#### A. Machine Components

The "DYNAMIC DESIGN, DEVELOPMENT AND FABRICATION OF CAM VICE" requires the following components to complete the complete operation of the machine.

- Cam arrangements
- Fixed and movable jaws
- Frame stand
- Lever
- Spring type puss back ram

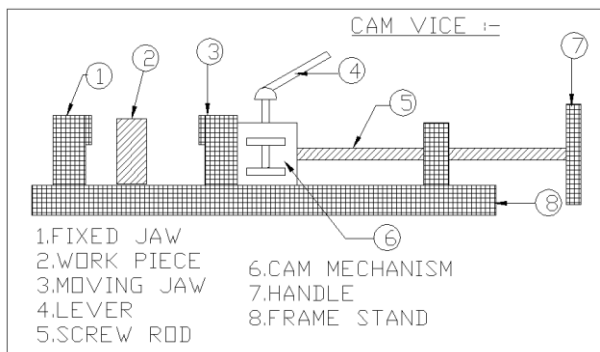


Fig. 1. Dimensional Drawing of Cam Vice

### VI. WORKING PRINCIPLE

The cam vice consists of Frame stand with fixed jaw, moving jaw, lever, lead screw, handle, lever with handle and cam mechanism to be operated. The fixed jaw is fixed on the frame. The moving jaw is arranged in a parallel axis through the fixed jaw. The cam arrangement is well placed before the moving jaw. The cam arrangement will consist of lever. The lead screw is perfectly arranged after the arrangement of cam mechanism. The lead screw arrangement is implicated to adjust the cam arrangement in the equipment. The main objective of the cam vice is used to clamp and unclamp the same size job component on it. This vice is used in area of mass production. The specimen is placed between the fixed jaw and moving jaw, and then the cam lever is operated by manually operated lever. The specimen is perfectly clamped at a predefined stage, and then the lead screw is used to fit the correct area in the cam arrangement. As a result, clamping and unclamping the same size of specimens are made easier.

After the operations were done on the job, the job is released from the jaws by operation cam lever opposite to the direction

of locking. When the cam lever is operated to release the job from the jaws, movable jaw moves backward to its original position. The next job is placed in between the jaws, and the same procedure is repeated to hold it in the fixture.



Fig. 2. Top View of Fabricated Machine Cam Vice



Fig. 3. Side View of Fabricated Machine Cam Vice

#### Merits:

- 1) Idle time of the machine is reduced
- 2) When compared with the mechanical vices, it continues less time for clamping and unclamping the job
- 3) It reduces the clamping time
- 4) Hence, production rate is higher
- 5) It is also hold irregular components

### VII. FACTORS DECIDING THE CHOICE OF THE MATERIALS

Factors that determine the choice of materials are listed below.

#### A. Properties

The material that is selected for manufacturing should be exactly suits for the proposed application. The various requirements that have to be accomplished must to be satisfied. It can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

Selections of materials are drastically affected by the four principle properties of materials. They are as follows,

- Physical
- Mechanical
- From manufacturing point of view
- Chemical

The various physical properties that are concerned are melting point, thermal Conductivity, specific heat of element, coefficient of thermal expansion involved, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties linked with these are strength in tensile, Compressive shear, bending, torsion and buckling load, elastic limit, endurance limit, and modulus of elasticity, hardness, fatigue resistance, impact resistance, wear resistance and sliding properties. The various properties viewed from the manufacturing point of view are,

- Cast ability
- Weld ability
- Surface properties
- Shrinkage
- Deep drawing etc.

#### B. Manufacturing Case

Sometimes the demand for optimally lowest possible manufacturing cost or surface qualities obtained by the application of suitable coating substances may also demand the use of special materials for this process.

#### C. Quality Required

Quality is the key factors which affect the materials as well as the manufacturing process. For example, If number of components is less and that too can be economically manufactured by hand forging and welding process it is never advised to go for casting for less number of components.

#### D. Availability of Material

Selection of materials should be considered as the primary importance where the short supply and scarcity of materials should also be considered; also it should be matched perfectly as the material that is designed. The prompt delivery of materials and the exact delivery date of product should also be kept in mind during the manufacturing process.

#### E. Space Consideration

Due to space limitations and forces involved during holding of jobs it's necessary to select materials having higher strengths. Cost of materials plays a vital role in selection as other problems and should not be ignored. On other hands other factors like less maintenance, appearance, utilization of scraps are also involved while selecting proper materials.

machines and human involved in manufacturing process. Cost of manufacturing this vice is optimal and can be used for any ranges of industrial work from small, medium to large scale industries. Future research recommendations can also be made to hold irregular sizes and shapes to be hold firmly against any manufacturing operations working at any speed and loads.

#### REFERENCES

- [1] R. K. Prashant, "Theoretical Analysis of Multi-Way Power Hacksaw Machine," *International Journal of Research in Advent Technology*, vol.3, no.4, April 2015.
- [2] R. Anand, Khomesh, S. Kumara and A. Verma, "Theoretical Analysis Of Four Way Hacksaw Blade Machine", *International Journal of Advance Research and Innovative Ideas in Education*, vol. 2, no. 2, April 2016.
- [3] N. R. Patel, M. A. Vasanthwala, B. Balkrushna Jani, M. D. Rathwa, and R. A. Thakkar, "Material Selection and Testing of Hacksaw Blade Based on Mechanical properties", *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 2, no. 6, June 2013.
- [4] D. V. Sabarinanda, V. Siddhartha, B. Sushil Krishnana and T. Mohanraj, "Design and Fabrication of Automated Hacksaw Machine", *International Journal of Innovative Research in Science, Engineering and Technology*, vol. 3, April 2014.
- [5] R. Ambade, A. Sartabe, Meghraj Arekar, Vaibhav Khachane, and P. Gawali, "Design & Fabrication of Human Powered Multi-Purpose Machine", *International Journal of Advanced Technology in Engineering and Science*, vol. 3, no. 1, April 2015.
- [6] R. K. Prashant, R. Nayan, P. R. Prashant, and P. H. Prashant, "Theoretical Analysis of Multi-way Power Hacksaw Machine," *International Journal of Research in Advent Technology*, vol. 3, no. 4, April 2015.
- [7] M. A. Mazidi, J. G. Mazidi, and R. D. McKinlay 'The 8051 Micro Controller and Embedded Systems', 2nd Edition, Pearson Education Inc. 2008.
- [8] B. N. Bardiya, T. karthik, and L Bhaskara Rao "Analysis and Simulation of Gearless Transmission Mechanism," *International Journal of Core Engineering & Management*, vol. 1, no. 6, pp. 136-142, Sept. 2014.
- [9] M. Tanodi, "Gearless power transmission offset parallel shaft coupling," *International Journal of engineering Research and Technology*, vol. 3, no. 3, pp. 129-132, March 2014.
- [10] A. Franke, J. Greiner, A. Gösele, J. Kiesel, R. Sperber, J. Stenkert, B. Wagner, and P. Weiss, *Triebstrang and Getriebe (Powertrain and Transmission)*, 2004.
- [11] K. Grad, "Development Trends for Tractor Power trains," 3rd AVL *International Commercial Powertrain Conference*, 20th-21st April 2005.
- [12] Graz, J. A. Greiner, C. Dörr, H. Nauerz, and M. Graeve, "The new, 7GTRONIC of Mercedes- Benz. Innovative Transmission Technology for Better Driving Performance, Comfort and Fuel Economy. SAE 2004-01-0649.
- [13] J. Greiner, G. Indlekofer, H. Nauerz, J. Dorfschmid, T. Gödecke, and C. Dörr, (The New Automatic Transmission 7G-TRONIC of Mercedes-Benz). *ATZ Automobile technische Zeitung* 105, Nr. 10: 920-930.

#### VIII. CONCLUSION

The main advantage of manufacturing these types of machine vice is to provide flexibility in holding the jobs of different size of components. This innovation is more desirable and economical which enhances the safety standards to