IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10540

Retrofitting of Traditional Lathe Machine

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Abstract: Nowadays, products are manufactured using modern technology which employs a communion of computer software, hardware and firmware, lathe machines play a vital role in manufacturing sector. While the manual lathe machines are more economical, they require to be operated by highly skilled workers otherwise their accuracy and efficiency is not up to the mark on the other hand, CNC machine provide the desired accuracy and efficiency of output, but require a huge capital. To solve this problem, we need to provide a low-cost alternative, and in this way, we can generate a greater competency in industrial and manufacturing system. This technique is aimed at strengthening modernization and helps to grow the metal working industry.

I. INTRODUCTION

Retrofitting refers to the addition of new technology or features to older systems this definition gives an almost all information about the word retrofitting. When we say that retrofitting related to some component that mean we try to upgrade that component and improve their efficiency through a present technology.

Here we are concerned with retrofitting in a Bench lathe machine. At times, Retrofitting is the process of replacing the CNC, servo and spindle systems on an otherwise mechanically sound machine tool to extend its useful life. Rebuilding and remanufacturing typically include a CNC retrofit. The anticipated benefits include a lower cost investment than purchasing a new machine and an improvement in uptime and availability. But there are often other unanticipated benefits to retrofitting including lower energy costs, higher performance and a new level of manufacturing data accessibility.

Assuming the machine tool is generally in good shape mechanically, CNC retrofitting is typically the lowest cost solution to improve the overall performance of an older machine tool. Though some electrical subassembly is often performed at the retrofitter's business location, most of the work can be completed at the machine site, avoiding costly machine rigging and transportation costs, and minimizing the time that the machine is out of commission.

Rebuilding typically includes the repair or replacement of some worn mechanical components such as ball screws, lubrication pumps, safety interlocks, guards, hoses, belts and electrical wiring. The rebuild is typically performed at the rebuilder's facility, so there may be additional transportation and rigging costs.
Remanufacturing goes a step further to repair or replace mechanical components to the original, as new, factory specification. It is likely that the machine will be completely disassembled, cleaned, inspected, repaired and painted. All pneumatic, hydraulic and electrical systems will be updated. The machine may also be modified or have mechanical accessories added to re-purpose it for a new application. Practically without exception, remanufacturing will take place at the remanufacturer's site. The main objective of the retrofitting in a Bench lathe machine is to improve the existing conventional Bench lathe machine to provide it features of CNC machine with very lower cost than the new CNC machine.

II. LITERATURE SURVEY

In 1984, Department of Mechanical Engineering, IIT, New Delhi [1], has taken a research topic named as "Machine tool failure data analysis for condition monitoring application". With the development of modern manufacturing technology, Flexible Manufacturing Systems have become key equipment in factory automation. Machine tool is heart of the Flexible Manufacturing Systems. Ex example Lathe machine is the general type of machine tool used by almost all the FMSs. During the operation of this machine tool, different kinds of failures are faced by the industry.

A systematic study of such failures can help in identifying the critical sub-system of these machine tools. This will be useful for identifying the condition monitoring needs of the machine tools. This deals with the identification of critical sub-system based on the failure data analysis for different type of machine tools. Initially lathe has been classified into various subsystems as shown in Figure. In the frequency of failures for each sub-system and failure modes have been considered for finding out the weakest sub-system. In analysis, failure frequency and downtime have been taken into

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consideration for deciding critical sub-systems of machine tools. It can be observed that the maximum failures took place in headstock and carriage sub-systems. These subsystems face failures in components like gear, gearbox bearing, spindle bearing, clutch and cross-slide jib. Here it could be observed that the bearing failures cause longer downtime.

He has developed attachment for an existing CNC machine. The CNC machine operates on mechatronic controls and a computer interface called CAMSOFT, and is used as a CNC Lathe after installing the respective attachment to it. He has designed the attachment using CAD software & fabricated different model. He has successfully design & fabricated the model. The working of the CNC Lathe attachment is tested & checked by making proper machining operation like turning and thread cutting. The machining operations are successfully done. The CNC machine becomes multifunctional with the presently developed lathe attachment and can be used accordingly by installing the respective attachment to it. The CNC machine is useful for research work in both the fields, when installed with the proper attachment.

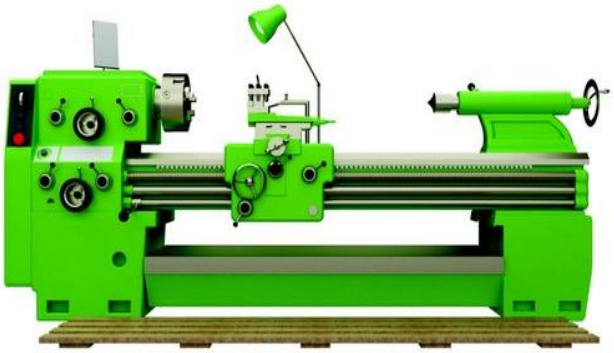
Developed design is successfully implemented in the proposed work for the development of the lathe attachment including headstock, tailstock and tool post. The work shows the process of the conceptual design and use of proper process planning for the development of the different components of the lathe attachment. The previously attachment and developed lathe attachment make the CNC machine multifunctional. Thus, further research can be carried out in both the fields respectively. The CNC machine is based on the mechatronic controls and the computer interface CAMSOFT. Various lathe operations like plain turning, step turning, taper turning, arc turning, threading operations and manufacturing of a bolt are successfully performed on the CNC machine, when installed with lathe attachment. The successful development of the lathe attachment for the CNC machine is done.

In 2013, M. Moses & Dr. Denis Ashok [4] M. Tech, Mechatronic from School of Mechanical and Building Science, VIT University, Vellore, India published titled as Development of a new machining setup for energy efficient turning process. In the production unit, lathe is one of the important protection machines. This paper focuses on producing a quality product in lathe machine with less power consumption. In order to achieve that, a special setup is developed in the lathe machine for turning and finishing of the components, to achieve quality product and also to improve the productivity. As a result of this new approach, profuse amount of energy can be saved, quality product can be obtained and tool life can be increased. The study aimed at evaluating the best process environment which could simultaneously satisfy requirements of both quality and as well as productivity. By conducting many experiments, it was found that this special setup process improves the quality and also reduces the power consumption as compared with the existing process.

He has concluded that the addition of surface finish tool in turning process helps to improve the surface finish and this setup increases the tool life of the turning tool. From the experimental results, it is confirmed that there is no change of power consumption even after the additional usage of surface finish tool. Hence, the set up will be helpful in improving the quality product, with lesser load and power consumption. In 2013, Karl-Heinz Schumacher [9] is invented about Multi Spindle Lathe.

III. WORKING PRINCIPLE

Lathe machine:



An important early lathe in the UK was the horizontal boring machine that was installed by Jan Verbruggen in 1772 in the Royal Arsenal in Woolwich. It was horse-powered and allowed for the production of much more accurate and stronger cannon used with success in the American Revolutionary War in the late 18th century. One of the key characteristics of this machine was that the workpiece was turning as opposed to the tool, making it technically a lathe. Henry Maudslay, who later developed many improvements to the lathe, worked at the Royal Arsenal from 1783, being exposed to this

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machine in the Verbruggen workshop.[8] A detailed description of Vaucanson's lathe was published decades before Maudslay perfected his version. It is likely that Maudslay was not aware of Vaucanson's work, since his first versions of the slide rest had many errors that were not present in the Vaucanson lathe.

During the Industrial Revolution, mechanized power generated by water wheels or steam engines was transmitted to the lathe via line shafting, allowing faster and easier work. Metalworking lathes evolved into heavier machines with thicker, more rigid parts. Between the late 19th and mid-20th centuries, individual electric motors at each lathe replaced line shafting as the power source. Beginning in the 1950s, servomechanisms were applied to the control of lathes and other machine tools via numerical control, which often was coupled with computers to yield computerized numerical control (CNC). Today manually controlled and CNC lathes coexist in the manufacturing industries.

WORKING PRINCIPLE:

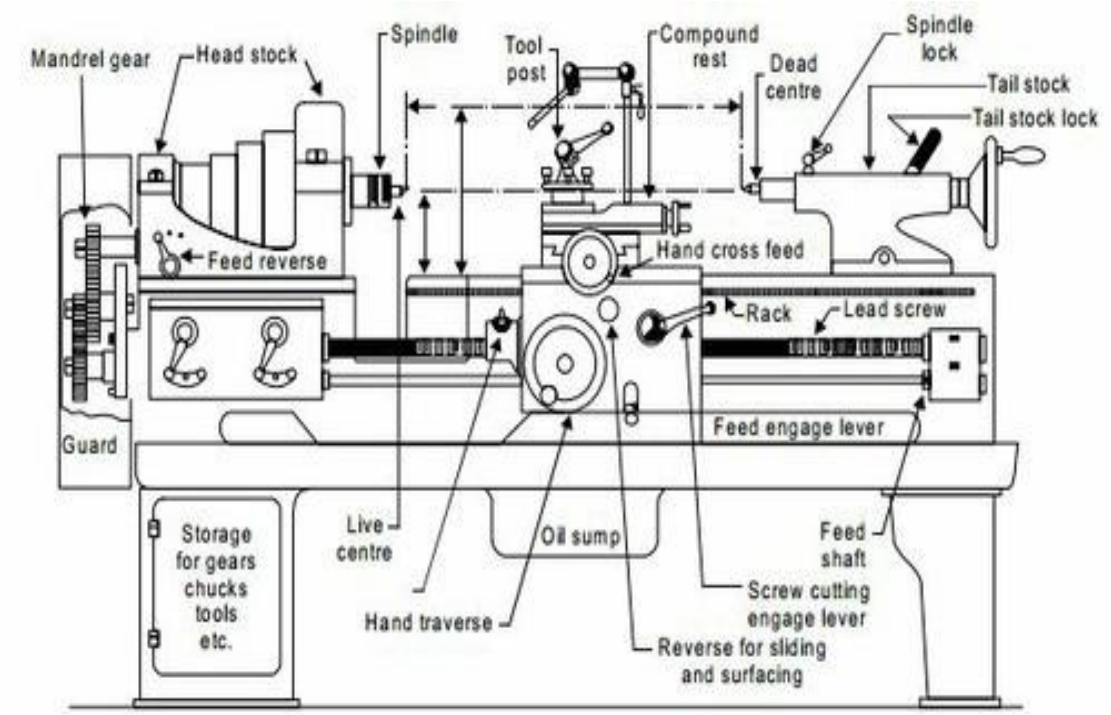
Principle of lathe machine is that the work piece is held in any holding device and allows rotating about the fixed axis at the same time tool bit moved parallel and perpendicular and Performa marching operation.

In initial time lathe is only used for a turning operation. However now day lathe machine is used not only for a turning but also used for a drilling, boring, tapping etc.

The main function of Lathe machine is to remove excess material in the form of chips by rotating the work piece against a stationary cutting tool. This is accomplished by holding the work securely and rigidly on the machine and then turning it against cutting tool which will remove metal from the work.

To cut the material properly the tool should be harder than the material of the work piece, should be rigidly held on the machine and should be fed or progress in a definite way relative to the work.

CONSTRUCTION:



Lathe machine consist a head stock, tail stock, bed, carriage, etc.; the simple construction of lathe machine is shown in the picture which is shown in Above fig

OPERATIONS PERFORMED ON LATHE MACHINE:

There are number of operations performed in a lathe machine according to arrangement of tool and work piece. But these all operations are manly derived into two categories from that in first category considerer those operation in which work

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piece is holed in between chuck and dead center while in second category work piece is hold only by a chuck or face plate of the lathe machine.
Let see all operations one by one, first we considered those operation in which work hold in between the chuck and face plate of the lathe machine.

- Straight turning
- Taper turning.
- Chamfering.
- Thread cutting
- Facing
- Knurling

From above straight turning, step turning and taper turning is basically performed only on a cylindrical face of the work piece but a difference is that in step turning mashing is performed for generate a solder or say step in work piece according to diameter while in a taper turning a taper is generates on the cylindrical face of the work piece.

While in a thread cutting thread is applies on an outer surface of the workpiece. For the thread cutting required a special arrangement of the lathe machine gears which is directly in contact with a carriage.

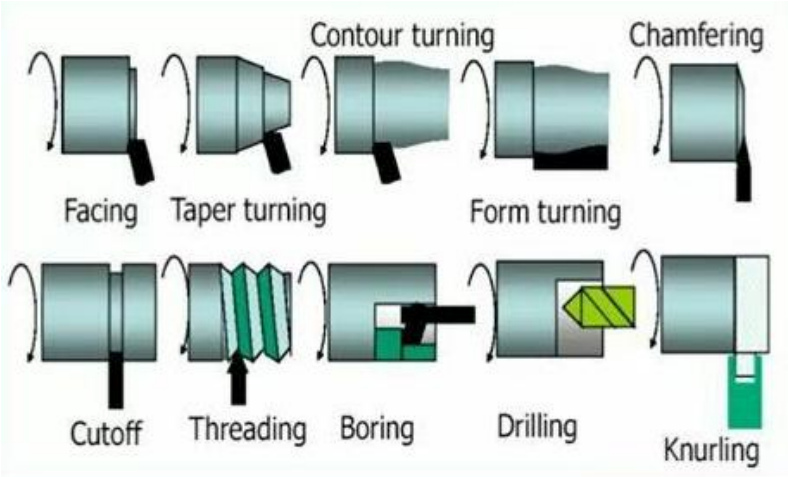
Facing is applies the vertical face of the work piece to straight a face of the work piece. While chamfering is applying on an edge of the work piece for a better appearance and reduces the stress construction. Knurling operation is performed for a providing better grip on the work piece.

Now let see a operation in which work piece is hold only by a chuck which is list out in below,

- Drilling
- Boring
- Counter boring
- Reaming
- Polishing
- Spinning
- Tapping
- Undercutting
- Parting off

From above all operation drilling, boring, counter boring and reaming have a same operational arrangement but they differ to each other by their tool which is used in operation. Form that drilling is used to provide a hole in face of the work piece while boring and counter boring a provides to increase the bore of the already drilled hole while reaming is used to provide a dimensional accuracy of the hole in leave of microns.

Undercutting is used to providing a solder inside a hole. Parting off is final operation of any mashing procedure on a lathe machine which is used to remove the final produced from the portion of raw martial which is held a work piece in chuck.



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OVERVIEW OF CNC MACHINE

Fig. CNC Milling Machin

Fig. CNC Lathe Machine

OPERATING PRINCIPAL OF CNC MACHINE:

For the better explanation of the principle of CNC machine we provide one block diagram which is given below. In fig 4.2.1 a block diagram of the CNC machine is shown. According to that the action of CNC is starts from the input. In the input we apply a part program of any particular component which is written in the coded language. There are many ways of input likes floppy disk, pen drive or USB connection or in some cases a computer is directly linked with an MCU. MCU contains two parts one is DPU or data processing unit and second one is CPU or control loop unit. From that CPU process the dates which are given in a part program and generate a sequence of the pulse which is actuate a drive system. Then according to movement of the drive system feedback is given to a CPU which controllers the movement of the drive sequence according to requirement.

MCU also display data and progress of work and other required information of machine in the display system. Here display is work as inter face of the machine. In pastern days a black and white display are used but now days a LED and LCD display is used which gives a better inter face between the controller and operator. BLU or Basic Length Unit is a unit corresponds to the position resolution of the axis of motion. For example, 1 BLU 0.0001" means that the axis will move 0.0001" for every one electrical pulse received by the motor. The BLU is also referred to as Bit (binary digit).

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Here we have divided the complete construction procedure into four steps. In which we have developed the complete Retrofitted lathe machine from conventional lathe machine. Theses all steps are listed below

Step 1: - Purchasing of electronic parts
Step 2: - Disassemble some parts from conventional lathe machine
Step 3: - Dimensionally Design and fabrication of required mechanical Parts
Step 4: - Assemble all manufactured parts & electronics parts at Desired place

APPLICATION & ADVANTAGES:

Application of retrofitted lathe is same as of CNC lathe but we'll get lesser accuracy than CNC lathe, advantages of retrofitted lathe are as follows,

- Less Capital investment.
- Less operating cost.
- Higher accuracy then conventional lathe.
- Higher precision then conventional lathe.
- Less maintenance cost.
- High production rate.
- Overall low production cost.

IV. CONCLUSION & FUTURE SCOPE

By developing automation in conventional lathe machine by retrofitting stepper-based method, the machine works as CNC trainer for teaching, learning of the student subject. Also Cost of machine is minimizes approx. 1 min left in book 94% mate 4 times below the original CNC trainer because developed retrofitted lathe machine prize is 2, 43,060 rupees while CNC trainer prize is nearly about7,50,000 rupees.

As automation in new developed retrofitted lathe is done by replacing or removing the components from conventional lathe machine, therefore setup cost is high as compare with standard lathe machine but production rate is too much high. So, it is very useful for mass production. The accuracy of the job manufactured in retrofitted lathe machine is also high so repeatability and dimensional stability of manufactured part is achieved. Surface finish in job manufactured on developed retrofitted lathe machine is better than conventional lathe machine as justifies in inspection report of Tirth Agro Pvt. Ltd. Therefore, job quality is good as compare with job manufactured on conventional lathe machine.

Also slide wear is too much low as there is a layer of turcide between two sliding surfaces because turcide has poly tetra fluro ethylene (PTFE) and bronze material. So superior sliding motion can be achieved and wearing of slide, saddle, carriage decrease. At last, some complex job which is not manufactured in conventional lathe machine can be manufactured in new developed retrofitted lathe machine.
In future one can add some parts like, motor operate automatic tool change device (Turret Head) for performing various operation speedily. Also, there is a provision to attach rotary encoder which is useful for threading operation and other complex operation. One can convert this developed turning center into CNC milling machine by making proper attachment. By making proper part program one can make complex job which is not possible to manufacture on conventional lathe machine. In future CAD/CAM integration can be done on this machine.

V. REFERENCES

1. Machine Tool Failure Data Analysis for Condition Monitoring Application Department of Mechanical Engineering, In dian Institute of Technology, New Delhi. Kegs. R. L., On-line Machine and Process Diagnostics, Annals of the CIRP., 32(2), 469-473, 1984.
2. Kriangkrai Waiyagan & E.L.J. Bohez from Department of Design and Manufacturing Engineering, Asian Institute of Technology, P.O. Box 4, Klong Luang, 12120 Pathumthani, Thailand Ninth International Conference on Computer Aided Design and Computer Graphics (CAD/CG 2005) 0-7695-2473-7/05 $20.00 2005 IEEE
3. Design of Hydraulic Circuit for CNCc Lathe Machine Converted from Conventional Lathe Machine Zin Ei Ei Win, Than Naing Win, Jr., and Seine Lei Winn, World Academy of Science, Engineering and Technology 18,2008.
4. Special issue on Recent Advances in Flexible Automation, International Journal of Innovative Computing, Information and Control Volume 4, Number 3, March 2008 ICIC International °c 2008 ISSN 1349-4198 1 min left

DOI: 10.17148/IJIREEICE.2022.10540

in book 97 % Department of Mechanical Engineering, University of Auckland, Private Bag 92019, Auckland, New Zealand.

5. ROY S. KUMAR FROM INST. ENG. INDIA SER. C (APRIL-JUNE 2013) 94(2):187- 195 DOI: 10.1007/S40032-013-0064-2
6. In 2013, M. Moses & Dr. Denis Ashok M. Tech, Mechatronic from School of Mechanical and Building Science, VIT University, 978-1-4673-6150-7/13/$31.00 ©2013 Vellore, India IEEE
7. ZinEiEi Win, Than Naing Win, Jr., and Seine Lei Winn (2008), Design of Hydraulic Circuit for CNC Lathe Machine Converted from Conventional Lathe Machine; World Academy of Science, Engineering and Technology,2,380-384.
8. JamesP. Womack and Daniel T. Jones (2003),Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Free Press Edition.
9. Albert, B. A. (2009), The American Machine Tool Industry (Machine Tool, Its History, Growth & Decline, A Personal Perspective, BookFactory.
10. Steven, K., Arthur, G., Peter, S. and Paul, W. (2003),Machine tool Technology Basics, Industrial Press.
11. N ollet, F., Floquet, T. and Perruquetti, W. (2008), Observer-based Second Order Sliding Mode Control Laws for Stepper Motors, Control Engineering Practice, 16 (4), 429-443.
12. Mohamed, S. B., Jameel, M., Minhat, M. (2014), A Reviewon Intelligence STEP-NC Data Model and Function Block CNC Machining Protocol, Advanced Materials Research, 85, 779-785.