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The hydraulically operated lathe carriage mechanism

Maharshi Shah[1], Sanjay Yadav[2], Sunny Trivedi[3], Kandarp Balar[4], PROF. Darshan K Bhatt

[1-4] Students of Indus Institute of Technology and Engineering
[5] Professor at Indus Institute of Technology and Engineering, Ahmedabad, Gujarat, India

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Abstract - *This project is on a hydraulically operated lathe carriage mechanism which could be another option for the traditional lead screw mechanism which comes with the arrangement of gears in an apron box. Apron has a different set of arrangement of gears while this hydraulically operated lathe carriage mechanism does not have any of the gear arrangement built in it but rather it has hydraulically operated cylinders which are operated with the help of the movements exerted by the motion of fluid in the cylinders. Lead screw (longitudinal) and cross slide movements of the carriage are controlled with the help of two different arrangements of cylinders which are operated with the help of hydraulic direction valves. This arrangement of cylinders can perform different lead screw and cross feed operations and it can also perform angular feed operations by arranging the set of cylinders. This mechanism also helps to reduce the effects caused by vibrations during lathe operations by eliminating screw and gear movements*

Key Words: **hydraulic, lathe carriage mechanism, longitudinal feed, cross feed, lathe bad, CNC, VMC, machine tools**

1.INTRODUCTION:

Lathe machines are one of the oldest machines ever made in history, however, there are many upgrades which have been done in the manufacturing machines. Different machines have their speciality like; drilling machines are useful for every kind of operation related to drilling while milling machines are useful to mill flat surfaces and also to irregular surfaces. In a similar way lathe machines are useful for turning and facing operations and also for tapping, threading and other operations. These are the basic machine tools used for manufacturing and many other advanced machine tools are also available for manufacturing processes like; CNC and VMC machines. These are the upgraded manufacturing machines used especially for mass production and higher accuracy of operations.

These advanced machine tools are incorporated with hydraulic drives rather than any mechanical drive, however, there are many other motions for which mechanical drives are used but for cutting motions, mainly, hydraulic drives are used. By looking into this even we incorporated hydraulic drive in the traditional lathe machines. So, we could benefit from hydraulic mechanisms which are already used in these advanced machine tools. This manufacturing mechanism could easily be built in any lathe as this doesn't require any other modifications to the machine. This has been shown in fig. c. This is what makes it convenient for the machine operator and worker to use it.

Hydraulic drive mechanisms are quick and responsive to the rapid change in the change in volume of the cylinders and as well as it could also sustain under high loading conditions. These properties of the hydraulic drives have led this project to make it possible to incorporate this change in the lathe machine.

2. Design:

The design of the hydraulic lathe carriage mechanism consists of hydraulic cylinders, hydraulic pumps and motors. These are the main components of the system which needs to be designed as per the specific requirement of the machine. However, it varies as per the operations that need to be performed by the lathe machine. This lathe carriage mechanism consists of the saddle, tool post, cross slide and compound rest. However, the traditional lathe carriage mechanism consists of a few more attachments like; clutch, half nut lever and power feed lever. The design of the mechanism has been given below.

Area of the cylinder (A) = L / P ---------- (1)

Where, L= load exerted on the cylinder (kg)

P= pressure developed in the cylinder (bar)

Return load = P * A ---------- (2)

Oil volume = 3.14 / [(4) (D^2)] ----------(3)

Where, D = bore diameter of cylinder (mm)

Kw = P * Lpm / 450 ---------- (4)

Where, Lpm = litre per minute

Equation 1 is used to find the area of cylinders used in the mechanism and by using this equation we have got the area of the cylinder as 8 cm^2. The total weight to be carried by hydraulic cylinders as per individual weights of lathe parts is 200kgs, and equation 2 is used for finding out the return load on the cylinder. In which the pressure and area of the cylinder are entered, and we have got a return load of 67.75 kg. By using equation 3 and 4 we have also got oil volume and Kw as 0.04647 lit/oil volume and 0.025 H.P respectively.

3. MODELLING:

The hydraulically operated lathe carriage mechanism has clamps to hold the cylinder assembly which plays a major role in the construction of this mechanism. The drawing of the clamps has been shown in fig. 1 and fig. 2. This is a set of clamps used in the assembly of the hydraulic cylinders. Fig. 1 is clamp (part 1) while fig. 2 is clamp (part 2) of the clamp section. The clamps are designed as per the size and specifications of the lathe and also as per the size of cylinders. The clamps shown below are the holding members of the cylinder and they have to be firm enough to carry the load of the cylinder.

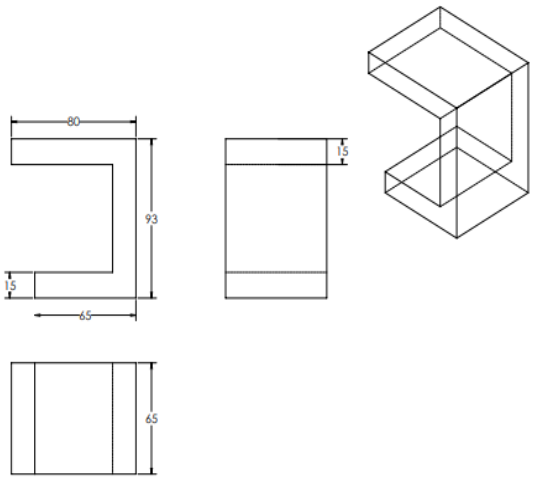

Fig -1: CLAMP (PART1)

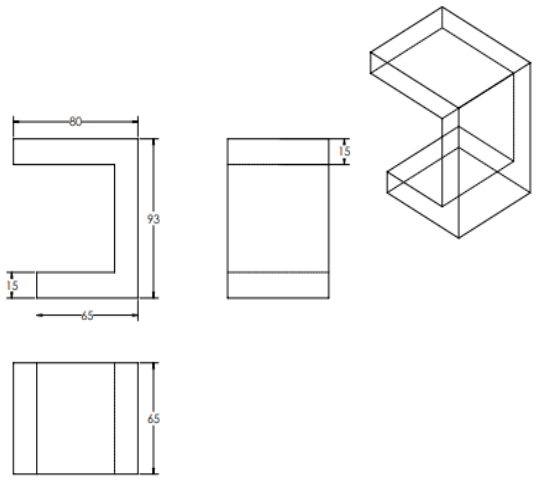

FIG -2: CLAMP (PART 2)

A 3D model of the mechanism has also been shown in fig. 3. which is the actual model of the constructed lathe incorporated with a hydraulically operated lathe carriage mechanism. As shown in fig. 3 lead screws are completely replaced by cylinders. And hose pipes are used to connect carriage and cylinders. This figure shows the arrangement of lead screw cylinder and as well as cross feed cylinder, in which the cross feed cylinder has been supported by a frame connected with the lathe bed which carries the load of the cylinder and the frame. This design could also be modified as per the required movement of the carriage and also to increase the number of operations to be performed.

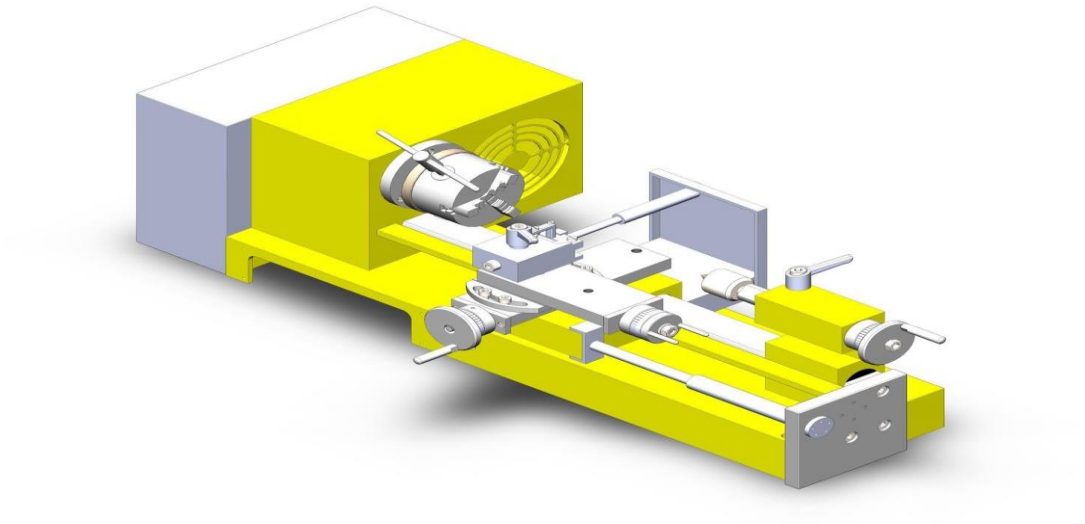

FIG -3: construction of hydraulically operated lathe carriage mechanism

This model is graphically validated and can also be constructed in any lathe by making some necessary constructional changes in the machine. The tail post of the lathe machine could also be replaced by a hydraulic cylinder to completely remove the motions transmitted through screws and by other moving parts.

4. DISCUSSION:

As shown in fig. C, assembling of hydraulic cylinders in the traditional lathe in place of a lead screw is possible and by doing so we have found that the performance of the system can be improved provided, every factor considered in design is as per the design criteria. This is what reduces the vibrations and so does the noise produced during the lathe operations and also helps to reduce the fatigue caused by it to the machine operator.

This reduction in fatigue and stress caused by noise and vibration helps to increase the production rate and also to increase the accuracy of the operations and in this way, it makes it economical and as well as efficient.

5. CONCLUSION:

To construct this mechanism in the lathe can be very economical and as well as very efficient if all the design criteria taken into account are true and also as per the specifications of the lathe. This carriage mechanism can perform operations like; turning, facing, grooving. However, other operations could also be made possible by increasing the number of cylinders used in the machine. This mechanism could also increase the working life of the machine as it removes those parts which are constantly in contact during the machining operations.

FUTURE SCOPE:

This mechanism can be further upgraded by a PLC (programmable logic control) system with sensors; the operations will be easy and painless for machine operators. The mechanisms of other traditional machines like; drilling, milling and shaping machines could also be replaced with a similar kind of hydraulic drive mechanism.

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