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1. Precision Gear-Cut Setting Attachment Through Shaping Machine

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ABSTRACT

Surfaces can be machined with the help of a shaping machine. Cuts curves, angles, and a wide variety of other geometric shapes. Although it can create a wide range of work, this machine is popular in a workshop due of its simple action. A shaper can only be used for one work at a time because it uses a single point cutting tool, which is not ideal for large production rates.

For high production rates, a shaper cannot be employed since it uses a single point cutting tool to machine one piece at a time. Because milling machines are the most commonly used for gear cutting, their costs are too high for small businesses. As a result of this arrangement, small-scale milling businesses can use their lathe equipment to do gear cutting operations for a lower initial cost.

The devices will take up less room as a result, freeing up space that may be put to better use. Still, it is experiencing various obstacles such machining of gear cutting on the shaft. To address this obstacle, it is required to design an attachment for the lathe. Which is able to overcome these challenges and flexible to use it.

KEYWORDS

Gear cutting, Design, Fabrication, Lathe attachment, Gear Shaping, Shaper Machine, Cylinder position.

Introduction:

High-speed and high-productivity technologies are becoming increasingly popular in gear cutting, particularly gear hobbing. For example, Mitsubishi Heavy Industries, Ltd. (MHI) has created a dry hobbing system that was the first of its kind. Automobile, gear train, and motorcycle manufacturers (the two primary consumers of gear cutting machines) have recently tended to integrate two or more elements into a single complex item in order to reduce the size and expense of the body and gear train. Shoulder gears and internal gears are two examples of this type of part. However, a hobbing machine is unable to cut these intricate pieces; instead, a gear-shaping machine is required. Therefore, gear shapers are expected to be as fast and productive as hobbing machines by many manufacturers. [1]

Cylindrical gears are commonly made using gear shaping as one of the primary ways. To cut the work piece's teeth, a modified cylindrical gear is used as a tool that axially reciprocates up and down (shown in Fig 1). At the beginning of the cutting operation, the cutter is radially fed into the work piece until it reaches the final depth of cut, emulating two gears. Gear shaping is less productive than gear hobbing (which makes use of a worm gear cutter), but it is more flexible. [2]

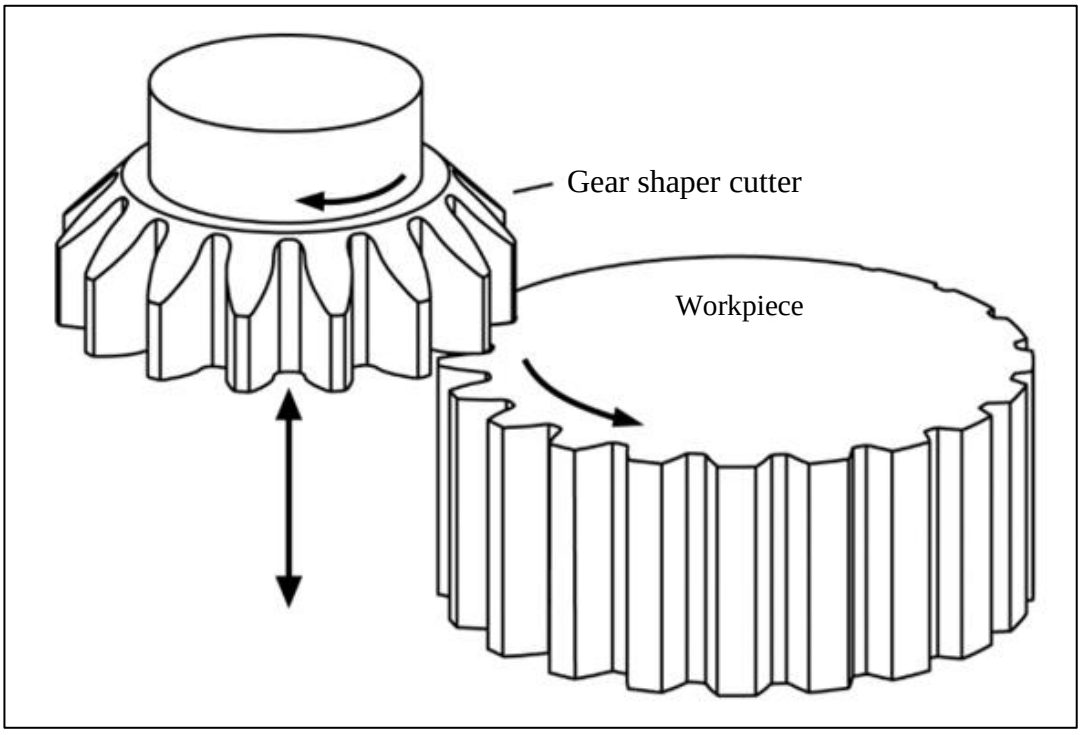

Fig. 1: Gear shaping process

A shaping machine's primary duty is to produce flat surfaces on a variety of surfaces. When the cutting and feeding motions of the reciprocating tool and the bed are combined, they produce a flat surface by gradually removing extra material layer by layer through the formation of chips, which are removed from the workpiece. [3] The tool holder can be lowered, the bed raised, or both can be used to provide vertical infeed.

Form tools can also be used to create straight grooves in various curved areas of a shaper machine. When using a reciprocating ram, the work piece is clamped either directly or indirectly in a vice installed on the bed, while the single-point straight or form tool is mounted on the front face. [4]

An extremely complicated motion is involved since the cutter and piece of work are moving concurrently. Reciprocating motion, rotational feed motion, and radial feed motion can all be viewed as a superimposition in terms of kinematics. Both the internal and external gear generation components are shown in Fig 2. [5]

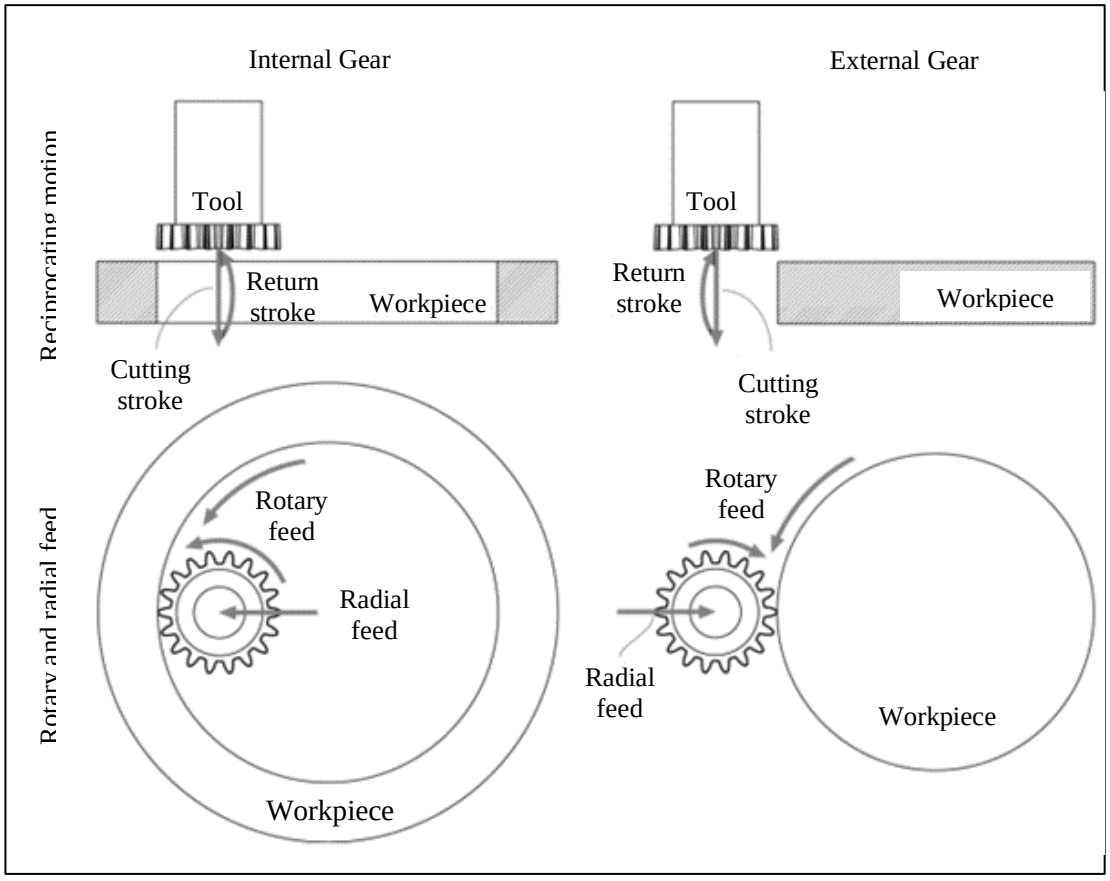

Fig. 2: Kinematic components in gear shaping.

Review of Literature:

Attachment, according to S. Amar [6], is a good instrument for modern industry that may unquestionably aid in increasing productivity and aiding enterprises in improving the standard of keyway operations. The compact design of the attachment makes it easier to operate the keyway. Dr. G. Naga MalleshwarRao [7] did a study on an overview of eccentric turning attachments. Using V-block, studs, centre plate, centre rod, base plate, nuts, and scale, they were able to successfully apply this design and execute this attachment. This might help shorten the time it takes to complete the intended operation.

As stated in Gadakh et al. [8] "Gear Production by using Conventional Lathe Machine," gear manufacturing by milling machine is expensive, so we've created a new attachment that makes a gear. On the lathe carriage, there is an arrangement like this. Gears can be made without the need for a pricey milling machine thanks to this inexpensive equipment. As an alternative to a milling machine, this attachment is a great option for small businesses. Using this setup, we can quickly and easily create spur gear. In addition to being simple to assemble and install, this attachment has a number of other advantages.

There is a keyway and gear cutting lathe attachment according to T. E. Smith [9]. He came up with the idea for a gear and keyway cutting attachment for a lathe by adding another motor to the cutting tools and chuck, but this attachment is heavy and complex.

Objectives:

- To Design and Analysis of Spur gear cutting attachment for Lathe machine to increased Productivity,
- To understand cutting conditions and cycle time and their comparison.
- To study transition of the sector span during shaping

Research Methodology:

The current research is descriptive in precision gear and is based on secondary data that has been collected from a range of sources, including books, education and development, journals, scholarly papers, government publications and printed and online reference materials.

Result and Discussion:

An example of the mode is shown below, which was created using SolidWorks and imported into ANSYS for additional study. [10]

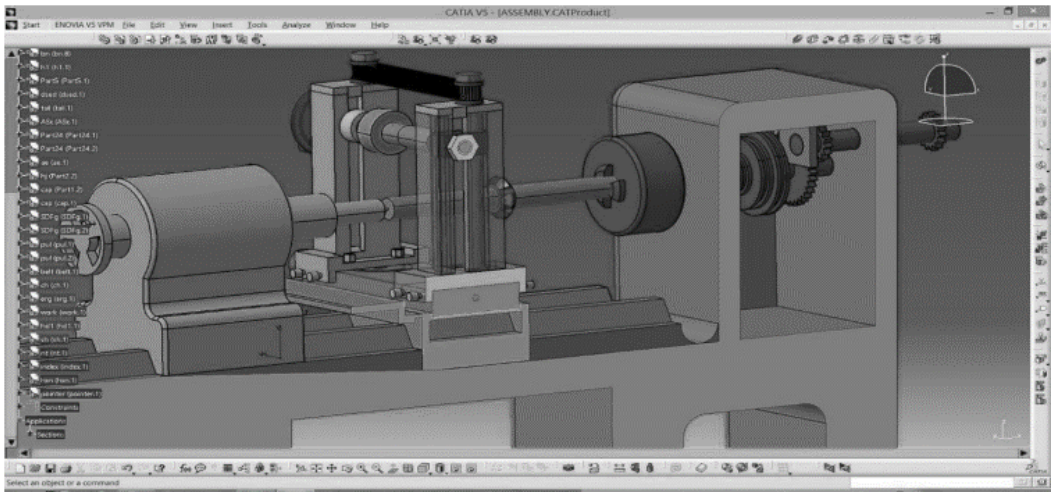

Fig. 3 Spur Gear Cutting Attachment for Lathe Machine: A Key to Increased Efficiency, Cost Reduction and Floor Space Requirement Decreased. The gear-shaping machine SE15A can be seen in action in the figure shown in Figure 4. For this workpiece, a typical machine's cycle time was 40 seconds, but the new machine's high-speed strokes and stiffness cut that in half, to 30 seconds (including the workpiece loading time with the ring loader) With a cutting speed that was 1.3 times faster than the standard machine and a 75% reduction in cycle time, the SE15A proved to be a more efficient tool. It was possible to achieve JIS N7-grade machining precision by keeping vibration to a minimum at high spindle stroke rates and suppressing vibration. [11]

Cutting Conditions for The Conventional Machine

Cutter Specifications		**Cutting conditions: double cutting (roughing/finishing)**		**Workpiece specifications**	
Outside diameter (mm)	Ø200.88	Spindle stroke speed (str/min)	1 100/1 500	Module (mm)	1.75
Cutting edge width (mm)	30	Cutting speed (m/min)	48.4/66	Number of teeth	21
Material	High-speed steel (MAC B)	Circumferential feed (mm/str)	2.749/0.55	Pressure angle (^{o})	20
Coating	PVD	Radial feed (mm/str)	0.017/0.007	Helix angle	Spur
		Depth of infeed (mm)	3.66/0.2	Outside diameter (mm)	Ø 41.2
		Coolant	Wet	Face width (mm)	10
		Cycle time (s)	40.2	Material	SCM415

Cutting Conditions for the SE15A

Cutter Specifications		**Cutting conditions: double cutting (roughing/finishing)**	
Outside diameter (mm)	Ø200.88	Spindle stroke speed (str/min)	2000/2000
Cutting edge width (mm)	30	Cutting speed (m/min)	88/88

— 30% Increase compared with the

convectional machine

Cutter Specifications		**Cutting conditions: double cutting (roughing/finishing)**	
Material	High-speed steel (MAC S)	Circumferential feed (mm/str)	2.741/1.1
Coating	Super Dry III	Radial feed (mm/str)	0.015/0.015
		Depth of infeed (mm)	3.66/0.2
		Coolant	Complete dry
		Cycle time (s)	30

-- 25% decrease compared with the conventional machine

Fig. 4: Comparison of cutting conditions and cycle time

To completion, the cutting speed is 1.3 times as fast and the cycle duration is 75% longer.

Example of gear shaping using SE15A machine depicted in Figure 5 is a continuous shaping During dry cutting, chips are quickly discharged, reducing thermal distortion and stabilising the sector span. Continuous wet shaping with SE15A offers the same level of stability as with SE15. [12]

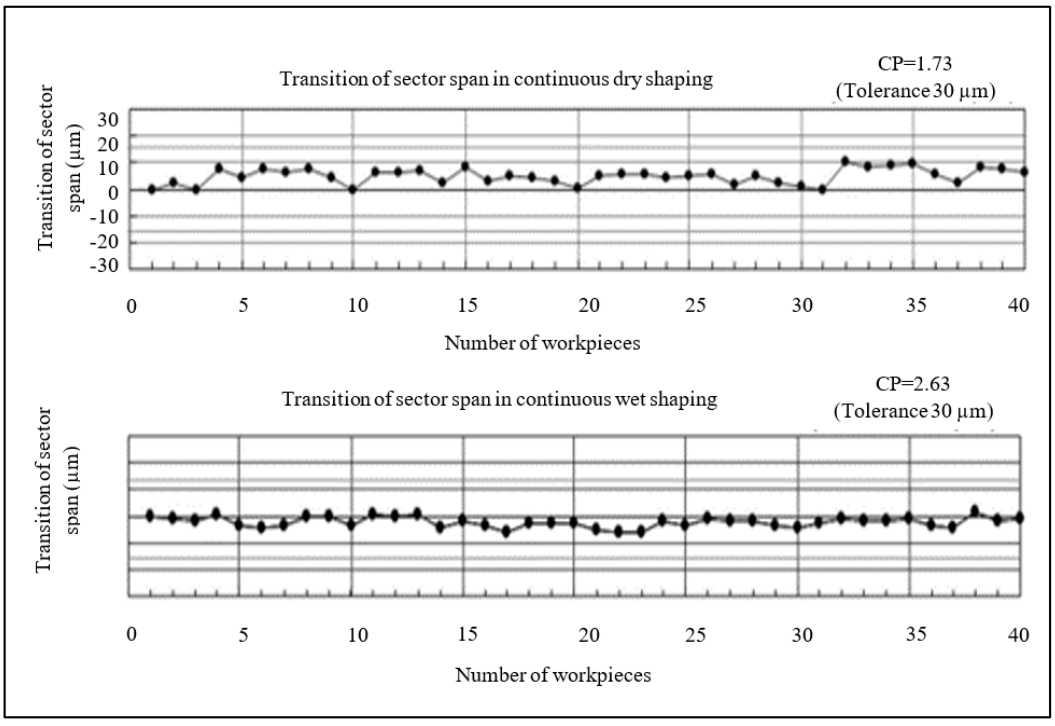

Fig. 5: Transition of the sector span during continuous dry/wet shaping

Conclusion:

A small-scale entrepreneur who selects and implements these tiny but beneficial ideas can save enormous amounts of time, energy, and money thereby enhancing the overall productivity of a firm and therefore contributing more efficiently in the GDP of a nation.

Variable speeds can be achieved by altering the timer device and pressurised air pressure in the gear shifting attachment for shapping machines. a. Constriction of the unit is a breeze because the mechanism is so basic and versatile that it can be operated by any user. The machine is easy to operate and has a quiet running.

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