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A study on Quick Return Mechanisms in Shaper, Planner and Slotter Machines

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Abstract – The main aim of every manufacturing process is to minimize the machining time. One of such means is quick return mechanism. This paper intends to study quick return mechanisms that are employed in common and basic reciprocating machines like shaper planner and slotter with sketches, principle of working. This paper intends to clear the doubts in understanding the working of quick return mechanisms that are employed in above said machines.

Key Words: Quick return mechanism, reciprocating machines, shaper, planner, slotter.

1.Introduction

In every machining process, primary aim is to reduce the machining time. It is not possible to increase the depth of cut since it may reduce surface finish and safety of tool and operator. Hence in order to reduce the machining time, it is advisable to increase the return stroke speed, when the machine is not loaded that is, when there is no contact between tool and workpiece. Since the return stroke is speedy, it is termed as quick return and this mechanism is called as quick return mechanism.

1.1 Quick return mechanisms in reciprocating machines

Basic and primary reciprocating machines in any machining shop are

- Shaper
- Planner
- Slotter

The quick return mechanisms in the above machines are given in the following table

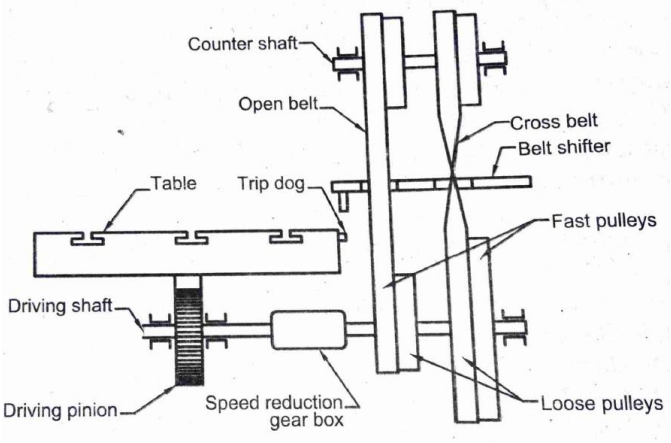
Table-1 reciprocating machines and their quick return mechanisms

Reciprocating machine	Quick-return mechanism
Planner	Open and crossed belt
Shaper	Crank and slotted link
Slotter	Whitworth mechanism

2. PLANNER

The quick return mechanism used in a planner machine is open and crossed belt drive is shown in the figure-1

Figure-1 planner quick return mechanism – open and crossed belt drive mechanism



It consists of a electric drive motor coupled with a driving pinion that drives the table, fast pulleys and loose pulleys are mounted and drives through countershaft through open belt and crossed belt drive through a belt shifter. During cutting stroke- belt shifter moves right, and crossed belt is shifted to bigger fast pulley and open belt to smaller loose pulley. Since the drive is through crossed belt, the direction is reversed and through bigger pulley hence speed of table is reduced. During the return stroke, shifter moves left and crossed belt shifted to bigger loose pulley and open belt to smaller fast pulley and the drive takes place through open belt smaller pulley, table moves faster in return stroke.

There are another two quick return mechanisms for planner.

- Electrical drive mechanism and
- Hydraulic drive mechanism

In electrical drive mechanism, an reversible electric motor coupled with reduction gearbox controlled by position switches in planner table.

As the table moves froward, based on gear ratio the table moves at slower speed since machining is done. As the table moves to its maximum stroke length, the position switch gives signal to motor and the direction of rotation of motor is

reversed. Since no machining takes place in return stroke, as per high gear ratios, the table returns quickly. This cycle continues.

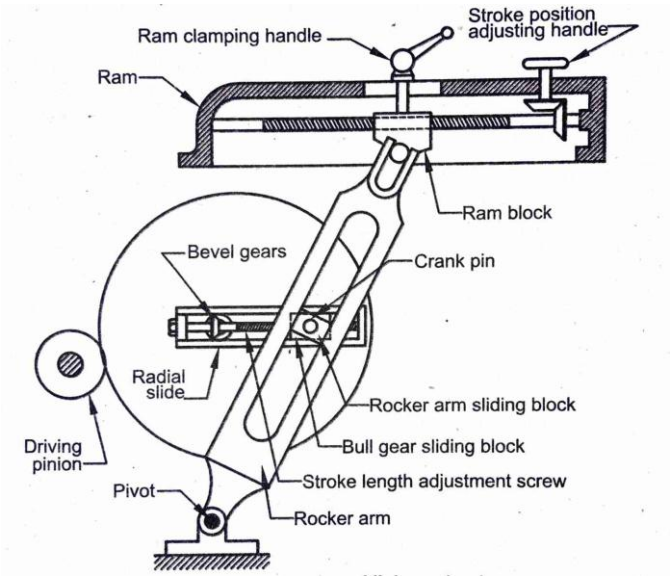
In hydraulic drive mechanism, a double acting piston along with cylinder controlled by servo motors and programmable logic controllers are employed for quick return mechanism.

As the table moves forward, based on gear ratio the table moves at slower speed since machining is done. As the table moves to its maximum stroke length, the PLC gives signal to servo motor and the direction of oil supply is reversed, that is the other side of piston. Since no machining takes place in return stroke, as per high gear ratios, the table returns quickly. This cycle continues.

3. SHAPER

The quick return mechanism used in a shaper machine is crank and slotted link is shown in the figure-2

Figure-2 shaper quick return mechanism – crank and slotted link mechanism

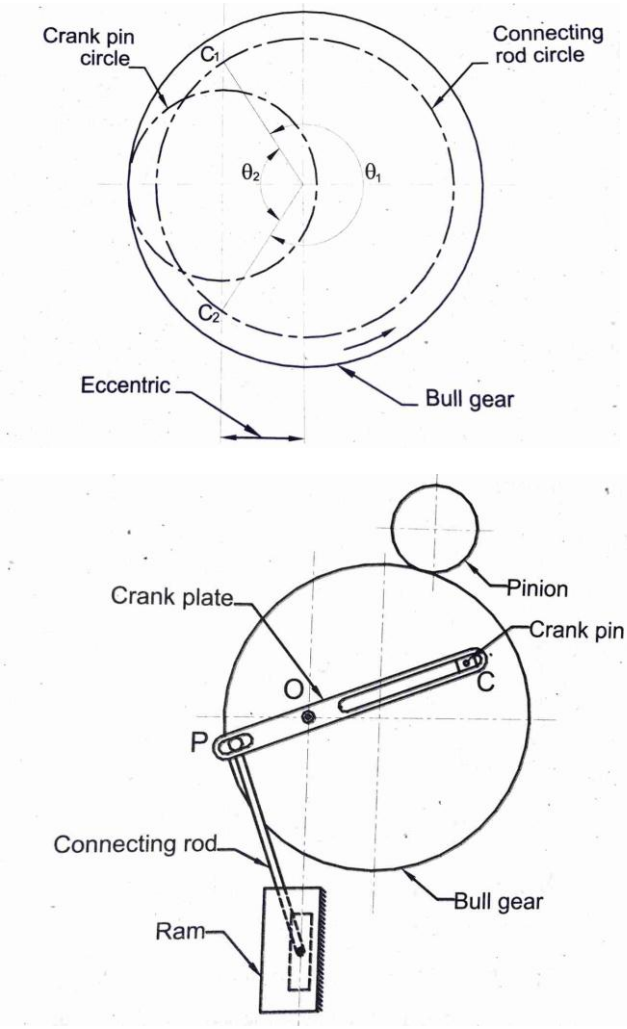


The above is the quick return mechanism employed in a shaper, which consists of a electric motor that drives a pinion called driving pinion, which in turn drives a bull gear. Along the diameter of the bull gear a radial slide is incorporated which has bevel gears for stroke length adjustment. A sliding block is attached to the stroke length adjustment screw and is assembled in such a way the sliding block slides inside the slot of the rocker arm. At the top end of the rocker arm, a ram block is attached through a screw, which is enclosed inside the ram and can be used for stroke length adjustment. As the bull gear rotates in clockwise direction, the ram moves from left to right and the sliding block moves radially and covers maximum angle during cutting stroke, hence it is slow. During return stroke the sliding block moves radially a smaller angle comparatively, hence the speed is more.

4. SLOTTER

The quick return mechanism used in a slotter machine is crank and slotted link is shown in the figure-3

Figure-3 slotter quick return mechanism – Whitworth mechanism



In slotter, the movement of ram is in vertical direction and the principle of operation is similar to that of a shaper machine. The above is the quick return mechanism employed in a shaper, which consists of a electric motor that drives a pinion called driving pinion, which in turn drives a bull gear. Along the diameter of bull gear a crank plate is attached. The ram is operated by a connecting rod. The rotary movement of bull gear is converted into vertical reciprocating movement. As the bull gear rotates in clockwise direction, the ram moves from top to bottom and the crank plate moves radially and covers maximum angle during cutting stroke, hence it is slow. During return stroke

the crank plate moves radially a smaller angle comparatively, hence the speed is more.

5. CONCLUSIONS

In this paper, the quick return mechanisms,

(in which, the return stroke is completed at a faster rate) employed in reciprocating machines – shaper, planner and slotter is studied and this paper will be helpful in understanding various quick return mechanisms, their working principle and application in various reciprocating machines for diploma level students in a lucid maner.

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