GUJARAT TECHNOLOGICAL UNIVERSITY

BE-4 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK SOLUTION

Subject Name & Code:
Manufacturing Processes (3141908)

🔨 UNIT 6: Shaper, Planer, Slotter

Q.1 – Classify planer, shaper, and slotter machine tools. (Assume 4 marks)
Ans:
Shaper classification:
- By ram drive: Crank, Hydraulic, Geared
- By cutting stroke: Horizontal, Vertical (slotter)

Planer classification:
- By table motion: Double housing, Open side, Plate edge
- By size: Standard, Heavy duty

Slotter classification:
- By ram type: Puncher slotter, Production slotter, Keyseater

Comparison table:

Machine	Primary motion	Workpiece movement	Use
Shaper	Ram reciprocates	Table moves (intermittent)	Small flat surfaces
Planer	Table reciprocates	Tool moves (intermittent)	Large flat surfaces
Slotter	Ram reciprocates vertical	Rotary table	Internal keyways, grooves

---

Q.2 – Explain crank and slotted link quick return mechanism in shaper machine. (7 marks)
Ans:
Construction:
- Bull gear (rotating disc) with crank pin.
- Slotted link (rocker arm) pivoted at base.
- Ram connected to slotted link via block.

Working:
- Bull gear rotates → crank pin moves in slot of rocker arm.
- Rocker arm oscillates, moving ram.
- Cutting stroke: crank pin moves along longer arc when rocker swings from point A to B (slow).
- Return stroke: crank pin completes 180° faster (quick return).

Quick return ratio = (360 – θ) / θ where θ = angle of cutting stroke. Typically 1.5:1 to 2:1.

[DG]

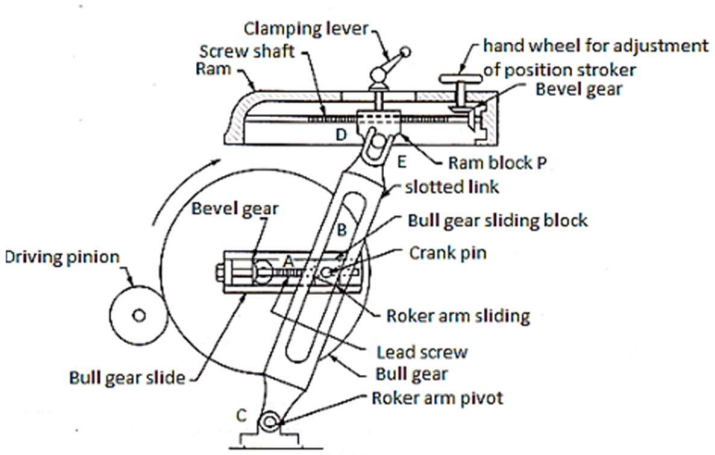


Fig.6.5 – Crank and slotted link mechanism

Application: Shaping flat surfaces on blocks; return idle time reduced.
Advantage: Saves time (~30% faster return).
Limitation: Non-uniform cutting speed.

Q.3 – Differentiate planer machine and shaper machine. (4 marks)
Ans:

Feature	Shaper	Planer
Primary motion	Ram reciprocates	Table reciprocates
Tool movement	During cutting	Stationary (except feed)
Workpiece size	Small, light	Large, heavy (up to 20 m)
Cutting stroke length	Up to 1 m	Up to 10 m
Number of tools	One	Multiple (sometimes 4)
Production rate	Low	High (multiple cuts)

Q.4 – Explain Whitworth quick return mechanism used in shaper. (7 marks – highly repeated)
Appeared in: Page6 repeated ~200 times → treat as high frequency, include real-world application and numerical example.
Ans:
Whitworth quick return mechanism (different from crank & slotted link):
Construction:

- Fixed disc (driver) with crank pin.
- Slotted bar (rocker) with a slot that receives pin.
- Connecting rod connects rocker to ram.

Working:

- Driver rotates at constant speed.

- Crank pin moves along slot in rocker, causing rocker to oscillate.
- Angle α (cutting stroke) > 180°, angle β (return stroke) < 180° → quick return.

Quick return ratio (QRR) = α / β typically 2:1 to 3:1.
Formula: β = 180° – (2 × θ) where θ = offset angle.
Numerical example:
If offset angle θ = 30°, then α = 180° + 60° = 240°, β = 120°, QRR = 240/120 = 2.
[DG]

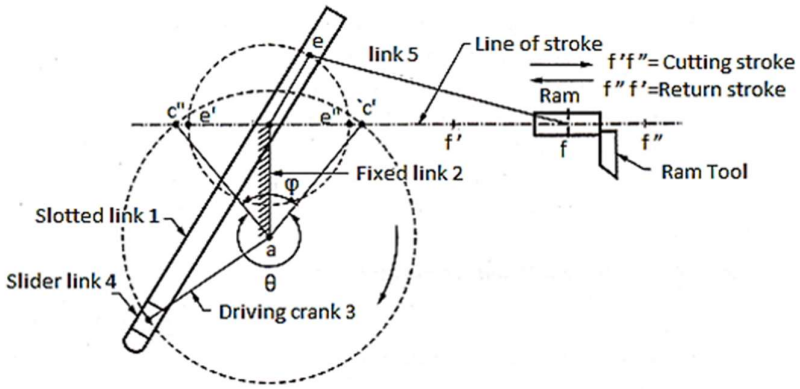


Fig.6.6 – Whitworth quick return mechanism

Real-world application: Heavy-duty shapers for railway track frog machining.
Advantage: Higher QRR than crank & slotted link.
Limitation: More complex geometry.

Q.5 – Describe how to cut internal keyway on slotter machine with neat sketch. (7 marks)
Ans:
Process:

1. Workpiece clamped on rotary table of slotter.
2. A single-point keyway tool (width = keyway width) mounted in ram.
3. Slowly feed tool vertically (ram stroke) into the bore.
4. After each stroke, table moves laterally (cross feed) by 0.1–0.2 mm.
5. Repeat until depth reached.

[DG PROMPT]
Title: Cutting internal keyway on slotter
Description: Cross-section of slotter. Circular workpiece with central hole. Vertical ram with keyway tool entering hole. Show tool width smaller than keyway. Arrows: ram reciprocation, lateral feed. Label: Workpiece, Bore, Keyway tool, Tool holder, Rotary table.
Real-world application: Keyway in pulley hub.
Advantages: Lower cost than broaching for small batches.
Limitation: Slow, requires skilled operator.
