Subject Name & Code:

MANUFACTURING PROCESSES-BE04000191

Experiment No: 1 – Study of Machine Tools

1. State the purpose of each of the following lathe parts: face plate, compound rest, feed rod, lead screw.

- **Face plate:** Used to hold large, irregularly shaped workpieces that cannot be held in a chuck. The workpiece is bolted directly to the face plate.
- **Compound rest:** Used to set the tool for angular cuts (e.g., short taper turning) and to provide fine, manual feed for the tool. It can be swiveled to any angle in the horizontal plane.
- **Feed rod:** Transmits power from the headstock to the carriage to provide automatic feed for turning, facing, and boring operations (not for threading).
- **Lead screw:** A long, threaded shaft used specifically for cutting threads. It engages with a split nut on the carriage to drive the tool at a precise pitch.

2. How knurling is different than turning?

- **Turning:** A metal cutting process that removes material from the workpiece to reduce its diameter and achieve a smooth surface.
- **Knurling:** A metal forming process that creates a patterned (straight, diamond, etc.) impression on the workpiece surface without removing material. It is used to create a better gripping surface.

3. How is feeding done on a shaper?

- Feeding on a shaper is an intermittent (step-by-step) motion. The feed is applied to the worktable (or tool head) at the end of the return stroke of the ram. A mechanism like a pawl and ratchet wheel moves the table horizontally (or vertically) by a small, set amount before the next cutting stroke begins.

4. How does a planer differ from a shaper?

- In a **shaper**, the tool reciprocates while the workpiece is held stationary (except for feed).
- In a **planer**, the workpiece reciprocates on a table, while the tool is stationary (except for feed). Planers are used for much larger workpieces than shapers.

5. List the various methods of making holes in a work piece.

- Drilling, Boring, Reaming, Tapping, Counter-boring, Countersinking, Trepanning, Punching (for sheet metal), Laser cutting, EDM (Electrical Discharge Machining).

6. What is meant by a self-holding taper?

- A self-holding taper (e.g., Morse taper) is a tapered shaft and socket design where the friction between the two mating surfaces is so high that the joint will not slip under load. It is commonly used for holding drills, centers, and other tools in spindles or tailstocks. No drawbar is needed for normal operation.

7. Distinguish between arbor mounted and shank mounted cutters.

- **Arbor mounted cutters:** Have a hole in the center and are mounted on a horizontal shaft (arbor) in a horizontal milling machine. Examples: slab mill, side and face cutter.
- **Shank mounted cutters:** Have a solid, cylindrical shank and are held directly in a collet or chuck in a vertical milling machine. Examples: end mill, slot drill.

8. List the most common abrasives used for grinding.

- **Natural:** Emery, Corundum, Diamond.
- **Artificial:** Aluminum Oxide (Al_2O_3), Silicon Carbide (SiC), Cubic Boron Nitride (CBN), Diamond (synthetic).

9. Why are the teeth of some milling cutters made helical?

- To provide smoother cutting action (less shock on the machine and cutter).
- To improve surface finish.
- To reduce vibration and chatter.
- To allow for a larger number of teeth in contact with the work at any one time.

Experiment No: 2 – Effect of parameters on type of chip

1. How does cutting speed affect chip formation?

- **Low speed:** Tends to produce discontinuous chips or chips with built-up edge (BUE), especially for ductile materials.
- **Medium speed:** Promotes the formation of continuous chips with BUE.
- **High speed:** Produces smooth, continuous chips without BUE, leading to better surface finish.

2. How does rake angle affect chip formation?

- **Positive rake angle:** Reduces cutting force, allows chip to flow more easily, and produces thinner, more continuous chips. Too high a positive rake can weaken the tool.
- **Negative rake angle:** Increases cutting force, produces thicker, more discontinuous chips, but strengthens the cutting edge, suitable for hard or tough materials.

3. How can BUE be reduced?

- Increase cutting speed.
- Increase the rake angle (use a sharper tool).
- Use an effective cutting fluid (coolant/lubricant).
- Reduce the depth of cut and feed rate.

Experiment No: 3 – Chip thickness ratio and shear plane angle

(No specific quiz questions were listed in the manual for Exp. 3, only for Exp. 1, 2, 4, 5, 6, 7, 8, 9.)

Experiment No: 4 – Job making on lathe

1. What is the importance of operation sequencing in the machining process?

- Proper sequencing ensures that all required features can be machined accurately and efficiently. It prevents issues like losing reference surfaces, interference between the tool and workpiece, and ensures that subsequent operations do not damage already finished surfaces. It also minimizes setup time and ensures dimensional accuracy.

2. What is the difference between turning and grooving?

- **Turning:** Removes material from the external surface of a rotating workpiece to reduce its diameter along a length.
- **Grooving (or recessing):** Cuts a narrow, straight or contoured channel (groove) of a specific width and depth into the workpiece, either on the external surface, internal surface, or face.

3. Why chamfering is performed at the work piece edge?

- To remove sharp, hazardous burrs for safety.
- To facilitate easier assembly of mating parts.
- To improve appearance.
- To protect the edge from damage (chipping or breaking).

Experiment No: 5 – Job making on milling machine

1. Comment on the limitation of the gear cutting method used.

- The manual does not specify the method, but if using a **universal dividing head with a form milling cutter** (as typical in a lab), limitations include:
    - Each gear requires a specific cutter for the given number of teeth and module (8-cutter set for each module).
    - The cutter is an approximate shape (based on the average tooth profile), leading to slight inaccuracies in the tooth form (not a true involute).
    - Slow process for mass production.
    - Requires a different cutter for each module.

2. Justify the feed and speed selected for the operation.

- **Speed (RPM)** is selected based on the cutting speed recommendation for the tool material (e.g., HSS) and workpiece material (e.g., mild steel) to avoid excessive tool wear or burning. Formula: $N = (V \times 1000) / (\pi \times D)$.
- **Feed (mm/min)** is selected based on the recommended feed per tooth for the cutter material, number of teeth, and workpiece material. A lower feed gives better surface finish; a higher feed gives faster material removal. The selection balances tool life, surface finish, and machining time.

Experiment No: 6 – Demonstration of job making (Drilling, Grinding, Shaper, Slotter)

1. What is the difference between pillar type of drilling machine and radial drilling machine?

- **Pillar/Column Drill:** The drill head and table are fixed on a vertical column. To position the drill, the heavy workpiece must be moved and clamped.
- **Radial Drill:** The drill head can move horizontally along a radial arm, which can be raised/lowered and swiveled around a column. This allows positioning of the drill over a stationary, heavy workpiece.

2. What are the advantages of boring over drilling?

- Boring can enlarge an existing hole to a precise diameter with high accuracy and good surface finish.
- Boring can correct the position of an existing hole that was drilled off-center.
- Boring can achieve larger diameters than standard drill bits.

3. With neat sketch explain the working of crank and slotted lever quick return motion mechanism.

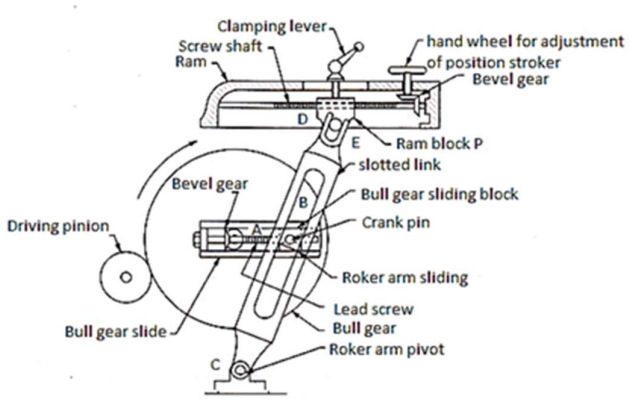

Fig.6.5 – Crank and slotted link mechanism

- The crank and slotted link mechanism is shown in Fig 6.5
- The crank AB rotates about the fixed center A, the end B having the form of a sliding block that fits the slot in the link CD.
- As B rotates about A, it slides up and down in link CD and causes this to oscillate about the center c (pivot point of the slotted link) so that as CD oscillates, the ram is operated backward and forwards.
- The quick return feature is derived from the configuration of the mechanism.
- When the link in the position CD_1 tangential to the pitch circle of B, the ram will be at the extreme backward position of is stroke and when it is at D_2, the extreme forward position of the stroke will have been reached.
- The time is taken by cutting and idle stroke of the ram is proportional to the angles B_2 K B_1 and B_2 L B_1 respectively.
- The ratio between cutting time and idle time may be determined from the formula

$$\frac{\text{Cutting time}}{\text{Cutting time}} = \frac{\angle B_2 K B_1}{\angle B_2 L B_1}$$

- Cutting time to return time ratio usually varies between 2: 1 and the practical limit is 3:2.
- The cutting speed and return speed is not constant throughout the stroke. It is minimum when rocker arm is at the two extremities and speed is maximum when the rocker arm is vertical.

4. What is the difference in the single point cutting tool used in turning and shaping?

- The geometry is largely the same. However, a shaper tool often has a slightly more robust shank (square or rectangular) and a more positive rake angle to handle the interrupted, impact nature of the shaping process. The tool is not continuously engaged like in turning.

5. Identify the grinding wheel used on your grinding machine with its marking system.

- *(Answer will depend on the wheel. A typical example:* A 46 K 5 V*)*
- **A** = Abrasive (Aluminum Oxide)
- **46** = Grain size (Medium)
- **K** = Grade (Medium-soft)
- **5** = Structure (Dense)
- **V** = Bond type (Vitrified)

Experiment No: 7 – Measuring cutting forces using dynamometer

(No specific quiz questions were listed in the manual for Exp. 7.)

Experiment No: 8 – Machining time calculation

(No specific quiz questions were listed in the manual for Exp. 8 – only numerical problems.)

Experiment No: 9 – Alignment test on lathe

1. Write a report showing the stepwise procedure followed in carrying out the tests.

- **Test 1 (Spindle axis parallel to bed):** Mount a test mandrel between centers. Place a dial gauge on the carriage. Move the carriage along the bed, measuring the mandrel top (vertical) and side (horizontal). Deviation indicates bed/spindle misalignment.
- **Test 2 (Cross slide perpendicular to spindle axis):** Face a flat disc. Place a dial gauge on the cross slide and sweep across the faced surface from center to edge. Deviation indicates non-perpendicularity.
- **Test 3 (Parallelism of quill movement with bed):** Mount a dial gauge on the carriage touching the quill. Extend the quill and measure horizontal and vertical deviation.

2. Mention the precautions to be taken in performing the tests.

- Ensure the machine and all components are perfectly clean.
- Use precision-ground, certified test mandrels and standards.
- Set the dial gauge to zero and ensure it has solid, vibration-free contact.
- Take multiple readings at different positions for averaging.
- Ensure the machine is leveled before performing alignment tests.
- Perform tests under no-load conditions (machine off or disengaged).

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