

Manufacturing Tooling

4. Work Holding Principles

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Clamping

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Clamping surfaces

- ◆ Generally the clamping surface should be opposite to that of a location surface for clamping to be effective.
- ◆ However, normally the surface opposite to location would be the surface to be machined.
- ◆ Hence this choice would only be possible if all of that surface is not to be machined or a parallel surface to this is available.

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Clamping surfaces

- ◆ If the surface opposite to location is not available for clamping, alternate surfaces should be chosen for clamping such that resultant clamping force is acting against the locators.
- ◆ As far as possible already machined surfaces should be avoided as clamping surfaces as they are likely to be spoiled under the clamping forces.

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Clamping surfaces

- ◆ Care has to be exercised to distribute this large clamping force over a large area of the workpiece surface.
- ◆ Choose a surface with enough rigidity such that no deformation of the component takes place under the clamping forces.

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Clamping surfaces

- ◆ Always choose the clamping surface area large enough such that the clamping forces are properly distributed and no surface plastic deformation takes place on the component.
- ◆ The clamping force used should take care of the cutting forces likely to come and maintain the stability of the workpiece within the fixture.

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Tool Forces

- ◆ Magnitude and direction of cutting forces is useful for designing the clamping

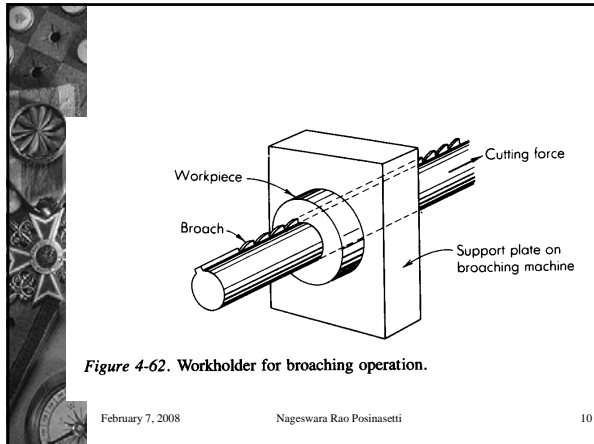
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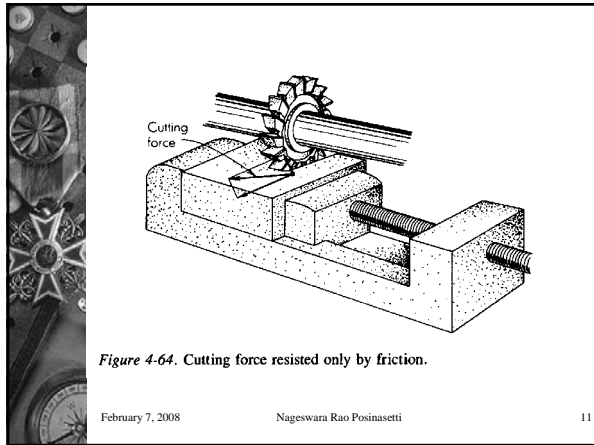
4-60. Pin-type drill fixture resisting torque and thrust.

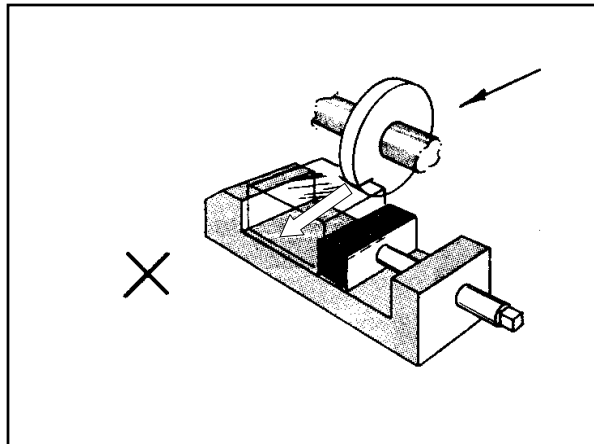
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Figure 4-61. Designing a workholder to resist torque and thrust in a tapping operation.

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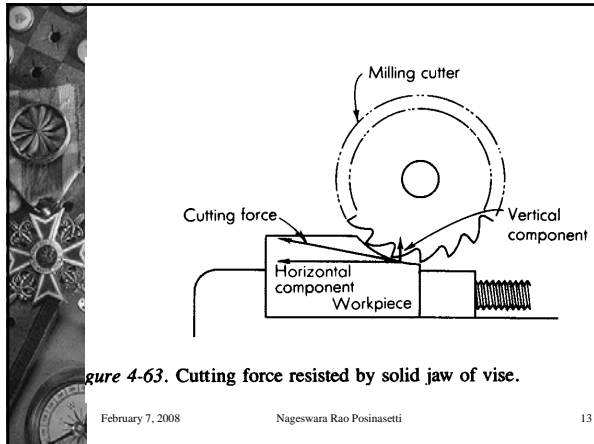
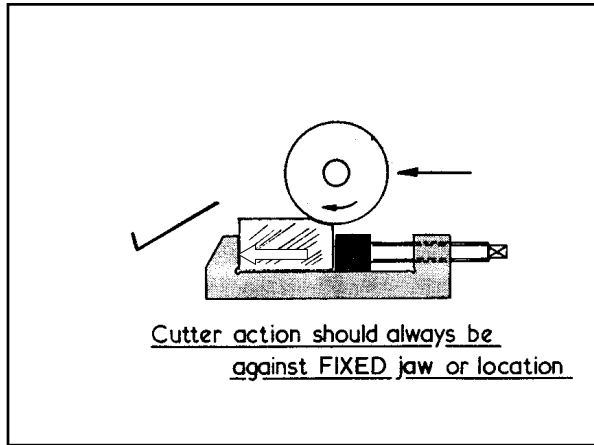


Figure 4-63. Cutting force resisted by solid jaw of vise.

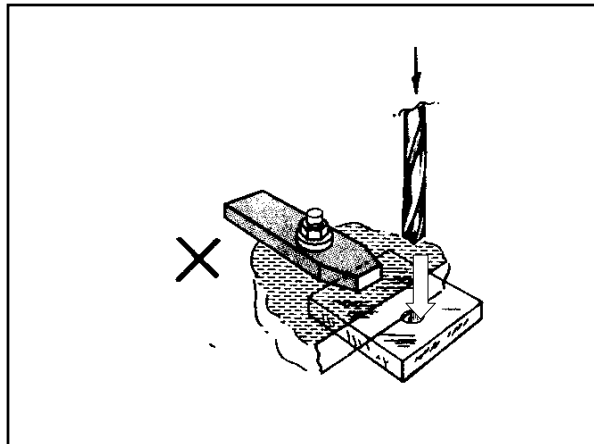
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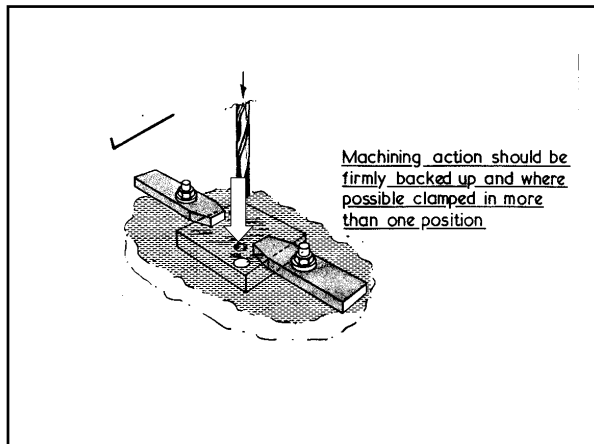
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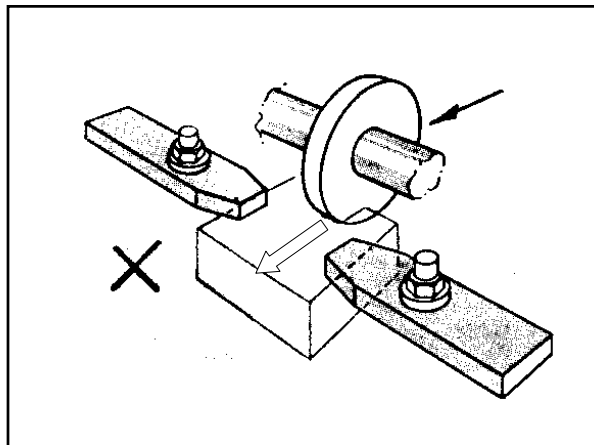
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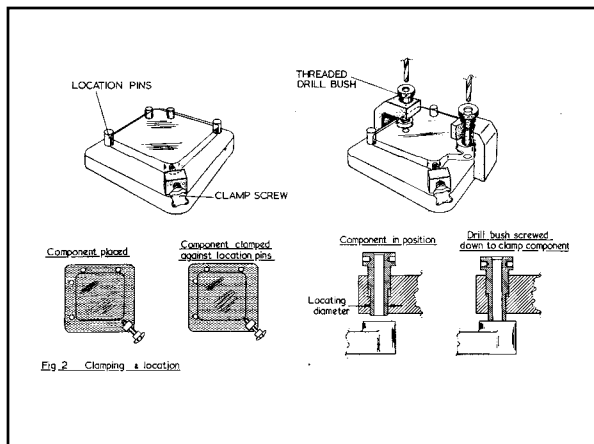


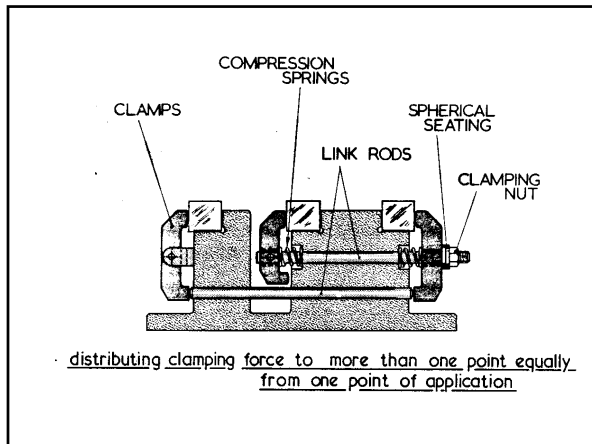
Cutter action should always be against FIXED jaw or location

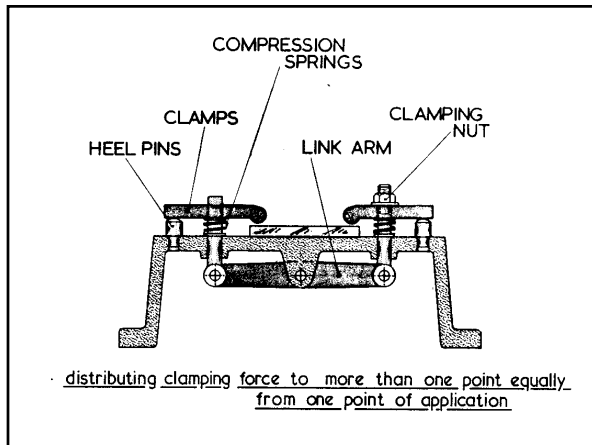


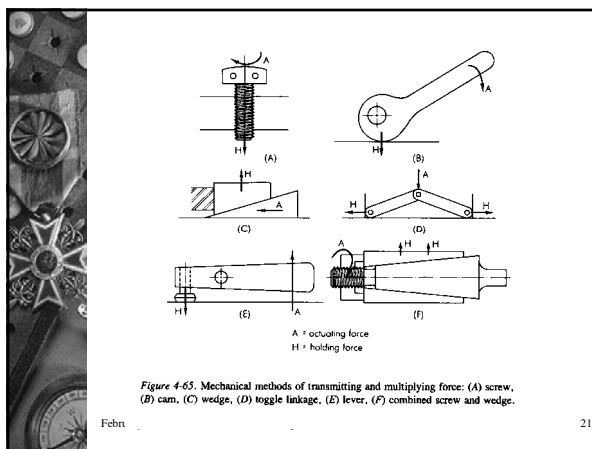




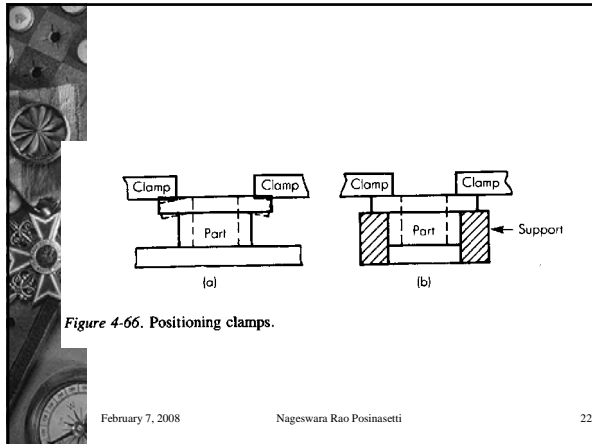








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Factors for Clamping Design

- ◆ 1. Simple clamps are preferred because complicated ones lose effectiveness as they wear.
- ◆ 2. Some clamps are more suitable for large and heavy work, others for small pieces.
- ◆ 3. Rough work pieces call for a longer travel of the clamp in the clamping range, but clamps may be made to dig into rough surfaces to hold them firmly.

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Factors for Clamping Design

- ◆ 4. The type of clamp required is determined by the kind of operation to which it is applied. A clamp suitable for holding a drill jig leaf may not be strong enough for a milling fixture.
- ◆ 5. Clamps should not make loading and unloading of the work difficult, nor should they interfere with the use of hoists and lifting devices for heavy work.

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Factors for Clamping Design

- ◆ 6. Clamps that are apt to move on tightening, such as plain straps, should be avoided for production work.
- ◆ 7. The anticipated frequency of setups may influence the clamping means. For example, the use of hydraulic clamps, even if simple and of low cost, might be inadvisable if frequent installation and removal of piping and valves is necessary.

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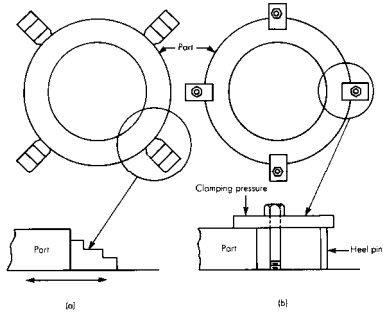
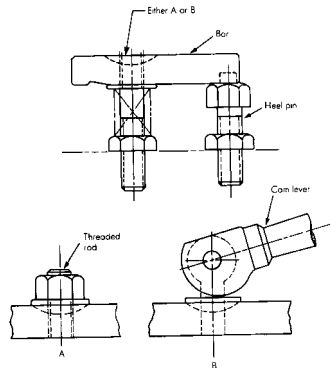


Figure 4-67. Clamping large rings.

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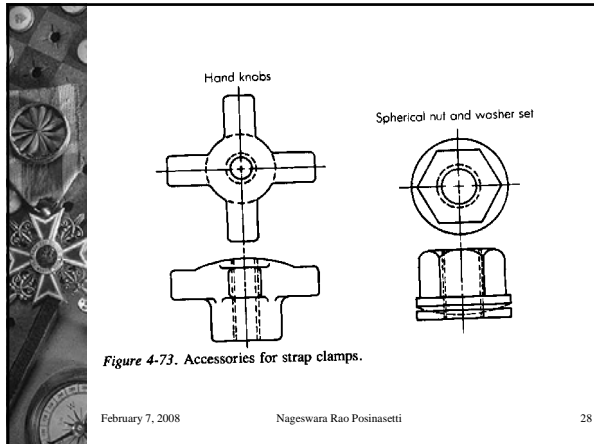
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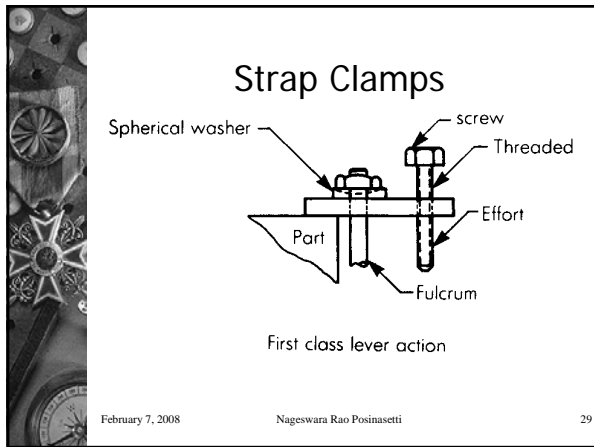


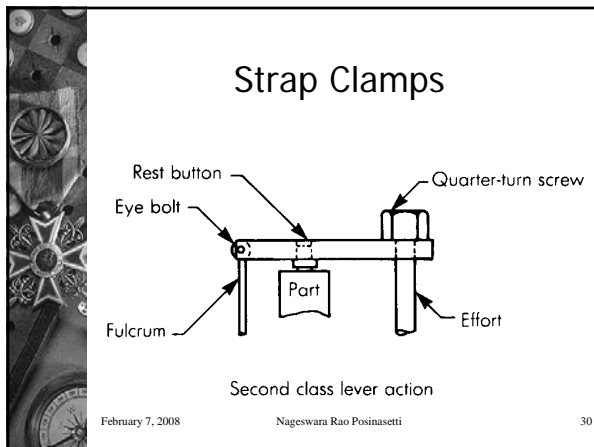
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Figure 4-72. Strap clamps.

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Strap Clamps

Spherical nut and washer

Fulcrum

Heel pin

Effort

Third class lever action

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Strap Clamps

Latch clamp

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Strap Clamps

Sliding slot

Heel pin slot

Sliding clamp

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Strap Clamps

Eye bolt

Hinge clamp

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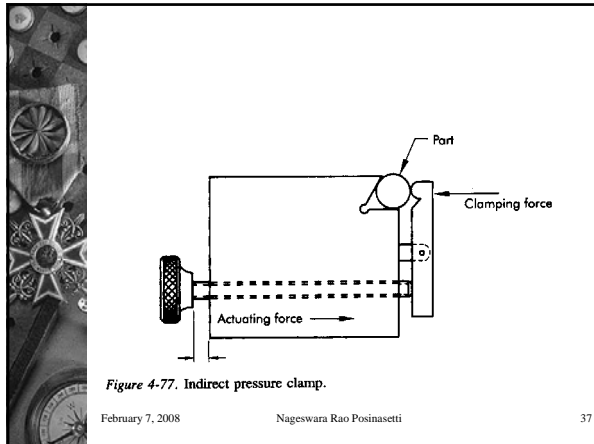
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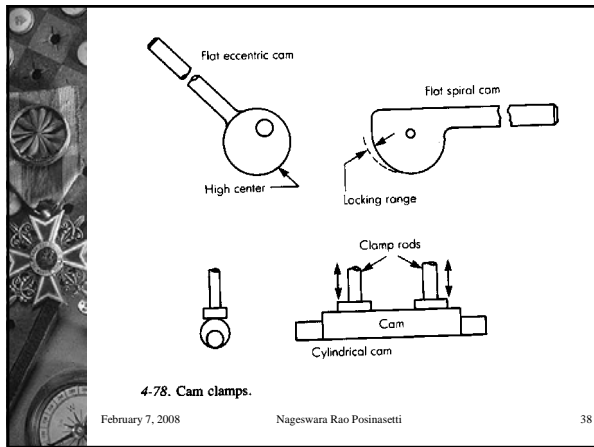
Screw clamps

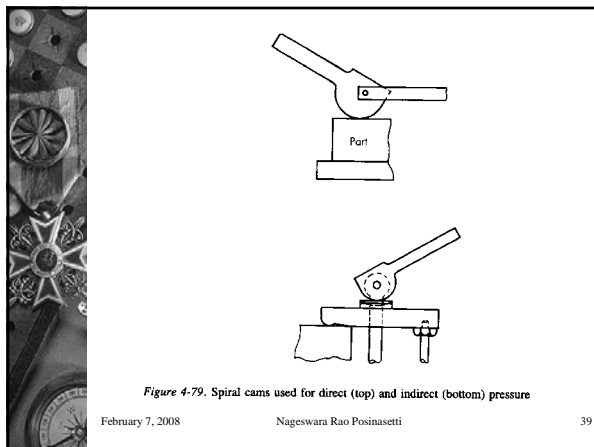
Spring Hook clamp Swing clamp

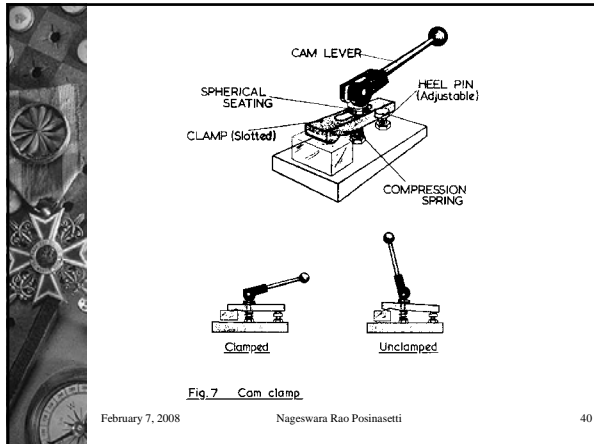
Quick acting knob

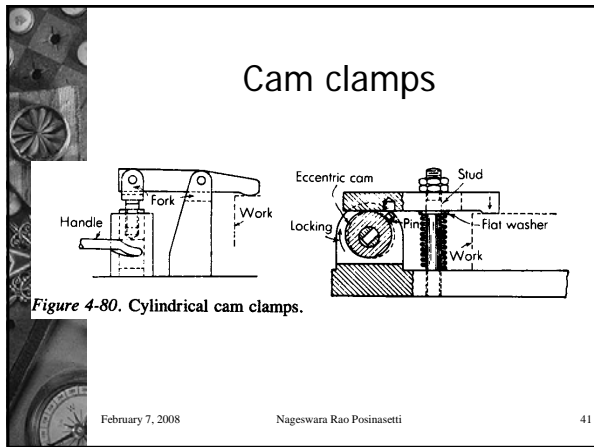
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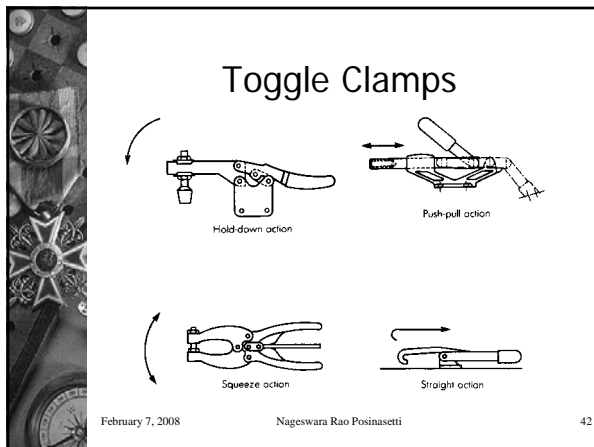


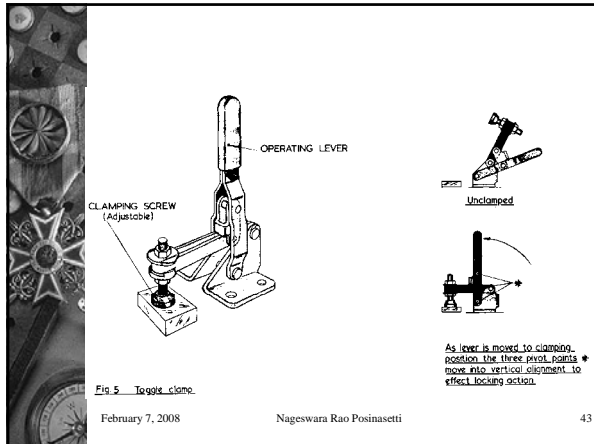


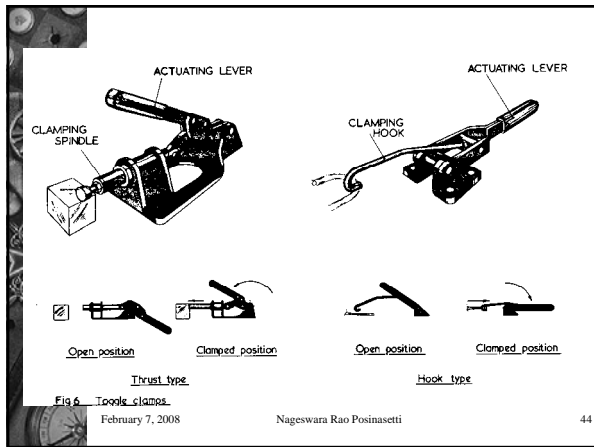


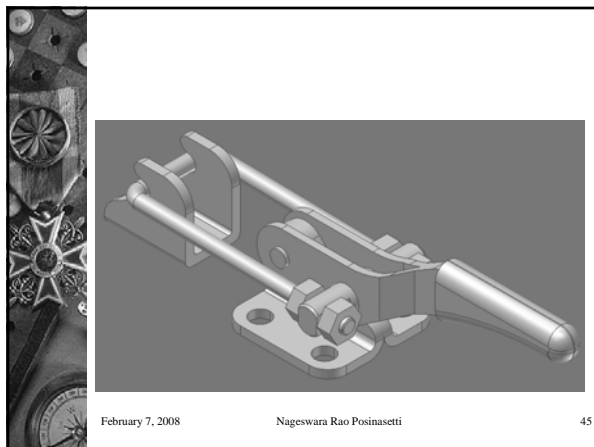


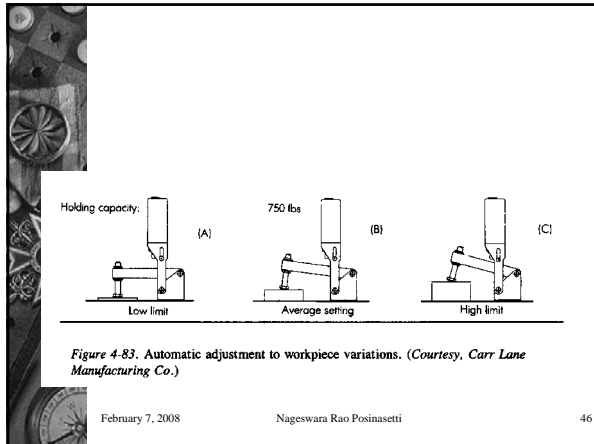


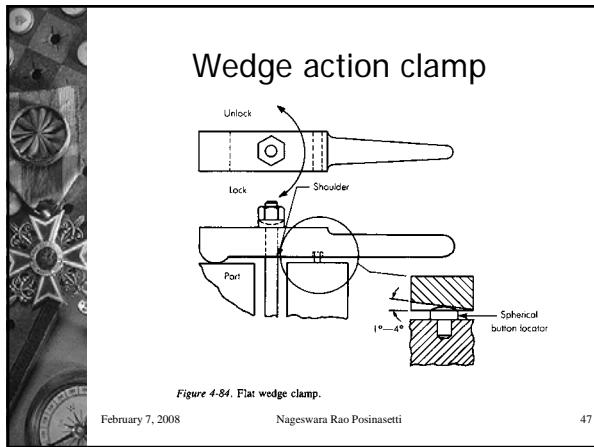


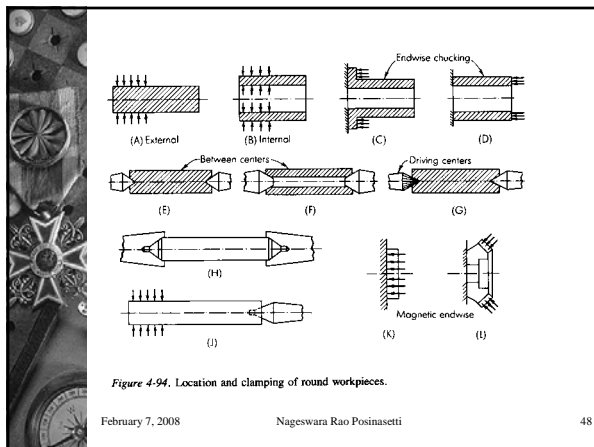












Expansion of a split bushing

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Figure 4-102. Split collet.

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Figure 4-103. High-range type collet.

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Basic Construction Principles

- ◆ **Cast**
 - Stability and vibration damping
 - Good material distribution
 - Used for high volume production
- ◆ **Welded**
 - Easy fabrication and low lead time
- ◆ **Built-up**
 - Most versatile
 - Frequently used

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