Chapter 6

Special Forming Applications
Figure shows stages in shape rolling of I-beam.

Various other structural sections (e.g. channels and rails) are also rolled by this kind of process.
Roll Forging (Cross Rolling)

- It is a deformation process used to reduce the cross-section of a cylindrical (or rectangular) workpiece by passing it through a set of opposing rolls with grooves matching the desired shape of the final part.

- Tapered leaf springs and knives can be made by this process.
Thread Rolling

- **Threaded fasteners** are made economically by thread rolling at high rates of production.

- Thread rolling with **reciprocating flat dies:**

- Thread rolling with **two rotary dies:**

![Reciprocating Flat Dies Diagram](image1)

![Two Rotary Dies Diagram](image2)
Unlike machining (*cuts through the grains of metal*), rolling of threads gives **improved strength** due to cold working and favorable grain flow.

Rolled thread has **good surface finish without loss of material** (scrap).

Thread rolling induces **compressive residual stresses** on the work surface, which improves the **fatigue life**.
Cold Heading (Upsetting)

- It is used for **forming the heads on fasteners** (e.g. bolts, screws, nails, rivets).
- Highly automated, high production rates, noisy.
- Tendency of the bar to **buckle** if its unsupported length to diameter ratio is more than 3:1.

![Diagram of Cold Heading process]

- Kickout pin
- Die
- Blank
- Punch

- Head formed in punch
- Head formed in die
A solid rod or tube is subjected to radial impact forces by a set of reciprocating dies.

Schematic illustration of rotary swaging process

Forming internal profiles on a tubular workpiece

Forming of a stepped shaft using a die-closing swaging machine

Typical parts
Coining is used for minting coins and jewelry.

Completely closed dies and high pressures (5-6 times the workpiece strength) are used to obtain fine details.

Lubricants cannot be used as they are incompressible.
Impact Extrusion

forward extrusion

backward extrusion

forward & backward extrusion
Impact Extrusion

- Schematic illustration of impact extrusion.

- Extruded parts are **stripped** with stripper plate as they tend to stick to the punch.

- Typical products shown below: a) collapsible tube (**Hooker process**) b & c) other examples

- These parts may also be made by casting, forging, or machining.

- The choice of process depends on material, part dimensions, wall thickness, and desired properties.
Steel Balls

► Production of steel balls by **skew rolling**:

► Production of steel balls by **upsetting**:

► Note **the formation of flash**.

► The balls made by these processes are subsequently ground and polished for **use in ball bearings**.
Manufacturing steps for a stepped pin:
1. A solid cylindrical blank
2. Extrusion (stage I)
3. Extrusion (stage II)
4. Upsetting (conical section)
5. Impression-die forming
6. Piercing (for boring)
The figure below shows the production steps for a **cold-extruded spark plug**: