Machine Elements

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ME 101 : Introduction to Mechanical Engineering
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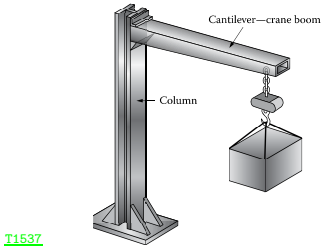
Overview

Key Machine Elements ···



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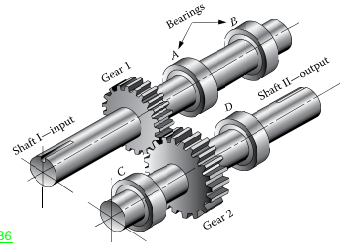

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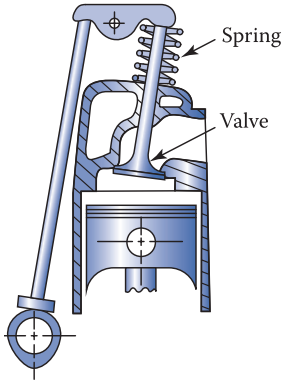

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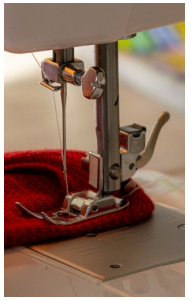
Columns

T1890



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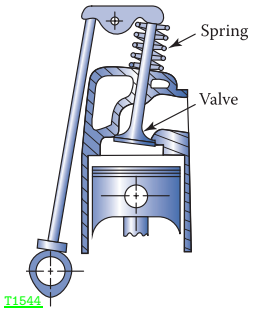
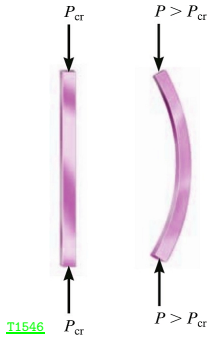


T1544

- Compression members are widely used in machinery of all types. A column is a slender compression member that deforms laterally, or buckles, before stresses reach the yield strength of the material.
- In buckling, loads below a critical value can be supported, but once the critical load is exceeded, large deformations result.

Euler Column Formula and Critical Load



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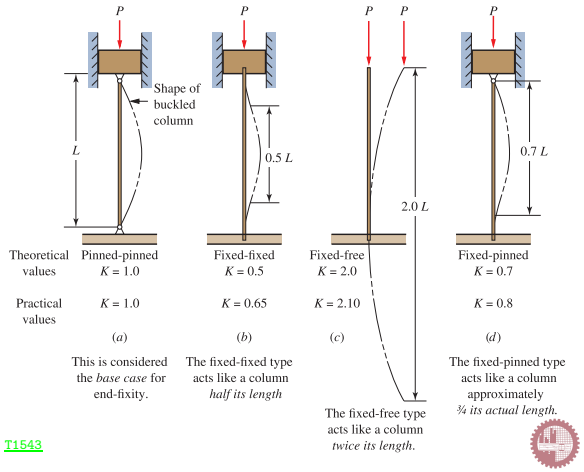
- $P_{cr} = \left[\frac{\pi}{L_e/r}\right]^2 EA$
- $L_e/r > 100$
- $L_e = KL$



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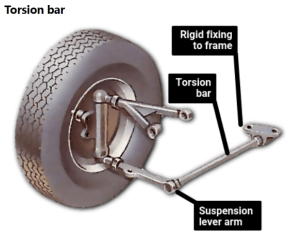
Springs

T1545

- A spring is a flexible machine element used to exert a force or a torque and, at the same time, store energy.
- Energy is stored in the solid that is bent, twisted, stretched, or compressed to form the spring. The energy is recoverable by the elastic return of the distorted material.

Automotive Springs

T1547



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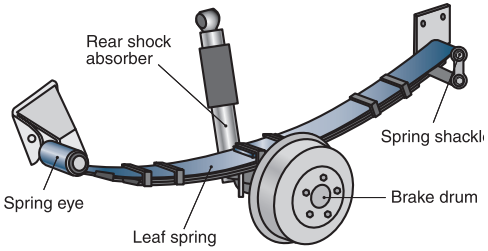

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Gears

Gears are very popular power transmission devices, combining the attributes of high efficiency, long and maintenance-free service life, reasonable manufacturing cost, and relatively large torque capability in a compact size.

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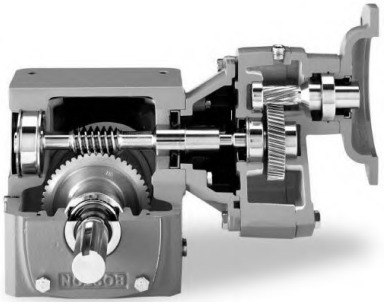

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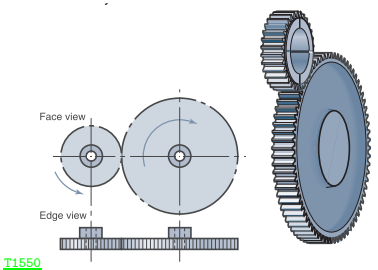
Spur Gears



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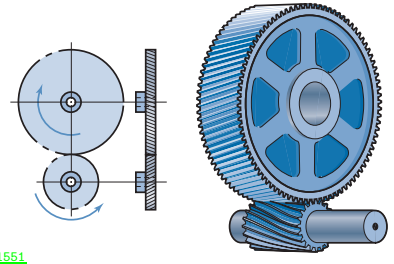
Spur gears are parallel-axis gears with straight teeth. These are the simplest and the most common type of gear, as well as the easiest to manufacture.

Helical Gears



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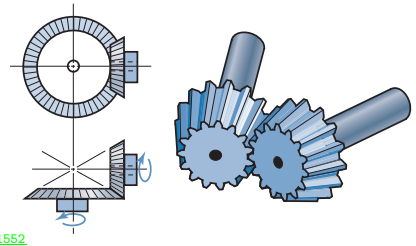
Helical gears are parallel-axis gears with teeth cut on helix that wraps around cylinder. These have greater load-carrying capacity than spur gears of the same size.

Bevel Gears



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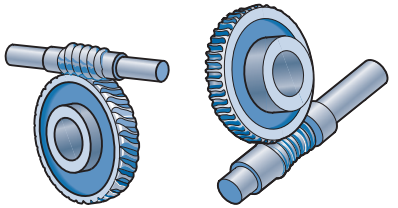
Bevel gears have nonparallel axes that lie in the same plane. Usually, bevel gears are mounted perpendicular to each other, but almost any shaft angle can be accommodated.

Worm Gears



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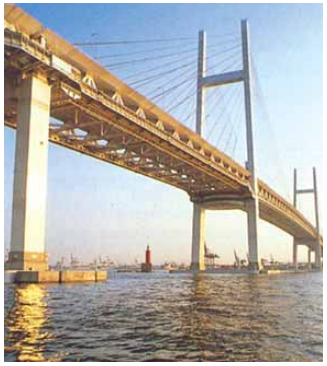
Worm gears are unique in that they cannot be back-driven; that is, the worm can drive the worm gear, but the worm gear cannot drive the worm. This is a function of the thread geometry and is referred to as self-locking.

Beams

Beams are structural members, subjected to transverse loads. Examples include machinery shafts, building floor joists, leaf springs, automobile frame members and numerous other machine and structural components.



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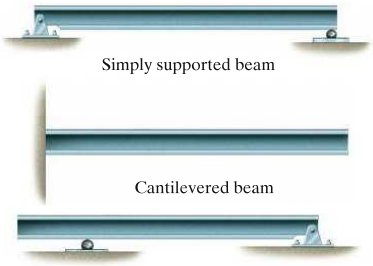

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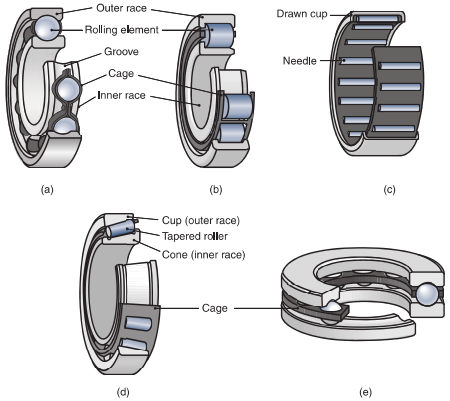
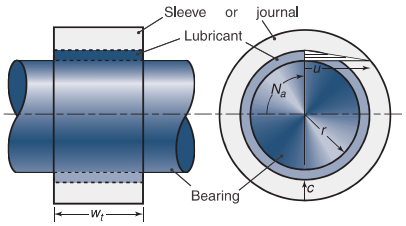
Rolling Contact Bearing



T1554

(a) Deep groove ball bearing; (b) cylindrical roller bearing; (c) needle bearing with drawn cup and no inner race. In such a circumstance, the needles roll on a ground and hardened shaft. (d) Tapered roller bearing; (e) thrust ball bearing.

Journal Bearing



T1555

Journal bearings: the bearing surfaces are parallel to the axis of rotation, Journal bearings are used to support shafts and to carry radial loads with very low power loss and extremely low wear. The journal bearing can be represented by a plain cylindrical sleeve (bushing) wrapped around the journal (shaft) but can adopt a variety of forms. The lubricant is supplied at some convenient location in the bearing through a hole or a groove.

Lubrication & Lubricants

- A lubricant (sometimes shortened to lube) is a substance that helps to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generated when the surfaces move. Key functions of lubrication systems are:
  - reduce friction between mating machine parts,
  - cools moving parts,
  - seals the macro-gap between mating parts,
  - reduces rust formation and the system lifetime is extended
- Classifications of lubricants:
  1. liquid lubricants: mineral oils and synthetic oils.
  2. solid lubricants: graphite.
  3. semi-liquid lubricant: grease.