Engineering Design II

Introduction

Power Transmission:

Electrical Power transmission

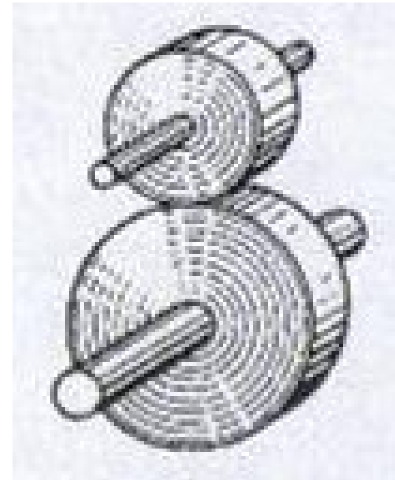
Hydraulic power Transmission

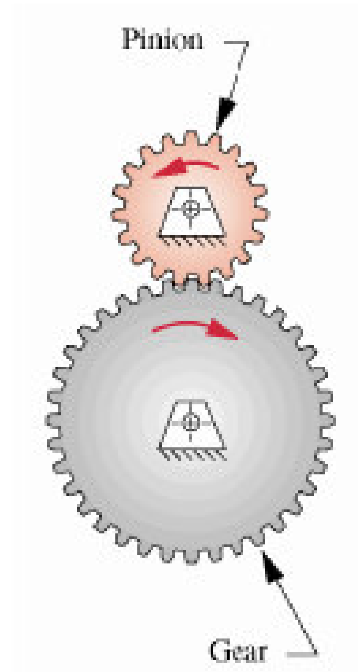
Mechanical Power transmission

- Gears
- belts
- Chains

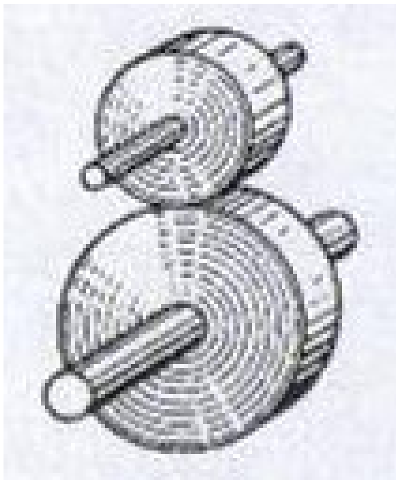
Gear Design:

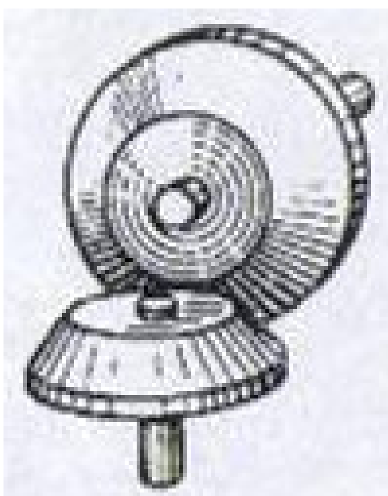
When two smooth cylinders are mounted on two parallel shafts and pressed together lengthwise, it is possible to transmit power from one shaft to the other by means of friction (friction drive)
The above arrangement, however, can not be used for uniform velocity transmission due to the slippage which may be caused by various factors.
To overcome the problem of slippage, toothed wheels or gears are used which produce positive drive with uniform angular velocity ratio.





In engineering, the term gear is defined as a machine element used to transmit motion and power between rotating shafts by means of progressive engagement of projections called teeth.





Types of gears

Spur gears

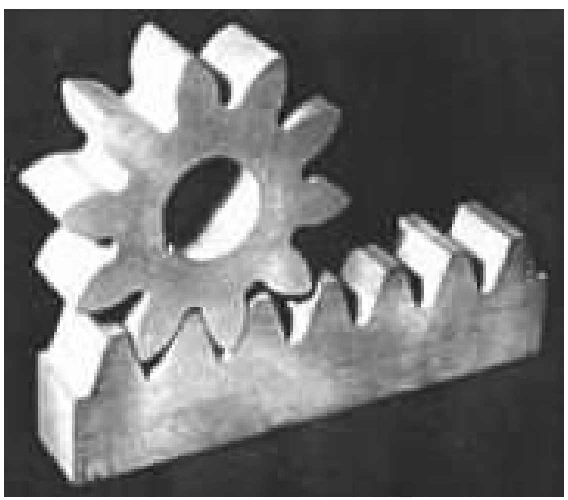
Helical gears

Crossed helical (spiral) gears

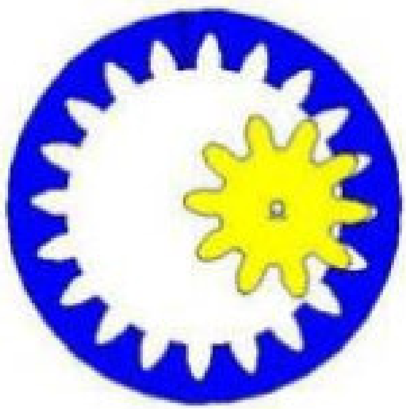
Bevel gears

Spiral bevel gears

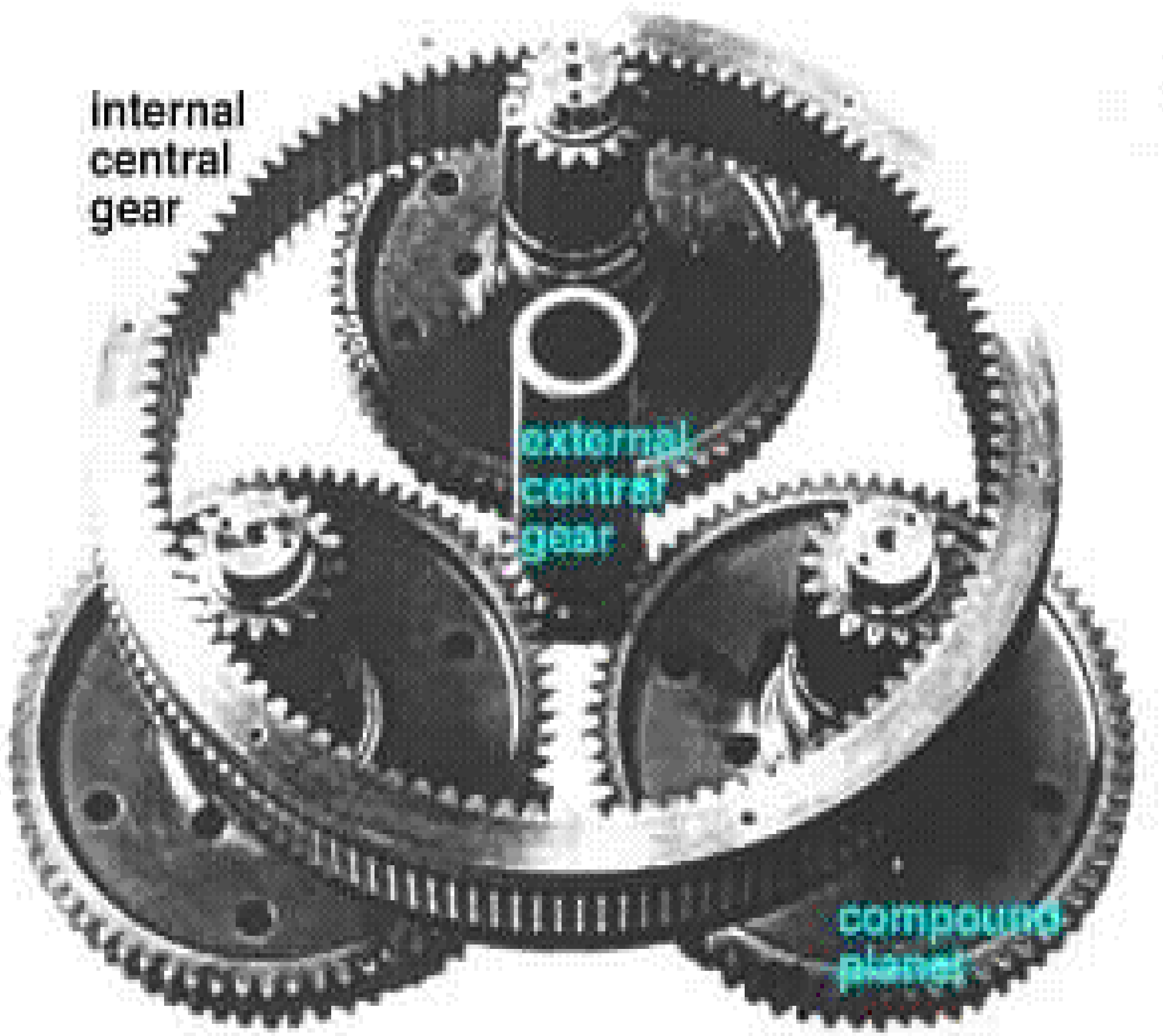
Worm gear

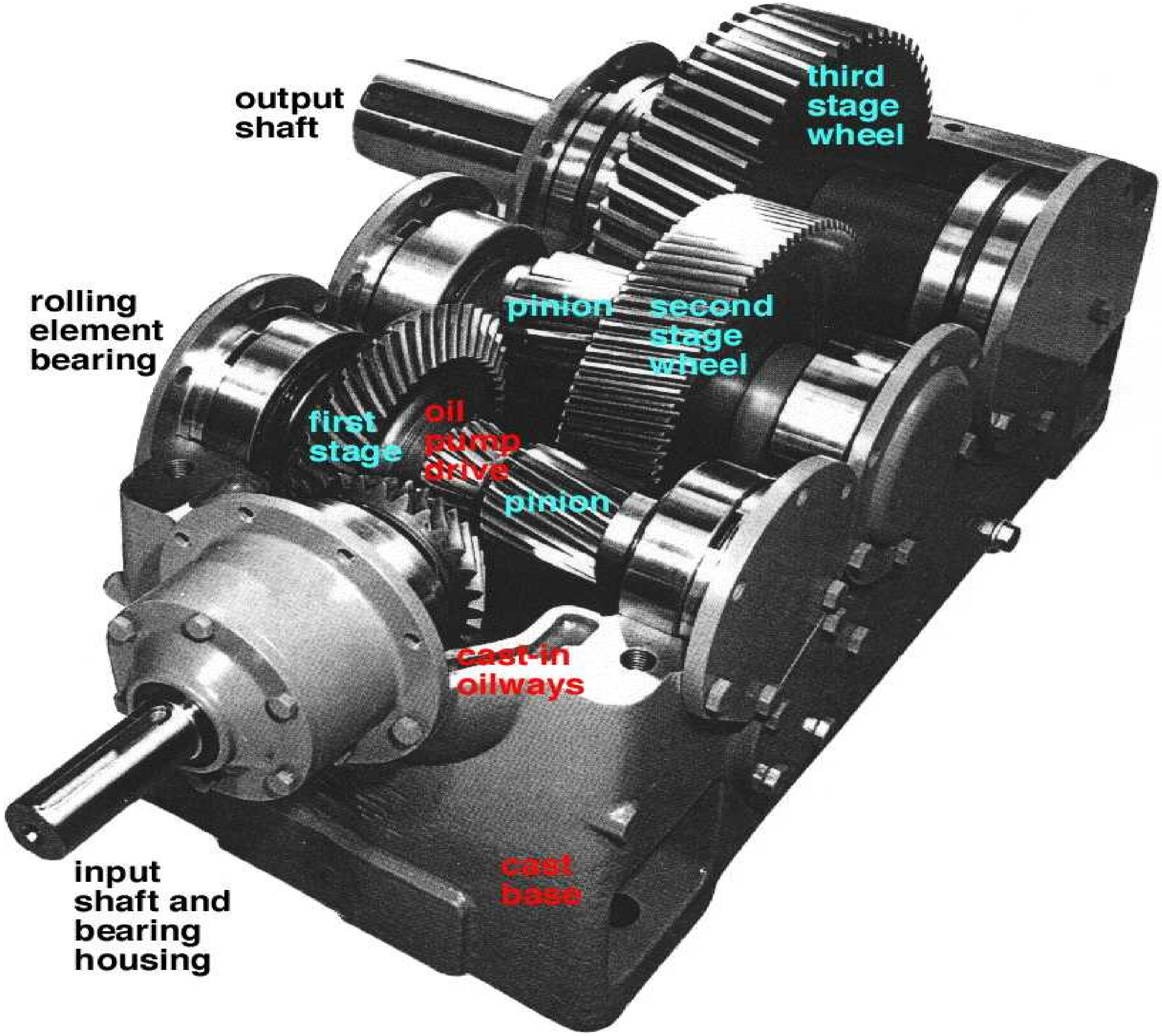


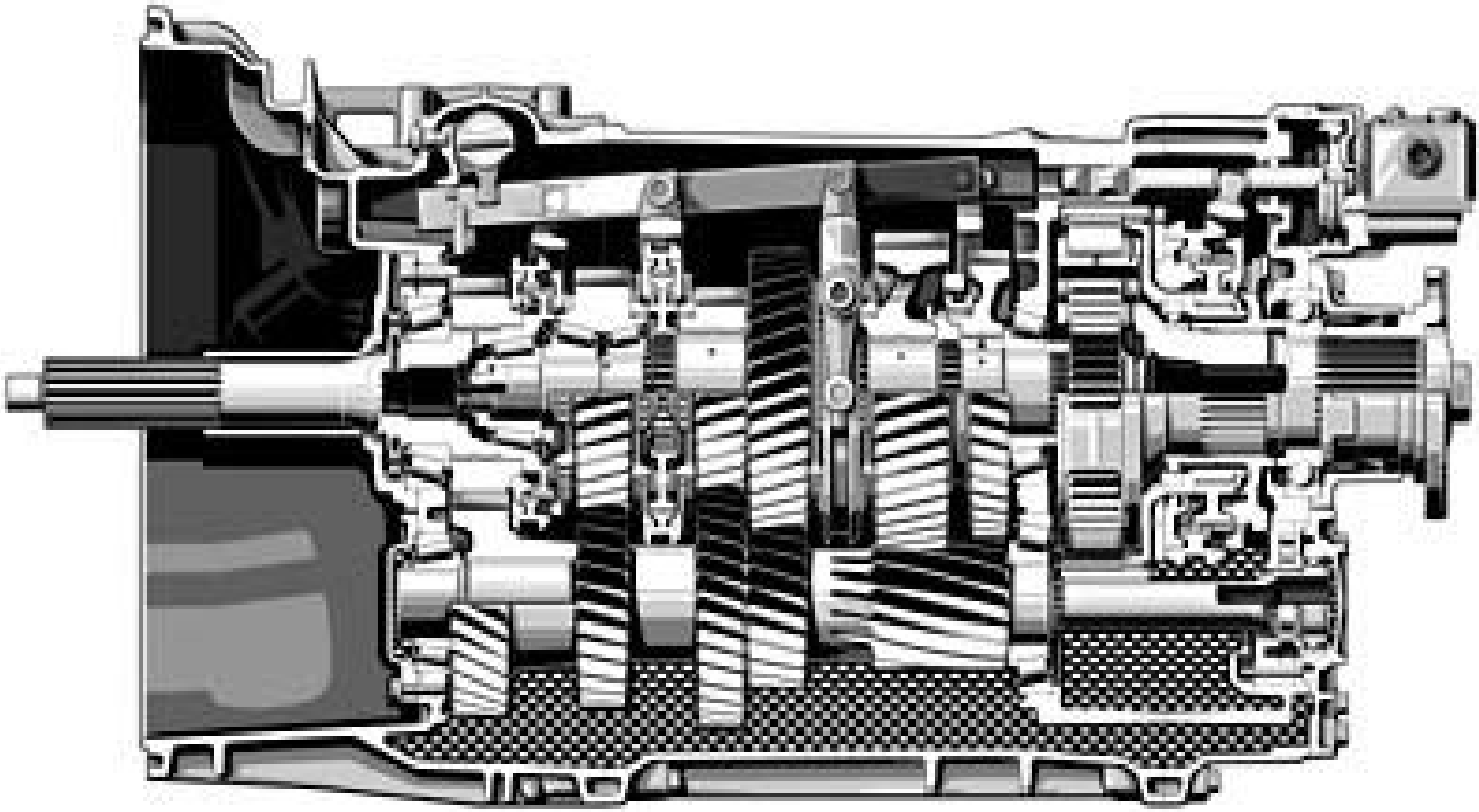
Rack and pinion gears



Internal gears




output shaft
third stage wheel
rolling element bearing
pinion
second stage wheel
first stage
oil pump drive
pinion
cast-in oilways
input shaft and bearing housing
cast base



Mercedes-Benz Actros, manual transmission


Ships' high speed turbine gears, circa 1960
John Brown Shipbuilders, Clydebank

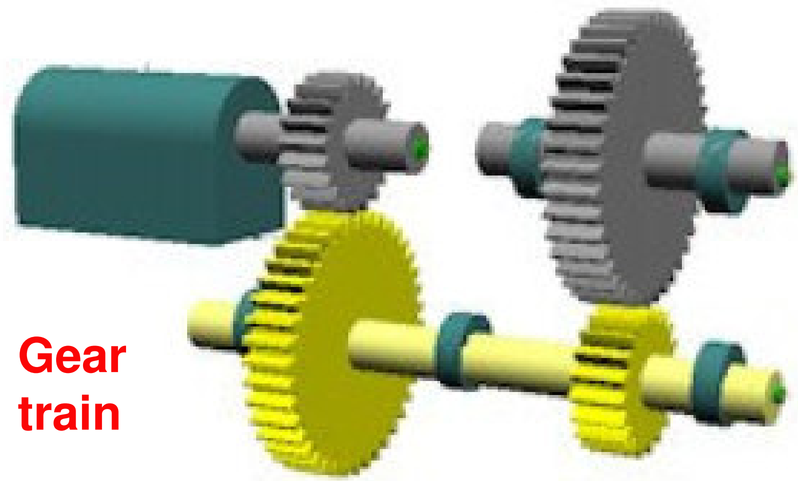
Spur Gears

Introduction:

- The simplest means of transferring rotary motion of one shaft to another is a pair of roller cylinders. Provided that sufficient friction is available at the rolling interference.
- Preventing slipping requires some meshing teeth to the rolling cylinders. Then, they become gears and they are together called a gear set. The smaller one is called the pinion and the other is the gear.


gear set

Gear train



Speed ratio:

Transmission ratio:

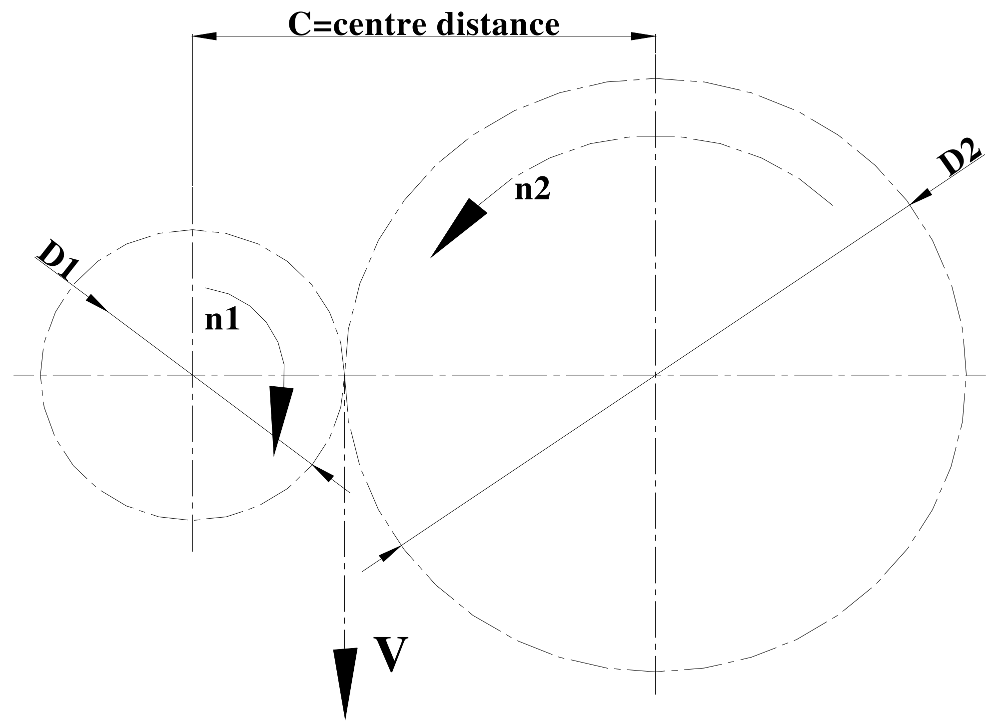
$$i = \frac{\omega_1}{\omega_2}$$

ω is the angular velocity

$$\boxed{\omega = \frac{2\pi n}{60}}$$

n is the r.p.m

$$\therefore \; i = \frac{n_1}{n_2}$$

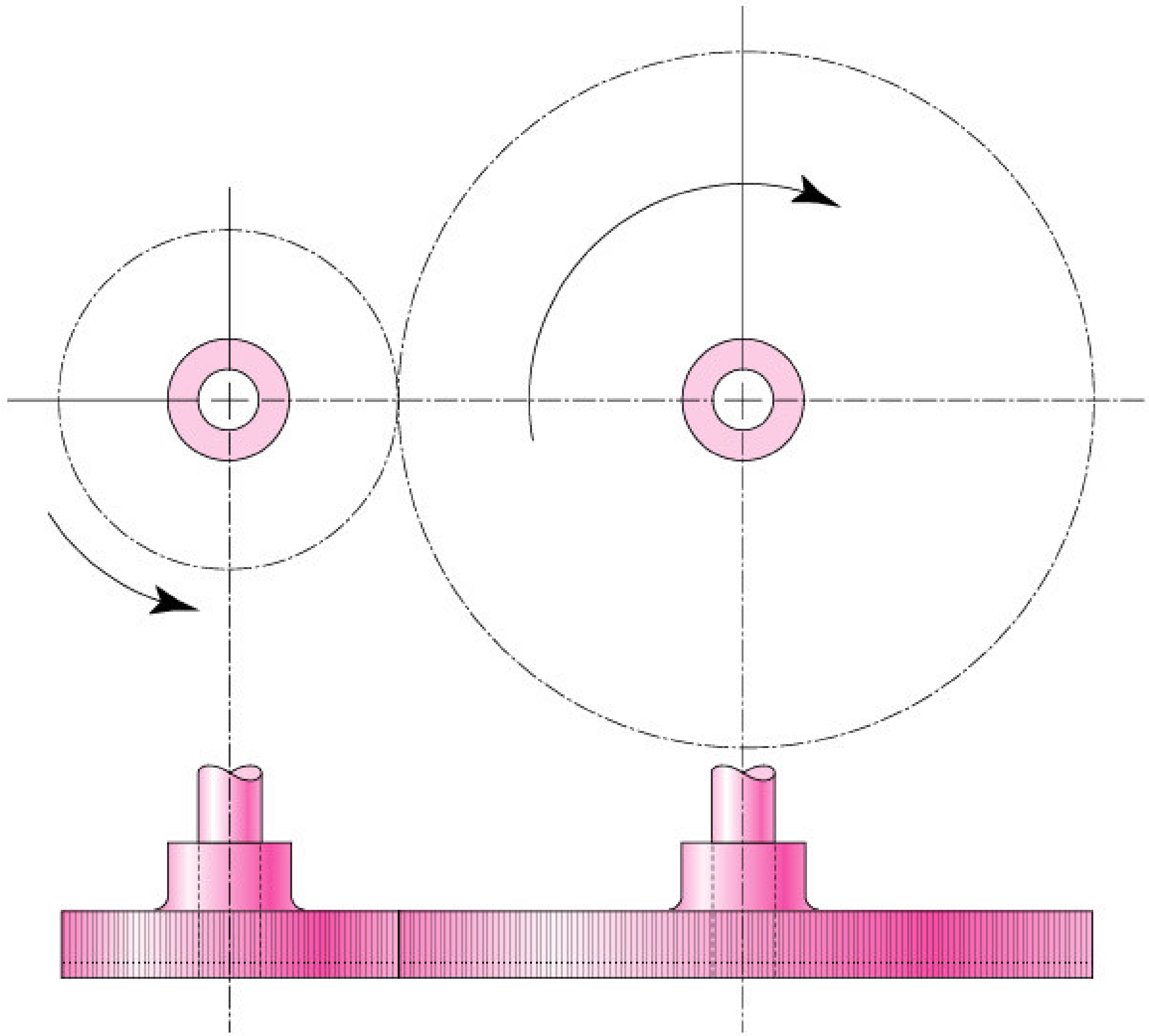


$$V = \omega_1 r_1 = \omega_2 r_2$$

$$\frac{\omega_1}{\omega_2} = \frac{r_2}{r_1} = \frac{d_2}{d_1} = \frac{d_g}{d_p} = \frac{mN_g}{mN_p} = \frac{N_g}{N_p}$$

$$\boxed{i = \frac{\omega_1}{\omega_2} = \frac{n_1}{n_2} = \frac{d_2}{d_1} = \frac{N_2}{N_1}}$$

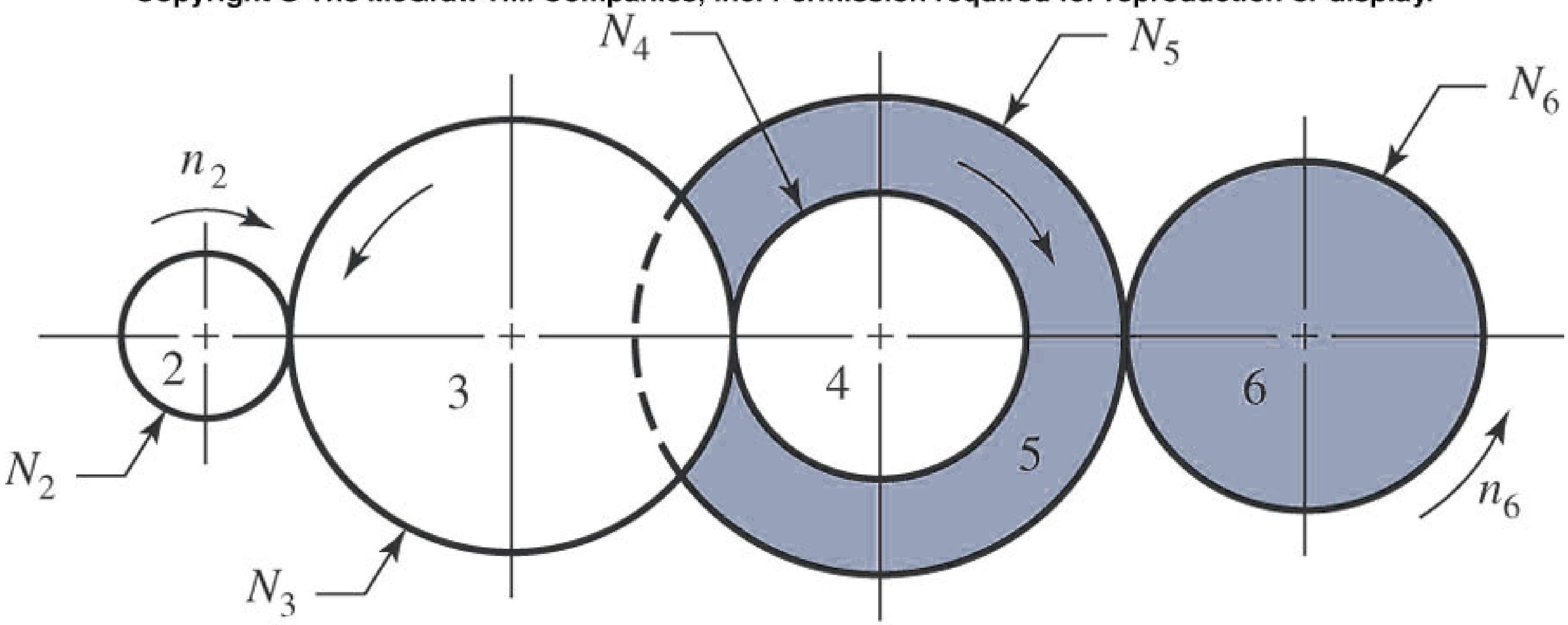
Speed ratio:



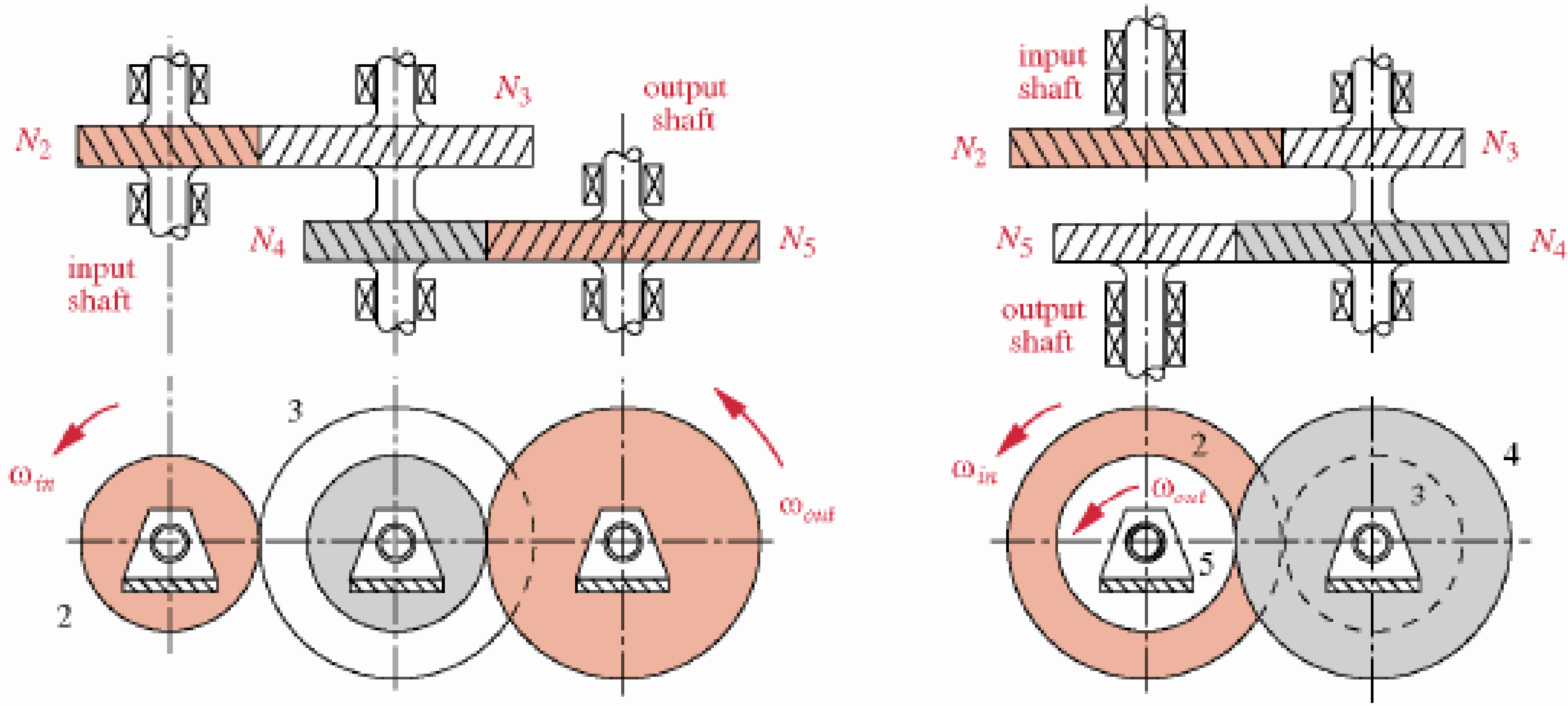
Gear Trains

For the gear train shown in figure, if the driving gear is gear number 2. The transmission ratio of the gear train:

$$i_T = \frac{n_i}{n_o} = \frac{N_3}{N_2}\,\frac{N_4}{N_3}\,\frac{N6}{N_5}$$



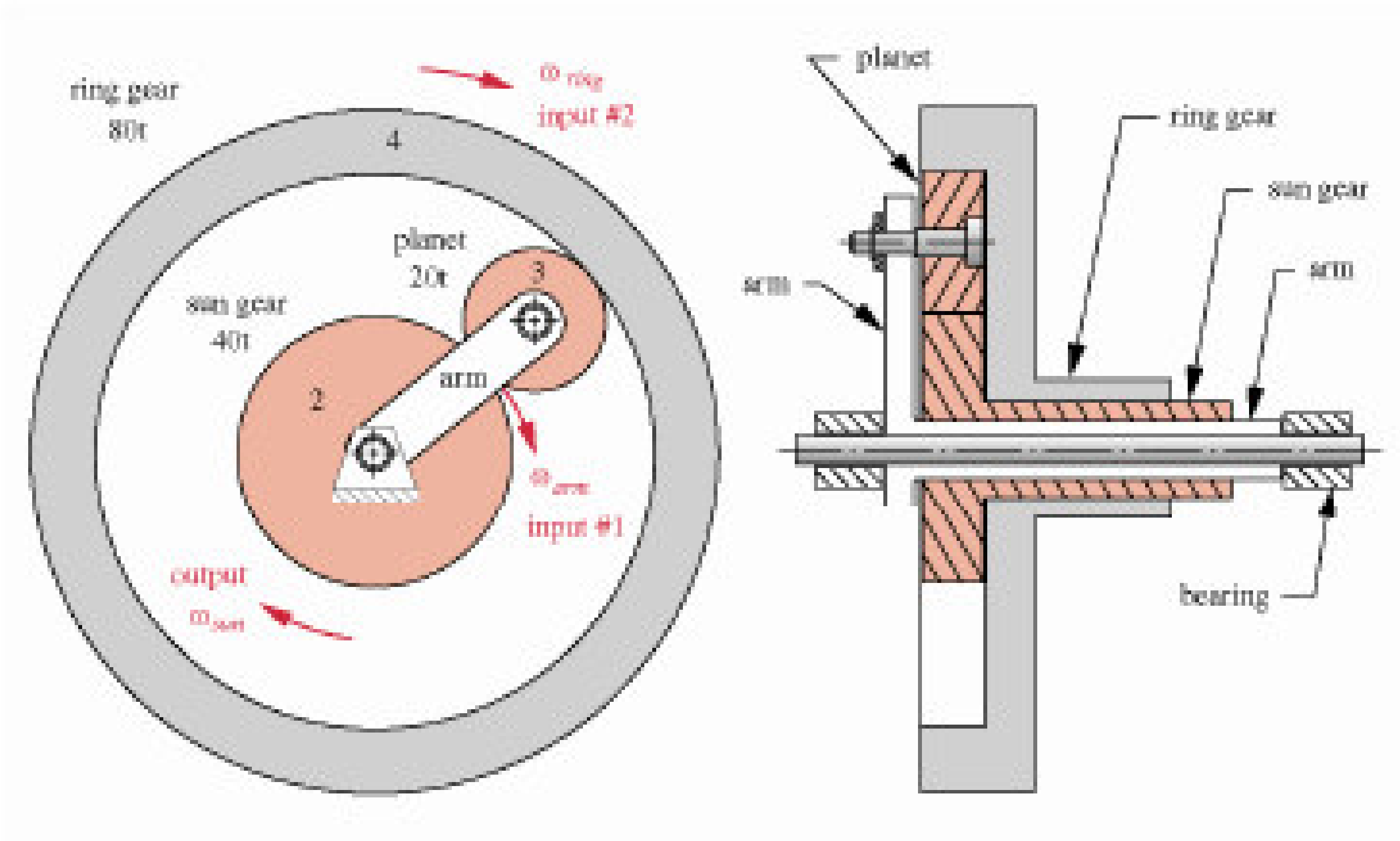
Compound Gear Trains

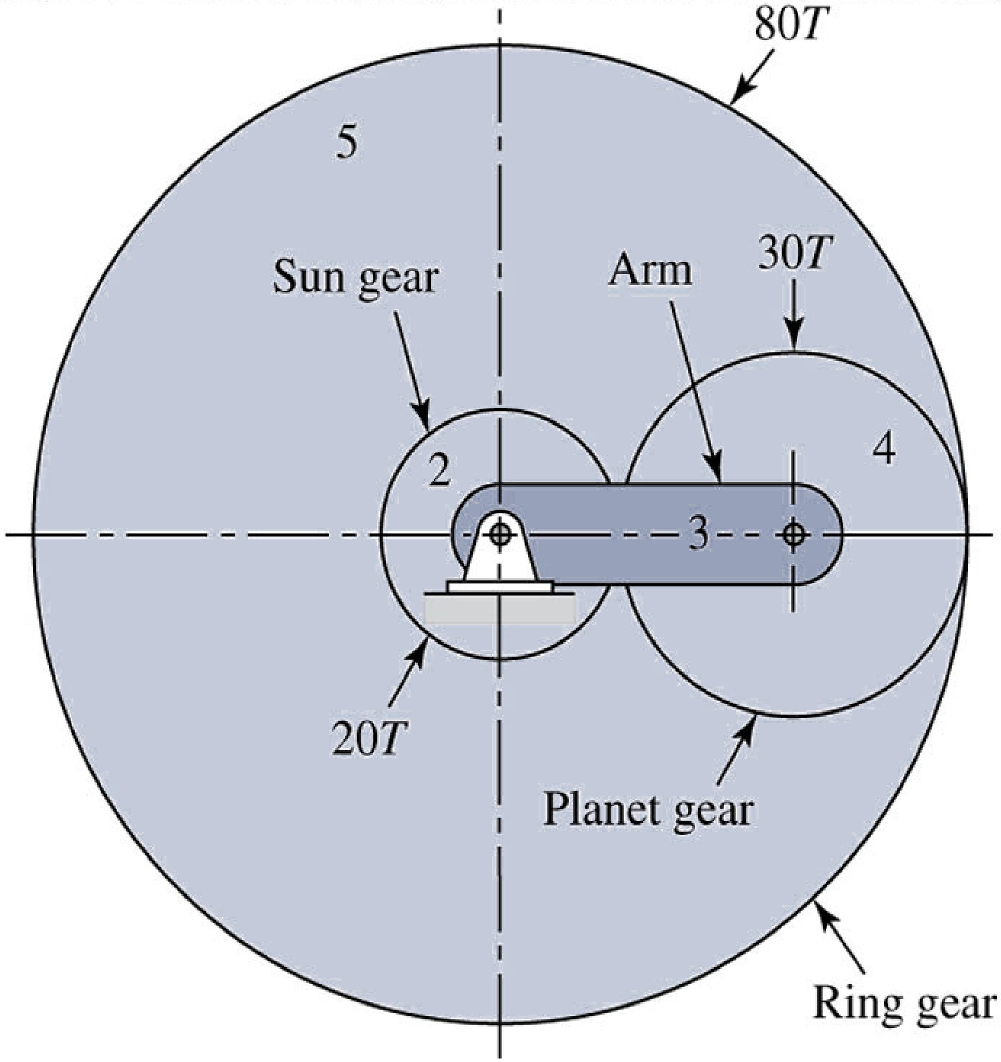


(a) (b)

Planetary Gearset with Ring Gear Output

- Two inputs (sun and arm) and one output (ring) all on concentric shafts





$$\pm \frac{\text{product of number of teeth on driver gears}}{\text{product of number of teeth on driven gears}} = \frac{n_L - n_a}{n_F - n_a}$$