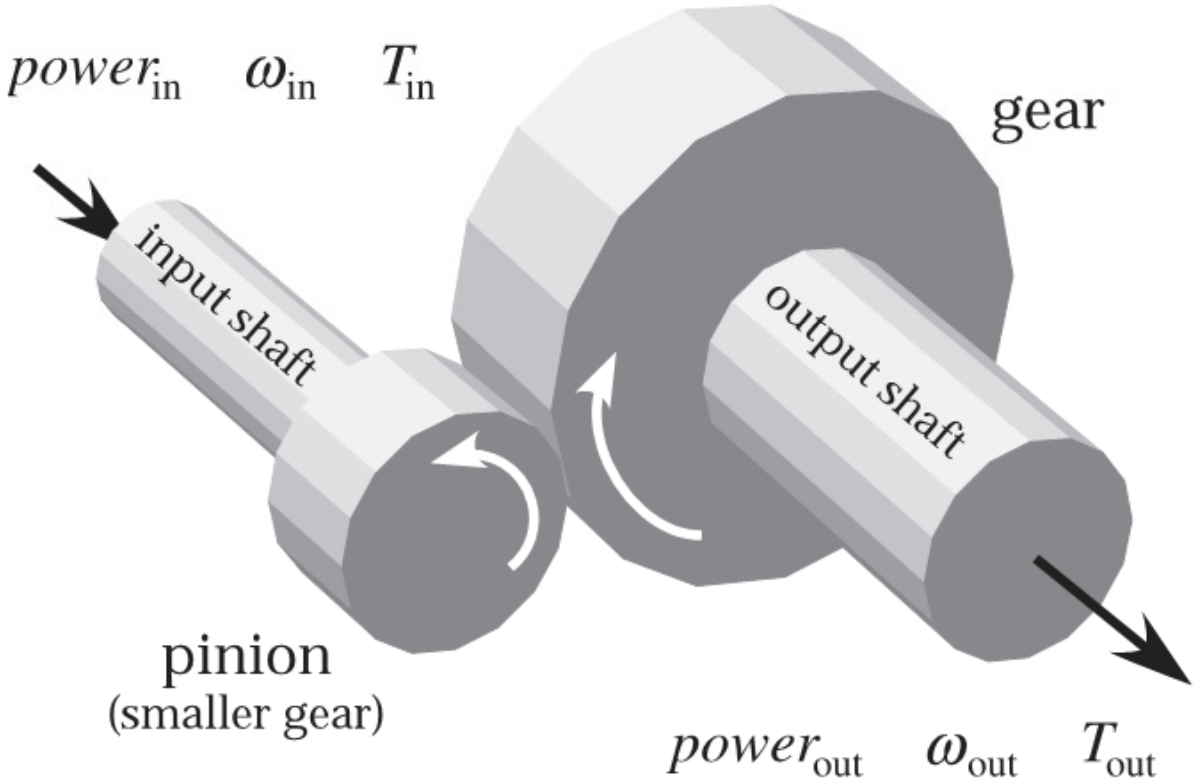
Gear Metrology

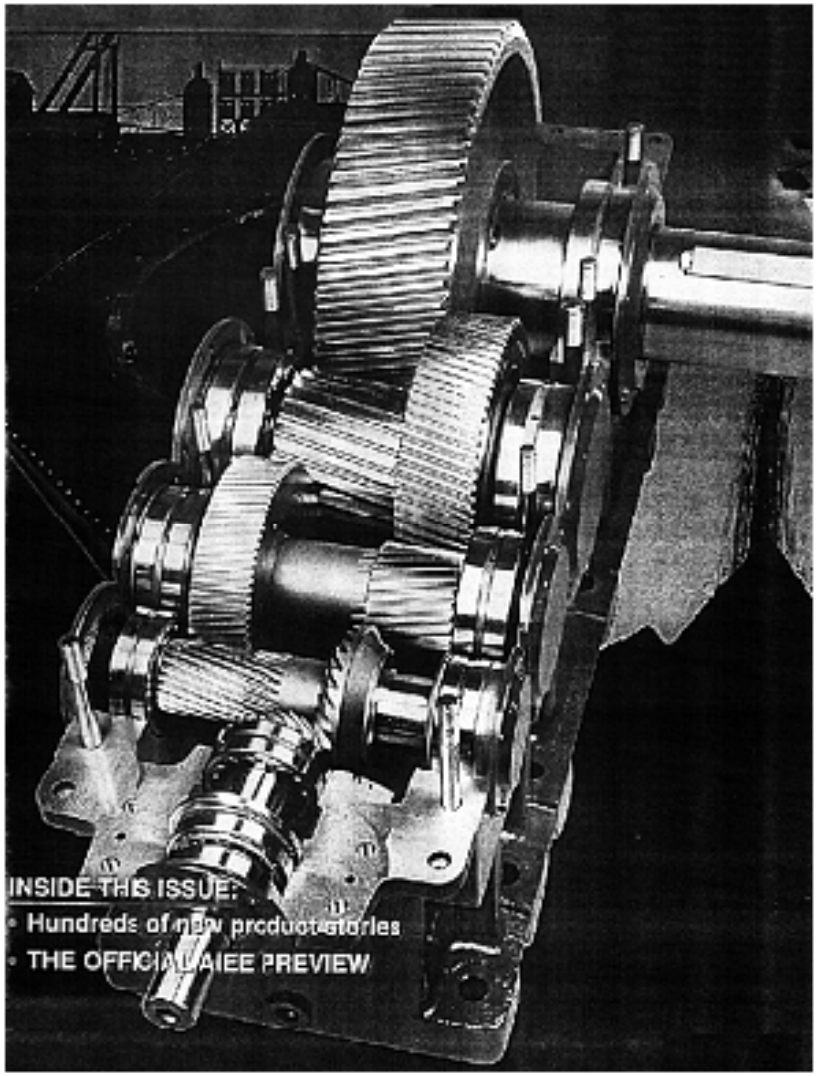
Gear


$power_{in}$
ω_{in}
T_{in}
gear
input shaft
output shaft
pinion
(smaller gear)
$power_{out}$
ω_{out}
T_{out}

Functions of a Gear

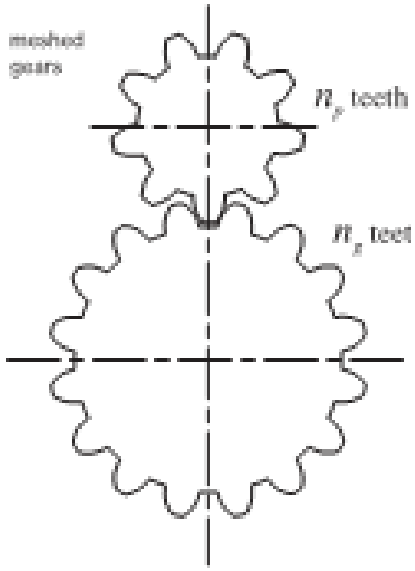
- Power transmission
- Change rotational speed/torque
- Maintain constant speed ratio

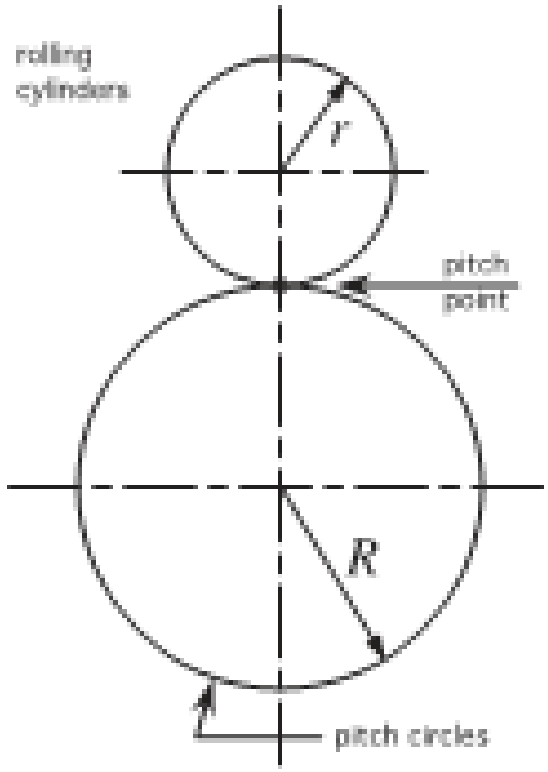
Gear Box

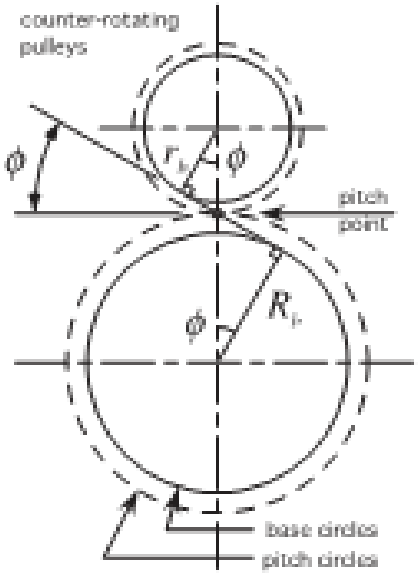


ME 338: Manufacturing Processes II
Instructor: Ramesh Singh; Notes: Profs. Singh/Kurfess

Gear Kinematics





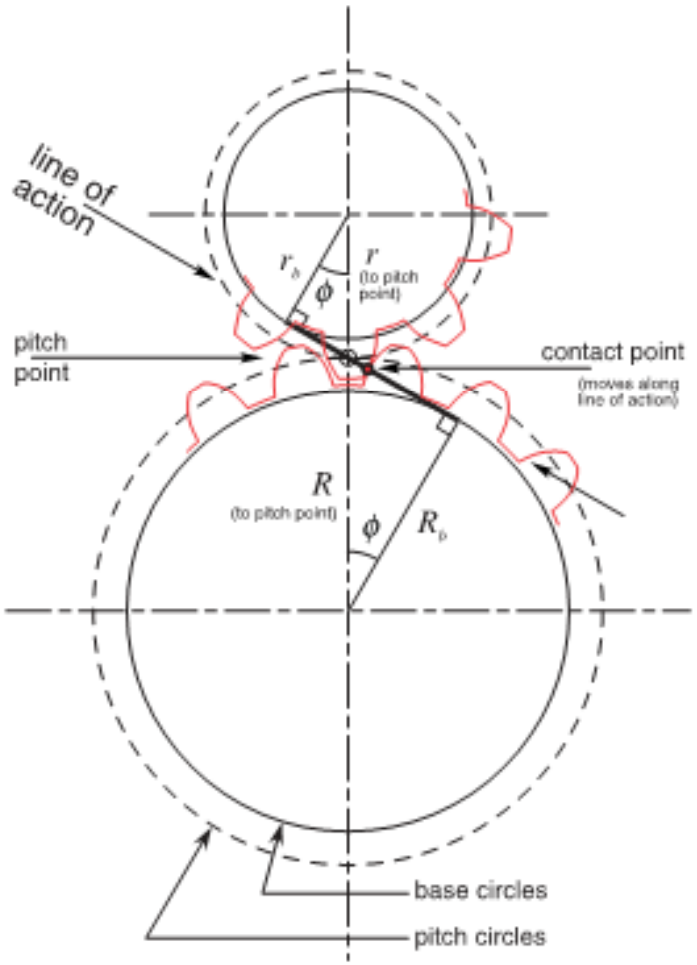


The "gear ratio" is:

$$\frac{n_g}{n_p} = \frac{R}{r} = \frac{R_b}{r_b}$$

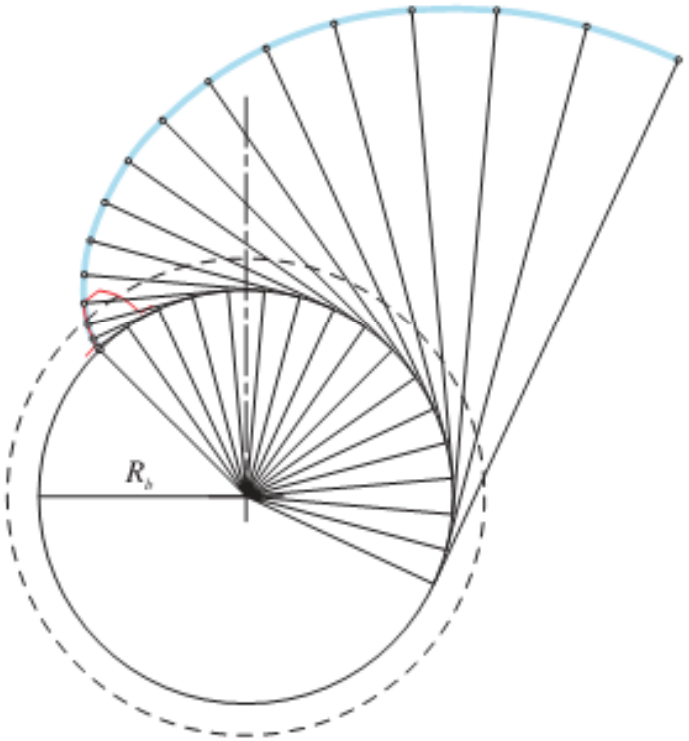
Line of Action

Contact between a meshing pair of gears is arranged to occur purely along a specified "line of action":



Involute Profile

- Formed by unwrapping a tangent chord from the base circle

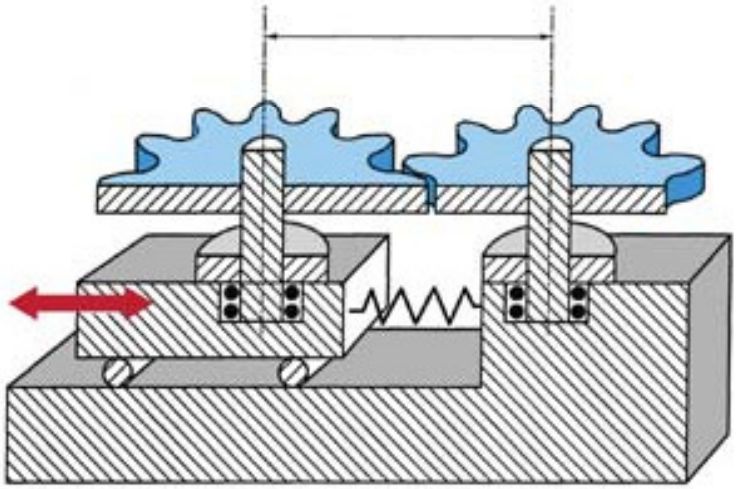


Definitions

- Diametral pitch, P = N/D
- Module M is reciprocal of P = D/N
- Circular pitch = πM (arc on pitch circle from flank of one tooth to other tooth)
- Base pitch = Pb = πM cosϕ
- Addendum = M
- Dedendum = 1.157 M/1.250M/1.400M
- Clearance = Dedendum-addendum
- M, N, ϕ are required for characterization

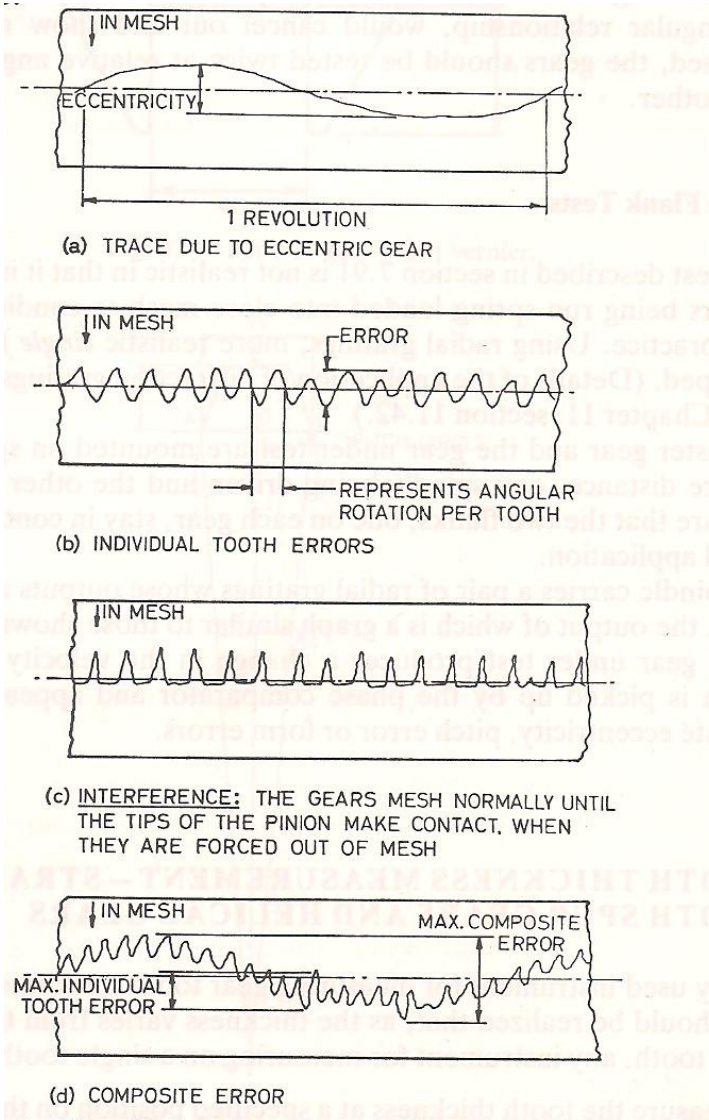
Gear Measurement

- General Tests
- Measurement of individual elements



Dual flank test

Test Results



Gear Tooth Measurement-Gear Tooth Vernier

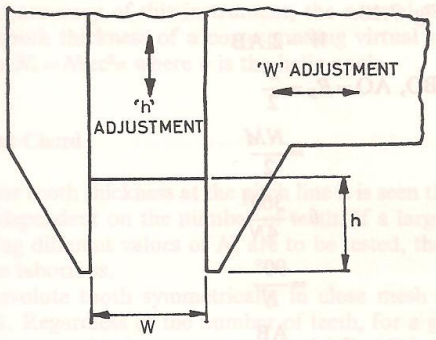


Fig. 7.9. Jaws of gear-tooth vernier.

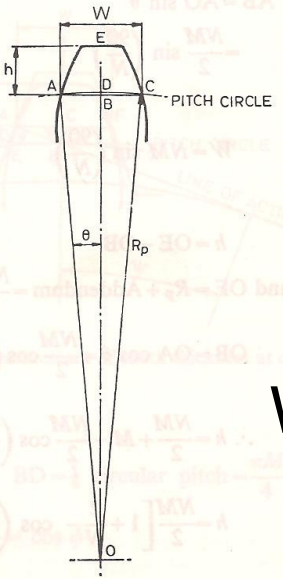
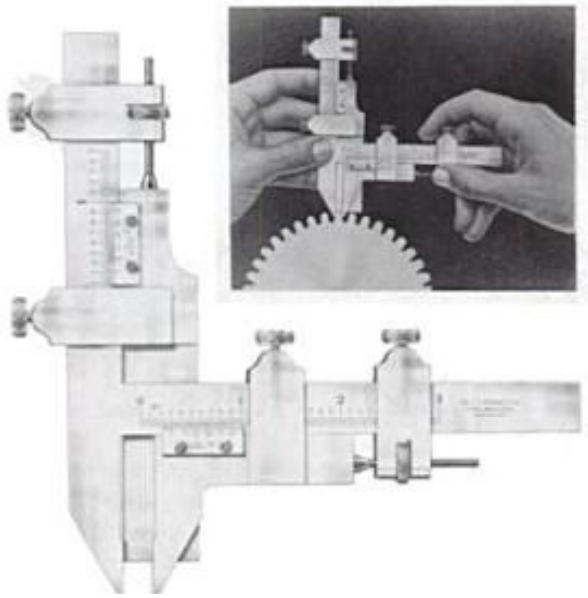


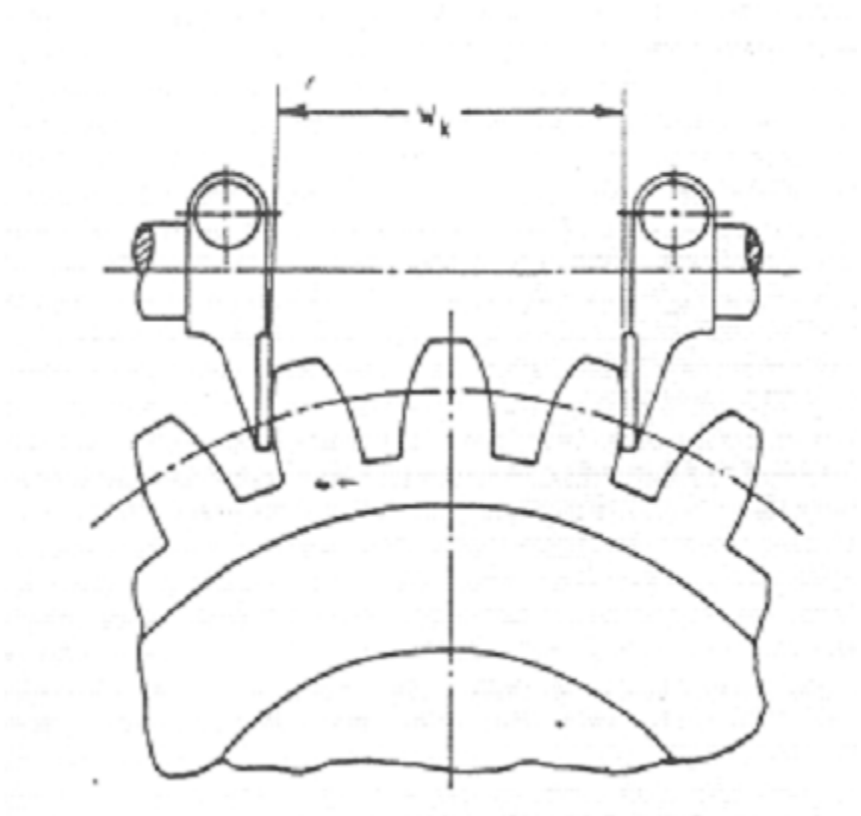
Fig. 7.10. Measurement of chordal thickness at pitch line.



$$W = NM\sin(90/N)$$

Base Tangent Method

- Single tooth measurement has errors so multiple teeth can be measured at one go



Base Tangent Method

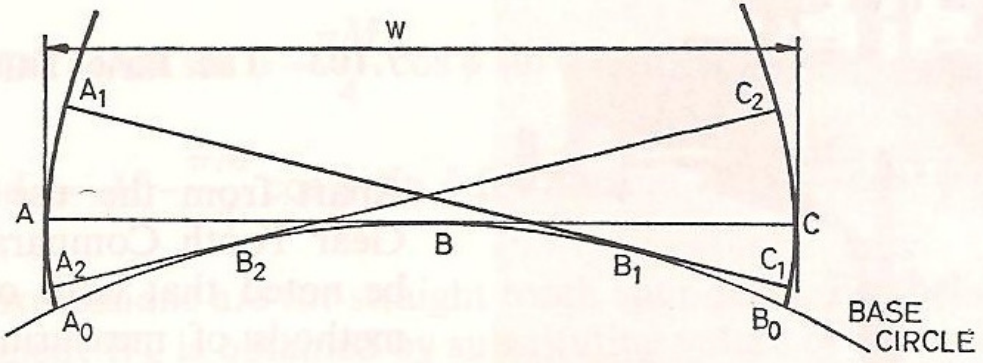


Fig. 7.14. Generation of a pair of opposed involutes by a common generator.

$$W = NM\cos\phi\left[\tan\phi - \phi + \frac{\pi}{2N} + \frac{\pi S}{2N}\right]$$

Where N=No. of teeth; M=Module; ϕ=Pressure angle;
S= No. of tooth spaces in W

Pitch Measurement

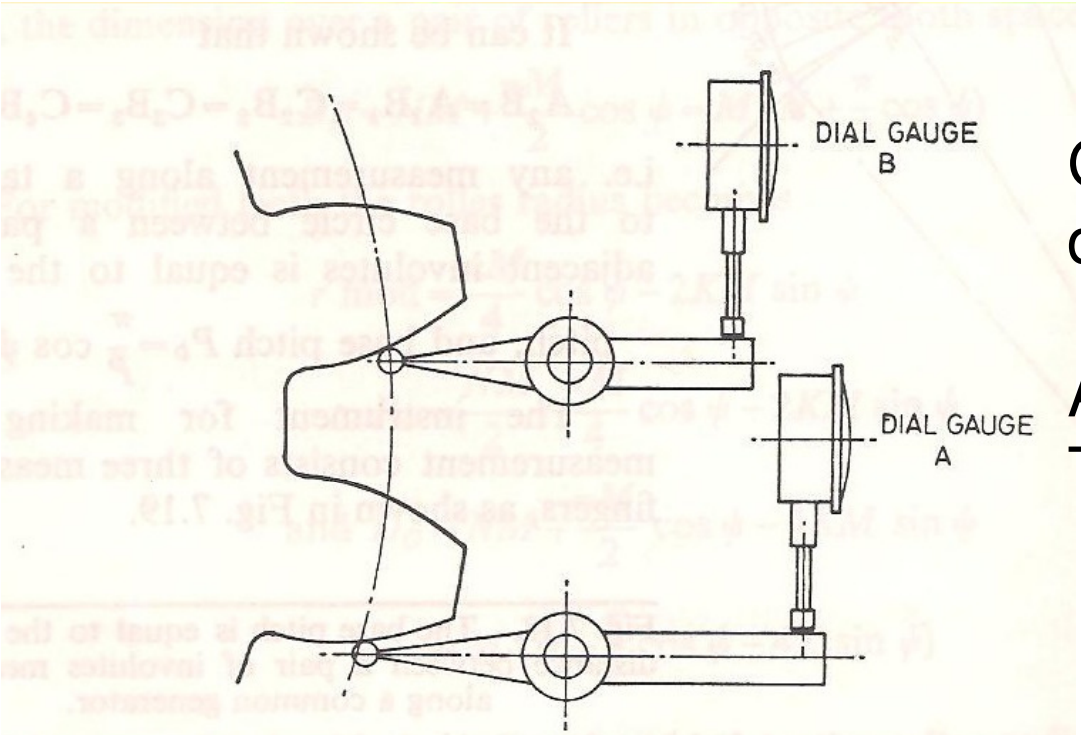


Fig. 7.20. Use of two dial gauges to determine tooth-to-tooth pitch errors.

Gage A is constant
due to gear indexing

Any change in gage B shows
That there are errors