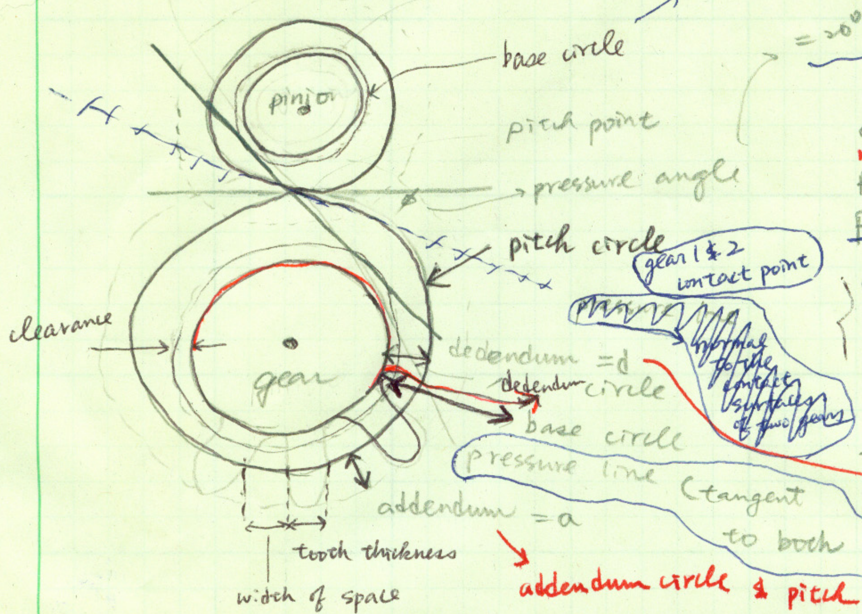
→ module $m = \frac{d_2}{N_2} = \frac{d_1}{N_1}$

→ pitch circle
→ pressure angle 20° or 25° ϕ
→ base circle → N
→ $a = \frac{1}{P}$
→ $b = \frac{1.25}{P}$

defined as circles tangent to pressure line

= 20° or 25°, only $F\cos\theta$ exert useful torque



d = pitch diameter
m = module = $\frac{d_2}{N_2} = \frac{d_1}{N_1}$
p = circular pitch = $\frac{\pi d}{N}$
P = diametral pitch = $\frac{N}{d}$
a = $\frac{1}{P}$ — standard
b = $\frac{1.25}{P}$ — standard

$\frac{w_2}{w_1} = -\frac{d_1}{d_2}$ inverse porportion

involute of a circle : locus traced by the free end of a taut string that is "unwrapped" from the circle

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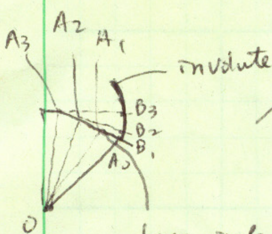
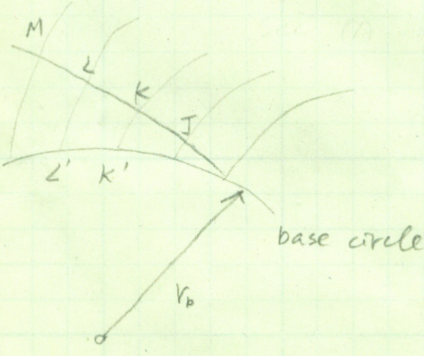
interference : intersections of pressure line and base circle
→ interference points
if intersection of addendum & pressure lines comes outside of these points
→ interference.



$\overline{A_0A_1} = \overline{A_1A_2} = \overline{A_2A_3} = \cdots$
make tangent lines on $A_1, A_2, A_3 \ldots$
along A_1 tangent line
fine B_1 such that
$\overline{A_1B_1} = \overline{A_1A_0}$



$\overline{ML} = \overline{LK} = \overline{KJ} = \cdots$

taut string property
$\overline{LK} = \overset{\frown}{L'K'} = \frac{2\pi r_b}{N}$

1 tooth → length $\overline{LK}$
$\frac{1}{\overline{LK}}$ tooth → tooth/length → No. of teeth in length

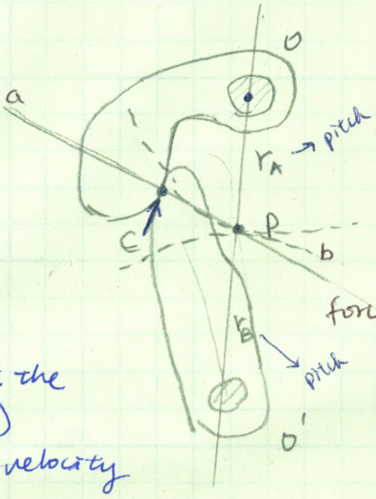
$\frac{\overline{CD}}{\overline{LK}} = \frac{\overline{CD}}{2\pi r_b/N} \equiv$ contact ratio

- Conjugate Action   modul $m = \frac{d}{N}$

When tooth profiles are designed to produce a constant angular velocity ratio during meshing

In theory, given one tooth profile, one can fine the profile for meshing tooth for conjugate action

One solution is "involute profile" ⟶ universal use for gears



if P is not changing, O & O' do not feel the change (no matter what the shapes are)

⟹ constant angular velocity

C is the contact point where two surfaces are tangent to each other

force is acting on common normal $\overline{ab}$, called line of action — normal to surface (contact point C)
pressure line — normal to base circle

~~the~~ P is the intersection point of $\overline{ab}$ & $\overline{OO'}$

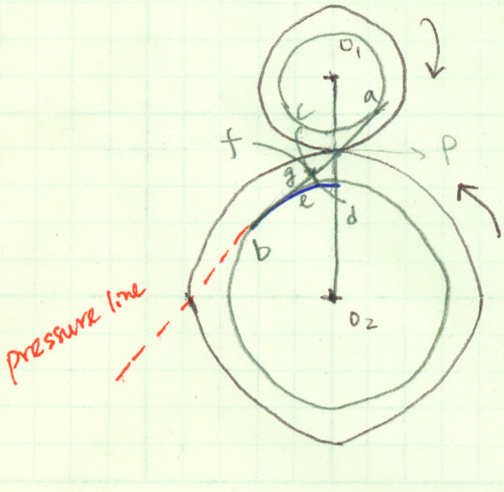
⟹ pitch point

r_A — pitch radius
r_B

to maintain a constant angular velocity ⟹ every instantaneous point of contact must pass through the same point P

⟸ involute will satisfy this

- ~~Generating Involute~~



a.b is a tighten cord, $\overline{ab}$ generating line

point of contact is the tracing point

generating line does not change position,

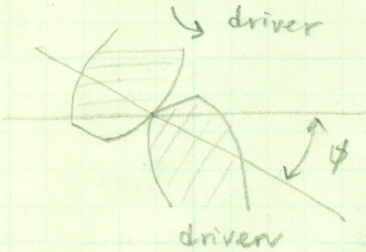
⟶ always tangent to base circles

⟶ - - - normal to the involute at point of contact

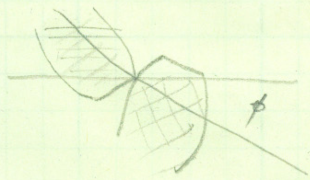
⟹ satisfy the requirement

· contact length & contact ratio

Initial contact point



final contact



⟹ contact starts when $\boxed{\text{addendum circle}}$ of driven gear intersects the pressure line

ends when addendum circle of driver gear intersects the pressure line

· recitation handout

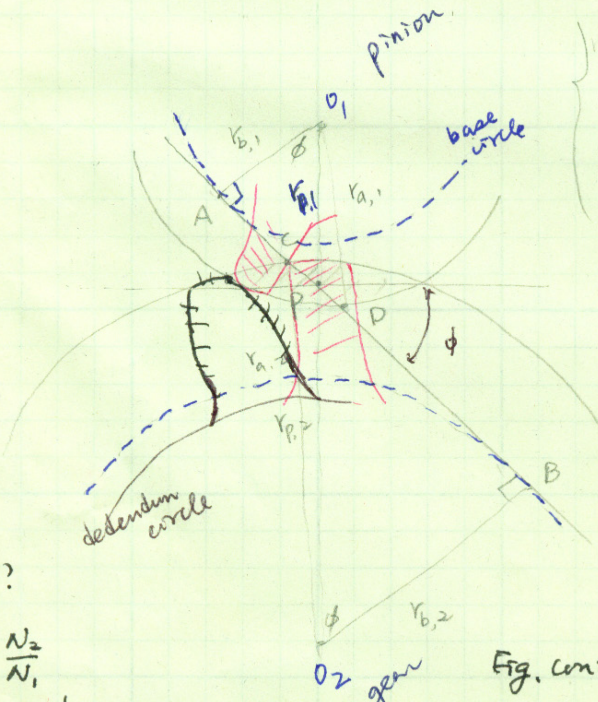


Fig. contact

$$\begin{cases} r_b = r_p \cos\phi \\ r_a = r_p + \frac{1}{P} \end{cases}$$

$$\begin{cases} \overline{AD} = \sqrt{r_{a,1}^2 - r_{b,1}^2} \\ \overline{BC} = \sqrt{r_{a,2}^2 - r_{b,2}^2} \\ \overline{AB} = r_{p1}\sin\phi + r_{p2}\sin\phi = O_1O_2 \sin\phi \\ \overline{CD} = \overline{AD} + \overline{BC} - \overline{AB} \end{cases}$$

$$C.R. = \frac{CD}{2\pi r_b / N} \qquad \frac{r_b}{N} = \frac{r_{b1}}{N_1} = \frac{r_{b2}}{N_2}$$

$1.5 < C.R. < 2.0$

interference

$\overline{BC} > \overline{AB}$ or ← A is inside the arc of action

$\overline{AD} > \overline{AB}$ ← B is inside the arc of action

why $\frac{r_{b1}}{N_1} = \frac{r_{b2}}{N_2}$?

$$\frac{\omega_1}{\omega_2} = \frac{d_2}{d_1} = \frac{N_2}{N_1}$$

module $= m = \frac{d_2}{N_2} = \frac{d_1}{N_1}$ must be the same

See Fig. contact

$$\frac{d_2}{d_1} = \frac{r_{b2}}{r_{b1}} = \frac{N_2}{N_1} \quad \Rightarrow \quad \frac{r_{b1}}{N_1} = \frac{r_{b2}}{N_2}$$