28. *Fundamental Theory of Toothed Gearing (VI).*

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Suppose that there are given on a unit sphere a pair of pitch curves K_1 and K_2 and a pair of profile curves F_1 and F_2 invariably connected with K_1 and K_2 respectively, and that the length of arcs of K and F are given the signs as well as in the case of plane curves.

§ 1. Sliding of profile curves.

At the sliding contact motion of the profile curves F_1 and F_2, let a part of arc $d\varsigma_1$ of F_1 and a part of arc $d\varsigma_2$ of F_2 slide one along the other during infinitesimal time interval dt, and let $d\xi$ be, in this case, the length of arc of contact of the pitch curve K_1 or K_2. Then the point C on F_1 slides along F_2 for the distance $d\varsigma_2 - d\varsigma_1$, and consequently its velocity v_{p1} is given by

$$(1)_1 \qquad v_{p1} = \frac{d\varsigma_2 - d\varsigma_1}{dt} .$$

v_{p1} is named the velocity of sliding of F_1 (af the point C on F_2). In like manner the velocity of sliding of F_2 may be defined :

$$(1)_2 \qquad v_{p2} = \frac{d\varsigma_1 - d\varsigma_2}{dt} .$$

Denoting by ω_1 and ω_2 respectively the instant angular velocities of K_1 and K_2 at the rolling contact motion and by λ_1 and λ_2 the spherical radii of curvature of K_1 and K_2 respectively at the instant common pitch point P we have

$$(2) \qquad \omega_1 = \frac{1}{\sin\lambda_1}\frac{d\xi}{dt}, \quad \omega_2 = \frac{1}{\sin\lambda_2}\frac{d\xi}{dt} .$$

Let ω denote the relative rolling angular velocity of K_1 to K_2, then ω is gven by

$$(3) \qquad \omega = \omega_1 \cos\lambda_1 - \omega_2 \cos\lambda_2$$

and accordingly from (2) follows

$$(4) \qquad \omega = \left(\frac{1}{\tan\lambda_1} - \frac{1}{\tan\lambda_2} \right) \frac{d\xi}{dt} .$$

Next, let φ be the singed length of the arc of the great circle connnecting P with the point of contact C of F_1 and F_2, then the velocity v_{p1} of C is represented by $\sin\varphi \cdot \omega$, that is,