9. For equilibrium of sprag F.B. :-

$\curvearrowleft \Sigma M_O = F_1 r_1 - F_2 r_2 = 0$ (1)

$\uparrow \Sigma F = N_1 - N_2 \cos\alpha + F_2 \sin\alpha = 0$ (2)

$\rightarrow \Sigma F = F_1 - N_2 \sin\alpha - F_2 \cos\alpha = 0$ (3)

It is apparent from the sketch that $F_1/N_1 > F_2/N_2$, i.e. slipping on inner race will limit torque transmission.

So $F_1 = \mu N_1$ (4)

Eliminating F_1, F_2

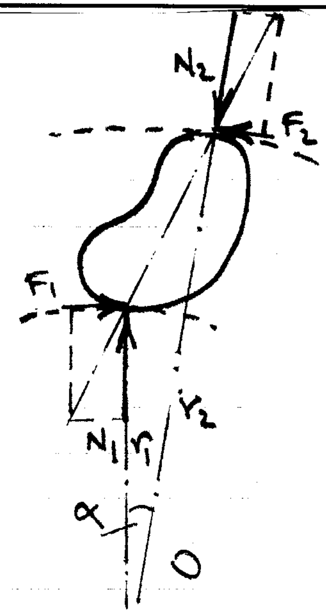
$$\frac{N_1}{N_2} = \frac{\cos\alpha}{1+\mu\frac{r_1}{r_2}\sin\alpha} = \frac{\sin\alpha}{\mu(1-\frac{r_1}{r_2}\cos\alpha)}$$

i.e.

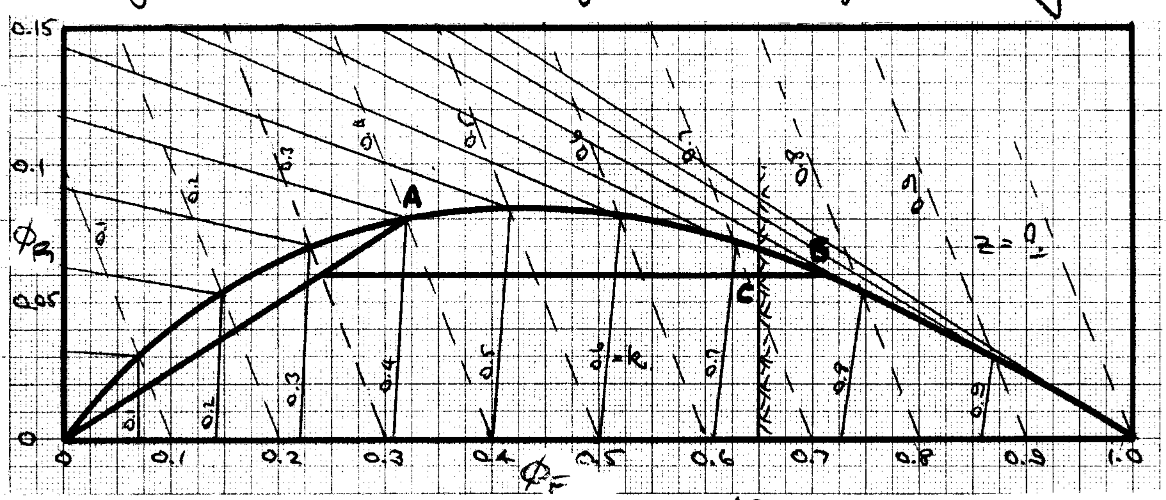
$$\sin\alpha = \mu(\cos\alpha - r_1/r_2)$$ when slip occurs.

Therefore to prevent slip, for small α,

$$\alpha < \mu(1-r_1/r_2).$$



10. Use of equations (22) yields the following :



If control characteristic is $\phi_R/\phi_F = 1/4$, it is represented by line OA. Inserting into (24) gives on the vehicle characteristic at A :

$\phi_F = 0.32$ ∴ $\phi_R = \phi_F/4 = 0.08$ ∴ $k = z = \phi_F + \phi_R = 0.4$

i.e. max. deceleration $= 0.4 \times 9.81 = 3.9\ m/s^2$

If ϕ_R is limited to 0.06 then the limiting characteristic 'B' is obtained.

Inserting $\phi_R = 0.06$ into (24) yields $\phi_F = 0.705$

∴ on the characteristic, at B, $k = z = \phi_F + \phi_R = 0.765$

i.e. max. deceleration $= 0.765 \times 9.81 = 7.5\ m/s^2$

To avoid B, we may stipulate also that front wheel is limited to $\phi_F = 0.65$ as at C above. This vehicle is most unusual - note the small contribution of rear.