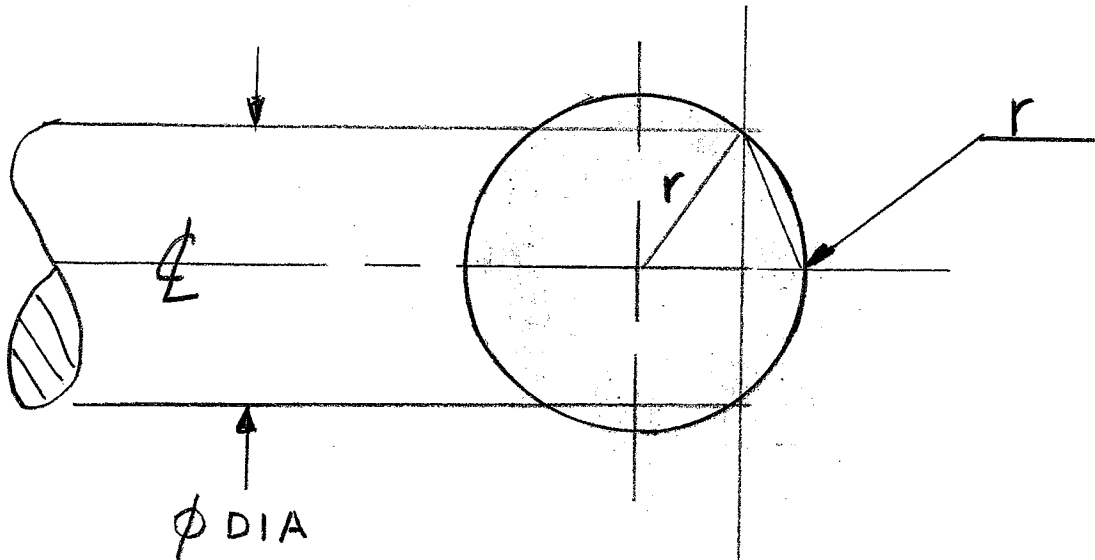


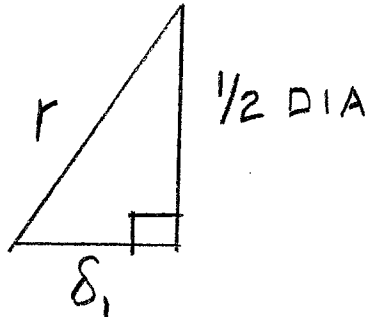
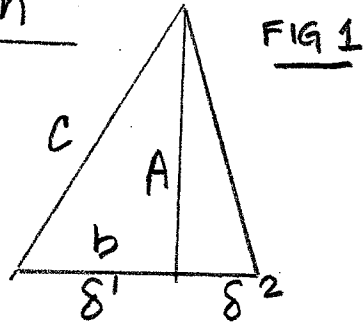
CALCULATING Spherical Radius



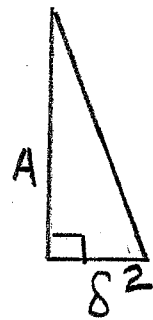
Pythagorean
THEORY

$$A^2 + b^2 = c^2$$

$$b = \sqrt{c^2 - A^2}$$



Scalene RIGHT
ANGLED
TRIANGLE



EXAMPLE:

φ 1.50 DIA

w/ .875 RADIUS

CALCULATE the
RADIUS END POINT.

$$\delta_1 = \sqrt{(r^2) - (\frac{1}{2} \text{ DIA})^2}$$

$$r - \delta_1 = \delta_2$$

$C = r$ (SEE FIG 1)

$$A = \frac{1}{2} \text{ DIA}$$

$$b = \delta_1 \text{ (to solve for)}$$

$$\delta_1 = \sqrt{(1.875)^2 - (.750)^2}$$

$$\delta_1 = \sqrt{0.765625 - 0.5625}$$

$$\delta_1 = 0.45069$$

now solve for δ_2 (SEE FIG 2)

$$r - \delta_1 = \delta_2$$

$$.875 - .45069 = .42431 \text{ (Z END POINT)}$$

Program:

X0 Z0

G02 X1.50 Z-.42431 R.875

NOTE:

ALL CALCULATIONS MUST BE WITHIN .0001"
OTHERWISE ERROR WILL OCCUR WITH G02 OR G03
ARC COMMAND.

$$F = R_1 + R_2$$

$$D = \frac{A\phi - B\psi}{2}$$

$$C = R_1 - D$$

$$E = C + R_2$$

$$G = \sqrt{F^2 - E^2}$$

$$\alpha = \tan^{-1} \frac{E}{G}$$

$$H = (R_2)(\cos \alpha)$$

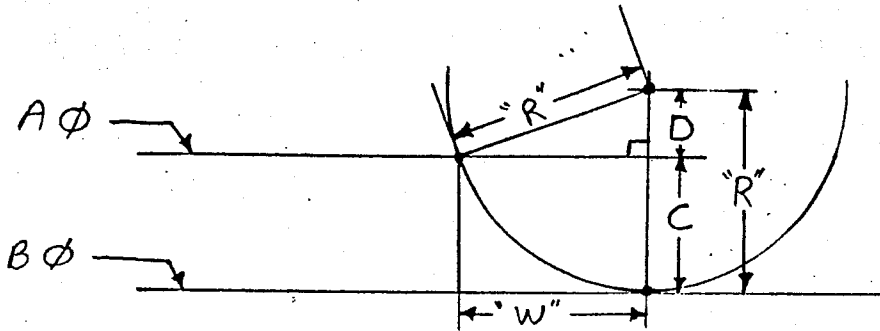
$$J = (R_2)(\sin \alpha)$$

$$K = R_2 - J$$

$$L = D - K$$

$$M = G - H$$

FINDING START + FINISH POINTS
FOR GENERATING A SEGMENT OF A RADIUS.



$$\frac{A\phi - B\phi}{2} = C$$

$$R - C = D$$

$$R^2 - D^2 = W^2$$

$$\sqrt{W^2} = W$$

R = SIZE OF RADIUS

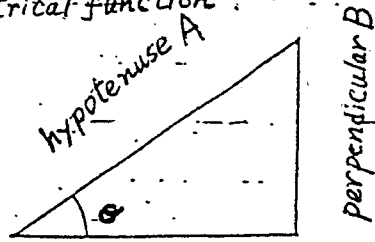
A = MAJOR DIA.

B = MINOR DIA.

W = LENGTH OF RADIUS SEGMENT

Solution of point-coordinate.

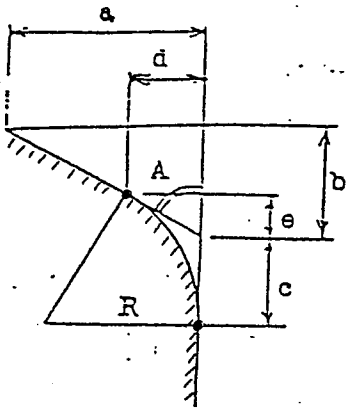
1. Trigonometrical function.



$$\begin{aligned} \sin \theta &= \frac{B}{A} \\ \cos \theta &= \frac{C}{A} \\ \tan \theta &= \frac{B}{C} \\ A^2 &= B^2 + C^2 \end{aligned}$$

Hypotenuse (A)	base C Perpendicular (B)	Base (C)	Angle (θ)
$A = \frac{B}{\sin \theta}$ $A = \frac{5}{\sin 25} = \frac{5}{0.422618} = 11.831$	$B = A \times \sin \theta$ $B = 10 \times \sin 20 = 10 \times 0.34202 = 3.420$		$\theta = \sin^{-1} \frac{B}{A}$ $\theta = \sin^{-1} \frac{5}{10} = \sin^{-1} 0.5 = 30^\circ$
$A = \frac{C}{\cos \theta}$ $A = \frac{8}{\cos 30} = \frac{8}{0.866025} = 9.238$		$C = A \times \cos \theta$ $C = 9 \times \cos 32 = 9 \times 0.848048 = 7.632$	$\theta = \cos^{-1} \frac{C}{A}$ $\theta = \cos^{-1} \left(\frac{9}{12} \right) = \cos^{-1} 0.75 = 41.4096$
	$B = C \times \tan \theta$ $B = 7 \times \tan 25 = 7 \times 0.466308 = 3.264$	$C = \frac{B}{\tan \theta}$ $C = \frac{5}{\tan 27} = \frac{5}{0.509525} = 9.813$	$\theta = \tan^{-1} \frac{B}{C}$ $\theta = \tan^{-1} \left(\frac{7}{9} \right) = \tan^{-1} 0.7778 = 37.875$
$A = \sqrt{B^2 + C^2}$ $A = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$	$B = \sqrt{A^2 - C^2}$ $B = \sqrt{7^2 - 5^2} = \sqrt{49 - 25} = \sqrt{24} = 4.899$	$C = \sqrt{A^2 - B^2}$ $C = \sqrt{9^2 - 5^2} = \sqrt{81 - 25} = \sqrt{56} = 7.483$	

3. Solution of point-Coordinate when straight line - arc - taper work.



$$A = \tan^{-1}\left(\frac{a}{b}\right)$$

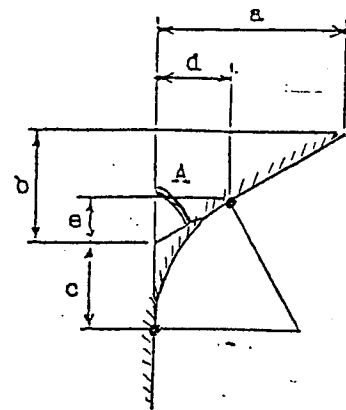
$$a = b \times \tan A$$

$$b = \frac{a}{\tan A}$$

$$c = R \times \tan \frac{A}{2}$$

$$d = R - R \times \cos A$$

$$e = R \times \sin A - c$$



$$A = \tan^{-1}\left(\frac{a}{b}\right)$$

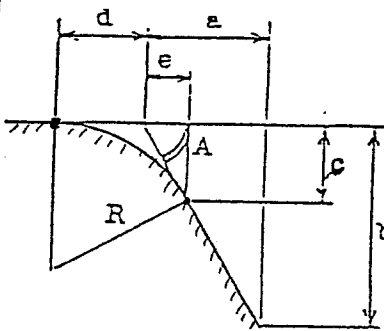
$$a = b \times \tan A$$

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$$A = \tan^{-1}\left(\frac{b}{a}\right)$$

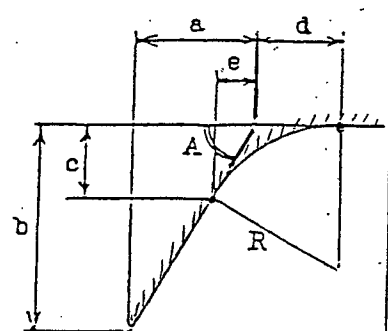
$$a = \frac{b}{\tan A}$$

$$b = a \times \tan A$$

$$c = R - R \times \cos A$$

$$d = R \times \tan \frac{A}{2}$$

$$e = R \times \sin A - d$$



$$A = \tan^{-1}\left(\frac{b}{a}\right)$$

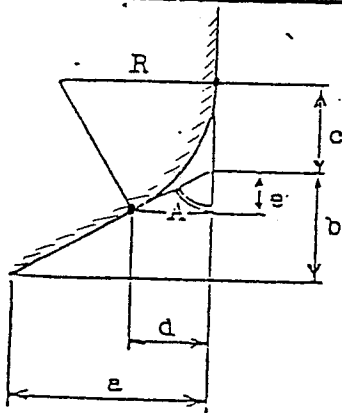
$$a = \frac{b}{\tan A}$$

$$b = a \times \tan A$$

$$c = R - R \times \cos A$$

$$d = R \times \tan \frac{A}{2}$$

$$e = R \times \sin A - d$$



$$A = \tan^{-1}\left(\frac{a}{b}\right)$$

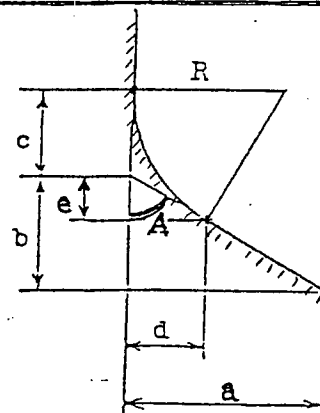
$$a = b \times \tan A$$

$$b = \frac{a}{\tan A}$$

$$c = R \times \tan \frac{A}{2}$$

$$d = R - R \times \cos A$$

$$e = R \times \sin A - c$$



$$A = \tan^{-1}\left(\frac{a}{b}\right)$$

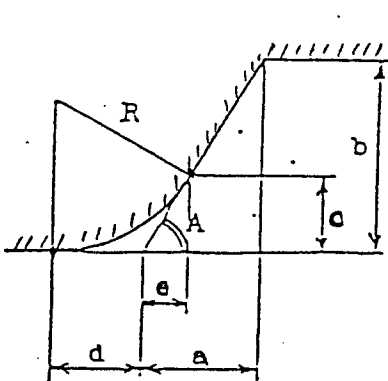
$$a = b \times \tan A$$

$$b = \frac{a}{\tan A}$$

$$c = R \times \tan \frac{A}{2}$$

$$d = R - R \times \cos A$$

$$e = R \times \sin A - c$$



$$A = \tan^{-1}\left(\frac{b}{a}\right)$$

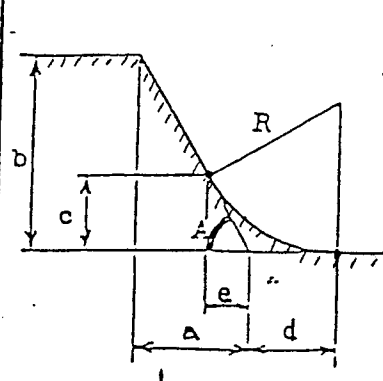
$$a = \frac{b}{\tan A}$$

$$b = a \times \tan A$$

$$c = R - R \times \cos A$$

$$d = R \times \tan \frac{A}{2}$$

$$e = R \times \sin A - d$$



$$A = \tan^{-1}\left(\frac{b}{a}\right)$$

$$a = \frac{b}{\tan A}$$

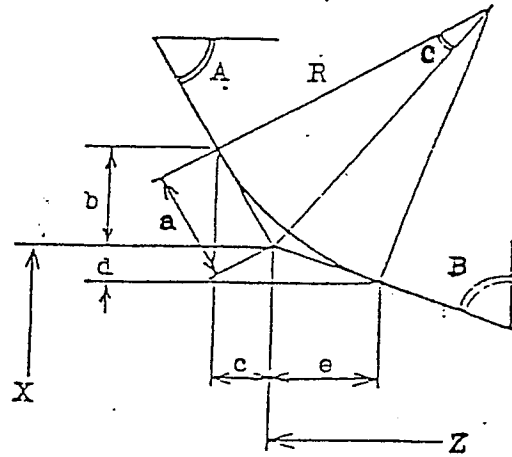
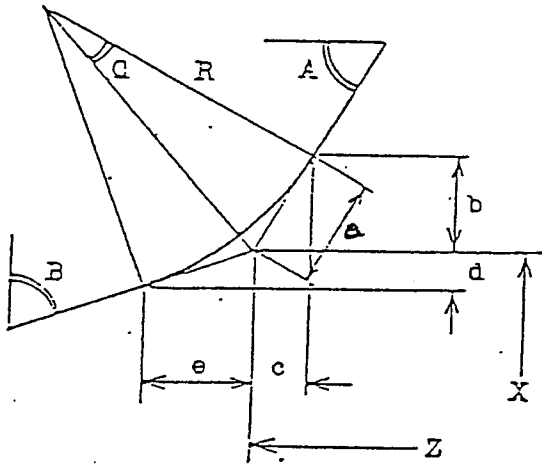
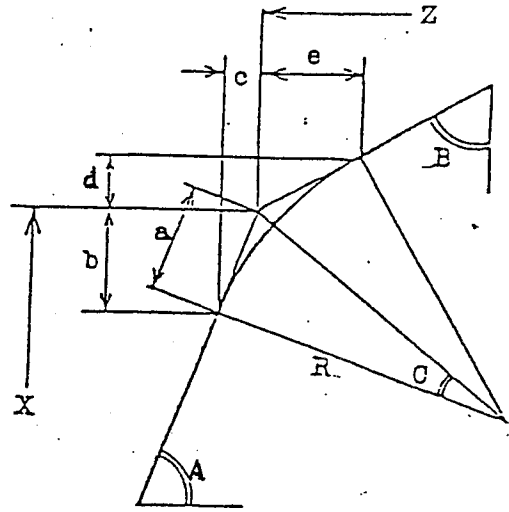
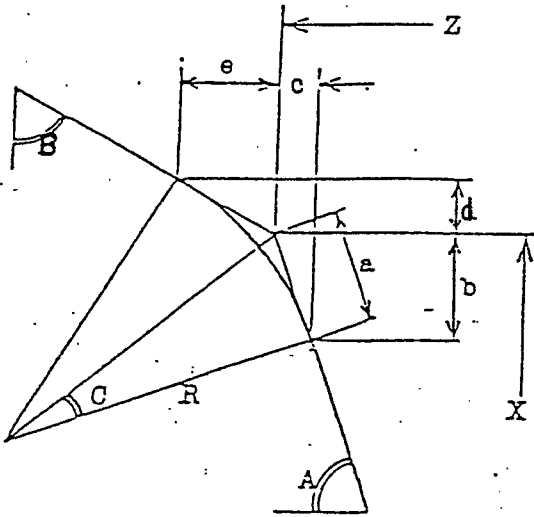
$$b = a \times \tan A$$

$$c = R - R \times \cos A$$

$$d = R \times \tan \frac{A}{2}$$

$$e = R \times \sin A - d$$

4. Solution of point - Coordinate when taper - arc - taper work



$$C = \frac{A + B - 90}{2}$$

$$a = R \times \tan C$$

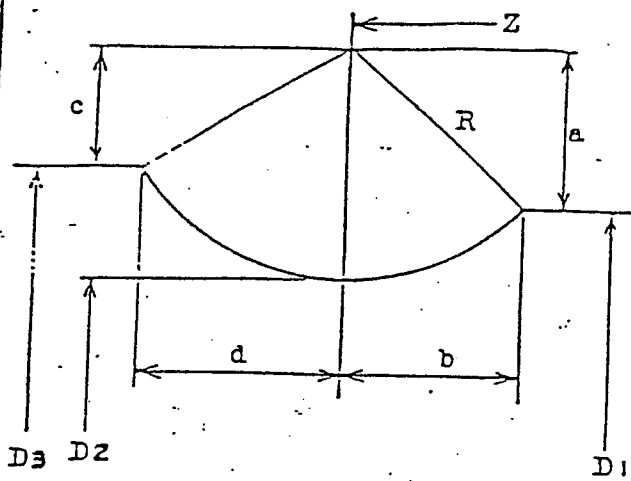
$$b = a \times \sin A$$

$$c = a \times \cos A$$

$$d = a \times \cos B$$

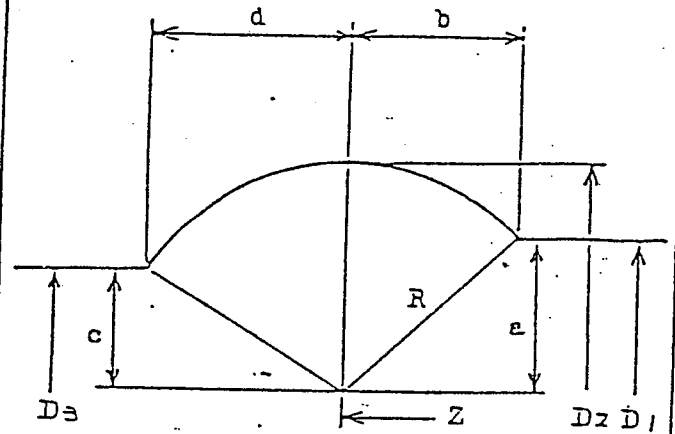
$$e = a \times \sin B$$

5. Solution of point - Coordinate when line - arc - line.



$$a = R - \frac{D_1 - D_2}{2} \quad c = R - \frac{D_2 - D_2}{2}$$

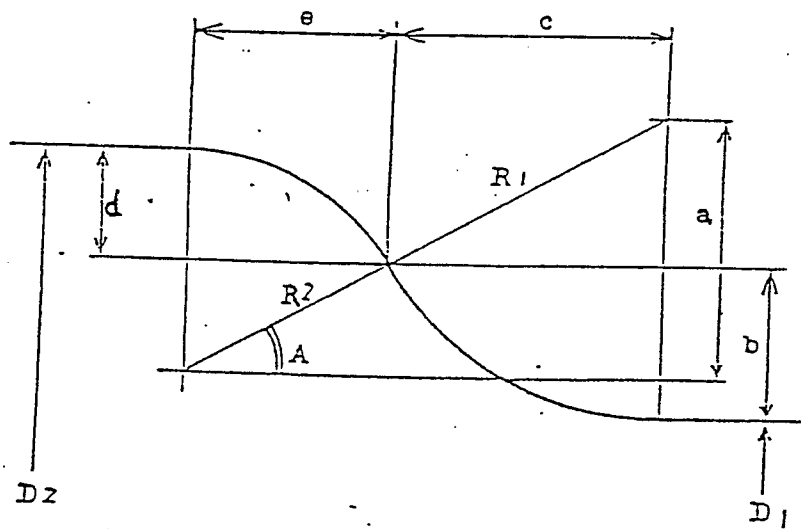
$$b = \sqrt{R^2 - a^2} \quad d = \sqrt{R^2 - c^2}$$



$$a = R - \frac{D_2 - D_1}{2} \quad c = R - \frac{D_2 - D_2}{2}$$

$$b = \sqrt{R^2 - a^2} \quad d = \sqrt{R^2 - c^2}$$

6. Solution of point - Coordinate when arc - a



$$a = \left(R_1 + \frac{D_1}{2} \right) - \left(\frac{D_2}{2} - R_2 \right)$$

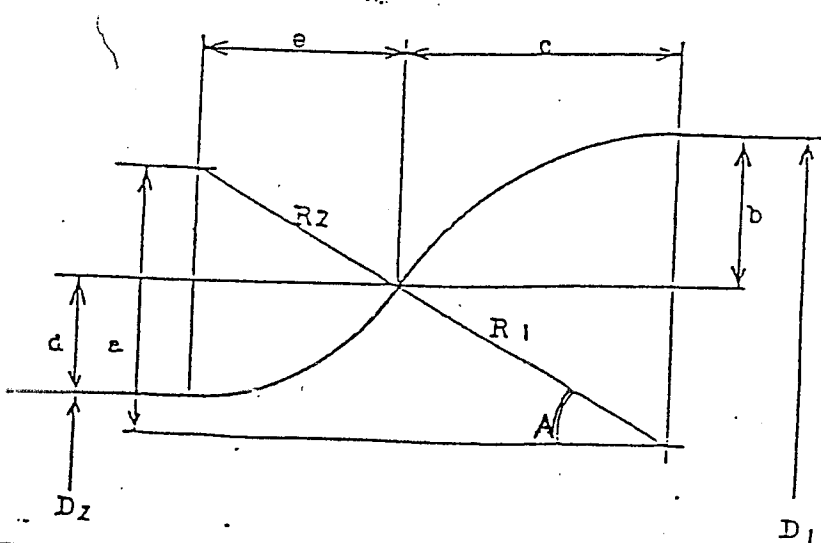
$$A = \sin^{-1} \left(\frac{a}{R_1 + R_2} \right)$$

$$b = R_1 - R_1 \times \sin A$$

$$c = R_1 \times \cos A$$

$$d = R_2 - R_2 \times \sin A$$

$$e = R \times \cos A$$



$$e = \left(\frac{D_2}{2} + R_2 \right) - \left(\frac{D_1}{2} - R_1 \right)$$

$$A = \sin^{-1} \left(\frac{e}{R_1 + R_2} \right)$$

$$b = R_1 - R_1 \times \sin A$$

$$c = R_1 \times \cos A$$

$$d = R_2 - R_2 \times \sin A$$

$$e = R_2 \times \cos A$$