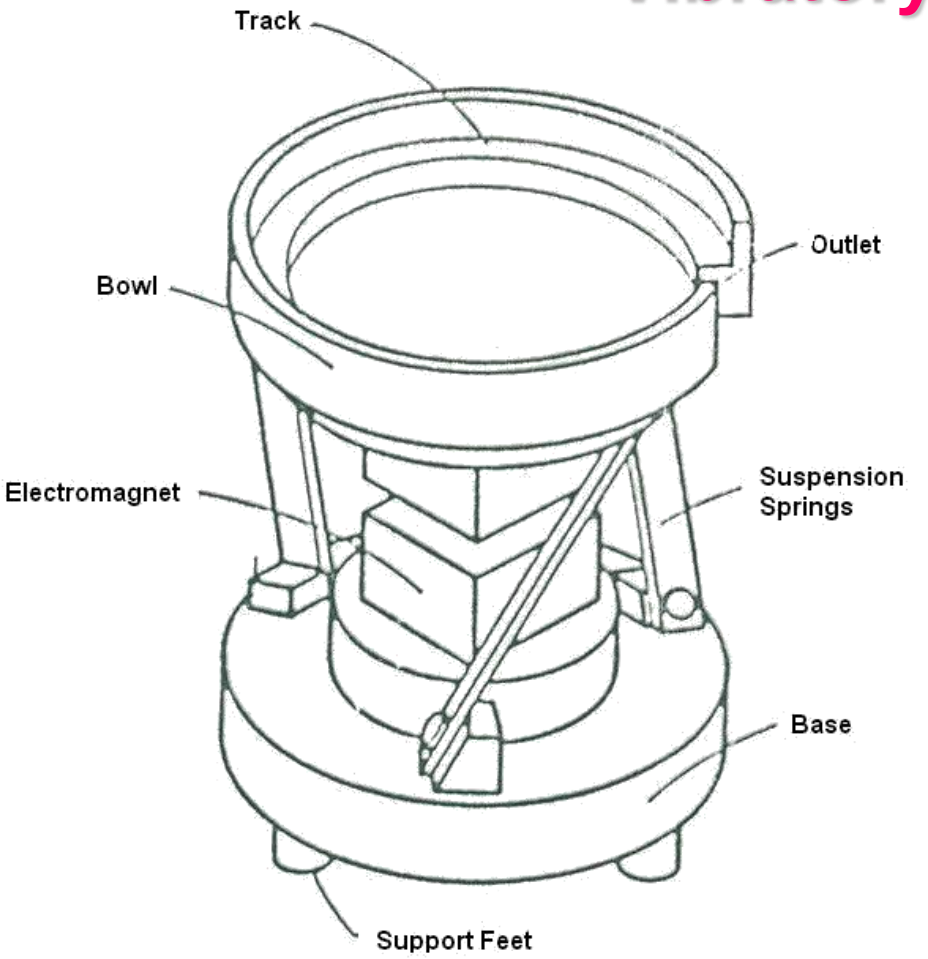
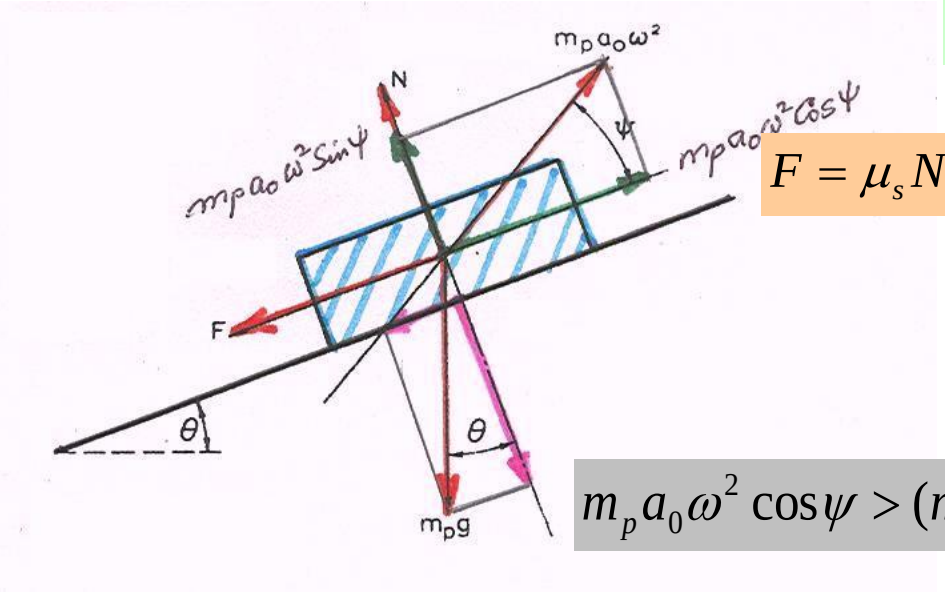
Vibratory Bowl Feeder



- Vibration is applied to the bowl from the electromagnet mounted on the base
- It has a torsional vibration about its vertical axis coupled with a linear vertical vibration
- Any part of the inclined track vibrates along a short straight path which is inclined to the horizontal at an angle greater than that of the track

Mechanics of Vibratory Conveying



For sliding up the track to occur:

$$m_p a_0 \omega^2 \cos\psi > m_p g \sin\theta + F \quad \text{..(1)}$$

Where,

$$F = \mu_s N = \mu_s (m_p g \cos\theta - m_p a_0 \omega^2 \sin\psi) \quad \text{..(2)}$$

μ_s **-Coefficient of static friction between the part and the track.**

Combining (1) and (2), we get:

$$m_p a_0 \omega^2 \cos\psi > (m_p g \cos\theta - m_p a_0 \omega^2 \sin\psi)\mu_s + m_p g \sin\theta$$

Or, $$a_0 \omega^2 (\cos\psi + \mu_s Sin\psi) > g(\sin\theta + \mu_s \cos\theta)$$

Or, $$\frac{a_0 \omega^2}{g} > \frac{\mu_s \cos\theta + \sin\theta}{\cos\psi + \mu_s Sin\psi}$$

Similarly, it can be shown that for backward sliding to occur during the vibration cycle:

$$\frac{a_0 \omega^2}{g} > \frac{\mu_s \cos\theta - \sin\theta}{\cos\psi - \mu_s Sin\psi}$$

Mechanics of Vibratory Conveying

The operating conditions of vibratory conveyor may be expressed in terms of dimensionless Normal Track Acceleration, A_n/g_n, where,

$$A_n = a_n\omega^2 = a_0\omega^2 \sin\psi$$ **Normal Track Acceleration**

$$g_n = g\cos\theta$$ **Normal Acceleration due to gravity**

g – Acceleration due to gravity = 9.81 m/sec^2

So, $$\frac{A_n}{g_n} = \frac{a_0\omega^2 Sin\psi}{gCos\theta} \quad ...(3)$$ **Substituting (3) in earlier equations,**

For Forward Sliding, $$\frac{A_n}{g_n} > \frac{\mu_s + \tan\theta}{Cot\psi + \mu_s}$$

And, For Backward Sliding, $$\frac{A_n}{g_n} > \frac{\mu_s - \tan\theta}{Cot\psi - \mu_s}$$

$$\frac{a_0\omega^2}{g} > \frac{\mu_s \cos\theta + \sin\theta}{\cos\psi + \mu_s Sin\psi}$$

$$\frac{A_n}{g_n} = \frac{a_0\omega^2 Sin\psi}{gCos\theta} \ldots(3)$$

$$\frac{a_0\omega^2}{g} = \left(\frac{A_n}{g_n}\right)\frac{\cos\theta}{\sin\psi}$$

$$\frac{A_n}{g_n} > \frac{\dfrac{\left(\mu_s \cos\theta + \sin\theta\right)}{\cos\theta}}{\dfrac{(\cos\psi + \mu_s \sin\psi}{\sin\psi}}$$

$$\frac{A_n}{g_n} > \frac{\mu_s + \tan\theta}{Cot\psi + \mu_s}$$

Mechanics of Vibratory Conveying

For values of μs =0.8, θ = 3 degree and ψ = 30 degree,
An/gn must be > 0.34 for forward sliding, and
An/gn > 0.8 for backward sliding.

The limiting condition for forward conveying to occur is given by:

$$\frac{\mu_s + \tan\theta}{Cot\,\psi + \mu_s} = \frac{\mu_s - \tan\theta}{Cot\,\psi - \mu_s} \; or, \; \mu_s^{\,2} = \tan\theta + Cot\,\psi$$

So, the limiting condition is ; $\tan\psi > \dfrac{\tan\theta}{\mu_s}$

when θ is small, $\tan\psi > \dfrac{\theta}{\mu_s}$

Mechanics of Vibratory Conveying

For sufficiently large vibration amplitudes, the part will leave the track and 'hop' forward during each cycle. The condition for this to occur is where the normal reaction, N between the part and the track becomes zero.

From the figure,

$$N = m_p g Cos\theta - m_p a_0 \omega^2 Sin\psi = 0$$

So, for the part to leave the track,

$$\frac{a_0\omega^2}{g} > \frac{Cos\theta}{Sin\psi}, or, \frac{A_n}{g_n} > 1$$

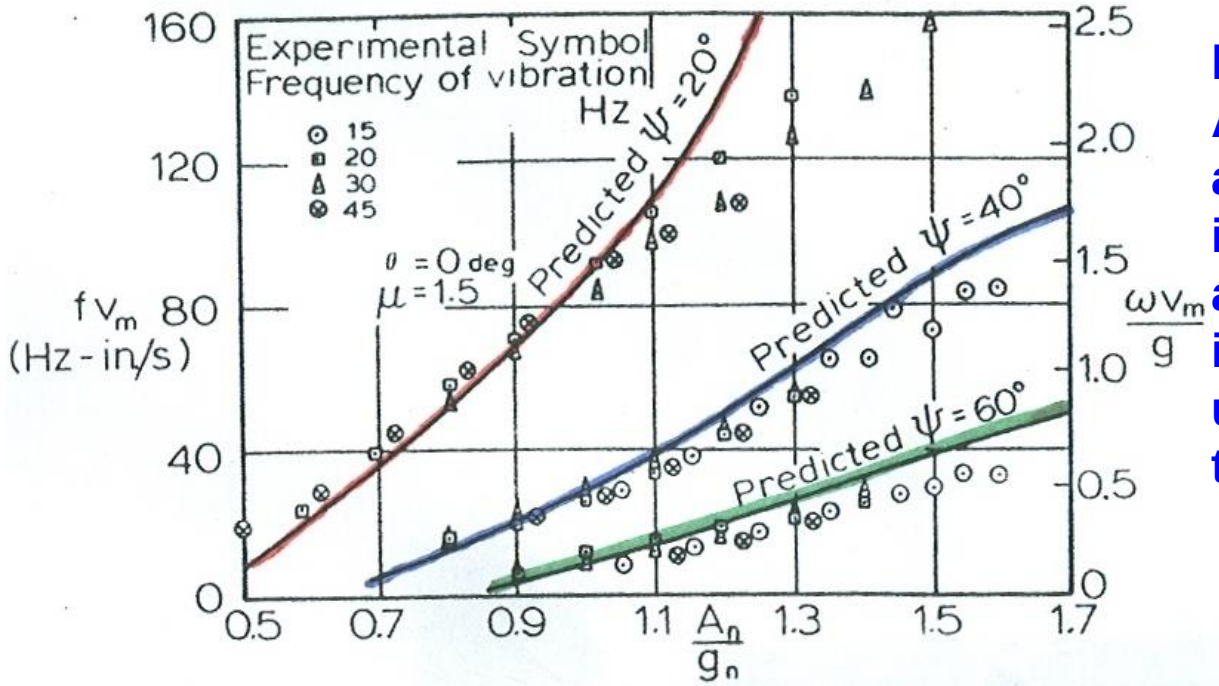
Effect of Frequency

Result of the theoretical work: The Mean conveying velocity, Vm is inversely proportional to the vibration frequency, f.

or, $f.V_m = \text{Constant}$

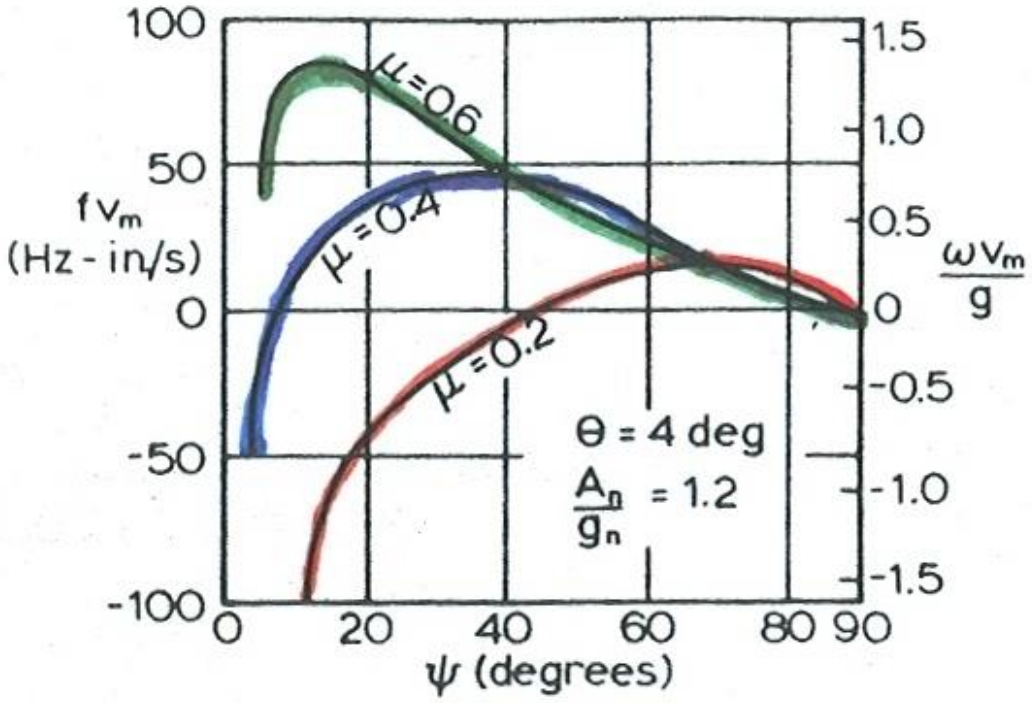
One consequence of this result is that for high conveying velocity and hence high feed rates, it is desirable to use as low a frequency as practicable. However since the track acceleration must be kept constant, this result means a corresponding increase in track amplitude.

Effect of Track Acceleration



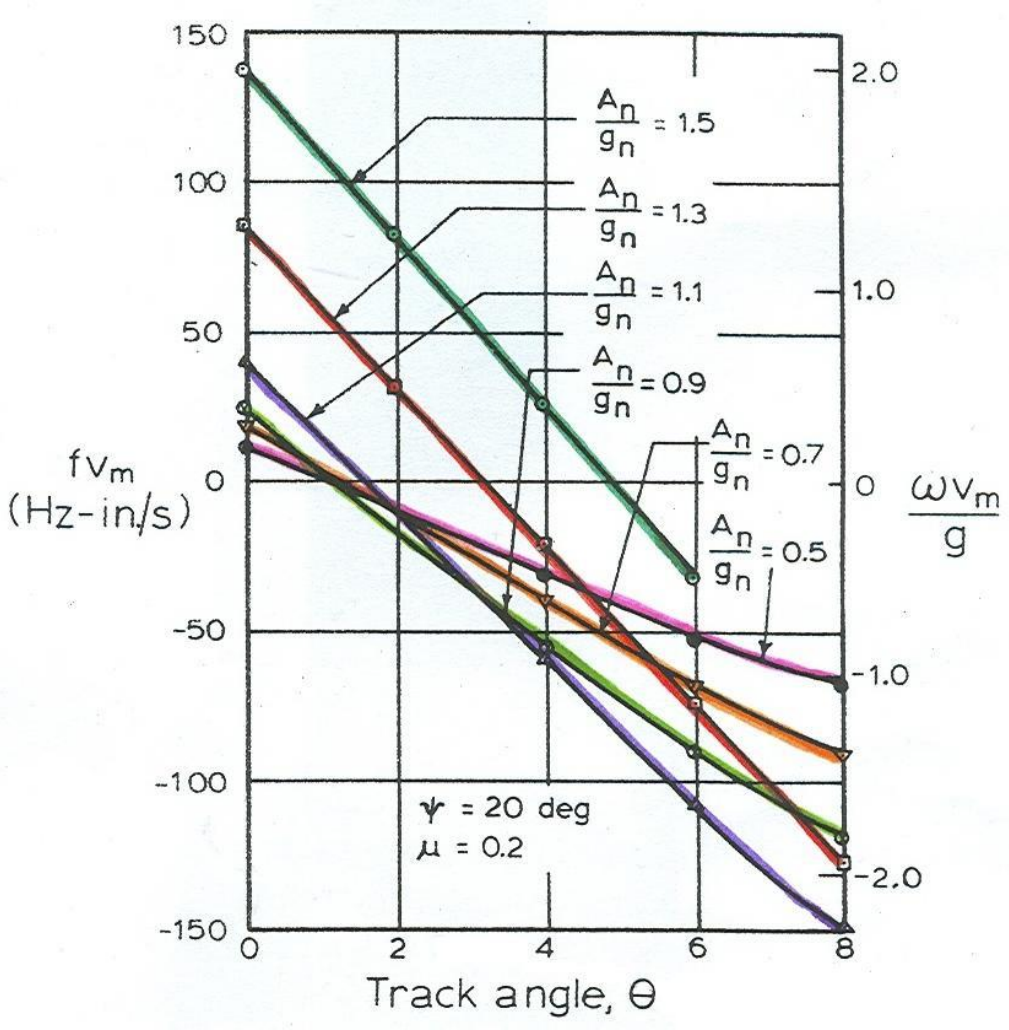
Parts start to 'hop' as $A_n/g_n>1$. At first the velocity of impact as the parts land on the track is small, but as the track acceleration is increased, the impact velocity also increases until at some critical value, the parts start to bounce.

Effect of Vibration Angle



These curves show the existence of an optimum vibration angle for given conditions.

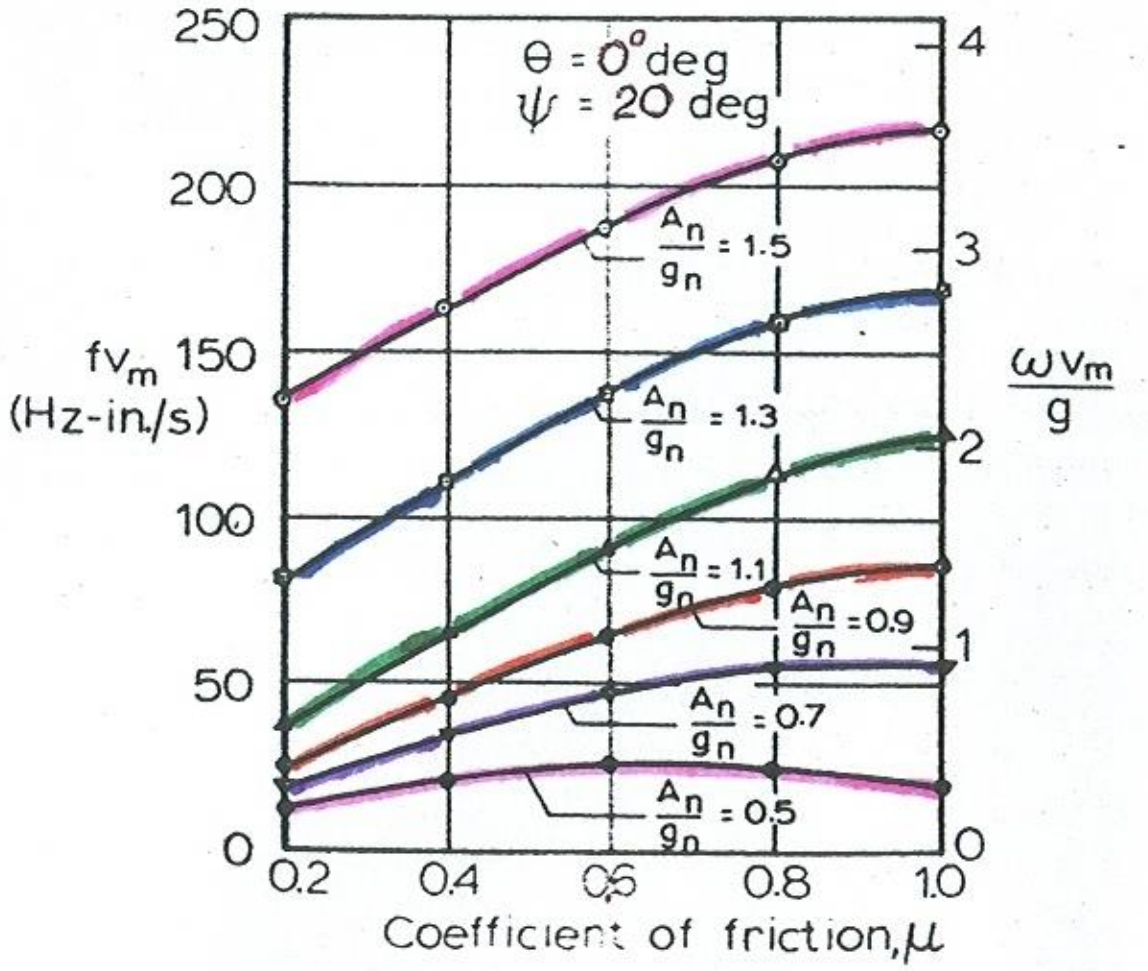
Effect of Track Angle



Results Show: The highest velocities are always achieved when track angle is zero degree.

The mechanical design of a bowl feeder necessitates a positive track angle of 3 to 4 degrees in order to raise the parts to the bowl outlet. Therefore, the parts located at the bottom having zero degree track angle will push the other parts on the track.

Effect of Coefficient of Friction



Results show: For practical values of track acceleration, an increase in coefficient of friction leads to an increase in conveying velocity.

Hence, increasing of μ_s by coating the track with rubber is justified. Coating can also reduce the noise level due to the motion of the parts.

NUMERICAL EXAMPLES:

Problem – 1 : On Flow Line Performance

A machine tool component has to be produced on a 10-station transfer machine, the ideal cycle time of which is 1 min. For similar transfer lines, the breakdowns of all types normally occur with 0.1 breakdowns/cycle and the average downtime per line stop is 6 min. The raw material costs Rs. 50 each, the cost of operating the line is Rs.2400 per hour and the cutting tools cost is Rs.6/piece. Considering the scrap rate of 5%, evaluate, only for good pieces:

i) Production Rate ii) Time to produce 1500 pieces/week
III) Line Efficiency iv) Cost per piece

SOLUTION:

(i) Average Production Time/piece, $T_p = T_c + FT_d = 1 + 0.1(6) = 1.6$ min

Average Production rate, $R_p = 1/T_p = 1/1.6 = 0.625$ pcs/min = 37.5 pcs/hr

Production Rate for good parts = 0.95(37.5) = 35.625 pcs/hr = 0.593 pcs/min **Ans.**

(ii) Time taken to produce 1500 pcs/week = 1500/35.625 = 42.1 hr = 2526 min

(iii) Line Efficiency, E = 1.0/1.6 = 0.625 = 62.5%

(iv) Cost/good pieces = 1/0.95[50 + 40(1.6) + 6] = Rs. 126.315

NUMERICAL EXAMPLES:

(b) It is decided that the rejected components in Prob. above would be repaired at a cost of Rs.80/piece. Suggest whether it would be economical.

Solution:

C_{pc} = 50 + (40x1.6) + 6 + 0.05(80) = 124 Rs/piece
which is less than Rs. 126.315,

Hence it would be economical.

Problem – 1 : On Vibratory Bowl Feeder

For a vibratory bowl feeder with 3^0 track inclination angle and 30^0 vibration angle, determine the values of dimensionless normal track acceleration (A_n/g_n), and the amplitude of vibration (a_0) for a positive feed rate to occur.

Solution:

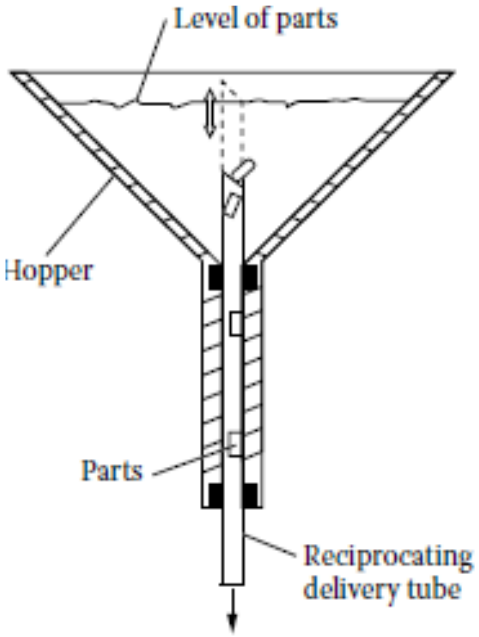
Limiting condition for forward motion: $\tan \Psi = (\tan\theta/\mu^2)$

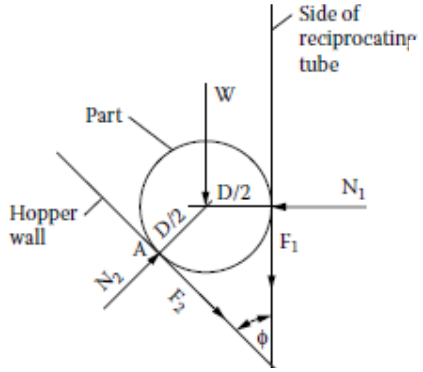
Therefore, $\mu^2 = (\tan 3/ \tan 30) = 0.0907$; or, $\mu = 0.301$

$$\frac{A_n}{g_n} > \frac{\mu + tan\theta}{cot\Psi + \mu} = \frac{0.301 + tan3}{cot30 + 0.301} = 0.174$$

$$\frac{A_n}{g_n} = \frac{a_0\omega^2 sin\Psi}{g\ cos\theta}; \quad or, a_0 = \frac{0.174x9.81\ cos3}{(314.6)^2 sin30} = 3.44\ x\ 10^{-5}\ m$$

Reciprocating Tube Hopper Feeder





$$F_1 + W + F_2 \cos \phi = N_2 \sin \phi$$

$$N_1 = N_2 \cos \phi + F_2 \sin \phi$$

$$F_1 (1 + \cos \phi) D/2 + W(D/2) \cos \phi = N_1 (D/2) \sin \phi$$

F1 is the force driving the tube down
F2 is the friction force

where ϕ is the hopper wall angle, and D the diameter of the part.
Eliminating W from Equation 4.1 and Equation 4.3 gives, after rearrangement,

$$N_1 \sin \phi = F_1 (1 + \cos \phi) + \cos \phi$$

$$\times (N_2 \sin \phi - F_2 \cos \phi - F_1) \qquad (4.4)$$

$$F_1 + W + F_2 \cos\phi = N_2 \sin\phi$$

$$W = N_2 \sin\phi - F_2 \cos\phi - F_1$$

$$F_1 (1 + \cos\phi)\, D/2 + W(D/2) \cos\phi = N_1 (D/2) \sin\phi$$

$$F_1(1+\cos\phi)\frac{D}{2} + \cos\phi(N_2 \sin\phi - F_2 \cos\phi - F_1)\frac{D}{2} = N_1(\frac{D}{2})\sin\phi$$

$$N_1 \sin\phi = F_1(1+\cos\phi) + \cos\phi(N_2 \sin\phi - F_2 \cos\phi - F_1)$$

$$F_2 = N_2\mu_s$$

$$= F_1 + F_1 \cos\phi + N_2 \cos\phi(\sin\phi - \mu_s \cos\phi) - F_1 \cos\phi$$

$$= F_1 + \frac{N_1 \cos\phi}{\cos\phi + \mu_s \sin\phi)}(\sin\phi - \mu_s \cos\phi)$$

$$\sin ce, N_2 = \frac{N_1}{\cos\phi + \mu_s \sin\phi}$$

$$N_1 \sin\phi\left(\cos\phi + \mu_s \sin\phi\right) = F_1\left(\cos\phi + \mu_s \sin\phi\right) + N_1 \cos\phi(\sin\phi - \mu_s \cos\phi)$$

$$\frac{F_1}{N_1} = \frac{\mu_s}{\cos\phi + \mu_s \sin\phi}$$

Reciprocating Tube Hopper Feeder

The maximum value of F_2 is given by $\mu_s N_2$ (where μ_s is the coefficient of static friction) and, thus, writing $F_2 = \mu_s N_2$ in Equation 4.2 and Equation 4.4 and eliminating N_2 give

$$\frac{F_1}{N_1} = \frac{\mu_s}{\cos \phi + \mu_s \sin \phi} \tag{4.5}$$

For the tube to slide, $F_1/N_1 > \mu_s$, and, therefore, from Equation 4.5,

$$\frac{1}{\cos \phi + \mu_s \sin \phi} > 1 \tag{4.6}$$

Reciprocating Tube Hopper Feeder

The expression indicates that the value of ϕ should be as large as possible to prevent jamming when μ_s is large. However, when $\mu_s < \cot \phi$, the parts cannot slide down the hopper wall. The best compromise is probably given by writing the following two limiting conditions:

$$\mu_s = \cot \phi \tag{4.7}$$

$$\cos \phi + \mu_s \sin \phi = 1 \tag{4.8}$$

Combining Equation 4.7 and Equation 4.8 gives $\phi = 60°$ and, on substitution of this value in expression 4.6, it is found that, to prevent jamming under these conditions, the coefficient for friction μ_s must be less than 0.577. Because this value is greater than that expected in practice, it may be concluded that, with a hopper angle of 45°, the possibility of jamming will generally be avoided if the coefficient of friction is less than 0.414.

Reciprocating Tube Hopper Feeder

General Features:

- Optimum hopper load = half the volume of the hopper
- Delivery tube should just rise above the maximum level of parts in the hopper
- The inside silhouette of the delivery tube must be designed to accept only correctly oriented part one at a time
- Linear velocity of the delivery tube should be less than or equal to 0.6 m/sec

NUMERICAL EXAMPLES:

For a reciprocating tube hopper feeder with a static coefficient of friction between the parts and the hopper wall of 0.3945, determine the hopper angle so that the parts do not jam.

Solution:

Given, $\mu_s = 0.3945$

For parts not to jam, $\dfrac{1}{cos\Phi + \mu_s sin\Phi} > 1$

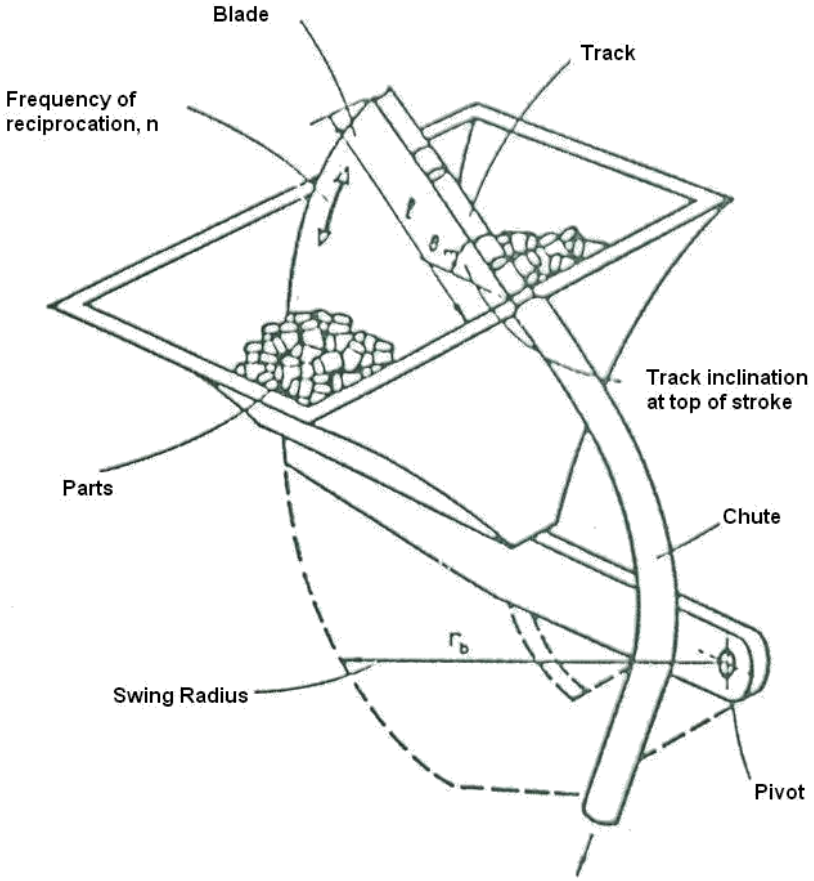
$$or, \quad cos\Phi + \mu_s sin\Phi < 1; \; or, \quad \mu_s sin\Phi < 1 - cos\Phi$$

$$or, 2\mu_s sin\frac{\Phi}{2} cos\frac{\Phi}{2} < 2sin^2\frac{\Phi}{2}; \quad or, tan\frac{\Phi}{2} > \mu_s;$$

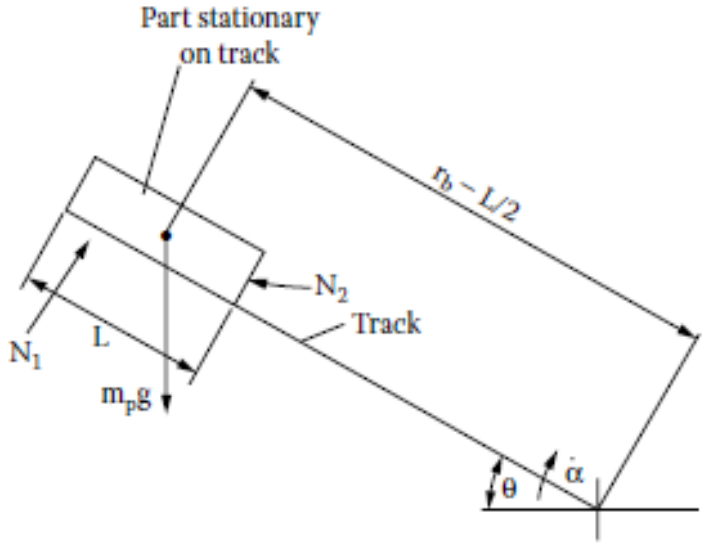
$$or, \frac{\Phi}{2} > tan^{-1}(\mu_s); \; or. \Phi > 2\, tan^{-1}(\mu_s);$$

$$or, \Phi > 43^0$$

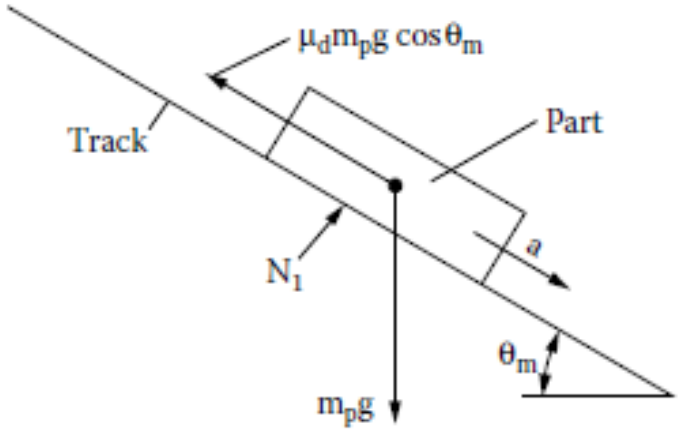
Centerboard Hopper Feeder



- Suitable for feeding cylindrical parts
- An optimum value of track inclination angle exists and theoretically shown to be functions of only μ_d and (r_b/l)
- For example, for $(r_b/l) = 2$, $\mu_d = 0.4$, $\theta_{opt}=36^0$



Forces acting on a part during the upward motion of the blade.



Forces acting on a part as it slides down a track.

For reaction between the track and the part to become zero, N = 0:

$$N - m_p g\, cos\theta_m = m_p \ddot{\theta}\left(r_b - \frac{L}{2}\right);\ \ or,\ \ m_p \ddot{\theta}\left(r_b - \frac{L}{2}\right) = -m_p g\, cos\theta_m$$

$$or, \qquad -\ddot{\theta} = \frac{g cos\theta}{r_b}$$

For simplicity, it is now assumed that, during the period of the upward motion of the blade, the drive to the blade is designed to give

(1) a constant acceleration of (*g cos θm)/rb, followed by*

(2) a constant deceleration of (g cos θm)/rb.

Under these conditions, the total time *t1 taken to lift the blade so that the track is inclined* at an angle θ*m to the horizontal is given by:*

$$t_1^{\,2} = \frac{4 r_b \theta_m}{g \cos \theta_m}$$

It is now assumed that when the blade is in its highest position, it dwells for a period *t2, just long enough to allow the parts to slide down the track.*

This is given, in the worst case, by the time taken for one part to slide the whole length of the track. The forces acting on a part under these circumstances are shown in Figure, and resolving in a direction parallel to the track gives

$$m_p a = m_p g \sin \theta_m - \mu_d m_p g \cos \theta_m$$

Where, *a is the linear acceleration of the part down the track, and μd is the* coefficient of dynamic friction between the part and the track. The minimum dwell period *t2 is now given by*

$$t_2^2 = \frac{2\ell}{g(\sin\ \theta_m - \mu_d \cos\ \theta_m)}$$

If the time taken to return the blade to its lowest position is now assumed to be the same as the time for the up stroke, then the total period *tf of the feeder* cycle is given by

$$t_f = 2t_1 + t_2 = 2\left(\frac{4r_b\theta_m}{g\cos\theta_m}\right)^{1/2} + \left[\frac{2\ell}{g(\sin\theta_m - \mu_d\cos\theta_m)}\right]^{1/2}$$

This equation consists of two terms; one that increases as θ*m is increased* and one that decreases as θ*m is increased.*

An optimum value of θm always exists that gives the minimum period tf and, hence, a maximum theoretical feed rate. It can be shown mathematically that this optimum value of θm is a function only of μd and the ratio rb/l.

The maximum number of parts that may be selected during each cycle is given by l/*L*.

In practice, the average number selected is less than this and, if E is taken to be the efficiency of a particular design, the average number of parts fed during each cycle is given *E/L, and the mean feed rate F of the hopper* feeder is given by:

$$F = \frac{nE\ell}{L}$$

Where, the blade frequency *n is given by*. $n = \frac{1}{t_f}$

In practice, the values of efficiency *E must be obtained from experiments*.

Numerical Example

A centreboard hopper feeder has a blade length of 260mm and is designed to feed cylindrical parts end to end. The centre of rotation is 250mm from the lower end of the blade track. The inclination of the track when the blade is in its highest position is 45^0 and the coefficient of sliding friction between the parts and the track is 0.3. Calculate the cycle time of the blade for the upward motion of the blade.

Solution:

For reaction between the track and the part to become zero, N = 0:

$$N - m_p g\, cos\theta_m = m_p \ddot{\theta}\left(r_b - \frac{L}{2}\right);\ \ or,\ \ m_p \ddot{\theta}\left(r_b - \frac{L}{2}\right) = -m_p g\, cos\theta_m$$

$$or, \qquad -\ddot{\theta} = \frac{g cos\theta}{r_b}$$

Time to lift the blade, $t_1{}^2 = \dfrac{4 r_b \theta_m}{g \cos\theta_m}$

Dwell time, $t_2{}^2 = \dfrac{2l}{g(sin\theta_m - \mu_d cos\theta_m)}$

Numerical Example

Therefore the total cycle time, $t_f = 2t_1 + t_2$

$$t_f = 2\left(\frac{4r_b\theta_m}{g\cos\theta_m}\right)^{\frac{1}{2}} + \left[\frac{2l}{g(sin\theta_m - \mu_d cos\theta_m)}\right]^{\frac{1}{2}}$$

Given,

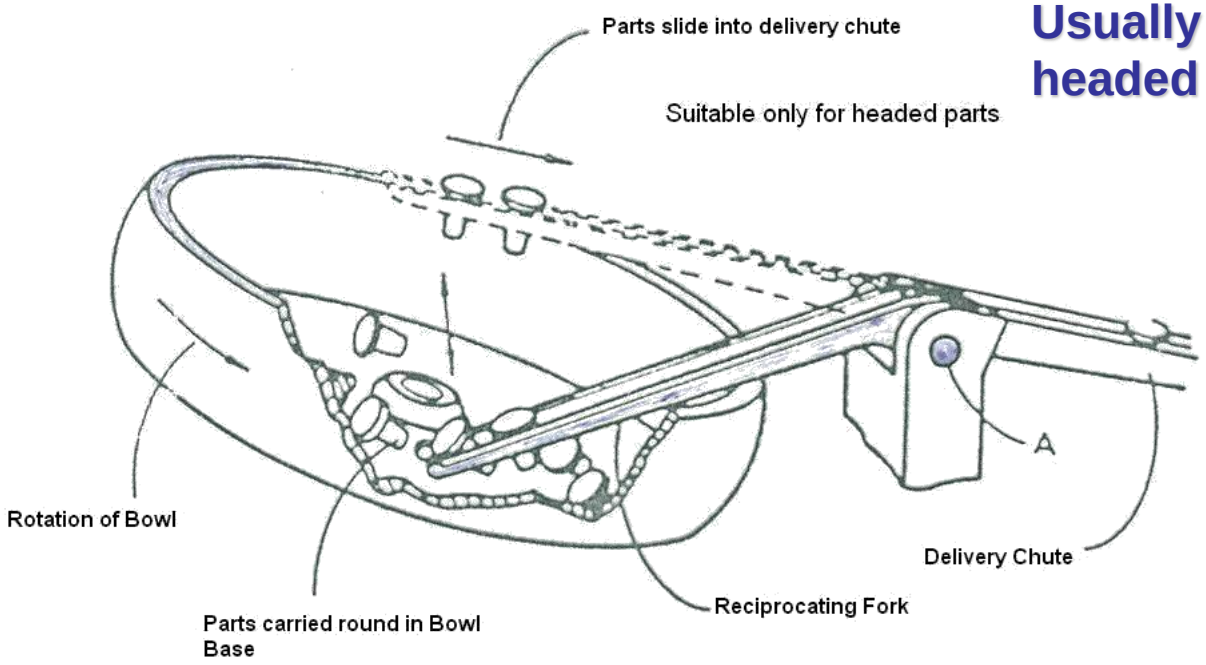
$r_b = 260 + 250 = 510$ mm

$\theta_m = 45^0 = 0.785$ rad

$g = 9810$ mm/sec^2 ; $l = 260$ mm; $\mu_d = 0.3$

$$t_f = 2\left(\frac{4x510x45\frac{\pi}{180}}{9810\,x\cos 45}\right)^{\frac{1}{2}} + \left[\frac{2x260}{9810(sin45 - 0.3cos45)}\right]^{\frac{1}{2}} = 1.29\,Sec$$

Reciprocating Fork Hopper Feeder

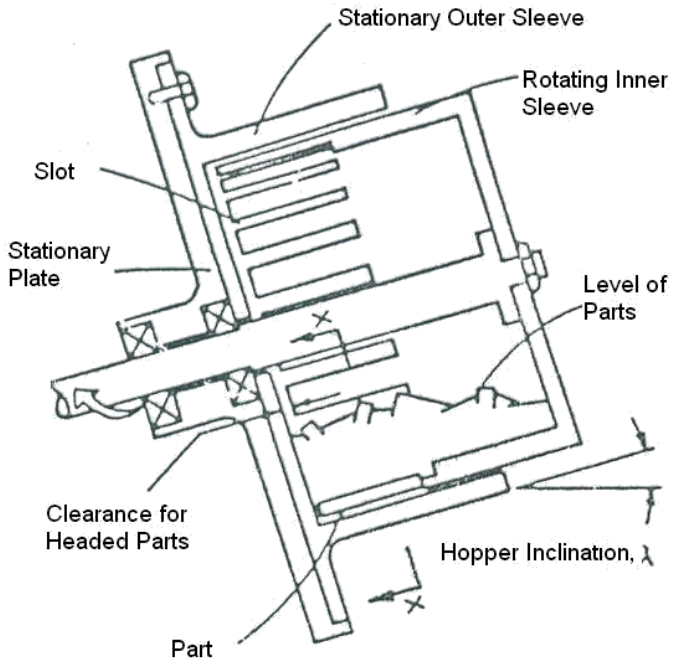


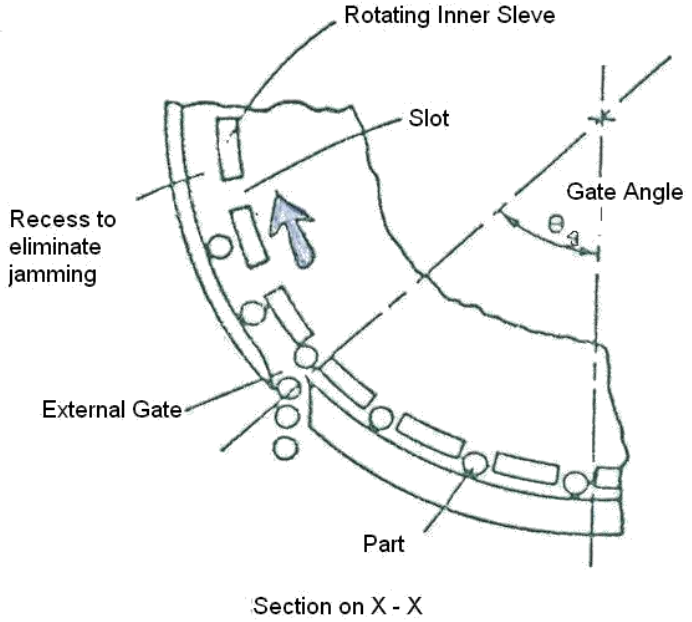
Usually used for feeding headed parts

Analysis for the max. fork inclination and the max. rate of reciprocation is similar to that of centerboard hopper feeder

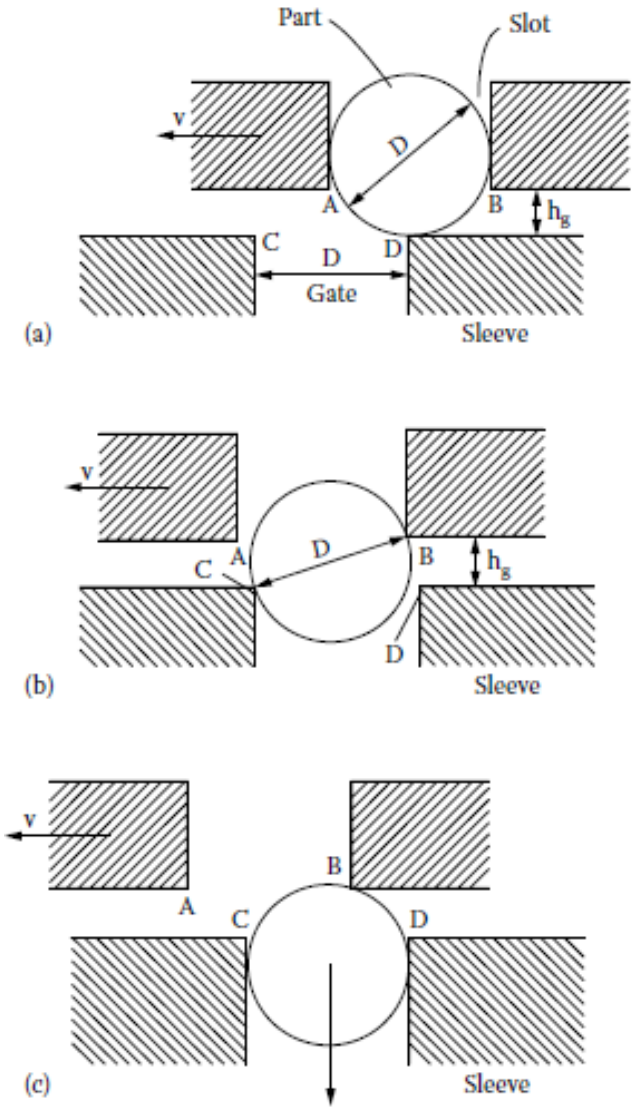
External Gate Hopper Feeder

For design purpose, max. peripheral velocity of the inner cylinder is determined for feeding to occur





Max. feed rate is determined as ratio of the velocity and the centerline distance between adjacent slots of the cylinder



At a limiting velocity, V, the part will neither fall through the gate nor pass over but will become jammed between corners B and C of the slot and gate (Fig.b). At any velocity below V, the part will drop through the gate (Fig c).

In Fig.(b), the part has moved horizontally from the position shown in Fig.(a) by:

$$D - \frac{1}{2}\sqrt{D^2 - h_g{}^2}$$

In a time interval:

$$\frac{D - 0.5(D^2 - h_g{}^2)^{\frac{1}{2}}}{V}$$

During this time the part has fallen a distance:

$$\left(\frac{D}{2} - \frac{h_g}{2}\right)$$

Since the part has fallen freely, the time taken is given by:

From the basic equation:

$$L = \frac{1}{2}at^2,\ t = \sqrt{\frac{2l}{a}}$$

$$\left[\frac{2\left(\frac{D}{2} - \frac{h_g}{2}\right)}{g}\right]^{\frac{1}{2}}$$

Since the time is the same:

$$\frac{D - 0.5(D^2 - h_g{}^2)^{\frac{1}{2}}}{V} = \left[\frac{2\left(\frac{D}{2} - \frac{h_g}{2}\right)}{g}\right]^{\frac{1}{2}}$$

To give the largest values of v, the gap h_g between the cylinder and sleeve should be as large as possible. For values of h_g greater than $D/2$, there is a danger that the parts may become jammed between the corner B in the slot and the inner surface of the sleeve. Thus, taking $h_g = D/2$, Equation 4.17 becomes, after rearrangement,

$$v = 0.802\ (Dg)^{1/2}$$

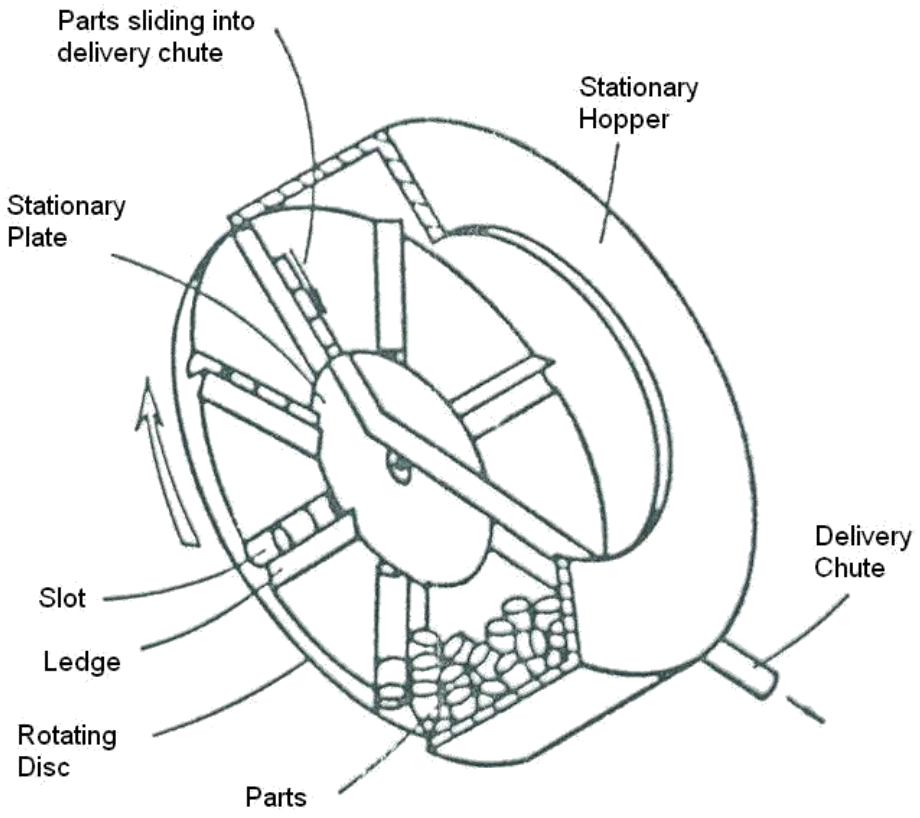
If a_s is now taken to be the centerline distance between adjacent slots of the cylinder, the maximum feed rate F_{max} from the feeder is

$$F_{max} = \frac{v}{a_s} = \frac{0.802}{a_s}(Dg)^{1/2}$$

In general, not all of the slots will contain parts and, if E is taken to be the efficiency of the feeder, the actual feed rate is given by

$$Actual\ Feed\ Rate, F = \frac{0.802(Dg)^{\frac{1}{2}}}{a_s}$$

Rotary Disk Feeder



Parts are carried by the slots in the rotating disk around the stationary plate until they are aligned to the delivery chute

Types:

a) **Indexing Rotary Disk Feeder**

b) **Rotary Disk Feeder with Continuous drive**

(a) Indexing Rotary Disk Feeder

If a Geneva mechanism is employed to index a rotary-disk feeder, the time taken for indexing will be approximately equal to the dwell period. The time *ts required for all parts in one slot to slide into* the delivery chute is given by:

$$t_s^2 = \frac{2\ell}{g(\sin\theta - \mu_d \cos\theta)}$$

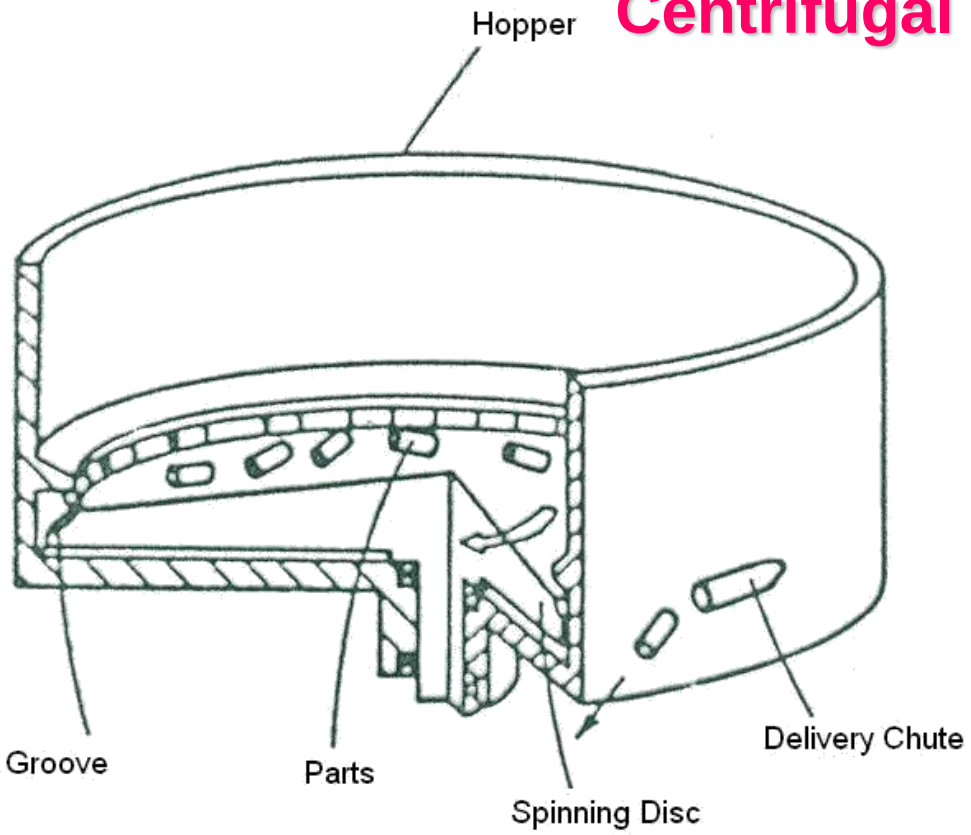
where l is the length of the slot, θ the inclination of the delivery chute, and μ*d* the coefficient of dynamic friction between the part and the chute. With a Geneva drive, the total period of an indexing cycle *ti is therefore given* by:

$$t_i = 2t_s = \left[\frac{8\ell}{g(\sin\theta - \mu_d \cos\theta)}\right]^{1/2}$$

If *L is the length of a part, the maximum number that may be selected in a* slot is *lL. In practice, however, the average number selected will be less than* this. If *E is taken to be the efficiency of the feeder, the feed rate F will be given by:*

$$F = \frac{E\ell}{Lt_i} = E\left[\frac{\ell g(\sin\theta - \mu_d \cos\theta)}{8L^2}\right]$$

Centrifugal Hopper Feeder



- Suitable for feeding plain cylindrical parts
- Unrestricted feed rate is proportional to the square root of the hopper diameter and inversely proportional to the length of the part

If a part is moving with constant velocity *v around the inside wall of a centrifugal* hopper, the radial reaction at the hopper wall is equal to the centrifugal force *2mpv2/d, where mp is the mass of the part and d the diameter of the hopper. The* frictional force *Fw at the hopper wall tends to resist the motion of the part and* is given by

$$F_w = \frac{2\mu_w m_p v^2}{d}$$

Where, μ*w is the coefficient of friction between the part and the hopper wall. When* the peripheral velocity of the spinning disk is greater than *v, the disk slips under* the part, and the frictional force *Fb between the part and the spinning disk is* given by

$$F_b = \mu_b m_p g$$

Where, μ*b is the coefficient of friction between the part and the spinning disk.* Because, under this condition, *Fb = Fw, setting Equation 4.26 equal to Equation* 4.27 gives

$$v = \left[\frac{g\mu_b d}{2\mu_w}\right]^{1/2}$$

and the maximum feed rate *Fmax of parts of length L is given by*

$$F_{max} = \frac{v}{L} = \frac{(g\mu_b d/2\mu_w)^{1/2}}{L}$$

and the actual feed rate *F may be expressed as*

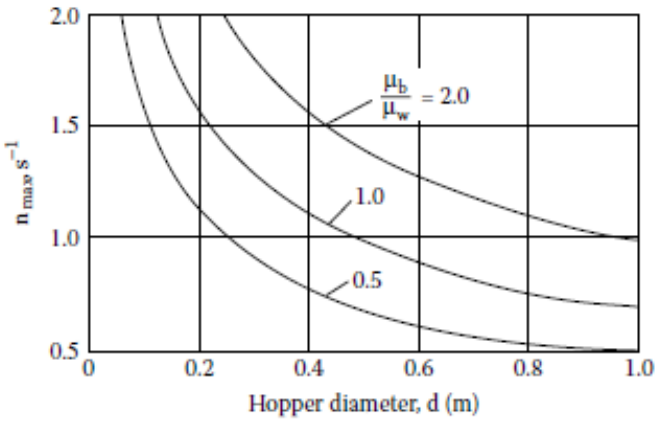
$$F = E\left[\frac{(g\mu_b d/2\mu_w)^{1/2}}{L}\right]$$

This equation shows that the unrestricted feed rate from a centrifugal hopper is proportional to the square root of the hopper diameter and inversely proportional to the length of the parts.

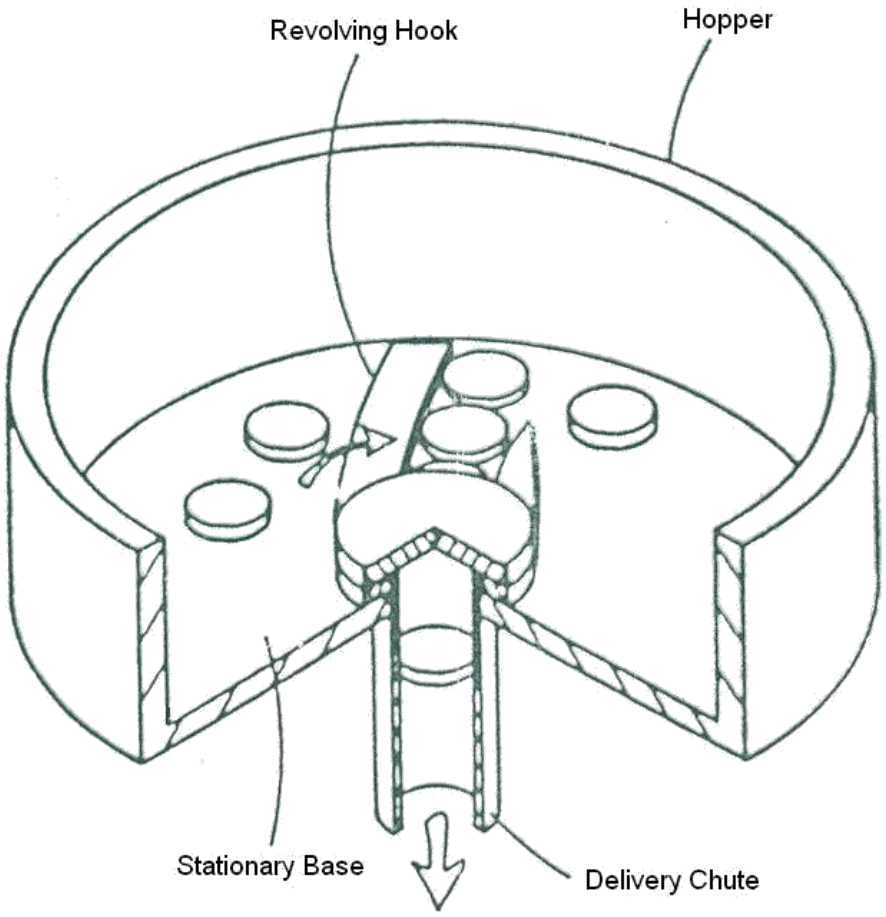
Using the Equation of V, the maximum rotational frequency *nmax of the spinning* disk, above which no increase in feed rate occurs, is

$$n_{max} = \frac{v}{\pi d} = \frac{[(g/2d)(\mu_b/\mu_w)]^{1/2}}{\pi}$$

This equation is plotted here and can be used to choose the maximum rotational frequency of the hopper.

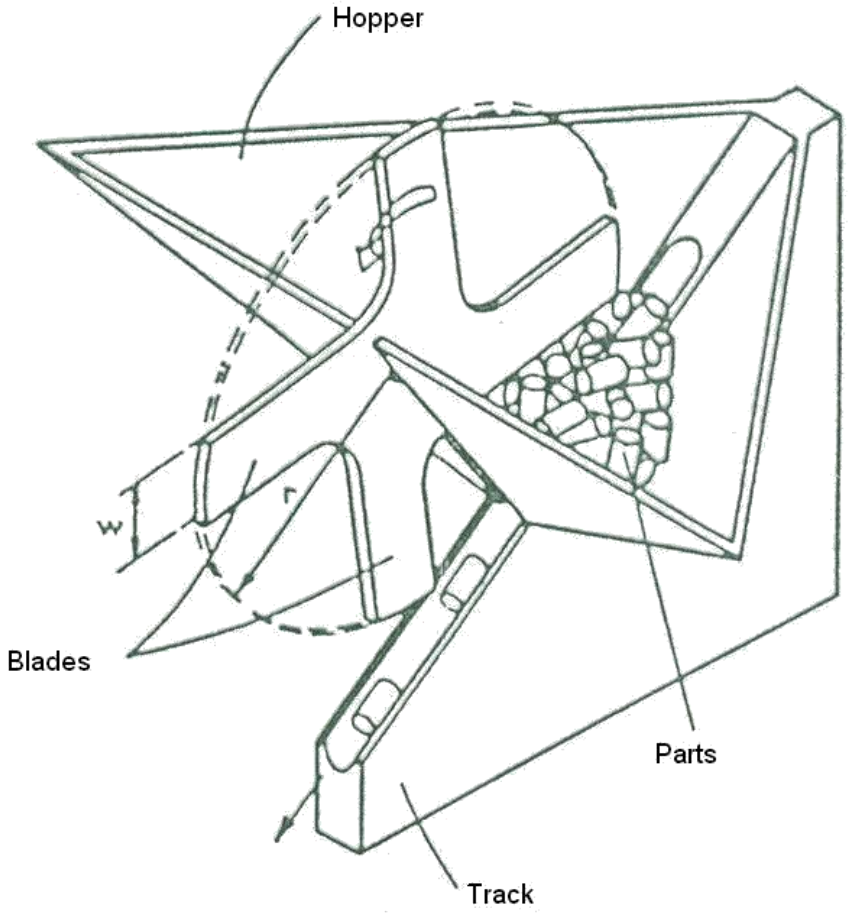


Revolving Hook Hopper Feeder



If the rotational frequency of the hook is too high, centrifugal action prevents the parts from moving inward toward the delivery chute

Bladed Wheel Hopper Feeder



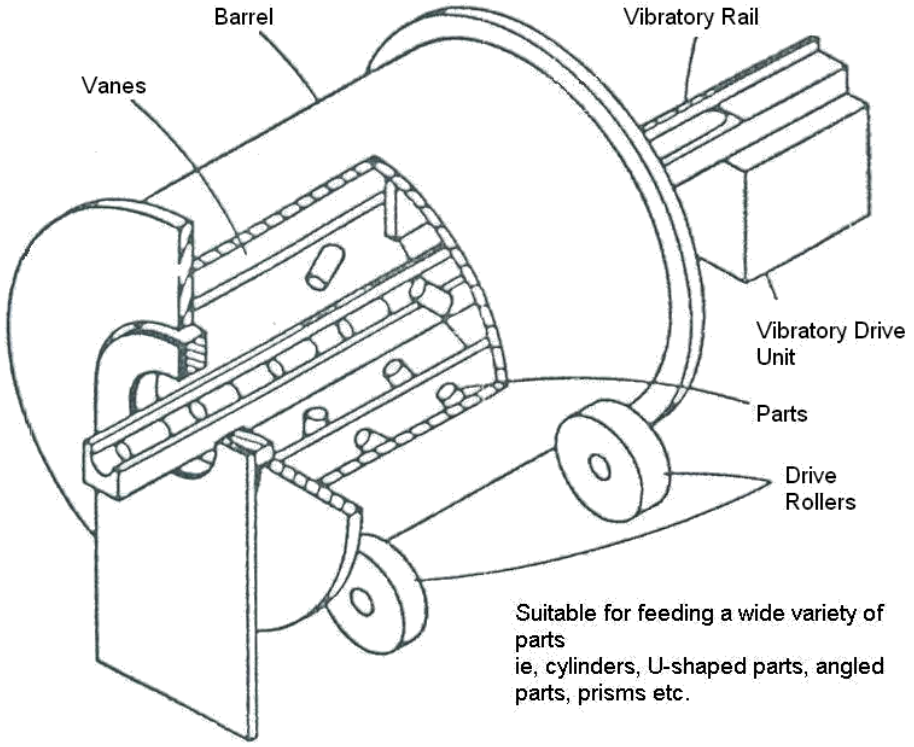
Rotation of the wheel agitates the parts in the hopper and causes parts arriving at the delivery point in the wrong attitude to be pushed back into the mass of the parts

Track inclination angle = 45^0

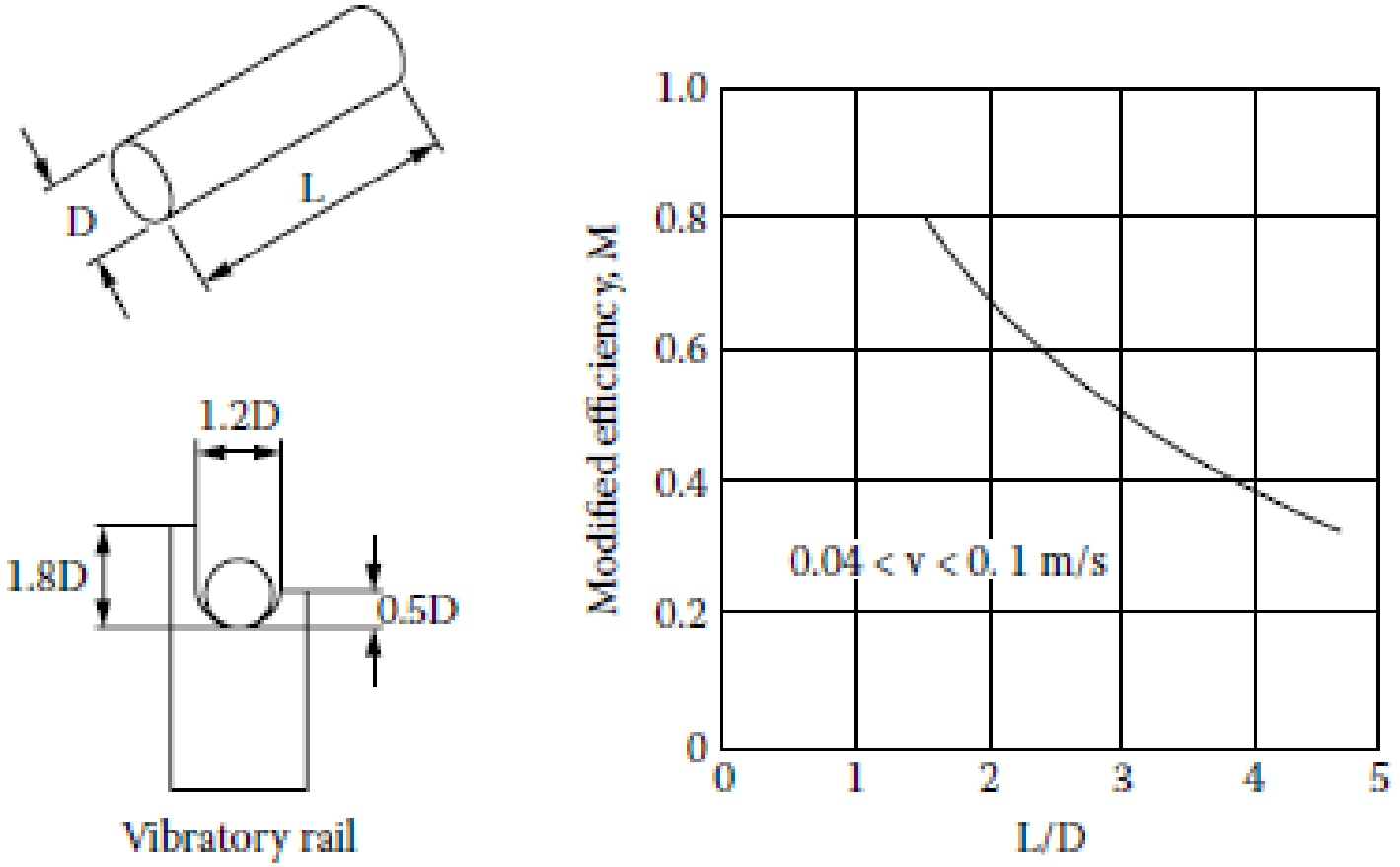
Max. Linear Velocity of the Blade Tip = 0.7 m/s

Used for feeding nuts and cylinders

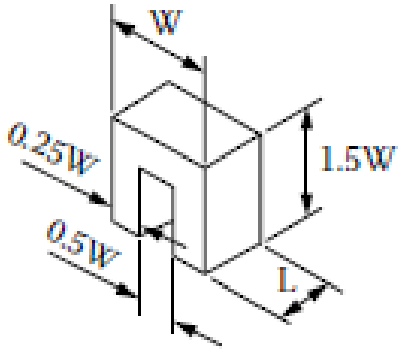
Tumbling Barrel Hopper Feeder

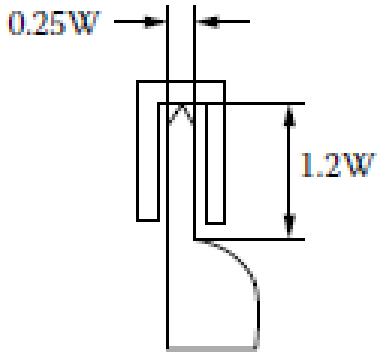


Parts are carried upward by the fins of barrel until at some point they slide off the fins to the vibratory feed track

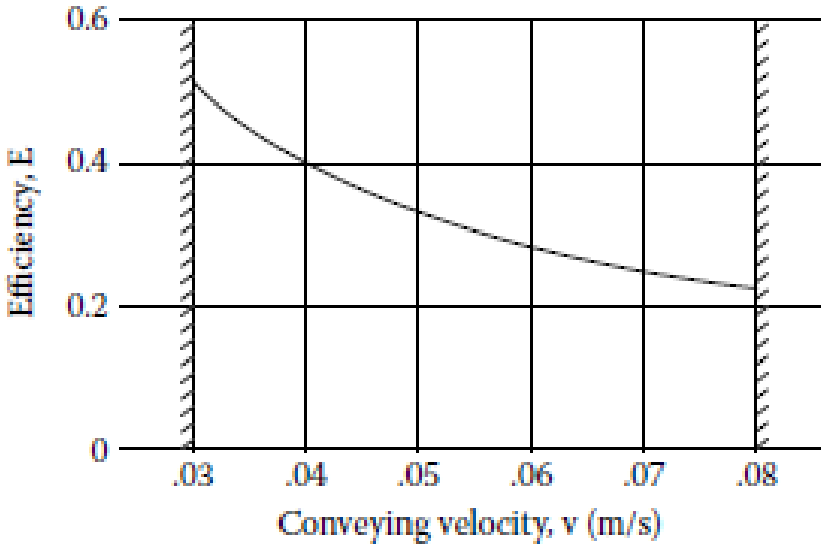


Performance of a tumbling-barrel hopper when feeding cylinders. The feed rate is *Mv/L + 0.7 parts/sec, where M is the modified efficiency, v the conveying velocity* on the vibratory rail (m/sec), and *L the part length (m). The ratio of barrel length to diameter d is 1.2; d/D = 21.*



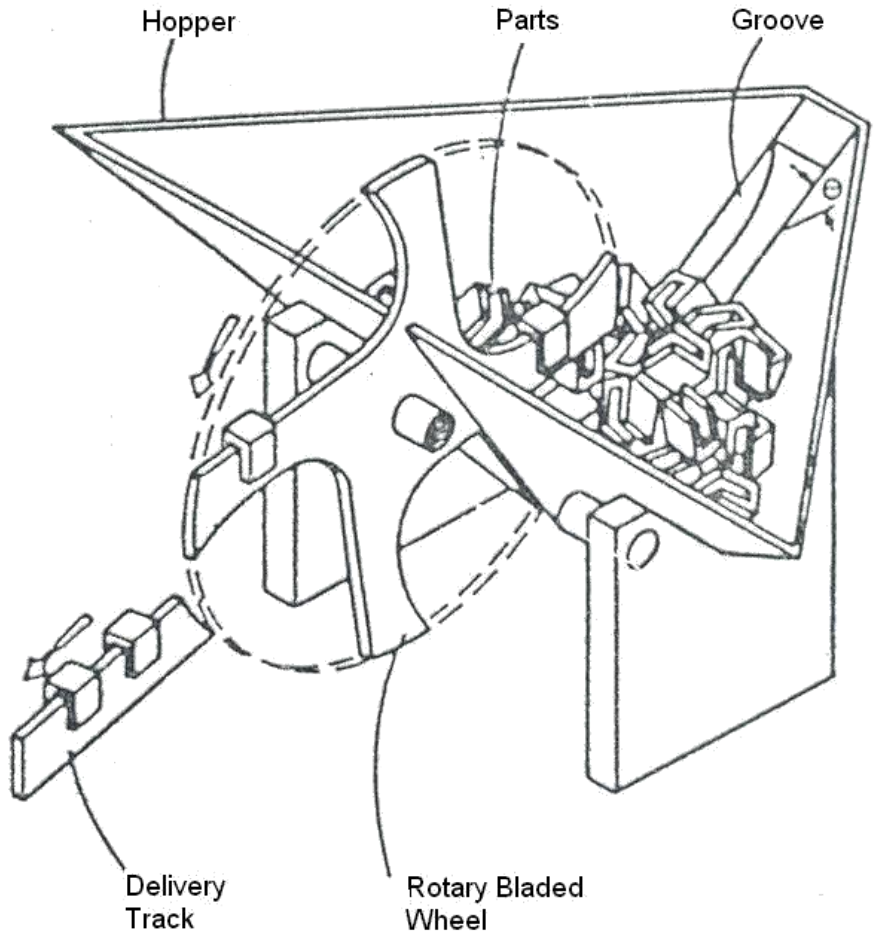


Vibratory rail

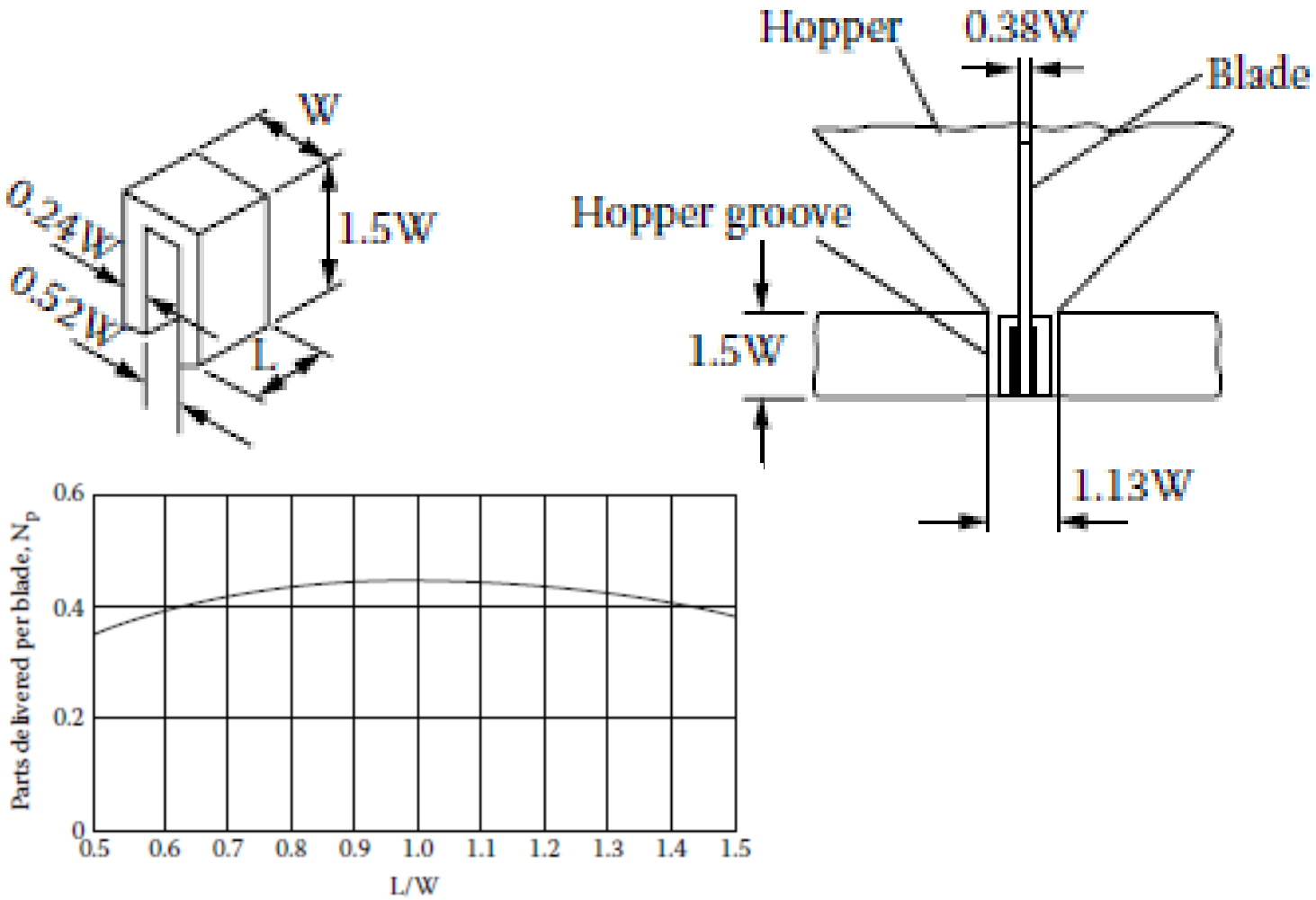


Performance of a tumbling-barrel hopper when feeding U-shaped parts. The feed rate is *Ev/L, where E is the efficiency, v the conveying velocity on the vibratory rail,* and *L the part length. The ratio of barrel length to diameter d is 1.2; d/W = 13; and 0.4 < L/W < 1.2.*

Rotary Centerboard Hopper Feeder

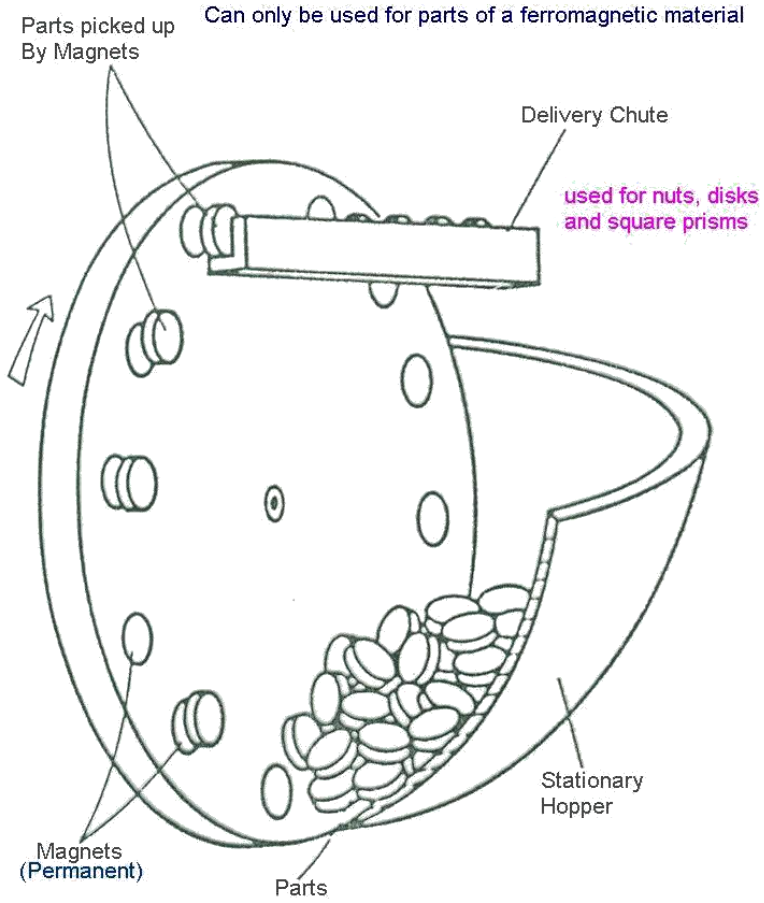


The edges of the blades are profiled to collect parts in the desired attitude and lift them clear of the bulk, later to slide off the blade

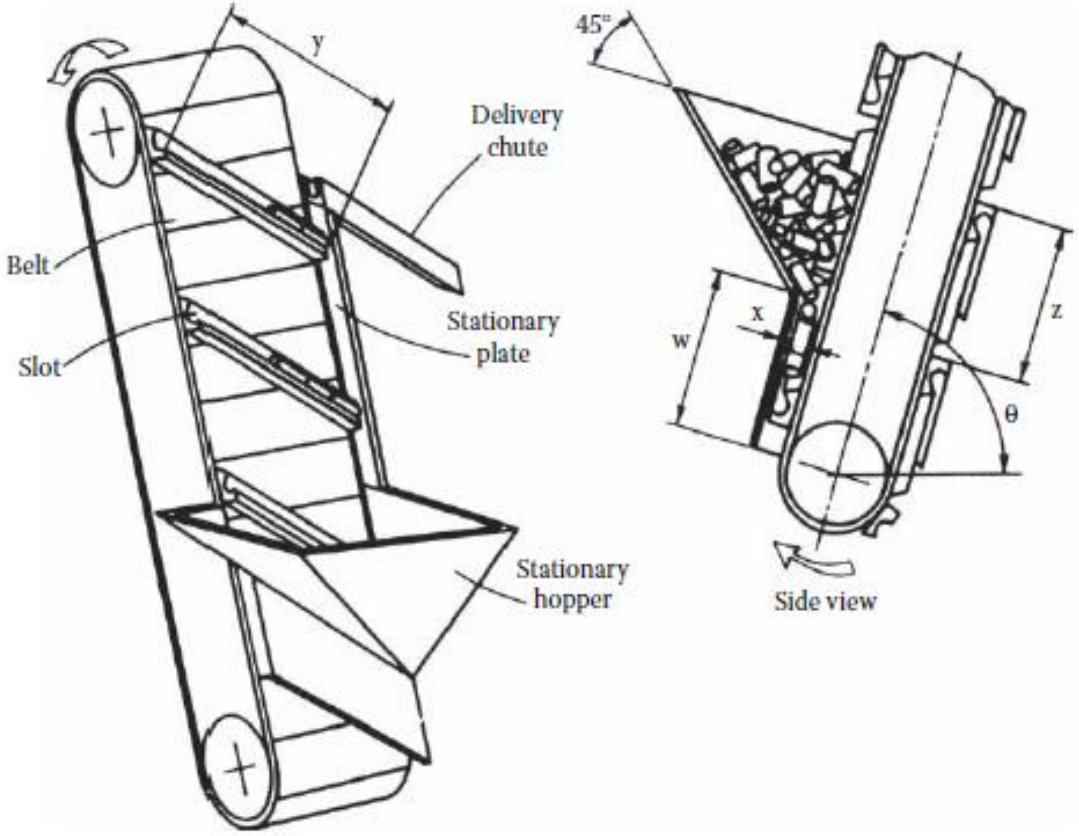


Performance of a rotary-centerboard hopper when feeding U-shaped parts.

Magnetic Disk Feeder



Magnetic Elevating Hopper Feeder



The magnetic elevating hopper feeder is basically the same as the elevating hopper feeder except that, instead of ledges, permanent magnets are fitted to the endless belt. Thus, the feeder is suitable only for handling ferromagnetic materials and cannot easily be used for orientation purposes. This feeder is usually used to strip the parts from the magnets at the top of the belt conveyor.