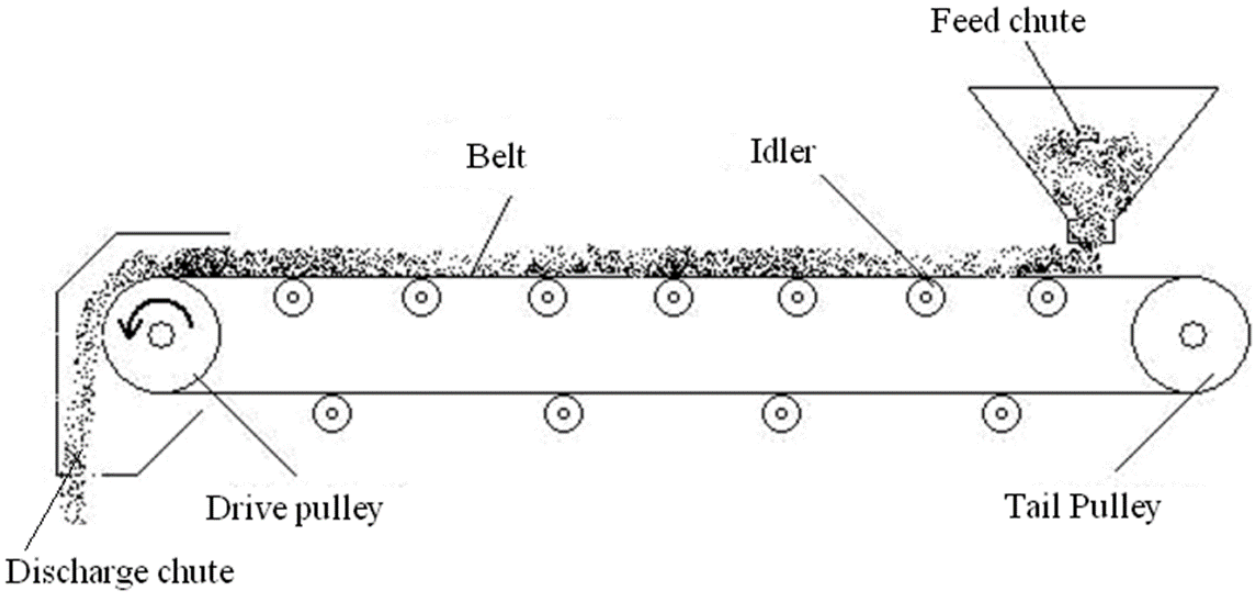
BELT CONVEYOR

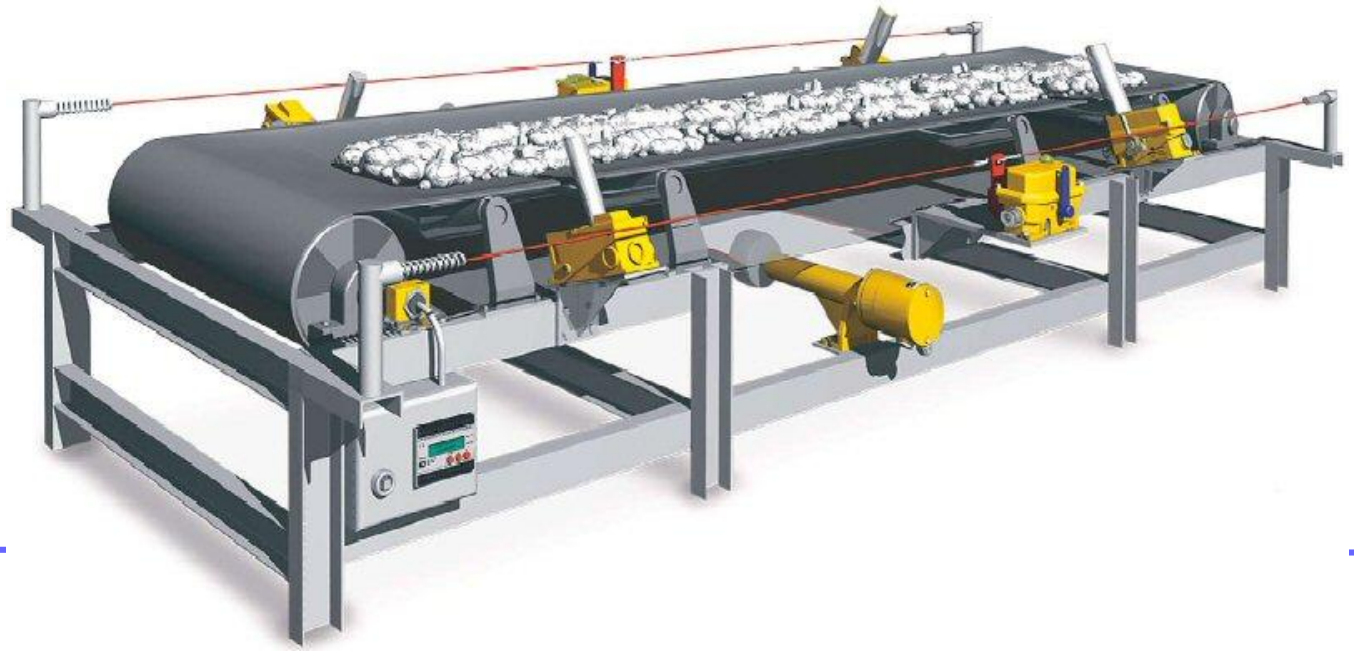
1. Definition/ Description (1)

- The belt conveyor is esentially an endless belt operating between two or more pulleys. The belt and its load are usually supported on idlers.

- Belt conveyors have a high mechaincal eficiency since, in larger installations, all the load is carried on antifriction bearings.

1. Definition/ Description (2)





2. General Characteritics

i. Belt conveyors operate in one vertical plane, horizontally or with an inclination (up or down) depending on the frictional property of the load conveyed.

ii. For changing direction of the materials being conveyed, in the horizontal plane, more than one belt conveyors are needed.

iii. Conveying capacity of a conveyor can be controlled by changing belt speed.

iv. Belt conveyors are generally employed for continuous flow of materials.

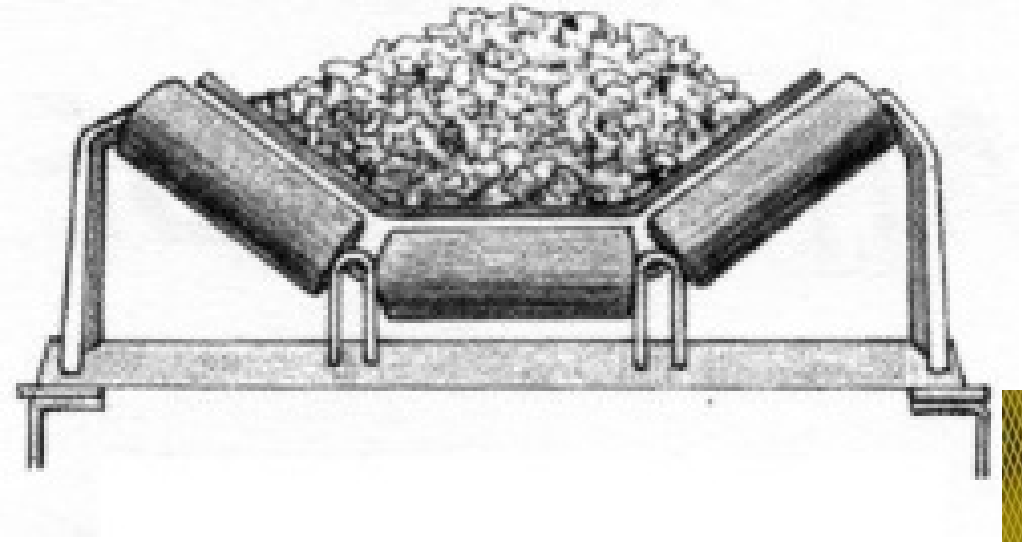
v. Metal/special belts can carry hot, abrasive or reactive materials.

3. Types of Belt Conveyors

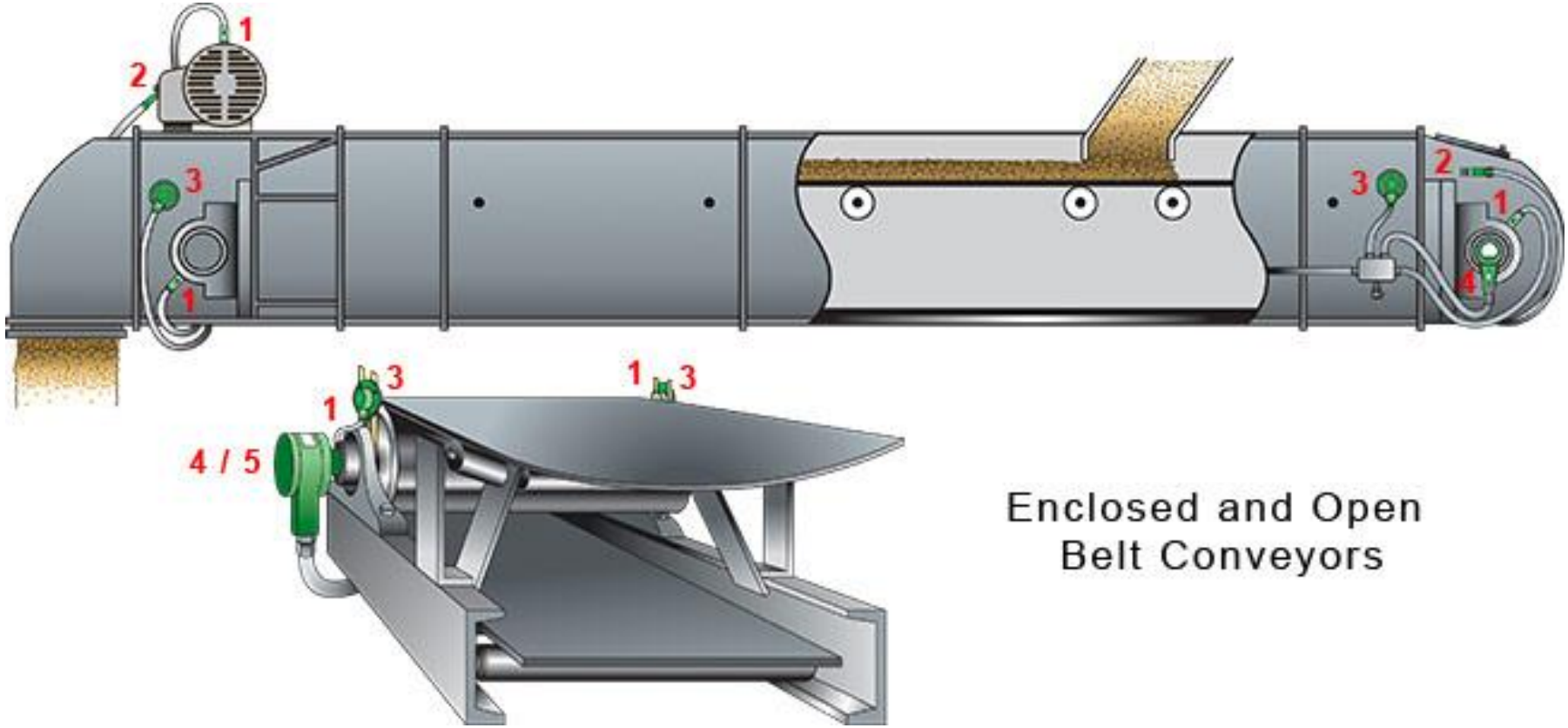
- Flat Bed Conveyor
- Troughed belt Conveyor
- Closed Belt Conveyor
- Metallic Belt Conveyor
- Portable Conveyor
- Chain/Rope Driven Belt Conveyor
- Submerged Belt Conveyor

3.1. Flat Belt Conveyor

3.2. Troughed Belt Conveyor

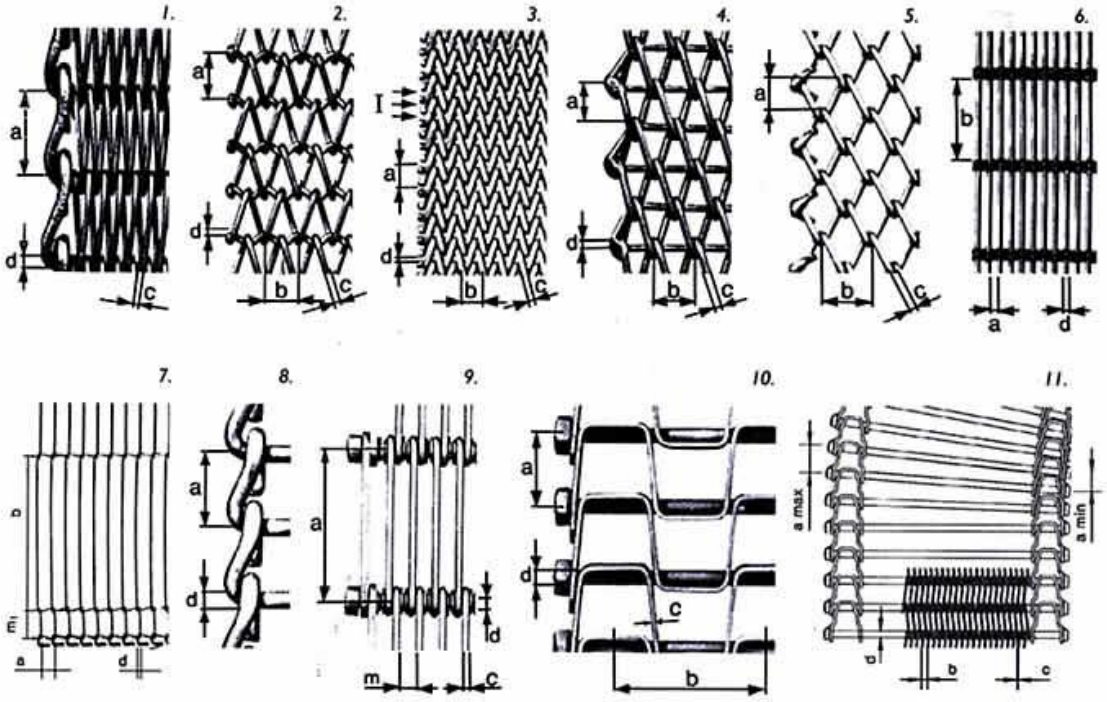


3.3. Closed Belt Conveyor

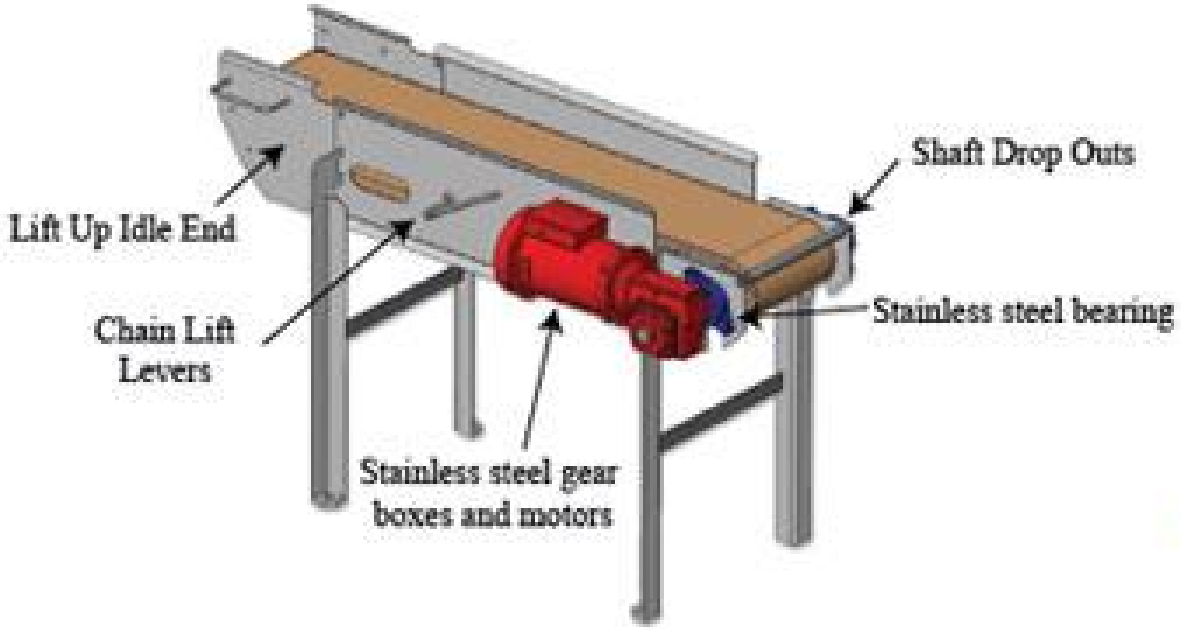


Enclosed and Open
Belt Conveyors

3.4. Metallic Belt Conveyor



3.5. Portable Conveyor

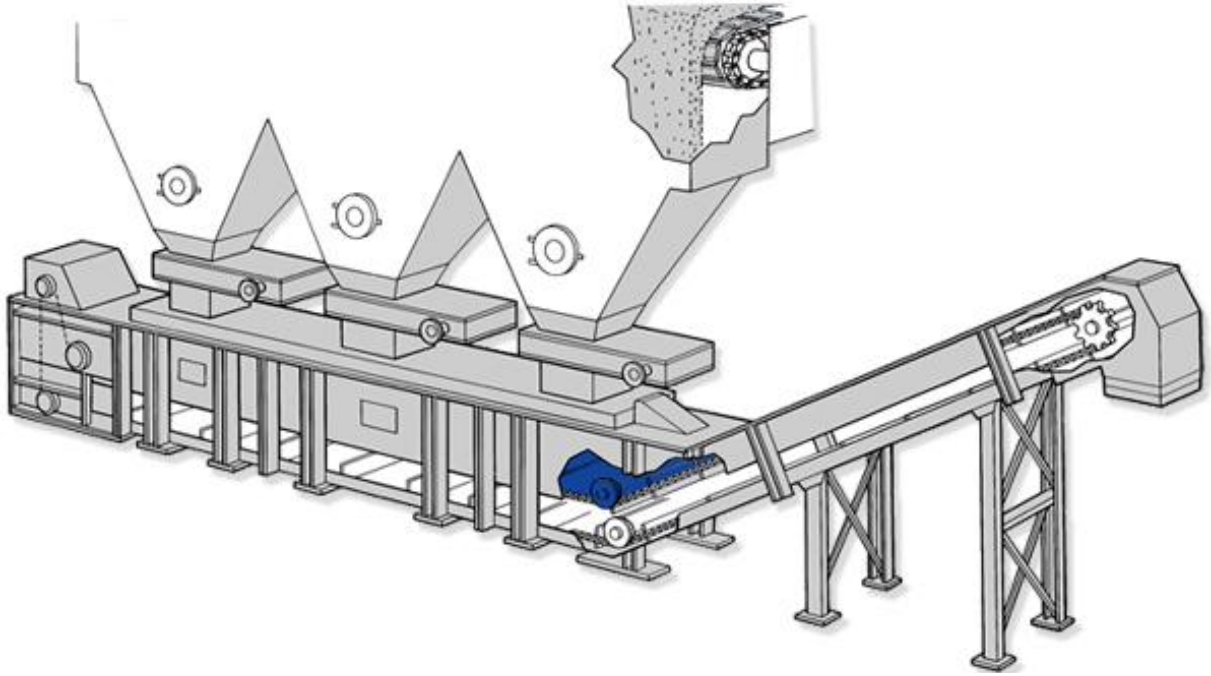


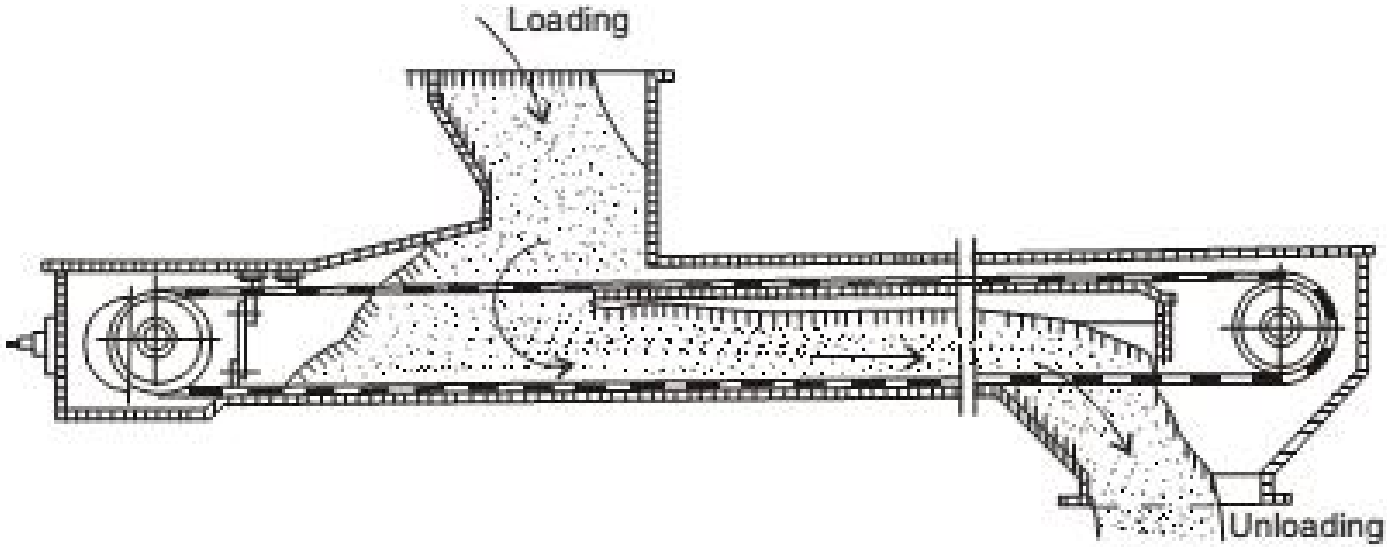
Permanent

Portable

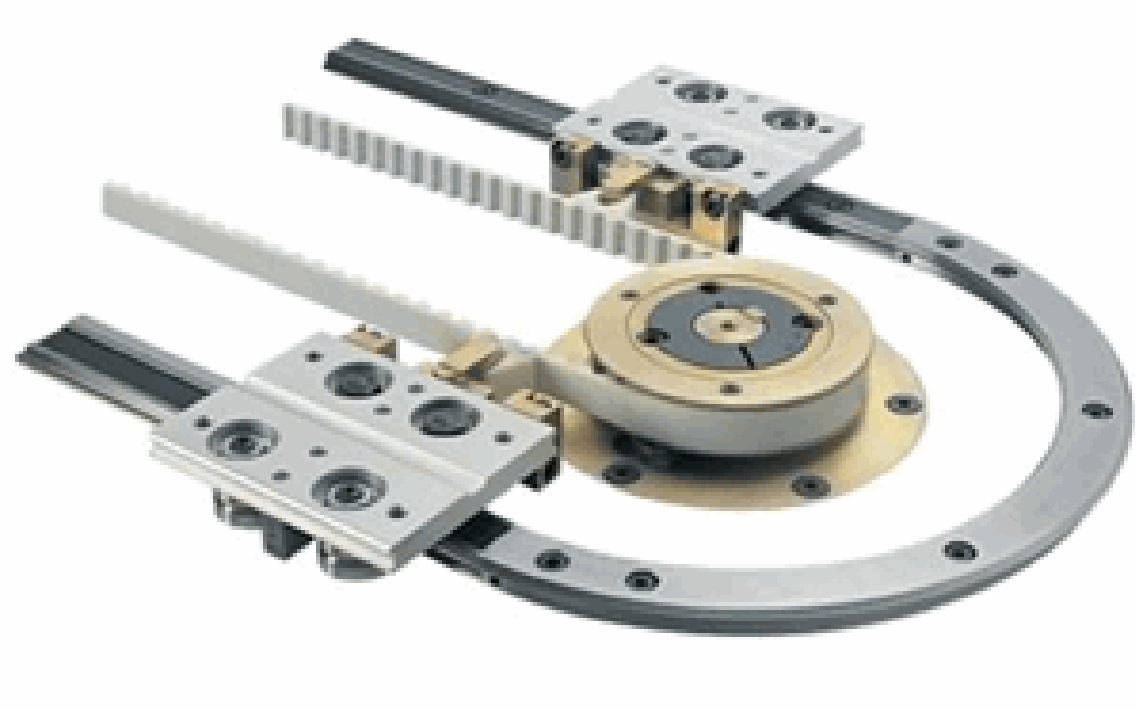
3.6. Chain/Rope Driven Belt Conveyor

3.7. Submerged Belt Conveyor



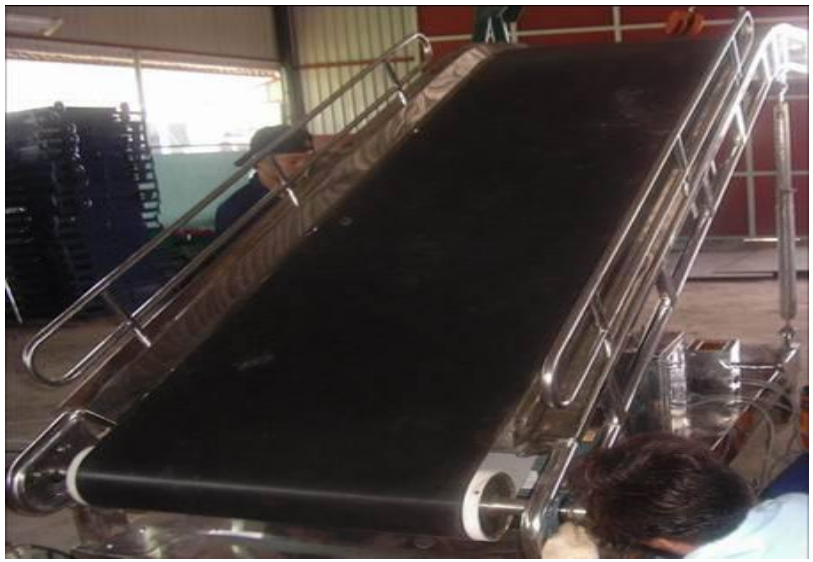


3.8. Single – Purpose Conveyor



3.9. Direction of Conveyor

Horizontal



Incline

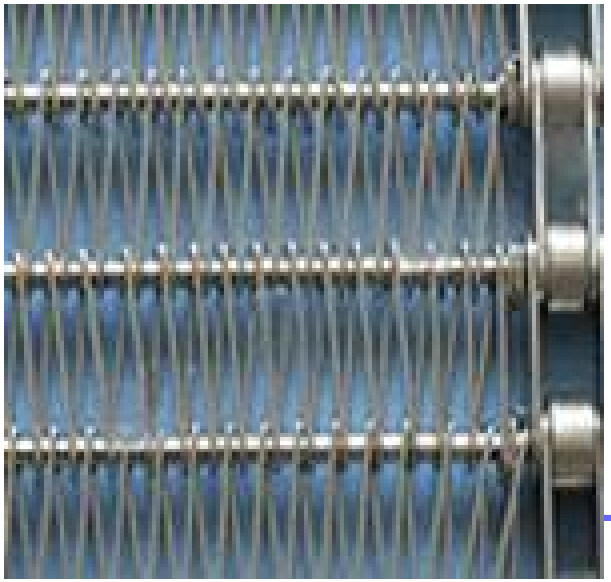
Combination

4. Parts of a Belt Conveyor

The essential elements of typical belt conveyors are:

1. The *belt,* which forms the moving and supporting surface on which the conveyed material rides.
2. The *idlers*, which form the supports for the troughed carrying strand of the belt and the flat return strand.
3. The *pulleys*, which support and direct the belt and control its tensions.
4. The *drive*, which impacts power through one or more pulleys to move belt and its load.
5. The *structure*, which the supports and maintains alignment of idlers, pulleys, and drive.

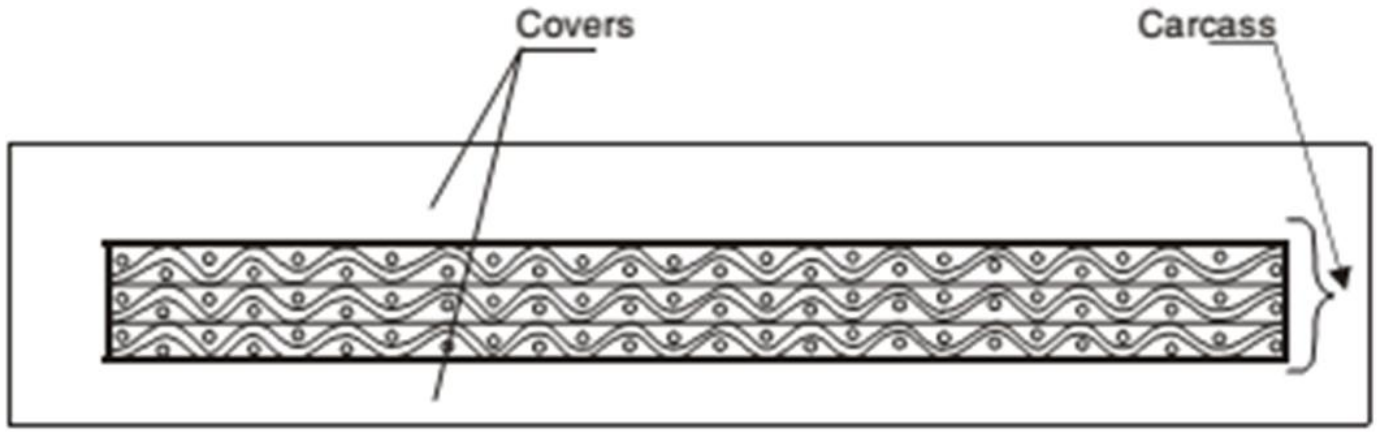
4.1. Conveyor Belts



http://www2.hcmuaf.edu.vn/?ur=dangnh

4.1. Conveyor Belts (1)

- Belt Contruction
- Belt Covers
- Belt Designation
- Belt Width
- Belt Splicing



4.1. Conveyor Belt (3)

Belt Width: Unless otherwise agreed between the manufacturer and buyer, the standard widths of belting as per IS specification are: 300, 400, 500, 600, 650, 800, 1000, 1200, 1400, 1500, 1600, 1800 and 2000 mm with a tolerance of ±5 mm upto 500mm width and ±1% of belt width for widths higher than 500 mm

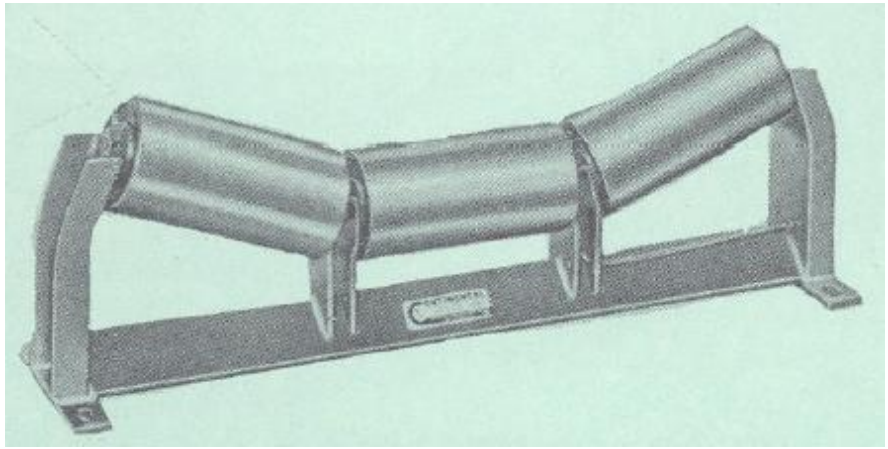
4.1. Conveyor Belt (4)

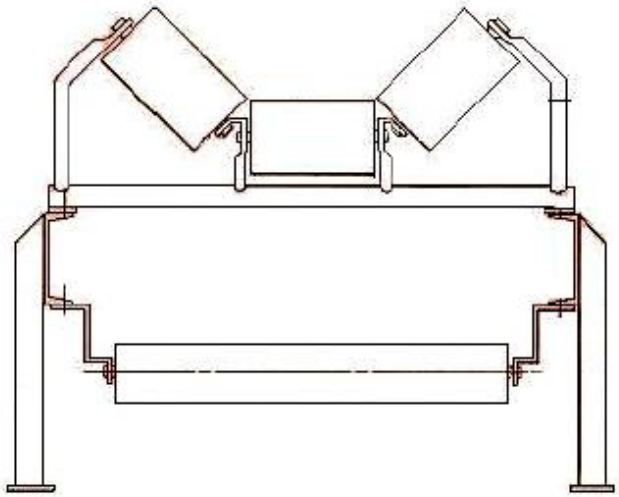
4.2. Idlers (1)

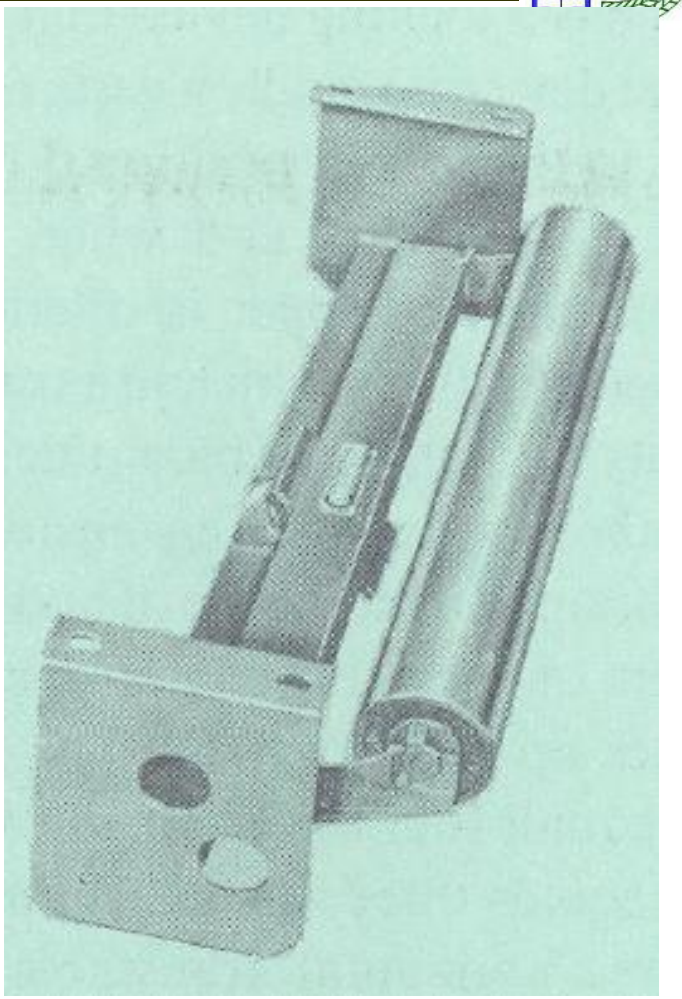
- Idler construction
- Idler dimensions
- Idler spacing

4.2. Idlers (2)

Two types of Idlers

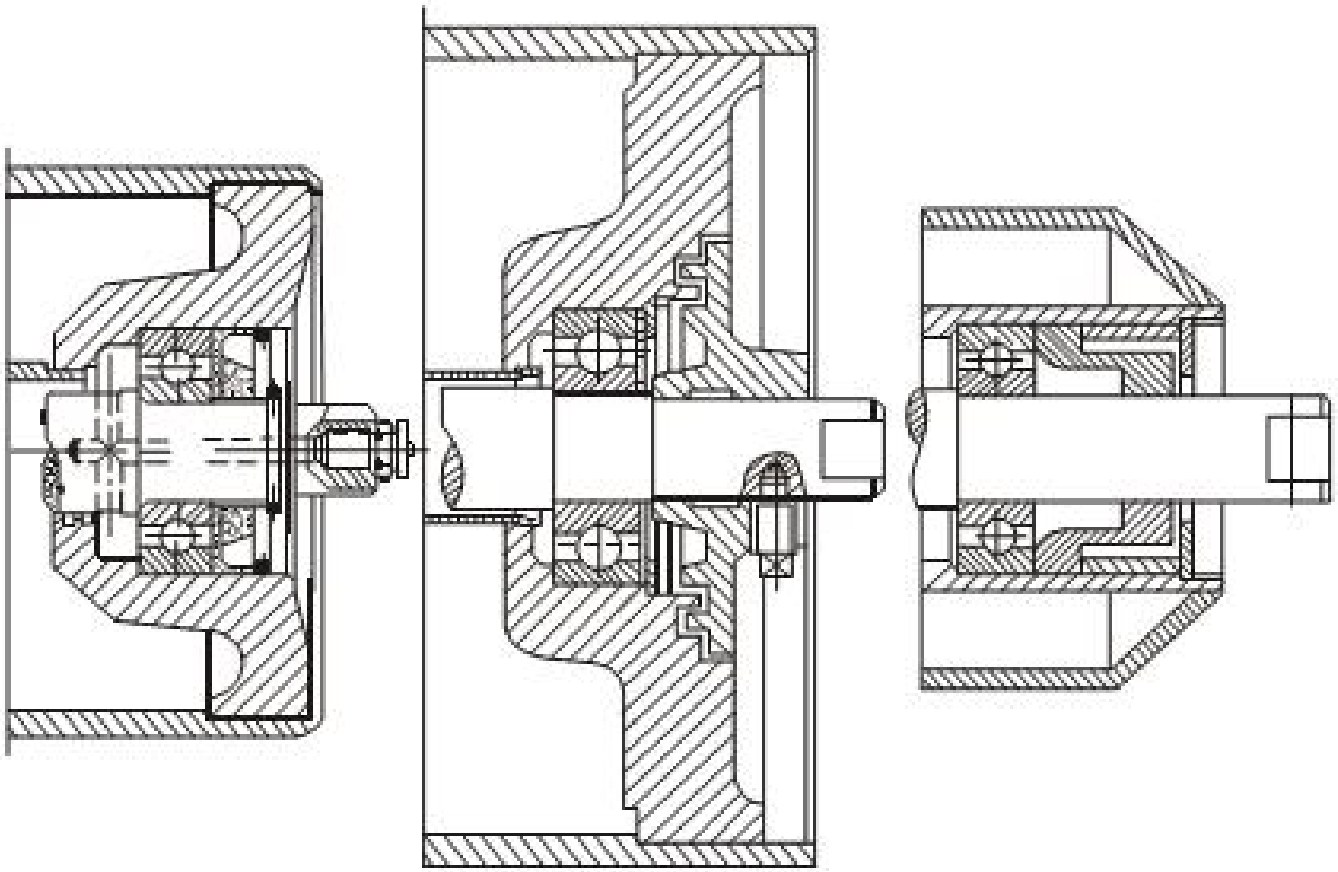






4.2. Idlers (2)

4.2. Idlers (4)



4.2. Idlers (5)

- Diameter, length and troughing angle have been standardized by BIS in IS 8598 :1987(2). The carrying and return idler diameters in mm are : 63.5, 76.1, 88.9, 101.6, 108, 114.3, 127, 133, 139.7, 152.4, 159, 168.3 and 193.7. The maximum diameter of 219.1mm is used for carrying idler only.

- Troughed idler sets are made with troughing angle (the angle made by the inclined roller with horizontal) of 15°, 20°, 25°, 30°, 35°, 40° and 50°. Troughing angle of 15° is applicable only to two roll troughed idlers. The value of troughing angle of troughed return idlers are selected from 0°, (i.e., straight idler), 10° and 15° for all widths of belt.

4.2. Idlers (6)

Belt Width B	Edge Clearance		
	Flat idler	2-roll idler	3-roll idler
400	50	40	35
500	50	40	40
650	50	50	50
800	75	75	70
1000	75	75	70
1200 to 2000	100	100	100

4.3. Conveyor Pulleys

At each of the two ends of a belt conveyor, one large diameter pulley is installed against which the belt turns and changes direction. These pulleys are called terminal or bend pulley.

4.3. Conveyor Pulleys (2)

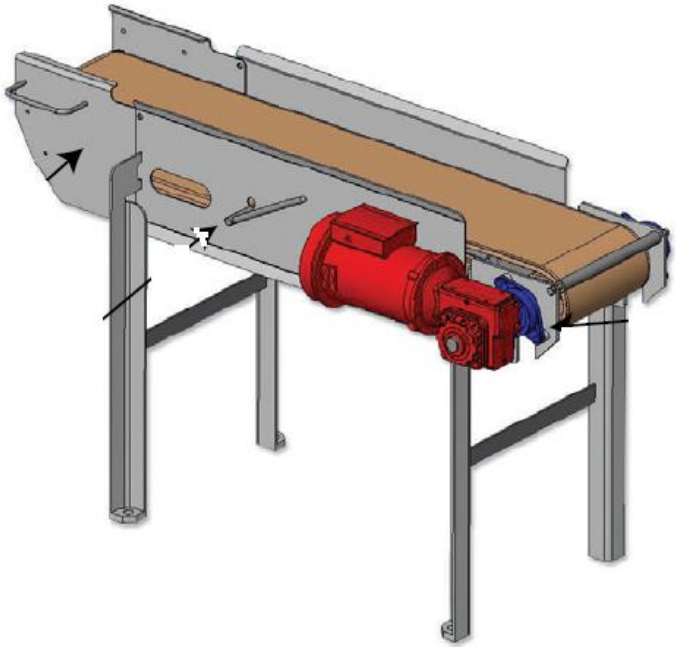
- The surface of the pulley may be left bare smooth, or may be covered up to a thickness of 6 to 12 mm by rubber, polyurethane or ceramic layer with herringbone patterned grooves to increase the friction between the pulley and belt

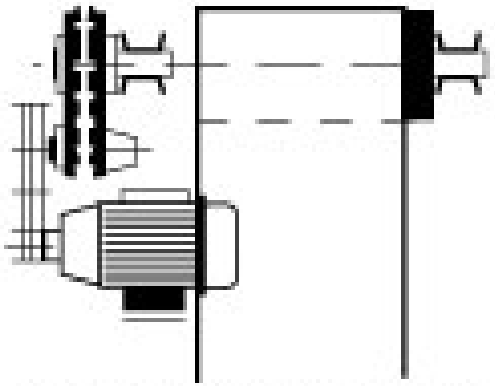
4.4. Drives for Belt Conveyor (1)

✓ **Belt conveyor drive equipment normally consists of a motor, speed reducer, drive shaft, and necessary machinery to transmit power from one item to another; the simplest arrangement using the least number of components is the best.**

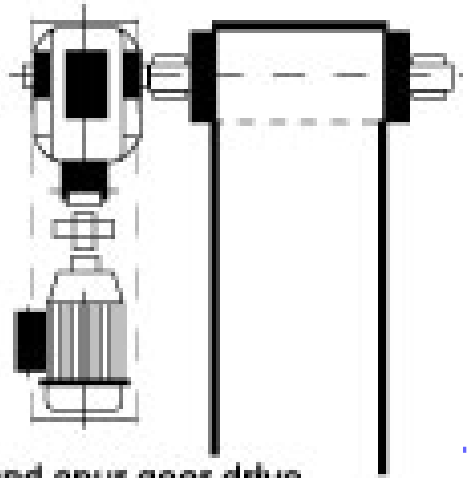
✓ **Often however, special-purpose components must be provided to modify starting and stopping, provide for a hold-back, or vary belt speed.**

4.4. Drives for Belt Conveyor (2)





Flat gear with V-belt transmission

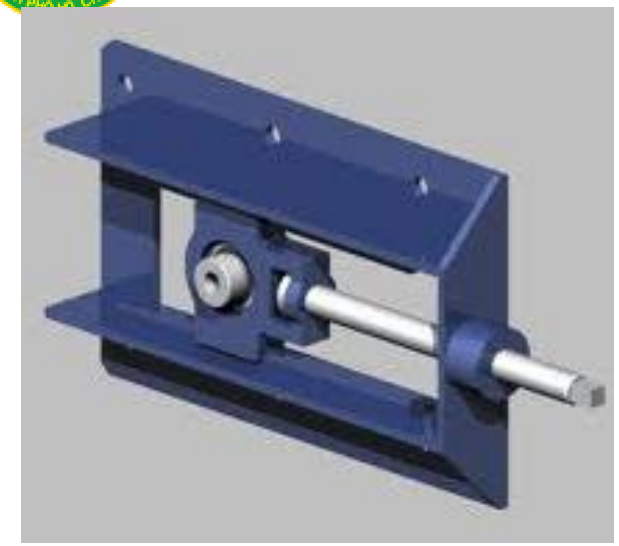


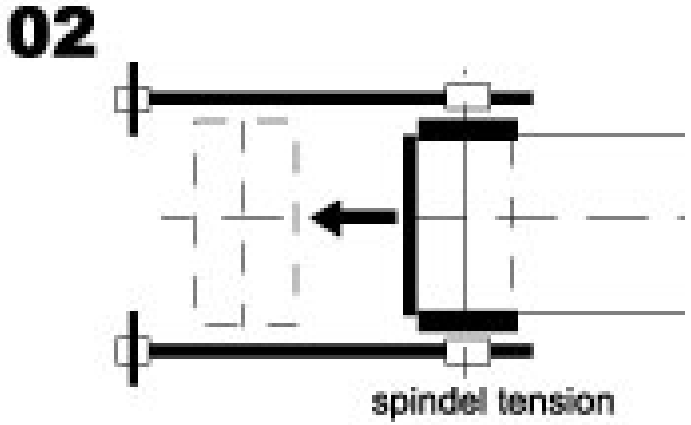
bevel and spur gear drive

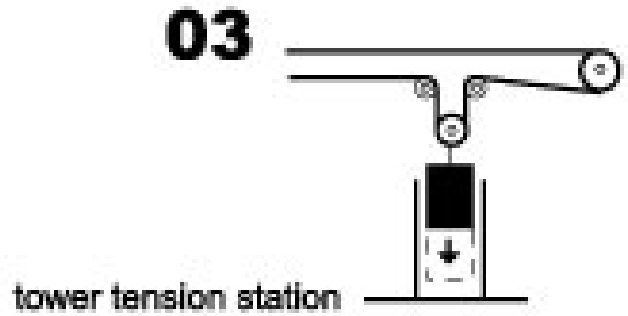
4.5. Take-ups or Belt Tensioning Devices (1)

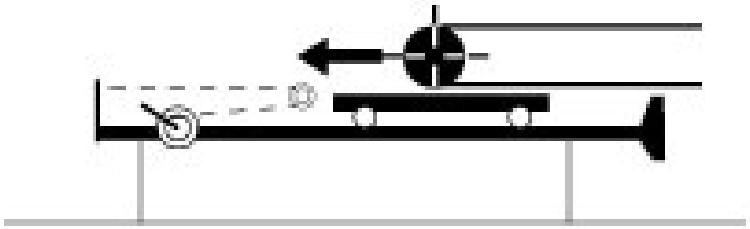
Endless conveyor belt after being threaded through the entire length of the conveyor need to be tightened so that sufficient frictional force is developed between the drive pulley and the belt, to make the belt move.

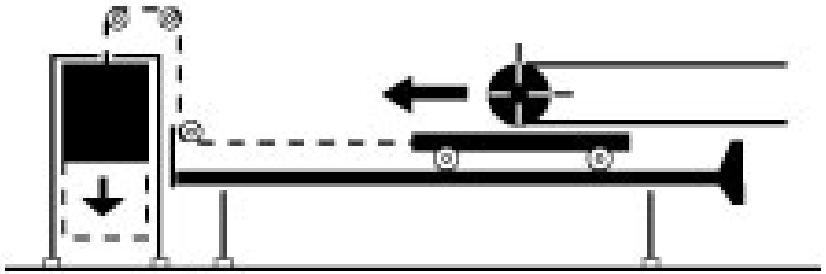
4.5. Take-ups or Belt Tensioning Devices (2)







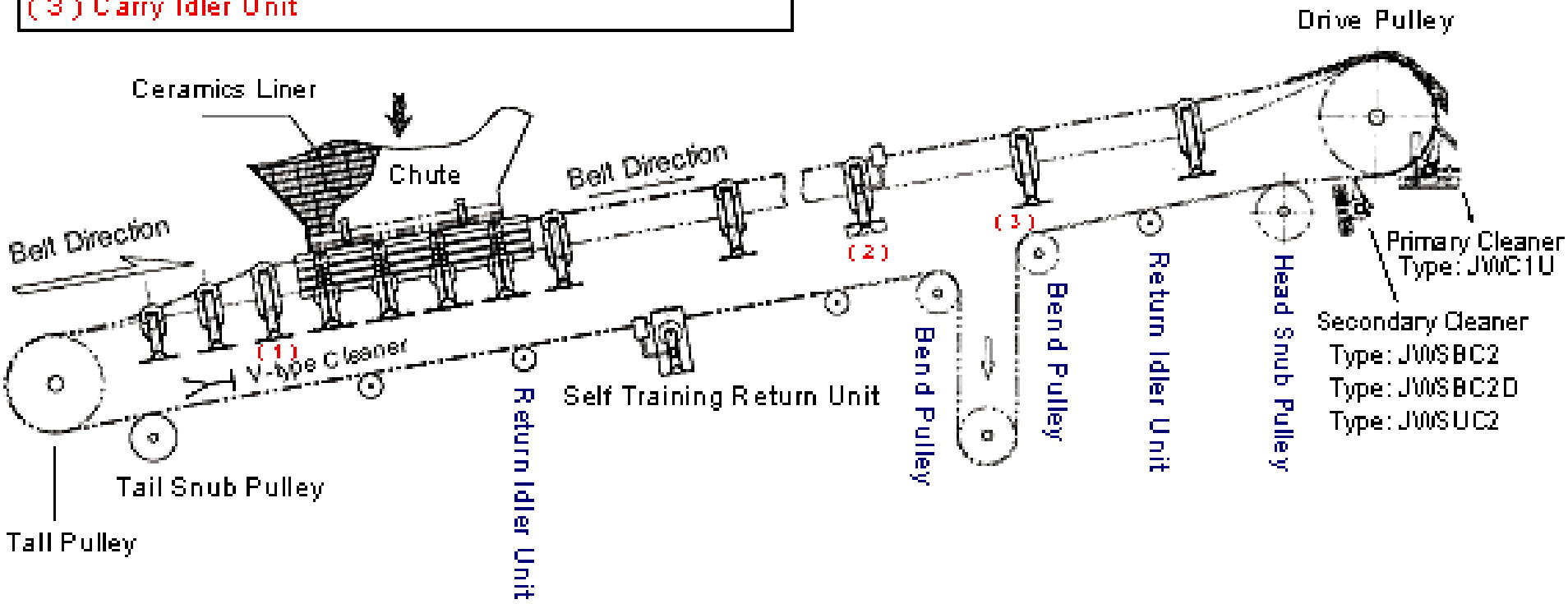

tow tension


weight tension

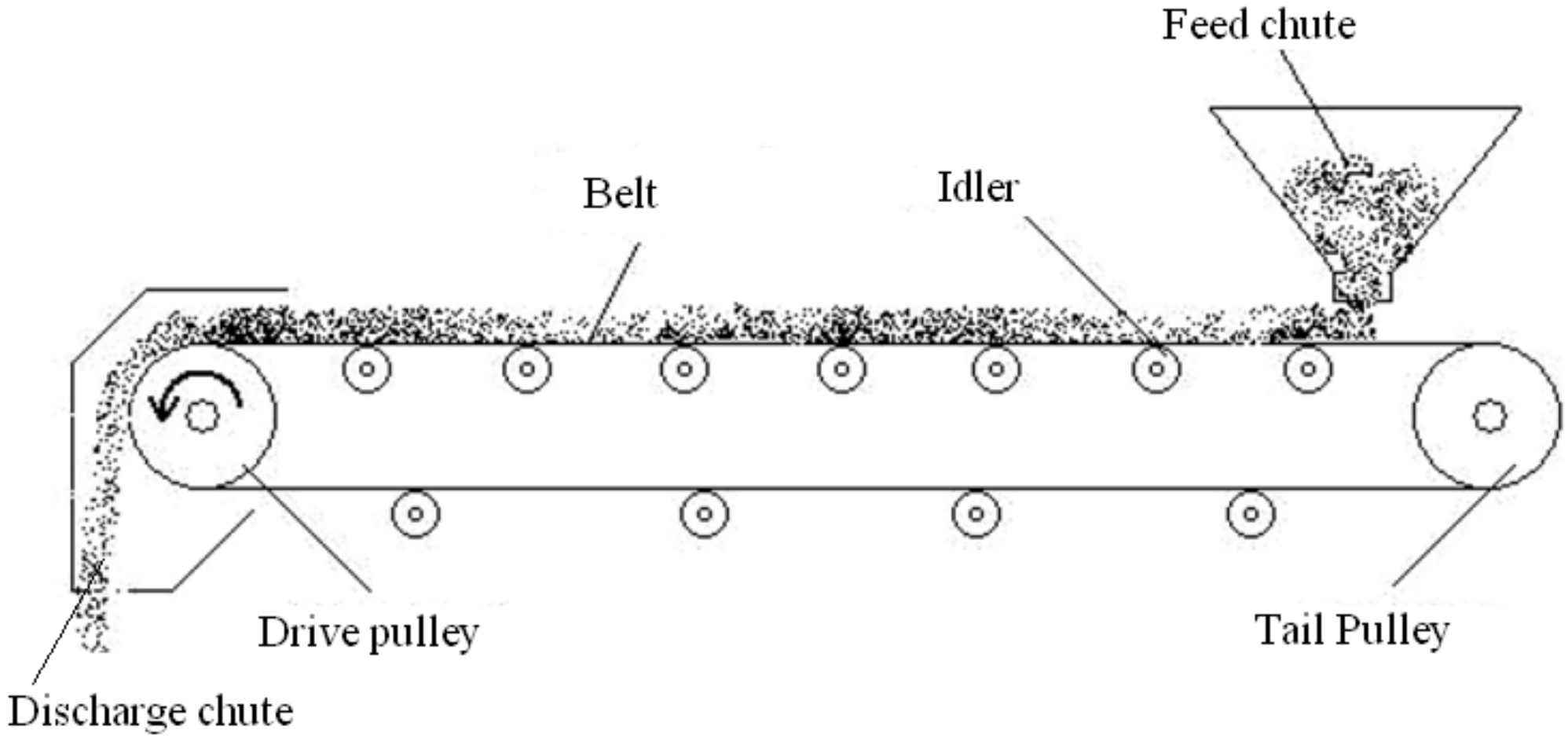
4.5. Take-ups or Belt Tensioning Devices (3)

(1) Impact Cradle Reduce Spill And For Transfer Point
(2) Self-Training Carry Unit
(3) Carry Idler Unit

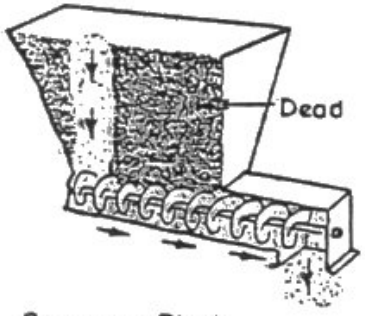
****
Impact Slide Bar
****



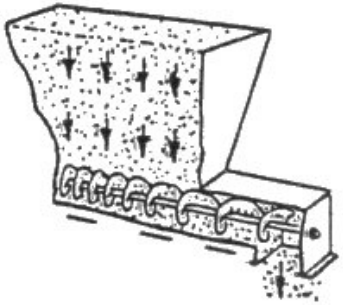
4.6. Loading and unloading devices (1)



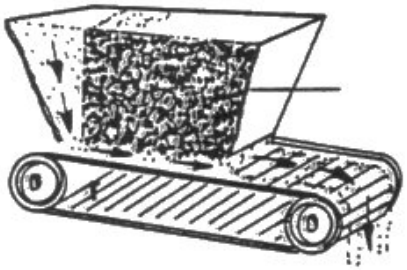
4.6. Loading and unloading devices (2)



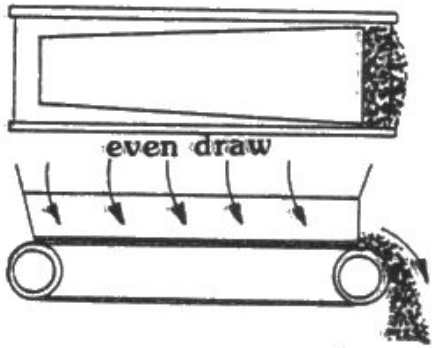
(a) Constant Pitch



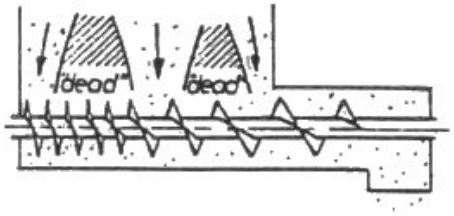
(b) Variable Pitch



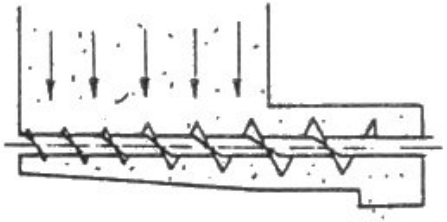
(a)
Parallel Outlet



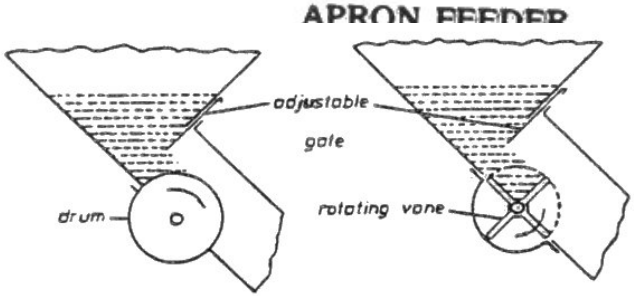
(b)
Tapered Outlet



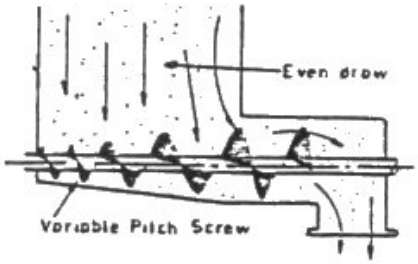
(c) Stepped Pitch



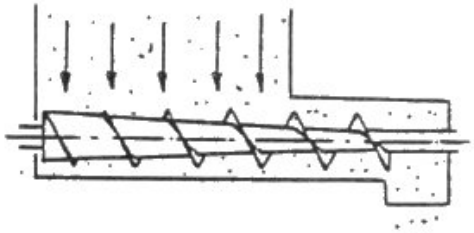
(d) Variable Diameter



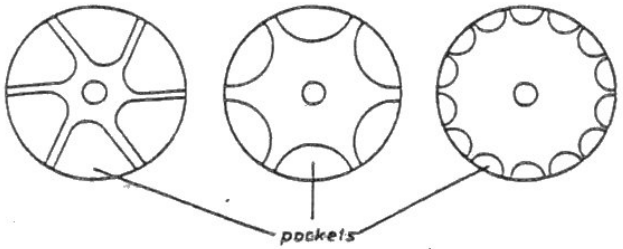
(a) (b)



(e) Variable Pitch and Diam.

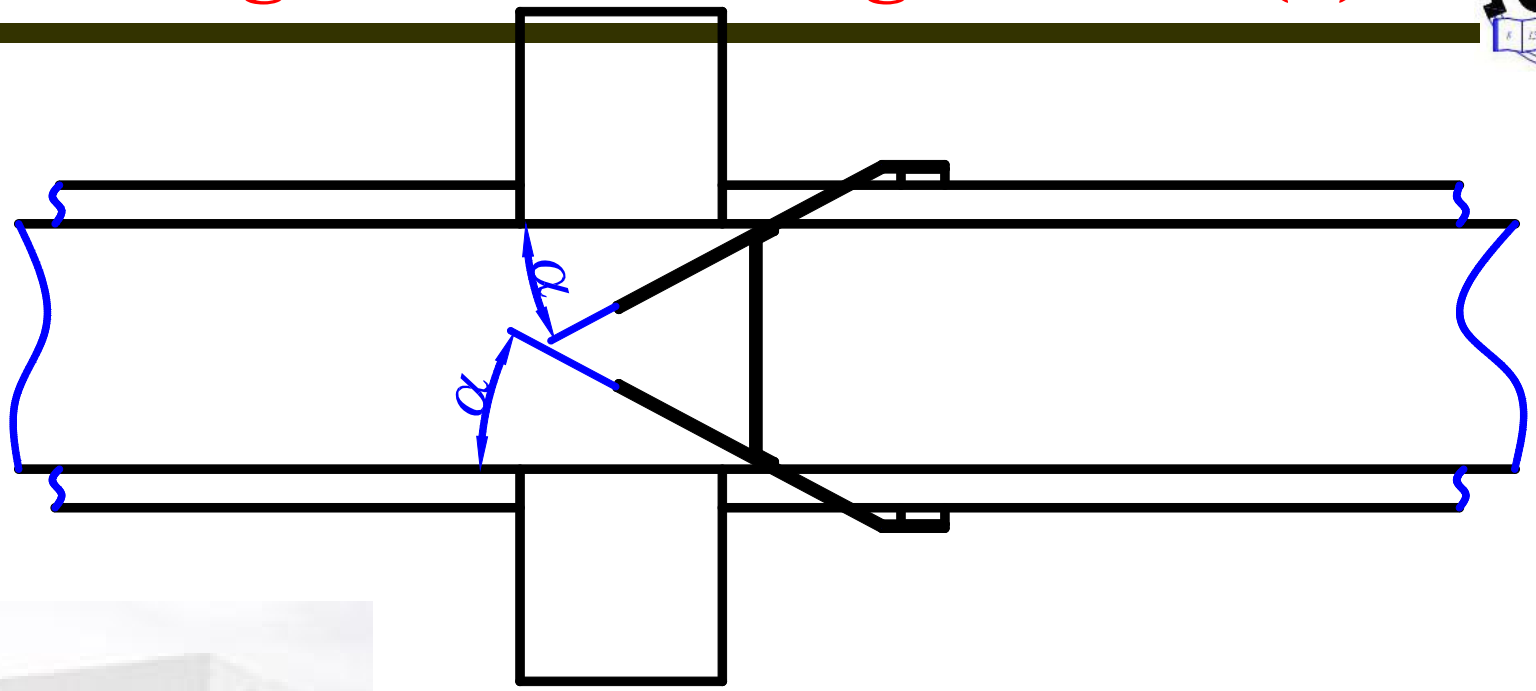


(f) Variable Shaft Diameter



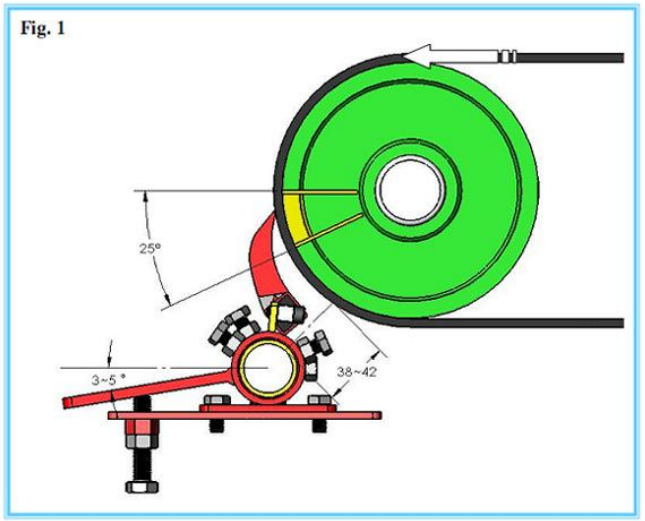
(c)

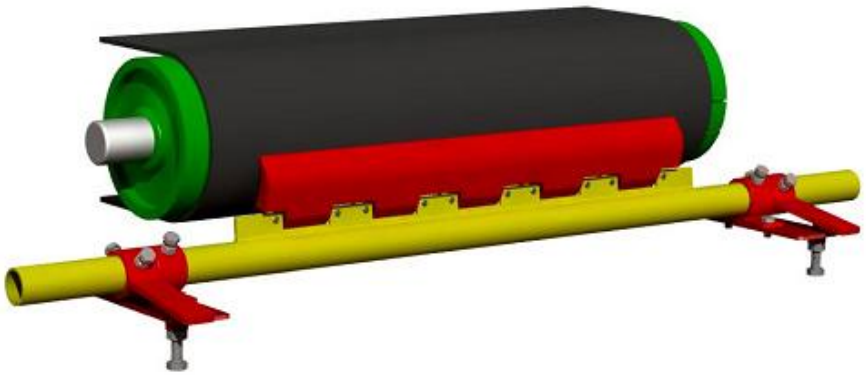
4.6. Loading and unloading devices (3)

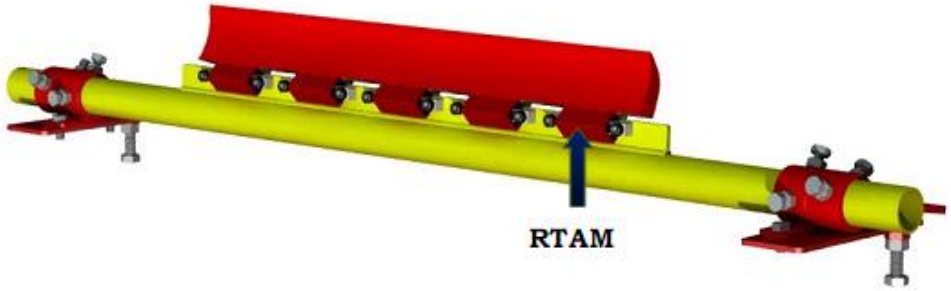


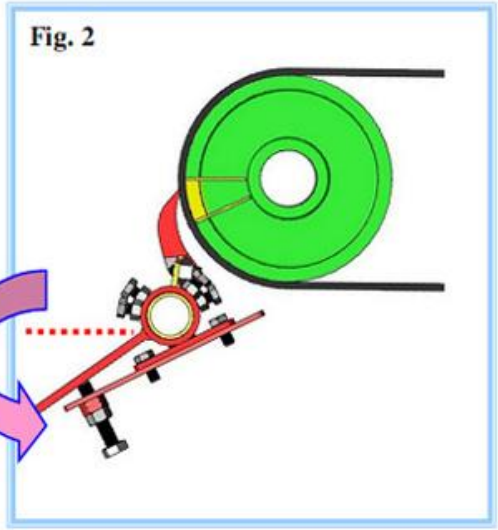
4.7. Belt cleaners

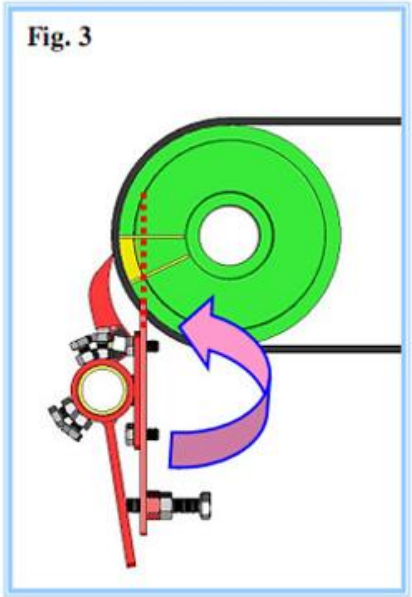
4.7. Belt cleaners (7)



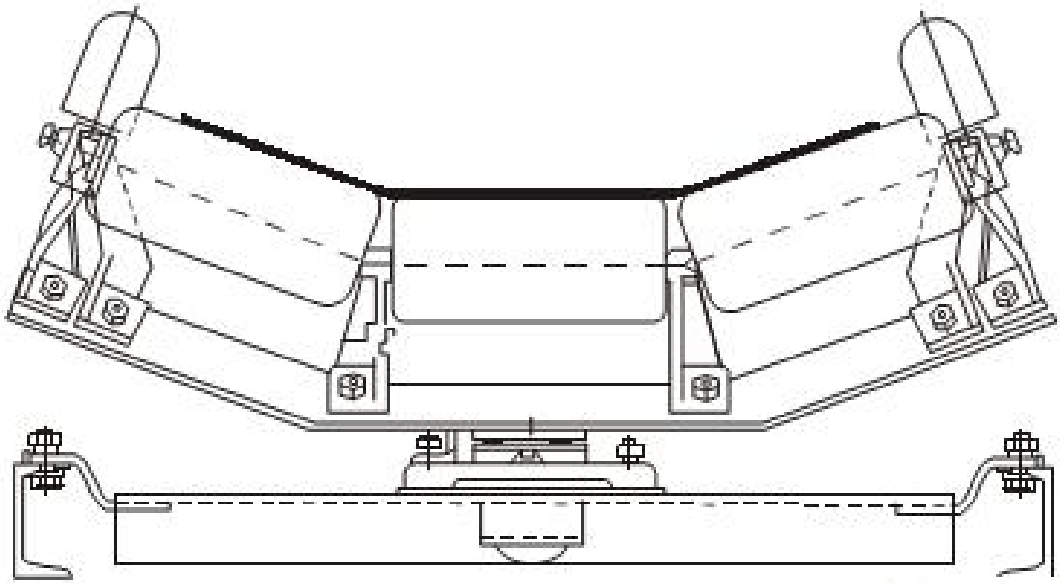


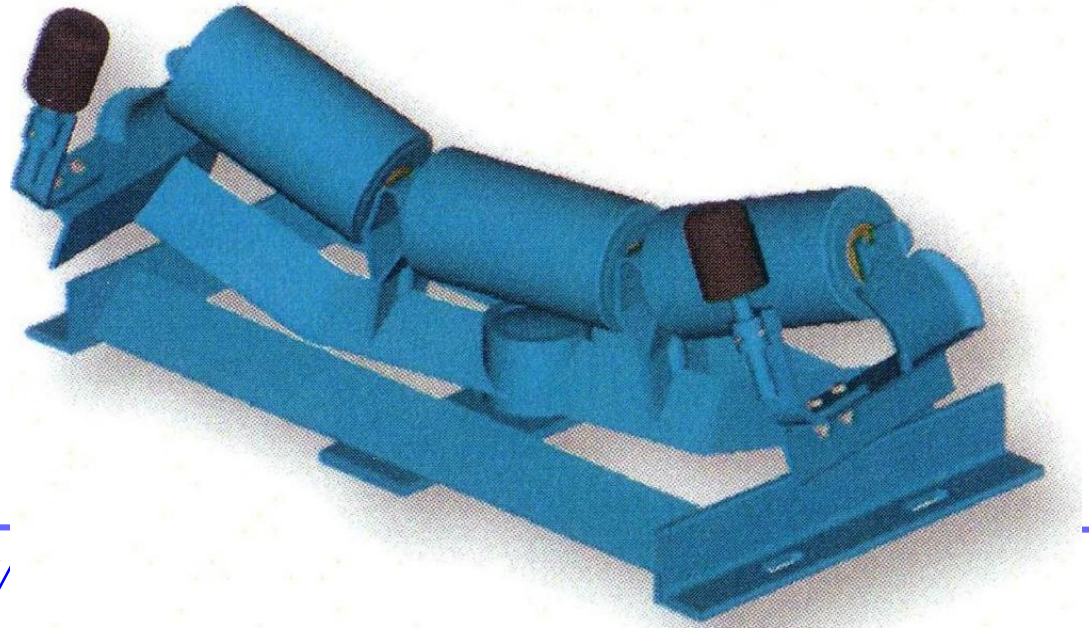






4.8. Training idlers





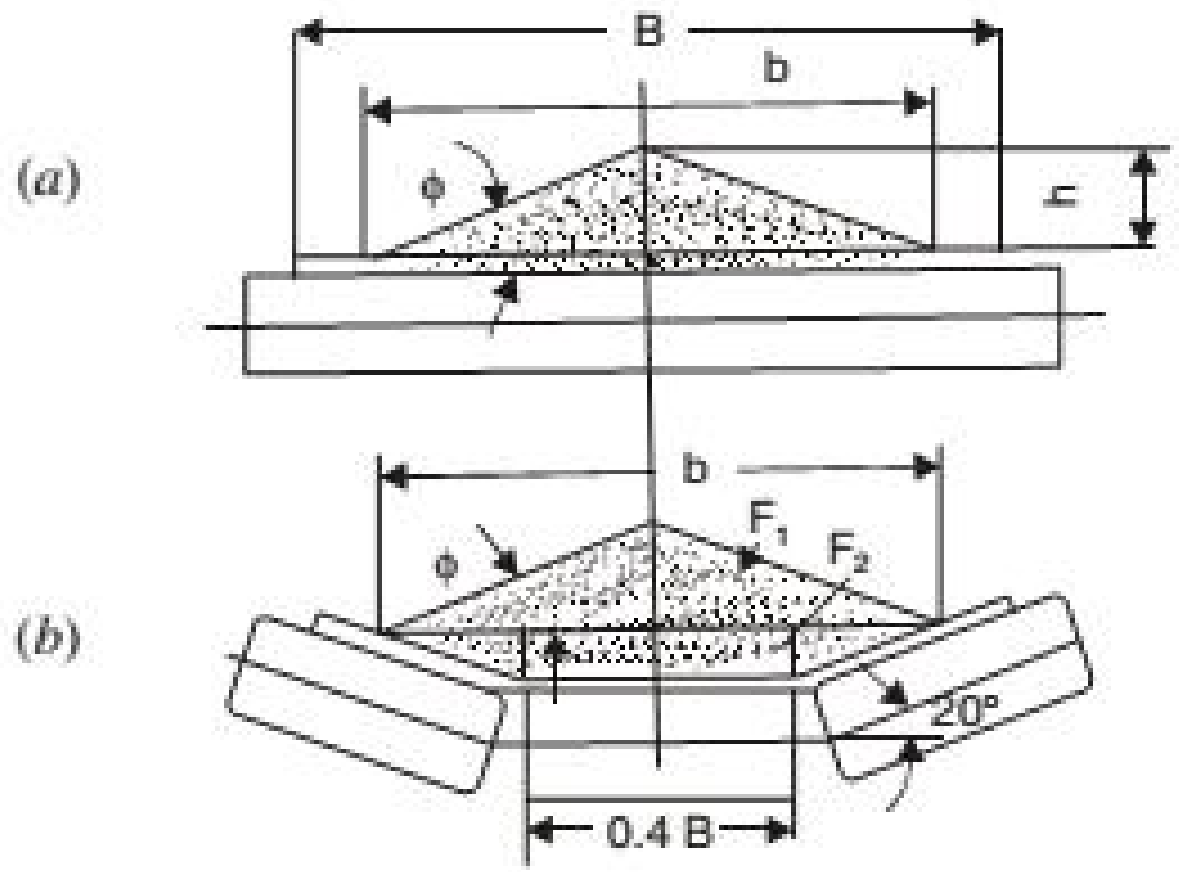
4.9. Conveyor structure

5. Aspects of Belt Conveyor Design

1. Checking/ determining capacity of conveyor
2. Calculating max belt tension and select of belt
3. Selection of driving pulley
4. Determining motor power
5. Selection of idlers and its spacing

5.1. Checking/ Determining Conveyor Capacity (1)

- Belt Width
- Belt Speed



5.1. Checking/ Determining Conveyor Capacity (2)

Table 6.1.2. Lump size factor

Material	Lump Size	Lump Size Factor	Air Borne Factor
Fine Grain to Dust	< 10 mm	0	4
Granular	< 25 mm	1	0
Sized and Unsized	Quantity of largest lump is < 20 per cent of maximum permissible lump size (for the selected belt width)	2	0
Sized	Quantity of largest lump is < 60 per cent of maximum permissible lump size (for the selected belt width)	3	0
Unsized	Largest lump does not exceed maximum permissible lump size (for the selected belt width)	4	0

Table 6.1.3. Abrasiveness Factor

Abrasiveness	Type of Material	Abrasiveness Factor
Non Abrasive	Free flowing materials, such as cereal grains, wood, chips, wood pulp, fullers earth, flue dust, soda lime, char, loam sand, ground gravel.	1
Mildly Abrasive	Materials, such as aggregate, run-of-bank sand and gravel, slate, coal, salt, sand stone.	2
Abrasive	Materials, such as slag, spar, limestone concentrates, pellets.	3
Very Abrasive	Iron ores, taconite, jaspar, heavy minerals, flint rock, glass cullet, granite, traprock, pyrites, sinter, coke etc.	4

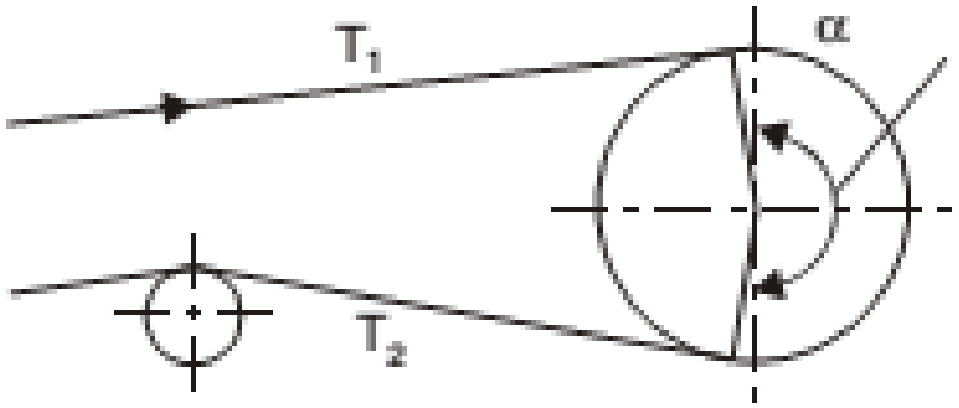
5.1. Checking/ Determining Conveyor Capacity (3)

Table 6.1.4. Maximum Recommended Belt Speeds (m/s)

Belt Width, mm / Speed Factor	Upto 500	600 to 650	750 to 800	950 to 1050	1200 to 2000
1	2.50	3.00	3.50	4.00	4.50
2	2.30	2.75	3.20	3.65	4.12
3-4	2.00	2.38	2.75	3.15	3.55
5-6	1.65	2.00	2.35	2.65	3.00
7-8	1.45	1.75	2.05	2.35	2.62

Degrees	0-2	4	6	8	10	12	14	16	18	20
'k' factor	1	0.99	0.98	0.97	0.95	0.93	0.91	0.89	0.85	0.81

5.2. Belt Tension (1)

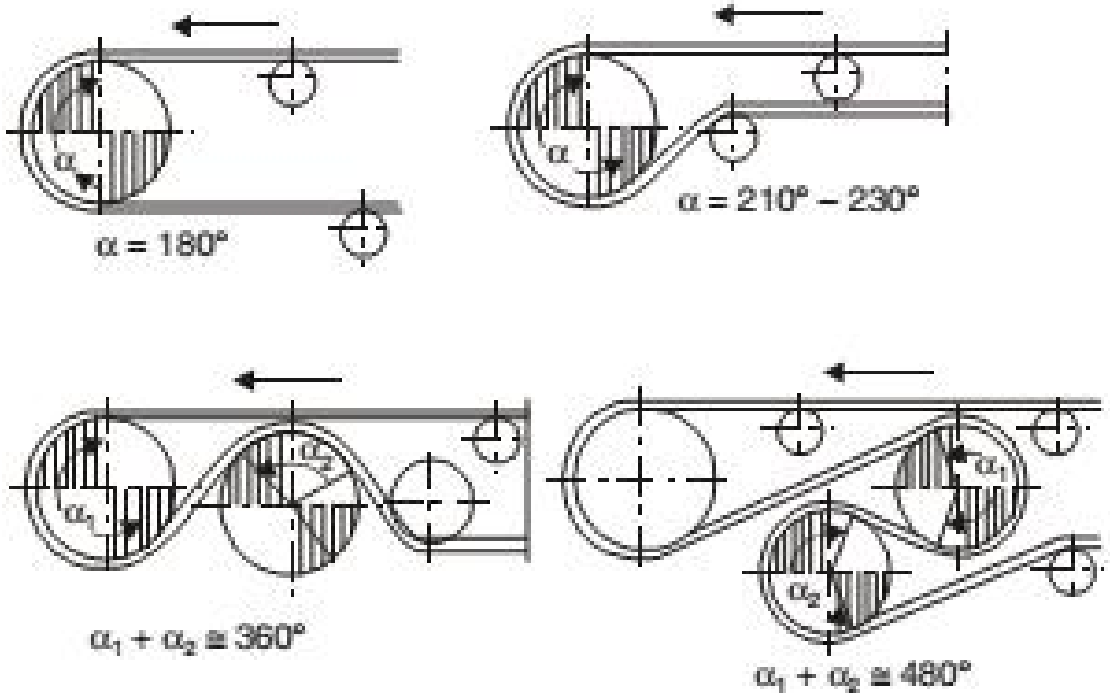


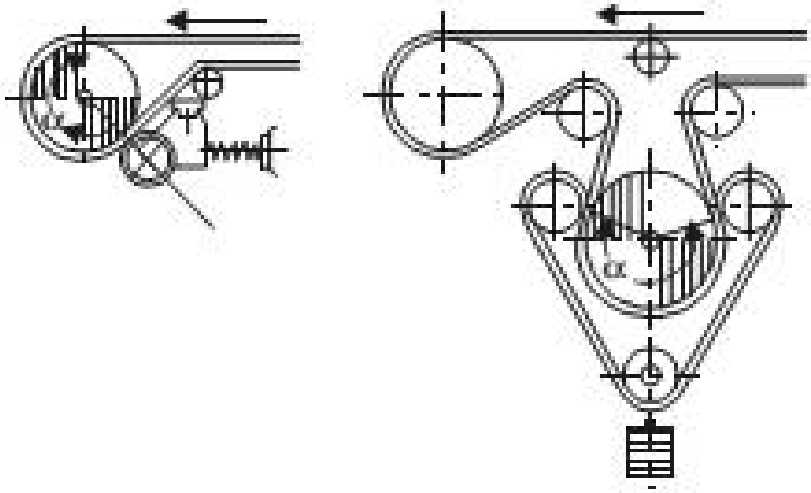
5.2. Belt Tension (2)

Table 6.1.5. Friction Coefficient between Driving Pulley and Rubber Belting

Pulley Surface / Operating conditions	Smooth Bare Rim Steel Pulley	Rubber Lagging with Herringbone Patterned Grooves	Pulyurethane Lagging with Harringbone Patterned Grooves	Caramic Lagging with Harringbone Patterned Grooves	PVC Belt Type
Dry condition operation	0.35 to 0.4	0.4 to 0.45	0.35 to 0.4	0.4 to 0.45	0.25 to 0.35
Clean wet condition (water) operation	0.1	0.35	0.35	0.35 to 0.4	0.15 to 0.30
Operation under wet and dirty (clay or loam) conditions	0.05 to 0.1	0.25 to 0.3	0.2	0.35	Less than 0.25
Operation under very wet and dirty condition	0.05	0.25	0.2	0.3	0.15

5.2. Belt Tension (3)





5.3. Selection of Driving and Other Pulleys

- However, as a thumb rule, diameter ‘D’ can be approximated from the relation, D ≥ ki, where i = number of plies of belt, and k = 125 to 150for i between 2 to 6, and k = 150 for i between 8 to 12. Calculated ‘D’ is rounded off to the larger standard sizes of 250, 315, 400, 500, 630, 800,1000,1250,1400,1600, 1800 and 2000 mm. The length of the barrel is kept 100mm to 200 mm more than the belt width.

5.4. Motor Power

The power required at the driving pulley just for driving the belt is given by the formula:

$$P_d = \frac{T_e \times V}{1000} \text{ kW, where } T_e = \text{effective tension} = (T_1 - T_2) \text{ in Newton}$$

V = belt speed, m/sec

P_d = driving power, kW

However, the actual power requirements, considering the wrap resistance between belt and driving pulley, and driving pulley bearings resistance, the actual motor power, P_A is given by

$$P_A = \frac{T_e V}{1000} + \frac{(R_{wd} + R_{bd})V}{1000} \text{ kW, where}$$

R_{wd} = wrap resistance between belt and driving pulley.

R_{bd} = driving pulley bearing resistance.

5.5. Selection of Idlers (1)

Table 6.1.6. Idler Classification

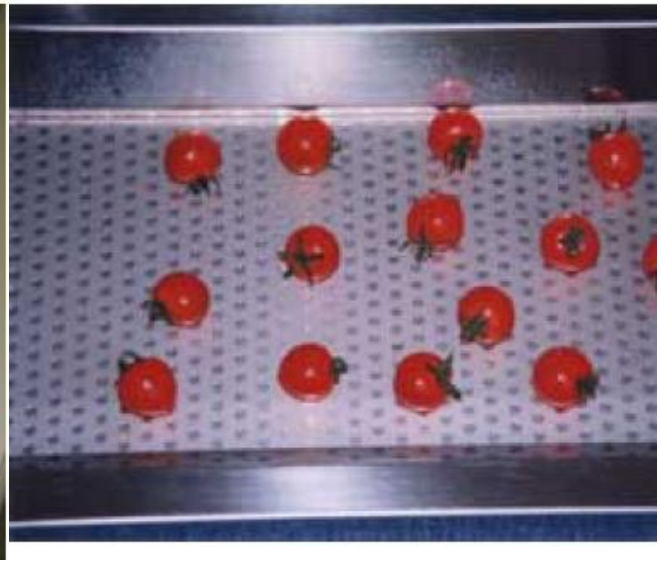
Idler Series	Roller Diameter	Belt Width	Maximum Belt Speed, m/s	Suitable for
I.	63.5 to 101.6	300-800	2.5	Fine material with small lumps-Nonabrasive, intermittent duty.
II.	88.9 to 139.7	400-1000	4.0	Fine material, small sized lumps, slightly abrasive, continuous duty.
III.	101.6 to 139.7	500-1200	4.0	Unsized medium lumps, mixed with fine sized small lumps, moderately abrasive, continuous duty.
IV.	127 to 139.7	500-1400	4.0	Unsized, large lumps, mixed with small sized medium lumps moderately abrasive continuous duty.
V.	139.7 to 219.1	800-2000	5.0	Large size lumps, highly abrasive, critical duty.
VI.	168.3 to 219.1	1600-2000	4.0	Large capacity conveyor with lumps.

5.5. Selection of Idlers (2)

Table 6.1.7 Recommended Idler Spacing

Belt Width	Troughed Belt		Flat Belt	Return Idler Sets
	Carrying Idler Sets for Materials of Bulk Density (t/m^3)			Troughed and Flat Belt
	0.40 to 1.20	1.20 to 2.80		-
	Recommended Spacings, mm			
300 400 500 650	1500	1200	1000	3000
800 1000	1200	1000		
1200 1400 1600 1800 2000	1000	1000	750	

Belt conveyors on practical.



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Bài tập

- BT01: Đọc Page: 65 – 74 : TL2/ (Paddy posharvest_IRRI) phần Belt Conveyor. Tóm tắt, đặt 2 câu hỏi.
- BT02. Đọc bài giảng, đặt 4 câu hỏi kèm trả lời.