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# INDUSTRIAL PLANTS

## Chapter twenty-one:

## Chian conveyors

**DOUBLE DEGREE MASTER IN**

**“PRODUCTION ENGINEERING AND MANAGEMENT”**

**SEAT OF PORDENONE**

**UNIVERSITY OF TRIESTE**

# Classification

The **chain conveyors** are characterized by the fact that the handling of the material is ensured by the traction of one or two chains. The material is supported by suitable supporting elements (beams, trolleys, plates etc.).
We identify:

- overhead conveyors monorail and dual rail;
- conveying trolleys with chain pulling above or below the plan land or air;
- chain conveyors or apron;
- shutters conveyors.

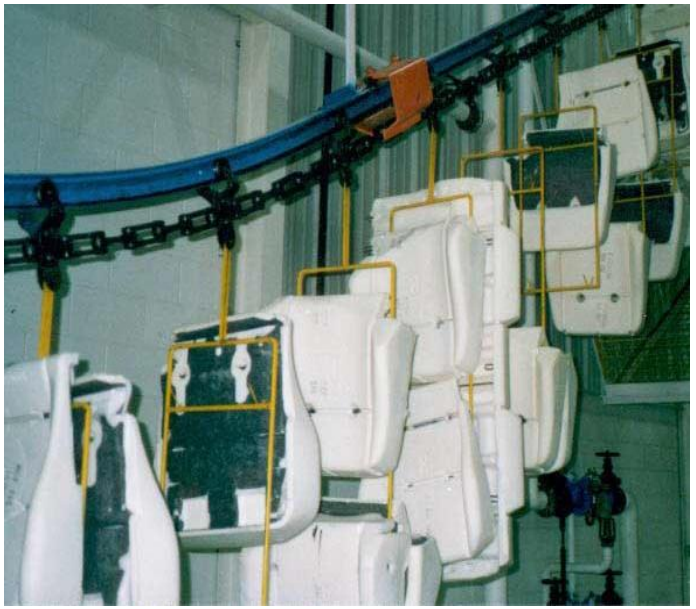
# Overhead conveyors

Fall into this category of materials handling those systems in which the components in contact with the loads, while transporting them, may be temporarily removed from the line so as to allow an accumulation of the components. Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**a) monorail**

In a closed circuit, a tracting chain drag of the sliding carriages (trolley) above a runway (ad example profiled IPN). The "slingbar" (hooks, shelves etc.) of the carriages have the function to support the load.

With these conveyors are exceeded of differences in altitude with the presence of curves in vertical planes, the inclination of which is 30 - 45°

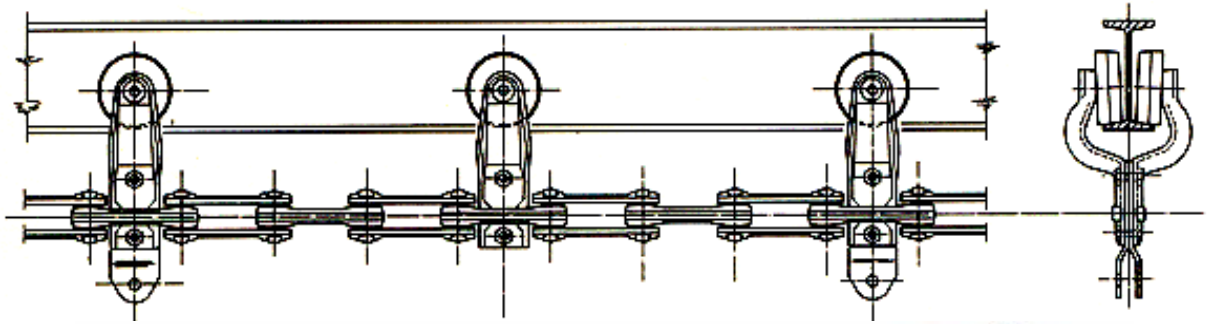


# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**a) monorail**

The motion of the chain of the overhead conveyors is generated by a toothed wheel or by a group of command equipped with chain drive with teeth that mesh in the chain of the conveyor (caterpillar).



# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**a) monorail**

The chain tension is ensured by appropriate tensioning.

Upper than 2 to 2.5 kN, there is provided a coupling of two trucks with a load-bearing bar or are taken of the trolleys with four wheels.

The transmission of motion, instead of being entrusted to a chain sliding, can be obtained by equipping each element with an electric motor self; in this way is released the motion of each single component from that of the other elements constituting the system. The result is a modular system, highly flexible and manageable for single the self-propelled. The functionality of the system are in fact comparable to those of a system of AGV. It also does not generate dimensions to the floor and allows translation speed greater

# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**b) dual rail**

The operating principle is such that each constituent element of the transmission system is engaged along a rail (route of lower stroke), along which it can slide freely through a system of guides. The guide element is dragged into movement by an element, which is connected rigidly to the drive chain. Engaging or disengaging the systems can constrain the element of the handling system to move rigidly with the chain or free it, allowing for example the accumulation of pieces in correspondence with a mounting station.

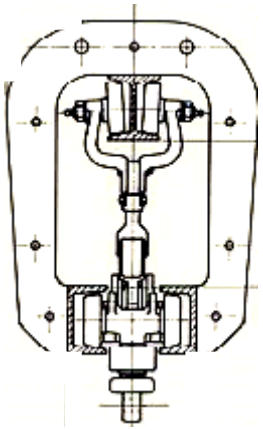
# Overhead conveyors

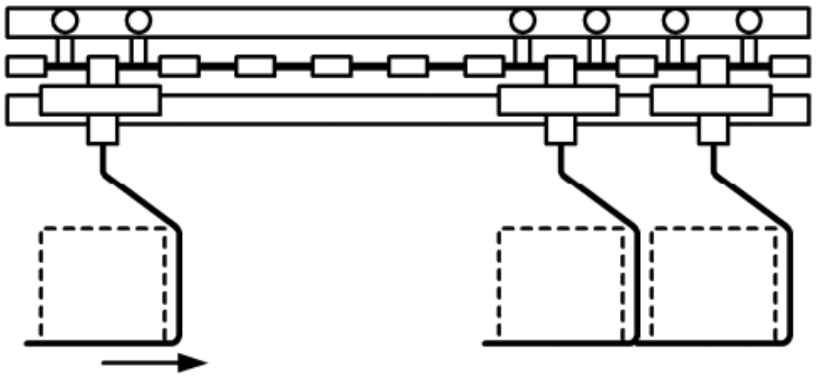
Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**b) dual rail**

The overhead conveyors at dual rail have two runways:

- the upper may be of the type IPN or sheet cold-shaped to bear the trolley supporting the traction chain;
- the lower one, consisting of profiles in CPN or sheet, whose slingbars run with the load borne by special elements.

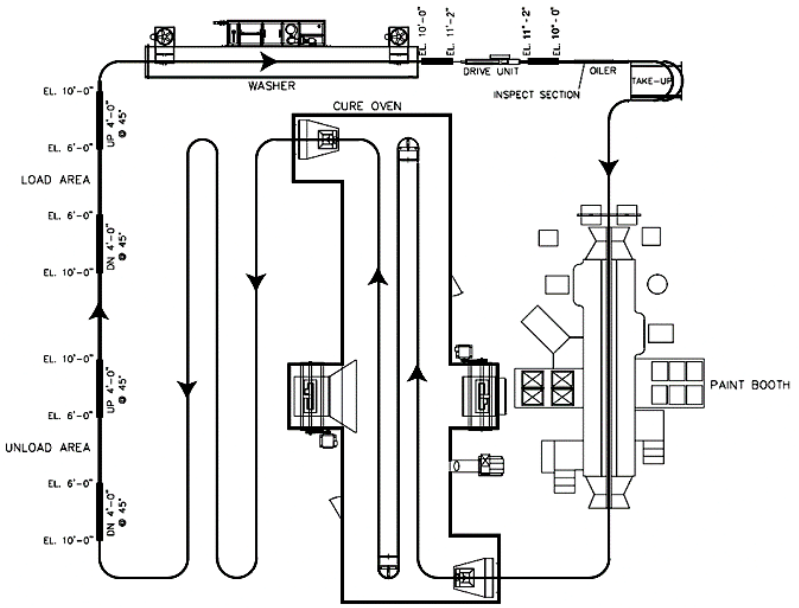




# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**b) dual rail**

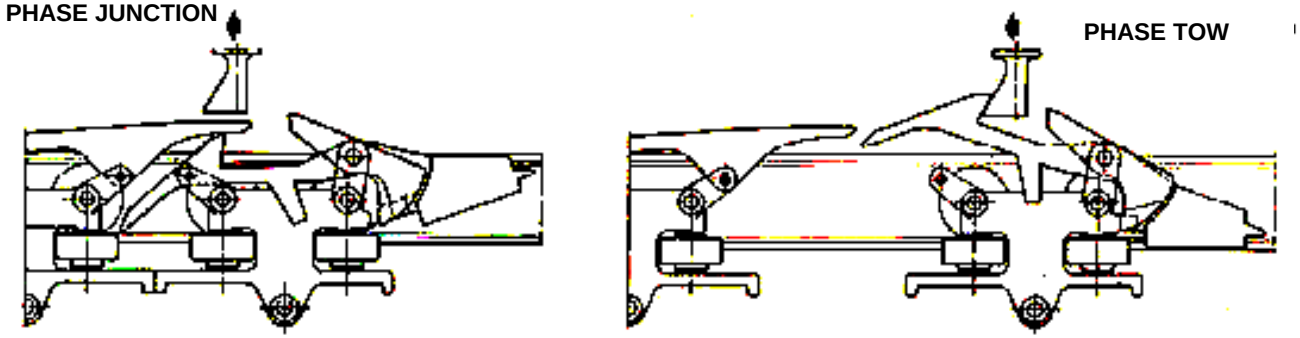


# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**b) dual rail**

The release between the motor element and the loose element can be realized automatically devising suitably the system. There are two examples of possible release of the trolleys: disengagement obtained removing the runways or through a system of levers and then on command



# Overhead conveyors

Typical systems of mobile conveyors not bound are overhead conveyors monorail and dual rail.

**b) dual rail**

When the trolley of a slingbar arrives in proximity of the trolley of bream preceding, a mechanical device generates the automatic release from the chain tracting, thus allowing the arrest and accumulation of more racks

# Overhead conveyors

The speed of the overhead conveyors depends on:

- potential request to the handling system;
- system of loading and unloading employed;
- load transported and path length;
- preset requests to the conveyor.

For the monorail conveyor, the conveying speed ranges from 6 m/minute for unit loads between 150-200 N with loading-unloading, at 8-10 m/minute for light loads with manual loading and unloading, while for the conveyors to dual rail it has speeds up to 20 m/minute for unit loads between 2 to 2.5 kN with automatic loading-unloading.

# Overhead conveyors

The potential of transport P of the overhead conveyor is equal to:

$$P = k \cdot \alpha \cdot \frac{Q}{d} \cdot v$$

where:

k = coefficient, which takes account of the units of measurement used;

$\alpha$ = reduction factor for the incomplete utilization of the capacity of the slingbar (0,5-0,9);

Q = rated capacity of each slingbar;

d = pitch of the slingbars;

v = speed of conveyor.

# Overhead conveyors

To the **sizing** a plane conveyor, you must know the location of horizontal and vertical alignment are reported in which the points of loading and unloading, the size, bulk and weight of individual loads, the method of loading-unloading operations which are subject the materials transported, the type of beams, and the number of trolleys to be transported per unit time.

It must determine the maximum tension of the chain, the power absorbed by the electric motor and the size of the support structures of the tracks, which are supported from the roof of the building or resting on the floor.
It must install safety devices to stop the trolley in the case where the chain is broken.

# Overhead conveyors

The benefits are seen in overhead conveyors are:

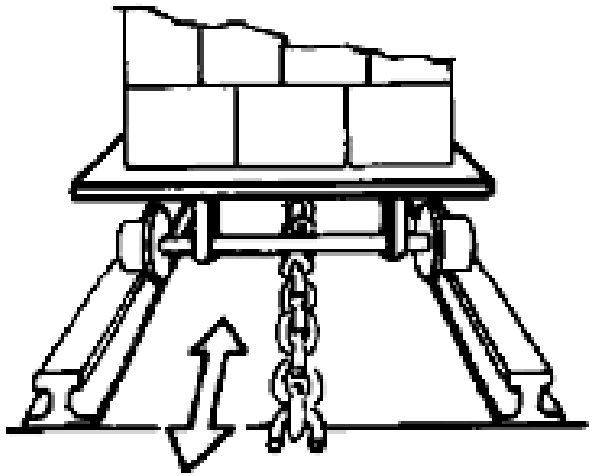
- capacity to perform tortuous paths in the plan and in elevation;
- availability of the space below;
- possibility to accumulate of the material;
- feeding of the loads favorable for the operator.

# Chain conveyors

The chain conveyor for hauling carts are divided into:

**a) chain conveyors to floor**

Are adopted for the working lines (for example, the movement of the carriages with green bricks moved in the plant of drying) where the chains do not constitute a hindrance

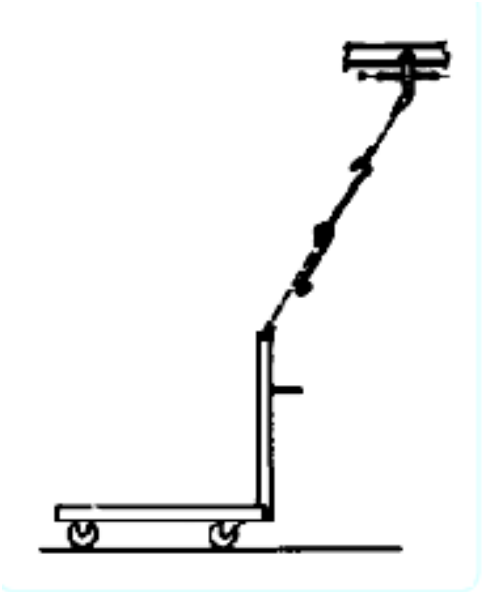


# Chain conveyors

The chain conveyor for hauling carts are divided into:

**b) conveyors with chain plane**

Movement to the trolleys by means of their attachment to an overhead conveyor at monorail upper. Attention to the hindrance of the attack and suspended from the conveyor of the uncoupling and coupling operation that can be difficult



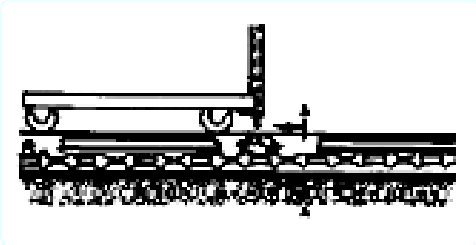
# Chain conveyors

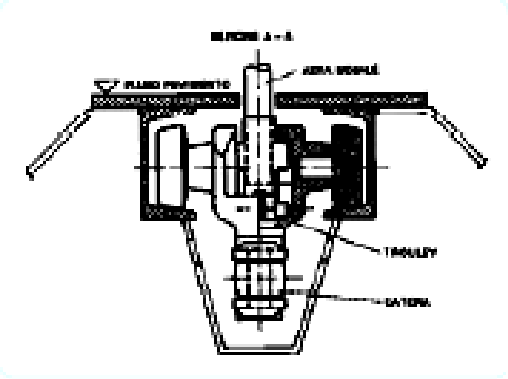
The chain conveyor for hauling carts are divided into:

**c) conveyors with chain under floor level**

In these conveyor the chain traction moves in an appropriate seat obtained under the floor level. The chain is supported by trolley properly spaced and equipped with a seat in which can fit the movable rod present on the cart.

You can get the automatic shutdown of the trolleys. They are used to make these conveyors are called irregular paths truckveyor. The conveyors are motorized.

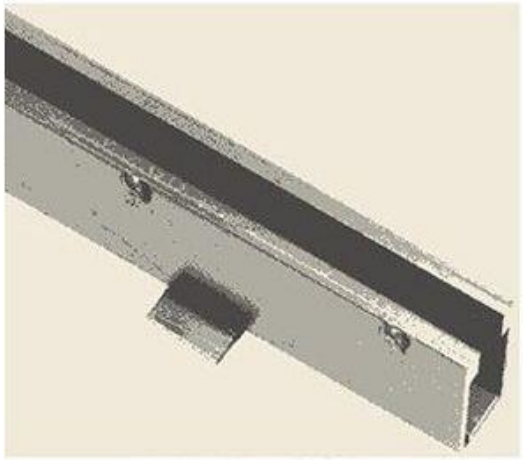




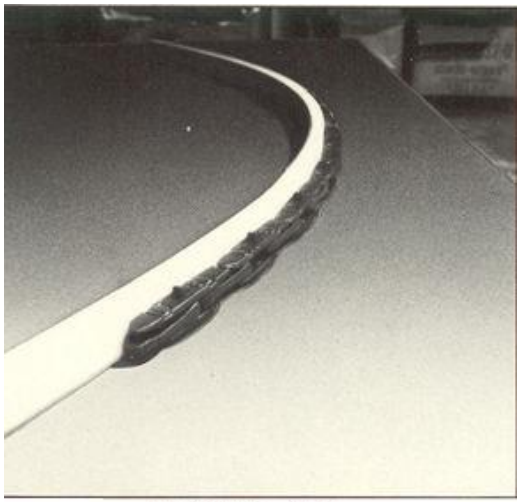
# Chain conveyors

The chain conveyor for hauling carts are divided into:

**c) conveyors with chain under floor level**



Mainline track section



UHMW plastic turn

Slide-Tow rivetless chain

# Chain conveyors

The chain conveyor for hauling carts are divided into:

**c) conveyors with chain under floor level**

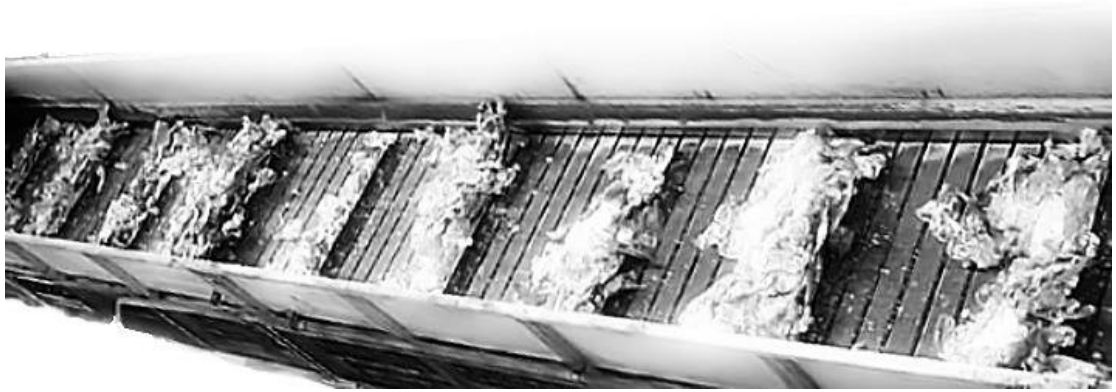
# Chain conveyors

There are also a magnetic stripe of the conveyors, which trolleys are moved by a tractor automatic guided by flexible conductors placed on the floor to a depth of 10-20 mm. These conductors transmit low frequency signals that defines the path. We have safety devices to prevent the tractor does not follow the assigned route.

The tractors have a flexible front bumper, causing the arrest to contact with any object, flashing light always on when running and warning acoustic.

# Slat conveyors (apron and shutters)

The **slat conveyors** are constituted by plates borne by the wheels and carried by two chains arranged at the sides. The movement is assured by toothed wheels installed in correspondence with the driving head.



The **chain conveyors** or **apron** consist of plates drag normally from a central chain or two side chains, but differ from those shutters for the absence of interstices thanks to the particular profile articulated allowing their rotation on the horizontal plane, preventing the fall of the material between a plate and the other. The plates have different forms depending on the specific application.

# Slat conveyors (apron and shutters)

The chain conveyors or apron are particularly suitable for the transport of heavy materials or abrasive or having the high temperatures.
The speed of these conveyors is around 6-10 m/minute, while the plates have widths normal up to 1.20 m are made long conveyors up to 50-60 m.

## Slat conveyors (apron and shutters)

The **shutters conveyors** are similar to plates apron conveyors, but differ because the plates, formed by planks of wood, plastic or sheet metal (hence the name shutters) are devoid of flaps and have interstices between the one and the other.

The shutters conveyors are suitable for the transport of packages, bags, boxes etc., while the speeds reached are of 10-20 m/minute.

The metal shutters conveyors are used for the transport of heavy material and impossible to be handled with other types of conveyors. They are used for the transport of solid urban waste, for the handling and waste plastic in various plants for selection, for moving heavy packages in the most varied types of industries, or for the handling of bales of fiber or the fiber unraveled in the textile industry .

# Slat conveyors (apron and shutters)

Shutters conveyor

# Slat conveyors (apron and shutters)

Shutter conveyor

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  **a) effort required to drag the material horizontally:**

$$F_1 = f_g \cdot q_m \cdot L_m$$

where:

$f_g$ = coefficient of friction, which for chains borne by wheels which run on guides of steel values are detectable from the table:

| Pins mounted on: | Diameter of the wheels (mm) | | | | |
|---|---|---|---|---|---|
| | 50 | 75 | 100 | 125 | 150 |
| - plain bearings non-lubricated | 0,30 | 0,26 | 0,25 | 0,24 | 0,22 |
| - poorly lubricated bearings | 0,20 | 0,12 | 0,10 | 0,09 | 0,08 |
| - rolling bearings | 0,08 | 0,06 | 0,05 | 0,04 | 0,03 |

$q_m$ = weight of material transported per unit length

$L_m$ = length of the path in the horizontal made by the material

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  **b) effort required for movement of all moving parts of the conveyor (chain, rollers etc.):**

$$F_2 = f_g \cdot q_s \cdot L_s$$

where:

$q_s$ = weight of the moving parts of the conveyor per unit length

$L_s$ = length of the horizontal projection of the conveyor

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  **c) effort needed to lift material vertically:**

$$F_3 = q_m \cdot H$$

  where:

  H = difference in level of the conveyor to overcome

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  **d) effort required to overcome the resistance of friction between the chain and the transmission system:**

  It may account for this effort for every postponement:

  - increasing $L_s$ and possibly $L_m$ of 6 or 10 m depending on which postponements are respectively on rolling bearings or plain;
  - increasing the H of the 5%.

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  e) **tension of the tensioner $F_4$ and, where the motor group is on the highest point of the conveyor, the dial of the active weight of the moving parts of the conveyor $F_5$**

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  Known the maximum strength T on each chain :

$$T = F_1 + F_2 + F_3 + F_4 + F_5$$

  as well as the specific pressure on the bushings of the wheels $p_b$:

$$p_b = \frac{T}{d_b \cdot b_b}$$

  where:

  $d_b$ = diameter of the bushings of the wheels

  $b_b$ = length of the bushings of the wheels

# Sizing of chain conveyors

The dimensioning of the chains tracting by the various types of conveyors part by the determination of:

- **maximum effort of traction that is defined by the sum of the individual contributions**:

  The values of the specific pressure on the pins and bushings of the wheels are needed to select the type of chain (stainless steel, cast iron etc.). Fact, if the specific pressures exceed the maximum permissible work for the chain according to the effort of traction, you must choose a chain more robust to ensure more contact surfaces between the rollers and bushings, and between them and the pins.

# Sizing of chain conveyors

The dimensioning of the chains pulling by the various types of conveyors part by the determination of:

- **pitch of the chain**
- **specific pressure of the pins**

  One can determine the specific pressure on the pins p:

$$p = \frac{T}{d \cdot b}$$

  where:

  d = diameter of the pins

  b = length of the pins

# Sizing of chain conveyors

The power absorbed by the electric motor N is equal to:

$$N = \frac{T \cdot v}{102 \cdot \eta}$$

where:

T = tractive effort total

v = speed of the conveyor

$\eta$ = performance of the winch (0,7-0,8)