ANALYSIS OF EXISTING AND PROSPECTIVE CONVEYOR TYPES FOR MOVEMENT OF PIECE CARGOES

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Abstract . The successful operation of modern light industry enterprise implies movement large number of various cargoes. Due to this, main part of equipment of these enterprises is a variety of transporting and lifting machines and devices that are widely used in mechanization and automation of production processes.
Most of the nomenclature of piece cargoes consists of products with a flat support surface, moved by conveyors of various types, which are the main executive devices and represents transportation system that implements control algorithms of loads transferring.
Conveyors are one of the most versatile types of industrial equipment. From the all variety of conveyors, the vast majority of conveyors are used to move piece loads.
Some types of conveyors are considered in the work: belt, roller (gravitational and driven), chain conveyors.
Tasks for further research are formulated.
Keywords: transportation, transportation objects, belt conveyors, roller conveyors, chain conveyors, overloading.

Introduction

Transportation, loading/unloading and warehouse operations at the modern light industry enterprise are associated with movement of large number of various cargoes. Due to this, main part of the equipment of these enterprises is a variety of transporting and lifting machines and devices, which are widely used in the mechanization and automation of production processes [1]. The operation of entire enterprise depends on the reliable logistics of shoe production. Therefore, the problem of analyzing production logistics schemes is relevant and timely.

Mass production is based on continuous production, where transportation machines, being an integral part of technological process, ensure transferring of the semi-finished product from one operation to another and clear operation of the entire flow. High productivity of the enterprise can be achieved only with the rational usage of various transportation and lifting machines at all stages of production – from supply of materials to delivery of finished products [2].

Most of the nomenclature of piece cargoes consists of products with a flat support surface, moved by conveyors of various types, which are the main executive devices and represents transportation system that implements control algorithms of loads transferring [3, 4].

The classification division of transport systems can be applied to any transportation process, where technological equipment can be presented by overloading devices, which performs weighing, marking, dosing and other devices through which cargo flows pass.

In synchronous systems, technological equipment is connected by a conveyor. After finishing certain processing on all equipment, the cargo is simultaneously moved by conveyor to the next positions, where further processing takes place. In asynchronous systems, technological equipment and conveyors work independently of each other. Accumulator device is located before each of them. Processed cargo from each unit of technological equipment is transported to this accumulator by conveyor and, if necessary, goes further to next one. Independence of the transport system operating from the technological equipment operating allows uninterrupted processing of the cargo flow.

There are many examples of both transport systems and conveyors classification in the literature [3-6].

Conveyors are one of the most versatile types of industrial equipment. From the all variety of conveyors, the vast majority of conveyors are used to move piece loads.

In general, conveyors use the movement of production objects to solve various tasks, such as [3]:

– prompt movement of production objects from point A to point B in order to exclude usage of forklifts, etc.;
– relocation of production facilities that are too heavy for workers;
– moving the product while operators continue working with it (or adding additional parts to it). For instance final assembly conveyor at a car factory;
– protecting workers from repetitive motion injuries. Or protection against product damage;
– delivery of products robotic devices for processing. Or receiving products from the robot, prepared for the next step;

Stores and buffers are used for:

– storage of products between processes or at the last stage of the process;
– creation of buffer or accumulative stock. Used as a flexible storage system to balance technological flow;
– arrangement or changing sequence of products between processes;
– overloading of production facilities from one vehicle to another in order to create a single closed transportation and logistics chain.

Belt conveyors. In the modern world, this type has gained the widest distribution, due to its versatility. Such equipment is used for the transportation of bulk, piece, lumpy and other types of cargo. It is also used on the continuous production for the purpose of interoperational transportation.

Belt conveyors differs by design. Following types are most common: straight conveyors, which have gutter in cross-section and inclined.

In our opinion, a Z-shaped or L-shaped conveyor, in which some part of track is straight, and the other part is inclined, is one of the most interesting. [5, 7].

Fig. 1. Z-shaped conveyor

Among the devices, the Z-shaped conveyor is considered as one of the most complex. They are used, as a rule, when is necessary to install them in a limited space, where is impossible to construct a line consisting of ordinary straight and inclined conveyors. It is expedient to use it for overloading production facilities from one vehicle to another, which is located at a different height.

If there is a need to change movement direction of transportation objects, rotary conveyors are used. In this case, conveyor belt moves in steel base on sliders divided into segments. A distinctive feature of this equipment is presence of torque transmission system.

When there is a need to change the point of unloading or overloading, telescopic conveyors are used [4].

Fig. 2. Telescopic conveyor

The telescopic conveyor allows to change distance and inclination angle during work. There is no need to stop device and release it from the load. Process of loading and unloading when using this equipment is as much efficient as possible.

Roller conveyors. They are divided into gravitational and driven.

Gravity roller conveyor. This is one of the simplest types, they are very affordable. Rollers installed on the side frame provide a rolling surface. [3].

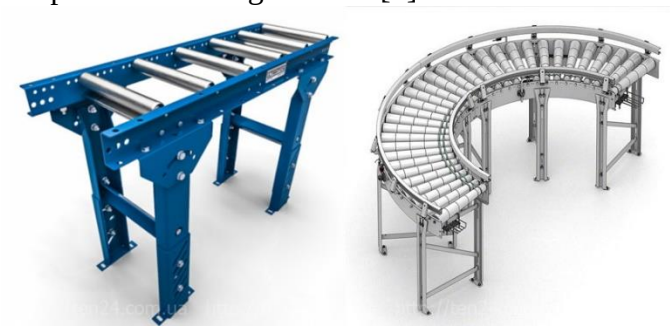

Fig. 3. Gravity roller conveyor

When installed at inclination angle, parts move by means of gravity. However, when using gravity conveyors for parts of different sizes and weights, this can be more difficult. Therefore, there is a need for speed control. These can be devices for changing the angle or various braking systems (brake rails, guides, brake rollers of various designs).

The conveyor frame can be stationary or telescopic, which allows change rapidly location of both loading and unloading areas.

Fig. 4. Gravitational telescopic roller conveyor

Spiral conveyors (elevators). Are used for transporting products in standardized packaging between floors of warehouse racks or between vehicles located on different levels. Spiral conveyors based on roller conveyors are used to descent boxes, cases and containers. The minimal dimensions of the elevator combined with high productivity make this equipment very useful at enterprises and in logistics complexes with large cargo flows of small objects [4].

Fig. 5. Spiral conveyors (elevators)

Roller conveyor with chain drive.

When combining rollers of the gravity conveyor with chains of the chain drive system, we can link the rollers one to each other.

Fig. 6. Drive roller conveyor

Usage of gearbox in the drive, which allows to change movement speed is sensible approach. Conveyors with such drive can be used in transportation systems with flexible work rhythm.

Roller conveyors, both gravity and driven, can be used as robotic devices to transfer production objects from one vehicle to another.

Fig. 7. Examples of roller conveyors usage for production objects overloading

A special place is reserved by conveyors with an individual roller drive that consists of electric motor and reduction gear (Fig. 8) [3]. Rollers are made of thick-walled pipes or forged workpieces designed for perception of large dynamic loads. Currently, special asynchronous electric motors are produced, designed for operation in a heavy mode with a large number of

inclusions. Frequency of shaft rotation of such motors is regulated by changing the frequency of electrical current within 10...70 Hz. Power of electric motor is determined by the average energy consumption on a separate roller. Losses consist of moments from resistance forces to rotation of the idler roller.

Fig. 8. Individual roller drive

Successes of electrical engineering industry have expanded application areas of conveyors with individual drive and, in particular, with electric motors built into the rollers. The operation of drive rollers with AC motors is quite synchronous. For example, motor-rollers with diameter of 120 mm with built-in AC electric motor are produced in Japan.

Chain conveyors. They are mainly used for heavy production objects. Also they are especially useful for objects with an uneven bottom surface[3].

Fig. 9. Chain conveyor

The conveyor's chain provides two or three contact points at the bottom of the load. As the chain moves, it moves the product forward. They are used to transport pallets and large industrial containers. If necessary, products are placed on pallets and transported by chains. The disadvantage of these conveyors is that they are metal-intensive (heavy) and usually move at a low speed.

Other examples of transportation equipment are considered in[7-11].

Conclusions.

1. The introduction of new conveyors types with simultaneous improvement of known structures, by reducing capital costs for transport, increasing versatility of transport devices, reducing energy and metal consumption for process of transporting objects will allow to increase level of mechanization of transport processes.

2. Existing conveyors types are not totally meeting requirements of quick reconfiguration and versatility when switching to a new nomenclature of transportation objects, sometimes they can't combine and provide next operations at the same time: transportation,

reverse movement, orientation, accumulation of objects, such cases require additional devices for listed operations, and ultimately increase cost of overloading operations.

3. It is necessary to determine optimal dimensions and constructions of transition section from one transportation unit to another in transportation system, which will ensure reliable operation of the transportation and logistics system.

4. Continue further research of dynamic processes of robotic devices that take part in overloading of transportation objects in transport and logistics systems.

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