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A Developed Power and Free Conveyor for Light Loads in Intra-Logistics

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Abstract**—**Nowadays there are lots of applications of power and free conveyors in logistics. They are the most frequently used conveyor systems worldwide. Overhead conveyor technologies like power and free systems are used in the most intra-logistics applications in trade and industry. The automotive, food, beverage and textile industry as well as aeronautic catering or engineering are among the applications. Power and free systems employ different manufacturing intervals in manufacturing as well as in production as temporary store and buffer. Depending on the application area, power and free conveyors are equipped with target controls enabling complex distribution-and sorting tasks. This article introduces a new power and free conveyor design in intra-logistics and explains its components. According to the explanation of the components, a model is created by means of their technical characteristics. Through the CAD software, the model is visualized. After that, the static analysis is evaluated. This analysis helps the calculation of the mandatory state of structures under force action. This powerful model helps companies achieve lower development costs as well as quicker market maturity**.**

Keywords**—**Intra-logistics, material flow, power and free conveyor.

I. Introduction

THE manual overhead truck is the simplest and oldest conveyor technology. Trolleys are running in a wood rail profile, which are manually displaceable and able to carry loads with different geometries and weights. Main area of use is the flexible connections of individual processing areas, which are not chained automatically as a rule. The process happens manually [2]. The transport way is usually horizontal, larger increases and slopes can only be managed by driven means.

Power and free conveyors consist of a slide section and a chain for the carrying and continuance of the transport goods. The chain, often a gimbal link chain, runs in a hollow rail profile of the carrier and guide rail. Power and free conveyors serve the constant, automatic transport of piece goods. Their feasible path length depends on the weight of the transported material, the admissible chain force of the chain and on the number of drives. Within these boundaries, every desired path length is possible. Power and free conveyors make an enforced inter-linkage of process areas possible, which are driven through continuously, in a clocked manner or with adjustable speeds [6].

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II. Components of the System

Main components of the system are shown and explained here:

A. Rail

Rails are made of dimensionally stable special profiles from hard-wearing steal [1].

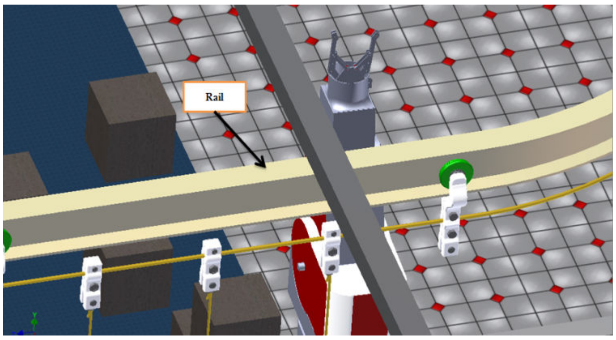

Fig. 1 Rail of the system

Fig. 1 represents rail of the system. They are installed one on top of the other and connected to one another by means of welded rail distancing. Horizontal and vertical curves are constructed according to the same principle.

B. Robot Arm

Robot arm is a universal, programmable machine for handling, mounting or processing work pieces.

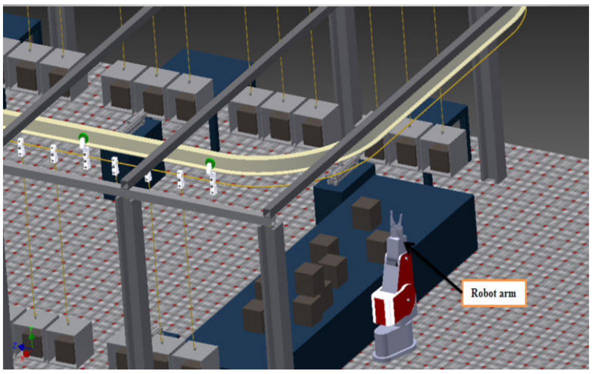

Fig. 2 Robot arm

Fig. 2 represents robot arm. These robots are constipated for usage in industrial environments. In general, the machine is made up of the manipulator, the control system and an effector (tool, gripper, etc.) Often robots are also equipped with different sensors. Once programmed, the machine is able to carry out a working process autonomously with varying task performance depending on sensor information to a certain extent.

C. Drive Unit

Drive unit is realized with friction clutch [7]. The cable carriers interfere with their drive rollers between the guide roles of the conveyor chain.

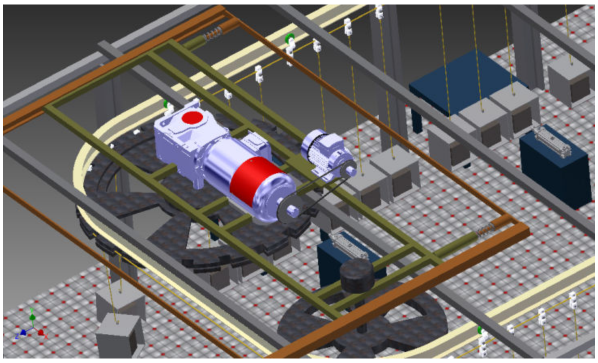

Fig. 3 Drive unit

Fig. 3 represents the drive unit of system. Between the drive aggregate and the chain wheel a security-sliding hub with electrical surveillance is incorporated. It automatically switches off the drive in case of transgression of the adjusted torque of the drive.

D. Piston

Piston is a moveable component forming a closed cavity together with a static component, the cylinder, the volume of which might be changed [3].

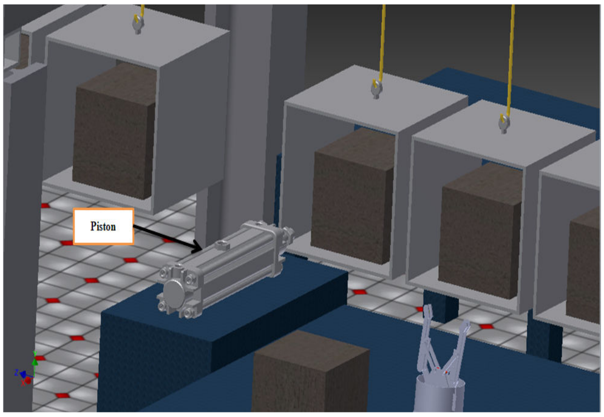

Fig. 4 Piston

Fig. 4 represents piston of the system. In the next chapter mechanism of the system will be mentioned.

III. Process of the System

Here the process of the system will be explained:

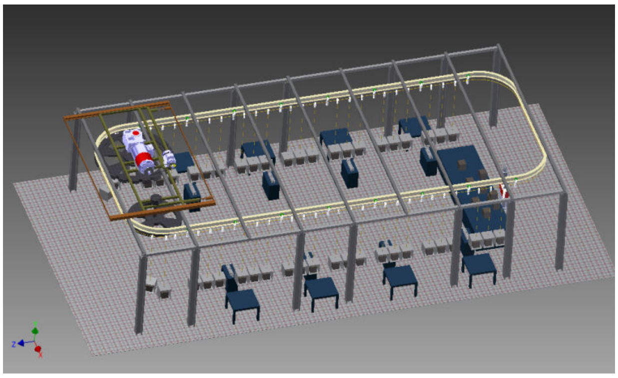

Fig. 5 Entire system

Both loading and unloading of products as well as loading by means of the robot arm is realized automatically in the system. In Fig. 5 the entire system is shown. Moreover, each package weighs maximally 10kg. Depending on their transport position, all packages are marked with a suitable barcode during packing. After packing, the packages are placed on the power and free conveyors by means of the robot arm. Here, it is important that the robot arm places the packages correctly on the power and free conveyors, so that the bar codes can be detected by the sensors. The following example explains how a package is delivered to the correct place. As a package, which must be delivered to a place, where correct position is, the piston is stimulated by sensors. This way, the piston will push the package to right position. Sensors are located everywhere throughout the system. But only sensors on the main position can stop the engine. Sensors located at other positions, are only allowed to stimulate the piston.

IV. Static Analysis

Static analysis presents the calculation of the enforced state of structures under the force action, which is constant in time. Today this is probably the most demanded task in design. With the module “Static Analysis”, the engineer can evaluate the acceptable tensions in the design, which is worked on, by determining the mistakes of the design and making the necessary changes of the product (optimizations).

The static analysis also allows:

- Taking the geometric non-linearity into consideration
- Determining the stress-strain state of the temperature effect
- Leading calculations of the problems in connection with it

Power, pressure, rotation, acceleration, work strain, hydrostatic pressure, torque and temperature can be used as the external strains [4].

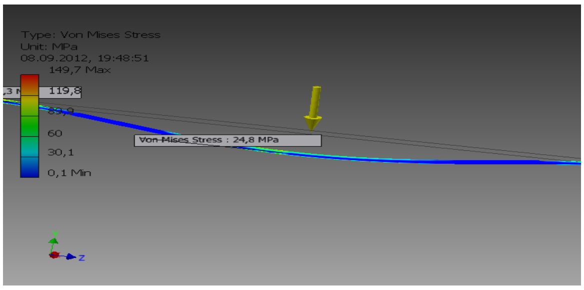

Fig. 6 Breakpoint of the rope

Fig. 6 represents the breakpoint of the rope. If a load on the rope strains more than 149.7MPa, the rope will be broken (where 1MPa is 1N/mm^2).

In order to establish the structure, the full limitation of the movement can be used as well as the partial limitation with reference to the axes (in Cartesian, cylindrical and spherical coordinate systems).

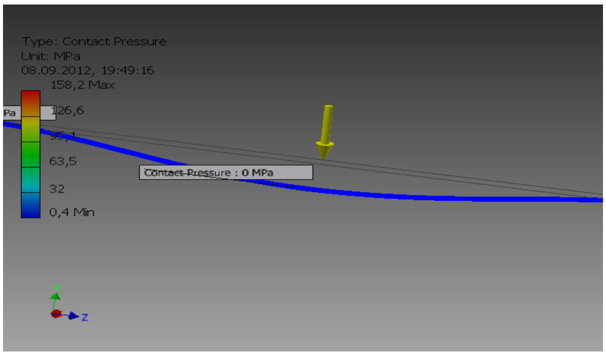

Fig. 7 The maximal stress on each frame

In Fig. 7, the maximal stress (MPa) used on each frame profile is depicted. If the maximal stress (MPa) on each frame profile reaches 158.2MPa, it could be a risk for the system. According to application area, dimensions of the frame profile can be determined.

V. Conclusion

Demands to power and free conveyors in industry have grown constantly. Power and free conveyors represent highest movement flexibility in the most limited space [5]. The robust technology and the high degree of flexibility secure an optimal procedure and guarantee the article and target oriented material flow in any company. Power and free conveyors can be adjusted to any individual need of carrier ability and conveyor speed and can be combined with other systems. This inexpensive alternative is used with facilities with low piece goods or with lighter loads. Substantial advantages of this system are freely selectable loading and acceptance points, accumulators, different transport speeds, a continuous material flow as well as the realization of different procedures by bar codes of every single transport unit.

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