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ON THE TRANSPORTATION SYSTEMS FOR BULK MATERIALS AND GOODS

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Abstract: *The paper studies a large area of transportation systems of bulk materials and goods approaching primarily their classifications and characterizations. These aspects are useful in the building of databases appearing in the product development of complex systems. In this idea, the paper gives classification schemes of transportation systems and several considerations of characterization, being an interest survey in the studied field for academic education and researches.*
Key words: *transportation systems, classifications, conveyors, vehicles, automated guided vehicles*

1. INTRODUCTION

The transportation systems are destined to travel the bulk materials and goods between different operational places – a process needed in different engineering or social-economic activities. The interoperation transport (included in them) is considered to be between processes from manufacture: for example, production and montage.

Their large area of types and solutions is difficult to be classified. Really, the references (especially those with education aim) are generally very old (Spivakovskiĭ & Rudenko, 1949; Segal et al., 1960; Segall, 1988) and give classifications of these systems at the time of the books' writing. New references classifying only some types of transportation systems for the bulk materials and goods, for example: Alspaugh (2008), Boteanu (2006), Enciu (2008), Iordache (2007), Radulescu & Vatau (2008). Alspaugh (2008) treats particularly the belt conveyors used for the transportation of bulk materials; Radulescu & Vatau (2008) analyze the moving systems as automated transportation systems, especially the automated guided vehicles; Boteanu (2006) and Iordache (2007) study electromechanical controlled transportation systems, especially the conveyor types for bulk materials and goods.

The present paper proposes own classification schemes of the transportation systems for bulk materials and goods (individual products) on the basis of the literature (selected in the list of references) and on the own experience in the field. Definitions and considerations (characterizations) on the classification schemes are also achieved. Thus, the paper is an attempt of survey or overview of the mentioned knowledge field needed in the academic education and researches.

Future studies will suggest new classifications and corresponding classifications for complex transportation systems as combinations by many individuals included in the given classifications. Moreover, future researches could be oriented to develop software and the necessary databases referring to transportation systems appearing in the product development.

2. CLASSIFICATIONS, CONSIDERATIONS

The general classification of the transportation systems used for bulk materials and goods is represented in the fig. 1. It is visible that the transportation systems can be classified after several criteria: the relative fixation on frame or ground; the transport direction; the working position; the driving manner; the action continuity; the trajectory type. In the restricted space of the paper, the given examples are limited.

About the relative fixations on frame or ground, the systems could be fixed (conveyors, sub-classified into the fig. 2) or moving (vehicles, sub-classified in the fig. 3).

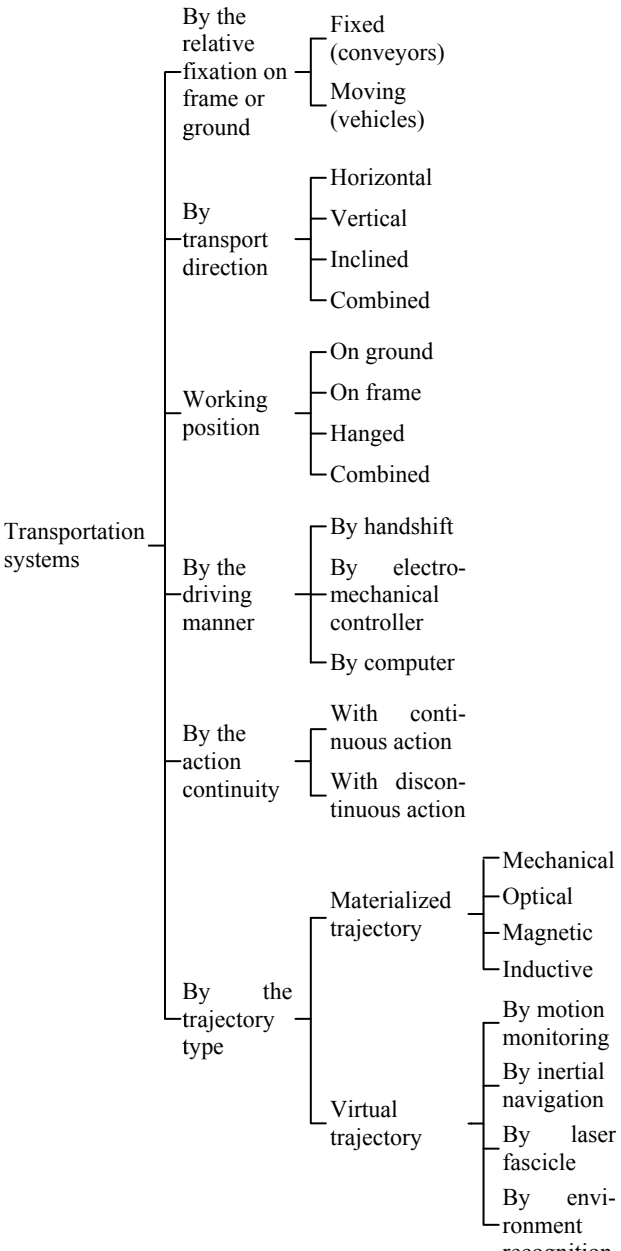

Fig. 1. General scheme of the transportation systems for bulk materials and goods

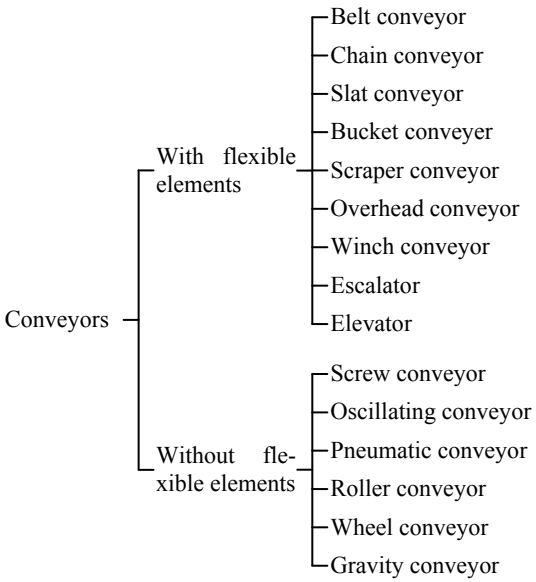

Fig. 2. Detailed sub-scheme for conveyors

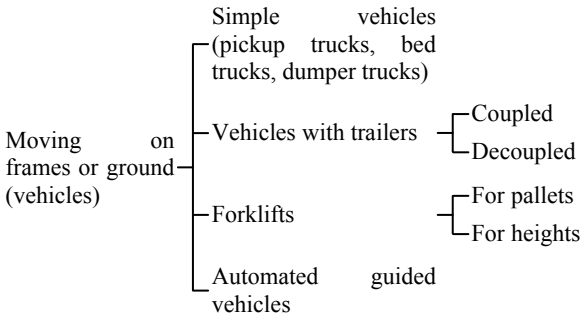

Fig. 3. Detailed sub-scheme for the part of moving systems on frames or ground (vehicles)

Evidently, the moving transportation systems (fig. 3) offer new service functions in comparison with the fixed system ones.

The conveyors with flexible elements (belt, chain etc.) offer the motion between the components and by this a supplementary freedom degrees needed in many applications, in the conditions of a simple building and reliable function. The other type of conveyors (without flexible elements) has a limited number of freedom degrees and could operate in some cases in extreme conditions of environment (temperature, pressure, corrosive materials etc.).

The vehicles (on wheels for travel) are in a large constructive diversity synthesized in the fig 3 (without other discussion): simple vehicles, vehicle with trailers (coupled or decoupled), forklifts (for pallets or for heights) and automated guided vehicles.

The transportation systems travel the bulk materials and goods on direction: horizontal (slat conveyor), vertical (bucket conveyor), inclined (screw conveyor) or combined in function of necessity.

By the working position, the transportation systems can be placed on ground (winch conveyors), on frame (chain conveyors, escalators), hanged (overhead conveyor) or combined.

By the driving manner, the systems can be driven by handshift (electrocar), electro-mechanical controller (roller or wheel or flexi conveyers) or computer (automated guided vehicles).

By the action continuity, the systems can be with continuous action (in the montage or assembling production line) or with discontinuous action (shipping conveyors, construction cranes).

By the transport trajectory type, the materialized ones have concrete shape: mechanical (rail, cable, band, belt), optical (transport reflective band), magnetic (magnetic guide) or inductive (guide using inductive coils).

The virtual trajectory is carried out by computer. The system needs also sensors to establish the current position (of the vehicle, transported product) by measurement of: the motion (of wheels); the mass inertia (of an accelerometer) for translation or rotation; the deviation from a laser radius or from the intersection of two laser radius. Another way to establish the position on the virtual trajectory is based on the environment recognition; using signals from optical or acoustic devices, the computer establishes the current environment relief, the effective position and the travel direction of the product in this space avoiding the collisions.

The discussed schemes are useful for the CAD approach of technological processes using expert software.

3. CONCLUSIONS

The conclusions are given punctually below.

1. The classification and characterization of the transport systems destined for bulk materials and goods represent a complicate problem to solve in the actual state of these types of product in engineering area.
2. A general scheme of the transportation systems and two sub-schemes about different criteria for main sub-components (conveyors and vehicles) give a primary image on the existing such systems. These schemes could be enlarged and improved in another attempt of this aim.
3. Future researches are necessary to build software and database to design transportation systems in the product development.

4. ACKNOWLEDGEMENTS

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