TECHNOLOGY OF CONTAINER TRANSPORTATION USING LOAD-LIFTING PILLARS

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ABSTRACT

The article is devoted to solving problems related to the slow pace of development of container transportation due to lack of specialized terminal complexes, construction of which requires large capital investments, as well as specialized delivery equipment. The article substantiates the need for greater attention to improvement of container transportation technology as the most promising way to deliver cargo in direct and mixed traffic. A description of a new design of a transportable container with load-lifting pillars is given, the use of which will improve the organization of container transportation.

Keywords: transportable container, container transportation, load-lifting pillars, terminal complexes, cargo delivery, direct and mixed traffic.

Background. *In long-distance transportation container transportation is considered as a promising way to conduct reloading-free delivery of goods from a consignor to a consignee in a sealed container, thereby eliminating additional loading-unloading operations directly for goods [1, 2]. Container technology of cargo transportation allows to solve a problem of complex mechanization and automation of transshipping operations, and becomes, in fact one of the major directions of technological progress in transport [3, 4].*

Objective. *The objective of the authors is to consider container transportation and to offer a new design of a transportable container with load-lifting pillars.*

Methods. *The authors use general scientific and engineering methods, modeling, economic evaluation, mathematical calculation.*

Results. *Container transportation as a progressive technology of goods delivery originates from the 1960s, when the first marine standardized container [8] was developed. The size and characteristics of devices for door latch, devices for securing the container to the suspension of cranes-fittings and others have been defined by the International Organization for Standardization ISO (ISO) [10]. With a standard width and a height of a container of 2,44 m, to fix a length a modular construction principle is used. Special containers have been created conforming to ISO standard: collapsable; demountable; expandable; bulk, tank containers, containers for transportation of insulated and refrigerated and other goods. The container began to express a unified unit of cargo weight and the unit of transport work in intermodal transportation [5, 6]. Ratio of containers corresponding to ISO standards in relation to others – 86% to 14%.*

Advantages of container transport systems neutralize their disadvantages, which are additional costs of creation and maintenance of a fleet of containers and specialized rolling stock, as well as transportation of empty containers and service staff of the container industry. The use of containers allows to increase productivity by an average of 4–6 times, and maritime transport – up to 30 times, to reduce by 7-10 times the cost of cargo handling works, reduce by 1,5–2 times costs on packaging, increase the safety of transported products, accelerate by 25–30% cargo delivery.

The technical base of container transportation system are: container fleet, rolling stock used for the carriage of containers, reloading equipment and permanent installations for transshipment and unloading of containers, concentrated in the areas of initial departure. In rail transport, container terminals are specialized stations. In sea and river transport they

Pic. 1. Marine container terminal.

Pic. 2. Removal of a container from a vehicle.

are complexes of equipment, including outdoor areas for accumulation and grouping of small shipments of containers, sorting platforms, railway approach roads, driveways, warehouses of loading and unloading of containers, weighing devices (Pic. 1) [9].

The existing container technology of cargo delivery includes the following steps:

1) loading of cargo in a container at consignor's site and sealing;

2) loading of a container on a container car;

3) transportation of a container to a terminal complex;

4) removal of a container from a container car and stacking;

5) storage at the terminal complex before the main transport is delivered;

6) loading of a container on the main transport;

7) transportation of a container by the main transport to the second terminal complex;

8) unloading of a container from the main transport and stacking;

9) storage at the terminal complex;

10) loading of a container to a container car;

11) transportation of a container to a site of a consignee;

12) removal of a container;

13) checking of a seal, removal of seals and unloading of cargo from a container;

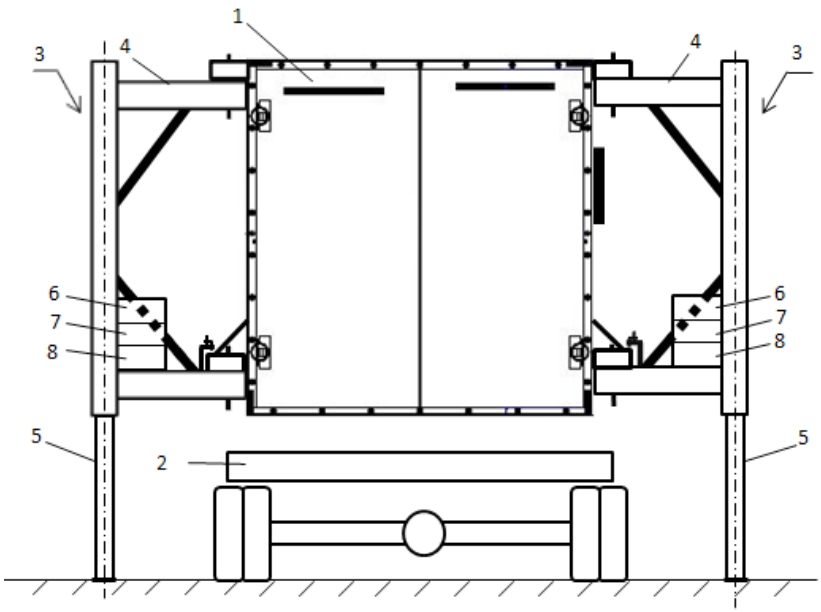
14) delivery of a container car;

15) loading of an empty container on a container car;

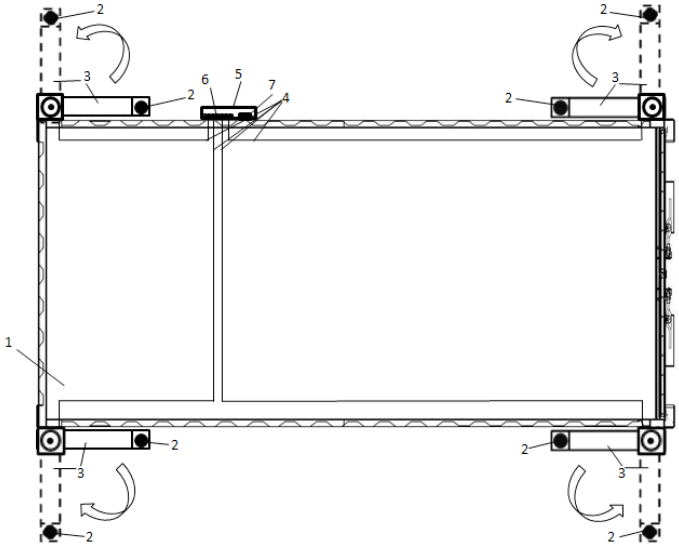
16) transportation of an empty container by a container car to a consignor or a terminal complex.

The containers can be unloaded (loaded) in two ways: with removal and without their removal from a container car. When using the first method idle hours of rolling stock decrease and it is more convenient to unload goods from a container. Cargo loading can be carried out directly in shops with delivery of containers there by internal transport of a plant and mechanisms. An exchange container point is located at client's site [7]. But this method is rarely used because many customers do not have expensive special tools to remove a container from a vehicle (Pic. 2).

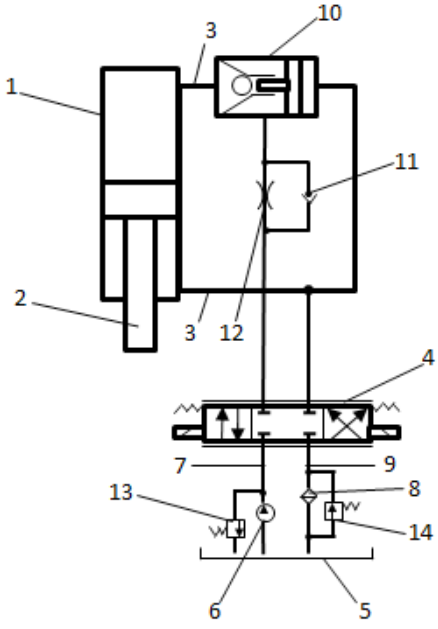
Adopted container transportation technology has a significant drawback, which is a large number of stages (16 stages) and a greater number of relevant container terminals and specialized semi-trailers, the number of which is not enough in Russia, and it



Pic. 3. New design of transportable containers, side view: 1 – container body; 2 – platform of a vehicle; 3 – load-lifting pillars; 4 – power body; 5 – telescopic sliding element; 6 – hydraulic pump; 7 – storage tank with working fluid; 8 – throttling direction control valve.



Pic. 4. Top view of a transportable container:
1 – container body; 2 – load-lifting pillars; 3 – power body; 4 – wires; 5 – cabinet unit; 6 – control unit; 7 – electric cable.



Pic. 5. The hydraulic circuit of a load-lifting pillar:
1 – hydraulic cylinder; 2– retractable rod; 3 – hoses: 4 – throttling direction control valve; 5 – storage capacity with working fluid; 6 – hydraulic pump; 7 – pressure line; 8 – filter; 9 – drain pipe; 10 – pilot controlled check valve; 11 – return valve; 12 – choke; 13 – safety charge valve; 14 – safety discharge valve.

reduces the possibility of the use of containers themselves.

To solve this problem, we propose a new design of a transportable container (Pic. 3), with load-lifting pillars that allow to conduct operations of loading and unloading of containers on semi-trailer container car or on a platform of a universal vehicle that extends the use of such containers.

The container helps to reduce by more than 2 times the number of process steps, because it can perform them on its own, but it also results in a significant economic effect.

Pic. 4 shows a top view of a proposed transportable container with load-lifting pillars; Pic. 5 shows a hydraulic circuit of a load-lifting pillar; Pic. 6 is a front view of a control panel.

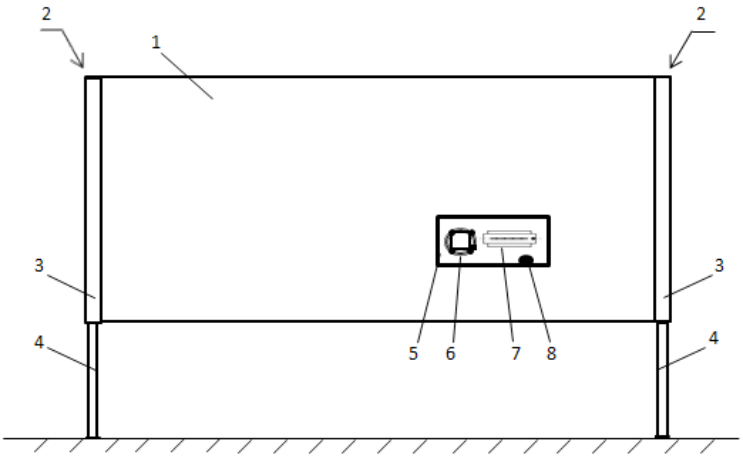
Load-lifting pillars 2 (Pic. 4) are mounted on the side walls of the container 1 in rectangular frames 3 mounted on the container corners with a possibility of rotation around a vertical axis by 90 degrees and fixing in extreme positions.

To maintain the width dimension of the container load-lifting pillars are mounted on the end walls of the container with a possibility of rotation around a vertical axis by 180 degrees and fixing in extreme positions.

Each load-lifting pillar is equipped with its own source of hydraulics, all the units of which are secured on the power body of a pillar. Throttling direction control valves of each load-lifting pillar are wired to a control panel that is installed in the cabinet unit secured to the container body. In the cabinet unit there is also an electrical cable available with a connector and «crocodile» type clips connected to it.

Load-lifting pillars allow to raise a container above a train platform and to put it on a platform of a vehicle, which delivers a container to the destination. On loading-unloading platform of destination load-lifting pillars of a container can independently remove it from a vehicle platform and to lower a container to a site or to place it at the optimum height convenient for unloading-loading of cargoes. Usually, container back loading is carried out on the railway platform. Typically, four load-lifting pillars are used that are fixed in the corners. However, the number of such pillars for high capacity containers can be increased to six or eight, additional pillars are secured to the middle part of the body of a container module.

The horizontal position of a container before the start of its use, as well as in the process of lifting and lowering is achieved by regulation of speed of lifting of load-lifting pillars from the control panel 7 (Pic. 6) according to the position pointer mounted on it, for



Pic. 6. Side view to a control unit of a transportable container:
1 – container body;
2 – load-lifting pillar;
3 – power body;
4 – telescopic sliding element; 5 – cabinet unit; 6 – electrical cable; 7 – control panel; 8 – container's position indicator relative to the horizontal plane.

example, a level vial 8, which is used in many devices. In the horizontal position the air bubble is in the middle of the level vial, and at a deviation of a container body from the horizontal position the air bubble is displaced from the center of the level vial greater, the greater is the deviation. Systems of automatic posting of truck cranes can also be used.

Load-lifting pillars can quickly be folded, fold out and transported with the container, which extends the possibilities of its use and reduces time spent on loading and unloading. The control of all load-lifting pillars of a container is performed by a single operator from a control unit. Electric cable with connector and clamps of «crocodile» type connected to it make it possible to connect load-lifting pillars of a container to a stationary power supply device or a vehicle battery that extends the use of a transportable container.

It should be noted that all the loading-unloading operations on transportable containers of the new design are amenable to automation, that reduces the time for their execution.

The developed design of a transportable container can be made on any machine-building plant, as well as enterprises on repair of containers.

Conclusion. *Thus, improvement of container transportation technology through the use of a developed transportable container in direct and mixed message allows not only to ensure delivery without terminal complexes, but also to reduce the execution time of many process operations, which will contribute to the expansion of the container transportation and improvement of transport efficiency in the Russian Federation.*

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