The invention refers to a wagon for transport and controlled tilting of hygroscopic material. Wagon is comprised of frame (1) equipped with bogies (3) and with at least two controllable wagon boxes (2). Each wagon box (2) has on each of the lateral sides one or more controllable lateral segments (2.2) for lateral tilting and an additional frontal segment (2.3) in case the box (2) is placed at the front or rear end of the wagon frame (1). The wagon has the ability of controlled lateral tilting, achieved by regulation of inclination of the wagon box (2), as well as by regulation of displacement of the lower edge of the controllable lateral segment (2.2). Additionally, the wagon has a tarpaulin (7.1) which is automatically wound and unwound over the cargo space (2.5) of each of the boxes (2), and where the winding mechanism does not take space from the wagon cargo space (2.4). Programmable logic controller (PLC) oversees tilting operations in order to prevent wagon from tipping-over.
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WAGON FOR TRANSPORT AND CONTROLLED SILTING OF HYGROSCOPIC MATERIAL

DESCRIPTION

Technical field

The present invention relates to the field of railways; to the construction and functioning of the chassis parts or wagons themselves, with application to wagons for transporting and silting of hygroscopic materials, where the wagon is characterized by the ways and means to carry out the silting. Specifically, the present invention relates to wagon for transporting and controlled silting of hygroscopic material from all sides of the wagon; both lateral and frontal sides.

Technical problem

In everyday rail transport practice, bulk cargo is typically transported and silted directly from a wagon. Often, bulk cargo is hygroscopic material, making its transport sensitive to atmospheric conditions, which can significantly influence such kinds of cargo.

Manipulation of wagons transporting bulk cargo should be simple and reliable. This applies primarily to the ability to manage ways of silting from the cargo space. Common practice shows that once silting of the bulk has started from one side of the wagon, silting is difficult to control and/or to cancel. Namely, there is a significant transformation of potential, to kinetic energy involved, when large bulk cargo mass starts to move at a certain velocity; that bulk mass cannot be stopped by means of mechanical/manual operation of wagon sides. That leads to silting of large quantities of bulk material to one spot. The first technical problem solved with the present invention is a completely controlled/dosed silting of bulk material, both to lateral and frontal sides of the wagon.
Typically a complete process of silting from the wagon is not fully automated. Also, usually more than one person is involved in off-loading, requiring the application of operator's physical force with certain locking or unlocking of the cargo space. The second technical problem solved by the present invention is allowing for a single operator to safely handle the said controlled silting, with continuous control by a Programmable Logic Controller (PLC), which prevents wagon from unintentional tipping-over or other operator's mistakes, such as simultaneous off-load from lateral and frontal sides.

Transportation of bulk cargo or granulate used in silting has its shortfalls, particularly if the transport is done through urban areas and if the wagon has no canopy. In such a case airflow around wagon removes parts of the cargo, covering the surrounding area with dust, or polluting it in some other way. In case of a hygroscopic cargo, such as lime or similar, the problem is even more pronounced because atmospheric influences in addition significantly deteriorate quality of the bulk cargo during transportation. The third technical problem solved by the present invention pertains automatic winding and unwinding of tarpaulin/canopy during loading of the bulk cargo, in such a way that said canopy and its mechanism do not take up cargo space and do not diminish nominal carrying capacity of the wagon.

State of the Art

Relevant prior art is quite rich in patent literature, and understandably so, considering the long-term development of the railway as an important, and for many years the only, infrastructure for the transport of goods.

Due to the above mentioned technical problems solved by the present invention, the closest prior art found is a technical solution described in the international patent application PCT/US2001/40157 (ANDERSON C. et al), published as WO 02/08041 A1.
The said prior art deals with a wagon with two boxes that allow silting to each of the lateral sides and independently for each box. In the said document WO 02/08041 A, each of the boxes' side walls to be opened is comprised of two mutually connected panels, listed as positions (48) and (50), opening as shown on Figure 5. On page 5 of the said prior art, lines 14-21 describe a way of functioning of side panels and imply that control of the lower side panel (5) could be done with a hydraulic or a pneumatic actuator. Said actuator is not mentioned anywhere else in the said prior art nor is it indicated in Figures, making its actual application unclear. Tipping of the boxes is controlled via hydraulic or pneumatic cylinders (32), whist box-frame connections are controlled via mechanically connected clips (5) which are positioned on every side, and are jointly operated in some of the known methods of the prior art.

In the prior art we also find the international patent application PCT/DE92/00920 (AUBKE, K.H., et al.), published as WO 93/09014 A1, which applies to a wagon able to silt to any of the lateral sides, where the box is controlled via hydraulic cylinders, and with side panels which are controlled by outward opening and through that control the direction and the distance of silting. According to said prior art, the whole wagon is equipped with remote control for silting realized with safety logic devices (PLC), enabling an operator to stay outside of the risk zone during silting.

The present invention, unlike mentioned prior art, enables fore and aft boxes to also silt through their respective fore and aft side panels. In addition, control of the position and speed of the silting is done at side controllable segments, realized on side panels, which are not placed as in the prior art, but are controllably opened by displacing from the bottom of the wagon box. Controlling one or more of the lateral segments is especially important at formation of larger wagon boxes, and is not discussed.
in the previous art. Furthermore, wagon can be additionally covered, which is not discussed in the prior art.

With regards to the technical solutions enabling silting from three sides, their most frequent application is with tip trucks. One such solution is described with a document US 2,694,599 (PORTER J.H. et al.), and discusses a truck with a box able to silt through lateral and aft side. But, the solution of the present invention forms a detachable link of the box and the frame different from the said prior art, thus said prior art only generally defines a state of the art. On Figure 10 of the WO 02/08041 A document, a way to form connection points is shown with positions (56A) and (56B), enabling the box from that technical solution to tilt during silting to two sides, but not to the aft side.

With regards to technical solutions dealing with tarpaulin or canopy, in the previous art we find the document US 6,478,361 B1 (WOOD R. L.), which deliberates about a device for spanning of tarpaulin over the wagon. The said prior art only defines the field, bearing no resemblance to the suggested technical solutions in the present invention.

**Summary of the invention**

The present invention refers to a wagon for transport and controlled silting of hygroscopic material, comprised of wagon frame equipped with bogies and with at least two independently controllable wagon boxes.

Each of the wagon boxes has on its side panels realized one or more controllable lateral segments through which lateral silting is done from the cargo space, and with eventual additional frontal segment for frontal silting realized on a frontal side panel in case the box is situated at one of the frontal ends of the wagon frame. Lifting of the frontal segment enables silting exclusively over the edge of the wagon frame directly onto the tracks. Said lateral segments and
frontal segment of the wagon box are opened by displacement of their lower end from the bottom of the wagon box, making the lateral displacement completely controllable.

The wagon additionally has controllable connection points formed at the bottom side of the box, whose activation/deactivation controls detachable mechanical connection between the wagon box and the wagon frame. The activated connection point enables solid mechanical connection of the wagon box with the wagon frame, enabling the wagon box to be tilted at a certain angle around such activated connection point.

The wagon frame is equipped with one or more hydraulic cylinders with a telescopic piston per each realized wagon box, responsible for a controlled lifting of the bottom of the box. Activation of hydraulic cylinders with telescopic pistons and the state of the controllable connection points define direction and angle of the tipping of each wagon box individually relative to the wagon frame.

Each wagon box is equipped with a tarpaulin which covers and secures hygroscopic material in the cargo space, and can be spanned over the cargo space or completely rolled on a drum via mechanism built into the frontal end of the wagon.

In wagons according to the present invention, controllable lateral segments are controlled via hydraulic cylinders whose pistons are synchronized in displacement for each of the independently controllable lateral segments.

Silting speed of material from the cargo space of one of the boxes during lateral silting is determined with a controllable independent opening of one or more lateral segments at the desired side of the box, and with the controlled lifting of the box through activation of hydraulic cylinders with telescopic pistons. Silting speed through frontal segment is determined also through activation of
hydraulic cylinders with telescopic pistons, with prior unlocking of the frontal segment from the bottom of the box. For silting through either the lateral sides or through the frontal side, the activation/deactivation of the connection points, the state of displacement of lateral segments and the unlocking of the frontal segment is controlled and supervised with the help of the programmable logic controller (PLC) connected with hydraulic or pneumatic or electric wagon system, independently for each wagon box. Programmable logic controller (PLC) supervises silting operations in order to prevent tipping-over of the wagon.

**Brief description of the drawings**

Figure 1 is a spatial representation of a wagon with two freight boxes and a tarpaulin spanned over the cargo space in the state prepared for transport. Figure 2 shows the side view of the wagon with two freight boxes.

Figures 3 and 4 show some of the possible independent ways of independent silting from the said wagon through the frontal segment of the box and/or lateral silting through lateral segments; freight boxes on said Figures are not covered with tarpaulin.

Figure 5 shows the rear lateral position shown earlier in Figure 4. Figure 6 shows the wagon chassis with bogies and the distribution of elements on the chassis that participate in a functional connection with wagon boxes.

Figure 7 shows the spatial portrayal of a wagon box with a view covering the lower part of the box. Figure 8 shows the front part of the box with an open left lateral controllable segment of the box.

Figure 9 shows a box with semi-opened cargo space and an indicated mechanism for tarpaulin winding/unwinding - detail "A", which has
been enlarged in more detail in Figure 10. The same mechanism is additionally shown in Figure 11 in view of the front part of the box.

**Detailed description**

The present invention solves three main problems encountered with the known wagons for transporting and silting of bulk cargo, preferably in the form of granules, and especially if the said cargo is hygroscopic.

Figures 1-11 show one of the possible embodiments of the present invention and in no way restrict the very idea of the invention. Wagon for transport and controlled silting of hygroscopic material according to the present invention is comprised from a wagon frame (1) which is equipped at its bottom side with at least two bogies (3) which are well known in the prior art, for example, as shown in Figure 1. The wagon frame itself can be set with two or more steerable cargo boxes (2) where the cargo space (2.4) is covered with a tarpaulin (7.1).

Although the previous art also contains wagons with one or two boxes, according to the present invention a number of boxes (2) realized on a frame (1) can be larger than two. Each of the said boxes (2) is connected to the frame (1) at the bottom side of the box (2.1) via controllable connection points (4) and hydraulic cylinders with telescopic piston (5) serving for an independent tipping/steering of each box (2), as for example indicated in Figure 2. The number of hydraulic cylinders with telescopic piston (5) for tipping of the box (2) per box can be one or more, depending on a desired way of silting from the box, calculated strain of the bottom of the box (2.1), desired forces and other parameters well known in the state of the art. In the embodiment shown in figures that number of hydraulic cylinders with telescopic piston (5) is two per box.
Figure 3 shows basic silting operations which can be done according to the present invention. In accordance with the invention, frontal boxes (2), positioned at the fore and aft sides of the wagon (1), have to be able to do both lateral silting and silting over the wagon edge directly onto the tracks. Eventual centrally located boxes, in case of three or more boxes (2) on wagon frame (1), have to be able to do only lateral silting of the material from the cargo space (2.4) of the box. Lateral silting is done through controllable lateral segments (2.2) realized at the lateral box (2) sides, while frontal silting is done through frontal segments (2.3) directly onto the tracks, as previously mentioned. Figure 3 shows one wagon box, a left one, in the phase of lateral silting through controllable lateral segment (2.2), and a right box in the silting phase through the frontal segment (2.3).

Although in Figures 3 and 4 just one controllable lateral segment (2.2) is shown per each lateral side, number of such segments per side can be larger. It is especially important that number of such controllable lateral segments (2.2) is larger than one per lateral side of the box (2) in case of, for example, longer boxes and the need for selective box emptying. Furthermore, in case that the boxes, i.e. cargo spaces (2.4) are internally divided for transport of two or more kinds of different material, which are not necessarily silted at the same location, it is also desirable to realize several controllable lateral segments (2.2) per each lateral box side (2).

In order to efficiently and safely perform the operation of box (2) tipping with reference to frame (1), besides hydraulic cylinders with telescopic piston (5), serving to tilt the box, it is also necessary to realize controllable connection points (4) which mechanically connect bottom of each box (2.1) to a frame (1). Connection points (4) are well known in the prior art in various forms, but according to the present invention they are derived from fork supports (4.1) placed on a frame (1) and forks (4.2) placed on
the lower side of the bottom of the box (2.1), as shown in Figures 3, 5, and 6. Each fork support (4.1) has its fork (4.2). Number of controllable connection points (4) derived on a wagon depends on a number and size of each of the boxes (2) as well on the required way of functioning of each box; lateral and frontal silting or just lateral silting in case of centrally placed box for the wagon embodiment with three boxes (2), not explicitly shown in drawings.

Activation and deactivation of the connection point (4) controls a detachable mechanical connection between wagon box (2) and wagon frame (1) in said connection point (4). Deactivated connection point (4) allows for a physical separation of forks (4.2) from respective fork supports (4.1). Activated connection point (4) enables solid mechanical connection of wagon box (2) with wagon frame (1) where a fork support (4.1) firmly encompasses a fork (4.2). Activated connection point allows pivoting of the wagon box (2) at an angle around such activated connection point (4) in a way known in prior art. Activation/deactivation of each controllable connection point (4) can be done via electromagnetic (later in test: "electro"), hydraulic, or pneumatic alternatives in ways well known in prior art, where term "ways" also includes "means" to execute ways, for example a hydraulic cylinder with a piston in case of hydraulic ways.

In order to efficiently carry out silting from the cargo space, besides the adequate box (2) tipping with reference to wagon frame (1), it is necessary to open adequate lateral controllable segments (2.2) or a frontal segment (2.3) of one of the frontal boxes (2).

According to the present invention, each box (2) placed on a wagon frame (1) is equipped, at each of its lateral sides, with one or more controllable lateral segments (2.2), which serve for silting from cargo space (2.4). For simplicity, Figure 7 contains spatial representation of the box (2) with only one controllable lateral segment (2.2), realized at each of the lateral sides of the said box.
(2). Multiplication of such lateral segments (2.2) along lateral box sides is not a technological problem; rather it is problem of control realization over said segments (2.2).

As clearly depicted on Figures 7 and 8, each controllable lateral segment (2.2) is connected to the box (2) with stud bolts (2.5), which represent a fixed pivotal point—an anchorage—for controllable lateral segments (2.2). Displacement of controllable lateral segments (2.2) is done with hydraulic cylinders (6.1) located below the box bottom (2.1), which use their pistons (6.2) to move levers (6.3) connected to the lower side of the controllable lateral segments (2.2); said lower side is found opposite from the side connected with stud bolts (2.5), Figure 8. It is obvious to an average expert in the field that all hydraulic cylinders (6.1), which control the same controllable lateral segment (2.2), have to be synchronized in their motion in order to prevent damage to the box (2), to a controllable segment (2.2), or to their mutual mechanical connection. Minimum number of hydraulic cylinders (6.1), required for controlled opening of a single controllable lateral segment (2.2), is just one, but in practice and in Figure 7 a technical solution with three hydraulic cylinders (6.1) is used to control a single controllable lateral segment (2.2). In practice generally a number of hydraulic cylinders (6.1) will range from two to five, depending on the box (2) concept and on the material which each controllable lateral segment (2.2) has to contain during silting.

Each controllable lateral segment (2.2) has on its lower side a sealing edge (2.6), which fits into a provided sealing point (2.7) realized at the bottom of the box (2.1), see Figure 8. The sealing edge (2.7) and the corresponding sealing point (2.7) can be realized in any way known in the prior art, for example with two sealing edges (2.6), fitting into the sealing point (2.7) as shown in Figures 7 and 8. Said sealing edge (2.6) and sealing point (2.7), by the way they are constructed, are required, besides the reliable
closing of the lateral box (2) side, to enable easier interruption of the initiated silting procedure – stopping the flow of the granulate.

A frontal segment (2.3), shown in Figures 3, 7, and 8, does not have a separate controlling unit. The frontal box segment (2.3) is connected with stud bolts (2.8) to the box (2), see Figure 8, and in its bottom segment it has a system to lock and unlock the frontal segment from the bottom (2.1) of the box (2), but is not explicitly shown because it is known in the prior art. Unlocking and locking of the frontal segment (2.3) can be done in any appropriate way known in the prior art, e.g. in an electro, a pneumatic, or a hydraulic way.

If the box (2) is placed in-between two other boxes or at the frontal end of the frame (1), according to the present invention each of the boxes (2) has to be able to do controlled silting from both lateral wagon sides. The controlled silting from lateral sides is realized through synchronous or asynchronous performance of two basic functions. By asynchronous here we assume consecutive execution of the first function, than second one, than first one again, etc.

The first function – regulation of the opening of one or more controllable lateral segments (2.2) of the wagon box (2) through one or more hydraulic cylinders (6.1) connected to an individual controllable lateral segment (2.2).

The second function – regulation of the controlled box (2) tipping, in this case pivoting, to a desired side, by activation of cylinders with telescopic pistons (5). Pivoting side is determined by activation/deactivation of the desired connection points (4) of the wagon, as described earlier.
As the regulation of the displacement of the controllable lateral segments (2.2), of state of the cylinders with telescopic pistons (5), and of the connection points is a rather complex to manage, according to the present invention those functions are regulated with a help of a programmable logic controller (PLC), which implements the desired operator's actions without any requirement for other eventual manual labor with regards to the wagon's silting process. Moreover, PLC ensures that eventual box pivoting will not tip-over the wagon due to the careless silting and shifting of the center of mass of freight and wagon, in accordance with previously programmed silting protocol, or with the help of eventual other sensors providing feedback to PLC in order to make decisions.

The situation is simpler for silting through frontal segments (2.3); it will suffice to just unlock the frontal segment (2.3) from the bottom of the box (2.1), execute required activation/deactivation of the desired connection points (4) for frontal silting, and to initiate lifting of the box (2) via cylinders with telescopic pistons (5), which regulate controlled lifting of the box (2), which is tipped towards the frontal side. The box (2) inclination, relative to the frame (1), defines the silting speed from the cargo space (2.4). All of the aforementioned functions are also controlled via the PLC, which implements the desired operator's actions without any requirement for other eventual manual labor with regards to the said silting process.

Aside from the standard safety operations, PLC also disables unintentional start of two kinds of silting operations from the same box (2); e.g. the frontal silting through frontal segment (2.3) in parallel to the lateral silting through one of the controllable lateral segments (2.2) of the same box (2). Basic description of those control functions can be found in the prior art, e.g. in document WO93/09014A1.
An average expert in the field will clearly understand that any of the previously described kinds of silting is determined by a significantly large number of wagon parameters, which need to be controlled. If each of said parameters would require independent regulation, especially by the semiskilled operator, it would render such wagon unusable and dangerous to handle. Thus, typically in such occasions programmable logic-controllers (PLCs) are used to regulate every box (2) individually, or to manage all boxes (2) on a single wagon - which eases the work of the operator and provides reliability to wagon operations in all operating conditions.

The PLC used in such a wagon helps to solve the first technical problem - completely controlled/dosed silting of bulk material from a cargo space through lateral or frontal wagon sides. In case of lateral silting, box (2) inclination and displacement of the lateral segments (2.2) define silting speed, whilst for the silting process through frontal segment (2.3) the silting speed is determined exclusively by the box (2) inclination with reference to frame (1), and with it the amount of the material silted from the cargo space. At the same time, the said PLC use enables literally a single operator to perform all required silting actions with high safety standards - which solves the second technical problem.

The third technical problem solved by the present invention refers to the automatic winding and unwinding of a tarpaulin/canopy (7.1) over the cargo space (2.4). As already mentioned while defining the technical problem, it is of great importance, while in transit through urban areas and/or when hygroscopic material is transported, to avoid significant and direct contact of freight and airflow around wagon box (2), or to avoid direct influence of precipitation on freighted material. While solving this technical problem several given parameters have to be kept in mind; protection has to be efficient, coverall construction should not occupy the space of the wagon box (2) - which would consequently reduce the cargo space (2.4), winding and unwinding of the tarpaulin (7.1) over the cargo
space has to be done automatically and quickly, and the whole procedure can be managed by a semiskilled operator.

The mechanism for winding and unwinding of the tarpaulin is located under the lid (7.2) at the frontal part of the box (2), as indicated in Figure 7. Figures 9, 10, and 11 depict the said mechanism, which is comprised of several cog wheels (7.3) leading a chain (7.4), of chain tensioners (7.5), and of a pulling element (7.6) attached to the chain (7.4).

The pulling element (7.6) is spread throughout the length of a box (2) over a cargo space (2.4). The tarpaulin (7.1) is connected to the pulling element (7.6), in a way that the pulling element (7.6) pulls the tarpaulin (7.1) along the guideline (7.7) and unravels it from a tarpaulin winding drum (7.8) during the spanning over the cargo space (2.4). Also, pulling element (7.6) helps the uniform winding up of the tarpaulin (7.1) onto the winding drum (7.8) during the cargo space (2.4) disclosure.

Wrapping and unwrapping of the tarpaulin is done via one of the adequate realizations; e.g. with a help from hydromotor, pneumatic unit, electromotor, or a manual lever mechanism. Regardless of the used realization, that realization is moving the chain (7.4) along with the pulling element (7.6) and the tarpaulin winding drum (7.8). It should be mentioned here that the arc of the cargo space (2.9), seen on Figures 4 and 9, is serving as an additional mechanical tarpaulin support (7.1).

The tarpaulin (7.1) can be realized from any suitable waterproof material, for instance from standard waterproof fabric known in the prior art, e.g. rubberized fabric, polymer materials or similar.

The wagon realized in accordance with the present invention requires a significant amount of energy for its silting operation. It is
known that overall train system profusely uses pneumatic systems in a standard exploitation of the train vehicles.

An average expert in the field, specifically for the field of hydraulics/pneumatics, will know how to implement pneumatic-hydraulic turbines for the transformation of always readily available pneumatic energy into hydraulic energy, in a way well known in the previous state of the art. The hydraulic pressure obtained in this way can be used to control hydraulic cylinders, hydromotors, and other mechanical devices on the wagon.

**Industrial applicability**

Figures used in the description of the present invention refer exclusively to a wagon for transport and controlled silting of hygroscopic material from two wagon boxes (2) on a frame (1). Each box (2) on each lateral side has only one realized controllable lateral segment (2.3) for silting. Both boxes (2) have functions of independently controlled lateral silting via controllable lateral segments (2.2) and of frontal silting via frontal segment (2.3) with an additional tipping control for each of the boxes (2) via the control of the displacement of hydraulic cylinders with a telescopic piston (5). Said actions are controlled via a PLC, and the wagon has cargo protection in the cargo space (2.4) from the atmospheric influences via a tarpaulin (7.1). According to the entire description and here shown preferred wagon embodiment, the present invention as a whole improves wagon properties for transportation and silting of bulk material, especially hygroscopic material, making its applicability unquestionable.

Notwithstanding the above example, which is supported by the drawings, it only has an illustrative role, and the present invention is not limited solely to the described embodiment. An average expert in the field will understand all possible
modifications, additions, and changes that can be done without leaving the scope of protection defined by the present invention.

References

1  - frame
2  - wagon box
2.1 - box bottom
2.2 - controllable lateral segment
2.3 - frontal segment
2.4 - cargo space
2.5 - stud bolt of the lateral segment
2.6 - sealing edge
2.7 - sealing point
2.8 - stud bolt of the frontal segment
2.9 - arc of the cargo space
3  - bogie
4  - controllable connection point.
4.1 - fork support
4.2 - fork
5  - hydraulic cylinder with telescopic piston
6.1 - hydraulic cylinder of segment 2.2
6.2 - cylinder 6.1 piston
6.3 - piston 6.2 lever
7.1 - tarpaulin
7.2 - tarpaulin mechanism lid
7.3 - cog wheel
7.4 - chain
7.5 - chain tensioner
7.6 - pulling element
7.7 - pulling element guideline
7.8 - tarpaulin winding drum
1. A wagon for transport and controlled silting of hygroscopic material, comprised from frame (1) equipped with bogies (3) and with at least two independently controllable wagon boxes (2), characterized by that:

- each wagon box (2) has on its lateral sides realized one or more controllable lateral segments (2.2) which serve for lateral silting from a cargo space (2.4), and an additional frontal segment (2.3) in case the box (2) is placed at one of the ends of the wagon frame (1), where the opening of the frontal segment (2.3) results in silting solely over the edge of the wagon frame (1) directly onto the tracks; where said controllable lateral segments (2.2) and the frontal segment (2.3) of the box (2) are opened through displacement of their lower side from the bottom of the box (2.1);

- said wagon has controllable connection points (4) formed from fork supports (4.1) set on a frame (1), and from forks (4.2) set on a lower side of the bottom of the box (2.1);

  o where through activation/deactivation of the connection point (4) a control is realized over detachable mechanical connection between wagon box (2) and wagon frame (1) in a said connection point (4), while

  o the activated connection point (4) enables solid mechanical connection of the wagon box (2) with the wagon frame (1), allowing for pivoting of the wagon box (2) for a certain angle around such activated connection point (4);

- said wagon frame (1) is equipped with one or more hydraulic cylinders with telescopic piston (5) per each set wagon box (2) for controllable lifting of the bottom of the box (2.1);

- where activation of hydraulic cylinders with telescopic pistons (5) below the wagon box (2) and the state of controllable connection points (4) of each of the said boxes (2) define the direction and the angle of tilting of each of
the wagon boxes (2) individually, with reference to the wagon frame (1); and
- where tarpaulin (7.1) which roofs and preserves the hygroscopic material in the cargo space (2.4) of each box (2) can be independently wound over the cargo space (2.4) or completely rolled onto the tarpaulin winding drum (7.8) placed in the lateral part of the wagon box (2) with the tarpaulin mechanism placed in the frontal part of the box (2) under the lid (7.2).

2. A wagon for transport and controlled silting of hygroscopic material as defined in claim 1, characterized by that:
- the controllable lateral segments (2.2) of the wagon box (2) are controlled with hydraulic cylinders (6.1) whose pistons (6.2) are, for each separately driven controllable lateral segment, synchronized in displacement, and where pistons (6.2) are fixed to levers (6.3) attached to the bottom of controllable lateral segments (2.2) which are with its upper parts connected by stud bolts (2.5) to the wagon box (2);
- the displacement of the controllable lateral segments (2.2) with reference to the bottom of the box (2.1) is regulated by the position of levers (6.3); and
- said controllable lateral boxes (2.2) have in their lower part sealing edges (2.6) which fit into the sealing point (2.7) realized at the bottom of the box (2.1).

3. A wagon for transport and controlled silting of hygroscopic material as defined in claim 2, characterized by that a silting speed of material, from the cargo space (2.4) of one of the boxes (2), for lateral silting, is determined by:
- controlled independent opening of one or more controllable lateral segments (2.2), on a desired lateral side of the box (2), with their hydraulic cylinders (6.1), which changes the position of the edge (2.6) of each of the controllable lateral segments (2.2) with reference to the sealing point (2.7) at the
bottom of the box (2.1) on a desired lateral side of the box (2), and
- controlled lifting of the box (2) through activation of the hydraulic cylinders with telescopic pistons (5) by controlling the activation/deactivation of desired connection points (4), which jointly define the silting side and the amount of the relative tilt of the box (2) with reference to the wagon frame (1) -

4. A wagon for transport and controlled silting of hydroscopic material as defined in claim 1, characterized by that a silting speed through the frontal segment (2.3), fixed by stud bolts (2.8) to the wagon box (2), is determined by activation of hydraulic cylinders with telescopic pistons (5), defining the relative tilting angle of the box (2) with reference to the wagon frame (1) towards the front end of the wagon, with prior appropriate activation/deactivation of connection points (4) between the box (2) and the frame (1), allowing for tilting of the box (2) only towards the front end of the wagon, and unlocking of the frontal segment (2.3) from the wagon box (2).

5. A wagon for transport and controlled silting of hydroscopic material as defined in any of the previous claims, characterized by that the activation/deactivation of connection points (4) and unlocking of the frontal segment (2.3) from box (2) is controlled in a hydraulic, pneumatic, or electric way.

6. A wagon for transport and controlled silting of hydroscopic material as defined in any of the previous claims, characterized by that the state of all of connection points (4), hydraulic cylinders (6.1) of controllable lateral segments (2.2), hydraulic cylinders with telescopic piston (5), and by unlocking of the frontal segment (2.3) is regulated with the help of the programmable logic controller (PLC) connected with a hydraulic, a pneumatic or an electric system of the wagon, for each wagon box (2) separately.
7. A wagon for transport and controlled silting of hydroscopic material as defined in claim 6, characterized by that the PLC system:
- controls and synchronizes opening operations of controllable lateral segments (2.2) using cylinders (6.1),
- performs unlocking of the frontal segment (2.3),
- controls the tilting of the box (2) in reference to the wagon frame (1) through activation/deactivation of connection points (4) in accordance with the operator's request and without the need for manual locking or unlocking of wagon connections;
- in a way that programmable logic controller (PLC) has integrated safety parameters, ensuring that eventual tilting of the wagon box (2) does not tip-over the wagon due to the careless silting and movement of the center of mass of cargo and wagon; or to stop simultaneous silting through controllable lateral segments (2.2) and frontal segment (2.3) from the cargo space (2.4).

8. A wagon for transport and controlled silting of hydroscopic material as defined in any of the previous claims, characterized by that the mechanism for tarpaulin winding and unwinding is placed under the lid (7.2) at the frontal part of the box (2), where the said mechanism is comprised from cog wheels (7.3), chain (7.4), chain tensioner (7.5), and pulling element (7.6) attached to the chain (7.4), where the pulling element (7.6) is placed along the entire length of the box (2) over the cargo space (2.4), and to which a tarpaulin (7.1) is fixed;
- where the pulling element (7.6) pulls the tarpaulin (7.1) along the guideline (7.7) and is unwound from the tarpaulin winding drum (7.8) during the tarpaulin placement over the cargo space (2.4), or,
- which helps that the tarpaulin (7.1) is evenly wound onto the winding drum (7.8) during the tarpaulin removal over the cargo space (2.4); where winding and unwinding of the tarpaulin is realized using the installed hydromotor, pneumatic unit, or a manual lever
mechanism; driving the chain (7.4), and with it the pulling element (7.6) as well as the winding drum (7.8); and where the arc of the cargo space (2.9) serves as an additional mechanical support for the tarpaulin (7.1).

9. A wagon for transport and controlled silting of hydroscopic material as defined in any of the previous claims, characterized by that the tarpaulin (7.1) is realized from waterproof materials, chosen from standard waterproof fabric, rubberized fabric, or from polymer materials.

10. A wagon for transport and controlled silting of hydroscopic material as defined in any of the previous claims, characterized by having two wagon boxes (2) on a frame (1), and each box (2) on each lateral side has realized one controllable lateral segment (2.2) for silting, both boxes (2) with functions of an independent control of lateral silting through the regulation of the controllable lateral segments (2.2), and frontal silting through the frontal segment (2.3) with an additional tipping control for each of the boxes (2) through regulation of the cylinder stroke for two hydraulic cylinders with telescopic pistons (5), controlled through PLCs, and with the material in the cargo space (2.4) protected against atmospheric influences by the tarpaulin (7.1).
Figure 7
**INTERNATIONAL SEARCH REPORT**

International application No

PCT/HR2013/000006

A. CLASSIFICATION OF SUBJECT MATTER

INV. B61D9/02  B61D9/06

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61D  B60P  B60J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
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<th>Relevant to claim No.</th>
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<td>DE 10 2009 048064 A1 (LEONHARD WEISS GMBH &amp; CO KG [DE]) 14 April 2011 (2011-04-14) paragraph [0015] - paragraph [0017] paragraph [0020]; figures 1,2</td>
<td>1,2,10</td>
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<td>A</td>
<td>EP 0 073 621 A1 (NEVILLE TRUCK EQUIPMEN GEORGE [GB]) 9 March 1983 (1983-03-09) page 5, line 4 - page 6, line 27; figures 7-10</td>
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Date of the actual completion of the international search 26 July 2013

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