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CA 2467019 C 2012/08/21

(11)(21) 2 467 019

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2002/11/01
(87) Date publication PCT/PCT Publication Date: 2003/05/22
(45) Date de délivrance/Issue Date: 2012/08/21
(85) Entrée phase nationale/National Entry: 2004/05/13
(86) N° demande PCT/PCT Application No.: NO 2002/000399
(87) N° publication PCT/PCT Publication No.: 2003/042618
(30) Priorité/Priority: 2001/11/14 (NO20015573)

(51) Cl.Int./Int.Cl. *F27D 3/12* (2006.01), *C25C 3/06* (2006.01), *C25C 3/22* (2006.01), *C25C 7/06* (2006.01), *F27D 15/02* (2006.01)

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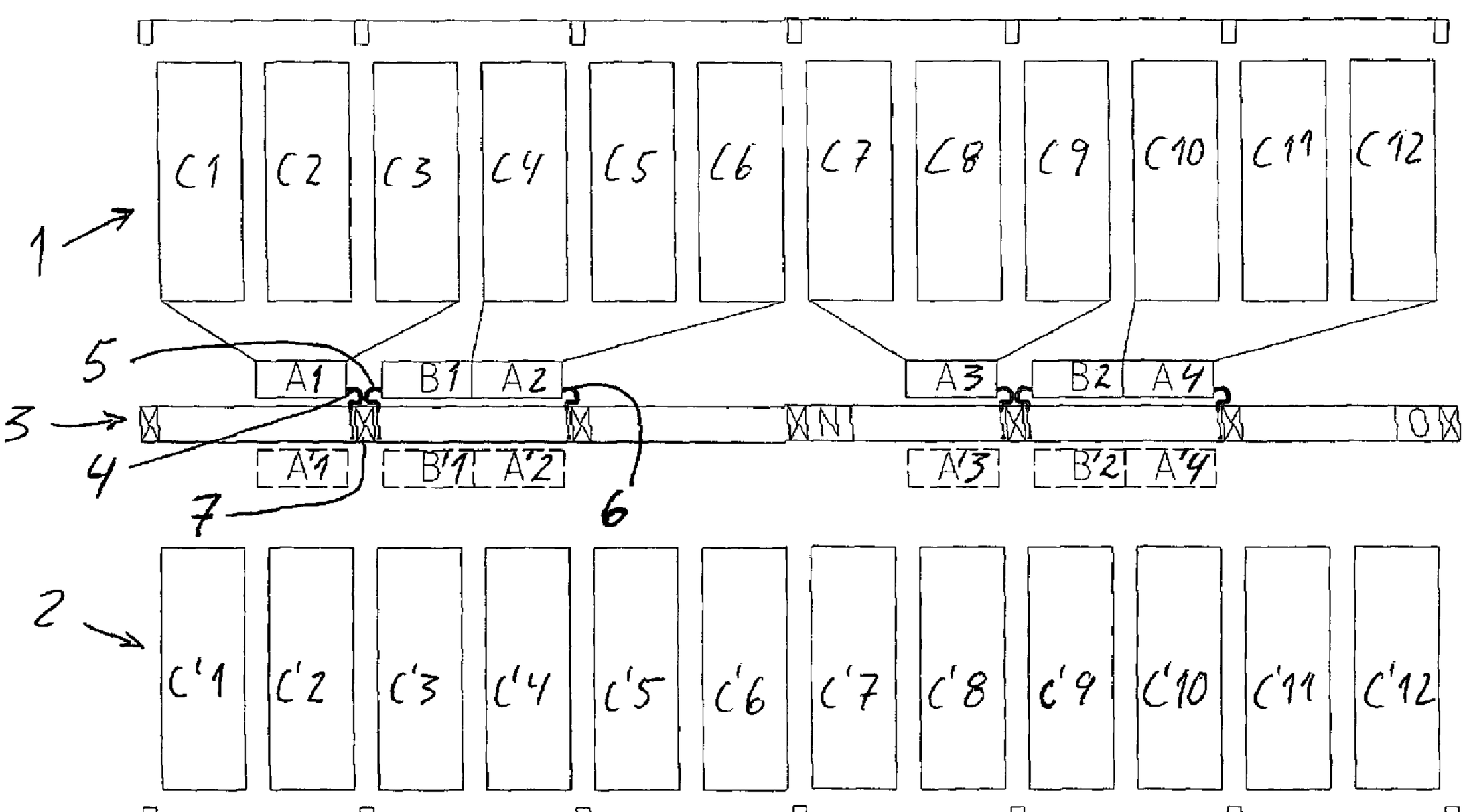
(54) Titre : PROCEDE PERMETTANT DE FAIRE FONCTIONNER UN SYSTEME DE CELLULES A L'ELECTTROLYSE PRE-CUITES ET DISPOSITIF DESTINE A ETRE UTILISE DAN CE SYSTEME

(54) Title: A METHOD FOR DESIGNING A PRE-BAKE ELECTROLYSIS CELL SYSTEM AND AN ARRANGEMENT FOR USE IN THIS SYSTEM



(57) Abrégé/Abstract:
The present invention concerns a method and an arrangement for use in an electrolysis cell system, comprising a hall with electrolysis cells (C) that use anodes of the pre-bake type for the production of aluminium. The electrolysis cells are arranged in two parallel rows at a distance from each other forming an area for transport of materials to and from the cells between them. A centrally arranged structure is located between said rows of cells. The hall further comprises temporary storage of consumed

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(57) Abrégé(suite)/Abstract(continued):
anodes and other material that are removed from the cells, in closable storage arrangements. Hot gases are extractable from the storage arrangements that are arranged in a formation along said structure so that the operations performed on the cells are free from obstruction by the storage arrangements. The storage arrangements have means for connection to extraction connections located close to or at said structure. The storage arrangements are specially designed with means to reduce emissions of gas to the surroundings and to enhance the efficiency of the cooling process. They are also designed to be transported by a vehicle.

26625-359

Abstract

The present invention concerns a method and an arrangement for use in an electrolysis cell system, comprising a hall with electrolysis cells (C) that use anodes of the pre-bake type for the production of aluminium. The electrolysis cells are arranged in two parallel rows at a distance from each other forming an area for transport of materials to and from the cells between them. A centrally arranged structure is located between said rows of cells. The hall further comprises temporary storage of consumed anodes and other material that are removed from the cells, in closable storage arrangements. Hot gases are extractable from the storage arrangements that are arranged in a formation along said structure so that the operations performed on the cells are free from obstruction by the storage arrangements. The storage arrangements have means for connection to extraction connections located close to or at said structure. The storage arrangements are specially designed with means to reduce emissions of gas to the surroundings and to enhance the efficiency of the cooling process. They are also designed to be transported by a vehicle.

26625-359

A method for designing a pre-bake electrolysis cell system and an arrangement for use in this system

The present invention concerns a method for operating a pre-bake electrolysis cell system which includes handling consumed anodes and other material from the cells in the system and transportation of new anodes to the same cells, as well as an arrangement for use in this system.

In connection with the operation of a modern electrolysis system for the production of aluminium, there are extensive requirements for the transportation of various materials to the cells, for example oxide, fluoride, anodes, etc. Moreover, operation involves the removal of consumed anodes, crusts and other material from the cells in addition to the metal produced.

Some of this transportation is crane-based, i.e. the objects are handled by means of one or more cranes that can serve the cells in the electrolysis hall in connection with specific operations. Another part of the transportation is performed by means of wheeled vehicles.

One problem with electrolysis cell systems that are built so that the cells are arranged in two parallel rows with a row of supporting columns in the space between the rows is that it can be difficult to manoeuvre the vehicles in an effective manner in the system. When, for example, consumed anodes and other material are removed from an electrolysis cell, it is important that it can be transported fast either out of the hall or to a temporary store so that the hall atmosphere is not impaired on account of unnecessary delay in removing the stated anodes or material, which will emit gases after removal from the cell. If a temporary store is used, it is important that this is arranged so that the operation of the rest of the electrolysis cell system is affected as little as possible, while the distance over which hot material is transported is limited to a minimum.

US patent no. 5,182,869 shows apparatus for handling consumed anodes from electrolysis cells in which a long, stationary chamber is designed to receive consumed anodes. The chamber is connected to the main extraction system of the electrolysis system, which also extracts gas from the electrolysis cells. A conveyor is installed inside the chamber to convey consumed anodes from one end of the chamber to the other. The conveyor will be subject to high temperatures as the anodes may have temperatures of many hundred degrees. Moreover, its moving parts will be subjected to particulate material that can penetrate in between the conveyor's various moving parts and create further operating problems. Maintenance of the conveyor will be a demanding task in terms of temperature unless it is removed from operation and cooled. Moreover, operation of such a system will involve extensive transportation of hot material in the electrolysis cell system.

WO99/39027 discloses a procedure and equipment for handling and transporting carbon bodies used in electrolysis cells. This document discloses a transportation system for carbon bodies and crust material that is arranged in a tunnel, preferably below the operating floor of an electrolysis hall. It is disclosed two tracks that communicate with the operating floor via trap-doors. This system will require that useful operational space will be lost, in particular if the tunnel is arranged at operation floor level. Even if arranged below this floor level, the trapdoors and corresponding loading/unloading area may obstruct normal cell operations and transport connected hereto. The hall as such have centrally arranged supporting columns and the construction is commonly known as a double-hall. The tracks will normally be driven in one direction, to be able to get material in/-out of the hall in a reasonable manner. Such system will not have the same flexibility as the present storage arrangement that could easily be moved in / moved out of the plant and also crosswise in the plant between the columns.

Norwegian patent application no. 944973 shows a method and an arrangement for changing anodes in connection with aluminium melting electrolysis with heat recovery. The arrangement comprises transport containers that are designed to hold consumed anodes and bath material. The transport containers in which consumed anodes/bath material are placed are transported to a chamber in a heat exchanger system. The residual heat from the material in the stated containers is utilised to preheat new anodes. One problem with this system is that it comprises transportation of sometimes large containers that contain material at a very high temperature. The distances in an electrolysis system may be large and the transportation of such containers to a separate heat exchanger system will involve a risk of accidents that may be prohibitively high.

DE 4221882 A1 concerns a transport device for hot residual anodes. The transport device comprises a closed container in which consumed anodes are inserted. To limit emissions of contaminated gases into the hall atmosphere during transportation out of the hall, the container is fitted with a filter in order to retain such gases, at least partially. The container comprises swivelling lids to allow anodes to be inserted/removed. This solution is associated with some of the same risk as that stated above as containers

containing a material at a very high temperature must be transported through the hall. However, it is stated that consumed anodes can be left to cool in the container after they have been removed from the cell, right up until there is no longer any significant emission of harmful gases. In this connection, it is assumed to be advantageous for the container to be placed in an area where there is a certain extraction of hall air into the hall's extraction system in case the filter is unable to handle all harmful gas quantities emitted from the anodes and the other material. Another precondition for limiting emissions is that the container does not leak harmful gases at places other than through the filter.

EP 0838540 shows a temporary store for used anodes and bath material that consists of a container that is connected to an opening in the superstructure of an electrolysis cell. One disadvantage of this solution is that the container may easily obstruct other operations that are to be performed on the cell as it is placed right next to one end of the cell and will thus represent a physical extension of the cell. The extraction conditions in the cell may, moreover, be disturbed by activities performed with the container as this will involve periodic opening of the cell's extraction system to the ambient air. Moreover, the cooling time may be unnecessarily extended by heat being transferred from the electrolysis cell to the container on account of its proximity to the cell.
In the document, it is not expressed details regarding the construction of the hall and the overall transport in it, but the concept is most likely to be used in a single hall layout due to its constructional features that demand transversal space in the close vicinity of the cells.

With the present invention, the above disadvantages can be avoided. The arrangement in accordance with the present invention includes operating elements that enable consumed anodes and other material that are removed from the cells to be stored and cooled in the immediate proximity of the cells without disturbing other operations that must be performed on the cells. Moreover, the cooling time can be kept to a minimum and the other cooling conditions can be controlled independently of operation of the cells. The equipment may also comprise further adjustments that will increase the cooling time and reduce emissions of gases into the hall atmosphere without the extraction rate being prohibitively high. Furthermore, the present invention will result in reduced requirements for transportation in the electrolysis cell system as the same

equipment can bring new anodes into the system and remove used anodes on its return run.

In one aspect of the present invention, there is provided a method for the designing of an electrolysis cell system, comprising a hall with electrolysis cells that use anodes of the pre-bake type for the production of aluminium, the electrolysis cells being arranged in two parallel rows at a distance from each other thereby forming an area for transport of materials to and from the cells, and where a structure is arranged centrally in said area and parallel to said rows, the hall further comprising temporary storage in transportable storage arrangements of consumed anodes and other material that are removed from the cells where hot gases are extractable from the storage arrangements, wherein the storage arrangements are closable and arranged in a formation along said structure at the floor level so that the operations performed on the cells are free from obstruction by the storage arrangements, and that the storage arrangements are connected to extraction connections located close to or at said structure, where the storage arrangement have a closable opening facing towards the cells in the rows respectively.

In another aspect of the present invention, there is provided an arrangement for use in an electrolysis cell system, comprising a hall with electrolysis cells that use anodes of the pre-bake type for the production of aluminium, the electrolysis cells being arranged in two parallel rows at a distance from each other thereby forming an area for transport of materials to and from the cells, and where a centrally arranged structure is located between said rows of cells, the hall further comprising temporary storage of consumed anodes and other material that are removed from the cells in transportable storage arrangements arranged in the hall, where hot gases are extractable from the storage arrangements, wherein the storage arrangements are closable and arranged at the floor in a formation along said structure so that the

operations performed on the cells are free from obstruction by the storage arrangements, and that the storage arrangements have means for connection to extraction connections located close to or at said structure where the storage arrangements have a closable opening facing towards the cells in the rows respectively.

The present invention will be described in further detail in the following by means of examples and figures, where:

Figure 1 shows a diagram of a section of an electrolysis cell system, seen from above,

Figure 2 shows the installation of equipment in the electrolysis cell system, seen from one end,

Figure 3 shows equipment in the form of a temporary storage arrangement for consumed anodes,

Figure 4 shows other equipment for moving and handling a temporary storage arrangement as shown in Figure 3.

Figure 1 shows a diagram of a section of an electrolysis cell system consisting of two parallel rows 1, 2 of electrolysis cells. Row 1 comprises cells C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12. Row 2 comprises cells C1', C2', C3', C4', C5', C6', C7', C8', C9', C10', C11', C12'. The electrolysis cell system may comprise further cells in extension of the section shown.

Between the rows of cells and symmetrically along a line parallel to them, further equipment is mounted that consists of temporary storage arrangements or chambers A1, A2, A3, A4 and A'1, A'2, A'3, A'4 for anodes. Moreover, it consists of temporary storage arrangements or chambers B1, B2 and B'1, B'2 for material such as crusts that is removed from the cells. For an electrolysis cell system with two rows of electrolysis cells, as shown in the figure, the distribution of temporary storage arrangements (chambers) will be symmetrical. The operations performed on cell row 1 will, therefore, be equivalent to those performed on cell row 2. In the following, the description of the

present invention will, therefore, relate to cell row 1. This will also be similar to the situation with an electrolysis cell system with just one cell row.

As shown in the figure, a structure 3 is mounted between the cell rows and may consist of columns 7 to support the roof structure of the hall in which the electrolysis cell system is located. Moreover, the columns and this central area in the hall may be provided with different arrangements that are used during the operation of the system. The figure shows extraction points or extraction connections 4, 6 for the storage arrangements A1, A2 for anodes. It also shows an extraction connection 5 for a storage arrangement for material removed from the cells. The storage arrangements described here are arranged so that arrangement A1 serves cells C1, C2 and C3, while storage arrangement A2 serves cells C4, C5 and C6. Storage arrangement B1 for material removed from the cells serves cells C1, C2, C3, C4, C5 and C6 in this embodiment. In this example, storage arrangements are arranged in the same way for the other cells in the system. Extraction connections are only shown for the other storage arrangements A3, B2 and A4 in this figure.

Figure 2 shows the installation of equipment in the form of storage arrangements A1, A'1 with extraction connections 4, 4' in the electrolysis cell system, seen from one end. In the figure, the storage arrangements are mounted by a column 7 on which the extraction connections 4, 4' are mounted. The extraction connections comprise a collecting pipe 8 that communicates with an extraction system that may comprise means for gas purification (not shown). The collecting pipe has a branch 9 to be able to serve the two storage arrangements. From the branch 9 and up to the storage arrangements, the extraction connections comprise flexible pipe parts (hoses) 10, 10' that have a connection 11 that can be connected to an extraction opening 12 in the storage arrangement A1. When the extraction connection is not connected to the storage arrangement, the extraction opening can be closed by means of a cover 13. In the figure, the storage arrangement A1 is disconnected from the extraction connection 4, while the storage arrangement A'1 is connected to the extraction connection 4'. The

extraction connections 4, 4' are made at least partially of an electrically insulating material.

The connection comprises a quick-action coupling 15, where the connection 11 comprises a flange 14 that is inserted behind the projections 15', 15", 15"'. When the connection is not connected to the storage arrangement, it may be placed on a bracket 16 with a holding device 17 that is also in sealing contact with the opening of the connection so that no air is sucked in through it. The holding device may be open so that any dust in the hose can escape. The extraction connection can then be closed by means of valves 17, 17' mounted in the extraction system. The valve can be remote-controlled and can also be closed when the connection is not connected to a storage arrangement. It may also be relevant to operate the valves 17, 17' in accordance with the cooling period so that the valves can be closed when the necessary evacuation time for gases has been achieved after insertion of used anodes/bath residues. It is also possible to use a quick-action coupling (not shown) that can be connected automatically and that can also be designed so that it is protected against the extraction connection being torn apart if a storage arrangement is moved without the extraction connection being disconnected. Such protection may consist of a coupling that disengages at a specific tensile stress.

Figure 3 shows equipment in the form of a temporary storage arrangement A1 for anodes. In this figure, an anode 20 is shown inserted for the sake of clarity. The anode comprises a carbon block 21 with an anode suspender 22 and an anode bar 23. The storage arrangement shown may have space for six anodes that are placed down against the base of the storage arrangement, and the anode bar 23 may be retained in a recess 24 in the superstructure of the storage arrangement. The base may be constructed with angle irons or similar to ensure circulation of cooling air beneath the anode.

For the sake of clarity, only one removable cover 25 is shown, but the entire opening 26 may be covered completely by corresponding covers. The base structure of the storage arrangement comprises an open frame structure with an internal shell 34. In the internal well, there are a number of openings 30, 31, 32, 33 to allow cold ambient air to enter the base area of the storage arrangement. The openings are placed expediently so that the material cannot fall out of the storage arrangement when it is handled.

In the upper part of the storage arrangement, in its rear wall, there are extraction openings 36, 37, 38 for removal of gases from it. The extraction openings communicate with the extraction opening 12 (not shown) that is closed with a cover 13.

When the storage arrangement is connected to an extraction connection, gases will be drawn out through the openings 36, 37, 38, while cold ambient air will flow in through the openings 30, 31, 32, 33 and be mixed with hot gases from the material in the storage arrangement. This has proved to provide favourable gas flow conditions so that emissions of hot gases to the surroundings can be reduced to a minimum by opening one or more covers.

Storage arrangements of type A and B may, in principle, be identical apart from the arrangement B being fitted with additional internal vats designed to receive particulate material (crusts, etc.). Moreover, the recesses 24 for anode bars will be unnecessary so that the arrangement B is made without these recesses. Three vats that cover the entire base area of the arrangement may, for example, be inserted in a storage arrangement of type B.

Moreover, the storage arrangement A1 shown in the figure is not connected to an extraction connection as it is used for storing new anodes. When it is empty of anodes, it will gradually be connected to the extraction connection and made ready to receive used anodes (butts).

Figure 4 shows an arrangement for moving and handling a temporary store as shown in Figure 3. The figure shows part of a storage arrangement A1 designed for handling by a transport vehicle 42. The vehicle is fitted with a manipulator arm 43 with a hook 40 at its outer end. The hook is designed to engage with a bow 41 mounted on the storage arrangement and can pull the storage arrangement up onto the vehicle or push it off the vehicle. The storage arrangement may be fitted with wheels or rollers on its lower side to reduce the friction against the floor when it is handled.

The vehicle may comprise means 45 for handling covers 25, 25', 25'', 25''', 25'''', 25''''', 25'''''' during the unloading/loading of storage arrangements.

Schematic description of the transportation and operation cycle for storage arrangements in the electrolysis cell system:

The transport vehicle collects a storage arrangement with new anodes or an empty storage arrangement for hot material such as grabbed bath material from an anode service system or store. During transportation, the covers are held in place on the storage arrangements by a manipulator on the vehicle. The vehicle drives into the electrolysis hall and positions storage arrangements so that there are 2 storage arrangements for anodes and 1 storage arrangement for grabbed bath material at the allocated places along the central row of columns in the hall of the electrolysis cell system above the 6 electrolysis cells that they are to serve. The vehicle releases the covers from the manipulator on the vehicle so that they lie on the storage arrangements that are left behind in the hall. The operator of the vehicle connects extraction hoses to the storage arrangements using the quick-action couplings mentioned above. The storage arrangements may be provided with the possibility for extraction connection at both short ends for alternative positions.

The operator of a crane for handling anodes places the cell in question in anode change mode, i.e. the extraction is intensified, among other things. Moreover, the valve in the

extraction connection for the allocated storage arrangement is opened so that this extraction connection is activated. The crane then collects 2 used anodes (double change) from the cell in question, drives these to one of the storage arrangements and lifts off 3 covers on the arrangement (the crane is fitted with a cover manipulator that holds the covers during the loading/unloading of anodes/bath material into/out of cooling boxes). Furthermore, the crane inserts anodes in free spaces and the covers are put on. The crane drives to the cell, grabs material from the cell, drives this to the storage arrangement for bath material, lifts off 3 covers, unloads the grabbed material and then replaces the covers. This method may be repeated, if necessary, for the same cell. The crane then lifts off the necessary number of covers from the storage arrangement for new anodes, takes out new anodes, replaces the covers, drives to the cell with them and inserts the anodes.

The operations in the last section are repeated until all the relevant cells have been served. The storage arrangements remain connected to active extraction connections for approximately 4 hours after the last cell has been served. When the boxes have been in the hall for the necessary cooling time (approximately 24 hours), they are collected by the transport vehicle (which, in the meantime, has placed “new” boxes in another location in the hall and prepared for the next change). The boxes are pulled up onto the vehicle and the cover manipulator is activated to hold the covers in place during transportation. The vehicle drives to the anode service system, lifts off the covers and unloads the boxes in the allocated locations. Alternatively to the cover manipulator on the vehicle, there may be a stationary cover manipulator in the anode service system. The storage arrangement is then handled by the anode service (removal of used anodes, emptying of bath residues and bath material, reinsertion of new anodes). The transport vehicle collects a storage arrangement with new anodes or an empty storage arrangement for bath material directly from the anode service or from the store and drives to the allocated location in the hall for the next cell to be served.

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CLAIMS:

1. A method for the designing of an electrolysis cell system, comprising a hall with electrolysis cells that use anodes of the pre-bake type for the production of aluminium, the electrolysis cells being arranged in two parallel rows at a distance from each other thereby forming an area for transport of materials to and from the cells, and where a structure is arranged centrally in said area and parallel to said rows, the hall further comprising temporary storage in transportable storage arrangements of consumed anodes and other material that are removed from the cells where hot gases are extractable from the storage arrangements,

wherein

the storage arrangements are closable and arranged in a formation along said structure at the floor level so that the operations performed on the cells are free from obstruction by the storage arrangements, and that the storage arrangements are connected to extraction connections located close to or at said structure, where the storage arrangement have a closable opening facing towards the cells in the rows respectively.

2. A method in accordance with claim 1,

wherein

the storage arrangements have provisions for transportation by a vehicle, where said consumed anodes and other material from the cells are transported out of the hall in the storage arrangements, while new anodes are transported into the hall using the same arrangements.

3. An arrangement for use in an electrolysis cell system, comprising a hall with electrolysis cells that use anodes of the pre-bake type for the production of aluminium, the electrolysis cells being arranged in two parallel rows at a distance from each other thereby forming an area for transport of materials to and from the cells, and where a centrally arranged structure is located between said rows of cells,

the hall further comprising temporary storage of consumed anodes and other material that are removed from the cells in transportable storage arrangements arranged in the hall, where hot gases are extractable from the storage arrangements,

wherein

the storage arrangements are closable and arranged at the floor in a formation along said structure so that the operations performed on the cells are free from obstruction by the storage arrangements, and that the storage arrangements have means for connection to extraction connections located close to or at said structure where the storage arrangements have a closable opening facing towards the cells in the rows respectively.

4. An arrangement in accordance with claim 3,

wherein

the storage arrangements have provisions for transportation by a vehicle comprising a manipulator arm with a hook at its end, where the storage arrangements are fitted with a bow.

5. An arrangement in accordance with claim 4,

wherein

the vehicle comprises means for handling one or more covers.

6. An arrangement in accordance with claim 3,

wherein

the storage arrangements comprise at least one opening with means for rapid connection to the extraction system.

7. An arrangement in accordance with claim 6,

wherein

the means comprise projections that interact with a flange arranged on a hose in the extraction system.

8. An arrangement in accordance with claim 3,

wherein

the storage arrangements are provided with openings to let in ambient air.

9. An arrangement in accordance with claim 3,

wherein

the storage arrangements are fitted with extraction openings in their upper parts.

10. An arrangement in accordance with claim 1 or 3, wherein the structure comprises columns.

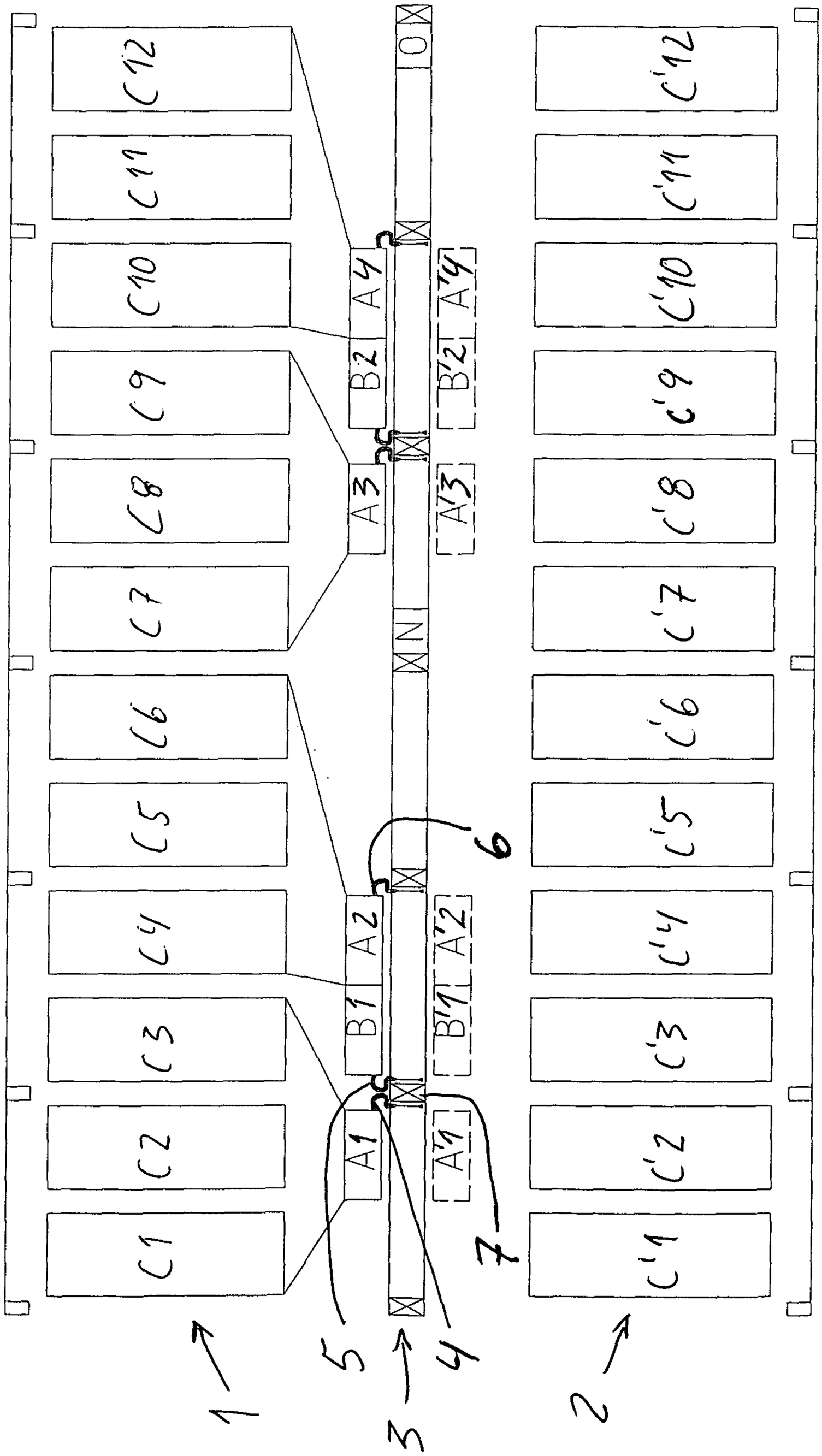
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Fig. 1

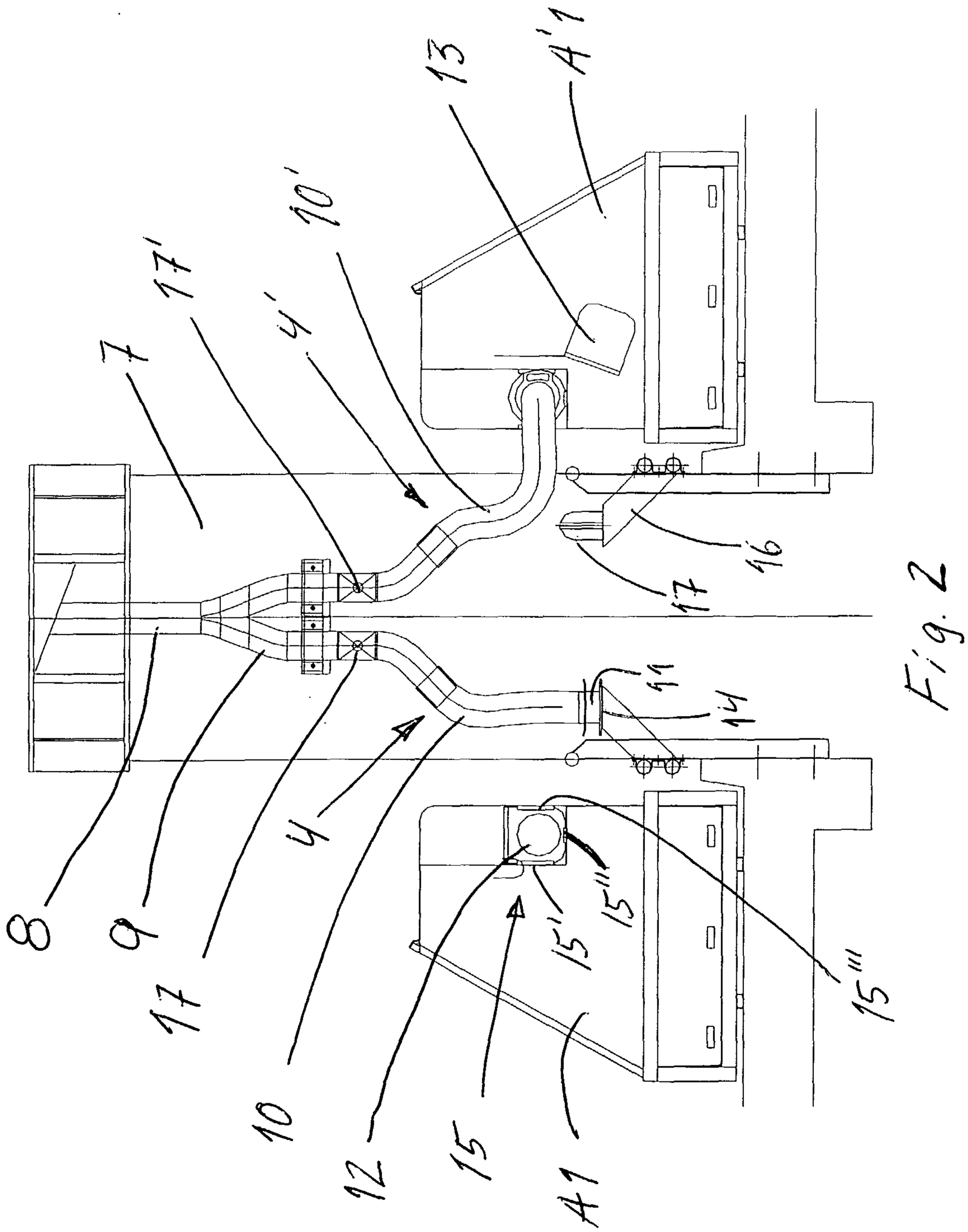


Fig. 2

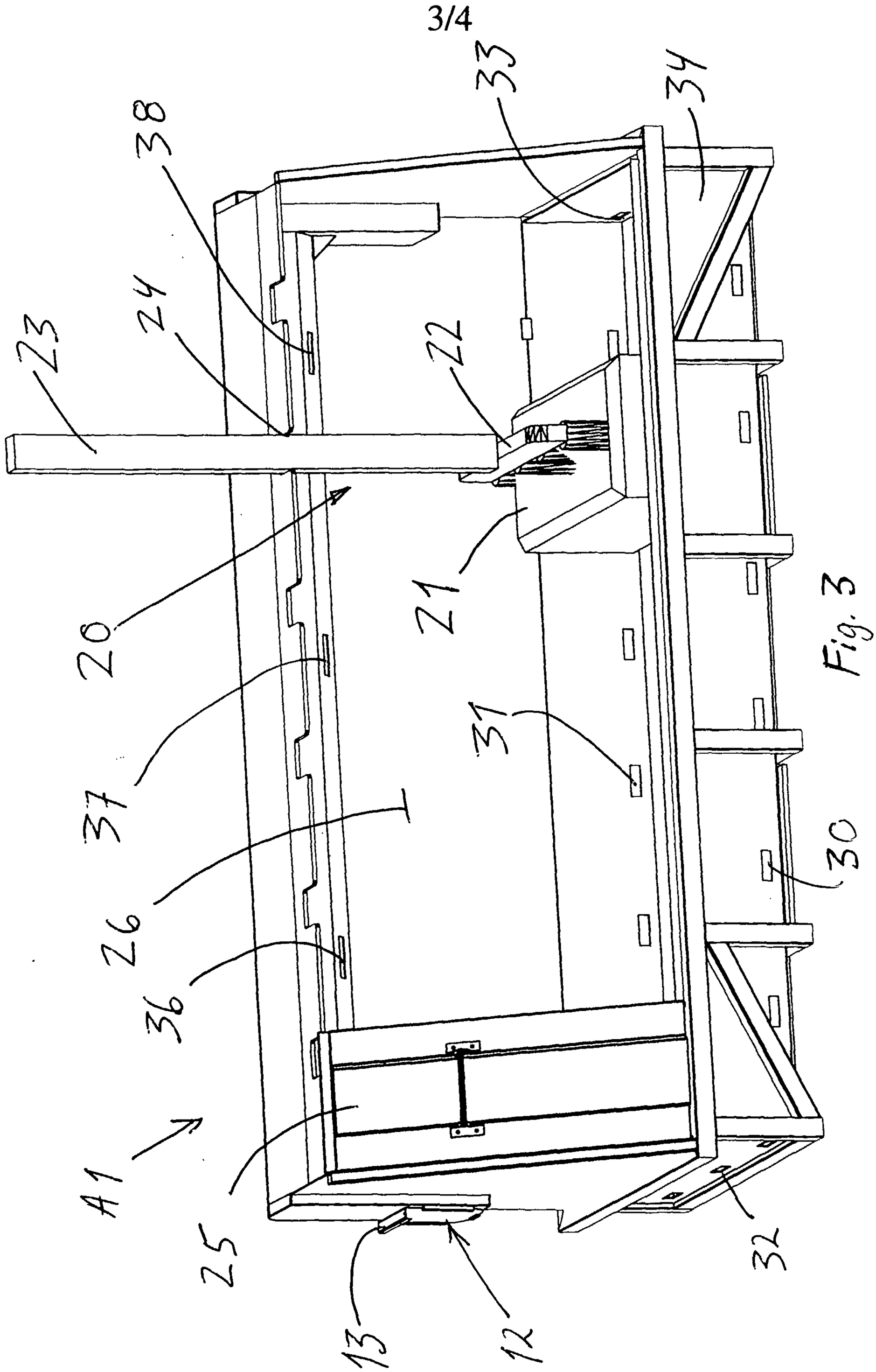


Fig. 3

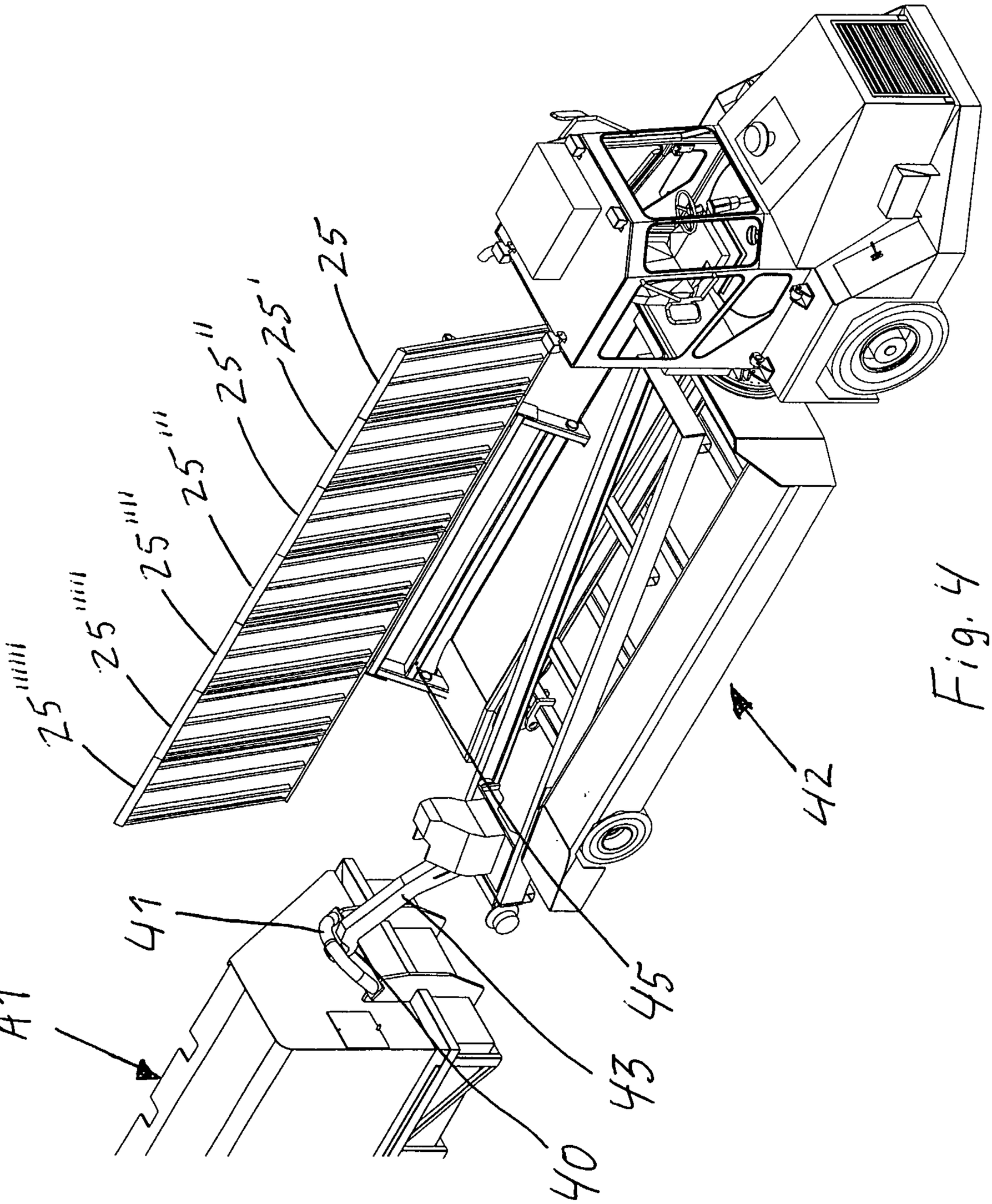
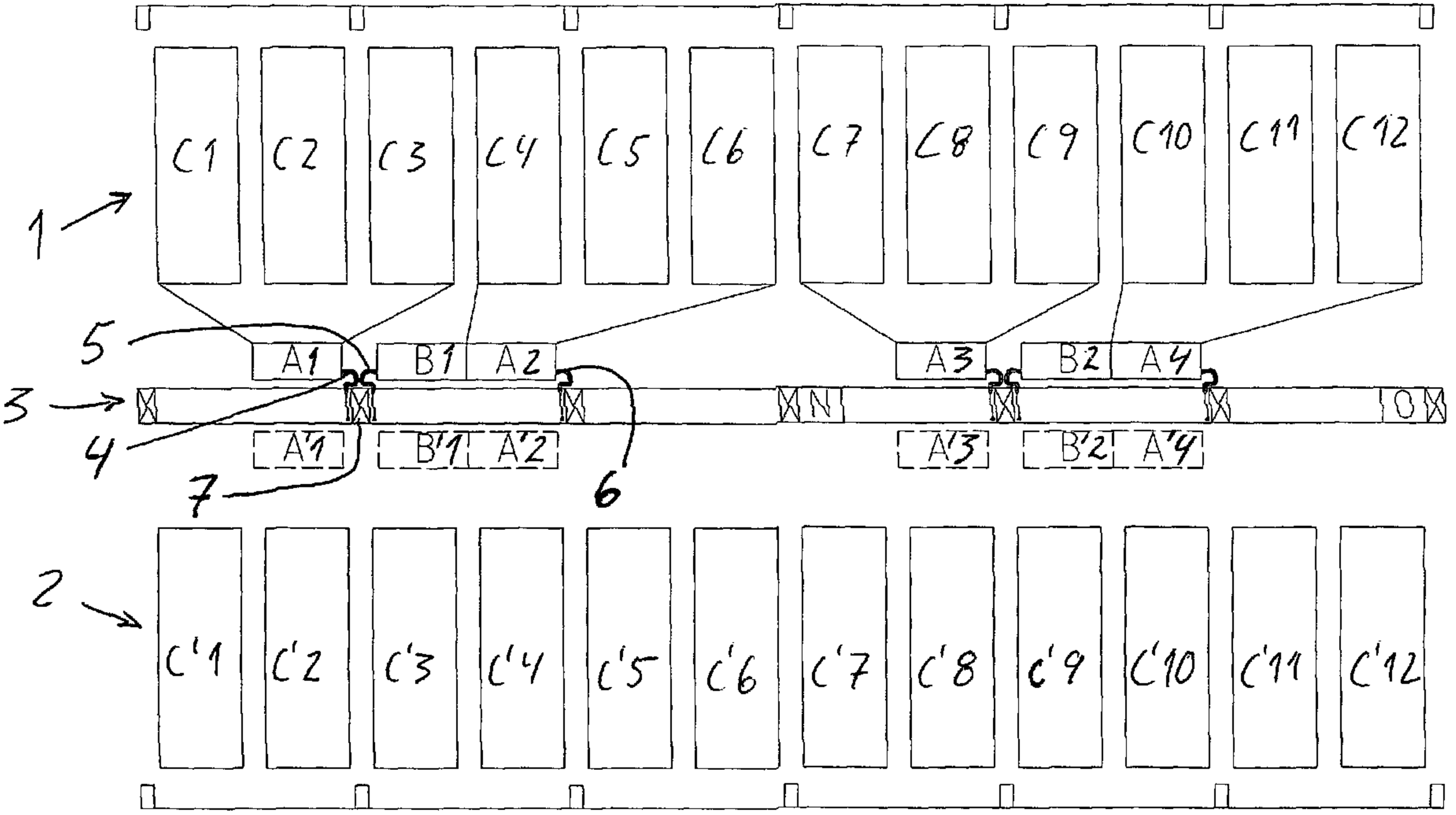


Fig. 4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