(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 516 992 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
**05.03.2025 Bulletin 2025/10**

(21) Application number: **24186708.4**

(22) Date of filing: **05.07.2024**

(51) International Patent Classification (IPC):
***D21B 1/34*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
**D21B 1/345**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
**BA**
Designated Validation States:
**GE KH MA MD TN**

(30) Priority: **04.09.2023 FI 20235982**

(71) Applicant: **Valmet Technologies Oy**
**02150 Espoo (FI)**

(72) Inventors:
- **HAUTANIEMI, Timo**
  **33840 Tampere (FI)**
- **LATTUNEN, Mauri**
  **33840 Tampere (FI)**
- **LEHTINEN, Erno**
  **33450 Siivikkala (FI)**
- **TOIVONEN, Tommi**
  **33900 Tampere (FI)**
- **LEHTINEN, Petri**
  **33100 Tampere (FI)**

(74) Representative: **Berggren Oy**
**P.O. Box 16**
**Eteläinen Rautatiekatu 10A**
**00101 Helsinki (FI)**

# (54) VERTICAL BALE PULPER

(57) The invention relates to a vertical bale pulper (10) comprising a vat (13), which has a substantially cylindrical upper part (13A) and a downwards convergent lower part (13B), a rotor (11) at the bottom of the vat (13), a vertical wall (14) surrounding the substantially cylindrical upper part (13A), at least one vertical baffle (12, 12X) extending vertically on the vertical wall (14) inside of the vat (13). The vertical bale pulper (10) further comprises a bale nose stopper (30) and the bale nose stopper (30) is integrated on top of at least one of the vertical baffles (12X).

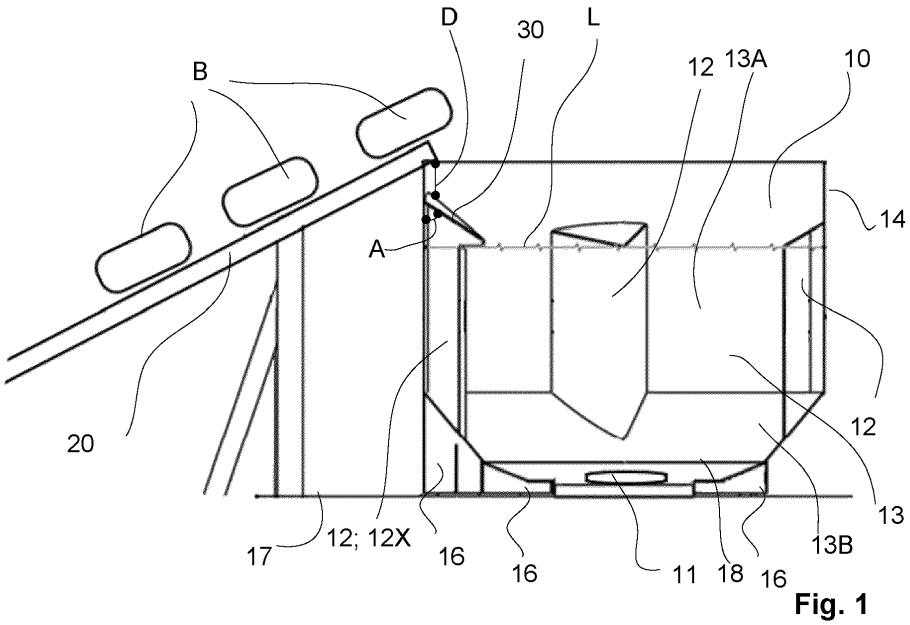


Fig. 1

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## Description

### Technical field

**[0001]** The present invention relates to vertical bale pulpers, especially in connection with pulp and fiber web production. More especially the invention relates to a vertical bale pulper according to the preamble part of claim 1.

### Background

**[0002]** As known from the prior art in fiber web machines, especially in paper and board machines, the fiber web is produced and treated in an assembly formed by a number of apparatuses arranged consecutively in a process line. A typical production and treatment line comprises a forming section comprising a head box and a forming unit and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and sections for finishing the fiber web, for example, a size press, a calender, a coating section. The production and treatment line also comprises typically at least one winder for forming customer rolls as well as a roll packaging apparatus.

**[0003]** Before the head box fiber suspensions comprising recycled and/or virgin fibers are treated in a treatment system to be fed into the head box to be used to produce the fiber webs. A treatment system of the fiber suspensions for example comprises a pulping section, a deashing system, a detrashing system, a coarse filtering section, a centrifugal cleaning section, a fractionation section, a fine filtering system, a fiber thickening system and fiber refining systems.

**[0004]** A pulp mill is a manufacturing facility that converts wood chips or other plant fiber source into a mass of fibers. Pulp mills are not necessarily integrated with fiber web production, so such mills produce market pulp and sell it to fiber web production facilities. Market pulp is dried and then cut into sheets that are stacked into bales so they can be transported. The pulp sheets are commonly pressed into bales, having a weight which may be e.g. 200-250 kg. A pulp drying machine comprises typically a forming section, into which the stock to be dried is delivered by means of a headbox. After the forming section there is a press section, a dryer section, cutting section and bale formation and finally baling system. In the cutting section the web is slit in its machine direction into a number of partial webs which in turn are cut in cross direction into sheets, which are piled into bales.

**[0005]** In pulping sections connected to the fiber web production lines, the bales are defibered to fiber pulp in bale pulpers; in vertical or horizontal pulpers for repulping of baled market pulps. A vertical pulper is typically used, when homogeneous slushing results with low energy consumption are needed, while a horizontal pulper, with its low height requirement, is typically used for rebuilds where limited space is available. The present invention relates to vertical bale pulpers for defibering pulp bales. In the vertical bale pulper inside of the pulper, i.e. in a vat, the fiber suspension comprising typically about 95% water and 5% fiber is caused to a rotating flow by a rotor. The vertical bale pulper has a generally cylindrical form and in vertical bale pulpers orientation of the center axis of the cylindrical form of the vat is substantially vertical. The rotor located at the bottom of the pulper, typically in a for example conical or dish end extension of the cylindrical form, causes a rotating flow inside the pulper. During the rotating flow caused by the rotor the fiber suspension is defibered. The pulper may be batch operated or continuous operating. Typically, in the batch operation every 20 seconds a bale is dropped and about 10 bales is dropped into the pulper for a defibration cycle in the pulper. A cycle takes typically about 15 minutes: 5 minutes for loading with the bales and the pulping liquid, 5 minutes for defibration and 5 minutes for emptying the pulper.

**[0006]** In utility model publication DE202008000684U1 is disclosed a pulper comprising a flow barrier on the inside wall of the container of the pulper, which flow barrier of the pulper has a cover on top of it.

**[0007]** Conveyor is used for transporting single bales, located sequentially in a queue on the conveyor, to a location at upper edge of a vertical bale pulper, from which location the bale is dropped into the pulper containing pulping liquid, typically water. The dropping of the bales into the pulper may cause impacts in the pulper structures and thus, the pulper structures, especially the rotor and its bearings, are at a risk of breaking, especially as during a day several hundreds of bales are typically handled in a vertical bale pulper.

**[0008]** It is known from prior art to use bale breakers to split a bale, when dropped into the pulper. The known bale brakers are formed of a beam element located across the diameter of the cylindrical form of the pulper such, that when the bale is dropped the beam element splits the bale and thus, decreases the impact of the bale in the pulper. The beam element is supported at its ends on the upper edge of the pulper and typically located at a distance below the upper edge of the pulper. The construction of these known bale brakers is thus rather complex and as being separate extra parts of the pulper increases the cost of the pulper. Also, the vertical location of the bale breaker must be taken in account in design of the pulper and the connected conveyor. Further, there is operational challenges, as the bales might stick between the vertical wall of the pulper and the bale breaker and as for bales with wrappings the beam element is not always effective enough for the splitting of the bale. Additionally, in order to provide the splitting effect there needs to be a minimum drop height from the conveyor to the beam element.

**[0009]** An object of the invention is to create a vertical bale pulper, in which the disadvantages and problems of

prior art vertical bale pulper designs relating to bale breaking are eliminated or at least minimized.

**[0010]** In particular, an object of the invention is to create a vertical bale pulper, in which the disadvantages and problems in respect of impacts on the pulper caused by bale dropping are eliminated or at least minimized.

Summary

**[0011]** In order to achieve the above objects and those that will come apparent later the vertical bale pulper according to the invention is mainly characterized by the features of the characterizing part of the independent claim 1. Advantageous aspects and features of the invention are presented in the dependent claims.

**[0012]** It has now been surprisingly noted that kinetic energy of the bale in the bale dropping causing impacts can be significantly reduced by a vertical baffle with a combined/integrated bale nose stopper at the top surface of the vertical baffle. When dropped the bale hits the bale nose stopper and thus, its kinetic energy is significantly reduced as the kinetic energy is passed to the support structures of the vertical bale pulper, advantageously to a support leg of the vertical pulper, in which case the bale nose stopper is located at location above the corresponding support leg. Vertical baffle/-s (also called vertical deflector/- s) located inside on the vertical wall of the pulper is/are used in the vertical bale pulpers to ensure flow towards the rotor and to prevent tangential flows of the fiber suspension inside the pulper in the vat. The bale nose stopper is advantageously located above the level of the fiber suspension in the vat and thus, the bale nose stopper does not cause disturbances in the fiber suspension flow inside the vertical bale pulper.

**[0013]** The bale nose stopper reduced the kinetic energy of the bale, when the bale is dropped onto it as the bale nose stopper functions as a separate bale breaker element and thus, the lifetime of the rotor and the bearing unit of the rotor in the pulper is increased.

**[0014]** The bale nose stopper integrated/combined to the vertical baffle can be provided to new construction pulpers and used in modernizing existing pulpers.

**[0015]** The top surface of the bale nose stopper is advantageously downwards and towards the center of the vat inclined and thus, it also guides the bale downwards and towards the center of the vat.

**[0016]** In case the vertical bale pulper is loaded via more than one conveyor the bale nose stopper combined with the vertical baffle is advantageously located at each of the conveyors.

**[0017]** Advantageously, the vertical baffle/-s is/are attached on the vertical wall of the pulper vat by welding to ensure fast attachment and load bearing ability of the vertical baffle.

**[0018]** Advantageously, the bale nose stopper is made of corrosion resistance steel, for example of acid-proof steel or stainless steel or Duplex stainless steel.

**[0019]** Advantageously, the vertical baffle/-s is/are made of corrosion resistance steel, for example of acid-proof steel or stainless steel or Duplex stainless steel.

**[0020]** According to the invention the vertical bale pulper comprises a vat, which has a substantially cylindrical upper part and a downwards convergent lower part, a rotor at the bottom of the vat, a vertical wall surrounding the substantially cylindrical upper part, at least one vertical baffle extending vertically on the vertical wall inside of the vat, wherein the vertical bale pulper further comprises a bale nose stopper, the bale nose stopper is integrated on top of at least one of the vertical baffles.

**[0021]** According to an advantageous feature of the invention the bale nose stopper is located above level of fiber suspension in the vat of the vertical bale pulper.

**[0022]** According to an advantageous feature of the invention the bale nose stopper protrudes from the vertical wall inclinedly downwards towards the center of the vat and the inclination angle is advantageously 15-50 °, more advantageously 30-45 °.

**[0023]** According to an advantageous feature of the invention the vertical bale pulper comprises support legs and that the bale nose stopper is a located above one of the support legs of the vertical bale pulper.

**[0024]** According to an advantageous feature of the invention the bale nose stopper is integrated on top of the corresponding vertical baffle by welding. Alternatively according to an advantageous feature of the invention the bale nose stopper and the corresponding vertical baffle are integrated as one piece.

**[0025]** According to an advantageous feature of the invention cross-sectional size of the bale nose stopper is bigger than cross-sectional size of the vertical baffle integrated with the bale nose stopper.

**[0026]** According to an advantageous feature of the invention thickness of the bale nose stopper in radial direction is greater than thickness of the vertical baffle integrated with the bale nose stopper in radial direction.

**[0027]** According to an advantageous feature of the invention the upper surface of the bale nose stopper is substantially triangular and has three corners, and one of the corners is at lower level in vertical direction than at least one of the two other corners.

**[0028]** According to an advantageous feature of the invention in an assembly of a vertical bale pulper according to the invention and at least one conveyor for transferring bales to the vertical bale pulper, the bale nose stopper is located under the conveyor.

**[0029]** The term "fiber suspension/-s" means liquids and suspensions, which contain fibers to be defibered and possible other occurring ingredients. The fibers can be synthetic or non-synthetic fibers. The fibers in connection with this invention primarily mean newly produced cellulose fibers, but also recycled cellulose fibers can come into question if provided in bales to the process. The vertical bale pulper according to the invention is suitable for different types of fiber suspensions of synthetic and/or non-synthetic fiber material.

**[0030]** By the invention and its advantageous features several advantages are achieved: The bale nose stopper decreases the kinetic energy in dropping of the bale and thus, the impact effect is significantly reduced. Further, the construction is simple being integrated with the vertical baffle/-s. Furthermore, the bale nose stopper does not set limitations in view of the design of the pulper and the conveyor, even a lower setup of the loading conveyor can be used and thus, various layouts are available in layout engineering. Also, the problems relating to sticking of the bales between the bale breaker and the inside wall of the pulper occurring in the pulpers with the known bale breakers of the beam type are avoided.

Brief description of the drawings

**[0031]** Aspects of the invention, however, together with additional objects and advantages thereof, will be best understood from the following description of some example embodiments when read in connection with the accompanying drawings and in the following the invention is described in more detail referring to the accompanying drawing, in which

**[0032]** In figure 1 is schematically shown an advantageous example of a vertical bale pulper and a thereto connected loading conveyor.

**[0033]** In figure 2 is schematically shown the advantageous example of a vertical bale pulper according to figure 1 as a 3D view as a longitudinal cross-sectional view from side.

Detailed description

**[0034]** During the course of this description like numbers and signs will be used to identify like elements according to the different views which illustrate the invention. Repetition of some reference signs may have been omitted in the figures for clarity reasons.

**[0035]** In the example of the figure 1 is shown the vertical bale pulper 10 and the thereto connected conveyor 20. Bales B are transported on the conveyor 20 in a successive queue of the bales B. The conveyor 20 extends from a location (not shown) of loading the bales B onto the conveyor 20 vertically inclined to upper edge of the vertical bale pulper 10, to the location, where the bales B are singly dropped into the vertical bale pulper 10. The vertical bale pulper 10 has a vat 13 formed of an upper, substantially cylindrical part 13A and a lower, downwards convergent or dish end part 13B. At the bottom of the vat 13 of the vertical bale pulper 10 the rotor 11 is located. Also, at the bottom of the vat 13 a screen plate 18 is located, though which the vertical bale pulper 10 is emptied, when the fiber suspension is ready and to be forwarded to further treatment, for example to refining. On the vertical inside wall 14 at least one vertical baffle/-s 12, 12X is/are located. The vertical baffles 12, 12X have a triangular cross-section and they extend substantially vertically along the vertical wall 14 of the vertical bale pulper 10. The vertical baffles 12, 12X are located along the inner circumference of the vat 13 spaced apart. The triangular form extends as a protrusion towards the center of the vat 13. The vertical bale pulper 10 is supported by support legs 16 on a floor or like. One of the vertical baffles 12, the vertical baffle 12X to be located under the conveyor 20 is provided with the bale nose stopper 30. The upper surface of the bale nose stopper 30 on the side of the inner wall 14 of the vertical bale pulper 10 is located at a distance D from the upper edge of the vertical bale pulper 10 and the bale nose stopper 30 is located above the level L of fiber suspension in the vat 13 of the vertical bale pulper 10, when ready for defibrating or defibrating. The bale nose stopper 30 extends from the inner wall 14 inclinedly downwards towards the center of the vat 13 as a protrusion. The upper surface of the bale nose stopper 30 is substantially triangular and has three corners 31, 32, 33. The one of the corners 31, 32, 33 is at lower level in vertical direction than at least one of the two other corners 31, 32, 33. The inclination angle A is 15-50 °, advantageously 30-45 °. Thus, the top surface of the bale nose stopper 30 is advantageously downwards and towards the center of the vat 13 inclined and thus, it 30 also guides the bale B downwards and towards the center of the vat 13. The bale nose stopper 30 is advantageously located above one of the support legs 16 of the vertical bale pulper 10, to transfer the kinetic energy caused by the hit of the bale B from the bale nose stopper 30 via the corresponding support leg 16 to the floor 17. Cross-sectional size of the bale nose stopper 30 is the same or bigger than cross-sectional size of the vertical baffle 12X integrated with the bale nose stopper 30, as shown in the figure. Thus, the thickness X30 of the bale nose stopper 30 in radial direction is the same or greater than thickness X12 of the vertical baffle 12X integrated with the bale nose stopper 30 in radial direction, as shown in the figure. Height of the vertical baffle 12X with the integrated bale nose stopper 30 can be of same height than the other baffles 12 or higher. Also additional stiffeners can be located inside the vertical baffle 12X integrated with the bale nose stopper 30. In case the vertical bale pulper 10 is loaded via more than one conveyor the bale nose stopper 30 combined with the vertical baffle 12X is advantageously located at each of the conveyors.

**[0036]** In figure 2 is further shown the example of the vertical bale pulper 10 according to figure 1 as a 3D view as a longitudinal cross-sectional view from side.

**[0037]** In the vertical bale pulper 10 of the example of the figures 1-2 the bales B are defibered to fiber pulp with homogeneous slushing result and with low energy consumption. In the vertical bale pulper 10 in the vat 13, the fiber suspension comprising typically about 95% water and 5% fiber is caused to the rotating flow by the rotor 11 and during the rotating flow caused by the rotor 11 the fiber suspension is defibered. The conveyor 20 is used for transporting the single bales B, located sequentially in a queue on the conveyor 20, to the location at upper edge of

the vertical wall 14 of the vertical bale pulper 10, from which location one bale B at the time is dropped into the vat 13 of the vertical bale pulper 10 containing pulping liquid, typically water. When dropping a bale B into the vertical bale pulper 10 it first hits the bale nose stopper 30, which reduces the kinetic energy and thus, decreased the impact effect of the bale B in the pulper structures and thus, the risk of damage in the structures and parts of the vertical bale pulper 10 structures are eliminated. The construction of the bale nose stopper 30 is simple as can also be seen from the figures 1 and 2 and thus, its cost effect in production or in modernization of the vertical bale pulper 10 is minimized. Also, the vertical location of the bale nose stopper 30 in the vertical bale pulper 10 is advantageous in view of the design of the vertical bale pulper 10 and the connected conveyor 20. Further, the bales B are not at any risk of sticking between the vertical wall 14 of the vertical bale pulper 10 and the bale nose stopper 30.

**[0038]** The kinetic energy of the bale B in the bale dropping causing impacts is significantly reduced by the vertical baffle 12X with the combined/integrated bale nose stopper 30 at the top surface of the vertical baffle 12. The vertical baffle/-s 12, 12X located inside on the vertical wall 14 of the vertical bale pulper 10 to ensure flow towards the rotor 11 and to prevent tangential flows of the fiber suspension in the vat 13. The bale nose stopper 30 located above the level L of the fiber suspension in the vat 13 does not cause disturbances in the fiber suspension flow inside the vertical bale pulper 10. Advantageously, the vertical baffle/-s 12, 12X is/are attached on the vertical wall 14 of the vertical bale pulper 10 by welding to ensure fast attachment and load bearing ability of the vertical baffle 12, 12X. The bale nose stopper 30 can be a separate, but integrated part advantageously also welded on top of the corresponding vertical baffle 12X or the vertical baffle 12X and the bale nose stopper 30 can be produced as one piece.

**[0039]** In the description in the foregoing, although some functions have been described with reference to certain features, those functions may be performable by other features whether described or not. Although features have been described with reference to certain embodiments or examples, those features may also be present in other embodiments or examples whether described or not. Above the invention has been described by referring to some advantageous examples only to which the invention is not to be narrowly limited. Many modifications and alterations are possible within the invention as defined in the following claims.

**[0040]** Reference signs used in the drawing:

10 pulper
11 rotor
12 vertical baffle
12X vertical baffle located at the conveyor
13 vat
13A cylindrical part of the vat
13B downwards convergent part of the vat
14 wall
16 support leg
17 floor
18 screen plate
20 conveyor
30 bale nose stopper
31,32,33 corner
A angle
B bale
D distance
L level
X12, X30 thickness

## Claims

**1.** Vertical bale pulper (10) comprising

- a vat (13), which has a substantially cylindrical upper part (13A) and a downwards convergent lower part (13B),
- a rotor (11) at the bottom of the vat (13),
- a vertical wall (14) surrounding the substantially cylindrical upper part (13A),
- at least one vertical baffle (12, 12X) extending vertically on the vertical wall (14) inside of the vat (13),

**characterized in**

- **that** the vertical bale pulper (10) further comprises a bale nose stopper (30),
- **that** the bale nose stopper (30) is integrated on top of at least one of the vertical baffles (12X).

**2.** Vertical bale pulper (10) according to claim 1, **characterized in that** the bale nose stopper (30) is located above level (L) of fiber suspension in the vat (13) of the vertical bale pulper (10).

**3.** Vertical bale pulper (10) according to claim 1 or 2, **characterized in that** the bale nose stopper (30) protrudes from the vertical wall (14) inclinedly downwards towards the center of the vat (13) and that the inclination angle (A) is advantageously 15-50 °, more advantageously 30-45 °.

**4.** Vertical bale pulper (10) according to any of claims 1 - 3, **characterized in that** the vertical bale pulper (10) comprises support legs (16) and that the bale nose stopper (30) is a located above one of the support legs (16) of the vertical bale pulper (10).

**5.** Vertical bale pulper (10) according to any of claims 1 - 4, **characterized in that** the bale nose stopper (30) is integrated on top of the corresponding vertical baffle (12X) by welding.

**6.** Vertical bale pulper (10) according to any of claims 1 - 5, **characterized in that** the bale nose stopper (30) and the corresponding vertical baffle (12X) are integrated as one piece.

**7.** Vertical bale pulper (10) according to any of claims 1 - 6, **characterized in that** cross-sectional size of the bale nose stopper (30) is bigger than cross-sectional size of the vertical baffle (12X) integrated with the bale nose stopper (30).

**8.** Vertical bale pulper (10) according to any of claims 1 - 7, **characterized in that** thickness (X30) of the bale nose stopper (30) in radial direction is greater than thickness (X32) of the vertical baffle (12X) integrated with the bale nose stopper (30) in radial direction.

**9.** Vertical bale pulper (10) according to any of claims 1 - 8, **characterized in that** upper surface of the bale nose stopper (30) is substantially triangular and has three corners (31, 32, 33), and that one of the corners (31, 32, 33) is at lower level in vertical direction than at least one of the two other corners (31, 32, 33).

**10.** Assembly of a vertical bale pulper (10) according to any of the previous claims and at least one conveyor (20) for transferring bales (B) to the vertical bale pulper (10), **characterized in that** the bale nose stopper (30) is located under the conveyor (20).

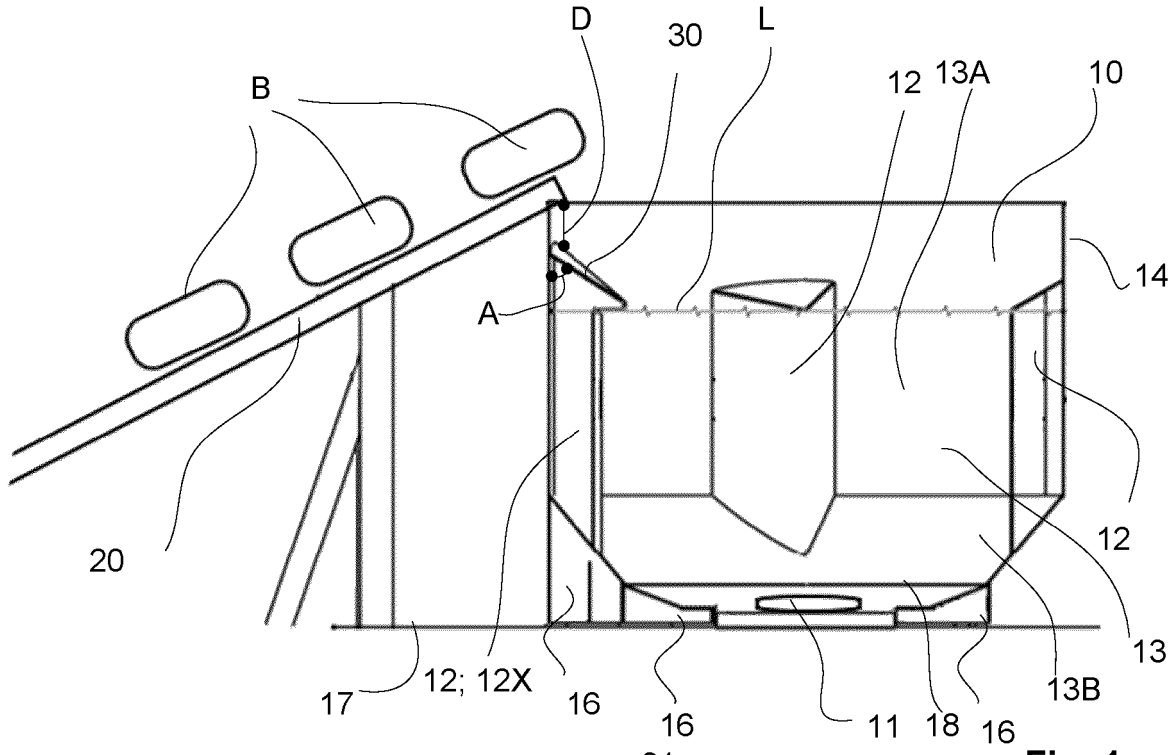
D
30
L
B
12
13A
10
14
A
20
12
13
17
12; 12X
16
16
11
18
16
13B

Fig. 1

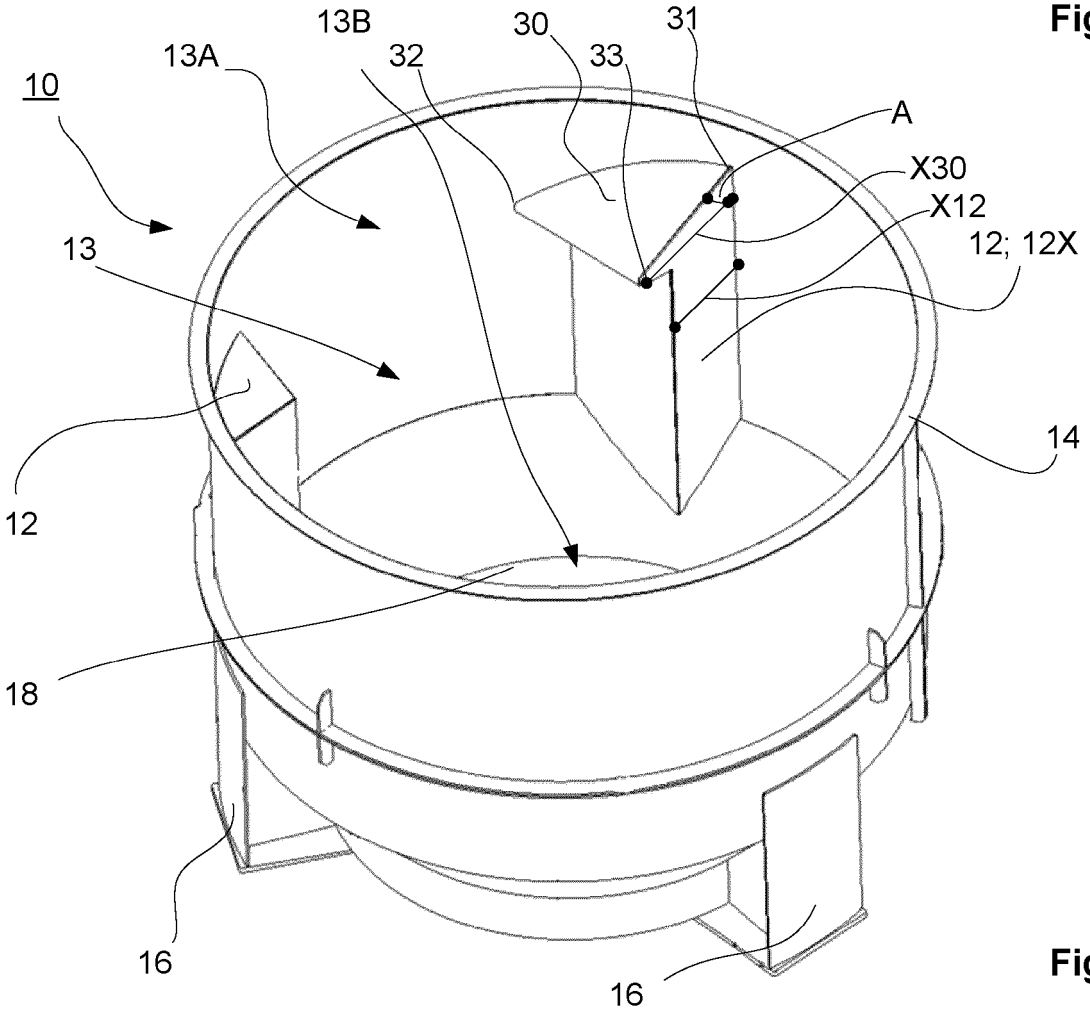
13B
30
31
13A
32
33
10
A
X30
X12
12; 12X
13
14
12
18
16
16

Fig. 2

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- DE 202008000684 U1 **[0006]**