



(11)

**EP 4 393 848 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**03.07.2024 Bulletin 2024/27**

(51) International Patent Classification (IPC):  
**B65G 27/04 (2006.01) B65G 27/32 (2006.01)**  
**B65G 43/00 (2006.01)**

(21) Application number: **23164273.7**

(52) Cooperative Patent Classification (CPC):  
**B65G 27/04; B65G 27/32; B65G 43/00**

(22) Date of filing: **27.03.2023**

(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:  
**KH MA MD TN**

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(30) Priority: **30.12.2022 PL 44335122**

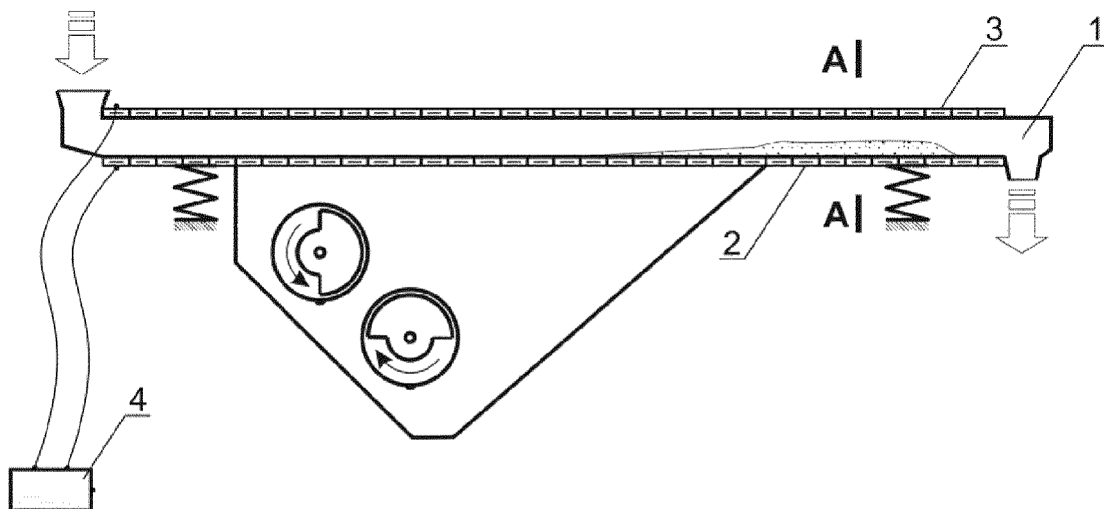
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(54) **TROUGH OF A VIBRATING CONVEYOR**

(57) The subject of the invention is a trough (1) of vibrating conveyor, which trough has closed profile, and comprise sensors distributed evenly in the trough (1) along the entire conveying path between the inlet and outlet openings, wherein one of compounding elements

of each sensor such as: a transmitter (2) or a receiver (3) is mounted at the bottom, in the horizontal, flat bottom of the trough (1), and the other corresponding sensor element such as: a receiver (3) or a transmitter (2) is mounted in the opposite wall, at the top of the trough (1).



**Fig. 1**

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## Description

**[0001]** The subject of the invention is a trough of a vibrating conveyor, that can be used, among others, in the glass, metallurgical, pharmaceutical industry to transport small portions of bulk material of fine fraction.

**[0002]** Solutions that use equipping the vibrating conveyor troughs with sensors are known for fine-tuning and controlling of their operation, or as the gates, perpendicular to the direction of a transport, to detect a material appearing in the trough or to measure the state of its accumulation. For example, in Chinese patent application CN106743191A, the vibrating conveyor trough is equipped with a sensor detecting the amount of material on the conveyor. The sensor, such as an ultrasonic sensor consisting of a transmitter and a receiver, is placed at the highest allowed height of the material. When the signals received between the sensors change, the situation of exceeding the allowed height of the material is signaled and a control device can change operating parameters of the vibrator to accelerate a transport of a material, and it returns to the initial transport speed after the condition changes again. In one variant of this solution, the control device also has a possibility of monitoring and controlling the inclination of the conveyor trough by means of an additional control unit.

**[0003]** Also known from the German utility model specification DE20108655U1 is an arrangement that monitors and regulates the vibrating conveyor system in such a way that a continuous supply of material is ensured. Detected by sensor technology, the flow intensity is returned as an adjustment quantity to the desired control value and adjusts the conveying capacity to the requirements. The detection of a material flow can be done both as monitoring of the flow quantity and as detection of a blockage, or as minimum or maximum amounts of feed. Any combination of transmitter/sensor, starting from a simple flow sensor or blockage sensor to an optical or photographic system, can be used here as a material flow measurement device.

**[0004]** Similarly, U.S. Patent specification US6273240B1 discloses a vibrating conveyor control system comprising a detector, such as a photocell, to detect the amount of product being transported on the conveyor, which detector is combined with means for regulating of the flow of material so that its flow rate is maintained at a predetermined value or near this value.

**[0005]** The presented invention solves the technical problem of evaluating a status of emptying of a vibrating conveyor by previously weighted down portion of material, especially of a fine fraction. A high accuracy (certainty) of such indication of the state of leaving the conveyor by a transported material, which is an important critical additive, e.g. modifying the parameters of the material in the technological process, guarantees achieving the planned result in terms of the material with desired color or mechanical properties or correct concentration of the active substance.

**[0006]** The essence of a trough of a vibrating conveyor, containing at least one sensor of a type of transmitter-receiver sensor mounted therein, that is signal-connected by a wired or wireless connection to a microprocessor device, that is the recording and analyzing element and controlling device of the conveyor drive, is in that the trough has a closed cross-section profile, and in that the sensors are distributed evenly in the trough along the entire conveying path, between inlet and outlet openings, wherein one of both elements of each sensor, that is a transmitter or a receiver, is mounted at a bottom, in a horizontal, flat bottom of the trough, and the other corresponding sensor element that is a receiver or a transmitter is mounted in an opposite wall, at a top of the trough.

**[0007]** The trough contains, preferably, electromagnetic sensors such as: optical or laser or microwave sensors, and preferably also the trough contains ultrasonic sensors.

**[0008]** In addition, preferably the distance between the sensors does not exceed the diameter of a base of a bulk cone of a portion of transported material at rest.

**[0009]** Also preferably, side walls of the trough or their lower portions are inclined so that they are converging downwards.

**[0010]** Preferably, the closed profile of the trough in cross-section is circular or elliptical.

**[0011]** Preferably, a width of the trough bottom decreases uniformly in the direction from the inlet to the outlet.

**[0012]** The invention makes it possible to detect residual material remaining in the trough, or to indicate the state of complete emptying of the trough from the transported material with a high degree of certainty. Furthermore, it is possible to ensure encapsulation or air-tight sealing of the structure and to use the conveyor as a tank before the conveying cycle.

**[0013]** The subject of the invention in the embodiments is presented in the drawing, in which fig. 1 shows a simplified view of the vibrating conveyor during transport of a material, fig. 2 shows a cross-section of the conveyor trough with a polygonal shaped closed cross-section profile.

**[0014]** The trough 1 of a vibrating conveyor (fig. 1) has a closed profile with a cross-section of the polygon shape. Lower parts of side walls of the trough are inclined so that they converge towards its narrow horizontal flat bottom. Along with the distance from the trough 1 inlet towards its outlet a width of the bottom decreases evenly. Electromagnetic - laser- sensors are arranged along the entire transport path, i.e. between the inlet and the outlet in the trough 1. In the bottom of the trough 1 transmitters 2 are mounted and corresponding receivers 3 are mounted above them, in the opposite upper wall (fig. 2), so that in the cross-section of the trough 1, the elements of the "transmitter-receiver" pair, constitute a single sensor unit. The distance between the sensors is constant and amounts to 5 cm, which is a value smaller than a diameter of the base of a heaping cone of the portion of the 4 kg

of the transported material, which amounts to about 20 cm under static conditions.

**[0015]** The transmitters 2 and receivers 3 of each sensor are connected by a signal cable to a microprocessor device 4, which constitutes a recording and analyzing element and is controlling the conveyor drive.

**[0016]** In another embodiment, the reverse location of the sensors is used, so that receivers 3 are installed in the bottom of the trough 1, while transmitters 2 are installed at the top.

**[0017]** In yet another embodiment, an alternating configuration of transmitters 2 and receivers 3 is used.

**[0018]** Additional embodiments of the invention are possible, wherein other known sensors are used, such as optical or microwave sensors, as well as ultrasonic sensors.

**[0019]** The main purpose of the device is to detect the complete emptying of the trough 1 without the use of weighing systems and to provide information about the possibility of switching off or automatically switching off the conveyor drive. The signal strength in receivers 3 depends on the amount of the broadcast and its distribution along the trough 1. The signal measured by the individual sensors is recorded and analyzed in the microprocessor device 4, so that it is possible to detect and visualize changes in the distribution of material in the trough 1. The dynamics of changes that is measured can also be used as information for controlling the conveyor drive so as to optimize the speed at which the transported material leaves the trough 1, when it is important in the technological process, for example, when said material is mixed with other ingredients.

## Claims

1. Trough of a vibrating conveyor containing at least one sensor of the type of transmitter-receiver mounted therein that is signal connected in a wired or wireless manner to a microprocessor device that constitutes a recording and analyzing element and element controlling the conveyor drive, **characterized in that** the trough (1) has a closed cross-section profile and the sensors are distributed evenly in the trough (1) along its entire conveying path between inlet and outlet openings, wherein one of the elements of each sensor, such as a transmitter (2) or a receiver (3), is mounted at the trough bottom, in the horizontal flat bottom of the trough (1), and the other corresponding sensor element, such as a receiver (3) or a transmitter (2), is mounted in the opposite wall, in the upper part of the trough (1).
2. The trough according to claim. 1, **characterized in that** it comprise electromagnetic sensors, such as: optical or laser or microwave sensors.
3. The trough according to claim 1, **characterized in**

**that** it comprise ultrasonic sensors.

4. The trough according to claim 1, **characterized in that** the distance between the sensors does not exceed the diameter of a base of a bulk cone of the portion of the transported material at rest.
5. The trough according to claim 1, **characterized in that** the side walls of the trough (1) or their lower parts are inclined so that they are converging downwards.
6. The trough according to claim 1, **characterized in that** the width of the trough (1) decreases evenly in the direction from the inlet to the outlet.

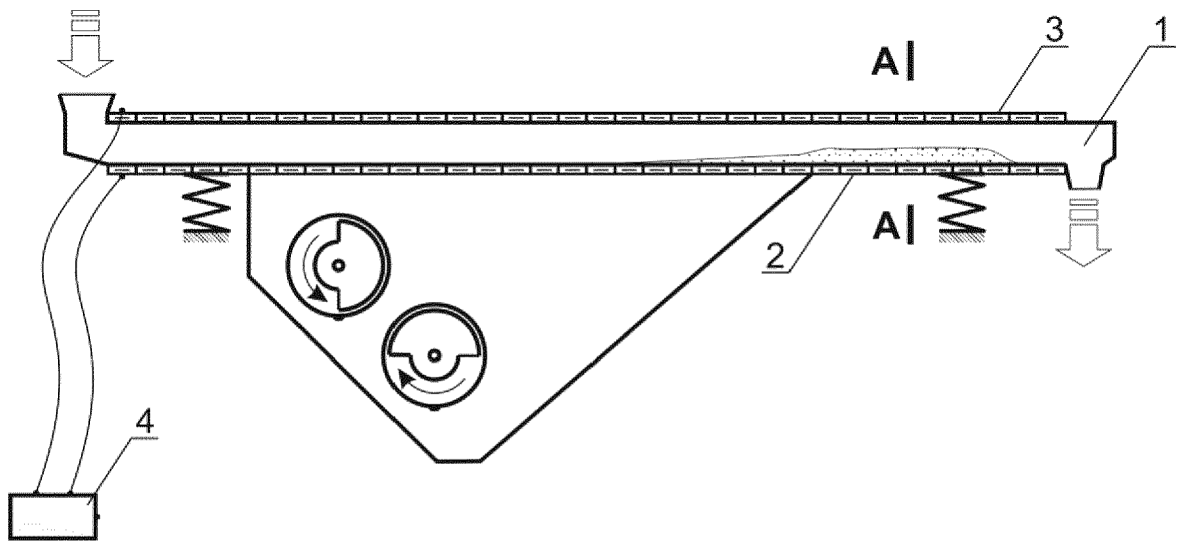


Fig. 1

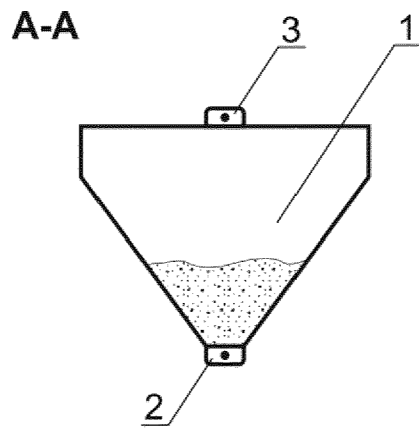


Fig. 2



EUROPEAN SEARCH REPORT

Application Number  
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 3 917 050 A (GREGOR VAUGHN) 4 November 1975 (1975-11-04) * pages 1-5; figures 1-9 * -----	1-6	INV. B65G27/04 B65G27/32 B65G43/00
A	KR 101 891 515 B1 (SCIGENTEC CO LTD [KR]) 27 August 2018 (2018-08-27) * abstract; figures 1-7 * -----	1-6	
A	JP 2001 215146 A (FUJI ELECTRIC CO LTD) 10 August 2001 (2001-08-10) * abstract; figures 1-6 * -----	1-6	
A	JP S59 114211 A (SHINKO ELECTRIC CO LTD) 2 July 1984 (1984-07-02) * abstract; figures 1-7 * -----	1-6	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B65G
Place of search		Date of completion of the search	Examiner
The Hague		13 September 2023	Martin, Benoit
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 23 16 4273

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-09-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3917050 A	04-11-1975	AU 7740075 A	22-07-1976
		BE 825936 A	16-06-1975
		CA 1014100 A	19-07-1977
		DE 2502943 A1	04-09-1975
		FR 2262632 A1	26-09-1975
		GB 1487448 A	28-09-1977
		IT 1031162 B	30-04-1979
		JP S5618481 B2	30-04-1981
		JP S50127369 A	07-10-1975
		NL 7501896 A	01-09-1975
		SE 414908 B	25-08-1980
		US 3917050 A	04-11-1975
		-----	-----
KR 101891515 B1	27-08-2018	NONE	
-----	-----	-----	-----
JP 2001215146 A	10-08-2001	NONE	
-----	-----	-----	-----
JP S59114211 A	02-07-1984	JP H0227250 B2	15-06-1990
		JP S59114211 A	02-07-1984
-----	-----	-----	-----

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- CN 106743191 A [0002]
- DE 20108655 U1 [0003]
- US 6273240 B1 [0004]