PATENT SPECIFICATION (11) 1 574 648

1 574 648

(21) Application No. 11680/77 (22) Filed 18 March 1977 (19)

(31) Convention Application No. 2 611 900

(32) Filed 20 March 1976 in

(33) Fed. Rep. of Germany (DE)

(44) Complete Specification published 10 Sept. 1980

(51) INT. CL.³ B65G 11/08

(52) Index at acceptance

B8S BM

(72) Inventor GERT SCHUSTER

(54) APPARATUS FOR THE VERTICALLY DOWNWARD DELIVERY OF FLOWABLE SOLIDS

(71) We, METALLGESELLSCHAFT AKTIENGESELLSCHAFT, a body corporate organized under the laws of the German Federal Republic, of Reuterweg 14, 6000 Frankfurt am Main, German Federal Republic, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for the vertically downward delivery of flowable solids, especially from a great height.

When flowable solids, such as sintered material, pellets and other metallurgical products, feed material and intermediates, are to be delivered vertically from a great height, destruction of the flowable solids and damage inflicted by the flowable solids on structures on which the solids impinge must be prevented.

It has been proposed to cause the solids to trickle over a cascade in a vertical tube which has a charging opening at its top and a discharge opening at its bottom and which contains horizontal steps, which are spaced 180° apart and support beds of solids. The solids charged at the top trickle along a zigzag path from step to step and finally to the discharge opening. In this arrangement, the material is deflected through 180° on each step and is thus strongly retarded and accelerated. This results in high stresses and destruction. The tube must be relatively large in cross-section in order to avoid impact of the solids on the tube wall.

It is an object of the invention to enable the solids to be handled carefully and to minimize the wear of the tube even when it has relatively small dimensions.

According to the present invention there is provided apparatus for the vertically downward delivery of flowable solids, wherein the apparatus comprises a vertical tube having an upper charging opening and a lower discharge opening for the solids, and a plurality of horizontal members provided in the tube and each formed with an opening which is surrounded by an upstanding narrow rib, the openings in said members being disposed in a substantially helical line (as hereinafter defined), and wherein the arrangement is such that, when the apparatus is first put into operation, beds of flowable solids build up on each horizontal member, each bed extending from the rib to the inside surface of the tube to form the surface of a chute on which subsequently supplied solids can trickle downwards to fail through the opening of a horizontal member only onto the bed of solids on the next lower member rather than into the opening thereof.

The vertical tube may be round or square or polygonal. The narrow ribs which surround the opening preferably have a thickness below 10 mm so that the edges of the solids forming the bed protrude beyond the edge and deflect trickling solids so that contact of the latter with the ribs is virtually avoided and the ribs are hardly subject to any wear. The term 'substantially helical' means that the passage openings must be spaced less than 180° apart in the same sense.

In a preferred embodiment, the openings of the horizontal members are round so that there are no corners, the wear is small and the risk of a clogging by larger lumps is avoided.

In another preferred embodiment, the openings of successive horizontal members are spaced 90° apart in the same sense. With that angle, the risk of a clogging of the openings even with small vertical distances between adjacent horizontal members is smaller than with larger angles.

Each horizontal member is preferably formed in a separate tubular portion, a plurality of which form said vertical tube, as this facilitates the assembling and disassembling of the apparatus during con-

struction and repairs and reduces the manufacturing costs.

In one embodiment, the vertical tube is disposed in a bin and at least one lateral opening is formed in the wall of the vertical tube between any two adjacent horizontal members and disposed so that, when the apparatus is in use, it will lie above the bed of solids. When the vertical tube is filled with solids from its lower end to one of the lateral openings, the latter serves as an outlet for the solids, which flow through said lateral opening back into the bin and build up around the tube a heap which slopes down toward the bin wall. This build-up of the heap continues until the heap has reached the lateral opening concerned. The solids now build up in the tube to the next upper lateral opening. When the tube is not filled with solids, no solids flow into the bin. As material flows out of the lower outlet opening of the tube, solids from the bin flow in the opposite direction into the tube through the lateral openings, which now serve as inlets. Again, the tube wall preferably has a thicknes of 10 mm. or less so that the edges of the lateral openings are substantially protected from wear.

The vertical tube is preferably round so that the solids flow evenly around the tube and the wear is reduced, and two lateral openings which are spaced 180° apart, are formed between any two adjacent horizontal members so that the tube has a high strength and the bin is evenly charged and discharged.

Each horizontal member preferably occupies only part of the cross-section of the vertical tube and has a terminal edge, at which a vertical metal plate for retaining the bed of solids is provided. In a round tube, each horizontal member forms a segment of a circle and is larger than one-half of the inside cross-section of the tube so that the dead space formed in the tube as the solids build up is minimized.

Lateral openings provided in the vertical tube between adjacent horizontal members may be arranged on the same level and the lower edges of said lateral openings are so disposed that when the vertical tube is first filled up to form the chute concerned, solids flow first over the vertical metal plate at the terminal edge of the horizontal member and only subsequently flow through the lateral openings into the bin. When the solids have built up in the tube to form a chute, a heap of deposited solids forms first on the chute. The level of the lower edge of the lateral openings in the tube wall and the level of the upper edge of the vertical metal plate on the terminal edge of the horizontal member are so selected that the solids trickle first into the free cross-section so that a heap of deposited solids is formed which has an apex under the passage openings of the next upper chute. On that heap of deposited solids, the solids trickle uniformly through the lateral openings into the bin. This rtsults in good distribution in the bin.

In order to enable the invention to be more readily understood, reference will now be made to the accompanying drawings, which ilustrate diagrammaticaly and by way of example some embodiments thereof, and in which:

Fig. 1 is a transverse sectional view showing a delivery apparatus disposed between a screen and a belt conveyor.

Fig. 2 is a sectional view taken on line A—A in Fig. 1,

Fig. 3 is a transverse sectional view showing a delivery apparatus arranged in a bin, and

Fig. 4 is a sectional view taken on line B—B in Fig. 3.

Referring now to Figs. 1 and 2 there is shown a delivery apparatus in which flowable solids are charged from a vibrating screen 13 into a vertical tube 1 through an upper charging opening thereof. The tube 1 contains a plurality of superimposed separate tubular portions 6 that are assembled one over the other to form the tube 1, which, for simplicity is shown as an integral tube in Fig. 1. Each portion 6 comprises a horizontal bottom member 9 formed with a circular opening 3, which is surrounded by a narrow rib 4, the arrangement being such that, when solids are fed in through the upper charging opening, a bed 5 of solids is formed, which extends from the rib 4 to the wall of the tube 1 in each member 6 and the surfaces of which constitutes a respective chute 2. The openings 3 of any two adjacent horizontal members 9 are spaced apart 90° and disposed so that solids cannot fall from an opening 3*a* of an upper chute such as 2*a* directly into the opening, e.g. 3*b*, of the next lower chute such as 2*b*. Solids charged into the vertical tube 1 trickle on the bed of solids 5*a* of chute 2*a* to the flow passage 3*a*, then fall onto the bed of solids 5*b* of chute 2*b*, trickle on the bed of solids 5*b* to the passage opening 3*b* etc. It is apparent that the solids trickle down the tube 1 to the lower discharge opening thereof along an approximately helical line and then fall onto the discharge chute 14 and from the latter to a belt conveyor 15.

Referring now to Figs. 3 and 4, there is shown a vertical tube 1, which is disposed in a bin 7 and which is similar to the tube shown in Figs. 1 and 2 in that chutes can be formed therein. Between any two horizontal bottom members 9 supporting adjacent chutes 2*a*, 2*b*; 2*b*, 2*c*; etc the wall of the tube is formed with two lateral openings 8, which are disposed above the respective beds of solids 5*a*, 5*b*, etc. and which are

spaced 180° apart. The bottom member 9 of each chute 2 occupies only part of the cross-section of the tube 1 and leaves free a part of the cross-section. Each bottom member 9 is provided at its terminal edge 10 with a vertical metal plate 11, which retains the bed of solids 5 on that side. The lateral openings 8 between adjacent bottom members 9*a*, 9*b* etc. are disposed on the same level. When the bin 7 is empty and solids are bing charged from a belt conveyor 13*a* into the tube 1 only at the rate at which solids are withdrawn by a belt conveyor 15, the solids trickle through the tube 1 in the manner described with reference to Fig. 1. When solids are not being withdrawn or the rate at which solids are charged from the belt conveyor 13*a* exceeds the rate at which solids are withdrawn by the belt conveyor 15, the solids build up in the tube 1 from its lower end and flow out of the lateral openings 8 into the bin 7. The lower edges 12 of lateral openings are so disposed that a heap of deposited solids is initially formed above the metal plate 11 of that chute 2 which is disposed over the filled part of the tube, whereafter solids from that heap of deposited solids trickle across the metal plate 11 into the free cross-section of the tube, a heap of deposited solids is formed which has an apex that is disposed under the opening 3 of the next upper chute 2, and solids trickle onto the latter heap through the lateral openings 8 into the bin 7. As the bin 7 is emptied, solids trickle through the lateral openings 8 into the tube 1 and enter the uppermost chute 2 up to which the tube 1 is surrounded by solids in the bin.

An advantage of the present apparatus is that solids trickle continuously from chute to chute along an aproximately helical line and are only slightly retarded and accelerated as they trickle so that the solids are only slightly stressed, also, that the height of fall from chute to chute may be small and large openings may nevertheless be provided so that the solids are handled carefully, on the one hand, and the risk of clogging is reduced, on the other hand. Moreover the vertical tube is subject only to a small wear even though its dimensions may be small.

WHAT WE CLAIM IS:—

1. Apparatus for the vertically downward delivery of flowable solids, wherein the apparatus comprises a vertical tube having an upper charging opening and a lower discharge opening for the solids, and a plurality of horizontal members provided in the tube and each formed with an opening which is surrounded by an upstanding narrow rib, the openings in said members being disposed in a substantially helical line (as hereinbefore defined), and wherein the arrangement is such that, when the apparatus is first put into operation, beds of flowable solids build up on each horizontal member, each bed extending from the rib to the inside surface of the tube to form the surface of a chute on which subsequently supplied solids can trickle downwards to fall through the opening of a horizontal member only onto the bed of solids on the next lower member rather than into the opening thereof.

2. Apparatus as claimed in Claim 1, wherein the openings in the horizontal members are round.

3. Apparatus as claimed in claim 1 or 2, wherein the openings of successive horizontal members are spaced 90° apart in the same sense.

4. Apparatus as claimed in any one of claims 1 to 3, wherein each horizontal member is formed in a separate tubular portion a plurality of which form said vertical tube.

5. Apparatus as calimed in any one of claims 1 to 4, wherein the vertical tube is round.

6. Apparatus as claimed in any one of claims 1 to 5, wherein the vertical tube is disposed in a bin and at least one lateral opening is formed in the wall of the vertical tube between any two adjacent horizontal members and disposed so that, when the apparatus is in use, it will lie above the bed of solids.

7. Apparatus as claimed in claim 6, wherein two lateral openings which are spaced 180° apart, are provided between any two adjacent horizontal members.

8. Apparatus as claimed in claim 6 or 7, wherein each horizontal member occupies only part of the cross-section of the vertical tube, and wherein the horizontal member has a terminal edge at which a vertical metal plate for retaining the bed of solids is provided.

9. Apparatus as claimed in claims 7 and 8, wherein the lateral openings provided in the vertical tube between adjacent horizontal members are arranged on the same level and the lower edges of said lateral openings are so disposed that when the vertical tube is first filled up to form the chute concerned, the solids flow first over the vertical metal

plate at the terminal edge of the horizontal member and only subsequently flow through the lateral openings into the bin.

10. Apparatus for the vertically downward delivery of flowable solids substantially as hereinbefore described with reference to Figs. 1 and 2 or Figs. 3 and 4 of the accompanying drawings.

TREGEAR, THIEMANN & BLEACH,
Chartered Patent Agents,
Enterprise House,
Isambard Brunel Road,
Portsmouth PO1 2AN,
and
49/51 Bedford Row,
London WC1V 6RL.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

1574648 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

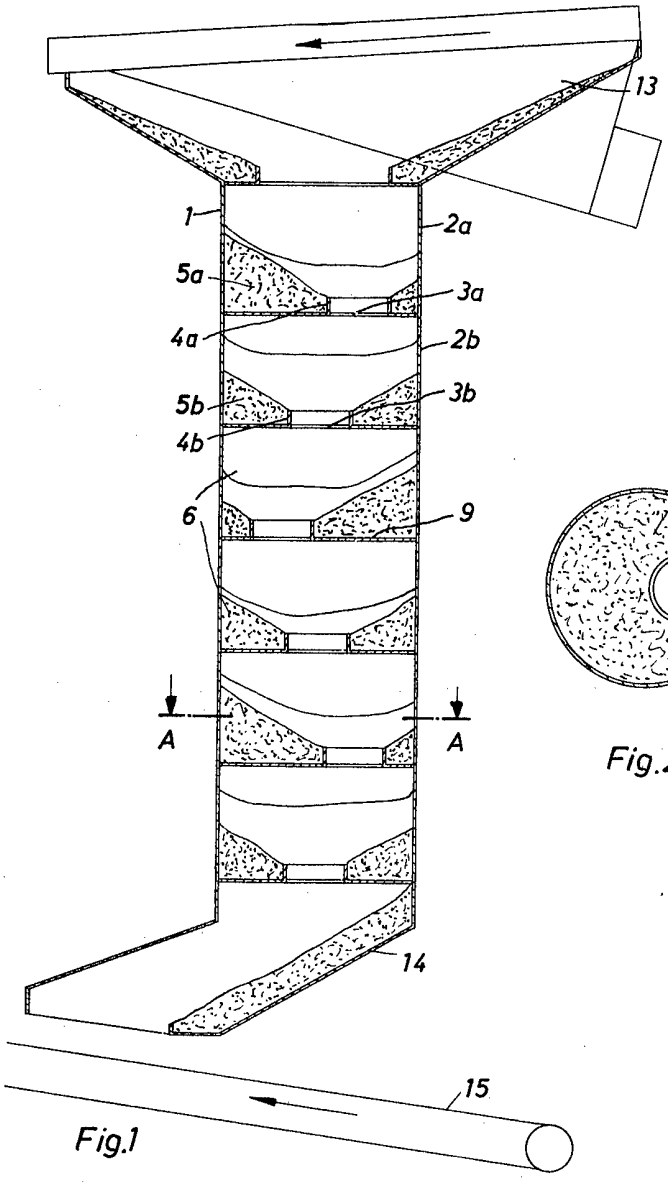

Fig.1

Fig.2

1574648 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

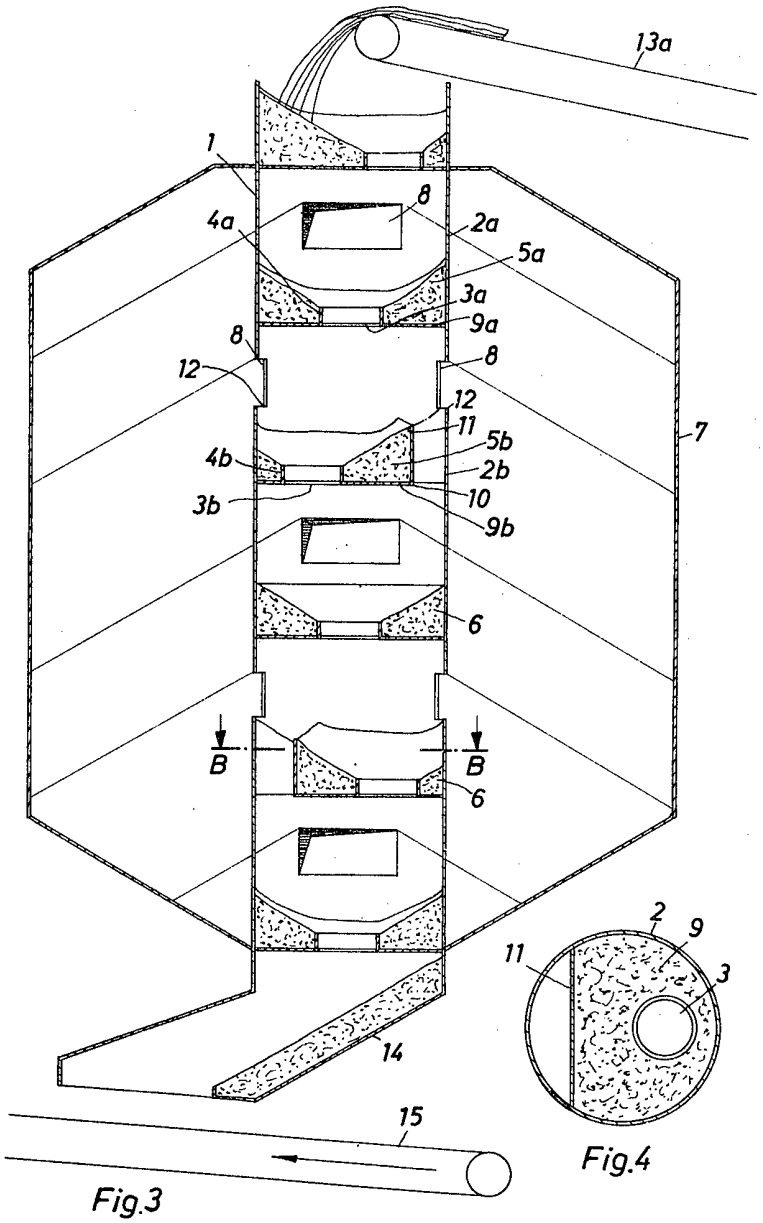

Fig.3

Fig.4