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(54) **Handling device for downwardly discharging material from the top of the mass stored in a receptacle.**

(57) A material handling device is disclosed for use in a material holding, or storage, receptacle. The device includes a vertically positioned discharge duct having spaced apertures therein with the bottom of the duct connected to a discharge access passage whereby granular, free flowing material, such as grain, within the receptacle, is withdrawn through the apertures and discharge duct in a manner such that the withdrawn material is from the top of the stored mass. The apertures are either staggered or opposed with respect to one another along the discharge duct. Material loading is through the top of the receptacle with the loading duct, or channel, being formed in a manner so as to prevent damage by impact to the material being introduced.

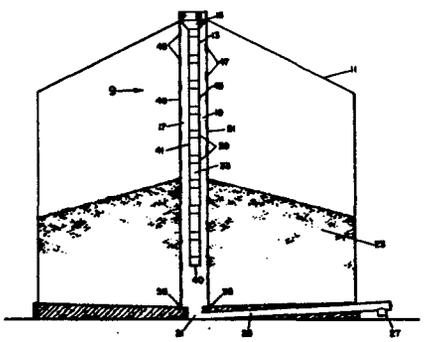

FIG. 1

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TITLE MODIFIED
see front page

DUCTED MATERIAL HANDLING DEVICE FOR TOP UNLOADING OF A STORAGE RECEPTACLE

This invention relates to a material handling device and, more particularly, relates to a device within a receptacle for handling granular free flowing material to be loaded into and withdrawn from the receptacle.

It is oftentimes desirable, or necessary, to load material into a holding receptacle and then later remove the stored material from the receptacle.

While this is not a difficult problem with some materials, such as liquids, or even with some solid state materials, problems have arisen where the material to be handled and stored is a material that is subject to damage by impact during handling. Such a material, for example, could be any granular or pelleted material including grain, seeds and nuts and/or could be chemicals or the like that might be damaged by impact during handling.

In handling of grains, a grain ladder has heretofore been utilized to introduce grain into a storage receptacle, with withdrawal of the grain being commonly from the bottom of the receptacle.

The grain ladder is a device designed to slow the descent of grain (or seeds or other granular of free-flowing materials) into the storage receptacle (or processing, conditioning or holding chamber or vessel).

Such a ladder typically consists of one or more rectangular (or square) tubes, or passages, that are vertically positioned and attached to the walls of the receptacle for support with the passages generally being positioned out of the primary grain flow path when the receptacle is unloaded by withdrawal of stored material through an outlet in, or near, the base of the receptacle.

The grain or material ladder derives its name from the fact that the passage into which the material is introduced for flow downward into the storage, or holding, receptacle is equipped with a series of internal baffles to retard the flow and maintain descent velocity below that critical for damage as the grain, seed or material impacts on the mass accumulated in the receptacle. The baffles usually project alternately from two opposite inside surfaces of the ladder passage, and are spaced at alternate points along the passage length. The resultant flow path forms a zig-zag pattern, and the continual change in flow direction as the material descends slows the flow velocity. Such a ladder is normally equipped with outlet ports, which are cut out of the tube wall at points between the locations or elevations of the baffles.

In operation, material descends slowly down the zigzag ladder inside the ladder passage until it reaches the level of that accumulated in the storage receptacle. At this point, the ladder tube outlet is blocked by accumulated material, and the tube starts to fill. With outlet ports spaced at frequent intervals, the passage fills only to the level of the next higher outlet, resulting in a very short drop onto the accumulated material mass in the storage receptacle.

Grain and material ladders, as now known and normally used, are positioned along the wall of the storage

receptacle for support, and to insure that they will be out of the primary grain flow path when the storage is unloaded. The purpose is to minimize the frictional drag on the outside surface of the ladder, which may bring about structural distortion or complete failure and collapse of the ladder assembly as the material flows around and along the tube, or passage, during unloading. Such collapse may also damage the storage structure or associated handling equipment.

Positioning of the grain or material ladder on one or more inside walls of the storage, or holding, receptacle requires that the wall of the receptacle be capable of sustaining of the unbalanced sidewall loading due to the angle of repose of the material. For most free-flowing grains and seeds, this angle of repose is typically 25° to 30° above horizontal. This will result in roughly a 4.6 m fill height on the inside of the storage receptacle at the grain ladder for a 9.15 m wide structure. This unbalanced loading may cause the wall of the storage receptacle to distort and possibly cause total structural failure by collapse or tipping.

Since many grains, seeds and nuts and a number of free-flowing materials are stored in thin wall structures and vessels that require uniform sidewall loading essentially at all times for structural stability, such side mounted grain or material ladders or flow retarders now known cannot be used.

This invention provides an improved material handling device useful for loading and unloading granular, free flowing materials into and out of a storage, or holding, receptacle. The device is suitable for use in thin wall storage receptacles requiring uniform sidewall loading for structural stability.

It is therefore an object of this invention to provide

an improved material handling device.

It is another object of this invention to provide an improved material handling device useful for loading and unloading storage receptacles.

It is yet another object of this invention to provide an improved material handling device that enables unloading or withdrawal of material from the top surface of the mass of material within the receptacle.

With these and other objects in view, this invention resides in a material handling device for use in a material holding receptacle, this device comprising: an inlet passage positionable within a holding receptacle for loading flowable materials into said receptacle, said inlet passage having apertures therein opening into said receptacle; wall means defining a discharge passage positionable within said holding receptacle contiguous to and extending at least partially along said inlet passage, said wall means having a plurality of spaced apertures therein opening said passage to said receptacle when within said receptacle and through which flowable materials stored in said receptacle may pass into said discharge passage, said apertures in said wall means being oriented so that said apertures are at different heights with material flow being substantially only from the highest of said apertures having flowable materials thereat when material is withdrawn through said discharge passage; positioning means for positioning said discharge passage within said holding receptacle so that material in said receptacle is contiguous to at least a portion of said wall means having said apertures therein; and discharge means communicating with said discharge passage and through which material is withdrawn from said discharge passage resulting in additional

material in said receptacle being drawn into said discharge passage substantially only through said higher one of said apertures so long as said material is contiguous to a said higher one of said apertures.

Other features of the invention will appear from the following description given by way of non-limitative examples with reference to the enclosed drawings.

FIGURE 1 is a cutaway side view of a storage receptacle showing the handling device of this invention mounted therein;

FIGURE 2 is a cutaway partial side view of a storage receptacle with the handling device of this invention mounted therein as shown in FIGURE 1 but rotated 90° with respect thereto;

FIGURE 3 is a perspective view of a partial section of the handling device as shown in FIGURE 1;

FIGURE 4 is a partial side view of the outer walls of the outer duct illustrating use of a hood above the apertures therein as an alternate embodiment;

FIGURE 5 is a side view of an alternate embodiment of the handling device of this invention with a spiral channel for loading; and

FIGURE 6 is a side view of another alternate embodiment of the handling device of this invention with a spiral channel for loading enclosed in an outer duct.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawings, and to the appended claim in which the various novel features of the invention are more particularly set forth.

As shown best in FIGURE 1, a material, or grain ladder 13 is mounted in receptacle 11 with an inlet access passage 15 communicating therewith at the top of the receptacle. One or more discharge passages, or ducts (numbered 17 and 19 as shown in FIGURE 1) are contiguous to the ladder 13 with an outlet access passage 21 communicating with the discharge ducts at the bottom of receptacle 11. The entire unit is thus anchored at top and bottom.

By this arrangement, material 23 is fed into the receptacle by gravity feed at the top of the receptacle and material is removed from the receptacle at the bottom thereof. In this invention, however, the design and orientation of the discharge ducts is such that the material flow is off of the top surface of the stored mass even though the material is withdrawn at the bottom of the receptacle. As also indicated in FIGURE 1, a conventional conveyor mechanism 25 may be utilized to convey the withdrawn material to a material discharge chute 27 exteriorly of the receptacle. The bottom connector and support to the floor can be designed for use of a modified sweep unloader in a flat bottom receptacle, or for the temporary removal of the bottom connector and support for conventional use of a sweep unloader.

Ladder 13 may be conventional and is an elongated passage, or duct, of preferably a rectangular or square cross-section and having a series of spaced apertures 29 and 31 therein. As shown best in FIGURE 3, the apertures in the inlet passage, as utilized in this invention, may be alternated at two opposite sides 33 and 35 of the passage along the length thereof. In other words, each aperture 29 in wall 33 may be longitudinally spaced both with respect to the other apertures 29 in wall 33 and from the apertures 31 in wall 35, as is also true for the apertures 31 in wall 35. The positioning and contour of the apertures may, however, be selected as desired for a particular application. As indicated hereinabove, ladder 13 preferably includes a series of baffles, or deflectors 37 and 39 alternately mounted in walls 33 and 35, respectively, above the apertures 29 and 31, respectively, in the walls. This causes

material introduced into the receptacle to follow a zig zag path in dropping, under the force of gravity, into the receptacle through the inlet passage (i.e., ladder 13). The bottom end 40 of ladder 13 is preferably closed and terminates in the lower portion of the receptacle but above the bottom of the receptacle as shown in FIGURE 1.

In this invention, one or more discharge passages, or outlet ducts 17 and 19 are mounted on the unported opposite sidewalls 41 and 43 of ladder 13, respectively. As indicated in FIGURE 1, where two ducts 17 and 19 are utilized, both open to discharge access passage 21.

Discharge ducts 17 and 19 are preferably of rectangular, or square cross-section and have apertures 45 and 47 therein, respectively, which apertures are preferably on the sidewalls 49 and 51, respectively, opposite to the sidewall contiguous to the inlet passage 13. As indicated in FIGURE 3, the apertures, or ports 45 and 47 in the sidewalls 49 and 51 may be alternated from duct to duct, but may, however, be positioned and contoured as desired for a particular application.

As indicated in an alternate embodiment in FIGURE 4, the apertures 45 and 47 may have a hood 53 thereabove formed by outwardly and downwardly flaring the sidewall immediately above each aperture, or port. Such a hood increases the effects of forces acting in the material (such as grain) conducted past the exposed but submerged port below the upper-most submerged port when all inflow of material is intended to accomplish top unloading of the material.

As indicated in FIGURES 1 and 2, the area of connection of the bottom of the outlet ducts 17 and 19 to the outlet access passage 21, as at 55. This connection may be flared where a hopper is utilized. Such a flare may be necessary, for example, where a hopper is utilized to add a force component to the descending material being unloaded and thus reduce the increased lateral pressure of the material trying to inflow off of a sloped floor, or bottom. The clearance between

the bottom of the inlet passage and the bottom of the receptacle should be adjusted to minimize inflow forces on a sloped receptacle bottom, but still bring about complete removal of stored material when directed flow has ceased.

In operation utilizing a unit having a grain, or material, ladder 13 and two discharge ducts 17 and 19, the unit is installed in the center of a receptacle such as a grain, seed, nut or other free-flowing material storage or vessel (a plurality of units in the central portion may also be utilized in lieu of one centrally positioned unit). The material to be placed in storage is conveyed or otherwise delivered into the top of the ladder through inlet passage 15, which is positioned in the center of the assembly. The material descends downward (through the zig-zag path of the material ladder due to the flow retarders) exiting at the port just above the level of accumulated material. With the storage unloading outlet, or passage 21 closed or stopped, no outflow takes place from the unloading ducts 17 and 19. Thus, the ducts simply fill with material as the storage depth accumulates.

When the filled (or partially filled) storage is to be unloaded, the unloading outlet 21 is opened or activated by commercially available devices. The material in the unloading ducts flows downward under the force of gravity and out of the receptacle. As flow is initiated in the unloading ducts, the stored material from the storage surface inflows through the upper-most inlet port, or aperture, that is submerged or partially exposed in the material mass.

Inflow will occur only at the upper-most one or two submerged or partially exposed inlet ports, because these are the only ports in the unload duct exposed to an unfilled or only partially filled unload duct.

With a full duct of material being conducted down each side of the grain, or material, ladder, the forces acting in the flowing stream in the duct, when passing a submerged inlet port, will be greater than the forces in the stored mass across the face of the exposed port that act to bring about inflow into the duct.

Thus, unloading inflow from the storage receptacle will be substantially entirely from the top. With essentially all vertical flow of grain from the structure occurring within the unload ducts, no drag due to flow friction along the outside surface of the assembly need be considered in its design. The only vertical forces placed on the external surfaces of the assembly will be those friction forces associated with grain settling due to drying or storage conditioning.

The entire unit, including the material ladder and unloading ducts, may typically be fabricated from formed and welded sheet metal. The ducts 17 and 19 will be formed to mate with the nonported walls 41 and 43 and welded or bolted in place. The finished shape of the entire total unit, or assembly, is planned to bring about the greatest possible structural stability compatible with economical fabrication and installation of the finished unit.

In addition to the functional and structural advantages afforded, the unit of this invention enhances the human safety in storage unloading. The danger of suffocation by being drawn into a flowing grain or material stream is substantially eliminated in this design for duct unloading from a ladder assembly (assuming the unloading ducts and inlet ports are too small to permit entry of a human body).

Alternate embodiments of the handling device of this

invention are shown in FIGURES 5 and 6. In FIGURE 5, a center mounted outlet passage, or duct 60, is shown anchored at opposite ends to tubular inlet access passage 15 and outlet access passage 21. As shown in FIGURE 1, the inlet and outlet access passages are, in turn, anchored at the top and bottom walls of the storage receptacle 11.

Center unloading duct 60 serves both as a structural support for the unit and as the outlet passage for conveying the stored material from the receptacle with top unloading again occurring as described hereinabove with respect to the embodiment of the invention as shown in FIGURES 1 through 4. While not shown, a plurality of units could be used spaced within the receptacle (rather than utilizing a single center mounted unit).

Apertures, or ports, 62 are provided in duct 60 in the same manner as described in connection with apertures 45 and 47 in discharge passages 17 and 19 to enable top unloading in the same manner as previously discussed and indicated. The apertures are cut into the tubular duct and, as shown in FIGURES 5 and 6, are spaced along the length of the duct and preferably alternated from side to side, as shown. The spacing and contour may be modified, as desired, for particular utilization as to bring about reasonably uniform unloading from the upper grain surface.

As shown in FIGURE 5, a spiral channel 64 is mounted on and wrapped about center duct 60. The upper end 66 of the spiral channel is connected to the bottom of the inlet access 15 (which access may be modified at bottom portion 67 to connect to the spiral channel) so that material loaded into the inlet access hopper is conducted downwardly along the spiral path (due to the force of gravity) which provides a controlled descent to reduce impact damage to material on contact with

other material in the receptacle or the receptacle walls or bottom. The materials will, of course, be conducted downwardly to the upper level of the stored material at the sprial path. Spiral channel 64 is preferably a U-shaped channel having bottom wall 68 and sidewalls 70 and 71.

As indicated in the embodiment shown in FIGURE 6, the spiral channel 64 may be enclosed in an outer duct 74 which surrounds center duct 60. Spiral channel 64 is positioned between the inner and outer ducts and material to be stored is conducted downwardly along the path in the same manner as described in connection with the embodiment shown in FIGURE 5. The amount of inclination of the spiral path determines, of course, the speed of descent of the material.

Outer duct 74 has a plurality of apertures, or ports, 76 and 77 therein which are alternated along the outer duct. Material loading into the storage receptacle is accomplished by material leaving the spiral path and passing through port 76 at or just above the level of the material in the storage receptacle.

Each port 77 is aligned with a port 62 in the inner duct 60 at an angle slightly above the static angle of repose for the material to be handled. As indicated in FIGURE 6, the access of each associated pair of aligned apertures 77 and 62 is preferably inwardly and downwardly directed. As material is withdrawn below the open bottom end 80 of the unload center duct 60, material inflows into the upper-most inlet port 76 exposed to grain pressure. Successive inlet ports inflow as the material level recedes as unloading proceeds. The inlet apertures, or ports 77 and 62 are preferably positioned spirally around the outer duct 74 and inner duct 60, respectively, so as to bring about a reasonably uniform unloading from the stored material surface. The spacing and configuration of

the apertures, can, however, be selected as desired for a particular utilization.

When utilizing outer duct 74, the outer duct is preferably closed at the lower portion (but above the outlet access 21) by horizontal wall 78. Wall 78 is preferably positioned just below the lowest outlet port 76 and slightly below the lower terminal point of the spiral channel to accumulate a small pocket or quantity of stored material to further help cushion the material descent just before discharge from the adjacent outlet port.

As also shown in FIGURE 6, the bottom end 80 of the unload duct 60 is positioned just above the outlet access 21 to permit material in-flow in the final quantity flow from the stored material surface. As an alternative, the lower end of duct 60 could be placed tightly over the outlet access, with provision for a manual opening of inlet ports into the unload duct immediately above the bottom of the storage receptacle, at one or more points around the duct. The discharge of material from the storage receptacle is, of course, blocked during filling, or loading, of material into the storage receptacle.

The device, or unit of this invention, can be utilized for handling of all granular or pelleted or natural material subject to damage from impact during handling into and out of a storage, vessel, or container for holding or transport.

The materials and grain are intended to include all grains and seeds plus nuts. The materials considered include such examples as pellets, both feed and plastic or raw materials; animal feed materials in granular or pellet for livestock, poultry, pets and fish or birds; human food such as cereals, and bulk handled produce items such as fruits and vegetables. Snack

foods and similar granular or pelleted food items are also considered.

The device can be utilized for any storage, vessel, or container whether on land, sea, water, or air. It is applicable to processes concerned with all manner of business, including agriculture, food processing, milling, food packaging, industrial manufacturing, and materials handling in all aspects of production, processing, transportation, marketing, conditioning, and distribution of grains and materials subject to impact damage in handling. In addition, the device can also be utilized in handling of chemical materials involving forms subject to undesirable shattering in impact.

As can be appreciated from the foregoing, this invention provides an improved device for handling granular free flowing materials, and more particularly, in loading materials into a receptacle and unloading the same therefrom.

Claims

1. A material handling device for use in a material holding receptacle, characterized in that said device comprises:

an inlet passage positionable within a holding receptacle for loading flowable materials into said receptacle, said inlet passage having apertures therein opening into said receptacle;

wall means defining a discharge passage positionable within said holding receptacle contiguous to and extending at least partially along said inlet passage, said wall means having a plurality of spaced apertures therein opening said passage to said receptacle when within said receptacle and through which flowable materials stored in said receptacle may pass into said discharge passage, said apertures in said wall means being oriented so that said apertures are at different heights with material flow being substantially only from the highest of said apertures having flowable materials thereat when material is withdrawn through said discharge passage;

positioning means for positioning said discharge passage within said holding receptacle so that material in said receptacle is contiguous to at least a portion of said wall means having said apertures therein; and

discharge means communicating with said discharge passage and through which material is withdrawn from said discharge passage resulting in additional material in said receptacle being drawn into said discharge passage substantially only through said higher one of said apertures so long as said material is contiguous to a said higher one of said apertures.

2. The material handling device of Claim 1 characterized in that said wall means is positioned by said positioning means so that said discharge passage extends in a substantially vertical direction, and wherein said discharge means communicates with the lower portion of said passage.

3. The material handling device of either of Claims 1 or 2 characterized in that both said inlet passage and said outlet passage include elongated passages.

4. The material handling device of any of claims 1 through 3 characterized in that said flowable material is a material subject to damage by impact during handling such as grain, and wherein said device includes means to protect against damage to said material by impact during handling of said material.

5. The material handling device of any of Claims 1 through 4 characterized in that said inlet passage has first and second side portions with said second side portion having apertures therein opening into said receptacle, and wherein said

discharge passage extends along said first side portion of said inlet passage.

6. The material handling device of Claim 5 characterized in that said apertures in said outlet passage are opposite said first portion of said inlet passage.

7. The material handling device of any of Claims 1 through 6 characterized in that said apertures in said vertical passage have an outwardly and downwardly curved hood at the top thereof.

8. The material handling device of any of Claims 1 through 7 characterized in that material is introduced into the top of said inlet passage, wherein said inlet passage has deflector means therein to slow material downward through said inlet passage with said material being introduced into said receptacle through said apertures in said passage until blocked by material accumulated in said receptacle, wherein material is discharged through the bottom of said device through said discharge means, and wherein the bottom of said discharge passage communicates with said discharge means.

9. The material handling device of any of Claims 1 through 8 characterized in that said inlet passage is of rectangular cross-section with said apertures therein on one pair of opposite sides, and wherein said outlet passage includes a pair of rectangular passages contiguous to the other pair of opposite sides of said inlet passage, said apertures being at the side opposite of that contiguous to said inlet passage.

10. The material handling device of any of Claims 1 through 9 characterized in that said apertures in said inlet passage are longitudinally spaced with

respect to one another and alternated at opposite sides of said inlet passage with said inlet passage being closed at the bottom.

11. The material handling device of Claim 10 characterized in that said inlet passage extends into the lower portion of said holding receptacle but terminates at a point above the bottom of said receptacle when mounted therein.

12. The material handling device of any of Claims 1 through 11 characterized in that inlet passage is a grain ladder having deflectors therein.

13. The material handling device of any of Claims 1 through 12 characterized in that said inlet passage includes means for retarding the flow of material into said receptacle, and wherein said discharge passage includes means at the bottom of said receptacle for carrying discharge material from the receptacle.

14. The material handling device of any of Claims 1 through 4 characterized in that said inlet passage defines a spiral inlet path for loading flowable material into said receptacle, and wherein said spiral inlet path is wrapped around said discharge passage over a substantial length of said discharge passage.

15. The material handling device of Claim 14 characterized in that said spiral path is positioned along said discharge passage so as to be spaced from said aperture in said discharge passage.

16. The material handling device of either of Claims 14 or 15 characterized in that said spiral path is opened to said receptacle when within the same.

17. The material handling device of any of Claims 14 through 16 characterized in that duct means are provided adjacent to said discharge passage, said spiral path being within said duct means.

18. The material handling device of Claim 17 characterized in that said duct means has apertures at the side thereof substantially opposite to that contiguous to said discharge passage whereby material in said receptacle can be unloaded by passing through said apertures in said duct means and said apertures in said discharge passage, said apertures being aligned with the axis of each pair thereof so aligned extending downwardly and inwardly.

19. The material handling device of Claim 18 characterized in that said device includes a duct surrounding said outlet passage and having said spiral channel therein, said duct having apertures therein.

20. The material handling device of Claim 19 characterized in that said apertures in said duct are aligned with said apertures in said outlet passage with the axes therebetween downwardly and inwardly directed.

21. The material handling device of any of Claims 1 through 20 characterized in that material loaded into said receptacle can be removed therefrom by gravity flow.

22. The material handling device of any of Claims 1 through 21 characterized in that positioning means positions said inlet passage and said discharge passage substantially at the central portion of said holding receptacle.

23. The material handling device of any of Claims 1 through 22 characterized in that said inlet

passage and said outlet passage are interconnected to provide a framework for said device.

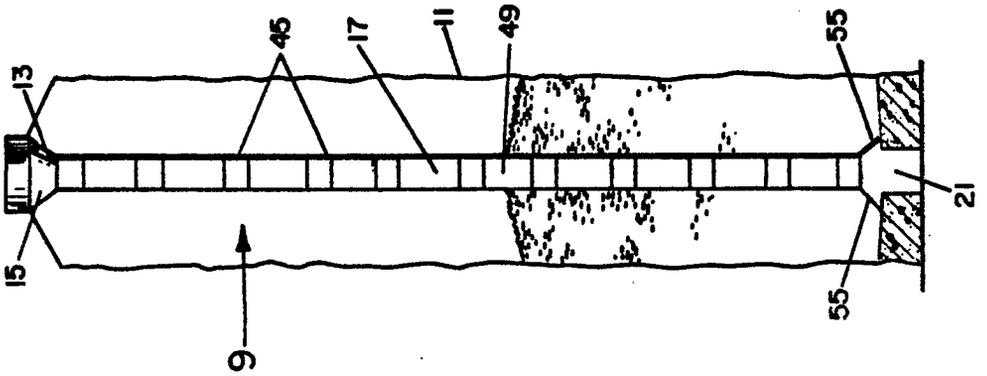
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FIG. 2

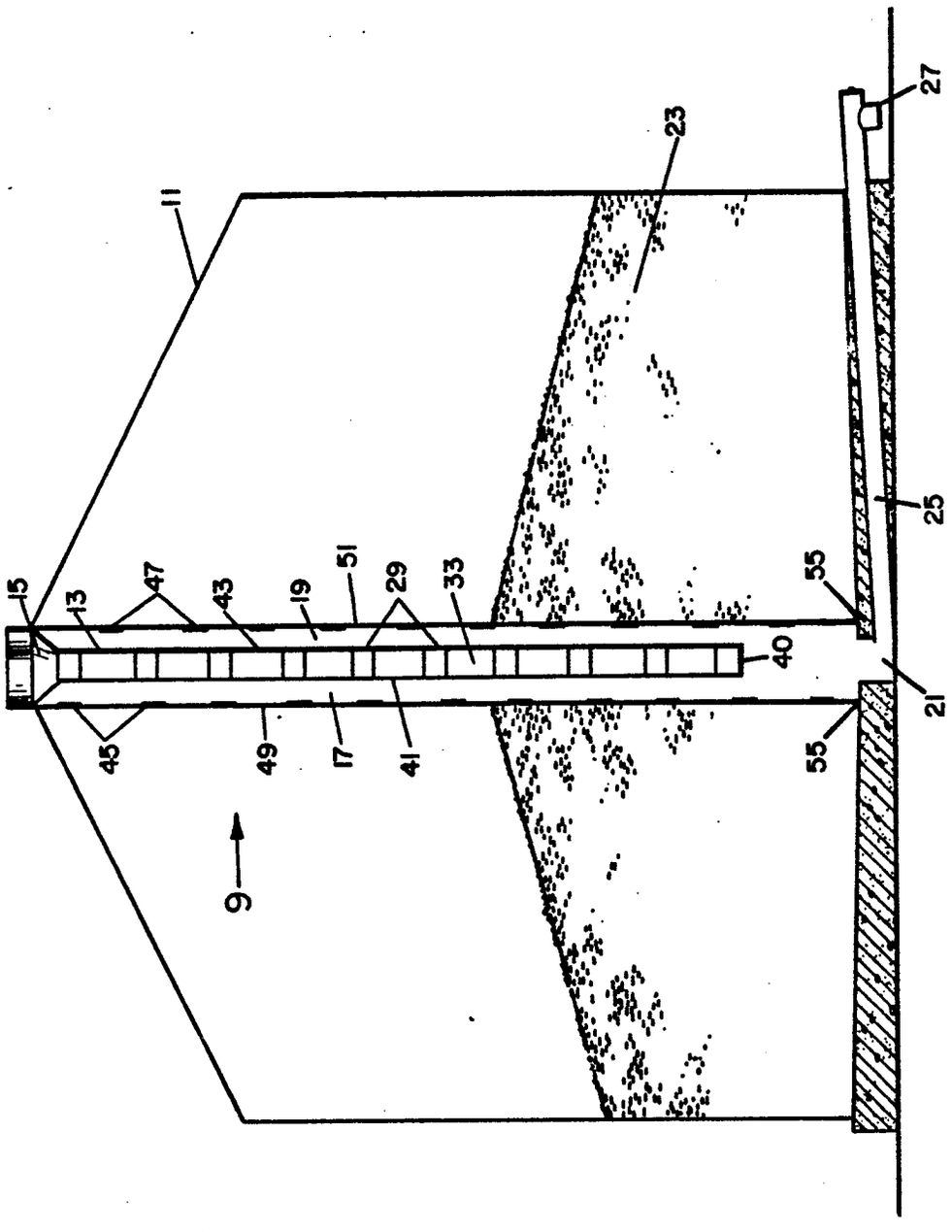
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FIG. 1

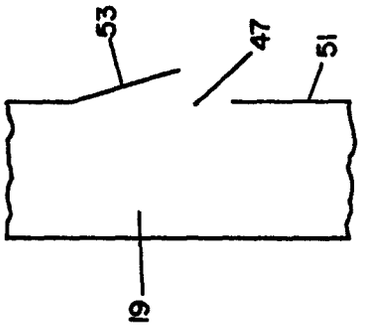
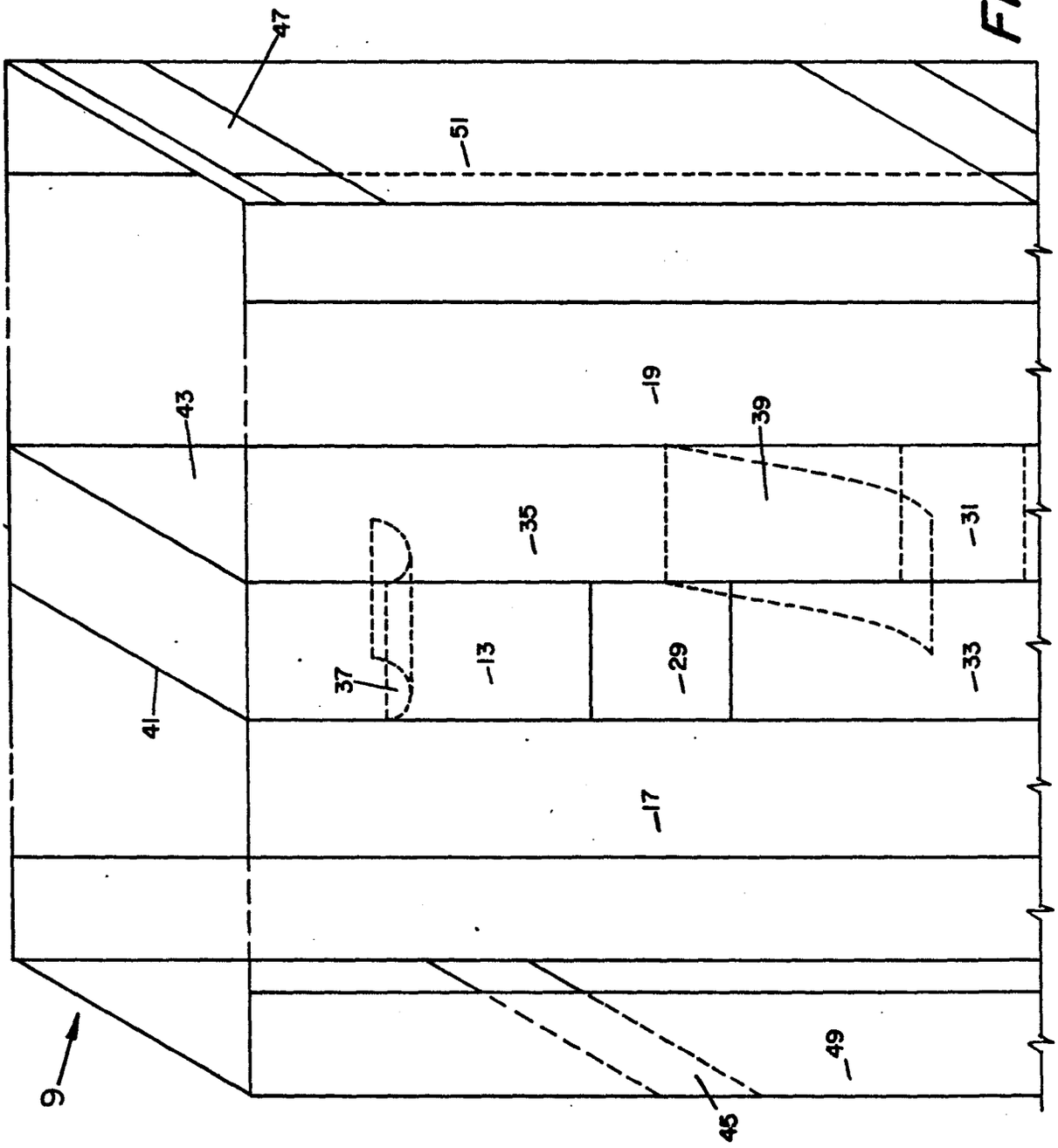


FIG. 4

FIG. 3



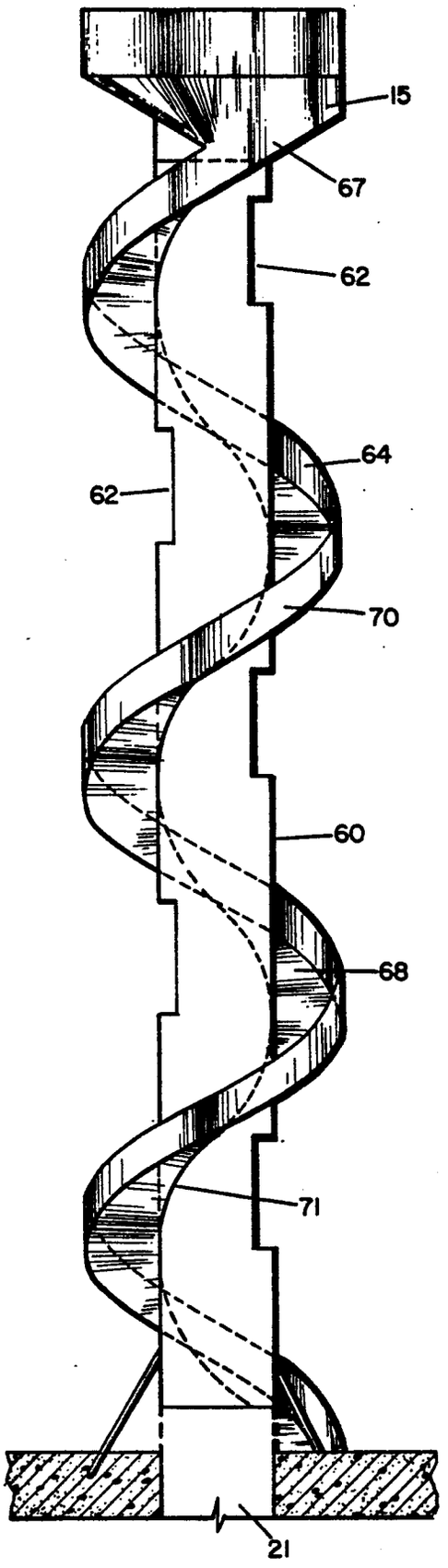

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FIG. 5

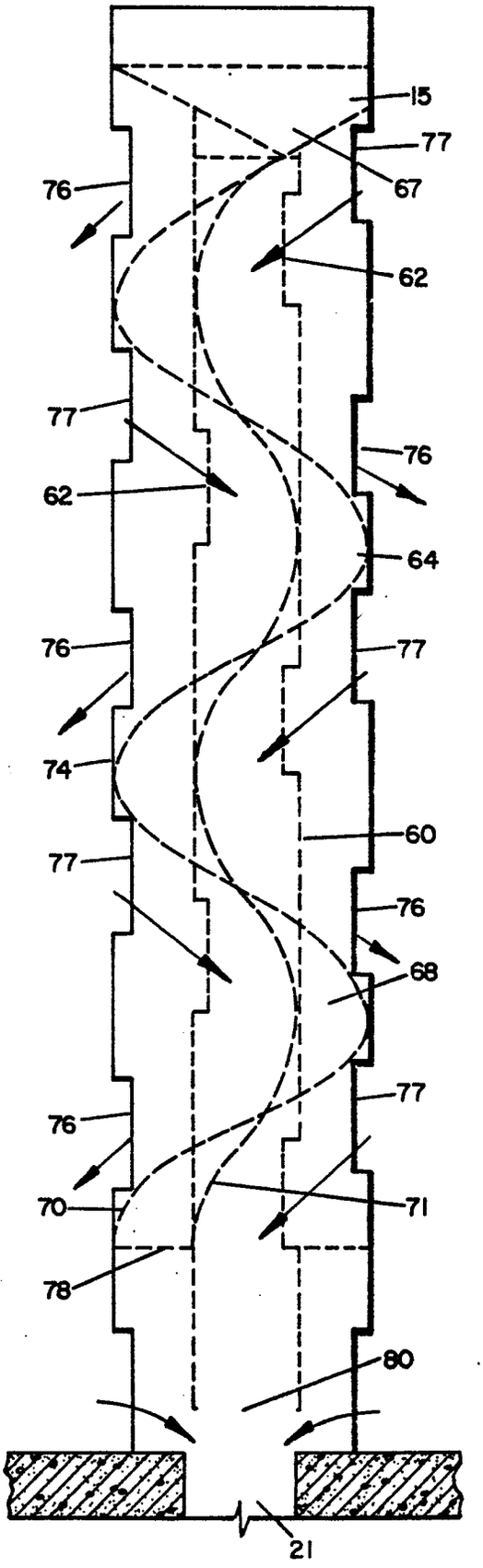
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FIG. 6

European Patent Office

0000577

EUROPEAN SEARCH REPORT

Application number

EP 78 10 0493

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	DE - C - 532 633 (BREMER LAGER HAUS) * Page 1, lines 25-71; figures *	1,2,3, 21-23
X	US - A - 1 861 976 (F. PARDEE) * Claims 1,5; figures *	1-4,8, 14,18 21-23
X	FR - A - 1 413 831 (THE NORTON HARTY ENG.) * Page 2, left-hand column, lines 15 to right-hand column, line 52; figures *	1-4,8 11,14, 16,21-23
X	GB - A - 1 019 487 (ANGLO TRANSVAAL CONSOL.) * Page 2, lines 35-75; figures *	1-5,8 11,14, 16,17, 19,21-23
	FR - A - 955 447 (ET. TANGEROIS D'EXPANSION) * Page 1, lines 9-18; figures *	2,21, 22
	GB - A - 1 096 581 (COAL IND. LIM.) * Claims 1,8; figures *	1,2,8 14,16, 21,23
	DE - A - 2 422 331 (MITSUI SHIPBUILDING) * Page 3, lines 14-32; figures *	12,13, 14,16

CLASSIFICATION OF THE APPLICATION (Int. Cl.)

B 65 G 69/16
B 65 G 65/36

TECHNICAL FIELDS SEARCHED (Int.Cl.)

B 65 G 69/16
B 65 G 3/10
B 65 G 3/16
B 65 G 3/18
B 65 G 69/00
B 65 G 65/36

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13-09-1978	VAN ROLLEGHEM