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METHOD FOR FILLING VERTICAL PROCESS VESSELS WITH PARTICULATE MATERIALS

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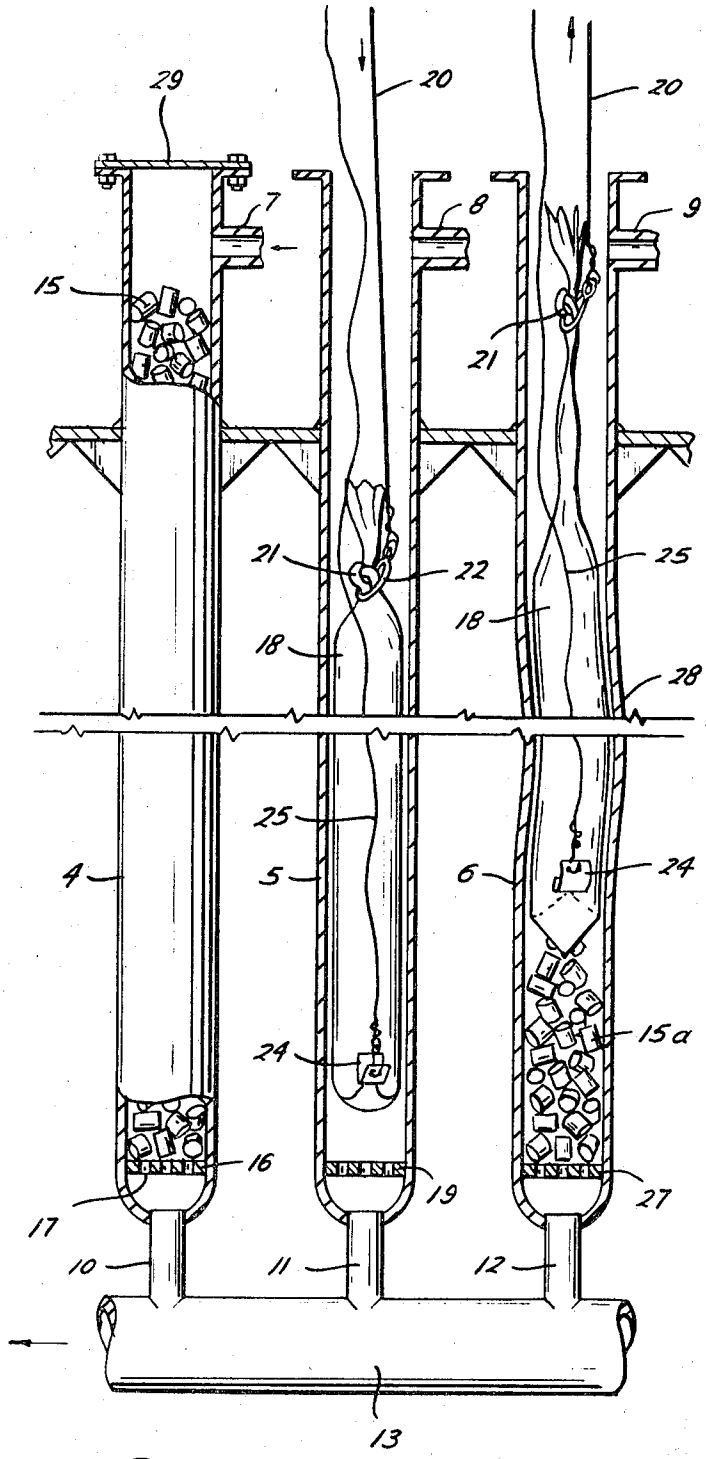

Fig. 1

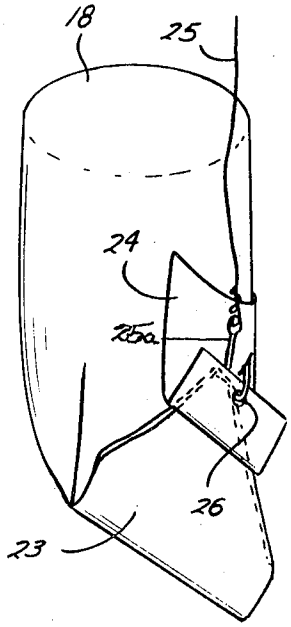

Fig. 2

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METHOD FOR FILLING VERTICAL PROCESS VESSELS WITH PARTICULATE MATERIALS

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ABSTRACT OF THE DISCLOSURE

A quick and relatively inexpensive method for filling vertical process vessels, for instance, reactors or packed towers, with particulate material such as catalyst or other packing, while preventing contamination and damaging thereof. A special flexible bag with a bottom seal which may be opened by means of a release line is filled with the material and then gently lowered into the vessel by means of an elevator attached to the upper portion of the bag. The bottom seal is then opened by pulling upon the release line, permitting the contained material to drop gently into the vessel. The bag is retrieved by pulling up on the elevator line, and the process is repeated until the vessel is filled to the desired level.

BACKGROUND OF THE INVENTION

(I) Field of the invention

This invention relates to methods of filling vertical process or treating vessels with particulate materials.

(II) Description of the prior art

In chemical, petroleum, and related industries, various particulate materials as catalyst and packing materials are utilized in the process operations. Over a period of time, the effectiveness of these materials in the functions they perform is considerably reduced, requiring their replacement with new materials. The initial charging and replacement of these particulate materials frequently result in contamination and/or damage to the materials, and steps to avoid these disadvantages are time-consuming and expensive.

The type of vessel used in such process operations usually is disposed vertically and embodies a grid placed at or near the bottom of the vessel for supporting the particulate material in the proper position therein. The grid has openings large enough to allow the passage of liquid or gaseous process materials, but small enough to prevent the dropping of the particulate material therethrough.

The simplest and most obvious method of filling such vertical process vessels with particulate materials is to drop the materials into the vessels through the open top thereof. As would be expected, dusting, fracturing, and other damage to fragile particulate materials often occurs, and some of the damaged or broken pieces may drop through the grid in an undesirable manner. The removal of these damaged or broken pieces, which must be accomplished before the vessel is put back into operation, is time-consuming and expensive. Furthermore, after the process vessel has been put back into operation, any broken or damaged pieces still within the vessel will tend to settle towards the bottom over a period of time. In addition to these broken or damaged pieces passing through the grid into the remainder of the process system which may upset the process operation or at least reduce its efficiency, the loss of particulate material from the process vessel reduces the efficiency of that particular process vessel in relation to its function in the process. One or both of these factors may require an unscheduled shutdown of the process vessel to remove the broken or damaged pieces and to add new particulate material. Obviously, any unscheduled or earlier than normal shutdown delays and increases the cost of operation.

In regard to some particulate materials such as catalyst materials, the filling of process vessels by dropping the materials from the top of the vessels may result in the creation of a substantial amount of dust or finely broken material. After the start-up of a vertical reactor, this dust or finely broken material may be carried into other parts of the process system by either gaseous or liquid process materials, causing contamination of the refined products and further reducing the process efficiency.

One solution to the problem of damaged and migrant particulate materials, as described above, has been to fill the vertical process vessels with water prior to dropping the particulate materials into the vessels. However, while this procedure usually solves the problem of breakage or damage, it results in the creation of various other problems. For example, some types of particulate catalyst materials lose their effectiveness upon being exposed to water for any substantial length of time. Furthermore, the addition of water, and its subsequent removal from the process system, requires an additional amount of down time for the process vessel which usually results in increased costs. Another problem is the frequent difficulty of being able to completely remove the water from the process system since the presence of water in most refined products cannot be tolerated.

SUMMARY OF THE INVENTION

The present invention has for its primary object a method which obviates the various disadvantages, as previously noted, of prior methods. Other objects and advantages of this invention will be apparent from the description and claims which follow.

I have invented a dry method for filling vertical process vessels with various particulate materials without contaminating or damaging the particulate materials during their insertion into the vessels. The method comprises filling a flexible, elongated bag or other container with the particulate material, lowering the filled bag into a vertical process vessel by means of an elevator cord or similar device attached to the upper portion of the bag until the bottom of the bag is substantially at the bottom of the open region of the vessel to be filled, and then pulling a release line attached to a tape or flap sealing the bottom of the bag, thus breaking the seal and releasing the particulate material. As the bag is retrieved from the vessel by pulling up on the elevator cord, the particulate material gently falls in place with a minimum of free fall, agitation and collisions.

For example, the method in accordance with this invention can be used to insert fragile and/or water-sensitive particulate catalyst and packing materials into vertical reactors or packed towers.

Since particulate materials can be gently yet quickly inserted into vertical process vessels by means of the flexible, elongated bag, damage to the particulate materials and the creation of dust is restricted to a minimum while avoiding the use of water. The elimination of any need for a water cushion allows vertical process vessels to be quickly, and thus relatively inexpensively, filled with particulate materials and, at the same time, avoids contamination of water-sensitive, particulate materials as well as process systems which require the absence of water for efficient operation.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawings which illustrate the invention:

FIG. 1 is an elevation, partly broken away, showing the different stages of filling a vertical process vessel with particulate material; and

FIG. 2 is a detail perspective view of the bottom of the flexible, elongated bag sealed with a piece of adhesive tape and the means for releasing the tape.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a series of vertical reactor vessels **4**, **5**, and **6** having top fluid inlets **7**, **8**, and **9** and bottom outlets **10**, **11**, and **12** all attached to and supporting the reactor vessels upon a common header **13**.

The left-hand reactor vessel **13** in FIG. 1 is shown after it has been filled with a particulate catalyst material **15** supported upon a grid **16** near the bottom of the vessel and having openings **17** to allow the fluid process material which enters through inlet **7** to pass through the catalyst and into the outlet header.

The center reactor vessel **5** and the right-hand reactor vessel **6** in FIG. 1 show the stages of filling such vertical process vessels with particulate materials in accordance with this invention. In the center vessel **5**, a flexible, elongated bag **18** containing the particulate catalyst material is shown being lowered into the vessel to a position just above the grid **19** therein, that is, substantially at the bottom of the open region of the vessel to be filled, by means of an elevator cord **20** which is attached to the pinched or knotted upper portion **21** of the bag by any suitable means as a looped clip **22**. The bag **18** is initially tubular with open top and bottom. The bottom of the bag is pinched to form a flap **23** which is folded over and sealed by a piece of gummed or glued tape **24**. A release line **25** is attached to the lower portion of tape **24** as by a hook **25***a* inserted in a hole **26** in the bottom portion of the tape. Preferably, the lower extremity of tape **24**, including hole **26**, will be folded upon itself to facilitate detachment of the tape from the flap, as will be explained.

The right-hand reactor vessel **6** of FIG. 1 shows the particulate catalyst material **15***a* being released from the bag **18** immediately after the tape **24** sealing the bottom of the bag has been detached from the flap **23** by pulling up on the release line **25**. Subsequently, the bag **18**, which was initially lowered to just above the grid **19**, as shown in the center reactor vessel **5**, is slowly pulled upward by means of elevator cord **20**, thus allowing the particulate catalyst material to be slowly released from the confines of the bag and to gently fall in place on grid **27** or the top of the catalyst already in position.

The right-hand reactor vessel **6** of FIG. 1 is shown to be warped at **28**, a condition which may result from overheating. Thus, even if process vessels of relatively small diameters are in this condition, they can be filled without any difficulty, as shown in FIG. 1, by the use of a flexible bag of limited length in accordance with this invention. The vessels are provided with removable covers, as at **29**.

To recapitulate, the procedure in accordance with this invention consists of first filling the novel flexible bag, of convenient dimensions, with a predetermined amount of particulate material, the flap at the bottom of the bag having been previously sealed with gummed tape which is releasable by pulling. The lower end of the tape is folded over, thus creating a flap, and a hole is made in this flap. The release line, conveniently a rope or chain or the like, is then attached to the tape by tying or by means of a hook as shown. After filling, the top of the bag is closed as by pinching and tying and the elevator cord is secured thereto. The bag is then gently lowered into the vertical process vessel, until it is just above the grid (FIG. 2). Thereafter, release line **25** is pulled to detach tape **24** from flap **23** to release the contained material for spilling onto the grid. Finally, elevator cord **20** is slowly pulled upwardly to draw the bag out of the vessel, allowing the particulate material to gently drop in place in the process vessel with a minimum of agitation.

If additional bags are needed to fill the process vessel, the procedure described above is repeated, the bag filled with particulate material being lowered to just above the level of the particulate material already in the process vessel. This procedure may be repeated as many times as is needed to fill each process vessel.

Although canvas or cloth and paper bags may be used in accordance with this invention, plastic bags, such as those made from polyethylene, are preferred since these bags are highly flexible, relatively strong, inert, and resistant to the stresses normally incident to the use of this invention. In addition, since plastic bags are relatively inexpensive, they can be prepacked and stored and they can be discarded after one use, thus precluding possible contamination of sensitive particulate materials by subsequent uses of the bags.

The maximum diameter of the bags used in accordance with this invention is necessarily limited by the inside diameters of the vertical process vessels to be filled with particulate materials. Other factors to be considered in determining the length, as well as the diameter, of the bags are limitations imposed by the structures surrounding the process vessels and ease of handling.

The use of the method according to this invention greatly facilitates the filling of vertical process vessels having relatively small diameters—that is, those vessels having inside diameters from approximately 1.5 inches to approximately 5.5 inches. Nevertheless, this invention may be used in filling process vessels of larger diameters subject, of course, to limitations imposed by the adhesive characteristics of the tape and the strength and resistance to stress characteristics of the bag. Also to be considered, as previously mentioned, are limitations imposed by handling of the bags and the structures surrounding the process vessels.

An example of the use of this invention has been in filling primary reformers or reactors, having inside diameters ranging from 2.8 inches to 5.5 inches, in ammonia plants with fragile and moisture-sensitive particulate catalyst material. Without damaging or contaminating this particulate catalyst material, the use of the method in accordance with this invention allows charging and recharging of large numbers of these reactors more expeditiously than previously, and with resultant substantial savings. The invention has also been used advantageously in the filling of packed towers or columns with fragile particulate packing materials, such as ceramic rings and saddles.

The invention may be modified in various respects as will occur to those skilled in the art, and the exclusive use of all modifications as come within the scope of the appended claims is contemplated.

I claim:

1. The method of charging the open region of a generally tubular process vessel with fragile particulate material, comprising the steps of placing the material in a generally tubular container of flexible material with an open bottom folded upon itself, passing said container into the vessel with the container bottom adjacent the bottom of said open region, and withdrawing said container from about the contained particulate material so as to deposit said material at the bottom of said region while preventing substantial free fall of said material.

2. The method described in claim **1** including the further step of attaching an elevator cord to said container, the container withdrawal step being performed by pulling on said cord.

3. The method described in claim **1** including the further steps of detachably closing the bottom of said container and securing a release line to said bottom for use in performing said bottom opening step.

4. The method described in claim **1** in which said container is a bag fabricated of flexible sheet material.

5. The method described in claim **4** in which said bag is initially formed with open top and bottom, and includ-

ing the further steps of folding and detachably securing said sheet material at the bottom of the bag upon itself and attaching a release line to said bottom material.

6. The method described in claim 4 including the further steps of pinching together said sheet at the top of said bag and securing said elevator cord to said bag top.

7. The method described in claim 4 in which said bag is initially formed with open top and bottom, and including the further steps of folding and detachably securing the said sheet material at the bottom of the bag upon itself, securing said sheet material bottom by means of adhesive tape, and attaching a release line to said tape for removing the same to thereby discharge the contained material.

8. The method of charging a treating vessel having an open region for filling with particulate material which comprises:

forming a flexible bag by pinching together and folding on itself the bottom of a flexible tube,

detachably securing said bottom in folded position,

attaching a release line to the bag bottom,

placing a quantity of the particulate material in the bag,

pinching together the top of said bag and securing an elevator cord to said pinched bag top,

utilizing said elevator cord to lower said bag to a position in the vessel with the bottom of said bag substantially at the botom of said region,

opening the bottom of said bag by pulling on said release line, and

withdrawing said bag from about the released particulate material by pulling on said elevator cord to discharge the particulate material while preventing substantial free fall thereof.

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