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Wegman

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(54) **SINGLE DOSE SCREENING FOR PARTICULATE MATERIALS**

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B65B 39/00 (2006.01)
G03G 15/08 (2006.01)

(52) **U.S. Cl.**

CPC ***B65B 1/08*** (2013.01); ***B65B 39/007*** (2013.01); ***G03G 15/0879*** (2013.01); *B65B 2039/008* (2013.01); *B65B 2210/10* (2013.01); *G03G 15/0894* (2013.01)

(58) **Field of Classification Search**

CPC B65B 1/08; B65B 2210/10; B65B 39/007
USPC 141/72, 75; 222/161, 196, 198
See application file for complete search history.

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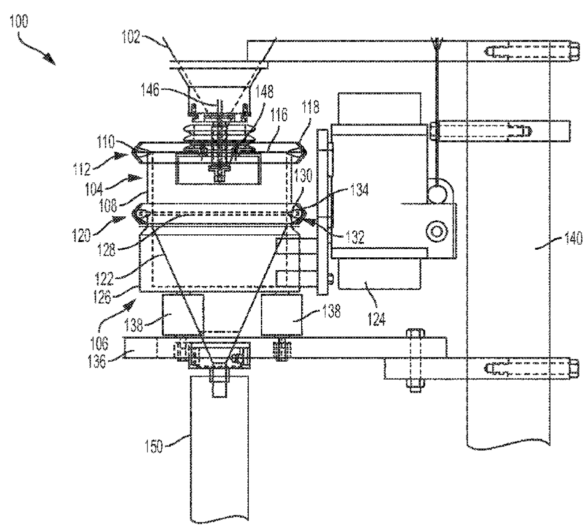
(57) **ABSTRACT**

A system for transferring a particulate material from a first container to a second container including an upper portion, a lower portion and a sieve. The upper portion having a housing and a high frequency vibrator, the housing having a first end, a second end opposite the first end, and a gasket positioned adjacent the first end. The lower portion having a collector funnel, a low frequency vibrator and a collar securing the low frequency vibrator to the collector funnel. The sieve having a mesh size, a perimeter and a gasket positioned adjacent the perimeter. The upper portion is releasably secured to the first container and the sieve is releasably secured between the second end of the upper portion and the lower portion.

9 Claims, 8 Drawing Sheets



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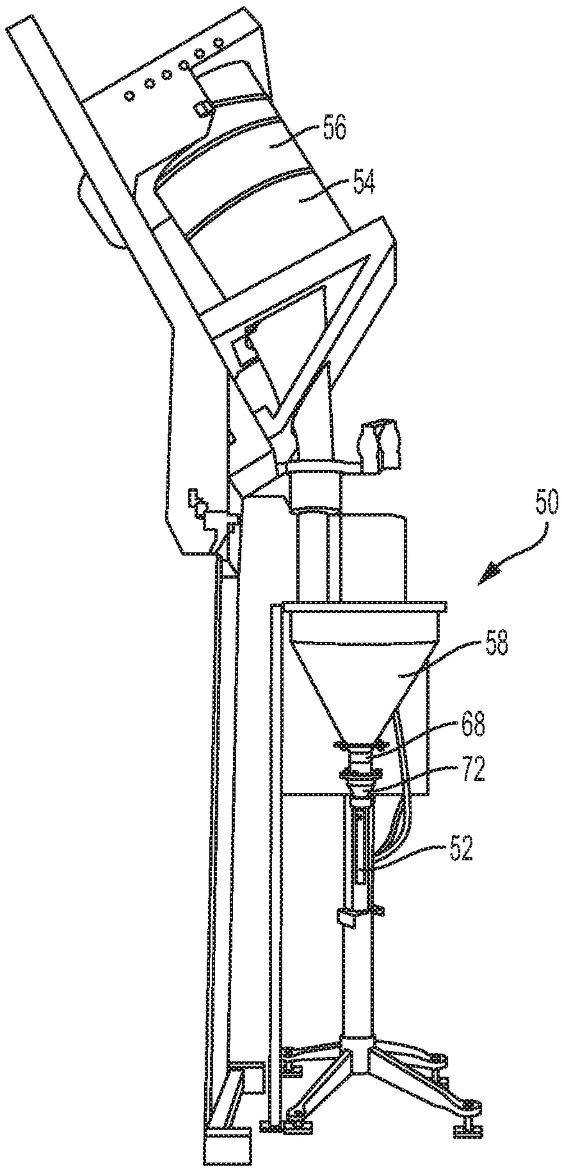

FIG. 1
PRIOR ART

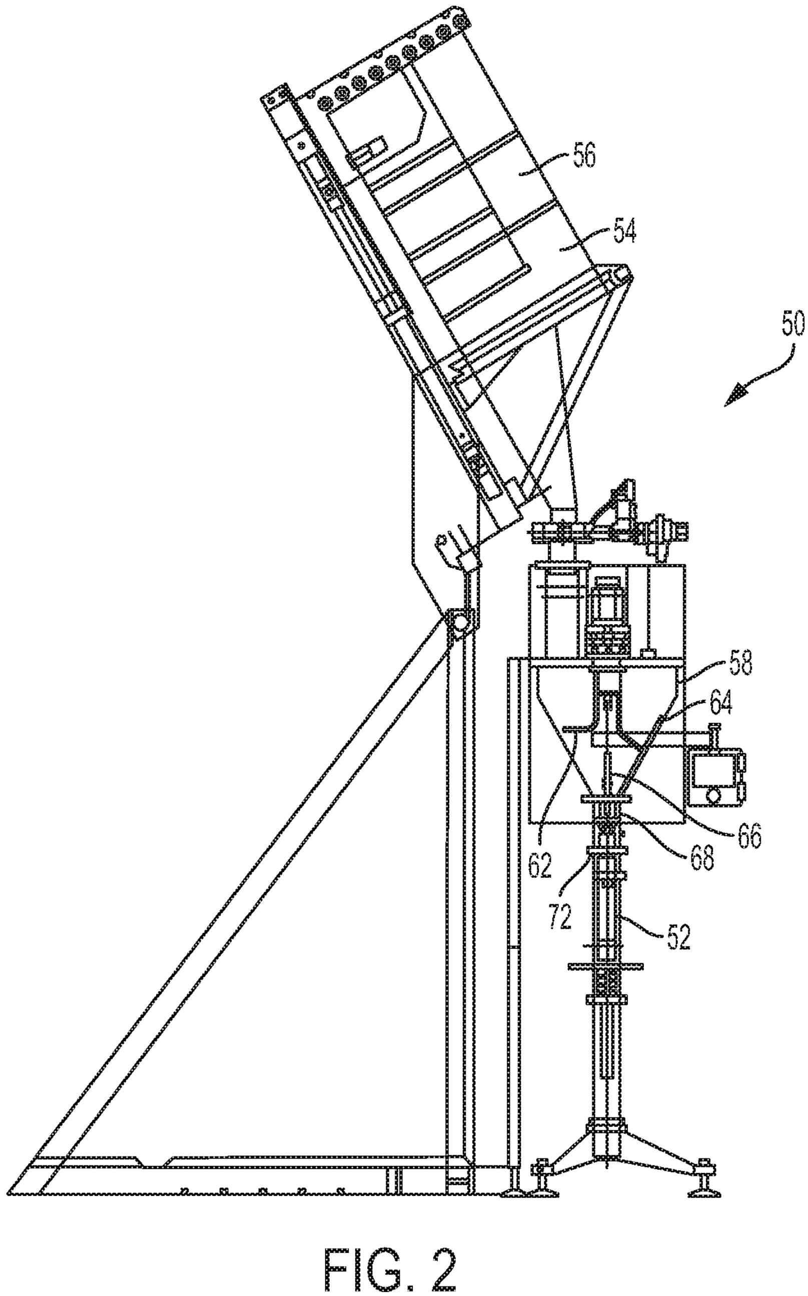

FIG. 2
PRIOR ART

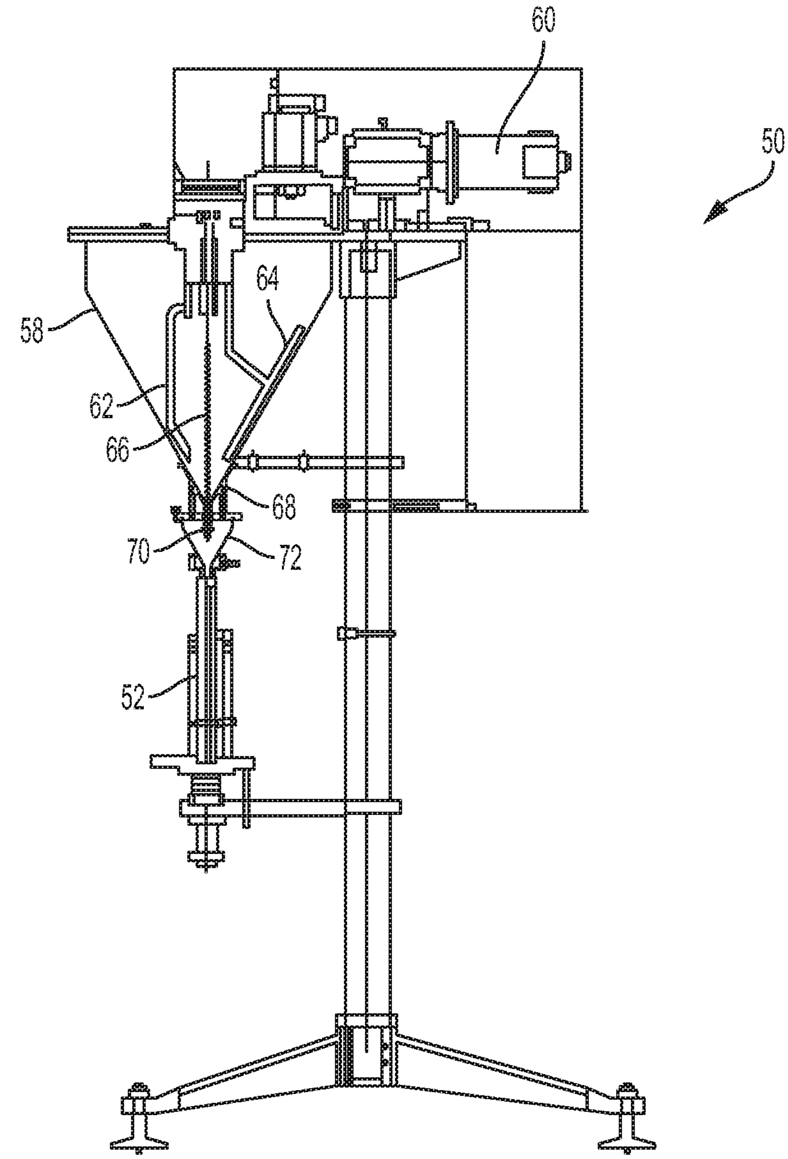

FIG. 3
PRIOR ART

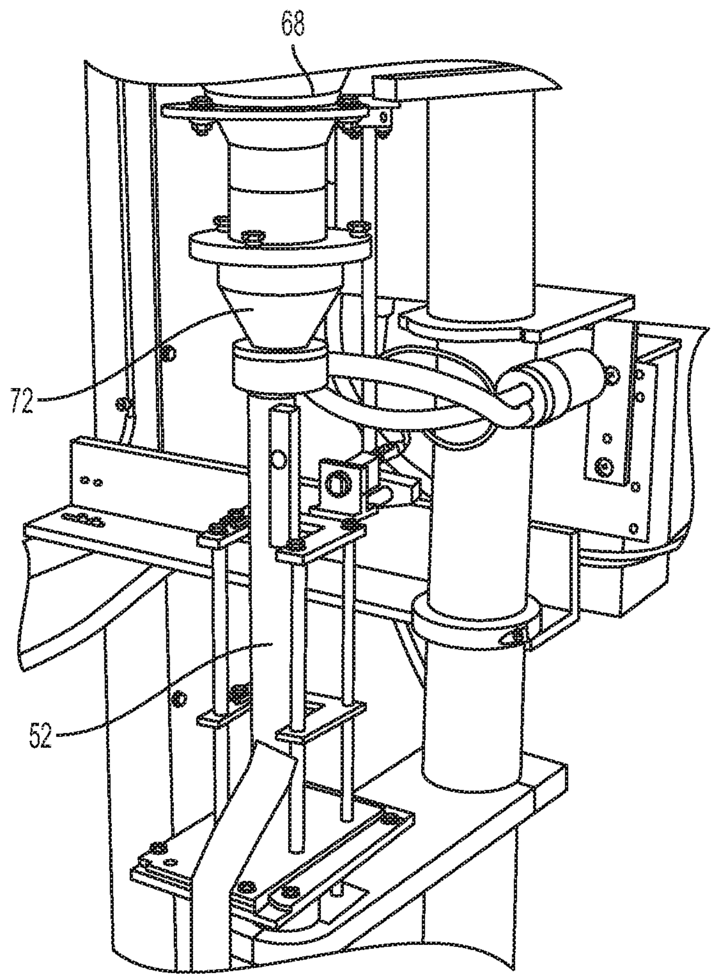

FIG. 4
PRIOR ART

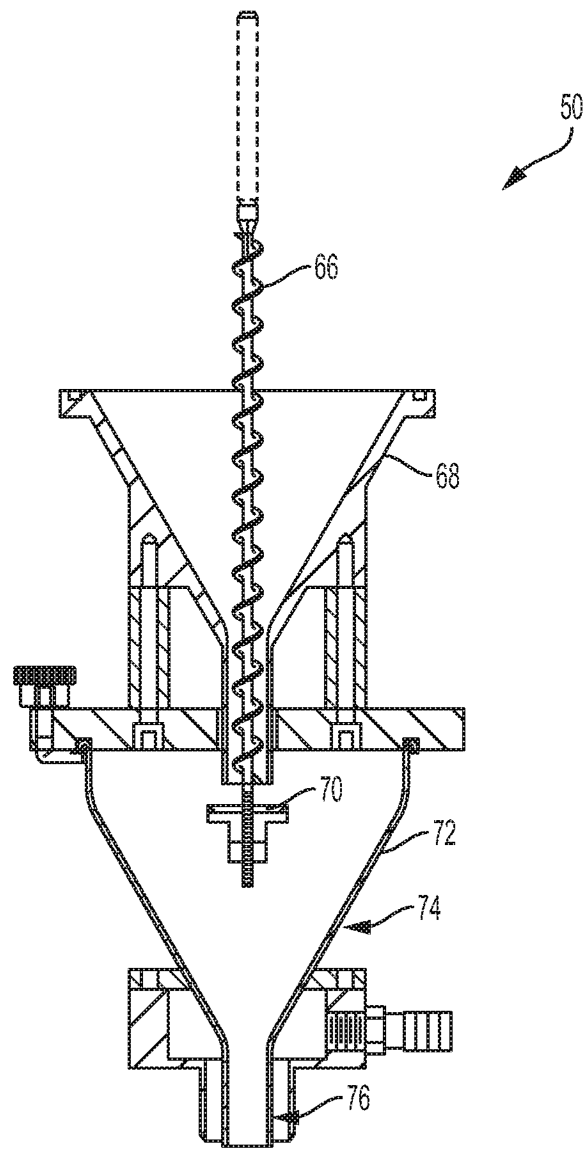

FIG. 5
PRIOR ART

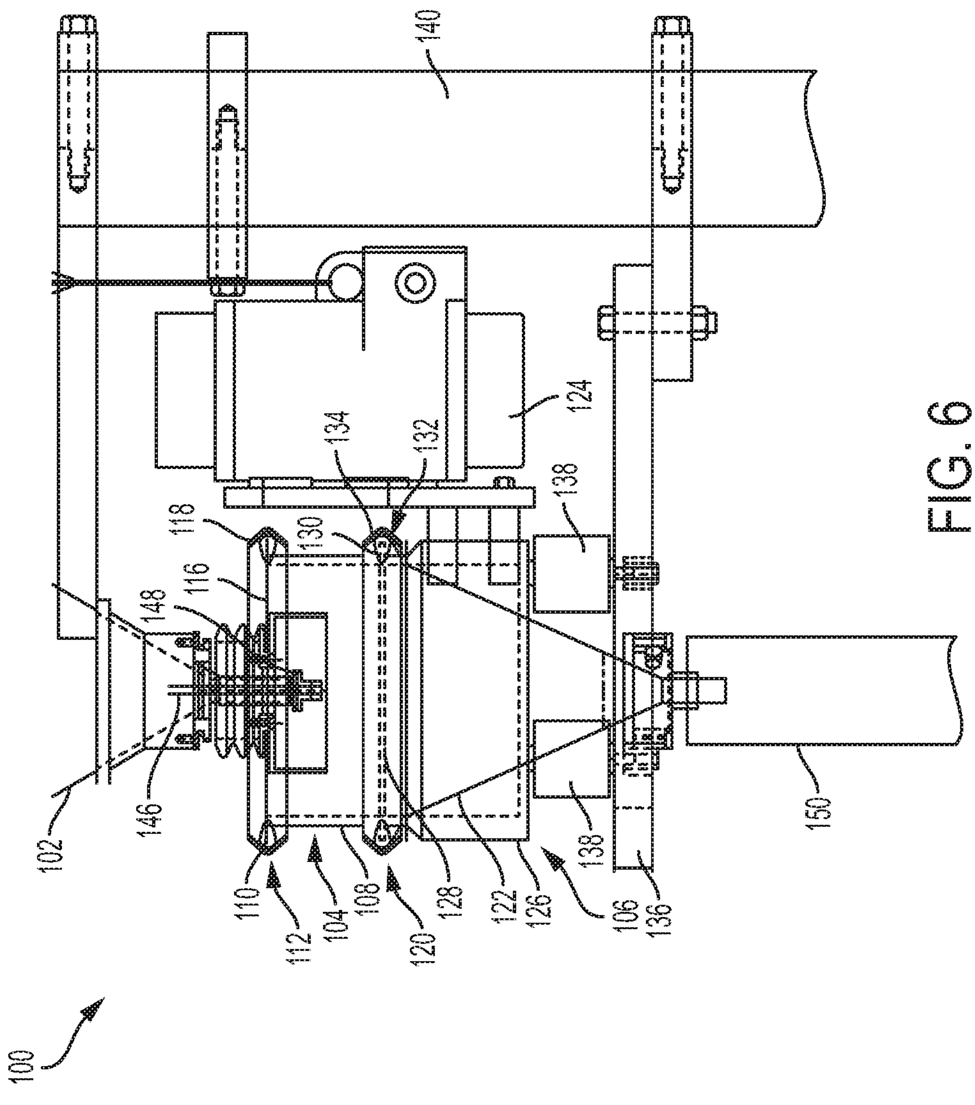
140
124
134
132
138
118
130
116
148
146
102
110
112
104
108
120
128
122
126
106
136
138
150
100

FIG. 6

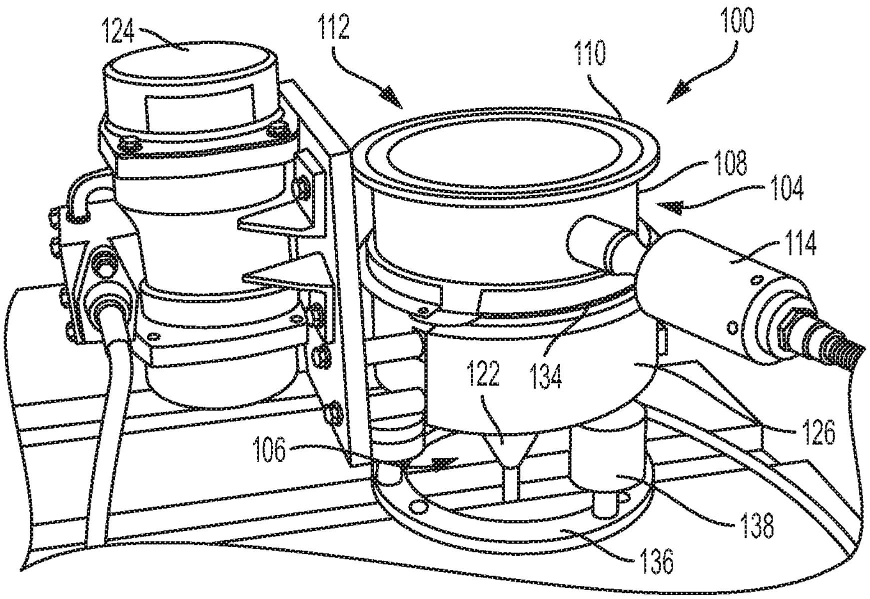
124
112
110
100
108
104
114
134
122
126
106
138
136

FIG. 7

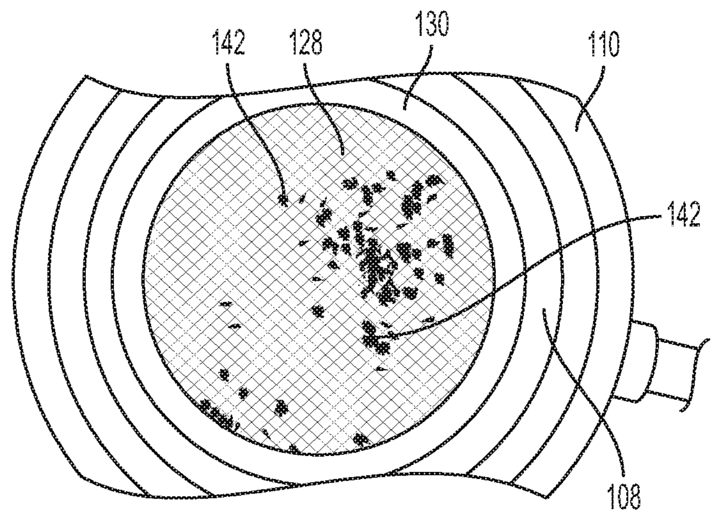
142
128
130
110
142
108

FIG. 8

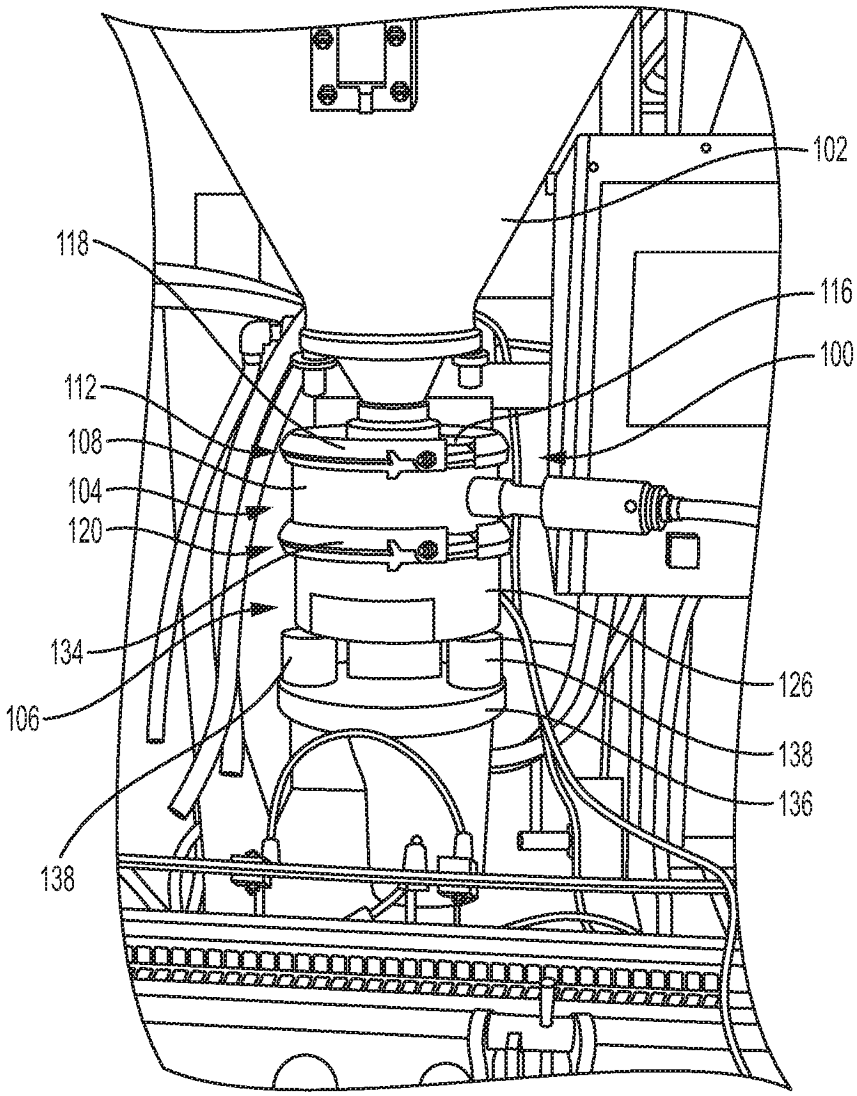

FIG. 9

SINGLE DOSE SCREENING FOR PARTICULATE MATERIALS

CROSS-REFERENCE TO RELATED APPLICATIONS

This patent application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Patent Application No. 62/255,507, filed Nov. 15, 2015, which application is incorporated herein by reference.

TECHNICAL FIELD

The presently disclosed embodiments are directed to providing an apparatus for handling a particulate material, more particularly to handling a fine particulate material, and even more particularly to handling a fine particulate material to prevent the formation of agglomerates and to prevent the transfer of agglomerates from one container to another.

BACKGROUND

Fine particulate materials, and in particular ultra-fine particles, often become agglomerated during packaging, transport, storage, subsequent handling, etc. Agglomeration can occur for a variety of reasons, e.g., humidity, temperature, pressure. Agglomerations of particulate materials may have detrimental effects on subsequent uses of those materials. For example, agglomerates of xerographic developer material, i.e., a mixture of a carrier and toner particles, can cause banding or streaking when used in a xerographic printing device.

Agglomeration of particulate materials was found to be particularly troublesome when transporting large containers over long distances. For example, xerographic developer material is packaged in bulk in barrels and transported from the United States to India. During transport, the materials are exposed to varying levels of heat and pressure. Agglomeration often occurs resulting in print quality defects when using those materials. Although decreasing the size of shipping containers decreases the occurrences of agglomeration, it increases packaging and shipping costs.

In addition to forming agglomerated materials during transport, repackaging particulate materials may also form agglomerates. For example, after transport to its destination, developer material must be transferred from the shipping containers, e.g., barrels or buckets, to xerographic replaceable units (XRUs), cartridges or other containers. Known system **50** is an example of a device used to transfer developer material from a bulk transport or storage container **54** to XRU **52**. Particulate material **56**, e.g., xerographic developer material, is passed from bulk container **54** to hopper **58**. Agitator motor **60** drives one or more agitators disposed within hopper **58**, e.g., central agitator **62** and/or edge agitator **64**. Agitators **62** and **64** to assist developer material **56** to remain evenly distributed within hopper **58** while auger **66** pushes or draws developer material **56** from hopper **58**. Developer material **56** exits hopper **58** through reduced region **68** with assistance from auger **66** and falls against spinning disc **70**. Spinning disc **70** imparts a centrifugal force on developer material **56** thereby throwing developer material **56** outwardly as it enters lower funnel **72**. Developer material **56** then passes through reduced region **74** to neck **76** and subsequently into cartridge **52**. It has been found that the foregoing arrangement results in the formation of some agglomerates, possibly due to heat and pressure generated by the interaction of auger **66** with developer material **56** within reduced region **68**. As described above, the formation of agglomerates results in undesirable printing defects when a toner cartridge containing those agglomerates is used.

The present disclosure addresses a system that minimizes and/or eliminates the formation of agglomerates during transfer and packaging of particulate materials.

SUMMARY

The present disclosure sets forth a device that is attached to an automatic filling system that allows a single dose of particulate material dispensed from a filler auger to be screened immediately prior to entering a container to which it is intended, e.g., an XRU, a cartridge or other suitable container. The screening operation assures that any agglomerates formed during transport or other handling of the particulate material, whether from processing, shipping, transfer, residing or subjected to the filling process, are removed so as to not contaminate the filled container. The present system maintains acceptable quality of the particulate material, thereby providing acceptable functionality from the particulate material, e.g., acceptable xerographic printing performance.

Broadly, the present disclosure describes a system for transferring a particulate material from a first container to a second container including an upper portion, a lower portion and a sieve. The upper portion includes a housing and a high frequency vibrator, the housing includes a first end, a second end opposite the first end, and a gasket positioned adjacent the first end. The lower portion includes a collector funnel, a low frequency vibrator and a collar securing the low frequency vibrator to the collector funnel. The sieve includes a mesh size, a perimeter and a gasket positioned adjacent the perimeter. The upper portion is releasably secured to the first container and the sieve is releasably secured between the second end of the upper portion and the lower portion.

Additionally, the present disclosure broadly describes a method of transferring a particulate material from a first container to a second container using a system. The system includes an upper portion, a lower portion and a sieve. The upper portion includes a housing and a high frequency vibrator, the housing includes a first end, a second end opposite the first end, and a gasket positioned adjacent the first end. The lower portion includes a collector funnel, a low frequency vibrator and a collar securing the low frequency vibrator to the collector funnel. The sieve includes a mesh size, a perimeter and a gasket positioned adjacent the perimeter. The upper portion is releasably secured to the first container and the sieve is releasably secured between the second end of the upper portion and the lower portion. The method includes: a) moving the particulate material to the upper portion from the first container; b) vibrating the upper portion with the high frequency vibrator and the lower portion with the low frequency vibrator; c) passing the particulate material through the sieve to the lower portion; and, d) moving the particulate material from the lower portion to the second container.

Other objects, features and advantages of one or more embodiments will be readily appreciable from the following detailed description and from the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments are disclosed, by way of example only, with reference to the accompanying drawings in which corresponding reference symbols indicate corresponding parts, in which:

FIG. **1** is a perspective view of a known system for transferring particulate material from a bulk container to a xerographic replaceable unit;

FIG. **2** is a side elevational view with partial cross sectional view of the system for transferring particulate material from a bulk container to a xerographic replaceable unit shown in FIG. **1**;

FIG. **3** is a side elevational view with partial cross sectional view of another embodiment of a known system for transferring particulate material from a bulk container to a xerographic replaceable unit;

FIG. **4** is an enlarged portion of the known system for transferring particulate material from a bulk container to a xerographic replaceable unit shown in FIG. **1** depicting the final filling stage;

FIG. **5** is a cross sectional view of another embodiment of a known system for transferring particulate material from a bulk container to a xerographic replaceable unit depicting a portion of the system from the bottom of the hopper to the collector funnel;

FIG. **6** is a side elevational view with partial cross sectional view of an embodiment of a present system for transferring particulate material from a bulk container to a xerographic replaceable unit depicting a portion of the system from the bottom of the hopper to the collector funnel and showing some internal components in broken lines;

FIG. **7** is a perspective view of another embodiment of a present system for transferring particulate material from a bulk container to a xerographic replaceable unit depicting a portion of the system from the bottom of the hopper to the collector funnel;

FIG. **8** is a top perspective view of an embodiment of a sieve used in a present system for transferring particulate material from a bulk container to a xerographic replaceable unit; and,

FIG. **9** is a perspective view of another embodiment of a present system for transferring particulate material from a bulk container to a xerographic replaceable unit depicting a portion of the system from the bottom of the hopper to the collector funnel and a conveyor for positioning containers to be filled with particulate material below the present system.

DETAILED DESCRIPTION

At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical, or functionally similar, structural elements of the embodiments set forth herein. Furthermore, it is understood that these embodiments are not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the disclosed embodiments, which are limited only by the appended claims.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which these embodiments belong. It should be understood that the use of "or" in the present application is with respect to a "non-exclusive" arrangement, unless stated otherwise. For example, when saying that "item x is A or B," it is understood that this can mean one of the following: (1) item x is only one or the other of A and B; (2) item x is both A and B. Alternately stated, the word "or" is not used to define an "exclusive or" arrangement. For example, an "exclusive or" arrangement for the statement "item x is A or B" would require that x can be only one of A and B. Furthermore, as used herein, "and/or" is intended to mean a grammatical conjunction used to indicate that one or more of the elements or conditions recited may be included or occur. For example, a device comprising a first element, a second element and/or a third element, is intended to be construed as any one of the following structural arrangements: a device comprising a first element; a device comprising a second element; a device comprising a third element; a device comprising a first element and a second element; a device comprising a first element and a third element; a device comprising a first element, a second element and a third element; or, a device comprising a second element and a third element.

Furthermore, as used herein, the term 'average' shall be construed broadly to include any calculation in which a result datum or decision is obtained based on a plurality of input data, which can include but is not limited to, weighted averages, yes or no decisions based on rolling inputs, etc. As used herein, "high frequency" or "ultra-high frequency" is intended to mean frequencies above 20,000 Hz typically, with a preferred but non-limiting range between 20,000-40,000 Hz, while "low frequency" is intended to mean frequencies below 120 Hz typically, with a preferred but non-limiting range between 1-120 Hz.

Moreover, although any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of these embodiments, some embodiments of methods, devices, and materials are now described.

Broadly, the present system provides a means for transferring particulate material from a bulk container to XRUs, cartridges or other suitable containers. System **100**, which is positioned below hopper **102**, includes upper portion **104** and lower portion **106**. Upper portion **104** includes cylindrical housing **108** having gasket seal **110** secured at first end **112**. Vibrator **114** is attached to cylindrical housing **108** and imparts higher frequency vibrations to housing **108** and thereby to system **100**. Vibrator **114** may be an ultra-high frequency vibration transducer such as a piezo-electric element, or any other means known in the art for imparting ultra-high frequency vibration. First end **112** is secured to hopper **102** at cover plate **116** with clamp **118**. Second end **120** is secured to lower portion **106**.

Lower portion **106** includes collector funnel **122**, vibrator **124** and collar **126** which secures vibrator **124** to collector funnel **122**. Vibrator **124** imparts lower frequency vibrations to collar **126** and collector funnel **122**, and thereby to system **100**. Vibrator **124** may be a low frequency vibrator such as a motor spinning an eccentric mass, or any other means known in the art for imparting low frequency vibration.

Sieve **128** is positioned between upper portion **104** and lower portion **106**. Sieve **128** includes gasket seal **130** about outer circumferential edge **132**. Clamp **134** secures sieve **128** to both upper portion **104** and lower portion **106**, while gasket **130** provides a seal therebetween. Sieve **128** may be constructed from any suitable material, such as stainless steel, aluminum, etc. Sieve **128** must have a mesh size sufficient to permit passage of discreet developer material particles while blocking passage of agglomerates. In short, the size of mesh used in sieve **128** is dependent on the size of individual particulate size being passed though system **100**. It should be appreciated that average sizes of toner particles or developer material particles, in some embodiments, can range between 8-10 micrometers; however, it is also possible to use system **100** with larger and small particle sizes by changing the mesh size of sieve **128**.

Collar **126** is secured to mount **136** via vibration isolators **138**. Mount **136** secures system **100** to main support column **140**, while vibration isolators **138** prevent vibration of system **100** from being transmitted to main support column **140**. Vibration isolators **138** may be formed from an elastomeric material or any other suitable material that minimizes or eliminates vibration transmission.

Particulate material **142**, e.g., xerographic developer material, is transferred from bulk container **144** to hopper **102**. As described above, material **142** is moved from hopper **102** via auger **146** and spinning disc **148** to upper portion **104**. The combination of low and high frequency vibrations provided by vibrators **114** and **124** cause material **142** to pass through sieve **128** without permitting the passage of agglomerated material. Moreover, the combination also assists with the passage of material **142** through sieve **128** as it has been found to increase the rate of passage. It is believed that the high and low frequency vibrations also aid in the separation of agglomerates formed in accordance with the description above. For example, the high frequency vibrations cause agglomerates to move up/down and side/side thereby impacting and/or abrading agglomerates against sieve **128**. The impacting and/or abrading cause discrete particles to break free of the agglomerates thereby permitting passage through sieve **128**. Subsequently, collector funnel **122** transfers material **142** to container **150**, e.g., an XRU. Thus, present system prevents the transfer of agglomerated particulate materials from a bulk container to a cartridge, a replaceable unit or other smaller container.

The present system includes a variety of components which each contribute to the overall performance of the system. Some components include but are limited to a screen and two separate and independent vibration sources. Both vibration sources combined provide vibration from very low to ultra-high frequencies tuned to allow rapid movement of particulate material through the screen. In other terms, the combination of low and high frequencies may be tuned to provide the desired ratio of material transfer across a sieve. Thus, the combination of particle size, sieve/mesh size and vibration frequencies results in a particular rate of material transfer through the sieve, i.e., a specific combination may be tuned to a desired material transfer rate by varying any one of the foregoing variables.

It will be appreciated that various of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

What is claimed is:

1. A method of transferring a particulate material from a first container to a second container using a system comprising an upper portion, a lower portion and a sieve, the upper portion comprising a housing and a high frequency vibrator, the housing comprising a first end, a second end opposite the first end, and a gasket positioned adjacent the first end, the lower portion comprising a collector funnel, a low frequency vibrator and a collar securing the low frequency vibrator to the collector funnel, and the sieve comprising a perimeter and a gasket positioned adjacent the perimeter, wherein the upper portion is adapted to be releasably secured to the first container and the sieve is releasably secured between the second end of the upper portion and the lower portion, the method comprising:

a) moving the particulate material to the upper portion from the first container;

b) vibrating the upper portion with the high frequency vibrator and the lower portion with the low frequency vibrator;

c) passing the particulate material through the sieve to the lower portion; and,

d) moving the particulate material from the lower portion to the second container.

2. The method of claim **1** wherein the first container is connected to a hopper and the system further comprises a first clamp for releasably securing the first end of the upper portion to the hopper.

3. The method of claim **1** wherein the system further comprises a second clamp for releasably securing the sieve between the second end of the upper portion and the lower portion.

4. The method of claim **1** wherein the system further comprises a mount and at least one vibration isolator connecting the mount to the collar, wherein the mount releasably secures the system to a main support column.

5. The method of claim **1** wherein the sieve comprises a mesh size, the particulate material comprises a plurality of discrete particles and a plurality of agglomerated particles, and the mesh size is selected to permit the passage of the plurality of discrete particles.

6. The method of claim **1** wherein the high frequency vibrator generates vibrations above 20,000 Hz.

7. The method of claim **6** wherein the high frequency vibrator generates vibrations between 20,000 Hz and 40,000 Hz.

8. The method of claim **1** wherein the low frequency vibrator generates vibrations below 120 Hz.

9. The method of claim **8** wherein the low frequency vibrator generates vibrations between 1 Hz and 120 Hz.

* * * * *