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Wardell

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[54] **APPARATUS FOR UNIFORMLY FEEDING NON-LIQUID MATERIAL**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 815,868, April 14, 1969, Pat. No. 3,598,286.

[52] **U.S. Cl.** **198/213,** 222/413

[51] **Int. Cl.** **B65g 33/00**

[58] **Field of Search** 198/213–217; 222/412, 413

[56] **References Cited**

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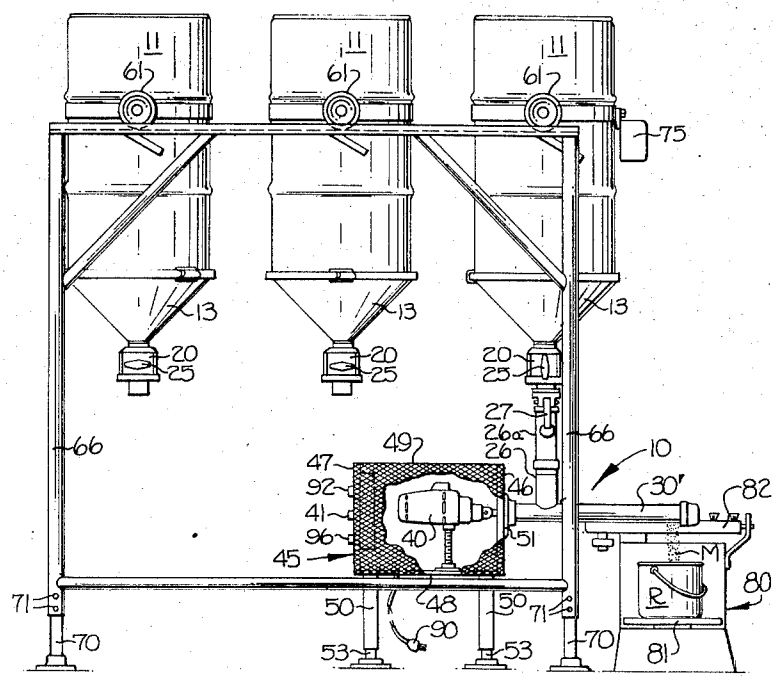
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Primary Examiner—Samuel F. Coleman
Attorney—Parrott, Bell, Seltzer, Park & Gibson

[57] **ABSTRACT**

Apparatus for uniformly feeding powder, crystalline, paste, pellet and the like non-liquid material including hopper means for dispensing the material, valve means attached to the bottom of the hopper means, enclosed, generally horizontally-extending conduit means for receiving and allowing passage therethrough of the material received therefrom and including an opening for the dispensing of the material from the apparatus, and rotary driven spiral conveying means disposed within the conduit for uniformly feeding the material therethrough. The spiral conveying means comprises a driven, cylindrical shaft, and a spiraled, generally cylindrical, flexible, resilient brush member having an initial predetermined inside diameter less than the diameter of the shaft so that the brush member may be force-fitted on the shaft to prevent relative displacement during use but allowing disengagement of the brush member for cleaning and replacement. The outside diameter of the brush member is greater than the diameter of the hollow interior of the conduit means so that the brush member will perform a cleaning action during use on the conduit means.

4 Claims, 9 Drawing Figures



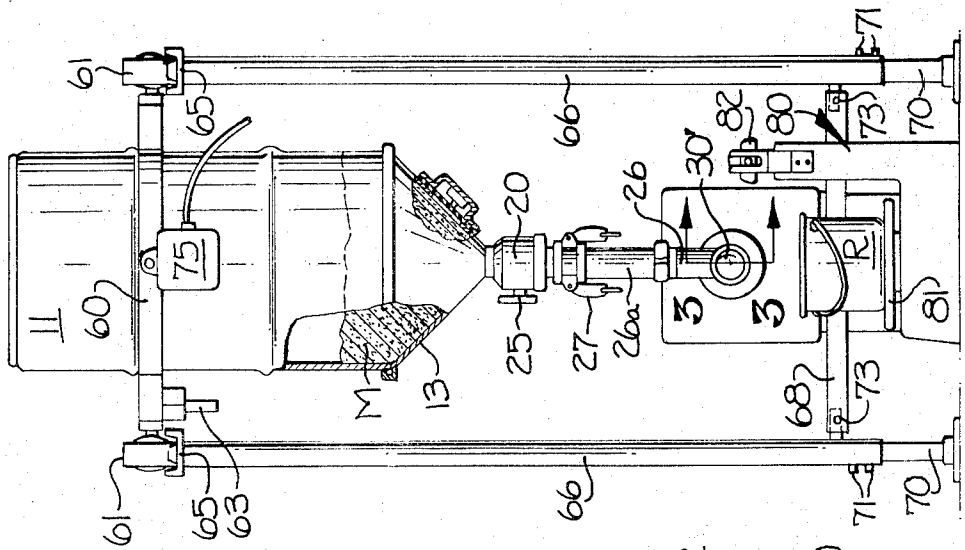


FIG. 2

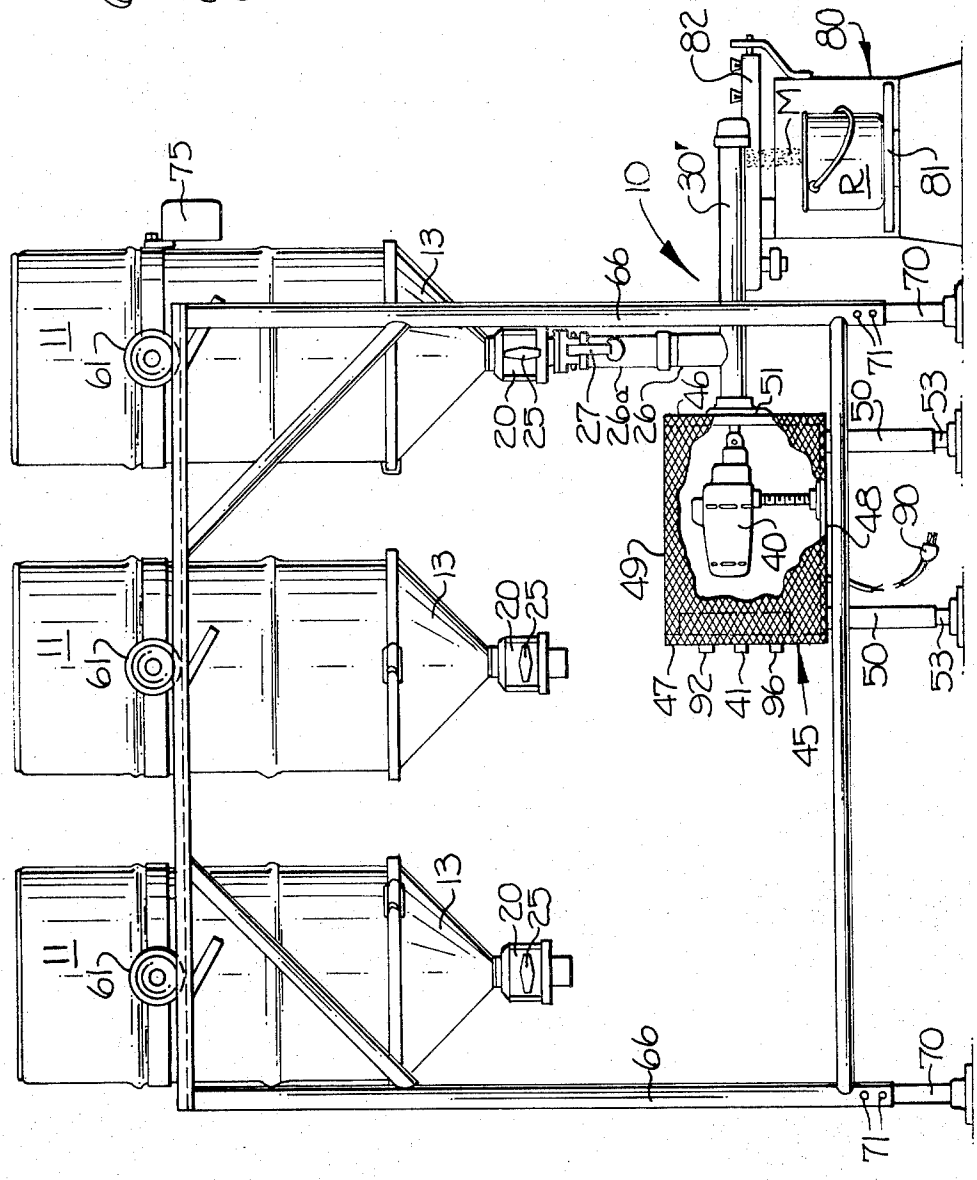


FIG. 1

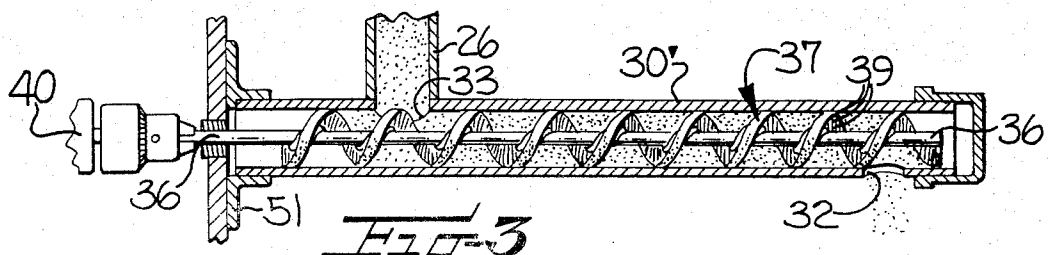


Fig-3

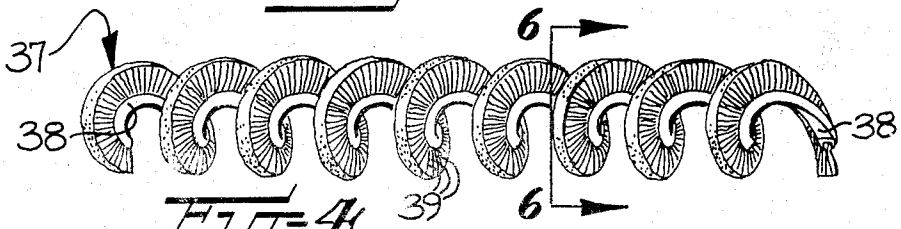


Fig-4

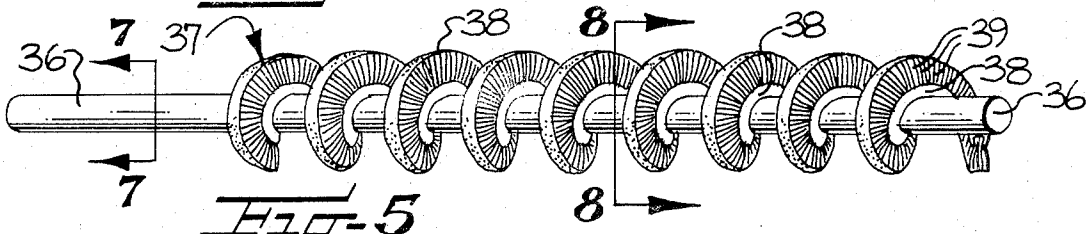


Fig-5

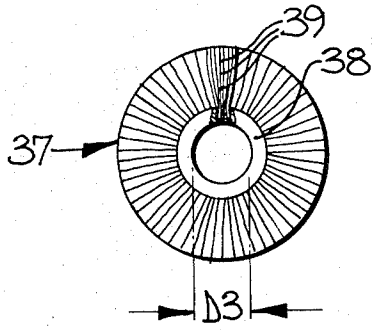


Fig-6

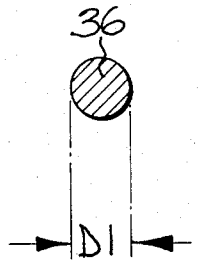


Fig-7

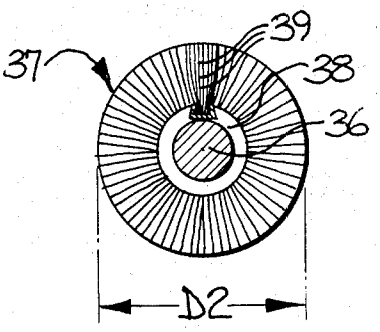


Fig-8

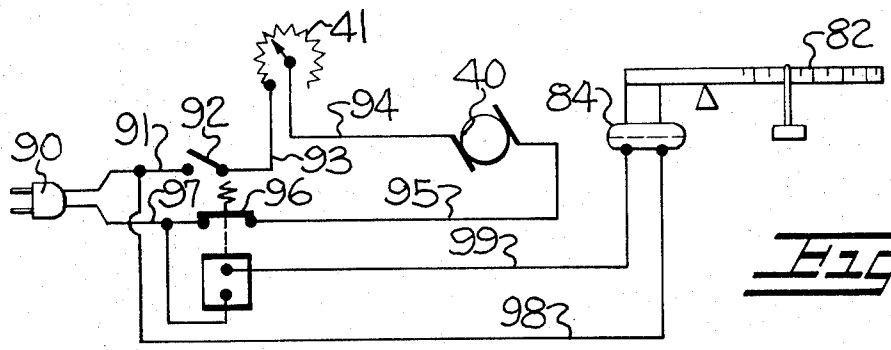


Fig-9

APPARATUS FOR UNIFORMLY FEEDING NON-LIQUID MATERIAL

This application is a continuation-in-part of application Ser. No. 815,868, filed Apr. 14, 1969, now U. S. Pat. No. 3,598,286, issued Aug. 10, 1971.

This invention is related to an apparatus for automatically and uniformly feeding powder, crystalline, paste, pellet and the like non-liquid material and is characterized by being substantially air and moisture tight to prevent damage to the material being fed and by having components thereof detachably secured together for ease in assembly and disassembly, and to an improved spiral conveying means therein.

In the use of many non-liquid chemical materials, particularly in powder, crystalline, paste and pellet form wherein the material is to be admixed in certain proportions or weights with other material for use in industrial operations, there has not heretofore been provided any satisfactory means for uniformly and automatically feeding of this type of material into a receptacle for the admixing thereof. Also, many of these types of material are susceptible to damage or deterioration when exposed to external air or moisture and the problem of removing these materials from the container in which they are shipped to obtain the proper weight or proportion thereof for industrial admixing without excessive exposure to external air and moisture has been a problem.

Heretofore, these operations have been done either entirely manually or semi-automatically with the result that the materials have been at least partially exposed to air or moisture causing harmful effects thereto and the operations were necessarily laborious, time consuming and uneconomical.

Accordingly, it is the object of this invention to provide an apparatus for automatically and uniformly feeding non-liquid materials, such as powder, crystalline, paste, pellet and the like, and characterized by being substantially air and moisture tight to prevent damage to the material being fed and by having components thereof detachably secured together for ease in assembly and disassembly.

It is a further more specific object of this invention to provide an improved spiral conveying means for use with automatic material feeding apparatus which will provide ease in disassembly and cleaning or replacement of the component parts and which will provide a cleaning action while feeding the material.

It has been found by this invention that the objects may be accomplished by the following apparatus.

An automatic and uniform feeding apparatus is provided which comprises a hopper means for dispensing the material being fed. An enclosed, vertically-extending valve means is sealingly attached to the bottom end of the hopper means for receiving the material from the hopper means and allowing passage therethrough when in an open feeding condition and preventing passage therethrough when in a closed non-feeding condition.

The apparatus further includes an enclosed, horizontally-extending conduit means defining a generally cylindrical hollow interior and being sealingly secured to the valve means for receiving and allowing passage therethrough of the material received therefrom and including an opening therein for the dispensing of the material therefrom. A driven, spiral conveying means is

disposed within the hollow interior of the horizontally-extending conduit for uniformly feeding the material therethrough and out of the dispensing opening.

Preferably, the spiral conveying means comprises a driven cylindrical shaft having a predetermined diameter and a smooth, non-grooved outer surface, and a spiraled, generally cylindrical, flexible, resilient brush member having a predetermined outside diameter and defining a hollow interior having an initial predetermined diameter less than the diameter of the shaft. The brush member is force-fitted on the shaft to prevent relative displacement during use, but allowing disengagement of the brush member from the shaft for cleaning and replacement. The outside diameter of the brush member is greater than the diameter of the hollow interior of the conduit means so that the brush member will wipe against the portion of the conduit means defining the hollow interior for performing a cleaning action.

Some of the objects and advantages of the invention having been stated, other objects and features will appear as the description proceeds when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevational view illustrating the preferred form of feeding apparatus of this invention;

FIG. 2 is a front elevational view taken from the right-hand side of FIG. 1;

FIG. 3 is an enlarged, side, sectional detail of the horizontally-extending conduit and spiral conveying means therein illustrated in the apparatus of FIG. 1;

FIG. 4 is an enlarged view of the improved flexible brush member forming a part of the spiral conveying means illustrated in FIG. 3;

FIG. 5 is an enlarged view of the spiral conveying means, illustrated in FIG. 3, showing both the driven shaft and the flexible brush member secured thereon;

FIG. 6 is a cross-sectional view of the spiraled brush member of FIG. 4 and taken generally along the line 6—6 of FIG. 4;

FIG. 7 is a cross-sectional view of the shaft member utilized in the spiral conveying means and taken generally along the line 7—7 of FIG. 5;

FIG. 8 is a cross-sectional view of the spiral conveying means and taken generally along the line 8—8 of FIG. 5; and

FIG. 9 is a schematic wiring diagram of the apparatus of FIG. 1.

A preferred embodiment of the apparatus for automatically and uniformly feeding powder, crystalline, paste, pellet and the like non-liquid material M is shown in its entirety in FIGS. 1 and 2 and is referred to therein generally by the reference numeral 10. The material M is normally shipped in drum-like containers 11 which include a removable lid (not shown) normally forming the top of the container and a "bung" hole (indicated at 12 in FIG. 6) normally formed in the bottom of the container and closed by a threaded plug (not shown) during shipment. The feeding apparatus 10 of this invention is preferably constructed for feeding the material M from any container or directly from the containers 11 and thereby eliminating excessive exposure of the material M to external air and moisture and eliminating the necessity to remove the material M to another container.

For this purpose, there is provided a hopper member **13**, which is preferably funnel-shaped, for being sealingly and detachably secured to the open end of the otherwise substantially enclosed container **11** of material M when the lid from the container is removed. The hopper **13** may be secured to the container **11** by the clamping band device **14** conventionally utilized on the container for holding the lid thereon. When the hopper member **13** is secured to the container **11**, the container **11** may be inverted so that the hopper means is on the bottom thereof for receiving the material M from the container.

However, the material M may be transferred from the container in which it is shipped to the apparatus **10** of this invention and, in that event, the hopper **13** would comprise an enclosed structure.

Sealingly attached to the bottom end of the hopper means **13** is a vertically-extending valve means **20** which may be of any convenient construction for receiving the material M from the hopper means **13** and allowing passage therethrough when the valve means **20** is in an open feeding condition and for preventing passage therethrough when the valve means **20** is in a closed non-feeding condition. This valve means, as more fully described in the aforesaid parent application, may comprise a vertically-extending housing defining a vertically-extending passage therethrough and which contains a rotatable ball member generally centrally thereof including a passageway extending therethrough. The valve member could also include a manually operable handle member **25** (FIG. 1) passing through the housing and secured to the ball member for rotating the ball member so as to align the passageway thereof with the passageway through the housing when it is desired to have the valve member in the open feeding condition and for rotating the ball member 180° so that the passageway of the ball member is non-aligned with the passageway of the housing when it is desired to have the valve in a closed non-feeding condition to prevent the passage of material M therethrough.

The feeding apparatus **10** may further comprise an enclosed, vertically-extending conduit means **26** having one end thereof sealingly and detachably secured to the bottom of the valve means by any convenient clamping means, indicated generally at **27** in FIG. 1, for receiving and allowing passage therethrough of the material M from the valve means **20** when the valve means is in the open feeding condition thereof and which may be conveniently detached from the valve means when no feeding of the material M or otherwise is desired. This vertically-extending conduit **26** may also include a portion **26*a*** which is flexible for ease in attachment and detachment to the valve means **20** and for ease in alignment of the feeding means **10** with the container **11** of material M. This flexible portion **26*a*** could also be constructed of a transparent material for viewing of the material M being fed.

To the open bottom end of the vertically-extending conduit **26** or directly to the valve means **20** there is sealingly secured an enclosed, horizontally-extending conduit **30** defining a generally cylindrical hollow interior **30'** and having a first opening **33** for receiving and allowing passage therethrough of the material M received from the conduit **26**. The horizontally-extending conduit **30** is closed at one end thereof by a cap member **31** and includes an opening **32** in the bottom thereof for dispensing of the material M therefrom.

The horizontally-extending conduit **30** has disposed internally within its hollow interior **30'** a driven, spiral conveying means **35** which extends generally the entire length thereof. This spiral conveying means will receive the material M dropping into the horizontally-extending conduit **30** from the vertically-extending conduit **26** and uniformly and evenly will feed this material M to the dispensing opening **32** for allowing the material M to drop out of the horizontally-extending conduit by gravity into any desired receptacle, as may be clearly seen in FIG. 3.

The preferred form of spiral conveying means comprises a driven cylindrical shaft **36** extending therefrom and out of the horizontally-extending conduit **30** and which is attached at its protruding free end thereof to a variable speed motor **40** for driving the spiral conveying means at a variety of speeds according to the type of material to be fed and the speed of feed desired. The speed of the variable speed motor **40** is controlled by a rheostat mechanism **41**, as will be described hereinafter.

Referring to FIGS. 3 - 8 specifically, the shaft **36** has a smooth, non-grooved outer surface and a predetermined diameter D1, see FIG. 7. The spiral conveying means **35** further includes a spiraled, generally cylindrical, flexible, resilient brush member **37** having a predetermined outside diameter D2, see FIG. 8, and defining a hollow interior having an initial predetermined diameter D3, see FIG. 6, less than the diameter D1 of the shaft **36**. This allows the brush member **37** to be force-fitted on the shaft **36**, as shown in FIG. 5, to prevent relative displacement during use, but allowing disengagement of the brush member **37** from the shaft **36** for cleaning and replacement. The outside diameter of the brush member **37** is greater than the diameter of the hollow interior **30'** of the conduit means **30** so that the brush will wipe against the portion of the conduit means defining the hollow interior for performing a cleaning action during feeding of the material M.

The flexible brush member **37** preferably comprises a spiraled, resilient base portion **38** having a generally U-shaped, transverse, cross-sectional configuration, as shown in FIGS. 6 and 8, and a plurality of individual flexible bristles **39** of predetermined length having one end of each secured within the base portion **38** and extending longitudinally outwardly therefrom, as may be seen in FIGS. 4, 5, 6 and 8. The base portion **38** may be formed of any resilient metal or the like material and the bristles **39** may be of any conventional brush bristle material.

Thus, the above preferred structural arrangement of the spiral conveying means provides a spiral conveying means in which the brush member **37** may be easily disengaged from the shaft **36** for cleaning and replacement and does not require the necessity of grooves in the shaft **36** or set screws, etc. for securing the brush member to the shaft which are objectionable in that the grooves and securing means provide areas for lodging of material being fed resulting in undesirable conditions.

For supporting the above-described apparatus, there is provided a motor housing, generally indicated at **45**,

comprising a front plate **46**, a back plate **47**, and a bottom plate **48** secured together and having a wire mesh or other suitable cover **49** thereon to form a generally rectangular housing. To the bottom plate **48** is attached four leg members **50** for supporting the housing **45** on the floor or other surface. The front plate **46** includes a threaded collar **51** for detachably receiving one end of the horizontally-extending conduit **30** and supporting it and the other above-described conduits in their described positions.

The leg members **50** include suitable vertical adjustment means for the raising and lowering thereof so that the height of the motor housing **45** and thus the horizontally-extending conduit **30** and the vertically-extending conduit **26** may be vertically adjusted to accommodate different size containers **11**. This adjustment means may be in the form of telescoping leg portions **53** received internally of the legs **50** and having suitable apertures therein which mate with suitable apertures in the leg members **50** for the reception of pin members **54** to maintain the leg members **50** in various vertical height positions.

The feeding apparatus **10** may also include means for supporting a plurality of containers **11** of material M in which one of the containers **11** may be placed directly above the feeding apparatus for connection thereto, as described above, for the feeding of material therefrom and in which other containers **11** of material M may be placed in reserve positions for easily and quickly moving into the feeding position when the material from the other container is spent. This means may comprise a clamping band **60** for detachably clamping around the container **11** of material M and having rotatable wheel means **61** on protruding outer ends thereof, as shown particularly in FIGS. **1** and **2**. The clamping band **60** may be of any convenient construction including a pivot **62** on one side thereof and a manual clamp securing means **63** on the other side thereof for detachably holding the clamping band **60** around the container **11** of material M.

There is further provided a pair of horizontally-extending, parallel, spaced-apart track members **65** supported on the top of vertically-extending leg member **66**. For providing additional support to this structure, horizontally-extending support members **67** and **68** extending between the four legs **66** near the bottom thereof are provided, as shown in FIGS. **1** and **2**.

The track members **65** are adapted to receive the wheel **61** secured to a plurality of the containers **11**, as shown in FIG. **1**. For ease in quickly replacing the spent container **11** with a new container **11** of material M, a separate hopper member **13** and valve member **20** may be attached to each of the containers **11** received on the track members **65**, as shown in FIG. **1**. The valve members **20** of the reserve containers **11** would be positioned in the non-feeding condition thereof to prevent the escape of material therefrom and when the container **11** of material M in the feeding position is spent, it may be simply removed from the track member **65** and a new container **11** of material M rolled into position over the vertically-extending conduit **26** and the valve member **20** attached to the conduit **26** by the clamping member **27**. Following this securement the valve member **20** may be opened to the open feeding condition thereof and feeding of the material M from the new container **11** resumed.

The track members **65** may include means for both horizontal and vertical adjusting means for accommodating various size containers **11**. These adjustment means could include telescoping leg members **70** received internally in the bottoms of the legs **66** with suitable apertures therein mating with suitable apertures in the leg members **66** for the reception of pins **71** therethrough for positioning the legs **66** in a variety of vertical height positions.

For adjusting the track members **65** horizontally toward and away from each other, the supports **68** joining the leg members **66** may be broken in the middle thereof and telescopingly receive an internal cylindrical member **72** which includes suitable apertures therein mating with apertures in the members **68** for the reception of pins **73** therein to hold the support members **68** and thus the track members **65** in a variety of horizontally-spaced positions.

The feeding apparatus **10** includes a vibrator means for attachment to the container **11** of material M for vibrating the container during feeding of the material to aid in equalizing the density of the material M in the container **11** for obtaining an even uniform feeding of the material M. This vibrator means may comprise a vibrator motor **75** which is attached to the container **11** in any suitable manner. As illustrated in the drawings, the motor is detachably secured to the clamping band **60** around the container **11** to rest directly on the wall of the container **11** for vibrating the container **11** during feeding of the material M therefrom.

The feeding apparatus **10** may also include a means for weighing a predetermined weight of material dispensed from the dispensing opening **32** in the horizontally-extending conduit **30** and for shutting-off operation of the variable speed motor **40** driving the spiral conveying means **35** when the predetermined weight of material has been received. This means includes any conventional scale mechanism **80** having a weighing platform **81** adapted to hold a receptacle R for receiving material M from the dispensing opening **32**, as shown in FIG. **1**. The scale mechanism **80** would conventionally include a pivoted arm **82** containing weights, etc., which may be set in a predetermined manner such that the arm will pivot when a predetermined weight of material has been received on the weighing platform **81**.

To one end of the pivoted arm **82** is attached a switch **84**, of any convenient type and preferably a mercury switch. The switch **84** is operatively attached to the variable speed motor **40**, as will be described in detail hereinafter, so that when the predetermined weight of material M has been received in the receptacle R on the weighing platform **81** of the scale means **80**, the pivoted arm **82** will pivot which in turn will cause the switch **84** to disengage and shut-off the operation of the variable speed motor **40** to stop the drive to the spiral conveying means **35** and thus stop the feed of the material M through the horizontally-extending conduit **30**.

Referring now to the schematic wiring diagram of FIG. **9**, it may be seen that a source of electrical power is indicated by the electrical plug **90** which is connected by a line **91** to a switch **92**. The switch **92** is an apparatus off-on switch and is located on the motor housing plate **47** which is utilized as a control panel for the apparatus. When the switch **92** is in operative en-

gagement or in the on position, electrical power will be transmitted through a line **93** from the switch to the rheostat means **41** which controls the amount of electrical energy supplied to the motor **40** through a line **94**. Thus, the rheostat means will control and vary the speed of operation of the motor **40** in a manner well understood by those with ordinary skill in the art.

From the motor **40** the circuit back to the source of electrical energy is completed through a line **95** which passes through a switch **96**, normally in engagement to bridge or connect the line **95** with a line **97** returning to the source of energy **90** for completion of the circuit. The above-described mercury switch **84** on the pivoted arm **82** of the scale means **80** includes a first contact connected in the circuit through a line **98** which connects directly to the line **91** leading from the power source **90**. The other contact of the mercury switch **84** is connected by a line **99** to the return line **97** such that the mercury switch is connected in parallel with the rheostat **41** and motor **40** so that the circuit or supply of electrical energy thereto may be broken by the mercury switch **84** when it is disengaged. The line **99** from the mercury switch **84** to the return line **96** coils around an extension of the switch **96** such that when the mercury switch **84** is disengaged, the switch **96** will be opened and will remain open even though the mercury switch **84** is subsequently engaged. The switch **96** forms a reset switch and will leave the circuit to the rheostat **41** and the motor **40** open until manually reset.

Thus, in operation of the feeding apparatus **10**, the electrical plug **90** will be plugged into any convenient source of electrical energy and will normally supply electrical energy through the rheostat **41** to the motor **40** for operating the feeding apparatus when the off-on switch **92** is manually closed to start operation of the feeding mechanism **10**. When a predetermined weight of material has been received on the scale mechanism **80**, the pivoted arm **82** will pivot breaking the normally engaged contacts of the mercury switch **84** which will break the circuit to the motor **40** and thus shut-off operation of the apparatus **10**. This will also open the reset switch **96** and the machine will be inoperative until the pivoted arm **82** and mercury switch **84** are returned to their normal position and the reset switch **96** is manually engaged again.

The feeding apparatus **10** may include a switch means **110** attached to the hopper member **13** and operatively associated with the driven spiral feeding means **35** for stopping operation thereof as the material M being fed from the container is spent and thus stop the feed of material M through the apparatus **10**. The switch means **110** includes a movable switch actuating member **111** extending from a suitable electrical switch **112** and protruding into the interior of the hopper member **13**. The switch **112** is suitably electrically connected to rheostat mechanism **41** and the variable speed motor **40** in any suitable manner such that when the switch is open, the current to the variable speed motor **40** will be broken and operation thereof will be stopped and when the switch is in a closed position, operation of the motor **40** may be continued. The actuating member **111** is adapted to normally assume a switch opening position in which the circuit to the variable speed motor **40** is broken and may be moved to a switch closing position, as shown in FIG. **2**, for allowing operation of the motor **40** for driving the spiral feeding means **35**. The switch means **110** further includes a resilient diaphragm member **113** bolted or otherwise secured to the inside of the hopper member **13** around the actuating member **111** for moving the actuating member into the switch closing position when the material M being fed is passing through the hopper member **13**. This is accomplished by the weight of the material M pressing the diaphragm **113** against the inside of the hopper member **13**, as shown in FIG. **2**. When the material being fed has been spent, the diaphragm member **113** will move to an outwardly curved position to allow the actuating member **111** to assume its normally switch opening position so as to break the circuit to the variable speed motor **40** to stop the feeding operation of the apparatus **10**.

The switch **110** may be operatively connected with a suitable alarm (not shown) in lieu of feeding means **35** for signaling an operator to manually shut off feed of the material M from one container **11** and begin feed of material M from another container **11**.

Thus, it may be seen that by this invention an apparatus has been provided which will uniformly feed non-liquid material and which includes an improved spiral conveying means.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. Apparatus for uniformly feeding powder, crystalline, paste, pellet and the like material; said apparatus comprising:

hopper means for dispensing the material being fed;

enclosed, generally vertically-extending valve means sealingly attached to the bottom end of said hopper means for receiving the material from said hopper means and allowing passage therethrough when in an open feeding condition and preventing passage therethrough when in a closed non-feeding condition;

enclosed, generally horizontally-extending conduit means defining a generally cylindrical hollow interior and being sealingly secured to said valve means for receiving and allowing passage therethrough of the material received therefrom and including an opening therein for dispensing the material from said apparatus; and

rotary driven spiral conveying means disposed within said hollow interior of said horizontally-extending conduit for uniformly feeding the material therethrough and out of said dispensing opening, said spiral conveying means comprising a driven cylindrical shaft having a predetermined diameter and a smooth, non-grooved outer surface, and a spiraled, generally cylindrical, flexible, resilient brush member having a predetermined outside diameter and defining a hollow interior having an initial predetermined diameter less than the diameter of said shaft, said brush being force-fitted on said shaft to prevent relative displacement during use but allowing disengagement of said brush member from said shaft for cleaning and replacement, the outside diameter of said brush member

being greater than the diameter of said hollow interior of said conduit means so that said brush member will wipe against the portion of said conduit means defining the hollow interior for performing a cleaning action.

2. Apparatus for uniformly feeding powder, crystalline, paste, pellet and the like material, as set forth in claim 1, in which said flexible brush member comprises a spiraled, resilient base portion having a generally U-shaped, transverse, cross-sectional configuration, and a plurality of individual flexible bristles of predetermined length having one end of each secured within said base portion and extending longitudinally outwardly therefrom.

3. Apparatus for uniformly feeding powder, crystalline, paste, pellet and the like material; said apparatus comprising:

enclosed, generally horizontally extending conduit means defining a generally cylindrical hollow interior and including a first opening into said hollow interior for receiving the material to be fed and allowing passage thereof through said hollow interior, and a second opening from said hollow interior for dispensing the material being fed from said conduit means; and

rotary driven spiral conveying means disposed within said hollow interior of said horizontally extending conduit means for uniformly feeding the material therethrough, said spiral conveying means comprising a driven cylindrical shaft having a predetermined diameter and a smooth, non-grooved outer surface, and a spiraled, generally cylindrical, flexible, resilient brush member having a predetermined outside diameter and defining a hollow interior having an initial predetermined diameter less than the diameter of said shaft, said brush member being force-fitted on said shaft to prevent relative displacement during use but allowing disengagement of said brush member from said shaft for cleaning and replacement, the outside diameter of said brush member being greater than the diameter of said hollow interior of said conduit means so that said brush member will wipe against the portion of said conduit means defining the hollow interior for performing a cleaning action.

4. Apparatus for uniformly feeding powder, crystalline, paste, pellet and the like material, as set forth in claim 3, in which said flexible brush member comprises a spiraled, resilient base portion having a generally U-shaped, transverse, cross-sectional configuration, and a plurality of individual flexible bristles of predetermined length having one end of each secured within said base portion and extending longitudinally outwardly therefrom.

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