United States Patent

Reckseit et al.

[15] **3,697,006**

[45] **Oct. 10, 1972**

[54] **HOIST PANS AND HOIST PAN HANDLING APPARATUS**

[72] Inventors: **Bernard S. Reckseit,** Cincinnati; **George A. Burgess,** Fairfield, both of Ohio

[73] Assignee: **Sweco, Inc.,** Los Angeles, Calif.

[22] Filed: **May 19, 1969**

[21] Appl. No.: **825,862**

[52] **U.S. Cl.**.....**241/171,** 51/164

[51] **Int. Cl.**.....**B02c 17/00**

[58] **Field of Search**.....241/109, 171, 189, 202, 222, 241/245, 248, 265, 271, 284, 301, 184; 214/741, 18 R, 18 GD, 18 V, 28, 32; 51/7, 163

[56] **References Cited**

UNITED STATES PATENTS

2,203,307	6/1940	Richardson	214/741 X
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Primary Examiner—Andrew R. Juhasz
Assistant Examiner—Gary L. Smith
Attorney—Lyon & Lyon

[57] **ABSTRACT**

A material handling system for vibratory finishing or grinding mills into which are placed materials and abrasive media and wherein the materials are operated upon. In a finishing mill the materials are parts which are finished, polished, or deburred, and in a grinding mill the materials usually are chemicals which are reduced in size. The system includes a vibratory mill into which such materials and media are placed, a vibratory screen separator for separating the materials from media after completion of the operation thereon, a hoist pan for handling the media or material and media, and a jib hoist system for moving and positioning the pan. Media or material and media are loaded into the pan, and same is lowered to the top of the finishing machine causing the load to be evenly dumped into the finishing machine. After the finishing operation, the material may be moved or transported in any suitable manner to any further operation stage, and the media is returned to the hoist pan. A pan driving mechanism is provided for rotating the pan as the media is supplied thereto from the separator or mill such that the pan is evenly loaded. Several bottom-dumping pan configurations are disclosed which provide a relatively even discharge of the media into the mill when the pan engages the mill.

13 Claims, 28 Drawing Figures

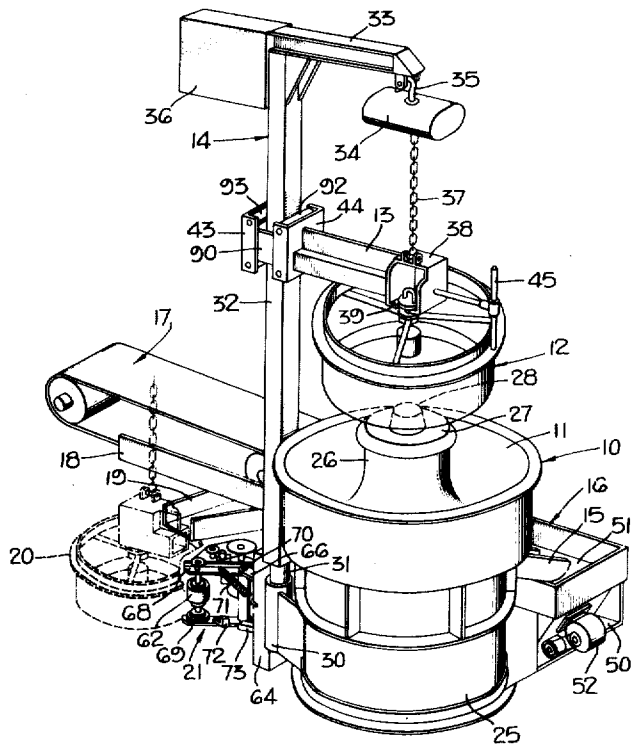


FIG. 1.

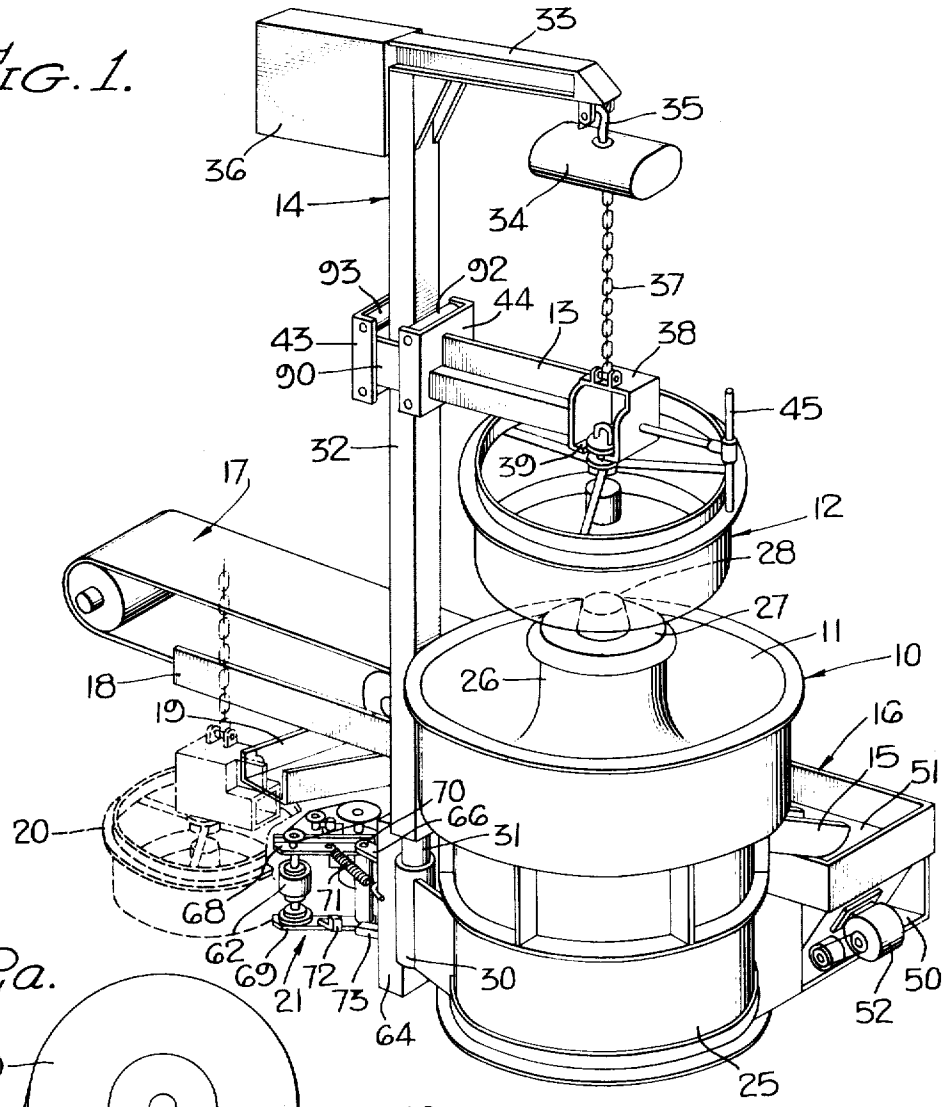
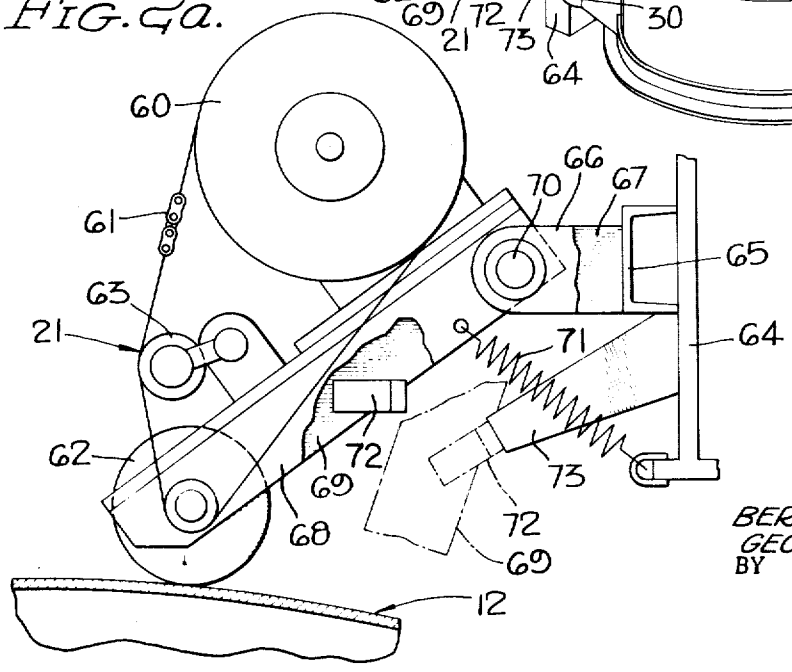


FIG. 2a.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 2b.

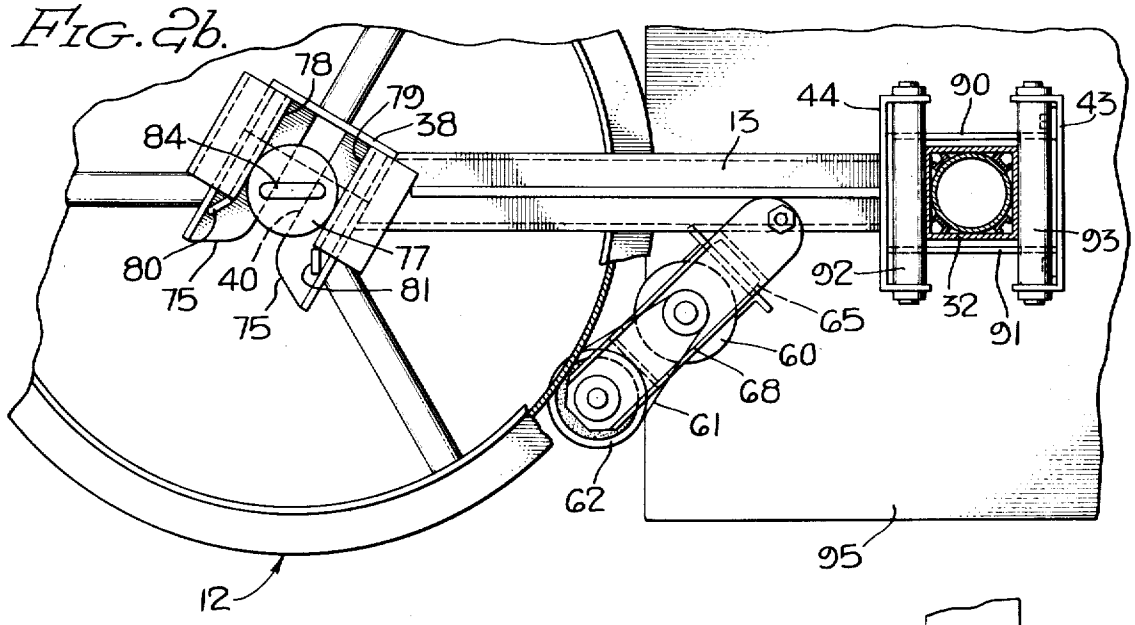


FIG. 2c.

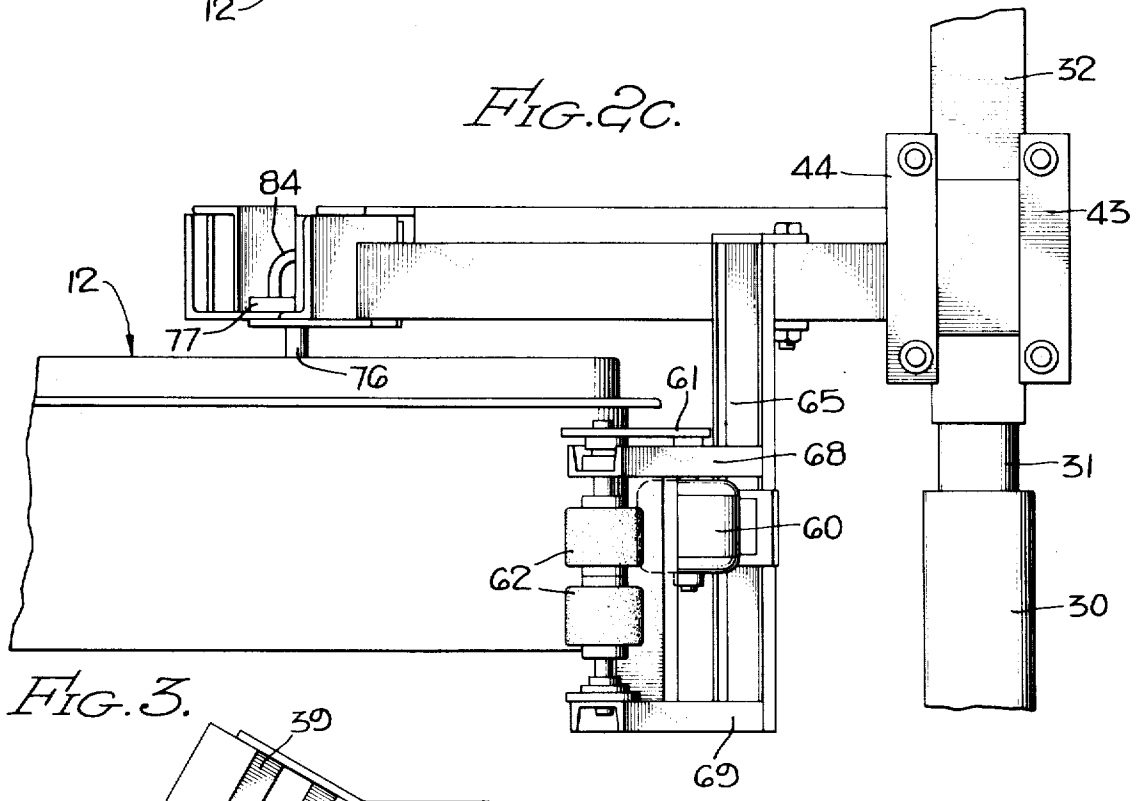
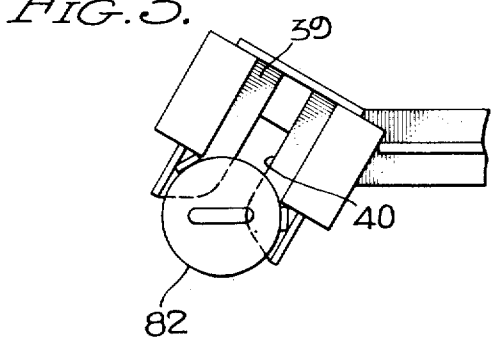


FIG. 3.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 4a.

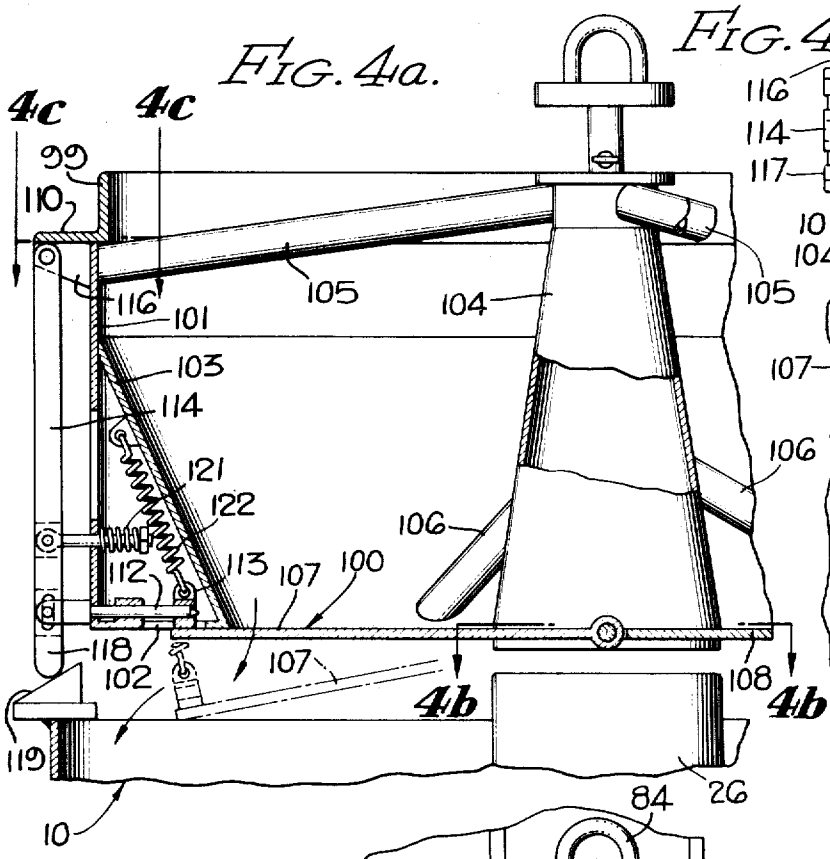


FIG. 4c.

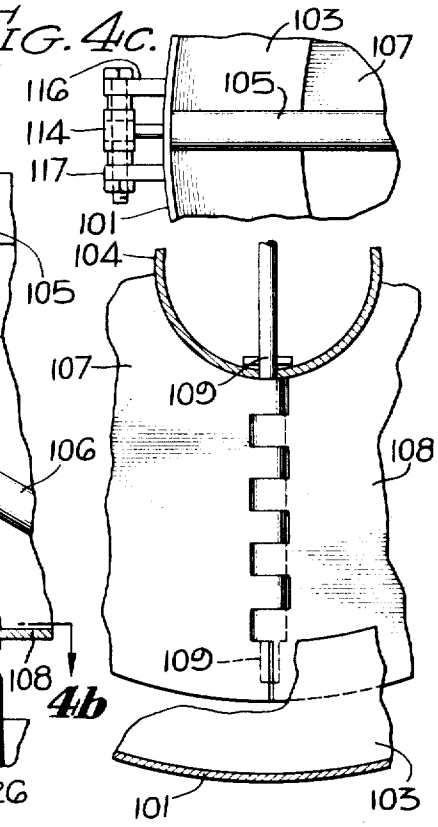
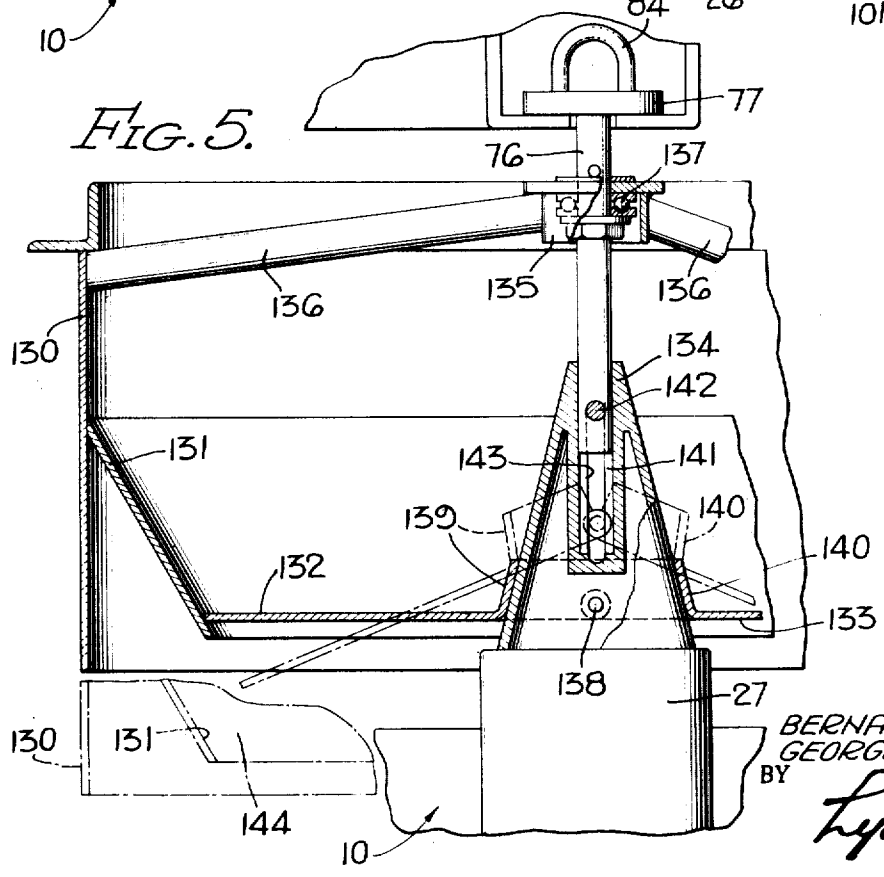


FIG. 4b.

FIG. 5.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 6a.

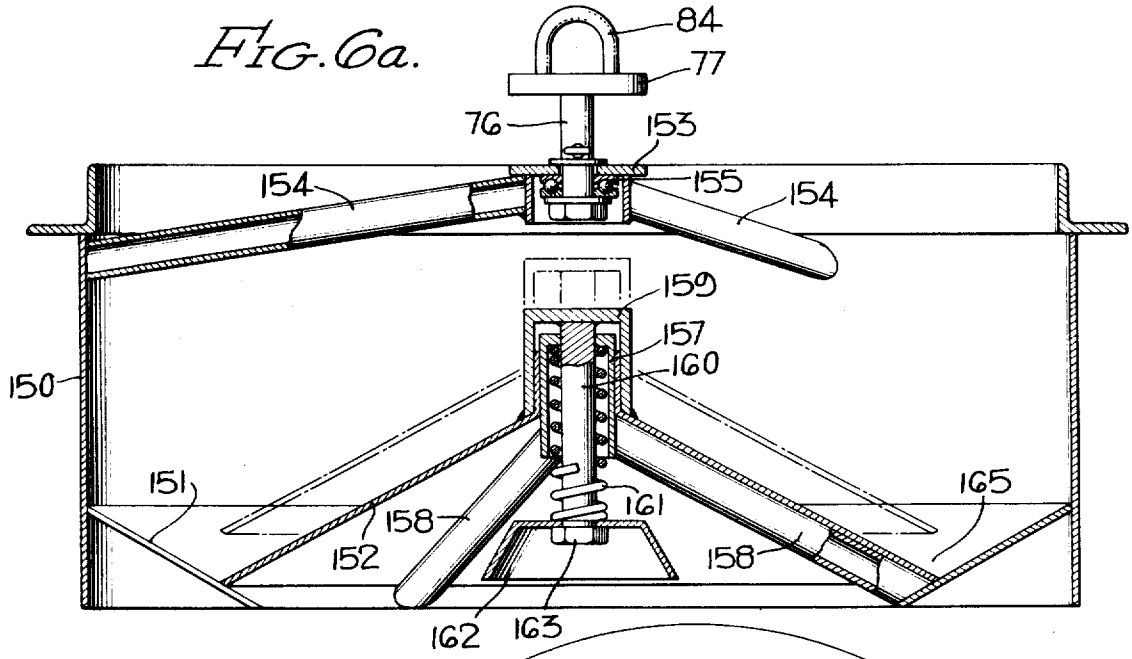


FIG. 6b.

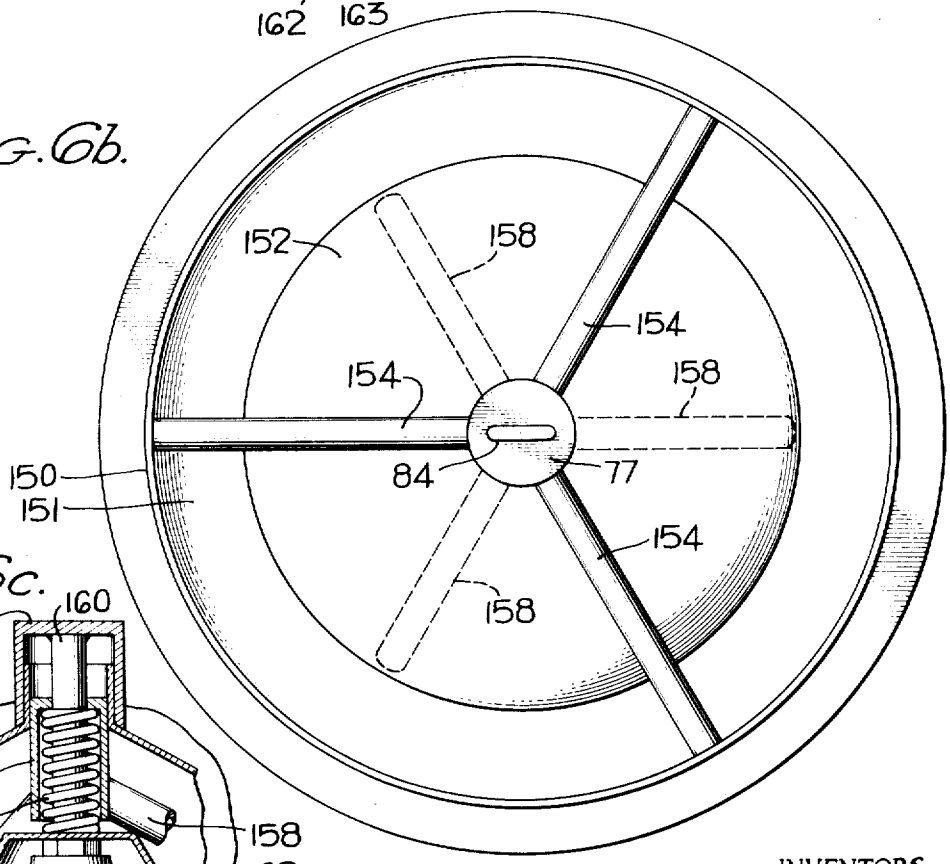
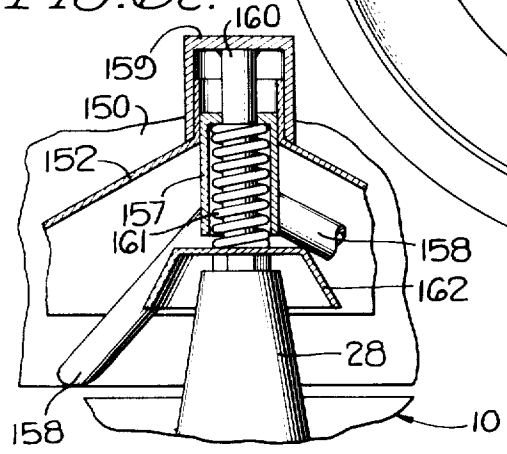
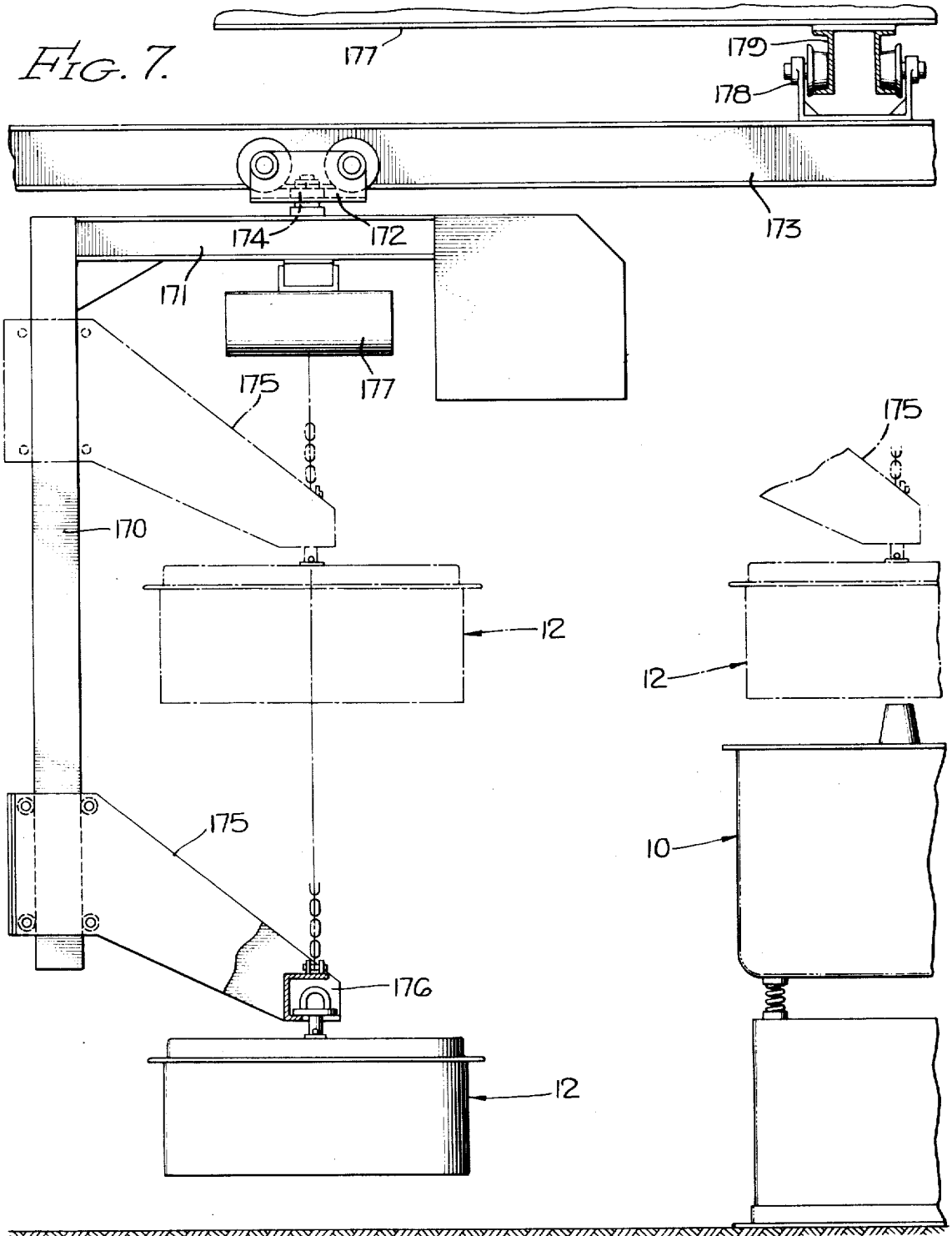


FIG. 6c.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 7.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 8a.

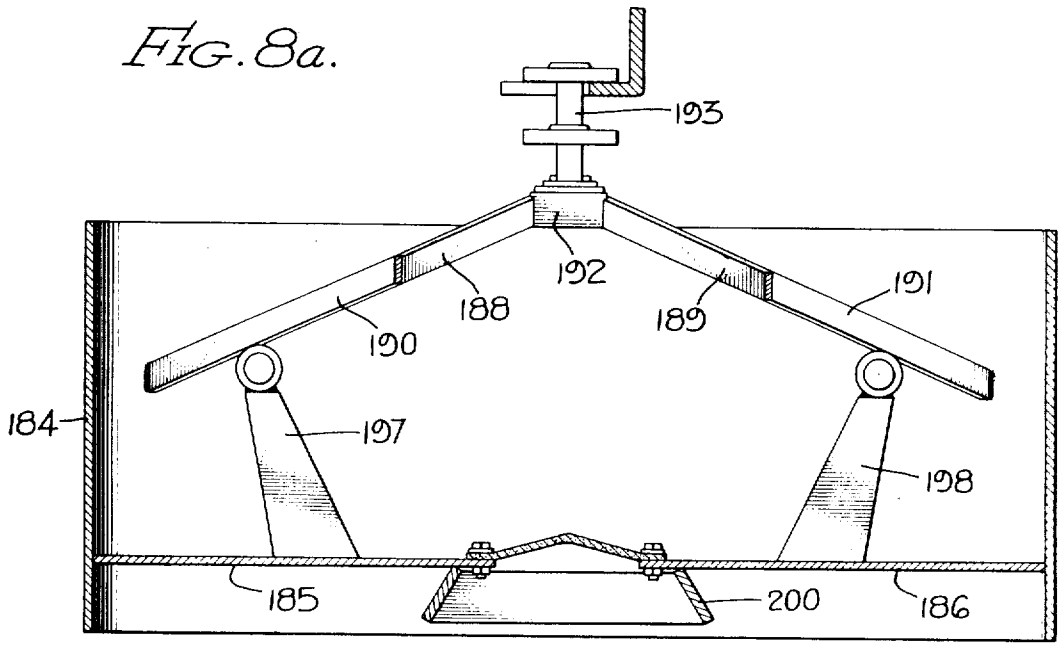
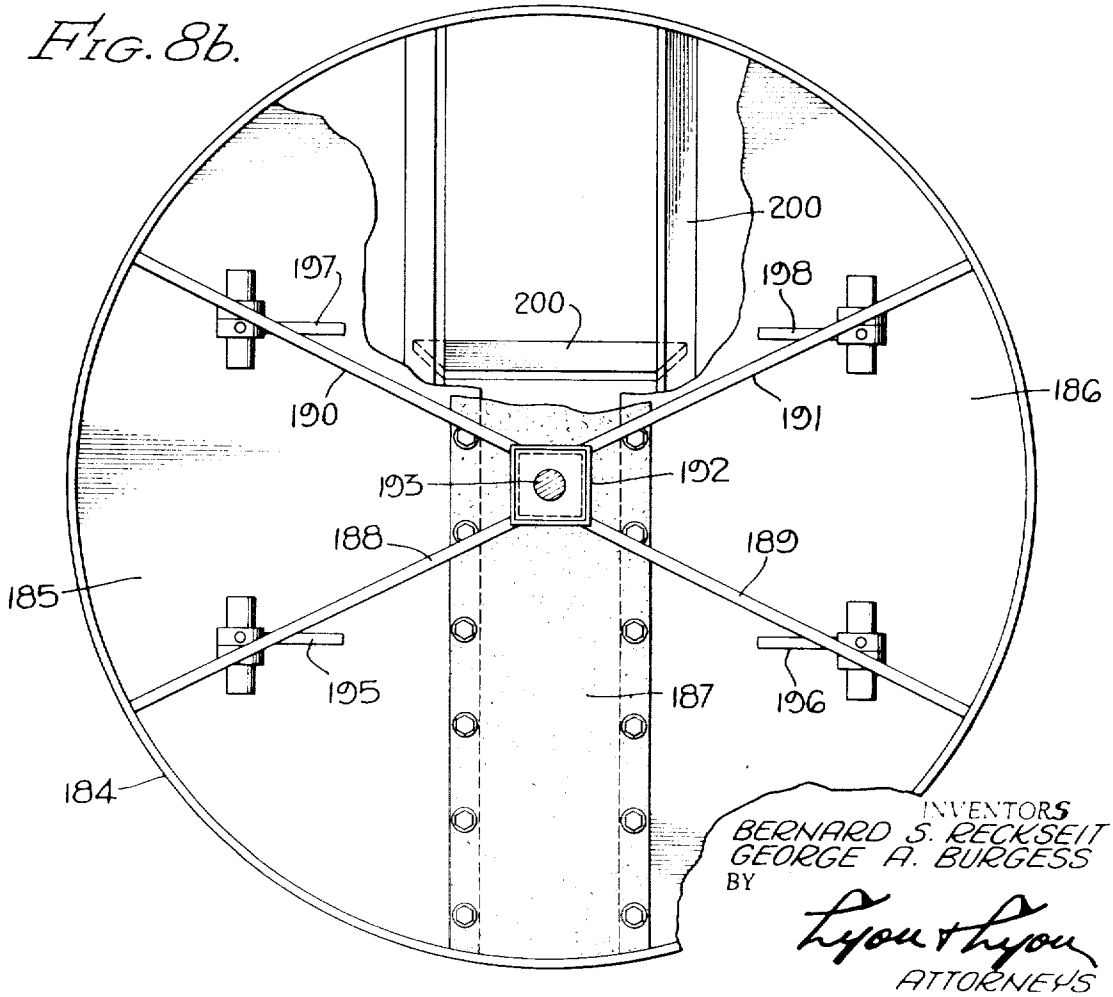


FIG. 8b.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 8c.

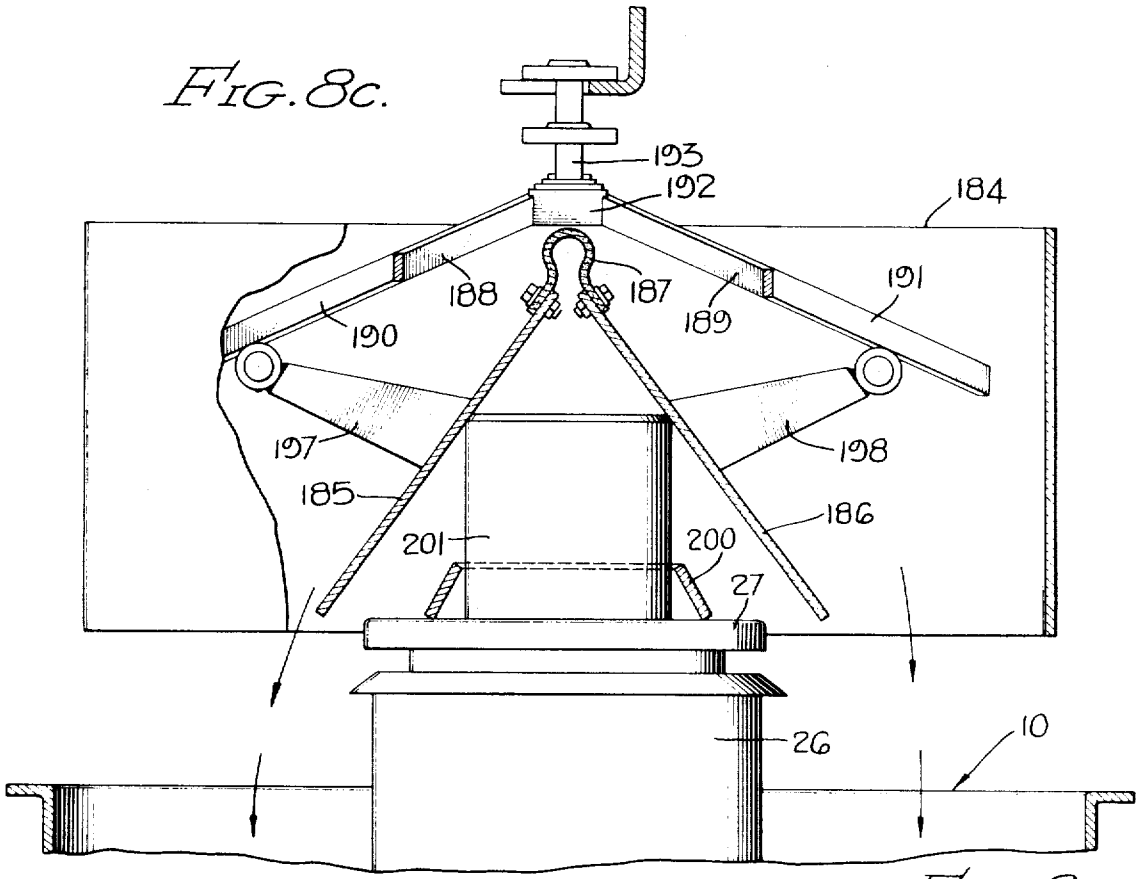


FIG. 8e.

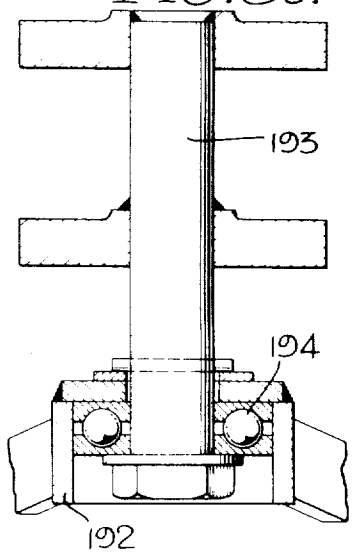
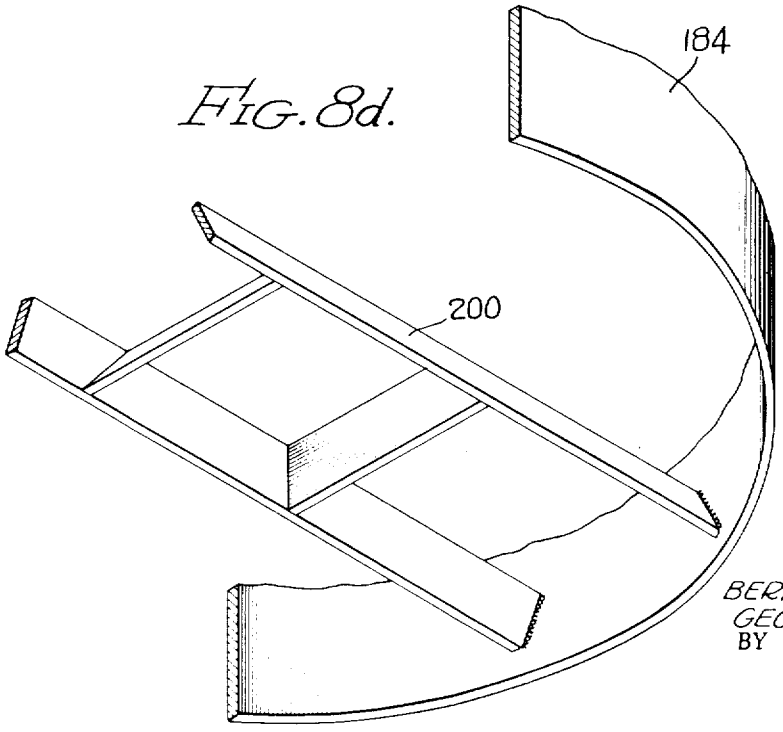


FIG. 8d.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 9a.

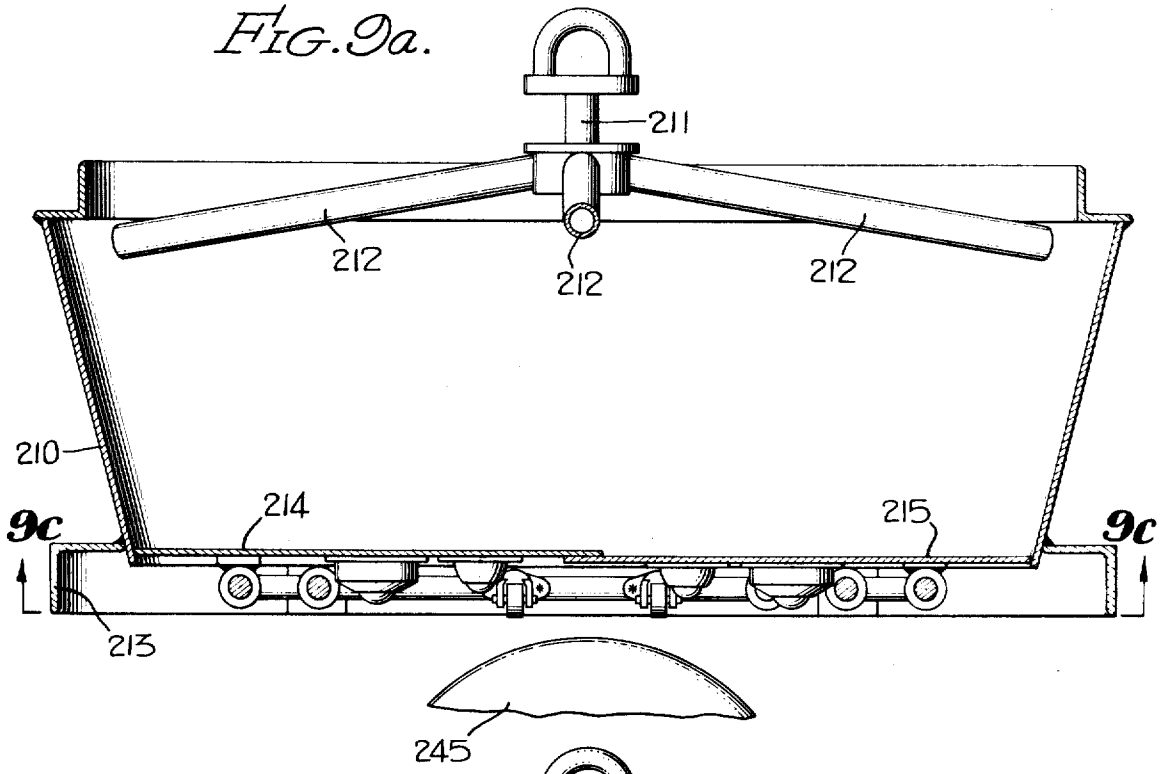
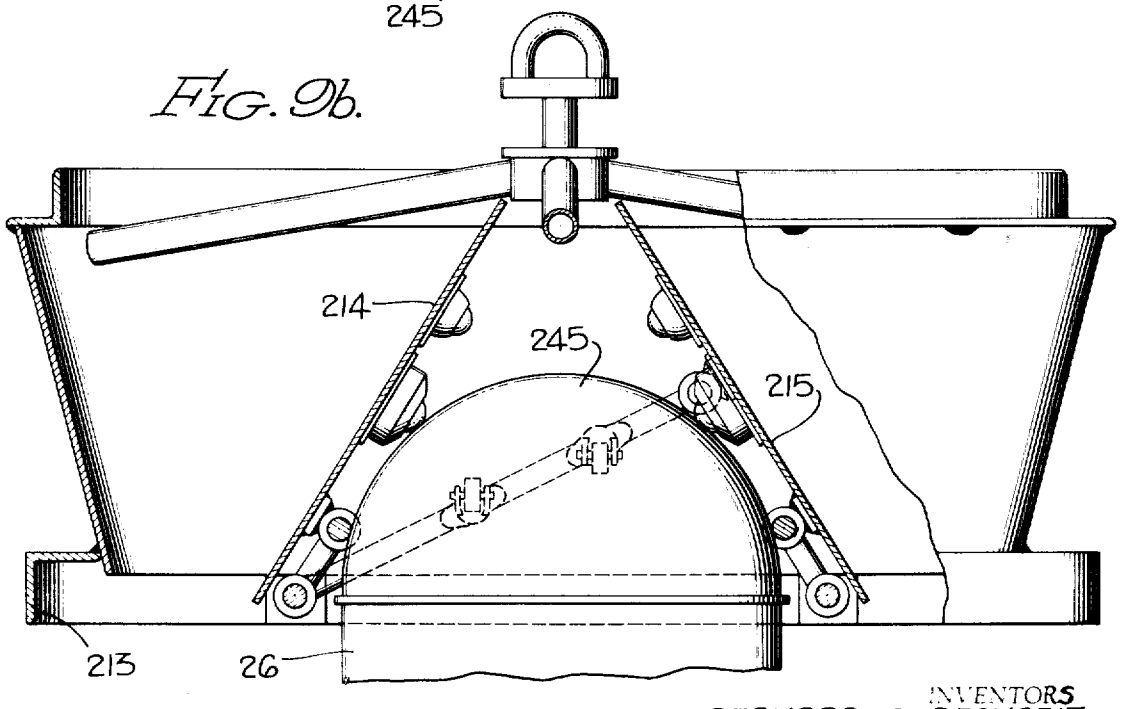


FIG. 9b.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 9c.

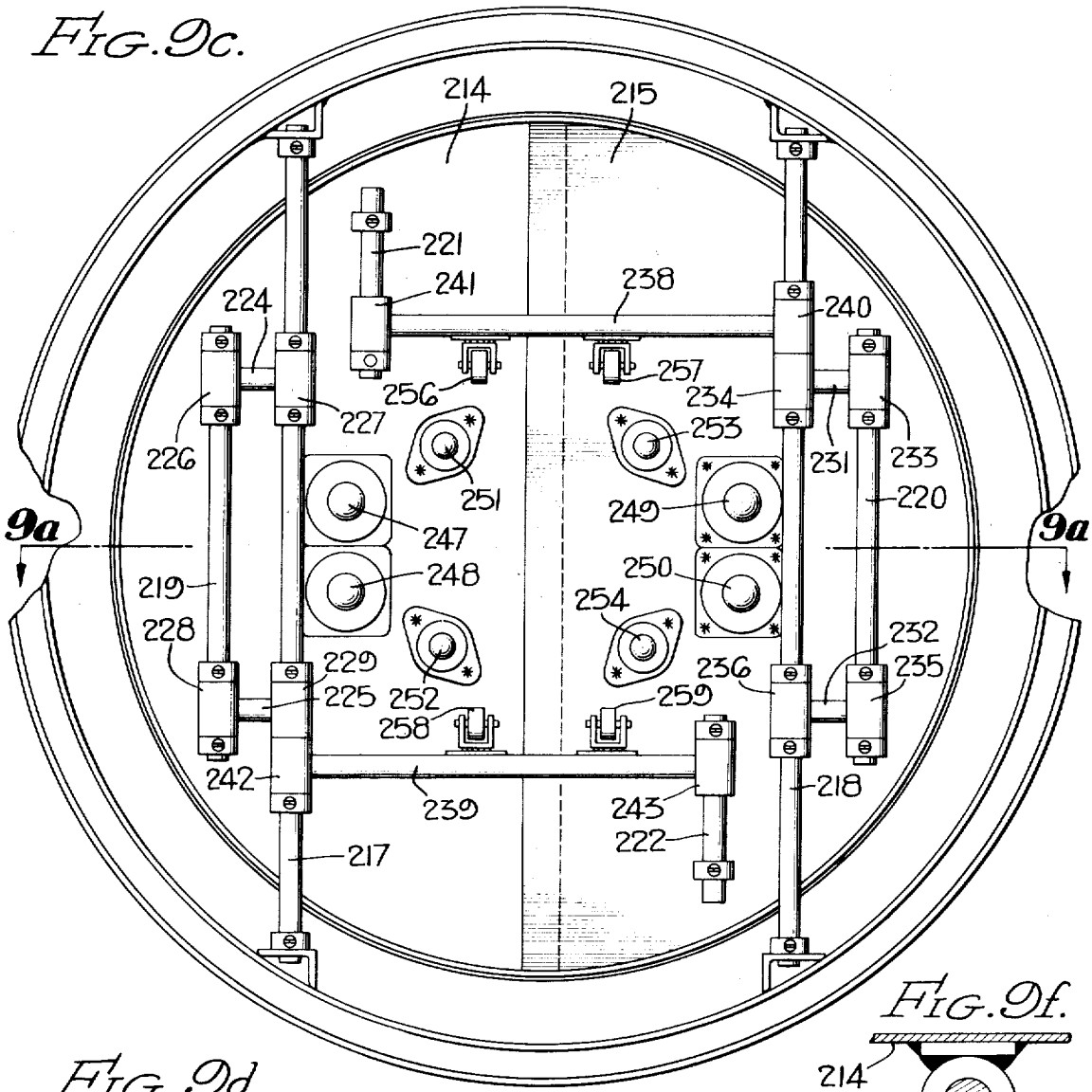


FIG. 9d.

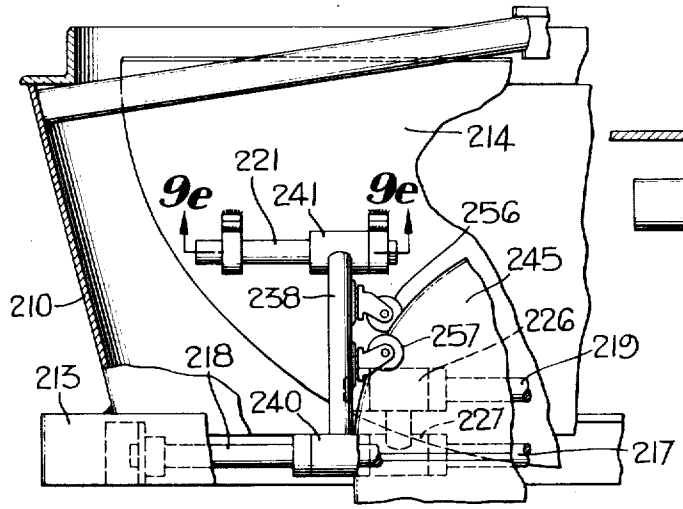


FIG. 9f.

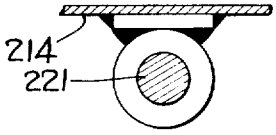
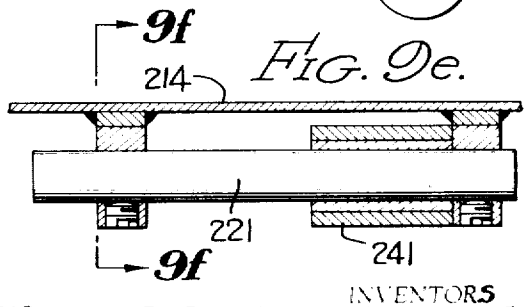


FIG. 9e.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

FIG. 10a.

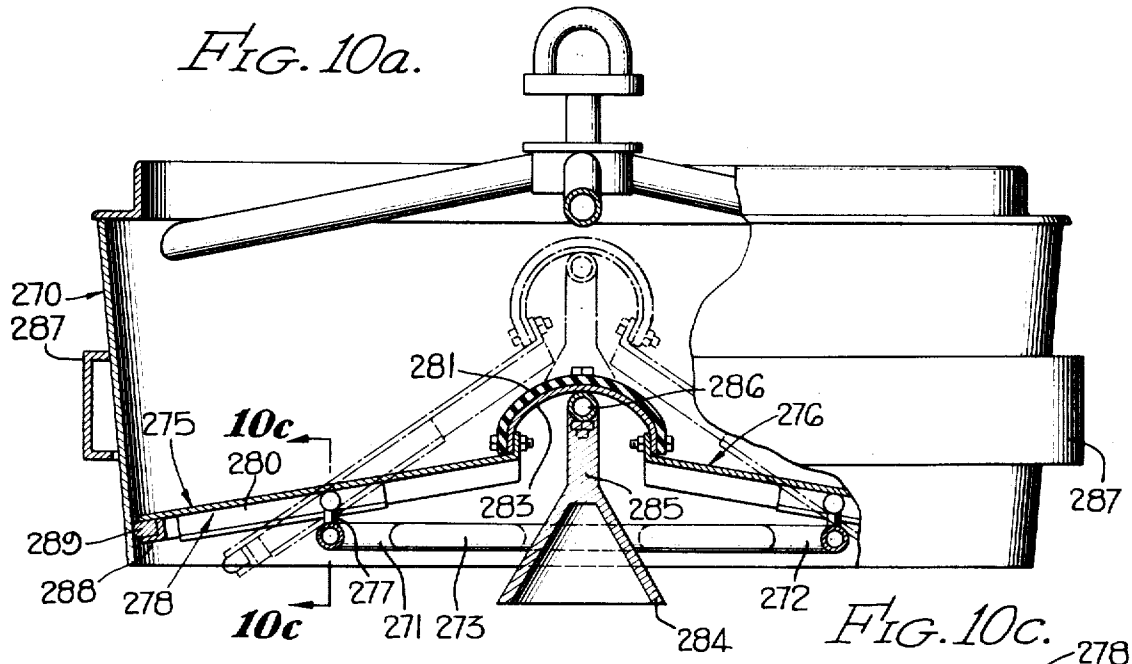


FIG. 10c.

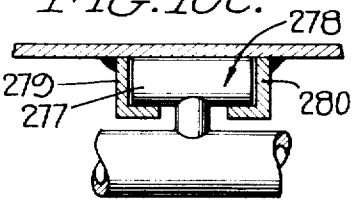


FIG. 10b.

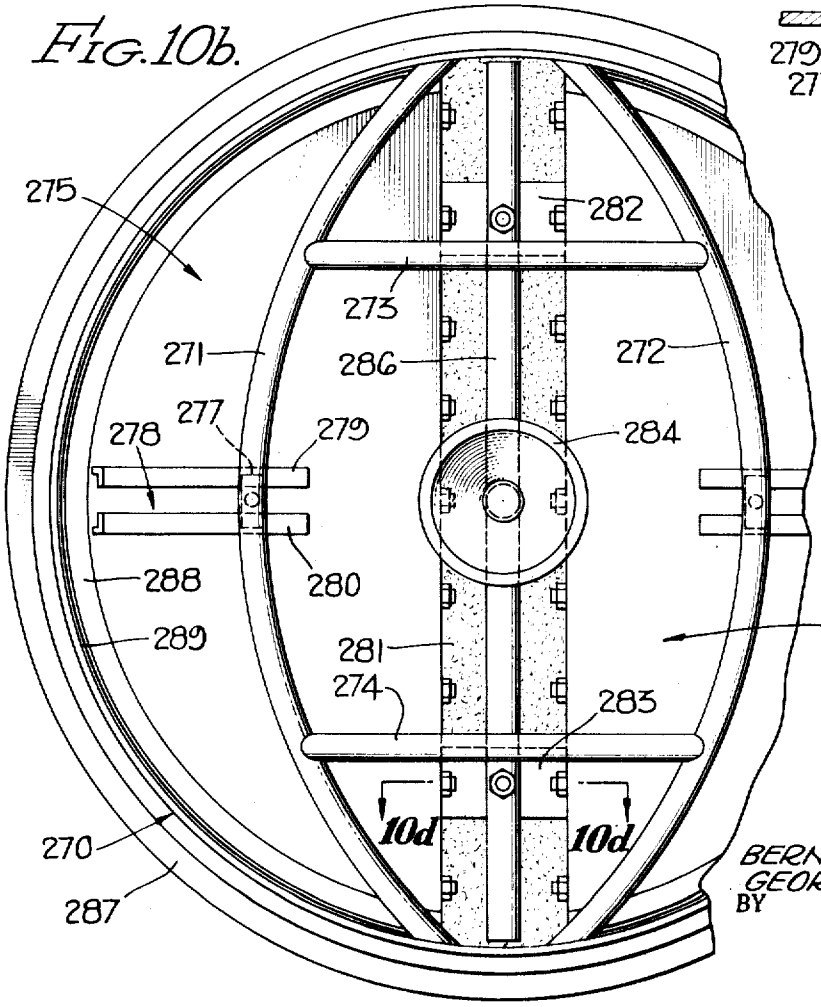
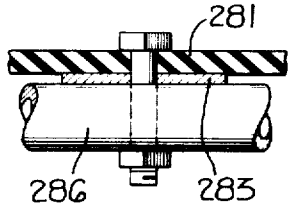


FIG. 10d.



INVENTORS
BERNARD S. RECKSEIT
GEORGE A. BURGESS
BY
Lyon & Lyon
ATTORNEYS

HOIST PANS AND HOIST PAN HANDLING APPARATUS

Reference is made to copending application Ser. No. 825,860 filed concurrently herewith in the name of John R. Strom entitled "Material Handling System for Vibratory Mills," and copending application Ser. No. 825,861 filed in the name of James P. Denight and George A. Burgess entitled "Driving Apparatus for Hoist Pan," both of said applications being assigned to the assignee of the present application, and the disclosures of said applications involve similar subject matter to that disclosed herein.

The present invention relates to vibratory mills and a material handling system therefor, and relates more particularly to hoist pan constructions for use in such systems and structures for handling such hoist pans.

Although applicable to both finishing and grinding mills, the concepts of the present invention will be described with reference to finishing mills. Various types of finishing mills have been in use for a number of years for finishing, polishing and deburring. An example of the construction of a mill of this type is disclosed in Podmore et al U.S. Pat. No. 3,100,088. This type of mill includes an annular bowl into which is loaded parts and abrasive media. Examples of such parts are castings of metal, plastic parts, and so forth. The mill may include a source of vibratory energy such as that described in Meinzer U. S. Pat. No. 2,284,671.

Conventionally, the media or parts and media are loaded into the mill manually. This has been accomplished through the use of a rectangular media receptacle having an opening at one end and suspended from an overhead hoist. Usually, two men, one holding the front end of the receptacle down while the other pushes the rear end of the receptacle up are necessary in order to redistribute the medial load in the pan from a carrying to a pouring position. The mill operator must be present in order to load the media into the mill, and the load media into the receptacle so as to properly distribute the media load in the receptacle to prevent uneven distribution thereof. It will be readily apparent that there are a number of disadvantages to media handling in this manner, not the least of which is the lack of ability to automate the operational steps required, and the complete reliance upon the adeptness of the men involved. Also, media generally is handled by bucket conveyors from which it is difficult to remove all media when it is desired to change to a different media. Consequently, undesirable mixing of different media can occur.

Although a round pan can be provided for evenly dumping the material into the vibratory mill, it is difficult to position the pan inasmuch as it tends to sway as the material is being dumped into the mill. Furthermore, it is desired that the pan have the necessary capacity while being as small as possible and also be able to efficiently dump the load of material into the mill.

Accordingly, it is a principal object of this invention to provide a new stabilizer arm arrangement for the hoist pan in a material handling system for vibratory mills.

Another object of this invention is to provide a jib hoist system, either self contained or mounted from a bridge crane, and which includes a stabilizing arm and supporting arrangement for positively securing an enabling accurate positioning of a hoist pan in a material handling system for vibratory mills.

A further important object of this invention is to provide new and novel hoist pans for use in a material handling system for vibratory mills.

A further object of this invention is to provide hoist pans for use in a material handling system for vibratory mills, and which can easily be operated to efficiently dump material evenly into the mill.

These and other objects and features of this invention will become better understood through a consideration of the following description taken in conjunction with the drawings in which:

FIG. **1** is a perspective view of a material handling system for vibratory mills according to the present invention;

FIG. **2***a* is a simplified plan view of a drive arrangement for the round hoist pan used in the system of FIG. **1**;

FIGS. **2***b* and **2***c* respectively are plan and elevational views of the pan and drive system;

FIG. **3** is a fragmentary view of an end of a stabilizer arm for supporting the hoist pan;

FIGS. **4***a* through **4***c* illustrate in more detail an embodiment of round hoist pan having an opening bottom for dumping material into the vibratory mill;

FIG. **5** is a partial view of another embodiment of a round hoist pan;

FIGS. **6***a* through **6***c* illustrate a further round hoist pan embodiment;

FIG. **7** illustrates a monorail and bridge crane for the jib hoist system;

FIGS. **8***a* through **8***e* illustrate another and preferred embodiment of a round hoist pan;

FIGS. **9***a* through **9***f* illustrate another preferred embodiment of a round hoist pan; and

FIGS. **10***a* through **10***d* illustrate another preferred embodiment of a round hoist pan.

Turning now to the drawings, FIG. **1** illustrates a media handling system for vibratory mills incorporating the concepts of the present invention, and includes a vibratory finishing mill **10** of conventional construction having a toroidal chamber **11** into which parts and abrasive media are placed and vibrated such that the parts are finished, polished, deburred, and so forth. This mill may be, for example, a Model FM-10 mill manufactured by SWECO, Inc., of Los Angeles, California. The abrasive media or, parts and media if desired, is handled by a round hoist pan **12** which is supported, moved and positioned by a stabilizer arm **13** of a jib hoist or bridge crane system **14**. The pan **12** is moved and centered above the machine **10** to dump the load within the pan into the bowl **11**. After the finishing operation is completed, the parts and media are discharged through a chute **15** into a vibrating screen separator **16** to separate the parts from the media. If the parts are of a metal susceptible to magnetic attraction, a moving belt magnetic separator **17** may be used to retrieve the parts rather than allowing them to discharge from an end **18** of the separator **16**. The separator **16** includes a media discharge chute **19** for allowing the media to be returned to the pan **12** when it is moved to the dotted line position **20** as seen in FIG. **1**. The separator **16** is of conventional construction and

includes a screen having a mesh size for allowing media to fall therethrough and into discharge chute **19**, the mesh size still being small enough to retain the parts for movement thereof to the discharge end **18** of the separator **16**. Alternatively a mill having its own separating means may be used without requiring the use of a separate separator **16**.

As will be described subsequently, a drive system **21** is provided to rotate pan **12** when it is in the position **20** during discharge of the media from the chute **19** to evenly distribute the media in the pan. Rotation of the pan during loading thereof causes the material fed thereto to be evenly distributed therein. Uneven distribution of material would cause the pan to hang unbalanced and create difficulty in transporting, positioning and dumping the pan, and discharge of material into the mill would be uneven. The drive system may be a friction drive such as a type employing a rubber surfaced wheel, but preferably is a magnetic drive system as described subsequently.

The separator **16** preferably includes different mesh screens such that reusable media can be separated from broken or chipped media, the latter being discharged through a chute (not shown). After the pan **12** has been reloaded with media from the separator **16**, it may be suitably stored on the floor, in a rack, stacked with other pans, or again discharged into the mill **10** with a new load of parts. Additionally, the reloaded pan may be discharged into another mill of the nature of the mill **10** by the jib hoist system **14**, or by another hoist system such as a bridge crane system. Another pan with a different size or type media may be picked up by the jib hoist system **14** and used with the mill **10**. Thus, it will be apparent that various combinations of pans, media types and sizes, mills, and so forth may be incorporated into the system of FIG. **1**.

Turning now to a more detailed discussion of the apparatus illustrated in FIG. **1**, the finishing mill **10**, as noted earlier, is a conventional unit. This mill **10** includes a base **25** from which is supported the bowl **11** by resilient members, such as springs (not shown). A vibratory source is mounted within the mill and coupled with the bowl to vibrate the same. The bowl includes a center column **26** which has been modified to include a cover **27** having a projection **28**. The projection, as will be described subsequently, serves to open the bottom of the pan **12** to cause discharge of the material contained therein evenly into and around the interior of the bowl **11**.

The jib hoist system **14** includes a stationary base **30** which is free standing or affixed in any suitable manner to the base **25** of the mill, such as by a pair of plates welded to both bases, or affixed to the separator base. The base **30** is provided with a vertical pivot or king pin **31** which supports a vertical column member **32** of the crane for rotation to allow proper positioning of the pan **12**. A horizontal beam **33** is affixed to the upper end of the member **32** to support a hoist or winch **34** by means of a hook **35**. A counterbalance **36** may be provided. A chain **37** is coupled between the winch **34** and a support bracket **38** on the outer end of the stabilizer arm **13**. The bottom **39** of the bracket **38** has a slot **40** therein perpendicular (note FIG. **1**) or angled (note FIG. **3**) with respect to the arm **13** for receiving and supporting the pan **12** as will be described subsequently. The inner end of the arm **13** is coupled to a pair of flange members **43** and **44** which are coupled together by a pair of plates and encircle the support member **32**. Rollers are provided on the inner sides (note FIG. **2b**) of these flange members to allow the stabilizer arm to roll up and down the member **32** as the winch **34** is operated. A handle **45** is provided for rotating the hoist system about the pivot **31** to allow the pan **12** to be moved to above the mill **10** or to another closely adjacent mill, to be moved to the dotted line position **20** for reloading the pan with media, or for moving the pan to another position where it may be stored, stacked, or the like. The pan has a diameter slightly smaller than the inside diameter of the bowl **11**.

The vibrating screen separator **16** may be a conventional unit including a base **50** which may be affixed to the base **25** of the mill, and a screening chamber **51**. The screening chamber includes one or more screens and is vibrated by means of a motor and vibratory drive system **52**. The screening chamber may include an upper coarse mesh screen for enabling the parts to be separated from the media, and a lower fine mesh screen to enable reusable media to be separated from broken and chipped media. The separator may also include a suitable washing system (not shown) for washing or treating the media and/or parts. As noted earlier, the reusable media is discharged through the chute **19** into the pan. Although the parts may be removed in any convenient manner from the upper screen of the separator, as noted earlier, a magnetic belt separator **17** may be employed for picking up certain metallic parts.

Considering now the drive system **21** as more completely illustrated in FIGS. **2***a* through **2***c*, the same includes an electrical motor **60** coupled by a chain **61** to a magnetic roller or rollers **62**. An idler **63** maintains proper tension of the chain **61**. One or more of the rollers **62** may be provided, and a typical roller is 4 inches in diameter. A metal wheel or pulley may be mounted on the motor shaft and directly contact and drive the rollers **62** thereby obviating the need for a chain drive **61**. This drive assembly may be mounted to the overall system in one of several ways. As illustrated in FIGS. **1** and **2***a*, a support bracket **64** may be affixed to the base of the separator **16**, or alternatively, may be affixed to the base **30** of the crane or to the base **25** of the mill. A channel member **65** as best seen in FIG. **2***a* is affixed to the bracket **64**, and has extending therefrom a pair of bracket plates **66** and **67**. These bracket plates may in turn pivotally support a pair of bracket arms **68** and **69** for supporting the motor **60** and roller **62** at a pivot **70**. A spring **71** is coupled between the arm **69** and the bracket **64**, and stop plates **72** and **73** are respectively affixed to the arm **69** and bracket **64** for aiding in release of the pan from the magnetic drive as will be described subsequently.

The magnetic roller or rollers **62** serve two purposes. As the round pan **12** is moved into position, the roller pulls the pan into engagement therewith, and drives the pan. Typically, the pan is driven at a speed of 15 to 20 revolutions per minute to enable uniform distribution of the media into the pan from the separator. As the pan is being loaded, there is a tendency for the first gush of media to move the pan off center and away from the driving roller **62**, but this is overcome by the

magnetic attraction of the roller. Additionally, problems of friction and pressure in driving the pan are eliminated by the use of the magnetic drive. The pan may be separated from the roller by moving the pan backward (clockwise about the pivot **70**) thereby extending the retention spring, and then pulling the pan forward briskly until the stop plates **72** and **73** engage such that the momentum of the pan snaps it away from the roller. If desired, discharge of parts or parts/media may be made directly from the finishing mill into the pan by physically rearranging the drive arrangement such that the pan is properly positioned with respect to the mill for receiving the material therefrom.

FIGS. **2***b* and **2***c* illustrate an alternative arrangement for mounting the drive assembly **21** wherein the channel member **65** thereof is pivotally secured to the stabilizer arm **13**. The drive assembly may be biased clockwise as viewed in FIG. **2***b* by suitable means, such as a spring (not shown) to maintain the rollers **62** against the periphery of the pan **12**. In the arrangement of FIG. **2***b*–**2***c*, the bracket arms **68** and **69** are affixed directly to the channel member **65**. It will be apparent that the rollers **62** illustrated in FIGS. **1** and **2** are journalled for rotation by suitable bearings or bushings.

As noted earlier, the support bracket **38** of the stabilizer arm **13** has a slot **40** in the bottom thereof. This slot may have the configuration illustrated in FIGS. **2***b* and **3** wherein it flares outwardly at **75** to enable the support stud **76** (note FIG. **2***c*) and flange **77** of the pan to be guided into engagement with the arm **13**. The bracket may be in the form of a box as shown in FIG. **1**, or may be open as shown in FIGS. **2***b*, **2***c* and **3** with sides **78** and **79** and inclined faces **80** and **81** to guide and receive the flange **77**.

FIG. **2***b* illustrates a flange **77** of one diameter for one size pan, and illustrates the manner in which the flange and support stud **76** may be positioned in the support bracket **38** at the center line of the stabilizer arm **13**. FIG. **3** illustrates the manner in which another size pan having a larger flange **82** is supported and retained slightly off center. This support configuration enables different diameter pans to be rotated by the magnetic drive arrangement. The chain **37** from the winch **34** may be directly coupled with a hook **84** of the pan, or alternatively, may be coupled near the outer end of the arm **13**.

FIGS. **2***b* and **2***c* also illustrate in greater detail the manner in which the flanges **43** and **44** of the arm **13** are coupled together by means of plates **90** and **91** and include pairs of upper and lower rollers, only the upper rollers **92** and **93** being seen in the drawings. These rollers bear against the faces of the column member **32** to allow the stabilizer arm **13** to freely move up and down the member **32** as described earlier. Additionally, a base plate **95** may be provided for supporting the base **30** of the jib crane, and may also have secured thereto the bases of the finishing mill and separator if desired.

Turning now to a consideration of the specific embodiments of the round hoist pan **12**, FIGS. **4***a* through **4***c* illustrate a pan **99** which includes a latching-type bottom **100** which is unlatched and caused to open as the bottom of the pan engages the top of the mill **10**. This pan includes a cylindrical housing or wall **101** with a bottom flange **102**, and a frusto-conical insert **103** secured to the housing and flange. A central cone **104** is provided and is secured at the top thereof by a plurality of rods **105** extending to the interior wall of the body **101**, and near the bottom thereof by a plurality of rods **106** extending to the insert **103**. The bottom **100** of the pan **99** comprises a pair of semicircular bottom segments **107** and **108** which are hinged together by a pin **109** which extends through the bottom of the central cone **104**. A flange **110** may be secured at the top of the housing **101** to reinforce the housing.

The bottom segments **107** and **108** are maintained in their normally closed position by a pair of latch mechanisms, only the left hand mechanism being shown for simplicity of illustration. Each latch mechanism includes a bolt **112** which releasably engages a bracket **113** affixed to the respective bottom segment. The bolt is coupled to a release arm **114** which is pivoted at **115** by a pair of brackets **116** and **117**. As the bottom **118** of the arm **114** engages a cam face **119** mounted at the top of the mill **10**, the bolt **112** is pulled from the bracket **113** allowing the respective bottom segment to lower as illustrated in dashed lines in FIG. **4***a*. The arm **114** is normally biased to close the bolt **112** with the bracket **113** by means of a spring **121**, and a spring **122** is provided to return the bottom segments **107** and **108** to their closed positions after the media has been dumped from the pan **99**. Latching mechanisms as just described are provided for both of the bottom segments **107** and **108**. It further will be apparent that the construction of the pan **100** dumps the media in a substantially annular pattern into the interior of the bowl **11** of the mill **10** to provide a relatively even distribution of the media around the bowl. No particular configuration is required at the top of the center column **26** to cause dumping of this pan embodiment.

FIG. **5** illustrates another round pan construction including a cylindrical housing **130**, a conical insert **131** and a pair of semi-circular bottom segments or doors **132** and **133**. The central stud **76** extends down into the pan and is coupled with the top of a cone **134**. A central flange **135** is affixed to the inner wall of the housing **130** by means of a plurality of radially extending rods **136**. A ball thrust bearing **137** is provided, and FIG. **5** shows the configuration thereof which is also used with the pan of FIG. **4***a*. The bottom segments **132** and **133** are hinged by a pin **138** in a manner similar to the bottom segments **107** and **108** in FIGS. **4***a*–**4***b*; however, the hinge pin **138** is not coupled with the cone **134**, and the bottom segments **132** and **133** are free to move up and down with respect to the cone **134**. Additionally, a pair of arcuate guides **139** and **140** are coupled at the inner circular edges of the respective bottom segments **132** and **133**. When the cone **134** is in its lower position, the central portions of the bottom segments **132** and **133** are supported thereon and the outer edges are supported on the insert **131**, and these segments assume the closed (full-lined) position. The weight of the media on the segments maintains the bottom of the pan closed. The lower end of the stud **76** extends into a cylindrical guide **141** in the cone **134**, and the stud and cone are coupled together with a pin **142**. The pin **142** rides in a slot **143** in the guide. In this manner the cone may move freely up and down on the stud **76**.

As the pan is lowered to the mill, the bottom of the cone **134** engages the cover **27** of the center column of

the mill **10** thereby preventing the cone **134** from lowering further, while allowing the body **130** to lower to the dashed lined position as seen in FIG. **5**. This action allows the central portions of the bottom segments **132** and **133** at the guides **139** and **140** to rise up with respect to the cone **134** because of the moment caused by the weight of the media at the outer edges of the segments **132** and **133** causing the segments to fold, thereby providing a substantially annular aperture **144** at the bottom of the pan for discharge of media. After the media is discharged, the pan is raised thereby allowing the cone to move down and the bottom segments to again assume the flat closed position. If necessary, the bottom segments may be closed manually.

Alternatively, the center column may include a remotely actuated mechanism, such as an air cylinder and piston, which can be operated to extend upwardly and engage the actuator of the pan. With this arrangement, the pan is merely lowered to above the mill and does not have to be lowered into engagement with the cover **27**.

FIGS. **6***a* through **6***c* illustrate another configuration of a round hoist pan providing an annular discharge of media. This pan includes a housing **150** having a conical insert **151** affixed thereto, and a moving conical bottom **152**. The pan is supported by means of a central bracket **153** which is secured to the housing **150** by radially extending rods **154**. A ball thrust bearing **155** is provided for the support stud **76**, and the same type of bearing is used with the pan of FIGS. **4**a and **5**. A central support column **157** is rigidly secured to the interior wall of the insert **152** by means of rods **158**. The movable bottom **152** is affixed to a central cap **159** which in turn is secured to a stud **160** which extends through the column **157**. A spring **161** is provided on the stud and is retained by means of an actuator **162** and nut **163**. The spring **161** serves to normally bias the actuator **162** and stud **160**, and thus the bottom **152**, downwardly to the full-lined position shown in FIG. **6**a. When the actuator **162** engages the cover of the center column of the mill, the bottom **152** is raised to the dashed-line position shown in FIG. **6**a to provide an annular aperture **165** for discharge of media evenly into the bowl of the finishing mill. The bottom of the actuator **162** is above the bottom of the pan thus enabling the pan to be placed on a floor for storage or loading without causing the bottom **152** to open. With each of the pans disclosed herein, resilient gaskets may be used at the edges of the movable bottoms to provide a good seal with the interior sides of pans.

FIG. **7** illustrates an alternative arrangement for raising, lowering and transporting the pan **12** similar to that shown in FIG. **1**, but employing a monorail system. Additionally, the monorail system may be mounted on a bridge crane system. A vertical support column **170** like the column **32** in FIG. **1** is provided, but is affixed to a horizontal beam **171** which in turn is mounted by means of a trolley **172** onto a monorail beam **173**. The beam **171** is mounted on the trolley **172** for rotation about a pivot **174** to thereby allow the stabilizer arm **175** to be rotated about the pivot **174** or to be moved to and fro along the monorail **173**. The stabilizer arm **175** is coupled to the column **170** by a roller arrangement like that shown in FIGS. **1**, **2***b* and **2***c*. Similarly, the holder **176** may be as shown in FIG. **1** or FIG. **2***b*. As was the case with the arrangement shown in FIG. **1**, a winch **177** is provided for raising and lowering the arm **175**.

A monorail type system is particularly suitable for a small, inexpensive and manually operated material handling system. For example, the monorail may replace the jib hoist arrangement and be arranged with one mill, separator, pan driving assembly and hoist pan. The rail may be hung from the ceiling **177** or floor supported, and has the advantage that it may be curved to relatively easily feed a second mill on the reverse side of the separator, or other arrangements may be provided as desired. Two mills may be positioned in a straight line and discharge into a single separator, and with a straight monorail, media can be received from the separator and fed to either one of the two mills.

Furthermore, instead of mounting the monorail **173** on the ceiling **177**, the same can be mounted on trolleys which in turn are mounted on rails affixed to the ceiling to provide a bridge crane system. Only a single trolley **178** and ceiling rail is illustrated in FIG. **7** for simplicity of illustration, it being understood that at least an additional trolley and rail would be mounted near the other end (to the left as viewed in FIG. **7**) for proper support and movement of the monorail **173**. With the bridge crane system the entire area of the building may be serviced, and this system lends itself well to full automation. The bridge may be mounted onto the ceiling **177**, or may be floor mounted if desired. The bridge crane system is particularly advantageous for large installations employing multiple mills and multiple medias.

FIGS. **8** through **10** illustrate further preferred embodiments of round hoist pans. These pans may be moved and transported in the same manner described above, and can be used with the magnetic drive arrangement.

The pan embodiment illustrated in FIGS. **8**a through **8**e includes an outer cylindrical housing or body **184** and movable bottom segments or doors **185** and **186**. These doors are semi-circular and do not extend all the way to the center of the pan, but are hinged together and joined by a flexible member **187** such as a rubber impregnated belt. Four rods **188** through **191** are affixed to the inner wall of the cylindrical body **184**, the other ends of which terminate in a support bracket **192**. A support stud **193** is rotationally coupled with the support bracket **192** by a bearing **194** as seen in FIG. **8**e to allow the pan to be rotated by the magnetic drive assembly. Four hinge legs **195** through **198** are pivotally coupled with the respective support arms **188** through **191**. The lower ends of the legs **195** and **197** are affixed to the door **185** and the lower ends of the legs **196** and **198** are affixed to the door **186**. The legs **195** through **198** may be pivotally coupled with the support rods **188** through **190** in any suitable manner such as by means of small stub shafts or rubber torsion bushings. A guide **200** may be affixed near the bottom of the body **184** as best seen in FIG. **8***d* to provide a guide for a projection **201** (FIG. **8***c*) from the cover **27** of the center column **26** of the mill **10**. As is seen in FIG. **8***c*, as the pan is lowered onto the mill **10**, both doors **185** and **186** pivot and rise to evenly dump the contents of the pan into the mill **10**. The hinge member **187** tends to return to a flat configuration and therefore acts both as a sealing hinge impervious to jamming by media and also acts to force

the doors **185** and **186** to the closed position against the inside wall of the body **184** as shown in FIG. **8***a*.

A typical pan as illustrated in FIGS. **8***a* and **8***b*, which are approximately to scale, has an outside diameter of 40 inches and a height of 17 inches, with the doors in the closed position being 3 inches above the bottom extremity of the body **184**. The central edges are spaced apart by 6 inches, with the flexible member being 8 inches wide to provide 1 inch along each side thereof for attachment to the door edges.

The hoist pan embodiment illustrated in FIGS. **9***a* through **9***f* includes a frusto-conical housing **210** which is rotatably supported from a support stud **211** by a bearing similar to the bearing **193** in FIG. **8***e*, and by means of a plurality of rods **212**. The pan may include a base flange **213** for protecting the bottom control linkage arrangement to be described subsequently.

A pair of semi-circular bottom doors **214** and **215** are provided at the bottom of the housing **210** and may slightly overlap as indicated in FIG. **9***a*. These doors are coupled to the body **210** by linkage arrangement as best seen in FIG. **9***c*. A pair of shafts **217** and **218** are affixed to brackets welded to the inner wall of the housing **210**. Shafts **219** and **220** are coupled respectively to the doors **214** and **215**. Shafts **221** and **222** also are affixed to the respective doors **214** and **215**. The shafts **217** and **219** are intercoupled by means of stub shafts **224** and **225** and bushings **226** through **229**. Similarly, shafts **218** and **220** are intercoupled by stub shafts **231** and **232** and bushings **233** through **236**. This arrangement allows the doors **214** and **215** to rotate about the respective shafts **217** and **218** and to rotate about the respective shafts **219** and **220**. Control arms **238** and **239** are respectively coupled between the shafts **218** and **221** and between the shafts **217** and **222** by means of bushings **240** through **243**. These shafts control the arc of movement of the doors **214** and **215** as the same open and close. Thus, it will be apparent that the doors may fold inwardly as illustrated in FIG. **9**b when the bottoms of these doors engage a projection **245** at the top of the center column **26** of the finishing mill. A plurality of ball type rollers **247** through **250** and **251** through **254** are secured to the bottoms of the doors **214** and **215** as shown in FIGS. **9**b and **9**c and roll against the dome shaped projection **245** to reduce friction and accomplishing efficient opening of the doors. Casters **256** and **257** are secured to the control arm **238** and casters **258** and **259** are secured to the control arm **239**, and these casters along with the rollers aid in centering and facilitating the proper opening of the bottom of the pan.

FIGS. **9***a*–**9***d* are approximately to scale, and the pan shown therein may have an outside diameter at the top thereof of 41 and ½ inches tapering to 34 and ½ inches at the lower extremity of the body **210**. A typical height of the body is approximately 13 inches, the upper and lower flanges adding approximately 2 inches each. The door segments have a diameter of 17 and ¼ inches. The center lines of the shafts **217–218** are each 10 inches from the center of the pan, the center lines of the shafts **219–220** are each 3 inches from the center lines of the respective shafts **217–218**, and each of the arms **238–239** is 17 inches between the pivot points thereof (e.g., arm **238** is 17 inches from the respective center lines of shafts **218** and **221**).

The pan illustrated in FIGS. **10**a through **10**d is similar to that illustrated in FIG. **8** and described above, but the bottom segments or doors are mounted and operated differently. In this embodiment, the pan includes a frusto-conical housing or body **270** which is supported for rotation in a manner similar to that of FIGS. **8** and **9**. Arcuate rods **217** and **272** are welded at the bottom of the housing, and cross rods **273** and **274** are welded thereto. The bottom segments or doors **275** and **276** are pivotally coupled with the rods **271** and **272**. This is accomplished for each door by means of a "T" shaped stud member **277** as best seen in FIG. **10***c* which is welded or pinned to the rod **271**, the arms of which ride within a chamber **278** formed by a pair of "L" channels **279** and **280** welded to the bottom of the door **275**. The door **276** is similarly coupled with the rod **272**.

The central edges of the doors **275** and **276** are hinged together by a flexible member **281** similar to the arrangement shown in FIG. **8***c*. Spring steel bands **282** and **283** also are affixed to these edges of the doors. An actuator comprising a conical member **284** which is welded to a spacer **285** which is in turn welded to a cross rod **286** is provided for opening the doors **275** and **276** upon engagement of the conical member **284** with the projection of the cover of the center column of the mill. The rod **286** is affixed to the bands **282** and **283** and the flexible member **281** as best seen in FIGS. **10***b* and **10***d*. A U-shaped channel member **287** may be welded to the periphery of the housing **270** to provide a circular surface for engagement with the magnetic roller for rotating the pan. A channel **288** may be welded to the lower outer edges of each door to retain a resilient gasket **289** as best seen in FIG. **10***a*.

As noted earlier, the concepts of the present invention also are applicable to grinding mills wherein material, such as chemical compounds, paint pigments, and so forth, and media are loaded into the mill to grind the material, or otherwise reduce the material in size.

What is claimed is:

1. A material handling system for mills comprising

a mill having a chamber for receiving material whereby the material may be operated upon within said chamber,

hoist pan means for receiving, transporting and discharging a load of material into said chamber, said hoist pan means comprising a housing and a movable bottom which may be opened upon engagement of said pan means with said mill for discharging said material into said chamber, and

crane means for supporting and moving said pan means to a position directly above said mill for discharge of said material into said chamber and for moving said pan means to a position near said mill for receiving material discharged from said mill, said crane means comprising a stabilizer arm having a first end coupled with a support member, and said arm having a second end for receiving and holding said pan means.

2. A system as in claim **1** wherein

said support member is mounted adjacent said mill for pivotal movement with respect to said mill, and said first end of said stabilizer arm includes bearing means for allowing said stabilizer arm to be freely moved up and down said support member while rigidly supporting said pan means.

3. A system as in claim 1 wherein
the upper end of said support member is pivotally coupled with a trolley device which in turn is coupled for movement along a rail member.

4. A system as in claim 1 wherein
said hoist pan means comprises a housing having at least a circular peripheral portion, means coupled with said housing for supporting said housing for rotation about the central axis of said housing, and said movable bottom comprises a plurality of movable doors which are normally retained in a closed position but which pivot and open to dump material into said chamber upon movement of said pan means into predetermined proximity with said mill.

5. A system as in claim 4 wherein
said means coupled with said housing for supporting said housing comprises a bearing assembly and arm means coupling said bearing assembly with said housing, and
said doors being coupled together by a resilient member and being pivotally coupled with said arm means.

6. A system as in claim 5 including
guide means coupled to said housing near the lower extremity thereof for facilitating positioning of said pan means at a central projection extending upwardly from the chamber of said vibratory mill.

7. A system as in claim 4 wherein
said means coupled with said housing for supporting said housing comprises a bearing assembly and arm means coupling said bearing assembly with said housing, and
said doors comprise a pair of doors coupled together by a linkage system coupled respectively to said doors and to said housing.

8. A system as in claim 7 wherein
said linkage system comprises first and second shafts coupled with the interior wall of said housing and spaced from the center thereof, third and fourth shafts respectively affixed to said doors near the outer extremities thereof, means pivotally intercoupling respectively the first and third and the second and fourth shafts, and a pair of control arm means pivotally coupled respectively between said first and second shafts and said doors.

9. A system as in claim 4 wherein
said means coupled with said housing for supporting said housing comprises a bearing assembly and arm means coupled between said bearing assembly and said housing,
support means coupled near the lower extremity of said housing, and
said doors being coupled together by a resilient member and being pivotally coupled with said support means.

10. A system as in claim 9 including
actuator means coupled with said doors and normally extending downwardly therefrom for engaging a portion of said mill when said hoist pan means is in predetermined proximity to said mill for opening said doors.

11. A system as in claim 1 wherein
said hoist pan means comprises a housing having at least a circular peripheral portion, means coupled with said housing including a bearing assembly for supporting said housing for rotation about the central axis of said housing, an insert mounted within said housing near the lower extremity thereof,
said movable bottom comprises a substantially conical member mounted for up and down movement within said housing, the outer periphery of which engages said insert to close said pan means, and
spring biasing means coupled between said movable bottom and said insert for normally closing said bottom, said spring biasing means comprising a spring housing mounted within said housing and coupled with said insert, said spring housing containing a spring therein, and said conical member including a shaft extending through said spring housing and terminating in an actuator near the central projection of said mill for causing said bottom to raise and dump the contents of said pan means into said mill.

12. A system as in claim 1 wherein
the second end of said arm has a holder for receiving a support member for said pan means, said holder having an aperture offset from the longitudinal axis for said arm, said support member for said pan means including a flange and a stud, and said holder including side guides and a bottom member, said aperture being in said bottom member and serving to receive said stud, said bottom means and side guides being configured to allow predetermined separate positionings on said holder of different size flanges used on respective different size pan means to cause proper engagement of a circular peripheral portion of said respective pan means with driving means for rotating said pan means.

13. A material handling system for mills comprising
a mill having a chamber for receiving material to be operated upon in said chamber,
hoist pan means for receiving and discharging a load of material into said chamber, said hoist pan means comprising a housing and a movable bottom which may be opened for dumping the contents of said pan means into said chamber upon the application of a predetermined force near the center of said bottom, and
crane means for supporting and moving said pan means to a position directly above said mill for discharge of said material into said chamber and for moving said pan means to a position near said mill for receiving material discharged from said mill, said crane means comprising a stabilizer arm having a first end coupled with a support member, and said arm having a second end for receiving and holding said pan means.

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