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(54) Title: APPARATUS AND METHOD FOR TREATING SEEDS

(57) Abstract: An apparatus and method for the application of a treatment solution to a particle, such as a seed, is provided. The treatment apparatus generally includes a plurality of collection tanks adapted to receive a respective one of a plurality of ingredients. The collection tanks are in fluid communication with a manifold having a plurality of inlets whereby a plurality of fluid pathways interconnect the collection tanks and the manifold inlets. A mixer in fluid communication with the manifold is operative to mix the ingredients received therefrom to form the treatment solution that is then applied to the particle or seed by a treatment application device such as an atomizer. A collection tank or a plurality of collection tanks may further be in communication with a respective ingredient source. A carriage assembly adapted to moveably support a treatment application device is further provided.



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APPARATUS AND METHOD FOR TREATING SEEDS

BACKGROUND

The present invention broadly relates to an apparatus for use in applying a treatment to particles. More particularly, the present invention is directed to a seed treatment apparatus for use in applying a chemical treatment to seeds as well as methodologies incorporating the same.

Farming practices have evolved significantly over time, enabling farmers to improve crop yields and crop profitability. Particularly, the evolution of both agricultural equipment and pest management have greatly improved crop yields while making efficient use of both time and land. With respect to pest management, research has led to the continuing discovery of new pest control products and methods of application that not only lessen their environmental impact, but improve the safety for the consumers and applicators. Primarily, there are two fundamental pest management techniques, the treatment of the crops or surrounding area, and the treatment of the seed itself. Of these two techniques, seed treatment is increasingly becoming a valuable tool in modern agriculture not only due to its increasing effectiveness for controlling pests and diseases, but also because of its reduced impact on the environment.

Generally, the term "seed treatment" is understood to mean the use and application of biological, physical and chemical agents and techniques used to protect seeds and growing crops from disease and insects during germination and emergence of the young plant and early growth of the crop. Seeds need protection because the seeds themselves, as well as the soil they are planted in, can harbor pathogens such as fungi, bacteria, and viruses, which subject them to damage or destruction by insects and other pests. For example, fungi and bacteria can cause seed rot and decay, seedling blights, and smuts. Soil insects, such as seed corn maggots and wire worms can attack the seed after it is planted, and birds and rodents can eat the planted seed and young seedlings. Effective seed treatment can reduce, control, and repel disease organisms, insects, or other pests that attack seed or seedlings, thereby increasing crop yields.

Seed treatment is commonly used on a variety of seeds, including corn, soybeans, and cotton, to name a few. To be effective, the selected treatment must first be harmless to the seed itself, and stable long enough for the seed to be planted.

This is because, typically, the treated seed is stored for a period of time prior to the time to being planted. Additionally, an effective seed treatment should evenly coat the seed and adhere well to the seed while not impairing the seed flow in planting equipment.

Seed treatment is typically applied to the seeds with a seed treatment apparatus or "seed treater". Generally, seed treaters are used to apply measured quantities of a chemical to a particular volume or weight of seed. There are a variety of seed treaters in use today, and generally, these seed treaters are highly specialized, complex apparatuses designed to treat large volumes of seeds at designated facilities in a continuous or batchwise processes. In conventional seed treaters, the operator is responsible for ensuring that the seeds flow through the treater at an optimal rate for proper treatment. If the rate of seed flow is too slow, the seeds receive too much treatment, which leads to waste of the chemical treatment, and if the rate of seed flow is too fast, the seeds do not receive enough treatment to be fully effective. The rate of seed flow can be dependent upon many factors, such as the size and weight of the seed, the volume of seed to be treated, and the chemical that is selected to treat the seed, all of which need to be taken into account by the operator. Simple miscalculations can lead to wasted seed treatment products, money, time, and, ultimately have adverse affects on crop yield.

In addition, with respect to conventional seed treaters, the chemical used to treat the seed is manually measured and transferred in open, calibrated vessels, such as a pitcher, from the chemical container in which it is packaged to a mixer. Accordingly, not only is there an opportunity for errors to be made in measuring the chemical treatment, but the operator is exposed to the chemical.

Various other factors related to some commercially available seed treaters also affect the quality of seed treatment, such as the maintenance of the equipment. For example, atomizers need to be routinely cleaned. Also, typically the first batch or bag of seeds to run through the treater do not receive an optimal amount of treatment, causing a significant of seeds to used that are not properly coated.

While commercially available seed treaters have successfully protected seeds from disease, insects, and other animals, there is still a need for improved treaters that are self-calibrating to reduce the instances of miscalculations and other related human errors, while greatly reducing human exposure to seed treatment products. There is a further need for an improved seed treater that includes features that

simplify the routine maintenance of the equipment and further, that increases the number of seeds with the proper amount and coating of the seed treatment. The present invention is directed to meeting these needs.

SUMMARY OF THE INVENTION

The apparatus disclosed herein is adapted to treat a selected particle with a treatment solution that contains a plurality of treatment ingredients. The apparatus may particularly be a seed treatment and generally includes a plurality of collection tanks adapted to receive a selected ingredient from a respective ingredient source. The collection tanks provided are in fluid communication with a manifold having a plurality of inlets, and communicate therewith via a plurality of fluid pathways, which may be in the form of hoses. A mixer, such as a static mixer in fluid communication with the manifold is operative to receive and mix the plurality of ingredients thereby to form the treatment solution to be applied to the particle or seed.

A collection tank, or plurality of collection tanks, may be placed in fluid communication with the source of the ingredient itself. In this way, the ingredient may be transported directly from the ingredient source to a respective collection tank by way of, for example, a transfer pump. Each ingredient may then be pumped from a respective collection tank thereby to be received by a respective inlet formed in the manifold before mixed by the mixer.

A plurality of valves may be associated with the fluid pathways and configurable into a plurality of valve states thereby to achieve a selected flow of the ingredient through its designated fluid pathway. In a first valve state, the treatment ingredient circulates from the collection tank, through the associated valve, and back through the collection tank. The valve may be configured into a second valve state whereby the treatment ingredient is permitted to flow from the collection tank to the manifold.

After the ingredients that form the treatment solution are mixed, the treatment solution may then flow to a treatment application device in fluid communication therewith. The treatment application device may be in the form of an atomizer. Thereafter, the treated seeds may enter into a mixing drum and exit therefrom into a receiving bin or a plurality of receiving bins. The receiving bins may further be associated with a scale operative to weigh the amount of treated seeds received therein after treatment.

Another aspect of the present disclosure is a carriage assembly that is adapted to support a seed treatment device, such as an atomizer associated with a seed treatment apparatus. The carriage assembly comprises a framework having first and second sidewalls and a bottom wall extending therebetween. A moveable treatment device support member is associated therewith and moveable between a first position wherein the seed treatment device is operative to apply the treatment solution to the seeds and a second position wherein the seed treatment device is inoperative to apply the treatment solution. The treatment device support member may be in the form of a pair of rails each located proximate to a respective sidewall of the framework. The rails may be moved simultaneously between the first and second positions.

The carriage assembly may further be provided with first and second carriage support arms that are secured to a respective rail and adapted to move the respective rail between the first and second positions. The carriage support arms may be adjustable in length.

The atomizer or selected seed treatment device is adapted to be moveably disposed on the first and second support rails such that when in the disengaged state, the atomizer is moveable therealong. Particularly, the atomizer may slide along the length of the rails. When the rails are returned to the first position, the atomizer is in confronting relation with the bottom surface of the bottom wall.

The carriage assembly may be associated with four spaced apart carriage support arms each being adjustable in length and adapted to simultaneously move the rails between the first and second positions.

Further disclosed herein is a method of treating seeds with a treatment solution containing a plurality of ingredients. The method comprises providing a first collection tank sized and adapted to receive a first ingredient of the treatment solution and a second collection tank sized and adapted to receive a second ingredient. The method includes placing the first collection tank in fluid communication with a source of the first ingredient so that the first ingredient can be transported into the tank. Particularly, the first ingredient may be pumped from the first ingredient source and into the first collection tank. A treatment solution containing the first and second ingredients is formed and thereafter transporting to a treatment device operative to apply the treatment solution to a selected quantity of

seeds. The first ingredient may be an active ingredient while the second ingredient may be a diluent.

The method may further include the step of placing the second collection tank in fluid communication with a source of said second ingredient whereby the second ingredient is transported or pumped into the second collection tank. The first and second ingredients may be recirculated between the first and second collection tanks and respective sources thereof.

These and other objects of the present invention will become more readily appreciated and understood from a consideration of the following detailed description of the exemplary embodiments when taken together with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view in elevation of a conventional seed treater;

Fig. 2 is a perspective view of an exemplary embodiment of the seed treater according to the present invention;

Fig. 3 is a side view in elevation of the seed treater shown in Fig. 2;

Fig. 4 is a schematic representation of an exemplary flow path of both an active ingredient and diluent;

Fig. 5a is a perspective view of the carriage assembly that is associated with the atomizer in the first position;

Fig. 5b is a perspective view of the carriage assembly in the second position and the atomizer exposed for routine maintenance;

Fig. 6a is a side view in elevation of the carriage assembly in the second position with atomizer exposed;

Fig. 6b is a side view in elevation of the carriage assembly again returned to the first position;

Fig. 7a is a side view in elevation of the rotating drum in the start position;

Fig. 7b is a side view in elevation of the rotating drum in the run position; and

Fig. 7c is a side view in elevation of the rotating drum in the cleanout position.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Generally, the present invention is directed to an apparatus for treating particles, and is particularly suitable for the treatment of seeds. To fully appreciate

the various features of the present seed treatment apparatus, it is perhaps first useful to describe the features of a conventional seed treatment apparatus.

Turning first to Fig. 1, a conventional seed treatment apparatus, or seed treater 10 is shown, which can be used to treat a variety of seeds such as corn, cotton, and soybeans. Seed treater 10 is operative to treat a selected quantity of seeds with a treatment solution that can contain or be formed from apply a variety of substances including pesticides, fungicides, and fertilizers. As with many commercially available seed treaters, seed treater 10 has three primary components, mix tank 12, a seed treatment device for the application of the treatment solution, such as atomizer 14, and mixing chamber in the form of drum 16, each of which is shown here to be supported by support frame 11. Similar to many commercially available seed treatment apparatuses, seed treater 10 can be described as having both a seed flow and a liquid flow. Here, the seed flow begins by transferring a quantity of untreated seed, which is usually received in pre-measured bags, onto supply conveyor 18, which transfers the seed to atomizer 14 at a metered rate. Atomizer 14, for example, is described in more detail in both U.S. Patent Nos. 6,551,402 B1, which issued on April 22, 2003 and 6,783,082 B2, which issued on August 31, 2004, both to Renyer et al. and both of which are incorporated by reference herein.

As the seed flows through atomizer 14, it is sprayed with a treatment solution, such as a selected liquid mixture. Thereafter the treated seed flows into the entrance drum 16 via chute 20, which is located at front portion 15 thereof. Drum 16 rotates at a selected speed, turning and thereby mixing the seeds inside to ideally achieve a seed that is uniformly treated. The seeds exit back portion 19 of drum 16 via seed outlets (not shown) and are transferred into receiving vessel 22 disposed on receiving conveyor 24 where the seed is then collected for use.

The liquid flow associated with seed treater 10 begins by transporting the selected liquid or liquids from a liquid source into mix tank 12. By way of example, pesticide manufacturers package various seed treatment ingredients, such as liquid active ingredients, in conventional totes or tanks. These ingredients are typically mixed with a diluent or diluting agent such as water and polar or suitable non polar solvents as well as formulation auxiliaries, such as polymers, surfactants, anti-foaming agents, and carrier materials to name a few. To achieve the correct mixture for the seed treatment, the operator must accurately measure the requisite amounts

of the active ingredient and diluent and transfer those measured amounts into mix tank 12. Once received therein, the liquids are mixed to form a treatment solution in the form of a homogenous mixture that flows directly to atomizer 14 and sprayed on the seeds.

With the foregoing in mind, and turning to Figs. 2 and 3, an exemplary embodiment of seed treatment apparatus or seed treater 110 according to the present invention can now be described. At the outset, perhaps the most noticeable difference between seed treater 10 discussed above and seed treater 110 shown here is its size and particularly, the inclusion of raised portion or upstairs portion 112 and lower portion or downstairs portion 114 connected by staircase 116. As may be more fully appreciated in the following description, the components of the seed treater disclosed herein are not limited to having an upstairs and downstairs configuration. Rather, it is contemplated that the assembly of components can be arranged in any suitable manner in effort to accommodate space availability, while still providing an apparatus capable of treating seeds.

For discussion purposes, seed treater 110 can be generally separated into three stations – a seed and liquid treatment receiving station 120, a seed treatment or treatment application station 140, and a treated seed exit station 190. Similar to seed treater 10 discussed above, seed treater 110 has a seed flow and a liquid treatment solution flow. Beginning first with the seed flow, seed is received at seed station 120 where seed is unloaded into seed hopper 122. Hopper 122 can be any conventional hopper suitable for receiving seed. Seed flows from hopper 122 into elevator 124 and transported upstairs 112 to seed treatment application station 140. As shown here, seed from hopper 122 is first received in lower portion 126 of elevator 124 and then transported upstairs via mid section 128 to upper section 130 to seed treatment application station 140. Elevator 124 can be any suitable seed or particle elevator such as those made commercially available by Deamco Corp. of 6520 East Washington Blvd., City of Commerce, CA 90040-1822.

From upper section 130 of elevator 124, seed flows from the elevator, through seed supply funnel 132 and onto belt 134, which transports the seeds to treatment station 140. Belt 134 can be any suitable belt capable of moving the seeds from funnel 132 to seed treatment application device, shown here in the form of atomizer 146, but could particularly be a weigh belt capable of monitoring the seed flow being transported based on pounds/minute and total pounds such as the weigh belt made

commercially available by Universal Seed Care located at 2320 124th Road, Sabetha, Kansas 66534. Use of a weigh belt such as provided by Universal Seed Care helps ensure that the seed flows at an optimum rate for the application of the seed treatment. In the event that a weigh belt is used, the atomizer need not also include a choke chamber, as described in the Renyer et al. US patents.

With continued reference to Figs. 2 and 3, the seed is carried on belt 134 to seed treatment application station where seed treatment is applied to the seed. Particularly, the seed flows through seed receiving funnel 142 and into atomizer 146, as perhaps best shown in Fig. 3. Atomizer 146 is more thoroughly described in both the US Patents to Reyner et al. identified above. However, as should be understood, any suitable seed treatment application device can be used without departing from the inventive concepts herein. Once the liquid treatment is applied to the seeds, they are fed into front end 152 of rotating drum 150 via chute 148. Rotating drum 150 can be any conventional drum, such as described in the US Patents to Reyner et al. However, rotating drum 150 could have additional features, which are more fully described below in reference to Figs. 7a-7c. Once in drum 150, the seeds are rotated for a select period of time sufficient to provide uniform coverage to the entire seed. The treated seeds exit drum 150 from back end 154 and flow through one or both chutes 192 and 194 where they are received by awaiting bins (not shown). The bins may be disposed on scales 196 and 198, which weigh the bins such that when the bin reaches a specified weight, treated seed dispensed from the respective chute can be stopped and the bin removed.

Generally, the seed treatment solution that is applied to the untreated seeds is often a homogenous mixture of one or more active ingredients, which are hazardous materials, and one or more other ingredients in the form of a suitable diluent. Various other ingredients may also be used to form the seed treatment solution. The active ingredients are typically packaged by the pesticide manufacturers in suitable containers, which are ultimately shipped to the site of the seed treatment apparatus. With respect to conventional seed treaters, as discussed above, the active ingredients are measured and manually transferred to a tank associated with the treater, exposing the operator to the hazardous material. This transfer of chemical material is commonly referred to as an open system.

The liquid transfer of active ingredients in the present seed treatment apparatus, however, operates in a closed system. Various active ingredients are

packaged in containers provided with suitable fittings adapted to be connected to a transfer pump, allowing the active ingredient to be pumped from the container. By way of example, Syngenta Crop Protection, Inc. having an office located at 410 Swing Rd., Greensboro, NC 27409 and assignee to this application, packages certain active ingredients in such a container. As will be appreciated from the following discussion, one of the seed treater disclosed herein is its ability to be used in conjunction with this type of packaging so as to reduce the amount of human exposure to these hazardous materials.

With reference then to Fig. 3, seed treater 110 includes a first collection tank shown here in the form of use tank 164 located at the seed and liquid receiving station 120. First use tank 164 is shown here as a cone bottom tank that is adapted to receive a first selected ingredient for forming the seed treatment in a closed system. On one side of use tank 164 is a second collection tank in the form of an identical use tank 164' for receiving a second ingredient for forming the seed treatment. On the other side of first use tank 164 is a third collection tank shown here in the form of a mix tank 168, which is adapted for collecting a selected ingredient, such as a nonhazardous diluent, in an open system. Seed treater 110 can be associated with any suitable number of collection tanks, such as use tanks and mix tanks, as appropriate and in whatever configuration and shape suitable for forming the seed treatment solution that is ultimately applied to the untreated seeds. From first and second use tanks 164, 164' and mix tank 168, the ingredients are mixed into a homogenous seed treatment solution prior to entering into the atomizer, which is discussed in more detail with reference to Fig. 4.

By way of an example, the respective ingredients may be collected by the collection and thereafter flow separately from one another upstairs 112 to a location adjacent to atomizer 146 where the ingredients are then combined, mixed, and sent to the atomizer via a plurality of fluid pathways. Fig. 4 is a schematic diagram illustrating an exemplary fluid pathway of both an active ingredient in a closed system and a diluent in an open system. First, the source of the first ingredient, or active ingredient, is received from the manufacturer within container 158. Container 158 is provided with conventional dry lock fittings (not shown) that are adapted to connect with hoses (not shown) such that container 158 and use tank 164 are in fluid communication with one another and having a plurality of fluid pathways therebetween and a plurality of valves that are configurable into a plurality of valve

states such that there can be described both a transfer scheme and a recirculation scheme. With respect to the transfer scheme, the active ingredient can be transferred from container 158 to use tank 164, where it is made available for use by the seed treatment apparatus. Particularly, following the direction of the fluid pathway arrows, the active ingredient is drawn from container 158 through a conduit which can be in the form of hose 160 via pump 113, which can be a conventional transfer pump. The active ingredient continues to flow into 3-way valve 115 and into pump 113 connected by another conduit which may be in the form of hose 162. From pump 113, the active ingredient flows through conduit or hose 163, into second 3-way valve 117 and into use tank 164 via conduit or hose 163'.

Additionally, with respect to the transfer scheme, the active ingredient can be transferred from use tank 164 back into container 158. In this way, active ingredient is drawn from use tank 164 through conduit or hose 161 via pump 113. The active ingredient flows to 3-way valve 115 and into pump 113 via conduit or hose 162. From pump 113, the active ingredient continues through hose 163, into second 3-way valve 117 and into container 158 via hose 165. As should be appreciated, a recirculation scheme also exists whereby the 3-way valves are configured into a first valve state to permit the recirculation of active ingredient in a loop that can be either from the use tank and back into the use tank or from the container and back into the container. The recirculation loops help keep the active ingredient from settling out.

Once the active ingredient is in use tank 164, it can then be used for seed treatment, which is also associated with a plurality of fluid pathways and valves that are configurable into a plurality of valve states. The active ingredient is drawn from use tank 164 and into conduit or hose 167 via metering pump 118 to mass flow meter 119. Mass flow meter 119 can be any conventional mass flow meter, and particularly measures the number of pounds of active ingredient passing through the meter each minute. As contemplated, however, the weigh belt discussed above in reference to Fig. 3 is associated with both pump 118 and meter 119 whereby once the weight of untreated seed on the weigh belt is known, meter 119 communicates to pump 118 the optimal speed in which the active ingredient needs to flow from use tank 164. Until this optimal setting is determined, valve 121 is configured into a first valve state wherein the active ingredient flows from use tank 164, through valve 121 and back to use tank 164 via conduit or hose 169. However, when the untreated seeds are ready to enter into the atomizer, 3-way valve 121 can be configured into a

second valve state whereby the active ingredient flows from use tank 164 and into an inlet in manifold, or coupling tube 170 via conduit or hose 168. It is in coupling tube 170 where the active ingredient is first commingled with the various other ingredients of the seed treatment solution before flowing into static mixer 172. Static mixer 172 mixes the ingredients entering from coupling tube 170 into a homogenized mixture suitable for the treatment of seeds.

As shown, manifold, or coupling tube 170 may have a plurality of inlets associated with several other 3-way valves 121' and 121'', each of which may be associated with a respective use tank containing another ingredient to the seed treatment and each having a plurality of valve states identical to that of valve 121 described above. It should be appreciated that the ingredient would be transferred to the use tank, and from there into the coupling tube in the same manner described above with respect to use tank 164. In this way, the ingredients drawn from the separate use tanks remain separate until they reach coupling tube 170, and then subsequently mixed by mixer 172. The homogenized liquid seed treatment thereby formed and containing the ingredients transported via the conduits from the respective use tanks flows from static mixer 172 to atomizer 146, where it is received in atomizer 146 via an outlet (not shown), which is described in more detail in the two US patents to Reynier et al.

Mix tank is also in fluid communication with manifold coupling tube 170 and associated with a plurality of fluid pathways and a 3-way valve similar to that described above. Here, supply diluent 166 is drawn from mix tank 168 via metering pump 109 and then through mass flow meter 127 to 3-way valve 129. When valve 129 is configured into a first valve state, it permits flow of diluent from mix tank 168, through valve 129, and back to mix tank. When valve 129 is configured into a second valve state, diluent is permitted to proceed from mix tank 168 and into coupling tube 170 via conduit 107.

Now that the general features of seed treater 110 have been discussed in reference to both the seed flow and liquid flow, various other features of the seed treater can be described in more detail. Turning then to Figs. 5a-6b, atomizer 146, which was generally introduced above, is movably supported relative to the seed treater by carriage assembly 180. Carriage assembly 180 includes framework or support frame 179 that is generally square in configuration and includes first and second opposing side walls 182 and 184 in spaced relation to one another, as well

as and bottom wall 178 having an upper surface and opposing bottom surface. Bottom wall 178 separates atomizer 146 from spreader chamber 144, which is disposed on the upper surface thereof. Chamber 144 assists in evenly distributing the seeds fed by the supply funnel before they flow into the atomizer. As shown here also, atomizer 146 includes feed tube 177, which receives the seed treatment from the static mixer.

Carriage assembly 180 further includes two identical pairs of carriage support arms. The first pair of carriage support arms is associated with first sidewall 182 and shown in Figs. 5a and 5b, and includes front carriage support arm 175 in spaced relation to back carriage support arm 176. The second pair of carriage support arms is associated with second sidewall 184 and shown in Figs. 6a and 6b, and includes front carriage support arm 175' and 176'. In this way, each carriage support arm is generally located at one corner of support frame 179.

Since both pairs of carriage support arms are identical, only the features of one pair, 175, 176 shown in Figs. 5a and 5b will be discussed in detail. As shown, carriage support arms 175 and 176 extend between first fasteners 159 and second fasteners 189. First fasteners 159 secure carriage arms 175 and 176 to front rotatable member 186 and back rotatable member 187, both of which are rotatable relative to first sidewall 182. Front rotatable member 186 may extend to second sidewall 184, joining the front fasteners associated with both pairs of carriage support members so as to form one continuous handle 174. Additionally, front rotatable member 186 is coupled to or joined with back rotatable member 187 by cross arm 155.

Second fasteners 189 extend through front opening 156 and back opening 157, fastening carriage arms 175, 176 to treatment device support member, shown here as first guide rail 181. As shown, carriage assembly 180 is further associated a moveable treatment device support member in the form of a first and second rails 181 and 183, which are disposed adjacent to first sidewall 182 and second sidewall 184, respectively. First and second rails 181 and 183 extend parallel to one another in spaced relation beyond the respective sidewalls 182 and 184, and terminating in respective first and second end stops 185 and 135. Atomizer 146, which is provided with platform 147, is slidably disposed on rails 181 and 183 such that atomizer 146 is adapted to be moved in either direction of arrows "A" or "B". Platform 147 may

further be provided with stoppers (not shown) extending downwardly therefrom and adapted to stop further movement of platform 147 in the direction of arrow "B".

As may now be appreciated, when first and second rails 181 and 183 are in the first position, shown in both Figs. 5a and 6b, atomizer 146 is in the seed treatment position and operative to apply treatment solution to untreated seeds. Rails 181 and 183 can then be moved into a second position, shown in Figs 5b and 6a, whereby atomizer 146 is disengaged from the seed treater and inoperative to treat seeds, thereby permitting it to be selectively moved along rails 181 and 183 in the direction of arrows "A" and "B". The ability to expose atomizer 146 permits the routine maintenance of the equipment.

To move rails 181 and 183 from the first position to the second position, handle 174 is moved in an appropriate direction to cause front rotatable member 186 and back rotatable member 187 to simultaneously rotate in the direction of arrow "C". As these members rotate, carriage support arms 175 and 176 move in respective openings 156 and 157 in the general direction of arrow "D", thereby increasing the distance between guide rails 181, 183 and bottom wall 178 of support frame 179. Once in the second position, atomizer 146 may be pulled via handle 151 in the direction of arrow "B" and out from under bottom wall 178.

Once atomizer 146 is returned beneath bottom wall 178 by sliding it in the direction of arrow "B", rails 181 and 183 may be returned to the first position as shown in Figs. 6a and 6b. Handle 174 is moved thereby to cause rotatable members 186 and 187 to rotate in the direction of arrow "E" and carriage support arms 175', 176' to move in the direction of arrow "F" in respective openings 156' and 157' thereby causing movement of the rails. Once rails 181 and 183 are back in the first position, and platform 147 is in confronting relation with the bottom surface of bottom wall 178, seed treatment can be resumed. Carriage support arms may be, for example, in the form of adjustable ball joints. In this way, the length of each carriage support arm can be separately adjusted so that platform 147 uniformly confronts bottom wall 178.

As shown in Figs. 6a and 6b, carriage assembly may further be provided with cone 193 (shown in phantom). Cone 193 is disposed on bottom wall 178, within chamber 144, and is adapted to facilitate the alignment of tube 195 (shown in phantom), through which the seed treatment mixture flows to atomizer 146.

As discussed above, the seed treater according to the present invention includes rotating drum 150, which may be a conventional drum, or one having the features adapted to retain therein the first bag or batch of seeds treated by the seed treater. As with conventional seed treaters, the first 40 to 50 pounds of seeds are usually not coated with the seed treatment as well as the treated seeds that follow. For this reason, it is desirable for the drum to retain the initial 40 to 50 pounds of seeds while permitting the subsequent treated seeds to flow into and out of the drum. Retaining just the initial seeds and rotating them within the drum allows them to become more uniformly coated.

With reference then to Figs. 7a – 7c, drum 150 is shown in three different positions. Fig. 7a shows the drum in the start position, Fig. 7b shows the drum in the run position, and Fig. 7c shows the drum in the cleanout position. Drum 150 is movable among these three positions by piston 136, which can be any suitable piston such as an electric screw driven piston. Piston 136 is operative to selectively extend or retract shaft 138 associated therewith, which is secured to drum platform 151. Front portion 152 of drum platform 151 is pivotably secured to bearing 139 so that as shaft 138 extends or retracts, drum platform 151 changes the angular position of drum 150. Bearing 139 may be, for example, a pillow bearing or other suitable bearing known in the art.

In the start position, drum 150 is preferably between a position wherein drum platform 151 is generally parallel to the support surface and a position wherein drum platform 151 is at a positive angle of about 2° to 3° . Once the initial batch of seeds has been retained in the drum for a select period of time, drum 150 can be moved into the run position wherein drum platform 151 is generally parallel to the support surface. Finally, once seed treatment is complete, drum 150 can be moved into the cleanout position, which is angle between about -3° and -10° .

In addition to the foregoing, it should be appreciated that the seed treater shown and described above may optionally include a controller, such as a PLC controller, that is adapted to control both the seed flow and liquid flow to deliver a predetermined amount of seed to the atomizer. The PLC controller may receive sensings from the load cells associated with the weigh belt, which transfers the seeds from the elevator to the atomizer. The weigh belt can communicate the number of seeds received per second, allowing the PLC controller to make any appropriate adjustments to the amount of seed treatment dispensed in the atomizer.

The PLC controller may also be used to control the angular position of the rotating drum, and opens or closes the chutes through which seeds exit the drum based upon the weight of the receiving bin as determined by the scales. It is further contemplated that the PLC controller can be pre-programmed for a particular seed treatment such when the operator enters the number seeds per pound, the controller calibrates the seed treater.

From the foregoing it should also be appreciated that both the atomizer and associated carriage assembly described in Figs. 5a-6b, as well as the drum described in reference to Figs. 7a -7c can be used in connection with conventional seed treaters. Similarly, the closed system for the liquid flow path that was described above in reference to Fig. 4 is not limited to being used with the seed treater of the present invention, but can be adapted for use with conventional seed treaters.

The present invention is directed to a method of seed treatment. To this end, it should be explicitly understood that the method can include any step that is inherent in the above-described structure. Generally, a method according to the present invention includes a first step calibrating the seed treater so that the seed flow and liquid flow are set for the optimal treatment of seeds. The method may further include the step of unloading a select number of pounds of seeds, whereby the seeds are first disposed on a weigh belt adapted to count the number of seeds traveling per second before the seeds reach the atomizer. The method may further include retaining a select number of treated seeds in a rotating drum for a select period of time before permitting them to exit the drum and into an awaiting bin.

There is also contemplated a method of disengaging an atomizer from the seed treater for the purpose of routine maintenance of thereof. The method can also method can include any step that is inherent in the above-described structure. The method then includes the step of mechanically moving a handle thereby moving the atomizer from its seed treatment position. The method may particularly include the step of lowering atomizer and then exposing the atomizer by pulling it away from the seed treater.

Accordingly, the present invention has been described with some degree of particularity directed to the exemplary embodiments of the present invention. It should be appreciated, though, that modifications or changes may be made to the

exemplary embodiments of the present invention without departing from the inventive concepts contained herein.

In the claims:

1. An apparatus adapted to treat a selected particle with a treatment solution containing a plurality of treatment ingredients, said apparatus comprising:

(A) a plurality of collection tanks adapted to receive at least one of said plurality of treatment ingredients from an ingredient source;

(B) a manifold in fluid communication with said plurality of collection tanks and including a plurality of inlets;

(C) a plurality of fluid pathways communicating between said plurality of collection tanks and said plurality of manifold inlets to permit said plurality of ingredients to flow from said collection tanks and into said manifold; and

(D) a mixer in fluid communication with said manifold and operative to receive and mix said plurality of ingredients into a homogenous treatment solution.

2. An apparatus according to claim 1 wherein said plurality of collection tanks includes

(A) a first collection tank adapted to receive a first one of said plurality of ingredients from a first ingredient source; and

(B) a second collection tank adapted to receive a second one of said plurality of ingredients different from said first ingredient from a second ingredient source.

3. An apparatus according to claim 2 wherein said plurality of manifold inlets includes:

(A) a first inlet associated with a first one of said fluid pathways through which said first ingredient flows into said manifold; and

(B) a second inlet associated with a second one of said fluid pathways and through which said second ingredient flows into said manifold.

4. An apparatus according to claim 2 wherein said first collection tank is adapted to be placed in fluid communication with said first source.

5. An apparatus according to claim 4 including a transfer pump in fluid communication with said first collection tank and said first source and operative to pump said first ingredient from said first source to said first collection tank.

6. An apparatus according to claim 1 including at least three collection tanks wherein each of said collection tanks is adapted to receive a respective treatment

ingredient from a respective treatment source and wherein each said collection tank is in fluid communication with a respective one of said ingredient sources.

7. An apparatus according to claim 6 wherein each of said three treatment ingredients is an active ingredient.

8. An apparatus according to claim 1 including a plurality of valves associated with said fluid pathways that are configurable into a plurality of valve states, including

(A) a first valve state wherein said treatment ingredient circulates from said collection tank, through said valve and back to said collection tank; and

(B) a second valve state wherein said treatment ingredient is permitted to flow from said collection tank, through said valve, and into said manifold.

9. An apparatus according to claim 1 wherein said mixer is a static mixer.

10. An apparatus according to claim 1 including an atomizer in fluid communication with said mixer and operative to treat the particle with said treatment solution.

11. An apparatus according to claim 1 wherein said fluid pathways are formed by a plurality of hoses.

12. A seed treatment apparatus adapted to treat seeds with a treatment solution containing a plurality of ingredients, comprising:

(A) a first collection tank adapted to receive a first ingredient of the treatment solution from a first source, said first collection tank adapted to be placed in fluid communication with said first source; and

(b) a treatment application device in fluid communication with said first collection tank and operative to apply the treatment solution containing said first ingredient to the seeds.

13. A seed treatment apparatus according to claim 12 including a second collection tank adapted to receive a second ingredient of the treatment solution from a second source and fluid communication with said device.

14. A seed treatment apparatus according to claim 13 wherein said second ingredient is a diluent selected from water, polar solvents, non polar solvents, polymers, surfactants, anti-foaming agents, and suitable carriers.

15. A seed treatment apparatus according to claim 13 wherein said second collection tank is in fluid communication with said second source.

16. A seed treatment apparatus according to claim 13 including a mixer in fluid communication with said first and second collection tanks and said device, said

mixer operative to receive and mix said first and second treatment ingredients and thereby to form the treatment solution for application by said device.

17. A seed treatment apparatus according to claim 12 wherein said first treatment ingredient is an active ingredient.

18. A seed treatment apparatus according to claim 12 including a first pump in fluid communication with said first collection tank and said first source and operative to pump said first ingredient from said first source to said first collection tank.

19. A seed treatment apparatus according to claim 18 wherein said first pump is a transfer pump.

20. A seed treatment apparatus according to claim 12 including a metering pump in fluid communication with said first collection tank and said device and operative to pump said first ingredient from said first collection tank to said device at a selected rate.

21. A seed treatment apparatus according to claim 20 including a mass flow meter in fluid communication with said first collection tank and operative to measure the quantity of said first ingredient flowing therethrough at the selected rate.

22. A seed treatment apparatus according to claim 12 wherein said device is an atomizer.

23. A seed treatment apparatus according to claim 12 including a mixing drum having an entrance and an exit, wherein treated seeds are received by said mixing drum via the entrance.

24. A seed treatment apparatus according to claim 23 including a receiving bin adapted to receive seeds leaving said mixing drum via the exit.

25. A seed treatment apparatus according to claim 24 including a scale adapted to measure the weight of said receiving bin.

26. A carriage assembly adapted to support an atomizer associated with a seed treatment apparatus, comprising:

- (A) a framework including a pair of spaced apart first and second sidewalls;
- (B) a first rail located proximately to said first sidewall;
- (C) a second rail located proximately to said second sidewall, said atomizer being disposed on said first and second rails between said sidewalls;
- (D) a first carriage support arm secured to said first rail;

(E) a second carriage support arm secured to said second rail, said first and second carriage support arms being adapted to move said first and second rails respectively, between a first position and a second position such that:

(1) when said first and second rails are in the first position, the atomizer is operative to apply a selected treatment to a quantity of seeds; and

(2) when said first and second rails are in the second position, the atomizer is unable to apply the treatment to the seeds;

27. A carriage assembly according to claim 26 including a bottom wall extending between said first and second sidewalls and having an upper surface and an oppositely facing lower surface.

28. A carriage assembly according to claim 27 wherein said atomizer is in confronting relation with the bottom surface of said bottom wall when said first and second rails are in the first position.

29. A carriage assembly according to claim 26 wherein said atomizer is in spaced relation to the bottom surface of said bottom wall when said first and second rails are in the second position.

30. A carriage assembly according to claim 27 including a spreader chamber disposed on the upper surface of said bottom wall and in communication with said atomizer when said first and second rails are in the first position such that untreated seeds may flow through said spreader and into said atomizer.

31. A carriage assembly according to claim 26 wherein said atomizer is adapted to slide along said first and second rails when in the second position.

32. A carriage assembly according to claim 26 including:

(A) a third carriage support arm secured to said first rail in spaced relation to said first carriage support arm at a location proximate said first sidewall; and

(B) a fourth carriage support arm secured to said second rail in spaced relation to said fourth carriage support arm at a location proximate to said second sidewall;

(C) wherein said third and fourth carriage arms are adapted to move between the first and second positions.

33. A carriage assembly according to claim 32 wherein said first, second, third, and fourth carriage support arms move between said first and second positions simultaneously.

34 A carriage assembly according to claim 26 wherein said carriage support arms have an adjustable length.

35. In a seed treatment apparatus operative to treat a quantity of seeds with a treatment solution, the improvement comprising:

(A) a carriage assembly including a support member moveable between a first position and a second position;

(B) a treatment application device operative to apply the treatment solution to a quantity of seeds, said application device being moveably supported by said support member such that

(1) when said support member is in the first position, said treatment device is operative to treat the seeds; and

(2) when said support member is moved into the second position, said treatment device is inoperative to treat the seeds.

36. An improvement to a seed treatment apparatus according to claim 35 wherein said support member is in the form of a pair of spaced apart rails, said treatment application device being adapted to slide therealong.

37. An improvement to a seed treatment apparatus according to claim 36 including a pair of carriage support arms wherein each said arm is secured to a respective rail and adapted to move said rails between the first and second positions.

38. An improvement to a seed treatment apparatus according to claim 37 wherein said pair of carriage support arms are adapted to simultaneously move said rails between the first and second positions.

39. An improvement to a seed treatment apparatus according to claim 37 wherein said pair of carriage support arms have an adjustable length.

40. An improvement to a seed treatment apparatus according to claim 35 wherein said treatment device is an atomizer.

41. A method of treating seeds with a treatment solution containing a plurality of ingredients, the method comprising:

(A) providing a first collection tank sized and adapted to receive a first ingredient of the treatment solution and a second collection tank sized and adapted to receive a second ingredient;

(B) placing said first collection tank in fluid communication with a source of said first ingredient whereby said first ingredient can be transported into said first collection tank;

- (C) forming a treatment solution from said first and second ingredients; and
- (D) thereafter transporting the treatment solution to a treatment device

operative to apply the treatment solution to a selected quantity of seeds.

42. A method according to claim 41 wherein said first ingredient is pumped from said first ingredient source to said first collection tank.

43. A method according to claim 41 wherein said first ingredient is an active ingredient and said second ingredient is a diluent.

44. A method according to claim 41 including the step of placing said second collection tank in fluid communication with a source of said second ingredient whereby said second ingredient can be pumped into said second collection tank.

45. A method according to claim 44 wherein said first and second ingredients are recirculated between said first and second collection tanks and respective sources thereof.

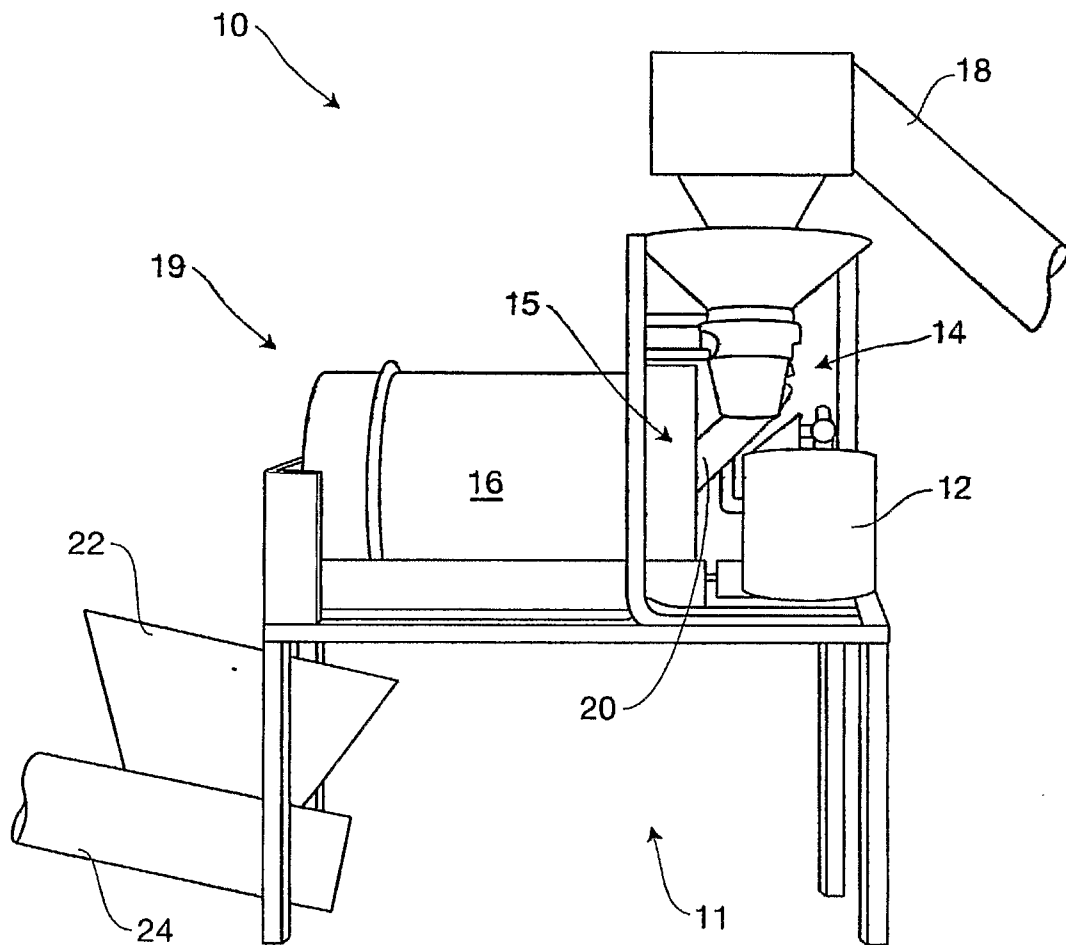


FIG. 1
(Prior Art)

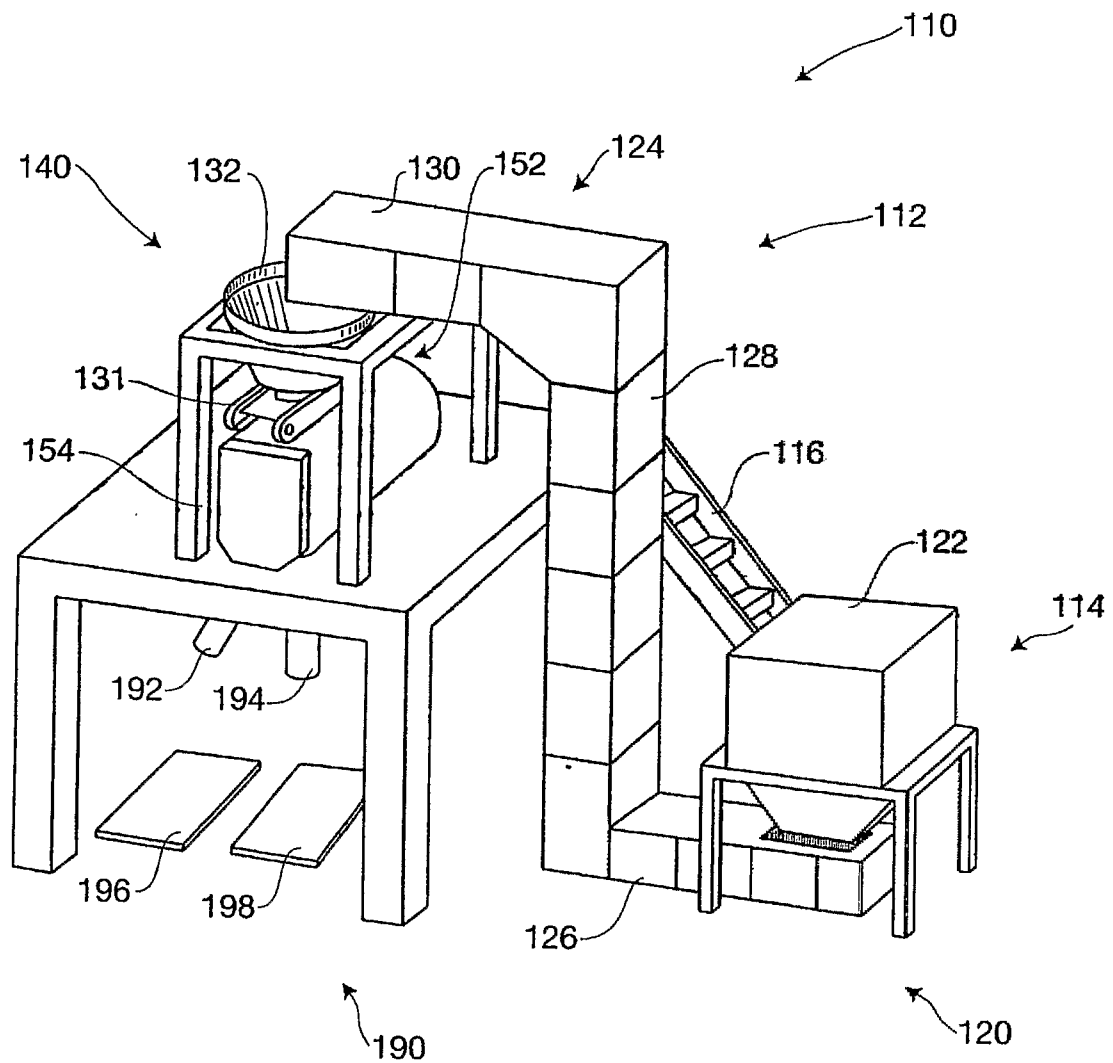


FIG. 2

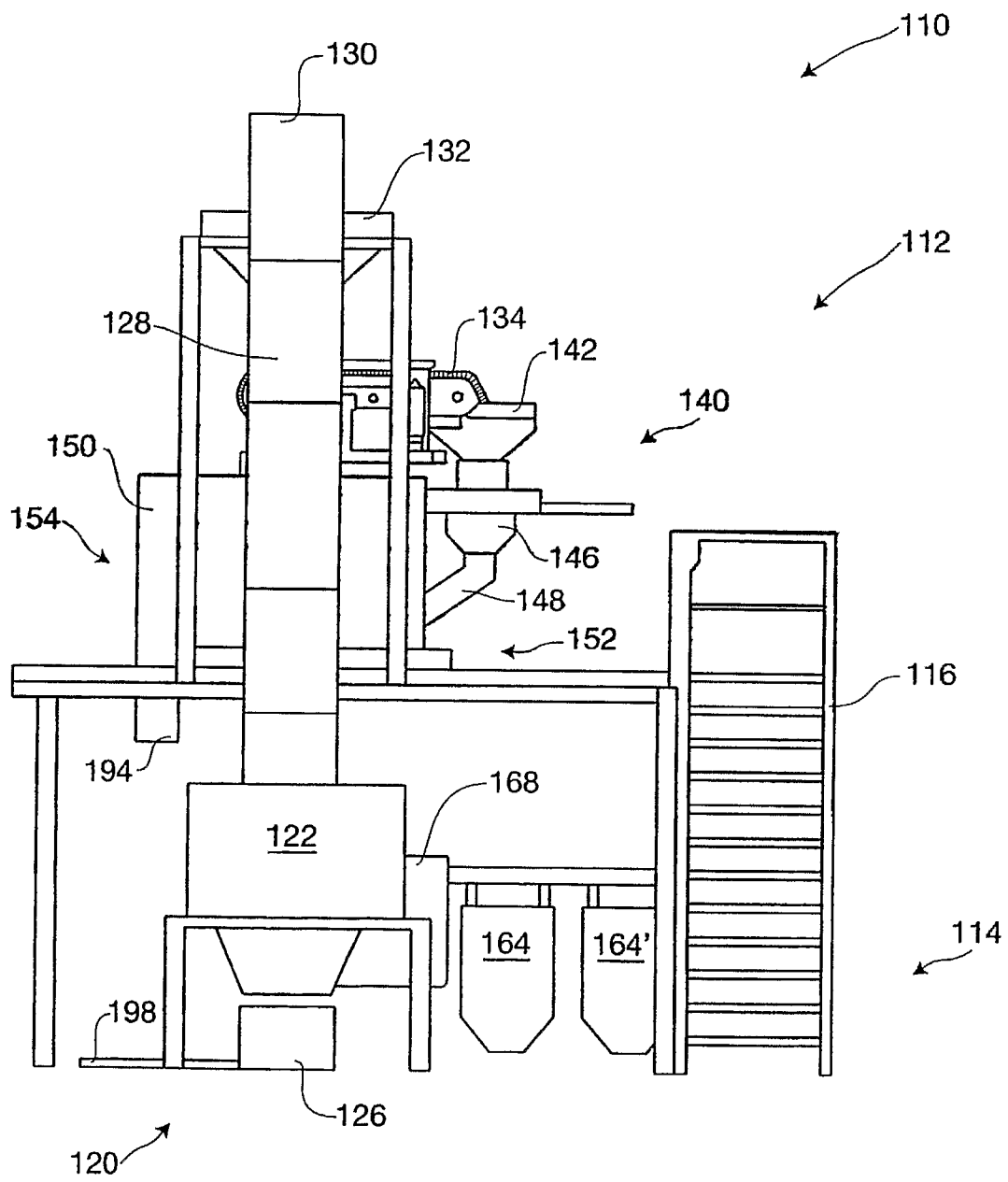


FIG. 3

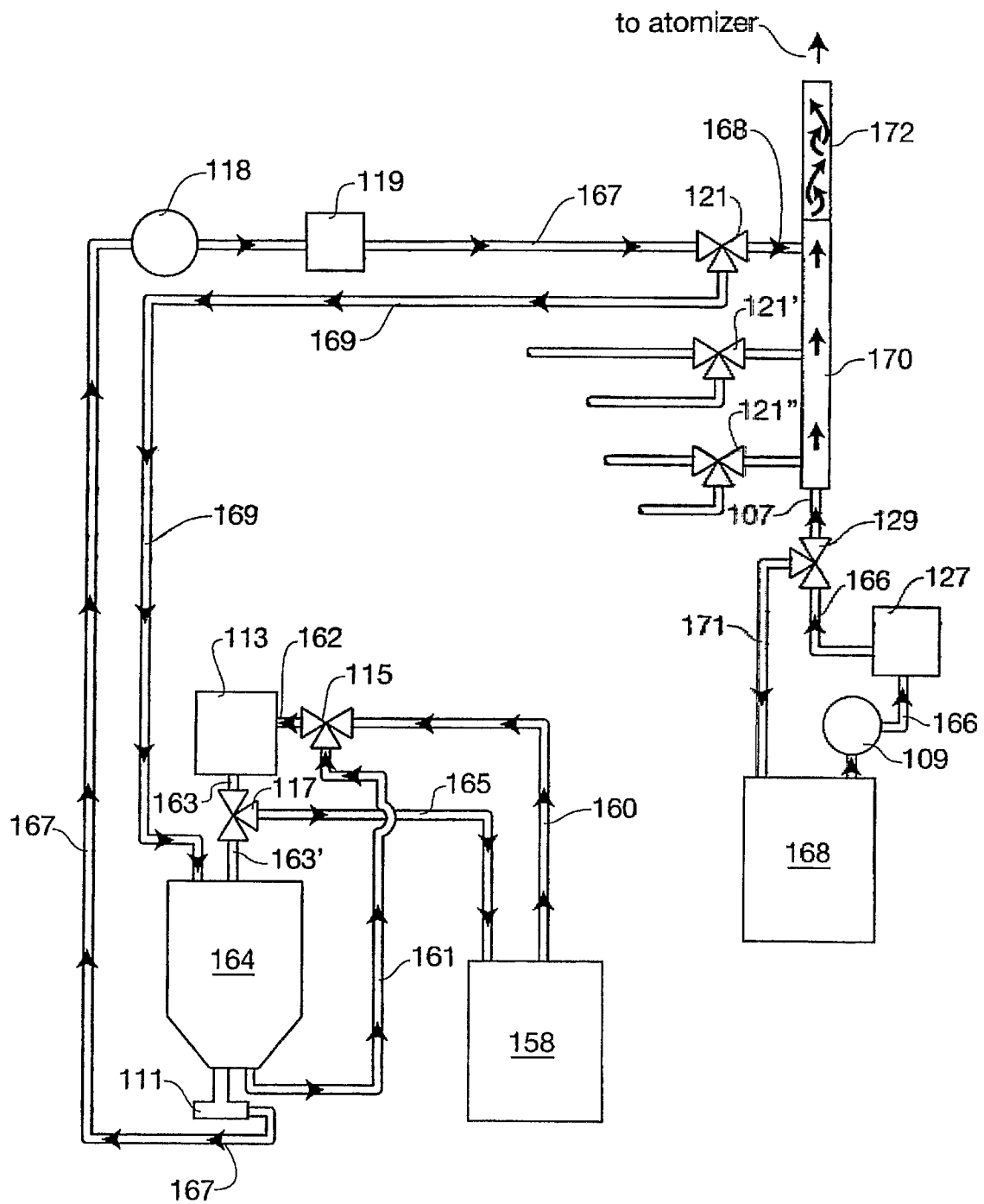


FIG. 4

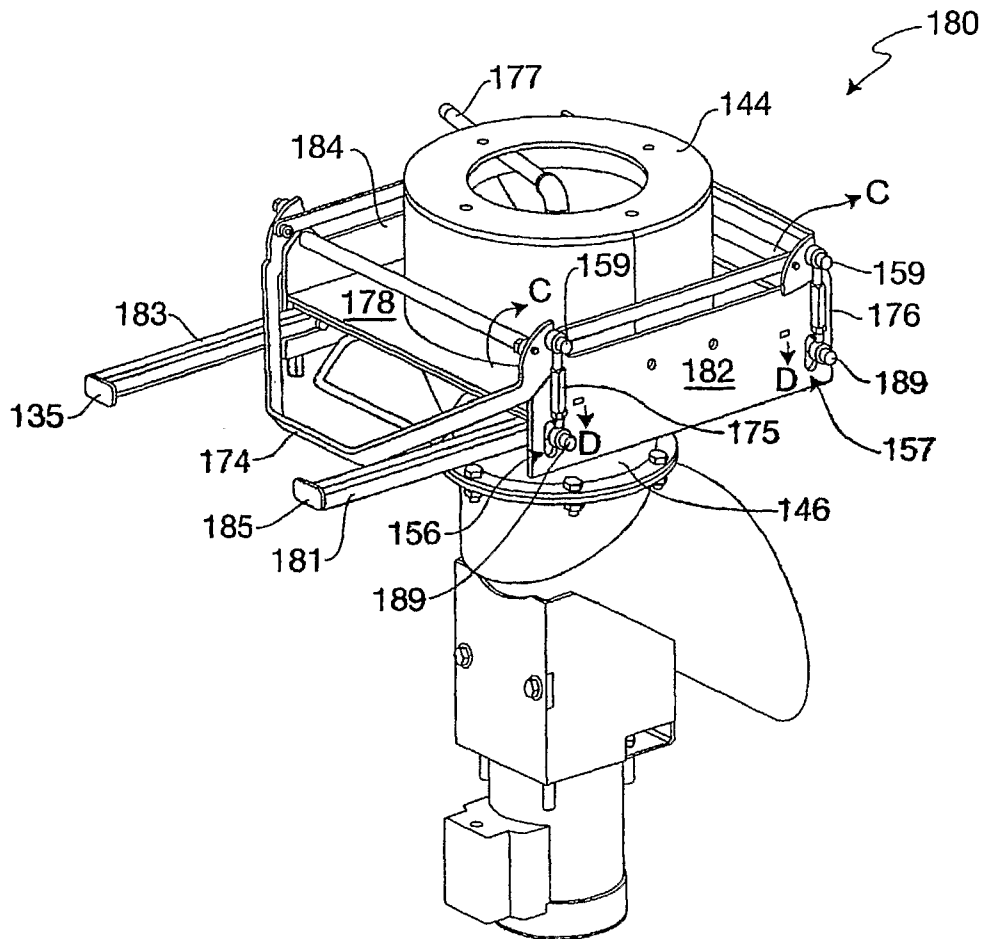


FIG. 5a

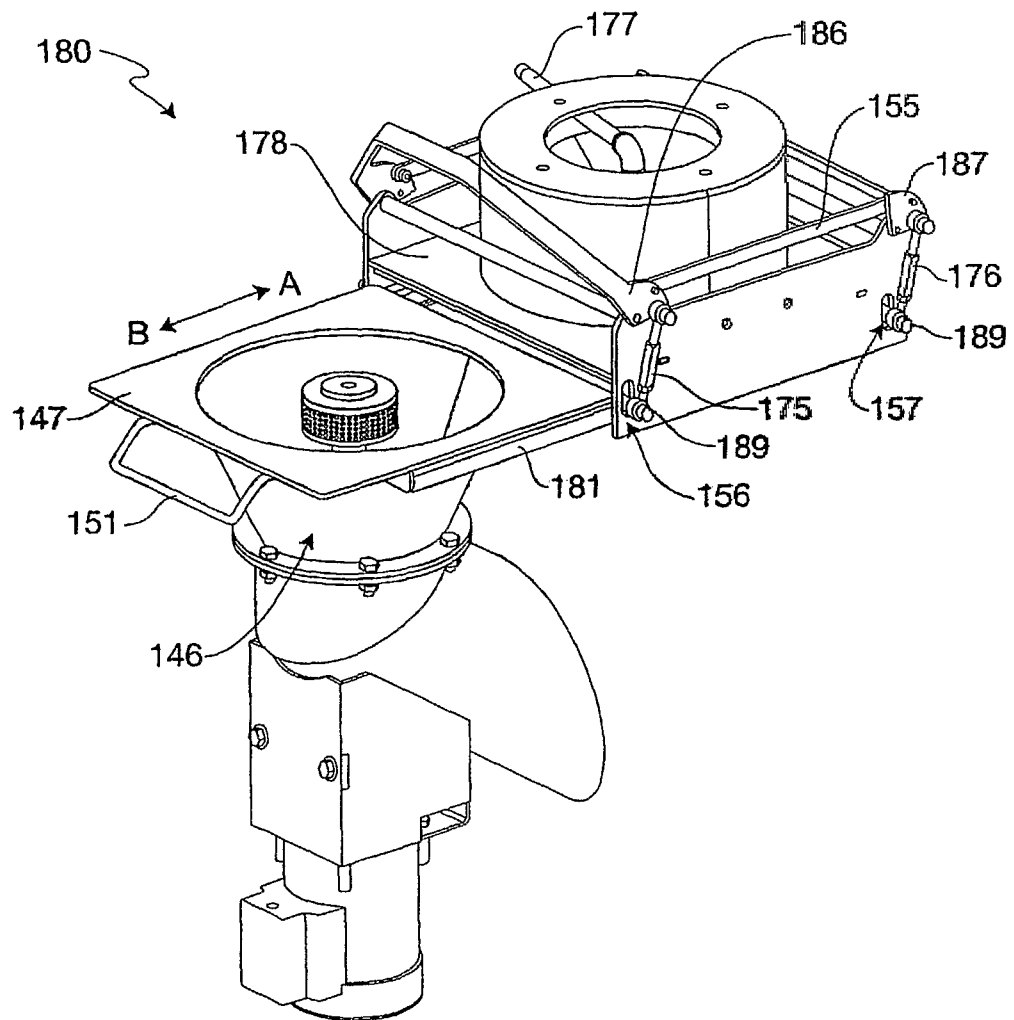


FIG. 5b

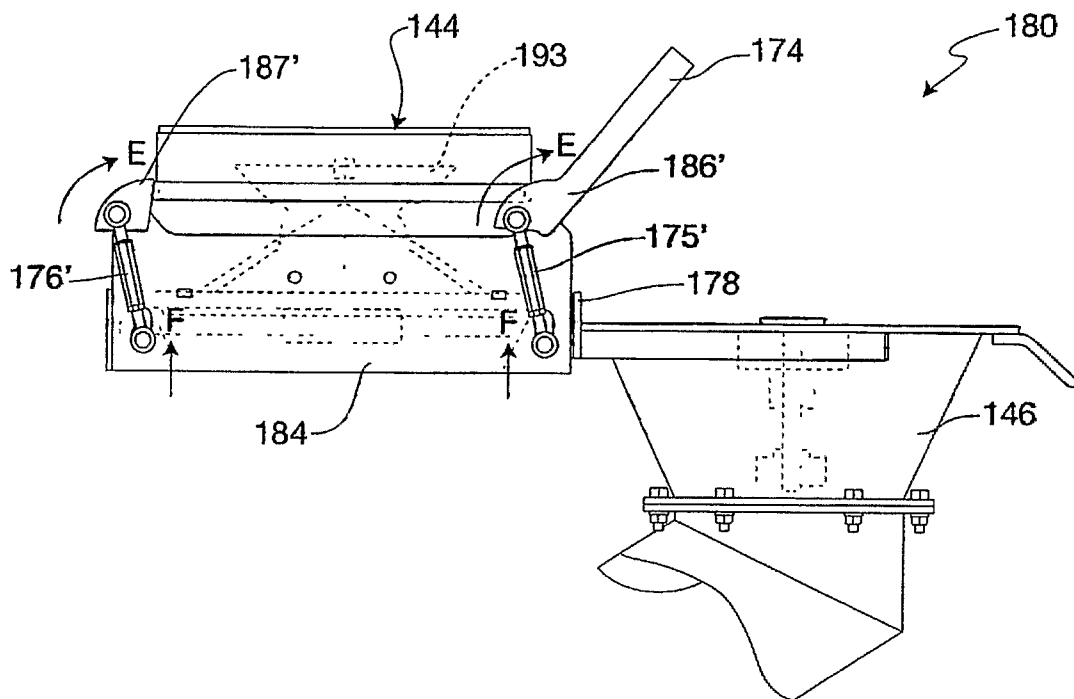


FIG. 6a

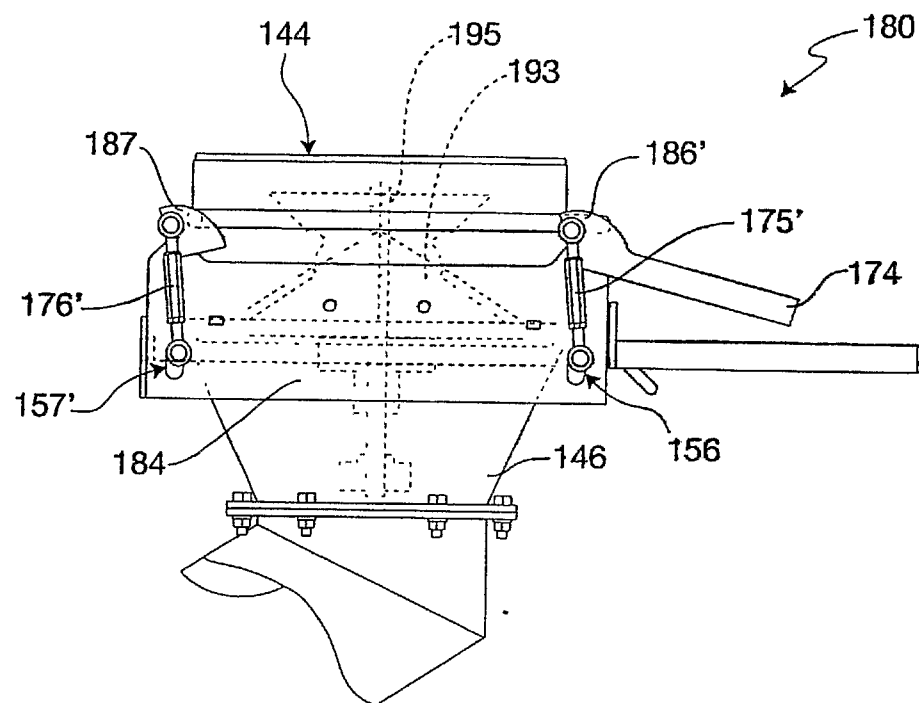


FIG. 6b

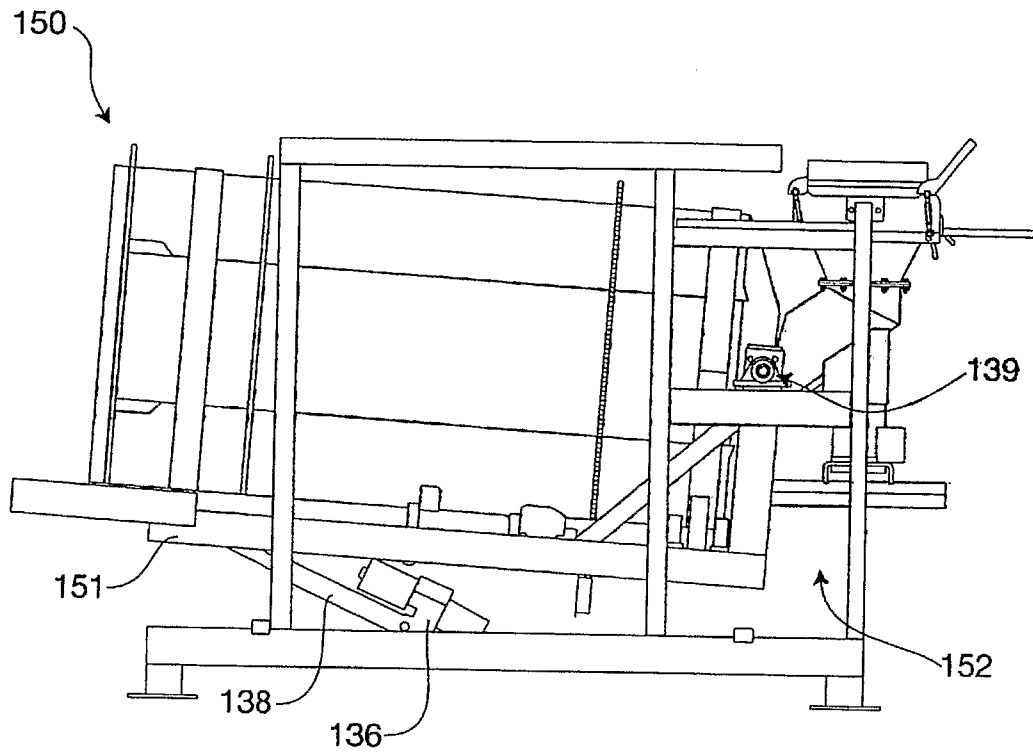


FIG. 7a

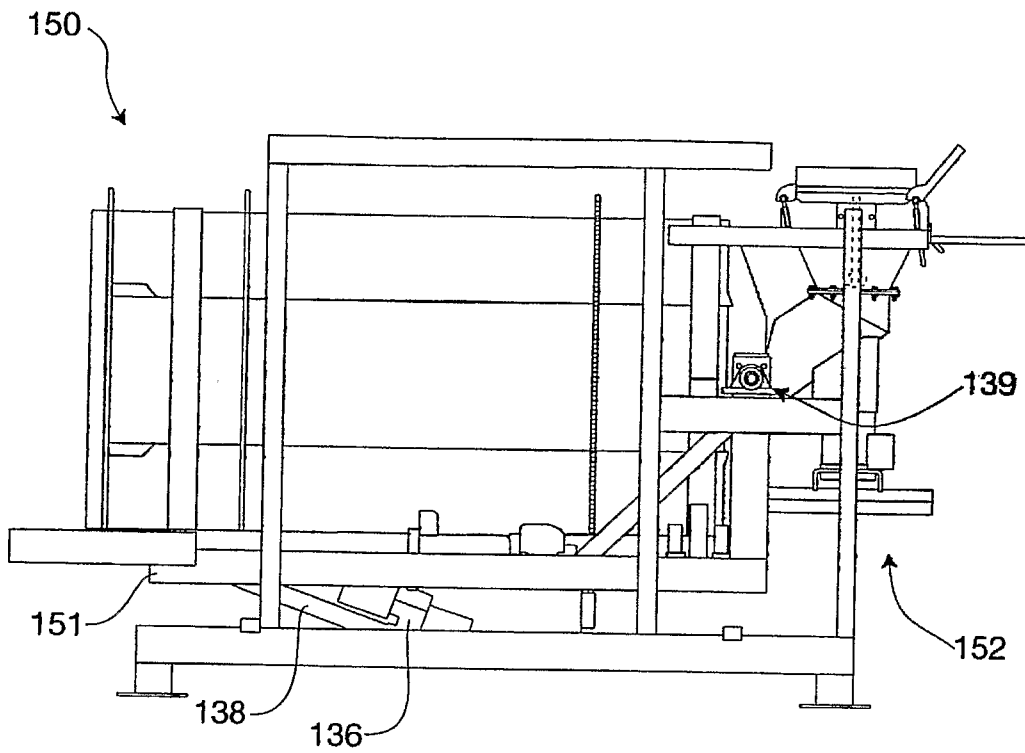


FIG. 7b

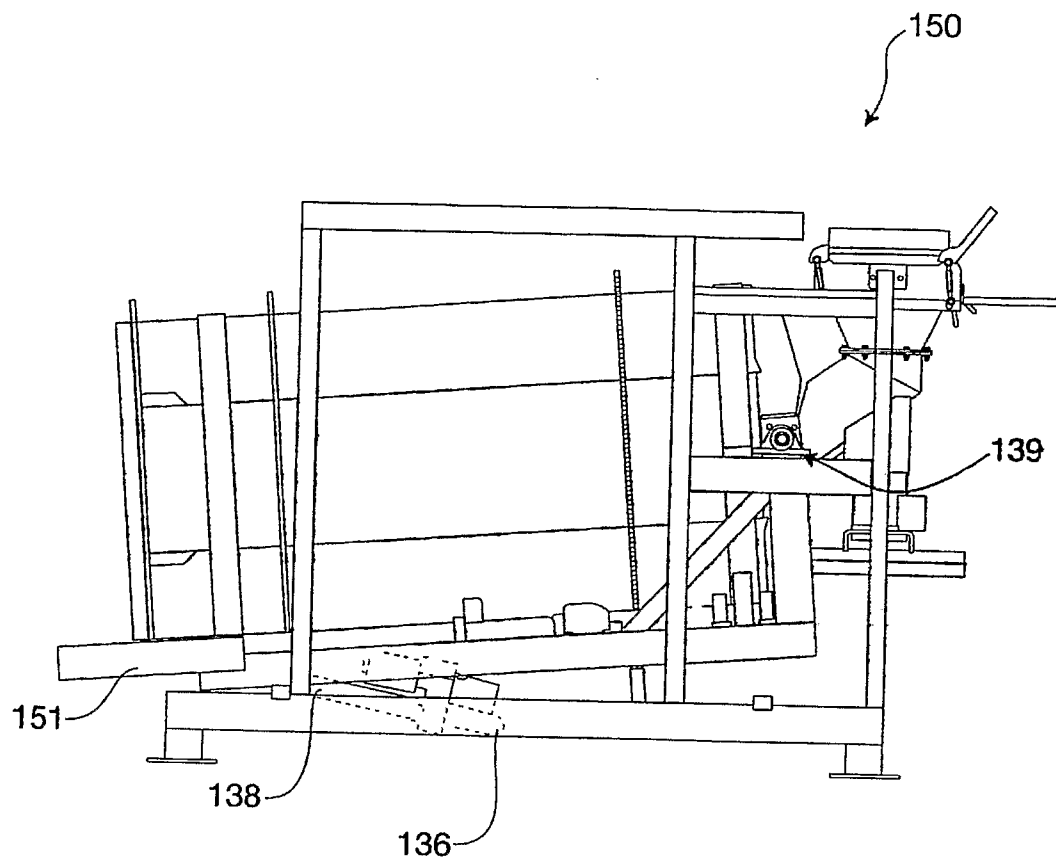


FIG. 7c

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US06/33358

A. CLASSIFICATION OF SUBJECT MATTER

IPC: A01N 57/18(2006.01)

USPC: 504/208

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 504/208

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,783,082 B2 (RENYER et al) 31 August 2004 (31.08.2004), see the whole document.	1-45
A	US 6,551,402 B1 (RENYER et al) 22 April 2003 (22.04.2003), see the whole document.	1-45



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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document member of the same patent family

Date of the actual completion of the international search

01 October 2007 (01.10.2007)

Date of mailing of the international search report

09 OCT 2007

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