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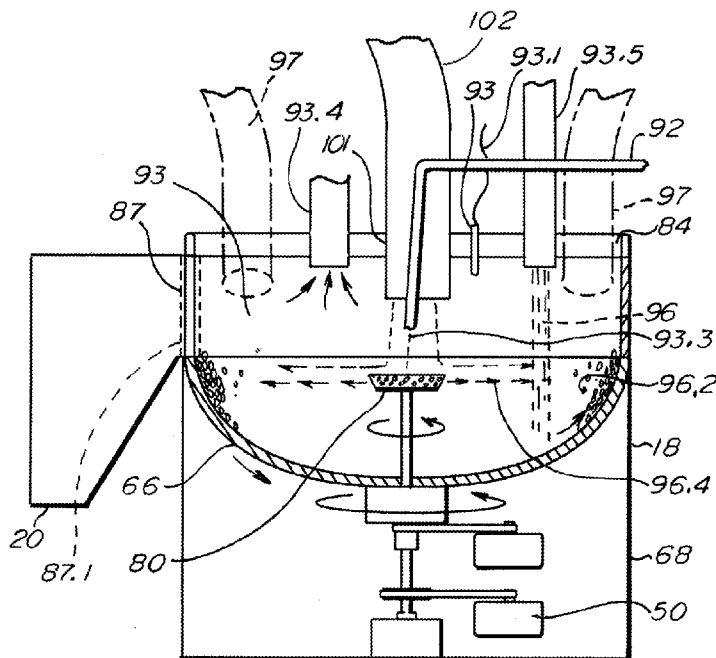


Fig. 3B

(57) Abstract: A seed treater provides enhanced seed coating capabilities and performance. The seed and/or treatment fluid may be heated for improving vaporization and absorption by the seed. Air may be injected in the seed treater to provide heat, dehumidified air, and to provide vaporization enhancement, and component cleaning functions. The functions may be controlled by a control processor based on recipes and may be changed dependent upon sensed or input environmental conditions such as temperature and humidity.

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SEED TREATMENT DEVICE WITH IMPROVED FLUID APPLICATION**RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional Patent Application No. 61/624,668, filed April 16, 2012, entitled SEED TREATER WITH IMPROVED FLUID APPLICATION MEANS, said application being hereby fully incorporated herein by reference.

FIELD OF THE INVENTION

The present invention generally relates to an apparatus for surface treatment of seeds. More particularly, the present invention relates to a device for surface treatment of seeds having an improved fluid application means.

BACKGROUND OF THE INVENTION

Seeds that are planted for agricultural and other purposes are often treated prior to planting. The treatments may accomplish many different purposes including deterrence or prevention of insect and other animal pests that would target sown or newly germinated seed for attack. These animals may directly cause damage to the seed or may introduce one or more pathogens, including viruses, directly into the seed. Treatments may also target bacteria, molds and fungus that have contaminated seeds or that are known to be present in the soil in which the seeds will be planted. Direct application of seed treatment allows for a reduction in the amount of treatment composition that would be required by application to soil after planting. Also, post-planting application may not penetrate the soil to a level or location where it would be effective.

Treatment of seeds, however, involves applications of chemicals and other agents that are expensive and may even be toxic to the seeds on which they are applied. The amount of treatment composition is also necessarily small and often provides protection or other advantage for only a short period of time after planting. However, in a number of situations, the advantages of treatment with one or more compositions will outweigh the disadvantages. These situations include the use of rare or expensive seed, the use of older seed or seed with low germination rates, the use of seed known to be contaminated or infested, the use of seed known to have been produced in conditions likely to lead to contamination or infestation, and the use of seed in fields known to be prone to contamination or infestation.

Various devices for treatment of seeds in batch or continuous treatment mode are known. U.S. 5,891,246 to Lund, the disclosure of which is hereby incorporated by reference, describes a seed coating apparatus for applying a coating fluid whereby seeds are dispersed with a seed dispersing member.

5 US 4,657, 773 to Mueller, the disclosure of which is hereby incorporated by reference, describes a process and apparatus for dressing seed in which seed is guided over a dispensing cone through a jet of dressing and onto a rotary table.

DE 4411058 to Niklas, the disclosure of which is hereby incorporated by reference, describes a device with a mixing bowl connected to a high speed, multi-tum
10 actuator and a mechanism to feed seed into the mixing bowl. The bowl rotates to rotate seed being treated therein. The seed treating formulation is sprayed in the bowl while the seed is being rotated to uniformly coat the seed with the formulation.

SUMMARY OF THE INVENTION

The apparatus of the invention is directed toward an apparatus for surface
15 treatment of seeds. Treatment apparatus according to the invention can treat seeds continuously or in batches. Treatment fluid is delivered into a treatment area of system by a fluid communication line and distributed onto seeds such as via rotation of an atomizer wheel configured as a centrifugal apertured plate. Means are provided to increase the absorption and/or adhesion and/or drying time of the treatment fluid with seed being
20 treated. In embodiments of the invention, means are provided to enhance the vaporization of the treatment fluid. In embodiments heat is added to the treatment region of the seed. In certain embodiments, conditioned air may be heated and/or dehumidified and provided into the seed treatment apparatus at, for example, the fluid application region. The conditioned air may be provided to the seed or seed stream prior to fluid application
25 region. In embodiments, conditioned air includes dehumidified air to enhance the vaporization of the treatment fluid. In an embodiment the treatment fluid temperature is altered.

In embodiments of the invention, heated air is directed at the centrifugal plate with an air delivery duct. In such embodiments, the air delivery tube delivering the heated air
30 may surround the fluid flow line delivering the treatment fluid to the fluid application region. The heated air flow also warms the fluid in the fluid flow line. In certain embodiments, the fluid may be more directly heated with a dedicated heat source, such as

electric heating elements, applied directly to a treatment fluid reservoir or to a fluid line in or going to the seed treater. Heating of the fluid may occur prior to the commencement of the seed treatment and/or during the seed treatment. In certain embodiments, the fluid may be heated to a particular temperature for treatment before dispersion. In certain
5 embodiments, the fluid may be heated from ambient to a particular temperature or temperature differential prior to application to the seeds. In certain embodiments, particular components of seed treater may be heated, that is, for example, a treatment bowl or centrifugal plate. This may provide reduced viscosity of fluid in contact with the component as well as lowering the vapor pressure of the fluid. In embodiments, the seed is
10 warmed prior to or during application of the fluid. In certain embodiments, the air may be injected within the seed stream flow ahead of the region where the seeds are treated effectively warming the seeds before treatment. In other embodiments, the seeds may be preheated by other means, such as heating the seed containment.

In embodiments of the invention, such heating and/or air conditioning as described
15 above, may be automatically controlled and may be part of treatment recipes provided to a process controller controlling the equipment. In embodiments, the heating and/or air conditioning as described above, may be automatically controlled based upon existing environmental conditions. For example, if an ambient temperature is below 50 degrees Fahrenheit, the seed stream may be warmed, and/or the treatment fluid may be warmed to
20 a desired temperature suitable for optimal seed treatment.

A feature and advantage of embodiment of the invention is optimally controlling the evaporative properties within a seed treater to maximize seed treatment efficacy and minimize treatment time.

A feature and advantage of embodiments of the invention is enhanced seed
25 coating, in particular, more uniform thorough coating in less time. Additionally, a feature and advantage of embodiments of the invention is less dust generation.

A feature and advantage of particular embodiments of the present invention where air is injected into the top side of the mixing bowl is improved dispersion of treatment fluid. Air is blasted from the air delivery tube into the centrifugal plate as the plate is
30 spinning providing enhanced dispersion of the treatment fluid. The combination of the blowing air with the spinning plate functions to increase the atomization of the fluid

particles, which provides better fluid dispersal from the atomizer. Providing heated and/or dehumidified air can further enhance the vaporization of the treatment fluid.

Another feature and advantage of embodiments of the present invention is enhanced treatment fluid absorption on the seeds. By heating the fluid, for example inline
5 with the air delivery tube surrounding the fluid communication line and at the centrifugal plate, the viscosity and vapor pressure of the fluid is lowered. As such, when the fluid is dispersed from the atomizer and contacts the seeds, the fluid is more readily absorbed and retained on the surface of the seeds.

Another feature of embodiments of the invention is the injection of the conditioned
10 air circumferentially inside a containment housing for a mixing bowl. In embodiments the air is injected in a radial direction at the top of the bowl containment. In an embodiment the air outlet port is radially outward and downward, in an embodiment the air is directed circumferentially to correspond with the rotation of the seed in the rotating bowl.

A further feature and advantage of embodiments of the present invention is a
15 cleaner fluid treatment bowl and centrifugal plate. Due to the enhanced dispersion of the warmed fluid, the increased absorption of the fluid by the seeds, and the air-scrubbing of the components, such as the spinning centrifugal plate, a greater percentage of fluid remains with the seeds. There is therefore less buildup of leftover fluid within the treatment area, resulting in cleaner post- treatment equipment.

Another feature and advantage of embodiments of the present invention is a
20 reduced amount of time to treat a batch of seeds. Increased dispersal of treatment fluid and absorption of fluid by the seeds means that the seeds need to spend less time being treated to obtain the same or better level of treatment. As such, each batch can be processed more quickly, which leads to increased seed capacity for the particular apparatus and the plant
25 utilized the apparatus as well as the ability to apply addition seed treatments.

Another feature and advantage of embodiments of the present invention is reduced
treated seed dust levels. Application of heated or unheated air during treatment fluid application allows for increased application rates of polymer based or other dust control
seed coating products to provide for better seed treatment adhesion to the seed and or
30 improved durability of the seed treatment to reduce attrition of the treatment during post treatment handling and planting.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments of the present invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

5 Fig. 1A is schematic view of a continuous feed seed treatment system according to an embodiment of the present invention.

 Fig. 1B is perspective view of a batch seed treatment system according to an embodiment of the present invention.

10 Fig. 2 is an image of a portion of a seed treatment system according to an embodiment of the present invention.

 Fig. 3A is a perspective view of a bowl, dispense portion, and air inlet port of a seed treatment apparatus of a batch treating system according to an embodiment of the present invention.

15 Fig. 3B is a cross section view of a bowl, dispense portion, and air inlet port as illustrated in Fig. 3A of a seed treatment apparatus according to an embodiment of the present invention.

 Fig. 3C is a perspective view of a bowl, dispense portion, and air inlet port of a seed treatment apparatus according to an embodiment of the present invention.

20 Fig. 4 is a drawing of a liquid dispersion portion of a seed treatment system according to an embodiment of the present invention.

 Fig. 4 B is a plan view of the dispense portion of a seed treatment system according to an embodiment of the present invention.

 Fig. 5 is plan view of a seed treatment system including an air conditioner according to an embodiment of the present invention.

25 Fig. 6 is a perspective view of a portion of a control processor with an interface and heater unit of a seed treatment apparatus according to an embodiment of the present invention.

 Fig. 7 is a side view of a portion of a continuous feed seed treatment system according to an embodiment of the present invention illustrating the seed stream.

While the present invention is amendable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the present invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1a shows a schematic figure of a system in accord with the invention. A seed treater 1 has a seed treatment region 2 and with a stock 3 of seeds to be treated, a fluid dispense station 4 providing treatment fluid to the seed treater. Conditioned air may be provided to the seed treater by air conditioning units 5 that may heat and/or dehumidify air. Alternate locations of providing the heated air are illustrated. Such conditioned air can also be provided to the seed treater either at the containment region or as the seed is being conveyed to the seed treater. Heat 6, indicated by the wavy lines, may be provided to the treatment fluid at the dispense station 4, at fluid lines 7 connected to the seed treater, directly to components of the seed treater, such as an internal fluid line. The heat may be provided by electric heating elements 19.1, such as radiant heat or by elements conductively connected to components, for example, electric heating coils. Also the heat 6 may be provided by heated air.

A control processor 8 with operator interface 8.1 can be connected to control all functions of the components and can store and or receive recipes. See co-owned applications Nos. WO 2012/078928 and WO 2012/078918 that are hereby incorporated by reference herein. The control processor and other equipment can be connected to the internet and remote locations with the functionalities and capabilities as described in these two co-owned application. The control processor 8 can be connected to sensors 9 that can sense environmental conditions, such as temperature and humidity, and change the operating characteristics/ parameters in accord with preprogrammed or input instructions. For example, when the temperature drops below a certain level, heat or heated air can be provided to the seed treater, and/or treatment fluid, and/or seed. Or, if the humidity is excessive, dehumidified air can be provided.

Figure 1b shows a seed treater apparatus 10 according to an embodiment of the present invention that can include an untreated seed hopper 12, scale 14, control panel 22,

and conveyance hopper 16. Treatment containment housing container 18 along with discharge hopper 20, premix containers 24, 46, metering pump motor controllers 30, 32, pumps 38, and bowl motor 81 are mounted to a lower frame component 42.

Seed for treatment may be introduced into untreated seed hopper 12 which is
5 mounted at the top of upper frame component 44. Seed contained therein may be dispensed to a scale 14 for weighing and identification of a batch for treatment. Scale 14 may be a manual scale and fed by means of a magnetic or vibratory feeder from untreated seed hopper 12 to scale 14. In the alternative, a load cell may be employed to identify and dispense a batch for treatment. Feed is controlled by control processor 22 to operate until
10 such time as scale 14 indicates to controller 22 that the desired weight has been reached. At this point, feeder is stopped and the batch dispensed to conveyance hopper 16. Conveyance hopper 16 operates to collect the batch identified for treatment and directs the batch to treatment container 18.

Treatment agents for use in the modular seed treatment apparatus of the invention
15 may be prepared in one or more pre-mix containers, which can be reversibly mounted to the frame assembly. The pre-mix containers 24, 46 may each hold up to ten gallons of solution. Fluid treatment reservoirs 19, configured as pre-mix containers 24, 46 may have agitation devices associated with them including a motor 26, 28 deploying a rod with two or more paddles for agitation of liquid contained therein and may also have heaters 19.2.
20 Referring to Figure 1A, fluid treatment reservoirs 19 configured as drums may have heating units 19.1 and sensors associated therewith to heat the liquid. Additionally heaters 19.2 may be applied to the liquid input line 7.

Containment housing 18, as seen in Figures 1A, 1B, 2, and 3B includes a body portion 68 and a lid 84. Lid 84 can be secured to body 68 by a mechanical connection
25 including, but not limited to, bolts extending through lid and into a flange on body or clamps. An atomizer comprising a centrifugal plate 80, as shown in Figures 3 and 4, is disposed within the interior 93 of treatment container and revolves at high speed to disperse treatment composition. Liquid dispersion portion 80 configured as a centrifugal tray or plate with a cylindrical or frustoconical shaped portion 80.2 extending upwardly is
30 driven by atomizer motor 50. Treatment container 18 can also include fins extending from lid 84 designed to direct seeds entering treatment container 18 and within treatment container toward centrifugal plate 80 and/or bowl 66. Bowl 66 is a seed dispersion portion

of the apparatus and is disposed within treatment container 18 and is driven by a bowl motor 81 to rotate in a horizontal plane. Bowl motor is set to operate at speeds sufficient to impart centrifugal force to seeds being treated to drive the seeds toward the wall and upward toward fins and an outlet port 87. Bowl motor is controlled by control processor 8.

5 Seed outlet port may include openable and closeable gate 87.1 which may be manually operated or electrically operated and may be automatic and controlled by control processor 8. Cover or lid 84 also defines one or more openings for traverse of one or more fluid communication lines 92, sensor lines 93.1 for temperature sensors 93.2, and dust discharge ports 93.4, and/or conditioned air outlet ports, and seed input ports 93.5. Seed treatment

10 liquid input line 92 discharges the treatment fluid 93.3 into the liquid dispensing portion or tray 80. Seed 96 enters the interior 93 through the port 93.5 and by way of the seed dispersion portion, the rotating bowl 66, which elevates the seed into an annular seed treatment region 96.2 where the spray 96.4 from the liquid dispersion portion 80 contacts the seed. Exterior blowers 98.4 with motors 98.5 may be used to remove dust and assist in

15 the exit of the conditioned heated air.

The figures illustrate an air inlet port 101 an air delivery conduit or duct 102 that extends from an air conditioner 97.8 to the open interior 93 of the containment housing 18 for injecting conditioned air into the system. In one embodiment, as can be seen in Figures 3A, 3B, 4, and 4B, the air delivery duct 102 surrounds the seed treatment liquid input line

20 92. Air can be delivered through air delivery tube 102 simultaneously as treatment composition is delivered through fluid communication line.

In one embodiment, air is provided by a blower. In another embodiment, the air is provided through a compressed air line with a diffuser. In an embodiment shown in Figures 4 and 5, air conditioner including a heater portion 95, the blower 95.2 or

25 compressed air source can be controlled by the control panel 22 of the control processor of device. If the air is to be heated and/or dehumidified prior to directing it to the treatment container 18, the control panel 22 can also contain the heat source. Control panel 22 can include various displays and controls, including, for example, outgoing air temperature, outgoing air relative humidity, incoming air temperature, incoming air relative humidity

30 and seed temperature.

Air provided through air delivery tube 102 can be heated air or non-heated air and/or dehumidified air. Blasting the centrifugal plate 80 with air during the application of

treatment fluid provides for better atomization of the fluid particles due to the combination of the spinning plate and the blowing air. Use of air also provides for a cleaner bowl 66 and plate 80 following treatment. Heating the air prior to dispersal can provide additional advantages. As the heated air travels through the air delivery tube 102 simultaneously as the treatment fluid 93.3 travels through the fluid communication line, the heated air elevates the temperature of the fluid in-line. Elevation of the temperature of the fluid causes the viscosity and vapor pressure of the fluid to be lowered, which results in better dispersion of the fluid by the centrifugal plate and better absorption of the fluid by the seeds. In addition, the heated air serves to warm the centrifugal plate 80, which magnifies the beneficial effects of the heated fluid by further heating the fluid. In one embodiment, heated air is provided at 150 degrees Fahrenheit. In other embodiments, about 140 degrees F. In other embodiments, about 130 degrees F. In an alternative embodiment, rather than, or in addition to, providing the air (heated or non-heated) via an air delivery tube 102 surrounding the fluid communication line 92, air can be injected circumferentially from around the side of the bowl 66 as illustrated by the air outlet 97 in Figure 3B. Figure 3C illustrates another embodiment where the conditioned/heated air 99 is directed out radially by an air deflector 99.1.

Addition of heated air into system has also been found to reduce the batch time necessary to coat a batch of seeds with treatment fluid and to reduce the amount of dust on treated seeds due to both the effects of the air flow and heat. Reduced application time provides the opportunity for significant advantages, including higher seed plant capacity as well as additional coating to improve dust retention, seed appearance and seed flow.

In one mode of operation, an operator may place a quantity of seed to be separated into batches and treated in place in untreated seed hopper 12. Seed is dispensed by operation of vibratory feeder into scale 14. Pre-mix container 24 is charged with ingredients for the treatment composition and agitator motor 26 is engaged to mix and maintain composition of the treatment composition. A second treatment composition may be prepared by charging a second pre-mix container 46 with ingredients for the second treatment composition and engaging agitator motor 28 to mix and maintain composition of the second treatment composition. When heated air is desired to be introduced into treatment container 18, a heat source and blower associated with the

control panel 22 may be activated. Predetermined quantities of seed are then dispensed by scale 14 to conveyance hopper 16. Seed falls into treatment container 18 and falls into bowl 66. Rotation of bowl 66 causes seed to be urged to the outside of the bowl and against the inner side of treatment container 18 as well as upward toward lid 84. Fins
5 direct seed back toward the center of treatment container 18 and down toward bowl 66. Controller 22 operates to introduce treatment composition from one or both pre-mix containers 24,46 by operation of pumps 38, 60 into the treatment space inside treatment container 18 through fluid containment line 92. Simultaneously, heated or unheated air is introduced into treatment container 18 through air delivery tube 102. Seed is then allowed
10 to interact with the one or more treatment compositions for a pre-determined period. Optionally, dry powder may be dispensed from powder container 34 into the treatment space from powder conveyer 36 according to the program set in controller 22. A second pre-determined period is allowed to elapse to allow for coating of treated seed with the introduced powder. Controller 22 then directs opening of seed exit gate or door 87.1 and
15 treated seed is directed through collection hopper 20 to packaging equipment or other destinations as desired by the operator. Further details of the features and operation of seed treatment apparatus can be found in United States Patent Application Publication No. 2006/0236925, which is hereby incorporated by reference.

Figures 1a and 7 depicts another embodiment of the present invention in a
20 continuous feed seed treatment apparatus 200 wherein heat such as through heated air is introduced into a continuous seed processing apparatus 200. Seed treatment apparatus 200 can include a housing 202 including an seed inlet port 204, a seed wheel 206, a dispersion portion configured as a cone 208 that leads to an annular treatment region 209, an atomizer wheel or centrifugal plate 210, and an outlet 212. Housing outlet 212 can connect
25 to a polishing drum 216 or mixing chamber. The atomizer wheel 210 can be fluidly connected to one or more tanks containing products for treating the seeds via an inlet tube that may be heated. The system can be connected to a computer system 8, a control processor, having a control panel for monitoring and/or adjusting the system. The system 200 can further include an air delivery tube 214 that delivers air to the system in the same
30 general manner as described above. As explained previously, air can be heated or unheated and dehumidified and can be provided by a blower or a compressed air source. In embodiments, the air provided is through a dedicated air inlet, that is separate from the other inlets and separate from the fluid inlet. Further details of continuous seed processing

system 200 can be found in United States Patent Application Publication No. 2011/0027479, which is hereby incorporated by reference.

Figure 7 illustrates an exemplary seed stream 96.9 through a continuous feed seed treater. Seed 96 can first be fed into the apparatus at the housing inlet such that it travels through the apparatus under the influence of gravity. In a preferred configuration, the apparatus is therefore vertically arranged. After entering the housing, the seed travels into and fills metering compartments, such as slots, in the seed wheel. The seed wheel is configured to collect a predetermined quantity of seed as it rotates to ultimately dispense the seed into a seed stream . In one embodiment, the seed wheel meters the seed based on a volume of the seed. Seed wheel 206 can be rotated by a motor, such as, for example, a 1/3 horsepower variable speed motor, to dispense the seed once it has been metered and to rotatably fill each adjacent slot in the wheel. After being dispensed from the seed wheel, seed falls onto the dispersion cone. The dispersion cone dispenses the seeds generally uniformly into a curtain of treatment fluid provided by the spinning atomizer wheel. Air is delivered to the atomizer wheel with the treatment fluid via air delivery tube 214. Seeds are then ejected out of the housing outlet and can subsequently be further processor or packaged. The embodiments above are intended to be illustrative and not limiting.

The above references in all sections of this application are herein incorporated by references in their entirety for all purposes.

All of the features disclosed in this specification (including the references incorporated by reference, including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including references incorporated by reference, any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment (s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any incorporated by reference references, any accompanying

claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed. The above references in all sections of this application are herein incorporated by references in their entirety for all purposes.

5 Although specific examples have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement calculated to achieve the same purpose could be substituted for the specific examples shown. This application is intended to cover adaptations or variations of the present subject matter. Therefore, it is intended that the invention be defined by the attached claims and their legal equivalents, as well as the following illustrative aspects. The above described aspects are embodiments of the
10 invention are merely descriptive of its principles and are not to be considered limiting. Further modifications of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the invention.

What is claimed is:

1. A seed treatment apparatus comprising:

a seed treatment containment housing having an open interior for the treatment of seed with a treatment liquid, the containment housing having a seed inlet port, a seed outlet port, an air inlet port;

a seed dispersion portion for distributing the seed in the open interior into an annular seed treatment region;

a seed treatment liquid input line extending into the containment housing and connected to a liquid dispersion portion, the liquid dispersion portion supported and positioned in the open interior of the housing for generating a radially outward and annular spray of the treatment liquid into the seed treatment region;

an air unit that takes ambient air; and

a duct connecting the air unit to the air inlet port for directing air into the open interior of the containment housing into the seed dispersion region to facilitate the seed treatment.

2. The seed treatment apparatus of claim 1 wherein the seed dispersion portion is a rotating bowl.

3. The seed treatment apparatus of claim 1 wherein the seed dispersion portion is a conical deflector, that is one of fixed or rotating .

4. The seed treatment apparatus of claim 1 wherein the liquid dispersion portion is rotating.

5. The seed treatment apparatus of claim 1 wherein the liquid dispersion portion has a rotating apertured axially extending portion.

6. The seed treatment apparatus of claim 5, wherein the rotating apertured axially extending portion has at least one of a cylindrical shape and a frustoconical shape.

7. The seed treatment apparatus of claim 1, wherein the seed treatment apparatus is configured as a batch treater and the seed dispersion portion is configured as a rotating bowl.

8. The seed treatment apparatus of claim 7, wherein the seat inlet port has an openable and closeable seed outlet gate at the seed outlet port.

9. The seed treatment apparatus of claim 8, wherein the outlet gate is positioned at a level of the housing such that the rotating bowl rotates the seed and the centrifugal force of the rotating seed elevates the seed to the level of the gate whereby the seed exits the gate when the gate is open.

10. The seed treatment apparatus of claim 7, wherein the housing further comprises a dust removal port extending out of the top lid, the dust removal port extending to a dust collection portion.

11. The seed treatment apparatus of claim 10, wherein the air unit is a conditioned air unit that at least heats the air and provides conditioned air, the seed treatment apparatus further comprises a conditioned air outlet from the seed treatment containment housing.

12. The seed treatment apparatus of claim 7, wherein the dust removal port also functions as a port for exiting the air that has enters the conditioned air inlet port.

13. The seed treatment apparatus of claim 1, wherein the apparatus further comprises means for heating the treatment liquid before the liquid is sprayed.

14. The seed treatment apparatus of claim 13, wherein the means for heating the treatment fluid comprises positioning a conduit that carries the treatment fluid to be contacted by the conditioned air before the conditioned air is discharged into the seed treatment region.

15. The seed treatment apparatus of claim 13, wherein the means for heating the treatment fluid comprises a heater associated with at least one of a treatment fluid reservoir connected to the seed treatment liquid input line or the seed treatment liquid input line.

16. The seed treatment apparatus of claim 1, wherein the seed treatment apparatus is configured as a continuous feed seed treater.

17. The seed treatment apparatus of claim 1, wherein the seed treatment apparatus is a continuous flow seed treater and comprises a roller drum associated therewith, and wherein the seed treatment housing has a seed outlet port that remains open and directs seed treated with the treatment liquid to the roller drum.

18. The seed treatment apparatus of claim 1, wherein the air unit is an air conditioner that lowers the relative humidity of the ambient air.

19. The seed treatment apparatus of claim 1 wherein the liquid dispersion portion is a rotating tray and the air inlet port directs air directly at the rotating tray.

20. The seed treatment apparatus of claim 1, wherein the air inlet port is configured and positioned for directing conditioned air flow primarily in a radially outward direction from a central position.

21. The seed treatment apparatus of claim 1, wherein the air inlet port is configured and positioned for directing conditioned air flow primarily circumferential direction in the open interior of the housing.

22. The seed treatment apparatus of any one of claim 1 through 10 and 12 through 20 wherein the air unit is an air conditioner that heats the ambient air.

23. A seed treatment apparatus comprising:

a seed treatment containment housing having an open interior for the treatment of seed with a treatment liquid, the containment housing having a seed inlet port, a seed outlet port,

a seed dispersion portion for distributing the seed in the open housing into an annular seed treatment region;

a seed treatment liquid input line extending into the containment housing and connected to a liquid dispersion portion, the liquid dispersion portion supported and positioned in the open interior of the housing for generating a radially outward and annular spray of the treatment liquid into the seed treatment region;

a means for providing heat into the interior of the housing when seed is being treated with the liquid treatment therein.

24. The seed treatment apparatus of claim 23 further comprising a reservoir connected to the seed treatment liquid input line and the means for providing heat comprises a heater associated with at least one of the reservoir and the seed treatment liquid input line.

25. The seed treatment apparatus of claim 23 wherein the means for providing heat comprises a conditioned air input port into the containment housing and an air conditioner that provides heated air connected to the air input port.

26. The seed treatment apparatus of claim 25 wherein the fluid dispersion portion comprises a rotating dispersion portion that radially sprays treatment fluid into the seed treatment region.

27. The seed treatment apparatus of claim 26 wherein the air input port directs air at the rotating dispersion portion that then deflects the air radially outward with sprayed treatment fluid.

28. The seed treatment apparatus of claim 23 wherein the means for providing heat comprises a seed storage reservoir and a heater associated therewith for heating the seed prior to treating the seeds.

29. The seed treatment apparatus of claim 23 wherein the means for providing heat comprises heating the seed treatment housing and components interior to the housing.

30. The seed treatment apparatus of claim 23 wherein the means for providing heat comprises an air conditioner that provides heated air into a seed stream one of prior to or during treatment of the seed with the seed treatment liquid in the seed treatment region.

31. The seed treatment apparatus of any one of the previous claims further comprising a control processor connected to the seed treatment apparatus and to an ambient condition sensor and wherein the control processor determines a parameter of operation of the apparatus based on an ambient condition.

32. The seed treatment apparatus of claim 31 wherein the sensor measures temperature and humidity.

33. The seed treatment apparatus of any one of claims 1 through 21 and 23 through 30 further comprising a control processor connected to the seed treatment apparatus and a user interface, and wherein an ambient condition may be input to the control processor which then automatically adjusts a treatment parameter based on the input ambient condition.

34. The seed treatment apparatus of any one of claims 1 through 21 and 23 through 30 further comprising a control processor connected to the seed treatment apparatus, a user interface, and sensors to detect temperature associated with one of a seed storage region and a treatment liquid and wherein said temperature is provided to the control processor and a treatment parameter based on said temperature is adjusted.

35. A method of increasing the treating efficiency of treating seeds with liquid seed treatment, the method comprising:

inputting seed into a seed treater containment housing;

dispersing the seeds in an annular seed treatment region in the containment housing;

pumping seed treatment liquid from a reservoir,

spraying the seed treatment liquid into the seeds being dispersed in the annular seed treatment region;

providing heat into the seed treatment region.

36. The method of claim 35 wherein the heat is provided by injecting heated air into the annular seed treatment region.

37. The method of claim 36 further comprising directing the heated air at a rotating dispersion portion that provides the spraying of the seed treatment liquid.

38. The method of claim 36 further comprising heating the seed treatment liquid before spraying the liquid.

39. The method of claim 35 further comprising providing heat to a seed stream before the seed is treated with the treatment liquid.

40. The method of claim 36 further comprising lowering the humidity of the heated air injected into the annular seed treatment area.

41. The method of claim 36 further comprising directing the air in a circumferential manner around the annular seed treatment region.

42. The method of claim 36 further comprising directing the air in a radially outward direction from a central location interior to the annular seed treatment region.

43. The method of claim 35 further comprising sensing an ambient condition and automatically adjusting a treatment parameter based on the sensing.

44. The method of claim 35 wherein the heat is provided by heating components of the seed treatment area.

45. A seed treatment apparatus comprising:

a seed treatment containment housing having an open interior for the treatment of seed with a treatment liquid, the containment housing having a seed inlet port, a seed outlet port;

a seed dispersion portion positioned in the containment housing for distributing the seed in the open housing into a seed treatment region;

a seed treatment liquid input line extending into the containment housing and connected to a liquid dispersion portion, the liquid dispersion portion supported and positioned in the open interior of the housing for generating a spray of the treatment liquid into the seed treatment region;

a means for providing heat into the interior of the housing when seed is being treated with the liquid treatment therein.

46. The seed treatment apparatus of claim 44 wherein the means includes a heater for heating air and a duct leading into the open interior.

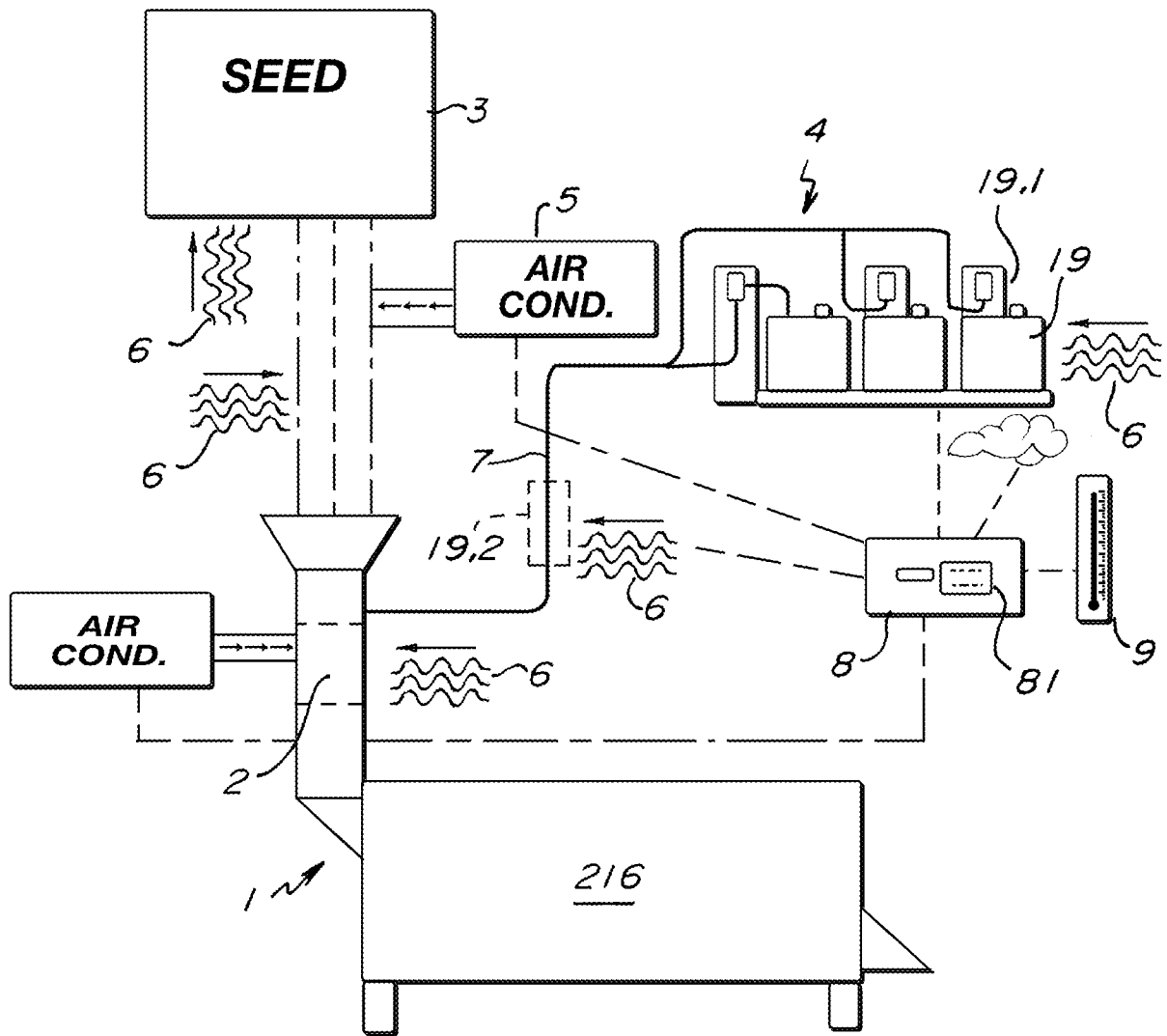


Fig. 1A

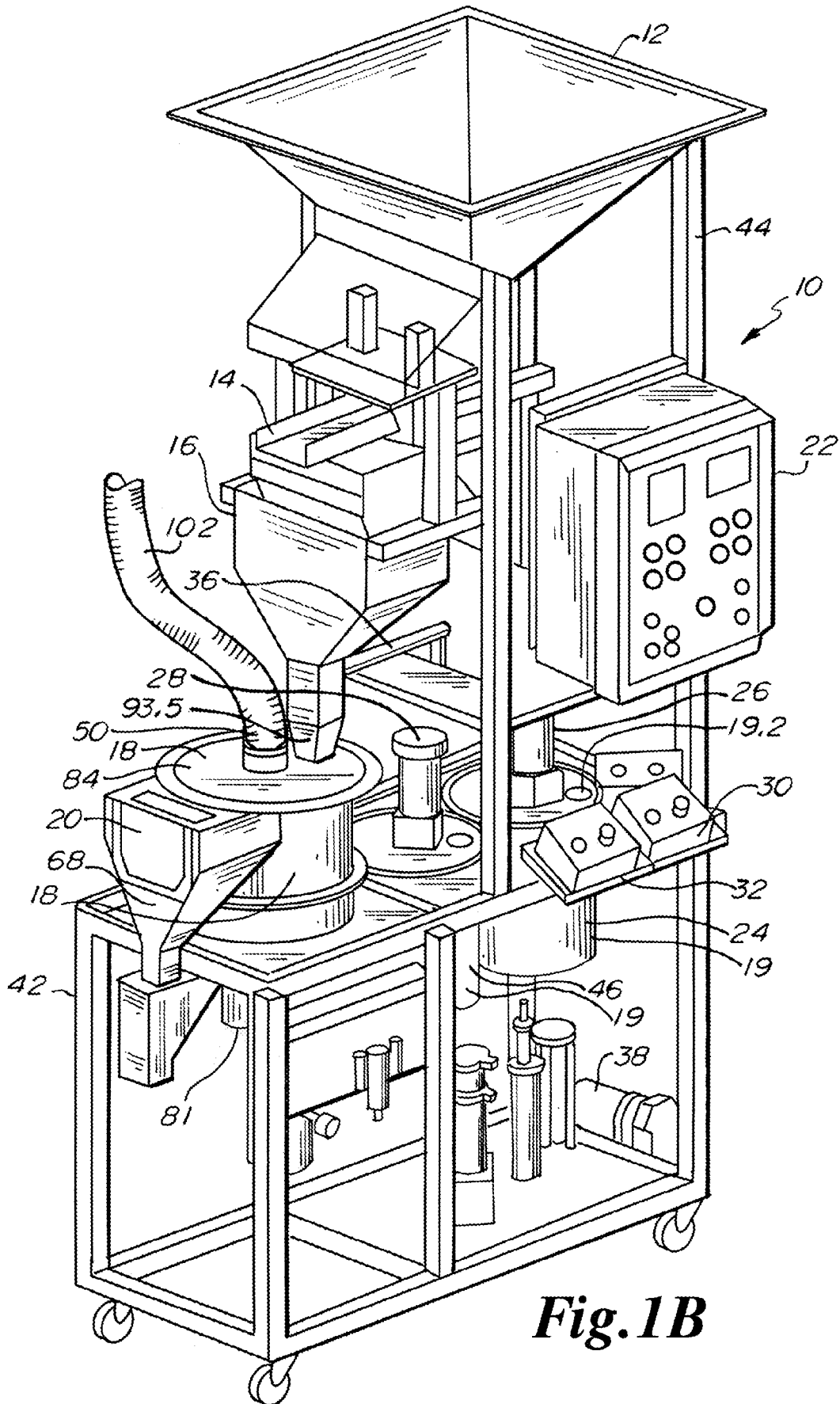


Fig. 1B

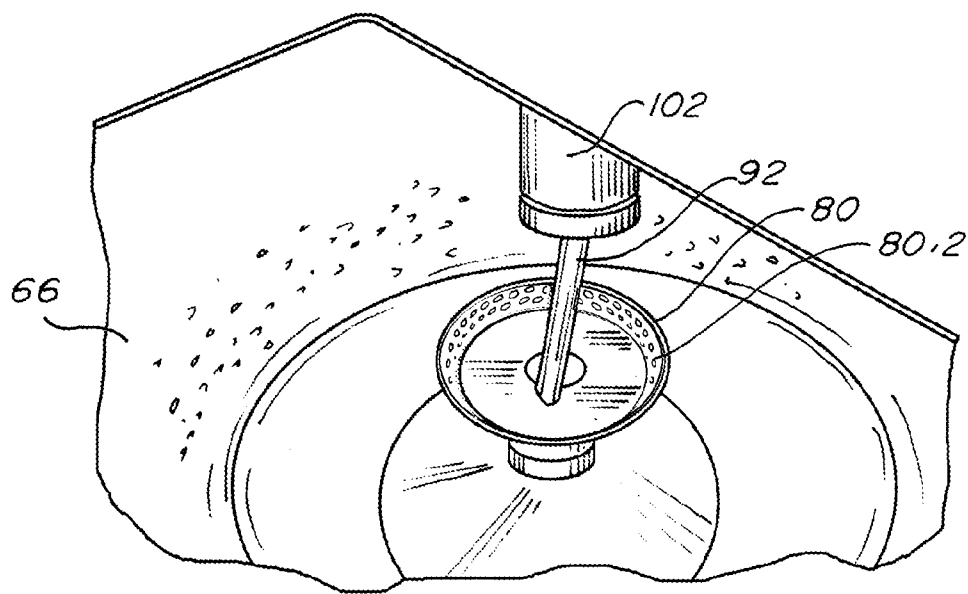
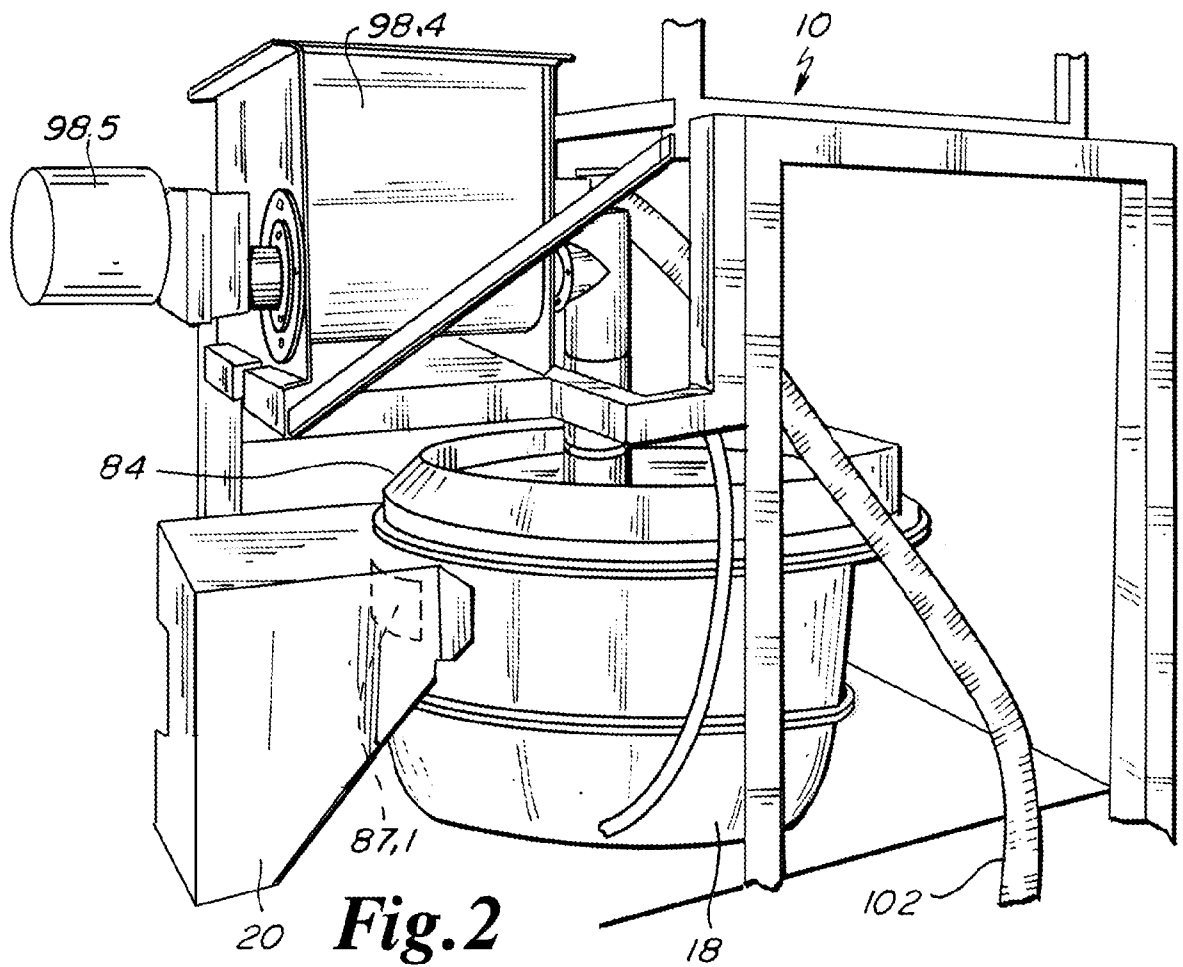


Fig. 3A

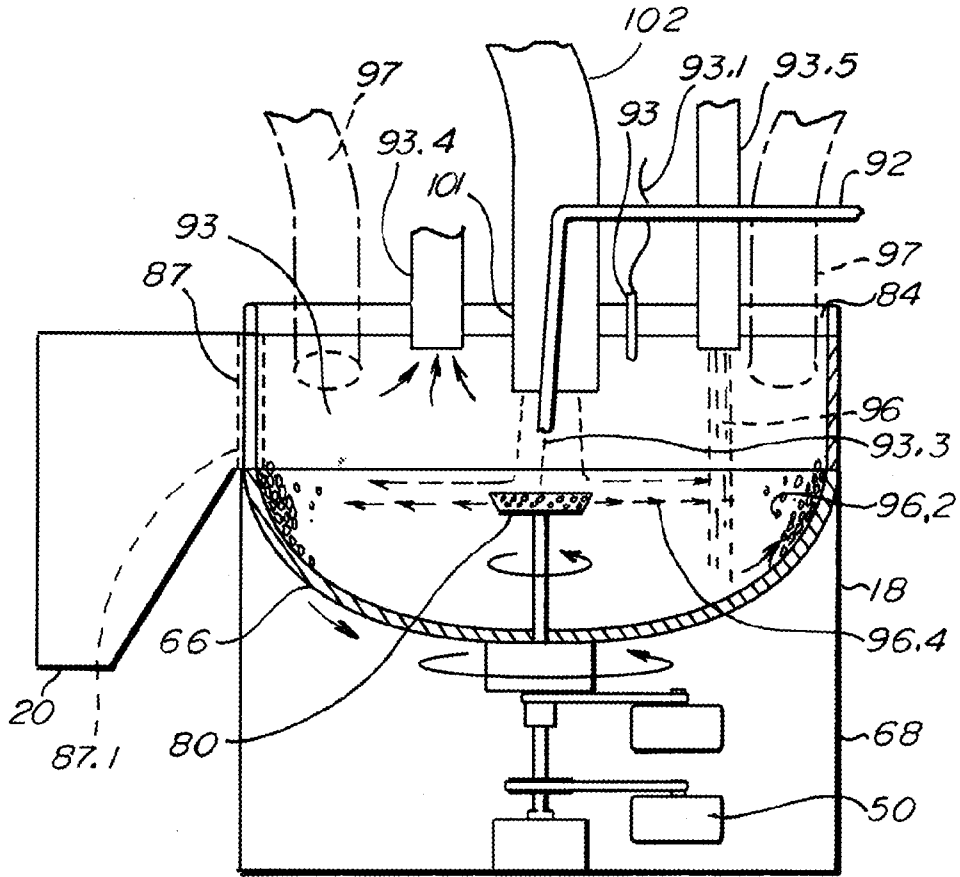


Fig. 3B

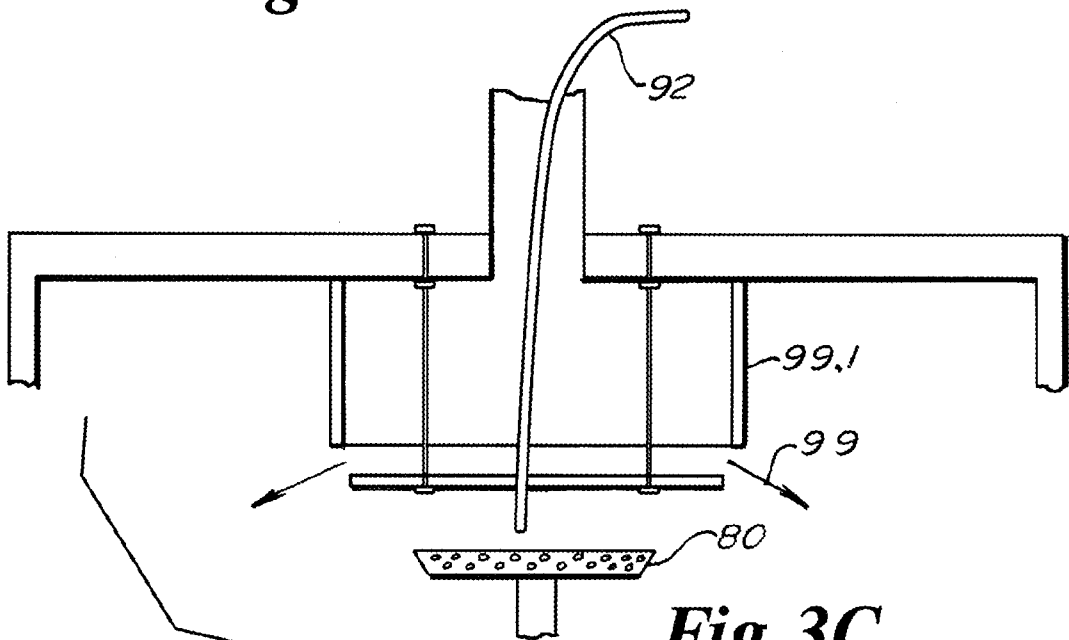


Fig. 3C

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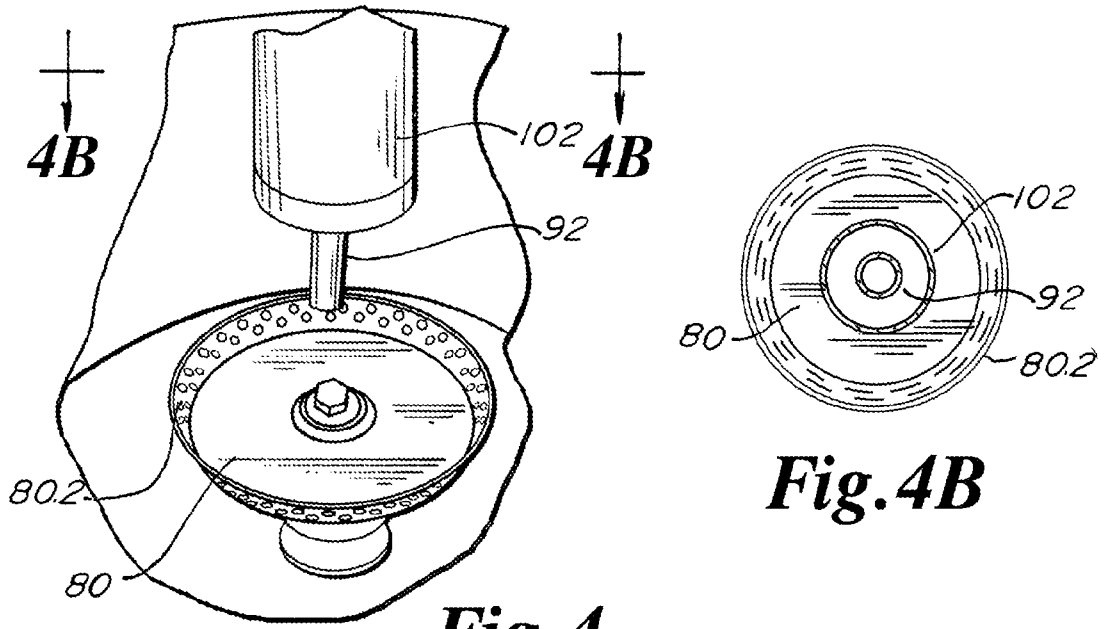


Fig. 4B

Fig. 4

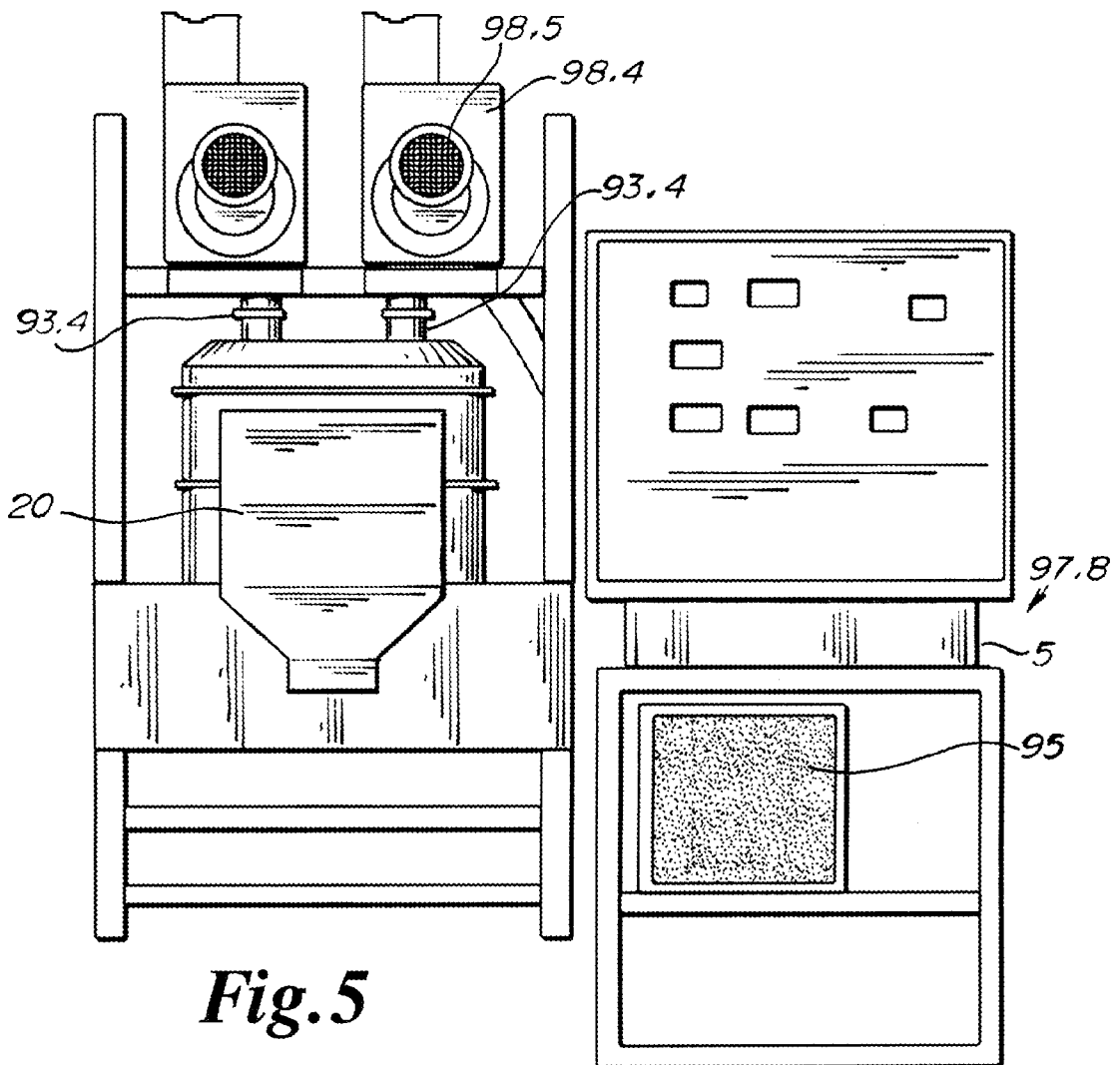
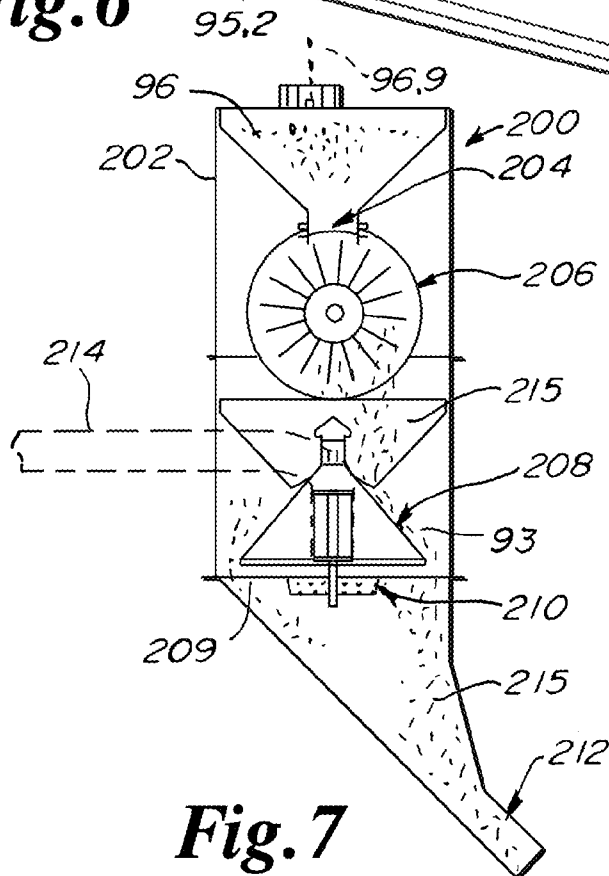
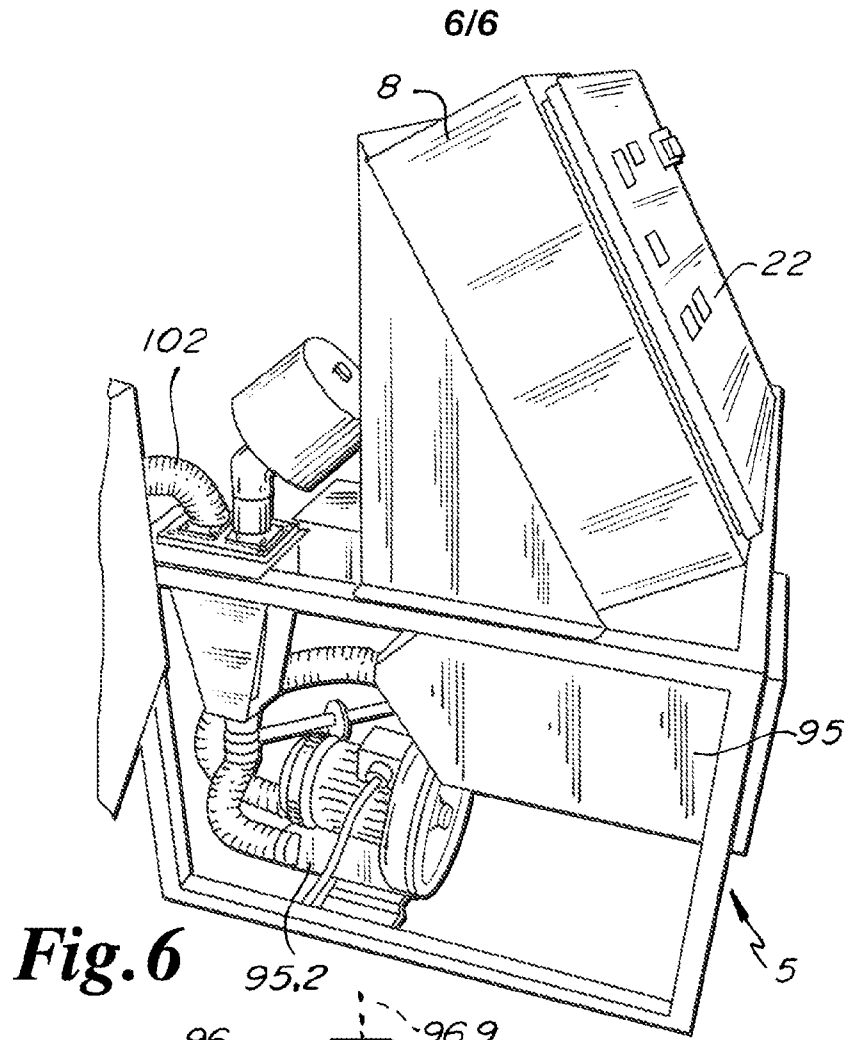


Fig. 5



Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: 32
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claim 32 is unclear, because it refers to multiple dependent claim 31 which does not comply with PCT Rule 6.4(a).

3. Claims Nos.: 31
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

A. CLASSIFICATION OF SUBJECT MATTER**A01C 1/08(2006.01)i, A01C 1/00(2006.01)i**

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)

A01C 1/08; B05B 17/00; A23G 3/26; B05C 3/00; B05D 1/12; A23G 3/00; B05C 5/00; A01C 1/06; A01C 1/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: seed, treatment, housing, air inlet port, seed dispersion portion, liquid dispersion portion, air unit, heater

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 2006-0236925 A1 (LUND, VIRGIL D.) 26 October 2006 See paragraphs [0029], [0031], [0034], [0036]-[0039]; claims 1, 4-7, 16-17; and figures 1, 4-7, 10, 15-16.	1-9, 16-17, 19-23 , 25-27, 29, 33, 35-37 , 41-42, 44-46 10-15, 18, 24, 28, 30 , 34, 38-40, 43
Y	US 5567238 A (LONG, JR., RICHARD L. et al.) 22 October 1996 See column 3, lines 7-16; column 4, lines 1-13, 24-34; and figures 1-3.	1-9, 16-17, 19-23 , 25-27, 29, 33, 35-37 , 41-42, 44-46
Y	US 5891246 A (LUND, VIRGIL D.) 6 April 1999 See column 3, lines 1-49, line 64 - column 4, line 9, lines 31-64; and figures 1, 3, 6.	3-6
Y	WO 2011-017252 A1 (BAYER CROPSCIENCE LP) 10 February 2011 See page 7, line 13 - page 8, line 14; page 9, lines 7-15, line 20 - page 10, line 19; and figures 1-3.	17
A	US 4987850 A (MCCRACKEN, ALAN) 29 January 1991 See abstract; column 3, lines 20-33; column 4, lines 21-44, line 64 - column 5, line 12; and figures 1-2, 5.	1-30, 33-46

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" 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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" 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

"&" document member of the same patent family


Date of the actual completion of the international search

22 August 2013 (22.08.2013)

Date of mailing of the international search report

23 August 2013 (23.08.2013)

Name and mailing address of the ISA/KR


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INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2013/036833

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4689249 A (THYGESEN, SOREN) 25 August 1987 See abstract; column 4, line 38 - column 5, line 32; and figures 1-2.	1-30, 33-46

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2013/036833

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 5567238 A	22/10/1996	US 6274190 B1	14/08/2001
US 5891246 A	06/04/1999	None	
WO 2011-017252 A1	10/02/2011	AR 077696 A1 US 2011-0027479 A1	14/09/2011 03/02/2011
US 4987850 A	29/01/1991	EP 0346278 A1 EP 0346278 B1	13/12/1989 26/02/1992
US 4689249 A	25/08/1987	EP 0180631 A1 WO 85-05142 A1	14/05/1986 21/11/1985