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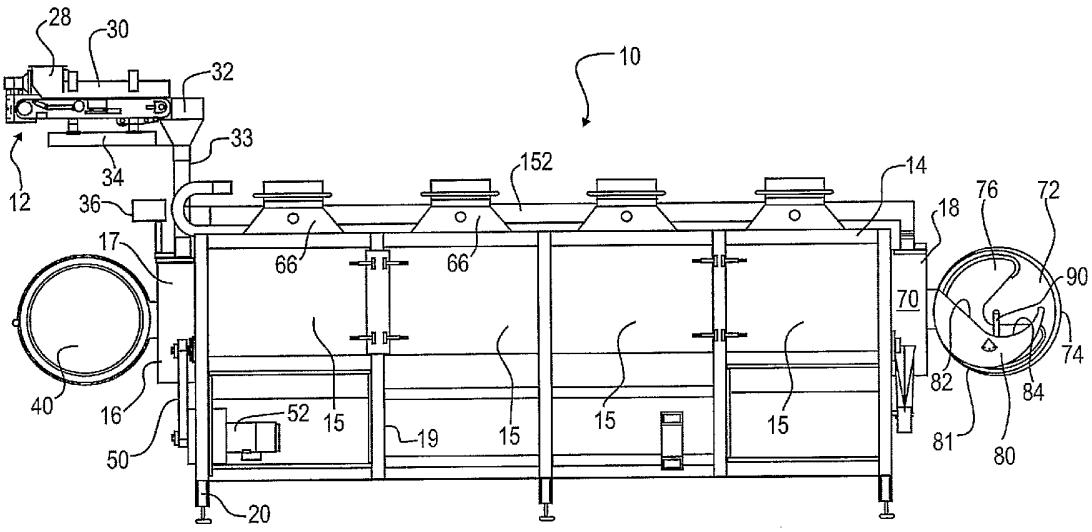
(54) **Title:** CONTINUOUS FEED TABLET COATING SYSTEM



(57) **Abstract:** A system for coating tablets and other small articles is provided. The system is comprised of an elongate housing containing a drum journalled for rotation about a horizontal axis. The drum has two open ends that receive and discharge a supply of tablets respectively. The drum is rotated about the axis by a drive means to tumble the tablets and advance the tablets through the drum. The system also includes a system for delivering a selected amount of coating to the tablets while they are being tumbled and a feeder for continually feeding tablets at a first end of the housing. The system employs a weir plate for maintaining a depth of tablets within the drum and for controlling the time that the tablets remain in the drum. Finally, the system has a tablet discharge region for receiving tablets for discharge.

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TITLE OF THE INVENTION

CONTINUOUS FEED TABLET COATING SYSTEM

FIELD OF THE INVENTION

[0001] The invention relates to processes and equipment for applying a coating onto tablets such as pharmaceutical tablets and similar articles, including without limitation small candies, seeds and the like. More specifically, the invention relates to systems which apply a spray-on coating within a horizontal axis tumbler.

BACKGROUND OF THE INVENTION

[0002] Coatings for tablets for human or animal consumption (as for other uses) may be applied with a system consisting of a rotating horizontal-axis drum for tumbling the tablets while a coating substance is sprayed within the drum. Typically, the drum is perforated to permit a flow of heated air through the drum wall to facilitate drying. As well, perforations permit cleaning fluid to readily drain. Such perforations may take on a variety of shapes and sizes suitable to the desired application. Tablet coating systems are used in a variety of other applications, for example in pharmaceuticals and for coating of candies. As well, such systems may be used for coating seeds. Tablets are typically produced in a wide range of shapes, sizes and densities. Accordingly, any system for coating the tablets or the like should be capable of efficient coating of a range of tablet types. A typical such system includes a housing, a horizontal-axis perforated drum journaled for rotation within the housing, drive means for rotating the drum, for example an electric motor which may be external to the housing and operatively connected to the drum, for example by a belt or chain drive, means for introducing uncoated tablets into the drum and for removing the coated tablets following the coated process.

[0003] Such a system requires a means for spraying or otherwise introducing a coating such a liquid coating solution into the drum. For pharmaceutical use a high level of precision in the coating process is required in

order to maintain a controlled thickness and weight of coating. Preferably, the system includes a means for introducing a flow of air through the drum wall, for example heated air to facilitate the drying process. Finally, the system should permit thorough washing of components which are in contact with the tablets and spray liquid. Washing of the equipment may be provided by means of fully or semi-automatic systems or a fully-manual approach.

[0004] Tablet coating systems are described in U.S. Patent 4,725,446 to Forster et al., which describes a rotateable horizontal axis drum having a perforated wall. A supply of drying air flows through the wall. Coating solution is sprayed onto the tumbling tablets via a sprayer centrally positioned within the drum directed generally downwardly towards the tumbling bed of pills within the drum interior.

[0005] Prior art systems generally provide for batch processing of tablets, which is relatively inefficient in comparison with a continuous industrial process. However, batch processing generally requires simpler equipment, particularly in the pharmaceutical processing context in which a high level of precision is required in supplying a selected amount of coating for a given batch size of tablets as well as tablet dwell time within the drum. Thus, it is relatively simple to introduce a carefully measured batch size of tablets into the drum and thereupon apply a measured amount of coating to the tablets. Continuous processing, while more efficient, introduces difficulties in terms of consistency of the coating process.

[0006] Another aspect of coating systems, particularly in the pharmaceutical industry, relates to rinsing and washing of the equipment, particularly those components in contact with the product. A high standard of cleanliness applies to the equipment, in particular when the machine is switched from one product to another. It is desirable to provide a convenient system for spraying a cleaning solution throughout the drum interior, with minimal worker contact with the equipment.

SUMMARY OF THE INVENTION

[0007] An object of the invention is to provide a system for coating tablets and other small articles such as seeds, operable in a continuous processing operation wherein tablets may be both introduced and discharged at a continuous rate. A further object is to provide a system which optionally is operable in both batch and continuous modes and able to switch seamlessly from one to the other mode. A further object is to provide an improved tablet coating system having a horizontal axis drum, including improved means for washing the tablet-coating drum and other components in contact with the tablets.

[0008] In one aspect the invention comprises a tablet coating system for continuous processing comprising:

a) an elongate housing having first and second ends and opposing lateral sides;

b) a drum oriented with its main axis generally horizontal within said housing journalled for rotation about a horizontal axis extending between said ends, said drum having first and second open ends for receiving and discharging respectively a supply of tablets, such that tablets are received in the first end of the drum and tumbled within the drum while being coated and optionally also dried, and discharged from the other end;

c) drive means for rotating the drum such as an electric motor, although any suitable drive means may be provided;

d) a delivery system for delivering a selected amount of coating into the drum for coating the tablets, such as via a sprayer within the drum for delivering a liquid coating material;

e) a feeder such as a weigh-in feeder for dispensing a stream of bulk tablets on a continuous basis into the first end of said housing, the stream comprising a selected rate, for example, by weight, of bulk tablets per unit of time;

f) a weir plate partly obstructing the open second end of the drum for maintaining within the drum a selected depth of tablets wherein excess tablets spill over said weir plate;

g) a tablet discharge region to receive coated tablets spilling over said weir plate for discharge from said system.

[0009] Preferably a controller is operatively connected to at least the weigh-in feeder to control operation. The controller may also be operatively connected to the drum drive means and liquid delivery system.

[0010] The height of the weir plate directly controls the average tablet dwell time within the drum. Rotation of the drum causes the tablets to tumble and to move from the first end to the second as tablets are introduced. Thus, as the weir plate is elevated the tablet depth is increased, thereby increasing the average dwell time.

[0011] The feeder preferably comprises a weigh-in feeder, which dispenses a selected weight of tablets per unit of time. The feeder may consist of a scale for weighing a stream of tablets passing over said scale, with a conveyor belt or other tablet transport system to carry tablets in bulk across said scale while being weighed, and a controller which determines the weight on a real time basis of tablets being conveyed into the system on a weight/time basis. The feeder also includes a dispenser for delivering a controllable stream of tablets to said scale. The controller is operatively connected to said scale and dispenser to receive signals from said scale and to control the amount of tablets delivered to said scale so as to maintain said selected constant flow of bulk tablets as a selected weight/time stream. Alternatively the feeder may dispense a controlled flow of tablets on a basis other than weight.

[0012] The system may be operated to process tablets in either of a batch or continuous processing operation. Preferably the system is controlled to permit

an initial batch process which then is changed with no or minimal interruption into a continuous processing mode.

[0013] A highly effective shape of the weir plate which permits adjustment of the effective system as defined in claim 1 wherein said weir plate is generally crescent-shaped comprising a substantially semi-circular lower edge and an upper edge comprising a generally flat first part merging with a generally hyperbolic second part. Preferably the weir plate is rotably mounted so as to selectively vary the obstruction of said drum so as to increase or decrease the depth of tablets within said drum, and operatively connected to the controller so as to control positioning of the weir plate in tandem with operation of the system.

[0014] According to another aspect, the invention relates to a system for coating tablets and other small articles, having an elongate horizontally-oriented drum for tumbling the tablets, journalled for rotation about a horizontal axis. The drum is housed within a housing, which includes opposing end walls. The housing includes a lower portion which is substantially sealed to permit cleaning liquid to accumulate within the base of the housing. A closable drain enters the housing, to permit cleaning liquid to drain from the housing when opened. The drum is positioned such that a lower portion of the drum extends into the lowermost sealed portion of the housing, such that cleaning liquid which accumulates within the lower base region of the housing may be in contact with the drum, in order to permit a thorough leaning of the drum. The cleaning liquid is dispensed through a spray bar disposed within the interior of the drum, parallel to the drum axis. The spray bar is operatively connected to a source of cleaning liquid, and is also connected to a mount which mounts the spray bar directly or indirectly to the housing. Preferably, the mount is rotatable, such that the spray bar is rotatable about its elongate axis. The mount may comprise the spray bar being rotatably journalled within a pair of rotary mounts, with each such mount connected to an overhead bracket exterior to the housing. The brackets preferably comprise a pair of engagement arms extending downwardly,

for supporting the mounts, the engagement arms being connected to an overhead beam. A rotary drive such as an electric motor rotates the spray bar within the rotary mounts. Preferably, the spray bar is supported by a frame structure, which also supports a second spray bar for dispensing a coating liquid within the interior of the drum. During operation, the coating liquid is dispensed onto a bed of tablets being tumbled within the drum. The frame is preferably adjustable in a vertical direction, for example by providing length adjustment means of the engagement arms, such that varying the length of the engagement arms raises or lowers the elongate frame, thereby varying the distance between the respective spray bars and the base of the drum.

[0015] Preferably, the system described above comprising the sealed lower housing and cleaning system also includes the feeder (preferably the weigh-in feeder) for dispensing a stream of bulk tablets or other small articles on a continuous basis, and the weir plate and tablet discharge region described above.

[0016] The system may also comprise a cleaning solution spray bar within the drum for selectively delivering a stream of cleaning liquid into the interior of said drum.

[0017] Preferably the base of the housing is sealed against liquid leakage so as to permit a selected depth of cleaning liquid to accumulate within said housing for cleaning of said system. The cleaning liquid spray bar is rotatable about its elongate axis and said mount comprises at least one rotary mount. The spray bar may be rotatably journalled within a pair of rotary mounts each connected to an overhead bracket exterior to said housing, said bracket comprising a pair of depending engagement arms for supporting said mounts joined by an overhead beam, and further comprising a rotary drive for rotating said spray bar. The base of the housing forms a sump or pan, within which the cleaning solution accumulates during the cleaning phase. The system components are arranged such that the drive components are all above the highest liquid level to avoid immersion.

[0018] The coating liquid delivery system preferably comprises an elongate manifold within the interior of the drum. An array of spray nozzles along the manifold directs spray onto the tablets. The nozzles are arrayed into a plurality of zones spatially distributed along the drum, each zone being independently controlled for on/off delivery of coating within the respective zone. Preferably, the manifold comprises a pair of independently rotatable pipe assemblies which are axially aligned. Heated air may be delivered into the housing, preferably via an array of independently controlled plenums which form effective zones within the housing with independently controlled temperature and airflow levels. Discharge ducts permit the air to exit the housing.

[0019] The invention also relates to a method of applying a coating to tablets in bulk comprising the steps of providing a system as defined above, feeding a supply of uncoated tablets and a supply of coating liquid into said system, removing said tablets from said system on a continuous basis, and controlling said system for continuous deliver, coating and removal of tablets at a selected rate comprising a selected weight of bulk tablets per selected unit of time.

[0020] The term "tablets" as used in this patent specification is not intended to be restricted to any particular type, size, shape or form of articles that may be processed in the system described and claimed herein. Rather, the term "tablets" is used to refer to any small article suitable for coating within a tumbling apparatus, including for example pills, lozenges, caplets and other sizes and shapes of similar articles, as well as candies, seeds and any other small article that receives a coating.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIGURE 1 is a side elevational view of the embodiment described herein of the tablet coating system.

[0022] FIGURE 2 is a front elevational view thereof.

[0023] FIGURE 3 is a rear elevational view thereof.

[0024] FIGURE 4 is a perspective view of the tablet discharge region of the system.

[0025] FIGURE 5 is a plan view from above of the discharge portion.

[0026] FIGURE 6 is a front elevational view of the discharge portion with the door in the open position.

[0027] FIGURE 7 is a perspective view of the drum support frame of the system with associated components.

[0028] FIGURE 8 is front view of the system with the drum removed to show internal components.

[0029] FIGURE 9 is a rear elevational view showing internal components.

[0030] FIGURE 10 is a side elevational view of the coating liquid spray system.

[0031] FIGURE 11 is a perspective view of the discharge region.

[0032] FIGURE 12 is a side elevational view of the discharge region with the door open.

DETAILED DESCRIPTION

[0033] The tablet coating system 10 described herein as one embodiment of the invention comprises in general terms a weigh in-feed conveyor 12, a housing 14, a tablet inlet entryway 16 and a coated tablet discharge region 18.

The housing 14 is supported by a frame 19, including length-adjustable legs 20 for leveling the system. The housing 14 fully encloses a horizontal-axis perforated rotateable stainless steel drum 22, seen in detail in Figure 7. The drum 22 is open-ended at both opposed ends. Access to the interior of the housing 14 is obtained by an array of doors 15 on both lateral sides of the housing. As well, front and rear circular end doors provide access from the ends. All doors of the housing are sealed with inflatable seals.

[0034] The in-feed conveyor 12 comprises a commercially-available unit, for example the type manufactured by Siemens AG™. The conveyor 12 comprises an inlet 28 to receive uncoated tablets, discharging onto a motor-driven conveyor belt 30, which in turn discharges into a hopper 32 for entry into the inlet entryway 16 through inlet conduit 33. The in-feed conveyor belt 30 rests on a scale 34 to detect the weight of the tablets deposited onto the conveyor at any given moment. This weight amount is calculated by subtracting the weight of the conveyor and associated components from the total weight detected by the scale. As discussed below, a system controller 36 extracts from this tablet weight information the rate of tablet in-feed into the system, in selected weight/time units.

[0035] The inlet 28 includes a controlled-flow dispenser to dispense tablets at a selected rate of supply onto the conveyor belt 30 in response to a control signal from the system controller 36. The feedback signal from the scale 34 permits a supply of tablets at a constant rate in units of weight per unit of time (for example a selected kg/min. rate of tablet supply).

[0036] It will be seen that tablets may alternatively be delivered at a rate based on other variables such as volume.

[0037] Tablets received in the inlet hopper 32 enter via gravity through the conduit 33 into the tablet entryway 16. The entryway 16 comprises an annular flange 17 which protrudes outwardly from a first end of the housing 14. The

entryway 16 communicates with the interior of the housing 14. The exterior end of entryway 16 is covered by an openable door 40, which opens for access into the interior of the housing 14. The conduit 33 communicates with the entryway 16 through an opening within the flange 17. The inlet chamber 16 is aligned with the rotateable drum 22 within the interior of the housing 14, such that tablets entering the chamber 16 are directed into the interior of the drum 22. The entryway 16 is also partly obstructed by a weir plate 79 having a shape similar to the discharge region weir plate 80 described below.

[0038] The drum 22 is housed within a cage comprising a plurality of spaced-apart hoops supported by a frame. The hoops include a central hoop 25 and first and second end hoops 27(a) and 27(b), all three of which have an outer contact surface 29 for contacting an array of drive and driven wheels 42. The central hoop 25 also includes raised flanges 31 on either side thereof. The flange have side edges for contact with a pair of horizontally-oriented opposed centering wheels 35 to maintain the fore-aft position of the drum. The frame is further comprised of an array of stave-like rods 110 fastened to the hoops 25 and 27. Drive wheels 42(a) are mounted to a rotateable shaft 44 extending the length of the housing. The shaft 44 is journalled for rotation within a bearing hub 46 mounted within a corresponding end wall of the housing. A first hub 46 supporting the drive axle includes a drive shaft 48 extending outwardly from an end wall of the housing. A pulley 50 is mounted to the drive shaft 48, which in turn is driven by an electric motor 52 mounted to the frame 18. The motor is controlled by the control system, described below. The driven wheels 42(b) are mounted to corresponding mounts within the interior of the housing 12.

[0039] The drum 22 is about 30 inches in diameter and comprises a perforated stainless steel wall. In one version, the overall length of the housing 14, including inlet and outlet chambers, is 206 inches, with the housing interior length being about 187 inches. The drum 22 extends the full length of the main

part of the housing interior. These dimensions are only a representative example.

[0040] As seen schematically in figure 9, within the interior of the housing 14 and extending axially the full length thereof is a stainless steel baffle 60 which effectively divides the interior space within the housing 14 exterior to the drum 22, in order to channel the flow of heated air through the tablet bed. The baffle 60 extends the full length of the housing 14, and is fastened to the floor of the housing 14. It extends inwardly with a free edge contacting or approaching the drum 22. The housing interior is thus effectively divided between air inflow and air outflow zones, each of which extends the full length of the housing 14.

[0041] Heated air is introduced into the air inflow zone via an array of intake plenums 66, which receive heated air from a common source, which is not shown. Operating temperatures are controlled to within about +/- 1 degree C by way of tandem packaged boilers, not shown, with turndown rations of 10:1 operatively connected to intake plenums 66. The interior of the housing effectively is in effect substantially divided into four independently controlled zones along the length of the drum 14, with the supply of heated air being effectively independently delivered within each zone. Independently controlled iris valves, not shown, within the plenums 66 allow for independent delivery of hot air into the housing to permit balancing and tuning of the hot air supply within the effective zones within the housing. Thus, within each zone the rate and temperature of heated air delivered into the drum may be independently controlled.

[0042] The baffles 60, 62 channel the heated air to flow through the drum 14, exiting the housing via an array of exit ducts 68, which channel the exhaust air via a common manifold for a discharge either into the exterior environment or through a treatment system, not shown. The baffle 60 is positioned so as to direct the stream of heated air through the tablet bed within the drum 14, such that all or most of the air flows through the tumbling bed of tablets. Since

during rotation of the drum, the tablet bed will be tilted in the direction of rotation of the drum, the baffles are positioned accordingly. For example, if the drum rotates clockwise, when viewed from a first end, the tablet bed will be tilted toward the left, such that the exposed surface of the tablet bed tilts upwardly and to the left, as seen in Figure 9. The speed of drum rotation as well as tablet depth will determine the position of the tablet bed.

[0043] Tablets within the drum exit via the tablet discharge opening 18. The discharge 18 comprises a cylindrical opening within the end wall of the housing, surrounded by a tubular flange 70 aligned with the drum 22. The flange opening is fully covered by a discharge door 72, comprising a circular panel hinged to the flange 70. An inflatable seal 74 provides a waterproof and airtight seal when the door is closed. The panel 72 includes a window 76 for viewing the drum interior. The door includes a weir plate 80 for retaining within the drum a selected depth of tablets while permitting the discharge of tablets which exceed this depth. As will be discussed below, the combination of the in-feed conveyor dispensing a metered amount of tablets, with the weir plate 80, permits a continuous coating operation of the system. The weir plate 80 is generally crescent-shaped. As will be seen in Figure 1, the shape of the plate departs somewhat from a crescent shape, in that the plate comprises a substantially circular lower edge, with an upper edge having a straight region 82 merging with a hyperbolic curved region 84. The overall shape thus is similar in appearance to a scimitar blade. The panel thus generally corresponds with the shape assumed by the upper surface of the tablet bed as the drum is rotated in a clockwise direction when viewed from the first end of the housing.

[0044] The weir plate 80 is rotateably mounted to the door 72, in a position spaced apart from the door and inboard thereof such that the weir plate 80 either protrudes slightly into the interior of the drum 22 or is in contact or very close proximity with the exposed edge of the drum so as to provide an effective barrier to tablets contained within the drum 22. The space defined between the door panel 72 and weir plate 80 provides a discharge region for tablets spilling

over the weir plate. As seen in Figures 4 to 6, 11 and 12, the weir plate 80 is mounted to the door 72 by an offset mount comprising a mounting shaft 86 which is fixedly mounted to the weir plate 80, for example by an array of bolts 88. The horizontal shaft 86 in turn is mounted at its opposed end to a first end of a mount arm 90. The opposed second end of the mount arm 90 is fixedly mounted to a second rotateable shaft 92, such that rotation of the second shaft 92 has the effect of swinging the weir plate 80 about an arc. The positioning and shape of the weir plate 80 and the associated mounting shafts and arm are arranged such that the lower edge of the weir plate describes a circular movement corresponding with the drum wall, when rotated.

[0045] The second shaft 92 extends through the door panel 72 at the centre thereof, and is rotateably journaled within a bearing mount 73 extending through the door 72. The second shaft 92 is rotateably driven by a drive means which may comprise any suitable means to precisely impart rotational positioning, such as an electro-pneumatic positioner 94, operatively connected to the second shaft 92 via linkages 95, 96. If motor driven, control of the motor is effected by the central control system, described below.

[0046] Tablets which spill over the top edge of the weir plate 80 exit via a discharge hopper 98 which opens into the space between the weir plate 80 and door panel 72. The coated tablets exiting the discharge hopper 98 thus exit the system and are handled in a conventional manner.

[0047] It will be seen that positioning the weir plate 80 such that it angles more steeply upwardly in the direction of drum rotation, will effectively raise the spillover height of the weir plate 80 thus permitting a greater tablet depth to accumulate within the drum. This has the effect of permitting a relatively longer tablet dwell time within the drum 22. As will be seen, tablets deposited in a first end of the drum will move towards the discharge end by rotation of the drum, by virtue of the continuous addition of tablets at one end and discharge at the other

end. Hence, the speed of drum rotation, rate of tablet introduction and height of the weir plate cooperate to establish an average dwell time.

[0048] As well, sufficient elevation of the weir plate 80 by rotational adjustment can permit the system to operate as a batch processor if desired, for example at the start of a production run. The weir plate 80 may then be rotated into an intermediate position for continued processing on a continuous basis.

[0049] A metered supply of a coating substance such as a coating liquid is dispensed via a spray manifold 100, shown in Figure 10. The manifold 100 extends axially within the interior of the drum and comprises two independently rotatable pipe assemblies 102a and 102b supported by a bracket 152 exterior to the housing, with the assemblies 102 being positioned within the interior of the drum and extending the length thereof. Each assembly 102a and 102b in turn comprises two parallel pipes 130 and 132, which communicate with each other internally via conduits 103. Conduits 103 also provide structural support for the assemblies. Each assembly is mounted to shaft 134, which in turn is rotatably journalled within bearing mounts 150 at either end of the housing. The shafts 134 are operatively connected to an external drive, not shown. The pipe 130 supports an array of Schlick™ spray guns 106 to spray coating in atomized form onto the tablets. It will be understood that other types of spray guns may be used as is appropriate. Pipes 130 and 132 are operatively connected to a pressurized supply of coating liquid by a flexible supply line, not shown. Pressurized air is delivered to the nozzles via hoses, not shown, connected through air fittings 140.

[0050] The bearing mounts 150 are each mounted to a support bracket 152, comprising a horizontal arm 154 extending the length of the housing 14 and having telescoping sections 156 at either end thereof, with telescoping vertical sections 158 at either end thereof to which the bearing mounts are engaged. The horizontal arm is mounted to the upper surface of the housing 14, with the vertical arms overhanging the ends of the housing and entering the respective

chambers 16 and 18. The vertical arms fit within slots 160 within the upper surface of the flanges 16/18. Each of the bearing mounts 150 is operatively connected to a drive, for independently rotating the assemblies 102a and 102b. The assemblies 102a and 102b are separable from each other and may be retracted away from each other by extending the arms 156 of the bracket 152. This permits the assemblies to be partly or fully withdrawn from the housing, for example for cleaning or maintenance. The supply line includes sufficient slack to permit such movement of the assemblies 102a and 102b. The bracket 152 includes a pair of hangers 142 to support cable loops in a convenient fashion.

[0051] The assemblies 102a and b can be rotated through 360 degrees, with an operative range of rotation being about 90 degrees to permit positioning of the spray guns 106, described below, such that they are perpendicular to the surface of the tablet bed. Further, the telescoping vertical sections 158 can vary the position of the spray assembly 102 within a range of about 90-100 millimeters in a direction perpendicular to the rotational axis of the assembly 102 so as to vary the distance between the spray guns 106 and the tablet bed so as to vary the spray pattern striking the tablet bed. The spray bar includes an intake end to receive fluid. A fluid spray is dispensed via a bank of spray guns 106 divided spatially into six zones along the length of the drum 22, directed generally downwardly towards the position of the tablet bed within the drum. Fluid is dispensed under pressure, preferably via a system for atomizing the spray liquid.

[0052] The spray guns 106 comprise three arrays or spray zones of three guns each, within each of the assemblies 102 a and b, for a total of 18 guns arranged in six independently controlled spray zones Each array of three guns within a given zone is independently controlled on or off. The independently controlled spray zones permit a controlled build-up of the sprayed coating to permit accurate coating weight gain, particularly in the transition time between the initial batch processing and the subsequent continuous mode operation. In

particular, the system reduces losses incurred through undercoating or off-spec coating while in the batch production mode.

[0053] A wash-in-place system activated for cleaning of the interior of the housing 14 and the drum 22. The system comprises a pair of conduits 120a and 120b for wash liquid (for example water) supported by the assemblies 102a and 102b respectively. The conduits 120 each receive a pressurized supply of liquid from a flexible hose, not shown. Cleaning liquid is dispensed under pressure via two nozzles 164a and b which are operatively connected to the conduits 120a and 120b respectively. The nozzles 164 are each capable of 360 degree rotation to deliver cleaning liquid towards the interior drum wall with full 360 degree coverage.

[0054] During the wash cycle, wash liquid collects within the base of the housing 14, filling the housing about ¼ to 1/3 of its height with solution to form an internal sump region. The components of the system are designed to maintain the primary drive components above the sump region while permitting immersion of the sump region. In practice, sufficient liquid will be introduced such that a portion of the drum will enter the collected wash liquid and during drum rotation is thus effectively washed. The spray nozzles also direct a liquid spray towards the end walls, so as to effectively wash the interior of the housing. The first and second doors are sealed against leakage of liquid, by means of a highly watertight seal formed by an inflatable gasket, fixedly mounted around the perimeter of the respective doors. Each door is also provided with a latch to tightly close the door.

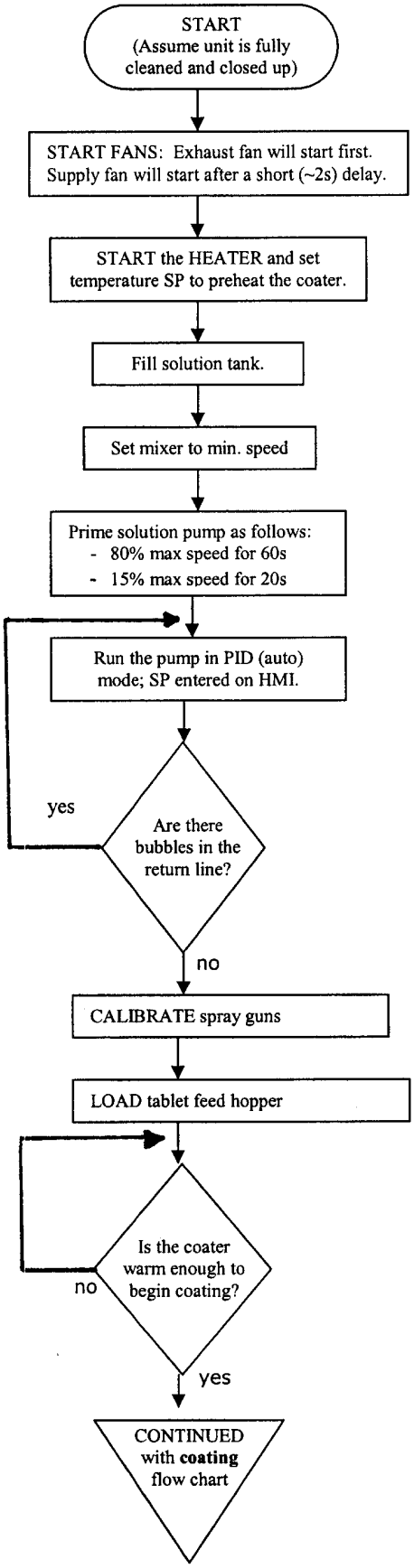
[0055] Liquid used for cleaning of the system which collects within the base of the housing may be drained, via one or more drains for either disposal or re-use.

[0056] Operation of the system 10, including tablet in-feed rate, drum rotation, coating spray delivery, heated air delivery, weir plate position and the

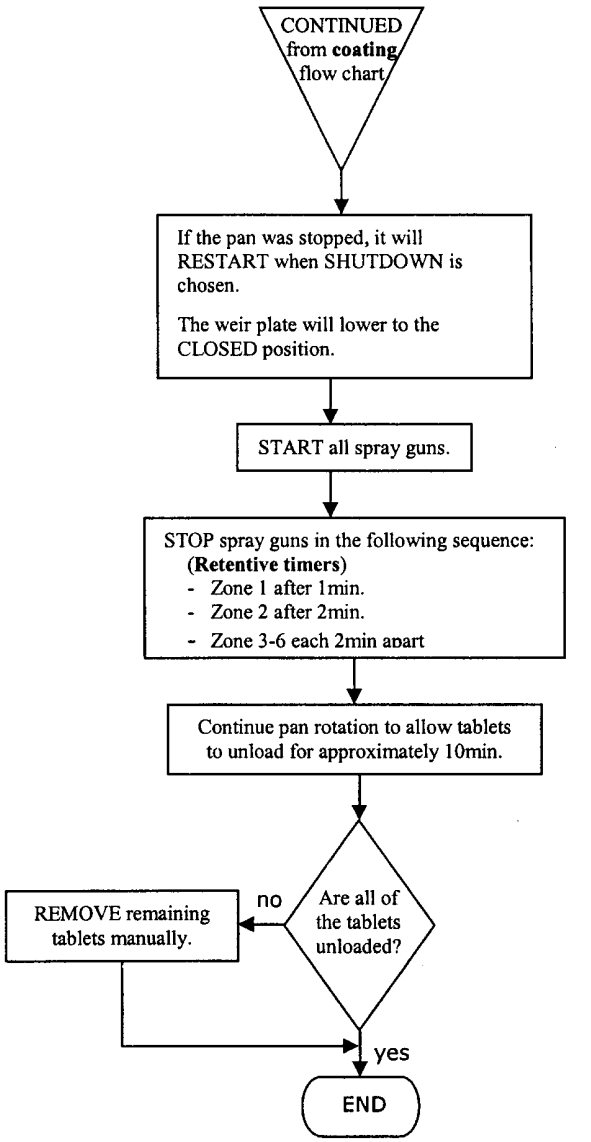
wash-in-place cleaning system, is controlled via the central controller 36, operatively linked to the tablet inlet 28, in-feed conveyor 26, drum drive motor 52, weir plate positioner 94, and coating spray and liquid dispensing systems. The controller 36 comprises any suitable electronic system capable of receiving electronic signals, processing the signals according to a logic sequence, and transmitting control signals. The controller 36 includes a user interface to permit programming of the system operation.

[0057] The following flow charts show the operation of controller 36 for controlling the system.

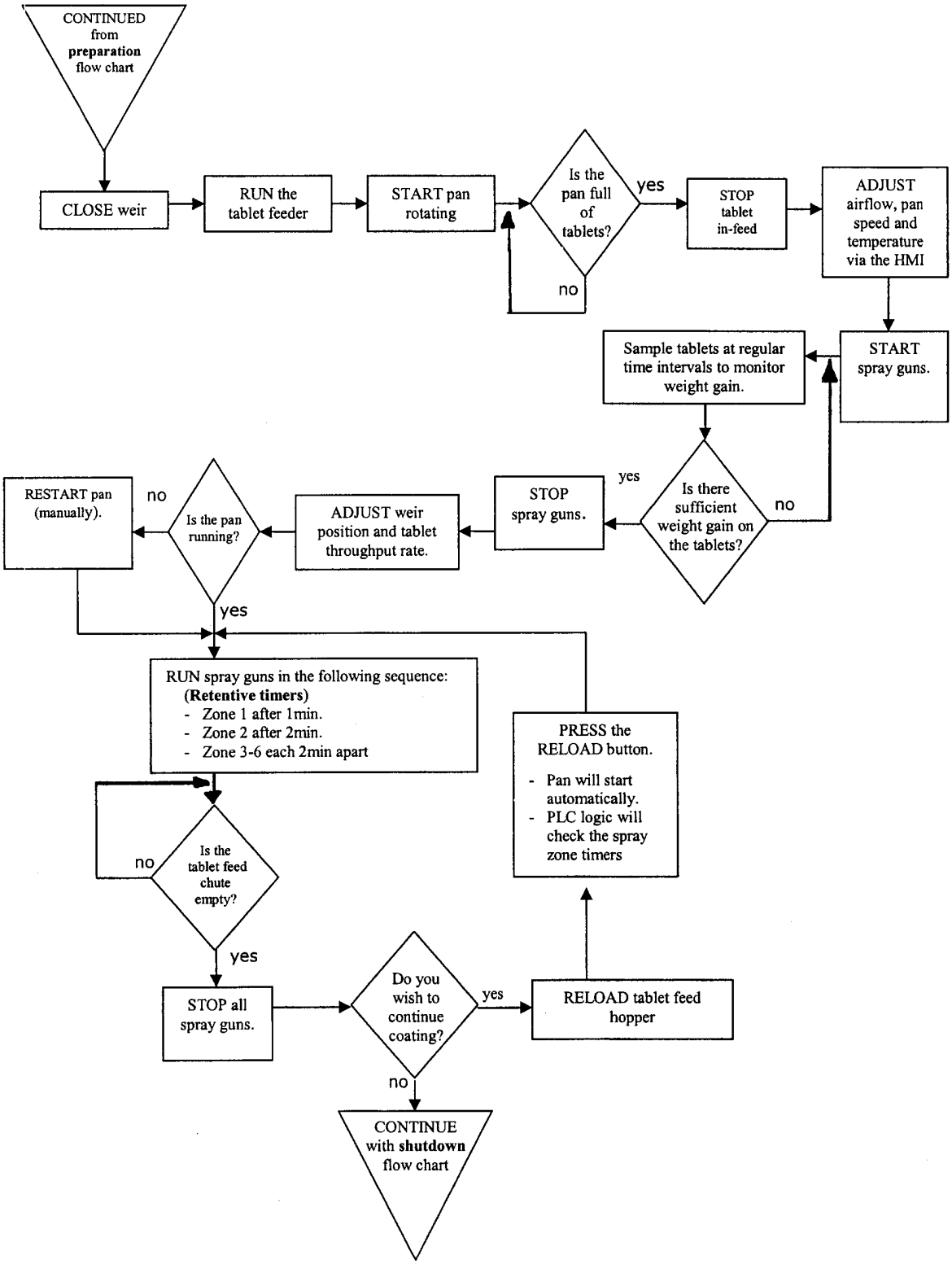
Operating Sequence – Preparation



Operating Sequence – Shutdown



Operating Sequence – Coating



[0058] Although the present invention has been described in part by reference to one or more embodiments described in detail, it will be understood that the invention is not limited in its scope to these embodiments nor to any particular aspect of same. Rather, the full scope of the invention is described by reference to this patent specification as a whole including the claims.

CLAIMS:

1. A system for coating tablets and other small articles by continuous processing comprising:

a) an elongate housing having first and second ends and opposing lateral sides;

b) a drum within said housing journalled for rotation about a horizontal axis extending between said ends, said drum having first and second open ends for receiving and discharging respectively a supply of tablets;

c) drive means for rotating said drum about said axis for tumbling said tablets within said drum and thereby facilitating transit of said tablets from said first end to said second end as said tablets are received at said first end and discharged from said second end;

d) a delivery system for delivering a selected amount of coating to said tablets within said drum as said tablets are tumbled within said drum;

e) a feeder for dispensing a stream of bulk tablets on a continuous basis at said first end of said housing, said stream comprising a selected unit of bulk tablets per selected unit of time;

f) a weir plate partly obstructing the open second end of said drum for maintaining within said drum a selected depth of tablets and average tablet dwell time wherein treated tablets spill over said weir plate for discharge from said system;

g) a tablet discharge region to receive coated tablets spilling over said weir plate for discharge from said system.

2. A system as defined in claim 1, wherein said delivery system comprises a sprayer for delivering a liquid substance positioned within the interior of said drum for delivering said liquid under pressure as a spray.

3. A system as defined in claim 1, wherein said feeder comprises a weigh-in feeder for dispensing a selected unit of weight of bulk tablets per selected unit of time.

4. A system as defined in claim 3, wherein said weigh-in feeder comprises a scale for weighing a stream of tablets passing over said scale, a tablet transport system to carry tablets in bulk across said scale while being weighed, a dispenser for delivering a controllable stream of tablets to said scale and a controller operatively connected to said scale and dispenser to receive signals from said scale and to control the amount of tablets delivered to said scale so as to maintain said selected constant flow of tablets.

5. A system as defined in claim 1, wherein said weir plate is generally crescent-shaped comprising a substantially semi-circular lower edge and an upper edge comprising a generally flat first part merging with a generally hyperbolic second part, said weir plate being rotably mounted so as to selectively vary the obstruction of said drum so as to increase or decrease the depth of tablets within said drum.

6. A system as defined in claim 1 further comprising a cleaning solution sprayer within said drum for selectively delivering a stream of cleaning liquid into the interior of said drum, wherein said housing is sealed against liquid leakage so as to permit a selected depth of cleaning liquid to accumulate within said housing for cleaning of said system.

7. A system as defined in claim 1 further comprising a controller operatively connected to said feeder and optionally to said liquid delivery system and said weir plate for controlling the delivery of tablets and coating to said system at a selected rate whereby said tablets are coated within said system and discharged on a continuous basis at a selected rate comprising a selected quantity of tablets per unit of time.

8. A system for coating tablets and other small articles comprising a housing having first and second opposed end walls, at least the lowermost portion of said housing being substantially sealed to permit cleaning liquid to accumulate

therein, a drum within said housing for tumbling said tablets journalled for rotation about a horizontal axis extending between said end walls, a closeable drain for selectively permitting cleaning liquid within said housing to drain, a portion of said drum being positioned within said lowermost portion, a sprayer within the interior of said drum parallel to said drum axis operatively connected to a source of cleaning liquid, and a mount for mounting said sprayer to said housing.

9. A system as defined in claim 8, wherein said sprayer comprises an elongate spray bar is rotatable about its elongate axis and said mount comprises at least one rotary mount.

10. A system as defined in claim 9, wherein said spray bar is rotatably journalled within a pair of rotary mounts each operatively connected to an overhead bracket exterior to said housing, said bracket comprising a pair of depending engagement arms for supporting said mounts joined by an overhead beam, and further comprising a rotary drive for rotating said spray bar.

11. A system as defined in claim 10, wherein said spray bar is supported by an elongate frame supported by the engagement arms, and further comprising a second spray bar for dispensing a coating liquid within said drum onto a tablet bed within said drum supported by said frame.

12. A system as defined in claim 11 further comprising an overhead bracket exterior to said housing for supporting said frame, said bracket comprising elongate beam and a pair of depending engagement arms, said frame being engaged to said arms by a pair of mounts.

13. A system as defined in claim 11 further comprising length adjustment of said arms for displacing said frame in a generally vertical direction so as to vary the distance between said spray bars and said tablet bed.

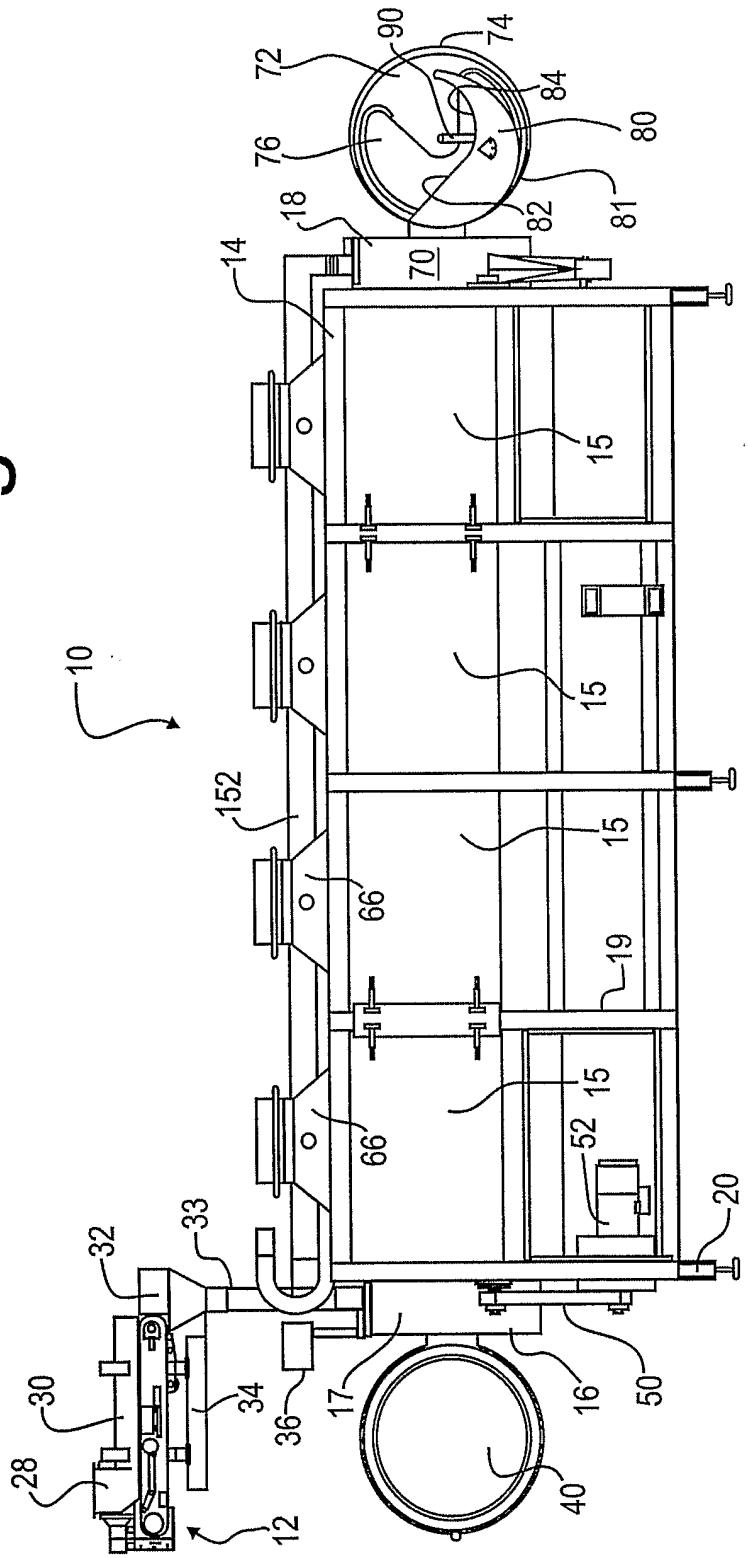
14. A system as defined in claim 12, wherein said frame is rotatably journalled to said mounts for rotation about an elongate axis, and further comprising a rotary drive for rotating at said frame.

15. A method of applying a coating to tablets in bulk comprising the steps of providing a system as defined in any of claims 1-7, feeding a supply of uncoated tablets and a supply of coating into said system, removing said tablets from said system on a continuous basis, and controlling said system for continuous deliver, coating and removal of tablets at a selected rate comprising a selected quantity of bulk tablets per selected unit of time.

16. A method as defined in claim 15, wherein said coating comprises a liquid delivered through an array of spray nozzles located within the interior of said drum, said array comprising a plurality of zones spatially distributed within said drum, each of said zones being independently controlled for delivery at a selected rate or non-delivery of said coating.

17. A method as defined in claim 16, wherein said zones each further comprise an independently controlled hot air delivery system for delivery of heated air into said zone at a rate and temperature independent of others of said zones.

Fig.1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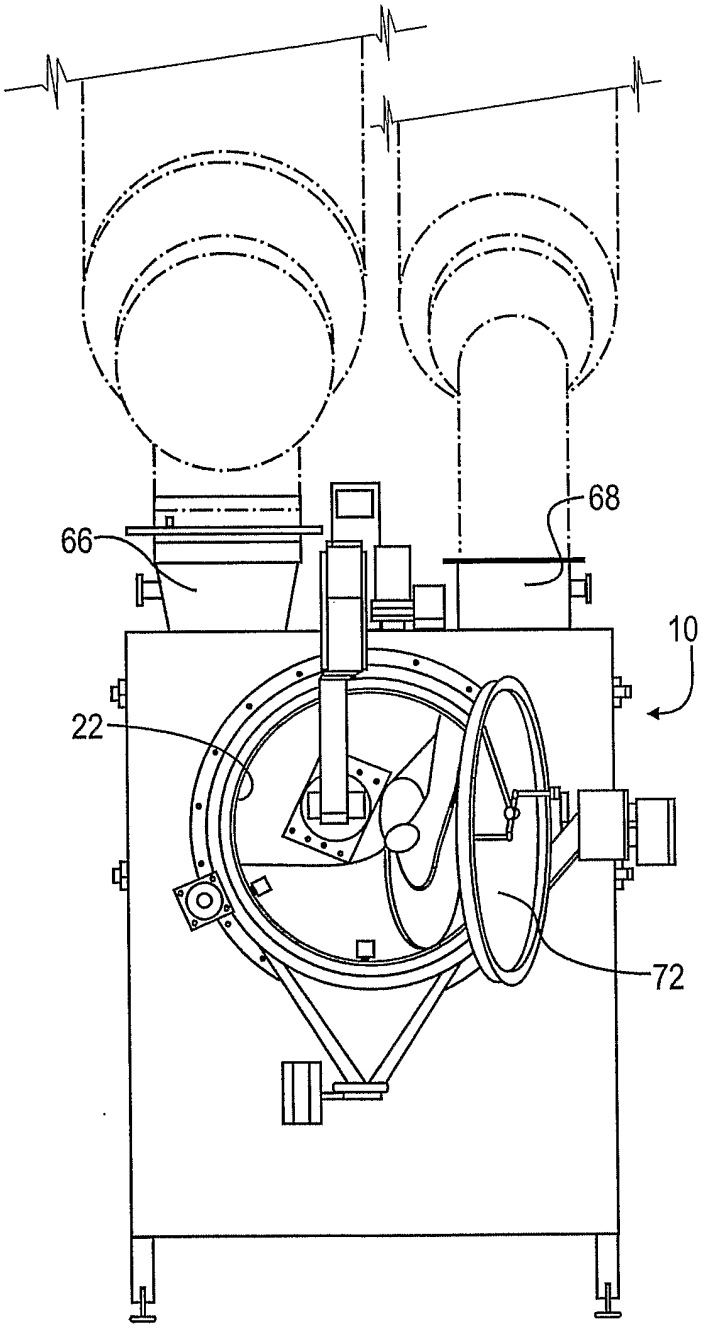

Fig. 2

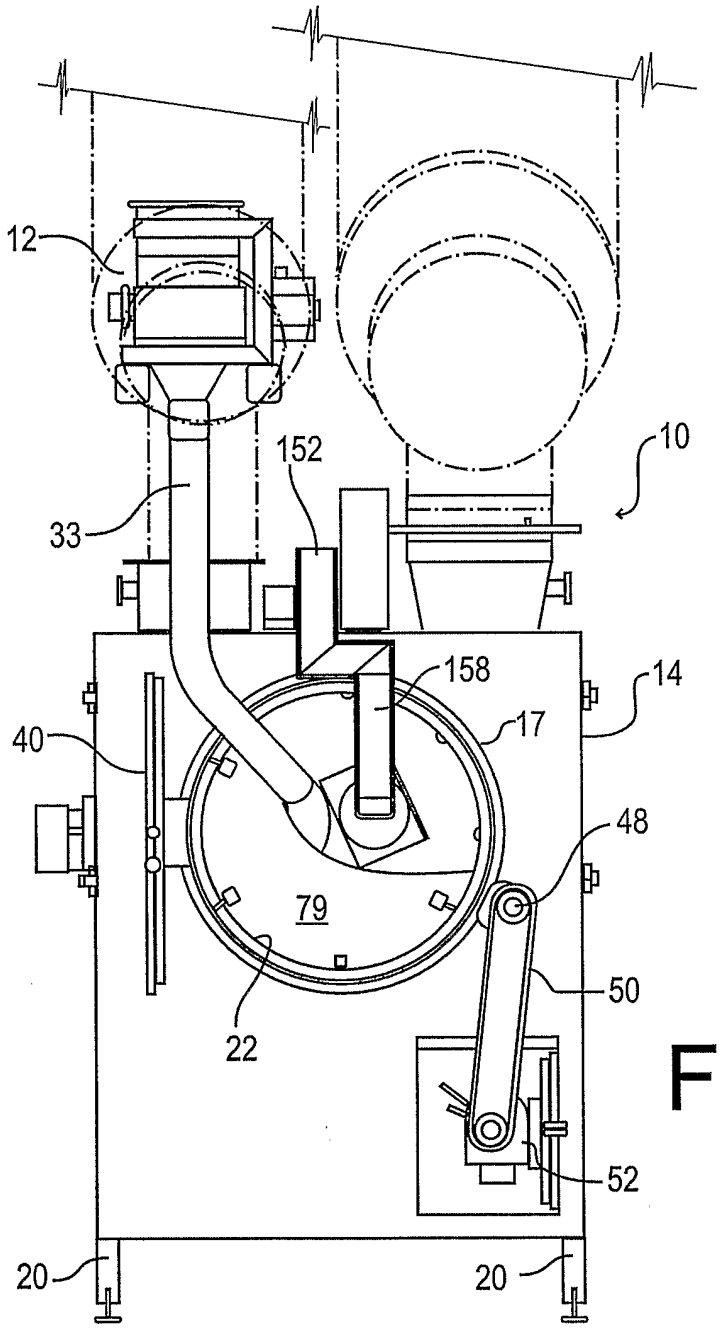

Fig.3

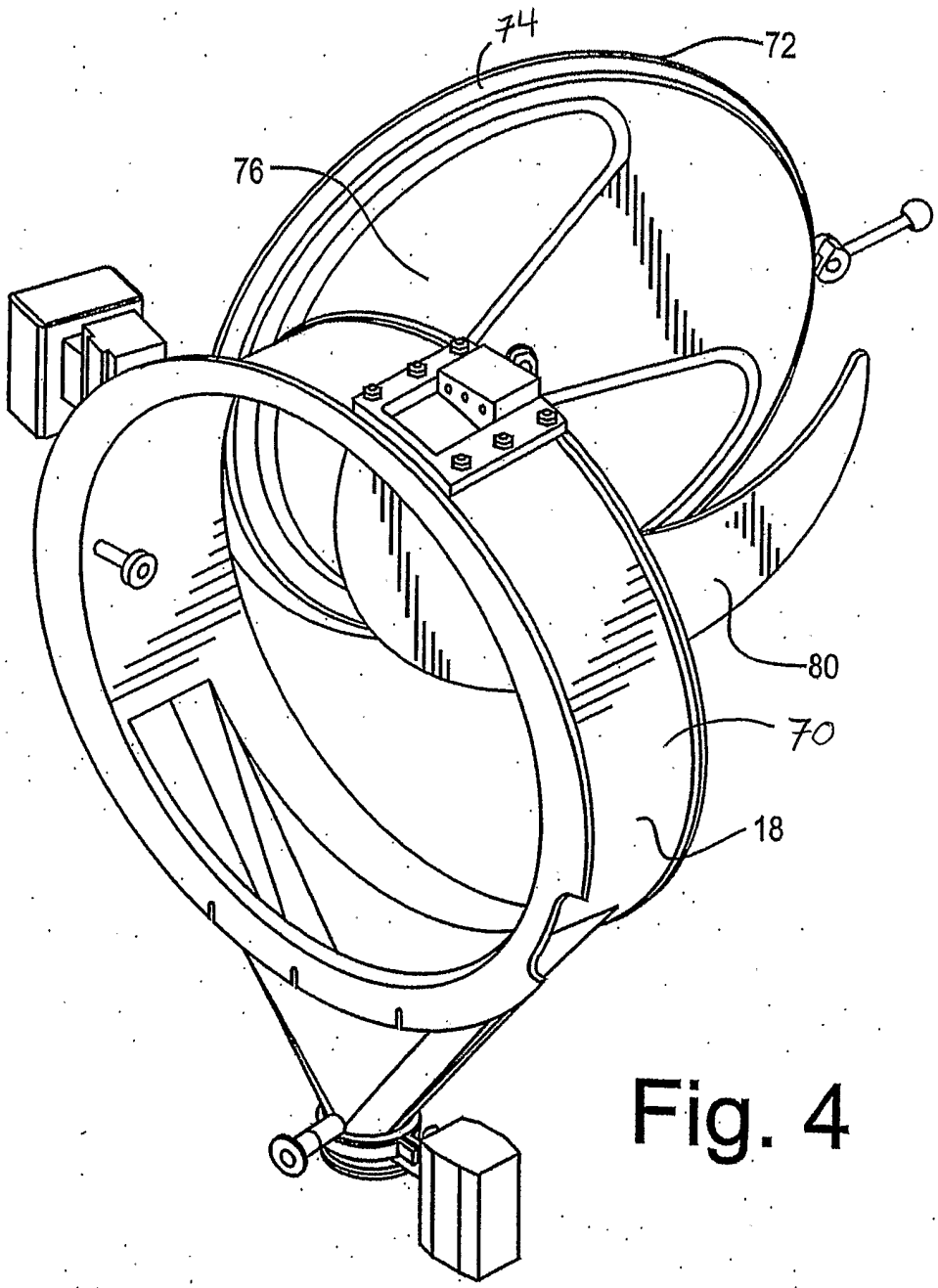

Fig. 4

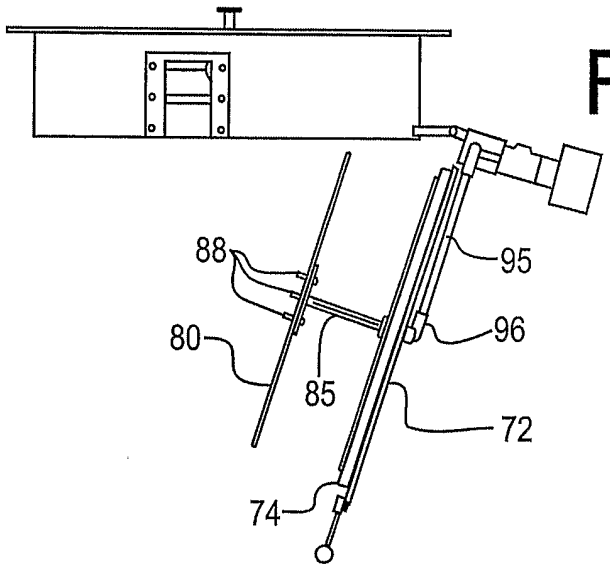

Fig. 5

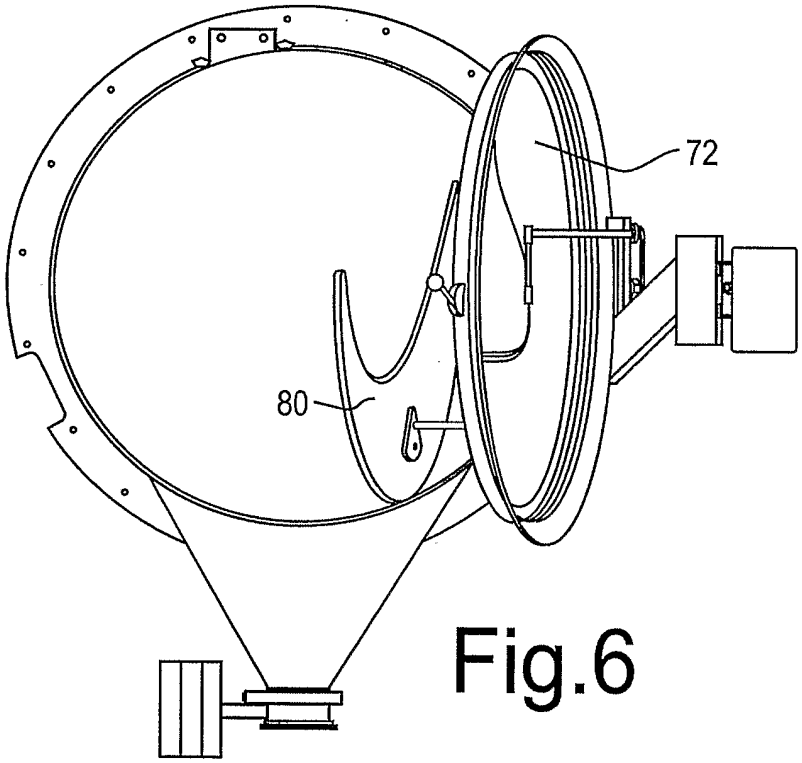

Fig.6

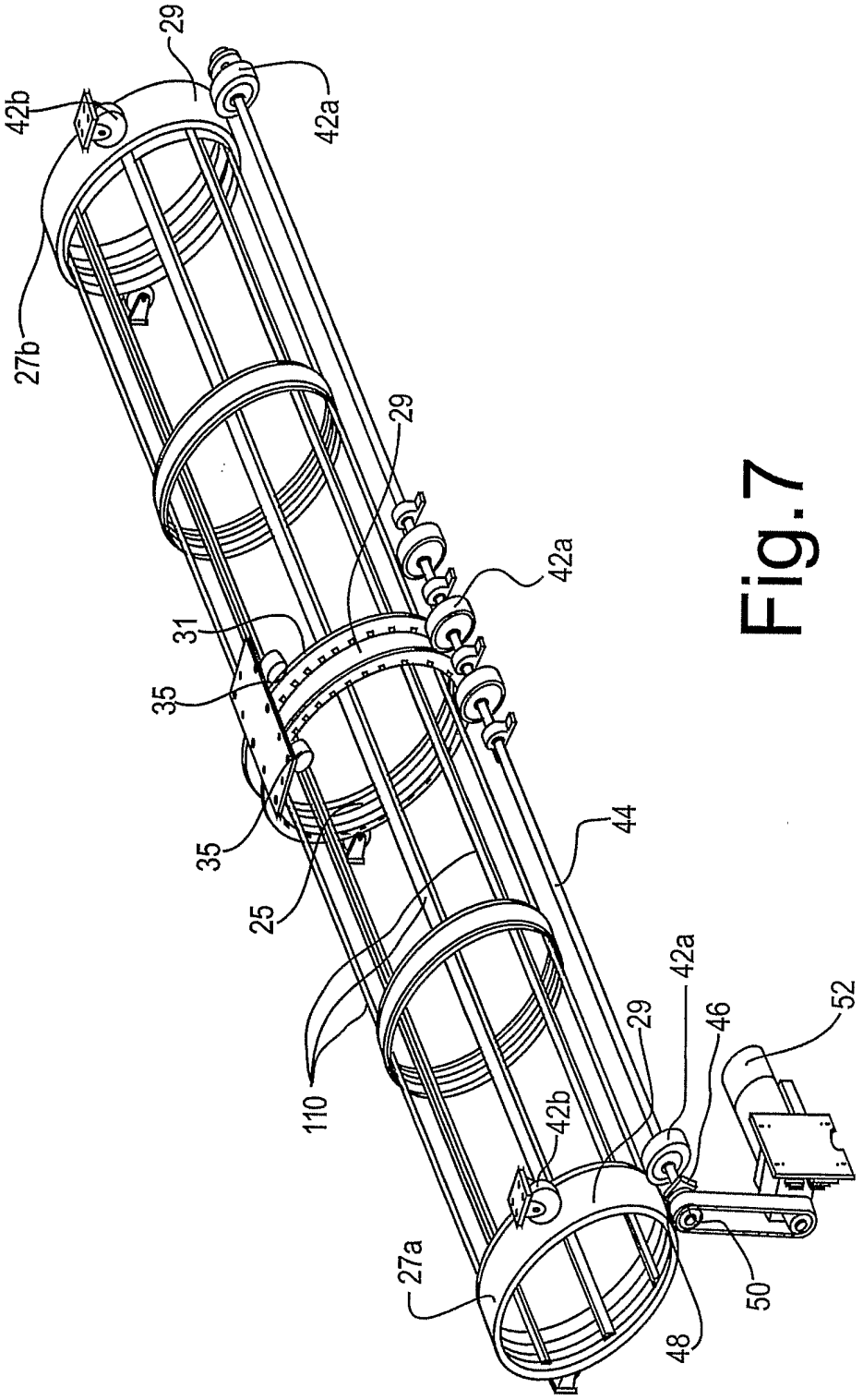

Fig.7

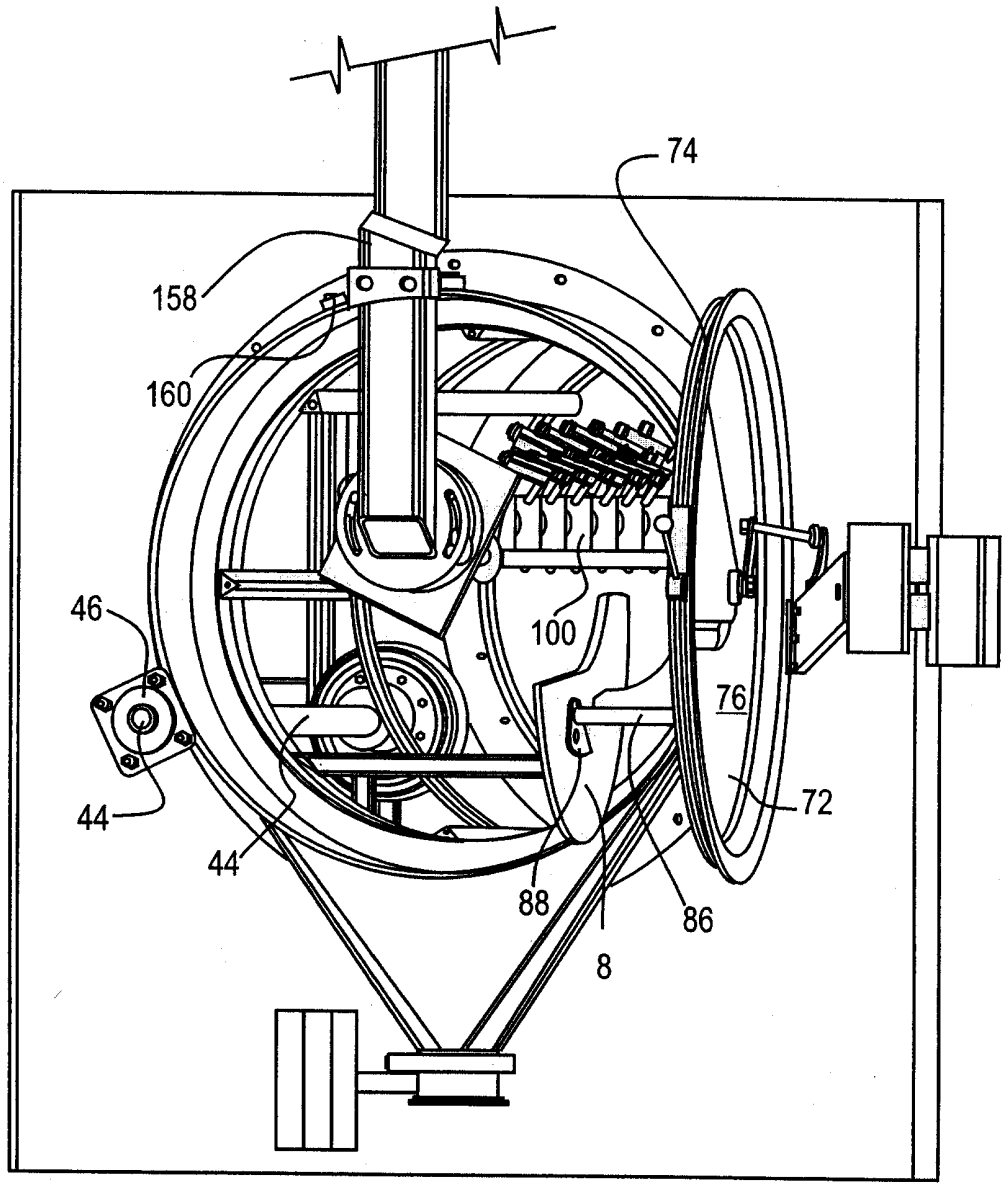

Fig. 8

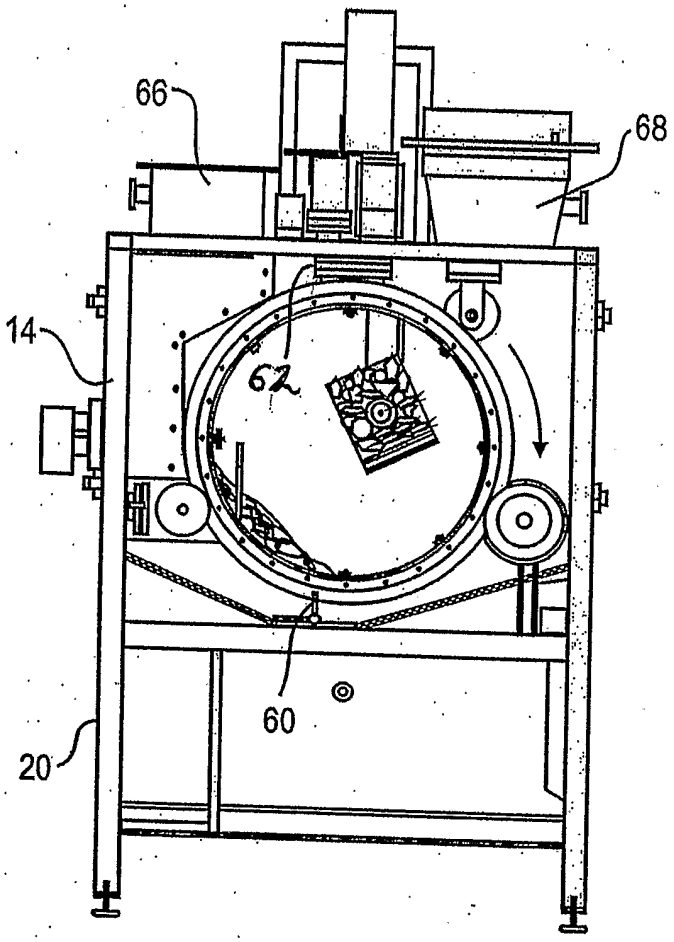

Fig. 9

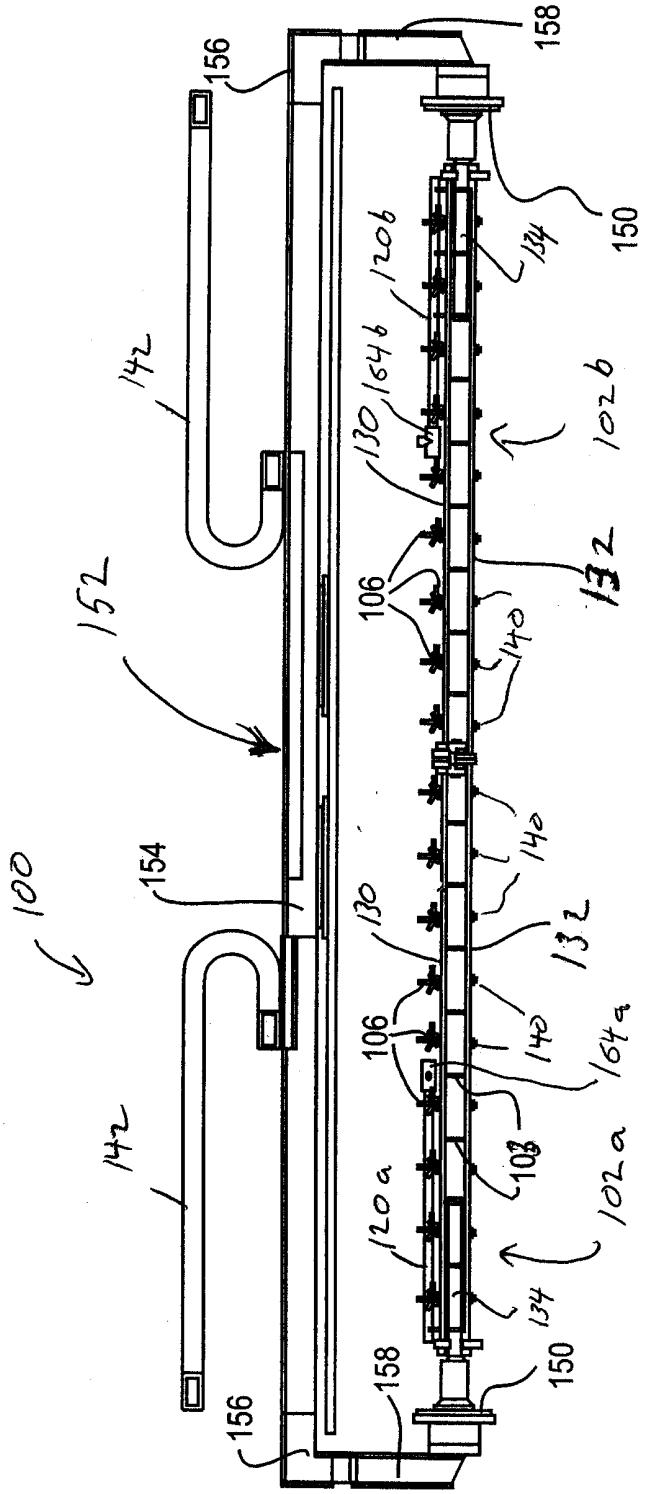
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Fig. 10

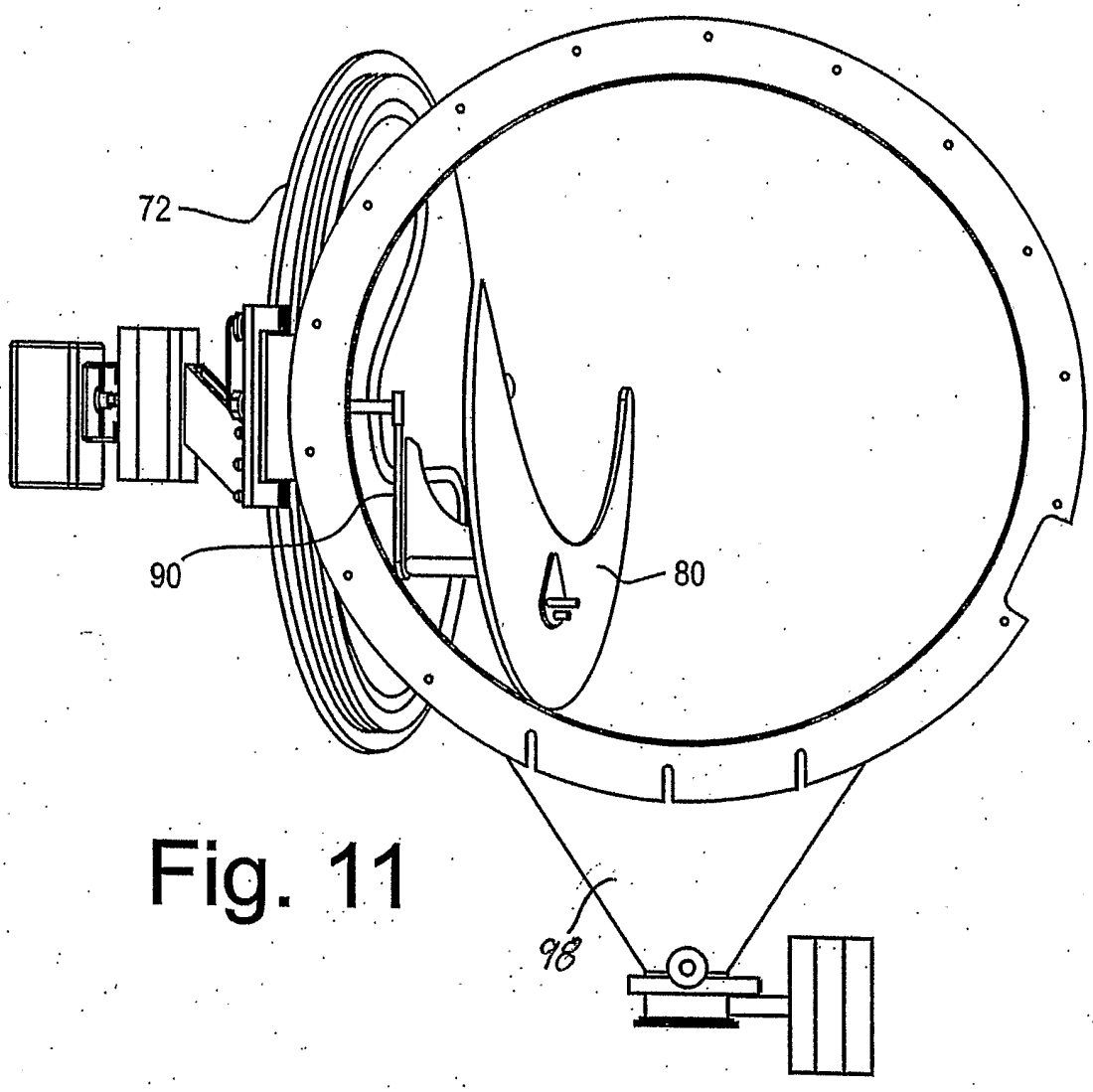

Fig. 11

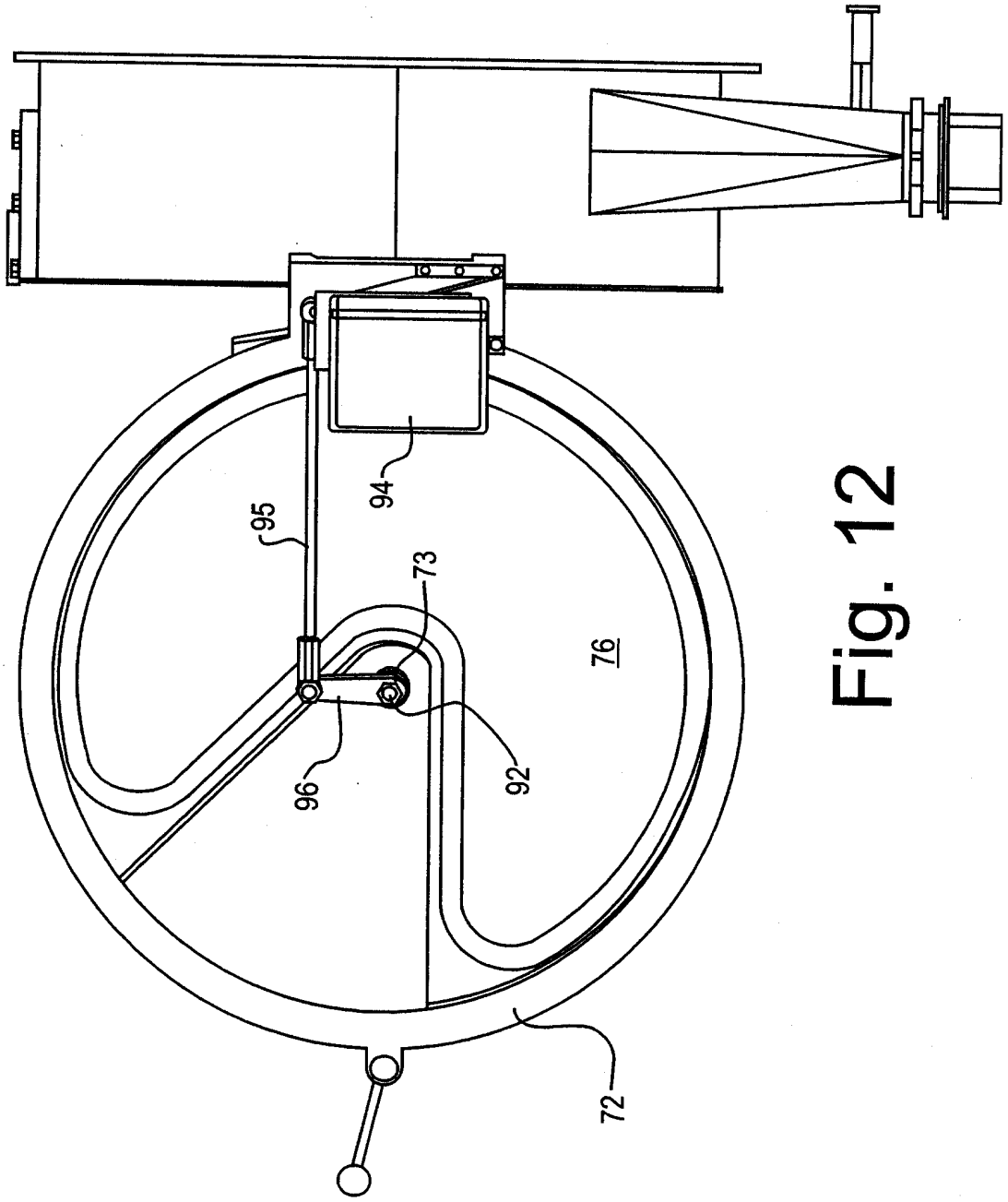

Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2006/000552

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***B05C 3/08*** (2006.01) , ***B05C 11/10*** (2006.01) , ***B05C 3/10*** (2006.01) , ***A23G 3/26*** (2006.01)
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)
IPC8: B05C, A23G, A61J

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
DELPHION, ESPACENET, CANADIAN PATENT DATABASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,991,225, BLOUIN, 9 November 1976 (09-11-1976) Col.5 lines 26-40; Col 7 lines 10-47; Col 10 lines 50-54; Col 14 lines 1-7.	1-4,7,15-17
Y	US 5,010,838, SIMELUNAS ET AL., 30 April 1991 (30-04-1991) Abstract; Fig.2; Col.2 lines 28-43; Col.5 lines 26-29; Col.8, lines 18-23.	1-4,7,15-17
Y	US 5,100,683, SINGER ET AL., 31 March 1992 (31-03-1992) ***See whole document***	1-7,15-17
A	US 6,365,203 B2, DEGADY ET AL., 2 April 2002 (02-04-2002) ***See whole document***	
A	US 3,937,176, NICHOLSON ET AL., 10 February 1976 (10-02-1976) ***See whole document***	
P,A	CA 2,455,192, O'HARA, 14 July 2005 (14-07-2005) ***See whole document***	

[ ] Further documents are listed in the continuation of Box C.

[X] 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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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	Date of mailing of the international search report
12 June 2006 (12-06-2006)	31 July 2006 (31-07-2006)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001(819)953-2476	David Chamberlain (819) 934-3594

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
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Continuation of Box No. III

Group A

Claims 1-7,15-17 are directed to a system and a method for coating tablets and other small articles wherein the coated tablets and other small articles are introduced and discharged from the system on a continuous basis, characterized by the components defined in Claim 1.

Group B

Claims 8-14 are directed to a system for coating tablets and other small articles, said system having a horizontal axis drum, including improved means for washing the tablet coating drum and other components in contact with the tablets.

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the 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. [ ] Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. [ ] Claim Nos. :
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 :

3. [ ] Claim Nos. :
because they are dependant 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 :

see extra sheet

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 additional fees, this Authority did not invite payment of additional fees.

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 claim Nos. :

4. [X] 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 claim Nos. : 1-7,15-17

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