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(54) Title of the Invention: **A combined cleaning apparatus for cleaning vegetables or other items and an associated method**  
Abstract Title: **Vegetable cleaning apparatus comprising consecutive rotary sections for washing and polishing**

(57) A combined cleaning apparatus 10 for cleaning vegetables or other items includes: a main frame, a first cleaning part 12 and a second cleaning part 14. The first cleaning part is configured to perform a first cleaning operation and is configured for rotation with respect to the main frame and has a barrel body 16 defining a central bore 30. The second cleaning part is configured to conduct a cleaning operation subsequent to the first cleaning operation. The second cleaning part is also configured for rotation with respect to the main frame and has a barrel body 18 defining a second cleaning part central bore 32. A connecting part 34 couples the first and second cleaning parts, the connecting part being coupled for rotation about an axis which is substantially parallel to an axis of rotation of the first and/or second cleaning part. The connecting part is configured for rotation with respect to one of the first and second cleaning parts, typically via a bearing member. The first cleaning operation may be washing and the second cleaning operation may be polishing or drying.

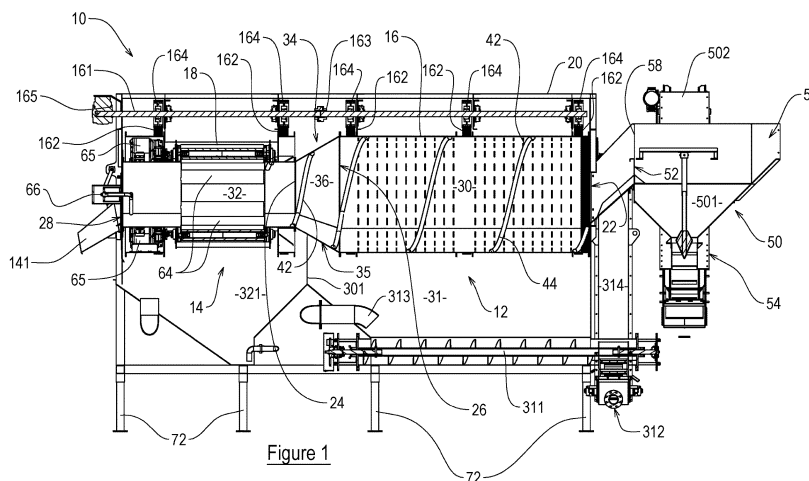


Figure 1

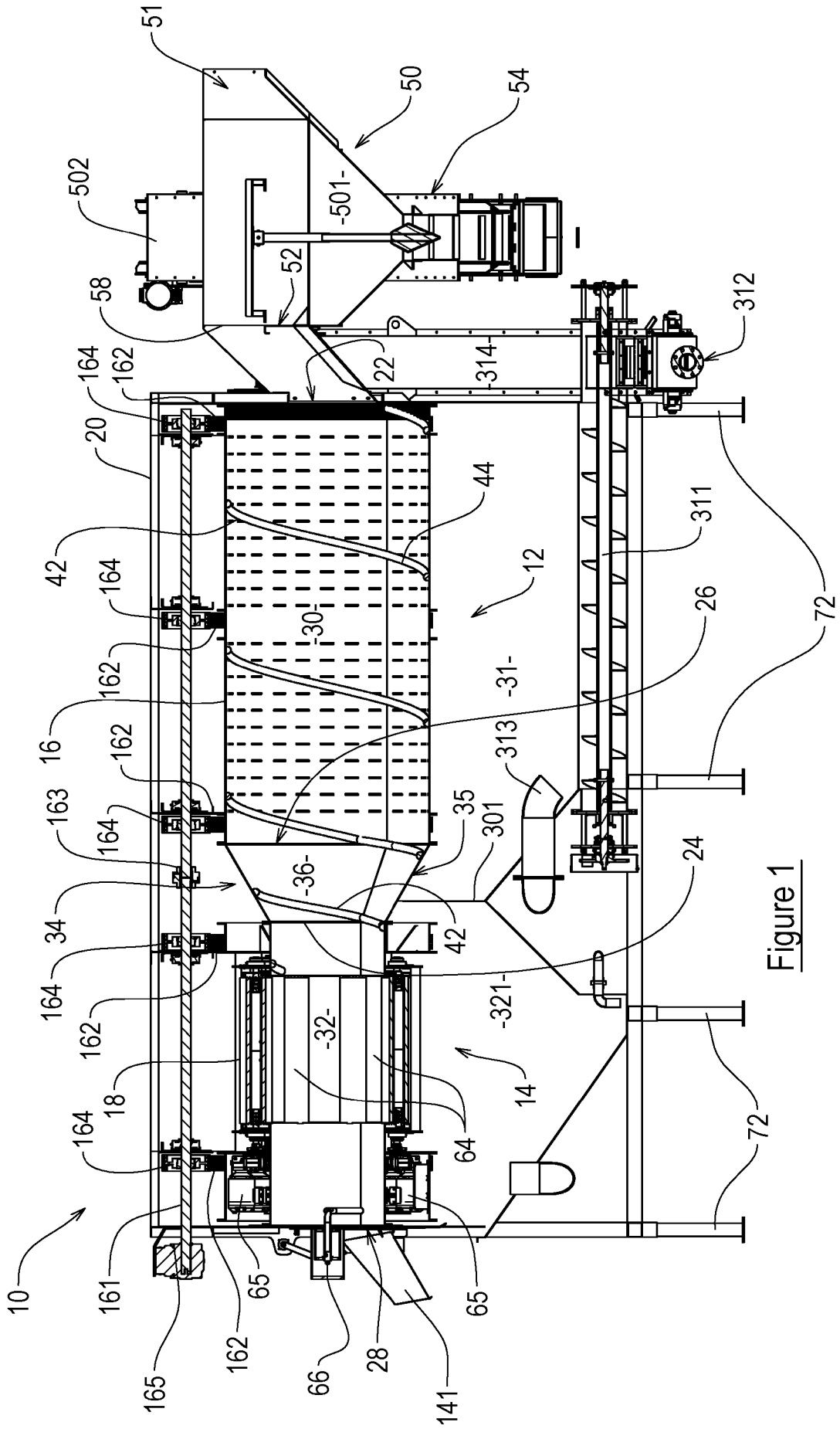
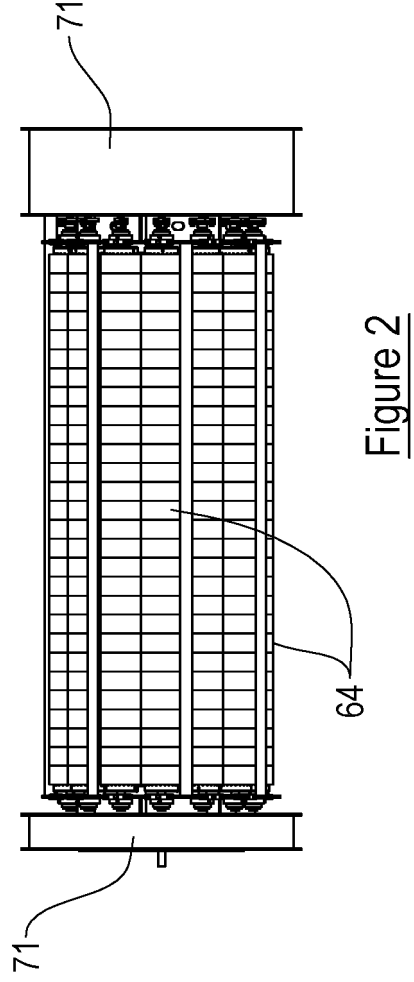
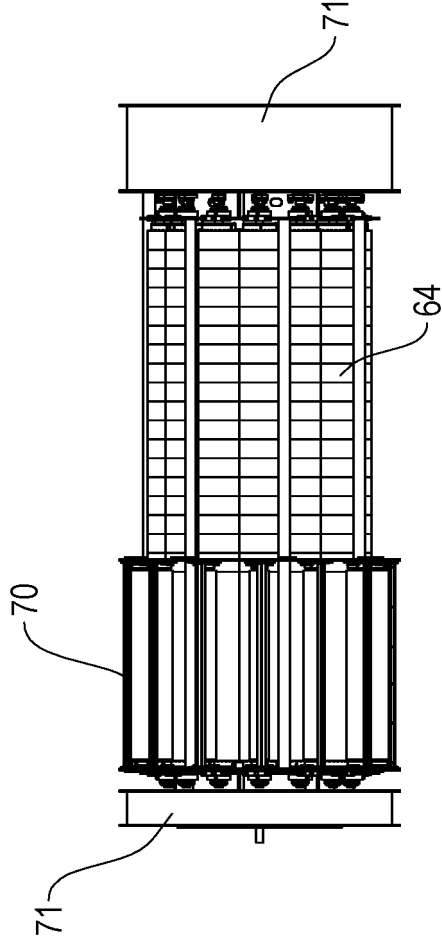
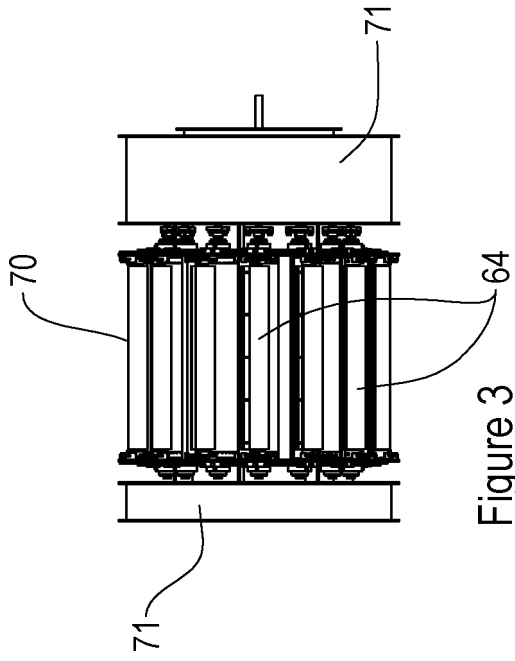


Figure 1



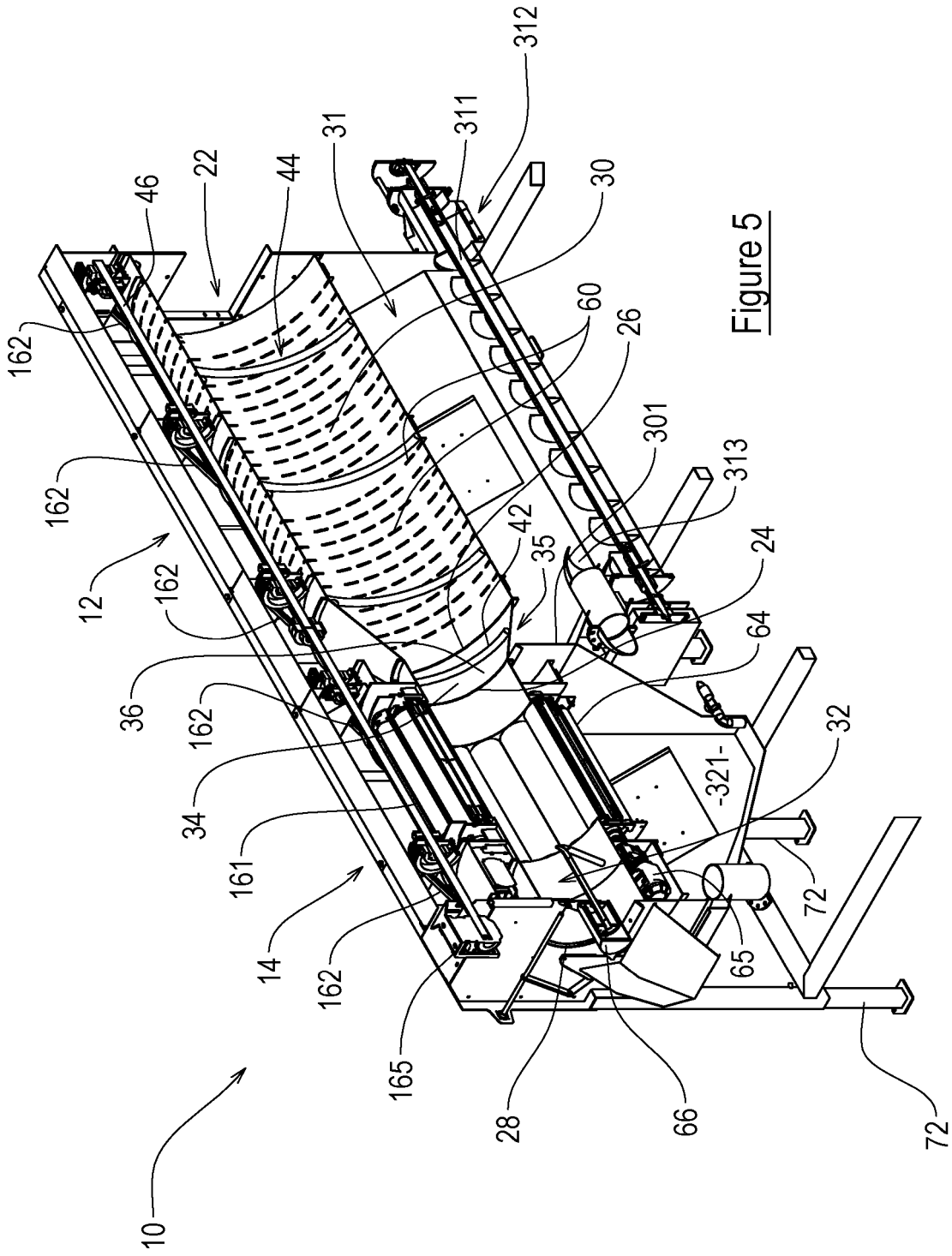


Figure 5

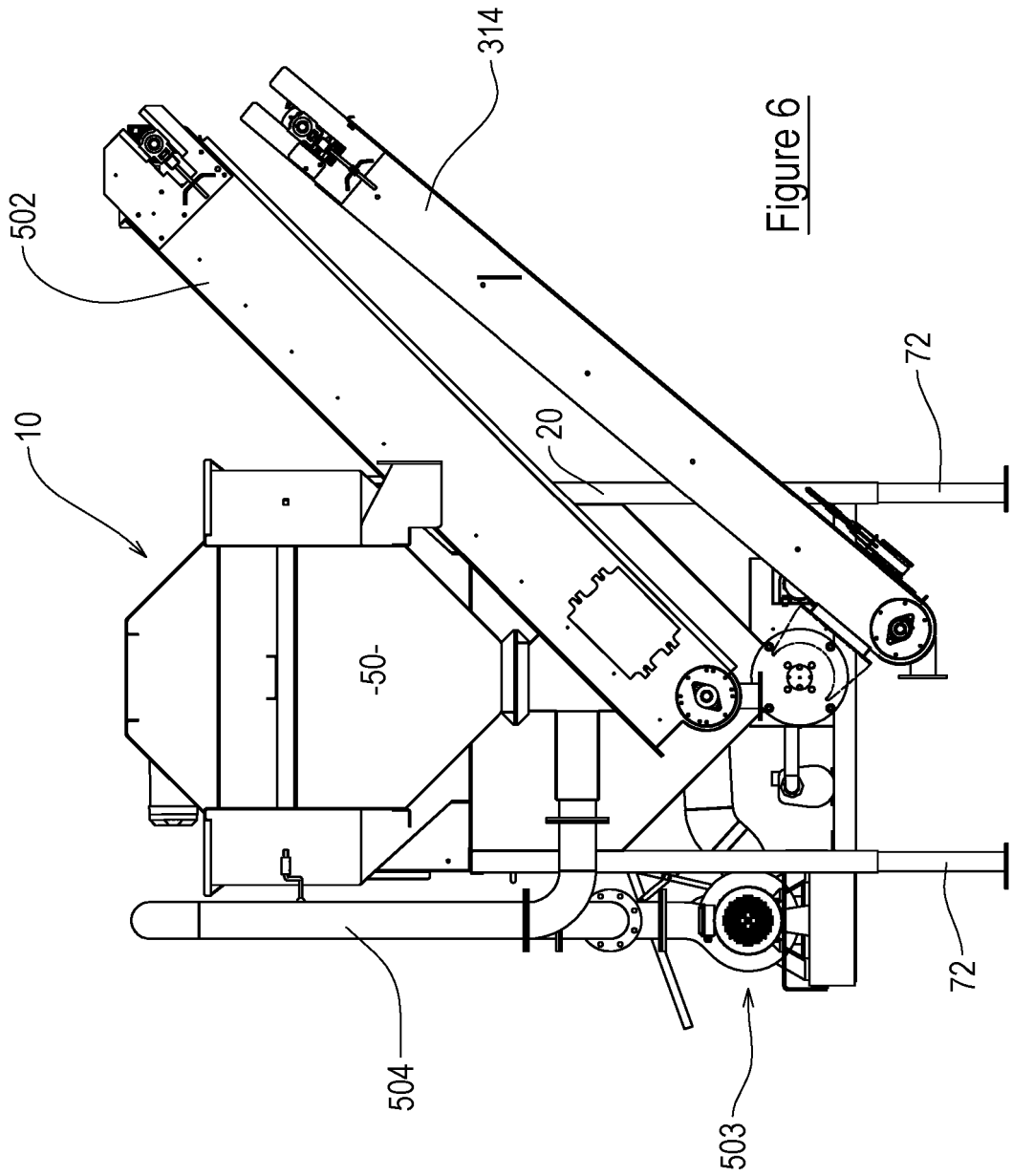


Figure 6

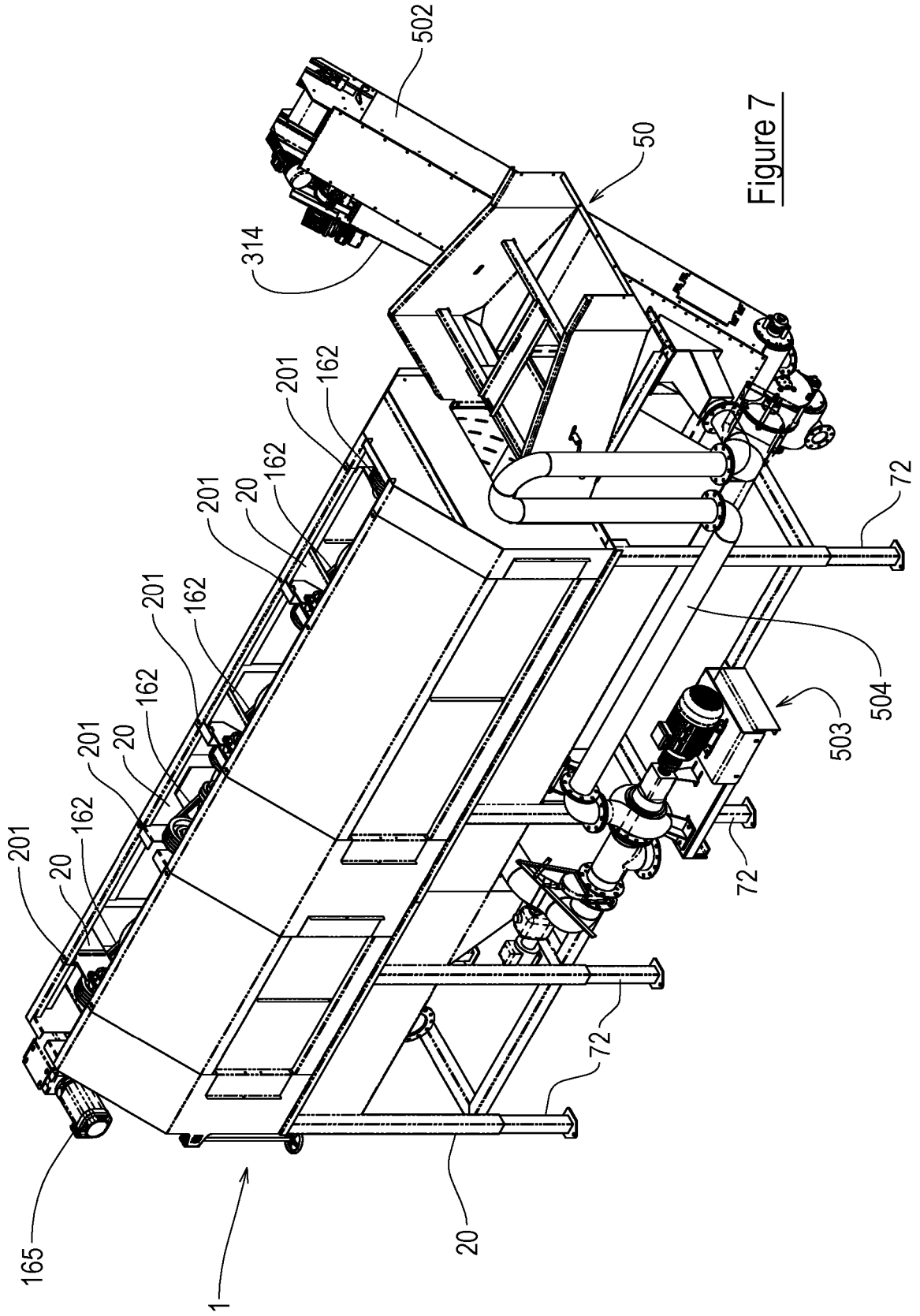


Figure 7

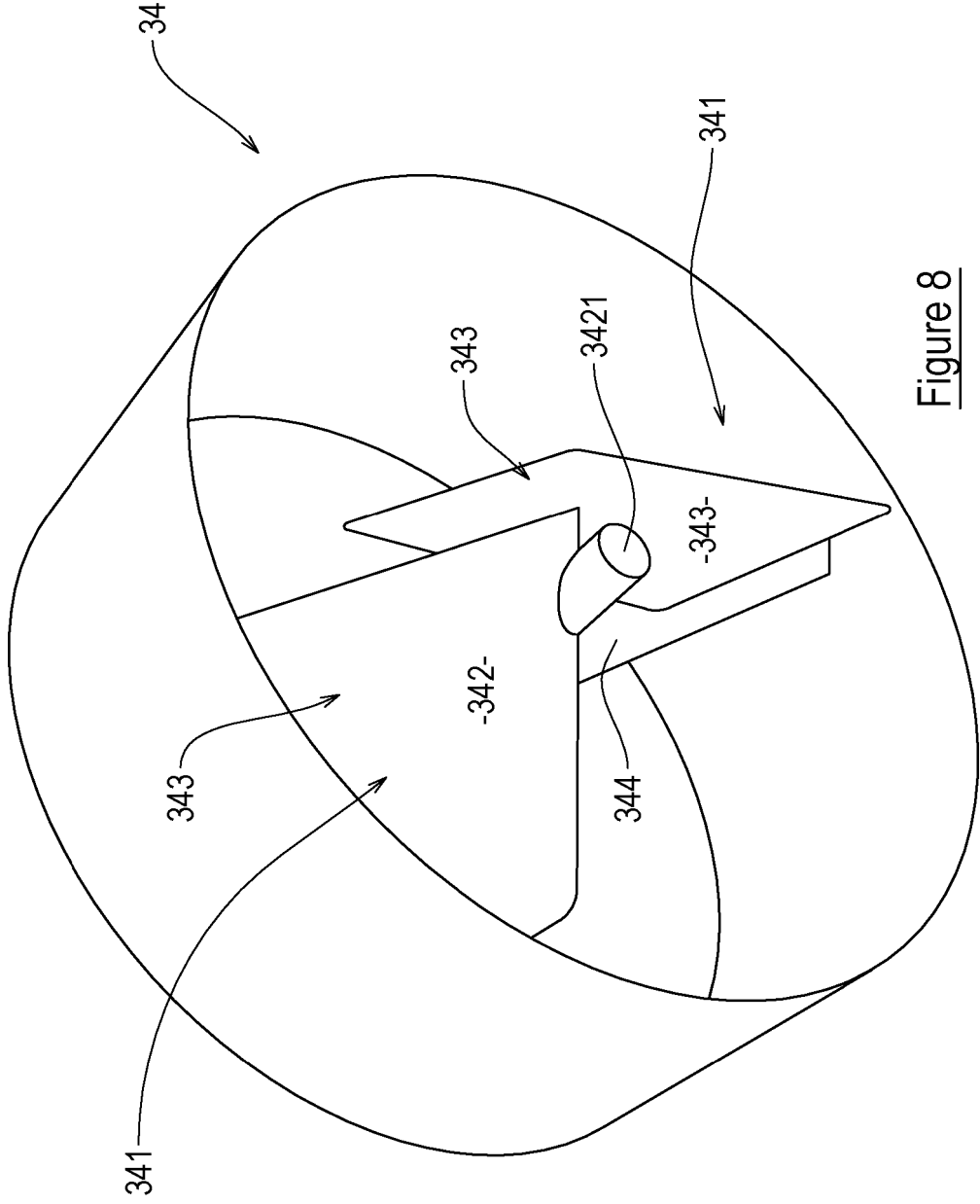


Figure 8

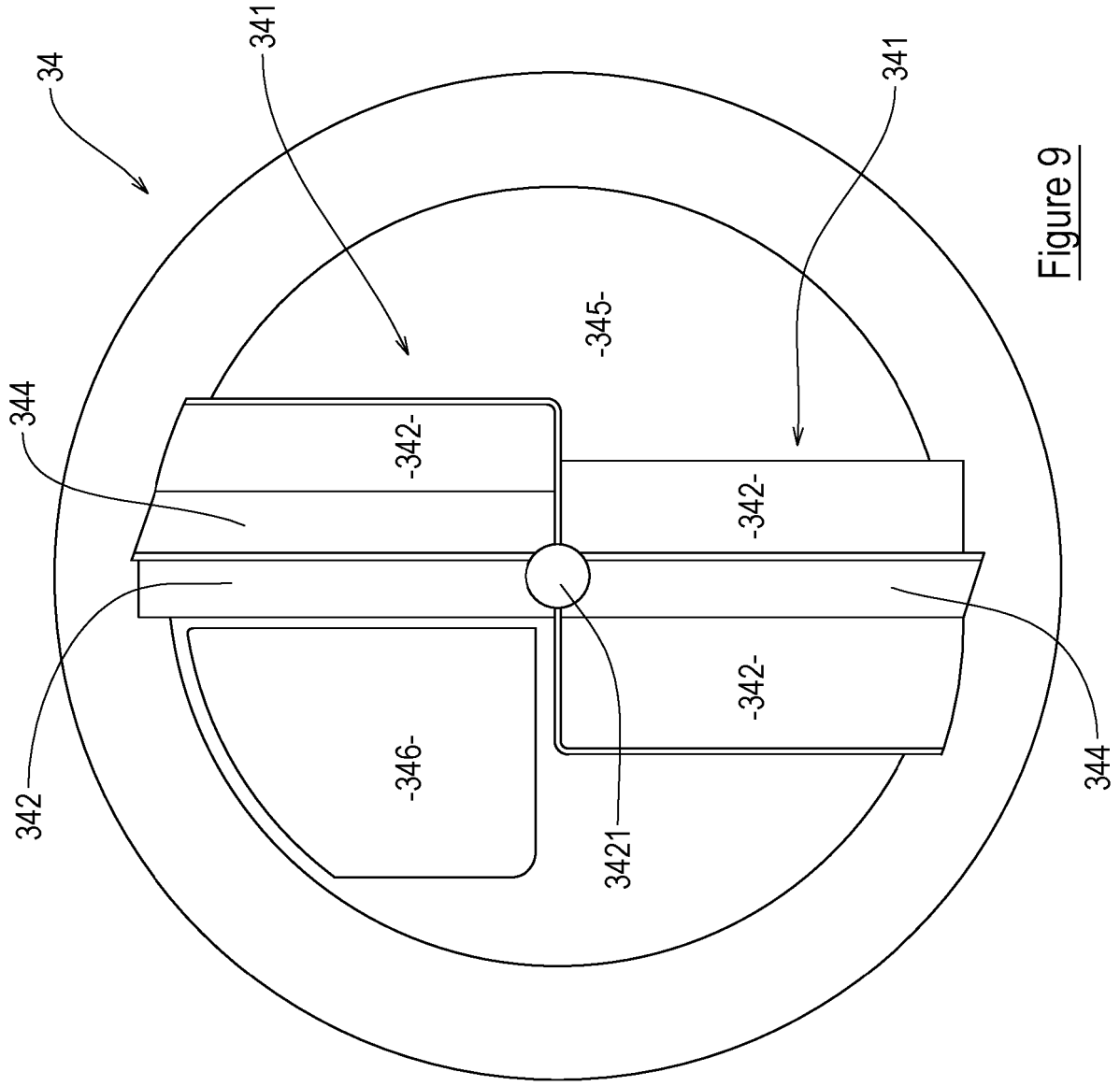


Figure 9



03 12 14

8 / 8

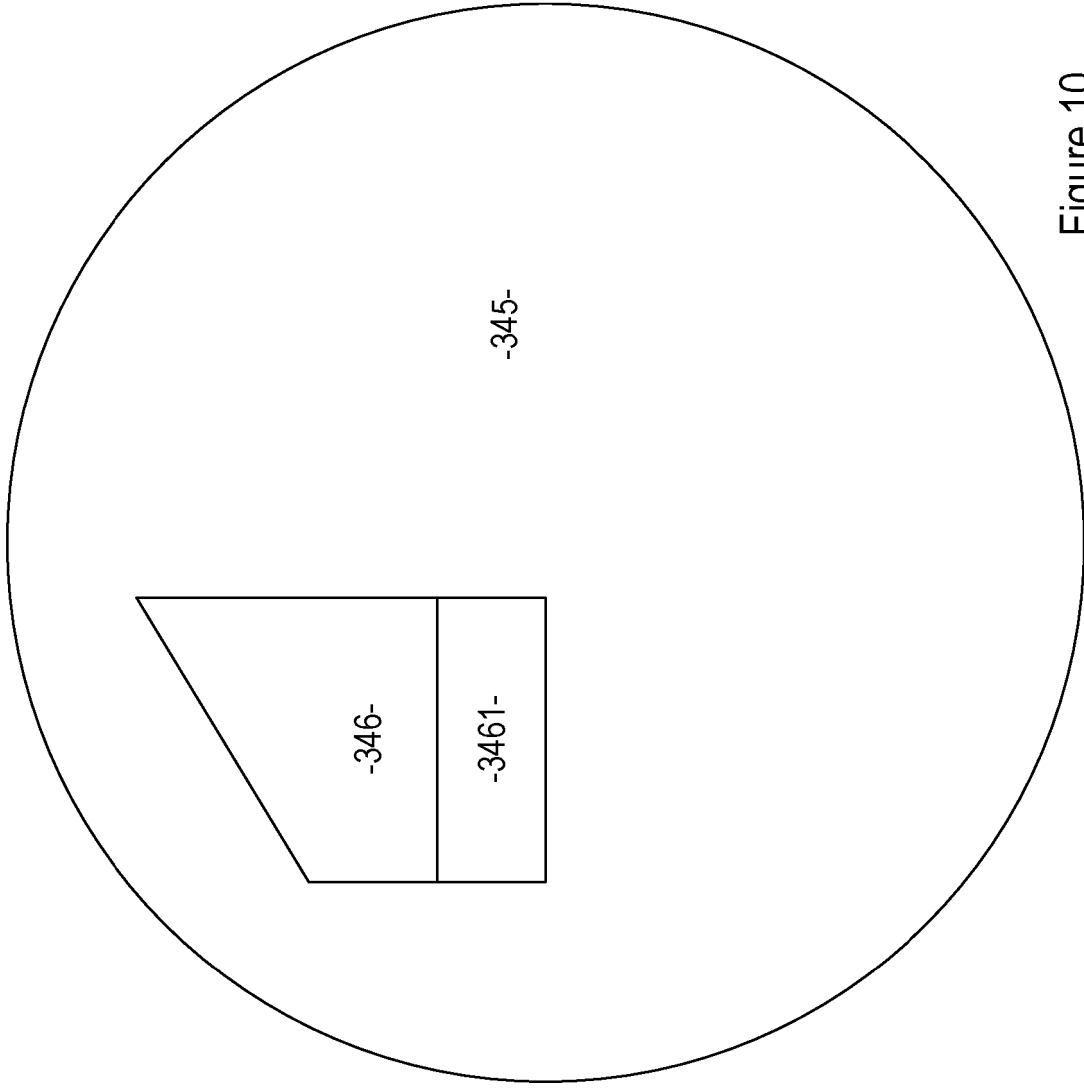


Figure 10

Title: A combined cleaning apparatus for cleaning vegetables or other items and an associated method.

5

### **Description of Invention**

The present invention relates to a combined cleaning apparatus, and more specifically to a combined cleaning apparatus for cleaning vegetables or other items. Embodiments of the present invention include an associated cleaning method.

When vegetables are harvested they are typically contaminated with soil and debris from the environment in which they have been harvested or grown. In addition, the vegetables may include minor surface imperfections or undesired features – for example, fine roots, and the like. This is especially the case for root vegetables which are grown underground and hence may have a comparatively high level of soil contamination.

In order to improve the appearance of the vegetables to potential purchasers and also in order to remove contaminants which may be undesired, a health risk, or may affect the taste of the vegetables, it is known to wash and polish the vegetables.

Washing machines and polishing machines have been developed for use in the agricultural industry to allow relatively large quantities of vegetables to be processed in a batch or substantially continuous manner.

A conventional vegetable washer consists of a large barrel with an input at one end and an output at the other. The barrel rotates around a central longitudinal axis and is configured to be either partially filled with water, or to have a water spraying arrangement, to aid vegetable cleaning. Vegetables will typically enter the barrel at the input end, pass through the rotating barrel in which the

movement of the barrel and the water removes contaminants from the vegetables, and then leave the barrel at the output end.

5 A conventional vegetable polisher – similarly – consists of a large barrel with an input at one end and an output at the other. The barrel is configured to rotate about its central longitudinal axis. Typically, the barrel carries a plurality of elongate rollers which define a central bore of the barrel. Each roller is covered in bristles. As the barrel rotates, each roller also rotates with respect to the barrel. The vegetables enter the barrel at the input end and  
10 contaminants are removed (along with some minor surface imperfections and undesired features) from the vegetables by the action of the bristles of the rollers.

15 It is not uncommon for vegetables to be processed by a washing machine and then, subsequently, processed by a polishing machine.

Conventionally, each of the washing and polishing machines are separate from one another and conveyor belts, or the like, are used to transport the vegetables from one machine to the next.

20

Using conveyor belts increases the risk of damage to the vegetables. Damage may occur to the vegetables because they fall from one machine (such as a cleaning machine) to the conveyor belt under gravity. In addition, vegetables may be fall from the conveyor belt itself.

25

In addition, the use of conveyor belts to transport vegetables between machines increases maintenance costs – as the conveyor belts must be kept in a good condition but are often exposed to abrasive contaminants from the vegetables during use.

30

Operating space (and, hence, costs) can also be a problem with conventional machines: each machine is large and each conveyer belt transporting vegetables from one machine to another also occupies a large amount of space.

5

Similar considerations also apply in relation to machines for processing other items – such as waste plastic, cans, and the like.

Embodiments of the present invention, therefore, seek to ameliorate one or  
10 more problems associated with the prior art.

According to an aspect of the present invention we provide a combined cleaning apparatus for cleaning vegetables or other items, the apparatus including: a main frame; a first cleaning part configured to perform a first  
15 cleaning operation on one or more items to be cleaned, the first cleaning part being configured for rotation with respect to the main frame and including a first cleaning part barrel body defining a first cleaning part central bore; a second cleaning part configured to perform a second cleaning operation on the  
20 or each item subsequent to the first cleaning operation, the second cleaning part being configured for rotation with respect to the main frame, and including a second cleaning part barrel body defining a second cleaning part central bore; and a connecting part coupling the first and second cleaning parts, the connecting part being coupled for rotation about an axis which is substantially  
25 parallel to an axis of rotation of the first and/or second cleaning part, wherein the connecting part is configured for rotation with respect to one of the first and second cleaning parts.

The connecting part may be coupled for rotation with one or both of the first and second cleaning parts includes a bearing member which is located  
30 between the connecting part and the one of the first and second cleaning parts with respect to which the connecting part is configured for rotation.

The connecting part may be configured to raise one or more items from the first cleaning part central bore up to the second cleaning part central bore.

5 The first and/or second cleaning part barrel body may include a central longitudinal axis which is aligned with and parallel to a central longitudinal axis of the connecting part.

10 The connecting part may be configured for rotation about its central longitudinal axis.

The connecting part may have a substantially annular inclined transportation surface which is configured to direct one or more items from the first cleaning part central bore up to the second cleaning part central bore.

15 The connecting part may include one or more lifting members which are configured to lift the one or more items up the inclined transportation surface.

The one or more lifting members may include one or more respective spiral ribs.

20 The connecting part may include one or more scoop members.

The connecting part may be configured for rotation with the other of the first and second cleaning parts.

25 The connecting part may be configured for rotation at a different speed and/or in a different direction of rotation compared to the first or second cleaning part. The apparatus may further comprise a connecting part fluid delivery arrangement which is configured to deliver fluid to one or more items on the  
30 connecting part

The first cleaning part barrel body may include a tubular wall defining a plurality of apertures therethrough.

5 The second cleaning part may include a plurality of rollers which are configured for rotation with respect to the second cleaning part barrel body.

10 The apparatus may further include a third cleaning part which is coupled to the first cleaning part and is configured to perform a cleaning operation on the one or more items before the one or more items are passed to the first cleaning part.

The first and second cleaning part barrel bodies may include respective central longitudinal axes which are parallel to and aligned with each other.

15 The apparatus may further comprise a drive shaft, wherein in rotation of the drive shaft drives rotation of the first and second cleaning parts.

Rotation of the drive shaft may be driven by a motor.

20 The apparatus may further include a first tank associated with the first cleaning part.

The apparatus may further include a second tank associated with the second cleaning part.

25

The first and second tanks may be in liquid communication via a transfer valve.

30 The first cleaning part barrel body may be at least partially located within the first tank.

The main frame may be a common main frame for the first and second cleaning parts.

5 The connecting part may be configured to lift the one or more items from the first to the second cleaning part without the one or more items falling a substantial distance.

The first cleaning operation may be a washing operation.

10 The second cleaning operation may be a polishing and/or drying operation.

The angle of the first and second cleaning parts, and the connecting part, with respect to a ground surface may be alterable using one or both of the main frame and a drive shaft.

15

Another aspect of the present invention provides a method of cleaning one or more items, the method including: providing an apparatus as above; driving rotation of the first cleaning part; driving rotation of the connecting part; driving rotation of the second cleaning part; delivering one or more items to the first  
20 cleaning part; performing the first cleaning operation; driving rotation of the connecting part with respect to one of the first cleaning part and the second cleaning part; and performing the second cleaning operation.

25 The method may further comprise directing the one or more items up the inclined transportation surface from the first to the second cleaning parts.

The one or more items may include one or more vegetables.

30 Another aspect of the present invention provides a combined cleaning apparatus for cleaning vegetables or other items, the apparatus including: a common main frame; a first cleaning part configured to perform a first cleaning

operation on one or more items to be cleaned, the first cleaning part being configured for rotation with respect to the main frame and including a first cleaning part barrel body defining a first cleaning part central bore; a second cleaning part configured to perform a second cleaning operation on the or  
5 each item subsequent to the first cleaning operation, the second cleaning part being configured for rotation with respect to the main frame, and including a second cleaning part barrel body defining a second cleaning part central bore; and a connecting part coupling the first and second cleaning parts, wherein the first cleaning part, the connecting part, and the second cleaning part are all at  
10 least partially carried by the common main frame.

The first cleaning operation may be a washing operation and the second cleaning operation may be a polishing and/or drying operation.

15 Embodiments of the invention are described, by way of example only, with reference to the accompanying drawings, wherein:

*Figure 1 is a side on view of a combined cleaning apparatus;*

20 *Figure 2 is a cleaning part configured to perform a polishing operation;*

*Figure 3 is a cleaning part configured to perform a drying operation;*

25 *Figure 4 is a cleaning part configured to perform polishing and drying operations;*

*Figure 5 is a cross-section view of the combined cleaning apparatus;*

*Figure 6 shows an end view of a combined cleaning apparatus;*

30

*Figure 7 shows a perspective view of a combined cleaning apparatus;*



*Figure 8 shows a connecting part according to some embodiments;*

*Figure 9 shows another view of the connecting part of figure 8; and*

5

*Figure 10 shows an end wall used in some embodiments.*

With reference to the figures, embodiments of the present invention include a combined cleaning apparatus 10 for cleaning vegetables or other items.

10

The apparatus 10 includes a first cleaning part 12 and second cleaning part 14. The first cleaning part 12 is configured to carry out a first cleaning operation on one or more items to be cleaned, and the second cleaning part 14 is configured to carry out a second cleaning operation on the one or more items.

15

For example, the first cleaning operation may be a washing operation, to remove excess soil and debris (or other contaminants) from the one or more items (such as one or more vegetables). The second cleaning operation may be a polishing and/or a drying operation, to polish and/or dry the one or more items (such as one or more vegetables) before they leave the apparatus 10.

20

The first cleaning part 12 is rotatably mounted on a main frame and has a first cleaning part barrel body 16. The first cleaning part 12 also has a first cleaning part inlet 22, a first cleaning part outlet 26, and a first cleaning part central bore 30 defined by the first cleaning part barrel body 16 between the first cleaning part inlet 22 and the first cleaning part outlet 26.

25

The second cleaning part 14, similarly, is rotatably mounted on a main frame and has a second cleaning part barrel body 18. The second cleaning part 14 also has a second cleaning part inlet 24 and a second cleaning part outlet 28

30

and a second cleaning part central bore 32 defined by the second cleaning part barrel body 18 (or parts coupled thereto) between the second cleaning part inlet 24 and the second cleaning part outlet 28.

- 5 A connecting part 34 is provided to couple the first cleaning part outlet 26 to the second cleaning part inlet 24 such that the first and second cleaning parts 12,14 are in communication with each other. The coupling is such that one or more items which have passed through the first cleaning part barrel body 16 are transported by the connecting part 34 to the second cleaning part barrel  
10 body 18.

The connecting part 34 is configured, in some embodiments, to raise one or more items being processed from the first cleaning part 12 to the second cleaning part 14 (i.e. generally in a direction which is against gravity). As  
15 such, the one or more items do not fall (under gravity or otherwise) a substantial distance (or any distance in some embodiments) from the first cleaning part 12 to the second cleaning part 14 – which reduces the risk of damage to the one or more items.

- 20 The connecting part 34 may include a main body 35. The main body 35 of the connecting part 34 includes a transportation surface 36. The transportation surface 36 includes at least a portion which extends from the first cleaning part 12 towards the second cleaning part 14. The transportation surface 36 may be inclined from the first cleaning part 12 towards the second cleaning part 14.

25

The transportation surface 36 may include one or more lifting members 42 which are configured to direct the one or more items being processed along and up the transportation surface 36 from the first cleaning part 12 towards the second cleaning part 14.

30

In embodiments, the transportation surface 36 of the main body 35 of the connecting part 34 is a substantially annular surface. The connecting part 34, therefore, defines a central bore which is in communication at one end with the first cleaning part central bore 30 and at an opposing end with the second cleaning part central bore 32. A diameter of the bore of the connecting part 34 adjacent the first cleaning part 12 may be substantially equal to the diameter of the first cleaning part central bore 30. A diameter of the bore of the connecting part 34 adjacent the second cleaning part 14 may be substantially equal to the diameter of the second cleaning part central bore 32. As such, the bore of connecting part 34 may be generally frusto-conical in shape – with the smaller diameter being towards the second cleaning part 12.

Thus, in operation, one or more items to be cleaned may be delivered to the first cleaning part central bore 30. The one or more items pass through the first cleaning part central bore 30 towards the second cleaning part 14. On reaching the connecting part 34, the one or more items are directed upwardly to the second cleaning part 14 across the transportation surface 36 of the main body 35 of the connecting part 34. The one or more items to be cleaned pass, therefore, into the second cleaning part central bore 32.

In some embodiments, the connecting part 34 is provided in the form generally shown in figures 8 and 9. In such embodiments, the connecting part 34 includes a central bore which is in communication at one end with the first cleaning part central bore 30 and at an opposing end with the second cleaning part central bore 32. The connecting part 34 may carry one or more scoop members 341. The or each scoop member 341 comprises a wall 342 which extends from an inner surface of the connecting part 34 inwardly towards a central longitudinal axis of the connecting part 34. The wall 342 includes a transportation surface 343 which is inclined with respect to the central longitudinal axis of the connecting part 34 and a lateral plane of the connecting part 34.

The wall 342 may be supported by a bracing member 344 which is connected to the wall 342 on a side thereof which opposes the transportation surface 343. The bracing member 344 may comprise a wall which is inclined with respect to the longitudinal axis of the connecting part 34 and which may be approximately perpendicular to the wall 342. In some embodiments, the bracing member 344 comprises such a wall and is generally aligned with the wall 342 of another scoop member 341.

10 In some embodiments, two scoop members 341 are provided and the two scoop members 341 may include respective walls 342 which together extend across an entire, or substantially an entire, diameter of the central bore of the connecting part 34.

15 A shaft 3421 may be provided along at least part of the central longitudinal axis of the connecting part 34. The shaft 3421 may be configured for coupling to a feature of the first cleaning part 12 and/or may be configured to be carried by a bearing member (not shown) which is mounted to an end wall 345 (as described below). The bearing member may be moveable, in some  
20 embodiments, into a plurality of different locations with respect to the end wall 345 to allow adjustment of the angle of the connecting part 34 with respect to a main frame. In some embodiments, the shaft 3421 is not provided.

An end wall 345 of the connecting part 34 is provided towards the end of the connecting part 34 which is in communication with the second cleaning part  
25 central bore 32. The end wall 345 defines an exit aperture 346. The exit aperture 346 provides the communication between the central bore of the connecting part 34 and the second cleaning part central bore 32. The end wall 345 may be configured such that the or each scoop member 341 rotates with  
30 respect thereto about the central longitudinal axis of the connecting part 34. In embodiments, the end wall 345 is secured to a main frame (such as the

common main frame 20, first or second main frame described below). The end wall 345 may, in such embodiments, not form part of the connecting part 34 but may be part of the second cleaning part 14 or main frame.

5 In some embodiments, the exit aperture 346 has a width which is substantially equal to a width of the transportation surface 343. A height of the exit aperture 346 may be greater than the width of the exit aperture 346. In some embodiments, the exit aperture 346 is at least partially defined by a shutter member 3461 (see figure 10) of the end wall 345. The shutter member 3461  
10 may be configured to move with respect to the end wall 345 to alter the size of the exit aperture 346. The shutter member 3461 may, therefore, be lockable with respect to the end wall 345 in a plurality of different locations – each different location defining a different size of exit aperture 346. The exit aperture 346 may be rectangular in shape. The end wall 345 may be larger  
15 than the central bore of the connecting part 34 at the end thereof which is adjacent the second cleaning part 14 such that, apart from the exit aperture 346, the end wall 345 covers the entire or substantially the entire of that end of the central bore of the connecting part 34.

20 The end wall 345 may be spaced apart from the connecting part 34 by a clearance distance to allow the unhindered (or substantially unhindered) rotation of the connecting part 34 with respect to the end wall 345. In some embodiments, the level of liquid in the first cleaning part 12 and the relative positioning and/or size of the central bore of the connecting part 34 are such  
25 that at least part of the connecting part 34 is immersed in that liquid.

In embodiments, the connecting part 34 is configured for rotation with the first cleaning part 12 such that the or each scoop member 341 rotates with respect to the end wall 345. The or each scoop member 341 is configured to scoop or  
30 otherwise collect one or more of the items to be cleaned from the first cleaning part barrel bore 32 and/or a part of the central bore of the connecting part 34 in

- communication with the first cleaning part barrel bore 32. As the connecting part 34 rotates with respect to the end wall 345, the or each scoop member 341 is lifted to a position in which the one or more items collected by the scoop member 341 are presented to the exit aperture 346 (for example, a lower end of the inclined transportation surface 343 may approach and exit aperture 346). The or each item collected by the scoop member 341 travels down (at least partially under the effect of gravity) at least part of the transportation surface 343 and through the exit aperture 346 to the second cleaning part 14.
- 5
- 10 In other embodiments, the connecting part 34 is configured for rotation independently of the first cleaning part 12. In some embodiments, the connecting part 34 is configured for rotation with respect to the second cleaning part 14.
- 15 In embodiments, the connecting part 34 is configured for rotation with respect to the end wall 345 in a first direction – which may or may not be the same direction as the direction of rotation of either the first or second connecting parts 12,14. In some embodiments, the connecting part 34 is configured for rotation in the first direction such that after collecting one or more items and
- 20 delivering the one or more items to the exit aperture 346, the connecting part 34 continues rotation in the same direction to collect one or more further items for delivery to the exit aperture 346 and so on. In some embodiments, the connecting part 34 is configured for reciprocal rotational movement with respect to the end wall 345 such that the connecting part 34 moves from a first
- 25 position to collect one or more items and deliver the one or more items to the exit aperture 346 by rotation of the connecting part 34 in a first direction towards a second position, before rotating in a second opposing rotational direction with respect to the end wall 345 back towards the first position and then rotating in the first direction again (to collect one or more further items,
- 30 and so on).

Rotation of the connecting part 34 may, therefore, be driven by a drive shaft 161 (as described below) via a belt or may be driven by a different drive shaft which is couple to a different motor (not motor 165). In some embodiments, the connecting part 34 is coupled for rotation with the first and/or second  
5 cleaning part 12,14 and is, therefore, attached thereto.

In embodiments including the shutter member 3461, the exit aperture 346 size may be altered to control the rate at which items pass therethrough (for a given rotational speed of the connecting part 34 with respect to the end wall  
10 345).

The end wall 345 may inhibit liquid from the first cleaning part central bore 30 to the second cleaning part central bore 32. Accordingly, the end wall 345 and the position of the exit aperture 346 defined thereby may be such that a liquid  
15 level in the first cleaning part 12 and connecting part 34 is below the exit aperture 346.

In embodiments, the wall 342 of each scoop member 341 may define one or more drainage apertures in the transportation surface 343 (through an entire  
20 depth of the wall 342) which allow liquid to drain from the one or more items collected by the scoop member 341 as the or each item is lifted towards the exit aperture 346.

In some embodiments, the angle of the or each wall 342 with respect to the  
25 central longitudinal axis of the connecting part 34 can be varied. Each scoop member 341 may be associated with a hydraulic or pneumatic actuator to move the or each wall 342 about a hinge to vary the angle of the or each wall 342 in this manner. This variation in angle may be user controlled to control the rate at which items are delivered to the exit aperture 346 from the first  
30 cleaning part 12.

In some embodiments, the first and second cleaning parts 12,14 are mounted on a common main frame 20. In some embodiments, the first cleaning part 12 is mounted to a first main frame (not shown) and the second cleaning part 14 is mounted to a second main frame (not shown). The connecting part 34 may  
5 be mounted on the common main frame 20, and/or the first cleaning part 12, and/or the second cleaning part 14, and/or a third main frame (not shown).

The first cleaning part 12 and second cleaning part 14 according to some embodiments of the present invention are described in more detail below.

10

The first cleaning part 12 may be configured to carry out a washing operation on the one or more items to be cleaned. As such, in some embodiments, the first cleaning part barrel body 16 includes a tubular wall which defines a plurality of apertures 60 which extend through an entire depth of the tubular  
15 wall. The apertures 60 may be arranged in one or more circumferential bands around the circumference of the tubular wall of the first cleaning part barrel body 16. The first cleaning part barrel body 16 is configured for rotation with respect to the common main frame 20 or first main frame if provided.

20 The plurality of apertures 60 allow contaminants and debris from the one or more items to be washed out of the first cleaning part central bore 30. In addition, the apertures 60 may provide an abrasive surface which can help in the removal of contaminants and debris from the one or more items.

25 In some embodiments, the first cleaning part barrel body 16 is at least partially suspended from a drive shaft 161 by one or more belts 162. Rotation of the first cleaning part barrel body 16 may be driven by rotation of the drive shaft 161 via the one or more belts 162. The drive shaft 161 is, in some  
30 embodiments, located generally above a central longitudinal axis of the first cleaning part barrel body 16 and may be located generally above the first



cleaning part barrel body 16. A longitudinal axis of the drive shaft 161 may be parallel to the central longitudinal axis of the first cleaning part barrel body 16.

5 The or each belt 162 may pass around a respective part of the first cleaning part barrel body 16. In embodiments, each such part of the first cleaning part barrel body 16 is a substantially uniform surface which may not include any of the plurality of apertures 60 – in order to reduce the wear of the associated belt 162 during use. In embodiments, each such part is at least partially defined by a pair of external radially extending circumferential ribs around an  
10 external circumference of the first cleaning part barrel body 16 to inhibit movement of the associated belt 162 out of the part.

The first cleaning part barrel body 16 may, in some embodiments, include an internal spiral rib 44. The internal spiral rib 44 may be configured to direct one  
15 or more items to be cleaned from the first cleaning part inlet 22 towards the first cleaning part outlet 26. In some embodiments, the internal spiral rib 44 is integrally formed or is coupled to the or each lifter 42. As such, the or each lifter 42 may comprise an internal spiral rib. In this context, an internal rib is a rib which extends from an inner surface of the relevant part towards the central  
20 longitudinal axis of that part. A spiral rib is a rib which is of helical form.

The first cleaning part 12 may include a first tank 31. The first tank 31, if provided, is positioned beneath the first cleaning part barrel body 16 and is configured to hold a volume of liquid (such as water). In embodiments, the  
25 first tank 31 is mounted on the common main frame 20 or on the first main frame (if provided).

The first tank 31 may be configured relative to the first cleaning part barrel body 16 such that at least part of the first cleaning part barrel body 16 is within  
30 the first tank 31. Accordingly, a liquid in the first tank 31 may also be within at least a part of the first cleaning part barrel bore 30. In other words, the first

tank 31 is such that the first cleaning part barrel bore 30 may be at least partially submerged in a liquid in the first tank 31 when in use.

5 The first tank 31 may be defined by a plurality of walls. One 301 of the plurality of walls is provided towards the first cleaning part outlet 28. The wall 301 may be located such that an upper end of the wall 301 is adjacent the connecting part 34. In some embodiments, the wall 301 is adjacent a part of the connecting part 34 which has a diameter which is less than a diameter of the first cleaning part barrel body 16 adjacent the first cleaning part outlet 28.  
10 In other words, with the apparatus 10 in a normal orientation, the wall 301 may be higher than the tubular wall of the first cleaning part barrel body 16. This may allow the partial submergence of the first cleaning part barrel body 16 in the liquid in the first tank 31. The wall 301 may be one and the same as the end wall 345 and may be located (relative to the connecting part 34) generally  
15 as described above in relation to embodiments which include the connecting wall 345.

In embodiments, one or more first cleaning part liquid delivery arrangements (not shown) are provided which are configured to deliver liquid to the first  
20 cleaning part barrel body 16 and, specifically, to the first cleaning part central bore 32. The first cleaning part liquid delivery arrangement may include a spray arrangement which is located at least partially within the first cleaning part central bore 32 and which is configured to spray a liquid within the central bore 32. The first tank 31 may, therefore, collect liquid which is delivered to  
25 the first cleaning part central bore 32 by the one or more first cleaning part liquid delivery arrangements and which passes through the plurality of apertures 60.

The first tank 31 may include a drain 313 which is located to allow the  
30 circulation of fluid from the tank 31 to the or each liquid delivery arrangement (if provided).

In some embodiments, the connecting part 34 is provided with a liquid delivery arrangement (the 'connecting part liquid delivery arrangement'). The connecting part liquid delivery arrangement is configured to deliver liquid to one or more items on the connecting part 34. For example, the connecting part liquid delivery arrangement may be configured to deliver liquid to one or more items which pass from the first cleaning part 12 to the second cleaning part 14. In some embodiments, the connecting part liquid delivery arrangement is configured to deliver liquid to one or more items as they are carried or lifted by the connecting part 34 out of the volume of liquid held in the first tank 31. The connecting part liquid delivery arrangement may, therefore, be configured to supply 'clean' liquid which has not been recycled (i.e. circulated) from the first tank 31 to the connecting part cleaning arrangement. The 'clean' liquid may be water from a mains or tank supply. The connecting part cleaning arrangement may, therefore, be configured to supply a liquid to rinse the one or more items as they pass from the first to the second cleaning parts 12,14.

The connecting part liquid delivery arrangement may comprise a pipe which ends through the first and/or second cleaning part 12,14 such that a portion of the pipe is located adjacent the connecting part 34. That portion includes one or more apertures to allow liquid carried by the pipe to be sprayed onto the one or more items.

In embodiments in which the connecting part 34 includes a wall which is at an angle with respect to a longitudinal axis of the first and/or second cleaning parts 12,14, the connecting part liquid delivery arrangement comprising a pipe may be angled in a corresponding (e.g. parallel) manner. The pipe in some embodiments is an example of a liquid carrying conduit and other liquid carrying conduits could equally be used.

In some embodiments, the first tank 31 includes an auger 311 which is located towards the bottom of the first tank 31 and which is configured to drive the movement of contaminants and other debris (such as removed surface imperfections) which have been removed from the one or more items to be cleaned. Such contaminants and other debris may have been washed from the one or more items, passed through one or more of the apertures 60 and fallen through the liquid in the first tank 31 towards the bottom of that tank 31. The auger 311 may be configured to drive movement of the contaminants and other debris to a collection aperture 312 – from which the contaminants and other debris may be collected (e.g. by the connection of a collection vessel to the collection aperture 312). A conveyor belt 314 may be provided to deliver the contaminants and other debris from the collection aperture 312 to the collection vessel.

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In embodiments, the drain 313 (if provided) is located above the auger 311 (if provided).

In embodiments which include the auger 311, the auger 311 has a longitudinal axis which extends along a lower surface of the first tank 31. This longitudinal axis may be a substantially horizontal axis.

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Rotational movement of the auger 311 is driven by a motor and the motor may be located at either end of the auger 311.

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In some embodiments, the second cleaning part 14 is configured to carry out a polishing operation and/or a drying operation.

The second cleaning part barrel body 18 carries a plurality of rollers 64 which define the second cleaning part central bore 32. Each roller 64 is configured for rotation with respect to the second cleaning part barrel body 18 and the

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second cleaning part barrel body 18 is configured for rotation with respect to the main frame (such as the common main frame 20) to which it is mounted.

5 In some embodiments, one or more of the rollers 64 are configured to be rotatably driven by one or more motors 65 which are mounted on the second cleaning part barrel body 18 and which are configured for rotation therewith. In such embodiments, the or each motor 65 may be an electrical or hydraulic motor. A slip-ring arrangement 66 may be provided to deliver electrical power to the or each motor 65.

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The or each roller 64 may include a plurality of bristles which extend radially therefrom and which may be configured to act on one or more items to be cleaned which are passing through the second cleaning part central bore 32.

15 In embodiments, the or each roller 64 may include a drying section which may be a material which is configured to absorb a liquid (such as water) from the one or more items. The drying section may be a foam, felt, or sponge-like material. The or each drying section may be located towards the second cleaning part outlet 28 of the or each roller 64. In embodiments, a portion of  
20 each roller 64 includes the plurality of bristles and a portion includes the drying section (as in figure 4) but, in other embodiments, each roller 64 comprises either the plurality of bristles (as in figure 2) or the drying section (as in figure 3).

25 The second cleaning part barrel body 18 may carry one or more liquid extraction arrangements 70 which are configured to act on the drying section or sections of the or each roller 64 to extract the liquid therefrom – such that the drying section does not become saturated and can continue to dry the one or more items. The or each liquid extraction arrangements 70 may include  
30 one or more pressing rollers which are each located outside of the second cleaning part central bore 32 and which are each configured to press against a

drying part such that liquid carried by the drying part will leave the drying part for collection. The or each liquid extraction arrangements 70 may be located adjacent a part of the or each roller 64 towards the second cleaning part outlet 28.

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A second tank 321 may be provided to collect the liquid extracted by and/or used by the second cleaning part 14.

The second tank 321 is, in some embodiments, positioned below the second cleaning part barrel body 18. In embodiments, the second tank 321 is not in fluid communication with the first tank 311. In other embodiments, the two tanks 321, 311 are in fluid communication with each other such that liquid can pass between the two tanks 321,311. In some embodiments, at least a portion of the liquid in the second tank 321 is delivered to the first tank 311. In some  
10  
15  
embodiments, at least a portion of the liquid in the second tank 321 is provided to the first cleaning part liquid delivery arrangement.

In some embodiments, a transfer valve (not shown) is provided. The transfer valve is configured to control a fluid communication between the first and  
20  
second tanks 311,321. In particular, the transfer valve may be located between the two tanks 311,321 and may be mounted to the wall 301. The fluid communication may be between the two tanks 311,321 through part of the wall 301. The transfer valve may be configured to control the flow of fluid from the first tank 311 to the second tank 321 (or vice versa). The transfer  
25  
valve may be manually actuated (by use of a handle) or may be automatically actuated by use of a motor (which may be a servomotor). The transfer valve may be configured to allow the transfer of liquid from the first tank 311 to the second tank 321 relatively quickly (the liquid level in the first tank 311 being higher in many embodiments than the liquid level in the second tank 321).

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In some embodiments, the second cleaning part 14 also includes a liquid delivery arrangement (the 'second cleaning part liquid delivery arrangement') which is configured to deliver liquid (such as water) to the second cleaning part central bore 32. The second tank 321 may collect at least a portion of this  
5 water following its use in the second cleaning part barrel body 18. In some embodiments, at least a portion of the liquid in the first tank 311 is provided to the second cleaning part liquid delivery arrangement.

The liquid level in the first tank 311 may be higher than that in the second tank  
10 321 and the wall 301 which may separate the two tanks 311,321 has a height which is selected accordingly, in some embodiments, to inhibit the movement of liquid over the top of the wall 301 from the first tank 311 to the second tank 321. In embodiments, the wall 301 extends to a height such that the top of the wall 301 is higher (with the apparatus 10 in a normal orientation) than the  
15 lowest part of one or more of the liquid extraction arrangements 70, the rollers 64, and/or the second cleaning part barrel body 18 – to inhibit the water or other liquid in the first tank 311 from wetting the rollers 64 and, in particular, any drying section of the rollers 64.

20 In some embodiments, the second cleaning part barrel body 18 is at least partially suspended from the drive shaft 161 by one or more belts 162. Rotation of the second cleaning part barrel body 18 may be driven by rotation of the drive shaft 161 via the one or more belts 162. The drive shaft 161 is, in some embodiments, located generally above a central longitudinal axis of the  
25 second cleaning part barrel body 18 and may be located generally above the second cleaning part barrel body 18.

The or each belt 162 may pass around a respective part 71 of the second cleaning part barrel body 18. In embodiments, each such part 71 of the  
30 second cleaning part barrel body 18 is at least partially defined by a pair of radially extending external circumferential ribs around an external

circumference of the second cleaning part barrel body 18 to inhibit movement of the associated belt 162 out of the part 71.

As described above, a single drive shaft 161 may be provided to drive rotation of both the first cleaning part barrel body 16 and the second cleaning part barrel body 18. In embodiments, the drive shaft 161 may comprise a plurality of drive shafts which are mechanically coupled to each other such that rotation of one of the plurality of drive shafts will cause rotation of another of the plurality of drive shafts. The mechanical coupling 162 may be located between the first and second cleaning parts 12,14.

The drive shaft 161 may include a plurality of pulleys 164 which are each configured to abut a respective one of the belts 162.

A motor 165 may be provided to drive rotation of the drive shaft 161. This may be a single motor 165 which drives rotation of both the first cleaning part barrel body 16 and the second cleaning part barrel body 18 via the drive shaft 161.

The motor 165 and drive shaft 161 may be mounted to the main frame (which may be the common main frame 20 or one or more of the first, second, and/or third main frames).

The first cleaning part 12 may include an inlet chute which is coupled to the first cleaning part inlet 22 and which is configured to direct (under gravity, for example) one or more items to be cleaned, which are delivered to the chute, into the first cleaning part central bore 30.

The second cleaning part 14 may include an outlet chute 141 which is coupled to the second cleaning part outlet 28 and which is configured to direct one or more items which have been cleaned by the apparatus 10 out of the second cleaning part 14 (under gravity or otherwise).



The first cleaning part 12 and second cleaning part 14 are, in some embodiments, configured for synchronised and simultaneous operation. In this respect, both the first cleaning part barrel body 16 and the second cleaning part barrel body 18 may be driven by the same drive shaft 161. It may, in embodiments, be necessary to adjust the diameter of the or each pulley 164 of the drive shaft 161 in order to achieve the correct synchronised and simultaneous operation because of differing diameters of the first and second cleaning part barrel bodies 16,18.

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The connecting part 34 may be configured for synchronised and simultaneous operation with the first cleaning part 12 and the second cleaning part 14. In this regard, the connecting part 34 may be mechanically coupled to the first cleaning part 12 for rotation therewith. In some embodiments, the second cleaning part 14 is also mechanically coupled to connecting part 34 for rotation therewith. The mechanical coupling may comprise, for example, a plurality of coupling members (such as nuts and bolts) or a welded joint. In some embodiments, the connecting part 34 may be configured to permit rotation with respect to the first cleaning part 12 or the second cleaning part 14 to reduce the mechanical stresses on the connecting part 34 – a seal (such as a rubber or synthetic rubber o-ring may be provided between the connecting part 34 and one of the cleaning parts 12,14 with respect to which the connecting part 34 may be permitted to rotate).

As described herein, in some embodiments, the connecting part 34 may be configured for rotation with either the first or second cleaning parts 12,14 with respect to the other of the first or second cleaning parts 12,14. Accordingly, the connecting part 34 may be bolted, welded, or otherwise attached to one of the first or second cleaning parts 12,14. The connecting part 34 may abut the other of the first or second cleaning parts 12,14. A surface region of the cleaning part 34 which abuts the other of the first or second cleaning parts

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12,14 (with respect to which rotation is permitted) may include a bearing member (not shown). The bearing member may, for example, be a circumferential ring which extends around an end perimeter surface of the connecting part 34 adjacent the first or second cleaning part 12,14, as the case may be. The first or second cleaning part 12,14 may include a corresponding bearing member (not shown). This corresponding bearing member may also be a circumferential ring which extends around an end perimeter surface of the first or second cleaning part 12,14. The bearing member and corresponding bearing members may be configured to abut each other and to allow for rotation therebetween. The bearing member and further bearing member may be formed from a nylon material. In embodiments in which the connecting part 34 can rotate with respect to both cleaning parts 12,14, then the connecting part 34 may include two bearing members which each face a respective corresponding bearing member of the first or second cleaning parts 12,14.

In some embodiments, the connecting part 34 is configured for rotation with the first cleaning part 12 and with respect to the second cleaning part 14. The bearing members may be located between the connecting part 34 and the second cleaning part 14 such that rotation therebetween is permitted.

In some embodiments, the first cleaning part 12 and second cleaning part 14 are configured for rotation at different speeds and/or in different directions (the connecting part 34 may be configured for rotation with the first or second cleaning parts 12,14 in such embodiments). In some embodiments, the second cleaning part 14 is configured for rotation at a slower speed compared to the first cleaning part 12.

As discussed herein, the drive shaft 161 may comprise a plurality of drive shafts which may each be driven by a respective motor. In particular, in some embodiments, rotation of the first cleaning part 12 may be driven by a first

drive shaft by a first motor (with or without the connecting part 34) and rotation of the second cleaning part 14 may be driven by a second drive shaft by a second motor. The first and second drive shafts may be arranged such that they are aligned and substantially parallel. In some embodiments, the first and second drive shafts are coupled to each other by a bearing which allows for rotation of the first drive shaft with respect to the second drive shaft (the bearing may also provide mechanical support for the first and second drive shafts).

10 The central longitudinal axes of the first cleaning part barrel body 16, the second cleaning part barrel body 18, and the connecting part 34 are all, in some embodiments, parallel to and aligned with each other.

As will be appreciated, in some embodiments, the first cleaning part barrel body 16, the second cleaning part barrel body 18, and the connecting part 34 are configured to be driven at the same rotational speed with respect to, for example, the main frame (which may be the common main frame 20).

One or more trunnions (not shown) may be provided and configured to run against a portion of the first cleaning part 12, and/or the second cleaning part 14, and/or the connecting part 34 to inhibit lateral movement thereof.

In some embodiments, a sorter 50 is provided (see figure 1). The sorter 50 may be coupled to the first cleaning part inlet 22 and configured to deliver one or more sorted items to the first cleaning part 12.

In some embodiments, the sorter 50 is a de-stoner which is configured to remove heavy debris (such as stones) which is mixed in with the one or more items to be cleaned.

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A sorter 50 in the form of a de-stoner may comprise a flume arrangement which is configured to wash the one or more items from a sorter inlet 51 to a sorter outlet 52. The flume arrangement includes, in this example, a turbulent water stream which drives the one or more items from the sorter inlet 51 to the  
5 sorter outlet 52 whilst allowing heavy debris (such as stones) to fall through the water to a lower part of the sorter 50. In embodiments, the turbulent water stream includes an upsurge of water and the sorter 50 may be configured to provide such an upsurge – to cause the one or more items to be driven upwardly towards the sorter outlet 52 and allow debris and contaminants to fall  
10 towards the lower part of the sorter 50. To assist in the operation of the sorter 50, the flume arrangement may include a channel 501 which tapers towards its lower part.

In the lower part of the sorter 50, the debris is gathered by a conveyor belt 502  
15 of the sorter 50 which lifts the debris out of the water and to a collection vessel. Water is fed into the sorter 50 at the lower part of the sorter 50. This water may be provided from the first and/or second tanks 311,321. Accordingly, a sorter pump system 503 (see figure 7) may be provided which is coupled to a water or other liquid source (such as one of the tanks 311,321)  
20 and to the sorter 50 via a pipe 504. The pipe 504 may include an inverted u-bend to inhibit the passage of water (or other liquid) from the sorter 50 to the sorter pump system 503. The sorter pump system 503 may be mounted on the main frame (which may be the common main frame 20, or one or more of the first to third main frames).

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The sorter 50 may be mounted to the common main frame 20 or the first main frame (if provided). In embodiments, the sorter 50 is mounted in a cantilevered manner to the first cleaning part 12 or common/first main frame.

30 In some embodiments, the common main frame 20 includes a plurality of legs 72. The legs 72 may be height adjustable, allowing the first and second

cleaning parts 12,14 to be shifted to an optimum level and/or angle of incline. This may be achieved by the using telescoping legs 72 with each with a respective locking mechanism. The legs 72, as will be appreciated, are configured to support the apparatus 10 with respect to a support surface  
5 (typically a ground surface).

In some embodiments, the drive shaft 161 is mounted to the main frame by a plurality of slotted mounting members 201 (see figure 7) such that the height and angle of the drive shaft 161 can be altered with respect to the main frame.  
10 As will be appreciated, an alteration in the height or angle of mounting of the drive shaft 161 may also alter the height or angle of the cleaning parts 12,14 and connecting part 34 suspended therefrom.

As can be seen from figures 5-7, one or more side panels may be secured to  
15 the common main frame or main frames in order to improve the aesthetics of the apparatus 10, to contain the liquid being used in the operation of the apparatus 10, to reduce the risk of injury in the event that one or more of the one or more items being cleaned are flung from the apparatus 10 during operation, and to reduce the risk of injury in the event of the failure of a  
20 component (e.g. one of the belts 162).

Embodiments of the present invention seek to provide one or more of a compact apparatus 10, an apparatus 10 which is less likely to damage the one or more items being cleaned, and an apparatus 10 which uses less water (or  
25 other liquid) than previous systems due to the sharing of water between parts of the apparatus 10.

The apparatus 10 of embodiments of the present invention may be used in relation to the cleaning of one or more items which may include vegetables,  
30 fruit, metal objects, and plastic objects, for example. Such an apparatus 10

may, in particular find use in the food processing and metal/plastic recycling industries.

5 In addition, according to some embodiments, the angle of each cleaning part 12,14 and the connecting part 35 with respect to a support surface (such as a ground surface) may be altered in unison – as these parts are all mounted on a common main frame 20 and/or on a common drive shaft 161.

10 The second cleaning part 14 may be a cleaning apparatus as described in GB2491127 or EP2526786 which are hereby incorporated by reference in their entireties.

15 In embodiments, the first and second cleaning parts 12,14 are configured for rotation about respective axes (which may or may not be aligned and which may or may not be parallel with respect to each other). In embodiments, the connecting part 34 is also configured for rotation about an axis and the axis of rotation of the connecting part 34 is substantially parallel to the axis of rotation of one or both of the first and second cleaning parts 12,14 (and may or may not be aligned therewith also).

20 When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

25 The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse  
30 forms thereof.

**Claims:**

1. A combined cleaning apparatus for cleaning vegetables or other items, the apparatus including:

5 a main frame;

a first cleaning part configured to perform a first cleaning operation on one or more items to be cleaned, the first cleaning part being configured for rotation with respect to the main frame and including a first cleaning part barrel body defining a first cleaning part central bore;

10 a second cleaning part configured to perform a second cleaning operation on the or each item subsequent to the first cleaning operation, the second cleaning part being configured for rotation with respect to the main frame, and including a second cleaning part barrel body defining a second cleaning part central bore; and

15 a connecting part coupling the first and second cleaning parts, the connecting part being coupled for rotation about an axis which is substantially parallel to an axis of rotation of the first and/or second cleaning part, wherein the connecting part is configured for rotation with respect to one of the first and second cleaning parts.

2. An apparatus according to claim 1, wherein the connecting part includes a bearing member which is located between the connecting part and the one of the first and second cleaning parts with respect to which the connecting part is configured for rotation.

3. An apparatus according to claim 1 or 2, wherein the connecting part is configured to raise one or more items from the first cleaning part central bore up to the second cleaning part central bore.

4. An apparatus according to any preceding claim, wherein the first and/or second cleaning part barrel body includes a central longitudinal axis which is aligned with and parallel to a central longitudinal axis of the connecting part.
- 5 5. An apparatus according to claim 4, wherein the connecting part is configured for rotation about its central longitudinal axis.
6. An apparatus according to any preceding claim, wherein the connecting part has a substantially annular inclined transportation surface which is  
10 configured to direct one or more items from the first cleaning part central bore up to the second cleaning part central bore.
7. An apparatus according to any preceding claim, wherein the connecting part includes one or more lifting members which are configured to lift the one  
15 or more items up the inclined transportation surface.
8. An apparatus according to claim 7, wherein the one or more lifting members include one or more respective spiral ribs.
- 20 9. An apparatus according to any preceding claim, wherein the connecting part includes one or more scoop members.
10. An apparatus according to any preceding claim, wherein the connecting part is configured for rotation with the other of the first and second cleaning  
25 parts.
11. An apparatus according to claim 10, wherein the connecting part is configured for rotation at a different speed and/or in a different direction of rotation compared to the first or second cleaning part.



12. An apparatus according to any preceding claim, further comprising a connecting part fluid delivery arrangement which is configured to deliver fluid to one or more items on the connecting part.
- 5 13. An apparatus according to any preceding claim, wherein the first cleaning part barrel body includes a tubular wall defining a plurality of apertures therethrough.
14. An apparatus according to any preceding claim, wherein the second  
10 cleaning part includes a plurality of rollers which are configured for rotation with respect to the second cleaning part barrel body.
15. An apparatus according to any preceding claim, further including a third  
15 cleaning part which is coupled to the first cleaning part and is configured to perform a cleaning operation on the one or more items before the one or more items are passed to the first cleaning part.
16. An apparatus according to any preceding claim, wherein the first and  
20 second cleaning part barrel bodies include respective central longitudinal axes which are parallel to and aligned with each other.
17. An apparatus according to any preceding claim, further comprising a  
25 drive shaft, wherein in rotation of the drive shaft drives rotation of the first or second cleaning part.
18. An apparatus according to claim 17, wherein rotation of the drive shaft  
is driven by a motor.
19. An apparatus according to any preceding claim, further including a first  
30 tank associated with the first cleaning part.

20. An apparatus according to claim 19, further including a second tank associated with the second cleaning part.
21. An apparatus according to claim 20, wherein the first and second tanks  
5 are in liquid communication via a transfer valve.
22. An apparatus according to any of claims 19 to 21, wherein the first cleaning part barrel body is at least partially located within the first tank.
- 10 23. An apparatus according to any preceding claim, wherein the main frame is a common main frame for the first and second cleaning parts.
24. An apparatus according to any preceding claim, wherein the connecting part is configured to lift the one or more items from the first to the second  
15 cleaning part without the one or more items falling a substantial distance.
25. An apparatus according to any preceding claim, wherein the first cleaning operation is a washing operation.
- 20 26. An apparatus according to any preceding claim, wherein the second cleaning operation is a polishing and/or drying operation.
27. An apparatus according to any preceding claim, wherein the angle of the first and second cleaning parts, and the connecting part, with respect to a  
25 ground surface is alterable using one or both of the main frame and a drive shaft.
28. A method of cleaning one or more items, the method including:  
providing an apparatus according to any preceding claim;  
30 driving rotation of the first cleaning part;

driving rotation of the connecting part with respect to one of the first cleaning part and the second cleaning part;

driving rotation of the second cleaning part;

delivering one or more items to the first cleaning part;

5 performing the first cleaning operation;

driving rotation of the connecting part; and

performing the second cleaning operation.

29. A method according to claim 28, further comprising directing the one or  
10 more items up the inclined transportation surface from the first to the second cleaning parts.

30. A method according to claim 28 or 29, wherein the one or more items  
15 include one or more vegetables.

31. A combined cleaning apparatus substantially as herein described with  
reference to the accompanying drawings.

32. A method substantially as herein described with reference to the  
20 accompanying drawings.

33. Any novel feature or novel combination of features disclosed herein.

Amendments to the claims have been filed as follows.

**Claims:**

1. A combined cleaning apparatus for cleaning vegetables or other items, the apparatus including:

5 a main frame;

a first cleaning part configured to perform a first cleaning operation on one or more items to be cleaned, the first cleaning part being configured for rotation with respect to the main frame and including a first cleaning part barrel body defining a first cleaning part central bore;

10 a second cleaning part configured to perform a second cleaning operation on the or each item subsequent to the first cleaning operation, the second cleaning part being configured for rotation with respect to the main frame, and including a second cleaning part barrel body defining a second cleaning part central bore; and

15 a connecting part coupling the first and second cleaning parts, the connecting part being coupled for rotation about an axis which is substantially parallel to an axis of rotation of the first and/or second cleaning part, wherein the connecting part is configured for rotation with respect to one of the first and second cleaning parts.

2. An apparatus according to claim 1, wherein the connecting part includes a bearing member which is located between the connecting part and the one of the first and second cleaning parts with respect to which the connecting part is configured for rotation.

3. An apparatus according to claim 1 or 2, wherein the connecting part is configured to raise one or more items from the first cleaning part central bore up to the second cleaning part central bore.

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4. An apparatus according to any preceding claim, wherein the first and/or second cleaning part barrel body includes a central longitudinal axis which is aligned with and parallel to a central longitudinal axis of the connecting part.

5 5. An apparatus according to claim 4, wherein the connecting part is configured for rotation about its central longitudinal axis.

6. An apparatus according to any preceding claim, wherein the connecting part has a substantially annular inclined transportation surface which is  
10 configured to direct one or more items from the first cleaning part central bore up to the second cleaning part central bore.

7. An apparatus according to any preceding claim, wherein the connecting part includes one or more lifting members which are configured to lift the one  
15 or more items up the inclined transportation surface.

8. An apparatus according to claim 7, wherein the one or more lifting members include one or more respective spiral ribs.

20 9. An apparatus according to any preceding claim, wherein the connecting part includes one or more scoop members.

10. An apparatus according to any preceding claim, wherein the connecting part is configured for rotation with the other of the first and second cleaning  
25 parts.

11. An apparatus according to claim 10, wherein the connecting part is configured for rotation at a different speed and/or in a different direction of rotation compared to the first or second cleaning part.

30

12. An apparatus according to any preceding claim, further comprising a connecting part fluid delivery arrangement which is configured to deliver fluid to one or more items on the connecting part.

5 13. An apparatus according to any preceding claim, wherein the first cleaning part barrel body includes a tubular wall defining a plurality of apertures therethrough.

10 14. An apparatus according to any preceding claim, wherein the second cleaning part includes a plurality of rollers which are configured for rotation with respect to the second cleaning part barrel body.

15 15. An apparatus according to any preceding claim, further including a third cleaning part which is coupled to the first cleaning part and is configured to perform a cleaning operation on the one or more items before the one or more items are passed to the first cleaning part.

20 16. An apparatus according to any preceding claim, wherein the first and second cleaning part barrel bodies include respective central longitudinal axes which are parallel to and aligned with each other.

25 17. An apparatus according to any preceding claim, further comprising a drive shaft, wherein in rotation of the drive shaft drives rotation of the first or second cleaning part.

18. An apparatus according to claim 17, wherein rotation of the drive shaft is driven by a motor.

30 19. An apparatus according to any preceding claim, further including a first tank associated with the first cleaning part.

20. An apparatus according to claim 19, further including a second tank associated with the second cleaning part.

21. An apparatus according to claim 20, wherein the first and second tanks  
5 are in liquid communication via a transfer valve.

22. An apparatus according to any of claims 19 to 21, wherein the first cleaning part barrel body is at least partially located within the first tank.

10 23. An apparatus according to any preceding claim, wherein the main frame is a common main frame for the first and second cleaning parts.

24. An apparatus according to any preceding claim, wherein the connecting part is configured to lift the one or more items from the first to the second  
15 cleaning part without the one or more items falling a substantial distance.

25. An apparatus according to any preceding claim, wherein the first cleaning operation is a washing operation.

20 26. An apparatus according to any preceding claim, wherein the second cleaning operation is a polishing and/or drying operation.

27. An apparatus according to any preceding claim, wherein the angle of the first and second cleaning parts, and the connecting part, with respect to a  
25 ground surface is alterable using one or both of the main frame and a drive shaft.

28. A method of cleaning one or more items, the method including:  
providing an apparatus according to any preceding claim;  
30 driving rotation of the first cleaning part;

driving rotation of the connecting part with respect to one of the first cleaning part and the second cleaning part;

driving rotation of the second cleaning part;

delivering one or more items to the first cleaning part;

5 performing the first cleaning operation;

driving rotation of the connecting part; and

performing the second cleaning operation.

29. A method according to claim 28, further comprising directing the one or  
10 more items up the inclined transportation surface from the first to the second cleaning parts.

30. A method according to claim 28 or 29, wherein the one or more items  
15 include one or more vegetables.





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**Examiner:** Kathryn Orme

**Claims searched:** 1-32

**Date of search:** 18 September 2014

**Patents Act 1977: Search Report under Section 17**

**Documents considered to be relevant:**

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	GB 127965 A (GOLD) see especially figure 1 and page 3 lines 13-30
A	-	JP 2004058035 A (KOKUBU HITOSHI) see whole document

**Categories:**

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

**Field of Search:**

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup> :

Worldwide search of patent documents classified in the following areas of the IPC

A22C; A23N; B08B

The following online and other databases have been used in the preparation of this search report

WPI and EPODOC

**International Classification:**

Subclass	Subgroup	Valid From
A23N	0012/02	01/01/2006
B08B	0003/04	01/01/2006
B08B	0003/06	01/01/2006