United States Patent

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[54] **MUSHROOM GRADER**
18 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **209/73,** 209/83, 302/14
[51] **Int. Cl.** **B07c 1/04**
[50] **Field of Search** 209/73, 83, 102, 106, 107, 162, 163, 208; 302/14

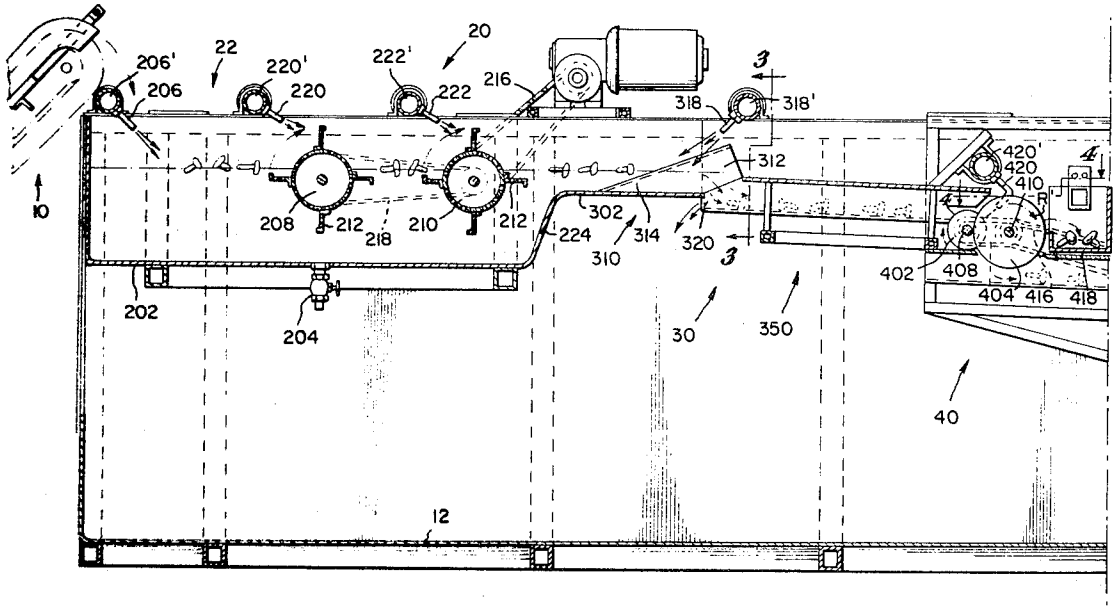
[56] **References Cited**

UNITED STATES PATENTS

2,082,302	6/1937	Ross	209/106 X
3,164,182	1/1965	Hughes	209/102 X
3,489,276	1/1970	Fiore	209/73

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ABSTRACT: A device for continuously grading uncut mushrooms according to size is provided wherein the mushrooms are moved hydraulically at a controlled rate past a plurality of stations. At each station the mushrooms are aligned axially into rows and are then serially graded into three different sizes before moving on to the next station. Each size grader comprises a pair of rotating capstan wheels which define a circular opening therebetween so that the axially aligned mushrooms which are undersize fall through the circular opening, while those of the selected grade, having a cap diameter too great to fit through the opening, pass over the downstream capstan wheel and are thereby graded according to size.



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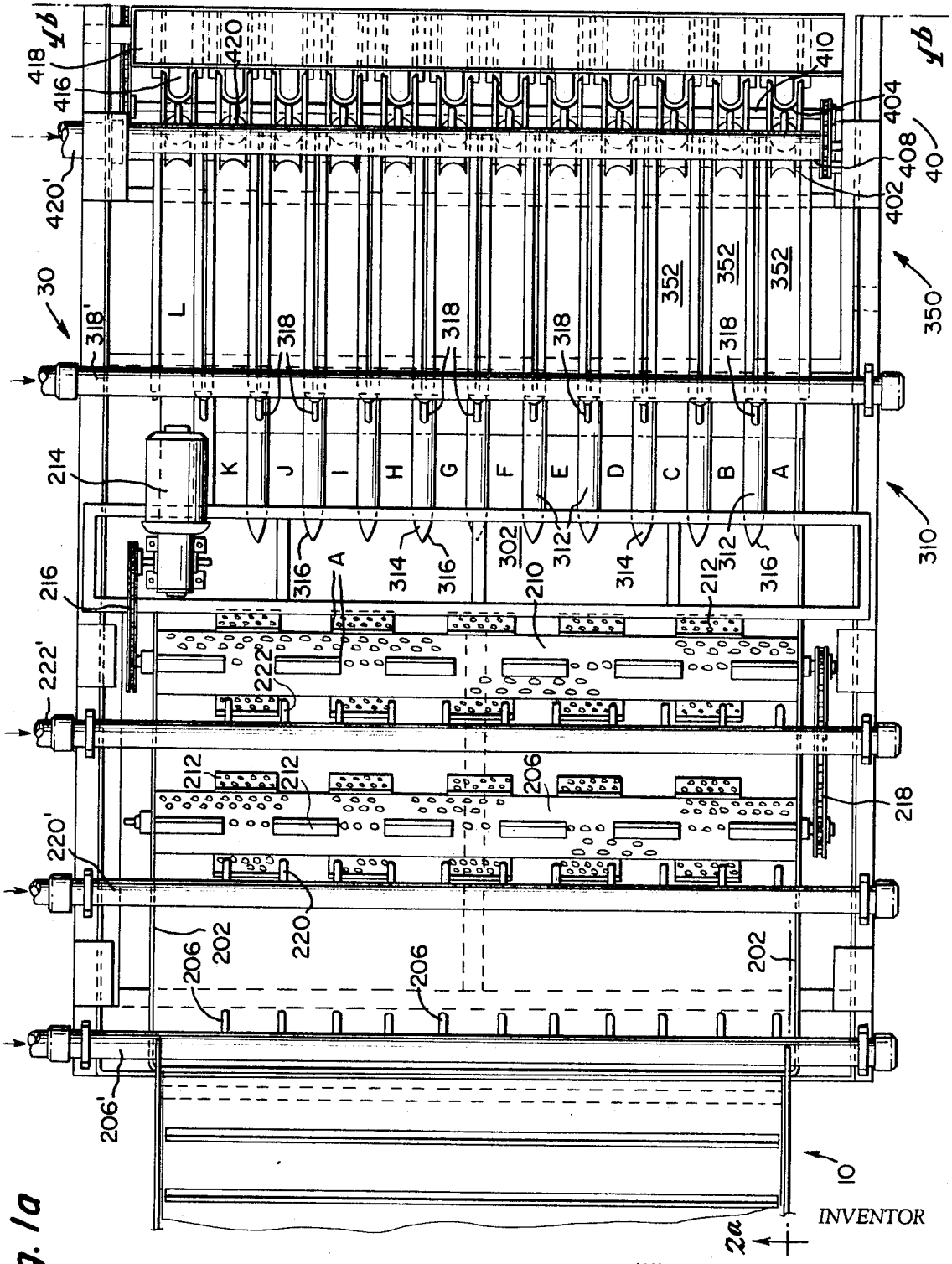


Fig. 1a

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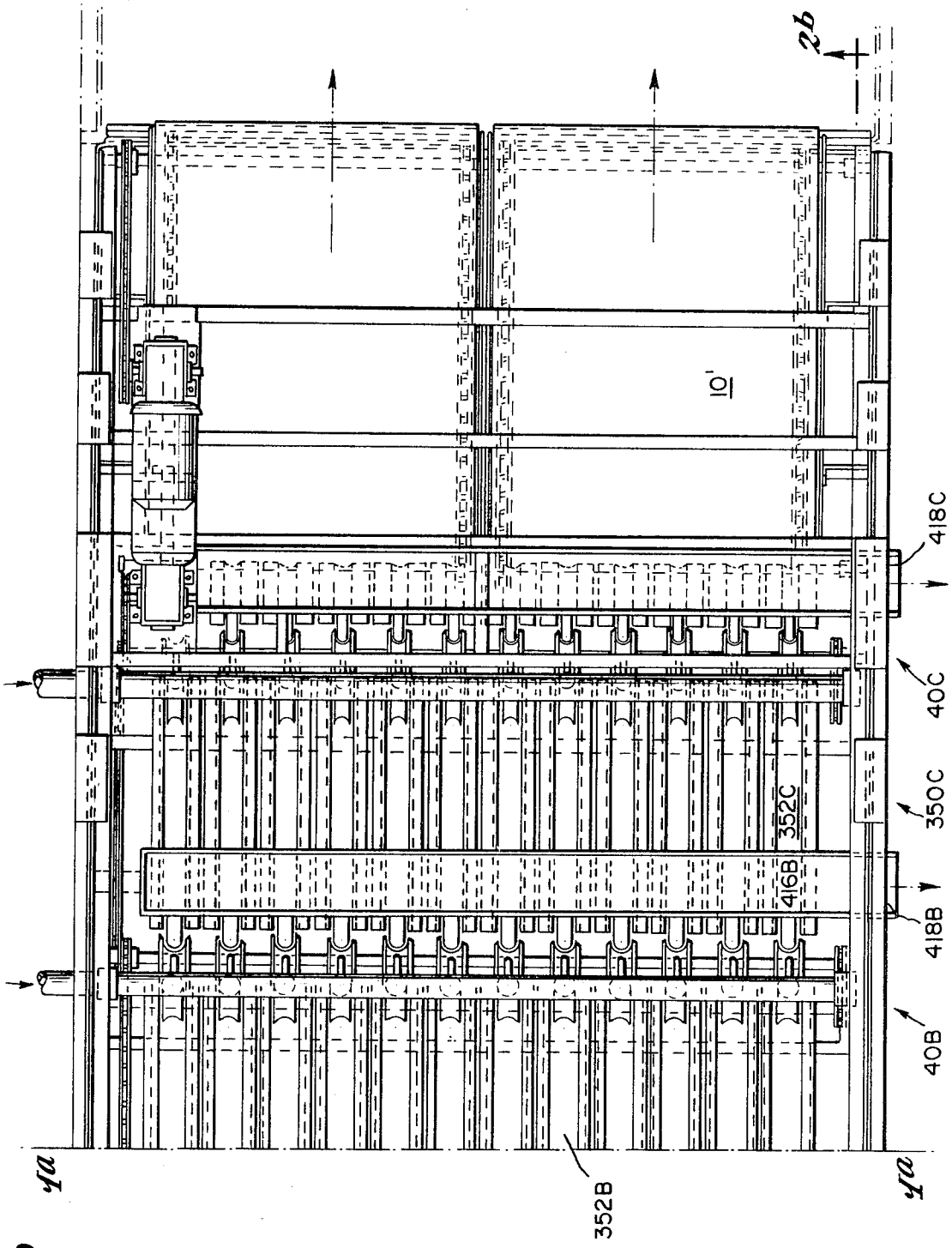


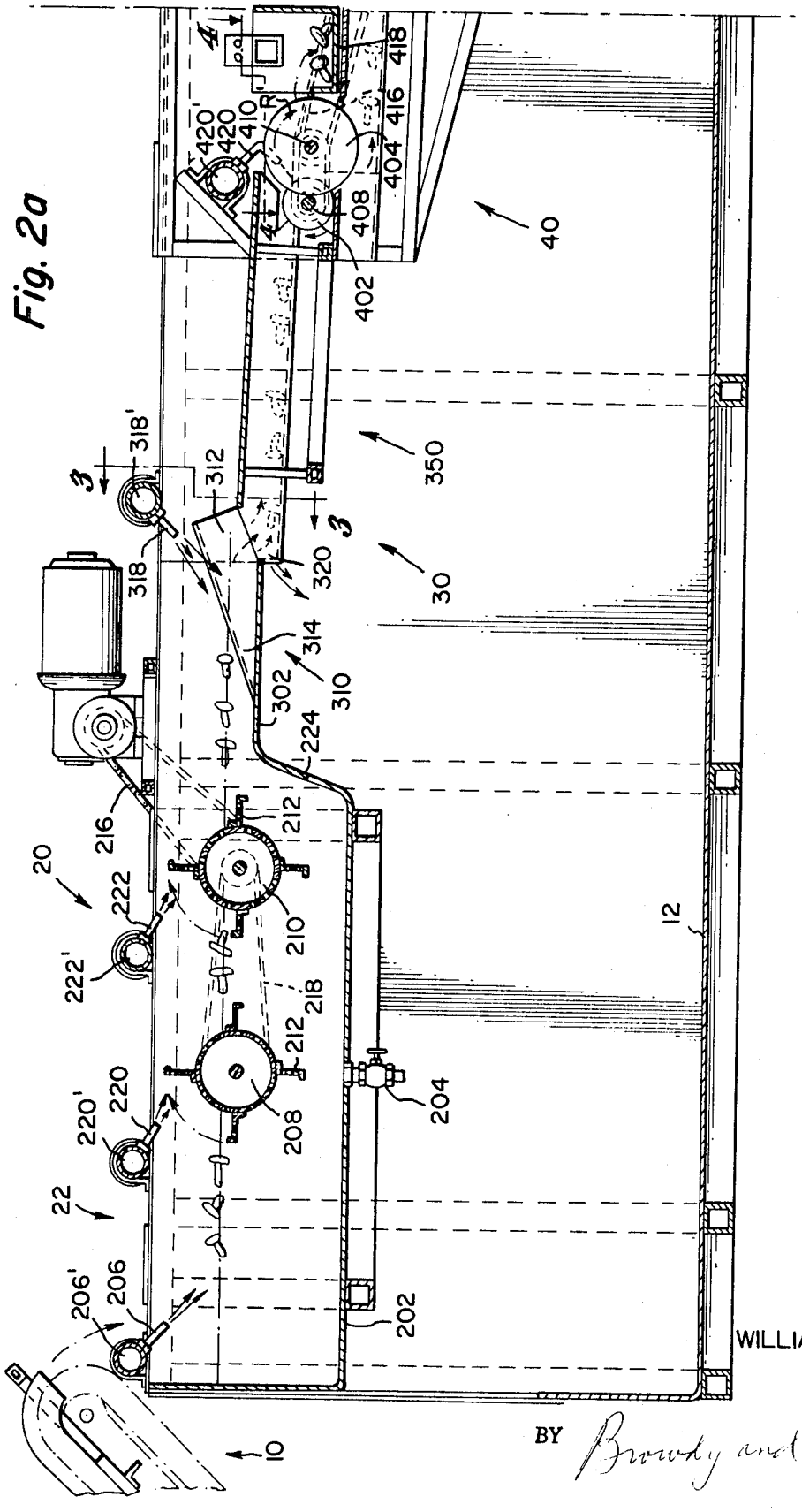
Fig. 1b

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Fig. 2a



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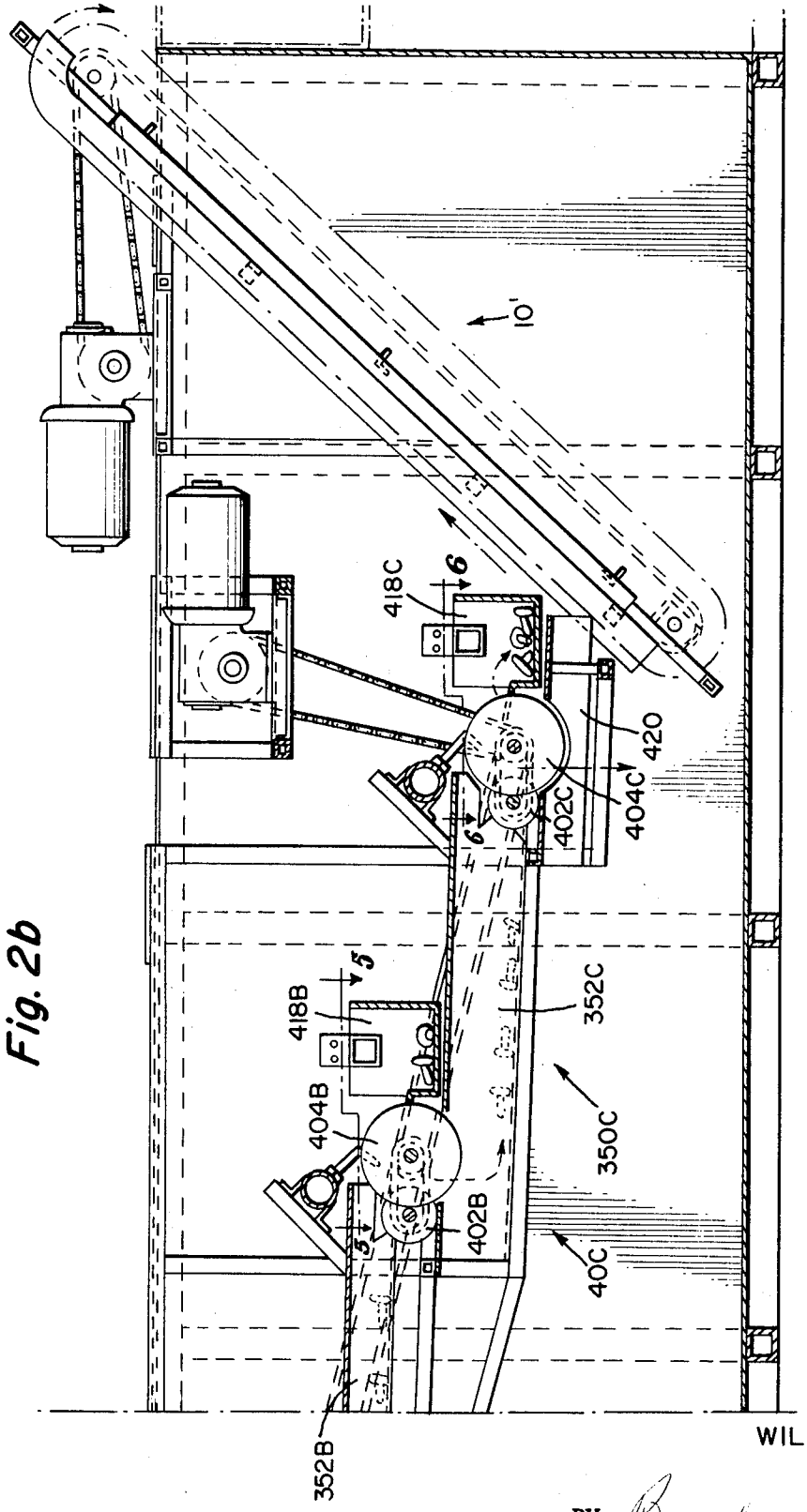


Fig. 2b

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Fig. 3

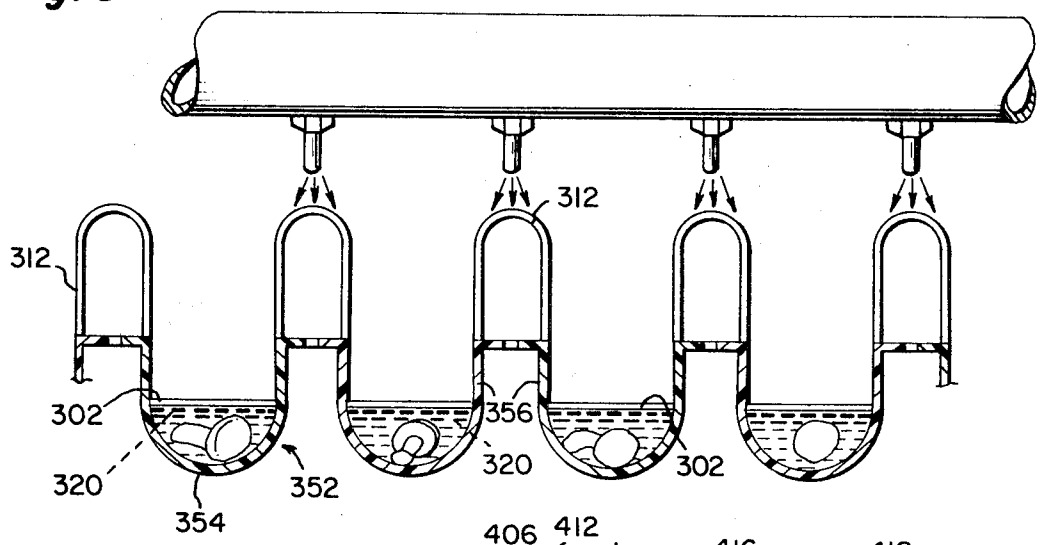


Fig. 4

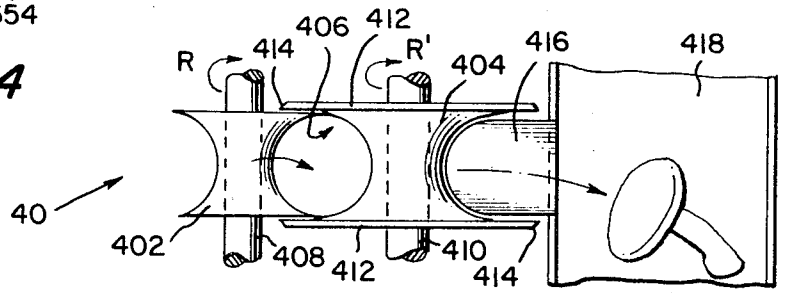


Fig. 5

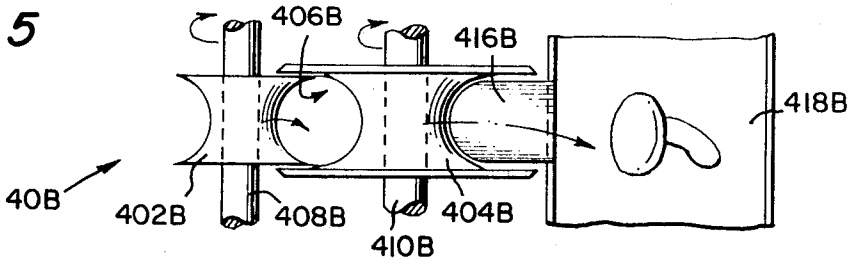
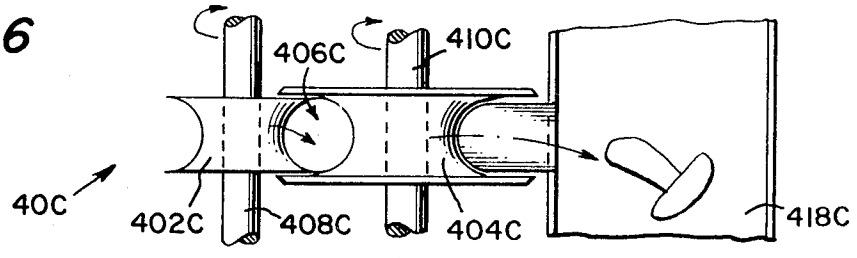


Fig. 6



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MUSHROOM GRADER

The present invention relates to a mushroom grader and, more particularly, to a device for continuously grading hydraulically fed uncut mushrooms according to size.

The automatic grading of uncut, or pulled, mushrooms has heretofore not been successfully accomplished. Accordingly, today as in the past, the grading of mushrooms must be done essentially by hand or, at best, in a semiautomatic manner using multiple personnel. Part of the difficulty in providing a successful mushroom grader resides in the particular characteristics of the mushrooms themselves; they retain surface dirt even after having been cleaned and, furthermore, they are very fragile. Devices contemplated in the past for automatically grading mushrooms have inevitably been subjected to clogging from dirt particles from the mushrooms and, additionally, have caused undue and excessive injury to too great a proportion of the mushrooms being handled.

It is, accordingly, an object of the present invention to obviate the deficiencies of the prior art, such as indicated above.

It is another object of the present invention to provide for the automatic grading of mushrooms according to size (maximum cap diameter).

It is another object of the present invention to provide not only an automatic mushroom grading apparatus, but such an apparatus which operates continuously.

It is another object of the present invention to provide for a mushroom grading system which is entirely automatic, and which is fast, self-cleaning, flexible in use and dependable.

It is another object of the present invention to provide for the grading of mushrooms using an hydraulic system.

It is another object of the present invention to provide for a mushroom grading apparatus which is capable of grading the mushrooms in a fast, economical and dependable manner.

These and other objects and the nature and advantages of the present invention will become more apparent from the following detailed description taken in conjunction with the drawings wherein:

FIGS. 1*a* and 1*b* are a plan view of one station of an embodiment of the present invention;

FIGS. 2*a* and 2*b* are vertical sectional views taken through the apparatus of FIGS. 1*a* and 1*b* along lines 2*a*–2*b*;

FIG. 3 is a sectional view taken along line 3–3 of FIG. 2*a*; and

FIGS. 4, 5 and 6 are, respectively, sectional views taken along lines 4–4 of FIG. 2*a*, lines 5–5 of FIG. 2*b* and lines 6–6 of FIG. 2*b*, showing details of the grading structure for different sizes of mushrooms.

In general, the apparatus in accordance with the present invention starts with mushrooms which have been thoroughly washed and which have the clumps broken into individual mushrooms; in addition, it is preferable that broken mushrooms be removed prior to introduction into the grader. The washing, breaking of clumps and removal of broken mushrooms may be accomplished through use of conventional washers and inspection tables in accordance with known practice.

The apparatus in accordance with the present invention functions on the principle that mushrooms may be safely and satisfactorily conveyed using an hydraulic medium, and that, furthermore, the water will serve to continuously clean both the mushrooms and the equipment without causing clogging. The grading of all the mushrooms is done according to the diameter of the mushroom caps. All mushrooms with a cap diameter larger than a predetermined size at each stage of the operation are graded out automatically and discharged either to be further handled by hand for hand trimming, or to be passed to automatic handling and trimming equipment such as that described in my copending application Ser. No. 722,267 filed Apr. 18, 1968, and now abandoned it being understood that each size is so handled separately. All mushrooms with a cap diameter smaller than a predetermined size will pass through the equipment and will be discharged automatically at the end. An illustrated embodiment of a portion of the grading apparatus in accordance with the present invention is shown in the drawing and comprises, in general, a suitable means **20** for controlling the rate and quantity movement of mushrooms from a zone **22** of mushroom infeed; a means **30** for axially orienting the mushrooms into at least one row, and preferably a plurality of rows, of mushrooms, with at least the largest size of mushrooms being aligned along a single axis in each row, and wherein the axial orienting means **30** includes a dividing and directing portion **310** and an aligning and conducting portion **350**; and means **40** to separate the largest size of the mushrooms in the aligned rows from the remaining smaller sizes, such remaining smaller sizes then passing downstream to a second aligning means and a second separating means where the next largest size of mushroom are removed and the smaller sizes are again permitted to pass through to a third aligning means and a third separating means. It should be understood that while in the preferred embodiment each station, such as that portion of the apparatus illustrated, will comprise three aligning devices **350** in series, each followed by a separator **40** for removing the largest remaining size, other arrangements may be used; thus, only two stages may be provided at each station, or the entire apparatus may comprise only one station involving as many stages of separation as are desired to produce the number of grades (sizes) of mushrooms sought.

In the preferred embodiment, however, four separate stations of three stages each will be provided giving a total of **13** grades of mushrooms including those passing through the 12 or final separator. In this embodiment each of the four stations will, as illustrated, be provided not only with three aligning means **350** which alternate with three separating means **40**, but also s single directing means **310** (which together with the first aligning means **350** forms an orienting means **30**) but also a rate controlling distribution means **20**. If desired, a distribution means **20** may be provided only in the first station, the subsequent downstream stations each beginning with a dividing and directing means **310**, although some control of flow is sacrificed by this arrangement. The zone **22** upstream from the rate controlling means **20** is fed by a suitable conveyor such as the ladder conveyor **10** from a bulk source of mushrooms; similarly, after the mushrooms have passed through the last separator in each station (see FIGS. 2*a* and 2*b*) they are taken by another ladder conveyor **10'** to the next station.

It should be understood that while various adaptations and modifications to the illustrated embodiment may be made without exceeding the scope of the invention, it is nevertheless an important aspect of the present invention that the mushrooms passing through the equipment be conveyed hydraulically.

Mushrooms from a bulk source (or from a preceding station) are passed via the ladder conveyor **10** of conventional design to a distribution tank **202** having a drain and valve **204** at the bottom thereof. Water is fed to the distribution tank **202** from a suitable source, such as the water jet sprays **206**, at the upstream end thereof to provide a head of water for continuously hydraulically conveying the mushrooms from the upstream end of the device (at the left of the illustration) to the downstream end of the device (at the right). This head of water carries the mushrooms floating on the surface of the water in the tank **202** to the distribution means **20** for controlling the rate and quantity movement of the mushrooms being continuously hydraulically fed.

The distribution means **20** comprises, disposed in the distribution tank **202**, a series of transversely extending perforated or otherwise foraminous paddle wheels or distribution drums **208** and **210** which are disposed in the water such that the water level passes through them with part of the drum being below the surface and part above as illustrated in FIG. 2*a*. These paddle wheels are preferably cylindrical as illustrated and are provided along the periphery thereof with a series of perforated or otherwise foraminous paddles **212**. As can best be seen in FIG. 1*a*, the paddles **212** are preferably

staggered in adjacent rows, and are most preferably of sufficient width so that at their edges they provide an overlapping path such as illustrated by the dimension A. While two such paddle wheels are shown in FIGS. 1*a* and 2*a*, it will be understood that a lesser or greater number may be used, but preferably two or three paddles wheels in series are all that are necessary or desirable.

In accordance with the illustrated embodiment, the first foraminous paddle wheel 208 will turn at a given speed, the perforated paddles 212 dipping into and under the water to lift the mushrooms up from the surface where they float and carry them thereover depositing them downstream between the drums 208 and 210. This controls the rate of feeding. The second paddle wheel 210 in the present embodiment, immediately downstream form the first 208, rotates at a speed twice as fast as the first wheel and thereby removes all the mushrooms between the two wheels so that no accumulation occurs. Where a third wheel is provided, such third wheel will rotate at a speed twice as fast as the second wheel 210, this also preventing accumulation of mushrooms between the second and third wheels. It will be seen that the paddle wheels serve to spread the mushrooms out on the surface of the water and prevent their accumulation in clusters. As can be seen in FIGS. 1*a* and 2*a*, all three wheels may be driven by a single motor 214 operating through suitable driving means such as the chains 216 and 218, or equivalent driving belts. The details of construction of the driving mechanism will be readily apparent to those having normal skill in the art and other driving means can be utilized as desired.

Another feature of the distribution means 20 is the provision of additional spray jets 220 and 222, and these serve the dual purpose of assisting the spray means 206 in creating a head of water, and also insuring that no mushrooms become hung up or stuck on, respectively, paddle wheel 208 and its paddles, and paddle wheel 210 and its paddles. As seen in FIG. 1*a*, the spray jets 220 and 222 are disposed across the width of the device just as are the upstream spraying means 206, in each case the sprays being serviced by means of a hollow water supplying pipe, respectively, pipe 206', 220' and 222'. As can be best seen from FIG. 2*a*, the jet sprays 220 and 222 are pointed so as to discharge water issuing therefrom across the top of the rotating paddle wheels 208 and 210, respectively.

It may be pointed out that the foraminous paddle wheels 208 and 210 are generally related in size to the approximate grade of mushrooms being handled. Thus, in the first station of the apparatus, the paddle wheels will be larger, and will become progressively smaller at each station. For a medium size mushroom (in the second and third stations of a four-station apparatus) the wheels will preferably be on the order of about 6 inches in diameter and the arms 212 will extend axially about 2 inches.

Whereas, in the illustrated embodiment, the distribution means including the tank 202 and the wheels 208 and 210 are all relatively wide, it will be understood that an axial orienting device is desirably narrow in width; however, in order to handle the desired capacity leaving the downstream end of the distributor 20, it is desirable to provide a plurality of parallel axial orienting devices in side-by-side relation which together constitute the axial orienting means 30. The number of axial orienting devices in parallel will depend upon the width of the apparatus and the particular station and stage of mushrooms being graded, it being noted in FIG. 1*a* and FIG. 1*b* that 12(*a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *j*, *k*, and *l*) devices in parallel are shown. As pointed out above, the axial orienting means has two functional parts, i.e. the directing means 310 which serves to direct the mushrooms into at least one, and preferably a plurality of rows, and the means 350 to align and conduct the mushrooms, the aligning and conducting means 350 comprising U-shaped flumes as best seen in FIG. 3.

Noting FIG. 2*a*, it is seen that immediately downstream from the last distribution drum 210, the bottom wall of the distribution tank 202 slopes upwardly at 224 until it reaches a point where the bottom wall 302 at the entrance to the axial orienting means 30 underlies the water level by only the approximate cap diameter of the largest grade of mushrooms being handled. Because of this shallow depth above the bottom wall 306, the current will be relatively great through the axial orienting means 30 compared with the current through the distribution means 20.

Spaced closely near the beginning of the bottom wall 302 are the means 310 for dividing and directing mushrooms into a plurality of parallel rows such that they flow separately into each row, rather than bunch into clusters. Such means 310 in the illustrated embodiment comprise a plurality of laterally spaced, longitudinally extending, inverted U-shaped baffles 312 located side-by-side as best seen in FIGS. 1*a* and 3. As is seen in FIG. 2*a*, the inverted U-shaped baffles 312 are inclined upwardly from its leading end at an angle (which, in the illustrated embodiment, is about 20°), and the leading portion 314, which constitutes the upper part of the inverted U, blends into the floor 306 along a V-shaped merger zone 316 as shown in FIG. 1*a*. Two of these inverted U-shaped baffles 312 spaced apart side-by-side will provide one corridor therebetween (such as the corridors A, B, etc.) into which the mushrooms pass to form a row. A plurality of such baffles spaced side-by-side will provide between adjacent baffles a plurality of such corridors as illustrated in FIG. 1*a*. The spacing between adjacent baffles 312 will correspond in size to the cap diameter of the largest mushroom being handled at the station in question, i.e. the distance between vertical sidewalls of adjacent baffles will correspond to the largest cap diameter.

Immediately above each baffle 312 is located a water jet spray 318 fed through a suitable mounting hose 318'. As is seen in FIG. 1*a*, the nozzles 318 direct the spray so that it impinges on top of each of the inverted U-shaped baffles 312 and moves down to the zone 316. The water jet spray causes an hydraulic lift around the V-shaped zone 316 and serves to maintain a head at this point. The downward movement of the water along the leading portion 314 of the baffle 312 also serves to prevent any mushrooms from being caught on top of the baffle 312. The combination of the water jet sprays 318 and the inverted U-shaped baffles 312 serve to direct mushrooms into rows or corridors located between such baffles and from here they pass to the axially aligning and conducting portion 350 of the orienting means 30.

As can be seen best in FIG. 2*a*, the bottom wall 302 ends immediately downstream from the inverted U-shaped baffles 312 and at this point the axial aligning section 350 begins. A plurality of openings 320 are provided along the width of the device below the terminal end of the bottom wall 302. A quantity of water flows through these openings 320 to the bottom of the holding tank 12 in which the apparatus is located. The smaller quantity of water flowing through the aligning section 350 provides a greater flow rate which improves alignment of the mushrooms. As best seen in FIG. 3, the aligning section 350 comprises a plurality of U-shaped parallel flumes 352 each having a bottom wall 354 and upper vertical size walls 356 of spacing only slightly greater than the cap diameter of the largest mushrooms being conveyed therein at the particular stage of the grader in question. As in my copending application Ser. No. 722,267, the flow of water through the flumes causes and maintains axial orientation of the mushrooms and conducts the mushrooms therein with either the cap first or the root first, the relatively high water flow rate serving to maintain axial alignment. While the flumes are shown in FIG. 2*a* as being inclined slightly downwardly from upstream to downstream end, it is understood that it is not essential to so slope the flumes, i.e. they may be disposed horizontally. The axial orienting means 30, having corridors between the baffles 312 and flumes 352 downstream therefrom, the corridors and flumes being only slightly wider than the diameter of the caps of the largest size mushroom being handled at the particular stage in question, insures that the mushrooms will align themselves with their long dimensions parallel to the vertical walls of the baffles 312 and the flume vertical walls 356 as they

move through the axial orienting means **30**, and the mushrooms will be conveyed through the flumes either cap first or root first to provide a row of mushrooms with the stems of the largest mushrooms all axially oriented in each flume.

As the mushrooms leave the downstream ends of the flumes of the axially orienting means **30** they pass to the means **40** for separating the largest size in the aligned row from the remaining smaller sizes. Such separating means **40** comprises a pair of rotating capstan wheels **402** and **404** which define a circular opening **406** therebetween, the capstan wheel **402** being upstream and the capstan wheel **404** being downstream. At each stage, the opening **406** is of a size equal to or slightly smaller than the cap diameter of the mushroom size intended to be separated. Accordingly, what occurs is that undergrade or undersize mushrooms pass through the hole **406** while the larger mushrooms of the desired grade cannot pass through the opening **406** and so are carried over the rotating capstan wheel **404**. The upstream capstan wheels **402** are all located immediately adjacent the discharge end of the flumes **352** so that the mushrooms flowing down the flumes immediately pass over the capstan wheels which rotate in the manner shown by the arrow R in FIGS. **4** and **2***a*. The parallel bank of upstream capstan wheels **402** are mounted on a common axle **408** which rotates, as indicated above, as shown by the arrow R.

The downstream capstan wheels **404** are similarly mounted on a common axle **410** which rotates in the same direction as the axle **408**, shown in FIGS. **4** and **2***a* by the arrow R'. As is clear from FIG. **2***a*, the axles **408** and **410** lie in the same horizontal axis.

The structure of the downstream capstan wheel **404** is slightly different from that of the upstream wheel **402**, and this is readily seen from the drawing. Thus, it is seen that the downstream capstan wheel **404** is provided at each side thereof with a circular plate **412** which overlap the path of the upstream capstan wheel **402** along two opposite tangents to the circle **406**. These circular plates **412** each terminate in a tapered knife edge **414** which serves to assist the downstream capstan wheel **404** in picking up the desired size mushrooms and passing them thereover. Thus, it will be understood that while undersize mushrooms after moving over the rotating capstan **402** will fall through the opening **406**, the mushrooms desired to be removed, being of a size too great to fit through the opening **406**, will be grasped by the downstream capstan **404**, or by its circular sideplates **412**, or by the edges **414**, or by all three depending on the precise shape of the cap and how it is radially aligned as it contacts the downstream capstan wheel **404**.

Immediately downstream from the downstream capstan wheel **404** is a catcher plate **416** which leads to a trough **418**, such trough **418** extending transversely across the width of the apparatus and overlying the second axial aligning means. This trough is inclined slightly from one side of the apparatus to the other side and is fed at one end by water. It will thus be seen that as the size of mushrooms desired to be removed at the particular stage of operation under consideration is grasped by the downstream capstan **404** and is carried thereover, it will strike the plate **416** and fall into the trough **418** where it will be carried by water to the side of the apparatus and from there past to further handling equipment such as that shown in my copending application Ser. No. 722,267.

Located above each pair of capstan wheels **402** and **404** is located a water jet spray **420** which is preferably adjustable to point at various locations. As with the other previously described water jet sprays, the nozzles **420** are carried by a suitable water supplying pipe **420'**. The adjustable nature of the water jet nozzles is desirable since it has been found that in grading the larger sizes better control is obtained by pointing the nozzle toward the ejecting area of the downstream wheel **404**; however, when grading the smaller size of mushrooms, better results are obtained by projecting the spray directly toward the hole **406**.

It is a preferred feature in accordance with the present invention that the downstream capstan wheel **404** rotate at a slightly greater speed than the rotating speed of the upstream wheel **402**, since this provides improved removal of the size of mushrooms desired to be removed. Another preferred feature assisting in this removal is the provision of a roughened surface on the capstan wheels.

As indicated above, those mushrooms having a maximum cap diameter smaller than the opening **406** will fall therethrough to the second stage of the device as best shown in FIG. **2***a*. These smaller mushrooms will drop directly into the second stage flumes **352B** which are narrower than the flumes **352** in the first stage. All the water from the first stage flumes pass along with the undergrade mushrooms to the second stage providing and maintaining the hydraulic flow. In the second stage, the mushrooms flow along to the second separating means **40B** shown in detail in FIG. **5** which is exactly the same as the first stage separator **40**, except that the elements are correspondingly smaller thereby providing a smaller opening **406B** between the capstan wheels **402B** and **404B** so that the next largest size of mushrooms may be removed. As described above in relation to the first stage, the second stage capstan wheels are rotated on parallel axles **408B** and **410B** and the mushrooms too large to pass through the hole **406B** are carried over the downstream capstan **404B** where they bounce off the plate **416B** and are deposited into the trough **418B** where they are carried to a second apparatus in accordance with my copending application Ser. No. 722,267.

In the meantime, the mushrooms smaller than the opening **406B** once again drop through, this time to the third stage aligning means **350C** which comprises the flumes **352C** which are narrower than the preceding second stage flumes **352B**. From here the mushrooms are passed to the third stage separator **40C** where the next largest size mushrooms are graded out by passage over the capstan wheels **402C** and **404C** and into the trough **418C**. In the meantime, the smaller mushrooms pass through the circular opening **406C** and down a ramp **420** to the ladder conveyor **10'** for passage to the next station.

The foregoing description of the specific embodiment will so fully reveal the general nature of the invention that others can, by applying current knowledge, readily modify such specific embodiment and/or adapt it for various applications without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the invention.

What I claim is:

1. A device for continuously grading mushrooms according to size, comprising:

means for continuously hydraulically feeding mushrooms, floating on the surface of an hydraulic medium, at a controlled rate and quantity;

means for continuously directing said floating mushrooms into at least one row;

means to axially align said hydraulically fed floating mushrooms in said at least one row with the stems of at least the largest size being aligned along a single axis in said row; and

means to separate said largest size of said floating mushrooms in said aligned row from the remaining sizes.

2. A device in accordance with claim **1** further comprising:

a plurality of separate stations in series downstream from said feeding means, each said station comprising (1) a said means for directing said mushrooms into at least one row, (2) at least one of said means to axially align said hydraulically fed mushrooms, and (3) at least one of said means to separate the largest size in said aligned row from the remaining sizes.

3. A device in accordance with claim **2** wherein each said station comprises in series a said directing means, a first said aligning means, a first said separating means, a second said aligning means, a second said separating means, a third said aligning means, and a third said separating means.

4. A device in accordance with claim 2 wherein said means for directing said mushrooms into at least one row comprises means to divide said floating mushrooms and to direct said mushrooms into a plurality of parallel rows, said axial aligning means comprising means to align said mushrooms in the plurality of parallel rows into which they have been directed by said directing means.

5. A device in accordance with claim 1 wherein said means for continuously hydraulically feeding mushrooms comprises an elongated tank, a water inlet at one end and a water outlet at the other end, the mushrooms fed to said tank being floated downstream by the head of water created by the inflow of water into said tank through the water inlet.

6. A device in accordance with claim 5 wherein said water inlet comprises a water spray above said tank directed downstream.

7. A device in accordance with claim 5 further comprising means to automatically feed mushrooms to said tank.

8. A device in accordance with claim 1 wherein said means to separate said largest size from said smaller sizes comprises a pair of rotating capstan wheels, defining a circular opening therebetween, one said wheel being upstream and one being downstream, said circular opening being of a size equal to or slightly smaller than the cap diameter of the mushroom size to be separated; whereby said axially aligned mushrooms pass over said rotating upstream capstan wheel one at a time, the smaller mushrooms falling through the circular opening and the larger mushrooms to be separated being lifted by said downstream capstan wheel thereover.

9. A device in accordance with claim 8 further comprising a water jet spray located above said capstan wheels and projecting theretoward.

10. A device in accordance with claim 8 wherein said means for feeding mushrooms at a controlled rate comprises a first transversely extending foraminous paddle wheel and a second transversely extending foraminous paddle wheel downstream from said first paddle wheel, said paddle wheels extending across the width of the device and being located with a portion thereof extending above the water level, and means to rotate said paddle wheels with said second paddle wheel rotating at a rate faster than said first paddle wheel.

11. A device in accordance with claim 10 wherein each said paddle wheel comprises thereon a plurality of staggered overlapping, foraminous pickup arms.

12. A device in accordance with claim 8 wherein said directing means comprises a pair of laterally spaced, longitudinally aligned baffles defining a corridor therebetween, the distance between said baffles being slightly greater than the largest mushroom cap diameter being graded, wherein the upstream ends of said baffles are curved to form a mouth larger than the corridor;

and wherein said axial aligning means comprises a U-shaped flume downstream from the corridor of said directing means.

13. A device in accordance with claim 8 wherein said downstream capstan wheel has a roughened surface.

14. A device in accordance with claim 8 including means for rotating said downstream capstan wheel at a greater speed than said upstream capstan wheel.

15. A device in accordance with claim 8 including means for rotating said downstream capstan wheel at a greater speed than said upstream capstan wheel.

16. A device in accordance with claim 1

wherein said means for directing said mushrooms into a row comprises means to divide said floating mushrooms and to direct said mushrooms into a plurality of parallel rows downstream from said rate controlling means, said directing means including a floor, a plurality of laterally spaced, longitudinally extending, inverted U-shaped baffles defining a plurality of longitudinally aligned corridors between adjacent baffles, said inverted U-shaped baffles being inclined upwardly from said floor at an acute angle from their upstream position to their downstream position and defining a V-shaped zone of merger with the floor at the upstream end of each U-shaped baffle, the distance across each corridor being slightly larger than the largest mushroom cap diameter being graded, and means to cause hydraulic lift at said mouths;

wherein said means to align said hydraulically fed mushrooms comprises a plurality of U-shaped flumes, each located immediately downstream from a corridor of said directing means for receiving mushrooms therein, said flumes having a transverse dimension the same as said corridors;

wherein said means to separate said largest size mushroom from said smaller sizes comprises—located immediately downstream from each flume—a pair of rotating capstan wheels defining a circular opening therebetween, one said wheel being upstream and one being downstream, said circular opening being of a size equal to or slightly smaller than the cap diameter of the mushroom size to be separated; whereby said axially aligned mushrooms pass over said rotating upstream capstan wheel one at a time, the smaller mushrooms falling through the circular opening and the larger mushrooms to be separated being lifted by said downstream capstan wheel thereover, and water jet spray means at said capstan wheels;

a second means to align said mushrooms located below and downstream from said separating means, said second orienting means comprising a plurality of U-shaped flumes having a transverse dimension smaller than the transverse dimension of the flumes in the first-mentioned separating means but greater than the largest mushroom cap diameter of the remaining mushrooms; and

a second means to separate the largest size mushrooms remaining from the smaller sizes comprising a pair of rotating capstan wheels downstream from said second orienting means and defining a circular opening therebetween, one said wheel being upstream and one being downstream, said circular opening being of a size equal to or slightly smaller than the cap diameter of the mushroom size to be separated; whereby said axially aligned mushrooms pass over said rotating upstream capstan wheel one at a time, the smaller mushrooms falling through the circular opening and the larger mushrooms to be separated being lifted by said downstream capstan wheel thereover, and water jet spray means at said capstan wheels.

17. A device for continuously grading mushrooms to separate said largest size from said smaller sizes comprising means for hydraulically feeding mushrooms, a pair of rotating capstan wheels defining a circular opening therebetween, one said wheel being upstream and one being downstream, said circular opening being of a size equal to or slightly smaller than the cap diameter of the mushroom size to be separated, said hydraulic feeding means feeding mushrooms one at a time onto said upstream capstan wheel; whereby mushrooms which are fed to said device pass over said rotating upstream capstan wheel, the smaller mushrooms falling through the circular opening and the large mushrooms to be separated being lifted by said downstream capstan wheel thereover.

18. A device in accordance with claim 17 wherein said downstream capstan wheel has a roughened surface.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,590,993 Dated July 6, 1971

Inventor(s) William H. BAKER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 72, delete "and now abandoned"
and insert --and now U.S. Patent No. 3,596,693 issued August 3, 1971--

Signed and sealed this 4th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents

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