United States Patent

Goodman, Jr. et al.

[15] **3,653,509**

[45] **Apr. 4, 1972**

[54] SIZING APPARATUS

[72] Inventors: **Hubert Coleman Goodman, Jr.**, Morgantown, W. Va.; **Donald D. Hamann**, Raleigh, N.C.

[73] Assignee: **Research Corporation**, New York, N.Y.

[22] Filed: **Dec. 9, 1969**

[21] Appl. No.: **883,377**

[52] **U.S. Cl.** **209/102**

[51] **Int. Cl.** **B07b 13/04**

[58] **Field of Search** 209/102, 100, 103

[56] **References Cited**

UNITED STATES PATENTS

1,204,685	11/1916	Phillips	209/102
1,251,093	12/1917	Palmer	209/102
2,776,746	1/1957	Envoldsen	209/102

FOREIGN PATENTS OR APPLICATIONS

688,275	3/1953	Great Britain	209/102
734,944	8/1955	Great Britain	209/102

Primary Examiner—Allen N. Knowles

Attorney—Stowell & Stowell

[57] **ABSTRACT**

Apparatus and method for sizing ovoidal bodies is provided. The sizing apparatus includes a pair of step-pulleys carried by a driven shaft with the minimum diameter pulleys thereof in opposed relation, a plurality of idler pulleys rotatably mounted on an idler shaft and conveying belts carried by each of the steps of the step-pulleys and trained about the idler pulleys. The step-pulleys and the idler pulleys are so arranged that the belts about the idler pulleys and the step-pulleys define a V-shaped slot increasing in width from the idler pulleys to the step-pulleys. Drive means are provided for driving the conveying belts.

5 Claims, 5 Drawing Figures

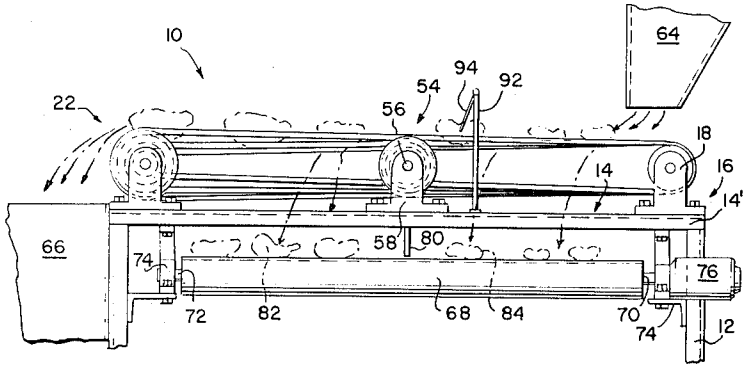


FIG. 1.

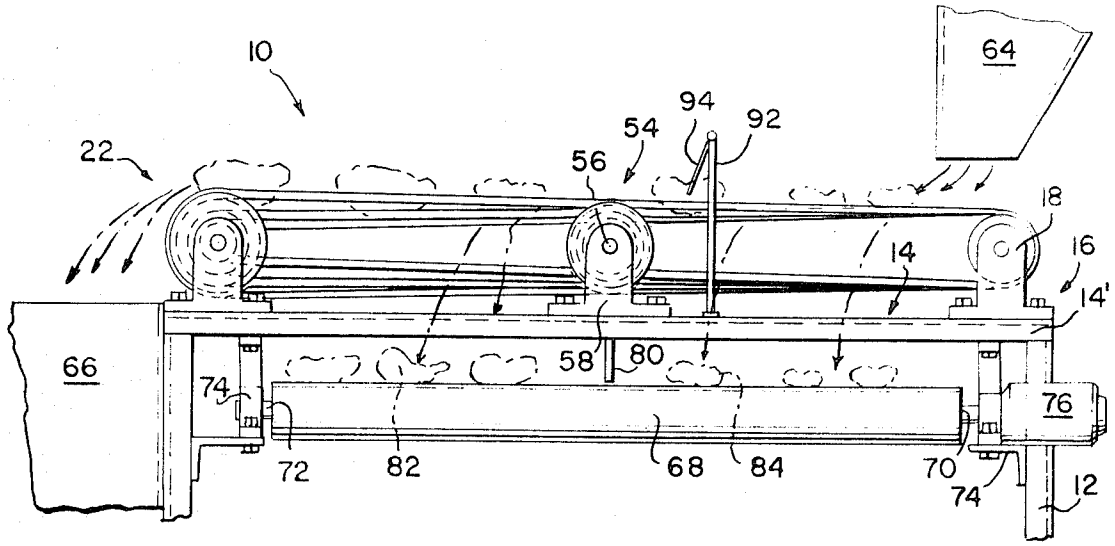
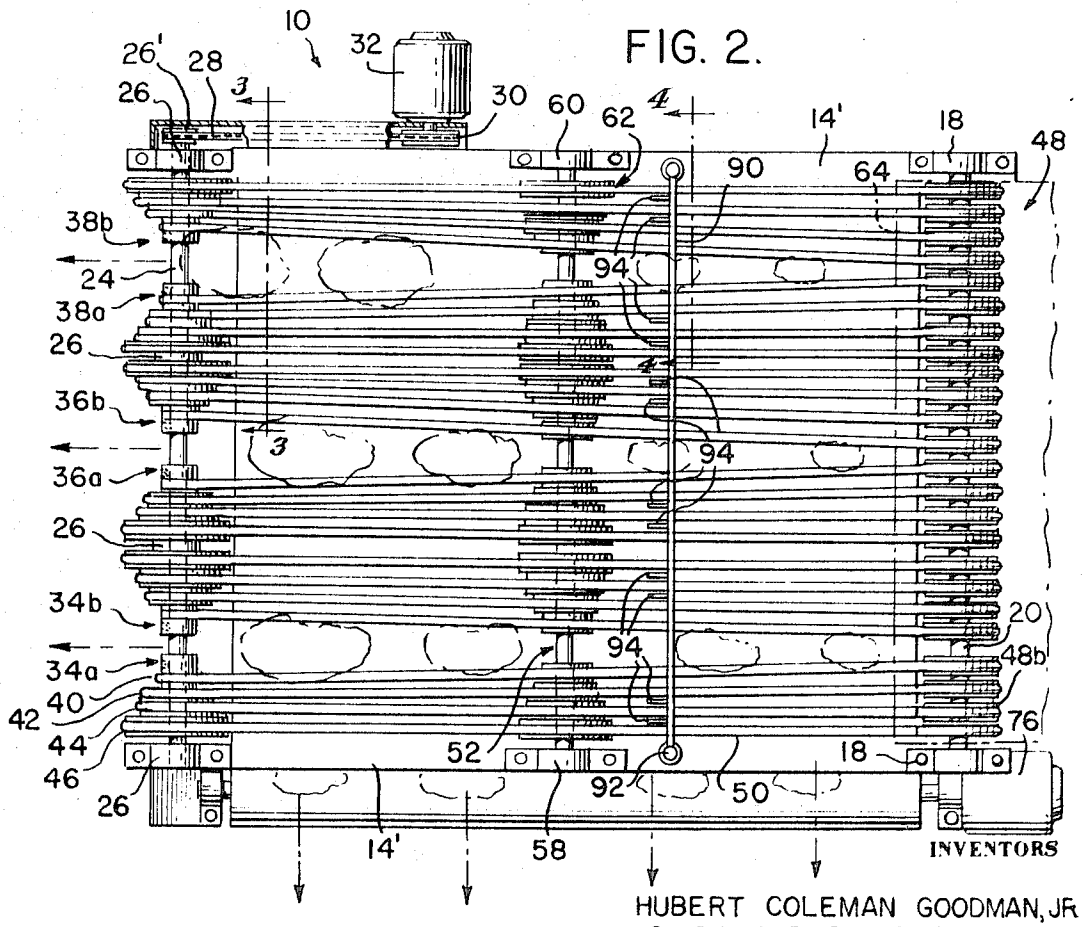


FIG. 2.

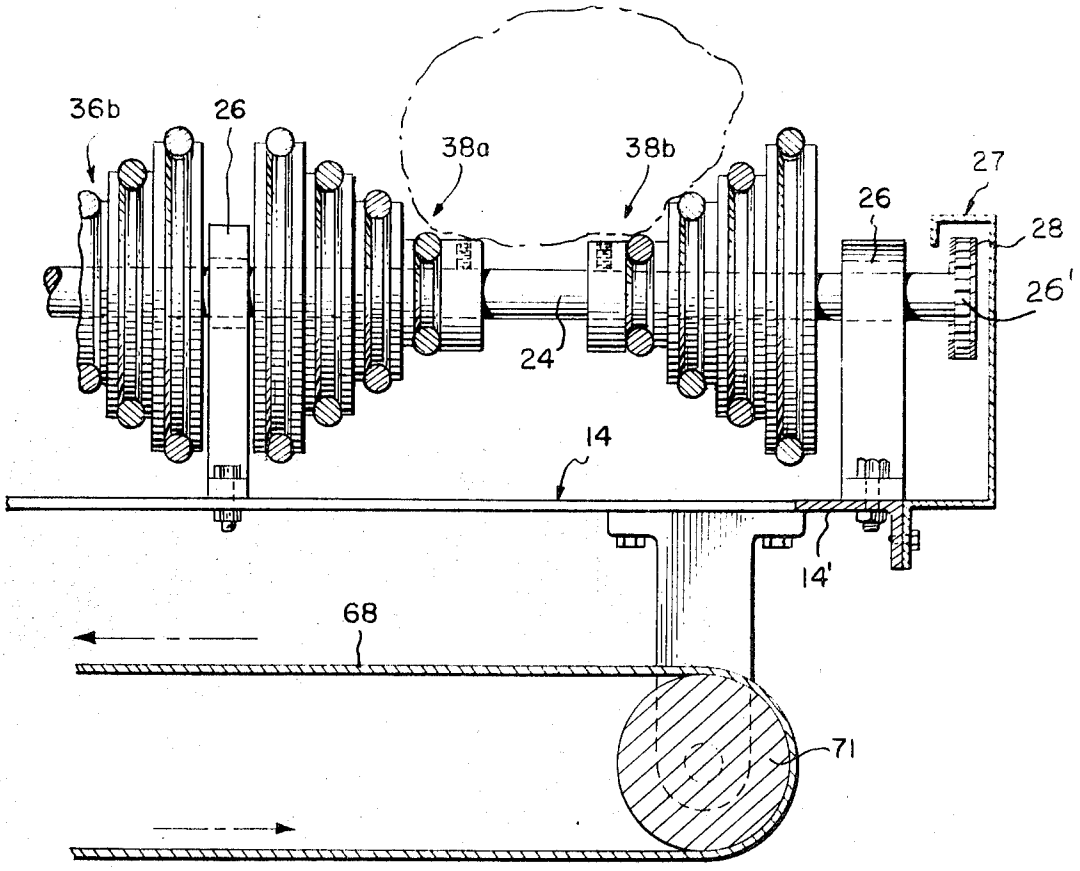


HUBERT COLEMAN GOODMAN, JR
& DONALD D. HAMANN

BY Stowell & Stowell

ATTORNEYS

FIG. 3.



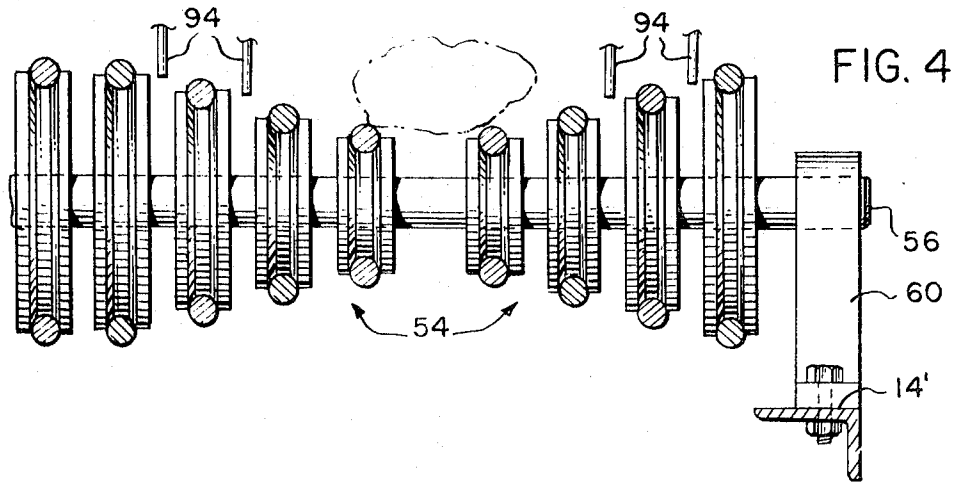


FIG. 4.

INVENTORS
HUBERT COLEMAN GOODMAN, JR.
& DONALD D. HAMANN
BY Stowell & Stowell
ATTORNEYS

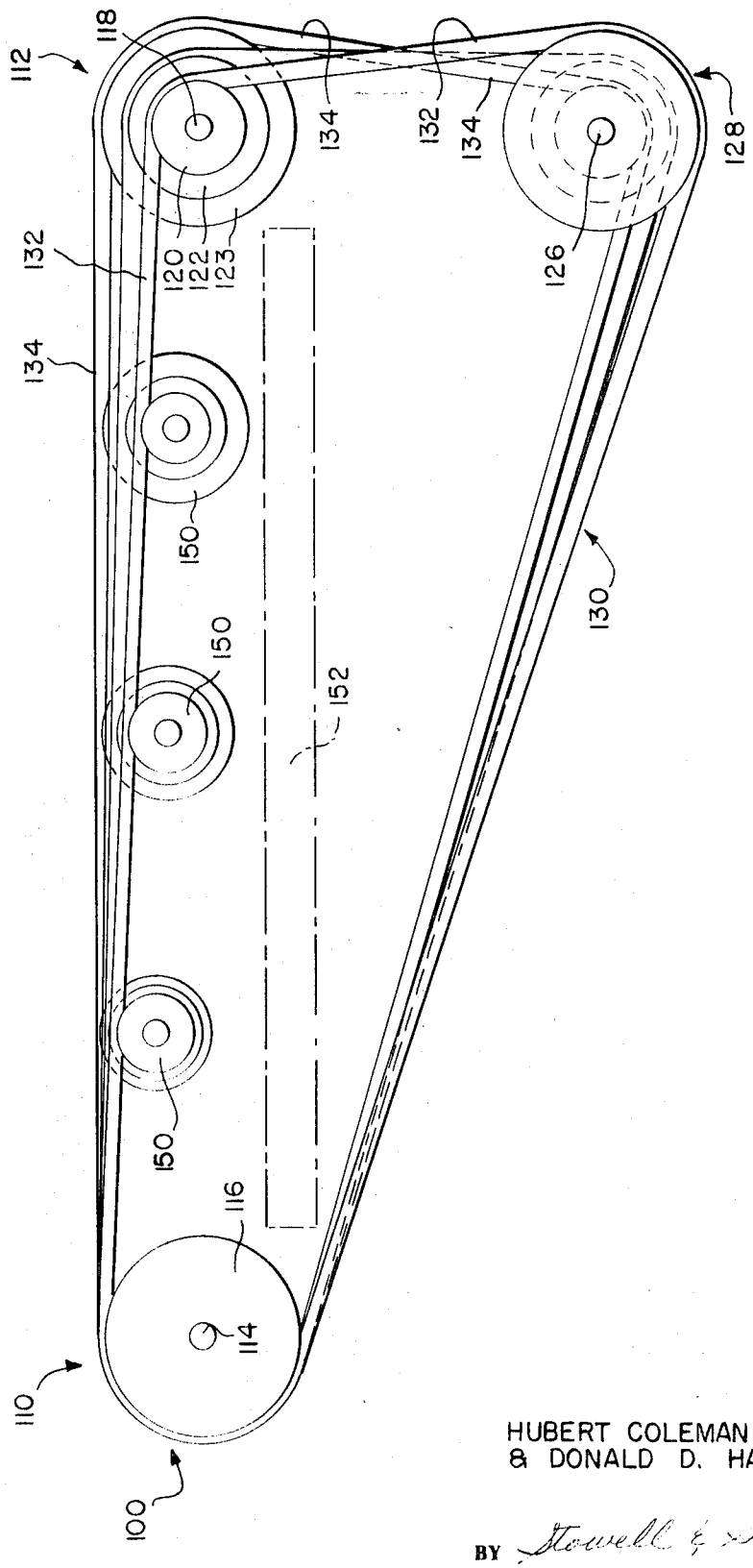


FIG. 5.

INVENTORS
HUBERT COLEMAN GOODMAN, JR.
& DONALD D. HAMANN

BY Stowell & Stowell

ATTORNEYS

SIZING APPARATUS

BACKGROUND OF THE INVENTION

Machines for sizing ovoidal bodies such as sweet potatoes, pears, eggs and the like are known in the art. In general, in order to properly size ovoidal bodies, it is necessary to provide means for orienting the bodies such that they travel with their major or minor axes in a prearranged relationship to the slot or opening into which the objects are to pass.

It is a primary object of the present invention to provide sizing apparatus and methods whereby ovoidal bodies are oriented and sized on a relatively simple highly effective apparatus.

It is a further object of the present invention to provide methods and apparatus whereby the bodies to be sized are subjected to a minimum of abrasion and handling thus avoiding skin abrasion and breakage where the bodies are frangible or sensitive to abrasion.

These and other objects and advantages are provided in a sizing apparatus for sizing ovoidal bodies comprising a driven shaft and a non-driven shaft parallel to and spaced from the driven shaft, a pair of step-pulleys secured to the driven shaft with the minimum diameter pulleys thereof in opposed relation; a plurality of idler pulleys, one for each step of the pair of step-pulleys; a plurality of belts with a belt trained about each of the steps of the pair of step-pulleys and then about its associated idler pulleys; the spacing between the step-pulleys and the idlers are so arranged that the belts about the pulleys define a V-shaped slot increasing in width from the idler pulleys to the step-pulleys; drive means for the shaft carrying the step-pulleys to drive the conveying belts with the uppermost flights traveling toward the step-pulleys; and means for directing ovoidal bodies to be sized onto the traveling belts adjacent the idler pulleys; and by a method of sizing ovoidal bodies comprising depositing ovoidal bodies onto one end of a plurality of belt conveyors arranged to present a V-slot in plan with the V-slot widening in the directing of travel of the belts and a V-configuration in transverse section, and driving opposed pairs of said belts at increasing linear speeds.

The invention will be more fully described in reference to the accompanying drawing wherein:

FIG. 1 is a fragmentary side elevational view of a sizing machine for sweet potatoes constructed in accordance with the teaching of the present invention;

FIG. 2 is a top plan view of a portion of the structure shown in FIG. 1 illustrating three sizing and orienting runs on a single apparatus;

FIG. 3 is a section on line 3—3 of FIG. 2;

FIG. 4 is a section on line 4—4 of FIG. 2; and

FIG. 5 is a diagrammatic side elevational view of a modified form of the present invention wherein the highest speed is applied to the belts forming the bottom of the V-configuration.

The detailed description of the present invention will be had in reference to a sizing machine for sweet potatoes. However, it is particularly pointed out that while the apparatus will be described in reference to orienting and sizing sweet potatoes the invention has utility in the sizing and orienting of other ovoidal produce and materials.

Sweet potatoes are generally marketed in two grades. The roots are graded in the field and then normally the No. 2's are delivered to the processing plant (cannery) and the No. 1's to a packing shed.

The U. S. No. 1 grade sweet potato may be from 1¾ t0 3½ inches in diameter and from 3 to 9 inches in length. These roots are used for fresh market sale or are cured and placed in storage for later sale as a fresh market product. For this reason, these roots must not be skinned or bruised since such damage creates a product which has an undesirable appearance on the market and make the roots more susceptible to wet rot in storage.

The U. S. No. 2 grade sweet potato may be from 1 to 2½ inches in diameter and from 3 to 7 inches in length. This grade is used for processing and is delivered to the cannery immediately after harvest. Damage to these roots is not as critical as it is to the No. 1 sweet potatoes because they will normally be processed within 48 hours after being dug. The prices of the No. 1 and No. 2 roots vary so that it is economically desirable for the producer to take advantage of the overlap in grade diameters and grade all the roots possible into the higher priced grade.

The skin of a sweet potato is very easily torn when any tangential force is applied with the shear strength at a minimum immediately after digging and increasing while the sweet potatoes are in storage. Higher normal forces can be applied to the roots without damage occurring as long as no tangential force is applied at the same time.

Referring to the drawing and in particular to FIGS. **1** and **2** thereof, **10** generally designates the improved sizing and orienting machine of the invention and includes vertical support members **12** and cross members **14'** connected to the upper end of the supports **12** which cross members carry the sizing mechanism per se. At end **16** of the bed **14** formed by the cross members, is mounted a plurality of supports **18** which support a cross shaft **20**. At the opposite end **22** of the bed **14** is rotatably supported a drive shaft **24**, for example, by bearing blocks **26**.

The shaft **24** has secured, at one end, a sprocket **26'** which is connected via chain **28** with a further sprocket **30** connected to, for example, an electric motor **32**. The electric motor **32** may include in its energizing system a rheostat or the like whereby the speed of rotation of shaft **24** may be controlled through a suitable range of speeds.

Secured to the shaft **24** are a plurality of pairs of step-pulleys designated **34***a*, **34***b*, **36***a*, **36***b*, **38***a* and **38***b*. As will be more apparent to those skilled in the art from the following description, at least a pair of the step-pulleys are essential for one orienting and sizing section. The number of runs or sections is not critical and three such runs are illustrated in the drawing.

In the illustrated form of the invention each of the step-pulleys **34***a* through **38***b* includes four steps designated **40**, **42**, **44** and **46**; however, a greater or lesser number may be used.

Shaft **20** rotatably supports a plurality of equal diameter pulleys generally designated **48** and the number of equal diameter pulleys **48** correspond to the total number of steps of the total number of step-pulleys. Thus, each step is provided with its own independently rotatable pulley mounted on shaft **20**.

While in this form of the invention uniform diameter pulleys are employed as the idler pulleys, the idler pulleys may also be step-pulleys of the same or of a different diameter than the step-pulleys employed to drive the belts.

A plurality of conveyor belts **50** are trained about the step-pulleys and the equal diameter pulleys **48**, with the belts running in non-cross uniform flights such that, for example, the belt contacting step **46** of step-pulley **34***a* engages pulley **48***a* and the belt contacting pulley **44** is trained over pulley **48***b*, etc.

In the illustrated form of the invention the belts **50** are formed of plastic and are circular in cross section; however, it is contemplated that for some applications it may be desirable to mold the belting material around, for example, roller chains and thus operate the device with sprockets rather than V-type pulleys.

The pairs of step-pulleys are mounted on the shaft **24** such that the minimum diameter steps of adjacent pulleys are in opposed relationship whereby opposed belts travel with the same linear speed with each succeeding belt traveling at the same speed as its corresponding belt on its opposed pulley and at a greater speed than its lower member.

Further, the pairs of step-pulleys are mounted such that a V-shaped slot **52** is formed between the belts trained about the pulleys with the V increasing in width from adjacent the equal diameter pulleys toward the pairs of step-pulleys to provide the grading or sizing slot.

Where the belt runs are substantial, a further set of stepped pulleys may be mounted intermediate the pulleys carried by shaft **20** and **24** as illustrated at **54**.

The support assembly **54** is mounted on a shaft **56**, carried in shaft support members **58** and **60**. The step-pulleys **62** of support assembly **54** are rotatably mounted on the shaft **56** so that synchronization of the pairs of step-pulleys is automatic.

The assembly also includes means for directing ovoidal bodies such as sweet potatoes adjacent the end of the orienting and sizing assembly containing the fixed diameter pulleys **48** and in the illustrated form of the invention the feeding means comprises a feed chute **64** connected to a suitable hopper. It will be recognized however, by those skilled in the art, that a conventional belt conveyor, for example, may be employed to feed sweet potatoes onto the sizing apparatus.

At the opposite end of the assembly, a receiving hopper is illustrated at **66** which hopper is adapted to receive the largest or first grade potatoes. Again, it will be appreciated that potatoes exiting adjacent the step-pulleys **34***a*, etc., may be deposited on a further conveyor system.

Below the bed **14** is mounted a further conveyor belt or apron **68** having a driven pulley **70** mounted on a shaft **72** which shaft is journaled in bearings **74** and which shaft is suitably driven by, for example, an electrical motor **76**.

The opposite end of the apron **68** is trained about an idler pulley **71** whereby sweet potatoes falling through the V slots **52** will be transported by the apron **68** to suitable receiving bins or other conveyor means as desired. In the illustrated form of the invention a divider **80** is mounted below shaft **56** to separate the sweet potatoes falling onto the apron **68** into a second grade **82** and a third grade **84** which includes small roots, stems and the like. The number of divisions for the apron **68** is not critical and single separation or a plurality such as four or more separations may be provided.

In order to prevent ovoidal bodies from riding across the V formed by the belts by contacting two belts traveling at the same speed the assembly may include a cross rod **90** supported by posts **92** mounted from the cross frames **14'**. The cross rod is provided with a plurality of relatively resilient plastic or the like fingers **94** which project between the belts so that cross suspended sweet potatoes or the like will be urged from their suspended position into the V trough and thereby be oriented with their major axes generally directed in the direction of travel of the upper flight of the V-belts.

While the fingers **94** are shown projecting downwardly between the belts, the same results are accomplished by having the fingers project upwardly between the belts.

In an illustrated example of the present invention, satisfactory grading of sweet potatoes was provided where the step-pulleys had diameters of 4, 5, 6 and 7 inches and the equal diameter idler pulleys were 5 inches in diameter. The belts **50** for the assembly comprised round vinyl plastic belting one-half inch in diameter. The spacing between the equal diameter idler pulleys was seven-sixteenths of an inch; the center to center distance between shafts **20** and **24** was 7 feet and the step-pulleys were adjusted on their shaft **24** so that the opening between the bottom two belts was 1¾ inches at the point at which the opening was the widest. In operation the belt speed was varied from about 100 ft. per minute to about 150 ft. per minute. During loading and sizing tests it was found that with the above defined assembly a sizing belt speed of about 125 ft. per minute was optimum as above this speed there was a tendency for increased belt jumping and the attendant abrasion of the sweet potatoes. At a speed of about 125 ft. per minute loading rates, in a four channel sizer, up to about 550 bushels per hour were obtainable, with grading accuracies in the order of 90 to 100 percent. Further, upon inspection of the sweet potatoes, graded by apparatus constructed as disclosed herein, they were found to be acceptable without undue skin damage.

OPERATION

In operation of the sizing and orienting mechanism hereinbefore described, the sizing belts are placed in motion by energizing motor **32** to cause the higher speed of the belts to travel at about 125 linear feet per minute and the apron **68** is similarly driven via motor **76** so that sized potatoes falling thereonto are conveyed from beneath the machine. With the belts and apron in operation sweet potatoes loaded onto the bin **64** fall into the V-shaped channels formed by the plural belts **50** and tend to ride to the bottom of the V-shaped channels on the bottom pair of belts, which travel at the same linear speed, with their major axes parallel with the direction of belt travel. Sweet potatoes not so oriented are caused to assume such orientation by being contacted by belts from more than one layer of belts traveling at different linear speeds thus causing the bodies to rotate and fall to the bottom of the V. Any sweet potatoes which might lie across a pair of belts traveling at the same linear speed, other than the bottom belts, are urged from such suspended position by for example the resilient fingers **94**. The smallest potatoes and stems, etc. fall through the V slots onto that portion of the apron **68** to the right of the partition **80** of FIG. **1**, the next larger size fall upon the apron between the shaft **56** and shaft **24** and the first grade potatoes pass over the ends of the step-pulley and are collected in bin **56**.

Referring specifically to FIG. **5** of the drawing, there is diagrammatically illustrated a modified form of the present invention wherein the conveyor belts are so driven and arranged that the lower-most belts forming the conveying and orienting Vee travel at the highest linear speed.

This form of the apparatus appears to provide more stability for the ovoidal bodies being conveyed, once the ovoidal bodies are oriented and positioned in the bottom zone of the V-slot formed by the plural conveyor belts. The modified device generally designated **100** has an end **110** adapted to receive the ovoidal bodies to be sorted and a final discharge end **112**. At end **110** is mounted an idler shaft **114**, which idler shaft, like idler shaft **20** illustrated in the form of the invention shown in FIGS. **1** through **4**, has rotatably mounted thereon a plurality of idler pulleys **116**.

At end **112** is a further idler shaft **118** which idler shaft rotatably mounts a plurality of pulleys which correspond to the step-pulleys of FIGS. **1** through **4** and three of which are designated **120**, **122** and **123**, each of which is graded in size and each of which is rotatably mounted on the shaft **118**. The pulleys **120**, **122**, **123** form one-half of the pair of step-pulleys to form a conveyor run. The assembly also includes a further shaft **126**, which shaft carries the plurality of step-pulleys **128** which step-pulleys are fixed to rotate with the shaft **126** and the shaft **126** is driven by means such as illustrated at **26'**, **28**, **30** and **32** in FIG. **2** of the drawing.

The idler pulleys **116**, the idler step-type pulleys **120**, **122** and **123**, etc., and the driven step-pulleys **128** have a plurality of conveyor belts **130** trained thereabout. The belts **130** are trained about the pulley such that, for the one-half Vee shown, belt **132** trained about the largest diameter of the driven step-pulley **128** passes about the minimum diameter pulley **120** of the freely rotatable step-like pulleys carried by shaft **118** and belt **134** trained about the minimum diameter step of the driven step-pulley **128** is trained about the largest of the pulleys **123** of the rotatable step-like pulleys carried by shaft **118**. Thus, the belt **132** which forms the lowest belt of the conveying, sizing and orienting run of the device travels at a greater linear speed in the conveying, sizing and orienting zone than the uppermost belt **134**.

Like the previous form of the invention, a plurality of belt supporting assemblies **150** are mounted between the end **110** and the discharge end **112** which support assemblies may be identical to support assembly **54**, illustrated in FIGS. **1** through **4** of the drawing. Further, this form of the invention includes a cross conveyor or apron **152**, which corresponds to cross conveyor or apron **68** of the previous form of the inven-

tion. Further, like the previous form of the invention, the spacing of the plural pulleys on their respective shafts is such that a sizing Vee extends from the idler pulleys **116** to the step-like idler pulleys **120, 122, 123**, etc.

From the foregoing specification, it will be seen that the objects and advantages of the invention are fully accomplished. It will also be recognized that various modifications may be made in the form of the apparatus without departing from the spirit of the present invention.

We claim:

1. An apparatus for orienting and sizing bodies of an ovoidal or elipsodial shape without damaging such bodies or abrading the surfaces thereof comprising

a. a generally horizontal bed having an input end for such bodies and a preselected minimum size output end;

b. a plurality of pulleys mounted as a first set group at the input end and arranged transversely of the bed;

c. a plurality of pulleys mounted as a second set group at the output end and arranged transversely of the bed with the pulleys of the second set being arranged so that each pulley has a corresponding pulley in the first set;

d. said pulleys of the second set being arranged to vertically present a generally V configuration in transverse section with the apex of the V configuration being defined by a bottom pair of side by side pulleys of the same diameter;

e. said bottom pair of pulleys of the second set being spaced apart transversely of the bed a greater distance than the transverse spacing between their corresponding pulleys of the first set;

f. a plurality of belts trained between corresponding pulleys of the first and second sets and having upper reaches on which the bodies are placed at the input end of the bed for movement and sizing between the input and the output ends of the bed, said belts having a vertical generally V-shaped pattern in cross-section with a bottom pair of belts engaged on the bottom pair of pulleys of the second set forming the apex of the V-shaped pattern and having substantially coplanar upper reaches that diverge from the pulleys of the first set to the bottom pair of pulleys of the second set and the other belts being arranged in paired substantially coplanar reaches on the outer sides of the bottom pair of belts so as to provide a sizing run; and,

g. driving means for moving the bottom pair of belts at the same linear speed and for moving the other belts at linear speeds having a differential relation to themselves and to the bottom pair of belts so that bodies contacting the other belts are caused thereby to turn upon themselves until their major axes are parallel with the direction of belt travel and their minimum diameters are normal to the direction of belt travel and they assume a position riding upon the upper reaches of the bottom pair of belts.

2. The sizing apparatus as defined in claim **1** including a plurality of first and second sets of pulleys to provide a plurality of parallel sizing runs.

3. The invention defined in claim **1** including an apron conveyor mounted below the belts and adapted to travel in a direction normal to the travel of the plurality of belts and drive means for said apron conveyor.

4. The invention defined in claim **1** including resilient fingers adapted to project between the plurality of belts to assist in orientation of ovoidal bodies directed to the belts.

5. The invention of claim **1** and including a set of idler pulleys mounted transversely of the bed intermediate the first and second sets of pulleys and providing support for the belts.

* * * * *