United States Patent

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[54] **DEVICE FOR SORTING AND TRANSPORTING PARTICULATE MATERIAL**
13 Claims, 6 Drawing Figs.

[52] U.S. Cl. 209/102
[51] Int. Cl. B07b 13/04
[50] Field of Search 209/102, 100, 103, 107

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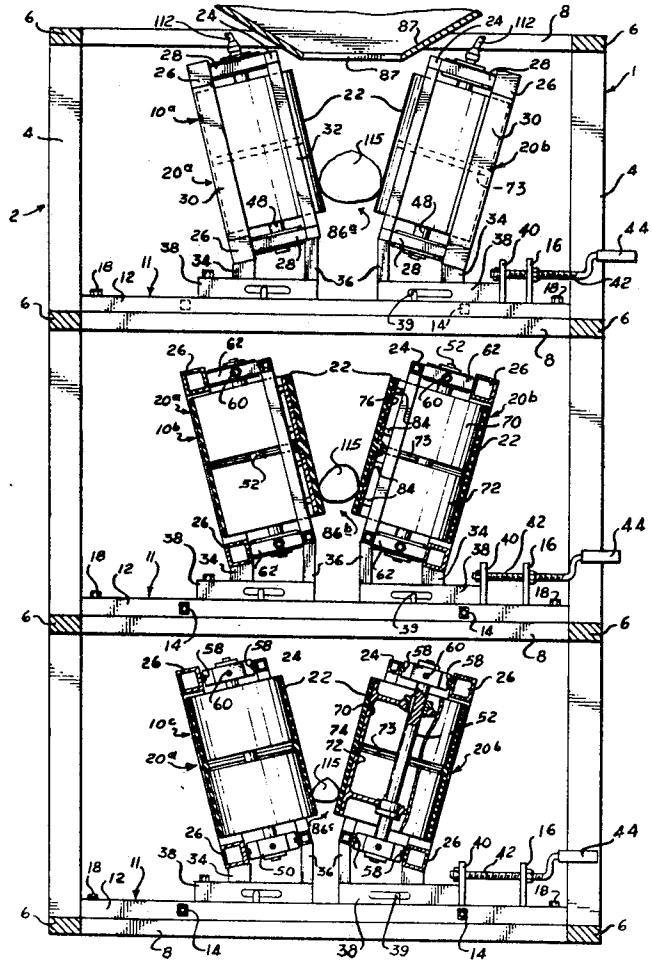
ABSTRACT: An automatic sizing device for solids comprising sets of moving parallel belts wherein belts of the first set are separated a predetermined distance throughout their length, allowing articles being sized of a smaller dimension than the distance between the belts to pass between the belts onto a second set of parallel belts spaced apart a distance less than that of the first set of parallel belts. Other sets of belts may be deposited in any desirable location.



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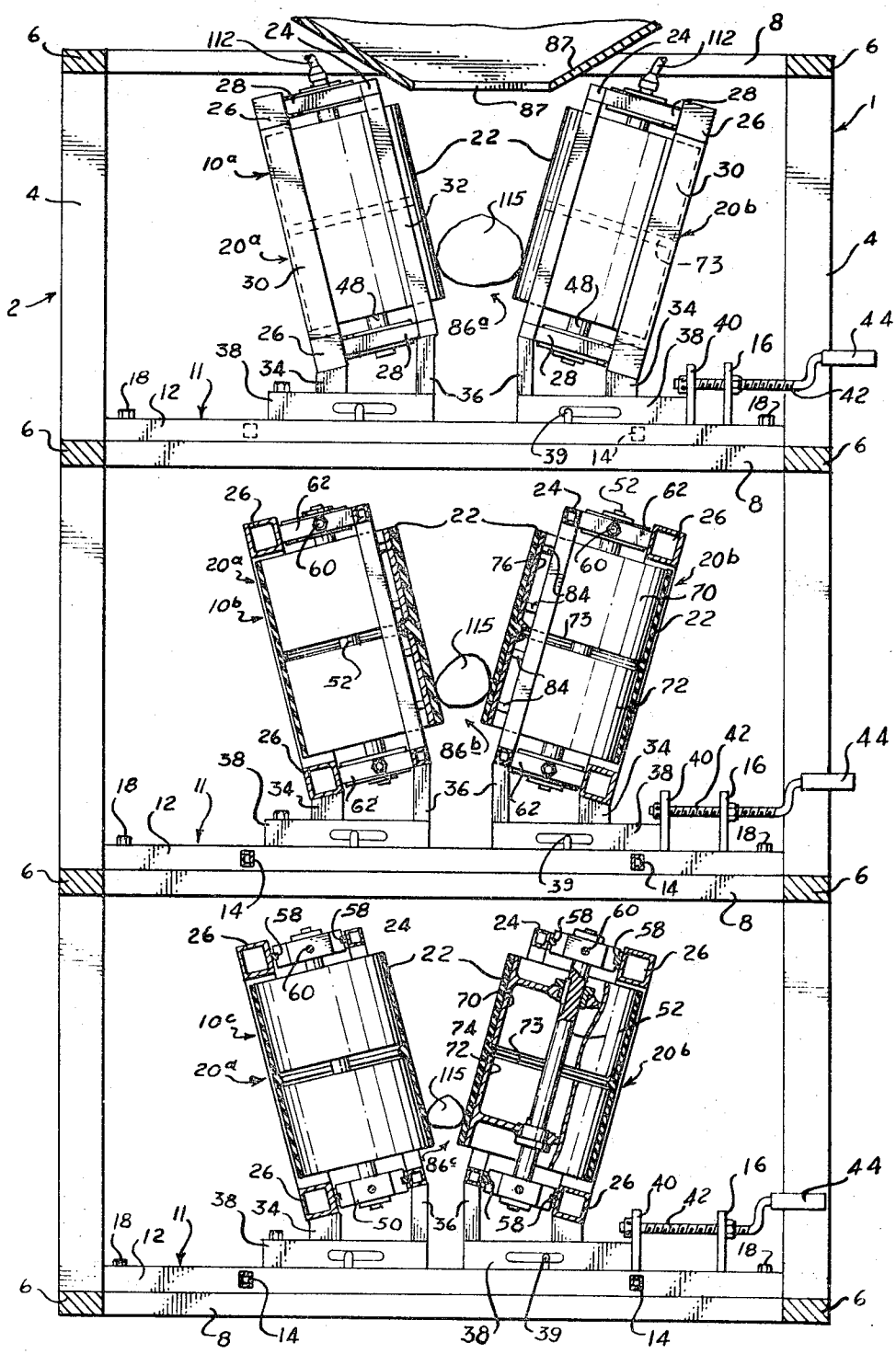

Fig. 1

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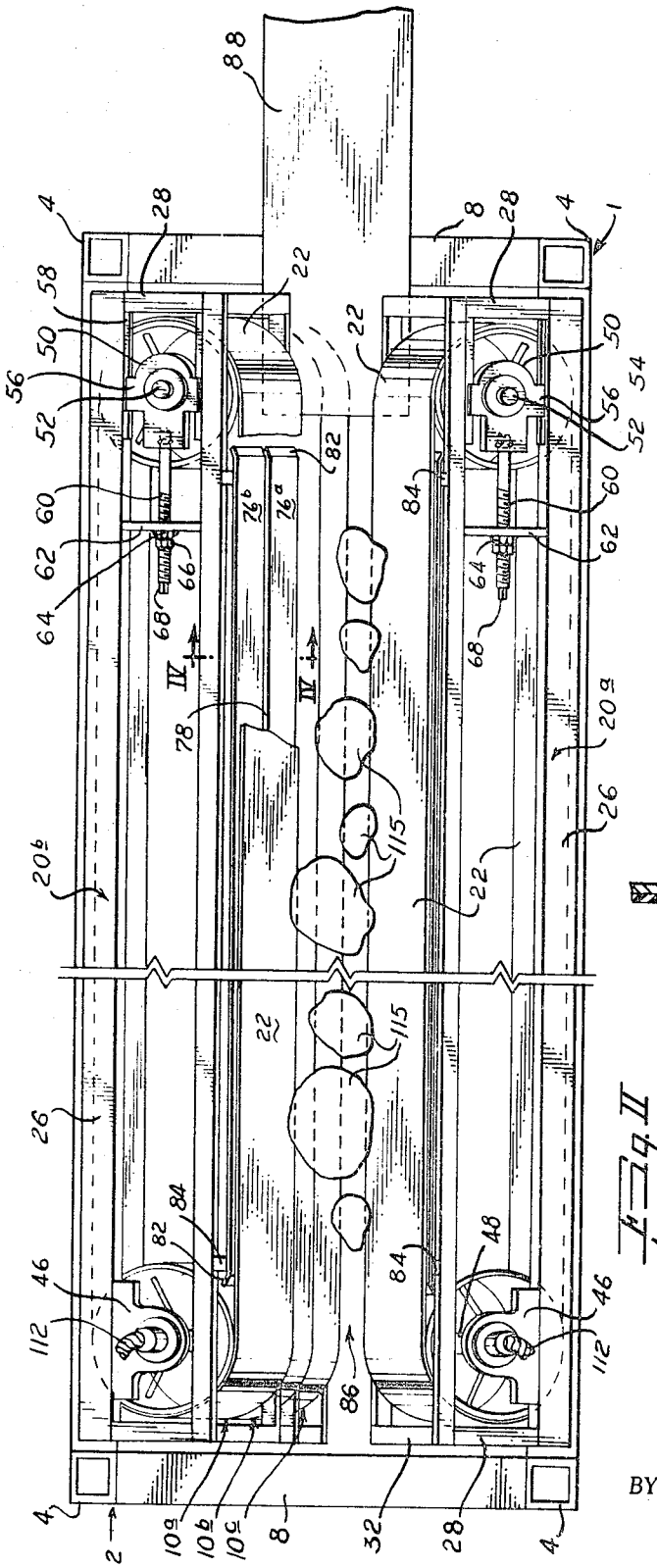

Fig. II

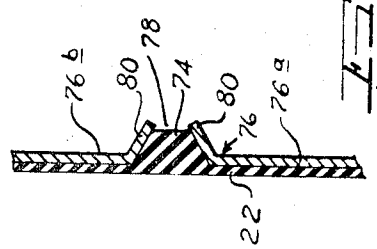

Fig. IV

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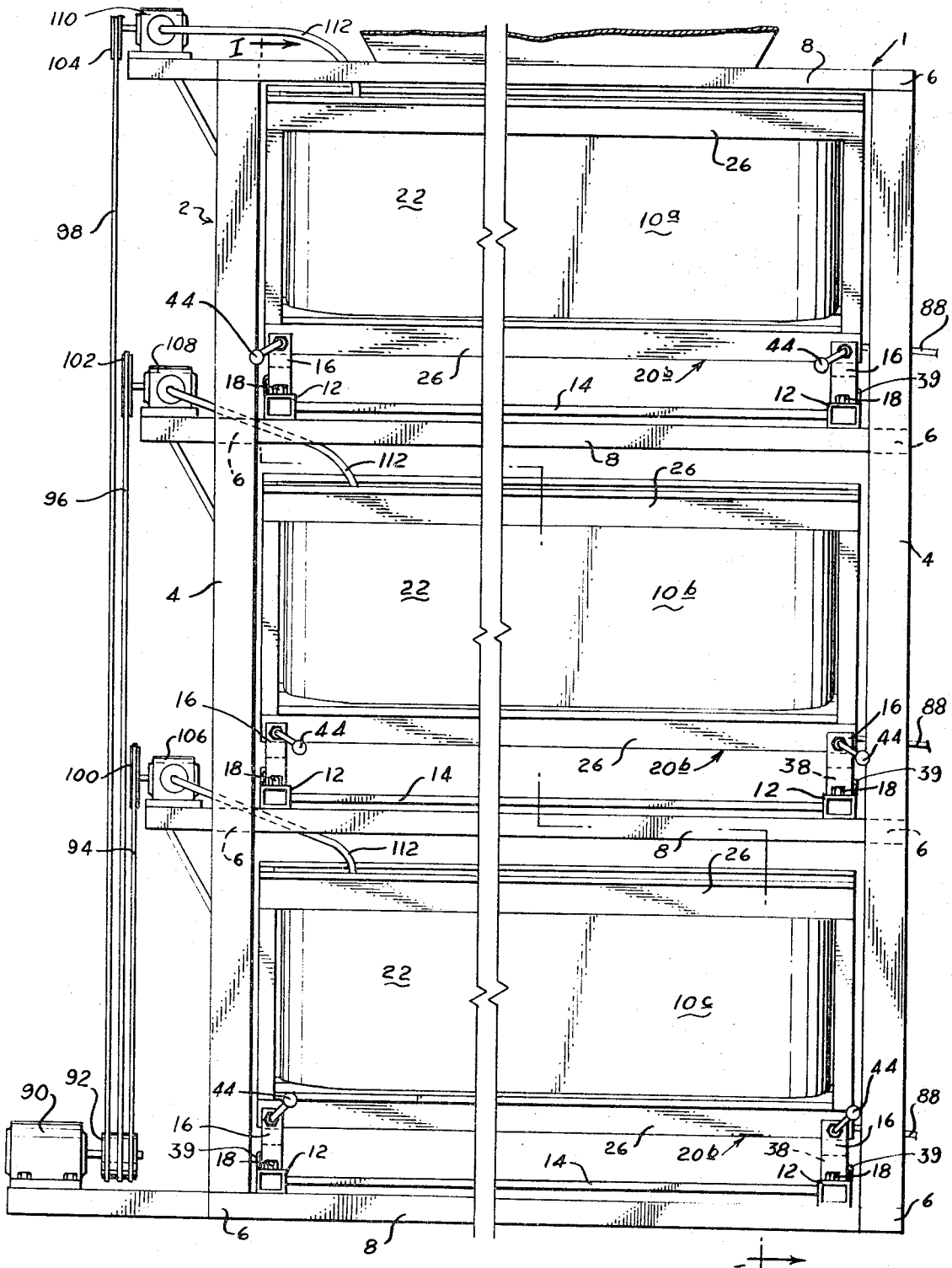

Fig. III

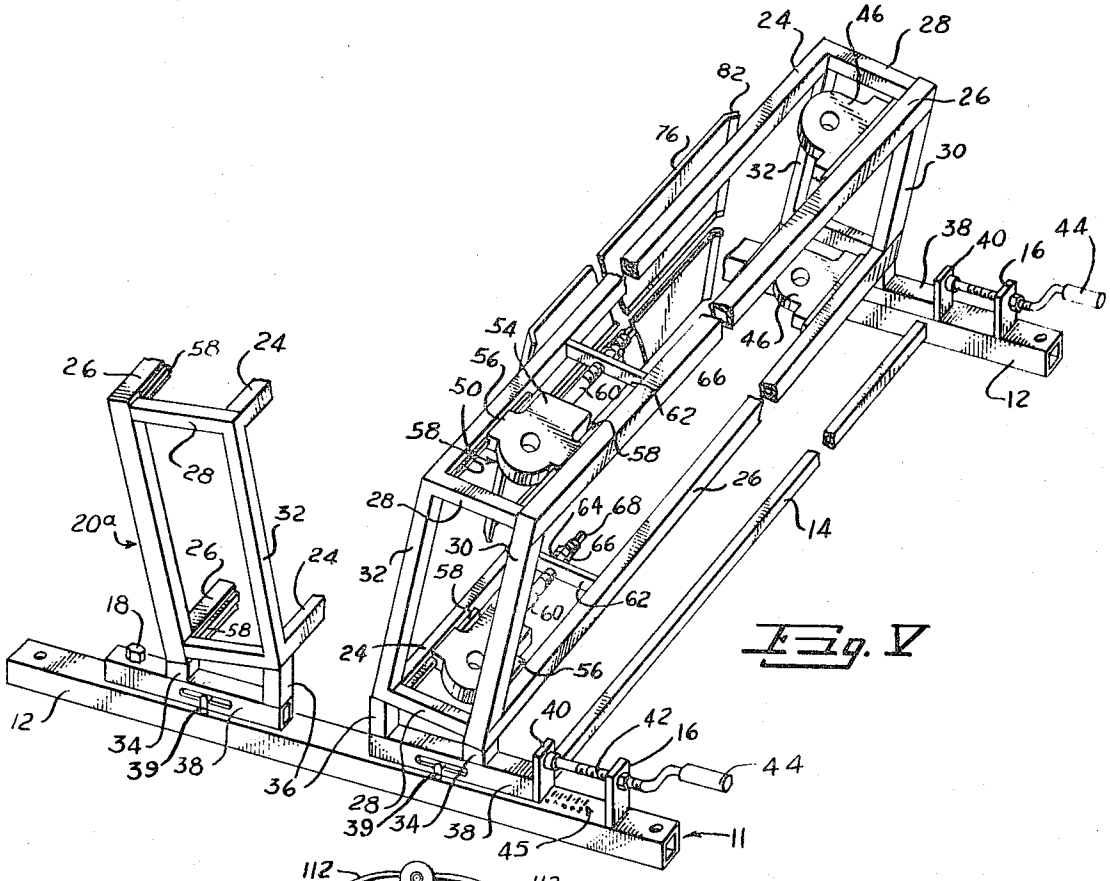

Fig. V

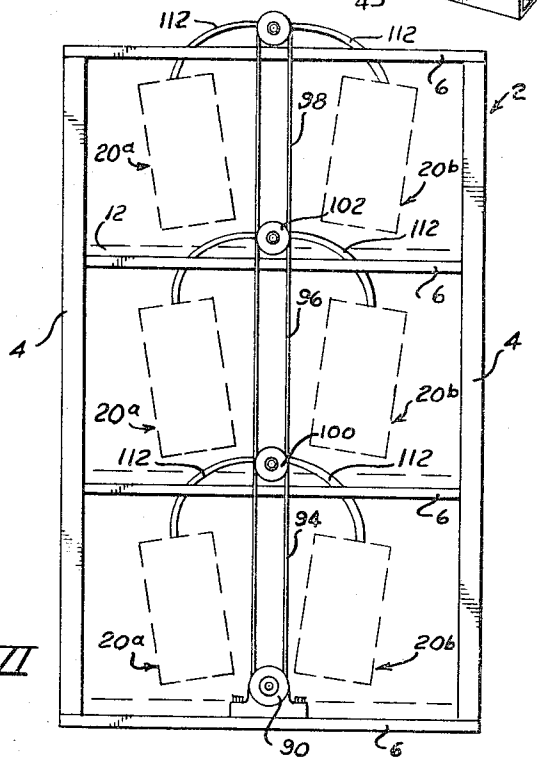

Fig. VI

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DEVICE FOR SORTING AND TRANSPORTING PARTICULATE MATERIAL

BACKGROUND OF THE INVENTION

Sizing machines heretofore developed have consisted of vibrating screens, diverging belts and diverging bar construction. These sizing machines have had the disadvantage of scuffing the articles being sorted and are large, cumbersome machines which required considerable time for changing sizes of the assortment.

One class of sizing machines heretofore used employed vibrators having superposed grids for the openings, utilizing one grid for each size. These grids have approximately 75 per cent open area with the remaining 25 per cent being consumed by wire strands. Objects falling through the grids are often damaged due to wedging, scuffing, and impacting with the vibrator itself. Each grid has to be changed to vary the size of the assortment.

Another class of sizers heretofore used employed vibratory conveyors to slide objects being assorted across a wedge-shaped opening. A heavy frame is required to support the vibrating bed and all of the objects being assorted must pass over the narrow portion of the wedge-shaped opening, reducing the capacity of the machine because the largest objects are the last to fall through the opening.

Another class of sizing machines uses diverging rollers and has the same disadvantages as the device using wedged-shaped openings.

A still further sizing device uses diverging belts and the primary disadvantage of this device is that the larger objects fall through the opening between the belts last and therefore clog the device reducing the capacity thereof.

SUMMARY OF INVENTION

The present invention uses sets of parallel belts stacked one above the other with the opening between the sets of belts being of progressively less width from the topmost down with the opening between the top belts being the largest width to move the largest objects first, thereby eliminating the most serious disadvantages of all sizing devices heretofore used.

A primary object of the present invention is to provide a sizing device with a very large capacity which will not scuff or otherwise damage the articles being assorted.

Another object of the present invention is to remove the largest diameter objects first to prevent unnecessary consumption of space, thereby reducing the overall size of the sorting device for a given capacity.

Another object of the invention is to provide a sorting device in which the open area afforded to the objects being sorted is 100 per cent.

A still further object of the present invention is to provide a sorting device in which objects are handled at higher speeds than is possible with existing separating and sorting devices.

A still further object of the invention is to provide a sorting device wherein the articles assorted are not damaged by scuffing, impact or wedging.

A still further object of the present invention is to provide a sizing device with novel adjusting means for varying the opening therein and consequently the various sizes of the objects in each assortment.

A still further object of the invention is to provide a sizing device which requires minimum handling of the objects assorted.

Another object of the invention is to provide a sorting device of simple economical construction which is easy to operate and requires minimum maintenance.

Other and further objects of the present invention will become apparent from the following description of a preferred embodiment taken in connection with the accompanying drawings and claims.

DESCRIPTION OF DRAWINGS

The accompanying drawings are provided so that the invention may be better and more fully understood, in which:

FIG. I is a cross-sectional view taken along lines I–I of FIG. III;

FIG. II is a plan view of a sizing device embodying the present invention with parts broken away to more clearly show details of construction;

FIG. III is a side elevation of the sizing device shown in FIG. I with parts broken away to more clearly illustrate details of construction;

FIG. IV is a cross-sectional view taken substantially along lines IV–IV of FIG. II with parts broken away to show details of construction of the slider bed;

FIG. V is a perspective view of a frame bed removed from the frame; and

FIG. VI is an end view showing a suitable drive means.

Numeral references are employed to indicate the various parts shown in the drawing and like numerals indicate like parts throughout the various figures of the drawing.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings the numeral **1** generally designates a suitable form of the present invention. A frame **2** with upright standards **4**, longitudinal beams **6** and cross sills **8** are provided to support a plurality of sizing units generally designated by the numerals **10***a*, **10***b* and **10***c*, as best seen in FIG. II of the drawing.

Each sizing unit has a rectangular bed plate **11** having end sills **12** joined by longitudinal members **14**. Each end sill **12** has an upstanding lug **16** mounted thereon to which adjusting means may be secured as hereinafter explained. As best seen in FIG. II of the drawing, the rectangular bed plate **11** of each sizing unit is supported by the frame **2** and suitable means such as bolts **18** are provided for detachably securing the bed plate to frame **2**.

A pair of box frame beds **20***a* and **20***b* are mounted on each rectangular bed plate for supporting gauging belts **22** in a desired relationship one to the other.

Each box frame bed **20***a* and **20***b* has inner and outer sills **24** and **26** respectively extending longitudinally of the bed connected by cross members **28** and inclined stanchions **30** and **32**, forming a box frame. The box frame is supported by spacer members **34** and **36** which extend upwardly from carriage members **38** positioned in spaced apart relation at opposite ends of the box frame.

Each sizing unit **10** has a first box frame bed **20***a* bolted or otherwise rigidly secured to end sills **12** of the bed plate. The carriage **38** of the second bed **20***b* is adjustably fixed to the end sills **12** to allow adjustment of the distance between the belts **22** while guides **39** maintain proper alignment. A plate **40** is welded or otherwise securely fixed to a portion of carriage **38** and one end of a micrometer adjusting screw **42** is attached thereto. The screw **42** passes through a threaded portion of lug **16** extending upwardly from end sills **12**. The handle **44** is provided at one end of screw **42** for turning the same. When handle **44** is turned one belt **22** will be moved with relation to the other belt **22** and the distance between the belts may be determined by reading from the indicator **45**.

As best seen in FIG. II, a bearing **46** is bolted or otherwise securely attached adjacent one end of outer sills **26** of each bed **20** forming a journal for power-driven shaft **48**.

Adjustable bearings **50** are mounted in spaced apart relation from bearings **46** forming a journal for idler shaft **52**. The bearing **50** is mounted to a movable carriage **54** which has outwardly extending channel members **56** thereon which ride upon guide members **58** extending inwardly from inner sill **24** and outer sill **26**. Adjustment screw **60** extends between carriage member **54** and cross bar **62**, which extends between inner sill **24** and outer sill **26**, and has a nut **64** welded or otherwise securely attached thereto for engaging the adjustment screw **60**. A jam nut **66** is provided to prevent loosening of the adjustment screw. A square portion **68** is provided on the outer end of adjustment screw **60** to facilitate turning thereof with a wrench. Rotation of screw **60** will cause bearing **50** to move longitudinally of bed frames **20***a* or **20***b*.

Each shaft **48** and **52** journaled in bearings **46** and **50** respectively have a pair of pulleys **70** and **72** mounted thereon in close end to end relation with a space **73** therebetween for receiving bead **74** protruding from a central portion of belt **22** extending longitudinally therealong.

The tension of the belt **22** may be adjusted using adjustment screws **60**.

As best seen in FIGS. IV and V a slider bed **76** is positioned behind each belt **22** forming a rigid backing therefor. The slider bed **76** consists of spaced apart parallel plates **76***a* and **76***b* with an elongated slot **78** therebetween for receiving bead **74** on belts **22**. Each parallel plate has a folded flange portion **80** shaped to complementarily receive the bead **74**. Each plate also has a folded flange portion **82** at each end thereof to prevent undue wear upon the belts **22**.

Spacers **84** mounted on the face of inner sill **24** hold slider beds **76** in close relation with belt **22**.

As is apparent from FIG. I, the purpose of slider bed **76** is to form a rigid backing for belts **22** and by reason of rib **74** running in slot **78** maintaining the lower edges of belts **22** straight and parallel one to the other and preventing the belts from slipping off the pulleys therefor.

As is best seen in FIG. II, belts **22** of each sizing unit **10***a*, **10***b* and **10***c* are disposed at a slight incline forming a through shaped conveyor with a uniformly spaced opening **86** the width of which may be increased or decreased by turning handle **44** of the adjustment screw **42**.

Sizing units **10***a*, **10***b* and **10***c* are stacked one above the other with opening **86***a* being wider than opening **86***b* which in turn is wider than opening **86***c*.

The objects **115** to be sized are placed into sizing unit **10***a* which has the widest opening **86***a* of the sizing units. The belts on the sizing units are rotated to agitate and convey the objects. Objects of a diameter larger than opening **86***a* will be retained upon the belts **22** of sizing unit **10***a* while objects of lesser diameter will fall through the opening to the belts of sizing unit **10***b*. Objects with a diameter larger than **86***b* will be retained upon the belts of sizing unit **10***b* while items of smaller diameter will fall through to sizing unit **10***c*. The sized objects are moved by the rotating belts to the ends and deposited on a conveyor or container **88**. Suitable means such as hopper **87** may be provided for loading the belts.

Each sizing device **10***a*, **10***b* and **10***c* may be of identical construction or they may be constructed with the belts of sizing unit **10***a* wider than the belts of sizing unit of **10***b* depending upon the nature of the sizing operation. For uniformly graded objects which are to be assorted into three sizes, approximately one third of the objects will be retained upon the belts of each sizing device. It might in this instance be desirable to make the belts on unit **10***a* wider than the belts on unit **10***b*. However, for sizing objects which are not uniformly graded, it is conceivable that substantially all of the objects might fall through opening **86***a* onto sizing device **10***b* requiring the capacity of sizing device **10***b* to be substantially the same as that of sizing device **10***a*.

While it is contemplated that the belts of each sizing unit will run at the same speed, it may be desirable for one belt of a given sizing unit to travel at a speed greater than the other belt, such as in grading elongated or elliptically shaped objects such as cucumbers. With one belt traveling faster than the other, elongated objects lying crosswise in the trough will be turned so as to align their longest axes parallel to the length of the trough.

Any suitable drive means may be utilized to rotate the belts **22**. All of the belts may run in the same direction or the belts of alternate sizing devices may run in opposite directions whichever is more expedient in a given situation. Conveyors **88** may be provided to remove the assorted articles from the ends of the belts **22**.

Each sizing unit may be powered separately or a single power unit may be provided for driving the entire sizing device. A suitable drive means is shown in FIG. III in which an electric motor **90** drives a multisheave pulley **92** which carries belts **94**, **96** and **98** to drive pulleys **100**, **102** and **104** mounted upon the shaft of gear reducers **106**, **108** and **110** respectively. Flexible couplings **112** may be used for transmission of power from the reducers **106**, **108** and **110** to the power driven shaft **48** and consequently the pulleys **70** and **72** providing a means for rotating the belts **22**.

It should be noted that the purpose of bead **74** upon the inner face of belts **22** is to maintain alignment of the belt **22** with respect to pulleys **70** and **72**. The bead is carried in grooves **73** between pulleys **70** and **72** and in slot **78** in the slider bed **76**, thereby eliminating the possibility of the belt **22** creeping up the pulleys **70** and **72** causing the opening **86** between the belts to vary.

While the specific details of one embodiment of the present invention have been herein shown and described, changes and alterations may be resorted to without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a device for sizing solids, a general frame; a plurality of sizing units stacked vertically on said frame, each sizing unit including a bed plate detachably secured to the general frame; first and second frame beds; a carriage at each end of each frame bed; means for fixedly securing the carriage of the first frame bed to the bed plate; means for adjustably attaching the carriage of the second frame bed to the bed plate; adjustment means for moving the second frame bed relative to the first frame bed; a power shaft and an idler shaft journaled adjacent opposite ends of each frame bed; pulley means mounted on each power shaft and idler shaft; endless belts mounted on said pulley means driven by said power shaft; the belt carried by the first frame bed having edges disposed in parallel relationship to the belt carried on the second frame bed, forming a trough-shaped container having an elongated opening in the bottom thereof with parallel edges and downwardly converging sides; and power means connected to each power shaft for rotating the belts.

2. The combination called for in claim **1** with the addition of a bead on the inner side of each belt; and a guide slot in each pulley for maintaining alignment between the said belt and the said pulleys.

3. The combination called for in claim **2**, including a slider bed secured to the frame bed behind the gauging belts and a longitudinal guide groove disposed in the slider bed for receiving the bead on the gauging belt for maintaining the gauging belts in parallel relation one to the other.

4. The combination called for in claim **3**, with the addition of a conveyor positioned at one end of each set of parallel belts for receiving items which are retained on said belts.

5. In a sizing device, a frame, a plurality of sizing units stacked vertically on said frame; each sizing unit including a pair of spaced apart gauging belts rotatably disposed in parallel relation on the frame; a separate frame bed for supporting each gauging belt; a carriage associated with each frame bed, the carriage of one frame bed being fixed with relation to the frame while the carriage of the other frame bed of each sizing unit is laterally movable with relation to the fixed bed; means to move the movable frame bed to vary the distance between the parallel gauging belts; a slider bed mounted on each frame bed behind the gauging belt; means slidably engageable between each slider bed and belt to maintain the gauging belt of each sizing device in straight, parallel relation one to the other; and power means for rotating the gauging belts.

6. The combination called for in claim **5**, wherein the means slideably engageable between the slider bed and the belt is a longitudinal guide slot in the slider bed and rib on the belt slideable in the slot.

7. In a sizing device, a frame, a plurality of sizing units stacked vertically on said frame; each sizing unit including a pair of parallel spaced apart gauging belts rotatably disposed on the frame; a separate frame bed for supporting each gauging belt; a carriage associated with each frame bed, the carriage of one frame bed being fixed with relation to the frame.

while the carriage of the other frame bed of each sizing unit is laterally movable with relation to the fixed bed; means to move the movable frame bed to vary the distance between the parallel gauging belts; a power shaft and an idler shaft journaled adjacent opposite ends of each frame bed; drive means connected to the power shaft; and means operably connected to the idler shaft for adjusting the belt tension.

8. In a sizing device, a general frame; a plurality of sizing units mounted in superposed relationship on the frame, each sizing unit comprising, a pair of side-by-side belts, said belts being downwardly converging toward each other with the lower edges thereof disposed in parallel relationship, the lower edges of the pairs of belts in the respective sizing units being progressively spaced apart less from the topmost down; roller means mounted at each end of the frame about which the belts rotate; power means for rotating the roller means; spaced apart guide plates under each belt, providing a continuous groove therebetween; a rib on the inner side of each belt movable in said groove; and a circumferential groove in each roller means to receive the rib to maintain the lower edges of the belts in parallel alignment.

9. In a device for sorting and transporting particulate material, a frame; gauging belts rotatably mounted in spaced apart parallel relation on the frame; said belts being arranged to form a trough-shaped container with downwardly converging sides and having an elongated opening in the bottom thereof with parallel edges; guide means on the frame extending longitudinally thereof; means on the gauging belts slidably engageable with the guide means on the frame to maintain each gauging belt in straight, parallel relation to the other gauging belt; and power means for rotating the gauging belts.

10. The combination called for in claim 9, wherein the guide means on the frame is a longitudinal slot and the guide means on the belt is a rib constructed and arranged to be slidably disposed in the longitudinal slot.

11. In a sizing device, a frame, a plurality of sizing units stacked vertically on said frame; each sizing unit including a pair of spaced apart gauging belts forming a trough-shaped container having an elongated opening in the bottom thereof, said belts being rotatably disposed on the frame; members extending along a portion of the length of the gauging belts; means slidably engageable between the members and the gauging belts to maintain the gauging belts in straight, parallel relation one to the other; and power means for rotating the gauging belts, said sizing units being arranged to progressively remove items from an assortment of sizes from large to small such that items of lesser diameter than the width of the opening in an upper trough fall into a lower trough-shaped container.

12. The combination called for in claim 11, with the addition of a separate frame bed for supporting each gauging belt; a carriage associated with each frame bed, the carriage of one frame bed being fixed with relation to the frame while the carriage of the other frame bed of each sizing unit is laterally movable with relation to the fixed bed; and means to move the movable frame bed to vary the distance between the parallel gauging belts.

13. In a sizing device, a frame, a plurality of sizing units stacked vertically on said frame; each sizing unit including a pair of spaced apart gauging belts forming a trough-shaped container having an elongated opening in the bottom thereof, said belts being rotatably disposed on the frame; a power shaft and idler shaft journaled adjacent opposite ends of each sizing unit; drive means; means for connecting the drive means in driving relation to the power shaft and belts; and means between the belts and the frame of each sizing unit for maintaining desired spacing between the belts, said sizing units being arranged to progressively remove items from an assortment of sizes from large to small such that items of lesser diameter than the width of the opening in an upper trough fall into a lower trough-shaped container.