United States Patent

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[54] **SEPARATOR**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **209/95**
[51] **Int. Cl.** **B07c 3/04**
[50] **Field of Search** 209/86, 95, 113

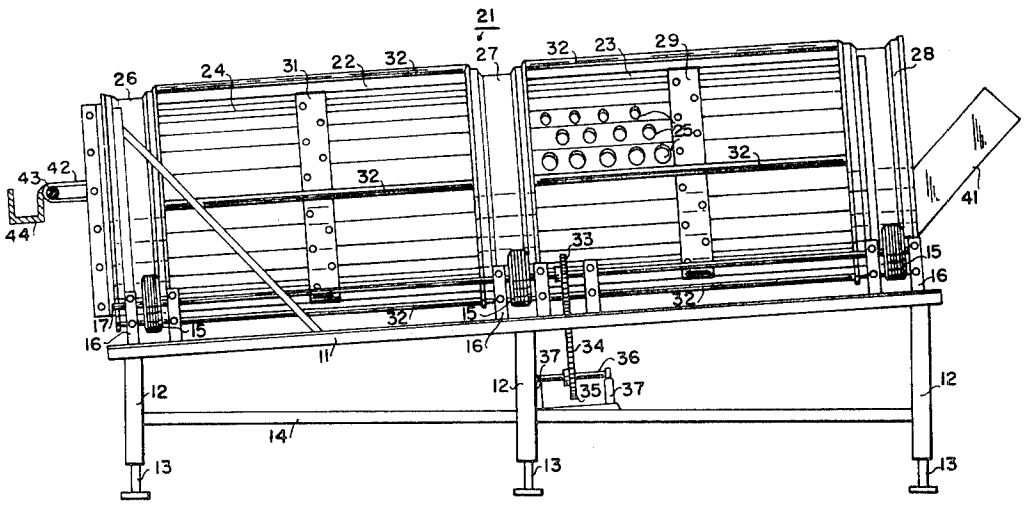
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ABSTRACT: A cylindrical separator comprises a cylinder formed of any suitable material with openings formed in its interior wall. The openings determine the threshold size of the items being separated. Items are inserted into one end of the cylinder which is mounted on an angle with the horizontal and is rotated. Those items which are smaller than the diameter of the openings in the interior wall of the cylinder are carried upwardly by its rotation and are discharged at the top onto a conveyor which carries them away. Those items which are larger than the diameter of the openings remain in the cylinder at the bottom and slowly move to the low end where they are discharged onto another conveyor.



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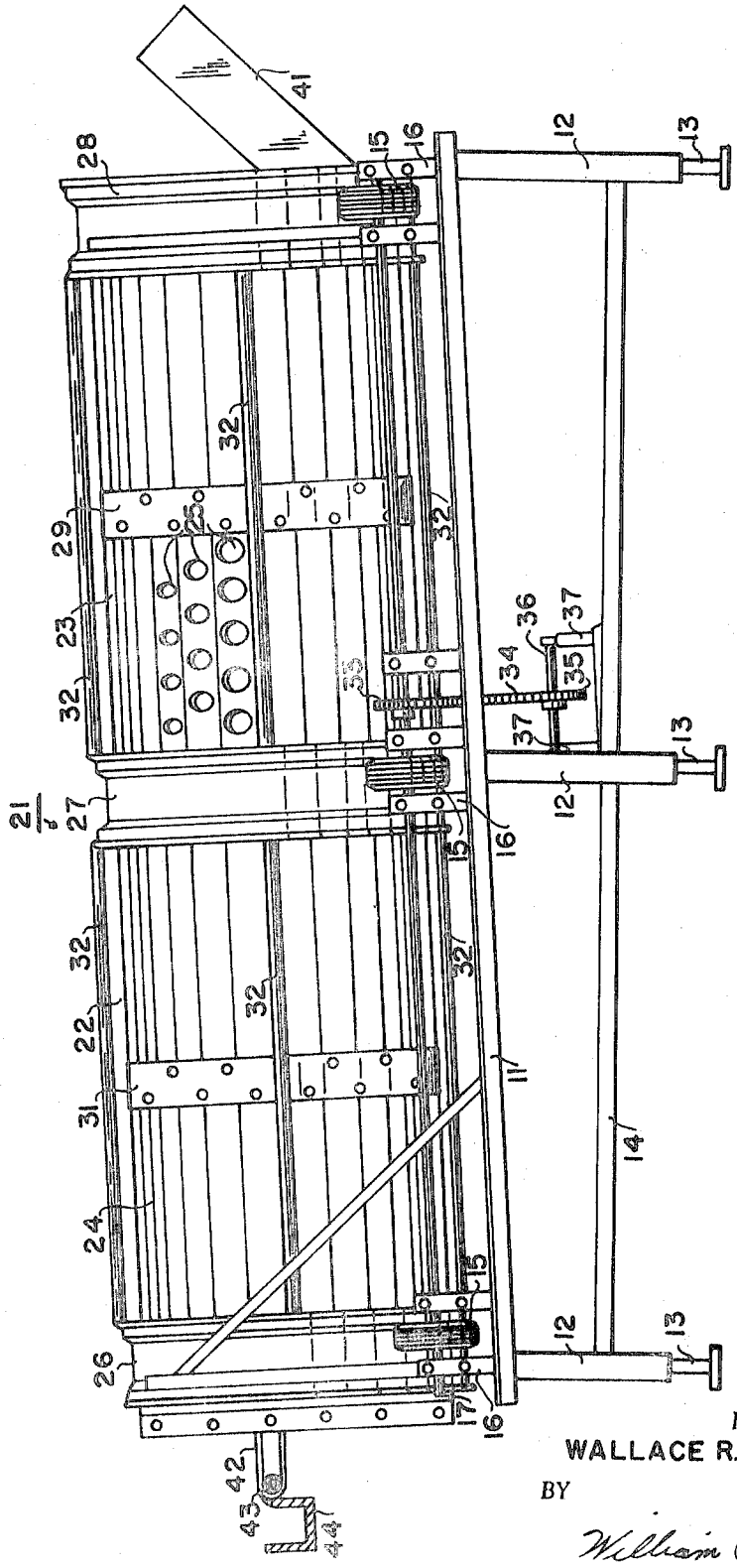


FIG. 1

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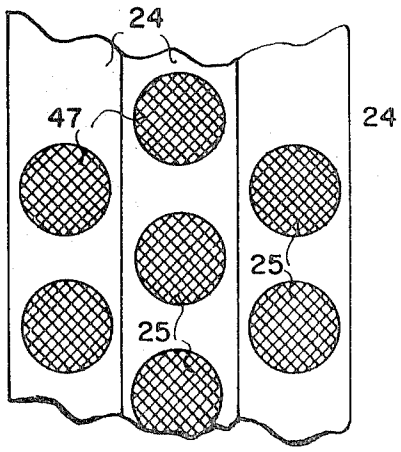


FIG. 3

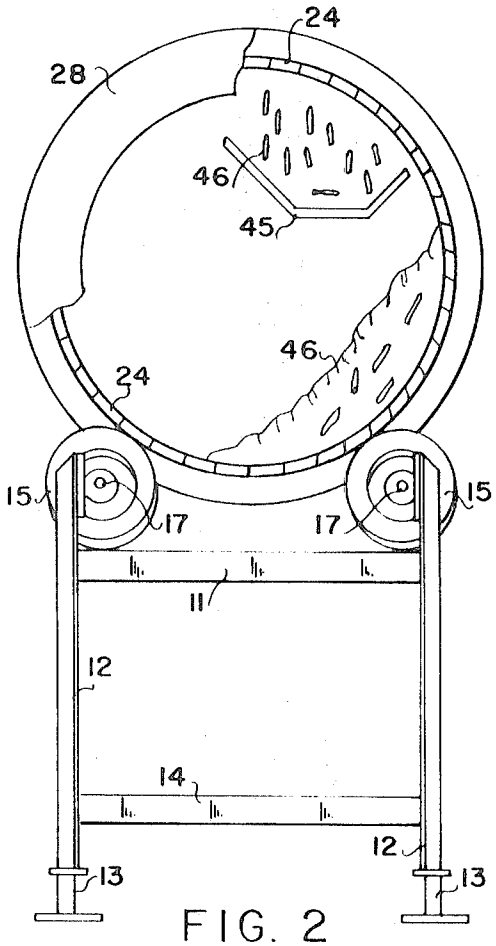


FIG. 2

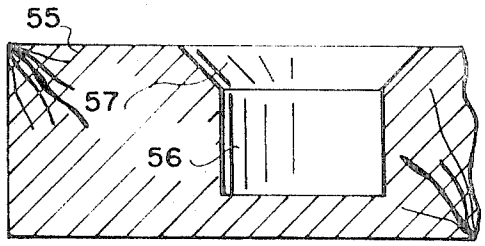


FIG. 5

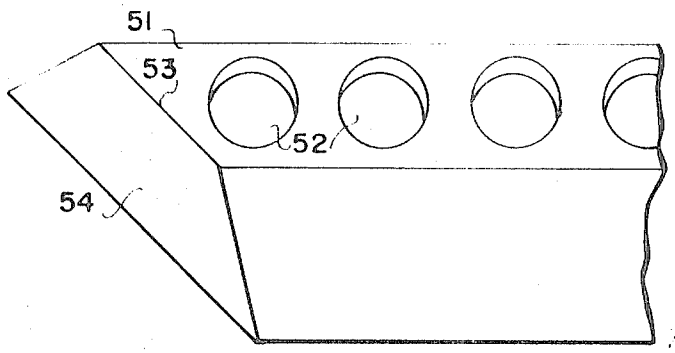


FIG. 4

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This invention relates to separators and, more particularly, to cylinder separators.

Automatic separators are not new but they have not enjoyed as great a popularity as they do now. As the cost of labor rises, the feasibility of using expensive machines to preform those tasks normally performed by manual labor increases. However, automatic equipment is usually very expensive, and in many activities it is still less costly to use human labor than to purchase, operate and maintain automatic equipment. In recent years the amount of automatic equipment used in the food industry has greatly increased because of the higher costs of labor and the decreasing number of itinerant workers. However, because automatic equipment is expensive to purchase, is expensive to maintain, and has not been as effective as human labor, many jobs are still being performed by unskilled workers. The amount or unskilled help is decreasing as the educational level of the population improves, and this results in labor shortages. When the use of expensive automatic machinery is dictated by the shortage of labor, the cost of the end product increases, and in the food industry such increases have been large. Inexpensive automatic machinery is required at all levels of effort in the processing of food. One of the important areas where such equipment is required is in the separation of poor and broken food articles from those which are acceptable. This invention provides one type of such machine.

It is an object of this invention to provide new and improved separation equipment.

It is another object of this invention to provide a new and improved automatic separation equipment.

It is a further object of this invention to provide new and improved automatic equipment for separating items by size.

It is still another object of this invention to provide new and improved automatic cylinder-separating apparatus which is simple in design and operation.

Other objects and advantages of this invention will become more apparent as the following description proceeds, which description should be considered together with the accompanying drawings in which:

FIG. 1 is a side view of the apparatus of this invention;

FIG. 2 is an end view of the apparatus of FIG. 1;

FIG. 3 is a detail view of one embodiment of these invention;

FIG. 4 is a detail view of another embodiment of this invention; and

FIG. 5 is a detail view of a third embodiment of this invention.

Referring now to the drawings in detail, the reference character 11 designates a frame or bed slanted with respect to the horizon by legs 12 which have adjustable feet 13. A lower frame member 14 reinforces the bed 11 and renders it more rigid. Mounted on each side of the frame 11 by means of vertical support members 16 are three wheels 15. A cylinder 21 rests on the wheels 15. The cylinder 21 comprises a plurality of staves or boards 24 spaced about end rims 26, 27 and 28 which are held together by rods or pipes 32 spaced 90° apart. In addition, bands 29 and 31 surround the cylinder about halfway between the rims 26 and 27 and 28. The cylinder 21 is supported on the wheels 15 so that the wheels 15 are in contact with the rims 26, 27 and 28. Each of the wheels 15 is rotatably supported on a shaft mounted on the vertical supports 16 with the wheel 15 adjacent the rim 27, which is the central rim, fixedly mounted on a rotatably shaft 30 to which a sprocket gear 33 is attached. A sprocket chain 34 passes over the gear 33 and over another gear 35 which is attached to a rotatable shaft 36. The shaft 36 is supported on vertical supports 37 mounted on the reinforcing member 14. The shaft 36 may be rotatably driven by any suitable means, not shown. Each of the staves of boards 24 are perforated by large diameter, generally cylindrical holes 25, only a few of which are shown in FIG. 1. At the high end of the cylinder 21 a chute or funnel 41 is mounted for supplying items to be separated to the interior of the cylinder 21, and a conveyor 42 is mounted within the cylinder 21 generally parallel to the longitudinal axis to carry to a trough or other conveyance 44 the separated items. The conveyor 42 normally extends the entire length of the cylinder 21 and may be driven by any suitable means connected for example, to the shaft 43. A second conveyor which may be at right angles to the longitudinal axis of the cylinder 21 carries away the items which exit from the low end of the cylinder 21 and are not carried off by the conveyor 42.

FIG. 2 shows the manner is which the cylinder 21 is supported on the wheels 15 and how the staves 24 abut each other to form the cylinder. In addition, a channel 45 containing the conveyor 42 but not so shown in FIG. 2 is shown at the upper right of the cylinder 21. A portion of the end rim 28 has been shown broken away so that the interior of the cylinder readily can be seen. Inside the cylinder 21 are shown items 46 which are being separated by size.

In one embodiment of the invention, the cylinder 21 is comprised of separate boards or staves 24 which are perforated by generally circular holes 25 which completely penetrate the boards 24. In order to prevent the items being separated from falling though these holes 25, the individual staves 24 are converted by a screen or mesh 47 as shown in FIG. 3, which illustrates the appearance of some of the staves 24 as seen from the interior of the cylinder.

The cylinder 21 is formed to two separate portions joined by the rim 27. But this form of construction is really for convenience and not necessary. If desired, the cylinder 21 can be formed as a single long device having rims at either end and, when necessary, reinforcing means in the center. In any case, the cylinder 21 is open at both ends and is mounted for rotation on the wheels 15. Any or all of the wheels 15 can be driven, but since the loading is fairly light, one drive wheel is normally sufficient. To render the entire assembly as freely rotatable as possible and to reduce the maintenance and increase the life of the apparatus, the wheels 15 could well be mounted on ball or roller bearings. Since the apparatus separates items by size, the diameters of the holes 25 are determined by the type and sizes of the items being separated. For example, assume it is desired to separate broken and bent beams from whole beans. The diameters of the holes 25 could all be the same and could run from 2½ inches to 3¾ inches. In the embodiment shown in FIG. 3, the holes 25 are formed of a uniform diameter through their depths and pass completely through the staves. The staves may be formed of wood which is about three-quarters to 1 inch thick. However, other suitable materials may be used instead of wood, if desired. For example, any strong, lightweight synthetic resin may be used. Most metals result in an assembly which is quite heavy, but if weight is not a disadvantage metal staves may also be used. If the drum or staves are made from either resin or metal materials, the perforations may be cast or molded in a single operation.

In operation, the drive means for the cylinder 21 is started and, as the cylinder is rotating slowly, the items to be separated are inserted into the cylinder 21 at the high end, through the chute 41 for example. Assume that the apparatus is being used to sort broken beans from the whole beans. Since the beans are very fragile—in fact, it is believed that the name snap beans comes from the fact that the beans snap in two so easily—they must be handled gently or the amount of wastage can be readily increased. The rotation of the cylinder 21 gently stirs the beans, and eventually all of them rest on the bottom of the cylinder as they gradually tumble from the high input end to the low output end. Those beans which are smaller in length than the diameter of the holes will drop into the holes, usually one bean per hole. The rotation of the cylinder 21 carries the beans which are in the holes upwardly until they reach the top of the drum 21. Gravity then causes the beans resting in the holes at the top of the rotation to drop out of the holes 25 onto the conveyor 42 in the trough 45. Those beans which are too long to remain in the holes 25 gradually move, by gravity, from the high end of the drum 21

to the low end, and are discharged onto a second conveyor, not shown. Thus, the high-quality items are discharged from the drum itself, and the lower quality items are carried out by the conveyor **42**. By using conveyors, the items are carried away as they emerge from the cylinder **21** and not in batches. In this way, further processing is made easier.

It is desirable to have the holes **25** deep enough so that items which fall therein do not just slip out again. No separation would occur if that happened. But it is also important that the broken or small-size items do not fall through the holes in the cylinder **21**. To prevent this, in the embodiment shown in FIG. **3**, each stave is covered on the outside with a wire mesh **47**. The wire mesh must be fairly close to prevent small burrs and the like on the items being separated out from catching in the mesh and preventing the release of the items onto the conveyor **42**. Although it might be less expensive to cover the entire drum **21** with mesh when it has been assembled, the application of the mesh to each stave individually provides much easier maintenance and repair. In that way, any one stave can be replaced easily. The holes **25** are shaped and sized to separate the particular items desired. For example, as mentioned above, holes which are from 2½ inches to 3¾ inches in diameter and generally circular are suitable for separating whole beans from broken beans. For cucumbers, the holes **25** are generally oval in shape with a long dimension from 3 inches to 7 inches and a short dimension which could range from one-half inch to 2 inches. Or, the separation can be done in stages, with cucumbers being separated by holes of one size in one part of the cylinder **21** and with holes of a large size in a second part of the cylinder. In this way the smaller cucumbers are separated out first, then the medium-size ones and finally the largest ones. Each portion of the cylinder **21** would have its own conveyor **42** and trough **45**. Although elongated objects such as cucumbers are inserted in the cylinder **21** in random arrangement, as the cylinder rotates, the elongated items tend to align themselves with the longitudinal axis of the cylinder. Therefore, the elongated openings **25** are also aligned with their long axes generally parallel to the longitudinal axis of the cylinder. Other items than cucumbers and beans may be separated by this invention. Among them are most of the fruits and vegetables, balls, nuts, etc. It should be borne in mind that the basic principle of operation of the apparatus of this invention is that all items less than a prescribed size are eliminated. Thus, the apparatus separates out not only the broken beans and undersized cucumbers and the like but also removes stones, chaff and other foreign items, leaving the best of the lot for packing. In addition to being capable of separating a wide variety of items by utilizing holes of a plurality of sizes and shapes, the apparatus of this invention is readily of different rotational speeds. The size of the gears **35** can be readily changed, and if a single bed is to be permanently installed with replaceable cylinders **21**, a transmission can be substituted for the single gear **35**. The capability of varying speed is often very important for devices of this nature. If metal objects are being separated, the cylinder **21** can be rotated at a rather high speed which is limited only by the thoroughness of the separation. However, when tender fruits or vegetables are being separated, it is often important to have the cylinder **21** rotate at a rather slow speed. This may slow down the speed of separation, but it prevents undue roughness and bruising of the items tumbling within the cylinder **21**. As mentioned, it is possible to have a line of separators with the output of one feeding the input to another. In such a system it is important that individual conveyors **42** be provided to carry the discarded articles away. In such an installation, it is often desirable to have the cascaded cylinders **21** arranged with holes **25** of increasing sizes so that each cylinder in the series separates out its own-size articles. If the frames **11** are permanently installed, the cylinders **21** can be lifted off the frames **11** and replaced with the cylinders having the proper-size holes. In addition, it is feasible to use the same beds **11** with cylinders of several types.

As mentioned above in connection with FIG. **3**, the staves **24** can contain perforations **25** which completely penetrate them. In that case, the outside of the staves **24** must be covered with a wire screen **47** or the like to keep the materials being separated from falling through. However, there are other ways in which this may be accomplished. For example, FIG. **4** shows a portion of a stave **51** having holes or openings **52** only part way through. The stave **51** is shown with a larger dimension **54** and a smaller dimension **53**. The smaller end dimension **53** is the edge of the stave **51** which is in the interior of cylinder **21**. Since the inside diameter of the cylinder **21** is smaller than the outside diameter, the inner width of each stave is smaller than the outer width of the same staves. For thin staves **51**, the difference in the sizes of the two widths is not great, but for the thicker staves, the difference becomes more pronounced. As shown in FIG. **4**, the stave **51** is thick in order to provide an opening **52** which does not go all of the way through. The openings or pockets **52** can be formed in any suitable way such as by drilling, but the bottoms must be left intact.

The openings **52** as shown in the stave **51** are of a generally cylindrical shape having the same diameter through its length. However, the openings need be all formed in that way. FIG. **5** is a sectional view of a portion of a stave **55** having a pocket formed therein. The opening has a small diameter **56** in its bottom portion and a tapering conical portion **57** which grows larger toward the outside surface. The conical portion **57** of the opening acts as a funnel and permits the items being separated to more easily enter the opening, and the cylindrical portion **56** tends to retain the items which enter it until the appropriate position in the rotation of the cylinder is reached. In the case of the stave **55** shown in FIG. **5** as well as the stave **51** shown in FIG. **4**, the openings are not formed all of the way through the stave so that the application of additional material on the outside of the stave to keep the items being separated in the cylinder **21** is not necessary. Since the openings in both FIGS. **4** and **5** can be formed in one operation by an appropriately shaped cutter, it is less expensive to form the bottomed openings of these figures than the holes **25** with the covering mesh **47**.

The above specification has described a new and improved device for separating articles by size. The separator of this invention is inexpensive to manufacture and to maintain, and its operation is simple and effective. The above description also includes details of operation and of modification, indicating the separator of this invention to be versatile.

What is claimed is:

1. A gravity separator for separating discrete items of a generally uniform nature into at least two groups, one of which groups contains items larger than a selected dimension and the other of which groups contains items smaller than that dimension, said separator comprising a slanted bed and a unitary cylinder removably supported for rotation on said bed, said bed comprising a frame, a plurality of legs supporting said frame on a slant, means for bracing said legs to provide a rigid support, a plurality of wheels mounted on said frame for rotatably carrying said cylinder, and means for driving at least one of said wheels in rotation, said wheels frictionally rotating said cylinder, said unitary cylinder comprising at least a pair of rigid grooved cylindrical end members, a drum arranged with its ends resting against said end members, and brace means distributed about said cylinder and connected to said end members to draw said end members toward each other against the ends of said drum to form a unitary cylindrical structure which readily can be lifted off said supporting wheels, the grooves in said end members being shaped to accommodate said wheels so that said cylinder is supported thereon by gravity, said drum having pockets formed in the insides surface thereof, said pockets being dimensioned readily to receive and discharge items of said other group as said cylinder rotates, and means within said cylinder for receiving items of said other group as said cylinder rotates and for maintaining the separated items of said other group separate from the items of said one group.

2. The gravity separator defined in claim 1, wherein the pockets in said drum are perforations through said drum, said drum further including an outer covering serving as a bottom to said perforations.

3. The gravity separator defined in claim 1 wherein said pockets are uniform in transverse size through their depths.

4. The gravity separator defined in claim 1, wherein said pockets have a varying transverse dimension through their depths.

5. The gravity separator defined in claim 1, wherein said cylinder comprises a plurality of separate drums placed in tandem with an end member at each end of said cylinder and an end member between each pair of drums, said drums comprising pockets of differing sizes so that said separator performs a series of separating functions within the same cylinder, and means contained within said cylinder for maintaining separate each of the separate groups of items.