United States Patent [19]

Walker

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[45] **Jan. 30, 1973**

[54] SCREENING CONVEYOR

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[73] Assignee: **FMC Corporation,** San Jose, Calif.

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[21] Appl. No.: **66,512**

[52] **U.S. Cl.** **209/307,** 209/102

[51] **Int. Cl.** **B07b 1/10**

[58] **Field of Search** ..209/92, 102, 307, 308; 171/12; 198/190

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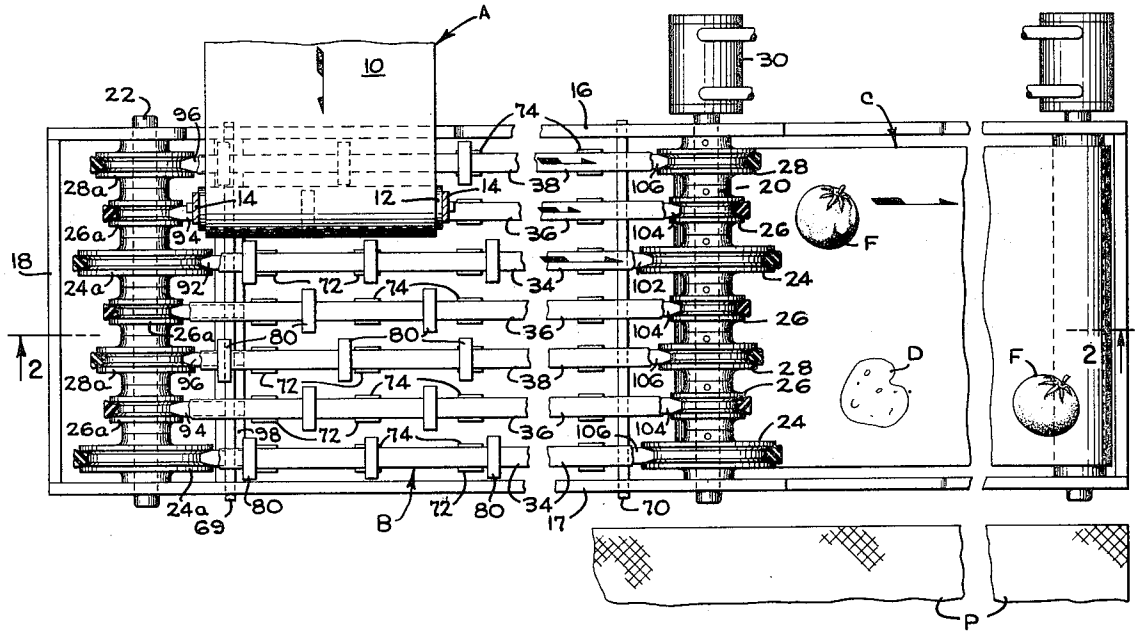
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[57] **ABSTRACT**

A screening conveyor for sifting out undersized fruit and breaking up and sifting out clods of dirt or similar materials includes longitudinally spaced drive and idler pulley shafts with each shaft mounting a row of different diameter pulleys on one shaft aligned with matched pulleys on the other shaft to form matched pairs of pulleys. V-belts are trained around the matched pairs of pulleys to form a series of troughs of a uniform depth. The drive shaft causes adjacent belts to run at different speeds for churning, sifting and sorting materials supported and advanced by the belt members. U-shaped cleats are spaced along the belt members for assisting in the action and for working on the sides of clods of dirt or the like, carried along in the troughs.

4 Claims, 8 Drawing Figures



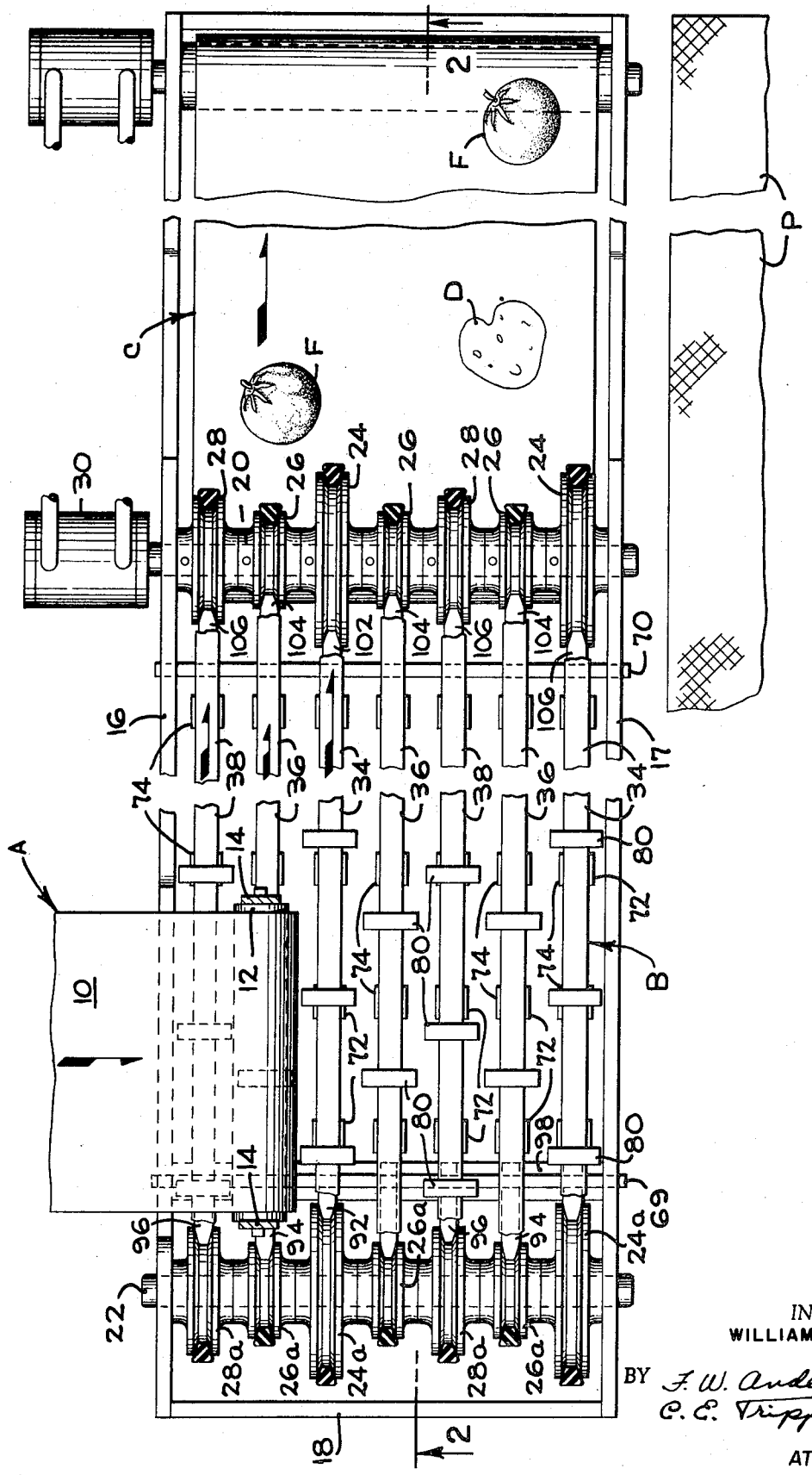


FIG. 1

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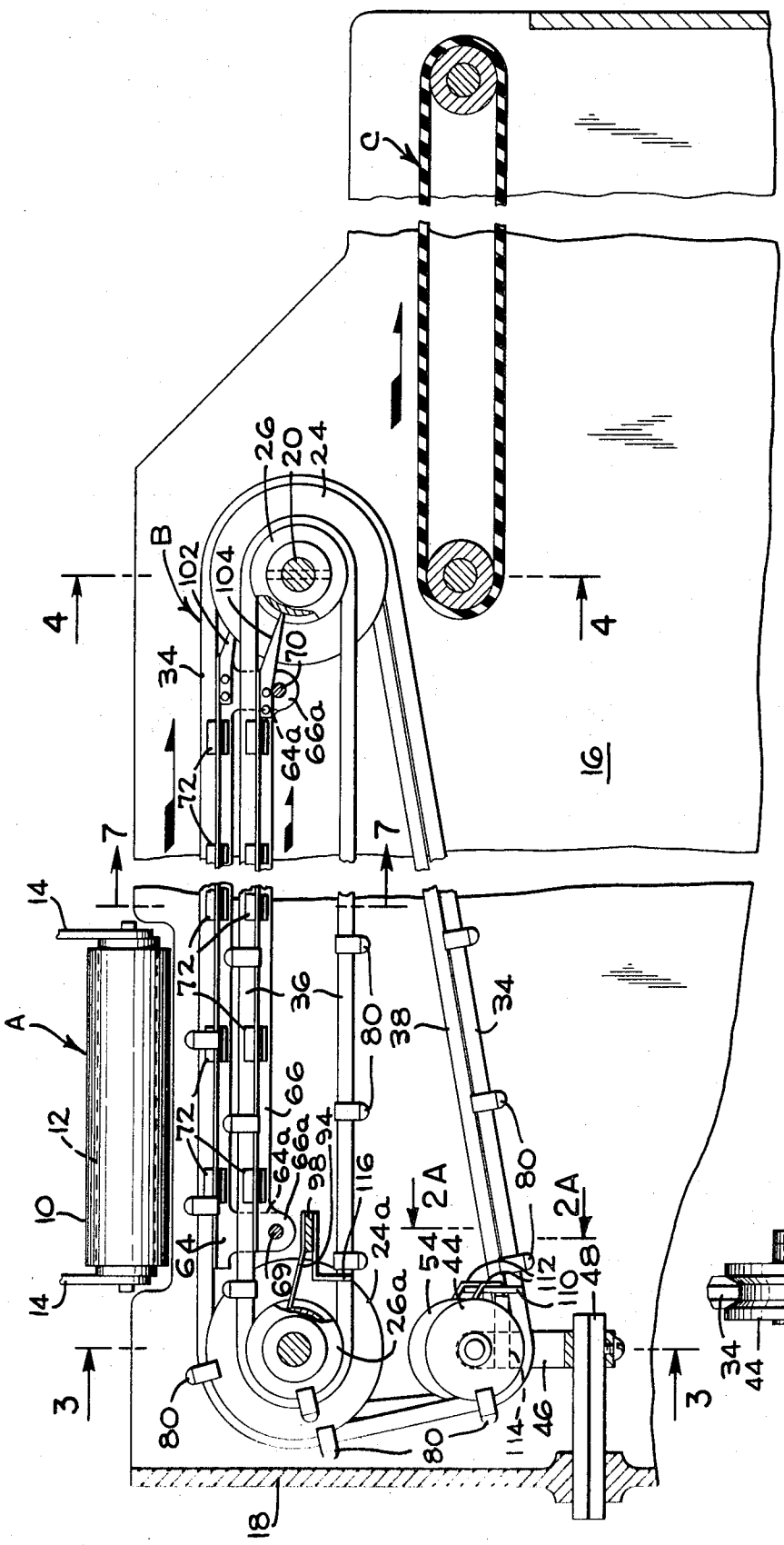

C
B
A
4
4
7
7
3
3
2A
2A
16
18
14
14
10
12
26
20
24
102
104
34
70
64a
66a
72
36
80
38
66
94
98
116
24a
26a
64
69
54
44
112
110
48
46
114

FIG_2

FIG_2A

FIG_3

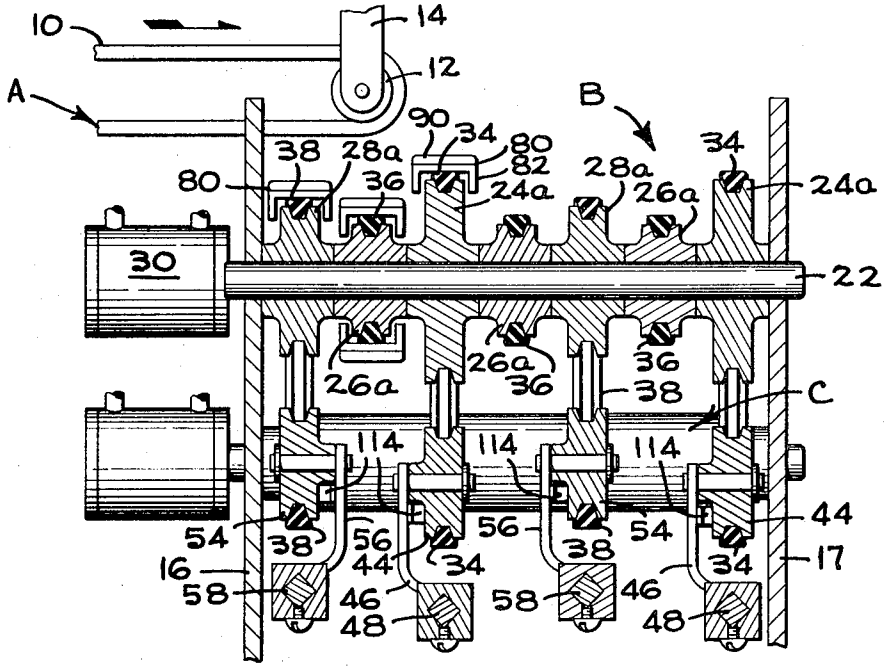

10
14
12
A
B
90
34
80
82
38
28a
36
24a
26a
24a
30
22
26a
36
C
114
44
54
56
38
34
16
17
58
46
48

FIG_4

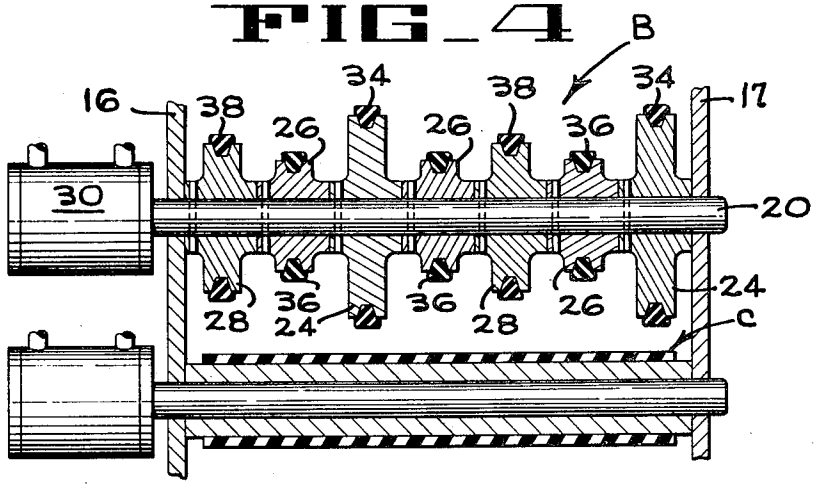

B
16
34
38
26
36
17
30
20
28
24
C

FIG_5

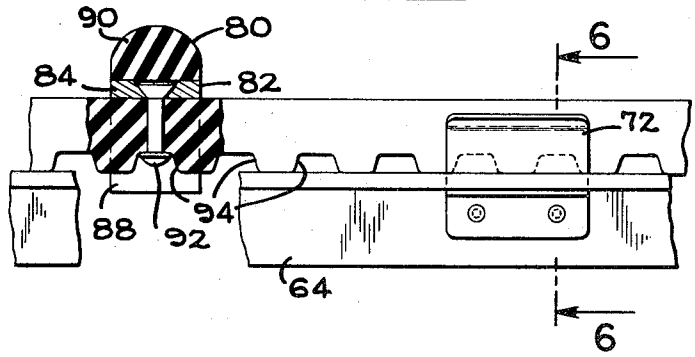


FIG_6

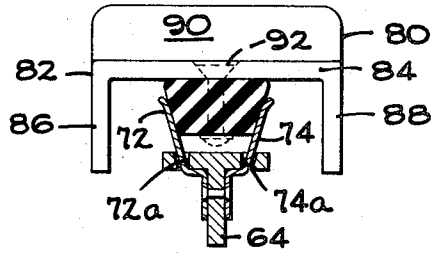
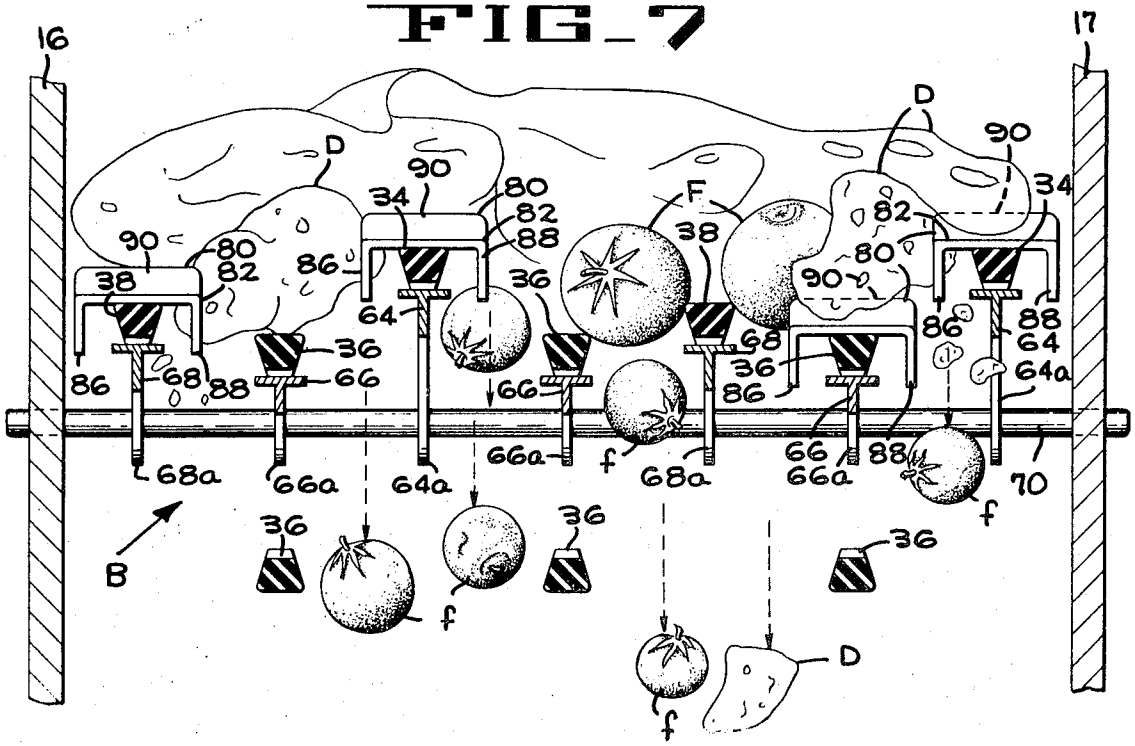


FIG_7



SCREENING CONVEYOR

REFERENCE TO RELATED APPLICATIONS

A screening conveyor of the general type disclosed and claimed herein is shown in a harvester for tomatoes or the like in the copending application of Cayton et al., Ser. No. 49,415, filed June 24, 1970 (SJ 5592) now U.S. Pat. No. 3,613,796, issued Oct. 19, 1971.

DESCRIPTION OF PRIOR ARTS

Cerruti U.S. Pat. No. 534,783, issued Feb. 26, 1895, shows divergent grading belts driven by different sized pulleys on the same drive shaft. There is some slight vertical spacing of the belts as they leave the drive shaft, but this is negligible and this is soon taken out by a first set of idler rollers.

Farrar et al. U.S. Pat. No. 1,062,775, May 27, 1913, discloses ropes driven in the same plane and at the same speed flanked by a pair of chains having cleats thereon and driven in a direction opposite to that of the ropes.

Wade et al. U.S. Pat. No. 1,552,366 Sept. 1, 1925, has alternately large and small drive pulleys on a drive shaft with all belts passing over upper idlers of the same diameter so that although the belts are driven at different speeds they lie in a common plane at their conveying surfaces.

Robbins U.S. Pat. No. 1,735,795, Nov. 12, 1929, forms fruit grading troughs by the use of three belts, the upper two of which gradually diverge from the central belt in a vertical plane. All belts are driven at the same speed. The U.S. Pat. to Whisnand et al., No. 1,888,709, Nov. 22, 1932, shows a similar arrangement.

Mauroner U.S. Pat. No. 2,350,691, June 6, 1944, shows a berry grader wherein the belts are all at the same level and driven at the same speed with small wire-like cleats wrapped around the convex upper surfaces of the belts. The aforesaid U.S. Pat. to Farrar et al. No. 1,062,775 also shows small wire-like cleats projecting upwardly from chain members.

Klem U.S. Pat. No. 2,547,473, Apr. 3, 1951, shows belts driven at different speeds by a shaft at one end driving one set of belts and a shaft at the other end driving another set. The belts are in the same plane.

Higgins, Sr. U.S. Pat. No. 2,979,199, Apr. 11, 1961, mounts a plurality of pulleys which gradually vary in diameter on spaced shafts to form a sinusoidal contour for the conveying surface. The pulleys for each belt are not matched pairs so that the troughs formed taper out at their mid-lengths and the disparity in vertical displacement of adjacent belts is small. Material flows laterally of the belts in this reference.

SUMMARY OF THE INVENTION

Although the sorting conveyor of the present invention is of more general utility, it will be described in connection with the handling of loose dirt, clods of dirt and loose tomatoes such as that supplied by a tomato harvester in the copending application of Cayton et al., Ser. No. 49,415, filed June 24, 1970 (SJ 5592) now U.S. Pat. No. 3,613,796, issued Oct. 19, 1971, assigned to the FMC Corporation. A similar utilization of the sorting conveyor of the present invention would be in connection with tomato harvesters such as those of the U.S. Pats. to Looker No. 3,031,331, issued Jan. 31, 1967 and Csimma, No. 3,340,935, issued Sept. 12, 1967 and assigned to the FMC Corporation.

In the utilization of the invention in connection with sorting tomatoes, a mass of loose fruit, clods of dirt and loose dirt is received from a conveyor and passed on for sorting. This sorting involves removal of undersized fruit as well as clods of dirt so that the remaining market sized fruit can be inspected and finally sorted. Under the present invention, while the mass of loose material is advanced along the conveyor, it is subjected to a churning and clod breaking action, as well as a sifting and screening action. As a result, not only are undersized fruits dropped out along with loose dirt, but large clods are broken up into smaller clods which, in turn, drop out along with the dirt and undersized fruit. This leaves only market sized fruit for further inspection along with some clods which are too large to have been broken up and screened out by the conveyor. The large clods do not represent a serious sorting burden.

The aforesaid action on the loose material is provided by forming the conveyor reach as a group of laterally spaced V-belts moving at different speeds and at alternately different elevations. Thus three belt troughs are formed along the lengths of the conveyor which expose the materials being conveyed to action from the side along the entire length of the conveyor. This provides a churning and tumbling of the material and hence insures that all of the fruit will settle to the belts so that undersized fruit can be dropped out between the belts. Likewise, this side action is exerted on the clods of dirt and tends to pulverize them and reduce them to a size sufficiently small so that they too will be sifted out along the length of the screening conveyor. The aforesaid action on clods of dirt is facilitated by the provision of U-shaped cleats that project laterally past the edges of the belts and are spaced longitudinally along the belts. These cleats are provided with side digging edges which work upon the clods and pulverize them as mentioned above.

When the conveyor is used to screen field crops that are mixed with dirt, the essential cleaning of the parts is provided by fixed scraper tongues projecting into the V-belt grooves in the pulleys. Also notched scraper tongues scrape the return reaches of the V-belts clean.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan of a conveyor system embodying the unit.

FIG. 2 is a section on line 2—2 of FIG. 1.

FIG. 2A is a section on line 2A—2A of FIG. 2.

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

FIG. 4 is a section of line 4—4 of FIG. 2.

FIG. 5 is a fragmentary enlarged side view of a belt and support rail.

FIG. 6 is a section on line 6—6 of FIG. 5.

FIG. 7 is an enlarged section on line 7—7 of FIG. 2.

DETAILED DESCRIPTION

Referring to FIGS. 1 and 2, in a system for utilizing the present invention,loose material, including objects such as large or market sized fruit F (FIG. 7), smaller undersized fruit f, loose dirt and large clods of dirt D are introduced into the system by a feeder conveyor A, having a belt 10, a delivery roller 12 and supporting brackets 14 for the roller. Details of the conveyor A are

not critical to the present invention and the conveyor may be of conventional construction.

The body of loose material introduced by the conveyor A is distributed across the screening conveyor B of the present invention wherein the sorting, sifting and clod breaking action previously mentioned is performed. The market sized fruit F, along with a few large clods D are deposited onto a belt conveyor C for further processing. The belt conveyor C may be a sorting conveyor or may lead to a sorting system as in the aforesaid copending application of Cayton et al or the aforesaid Looker and Csimma patents. If the conveyor C is itself a sorting conveyor, a platform P (FIG. 1) can be provided alongside of that conveyor to provide a sorting station for the desired number of sorting operators.

The screening conveyor B of the present invention is mounted between side plates **16** and **17** and has an end plate **18**. Extending between the side plates are a drive shaft **20** and an idler shaft **22**, the spacing between the shafts being sufficient to provide the necessary sorting and clod breaking action. This spacing is not critical to the present invention it only being necessary that these shafts be spaced far enough to suit the nature of the materials being handled by the conveyor B.

Mounted along the shafts **20** and **22** are matched pairs of V-belt pulleys of alternately varying diameter, there being a row of such pulleys on each shaft. For example, in the embodiment being described, the driving shaft **20** (reading from the bottom of FIG. 1) has pinned or keyed thereto a large V-belt pulley **24**, a small pulley **26**, an intermediate pulley **28**, another small pulley **26**, a second large pulley **24**, a third small pulley **26**, and a second intermediate pulley **28**. The drive shaft **20** is driven by a hydraulic motor **30** which is connected to a pump and a variable speed control system (not shown) in a conventional manner not critical to the present invention.

The idler shaft **22** has mounted therein pulleys **24*a***, **26*a***, **28*a***, **26*a***, **24*a***, **26*a*** and **28*a***, in the order named, to form matched pairs with their counterparts on the drive shaft **20**. The pulleys are mounted for free rotation on the shaft **22**.

V-belts **34** are trained over the large pulleys **24**, **24*a***, V-belts **36** are trained over the small pulleys **26**, **26*a*** and V-belts **38** are trained over the intermediate pulleys **28**, **28*a***. As a result of the varying diameters between adjacent matched pairs of pulleys, three-belt triangles are formed (FIGS. 3 and 7) and rotation of the drive shaft **20** imparts different linear speeds to the V-belts for each trough as indicated by the lengths of arrows placed on three of the belts in FIG. 1.

In order to minimize interference with materials dropping between the belts, not all of the lower reaches of the belts return in the same plane. For example, the belts **34** that pass over the larger pulleys **24**, **24*a*** also pass over idlers **44** below the pulleys **24*a*** (FIGS. 2 and 3). These idlers are mounted on brackets **46** which may be adjustably positioned along horizontal posts **48** mounted in the end plate **18** of the machine. This adjustment also serves for taking up tension on the belts **34**. Similarly, the belts **38** that pass over the intermediate pulleys **28**, **28*a*** are trained over idlers **54** mounted in brackets **56** adjustably secured on frame posts **58**.

In order to prevent the upper, conveying reaches of the belts **34**, **36** and **38** from sagging under the weight of the material they must carry, T-shaped support rails **64**, **66** and **68** are provided beneath the upper reaches of the belt **34**, **36** and **38** respectively. The rails **64**, **66** and **68** are supported at their ends by means of downwardly projecting ears **64*a***, **66*a*** and **68** *a* (FIGS. 2 and 7) which receive transverse rods **69** and **70** (see also FIG. 1) extending between the side plates **16** and **17**.

In order to guide the belts laterally along their paths while supporting them on the T-rails just described, clips **72**, **74** are riveted to the vertical portion if the T-shaped rails, a clip assembly on the rail **64** being shown in detail in the enlarged views of FIGS. **5** and **6**. These clips extend upwardly through apertures **72*a***, **74*a*** in the horizontal portion of the rails, as seen in FIG. **6**.

In order to advance the material along the belts, and work the material from below, as well as to work it from the sides as it rests in the troughs formed by the alternate bearing diameter pulleys, cleats **80** are mounted along the belts. The details of a cleat mounted on a belt **34** are illustrated in FIGS. **5** and **6**. Each cleat comprises a U-shaped member **82** having a transverse leg **84** and depending vertical legs **86**, **88**. A rib **90**, preferably made of plastic or rubber, is bonded to the transverse cleat leg **84**. The cleats are fastened to their associated belts by rivets **92**, the riveted ends of which may be recessed within the conventional notches **9**, formed in V-belts of this type. As seen in FIG. **7**, the lateral extent of the cleats is such that the depending legs **86**, **88** come close to passing one another in a common vertical plane. This action not only provides a side digging action, but also presents leading edges of both the horizontal portion **84** and the vertical portions **86**, **88** of the cleats to dirt or clods of the like to assist in the pulverizing or breaking action characteristic of the present invention.

SCRAPERS

Since considerable wet soil is introduced to the sorter of the present invention in the case of field harvesting, under these circumstances belt and pulley scrapers are provided. Referring to FIGS. **2** and **2A**, the grooves of pulleys **24*a***, **26*a*** and **28*a*** are scraped clean by tongues **92**, **94** and **96** respectively, projecting from a mounting bar **98**.

The grooves of pulleys **24**, **26** and **28** are scraped clean by tongues **102**, **104**, **106** respectively, projecting from the belt support rails **64**, **66** and **68**.

The grooves of idlers **44** and **46** are scraped clear by tongues **112** mounted on ears **114** projecting from the pulley mounting brackets **46**, **56**.

The belts **34**, **38** are scraped clean by notched fingers **110** on the ears **114** and the belts **36** are scraped clean by notched fingers **116** projecting down from the bar **98**.

TYPICAL EXAMPLE

The following design considerations are given as a typical screening conveyor embodying the invention and suitable for handling tomatoes:

Diameter of pulleys **24**, **24*a*** — 5.5 inches.
Diameter of pulleys **26**, **26*a*** — 3.5 inches.
Diameter of pulleys **28**, **28*a*** — 4.5 inches.
Linear speed of belts **34** — 120 ft/min.

Linear speed of belts **36** — 76 ft/min.
linear speed of belts **38** — 98 ft/min.
Minimum spacing of shaft **20**, **22**— 4 feet.
Lateral gap between vertical planes of U-belt side edges — 1.125

OPERATION

In operation when a sorter of the present invention is used in conjunction with the handling of tomatoes in the manner mentioned previously, a mass of materials including market tomatoes F, undersized tomatoes f, loose dirt, clods of dirt D and other material is deposited by the feeder conveyor A and spread across the receiving end of the screening conveyor B, of the present invention. This material works its way into the various three-belt troughs provided by the matched pairs of pulleys of alternating diameters characteristic of the present invention.

The belts that define each trough run at mutually different linear velocities, as shown by the three arrows at the top center of FIG. **1**. This exerts a turning, tumbling and churning action on the mass, causing the smaller objects to sift through the mass and the belts, and the larger objects to rest on the belts.

As seen in FIG. **1**, a vigorous churning action is also provided because of the provision of the three-belt troughs, with adjacent belts running at different linear velocities. The cleats **80** provide a dual action on the materials. Those cleat portions at the bottom of each trough roll and tumble the clods D and the tomatoes thereby facilitating the screening action so that the smaller tomatoes *f* will drop through between the belts and onto the ground or other receptacle. This rolling action does not damage the tomatoes.

In addition to the action described above, the downwardly projecting legs **86**, **88** of the cleats **80** engage the sides of clods D and erode or break away sections of the clods so that some of them fall down between the belts and are thereby eliminated from the system before the final sorting or inspection operation. Of course, the depending legs **86**, **88** also engage the larger tomatoes F along the sides of the latter, but since these objects (unlike the clods) essentially have surfaces of revolution, they are merely cammed and rolled aside by the cleats and are not cut or damaged thereby.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

What I claim is:

1. A screening conveyor for separating dirt and small objects from a mass of fruit or the like said conveyor being of the type comprising longitudinally spaced horizontal pulley shafts, each shaft mounting a row of pulleys of varying diameters, the pulleys of a given diameter on one shaft being aligned with those of the corresponding diameter on the other shaft to form pairs of matched diameter pulleys, belt members trained around each matched pair of pulleys with the upper reaches of said belt members being parallel and substantially horizontal, and means for driving all pulleys at the same rotational speed; the improvement wherein said belt members are rubberized V-belts and the pulleys on each shaft are arranged in a plurality of groups, each group comprising three pulleys, namely, a central small diameter pulley, a large diameter pulley on one side of the small pulley, and an intermediate diameter pulley on the other side of said small pulley so that said group of pulleys provide differential speeds to adjacent belts; and a plurality of longitudinally spaced cleats mounted over and to said belts, said cleats projecting laterally past both sides of their respective belts to provide differential speed, material churning side edges, particles of dirt or the like and small objects dropping out between the upper regions of said belts whereas larger objects are retained on and discharged from the belt.

2. The screening conveyor of claim **1**, wherein said cleats are U-shaped with their side edges being substantially at least as long as the adjacent sides of the belts on which they are mounted.

3. The screening conveyor of claim **2** wherein the side edges of said cleats on adjacent belts run substantially in a common vertical plane.

4. The screening conveyor of claim **1**, including auxiliary idler pulleys for alternate belts disposed below the shaft at the material receiving end of the conveyor, thereby providing lower, return belt reaches that run downwardly from the pulleys on the shaft disposed at the material delivery end of the conveyor.

* * * * *