United States Patent

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[72] Inventor **Cesare Roda**
7, Via Ugo Bassi, Cesena, Forli, Italy

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[33] **Italy**
[31] **814281/67**

[54] **FRUIT-GRADING APPARATUS**
5 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **209/90,** 209/74
[51] **Int. Cl.** **B07b 13/04**
[50] **Field of Search** 209/90, 91, 74, 101

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Primary Examiner—Richard A. Schacher
Assistant Examiner—Gene A. Church
Attorney—Holman & Stern

ABSTRACT: In a article-grading apparatus, a pair of endless belts, preferably formed by link chains support transversal shallow spaced trough-shaped containers provided with partitions and rear walls permitting their withdrawing from below the articles, when these are firmly held from their top point by frictional surfaces, constituted by swinging slats arranged at decreasing height above the articles in said trough-shaped containers. The articles, ejected from the advancing supporting trough-shaped containers due to their firm adherence to the underside of the slats, fall through the gap between subsequent containers onto discharge means.

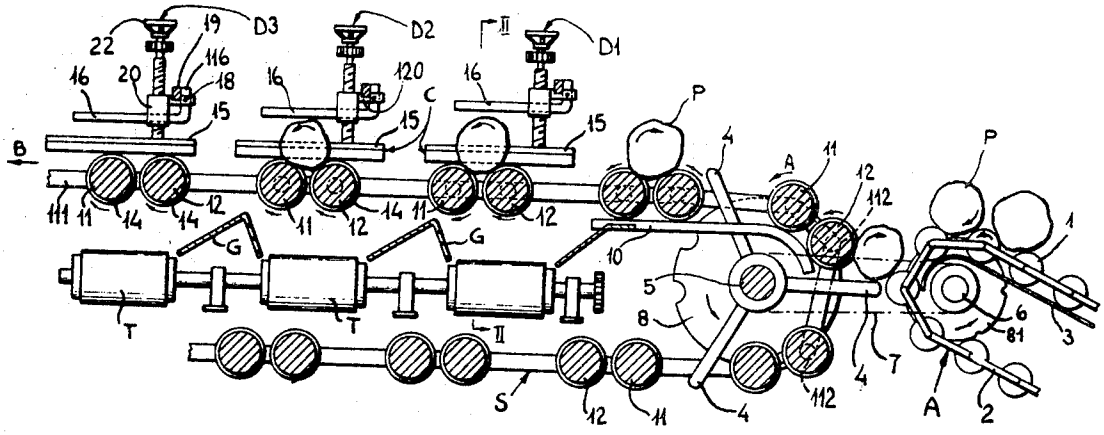


FIG. 1

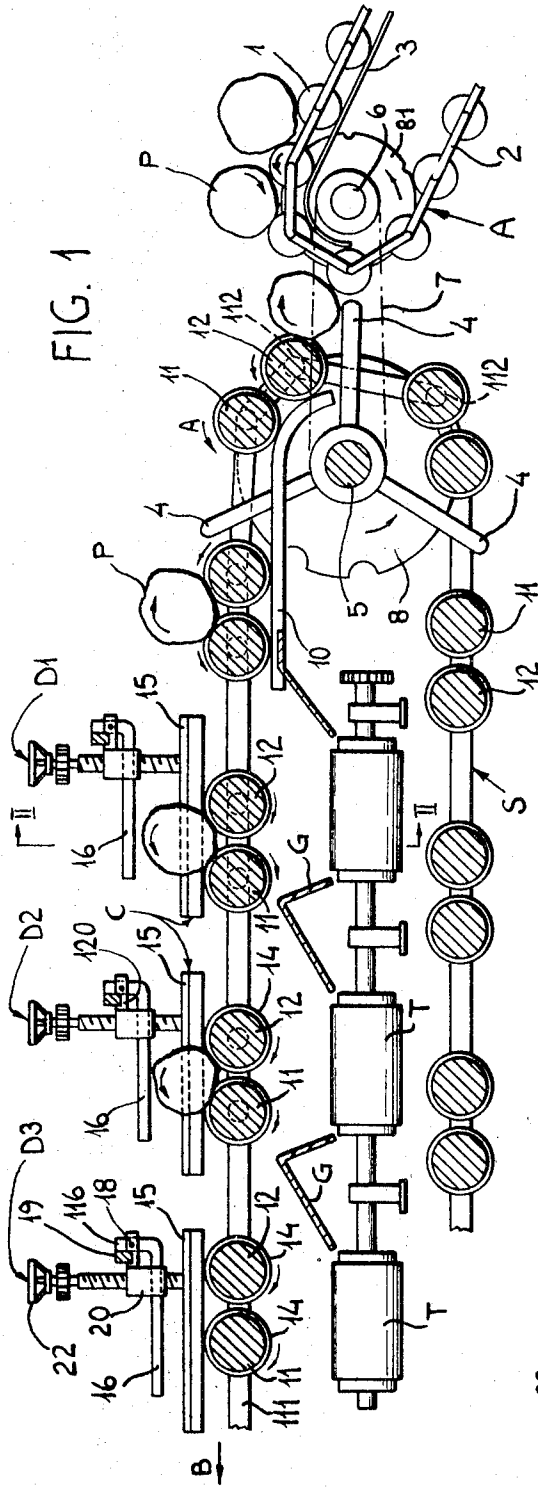


FIG. 4

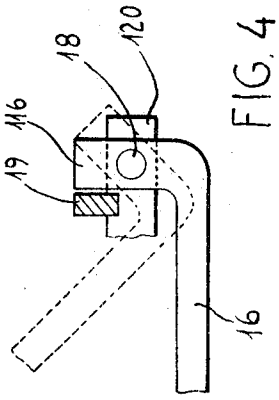
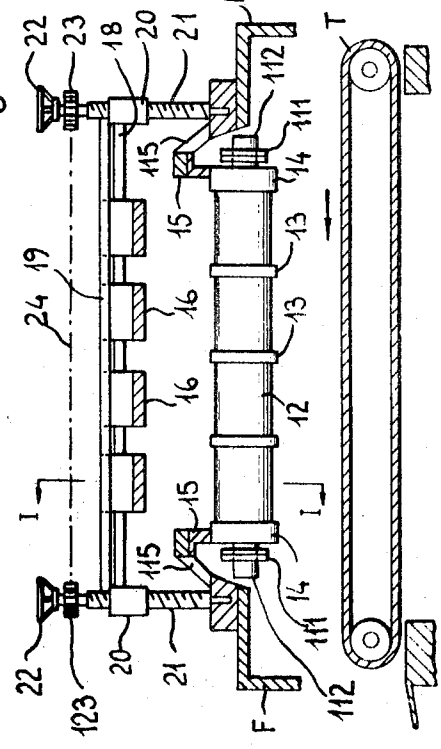


FIG. 2



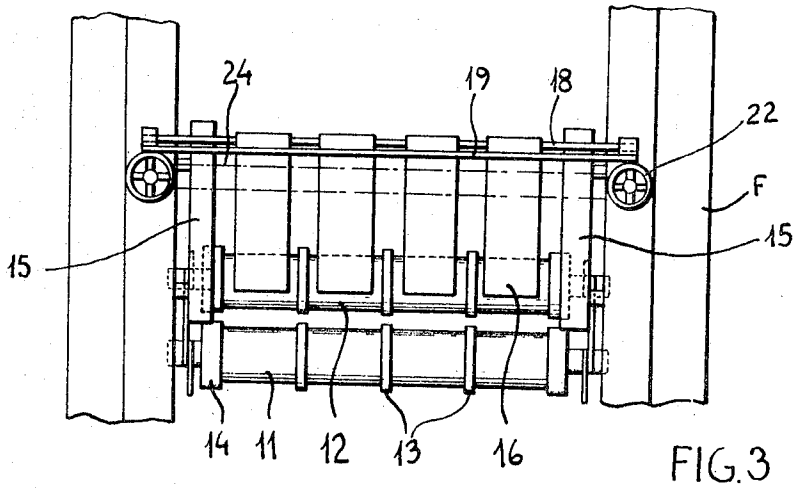


FIG. 3

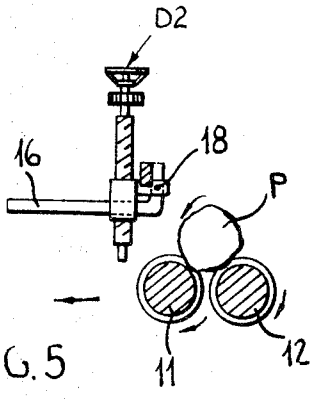


FIG. 5

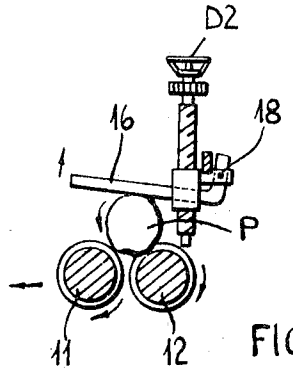


FIG. 6

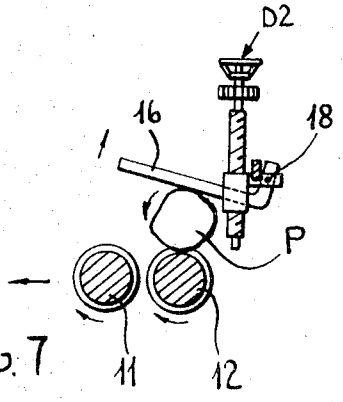


FIG. 7

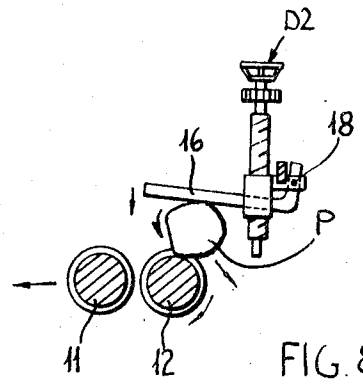


FIG. 8

FRUIT-GRADING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to an improved grading apparatus particularly for grading fruits and vegetables, and even other somewhat irregularly shaped products, but capable of rolling and which, for simplicity, shall be termed articles.

According to the invention, the articles are fed, by a suitable feeding device, to an endless belt conveyor formed by pairs of adjoining rollers connected by chains or the like, so that each pair of rollers defines a trough-like recess, divided by projecting partition rings, or otherwise, into a separate annular seat for each article. The calibrating devices, which are fixed with respect to the moving conveyor, consist of downwardly urged slats which are mounted horizontally and are capable of freely swinging upwardly, while the underside of these slats is flat and serves as friction surface when it comes into contact with the article to be graded, carried by the conveyor. In correspondence of the grading slats, the rollers are driven so as to roll in the same direction, so that the articles arranged on same, while being held firmly in contact with the underside of the swinging slats, permit to the rollers of the conveyor to continue their advancing movement, so that the articles roll off their seats from the adjoining rollers and fall from above the rear roller of the pair onto underlying receivers, ready to be packaged or to be further processed.

Among the products or articles which may be graded by the apparatus according to the invention, are those having an oblong or elongated shape, such as for example lemons or cucumbers, for whose grading the usual grading apparatus, which is based on the principle of the progressive opening of holes at the bottom of the housing seats, cannot give, due to obvious reasons, good results.

In order that the present invention may be clearly understood and carried into practice, reference is now made to the accompanying sheets of drawings, in which there is illustrated, by way of example, a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a diagrammatic vertical section on line I–I of FIG. 2, through a grading machine according to the invention;

FIG. 2 is a diagrammatic front view of the grading machine shown in FIG. 1, with parts in section on line II–II of FIG. 1;

FIG. 3 is a plan view of a grading unit;

FIG. 4 shows a detail on an enlarged scale of part of a slat of a grading unit; and

FIGS. 5, 6, 7 and 8 show different steps of how one article seated between two supporting rollers, by coming into contact with a grading slat, is ejected off the rear supporting roller.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The grading apparatus shown in FIG. 1, is particularly adapted for handling somewhat oblong or oval products or articles and comprises a first section 1, in which the articles are oriented with their axis transversally of the running direction of the conveyor and a second section, S, or grading section, to which the articles, already oriented, are fed in position to be readily graded.

In view of the fact that in many cases the first section of the apparatus is not necessary and the feeding of the articles (particularly when they are sufficiently round) may be effected by conventional means, the second, or grading section shall be first described hereinafter.

Referring particularly to FIGS. 1 through 3 of the drawings, the grading apparatus proper S comprises an endless belt, constituted by a pair of parallel endless link chains 111 carrying at wide intervals pairs of slightly spaced parallel rollers 11 and 12, each provided at their ends with trunnions 112 serving as pivot pins for two adjoining links of the chain 111 and as supporting members for the rollers 11 and 12, when they come in correspondence of a pair of correspondingly notched chain-driving discs 8, FIG. 1. The discs 8 (only one of which is shown in FIG. 1) are keyed on a control shaft 5 rotatably mounted in a conventional manner onto a machine frame F and driven by conventional means (usually, an electric motor and a stepdown gear) at the required speed and direction (see anticlockwise arrow on disc 5 in FIG. 1).

AS shown in FIGS. 1 and 2, the rollers 11 and 12 are provided with a number of partition rings 13 projecting above their cylindrical surface and serving for providing shallow annular recesses serving as seats, in which the products to be graded may even roll. At one end of the rollers 11, 12 there is provided a rim 14 made of soft rubber or other tire material and provided with a peripheral nonsmooth friction surface adapted for rolling when pressed against fixed lower and upper tracks 10 and 15.

The lower track 10 is curved at its rear end, in correspondence of the discs 8, at the charging end of the belt 111 while the upper tracks 15 are made of short rail sections arranged at a lower level on one side of a corresponding row of grading slats 16, now to be described.

The so-called grading slats 16 consist of elongated plates or frames lined at their underside with rubber or like friction material and swingably mounted on a rod 18. A tail portion 116 of the slats is bent at right angles whereby the downward swinging of the slats is limited by the abutment of the tail portion 116 against an abutment bar 19 mounted parallel to the rod 18. Both the rod 18 with the row of slats 16 and abutment bar 19 are fastened to screw-threaded sleeves or nuts 20 screwed upon a pair of screw-threaded posts 21 rotatably mounted in a block fastened to the machine frame and provided with an operating handwheel 22. In order to effect the simultaneous adjustment of the height of both sleeves 20 and attached slat-carrying rod 18 and abutment bar 19, the two posts are provided each with a sprocket wheel 23, 123, and the sprocket wheels are connected together by a drive chain 24. Chutes G are provided in correspondence of a clearance space C between subsequent grading units, which discharge the graded articles falling down from the rear rollers 12 onto a transversal conveyor T or into containers, as the case may be.

The operation of the above-described grading device is as follows:

The article P having been fed by suitable means into the annular recesses 12 between two adjacent rings 13 of the first roller pair 12–11 of the upper run of the conveyor chain 111, when the rollers by proceeding forwards (arrow B in FIG. 1), in the first section of their travel the rubber rims 14 of said roller pair roll against the track 10 and cause the rollers 12–11 to revolve (in anticlockwise direction in FIG. 1), the articles P thereon are compelled to roll so as to dispose themselves, if necessary, with their major axis transversally, with respect to the conveyor direction of movement.

Past this lower track 10, by proceeding further, the same roller pair comes in correspondence of first upper track 15 forming part of the first grading unit D1, in which the slat 16 is adjusted for the maximum size of the fruits. The rollers 11 and 12 by passing with their rim 14 tangent to the upper track 15 are driven in clockwise direction while the articles P thereon are caused to roll in an anticlockwise direction, which corresponds to the forward or running direction of the conveyor chain 111. If the top of the article does not come into contact with the slat 16, it rolls idle but remains in its trough, as shown in correspondence of D1 in FIG. 1 and in FIG. 5.

This happens until the article P is engaged by one of the slats which, as shown in FIG. 1, are adjusted at decreasing heights above the level of the track 15. In FIG. 1, this happens in correspondence of the grading unit D2 and in FIGS. 6, 7 and 8, the steps are shown for an article whose diameter is greater than the height of the slat above the supporting plane of the article P.

When an article is engaged under a slat 16 and the upper conveyor run continues its running in the direction of the

horizontal arrow (toward the left-hand side), the rollers **11** and **12** continue to be revolved in a clockwise direction while the article P tends to roll in an anticlockwise direction, but this rolling is prevented by the frictional contact of the article with the underside of the slat **16** (FIG. **6**).

By proceeding further, the roller **11** tends to urge the article P in a rearward direction and the roller **12**, by rolling thereunder in a clockwise direction while it is pulled forwards, tends to cause the article P to roll thereon rearwardly (FIG. **7**), until the article P, past the highest point of the roller **12** is allowed to fall rearwardly, i.e. in the substantial clearance space between D2 and D1.

Thus the articles P are allowed to fall down from the grading conveyor **111**, preferably onto a corresponding chute G and transversal conveyor T or other discharge means each time they frictionally engage an overlying slat **16**.

Of course, the articles P may be fed to the grading device by conventional means, such as hoppers and article-charging and distributing devices. If however the fruits or vegetables, although they are capable of rolling, have an oblong or a somewhat irregular form, in order to be able to grade their approximate size, they must be first oriented with their major axis in transversal direction, which is not always very easy.

In order to effect this preliminary operation and to effect the feeding of the above-described grading device in a very regular and efficient manner, the articles are fed to the grading apparatus by means of a feeding device F constituting the first section of the whole grading apparatus and which is shown on the right-hand side of FIG. **1**.

This device comprises a pair of parallel endless link chains **2** (only one of which is visible in FIG. **1**) provided with transversal rollers **1** whose ends are provided with projecting pivots or trunnions, like those indicated by **112** in FIG. **2**, which mesh into corresponding notches of a pair of driving discs **81**. The discs **81** are keyed onto a shaft **6** on which also a sprocket wheel (not shown) is keyed. A like sprocket wheel is also keyed onto the corresponding end of the shaft **5** of the grading conveyor. On this shaft **5**, in an intermediate position, also a turnstile device is mounted, and such device is provided with a plurality (three in the case as shown) of "arms" **4**, which in this embodiment are constituted by radially extending rakes, plates or the like, which are angularly spaced so as to extend between three clearance spaces between four adjacent roller pairs **11–12**, as clearly shown in FIG. **1** and to project with their ends well beyond the periphery of disc **8**.

The sprocket wheels on shafts **5** and **6** are connected by an endless chain **7**, so that by driving either of them, (we had assumed to drive shaft **5**) both shafts revolve, in timed relation, in the same direction (anticlockwise, in FIG. **1**), which corresponds to the forward direction (arrow B) of the conveyors.

The rollers **1** are also provided with friction rims (not shown) like those indicated at **14** in the grading conveyor rollers **11** and **12** and a fixed track **3** provided with a curved end section, is fitted in correspondence of the discharge end of the feed conveyor, below rollers **1** and in frictional contact with the friction rims.

The operation is as follows: The rollers **1** of the feed conveyor, when they arrive in correspondence of the track **3**, are revolved and the articles P carried thereby roll idle between the roller pair and thus dispose themselves with their major axis substantially parallel to the roller axes. At the discharge end of the feed conveyor, they fall down onto one of the projecting turnstile arms or rakes **4**, which, by revolving in an anticlockwise direction together with the shaft **5**, come to an upwardly inclined position, so that the articles P thereon roll first into frictional contact with the first roller **12** and then between the first roller pair **11–12**, which are revolved in an anticlockwise direction, due to the frictional contact with the lower track **10**.

The subsequent operations on the grading conveyor have been already described in connection with the description of the operation of the grading section of the apparatus and therefore need not again be described.

It may be further mentioned that from the demonstration of the successive steps shown in FIGS. **6**, **7**, **8** it appears evident the necessity that the slat **16** may freely swing upwardly, though being maintained in adherence against the article. This is indeed necessary in order to ensure the good operation of the grading apparatus and, in case that the weight of the slat was not sufficient, it would be advisable to arrange suitable means, for example spring means, which elastically urge the slat downwardly.

Of course, as said, the height of the rows of slats **16** will be decreasing in the direction of the movement of the upper run of the endless conveyor **111**, so as to effect the grading of the articles as they present themselves to the grading units with decreasing diameters.

It is understood that the present specification relates to a preferred embodiment illustrated with the omission of the constructive details relating to the structure of the frame and to the driving means of the conveyor belts, inasmuch as they are not essential to an understanding of the invention and in any case can be easily devised and carried out by those skilled in the art. Several variations and modifications, particularly as for what concerns the construction, are therefore possible. Thus, for example, the shape of the slats **16** may be modified together with their system of hinging and moving, provided that the same be restricted so as to stop the downward oscillation of the slats to the horizontal plane, although the slat is free to oscillate upwardly. It is obvious, in this respect, that there is a large number of possible solutions. Thus also the shape of the rollers may be modified. In fact they may present grooves so as to eliminate the need of the rings **13**.

In some cases, the rollers might be replaced by conventional trough-shaped supporting members, provided one of their walls be so inclined, and/or provided with rolling surfaces, as to permit its withdrawing from below the articles which are held firmly against the slats **16**, when the troughs are pulled forwards by the conveyor chains.

All these variations, which may be apparent to those skilled in the art, should be considered within the limits of the invention and the scope of the appended claims.

I claim:

1. An apparatus for grading articles having a substantially circular cross section in at least one direction so as to be capable of rolling, comprising an endless conveyor, a plurality of spaced article carrying means extending transversely of the conveyor, each carrying means including a pair of slightly spaced rollers serving to support articles in a row transverse to the conveyor, each roller pair being spaced longitudinally from the adjacent pair to provided article discharge openings between adjacent roller pairs, a plurality of grading means spaced longitudinally with respect to and above the conveyor including a plurality of slats adapted to engage the upper portion of articles carried therebelow on the roller pairs and dislodge the articles from the roller pairs, said slats moving slightly upwardly when in contact with the articles, means for receiving the articles falling through the discharge openings between adjacent roller pairs, and complemental means on the grading means and roller pair operative to effect rotation of the rollers to cause a rolling of the article supported thereby in the same direction as the direction of movement of the conveyor.

2. The article grading apparatus as claimed in claim **1** in which said endless conveyor includes spaced link chains, the rear roller of each roller pair being provided with end trunnions, the end trunnions serving to hinge adjacent links together and means for supporting the link chains and roller pairs defined by notched discs engaging the roller trunnions and a positively driven shaft for at least one of said notched discs.

3. The article grading apparatus as claimed in claim **1** in which the rollers of each pair are provided with annular spacing members providing separate shallow annular recesses for separating the single articles.

4. The article grading apparatus as claimed in claim **1** in which said complemental means includes a friction rim on the

rollers and a lower track for the grading means at the inlet end of the conveyor and a plurality of short upper tracks in correspondence of the slats, the slats being arranged in the path of the friction rim of the rollers for effecting rotation of the rollers and the rolling of the article supported thereby first in a direction opposite to the direction of movement of the conveyor and thereafter in the same direction as the direction of movement of the conveyor.

5. The article grading apparatus as claimed in claim 1 in which said slats are hinged to a supporting bar and are provided with an abutment section, a fixed abutment to prevent the dropping of said slats beyond a predetermined angle and means for adjusting the height above the level of the conveyor, said slat adjusting means comprising a pair of vertical screw spindles rotatably mounted in fixed supporting members and having threaded thereon screw threaded sleeves, supporting the ends of said slat supporting bar and abutment member, a hand wheel on at least one spindle, sprocket wheels on both spindles and a chain connecting said sprocket wheels.