Oct. 15, 1968 W. E. ZWIACHER ETAL 3,405,801

FRUIT SIZING MACHINE

Original Filed Oct. 18, 1963 8 Sheets-Sheet 1

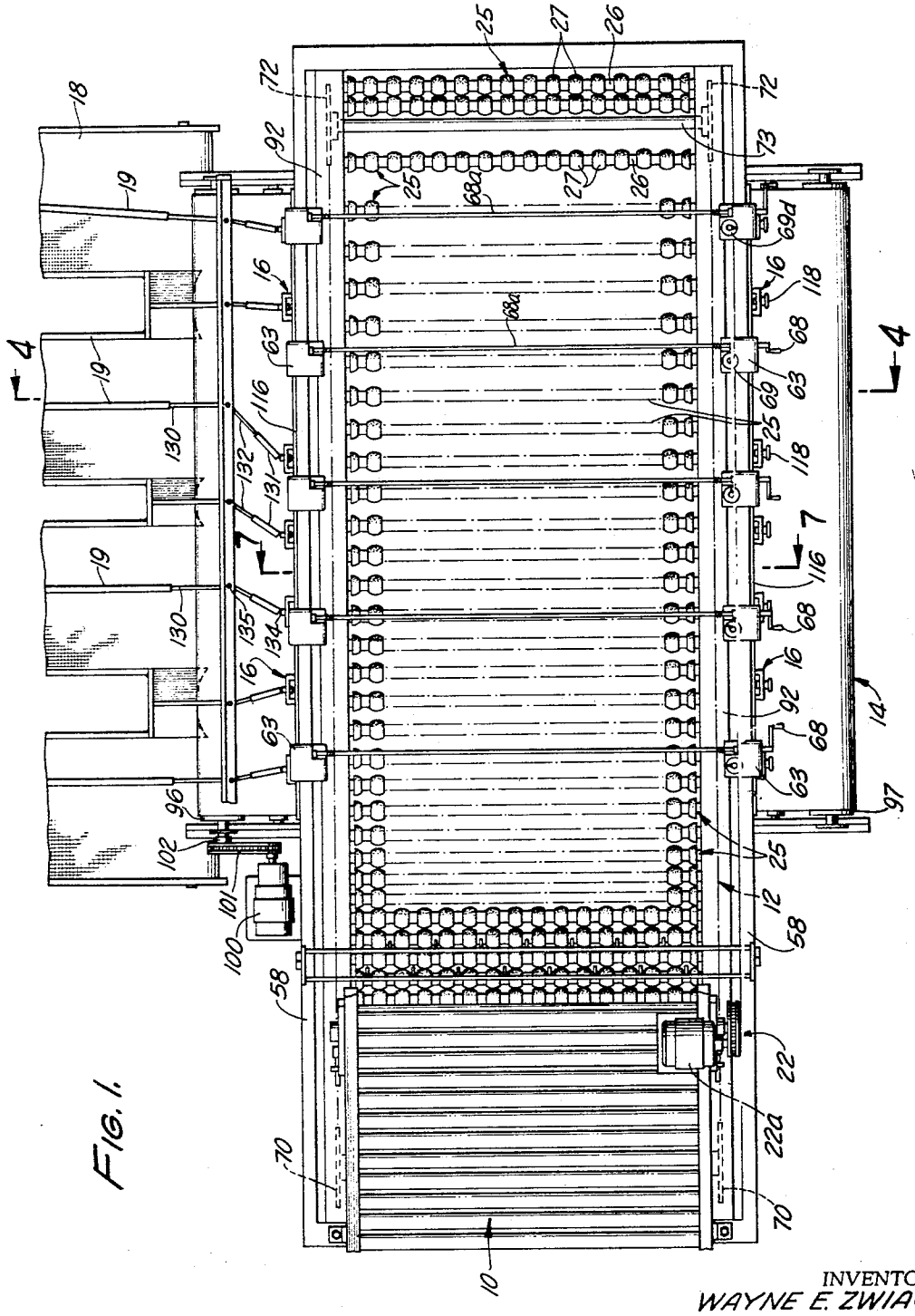


FIG. 1.

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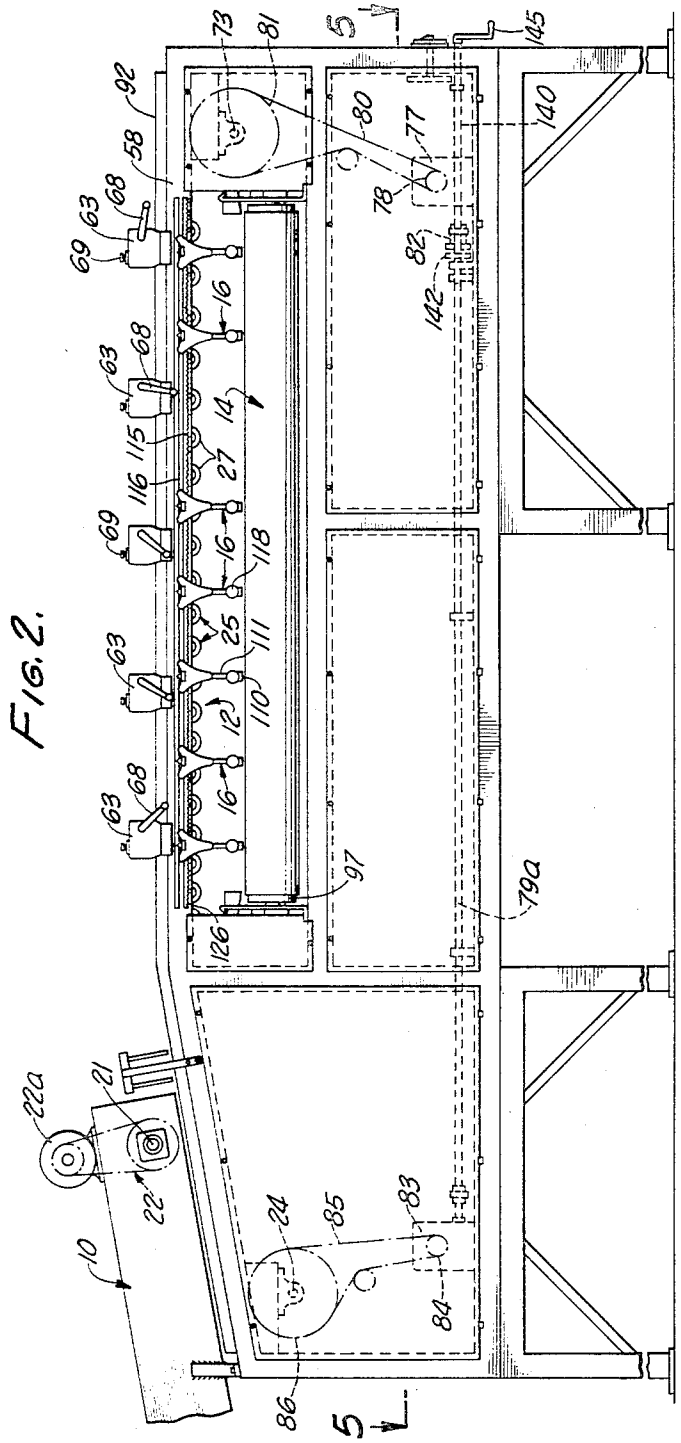


FIG. 2.

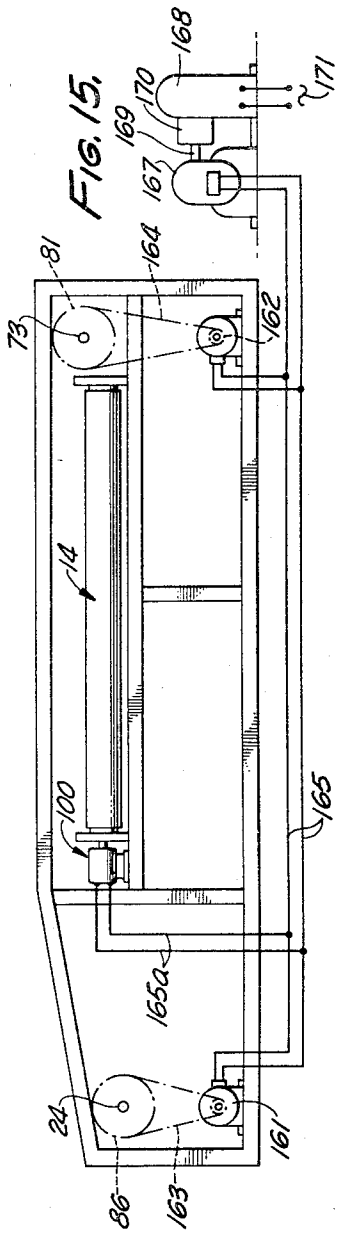


FIG. 15.

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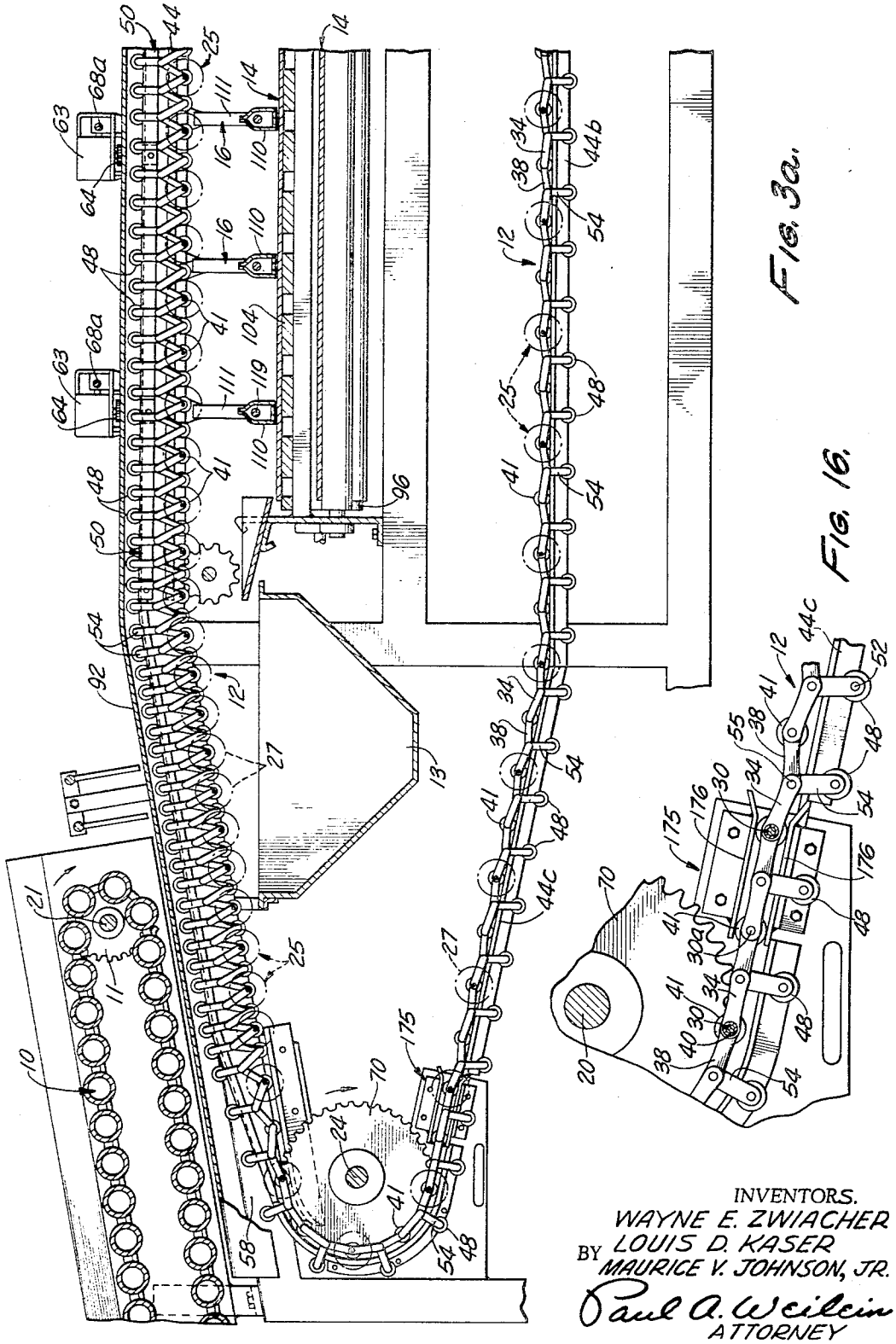


FIG. 3a.

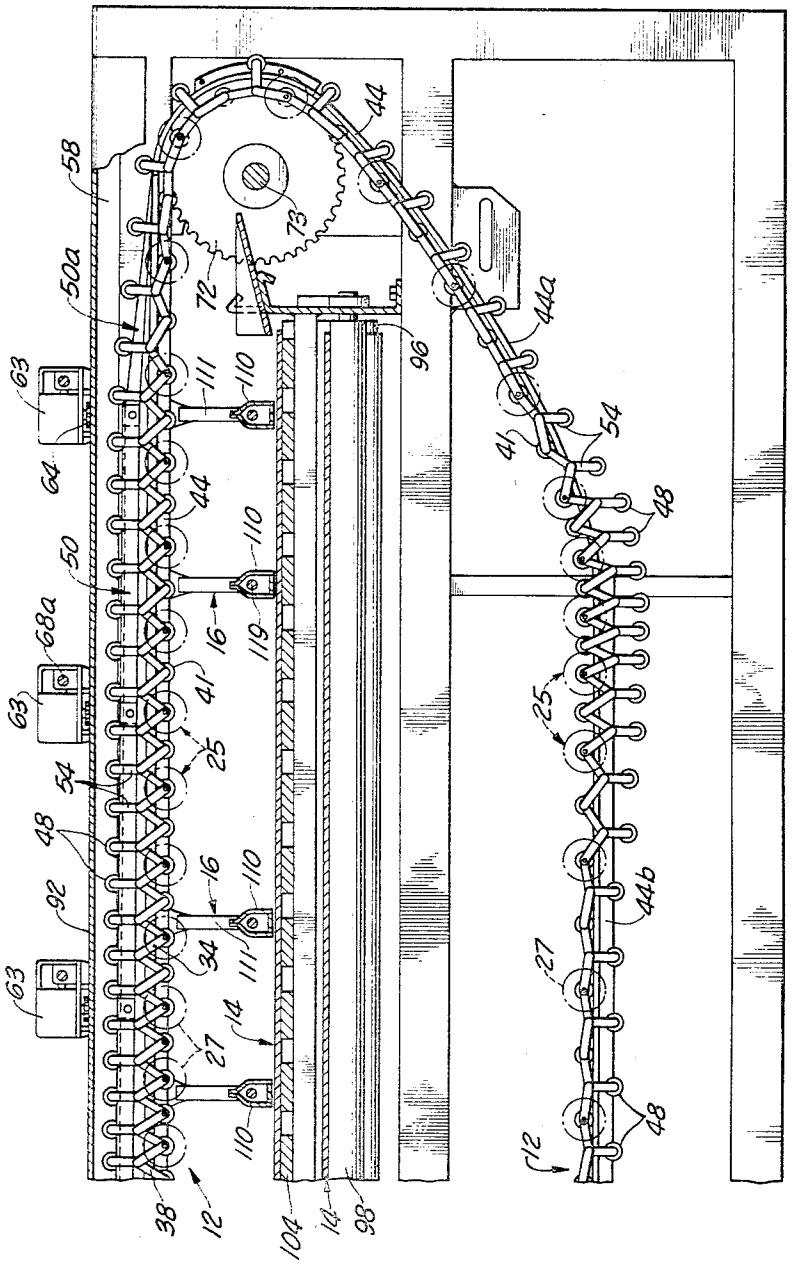
FIG. 16.

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F16.3b.

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FIG. 4.

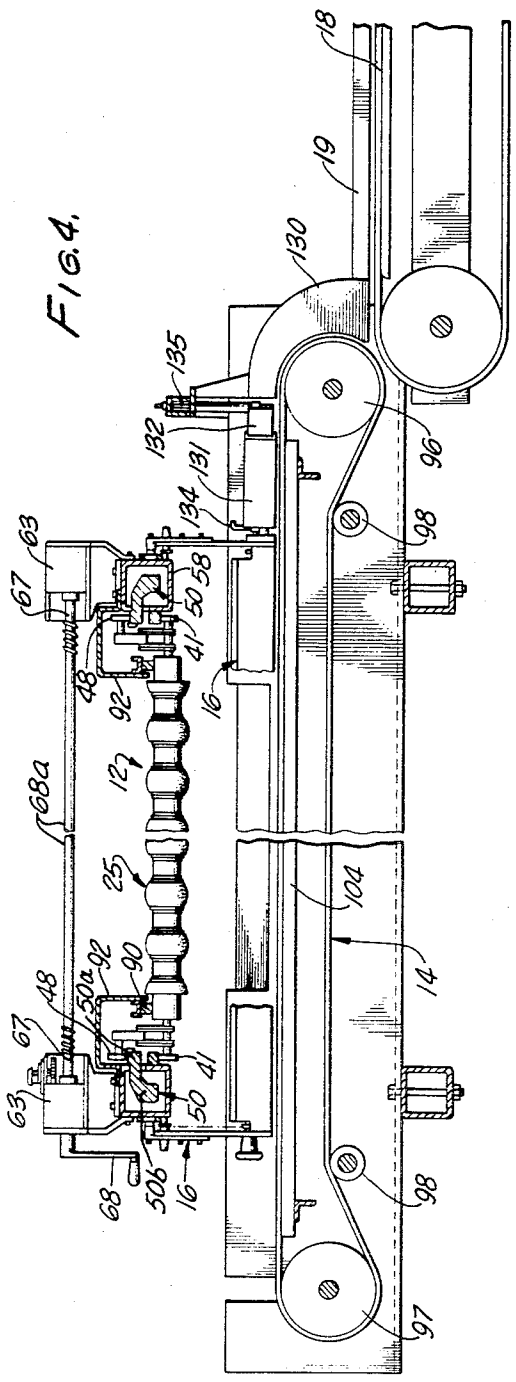


FIG. 6.

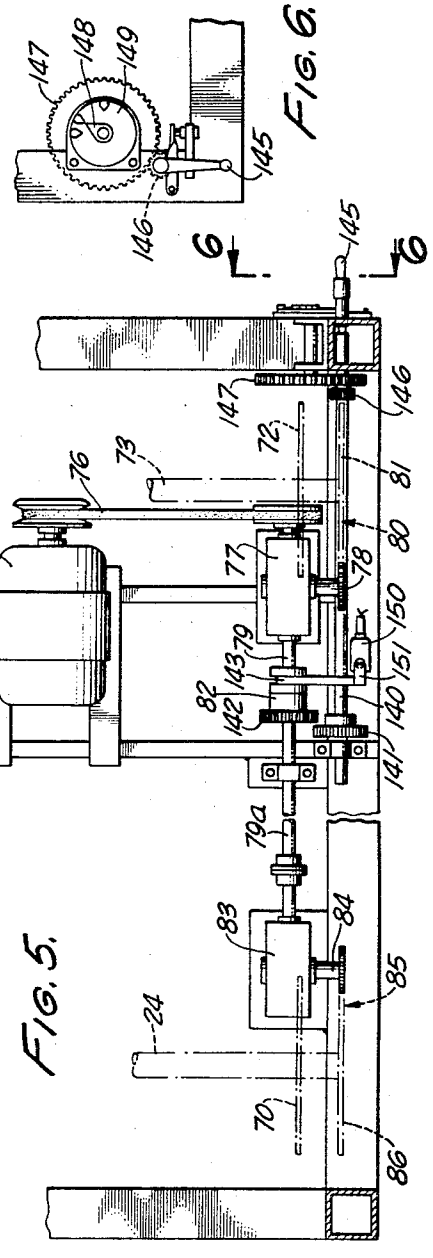


FIG. 5.

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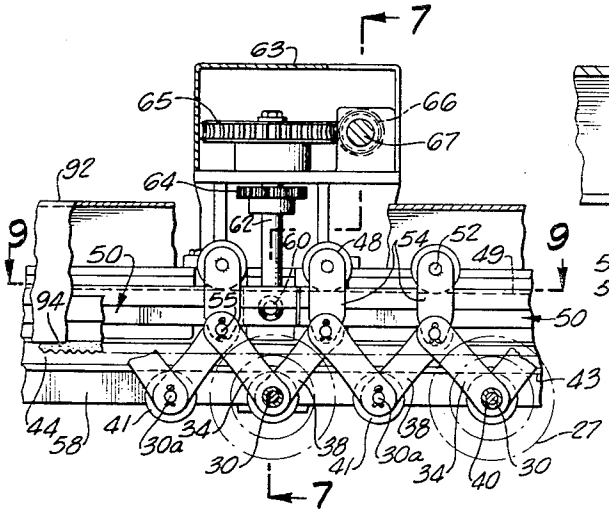


FIG. 8.

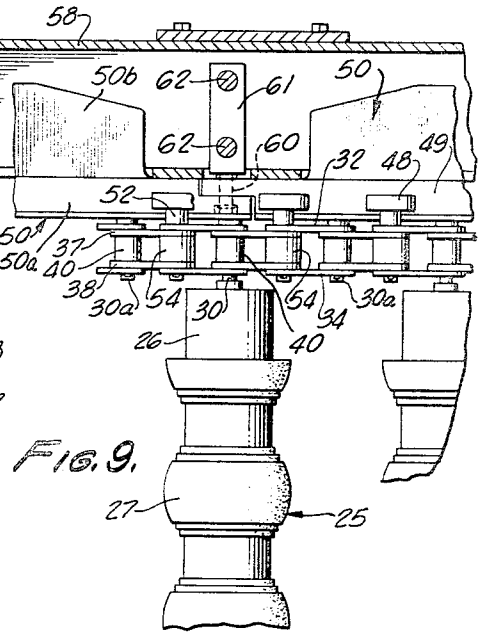


FIG. 9.

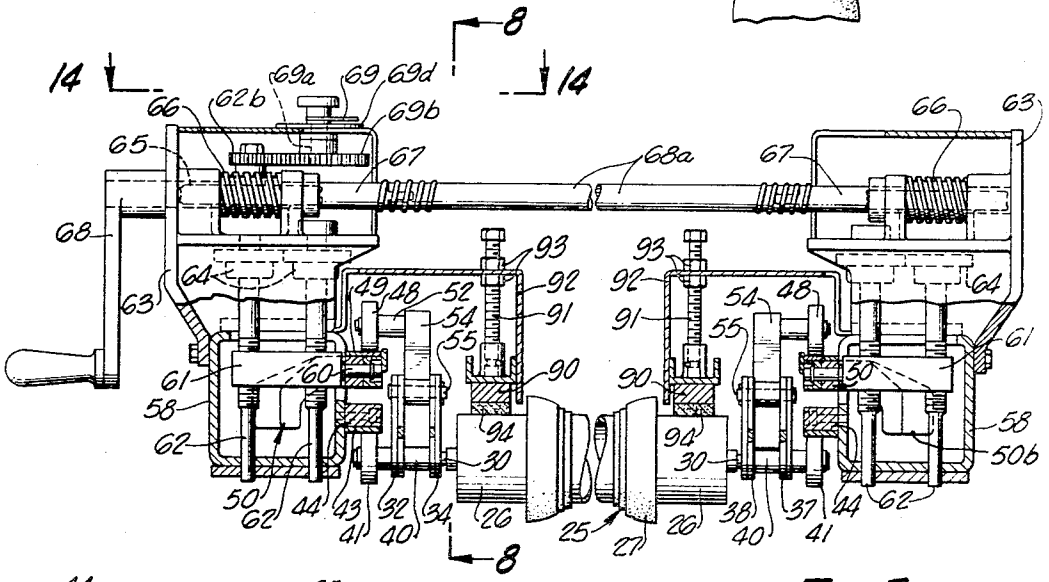


FIG. 7.

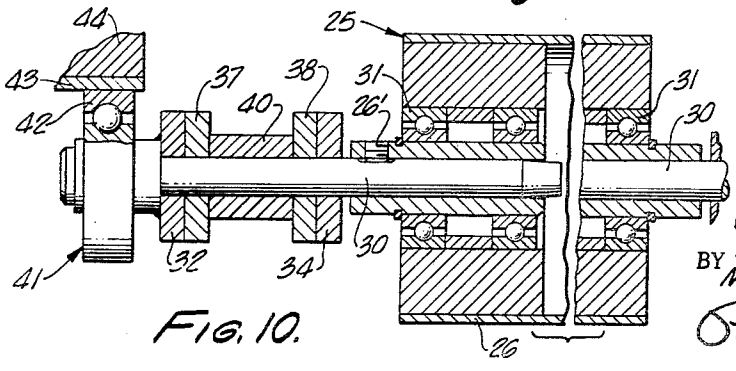


FIG. 10.

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FRUIT SIZING MACHINE

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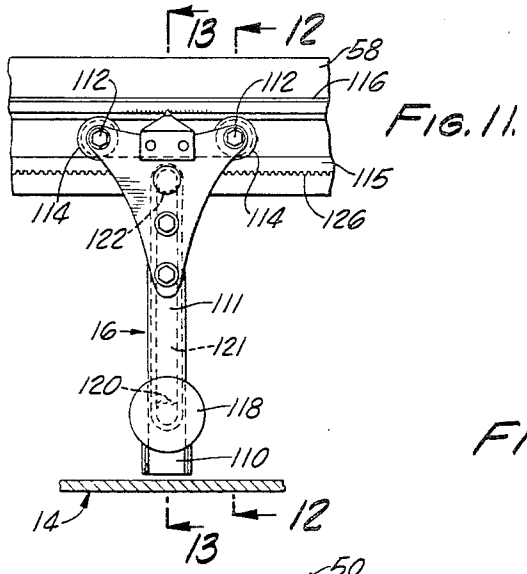


FIG. 11.

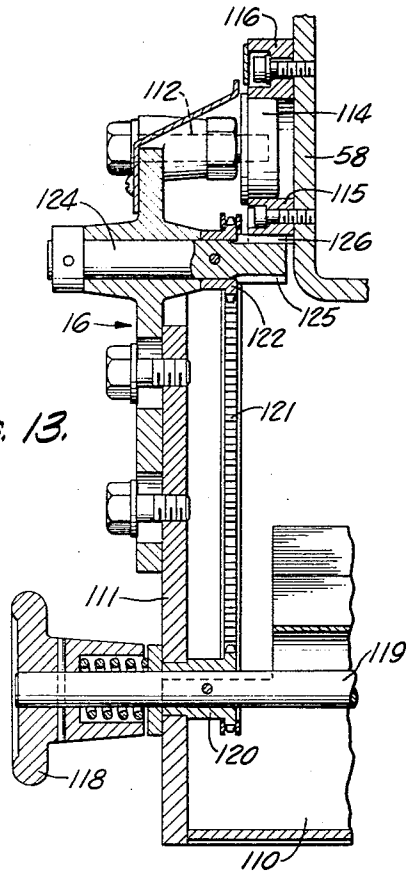


FIG. 13.

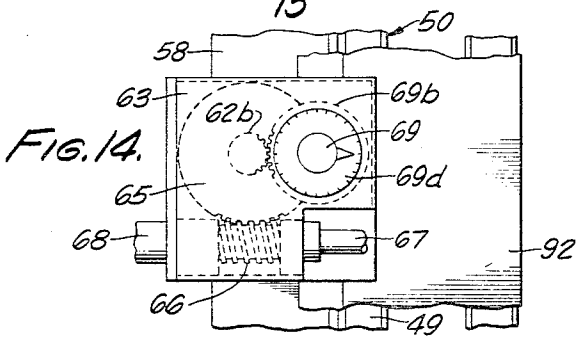


FIG. 14.

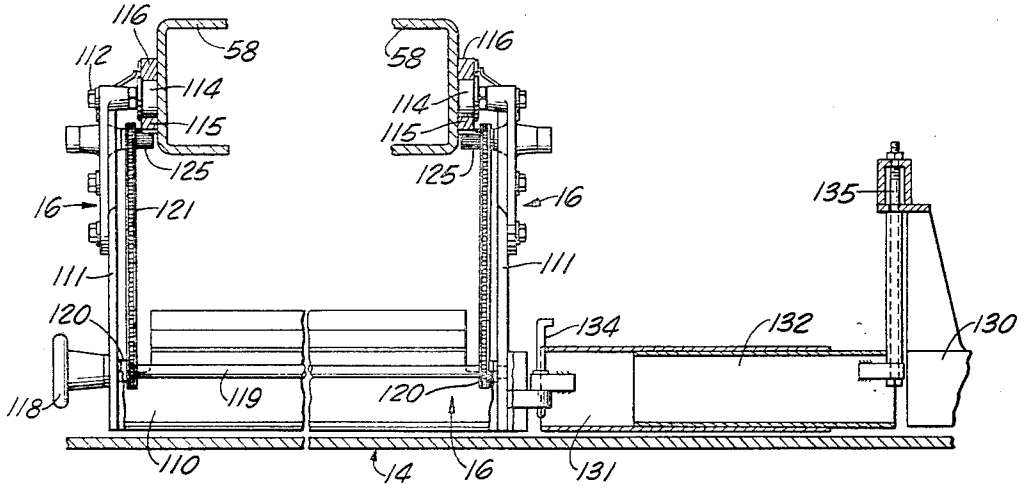


FIG. 12.

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FRUIT SIZING MACHINE

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FIG. 17.

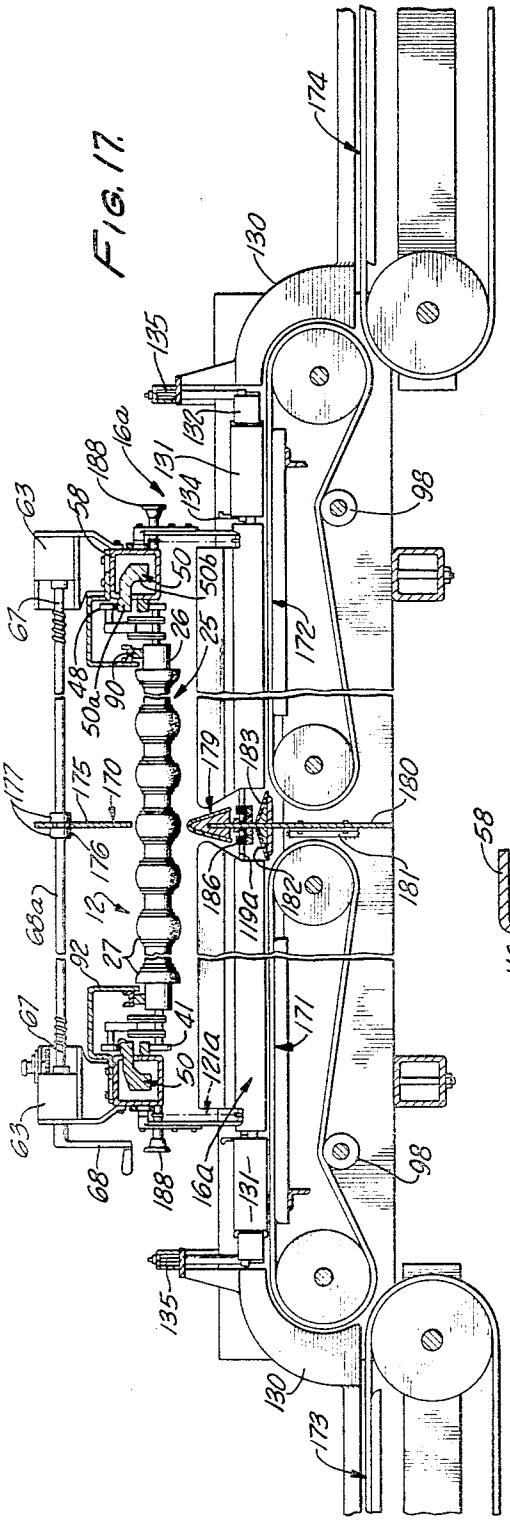
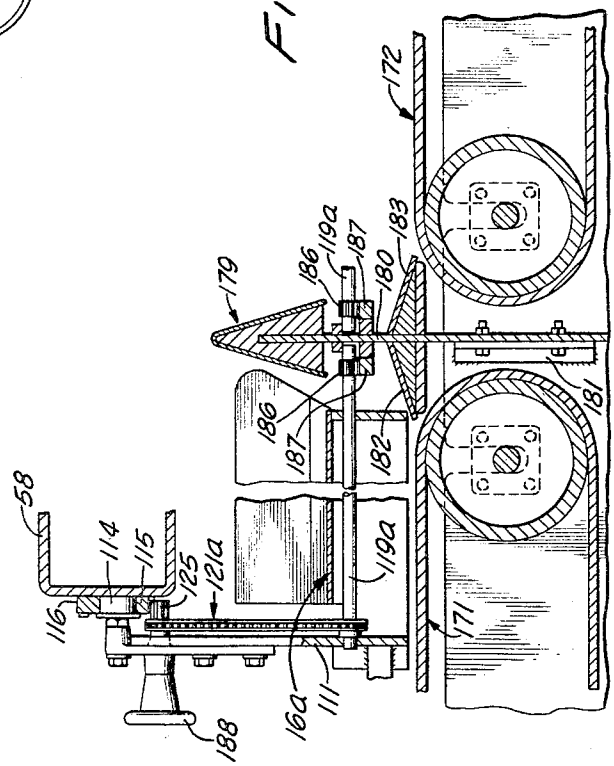


FIG. 18.



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United States Patent Office 3,405,801
Patented Oct. 15, 1968

3,405,801

FRUIT SIZING MACHINE

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Continuation of application Ser. No. 317,245, Oct. 18, 1963. This application June 15, 1967, Ser. No. 666,222
18 Claims. (Cl. 209—84)

ABSTRACT OF THE DISCLOSURE

A conveyor surface for sizing fruit is formed by transverse sizing rolls which are connected at their opposite ends to linkages which are incorporated in two parallel sprocket chains which pass around corresponding sprockets at the two ends of the conveyor. The linkages engage pairs of cam tracks on opposite sides of the conveyor for the purpose of controlling the spacing of the transverse sizing rolls, the cam tracks of each pair spreading apart to act on the linkages to spread apart the transverse sizing rolls as the sizing rolls traverse the tail half of the conveyor to cause the fruit to drop through different zones of the conveyor according to fruit size. The linkages make pressure engagement with the pairs of cam tracks in response to tension in the sprocket chains, such pressure engagement creating wear as well as resistance to conveyor operation. Towards the head end of the upper run of the conveyor the head end sprockets place the sprocket chains under longitudinal compression and thus minimize the pressure of the linkages on the pairs of cam tracks, but towards the tail end of the upper flight, the tail end sprockets place the sprocket chains under tension to cause the linkages to make pressure engagement with the pairs of cam tracks as required for controlled spacing of the transverse sizing rolls. Thus, the wear and resistance created by pressure engagement with the cam tracks by the linkages is limited substantially to the tail half of the upper run of the conveyor.

This application is a continuation of our application, now abandoned, Ser. No. 317,245, filed Oct. 18, 1963, for Fruit Sizing Machine.

The present invention relates generally to continuous sizing machines for citrus and other fruits, and more particularly to improved control means for the sizing means that enables a greater range of sizes of fruit to be handled by a given machine and also enables better adjustment of the sizing operation.

A machine of this general character is disclosed and claimed in an application of Maurice V. Johnson, Jr., and Donald C. Savage, Ser. No. 213,841, filed July 20, 1962, for Fruit Processing Machine, now Patent No. 3,244,276.

It is a general object of the invention to provide an improved machine that will receive fruit or the like at random and will orient and size the fruit in a continuous operation.

While fruit and vegetables each have a general characteristic shape, they are each subject to considerable variation in both size and shape. This is particularly true of citrus fruits, for which the present machine is especially adapted. Because of this, the present machine will be illustrated and described as a universal sizing machine for handling and sizing all kinds and sizes of citrus fruits, but it will be realized that in the broader aspects of the invention, the machine is not necessarily limited to citrus fruits.

In retail selling of citrus fruit, it is desired that all fruit of one grade appear to have substantially the same size. Using lemons as an example, it has been customary to size and classify lemons primarily on the basis of their

diameter taken at right angles to the longer axis of the fruit. When classified on this basis, elongated fruit of the same diameter as spherical fruit appears to be much larger because of the increased length, and in fact, such longer fruit does have a larger volume than spherical fruit of the same diameter. The eye normally takes into account the individual factors of diameter, length and projected area, all of which contribute to the general appearance, and consequently, fruit that are sized on the basis of one factor alone will not all appear visually to be all of the same size. Accordingly, the present machine has been designed to accurately size the various citrus fruits not only with respect to their diameter but also with respect to their lengths and general shape.

This sizing of fruit is carried out with a plurality of spaced, parallel sizing rolls, fruit of one kind, for example lemons, being fed into the machine at random in a plurality of different sizes. The commercial range of sizes for oranges is different than for lemons, and includes the full range of sizes for lemons but also extends beyond to fruit of larger sizes. The same is true of grapefruit. Grapefruit includes all of the size range for oranges and then extend beyond to include larger fruit.

Accordingly, it is also a general object of the present invention to provide a machine which, using the same sizing rolls, is adapted to efficient sizing and handling of the full range of sizes encountered in all citrus fruit from the smallest lemons to the largest grapefruit.

It is a further object of the present invention to provide a sizing machine of this character that, for given overall dimensions, operates on a wider range of fruit sizes than has heretofore been possible. This reduces the floor space occupied by a sizing machine handling the maximum range of sizes as compared with prior designs.

It is also a further object of the present invention to provide such a sizing machine having a plurality of spaced sizing rolls which includes means for adjusting the spacing between rolls at one or more positions along the sizing zone, thus permitting control by the operator over the size of fruit selected at any location throughout the length of the sizing zone.

It is another object of this invention to provide a sizing machine of the character described which will handle a large volume of fruit with each operation while accurately sizing the fruit in a manner that will greatly reduce bruising and injury which would result in loss of sales in the market.

It is a further object of this invention to provide a sizing machine which readily may be modified so that as one machine it will serve the purpose of two machines operable for simultaneously sizing fruit of different grades while providing all of the advantages herein set forth.

It is another object to provide as one form of the present invention a sizing machine of the character next above noted which will operate in a highly efficient manner to simultaneously size large quantities of fruit of different grades and to segregate the different grades with one operation of the machine.

It is another object of this invention to provide in a machine such as described, a novel combination of a sizing conveyor and drive means therefor in which separate motor means is drivingly connected to each end of the conveyor runs in an electrical circuit operable through the separate motor drive means to maintain a substantially constant tension in the tail half of the upper run of the conveyor as adjustments are made in the spacing between shafts in the upper run.

How the above objects and advantages of the present invention, as well as others not specifically mentioned herein, are attained will be more readily understood by reference to the following description and to the drawings, in which:

FIG. 1 is a partially diagrammatic plan view of a sizing machine embodying the present invention;

FIG. 2 is a side elevation thereof;

FIG. 3 (in two sections 3*a* and 3*b*) is an enlarged side elevation of the machine with the side cover plates removed showing details of the endless sizing conveyor;

FIG. 4 is a partial transverse cross section on line **4**—**4** of FIG. 1;

FIG. 5 is a fragmentary plan view of the drive mechanism for driving the endless sizing conveyor;

FIG. 6 is a fragmentary end elevation as indicated by line **6**—**6** of FIG. 5;

FIG. 7 is a fragmentary vertical transverse section on line **7**—**7** of FIGS. 1 and 8;

FIG. 8 is a fragmentary vertical section on line **8**—**8** of FIG. 7 showing in elevation a portion of the adjustable cam track which regulates the spacing between the sizer rolls;

FIG. 9 is a fragmentary combined plan and horizontal section on line **9**—**9** of FIG. 8;

FIG. 10 is an enlarged fragmentary detail section showing the end mounting of the sizing rolls;

FIG. 11 is an enlarged fragmentary elevation showing the end of one of the adjustable transverse dividers;

FIG. 12 is a fragmentary vertical transverse section on line **12**—**12** of FIG. 11 showing in side elevation one of the adjustable dividers;

FIG. 13 is a fragmentary vertical section on line **13**—**13** of FIG. 11, at a further enlarged scale;

FIG. 14 is a fragmentary plan of the dial gauge indicating the cam track spacing, taken on line **14**—**14** of FIG. 7;

FIG. 15 is a diagrammatic side elevation of a sizing machine illustrating a variational form of drive for the conveyor;

FIG. 16 is an enlarged fragment of FIG. 3 showing the safety clip guiding the conveyor links onto the drive sprocket;

FIG. 17 is a fragmentary sectional view similar to FIG. 4 of a modified sizing machine embodying the present invention; and

FIG. 18 is a fragmentary sectional view partly in elevation on an enlarged scale to illustrate details of the modified form of the machine shown in FIG. 17.

Referring now to the drawings, and particularly to FIGS. 1, 2 and 3, the general arrangement of the machine will be first pointed out. The fruit to be sized is supplied by means, not shown, to belt conveyor **10**, which may be of any suitable type but is here shown as being an endless belt conveyor, with a plurality of transverse rollers or bars, and passing over a drive sprocket **11** (see FIG. 3*a*). The fruit dropped off the upper end of conveyor **10** spills onto the sizing and orienting conveyor indicated generally at **12**. Beneath conveyor **12** when the fruit drops onto it may be a bin **13** to catch leaves, twigs, small fruit or any other matters that may drop through the conveyor. The top run of conveyor **12** moves to the right in the drawings, the right end being termed the back or tail end, and as the fruit is carried with the conveyor it is oriented by the conveyor and sorted according to sizes. This sizing operation is accomplished by progressively spreading apart the sizing rolls of the conveyor, as will be described later, allowing the fruit to drop from the sizing conveyor onto a transverse take-out belt **14**. It is obvious that the smallest fruit drops first and the largest drops last with the result that the fruit is sized progressively in the direction of the conveyor travel.

Belt **14** moves transversely to the direction of the movement of the conveyor **12** and carries the sized fruit out of the sizing machine. A plurality of adjustable dividers **16** are located immediately above belt **14** in order to provide a plurality of channels through which fruit moves, each channel defining a commercial grade or size of the fruit. As may be seen particularly in FIG. 4, the fruit is dropped off one end of endless belt **14** onto a second discharge conveyor **18** to a location where it is further processed or handled. A plurality of rails **19** extending parallel to the direction of travel of belt **18** establish a plurality of channels each containing fruit of one general size or grade.

Conveyor **10** may be of any conventional type or design and is preferably the same general width as sizing conveyor **12**. Conveyor **10** may be driven from any suitable source of power, but is here shown as being driven by a pair of spaced sprockets **11** mounted on drive shaft **21** which is driven, as shown in FIGS. 1 and 2, by chain or a sprocket drive **22** operated by a motor **22***a* mounted on the frame of the conveyor **10**.

Conveyor **12** comprises a plurality of sizing rolls **25** which, as may be seen in FIG. 1, are parallel to each other and spaced transversely from one another. Each sizing roll is formed by a hollow shaft **26** on which is mounted a plurality of rubber sleeves **27** that are spaced apart axially of the shaft **26**. As shown particularly in FIGS. 9 and 10, each hollow shaft **26** is mounted on the conveyor by means of a stub axle **30** at each end of the shaft mounted in a ball bearing assembly **31**. The outer race of the ball bearing assembly is non-rotatably attached to hollow shaft **26** while the inner race is attached to axle **30** in any suitable manner, permitting the sizing rolls to rotate freely with respect to axle **30**. The axle and bearing arrangement at one end of each shaft **26** is shown in FIG. 10, there being a single set screw **26'** at one end of each shaft to provide the necessary flexibility assuring that the conveyor **12** will operate efficiently.

Pivotally mounted upon each axle **30** is a pair of spaced outer arms **32** and **34**. A pair of inner arms **37** and **38** are mounted on axle **30** to pivot with respect to the axle. Between arms **37** and **38** is spacer **40** which is free to rotate on axle **30**.

Mounted on the outer end of each axle **30** beyond the outer arm **32** and attached thereto is a ball bearing **41**. The ball bearing has an outer race **42** which serves as a cam follower in the form of a roller that bears against the under face **43** of cam track section **44**. Thus, the plurality of rollers **41** disposed at each end of the several hollow shafts **26** provide a first set of rollers acting as cam followers.

A second set of cam followers is provided in the form of a plurality of rollers **48**, shown in FIGS. 7, 8 and 9. Each roller **48** is preferably a ball bearing similar to ball bearings **41** and having an outer race which engages the upper face **49** of an upper cam track section **50**. Rollers **41** and **48** lie substantially in a common longitudinal vertical plane. Each roller follower **48** is mounted upon a short shaft **52** which is connected to a depending link **54**. At its lower end, each link **54** is pivotally connected to a pair of inner arms **37** and **38** which are disposed one on either side of depending link **54**. Connection between the inner arms and the depending link is effected by pin **55** shown in FIG. 8. Pin **55** connects the depending link not only to the upper end of a pair of inner arms **37** and **38**, but also to the upper ends of a pair of outer arms **32** and **34**.

As shown particularly in FIG. 9 and FIG. 3, alternate pairs of outer arms **32** and **34** are connected at their lower ends to a shaft **26** of the sizing rolls while the intervening pairs of outer arms are connected pivotally to an axle **30***a* and thereby to a cam follower **41** by a construction which is the same as that illustrated in FIG. 10 except that no shaft **26** is connected to axles **30***a* which alternate with axles **30** in the conveyor. While it is satisfactory under some circumstances to connect the lower ends of all the inner and outer arms to a shaft **26**, a construction which is disclosed in the patent referred to above, it is preferred in this machine to adopt the construction illustrated which, in effect, omits every other sizing roll of the machine shown in said patent by placing a sizing roll only at the lower ends of alternate pairs of outer arms **32** and **34**. This construction is found advantageous because

it permits a greater maximum spacing between successive sizing rolls for a given size of the conveyor linkage comprising arms 32, 34, 37, 38 and 54.

The adjustable cam track, with which the two sets of rollers 41 and 48 cooperate, extends horizontally at each side of the machine parallel to the general path of the upper run of conveyor 12, and the cam track consists of two sections. The lower section 44 is stationary while the upper section 50 is adjustably supported for reasons which will become evident. Both sections of the cam track are supported by the frame of the machine. Lower cam section 44 is bolted or otherwise fixedly attached to horizontal frame member 58 and for practical purposes may be considered as being a straight, continuous member throughout its entire length.

The upper cam section 50 is movably mounted in order to vary the vertical distance between it and the lower stationary cam track 44, such movement serving to vary the distance between the two sets of rollers 41 and 48 as will become evident. The upper cam track consists of a plurality of straight segments, the ends of which segments are interconnected by a series of pins 60 thus producing an articulated track section. The upper track section is supported only at these points of pin-connection. As may be seen in FIGS. 7 and 8, each pin 60 is mounted in a traveling block 61 provided with a pair of threaded openings through each of which passes one of lead screws 62. The axes of screws 62 are vertical.

The upper ends of lead screws 62 extend into housing 63. Each lead screw carries a spur gear 64, the two gears intermeshing so that rotation of one lead screw produces equal and simultaneous rotation of the other. Since with this spur gear arrangement the screws will rotate in opposite directions, one is provided with a left hand thread and the other with a right hand thread. One of the two lead screws extends higher into housing 63 and is provided near its upper end with a worm wheel 65 as shown in FIG. 8, such worm wheel meshing with and being driven by worm 66 mounted upon shaft 67 extending horizontally across the machine above the conveyor. At one side of the machine the shaft 67 carries a crank 68 by means of which the shaft may be rotated, movement being transmitted through the gear train 66, 65 and 64 to the two lead screws 62 in order to raise or lower traveling block 61. As seen particularly in FIG. 7, the two horizontal shafts 67 at opposite sides of the machine are interconnected by shaft section 68*a* so that the two drive shafts 67 are rotated equally and simultaneously with the result that two traveling blocks 61 at opposite sides of the conveyor 12 are moved equally and simultaneously in the same direction upon rotation of crank 68. As a result, any adjustment in the position of upper cam track section 50 is made simultaneously and in equal amounts at both sides of conveyor 12.

To enable the operator to obtain a wide range of adjustments of the spacing between the two sections of the cam track, the upper section is made in a plurality of individually movable segments. Accordingly, there are a plurality of means just described for moving one track section relative to the other in order to vary the distance between the sets of rollers, each one of these means controlling a pair of pins 60, the members of the pair being disposed at opposite sides of the conveyor 12.

One of the important requirements in order to accomplish accurate sizing is track rigidity. The importance of this is due to the geometry of the linkage system in which a deflection of the track of .125" will result in a change in space between adjacent sizing rolls of 1.1" at the head end of the sizer and .24" at the other end. It will be seen that the change in sizing roll spacing is from about two to nine times greater than any change in track spacing. In order to secure the necessary rigidity at the supporting points the screws 62 are spaced laterally of the track 50. The track is made up of two integral portions, 50*a* which supports rollers 48, and a massive portion 50*b* which holds deflection of the track between supports to a minimum.

The distance between the cam sections at a given pin 60, and hence the spacing between successive shafts 26 at that point, is indicated by dial gauge 69 (FIGS. 7 and 14). The gauge comprises a pointer turned by shaft 69*a* which also carries spur gear 69*b*. This is driven by engagement with meshing pinion 62*b* on the upper end of a lead screw 62. A dial 69*d*, graduated in any desired unit, and placed below the pointer, cooperates with the pointer to indicate the rotational position of the latter and, as a known function thereof, the cam section spacing.

As can be seen from FIG. 3*b*, upper section 50 of the cam track terminates at the back end of the machine in a tapered section 50*a* at which the vertical spacing between cam surfaces 43 and 49 is gradually reduced. Lower section 44 of the cam track at each side of the machine continues on around sprocket 72, following generally the contour of the sprocket and leading the conveyor into the lower run over which the sizing conveyor is returned to the head end of the machine. The lower cam section 44 has an inclined portion 44*a* down which the conveyor elements move by gravity as they progress to the horizontal portion 44*b*. As the conveyor moves over the lower run it has considerable slack in it, allowing storage of the sizing rolls. It moves over an upwardly inclined track section 44*c* (FIG. 3*a*) which conducts it to drive sprockets 70 at the head end of the machine.

Immediately before reaching sprockets 70 the conveyor links at each side of the conveyor pass through a safety guide indicated generally at 175 in FIGS. 3 and 16. Guide 175 includes a pair of spaced bars 176 between which rollers 41 pass to flatten out the links 34 and 38 as shown, thus stretching the conveyor to its full length in order to space properly the successive elements 30, 54 and 30*a* for engagement by the teeth of sprockets 70. The single cam track extends around sprockets 70, becoming the upper section 50 of the cam track.

Conveyor 12 is driven at the feed end of head end by a pair of sprockets 70 (FIG. 3*a*) located one at either side of the conveyor and both mounted upon and driven by horizontal transverse shaft 24. The conveyor is also driven at the back or tail end by a similar pair of sprockets 72 (FIG. 3*b*) located one at each side of the conveyor and driven by horiozntal transverse shaft 73, as shown in FIG. 3*b*. The spacing of the slots between the teeth of the sprockets is such that these teeth engage both spacer sleeves 40 and links 54 when the chain is in the extended condition at each end of the upper run.

As shown particularly in FIGS. 2 and 5, both ends of the conveyor may be driven from a single prime mover. Power is supplied from electric motor 75 which drives through belt 76 the input shaft to gear box 77. This gear box has two output shafts at 78 and 79. Shaft 78 has a sprocket mounted on it which is connected by chain 80 to sprocket 81 mounted on shaft 73 to drive the tail end of the conveyor. Power for the feed end of the conveyor is supplied from shaft 79 throgh clutch 82 and shaft 79*a*, an extension of shaft 79, to the input shaft of gear box 83. The output shaft 84 of the gear box carries a sprocket which is connected by drive chain 85 to sprocket 86 mounted on transverse shaft 24 to drive the feed end of the conveyor. By dividing the power output from a single prime mover in this manner, both ends of the conveyor are driven simultaneously and at the same speed at all times.

As the upper run of the conveyor moves to the right, as viewed in the drawings, roller followers 48 move over upper cam surface 49 and roller followers 41 move over lower cam surface 43. The vertical spacing between these surfaces, and consequently the spacing between one set of rollers 48 and the other set of rollers 41, controls the lateral spacing between successive shafts 26. During the initial portion of the sizing operation, the spacing between successive shafts 26 is kept to a minimum, but as the sizing

operation continues and the fruit is carried away from the point where it is fed by conveyor **10** onto the sizing conveyor, the spacing between successive shafts is progressively increased, allowing fruit of larger and larger sizes to fall down between the shafts.

To assist in the sizing operation and to orient the fruit properly with respect to the sizing rolls, each shaft **26** is provided with a plurality of the sleeves **27** which are spaced axially along the shaft. A group of four sleeves **27** forms a pocket to receive one fruit, the plurality of sleeves forming a plurality of pockets for this purpose. Two successive sleeves on one shaft and two opposite sleeves mounted on the next adjacent shaft constitute such a group of four sleeves forming one pocket. For this reason, sleeves on adjacent shafts are aligned transversely of shafts **26**, as shown particularly in FIG. 1.

Sleeves **27**, as here shown, are formed of a suitable resilient material, for example rubber, and are preferably spaced from one another along each shaft in order to enable easy replacement thereof when worn or for other reasons that will become apparent, but otherwise it will be understood that the shafts and sleeves might be made integrally with each other and still perform in the same way.

Sleeves **27** on the sizing rolls are the elements that directly engage and support the fruit, each sleeve has one or more shoulders, each providing an annular ridge extending around the sleeve. Engagement with each fruit is a localized contact approaching a point or line contact at these ridges, as is explained in greater detail in the patent referred to above.

Sizing rollers **25** are rotated during their travel along the horizontal portion of the upper conveyor run, this rotation being preferred in order to orient the fruit in the pockets formed by sleeves **27**, as just explained, and to place in a pocket any fruit which may not have previously fallen into one. For the purpose of rotating the shafts **26** and the sizing rolls thereon, a track **90**, as shown in FIG. 7, is mounted upon a plurality of vertically extending screws **91** which are supported by brackets **92** from the machine frame. Each screw **91** is provided with a pair of lock nuts **93** which permit the screws to be adjusted up or down and then locked in position. The underside of each track **90** is covered with a pad **94** of rubber belting or other slightly yielding material which engages the extremity of a shaft **26** whereby the shaft is rotated by frictional engagement with pad **94** as the conveyor moves horizontally parallel to pad **94** and its supporting rail.

A similar track is provided at each side of the conveyor so that two tracks engage the two extremities of the hollow shafts **26**. Rotation of the shafts in this manner and sleeves **27** thereon, rotates and displaces the fruit as they fall from conveyor **10** onto sizing rollers **25**, whereby all the fruit falls into the pockets formed by each group of four adjacent sleeves. In the pockets, each fruit is oriented with the long axis of the fruit parallel to the axes of the shafts **26**.

As the fruit drops between sizing rolls **25**, it falls onto endelss belt **14**, the upper run of which moves transversely to conveyor **12** and carries the fruit out from underneath the sizing conveyor. Belt **14** passes over driven head roll **96** and an idling trail roll **97**, the belt being kept tight by a pair of idlers **98**. Power for advancing the belt is supplied by motor **100** (FIG. 1) which, through chain **101**, drives sprocket **102** on the end of the shaft supporting head roll **96**. As shown in FIGS. 4 and 3, the upper run of belt **14** is supported on a platform **104** in the zone where fruit drops onto it.

As the fruit drops onto belt **14**, it falls between adjustable dividers indicated generally at **16** in FIG. 3. These dividers are spaced apart in the direction of travel of sizing conveyor **12** and each space between them represents a zone in which the fruit corresponds, in general, to a particular commercial size. Since with different batches the width of a zone in which a given grade will be obtained will change, the dividers **16** are made adjustable.

The construction of these dividers is shown particularly in FIGS. 11, 12 and 13. There it will be seen that each divider comprises a hollow fence **110** supported at its ends by two hanger bars **111** which are each supported at its upper end from a beam **58** of the machine frame. Each hanger bar **111** carries at its upper end two axle pins **112** on each of which is mounted a roller **114**. The two rollers **114** ride in a track between a pair of parallel, spaced bars **115** and **116**, as shown particularly in FIG. 13.

In order to move a divider **16** longitudinally of conveyor **12**, there is provided at one side of each divider a hand wheel **118** mounted on shaft **119** which extends for the full length of the divider. Adjacent the opposite ends of the divider, shaft **119** carries a pair of sprockets **120** over each of which passes a chain **121** that also passes over an upper sprocket **122** non-rotatably attached to shaft **124** which rotates in a journal bearing in the upper portion of a hanger **111**. Axle **124** carries gear teeth **125** that mesh with rack teeth **126** on the underside of track bar **115**. Thus, by turning hand wheel **118**, both shafts **124** at opposite sides of conveyor **12** are rotated to shift the divider longitudinally of conveyor **12**.

As may be seen in FIGS. 1 and 4, the space above final discharge belt **18** is divided into several channels by stationary fences **130**. In order to provide continuity between adjustable dividers **16** and the stationary fences **130**, there is provided at the outlet end of each divider **16** a transition section as shown in FIG. 12. This transition section comprises a pair of telescopic members **131** and **132**. The former is pivotally connected by pin **134** to the outlet end of a divider **16**, while the other section **132** is pivotally connected by pin **135** to an end of a stationary rail **130**. In this manner movement of the dividers is permitted while continuity is maintained of the structure that guides the fruit as it is moved by belt **41** and drops onto belt **18**.

As previously mentioned, the transverse spacing between successive sizing rolls **25** is controlled by the distance between the two cam track faces **43** and **49**. It will be evident from FIG. 8 that as the vertical spacing between these two cam faces is increased by moving cam track sections **44** and **50** farther apart, the linkage interconnecting cam followers **41** and **48** is contracted, moving rollers **41** closer together. This movement decreases the transverse spacing between successive shafts **26** and the sizing rolls **25** thereon. Spacing between these shafts is increased by reversing the procedure and moving cam track sections **44** and **50** closer together.

Because of the articulated nature of the upper cam track section provided by interconnecting pins **60**, one segment of the upper track section **50** may be inclined with respect to the lower track section, thus producing a gradual increase in the spacing between sizing rolls **25** as they move the length of this segment of the cam track. A following segment of upper cam track may be parallel to the lower cam track section, thus maintaining a constant interval between successive sizing rolls **25** as they move the length of this parallel segment of the cam track.

When the lateral spacing between successive sizing rolls **25** is increased, a smaller number of sizing rolls is required to fill the upper run of the conveyor extending between drive sprockets **70** and **72**. Conversely, when the spacing between successive shafts is contracted, a larger number of these sizing rolls **25** is required to fill this space between sprockets **70** and **72**. It is therefore desirable to provide means whereby the number of sizing rolls on the upper run of the conveyor between the two sets of drive sprockets can be increased or decreased to maintain approximately constant tension in the tail end portion of the conveyor as the spacing between successive shafts is changed.

This adjustment may be accomplished when the conveyor is stationary by the mechanism shown in FIG. 5 and FIG. 6. A short jack shaft **140** is mounted on the

machine frame to extend parallel to drive shaft **79**. The jack shaft is slidably mounted in journal bearings and is provided with spur gear **141** which can be engaged or disengaged from gear **142** by axial movement of the jack shaft. Gear **142** is mounted on drive shaft **79***a*. Clutch operating fork **143** is also mounted on jack shaft **140**, and when the jack shaft is moved axially to the right in FIG. 5 to disengage clutch **82**, thus disconnecting the drive from shaft **79** to shaft **79***a*, the same movement causes gear **141** to engage with gear **142** attached to shaft **79***a*. Then, by manually turning handle **145** on the end of jack shaft **140**, power may be applied through drive shaft **79***a* to shaft **24** to turn sprockets **70** and thereby move a portion of conveyor **12** manually. This movement of the conveyor at sprockets **70** is designed to add shafts **26** or subtract them from the upper run of the conveyor. It will be apparent that clockwise motion of sprocket **70** as viewed in FIG. 3*a*, adds sizing rolls whereas motion of the sprockets in the reverse direction subtracts them from the upper run. All of the slack in the conveyor is in the lower run which contains an excess number of sizing rolls in storage which can be drawn upon to add sizing rolls to the upper run of the conveyor, as and when needed.

The axial movement of jack shaft **140** just described also causes pinion **146** on the shaft to engage spur gear **147** which, through a suitable gear reducing train, rotates pointer **148**. The pointer in cooperation with dial **149** serves as a visual indicator of the amount of motion imparted to sprockets **70** at the feed end of the conveyor. Accordingly, the number of shafts **26** which are added to or subtracted from the upper run of the conveyor is known for a given movement of pointer **148**. The machine operator coordinates this number with the readings of the several dial gauges **69** to keep the number of shafts in the upper run of the conveyor within the desired limits to maintain proper working tension in the tail half of the conveyor.

After the adjustment is completed, the jack shaft is returned to the position shown in FIG. 5, re-engaging the elements of clutch **82** and completing the drive from shaft **79** to shaft **79***a*.

As a safety measure, it is desirable to locate switch **150** in the power supply circuit to motor **75** at a position where the switch can be opened by arm **151** attached to jack shaft **140**. Switch **150** is a normally closed switch that is opened by arm **151** when the jack shaft is moved to the position disengaging clutch **82** and meshing gears **141** and **142**. When switch **150** is opened, motor **75** is de-energized and it will thus be impossible to accidentally move the drive sprockets **72** at the tail end of the machine. When the adjustment is over, returning clutch **82** to a driving position simultaneously releases switch **150**, returning it to a closed position in which motor **75** can be again operated.

The conveyor adjusting means just described is operated manually and only when the conveyor is not in operation, since it is dependent upon drive sprockets **72** being held stationary during the period of relative motion of drive sprockets **70**. An alternative adjustment means that permits adjustment of the number of sizing rolls **25** in the upper run of the conveyor while the conveyor is in normal operation, is shown in FIG. 15. Here each pair of sprockets **86** and **81** on drive shafts **24** and **73** which may be conveniently termed first and second sprocket means respectively, are driven independently from separate induction motors **161** and **162**, which may be termed first and second rotary actuating means respectively. Motor **161** drives sprockets **86** through drive belt or chain **163**, while motor **162** drives sprockets **81** through belt or chain **164**. Power for these two motors, which are wired in parallel, is supplied through electrical conductors **165** from alternator **167**. The alternator is driven mechanically from a main motor **168** through shaft **169**, the driving connection between the alternator and the motor including a variable speed drive **170**.

Motor **168** is any type of synchronous motor driven by alternating current from a commercial power source **171**. The speed at which the alternator is driven can be varied at will through changing the setting of variable speed drive **170**. This controls the frequency of the power output of the alternator, which frequency is a function of the rotor speed. In turn, the speed of the two induction motors **161** and **162** is dependent primarily upon the frequency of the power supplied to these units by the alternator. By this arrangement it is possible to drive the sizing conveyor at any speed desired, within the possible limits.

The voltage output of alternator **167** is controlled by varying the strength of the direct current field in this unit. Since the torque and power output of the induction motors **161** and **162** are known functions of the voltage of their power supply, a desired power output of the alternator can be obtained. In operation, the power of the driving motors is reduced so that neither motor **161** nor **162** has sufficient power to drive the sizing conveyor by itself, but the two driving motors together do have sufficient power to drive it. Under these conditions the motors automatically share the load. The front end motor **161** will push on the upper run of the sizing conveyor, and the tail end motor **162** will exert a pull so that the tension of the upper run towards the tail end of the conveyor can be maintained within desired limits. With this arrangement the cam track sections can be adjusted in either direction to change their spacing and hence the transverse spacing of the sizing rolls while the conveyor is running. This is possible because the two induction motors **161** and **162** automatically maintain the tension in the tail half of the upper run of the sizing conveyor within narrow limits, taking up any slack as it occurs or temporarily yielding to increased tension to lengthen the conveyor.

The drive and control system for the sizing conveyor **12**, as shown in FIG. 15, may also be employed to drive and control the motor **100** for operating the take-out belt **14**. For this purpose the motor is connected with the conductors **165** by means of the conductors **165***a* whereby the speed of the belt **14** is controlled according to the speed of the sizing conveyor **12**.

As shown in FIGS. 17 and 18, a modified form of the present invention consists in utilizing dividing means generally designated **170** in connection with the sizing conveyor **12** to provide a pair of sizing sections extending along the upper run of the sizing conveyor whereby different grades of fruit simultaneously may be sized. In addition to the dividing means **170**, a pair of take-off belts **171** and **172** are provided to take off sized fruit of different grades from opposite sides of the conveyor and to deliver the fruit onto a pair of discharge conveyors **173** and **174** likewise extending from opposite sides of the conveyor **12**. Each of the belts **171** and **172** may be of substantially the same construction and arrangement as the take-off belt **14**. Each of the discharge conveyors **173** and **174** may be of substantially the same construction and arrangement as the discharge conveyor **18**.

Since the sizing conveyor shown in FIGS. 17 and 18 and certain related elements are identical with the conveyor **12** shown in FIGS. 1–16, the same reference characters applied in other views will be applied to like parts in FIGS. 17 and 18.

The dividing means **170** is associated with the conveyor **12** without requiring any change or alteration in the construction of the conveyor and consists of an elongate plate-like divider member **175** which is suspended on edge from the sections **68***a* of the transverse shafts **67** above the conveyor, with the lower edge of the divider member **175** close to the upper run of the conveyor. As here shown, the divider **175** divides the upper run into two equal sections but it is obvious that the divider may be shifted to

one side or the other of the center of the conveyor as desired to provide a wider sizing section on one side than on the other side.

Any suitable means may be employed to mount the divider **175** on the shafts **68***a*. As here shown, the divider has openings **176** through which the shafts **68***a* extend. A pair of collars **177** are mounted on the shafts on opposite sides of the divider to hold the latter in place. The collars **177** are axially adjustable on the shafts to provide for selectively positioning the divider to either side of the center of the conveyor or at the center, as desired.

The divider means **170** also includes a divider element **179** located below the upper run of the sizing conveyor **12** and between the two take-off belts **171** and **172**. The element **179** is mounted on an upright support **180** fastened by a bracket **181** to the frame of the conveyor **12**.

Above the belts **171** and **172** are adjustable dividers **16***a* corresponding to those shown in FIG. 3*a* to provide a plurality of channels on the belts **171** and **172** for fruit of different sizes that are released from the upper run of the belt and are directed by the dividing element **179** so as to drop onto inclined pads **182** and **183** from which the fruit rolls onto the belts **171** and **172**. The dividers **16***a* are adjustable through the medium of mechanism similar to that shown in FIGS. 11, 12 and 13, there being shafts **119***a* rotatable through a chain and sprocket drive means **121***a* for the dividers on each of the two belts **171** and **172**. The shafts **119***a* have the dividers **16***a* fixed thereto to move therewith, the inner ends of the shafts **119***a* having pinions **186** thereon which mesh with rack bars **187** fixed on supports **180** for the divider element **179**. When the chain and sprocket drives **121***a* are operated, the shafts **119***a* upon being turned will travel on the rack bars **187** thereby adjusting the dividers **16***a* as required, the knobs **188** providing for manual actuation of the chain and sprocket drive means.

It will now be apparent that by simple changes and additions, the sizer unit **12** of this invention may be made to serve the purpose of two sizing machines. Fruit of different grades may be fed to the sizer and will be conducted in separate paths along the upper run of the sizer by reason of the divider element **175**. As the fruit drops according to size through the upper run of the conveyor, the separation of the different grades is maintained by the element **179** below the upper run and by the pads **182** and **183** so that fruit of one grade will be conducted to one of the two take-off belts and fruit of another grade will be disposed onto the other of the two belts.

In all other respects, this form of the invention is operated and controlled in the same manner as in the form shown in FIGS. 1–16.

An understanding of the mode of operation of the embodiment of the conveyor shown in FIG. 15 that is driven by the two induction motors **161** and **162** may be approached by employing the analogy of a freight train in which an engine at the rear end of the train corresponds to the induction motor **161** and an engine at the front end of the train corresponds to the second induction motor **162**. As stated, the power of the two driving motors is reduced so that neither motor **161** nor motor **162** has sufficient power to drive the sizing conveyor by itself. If the power of the rear engine and the front engine of the freight train are reduced so that neither alone has sufficient power to move the train but the two engines together do have sufficient power, then under these conditions, in accordance with the explanation given hereinabove, the engine at the rear end of the train will apply pushing force while the engine at the front end will apply pulling force because only this kind of cooperation is possible to move the train when neither engine alone has enough power to do so. The sizing rolls of the upper flight of the conveyor correspond to the freight cars of the train, the lower flight of the conveyor being ignored because relatively low power is used by the lower conveyor since, as stated above, the sizing rolls of the lower half gravitate from the sprocket **72** to the storage area shown in FIG. 3*b* where the stored sizing rolls crowd together.

In the freight train analogy, the couplings between cars in approximately the rear half of the train will be slack because the rear half of the train must be under longitudinal compression to receive driving force from the rear engine **161**. On the other hand, the couplings between cars in approximately the front half of the train will be stretched tight for maximum spacing between the cars because the front half of the train is under tension as required to receive actuating force from the front engine.

The significance of having tension in the half of the upper flight of the conveyor that is actuated by the motor **162** and in having longitudinal compression in the half of the upper flight of the conveyor that is actuated by the motor **161** is that tension in the half of the flight of the conveyor that is pulled by the motor **162** is required to cause the linkages to cooperate with the pairs of cam tracks to spread the sizing rolls apart. It is the tension in the sprocket chains that contracts the linkages against the pairs of cam tracks for controlling the spacing of the sizing rolls. No tension is required in the half of the upper run of the conveyor that is pushed by the induction motor **161** because tension is required only to spread the sizing rolls apart and not to crowd the sizing rolls together.

It may be readily appreciated that the conversion of tension of the sprocket chains into pressure of the linkages against the pairs of cam tracks causes excessive wear of the mutually contacting parts and in addition greatly resists travel of the conveyor. The feature of the present invention is that no tension exists in approximately one-half of the upper flight of the conveyor and only relatively light tension is required in the remaining half of the upper flight of the conveyor. The fact that only relatively light tension is required in the sprocket chains in the tail half of the upper flight of the conveyor that is driven by the induction motor **162** may be understood by referring again to the train analogy. If there were no rear engine and the whole train were pulled by the front engine, the tension between the engine and the leading freight car would be approximately twice as great as in a train of the same length in which a rear engine drives the rear half of the train.

With reference to the absence of tension in the head of the upper flight of the conveyor, it is to be noted in FIG. 15 as well as in FIG. 3*a*, that the upper run of the conveyor is inclined upwardly from the head end of the conveyor. Thus, gravity in this portion of the upper run of the conveyor cooperates with the pushing action of the induction motor **161** to crowd the sizing rolls **25** together and thereby minimize if not entirely eliminate the pressure of the linkages on the pairs of cam tracks in the head half of the upper run.

The fact that the first embodiment of the invention in which a single motor drives the sprockets at the two ends of the conveyor synchronously in a positive manner functions like the second embodiment where two induction motors are employed, may be understood by again employing the freight train analogy. If, while the forward engine is pulling and the rear engine is pushing as set forth in the first analogy with both engines in synchronism, a steel bar were suddenly extended from the rear engine to the front engine to rigidly interconnect the two engines, the cars of the train would behave in the same manner as in the absence of the steel bar. The first embodiment of the invention in which both sets of sprockets at the two ends of the conveyor are positively driven in synchronism by a single power source is analogous to the freight train wherein a steel bar interconnects the front and rear engines to keep them in synchronism.

It is to be borne in mind, as heretofore explained, that the number of sizing rolls **25** required in the upper run

of the conveyor for the described mode of operation in which one end of the upper flight is bushed and the other end is pulled, depends upon the average spacing of the sizing rolls as determined by the spacing of the cam tracks of the two pairs of cam tracks. Thus, if the cam tracks of the two pairs of cam tracks are increased in spacing relative to each other with consequent decreasing of the spacing of the sizing rolls, one or more sizing rolls must be added to the upper conveyor run to maintain the same mode of operation, i.e., to maintain the same crowding of the sizing rolls together in the region of the sprocket **70** and to maintain the required tension in the sprocket chains as the sprocket chains approach the sprocket **72**. If two induction motors are employed and the pairs of cam tracks are adjusted either to require more sizing rolls of fewer sizing rolls in the upper flight of the conveyor, the two induction motors will automatically accommodate themselves to the new situation by relative rotation out of synchronism. Thus, if additional sizing rolls are required in the upper run, the induction motor **161** may momentarily lag behind in the induction motor **162** or the induction motor **161** may momentarily gain on the induction motor **162** or, what is more likely, the induction motor **162** will lag and the induction motor **161** will simultaneously gain for the purpose of automatically adding the required number of sizing rolls to the upper run of the conveyor.

Returning to the analogy of a freight train, it was pointed out above that if a steel bar rigidly interconnects a front engine and a rear engine, neither of which is capable of moving the train alone, there would be no change in the behavior of the cars of the train. The cars in the rear half would still be crowded together under longitudinal compression and the cars in the forward half of the train would still be stretched out in tension. If with the steel bar interconnecting the two engines the forward engine were de-energized and the power of the rear engine doubled, there would still be no change, the cars in the rear half of the train being in compression and the cars of the front half of the train being in tension. This situation in which the two engines are rigidly connected by a steel bar and all of the power is delivered by the rear engine is analogous to the first embodiment of the invention where a single electric motor is positively connected to both the head end and the tail end of the conveyor.

As heretofore described, the adjustment that occurs automatically in the second embodiment of the invention is made manually in the first embodiment of the invention where a single motor drives both sprockets. Thus, for the purpose of adding sizing rolls to the upper run of the conveyor from the storage zone of the lower run of the conveyor, the short jack shaft **140** shown in FIG. 5 is shifted leftward by means of the handle **145** with the result that the switch **150** is actuated to de-energize the drive motor, the clutch **143** is operated to disconnect the shaft **79***a* from the shaft **79**, and the gear **141** meshes with the gear **142** for the purpose of operatively connecting the jack shaft to the shaft **79***a*. The jack shaft is then rotated by the handle **145** to actuate the shaft **79***a* and thereby actuate the sprocket **70** independently of the sprocket **72**, the jack shaft being rotated to cause the sprocket **70** to draw on the lower run of the conveyor to transfer one or more sizing rolls from the lower run to the upper run. As heretofore stated, guidance for carrying out this adjustment of the number of sizing rolls in the upper run of the conveyor may be provided by referring to the several dial gauges **69** that relate to the adjustments of the pairs of cam tracks and by referring to the pointer **148** of the single dial **149** that is operatively connected to the jack shaft as shown in FIG. 6.

While specific structural details have been shown and described, it should be understood that changes and alterations may be resorted to without departing from the spirit of the invention as defined in the appended claims.

We claim:

1. In an apparatus of the character described for sorting articles by size, wherein a conveyor surface of an upper conveyor run is formed by transverse sizing members which are connected at their opposite ends to linkages which are incorporated in two parallel continuous sprocket chains which pass around corresponding sprocket means at the two ends of the conveyor, the linkages straddling pairs of adjustably spaced cam tracks on opposite sides of the upper run for the purpose of controlling the spacing of the transverse members, said pairs of cam tracks acting on the linkages to limit the spreading of the transverse members in response to tensioning of the two sprocket chains thereby determining the spacing between transverse members, the transverse members being increased in spacing towards the tail end upper run to permit the articles to drop through the upper run in accord with the sizes of the articles,

the improvement comprising:

means normally driving said sprocket means at the opposite ends respectively of the conveyor synchronously;

the number of transverse sizing members in the upper run being of a number to cause the sprocket means at the head end of the upper run to push on the sprocket chains to crowd the transverse sizing members together in at least a portion of the head half of the upper run while permitting the sprocket means at the tail end of the conveyor to place the sprocket chains under tension in at least a portion of the tail half of the upper run to cause the linkages in said portion of the tail half to cooperate with the pairs of cam tracks to spread the transverse sizing members apart,

whereby pressure engagement of the linkages with the pairs of cam tracks occurs primarily in the tail half of the upper run with reduced pressure engagement in the head half and consequent reduction in the tension of the sprocket chains and wear of the linkages and cam tracks in the head half of the upper run.

2. An improvement as set forth in claim **1**

in which the lower run of the conveyor is slack to provide a number of transverse sizing members in storage whereby transverse sizing members may be transferred from the upper run to storage in the lower run or may be transferred from storage in the lower run to the upper run by causing relative rotation between the two sprocket means at the two ends of the conveyor thereby to compensate for adjustments in the spacing of the cam tracks of the pair of cam tracks and the consequent changes in the number of transverse sizing members required in the upper run.

3. An improvement as set forth in claim **1** in which the upper run is inclined upwardly from the sprocket means at the head end of the conveyor to promote crowding together of the transverse sizing members and local longitudinal compression of the sprocket chains in the head half of the upper run.

4. An improvement as set forth in claim **2** in which the two sprocket means at the two ends respectively of the conveyor are independently driven by two corresponding motors,

each of the two motors being of insufficient power to drive the whole conveyor by itself whereby the motor at the head end of the conveyor cooperates with the motor at the tail end of the conveyor by pushing on the sprocket chains in the head half of the upper run of the conveyor.

5. An improvement as set forth in claim **4** in which the two motors are induction motors whereby normally the two motors operate synchronously in a steady state condition but briefly rotate relative to each other for transfer of transverse sizing members to or from storage

in response to adjustments in the spacing of the cam tracks of the pairs of cam tracks in the tail half of the upper run of the conveyor while the two motors are actuating the conveyor.

6. An improvement as set forth in claim 2 in which mechanical means normally directly interconnects the two sprocket means at the two ends respectively of the conveyor for synchronous rotation of the two sprocket means,

said mechanical means being releasable to permit one of the sprocket means to be rotated relative to the other while the conveyor is idle thereby to transfer transverse sizing members to or from storage to compensate for adjustment in the spacing of the cam tracks of the pairs of cam tracks in the tail half of the upper run.

7. An improvement as set forth in claim 6 which includes:

means operable to release said mechanical interconnecting means; and

manual means movable from an idle position to an effective position at which it is operatively connected to said one sprocket means for rotation thereof.

8. An improvement as set forth in claim 6 which includes:

means to actuate said one sprocket means independently of the other sprocket means, said actuating means being normally disconnected from said one sprocket means;

means to release said mechanical interconnecting means to permit rotation of said first sprocket means independently of the other sprocket means; and

means operable to connect said actuating means with said one sprocket means for rotation thereof to transfer transverse sizing members to and from storage.

9. An improvement as set forth in claim 6 which includes:

manual control means movable from a normal idle position to an effective position to prepare for transferring transverse sizing members to and from storage;

means responsive to movement of said manual control means to its effective position to stop the conveyor in preparation for transferring the transverse sizing members to or from storage;

means to release said mechanical interconnecting means in response to movement of said control means to its effective position;

means to actuate said one sprocket means independently of the other sprocket means, said actuating means being normally disconnected from said one sprocket means; and

means to connect said actuating means with said one sprocket means in response to the movement of said control means to its effective position.

10. An improvement as set forth in claim 6 which includes indicator means to indicate changes in the spacing of the cam tracks of the pairs of cam tracks to determine the number of transverse sizing members that must be transferred to or from storage to compensate for changes in adjustment of the spacing of the cam tracks.

11. An improvement as set forth in claim 6 which includes indicator means to indicate the amount of rotation of the one sprocket means relative to the other sprocket means for guidance in transferring transverse sizing members to or from storage when said mechanical means is released.

12. A fruit sizing machine, comprising: a plurality of parallel shafts transversely spaced from one another; said shafts having on corresponding extremities a first set of rollers; a second set of rollers spaced from said first set; said first set and second set lying in a common vertical plane; link means interconnecting said first set and said second set to form an endless conveyor; adjustable means controlling the distance between said sets of rollers; drive means for said conveyor including a rotative driving means at each end of the conveyor runs; a separate induction motor drivingly connected to each driving means; and circuit means for connection with a source of alternating current of variable voltage; said circuit means connecting said two motors in parallel and operating to divide the total load between said motors whereby one motor may slip relative to the other motor to enable adjustment of said adjustable means.

13. A fruit sizing machine of the character described, comprising: a plurality of shafts transversely spaced from one another and having fruit sizing elements thereon; said shafts having thereon a first set of rollers; a second set of rollers spaced vertically from said first set of rollers; link means interconnecting said first set of rollers and said second set of rollers to form an endless conveyor having an upper run and a lower run; drive means for said conveyor; means cooperable with said rollers operable during the driving of said conveyor for varying the spacing of said rollers and thereby varying the spacing of said shafts; said drive means including motor means at each of the ends of said conveyor and a source of energy for each motor means operable to divide the load between the respective motor means; and one of the motor means being capable of slippage relative to the other motor means.

14. A fruit sizing machine as defined in claim 13, wherein said means for varying the spacing of said rollers comprises cam track means interposed between said first and second sets of rollers and including relatively angularly adjustable track elements and means for effecting adjustment of said track elements.

15. In an apparatus of the character described for sorting articles by size, wherein a conveyor surface of an upper conveyor run is formed by transverse sizing members which are connected at their opposite ends to linkages which are incorporated in two parallel continuous sprocket chains which pass around first sprocket means at the head end of the upper run and second sprocket means at the tail end of the upper run, the linkages straddling pairs of adjustably spaced cam tracks on opposite sides of the upper run for the purpose of controlling the spacing of the transverse sizing members, said pairs of cam tracks acting on the linkages to limit the spreading of the transverse sizing members in response to tensioning of the two sprocket chains thereby determining the spacing between transverse sizing members, the transverse sizing members being increased in spacing in a sizing zone towards the tail end of the upper run to permit the articles to drop through the upper run in accord with the sizes of the articles,

the improvement comprising:

first rotary actuating means and second rotary actuating means driving said first sprocket means and said second sprocket means respectively,

said two rotary actuating means sharing the total load,

said two rotary actuating means being free to rotate relative to each other in reaction to changes in their shares of the total load, thereby to respond to changes in the tension of the sprocket chains in said sizing zone by relative rotation in one respect to transfer transverse sizing members automatically from the lower run to the upper run when the spacing of the pairs of the cam tracks is increased and by relative rotation in the opposite respect to transfer transverse sizing members automatically from the upper run to the lower run when the spacing of the pairs of cam tracks is decreased.

16. In an apparatus of the character described for sorting articles by size, wherein a conveyor surface of an upper conveyor run is formed by transverse sizing members which are connected at their opposite ends to linkages which are incorporated in two parallel continuous sprocket chains which pass around first sprocket means at the head end of the upper run and second sprock-

et means at the tail end of the upper run, the linkages straddling pairs of adjustably spaced cam tracks on opposite side of the upper run for the purpose of controlling the spacing of the transverse sizing members, said pairs of cam tracks acting on the linkages to limit the spreading of the transverse sizing members in response to tensioning of the two sprocket chains thereby determining the spacing between transverse sizing members, the transverse sizing members being increased in spacing in a sizing zone towards the tail end of the upper run to permit the articles to drop through the upper run in accord with the sizes of the articles,

the improvement comprising:

first rotary actuating means and second rotary actuating means driving said first sprocket means and said second sprocket means respectively; and

means to supply power to said first and second rotary actuating means to operate the apparatus at a selected speed, said supply means dividing the power between the two rotary actuating means with neither rotary actuating means receiving enough power to be capable alone of driving the apparatus at the selected speed,

whereby the two rotary actuating means react to changes in the relative magnitudes of loads created by changes in tension of the sprocket chain in said sizing zone,

the two actuating means reacting by rotation relative to each other in one respect to transfer transverse sizing members from the lower run to the upper run in response to increase in the spacing of the pairs of cam tracks to decrease the spacing of the transverse sizing members in said sizing zone and by rotation relative to each other in the opposite respect to transfer transverse sizing members from the upper run to the lower run in response to decrease in the spacing of the pairs of cam tracks to increase the spacing of the transverse sizing members in said zone of the upper run.

17. An improvement as set forth in claim 16 in which said two rotary actuating means are induction motors wired in parallel

and in which said power supplying means includes:

a main motor energizer by current from a power source; and

an alternator driven by the main motor and connected to the two induction motors to deliver power thereto.

18. An improvement as set forth in claim 17

which includes means to vary the speed of the alternator to vary the frequency of the current delivered by the alternator thereby to vary the speed of the two induction motors;

and which includes means to vary the voltage output of the alternator thereby to vary the total power delivered to the two induction motors.

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