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Cox [45] **July 18, 1972**

[54] **METHOD FOR TRIMMING PROJECTIONS FROM GLOBULAR ARTICLES**

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[21] Appl. No.: **52,564**

Related U.S. Application Data

[62] Division of Ser. No. 707,512, Feb. 21, 1968, Pat. No. 3,538,969.

[52] **U.S. Cl.** **146/224,** 146/81, 146/83, 146/55
[51] **Int. Cl.** **A23n 15/02**
[58] **Field of Search** 146/224, 226, 81, 83, 85, 55, 146/27

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Assistant Examiner—Z. R. Bilinsky
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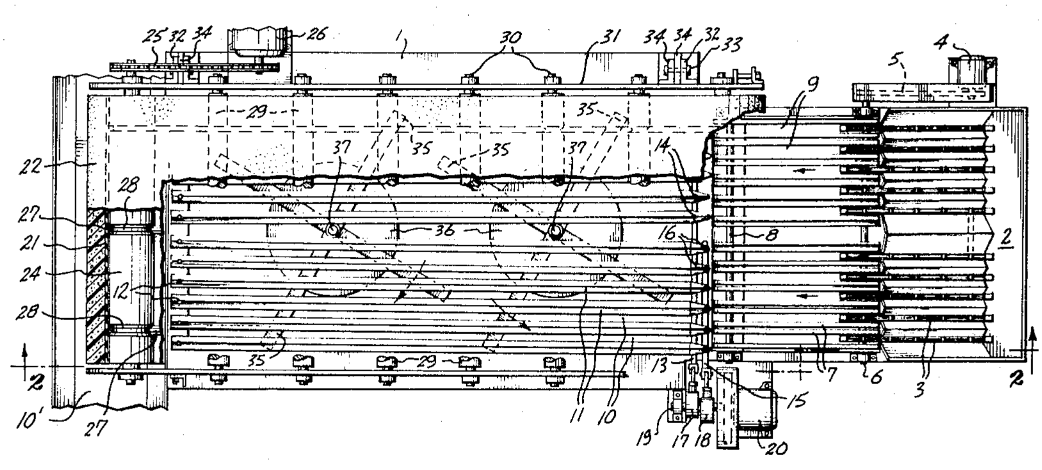
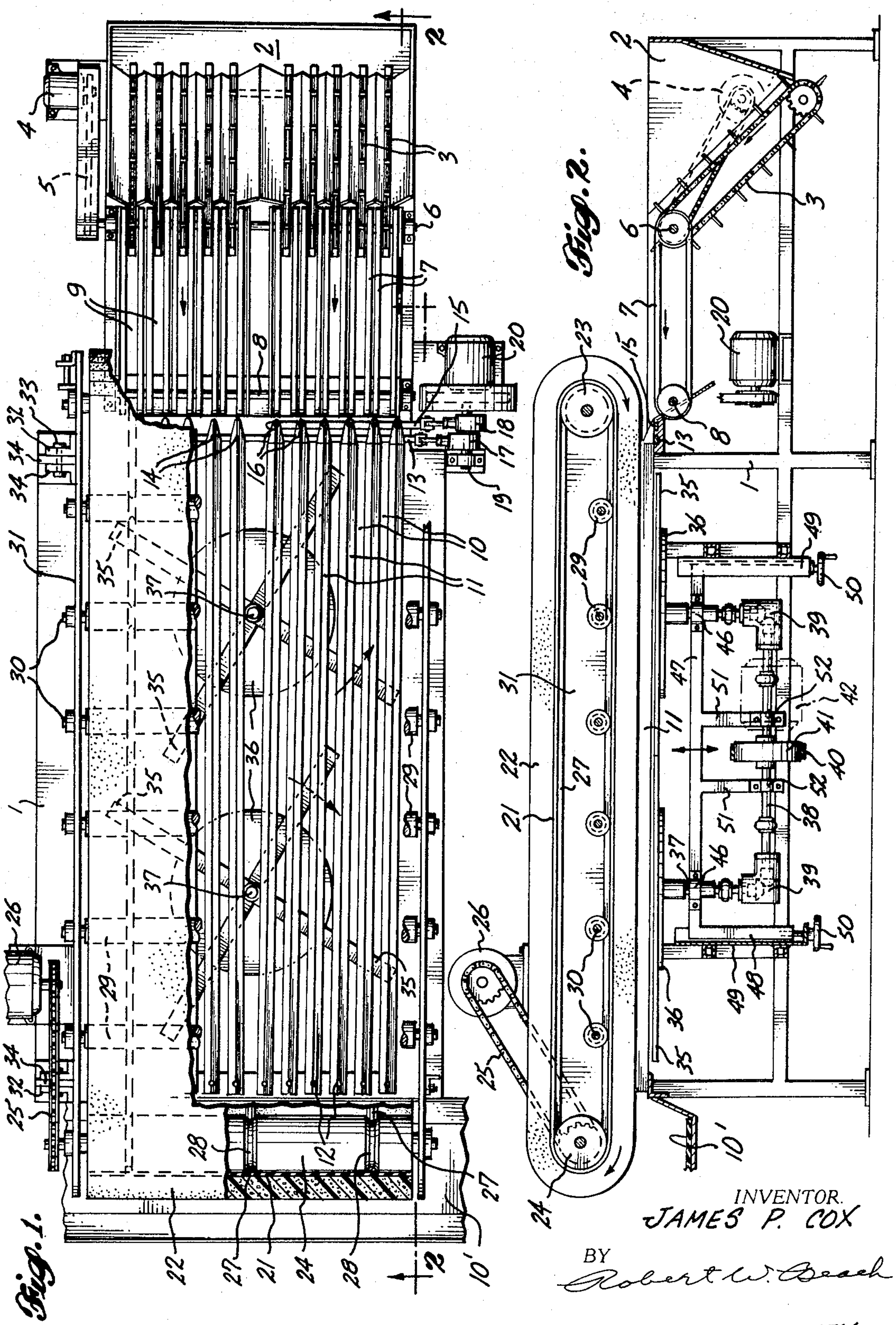
[57] **ABSTRACT**

By engagement of pad means with the upper side of a globular article, it is rolled along a slotted guideway in a compound rotation which periodically moves a projection of the article through the slot of the guideway. Such compound rotation in one form is effected by moving a pad above a linear guideway in a direction generally lengthwise of the guideway while the guideway is oscillated transversely of its length. A knife blade is rotated closely beneath the guideway to sever the projection of an article extending through the slot of the guideway. The knife blade is adjustable to vary the spacing between it and the bottom of the guideway to regulate the trimming of the projections.

6 Claims, 18 Drawing Figures





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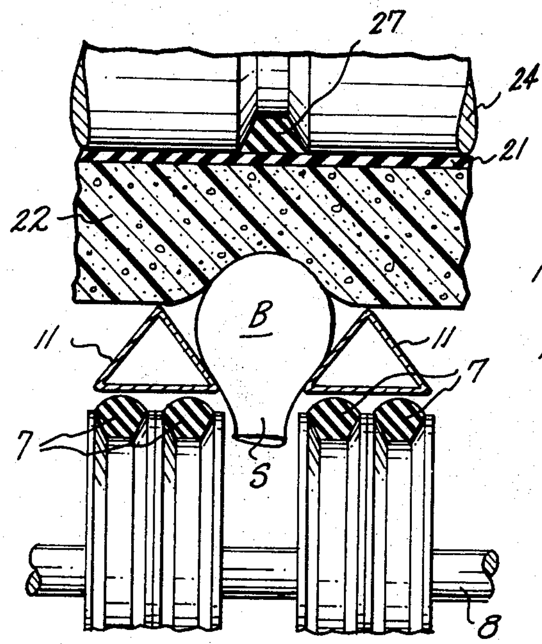

Fig. 5.

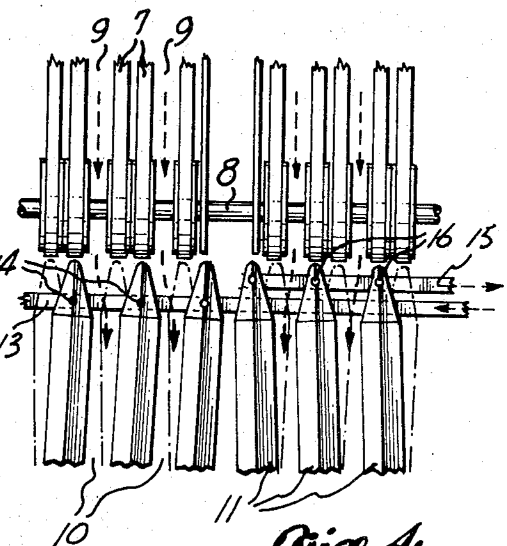

Fig. 4.

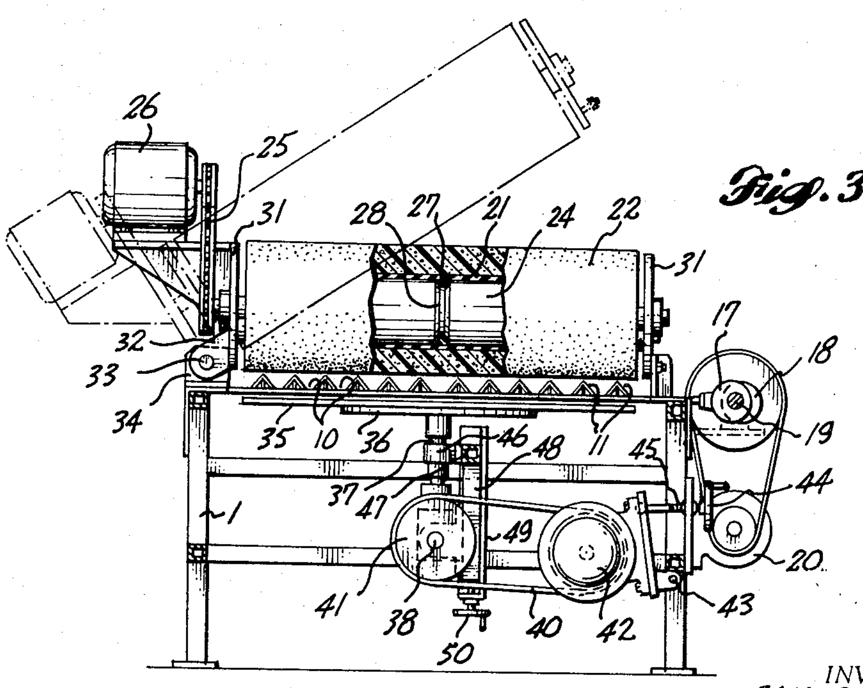

Fig. 3.

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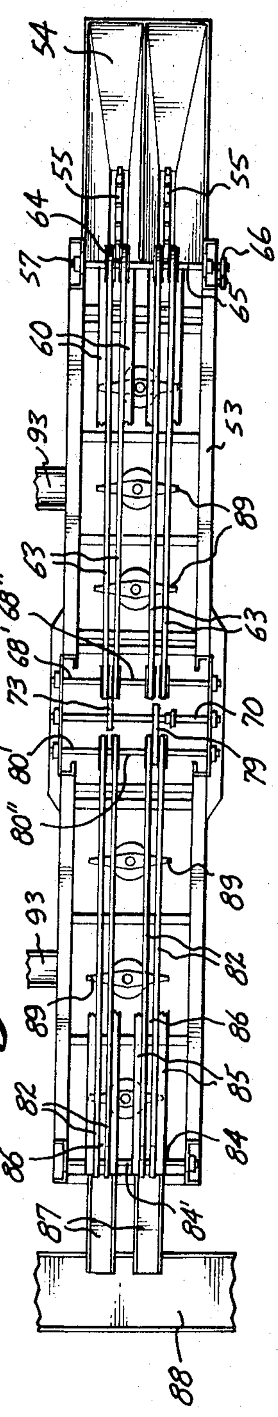

Fig. 6.

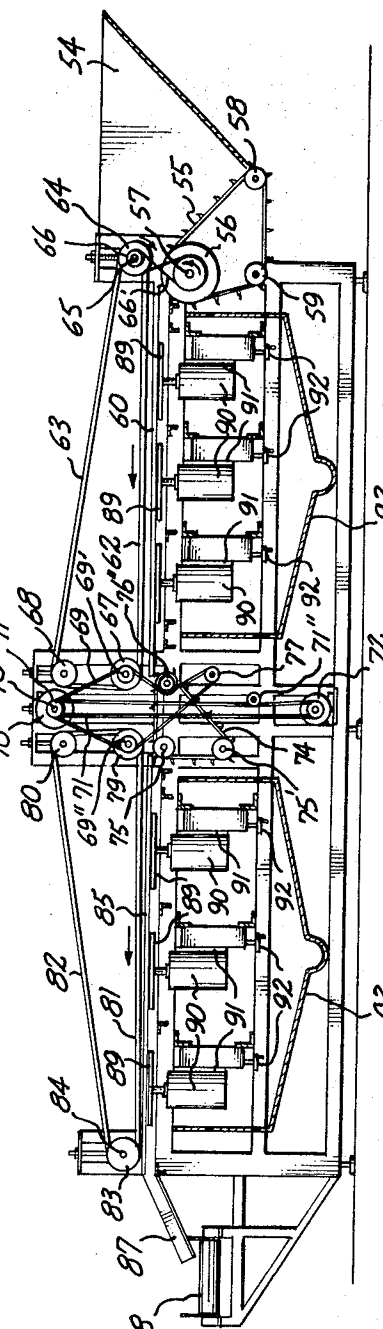

Fig. 7.

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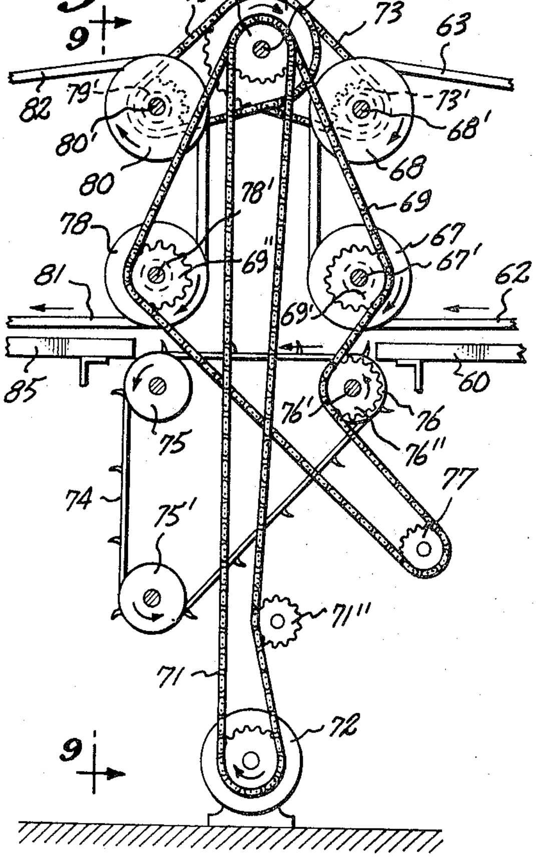
Fig. 8.



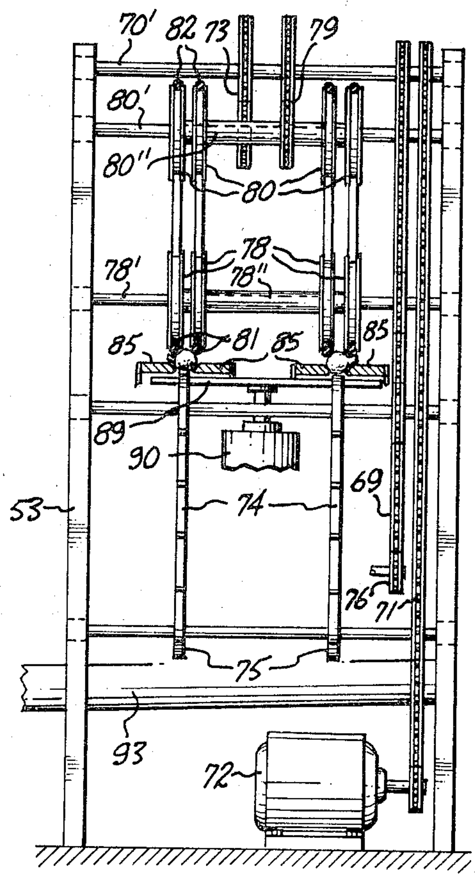


Fig. 9.

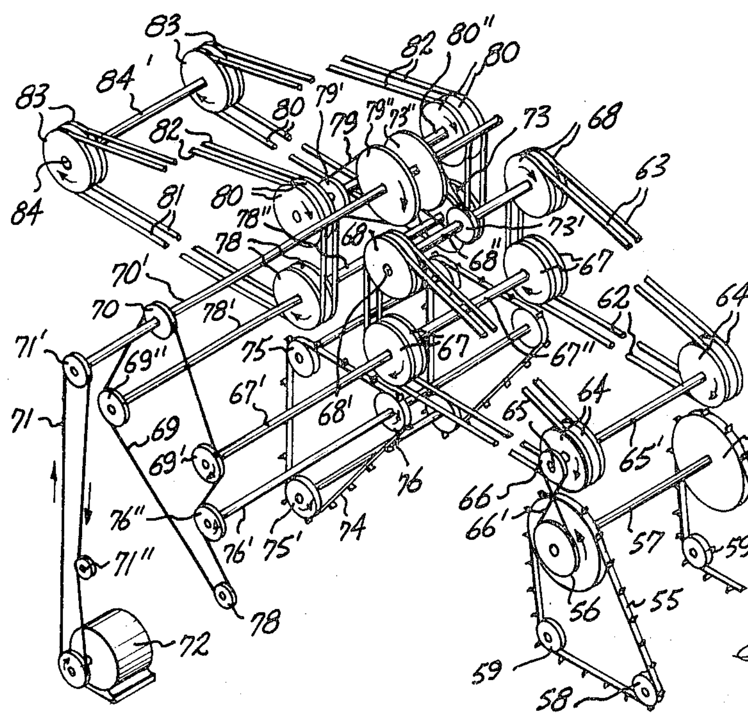


Fig. 10.

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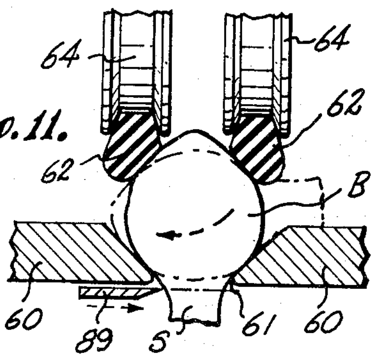

Fig. 11.

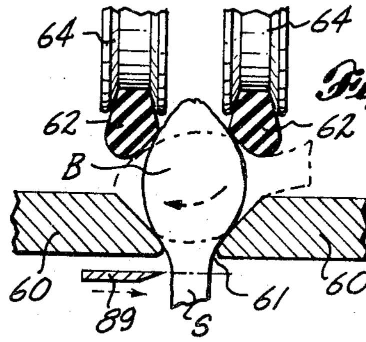

Fig. 12.

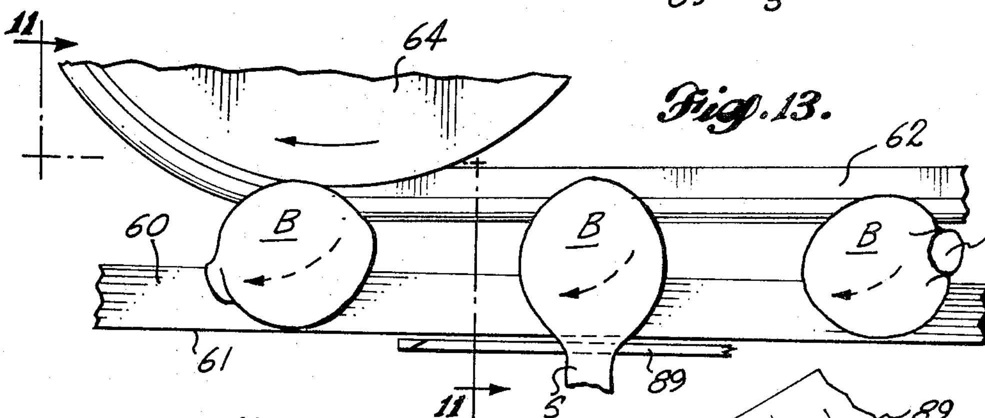

Fig. 13.

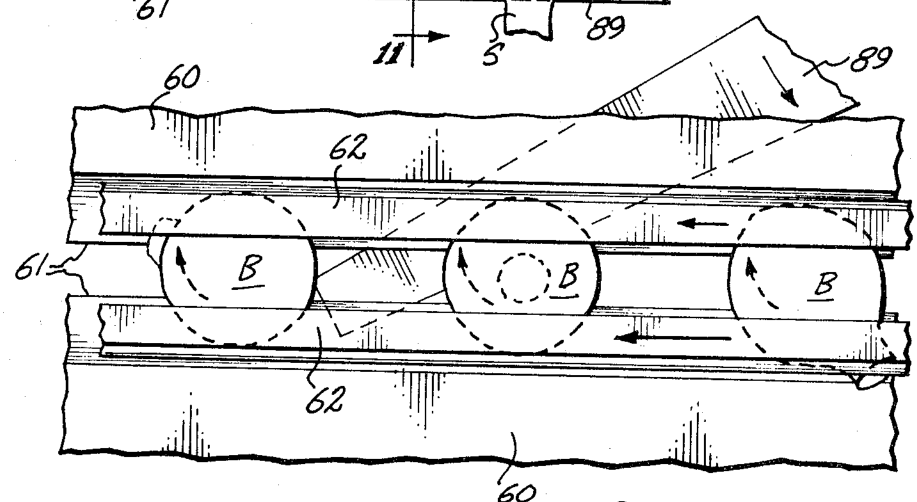

Fig. 14.

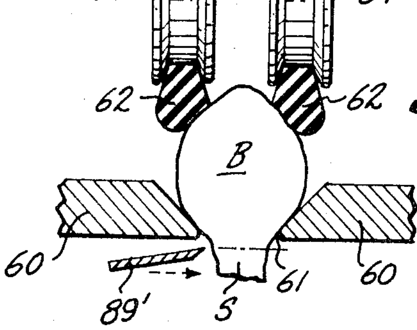

Fig. 15

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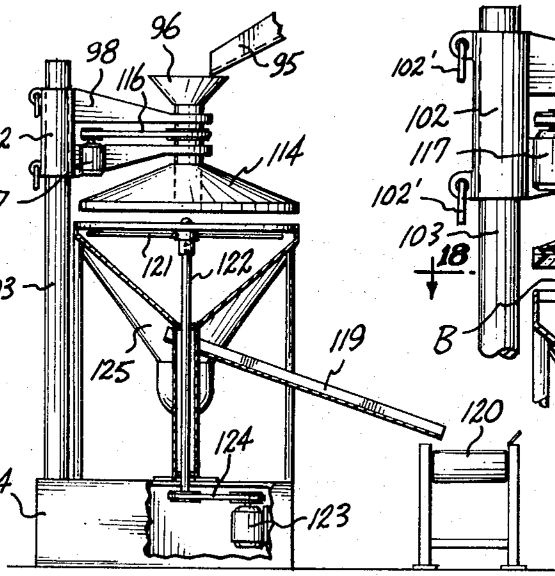

Fig. 16.

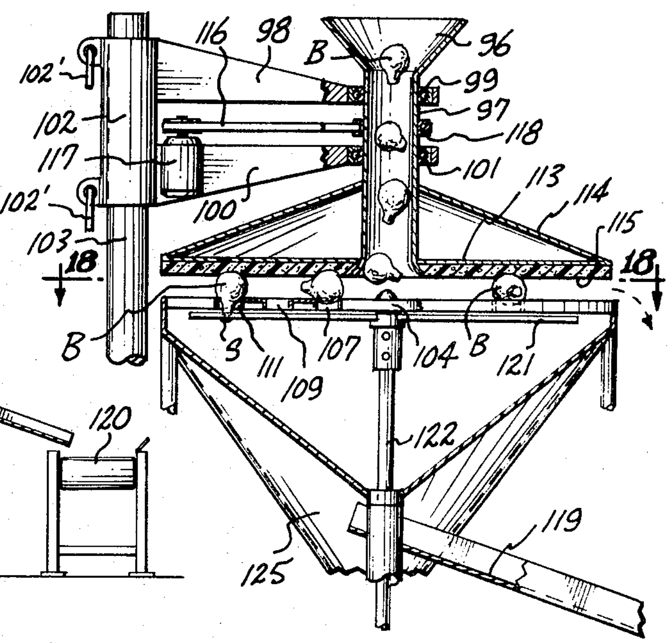

Fig. 17.

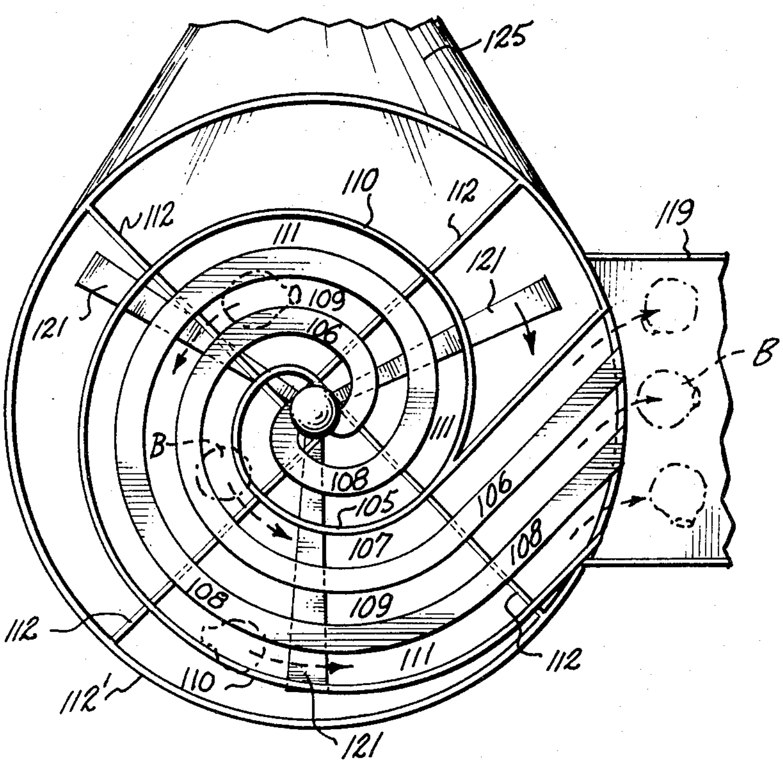

Fig. 18.

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METHOD FOR TRIMMING PROJECTIONS FROM GLOBULAR ARTICLES

This application is a division of application Ser. No. 707,152, filed Feb. 21, 1968, now U.S. Pat. No. 3,538,969, for Machine and Method for Trimming Projections from Globular Articles.

Brussels sprouts are globular articles, the bodies of which are generally spherical or elongated lengthwise of the stem, to a greater or lesser extent, in the shape of an ellipsoid. The stem projection varies in length and its end is usually more or less uneven or ragged. Heretofore, the stems of such Brussels sprouts have been trimmed by hand manipulation, which has required at least that each Brussels sprout be picked up individually in effecting a stem-trimming operation.

The principal object of the present invention, therefore, is to provide a method for trimming projections from globular articles, such as the stems of Brussels sprouts, automatically, reliably, and uniformly, so that it is not necessary to manipulate manually each individual article, either during the trimming operation or prior thereto, for the purpose of orienting the article in the proper position for a subsequent trimming operation.

Another object is to provide a method which will trim projections from globular articles automatically, irrespective of minor variations in shape of the article from generally spherical to ellipsoidal and irrespective of variations in size of such articles within predetermined limits.

A particular object is to accomplish the projection-trimming operation by placing the globular article relative to the slot of a machine so that the projection extends through the slot for engagement by a projection-trimming device at the side of the slot opposite the article.

FIG. 1 is a plan of a preferred type of projection-trimming machine with parts broken away and FIG. 2 is a longitudinal section through such machine taken on line 2—2 of FIG. 1. FIG. 3 is an end elevation of such machine having parts broken away.

FIG. 4 is a fragmentary detail plan of a portion of the machine shown in FIGS. 1, 2 and 3. FIG. 5 is an enlarged transverse vertical section of a portion of the machine shown in FIGS. 1 to 3, showing detail structure of the machine.

FIG. 6 is a plan of an alternate form of projection-trimming machine and FIG. 7 is a side elevation of such machine with parts broken away. FIG. 8 is an enlarged side elevation of the central portion of such machine with parts broken away and FIG. 9 is a transverse vertical section through the machine on line 9—9 of FIG. 8. FIG. 10 is a top perspective of the transport system of this machine with parts broken away.

FIGS. 11 and 12 are detail vertical transverse sections through a portion of the machine shown in FIGS. 6 and 7 on an enlarged scale, taken on line 11—11 of FIG. 13, and showing parts in different adjusted positions. FIG. 13 is a side elevation of a fragmentary portion on an enlarged scale of the machine shown in FIGS. 6 and 7 and FIG. 14 is a plan of such machine section.

FIG. 15 is an enlarged detail transverse vertical section through a portion of the machine corresponding to FIGS. 11 and 12, but showing a somewhat modified structure.

FIG. 16 is an elevation of another embodiment of the machine, parts being broken away. FIG. 17 is an enlarged vertical section through the upper portion of the machine shown in FIG. 16 and FIG. 18 is a horizontal section through such machine taken on line 18—18 of FIG. 17.

There is no appreciable problem in trimming projections of globular articles, such as the stems of Brussels sprouts, if such stems can be positioned predictably with relation to suitable projection-trimming means. The difficult problem is to arrange for placement of such articles without individual manual manipulation so as to position the projections reliably and automatically for engagement by the trimming means. Conveniently, the projection of a globular article can be located by a slot having trimming means at one side of it. The objective then is to orient each globular article automatically so that its projection is placed in registry with such slot and is then extended through the slot into position for engagement by the trimming means.

In the machine shown in FIGS. 1 to 5, its various components are mounted on a frame 1. The articles to be trimmed, such as Brussels sprouts, are dumped into a hopper 2 at one end of the machine, from which they are elevated automatically and fed to the remainder of the machine by finger-flight elevating conveyor chains 3 driven by a motor 4 through chain 5 which turns the drive shaft 6 for such conveyor. Such elevating conveyor dumps the articles onto the transfer belt conveyor. Such conveyor extends between pulleys on drive shaft 6 and on the shaft 8 at the opposite end of the conveyor.

A pair of conveyor belts 7 of the transfer conveyor is provided for each elevating conveyor chain 3 emerging from the hopper 2. The belts of each pair are spaced apart to provide a slot 9 between them, as illustrated best in FIG. 4. The articles are supported by spaced engagement of the belts 7 of each pair with such articles and the slot between the belts of each pair will accommodate a projection from an article if such projection should happen to be in registry with and projecting through a slot 9.

The slots 9 of the transfer conveyor are generally aligned with slots 10, respectively, between guide rails 11, which cooperate to form slotted guideways. As shown best in FIGS. 4 and 5, the guide rails 11 are generally horizontal and are tapered upwardly to form ridges elongated lengthwise of the guideways. The slots 10 between such guide rails flare upwardly corresponding to the upward taper of the guide rails themselves transversely of their lengths. The guide rails are spaced apart sufficiently to form slots 10 of a width adequate to receive a projection of a globular article, such as the stem S of a Brussels sprout B as indicated in FIG. 5. Preferably the feed ends of the rails 11 are tapered to facilitate movement into the spaces between such rails of articles supplied to them by the transfer conveyor belts 7.

The guide rails 11 are arranged in two groups of six rails each, disposed in parallel relationship with their lengths extending lengthwise of the frame 1 as shown in FIG. 1. The discharge ends of such rails are mounted on pivots 12, respectively, for swinging of such rails about these pivots. The feed ends of such rails of the two groups are supported independently. The feed ends of the rails of one group are supported by a reciprocable bar 13 to which the feed ends of the rails are attached by pivots 14, respectively. The feed ends of the rails in the other group are supported by a second bar 15 parallel to bar 13 and the rails of the second group are attached to bar 15 by pivots 16, respectively.

Reciprocation of each of the bars 13 and 15 will displace the feed ends of the respective rail groups transversely of the length of such rails. Longitudinal movement of either of the bars 13 and 15 will shift the corresponding ends of the corresponding group of rails so that the rails of such group will swing about their discharge end pivots 12. It is preferred that the movement of the supporting bars 13 and 15 be restricted sufficiently so that the tapered feed ends of the several guide rails do not move into registry with slots 9 between the belts 7 of the transfer conveyor to any appreciable degree. The extent of swinging movement of the guide rails permissible is illustrated in FIG. 4 between the solid-line positions and the broken-line positions.

It is not necessary that the swinging of any two guide rails 11 forming a slot 10 between them be coordinated with the swinging of any other guide rail, except that in a number of instances an article-receiving slot 10 is formed on each side of a particular guide rail. Consequently, it is necessary to move simultaneously as many guide rails as required to maintain the widths of the slots 10 constant. In the particular arrangement shown in FIG. 1, there are six guide rails 11 in each of the two groups which cooperate to form five slots 10 in each group. All of the guide rails in each group are, therefore, mounted to be swung simultaneously by reciprocation of the bars 13 and 15, respectively. It is not necessary that the reciprocation of such bars be coordinated, but it is convenient to drive them for lengthwise reciprocation by the same drive mechanism.

The mechanism used to reciprocate the two slide bars **13** and **15** are eccentrics **17** and **18**, respectively, mounted on the drive shaft **19**, which is rotated by motor **20**, through a suitable pulley and drive belt arrangement shown best in FIG. 3. The strokes of the eccentrics, preferably, are in opposite directions at any given time to reduce the vibration of the machine. Also, the length of the stroke of the bars produced by such eccentrics is that required to effect the oscillation of the guide rails **11** between the solid-line positions and the broken-line positions shown in FIG. 4. While variable-speed drive mechanism can be employed to enable the speed of reciprocation of the bars **13** and **15** to be regulated, the best results have been found to be obtained at an oscillating frequency of about 450 strokes per minute, **225** of such strokes in each direction.

Over the several guideways formed by the groups of parallel guide rails is positioned pad means engageable with globular articles on the guideways. In the form of apparatus shown in FIGS. **1**, **2**, **3** and **5**, the pad means includes a flexible fabric backing endless belt **21** to the exterior surface of which is bonded readily deformable resilient foam material **22**. This foam material, as indicated in FIG. **5**, it sufficiently soft as to be depressed readily by engagement with a Brussels sprout and is sufficiently resilient to recover its initial shape immediately upon moving out of contact with the Brussels sprout. Also, such resilient foam layer is sufficiently strong and stretchable as to enable the resilient pad layer to be bent around the end rollers **23** and **24** supporting opposite ends of the belt loop without damage or deterioration.

The composite belt, including the backing or carrier belt layer **21** and the resilient pad surface layer **22**, can be driven by turning roll **24** by a chain **25**, which is driven by motor **26**. Preferably, this belt is driven at a speed at least somewhat greater than the speed of transfer belts **7** to cause a rotating effect on the globular articles, occasioned by contact of the pad layer **22** with them, which effects rolling of the articles along the guideways. Actually, it is desirable for the movement of the surface of belt pad **22** to be approximately twice as great as the speed of movement of transfer belts **7**. The speed of the belt pad surface may be within the range of 60 to 400 feet per minute, which variation can be accomplished by the motor **26** being of the variable-speed type.

In order to maintain the composite belt **21,22** centered with respect to its supporting rolls **23** and **24** transversely of the direction of travel of the belt, it is desirable to bond to the interior surface of the carrier belt layer loop one or more V-belts **27**, which engage, respectively, in circumferential grooves **28** of the rollers **23** and **24**. Also, the lower stretch of such belt is held down in relation to the guideways by hold-down rollers **29** carried by shafts **30**, the ends of which project through opposite side plates **31** of the upper frame. The rollers **29** are of the idler type and have grooves in their peripheries to fit over the V-belt ribs **27** projecting from the inner face of the carrier belt layer so that such idler rolls will bear directly against such carrier belt layer.

In order to afford easy access to the guideways formed by the guide rails **11**, while, at the same time, being able to position the belt pad **22** in close proximity to the guideways, the upper frame of the machine, including side plates **31**, is mounted on ears **32**, projecting from one of such side plates as shown in FIGS. **1** and **3**. These ears are connected by pivot pins **33** to lugs **34** carried by the upper side of lower frame **1**. The belt **21,22** and the entire upper frame section can be swung upward about the pivots **33** from the full-line position, shown in FIGS. **1**, **2** and **3**, into the broken-line position of FIG. 3. With the upper frame component in this position, the guide rails **11** and reciprocating bars **13** and **15** can be serviced, repaired or replaced readily.

Rotary trimming blades **35** mounted on disks **36**, which turn about upright shafts **37**, are mounted close beneath the guide rails **11**, as shown in FIGS. **1**, **2** and **3**. While the number of blades mounted on each plate **36** and the spacing of the upright shafts can vary according to design requirements, a convenient arrangement, as shown in FIG. **1**, is to provide two rotary blade devices, each having blades of a length exceeding one-half the length of a guide rail **11**. The shafts **37** are then located closer together than the diametral length of a complete blade, but farther apart than a radial blade length. The rotary shafts **37** are then interconnected by a drive shaft **38** through bevel gears **39**, which are synchronized so that as the shaft **8** is turned, the blade rotors will turn in opposite directions and the blades **35** of the two rotors will be interdigitated as they revolve.

Drive shaft **38** for the rotors can be turned by a belt **40** encircling a pulley **41** on the drive shaft **38** and a second pulley which is driven by an electric motor **42**. It is preferred that the motor be of the variable-speed type or that it drive a variable-speed transmission to shaft **38** so that the speed of rotation of the knife rotor shafts **37** can be varied within the range from 500 to 1,800 rpm.

As shown best in FIG. 3, the motor **42** can be mounted for such movement as may be required to tighten belt **40** satisfactorily irrespective of the position of pulley **41**. The motor base is shown as being connected to the frame **1** by a pivot **43** about which the motor base can be swung by turning an adjusting crank **44** to move longitudinally bolt **45** connected to the base of motor **42** at a location spaced from pivot **43**. Swinging of the motor base about its mounting pivot will move the motor and its pulley toward or away from pulley **41** on shaft **38** to whatever extent may be desired.

In order to vary the extent to which projections of globular articles on the guideways are trimmed, it is desirable to mount the trimming blade rotors so that they can be raised or lowered. To provide for such adjustment, bearings **46** for rotor shafts **37** are secured to the horizontal top member **47** of a rotor mounting frame. Upright members **48** of such frame at its opposite ends are received in guide channels **49**. Such frame end members can be raised or lowered in their respective guide channels by turning crank wheels **50** carrying screws which are threaded into the lower ends of the frame members **48**.

The mounting frame for the trimming rotors has central legs **51** extending downward from the upper horizontal member **47**, to which bearings **52** supporting drive shaft **38** are secured. Consequently, the entire drive assembly between belt **40** and rotor shafts **37** is supported on the rotor mounting frame for vertical adjustment with it. Any variation in tension of belt **40**, which might result from vertical adjustment of the trimming rotors, can be compensated for by varying the position of motor **42** effected by turning the crank wheel **44** as discussed above.

In using the machine described above for trimming the stems of Brussels sprouts, it is desirable first to sort the Brussels sprouts generally according to size in order to achieve the best operation. Brussels sprouts vary in size within the approximate range of three-quarters of an inch in diameter to 1 and ½ inches in diameter. If the Brussels sprout is of ellipsoidal shape, the length of its major axis in alignment with the stem may be as much as 1 and ½ times as great as the length of its minor axis, disposed transversely of the stem. The Brussels sprouts may, therefore, be separated as to size generally according to variations in the length of the minor axis.

While the Brussels sprouts could be separated into three groups, namely, small sprouts having a minor axis of less than 1 inch in length, medium sprouts having a minor axis of a length from 1 inch to 1 and ½ inches, and large sprouts having a minor axis exceeding 1 and ¼ inches, it is preferred that the range of size be confined to a minor axis length variation of three-sixteenths of an inch.

A particular machine of the present invention will be designed or adjusted to trim the stems of Brussels sprouts in a particular size group. The guide rails **11** will be spaced apart a distance appropriate to support the Brussels sprouts B substantially as shown in FIG. **15** when its stem S extends downward through a slot between adjacent guide rails. For processing smaller Brussels sprouts the guide rails **11** would be located closer together and for processing larger Brussels sprouts the guide rails would be located farther apart. While the guide rails **11** could be mounted so that the spacing between them could be adjusted, it is preferred for the guide rails to be set for a selected spacing when they are assembled. It is preferred, therefore, that the spacing of the finger flight conveyors **3**, the belts **7** of the transfer conveyor and the guide rails **11** be correlated in the manufacture of a particular machine. It is possible, however, to interchange sets of guide rails having different spacings when the upper frame carrying the padded belt **21,22** has been swung upward about its mounting pivots **33** into the broken-line position of FIG. **3**.

The spacing between the knife blade paths and the bottoms of the guideways will also be related to the size of the Brussels sprouts being processed. The hand wheels **50** can be turned to raise or lower shafts **37** supporting the trimming blade rotors as may be necessary to effect the desired trimming of the stems of the Brussels sprouts processed by a particular machine. The important consideration, however, is to be able to place each Brussels sprout B reliably in a position, such as shown in FIG. **5**, with its stem S extended through a slot **10** so that a whirling knife blade **35** can trim the stem and sever the roots of the outer leaves as may be necessary to clean up the Brussels sprouts.

The two most important aspects of the problem of trimming the stems of Brussels sprouts are, first, to position automatically each Brussels sprout in a position in which its stem can be trimmed and, second, to effect the trimming operation quickly and neatly. In using a machine of the type shown in FIGS. **1** to **5**, therefore, each Brussels sprout must be manipulated so that its stem S will extend downward through a slot **10** in the position illustrated in FIG. **5**. Second, when a Brussels sprout has been positioned with its stem thus extending through the slot, the trimming knives must be manipulated to effect a quick and clean cutting action.

In operating the machine shown in FIGS. **1** to inclusive, globular articles with projections, such as BRussels sprouts, are dumped in bulk into the hopper **2**. From such a source of supply the articles are fed singly in rows to the stretches of transfer conveyor belts **7** by the finger flight conveyors **3**. In being picked out of a mass of Brussels sprouts, it is evident that the Brussels sprouts on the transfer conveyor stretches will not be oriented in any particular attitude. Such random orientation will presist as the upper surface of the Brussels sprouts are engaged by the pad layer **22** of the belt **21,22**. Such engagement will roll the Brussels sprouts off the discharge ends of the transfer conveyor stretches and onto the respective guideways formed by the guide rails **11**.

The oscillation of the guide rails **11** coupled with the movement of the conveyor pad **22** lengthwise of the guide rails will effect compound rotation of the Brussels sprouts, one component of such rotation being rolling along the guideways and the other component being transversely of the guideways so as to swing the projecting stems of the Brussels sprouts transversely of the lengths of the slots **10** to bring the projecting stem sooner or later during the gyrations of the sprouts into registry with the slots and to project them through such slots. Thus, the combined effect of the translatory motion of the belt pad and the motion of the guide rails transversely of their lengths effects a gyration of the Brussels sprouts which sporadically projects the Brussels sprout stems down through a slot **10** instead of simply rolling the Brussels sprouts along the guideways as would result from the engagement of the belt pad with the Brussels sprouts if the guide rails **11** were stationary.

As shown in FIG. **1**, the shafts **37** of the trimming blade rotors are located between the two sections of guideways. The blades **35** are long enough to extend from the axle entirely across each section of guideways. Except when a blade extends directly perpendicular to the lengths of the guide rails **11**, the blade will have a diagonal slicing movement relative to the direction of movement of a Brussels sprout stem instead of a frontal chopping movement. Consequently, each time a blade engages a Brussels sprout stem it will tend to sever the stem cleanly and neatly. The length of guide rails will be such that, in most instances, a stem of a Brussels sprout will extend through a slot **10** a plurality of times during its travel over the complete length of one of the guideways. At the end of the guideways the trimmed Brussels sprouts will be deposited in any suitable receptacle, such as a conveyor **10'**, the length of which extends transversely of the guideways to be removed from the machine for packaging or other processing.

In the machine shown in FIGS. **6** to **15**, inclusive, the machine frame **53** has a vertically divided hopper **54** mounted on one end of it. Finger flight elevating conveyors **55** run through the bottoms of these hoppers and extend around idler pulleys **58** and **59**. The flight conveyors **55** feed globular articles, such as Brussels sprouts, from the sections of supply hopper **54** to guideways formed by guide rails **60** shown in FIGS. **6, 7** and **11** to **15**. Such guide rails have adjacent oppositely inclined surfaces spaced apart to form slots **61** between them, as shown in FIGS. **11, 12** and **14** in particular.

Above the guideways formed by guide rails **60**, two of which guideways are shown in FIG. **6**, run the lower stretches **62** of a pair of belts spaced transversely of the guideways. As seen in FIGS. **7** and **10**, such endless belts have upper stretches **63**. The feed ends of the belt loops are carried by pulleys **64**, the outer ones of which are mounted on shaft **65**. This shaft also carries a pulley **66** driving a crossed belt **66'** for turning shaft **57** on which pulleys **56** are mounted to power the finger flight conveyors **55**. The opposite ends of the belt loops **62,63** are carried by lower pulleys **67** and upper pulleys **68**. Inner pulleys **64** are mounted on a sleeve **65'** rotatable independently of shaft **65**; similarly, inner pulleys **67** are mounted on sleeve **67''** and inner pulleys **68** are mounted on sleeve **68''**.

In order to afford sufficient length of travel of the globular articles to insure proper trimming of their projections without the lower stretches **62** of the belts sagging excessively, it may be desirable for two sets of belts arranged in tandem to be used as shown in FIGS. **6, 7, 8** and **10**. The drive mechanism for both sets of belts can be located at the center of the machine. Also, while two article paths through the machine have been shown, it will be evident that only one such path, or more than two such paths, could be provided. Particularly FIGS. **8** and **10** show drive connections for the various belts.

The lower stretches **62** of the belts closely overlie the guideway formed by the guide rails **60** having slot **61** between them as shown in FIGS. **11, 12** and **13**. Such guide rails are spaced apart the desired distance to accommodate globular articles of a selected size. In FIG. **11** the guide rails **60** are spaced farther apart than such guide rails shown in FIG. **12**. As illustrated, the size of Brussels sprouts to be accommodated in the guideway shown in FIG. **11** will be larger than the Brussels sprouts to be accommodated in the guideway shown in FIG. **12**. The important variable in the guideway shown in FIGS. **11** and **12** is the spacing between the adjacent edges of the guide rails **60** forming the guideway slots **61**. Unless there is a great difference in size between the articles to be processed in machines having two guideway sizes, the spacing between the lower belt stretches **62** can be the same and, also, the spacing between the belt stretches and the guide rails **60** probably need not be altered.

The endless belts having lower stretches **62** and upper stretches **63** constitute pad means, such as by being made of soft resilient material. Such belts may be made of sponge plastic material and the tension strength of such material can be supplemented as may be desired by the belts including in their structure cords or webs of fabric, or even wire or cable cores, to insure that the driving tension to which the belts are subjected can be transmitted reliably. At the same time, the material at the surface of the belts must be sufficiently deformable and resilient as to be able to engage opposite sides of the upper portion of a globular object, as shown in FIGS. **11** and **12**, without injuring a rather delicate product such as a Brussels sprout.

Brussels sprouts may be delivered by the finger flight conveyors **55** from the supply hoppers **54** in positions with the stems substantially horizontal and extending transversely of the slots 61 of the guideways, as shown in broken lines in FIGS. 11 and 12. In order to be able to trim the stems of the Brussels sprouts, they must be repositioned so that their stem extend through the guideway slots 61, as shown in full lines in FIGS. 11 and 12, and in the central position shown in FIGS. 13 and 14. Consequently, it is necessary not only to convey the Brussels sprouts along the guideways, but to rotate them so that their stems will be swung from the broken-line position of FIG. 11 or FIG. 12 to the solid-line position of either figure automatically. Such repositioning can be accomplished by effecting compound rotation of a Brussels sprout so that the Brussels sprout not only rolls along the guideways and rotates about a horizontal axis extending transversely of the slot 61 but, also, rotates about a different axis.

To exert a force component on a Brussels sprout transversely of the length of a slot 61 so as to rotate the Brussels sprout about an axis at an angle to the axis of roll extending transversely of the slot, one belt of each pair will travel at a speed different from that at which the other belt of such pair travels and such difference in speed may be such that one belt travels from 50 to 150 percent faster than the other belt. Thus, the linear speed of the inner or adjacent belts of the two pairs of the belts shown in FIGS. 6, 9 and 10 may be twice as great, for example, as the linear speed of the outer or remote belts. As an example, the linear speed of the outer belts may be 100 feet per minute and the linear speed of the inner belts may be from 150 feet per minute to 250 feet per minute. The result will be that the Brussels sprouts not only will be rolled along the guideways by the lower belt stretches 62, but engagement of such belt stretches with the Brussels sprouts will also twirl the sprouts. The resulting gyrations of the Brussels sprouts will swing the stems transversely of the lengths of the slots 61 so that periodically and sporadically the stems will be plunged down through the slots as the heads of the Brussels sprouts roll along the guideways formed by the guide rails 60.

The outer belts 62,63 are driven by rotation of shaft 67′ on which the outer pulleys 67 are mounted. A chain drive, shown best in FIG. 8, includes a chain 69 engaging a sprocket 69′ secured on shaft 67′. This chain is driven by a sprocket 70 mounted on shaft 70′, which, in turn, is driven by a chain 71 turning a sprocket 71′ secured on shaft 70′. This chain is driven by a motor 72 and a chain-tightener sprocket 71″ keeps the chain loop between the motor and sprocket 71′ tight. The outer pulleys 68 on shaft 68′ over which the outer belts run are simply idler pulleys. Similarly, the outer pulleys 64 on shaft 67 are idler pulleys as far as the outer belts are concerned, but these pulleys are secured on shaft 65 so that they will turn such shaft and sprocket 66 carried on it to drive shaft 57 for the finger flight elevator conveyors by crossed belt 66′ as described above.

The inner belts 62,63 of the belt pairs are driven from the same power source as the outer belts, although at a higher speed. These belts are driven by the inner pulleys 68, which are secured on opposite ends of a sleeve or tube 68″ that fits rotatively on the inner shaft 68′. Spacers may be provided between the pulleys 68 for the belts of each pair in order to maintain proper spacing between the belts and to keep the tube 68″ centered between the outer pulleys 68. The tube or hollow shaft 68″ is driven to turn the inner pulleys 68 by a chain 73 which is engaged with a sprocket 73′ secured on the hollow shaft 68″. Such chain, in turn, is driven by a sprocket 73″ secured on shaft 70′. The ratio of the diameters of sprockets 73″, 70 and 69′ establishes the relative linear speeds of the inner and outer belts. Thus, the diameter of sprocket 73″ can be twice as great as the diameter of either sprocket 70 or sprocket 69′ if the diameters of these latter sprockets are equal.

If the transport mechanism for the Brussels sprouts is divided generally in half, as shown in FIGS. 6, 7 and 10 in particular, the second half of such system will be substantially the mirror image of the first half. In such an installation it is necessary to transfer the Brussels sprouts from the discharge end of the first stem-trimming conveyor section to the feed end of the second stem-trimming conveyor section. Such transfer can be accomplished by finger flight conveyors 74 shown more or less diagrammatically in FIGS. 8, 9 and 10. While these figures illustrate such conveyors as having unconfined article-transporting upper stretches, such stretches actually will move through slotted troughs forming continuations of the guideways defined by the guide rails 60 shown in FIGS. 11, 12, 13 and 14. Such transfer conveyor may be driven by the same motor 72 as drives the two stem-trimming conveyor sections. Thus, as shown in FIGS. 8 and 10, the transfer conveyor belt 74 extends around two idler pulleys 75 and 75′ and a driving pulley 76. This driving pulley is mounted on a shaft 76′ on which a drive sprocket 76″ is secured that is engaged by drive chain 69.

Drive chain 69 is tightened by a tightener sprocket 77 to hold such chain in position laced around sprockets 70, 69′, 76″ and 69″. Sprocket 69″ is secured on shaft 78′ on which the outer pulleys 78 of the second stem-trimming conveyor sections are secured. While the outer lower pulleys 78 are driven by chain 69 through sprocket 69″ and shaft 78′, the same chain drives sprocket 70 to turn shaft 70′ for driving sprocket 79′ and chain 79 to turn the inner pulleys 80 of the upper belt-supporting pulleys.

The belts for moving the articles through the second projection-trimming section of the machine have lower stretches 81 and upper stretches 82 and the feed ends of such belt loops are supported by the pulleys 78 and 80 while the discharge ends of such belt loops extend around pulleys 83. The outer belts are driven by their pulleys 78 on shaft 78′, while the pulleys 78 engaged by the inner belts are mounted on the tube or hollow shaft 78″ encircling shaft 78′. Suitable spacers or thrust means are interposed between the pulleys 78 of each pair to maintain proper spacing of the belts and to keep the hollow shaft centered between the two outer pulleys 78. For this purpose, the ends of shaft 78″ may serve as thrust bearings engaging the central portions of the outer pulleys 78 as shown in FIG. 9.

Chain 79 connects sprocket 79′ secured on hollow shaft 80″ and sprocket 79″ secured on shaft 70′. A tube or hollow shaft 80″ carries the inner pulleys 80 so that they are rotatable independently of the outer pulleys 80 and shaft 80′ on which such outer pulleys are mounted. As in the case of hollow shaft 78′, the inner pulleys 80 may be secured to hollow shaft 80″ at locations spaced from its ends so that the end portion of such hollow shaft may be in thrust bearing engagement with the central portions of the outer pulleys 80 to maintain the inner pulleys 80 in proper spaced relationship to the outer pulleys and to hold the hollow shaft 80″ centered between the outer pulleys 80.

The inner pulleys 83 are rotatively independent of the outer pulleys 83 by mounting such outer pulleys on opposite end portions of the shaft 84 and mounting the inner pulleys 83 on a tube or hollow shaft 84′ fitted over shaft 84. Again, the ends of such hollow shaft can be in thrust bearing engagement with the central portions of the outer pulleys 83 for maintaining such tube centered between those pulleys and, also, maintaining the inner pulleys 83 in proper spaced relationship to the outer pulleys 83.

The second projection-trimming transport conveyor section of the machine shown in FIGS. 6 and 7 as being in tandem relationship to the first section also has guideways for the Brussels sprouts or other globular articles closely underlying the lower stretches 81 of the second belt pairs. Guide rails 85, spaced apart to provide slots 86 between them, as shown in FIGS. 6, 8 and 9, can form the guideways. These guideways operate in the same manner as the guideways formed by the guide rails 60 as described in connection with FIGS. 11, 12, 13 and 14. From this second conveyor section the articles are discharged into chutes 87 by which they are deposited into any suitable receptacle, such as a conveyor 88.

During the passage of the articles through the second section of the conveying mechanism, the articles will again be gyrated as they are rolled along the guideways in order to plunge their projections periodically and sporadically through the slots of the guideways. When the stems or projections extend through such slots, further opportunity is afforded for them to be trimmed. Particularly in FIGS. **7** and **9**, rapidly whirling projection-trimming blades **89** are shown as being mounted close beneath the guideways. Three rotary trimming blades are shown in each section in FIGS. **6** and **7**. These blades are rotated independently, each by its own drive motor **90**, instead of the blades being interconnected by synchronized rotation, as were the blade rotors of the machine shown in FIGS. **1** to **5**. Each of these motors is mounted on a slide **91** for vertical adjustment by rotation of a crank wheel **92** as shown in FIG. **7**, which turns an adjusting screw for moving the slide in a manner similar to that discussed in connection with FIGS. **2** and **3**. Beneath each section of the machine a hopper **93** may be provided to receive trimmings of projections such as stems and outer leaves of Brussels sprouts.

In FIG. **15** a modified type of projection-trimming blade arrangement is shown which can be used either in the machine of FIGS. **1** to **5** or in the machine of FIGS. **6** to **14**. In this instance, the rotary blade **89'** is canted or twisted so as to elevate its leading cutting edge. It is easier to position a blade of this type in close proximity to the bottom of the guideways. Also, engagement of such a canted blade edge with the article projection, such as the stem of a Brussels sprout, will tend to draw that stem farther downward through the slot **61** or the cutting edge will tend to slice upwardly through the stem or both. Consequently, a very close trimming operation can be accomplished by using a blade of this type.

The further form of apparatus shown in FIGS. **16, 17** and **18** is more compact than the machines of FIGS. **1** to **5** and **6** to **14**. In this instance the machine and its base **94** are of substantially circular horizontal cross section and the machine can be designated a circular machine, as distinguished from the linear machines described above.

The articles to be trimmed can be fed to the machine from any suitable supply source through a chute **95**, which deposits the articles into a funnel **96**, leading into the upright supply tube **97** located concentrically of the machine axis. This feed tube is rotatable, being supported from an upper arm **98** by a bearing **99** and from a lower arm **100** by a bearing **101**. Arms **98** and **100** are mounted in cantilever fashion on a split sleeve **102** carried by the upper end of a post **103** mounted on the base **94**. Preferably, such sleeve is adjustable elevationally along post **103** and can be secured in a desired position by rotating clamp-operating handles **102'**.

Beneath the feed tube **97** is a table **104** on which the articles to be trimmed are deposited. Such table is formed with spiral guideways defining nested spiral slots. Thus, spiral guide rails **105** and **106** define the spiral slot **107** between them. Guide rails **106** and **108** define the spiral slot **109** between them. Guide rails **108** and **110** define the spiral slot **111** between them. The initial portion of the spiral slot **111** is formed between guide rails **105** and **108** before guide rail **110** branches away from guide rail **105**. The several guide rails may be supported by a spider having radial arms **112**, the inner ends of which are connected together and the outer ends of which are connected by an encircling ring **112'**.

Encircling the article supply tube **97** and closely overlying the table **104** is an article-propelling disk **113** having an aperture in its central portion through which the lower end of the supply tube **97** extends. The central portion of the circular plate **113** is supported by the lower end of the supply tube and the peripheral portion of the plate is supported by the margin of a conical member **114** sloping upwardly and inwardly from the peripheral portion of plate **113**. The lower surface of this plate is covered with a thick pad **115** of readily deformable resilient sponge material, such as polyurethane, comparable to the pad **22** on the belt **21** shown in FIG. **2**. The position of sleeve **102** is adjusted along post **103**, as described previously, so as to locate the pad **115** in position to engage the upper portions of articles carried by the guideways of table **104** which have been deposited on such table through the supply tube **97**.

The articles deposited on table **104** are moved along the spiral slots **107, 109** and **111** by contact of pad **115** with the upper portions of the articles as such pad is rotated about the axis of supply tube **97**. Such rotation is effected by a belt **116** driven by a motor **117** and engaged with a pulley **118** secured on the supply tube **97**, as shown in FIGS. **16** and **17**. Movement of the Brussels sprouts along the spiral slots terminate in their discharge from the ends of the slots into any desired type of receptacle, such as the chute **119** shown in FIG. **16** as being arranged to deposit the articles in a conveyor **120**.

Projection-trimming blades **121** located close beneath the spiral slots of the table **104** are mounted on the upper end of an upright shaft **122** which is driven by a motor **123** through a drive belt **124**. It is preferred that the shaft **122** be mounted for lengthwise adjustment so as to be able to alter the elevation of blades **121** relative to the bottoms of the guide rails of table **104**. When the projections of the globular articles being processed, such as the stems of Brussels sprouts, extend downward through one of the slots **107, 109** and **111**, they will be trimmed by the rotating knife blades **121**.

As the articles, such as Brussels sprouts, are propelled along the spiral guideways, the stems will be projected periodically and sporadically downward through the slots of the guideways as the Brussels sprouts roll along the guide rails. Movement of the Brussels sprouts by rotation of the pad **115** in contact with them will tend to cause the Brussels sprouts to roll along a straight course tangential to the particular portion of the spiral slot above which it is supported. Because the inner guide rail of each spiral path is shorter than the outer guide rail, the relative movement of the pad **115** and the guide rails of unequal length will exert a force component on the Brussels sprout transversely of the length of the slot which will tend to rotate the Brussels sprout away from the convex guide rail and toward the concave guide rail. Such tendency will cause the article to gyrate as it rolls along a spiral guideway so that a projection will be swung transversely of the slot as the article rolls and, consequently, will move into registry with and be projected through the slot one or more times during its movement along the slot even though some of the time the projection extends transversely of the slot. Each time that a projection is moved into registry with a slot and plunged through it, such projection will be subjected to the trimming action of a blade **121**. The debris of the projections and other trimmings from the articles will fall through the spiral slots and collect in the bottom of hopper **125** from which the debris can be removed by air suction.

I claim:

1. The method of trimming a projection of a globular article which comprises supportingly engaging the lower portion of the article at spaced locations by spaced means establishing a substantially linear course of article travel, continuously engaging an upper portion of the article and by such upper and lower engagement exerting a force on such article generally parallel to such linear course of article travel for moving such upper and lower portions of the article relatively and thereby effecting rolling of the article along the course of the article-supporting means and simultaneously exerting a force on such article generally transversely of such linear course of article travel for swinging of the article projection sideways as the article rolls along such course to shift such projection transversely of the course into registration with the space between such engaged locations of the article lower portion and project such projection downward between such engaged locations of the article lower portion, and cutting the projection upon disposition thereof in such downwardly projecting position.

2. The method defined in claim **1**, including exerting the force on the article generally transversely of the linear course of travel of the article by moving the lower engaged portions and the upper engaged portion of the article relatively transversely of the linear course along which the article is rolled.

3. The method defined in claim **1**, including exerting the force on the article generally transversely of the linear course of travel of the article by moving the lower engaged portions of the article relative to the upper engaged portion of the article in a direction transversely of the linear course along which the article is rolled, and exerting the force on the article generally parallel to such linear course of article travel by moving the upper engaged portion of the article longitudinally of the linear course along which the article is rolled.

4. The method of trimming a projection of a globular article which comprises supportingly engaging the lower portion of the article at spaced locations by spaced means establishing a substantially linear course of article travel, continuously engaging the upper portion of the article at two locations spaced transversely of said linear course, moving such upper engaged portions of the article at different speeds relative to each other longitudinally of the linear course along which the article is rolled and by such upper and lower engagement exerting a force on such article for moving such upper and lower portions of the article relatively for effecting both rolling of the article along the course of the article-supporting means and swinging of the article projection sideways as the article rolls along such course to shift such projection transversely of the course into registration with the space between such engaged locations of the article lower portion and project such projection downward between such engaged locations of the article lower portion, and cutting the projection upon disposition thereof in such downwardly projecting position.

5. The method of trimming a projection of a globular article which comprises supportingly engaging the lower portion of the article by means establishing a linear course of article travel, continuously engaging an upper portion of the article, one of such engagements of the article being at two locations spaced transversely of the linear course of travel, moving such transversely spaced engaged portions of the article at different speeds relative to each other longitudinally of the linear course and by such upper and lower engagement exerting a force on such article for moving such upper and lower portions of the article relatively for effecting both rolling of the article along the course of the article-supporting means and swinging of the article projection sideways as the article rolls along such course to shift such projection transversely of the course into registration with the space between such engaged locations of the article lower portion and project such projection downward between such engaged locations of the article lower portion, and cutting the projection upon disposition thereof in such downwardly projecting position.

6. The method of trimming a projection of a globular article which comprises supportingly engaging the lower portion of the article at spaced locations by spaced means establishing a substantially spiral course of article travel, continuously engaging an upper portion of the article, moving the lower engaged portion and the upper engaged portion of the article relatively for effecting both rolling of the article along the spiral course of the article-supporting means and swinging of the article projection sideways as the article rolls along such course to shift such projection transversely of the course into registration with the space between such engaged locations of the article lower portion and project such projection downward between such engaged locations of the article lower portion, and cutting the projection upon disposition thereof in such downwardly projecting position.

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