

[54] **TABLE TOP PINEAPPLE SLICING AND CHUNKING**

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[21] Appl. No.: **336,153**

[52] U.S. Cl. **83/39, 83/404.2, 83/404.3, 83/595, 83/477.2, 83/664**

[51] Int. Cl. **B26d 3/26, B26d 7/06**

[58] Field of Search **83/39, 404.1, 404.2, 404.3, 83/407, 408, 599, 664, 477.2, 594, 595; 99/233.7**

[56] **References Cited**

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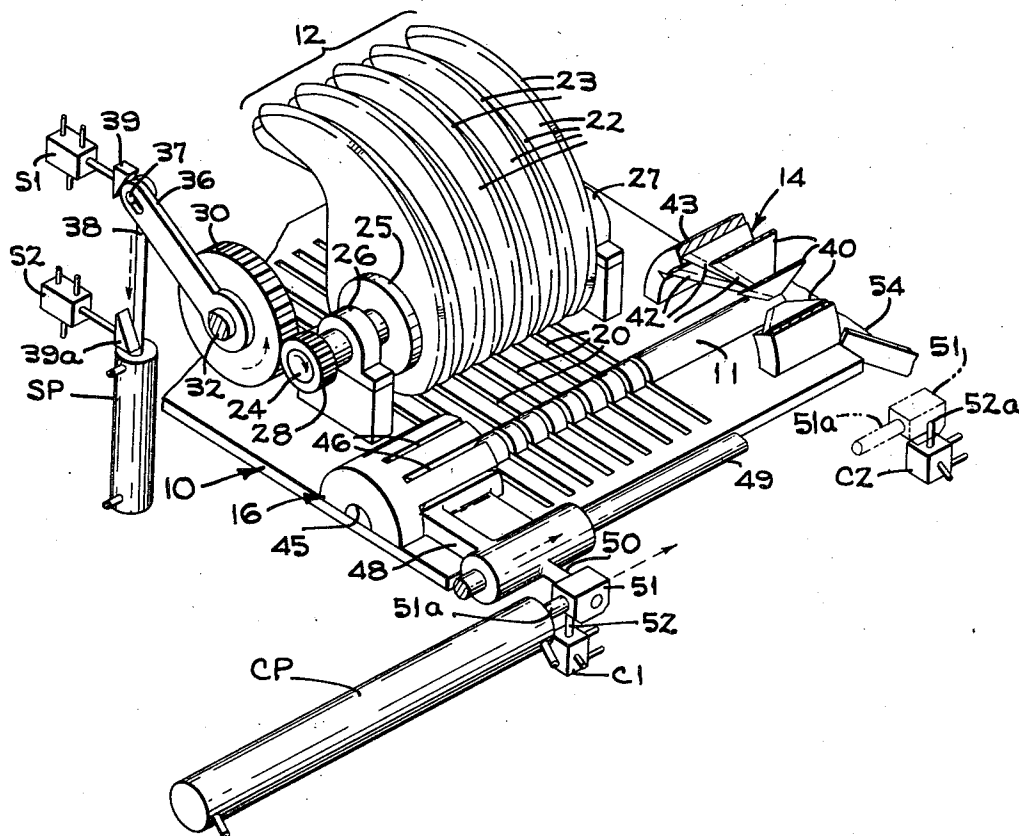
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3,656,529	4/1972	Vadas	99/233.7

Primary Examiner—Willie G. Abercrombie
Attorney, Agent, or Firm—C. E. Tripp

[57] **ABSTRACT**

Contour peeled pineapple halves are supported on a slotted table having a slotted guide rib within their core cavities. The halves are sliced transversely by knives that move below the table, whereupon a chunking plunger pushes the transversely sliced halves through radial chunking knives. In one embodiment the slotted table is advanced and retracted to alternately receive halves from two infeed conveyors, and the chunking plunger is double ended to alternately feed sliced halves through one of two sets of opposed chunking knives. The slicing knives can be mounted below the table and operated by planetary gearing.

17 Claims, 65 Drawing Figures



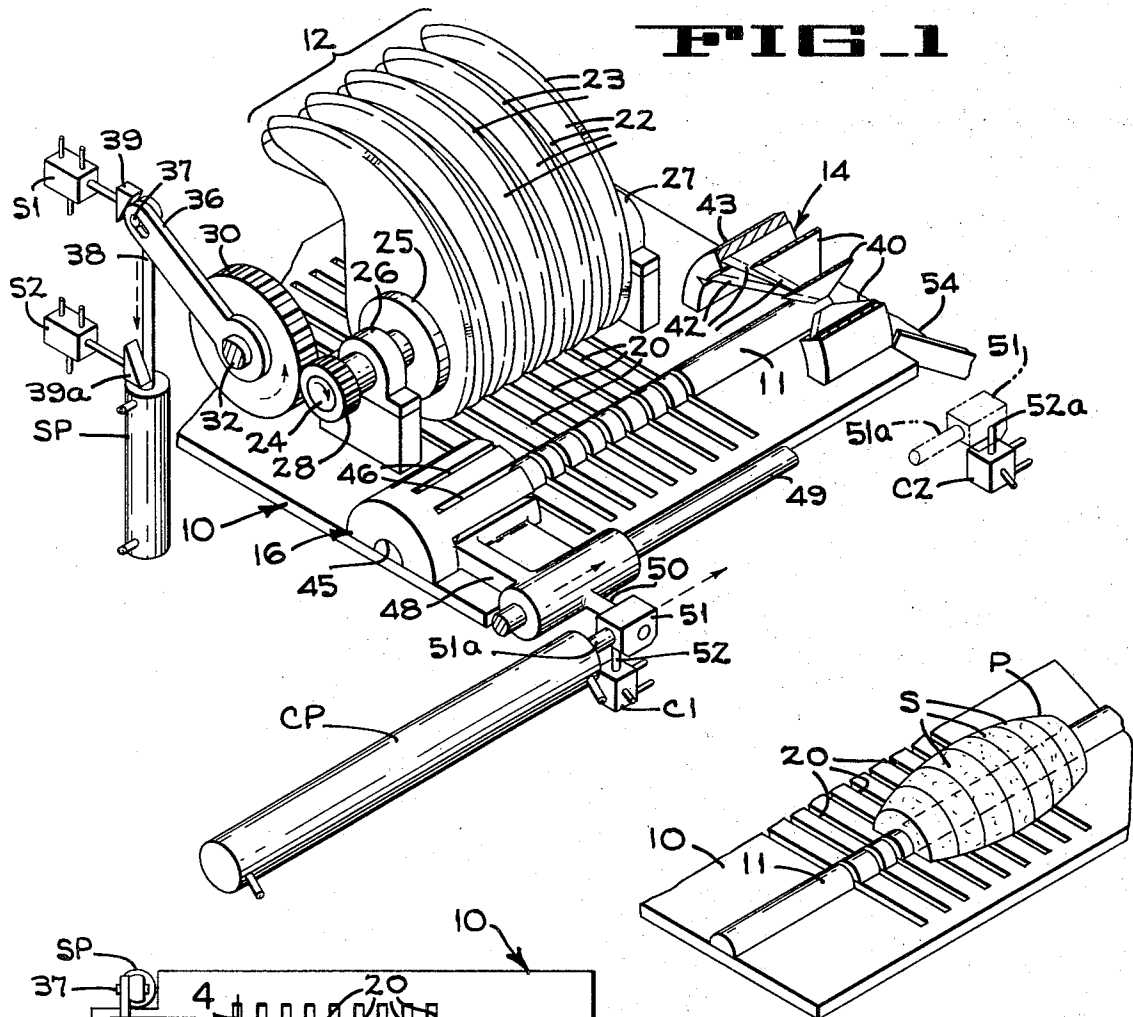


FIG. 2

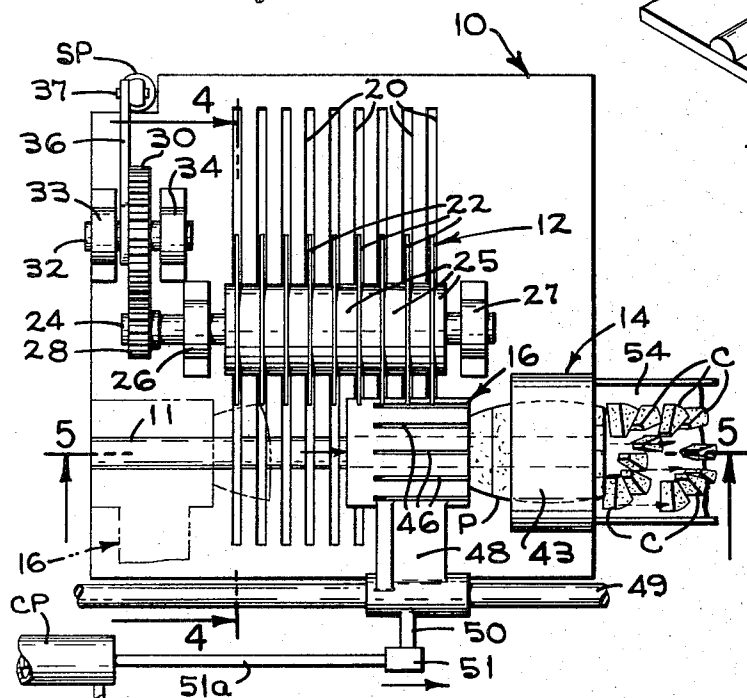
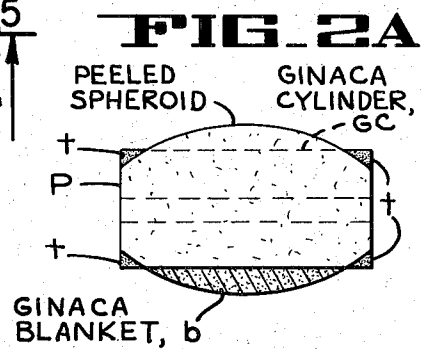


FIG. 3



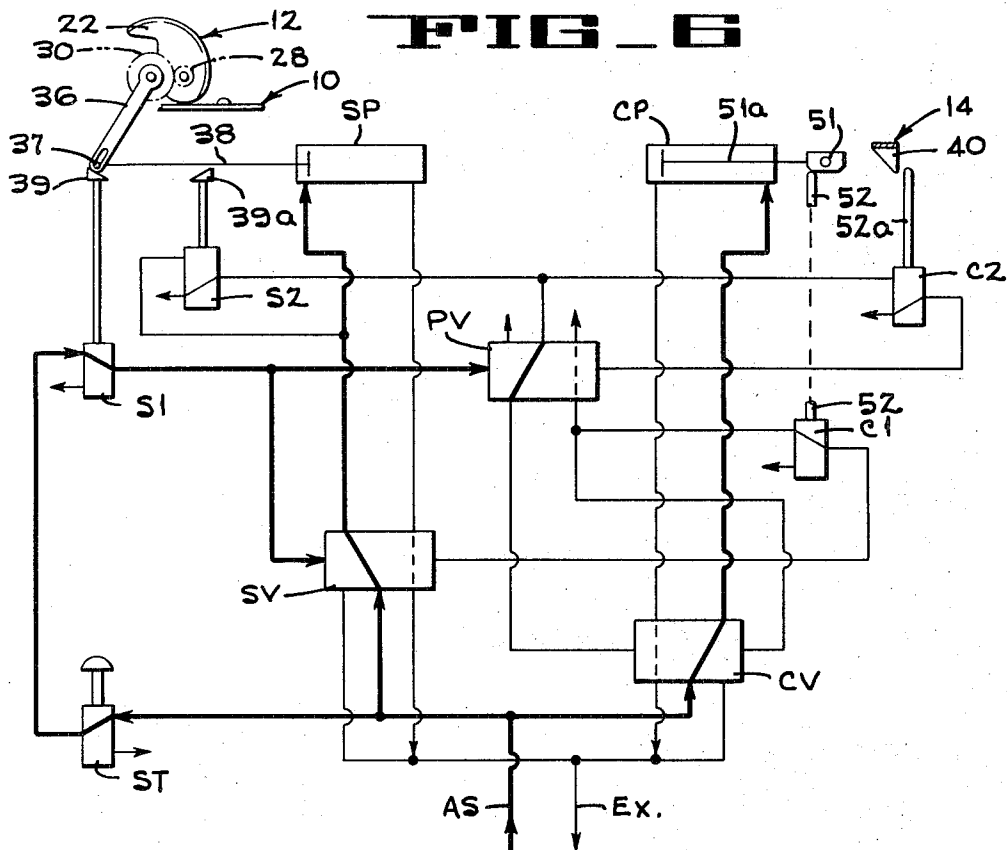


FIG. 6A

TABLE OF VALVE OPERATION

	ST	SI	S2	CI	C2	PV	SV	CV	FUNCTION
A. POS.	1 (START)	1	1	1	1	1	1	1	RETRACT SP (SLICE)
B. POS.	2	2	2	1	1	1	1	2	END RETRACTION SP START ADVANCE CP (CHUNK)
C. POS.	2	2	2	2	2	2	1	1	END ADVANCE CP START RETRACTION CP (RETRACT CHUNKER)
D. POS.	2	2	1	1	1	2	2	1	END RETRACTION CP ADVANCE SP (RETRACT KNIVES)
E. POS.	2	1	1	1	1	2	2	1	END ADVANCE SP (READY FOR NEW CYCLE)

FIG 7

POSITION 1

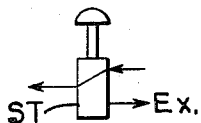


FIG 7A

POSITION 2

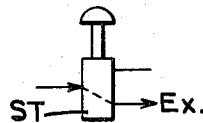


FIG 8

POSITION 1

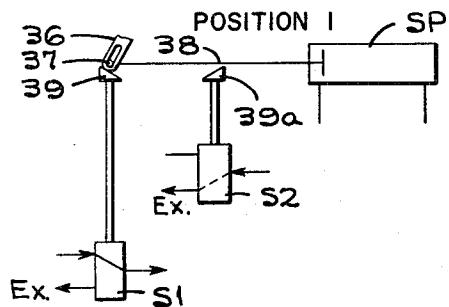


FIG 8A

POSITION 2

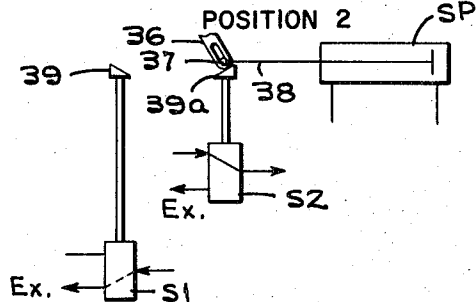


FIG 9

POSITION 1

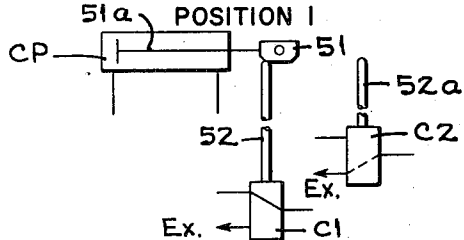


FIG 9A

POSITION 2

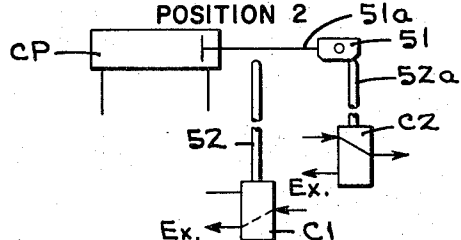


FIG 10

POSITION 1

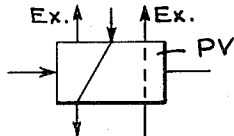


FIG 10A

POSITION 2

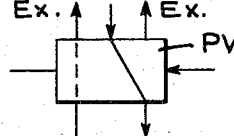


FIG 11

POSITION 1

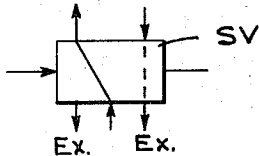


FIG 11A

POSITION 2

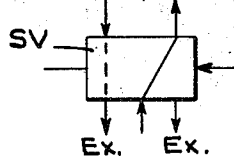


FIG 12

POSITION 1

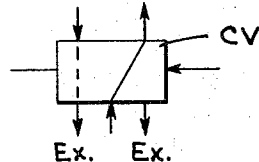
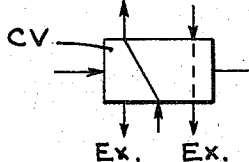
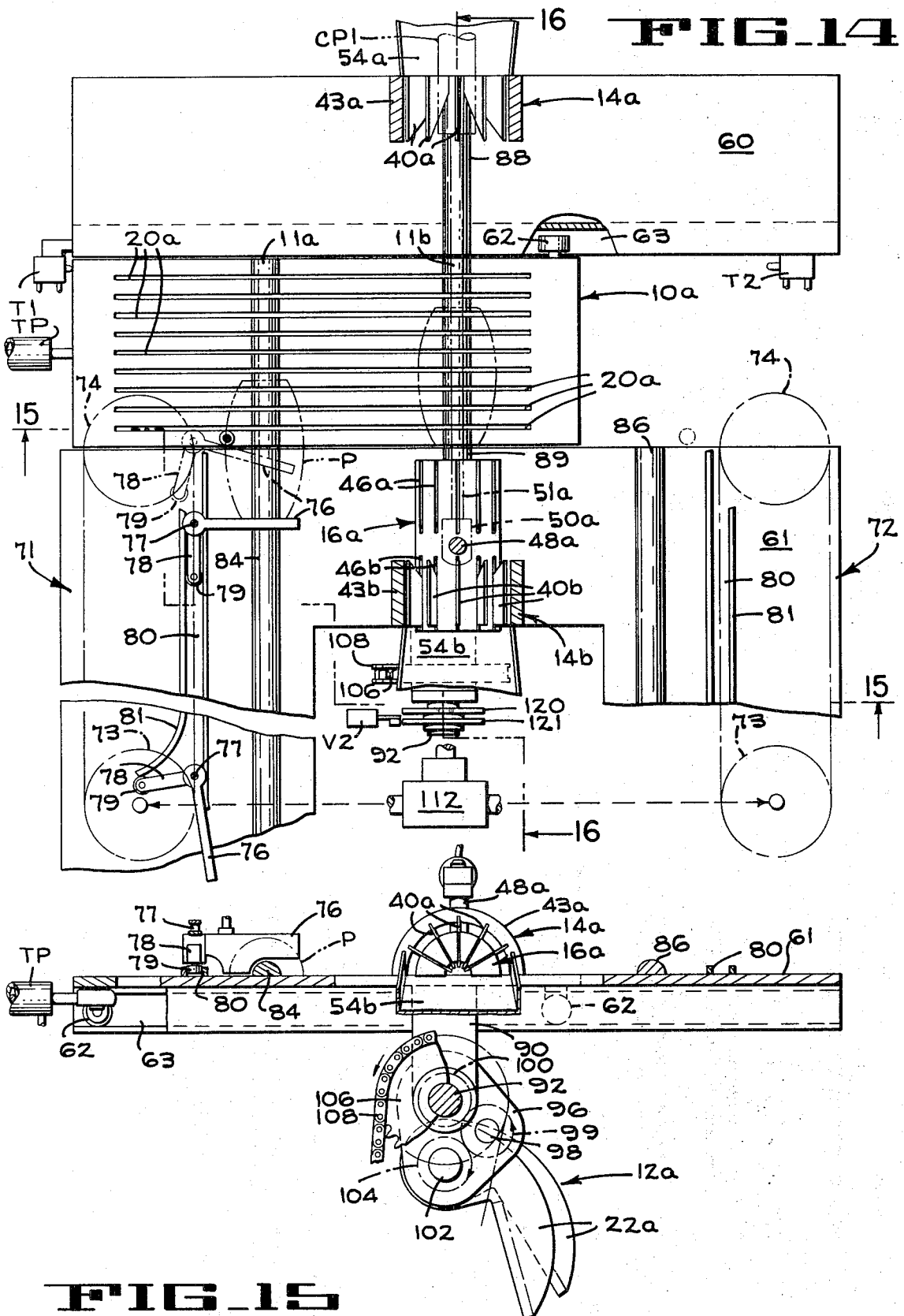


FIG 13

POSITION 2





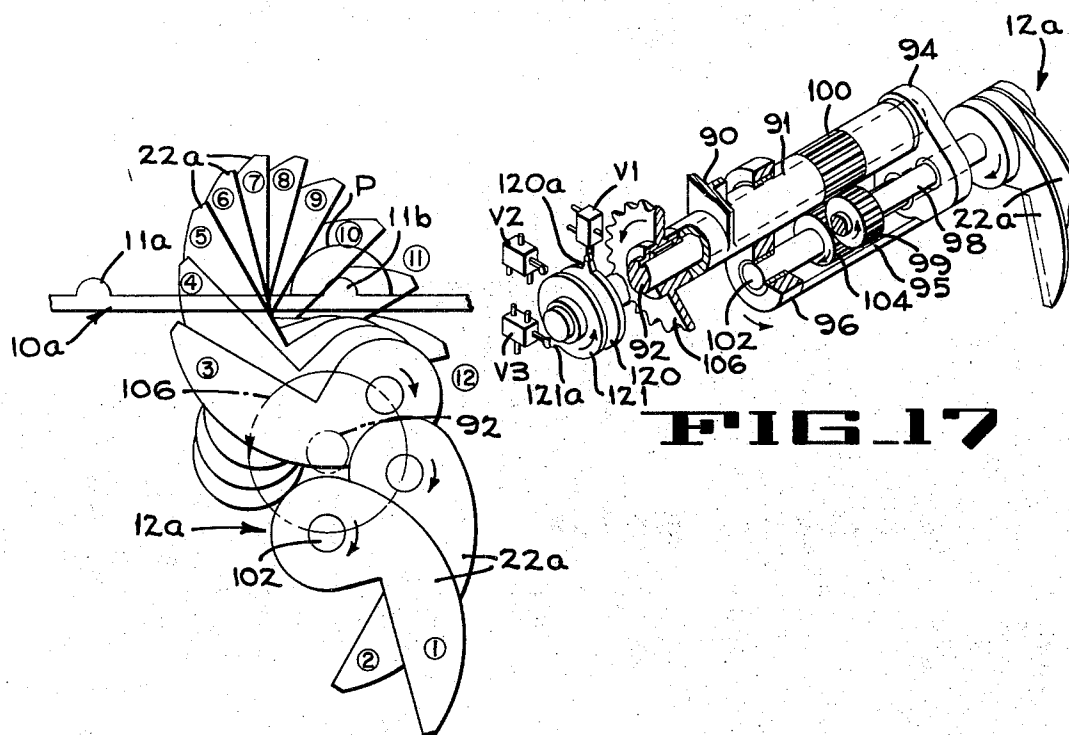
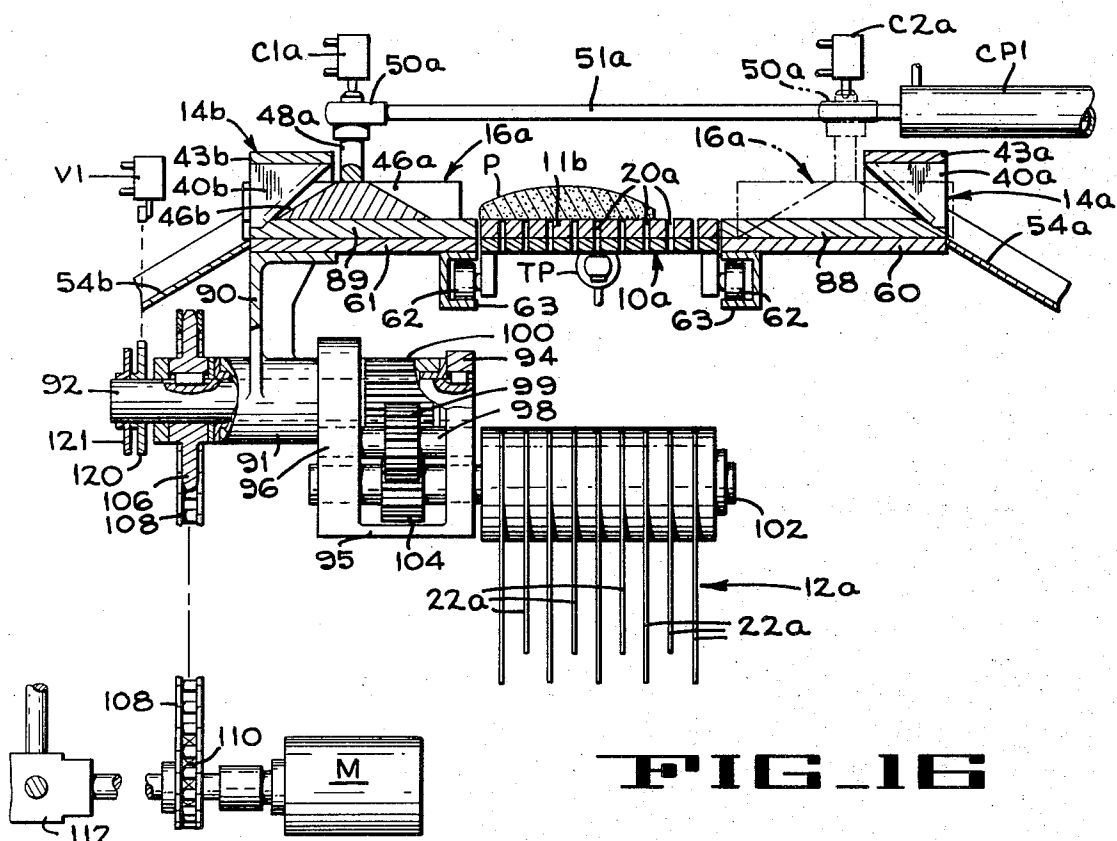


FIG. 18

FIG 19

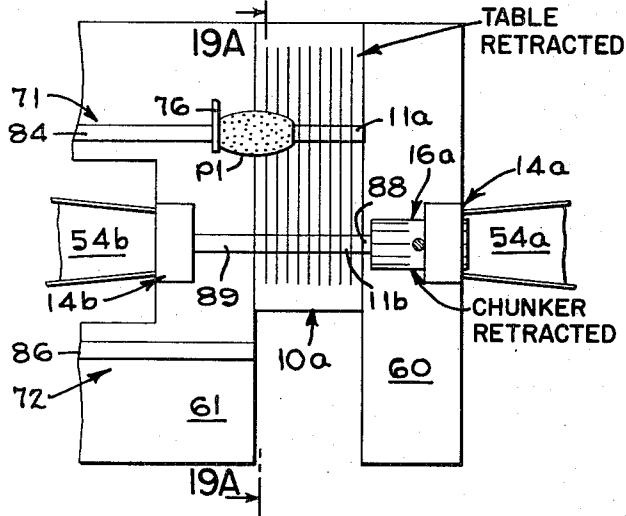


FIG. 19A

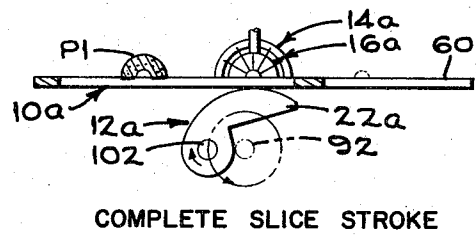
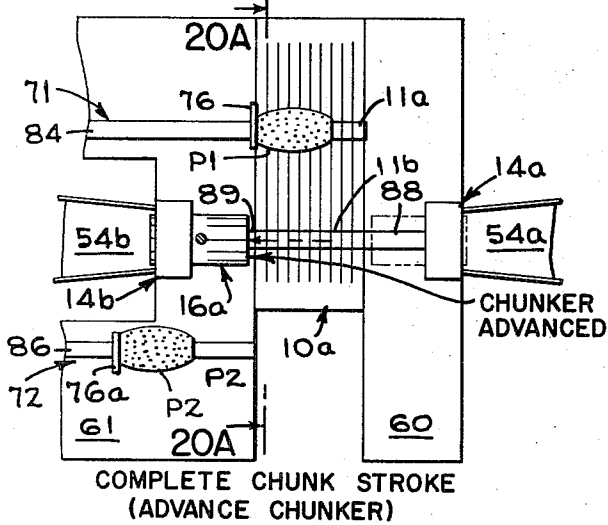


FIG. 20



FIG_20A

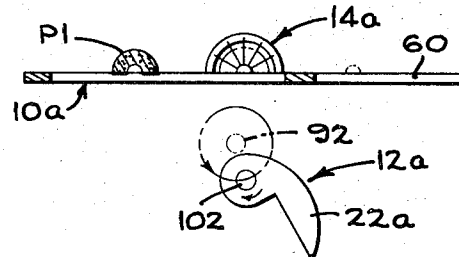


FIG. 21A

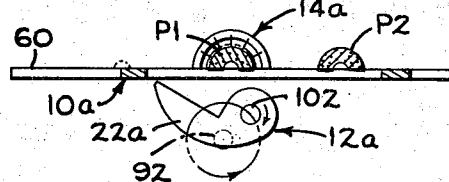


FIG. 22

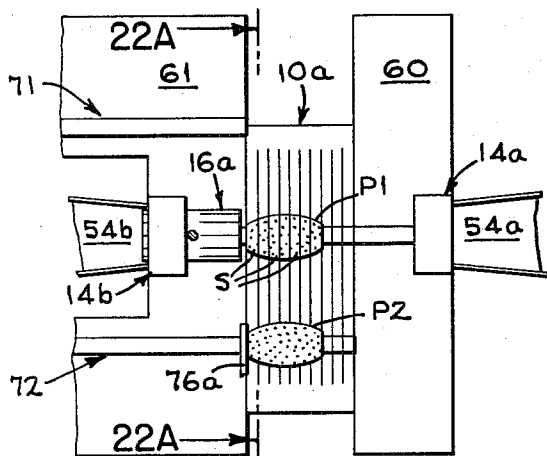
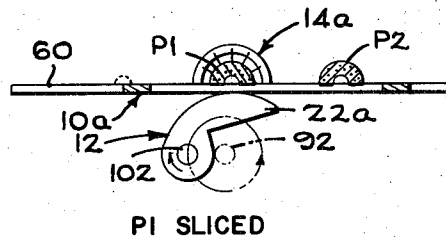


FIG. 22A



END OF HALF CYCLE

FIG. 23

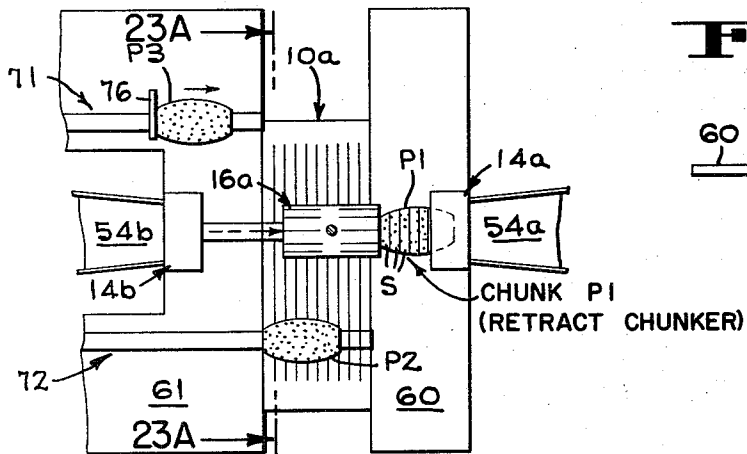


FIG. 23A

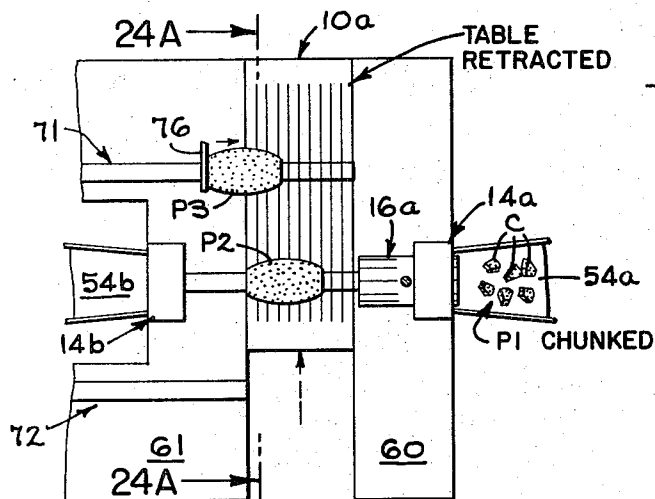
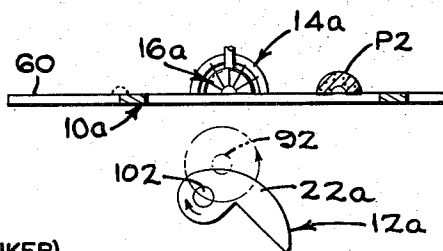


FIG. 24A

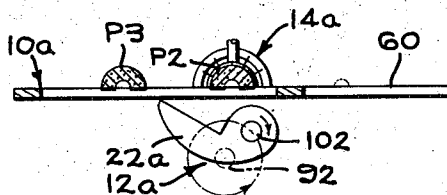


FIG. 24

FIG. 25

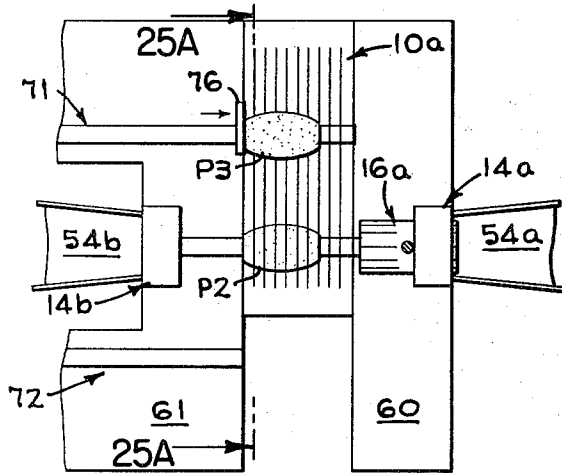
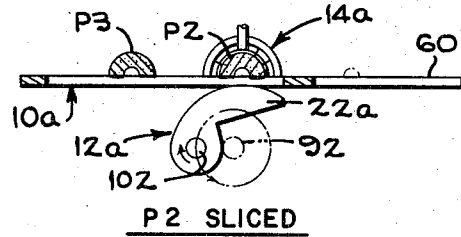


FIG. 25A



END OF FULL CYCLE

FIG. 26

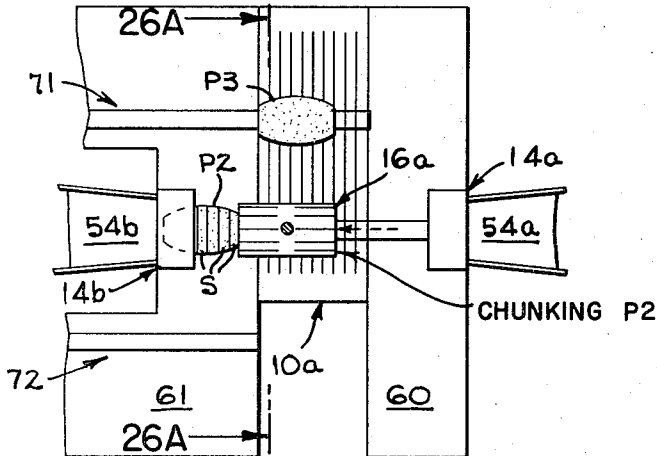


FIG. 26A

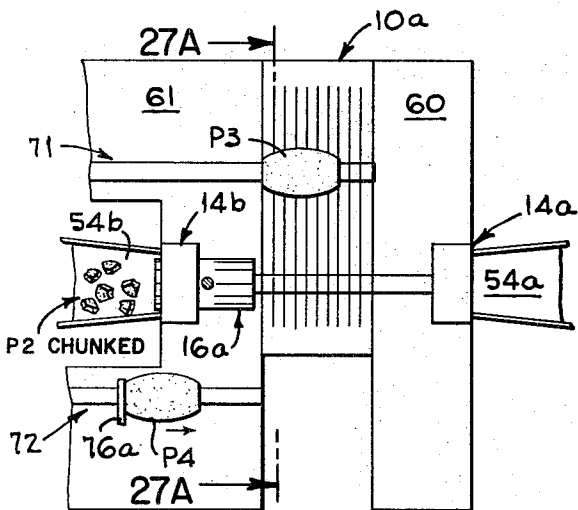
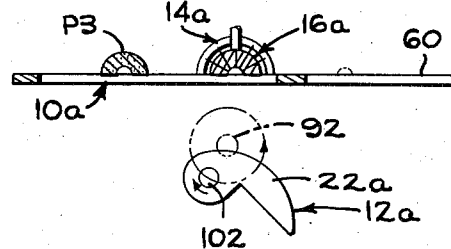


FIG. 27

FIG. 27A

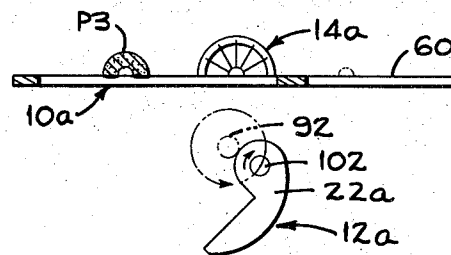


FIG 28

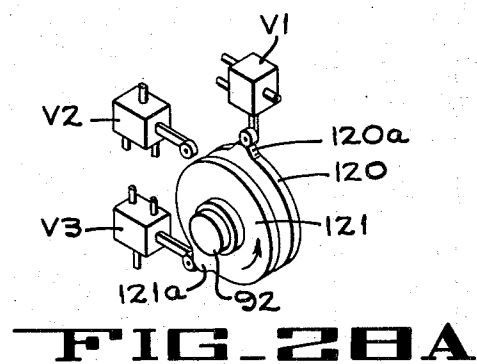
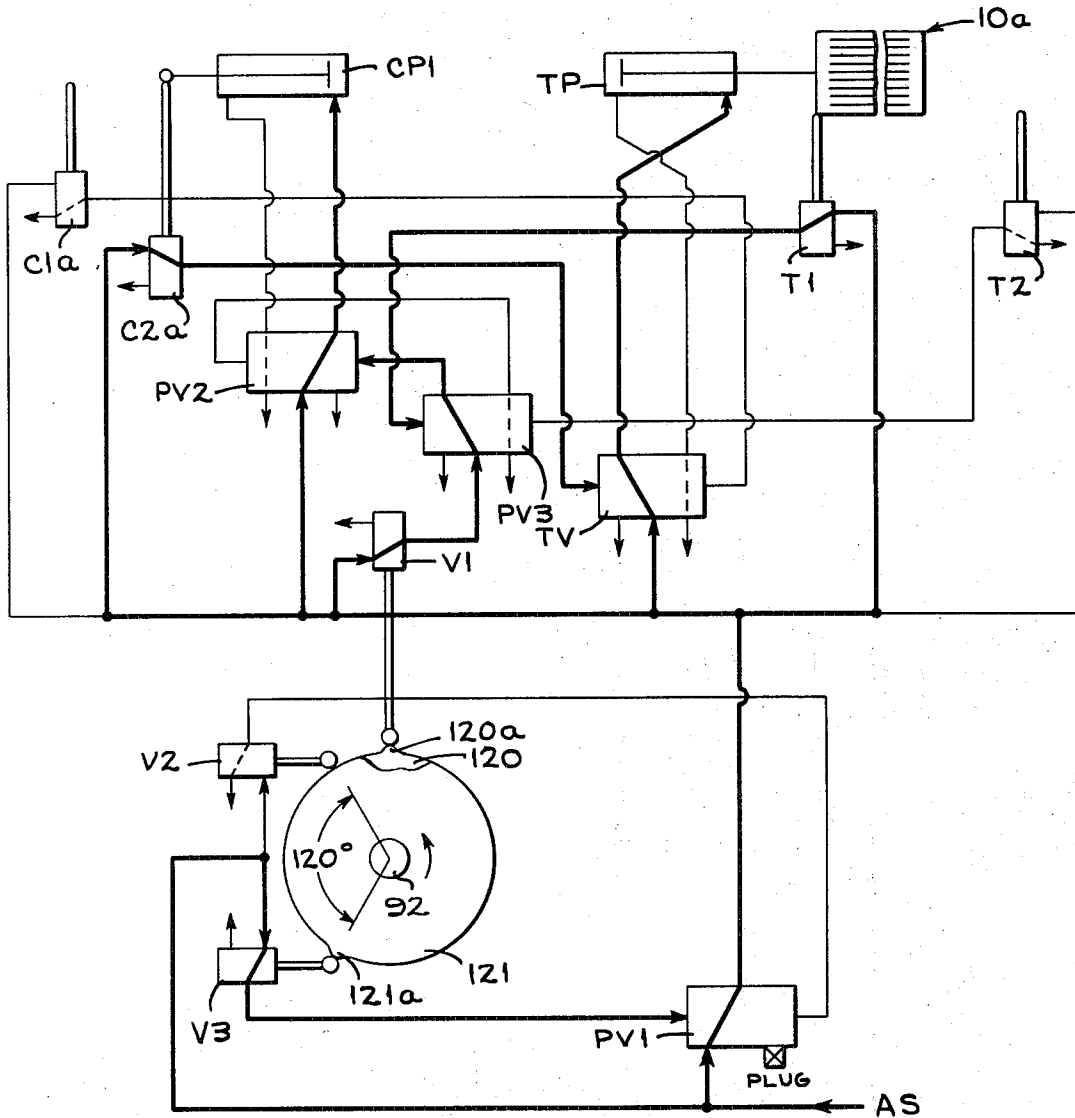


FIG 28A

FIG 29

TABLE OF VALVE OPERATION

	V1	V2	V3	PV1	PV2	PV3	TV	C1a	C2a	T1	T2	
FIG. 19 POS.	1	1	1	1	1	1	1	1	1	1	1	ADVANCE CHUNKER TABLE RETRACTED SLICE STROKE COMPLETED
FIG. 20 POS.	2	1	2	1	1	1	2	2	2	2	1	CHUNKER ADVANCED ADVANCE TABLE SLICER BELOW TABLE
FIG. 21 POS.	2	1	2	1	1	1	2	2	2	2	2	CHUNKER ADVANCED TABLE ADVANCED SLICER RISING
FIG. 22 POS.	2	2	2	2	1	1	2	2	2	2	2	CHUNKER ADVANCED TABLE ADVANCED P1 SLICED
FIG. 23 POS.	1	1	1	1	2	2	2	1	2	2	2	CHUNKER RETRACTING CHUNKING P1 TABLE ADVANCED SLICE BELOW TABLE
FIG. 24 POS.	2	1	2	1	1	2	1	1	1	1	1	CHUNKER RETRACTED P1 CHUNKED TABLE RETRACTED SLICER RISING
FIG. 25 POS.	1	1	1	1	1	1	1	1	1	1	1	CHUNKER RETRACTED TABLE RETRACTED P2 SLICED
FIG. 26 POS.	2	1	2	1	1	1	2	1	2	2	1	CHUNKING P2 TABLE RETRACTED SLICER BELOW TABLE
FIG. 27 POS.	2	1	2	1	1	1	2	2	2	2	1	P2 CHUNKED TABLE RETRACTED SLICER BELOW TABLE

FIG. 30 **FIG. 31**

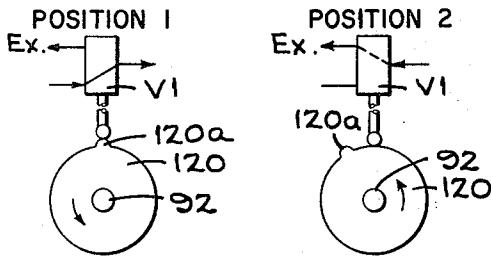


FIG. 32 **FIG. 33**

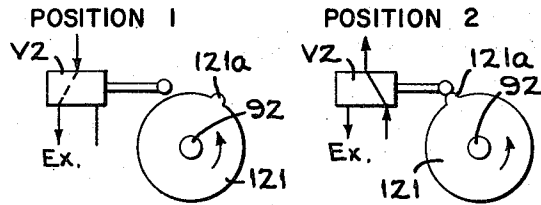


FIG. 34 **FIG. 35**

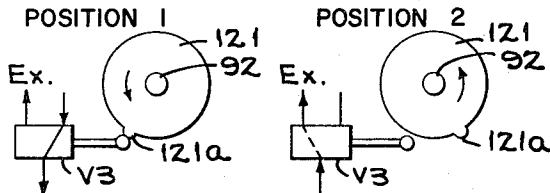


FIG. 36 **FIG. 37**

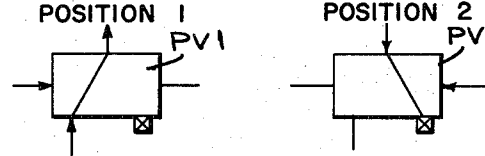


FIG. 38 **FIG. 39**

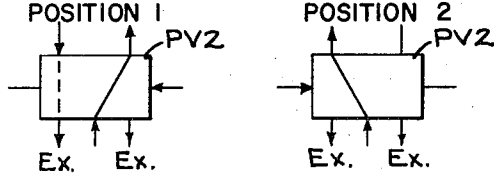


FIG. 40 **FIG. 41**

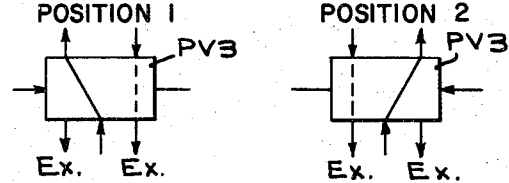


FIG. 42 **FIG. 43**

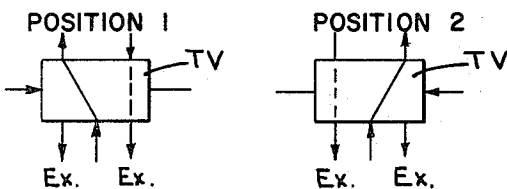


FIG. 44

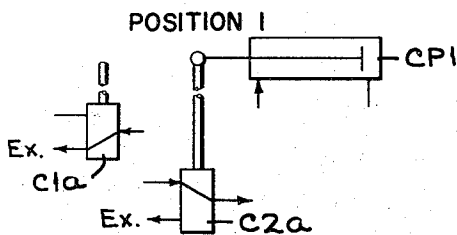


FIG. 45

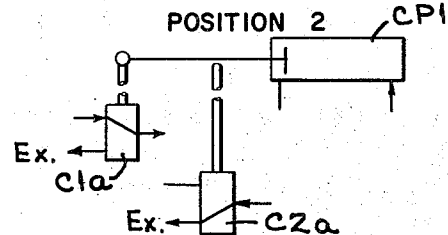


FIG. 46

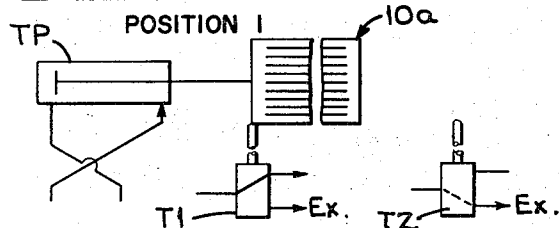


FIG. 47

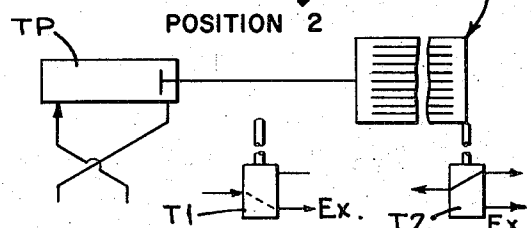


TABLE TOP PINEAPPLE SLICING AND CHUNKING

FIELD OF THE INVENTION

This invention relates to the processing of pineapples and more particularly to the forming of contour peeled spheroids into chunks.

REFERENCE TO RELATED APPLICATIONS

Vadas, Ser. No. 233,094, filed Mar. 9, 1972 slices contour peeled spheroid halves longitudinally and then forms chunks by a transverse cut. Vadas, Ser. No. 233,130, filed Mar. 9, 1972, now U.S. Pat. No. 3,760,665, halves contour peeled spheroids and guides them by their core cavities to a processing belt. Vadas, Ser. No. 197,700, filed Nov. 11, 1971 now abandoned, recovers contour peeled spheroid halves and slices them. These applications are assigned to Castle & Cooke, Inc.

DESCRIPTION OF PRIOR ART

For many decades pineapples have been formed into chunks starting with the widely known and conventional Ginaca process wherein the fruit is not peeled but is cored and pushed through a cylindrical knife that forms what is known in the art as a Ginaca cylinder. Even though the butt and crown ends of the fruit may have been trimmed, the Ginaca cylinder usually contains an annular body at both ends which contains eyes or portions of a peel and which must be trimmed by hand before the chunking operation. Hand trimming is not only costly in terms of labor but is invariably accomplished in a manner which removes more flesh than is required, simply to remove the defects from the aforesaid annular end regions. Of course, the fruit could have been trimmed to a short enough length so that no annular defect bodies would remain, but this would leave excess fruit on the ends that are trimmed off. Furthermore, the Ginaca process leaves a so-called blanket of fruit on the inner periphery of the hollow shell that includes the skin. This blanket, in order to be processed separately, must be eradicated from the skin and is usually relegated to the formation of juice which is a lower value material than the corresponding chunk material provided under the present invention.

Summary of the Invention

In accordance with the present invention pineapples are formed into chunks without requiring excessive trimming at the ends thereof, characteristic of the Ginaca process, without relegating the blanket of fruit that remains attached to the skin under the Ginaca process to juice recovery.

Under the present invention the pineapples are cored, contour peeled and trimmed at their ends. The contour peeling removes the annular bands of fruit at the trimmed ends of the resulting peeled spheroid, that formerly were hand trimmed under the Ginaca process. Furthermore, the contour peeling leaves the blanket, attached to the skin under the Ginaca process, intact with the peeled spheroid whereby the blanket material is incorporated in the chunks resulting from the present invention.

Applicant has found that contour peeled spheroids can be formed in chunks with minimum crushing and juice loss by first cutting the spheroids into halves along the core holes and placing the halves on a slotted table

having a transversely slotted guide rib that fits into, reinforces and guides the fruit half by means of the core cavity. It has been further found that these halves can be formed into chunks with a maximum recovery by first slicing the fruit transversely and then running the sliced fruit through radial chunking knives, all while the fruit is guided on and supported by a transversely slotted rib that fits into the core cavity hole. The transverse slicing knives must act on the fruit from above so that the flat surface of the fruit and the core cavity surface backed up by the slotted rib locates and supports the fruit against the force of the slicing and prevents displacement and crushing and other damage to the fruit during slicing operation. In accordance with the present invention, the fruit thus transversely sliced from above while supported by the core cavity is pushed through or run through a series of radial chunking knives so that even though the fruit has been sliced, the integrity of the peeled sliced halves structure is maintained as the fruit is formed into chunks. This process provides an increased yield over that of my aforesaid application, Ser. No. 233,094 wherein the fruit halves are first sliced axially and are chunked transversely.

The chunking process of the present invention lends itself to either a semi-automatic type of apparatus wherein the fruit is hand fed to the slicer and chunker units or to automatic apparatus wherein two lanes of peeled spheroid halves enter the apparatus from separate conveyor.

In accordance with the present invention, the axial motion chunking operation is performed after the transverse slicing operation by moving the slicing knives from above the fruit to a position below the slotted table, whereupon there is no interference with the mechanism that feed the transversely sliced fruit axially through a set of radial chunking knives. It is not practical to retract the slicing knives after slicing operation because this would disrupt the sliced spheroid. In accordance with one embodiment of the invention, the chunker knives are formed as a group of radial fixed blades with the sharp edges lying on a recessed conical surface. The transversely sliced fruit is pushed through the chunker blades by a sliced piston which is radially notched to accommodate the chunker blades and the end which can project past the blades, thereby ensuring that remnants of fruit do not remain in the chunking knives from operation to operation. Also, the blade accommodating slots in the chunking head or piston that pushes the fruit through the chunker blades have rear or bottom walls that diverge from the cutting edges of the chunking knives to render the slots in the chunking piston self-clearing of fruit fragments.

Although the slicing knives enter the fruit from above in order to maintain the contact, engagement and guiding support of the fruit by the ribbed slicing table, the action of the knives is such as to provide a progressive slicing operation which reduces the peak load on the fruit as the knives enter the fruit at the beginning of the slicing operation. In one embodiment the slicing knives are mounted above the table and in another they are mounted below the table, but in both they are at positions below the table during chunking.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of a hand fed apparatus embodying the invention.

FIG. 2 is a perspective showing a sliced spheroid half before chunking.

FIG. 2A is a diagram illustrating the differences between the use of a contour peeled spheroid and a Ginaca cylinder.

FIG. 3 is a plan of the apparatus of FIG. 1.

FIG. 4 is a partial section taken on line 4 — 4 of FIG. 3 showing the slicing action.

FIG. 5 is a section taken on line 5 — 5 of FIG. 3 with the chunking piston retracted.

FIG. 5A is a fragmentary section showing a chunking piston fully advanced into the chunking knives.

FIG. 6 is a schematic diagram of the pneumatic programming system with the parts in their initial feed position.

FIG. 6A is a table of valve operation.

FIGS. 7 — 13 are valve positioned diagrams to be read in connection with the Table of Valve Operation of FIG. 6A.

FIG. 14 is a plan of an apparatus designed for automatic feed.

FIG. 15 is a section taken on line 15 — 15 of FIG. 14.

FIG. 16 is a section taken on line 16 — 16 of FIG. 14.

FIG. 17 is a diagrammatic perspective of the knife actuating gearing.

FIG. 18 is a diagram indicating various positions of the slicing knives.

FIGS. 19 — 27A are operation diagrams showing step-by-step feeding and chunking of pineapple halves.

FIG. 28 is a schematic diagram of the pneumatic programming system with the parts in their initial position.

FIG. 28A is a perspective of the programming cam.

FIG. 29 is a Table of Valve Operation.

FIGS. 30 — 47 are valve position diagrams to be read in connection with the Table of FIG. 29.

DETAILED DESCRIPTION OF HAND FED EMBODIMENT

Suitable apparatus for providing contour peeled spheroids is disclosed in my U.S. Pat. No. 3,583,457, of June 8, 1971.

Apparatus for providing contour peeled spheroid halves appears in my U.S. Pat. No. 3,656,528 of Apr. 18, 1972, and in my aforesaid application, Ser. No. 233,130. Apparatus for re-coring spheroid halves appears in my U.S. Pat. No. 3,642,043, Feb. 15, 1972.

The mechanical details of a hand fed embodiment of the present invention appear in FIGS. 1 — 5A. In the hand fed embodiment, cored contour peeled and re-cored half spheroids are placed by hand on a slicing table and a start button is pressed which initiates programmed operation for one cycle. The spheroids are first sliced from above and when the slicing knives attain a position below the top of the table a chunking piston is advanced to slide the sliced spheroids along a slotted guide rib on the table and forces them through radial chunking knives to produce sector shaped chunks.

Referring to the perspective of FIG. 1, the major elements of the embodiment being described are a slotted table 10 having a transversely slotted guide rib 11 for the core recess in a peeled half. The apparatus includes a set 12 of specially curved slicing knives mounted

above the table, an array of radial chunking knives 14, a shiftable chunking piston or plunger 16, a slicing knife operated linear actuator or piston SP and a chunking piston linear actuator or piston CP. The slicing piston SP is under partial control of pilot valves S1 and S2 and the chunking piston CP is under partial control of pilot valves C1 and C2.

The table 10 is formed with a plurality of slots 20 which also pass through the core cavity guide rib 11. The set 12 of slicing knives includes 9 specially curved slicing knives 22, with the edges of alternate knives slightly offset to distribute the initial slicing load on the fruit, which offset is best seen in FIG. 4. The knives 22 are provided with specially curved, sharpened edges 23 (FIG. 4) which are so contoured as to always exert a downward force component on the fruit being sliced, so that the table 10 assisted by the guide rib 11 can restrain and guide the fruit during the slicing operation.

The knives 22 are keyed to a shaft 24 between spacers 25 and the shaft is supported in bearings 26, 27 on the top of the table 10. The knife shaft 24 is oscillated by a shaft pinion 28 meshed with a drive gear 30 on a shaft 32 supported by bearings 33, 34 on the table. The drive gear 30 is oscillated by a crank 36 secured to the gear and pinned at 37 to the piston rod 38 of the pneumatic linear actuator piston SP, previously mentioned. Thus, due to the step up drive between the drive gear 30 and the knife shaft pinion 28, retraction of the piston 38 of the linear actuator SP from its position shown in FIG. 1 will swing the knives 22 down through the pineapple and beneath the table 10, as shown in broken lines in FIG. 4. After the pineapple has been pushed clear of the table slots 20 during the chunking operation to be described presently, the linear actuator SP is advanced to the position of FIG. 1, which brings the knives 22 back up through the slots 20 in the table 10 (without interference by the fruit) and back to the initial or feed position of FIG. 1. This advance and retract of the slicing piston SP includes operation of cam actuators 39, 39a for the pilot valves S1, S2 in the air circuit shown in the diagram of FIG. 6, to be described presently.

The set 14 of chunking blades, in the present embodiment, is formed with five radial, individual knives 40 having sharpened forwardly facing edges 42, which edges lie on a concave conical envelope (FIG. 5A). The inner peripheries of the blades 40 are mounted in slots in the guide rib 11 and the outer periphery of the blades 40 are mounted in slots formed in a shroud 43 secured to the table 10.

The chunking plunger 16 is semi-cylindrical and is dimensioned to slide freely through the shroud 43 of the chunking knives. The chunking plunger has a semi-cylindrical recess 45 that fits over and slides along the core cavity guide rib 11 on the table. The chunking plunger is formed with radial slots 46 that accommodate the chunking blades 42 when the plunger is fully advanced. As seen in the diagram of FIG. 5A the rear or bottom walls 47 of the slots 46 in the chunking plunger 16 diverge outwardly from the cutting edges 42 of the chunking knives 40 by a small angle indicated at "a." This configuration provides a wedging or self-clearing action on small fragments of fruit that might otherwise be trapped between the chunking knives 40 and the bottoms 47 of the slots 46 formed in the chunking plunger 16.

The chunking plunger 16 is reciprocated by an integral bracket 48 that slides over a guide rod 49 connected to the table or the frame by means not shown. The bracket 48 has an extension 50 pivoted to a pilot valve actuator 51 on the end of the piston rod 51a of the chunking piston CP. The valve actuator 51 depresses actuators 52, 52a for the pilot valves C1, C2 forming part of the programming and control circuit of FIG. 6. A chute 54 is provided for receiving the sector shaped chunks c (FIG. 3) resulting from the sequence of transverse slicing and axial chunking operations.

MECHANICAL OPERATION

The operation of the embodiment of FIGS. 1-5A under description is relatively simple.

A contour peeled spheroid half P, having a core cavity is manually placed on the table 10 with the core cavity fitting over the guide rib 11. The slicing knives 12 will be retracted, as will the chunking plunger 16, which condition is illustrated in FIG. 1. A start button ST (FIG. 6) is pressed for initiating operation of the control circuit, to be described presently. Depression of the start button causes the slicing piston SP, by means of the linkages and gearing previously described, to rotate the knives 22 of the knife set 12 down and through the peeled spheroid as illustrated in FIG. 4. The slicing force is resisted by the top of table 10 and the rib 11. When the knives 22 are beneath the table, the programming fluid circuit causes advance of the chunking piston CP, which had previously acted as a stop for the peeled spheroid and hence determined the thickness of the associated end slice. When the chunking piston 16 advances the transversely sliced spheroid (which is in the condition of FIG. 2) and comprises individual slices s the fruit is pushed through the radial chunking knives 40. This generates the sector shaped chunks c seen in FIG. 3. The chunking plunger 16 continues its advance until its end projects past the chunking knife assembly as seen in FIG. 5A. This clears all chunks from the chunking knife assembly and due to the small divergent angle "a" between the bottoms 47 of the slots 46 in the chunking plunger and the edges 42 of the chunking knives, material that might have previously accumulated in this region is wedged free.

After the chunking operation is completed by advance of the chunking piston 16 to the position of FIG. 5A, the programming system retracts the chunking piston 16 back to the position of FIG. 1. When the chunking piston is thus retracted, the programming system then advances the slicing piston SP to swing the knives 22 back up through the slots 20 in the table 10 and the guide rib 11 to the position of FIG. 1. The programming system now automatically stops the apparatus in this position and the apparatus is ready for hand feeding of the next peeled spheroid half P against the chunking plunger, ready for the slicing and chunking operations.

FIG. 2A shows the increased yield effected by the apparatus of the present invention as compared to the conventional operation using Ginaca machines. To produce a conventional Ginaca cylinder GC, the butt and crown ends of the fruit are trimmed and a cylindrical knife removes a cylinder of fruit from the skin. Thus, a blanket "b" remains adherent to the skin and must be removed by an eradicator for juice is a less economically valuable product than the corresponding chunk material obtained from the blanket under the

present invention. Furthermore, the Ginaca cylinder GC usually has a small annular end portion "t" which contain eyes or the like and must be hand trimmed. These are never trimmed off without some over trimming, so that in practice the yield loss due to the annular bodies "t" on The Ginaca cylinder is greater than the loss provided when removing the bodies "t" by contour peeling. Of course, under the present invention the blanket "b" is part of the contour peeled spheroid, and hence is converted into chunks along with the rest of the spheroid. Experience has shown that as compared to chunking under the Ginaca process, the yield in chunks provided by the system of the present invention is increased by about 37 percent which under the high tonage operations involved, economically justifies the use of apparatus of the type to which the present invention relates as well as the essential contour peelers.

PROGRAMMING SYSTEM

FIG. 6 is a circuit diagram of the pneumatic programming system of the present invention with the parts shown in the position of FIG. 1 but just after the start valve ST has been depressed by the operator. A contour peeled spheroid half will first have been fed to the apparatus, against the chunking plunger 16 as previously described.

The programming circuit of FIG. 6 includes an air supply pressure line AS, and exhaust line EX and the pilot valves S1, S2 for slicing piston SP and the pilot valves C1, C2 for the chunking piston CP, previously mentioned. The air circuit also includes a pilot operated, four way programming valve PV, a pilot operated four way valve SV for the slicing piston SP, a pilot operated four way valve CV for the chunking piston CP and the manually operated two way start valve ST, also mentioned. The individual connections between these valves, the air supply line AS and exhaust line EX are simple and are clearly shown in FIG. 6, and is not believed necessary to describe them in detail.

The diagrammatic system herein employed for illustrating valve operation is shown for each of the valves in each of its two positions in the diagrams of FIGS. 7 to 13. In these diagrams each of the valves is shown as occupying a "position 1" and a "position 2" which correspond to one or other of the positions of the valves that take place during a cycle of operation of the apparatus. In order to simplify the description and reduce the number of drawings, a step by step operation of the system of FIG. 6 is set out in the Table of Value Operation of FIG. 6A. The mechanical positions of the parts during a cycle are previously described. The Table of FIG. 6A, when read in conjunction with the valve position diagrams of FIGS. 7-13 and the over-all schematic of FIG. 6, sets forth the various valve positions during a cycle.

To review the operation briefly, when the apparatus is in the position of FIG. 1, and a peeled spheroid half P has been fed against the chunking plunger 16 and over the guide rib 11 of the table, the start valve ST is depressed thereby setting up the condition illustrated in the schematic diagram of FIG. 6. The positions of the various valves are all outlined in table of FIG. 6A and pressing of the start button as just described, causes retraction of the slicing piston SP with attendant rotation of the set 12 of slicing knives 22 to slice the pineapple as previously described. At the end of the retraction of the slicing piston SP and with the knives 22 below the

table, the position of the valves given in line B of the table FIG. 6A is set up. With the valve thus positioned, the chunking piston CP begins its advance to force the transversely sliced pineapple through the chunking knife assembly 14, as previously described.

The valve position of line C of the table is set up at the end of advance of the chunking piston CP with the attendant completion of the chunking operation. When this condition is reached, which is illustrated in FIG. 5A, the programming circuit of FIG. 6 automatically starts retraction of the chunking piston CP.

The valve position of line D of the table is set up at the end of retraction of the chunking piston CP. When this retraction is completed, the advance of the slicing piston CP is initiated which causes retraction of the slicing knives back up through the slots in the table which is now free of the pineapple. At the end of retraction of the slicing piston CP, which is back to the position of FIG. 1 in the diagram of FIG. 6, the valves are set up to the position shown in line E of the table and the circuit is ready for a new cycle, which will not be initiated until the starting valve ST is again depressed as previously described.

AUTOMATIC FEED EMBODIMENT

FIGS. 14 to 18 illustrate the mechanical details of a modified form of the invention wherein the infeed is automatic. In this embodiment of the invention the slotted table with parallel guide ribs slides between positions for alternately receiving spheroid halves from one of two feed conveyors. A set of slicing knives is mounted below the table and come up through the table slots to perform the slicing operation and return to a position below the table. Opposed sets of radial chunking knives are provided and the chunking plunger is double ended for alternately pushing pineapples through one or the other of the opposed chunking knives. The fruit comes in on the conveyors in staggered relation, and during the time that the fruit from one conveyor is being sliced and chunked, fruit from the other conveyor is being fed onto the table, preparatory for aligning of the latter fruit with the slicing and chunking knives.

In the automatic feed modification under description, parts similar or analogous to the parts of the first embodiment previously described are given the same reference character with subscripts in small letters to indicate that the parts are somewhat different or are double acting, as in the case of the chunker plunger. Parts analogous to those of the previously described embodiment will first be mentioned.

A slotted table 10a is mounted for sliding motion and has two core cavity guide ribs 11a, 11b, the table and the ribs being slotted at 20a. A set 12a of slicing knives is provided with 9 individual knives 22a as before. Opposed chunking knife assemblies 14a and 14b are provided with radial blades 40a, 40b. The chunking plunger 16a is now double ended so that it can act in both directions and the plunger is provided with slots 46a, 46b for receiving the chunker blades. The chunker blades 40a, 40b have semicircular shrouds 43a, 43b.

The chunker plunger 16a is connected by a vertical bracket 48a to the cam end 50a of the piston rod 51a of a chunker cylinder CP1. The table 10a is reciprocated by a table piston TP which operates pilot valves T1, T2 (FIG. 14) at the ends of its stroke. The piston rod of the chunker piston CP1 operates pilot valves

C1a, C2a, (FIG. 16) at the ends of its stroke by means of a cam end 50a on the piston rod 51a for the chunker piston. Chunker chutes 54a, 54b are provided at opposite sides of the apparatus for receiving chunks pushed through the chunker knife assemblies 14a, 14b.

Elements of the apparatus of the automatic embodiment which are not substantially duplicated in the previously described embodiment will now be mentioned. Flanking the sliding table 10a are fixed tables 60, 61 (FIG. 14). The sliding table 10a is reciprocally mounted between the fixed tables by means of rollers 62 on the sliding table and tracks 63 on the fixed tables 60, 61 (see FIG. 16). Peeled spheroid halves are continuously but alternately fed to the slicing table 10a by means of endless conveyor 71, 72 at each side of the apparatus. These conveyors include endless chains or tension members, each of which passes around a drive pulley 73 and an idler pulley 74. Spaced pushers 76 are mounted along a conveyor tension member and are pivoted at 77 (FIG. 14) to chain link clips or the like on the tension members of the conveyors. Each pusher 76 has a control arm 78 terminating in a roller 79 that rides in a track 80 along the delivery reach of each conveyor. The inner wall of the track 80 has a cam configuration 81 (FIG. 14) at the pusher entry end of the conveyor, which picks up the arms 78 of the pushers and swings them around into pushing orientation relative to the fruit, as seen at the left of FIG. 14. The tracks 80 terminate at a zone which permits each pusher 76 to swing clear of the fruit after a fruit has been pushed onto either the guide rib 11a or the guide rib 11b of the sliding table.

The fixed table 61 has an unslotted guide rib 84 with which the slotted guide rib 11a of the sliding table is aligned when the sliding table is moved to the left or retracted, as viewed in FIG. 14. The fixed table 61 also has a parallel guiding rib 86 which is aligned with the slotted guide rib 11b of the sliding table when the latter is moved to the right or advanced, as viewed in FIG. 14. The fixed tables 60, 61 have guide ribs 88, 89 which are aligned with the sets of chunking knives 14a, 14b (FIG. 14).

The double ended chunking pushing plunger 16a slides along the guide rib 89 on the table 61 when the plunger is in the position of FIGS. 14 and 16 and slides along the guide rib 88 on the table 60 when the plunger is at its other extreme position as shown in broken lines in FIG. 16. The principle of operation of the chunking plunger 16a is that when the chunking piston CP1 is retracted from the advance position of FIGS. 14 and 16, a fruit on the slotted guide rib 11b of the sliding table is pushed through the chunking knives 14a, as shown in broken lines in FIG. 16. The chunking plunger 16a then remains in the position just mentioned whereupon the sliding table 10a shifts and a fruit on the guide rib 11b is pushed through the chunking knives 14b on the fixed table 61.

The set 12a of slicing knives 22a of the present embodiment, instead of oscillating as in the first embodiment, partake of a continuous rotary but non-circular motion which brings the knives from a position below the sliding table 10a, up through the slots 20a of the table, through the fruit and back down below the table, whereupon the table can be shifted to its other position. As best seen in FIGS. 15, 16 and 17, the knife assembly is mounted from a rigid bracket 90 depending from the fixed table 61 which bracket is formed with a sleeve 91

that receives an operating shaft 92 for the knives. The shaft 92 rotates spaced triangular arms 94, 96 which mount a planetary idler gear and a planetary knife shaft gear so that rotation of the shaft 92 not only imparts an eccentric rotary motion to the knife assembly as a whole but also rotates the knives simultaneously on their own axes for performing the slicing cut illustrated diagrammatically in FIG. 18.

In order to provide these motions the shaft 92 is keyed to the inner triangular arm 94 (FIG. 16) and the inner arm 94 has an extension 95 which connects it to the outer arm 96, which arm is rotatably mounted on the sleeve 91 for the shaft 92, previously mentioned. Rotatably mounted in the spaced arms 94, 96 is an idler shaft 98 carrying an idler gear 99 that is meshed with a fixed gear 100, machined in the sleeve 91. The slicing knives 22a are fixed on or keyed to a knife shaft 102, which shaft is also rotatably mounted in the bracket arms 94, 96. The knife shaft 102 has secured thereto a gear 104 which meshes with the idler gear 99 but not with the fixed gear 100 on the sleeve 91. Secured near the outer end of the operating shaft 92 is a sprocket 106 driven by a chain 108 which in turn is driven by a sprocket 110 (FIG. 16) from a motor M. The motor M not only drives the knife operating shaft 92 but drives a gear box 112, (FIG. 16) which by means of bevel gears, shafts, or other mechanical elements, drives the drive pulleys 73 for the infeed conveyors 71, 72 as indicated schematically by broken lines in FIG. 14. The mechanical means for accomplishing this angle drive are obvious and hence details are not shown.

FIG. 18 illustrates schematically a series of knife positions designated by the numbers 1-12 within small circles. The action is one of a rapid swinging of the knives below the table while reversing the orientation of the cutting edges, lifting the knives up through the slots in the table and bringing the knives down against the fruit while drawing them across the fruit with a slicing action, while the knives are above the table. With the gearing just described, this is accomplished by rotating the sprocket 106 on the knife shaft 92 in a counter-clockwise direction as viewed in FIGS. 15, 17 and 18 which due to the action of the planetary gears 100, 99 and 104 causes the knife shaft 102 and hence the knives to rotate on their shaft 102 in a clockwise direction as indicated in the figures. The knives 22a are completely below and clear of the table 10a during about 240° of rotation of the knife operating shaft 92 which gives ample time for shifting of the table 11a between the conveyors 71, 72.

The pneumatic control system shown in the schematic diagram of FIG. 8 is controlled or sequenced by timing cams 120, 121 secured to the knife operating shaft 92 (FIGS. 17 and 28A). The cams have protuberances 120a, 121a that operates pilot valves V1, V2 and V3 in a manner to be described presently.

SEQUENCE OF OPERATION

FIGS. 19, 19A-27, 27A are pairs of figures which illustrate schematically the sequence of operation automatically performed by the automatic feed embodiment of the invention under description. This sequence will be described briefly before describing the operation of the pneumatic control system of FIG. 28. To avoid confusion, it will be assumed that the first pineapple half is being introduced into the system and that half and succeeding halves will be traced through the

apparatus. In this sequence of diagrams the knives, which are mounted below the table are not shown in dotted lines in the plan views of FIGS. 19 - 17 but their action will be made evident by slicing cuts shown in the fruit being processed. However, in the end views of FIGS. 19A, 20A and 27A, the positions of the knives 22a during various portions of a cycle are indicated which views thus reveal the timing requirements of the knives relative to the drive to the conveyors 71, 72.

FIGS. 19, 19A

A first pineapple half P1 is being pushed onto the sliding table 10a (which is retracted) by a pusher 76 of the conveyor 71 (not shown). The chunking plunger 16a is fully retracted into the set of chunking knives 14a. The slicing knives 22a are about in position 12 of FIG. 18.

FIGS. 20, 20A

The pineapple P1 has now been deposited on the sliding table 10a and the pusher 76 will be released, as indicated in FIG. 14, to leave the pineapple in that position. The chunking plunger 16a has been advanced into the chunking knives 14b, and advance of the table can now begin. A second pineapple P2 is being advanced by a pusher 76a on the conveyor 72 (not shown). The slicing knives are about in position 2 of FIG. 18.

FIGS. 21, 21A

Table 10a has now been advanced to align the slotted guide rib 11a with the central guide rib 88 on the fixed table 60, and hence with the chunking knives 14a. The second pineapple P2 has been partially pushed onto the guide rib 11b of the sliding table 10a. As seen in FIG. 21A, the slicing knives 22a are about in position 3 of FIG. 18.

FIGS. 22, 22A

Both the table 10a and the chunker plunger 16a are still advanced.

The first pineapple P1 has been sliced by the knives 22a and the latter are about in position 12 of FIG. 18 so that they are below and clear of the table 10a. The second pineapple P2 has been fully deposited on the sliding table 10a and the pusher finger 76a will swing free and leave the pineapple in that position.

FIGS. 23, 23A

The transversely sliced first pineapple P1 is being pushed through the chunking knife 14a by the retracting chunking plunger 16a. As seen in FIG. 23a, the slicing knives 22a are in about position 2 of FIG. 18. A third pineapple P3 is approaching on the fixed table 61, being pushed by a finger 76 on the conveyor 71.

FIGS. 24, 24A

The sliding table 10a has been retracted back to its initial position which is possible because the knives 22a have been below the table. The chunking plunger 16a is retracted, completing the chunking operation on the transversely sliced first pineapple P1 and the resulting chunks "c" are discharged in the chute 54a. Retraction of the table 10a to the position of FIG. 24 aligned the second pineapple P2 on the sliding table guide rib 11b with the guide rib 88 on the fixed table 60 which is centered with the second set of chunking knives 14b. The slicing knives 22a are at about position 3 of FIG. 18.

FIGS. 25, 25A

With the slidable table 10a back in its original position, the second pineapple P2 has been sliced by the knives 22a, which as seen in FIG. 25A are about at position 12 of FIG. 18. The third pineapple P3 has been fully deposited on the rib 11a of the sliding table 10a by an arm 76 on the conveyor 71.

FIGS. 26, 26A

The chunking plunger 16a is now moving to the left (advancing) as seen in FIG. 26, pushing the sliced pineapple P2 through the chunking knives 14b. The knives 22a are between positions 12 and 1 of FIG. 18.

FIGS. 27, 27A

The transversely sliced second pineapple P2 has been pushed through the chunker 14b and hence completely chunked into small chunks "c" in the chute 54b. A fourth pineapple P4 is being pushed along the fixed table 60 by a pusher 76a on the conveyor 72 (not shown). The chunking plunger 16a is fully to the left (advanced) as viewed in FIG. 27, in order to get behind the third pineapple P3 after the table 10a is shifted again from the position shown on FIG. 27 to the position of FIGS. 21 and 22. The slicing knives are about at position 1 of FIG. 18.

Thus, as shown by the sequence of operational diagrams of FIGS. 19 to 27A, contour peeled pineapple halves are fed in staggered relation from infeed conveyors 71, 72 (FIG. 14) to a sliding table 10a, which first presents a pineapple to one side of a double ended chunking plunger 16a to be pushed through a set of chunking knives on the opposite side of the sliding table. The table is shifted and presents another pineapple to the opposite side of the chunking plunger 16a to be pushed through the opposite set of chunking knives. This operation is entirely schematically illustrated in FIG. 28, which will now be described in detail.

AIR CIRCUIT SYSTEM

The air circuit system (FIG. 28) is controlled by two one-lobed cams 120, 121 on the knife operating shaft 92. These cams sequentially operate pilot valves V1, V2 and V3. The pilot valve V1 directs air to a four way programming valve PV3. The pilot valves V2 and V3 are connected to the air supply AS and control a programming valve PV1 also connected to the air supply AS. A four way programming valve PV2 operates the chunking plunger piston CP1 and a four way programming valve TV operates the table piston TP. Pilot valves C1a and C2a are operated by the piston rod of the chunker piston CP1 at its limits of motion, and pilot valves T1 and T2 are operated by the slotted table 10a, at the limits of operation of the table.

FIG. 28 shows one position of the valves at the beginning of the cycle corresponding to the position of FIGS. 19 and 19A. FIG. 28A shows the relation of the two cams 120, 121 to the pilot valves V1-V3 in the position of the cam shown in FIG. 28. FIG. 29 is a Table of Valve Operation giving the various functions corresponding to the operational views of FIGS. 19 to 27A.

FIGS. 30 to 47 are valve position diagrams of the various valves and other elements of the air system, showing the valves in either "position 1" or "position 2." When these diagrams are read in conjunction with the

Table of Valve Operation of FIG. 29, the air system circuits set up for each of the operational views of FIGS. 19 to 27A are readily ascertained.

Reviewing the Table of Valve Operation (FIG. 29) briefly, in the position of FIG. 19, the valves are positioned as in FIG. 28 which is designated in the Table as "position 1." With these valve positions, the chunker plunger 16a is about to advance, the table 10a is retracted and the slicing stroke has been completed.

In the FIG. 20 valve position, the cams 120, 121 have turned to actuate the pilot valves V1, V3 as indicated in the Table. As seen in FIG. 20, the chunker plunger 16a will now be advanced and although the sliding table 10a is retracted, the valve circuit has been set up to start table advance. The slicer is below the table.

In the valve position of FIG. 21, the table 10a has been advanced, the chunker plunger 16a has been advanced and the slicer is rising.

In the valve position of FIG. 22, the slicer has sliced the pineapple P1, the chunker and sliding table remaining in their previous advanced positions.

In the valve position of FIG. 23, the chunker is retracting in order to chunk the sliced pineapple P1. The slicer is below the table and the sliding table 10a remains advanced.

In the valve position of FIG. 24, the chunker is fully retracted and the pineapple P1 has been chunked. The sliding table 10a has been retracted to bring pineapple P2 in front of the chunker plunger 16a and the slicer is below the table but rising.

In the valve position of FIG. 25, the conditions are back to those of FIG. 19. The chunker 16a is retracted, table 10a is retracted and pineapple P2 has been sliced.

In the valve position of FIG. 26, the chunker plunger 16a is in the process of chunking the sliced pineapple P2. The table 10a is retracted and the slicer is below the table.

In the valve position of FIG. 27, the pineapple P2 has been completely chunked, the table 10a remains retracted and the slicer is still below the table.

Although the embodiment of FIGS. 14 to 17 just described shows fixed radial chunking knives, it will be understood that it is also possible to use rotary radial chunking knives like that disclosed in FIG. 15 of the United States Patent to Vadas U.S. Pat. No. 3,656,520, Apr. 18, 1972 (FIG. 15). The only difference in mode of operation would be that rotary chunking knives of this type (which are conventional) can be rotated in the direction that renders them somewhat self feeding and the load on the chunking plunger 16a would thus be correspondingly reduced.

Thus, in conclusion it can be seen that the automatic feed embodiment, contour peeled spheroid halves are delivered alternately from conveyors to guide ribs on a sliding table, the halves are transversely sliced and a single chunking plunger pushes one sliced fruit through one chunking knife assembly and then pushes the next sliced fruit through the other slicing knife assembly. A self programming air system is provided which makes the entire operation automatic.

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

What I claim is:

1. Apparatus for slicing and chunking peeled pineapple halves that have core cavities, said apparatus comprising a slotted table having a slotted core guide rib for supporting the flat face of a fruit half, a set of slicing knives, means for moving said slicing knives down through a fruit half on said table to positions below the table, a set of chunking knives aligned with said table rib, and means for pushing the sliced fruit half axially through said chunking knives while said slicing knives are below the table.

2. The apparatus of claim 1, wherein said slicing knives have curved cutting edges shaped and disposed so that resistance to the slicing forces are withstood by the support provided to the fruit half by the table top and said guide rib.

3. The apparatus of claim 1, wherein said chunker knives comprise fixed radial blades with their cutting edges lying on a concave, generally conical surface, said fruit half pushing means comprising a reciprocable plunger having a flat pusher face for engaging the end of the pineapple half, and radial slots in said plunger for receiving said chunking knives at the end of the chunking stroke.

4. The apparatus of claim 3, wherein the bottom walls of the slots in said pusher plunger diverge outwardly from the cutting edges of said chunking knives for working trapped fruit fragments radially outwardly along the slots.

5. The apparatus of claim 3, wherein the flat pusher face of said plunger at least reaches the rearward edges of said chunking knives upon completion of the chunking stroke of said plunger.

6. The apparatus of claim 5, wherein the flat pusher face of said plunger projects past said rearward edges of the chunking knives upon completion of the chunking stroke.

7. Apparatus for slicing and chunking peeled pineapple halves that have core cavities, said apparatus comprising a table assembly having fixed tables flanking a sliding fruit supporting table, said sliding table having spaced parallel guide ribs for the fruit core cavities, said sliding table and ribs being slotted, slicing knives aligned with the slots in said sliding table, two fruit half feed conveyors leading to one of said fixed tables, two chunking knife assemblies facing said sliding table, means for aligning a fruit half on one of the sliding table guide ribs with a chunking knife assembly while the other sliding table guide rib is aligned with one of said conveyors for receiving a fruit half, means for operating said slicing knives to slice the fruit half aligned with a chunking knife assembly, means for feeding the sliced fruit half through said aligned chunking knife assembly, means for aligning another fruit half on the other of said sliding table guide ribs with the other chunking knife assembly, means for operating said slicing knives to slice the other fruit half, and means for feeding the other sliced fruit half through said aligned other chunking knife assembly.

8. The apparatus of claim 7, wherein said slicing knives are pivotally mounted below said sliding table and means for bringing the knives up through the table slots, down and across the fruit half and back to positions below the table.

9. The apparatus of claim 7, wherein the spacing of said feed conveyors is twice that of the guide ribs on said sliding table, said chunking knife assembly facing

each other and being disposed midway between said conveyors.

10. The apparatus of claim 9, wherein said means for feeding sliced halves through said chunking knife assemblies comprises an opposed face, reciprocating plunger.

11. The apparatus of claim 7, wherein said feed conveyors both lead to the same fixed table, and core cavity guide ribs on said fixed table aligned with said conveyors.

12. Apparatus for slicing pre-cored pineapple halves comprising a slotted table for supporting the halves on their cut faces, a slotted, core cavity guide rib on said table, a plurality of slicing knives having rotary hubs disposed beneath said table, a rotary knife operating shaft mounted below said table, and planetary gearing between said shaft and the rotary hubs of said knives for first projecting the free ends of the knife cutting edges up through the table slots and then sliding the knife cutting edges across and down through a fruit half supported on the slotted table.

13. Apparatus for slicing pre-cored pineapple halves comprising a slotted table for supporting the halves on their cut faces, said table having a core hole guide for positioning the fruit halves laterally, a plurality of slicing knives having cutting edges and having rotary hubs disposed beneath said table, a rotary knife operating shaft mounted below said table, and planetary gearing between said shaft and the rotary hubs of said knives, the relative positions of said core hole guide, the knife hub and said shaft being such that the planetary gearing first projects the free ends of the knife cutting edges up through the table slots, then brings the cutting edges against the fruit at an initial contact zone wherein the motion of the cutting edges has a component that urges the fruit against the table, and continues by sliding the knife cutting edges across and toward the table through a fruit half supported on the table.

14. The apparatus of claim 12, wherein said planetary gearing comprises an arm connected to said knife operating shaft, a fixed sun gear concentric with the shaft, a knife hub mounting shaft on said arm and having a planet gear thereon, and an idler gear on said arm meshed with said fixed sun and said knife shaft planet gears.

15. The method of chunking pineapples comprising the steps of halving cored fruit from which the peel has been removed, placing the flat faces of the fruit halves on a slotted table while guiding them by their core cavities, slicing the halves with knives moving down through the halves while resisting the slicing forces by the flat faces and core cavities of the halves, continuing downward motion of the slicing knives to positions below the table, and thereupon pushing the sliced halves axially through chunking knives while continuing to guide the sliced portions of the halves by their core cavities.

16. The method of chunking fruit such as pineapples comprising the steps of supplying cored, contour peeled and halved fruit in two parallel lanes with the fruits being supported on their flat faces and staggered between the lanes, providing opposed, axially aligned sets of chunking knives inbetween said lanes, shifting a fruit half from one lane into alignment with said sets of chunking knives, slicing the fruit half and pushing the sliced half axially through one set of chunking knives, shifting a fruit half from the other lane into alignment

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with said sets of chunking knives, slicing the fruit half and pushing the sliced half axially through the other set of chunking knives, and cyclically repeating these steps from lane to lane.

17. The method of claim 16, comprising slicing the

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halves by moving the slicing knives down and across the halves, and withdrawing the slicing knives to positions below the fruit support during the chunking operation.

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