United States Patent

[11] 3,620,369

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[73] Assignee **J & L Engineering Company, Inc.**

[54] **SUGAR CANE DRY-CLEANING PLANT**
9 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** **209/3,** 209/234, 209/247, 209/257, 209/284, 209/297
[51] **Int. Cl.** **B07b 9/00**
[50] **Field of Search** 209/241, 247, 284, 288, 297, 298, 307, 3, 152, 423, 255–257, 317, 482

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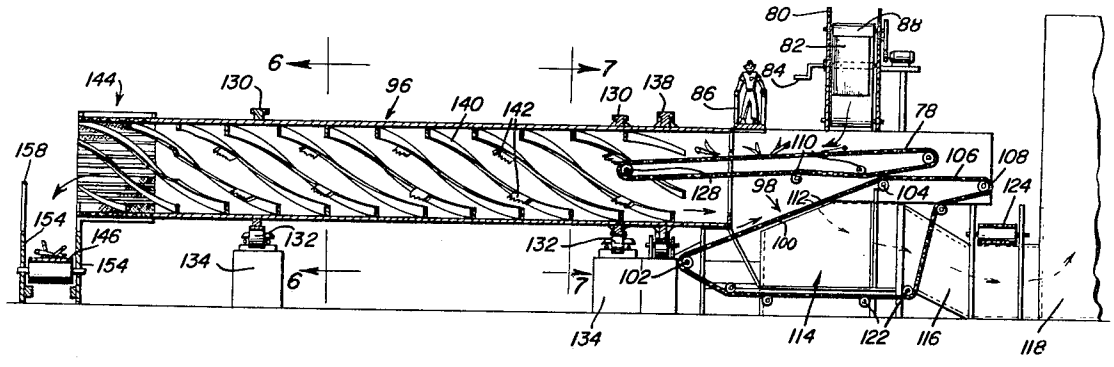
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Assistant Examiner—Ralph J. Hill
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ABSTRACT: A plant for receiving cane stalks, segmentizing the stalks and cleaning the stalks by a dry process with the trash being positively extracted from the cane and disposed of. The plant includes a cane introducing area comprising multiple conveyors which move the field harvested cane through cutters and levelers for segmentizing the cane and directing the cane to a cross conveyor which moves the cane into either of a pair of adjacent cleaning units comprising vacuum exhaust systems for drawing loose trash from the cane, and a pair of tumbler drums for effecting a further shaking or removal of trash from the cane. The drums terminate in communication with a discharge conveyor for removal of the cleaned segmetized cane. The trash removed by the vacuum system is conveyed to a burner for disposal thereof.



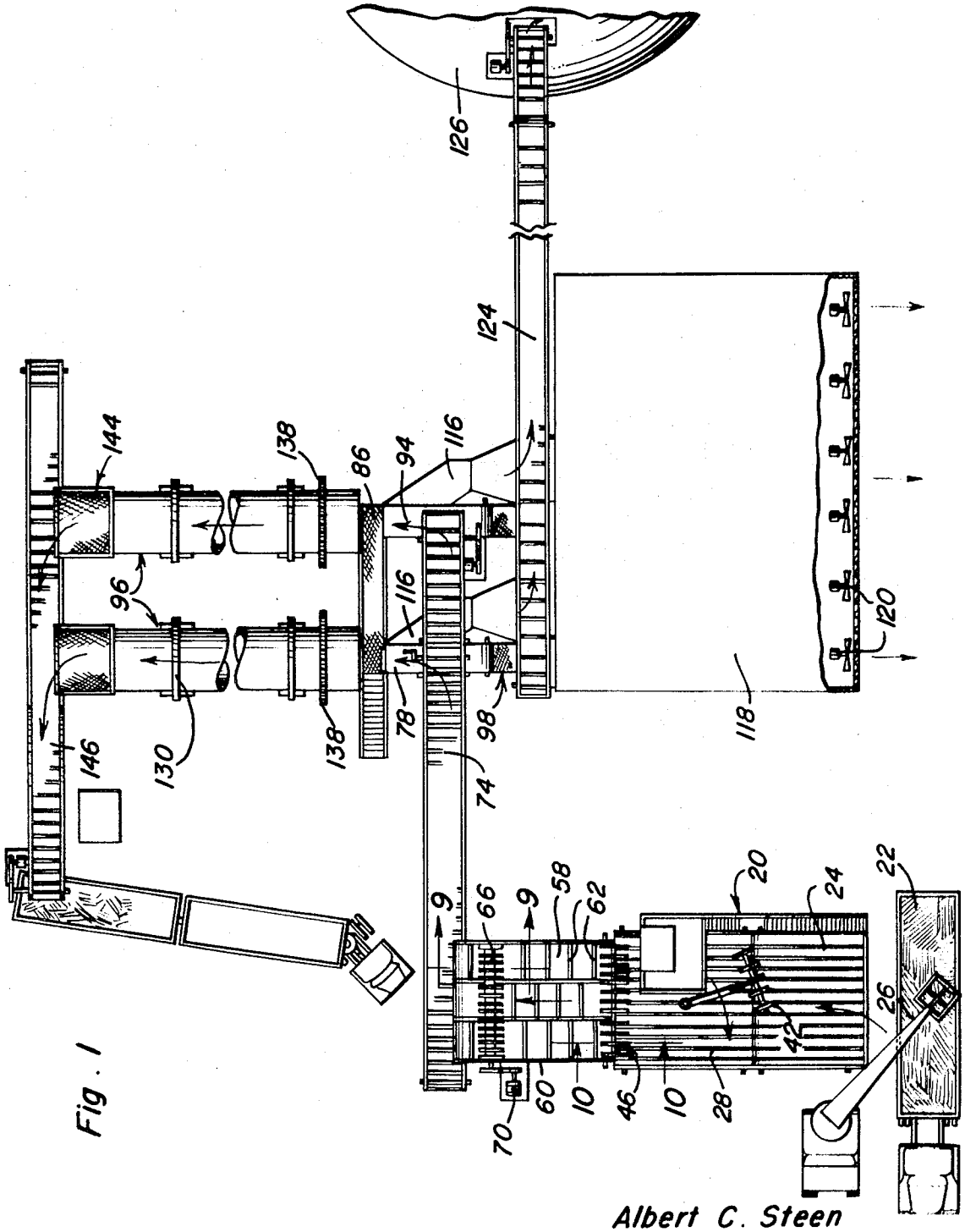


Fig. 1

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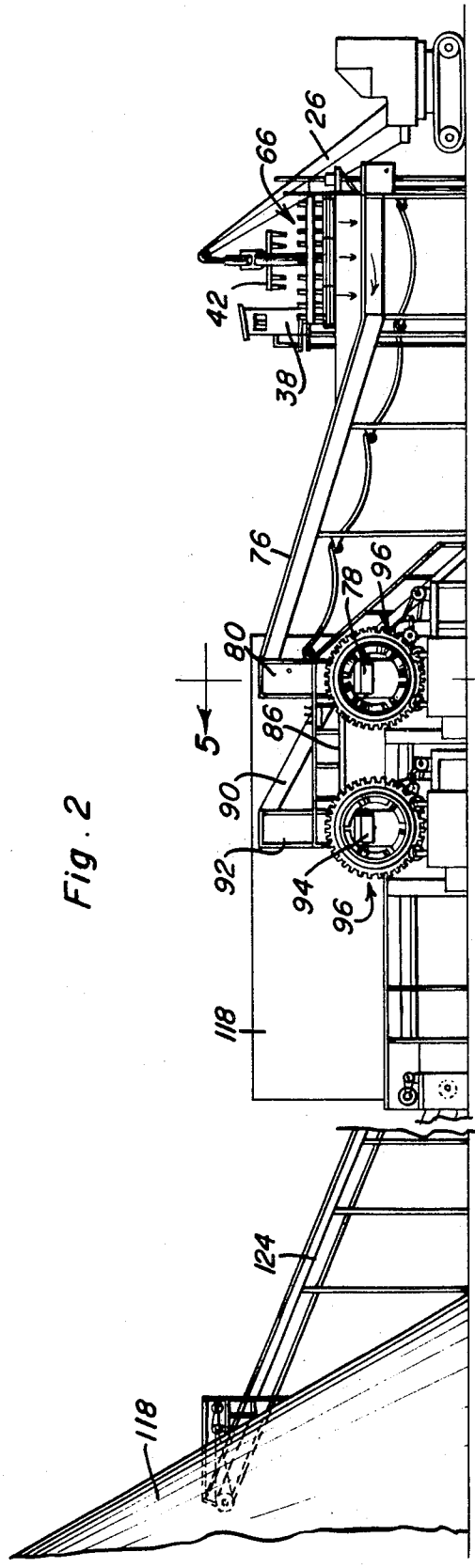
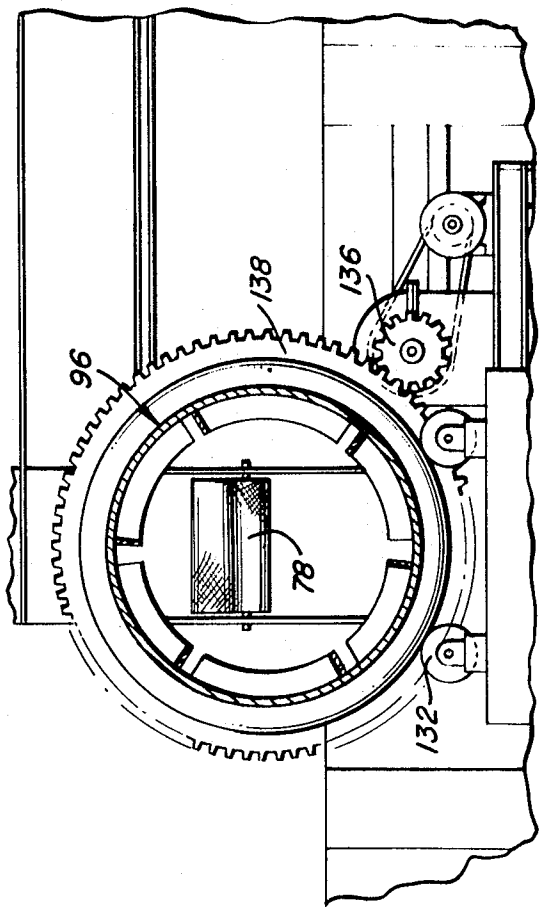


Fig. 2

Fig. 7



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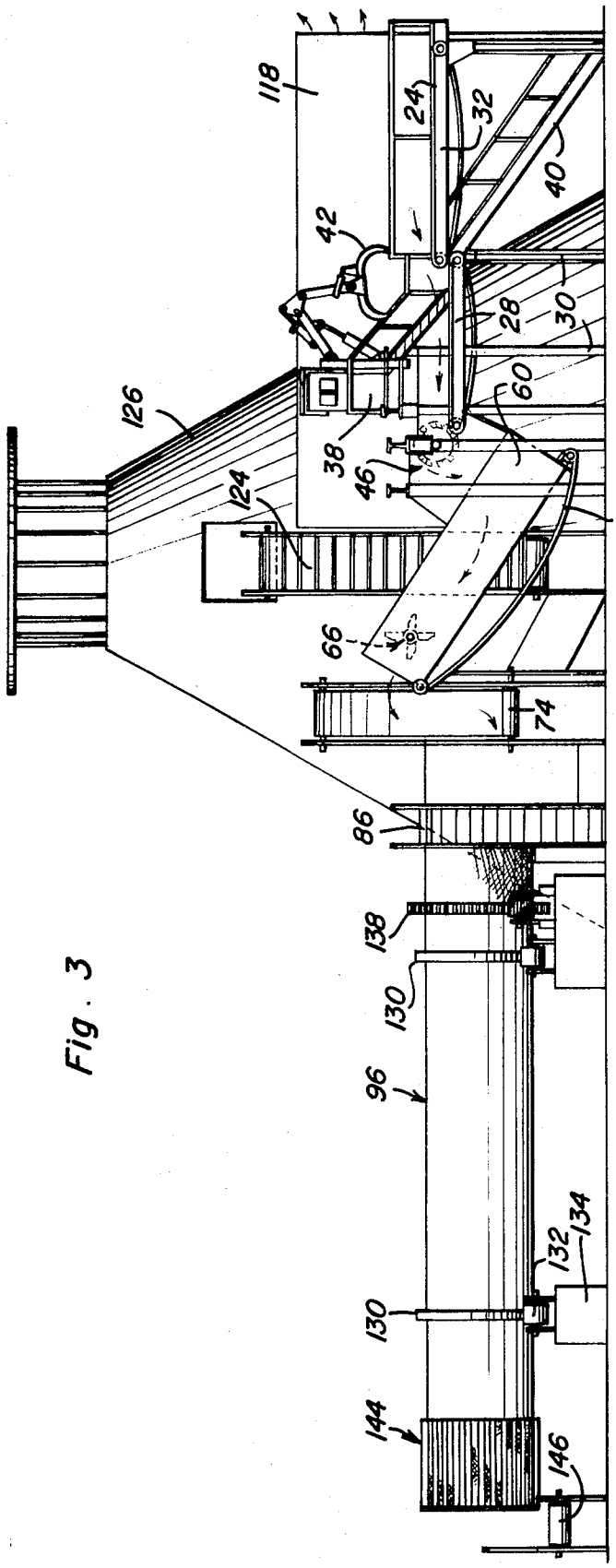


Fig. 3

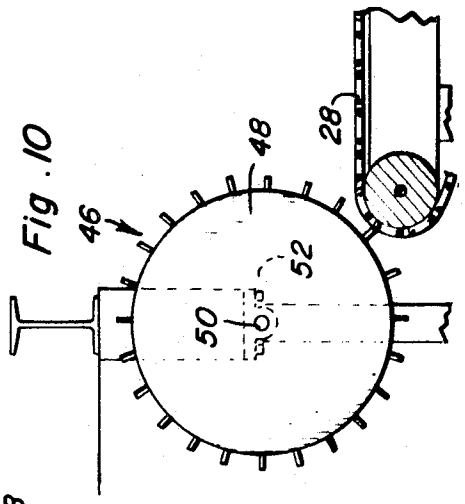


Fig. 10

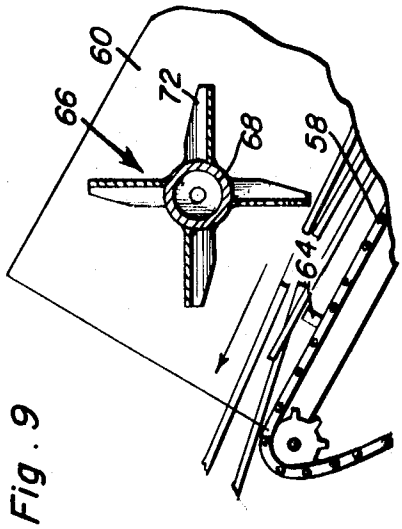


Fig. 9

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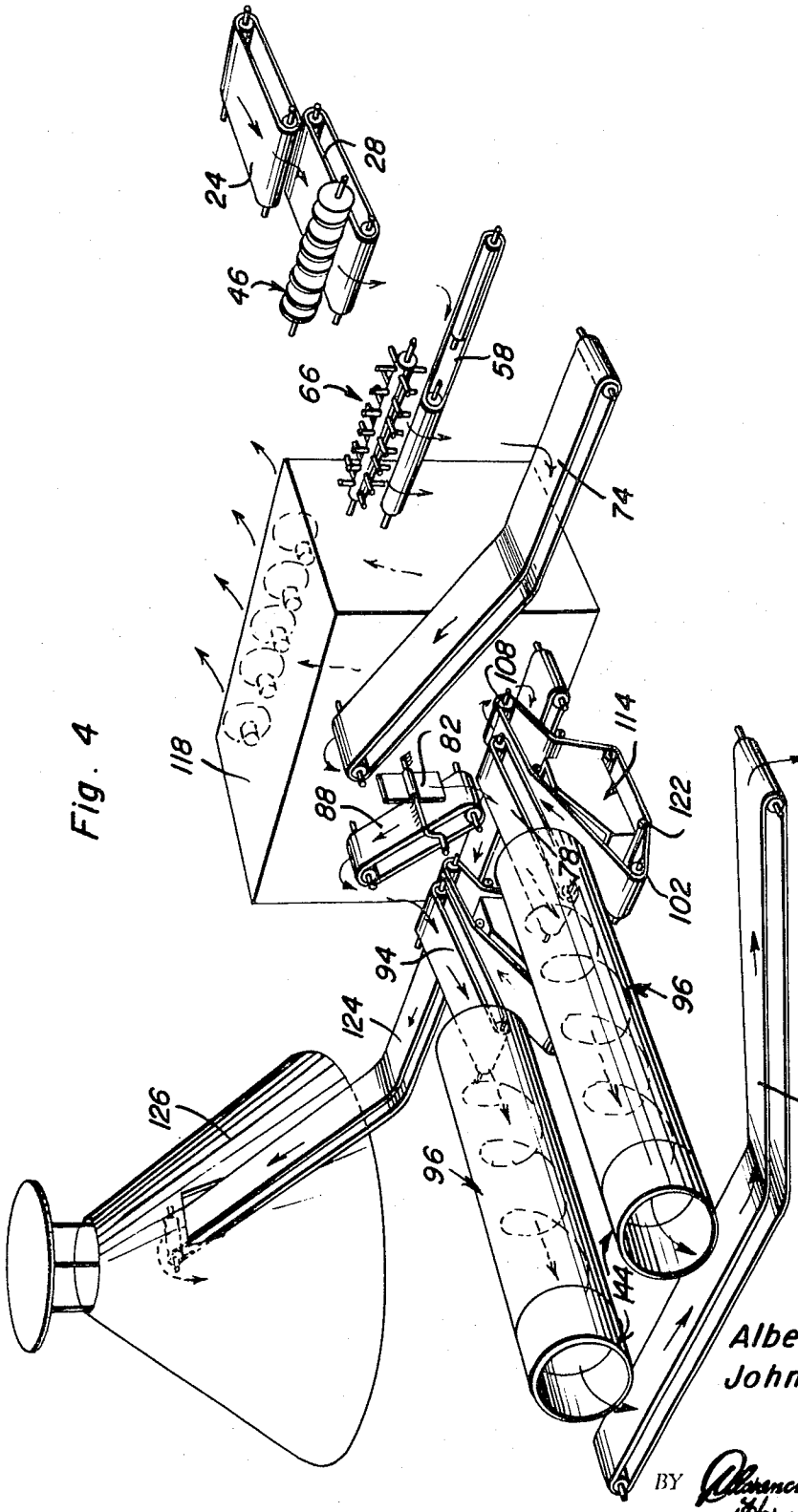


Fig. 4

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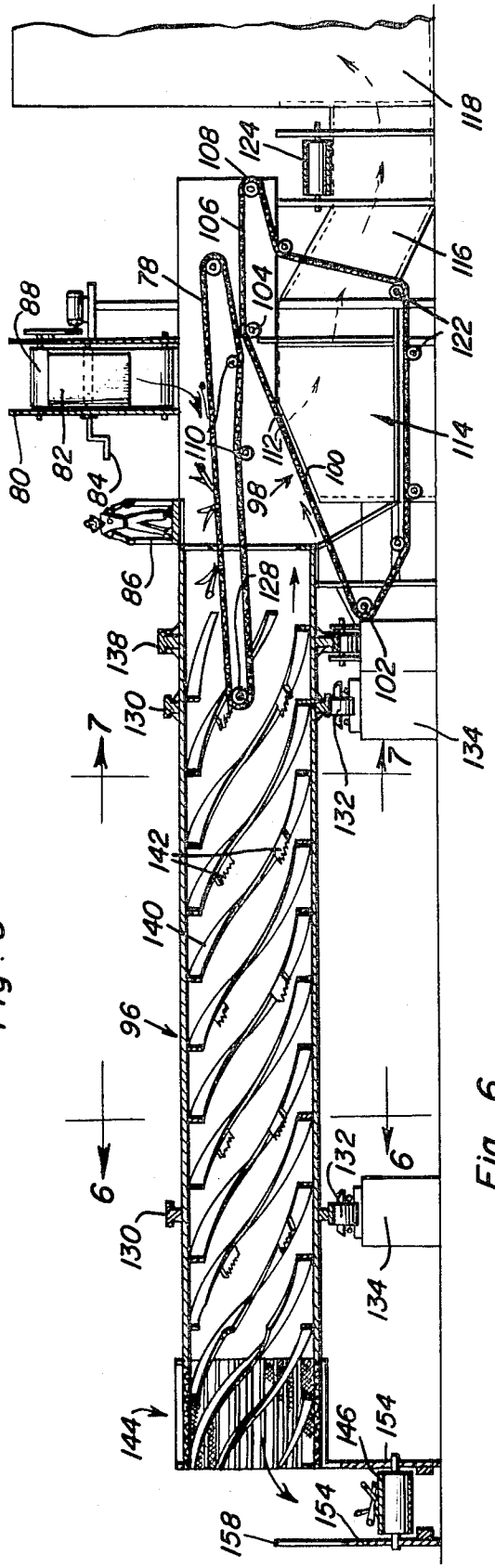


Fig. 5

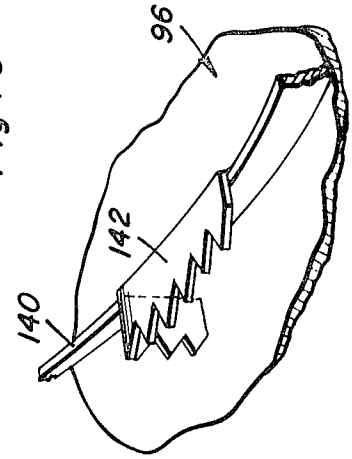


Fig. 8

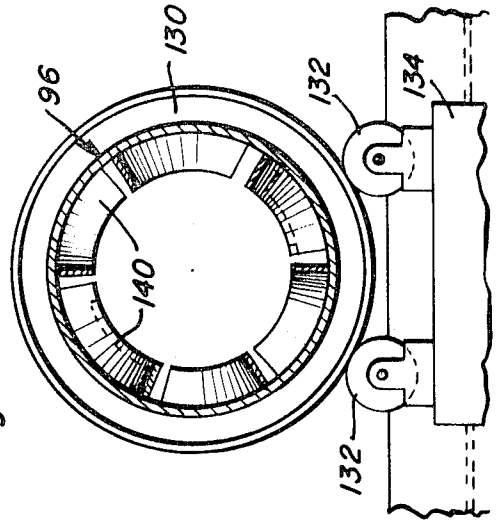


Fig. 6

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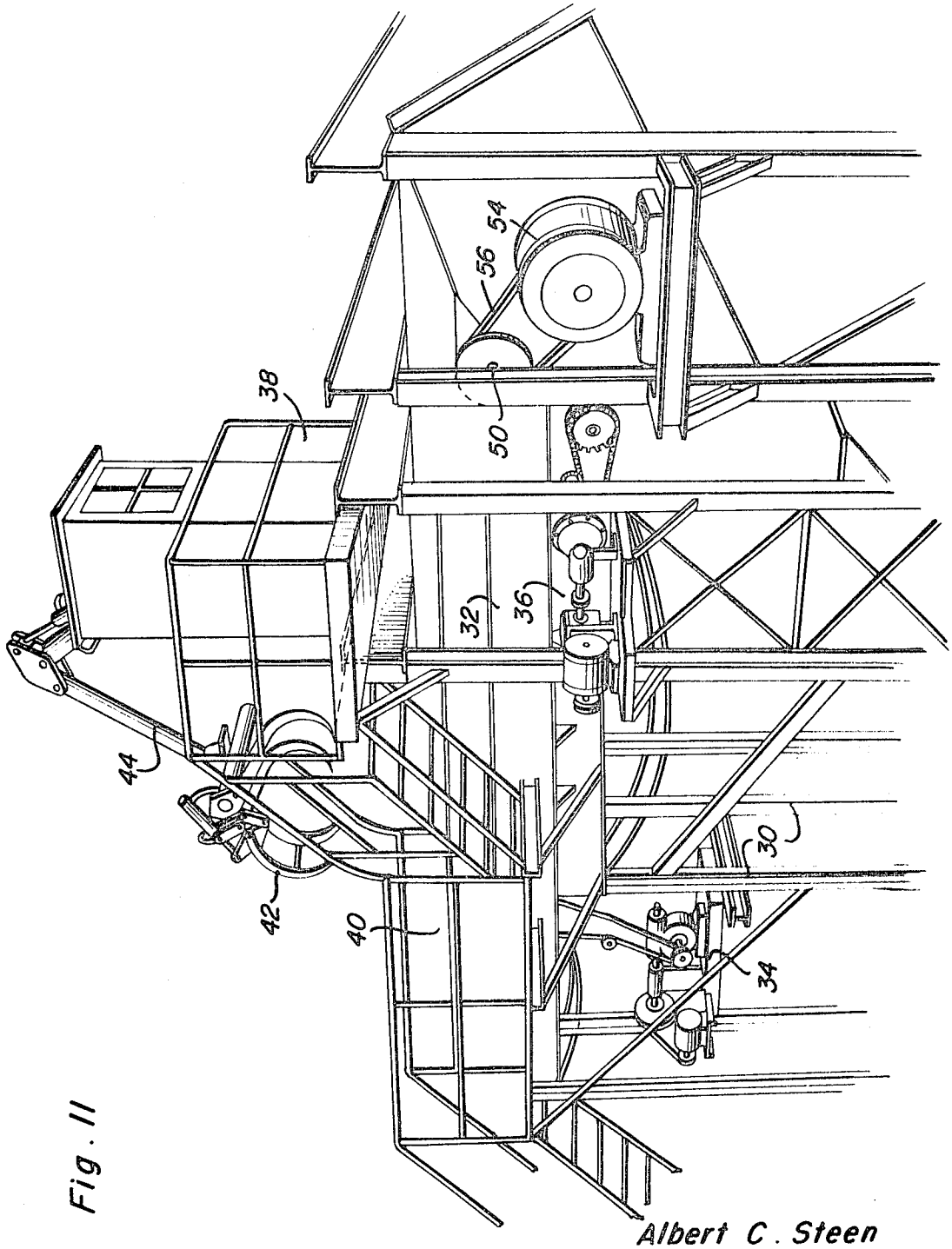


Fig. 11

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Fig. 12

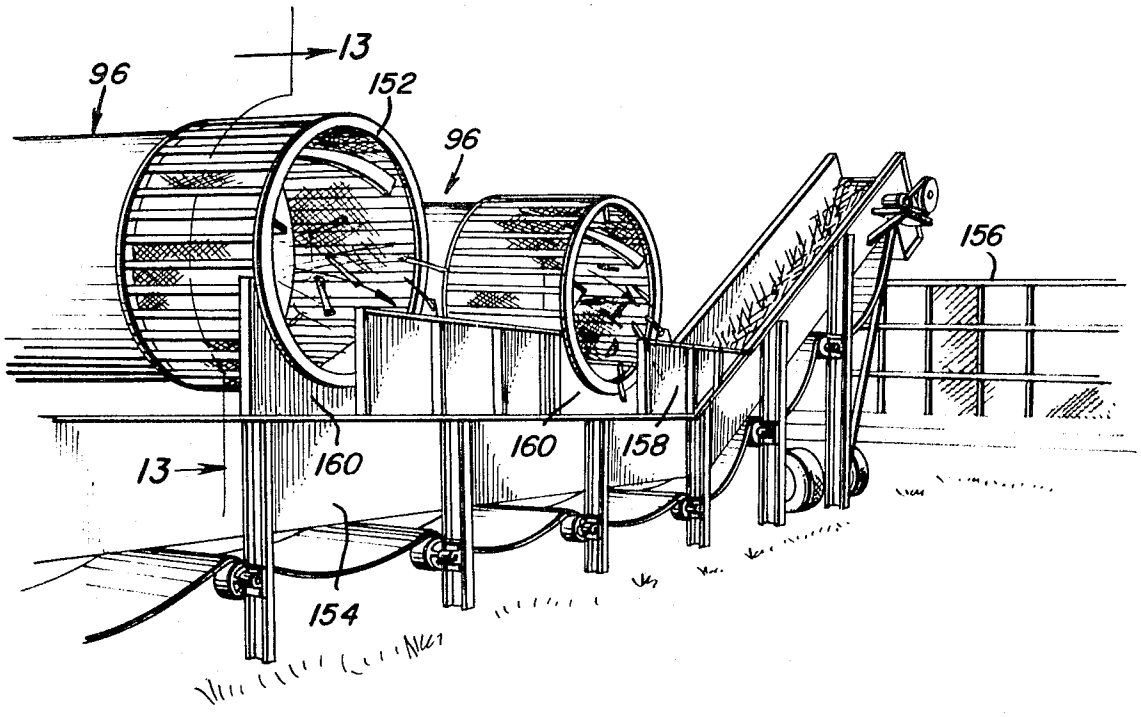
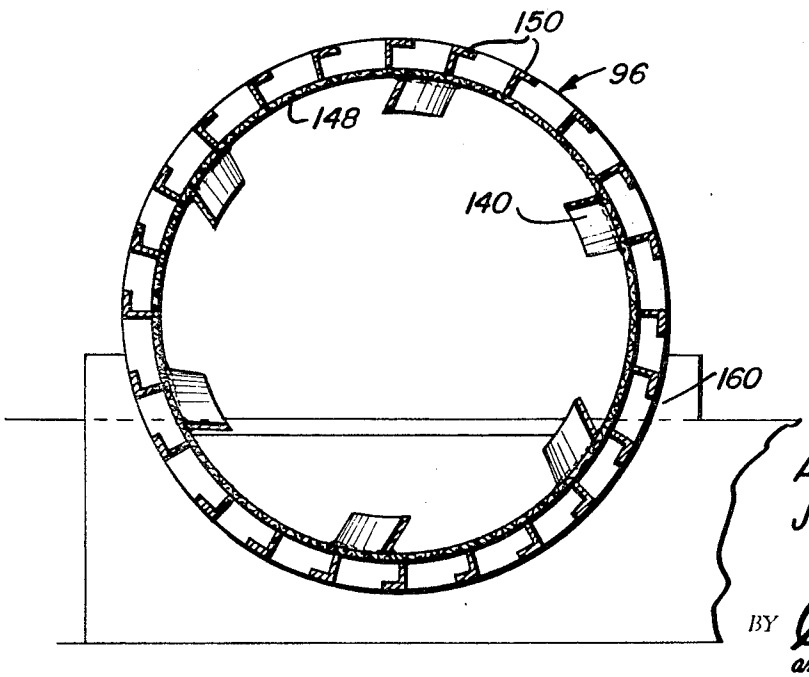


Fig. 13



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SUGAR CANE DRY-CLEANING PLANT

The instant invention is generally concerned with the handling of harvested sugar cane, and more particularly relates to a plant which receives the cane and subjects the cane to various segmentizing and cleaning operations so as to discharge a cleaned product ready for further processing, for example the milling of syrup.

It is an intention of the instant invention to provide a sugar cleaning plant which handles the cane in a substantially automatic manner, moving the cane from the vehicles bringing the cane from the field through a series of operations which segmentize and clean the cane, discharging and removing the trash therefrom through both a suction action and a tumbling action, and ultimately discharging the cane into, as an example, a transport vehicle. The plant uses a series of conveyors for receiving the initially introduced cane and moving the cane through cutting saws and a levelling unit for segmentizing and levelling the cane in preparation for an automatic movement of the cane through the actual cleaning portion of the plant. The segmentized cane is divided for movement through either of two separate cleaning units which include suction apparatus and elongated cane tumbling drums having, at the discharge ends thereof, mesh walls through which the trash loosened by the tumbling is discharged as the cane moves therethrough for reception on a transversely moving conveyor which ultimately discharges the cleaned cane.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a top plan view of the cleaning plant of the instant invention;

FIG. 2 is an elevational view of the plant from the discharge side thereof with the discharge conveyor removed;

FIG. 3 is an enlarged elevational view taken from the left hand side of FIG. 1;

FIG. 4 is a schematic perspective of the various operating units of the plant;

FIG. 5 is an enlarged cross-sectional view taken substantially on a plane passing along line 5—5 in FIG. 2;

FIG. 6 is an enlarged cross-sectional view taken substantially on a plane passing along line 6—6 in FIG. 5;

FIG. 7 is an enlarged cross-sectional view taken substantially along a plane passing along line 7—7 in FIG. 5;

FIG. 8 is a perspective detail of one of the toothed tumbling blades within the tumblers or tumbling drums;

FIG. 9 is a cross-sectional detail through the levelling apparatus taken substantially on a plane passing along line 9—9 in FIG. 1;

FIG. 10 is an enlarged cross-sectional detail taken substantially on a plane passing along line 10—10 in FIG. 1 and illustrating the cane segmentizing means;

FIG. 11 is an enlarged perspective view illustrating a portion of the cane introducing apparatus;

FIG. 12 is a perspective view of the discharge end of the plant; and

FIG. 13 is an enlarged transverse cross-sectional view taken substantially on a plane passing along line 13—13 in FIG. 12.

Referring now more specifically to the drawings, reference numeral 20 is used to generally indicate the cane introducing area which initially receives the cane brought from the field in suitable truck or tractor drawn trailers 22. The cane, as a first step, is moved from the trailer 22 to a conveyor-type feeder table 24 by an appropriate unloading crane 26 positioned to one side of the feeder table in a location so as to easily swing between the trailer 22 and the feeder table 24. The conveyor which constitutes the feeder table 24 is horizontally orientated and of a generally open network construction so as to constitute a positive support for the matted cane while allowing for a passage of loose trash, rocks and the like therethrough. The horizontal upper run of the feeder table 24 travels forwardly, moving the cane therewith for discharge onto a second saw conveyor 28 horizontally orientated below and forward of the feeder table 24. This conveyor 28 is also of a generally open network construction so as to allow for the continued passage of loose trash therethrough. Fig. 11 in particular generally illustrates the structural framework supporting the two conveyors 24 and 28, such consisting primarily of uprights 30 with appropriate structural beams 32 extending therebetween so as to define an elevated platform which, in addition to providing support for the two conveyors 24 and 28, also mounts the power units 34 and 36 therefor, along with an elevated controlled platform 38 and access stairs 40 thereto.

A hydraulically operated grab 42 is provided on a pedestal supported boom 44 mounted on and controlled from the control platform 38. The grab, through appropriate hydraulic controls, is maneuverable so as to swing between the overlapped end portions of the feeder table conveyor 24 and the saw conveyor 28 so as to control the movement of the normally matted cane from the conveyor 24 to the conveyor 28. Incidently, the power units 34 and 36 associated with the two conveyors 24 and 28 will preferably be individually controlled so as to, through the appropriate chain drive, enable an individual adjustment of the motion of each conveyor relative to the other for, in conjunction with the grab 42, providing a positive control of the movement of the cane.

Located transversely across and immediately above the forward or discharge end of the saw conveyor 28 is a saw unit 46 consisting of a plurality of toothed cane-cutting blades 48 affixed to a common shaft 50. The shaft 50 is rotatably mounted on the structural framework through appropriate bearing blocks 52 and is power driven by either one or two end located motors or power plants 54 engaged with an end of the shaft 50 by means of an appropriate drive chain or belt 56. As will possible be best appreciated from FIG. 10, the blades 48, while of course clearing the saw conveyor 28, pass sufficiently close thereto so as to insure a proper cutting or segmentizing of the cane immediately prior to and as the cane is being discharged from the conveyor 28.

The saw segmentized cane, upon moving past the saw unit 46, drops to the lower end of an upwardly and forwardly inclined conveyor 58, the cut cane being confined on the inclined conveyor 58 by appropriate side and back walls 60. The inclined conveyor 58 moves the cut lengths of cane, such being normally 20 inches long, upwardly along the upper run of the conveyor 58, assisted by transversely upwardly projecting bars or lugs 64 which tend to grip the cane and prevent any slippage thereof on the inclined conveyor. Incidently, the conveyor 58, as well as the other conveyors associated with the cleaning plant can, if deemed necessary, have a load-supporting deck in underlying relation to the upper conveyor run so as to assist in the support of the load of cane being moved therealong. Such decks will also normally be of an openwork construction so as to allow for the passage of trash therethrough. The conveyor 58 will of course also be power driven by an appropriate power unit preferably engaged with the upper roller shaft.

Mounted transversely across the upper discharge end portion of the inclined conveyor 58 is a leveler unit 66. This leveler consists of an elongated rotatably mounted shaft 68 power driven by an appropriate motor 70 at one end thereof and mounting a plurality of rigid radially outwardly extending angle bars 72. These angle bars 72 are arranged in coplanar groups of four orientated 90° from each other about the shaft 68 with a series of such groupings being provided at longitudinally spaced points along the shaft. Thus, as the cane approaches the upper end of the inclined conveyor 58 the rotating leveler or levelling unit 66 tends to align and level the cut cane and control the flow of the cane onto the first cross conveyor 74.

The cross conveyor 74 extends horizontally across the discharge end of the inclined conveyor 58 in vertically spaced relation therebelow and, at approximately the inner side of the

cross conveyor **58**, extends upwardly at an inclination. The cross conveyor **74** is housed within cane retaining sidewalls **76** and terminates, at the upper end thereof, in an elevated position in vertically spaced relation above the loading end of a substantially horizontally orientated first open network cane intake conveyor **78**. A vertical chute structure **80** receives the upper discharging end of the cross conveyor **74** and depends therefrom to the loading end of the intake conveyor **78** so as to guide the falling cane thereto, this chute consisting basically of laterally spaced sidewalls, Mounted transversely across the chute **80** vertically below the discharge end of the conveyor **74** is an enlarged flat valve-type flow divider **82** having a crank-type control handle **84** projecting from one side of the chute **80** for easy manual access thereto from an appropriate crosswalk **86** spanning the structure in an elevated position over the intake conveyor **78**. The divider **82** is manually movable between a first position within the chute **80** whereby the cane discharging and falling from the discharge end of the conveyor **74** passes vertically thereby onto the first intake conveyor **78**, and a second downwardly and forwardly inclined position which directs the falling cane onto the lower or loading end of a second inclined cross conveyor **88**, also housed within appropriate cane-retaining walls **90**. The second cross conveyor **88** carries the cane directed thereto upwardly toward the discharge end thereof which is housed within a second vertical chute **92** which in turn directs the cane discharged thereinto vertically downward onto the loading end of a second open network intake conveyor **94** in laterally spaced parallel relation to the first intake conveyor **78**. Thus, the flow of cane can be divided for movement through a duplicate pair of sections commencing with the intake conveyors **78** and **94** for enabling the handling of large volumes of cane while still insuring a proper subjecting of all of the cane to the specific cleaning actions to which the cane is to be subjected.

The forward or discharge ends of the intake conveyors **78** and **94** discharge within the loading or receiving end of a pair of enlarged elongated tumblers or tumbler drums **96**. Each of the intake conveyors **78** and **94**, between the load receiving end thereof and the entrance into the associated tumbler drum **96**, overlies a screenlike trash conveyor **98** which travels in a reverse direction from that of the overlying intake conveyor. With reference to FIG. **5** in particular, it should be appreciated that each of the trash conveyors **98** includes an upper run having a first section **100** inclining upwardly and rearwardly from a forward conveyor shaft **102** located below the intake end of the corresponding tumbler drum **96** and terminating, after passing over an idler conveyor shaft **104**, in a horizontal section **106** which travels rearwardly to and about a rear conveyor shaft **108** located rearward of the load receiving end of the corresponding intake conveyor **78** or **94**. The lower run of each of the intake conveyors **78** and **94** is supported and tensioned by a pair of idler rollers **110**. The inclined portion **100** of each of the screen-type trash conveyors **98** passes directly over the intake end **112** of an enlarged air duct **114** which is in turn communicated, through suitable ducting **116**, with an enlarged vacuum head **118**. This vacuum head **118** is in the nature of an enlarged sealed building having a plurality of air-exhausting units or fans **120** associated therewith for producing a suction forming flow of air through the ducts **114**. As will be appreciated, the lower run of each of the trash conveyors **98** is engaged about a series of idler shafts **122** so as to extend about the corresponding duct **114** and enable a positioning of this duct **114** with the open intake end **112** thereof located immediately below the inclined portion **100** of the upper run of the trash conveyor **98**. Thus, as the cane moves along the open network intake conveyors **78** and **94** the trash associated therewith both falls and is sucked therethrough onto the underlying screened trash conveyor **98** with the trash so drawn to the screen conveyor **98** being held against the upward and rearward travelling inclined portion **100** by suction. As the conveyor borne trash moves upwardly out of the area of influence of the associated vacuum duct **114**, the trash is in effect sandwiched between the rearwardly moving upper run of the trash conveyor **98** and the rearwardly moving lower run of the closely adjacent overlying intake conveyor, either **78** or **94**. The relationship between these runs immediately above the intake opening **112** of the duct **114** will be best appreciated from FIG. **5**. Finally, as the upwardly and rearwardly moving trash passes onto the horizontal portion **106** of the trash conveyor **98**, the trash holding action initially produced by the suction and subsequently by the overlying lower run of the upper conveyor is no longer needed to retain the trash which continues rearwardly along the horizontal portion **106** of the corresponding cross conveyor **98** for discharge on an elongated transversely extending wall confined disposal conveyor **124**. This disposal conveyor **124**, noting FIGS. **1** and **4**, travels horizontally past and beyond both trash conveyors that terminates in an upwardly and outwardly inclined portion dumping the collected trash in a laterally located tepee burner **126** or the like within which the collected trash is burned. The disposal conveyor **124** is of course solid so as to retain the collected trash thereon and is preferably provided with crossbars which engage and effect a positive movement of the trash therealong. This disposal conveyor **124**, as is the case with all of the conveyors, is of course power driven. Incidently, as an alternative to providing an actual moving conveyor belt, the disposal conveyor **124** can consist of a plurality of chain drawn crossbars or links movable along a solid deck for pushing the gathered trash therealong into the burner **126**.

Each of the tumblers or tumbler drums **96** is rotatably driven about the longitudinal axis thereof so as to effect a tumbling of the cane received therein from the corresponding intake conveyor **78** or **94**. It will of course be appreciated that the inner or discharge ends of the conveyors **78** and **94** will have to be supported through suitable cantilever means from a point outside of the rotating drums. This can be effected in any suitable manner such as through the provision of parallel beams projecting into the intake end of each drum **96** for rotatably mounting the inner conveyor shaft **128** between the inner ends thereof. With reference to FIGS. **5** and **6**, each drum includes a pair of annular tracks **130** fixed thereabout toward the intake and discharge ends thereof, each of these tracks **130** rotatably resting upon a pair of support wheels **132** laterally spaced from each other on pedestal blocks **134** so as to in effect rotatably nest the corresponding tumbler drum **96** therebetween. The driving of each of the drums **96** is effected, noting FIG. **7** in particular, through a power driven drive gear **136** which drivingly meshes with an enlarged annular or ring gear **138** surrounding and fixed to the corresponding drum **96**.

Each of the tumbler drums **96** is provided with a plurality of thin riblike helixes **140** fixed spirally to the internal wall thereof along the full length so as to effect a combined tumbling and forward movement of the cane contemplated to effectively dislodge and separate the remaining trash from the cane. In order to increase the tumbling action of the cane, angular toothed units or plates **142** are affixed to the helical ribs **140** at spaced points therealong, FIG. **8** being particularly significant in showing such a toothed plate **142**. Each of the tumbler drums **96**, at the discharge end thereof, is provided with a screened or open network portion **144** through which the trash dislodged by the tumbling action of the drum **96** can be discharged immediately prior to a discharge of the cleaned cane on the clean cane conveyor **146**. The screened portion **144** at the discharged end of each of the tumbler drums **96** is formed by means of an annular screen **148**, for example expanded metal mesh, secured to a plurality of longitudinally extending circumferentially arranged rigid angle bars **150**. These bars **150** have the inner ends thereof rigidly secured, as by welding, to the main body of the corresponding drum **96** and the outer ends thereof welded to a rigid ring **152** which defines the discharge mouth of the drum **96**.

The clean cane conveyor **146**, which receives the discharging cane from the tumbler drums **96**, includes continuous sidewalls **154** which confine the cane as it is transported laterally away from the tumbler drums **96**, up an incline, and

into a transport vehicle 156 for removal to, as an example, a syrup mill. The outer sidewall 154 associated with the conveyor 146 includes, opposed from the discharge end of each of the tumbler drums 96, an upstanding bulkhead or blocking wall portion 158 which insures a proper positioning of the discharging cane onto the conveyor 146. In addition, suitable cane-guiding wall portions 160 are provided on the inner one of the sidewalls 154 about the lower portion of the discharge mouth of each of the tumbler drums 96.

From the foregoing, the complete cleaning process of the plant will be readily apparent. In summary, bundled full stalk cane with trash is brought to the plant in trailers 22 from the field. The cane is then unloaded from the trailer by the unloading crane 26 and positioned on the conveyor-type feeding table 24. The feed control grab 42 controls and meters the movement of the cane flow from the feeder table to the saw conveyor 28, and also operates so as to position the cane perpendicular to the saws of the saw unit 46. The saw conveyor then moves the cane toward and through the saws which cut the full stalk cane into lengths of approximately 20 inches. The cane is then discharged onto the inclined conveyor 58 which conveys the cane toward the levelling unit 66 positioned across the discharge end of the inclined conveyor, this leveler controlling the flow of cane into the first cross conveyor 74. The first cross conveyor 74 elevates the cane for discharge through a first vertical chute 80 within which a manually controlled divider is located so as to selectively allow the cane to fall directly through the chute 80 on a first intake conveyor 78 or laterally direct the falling cane onto an inclined cross conveyor 88 which moves such deflected care upwardly for discharge through a second vertical chute 92 onto a second intake conveyor 94. The two intake conveyors convey the cane into a pair of elongated tumbler drums 96 passing over a pair of trash conveyors 98 which receive the loose trash from the overlying intake runs and against which the trash is maintained by underlying suction producing units 114. The trash is moved rearwardly, by the trash conveyors, relative to the direction of movement of the intake conveyors, with the trash being discharged onto a transversely extending disposal conveyor which in turn directs the trash to a suitable disposal means such as the tepee burner 126. The suction cleaned cane is then moved through the tumbler drums 96 by the action of the internal helical ribs with the cane being constantly tumbled through the rotational movement of the drums and the engagement of the ribs with the cane. This tumbling action is encouraged by the provision of toothed plates fixed to the ribs at selected points thereon. At the discharge end of each of the tumbler drums 96, the loosened trash, dirt, stones and the like are discharged through screened sections 144 just prior to a discharge of the cleaned cane itself on another conveyor which directs the cleaned cane laterally away from the tumbler drums to a transport vehicle, thus completing the cycle.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A cane cleaning plant including at least one generally horizontal elongated tumbler drum, mounting means mounting said drum for rotation about its longitudinal axis, means for rotating said drum, said drum including inlet and outlet ends, internal rib means in said drum orientated for the tumbling of received cane upon rotation of said drum and a moving of the cane longitudinally through said drum from the inlet end thereof to the outlet end thereof, means for separating of trash shaken loose from the cane by the tumbling action of the drum, the means for separating of the trash comprising an annular screened portion adjacent the outlet end of said drum providing an apertured body through which trash will fall while the cane will be retained for discharge through the outlet end of said drum, intake means for introducing cane into the inlet end of said drum, and suction trash removal means communicating with said intake means for assisting in the extraction of trash from the cane being introduced by the intake means, said suction trash removal means comprising a screen-type conveyor moving below the intake means, and suction producing means located immediately below said screen-type conveyor and producing a suction forming flow of air therethrough to draw trash to and retain trash against the screen-type conveyor for subsequent discharge therefrom.

2. The plant of claim 1 wherein said intake means comprises a conveyor, and a disposal conveyor located toward one end of the screen-type conveyor for a reception of trash therefrom, said disposal conveyor moving received trash outwardly to a disposal area.

3. The plant of claim 2 wherein the return run of the intake conveyor and the trash receiving run of the screen-type conveyor move in the same direction and act so as to partially confine received trash therebetween for discharge on the disposal conveyor

4. A cane cleaning plant including at least one generally horizontal elongated tumbler drum, mounting means mounting said drum for rotation about its longitudinal axis, means for rotating said drum, said drum including inlet and outlet ends, internal rib means in said drum orientated for the tumbling of received cane upon rotation of said drum and a moving of the cane longitudinally through said drum from the inlet end thereof to the outlet end thereof, means for separating of trash shaken loose from the cane by the tumbling action of the drum, intake means for introducing cane into the inlet end of said drum, and suction trash removal means communicating with said intake means for assisting in the extraction of trash from the cane being introduced by the intake means, said suction trash removal means comprising a screen-type conveyor moving below the intake means, and suction producing means located immediately below said screen-type conveyor and producing a suction forming flow of air therethrough to draw trash to and retain trash against the screen-type conveyor for subsequent discharge therefrom.

5. The plant of claim 4 including a second tumbler drum spaced from the first drum having both intake means and suction trash removal means associated therewith, an elongated conveyor extending outward from a first end overlying the intake means associated with the two tumbler drums for the carrying of cane thereto, and divider means positioned above the intake means and below the conveyor for selectively directing the cane to one or the other of the intake means.

6. The plant of claim 5 wherein said divider means includes a vertical chute having an enlarged divider panel therein, said divider panel being selectively movable between a first vertical position allowing a free fall of the cane thereby and a second inclined position effecting a lateral discharge of the cane for introduction on a second one of said intake means located outwardly from said chute.

7. The plant of claim 4 wherein said intake means comprises an endless open network conveyor having upper and lower runs, the lower run of said intake means conveyor moving in the same direction as said screen-type conveyor positioned therebelow with at least a portion of said lower run cooperating with the underlying screen-type conveyor so as to confine received trash thereon for a portion of the movement thereof.

8. A caNe cleaning plant including an elongated tumbler drum, mounting means mounting said drum for rotation about its longitudinal axis, means for rotating said drum, said drum including inlet and outlet ends, an elongated intake conveyor projecting partially into the inlet end of said drum for the introduction of cane thereto, said intake conveyor projecting outward of the inlet end of said drum, said intake conveyor including an upper run moving into said drum and an underlying lower run moving in a reverse direction outward thereof, and suction trash removal means underlying said intake conveyor, said suction trash removal means comprising a screen-type

conveyor positioned below said intake conveyor and including an upper run movable in the same direction as the lower run of the intake conveyor, the upper run of the screen-type conveyor extending from generally adjacent the inlet end of the drum outward beneath the intake conveyor to at least the outer extremity thereof, and suction producing means located below the upper run of the screen-type conveyor and producing a suction forming flow of air therethrough to draw trash to and retain trash against this upper run for subsequent discharge therefrom.

9. The plant of claim 8 including a disposal conveyor located toward and below the outer end of the screen-type conveyor for a reception of trash therefrom, said disposal conveyor moving received trash outward to a disposal area, the lower run of the intake conveyor and the upper run of the screen-type conveyor converging generally outward toward each other whereby trash received on the upper run of the screen-type conveyor is partially confined and held thereon during the movement thereof.

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