United States Patent [19]

Johnson

[11] **3,885,376**

[45] **May 27, 1975**

[54] **TOBACCO PROCESSING SYSTEM AND METHOD**

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[73] Assignee: **Research Corporation,** New York, N.Y.

[22] Filed: **Feb. 13, 1973**

[21] Appl. No.: **332,210**

[52] **U.S. Cl.** **56/27.5;** 83/408; 131/145; 241/101.7

[51] **Int. Cl.** **A01d 45/16**

[58] **Field of Search** 131/145, 146, 149; 56/27.5; 241/101.7; 83/408, 422, 356.1, 357

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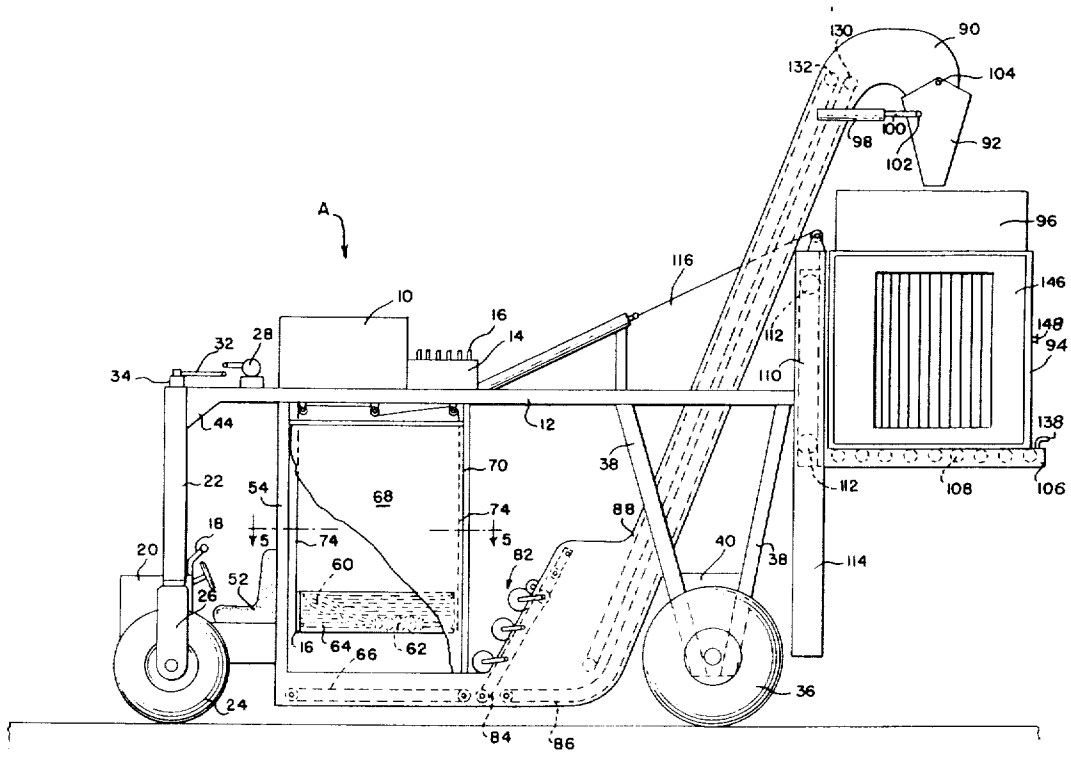
Primary Examiner—Robert W. Michell
Assistant Examiner—John F. Pitrelli
Attorney, Agent, or Firm—Harold L. Stowell

[57] **ABSTRACT**

Mechanism is provided for sequentially defoliating tobacco leaves; transporting the defoliated leaves through first and second leaf cutters; and transporting the cut leaves to bulk tobacco storage or treatment containers; and the system may include an oscillating distributor to provide uniform distribution of the cut tobacco in the storage or treatment containers.

10 Claims, 25 Drawing Figures



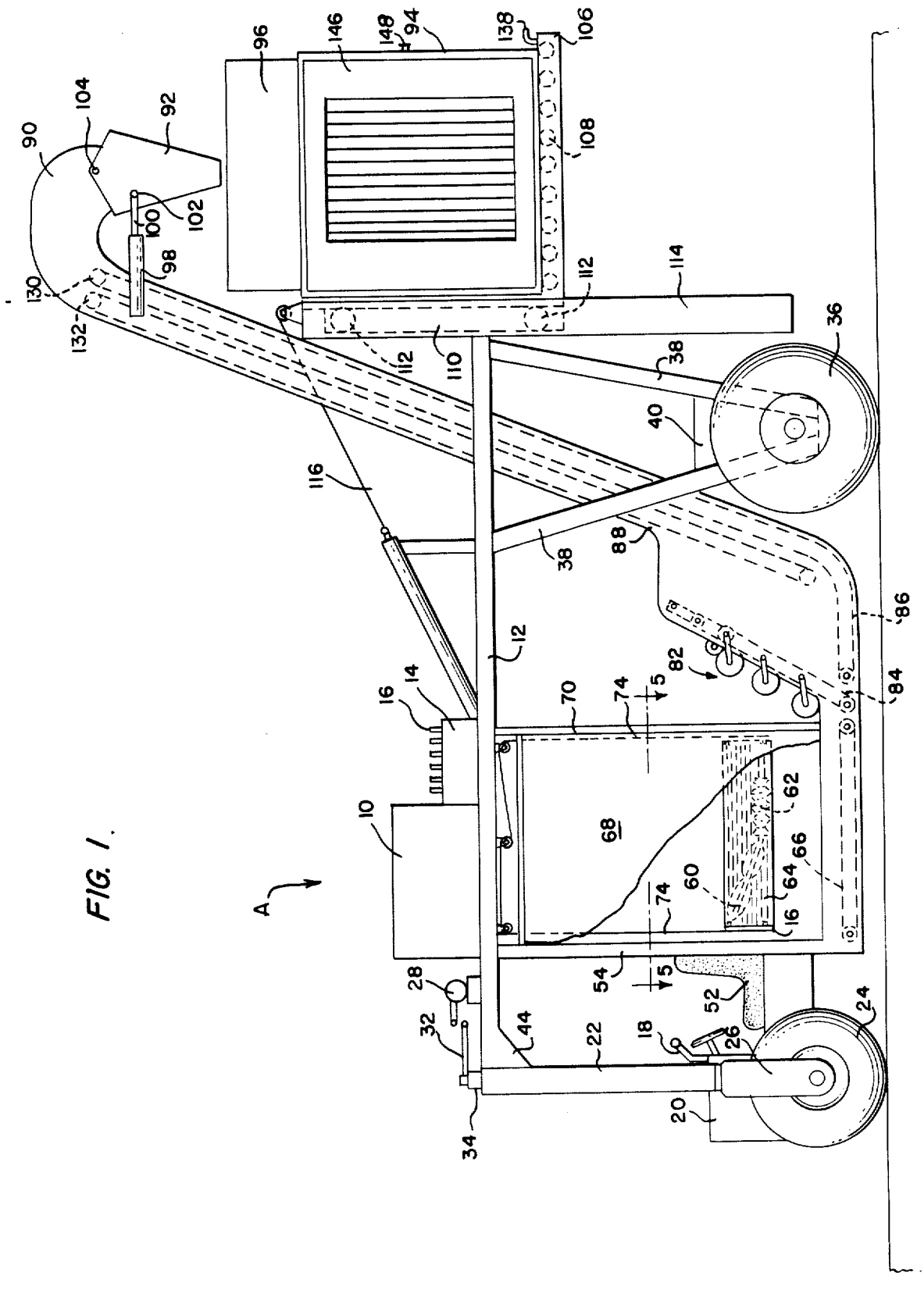

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FIG. 1.

FIG. 2.

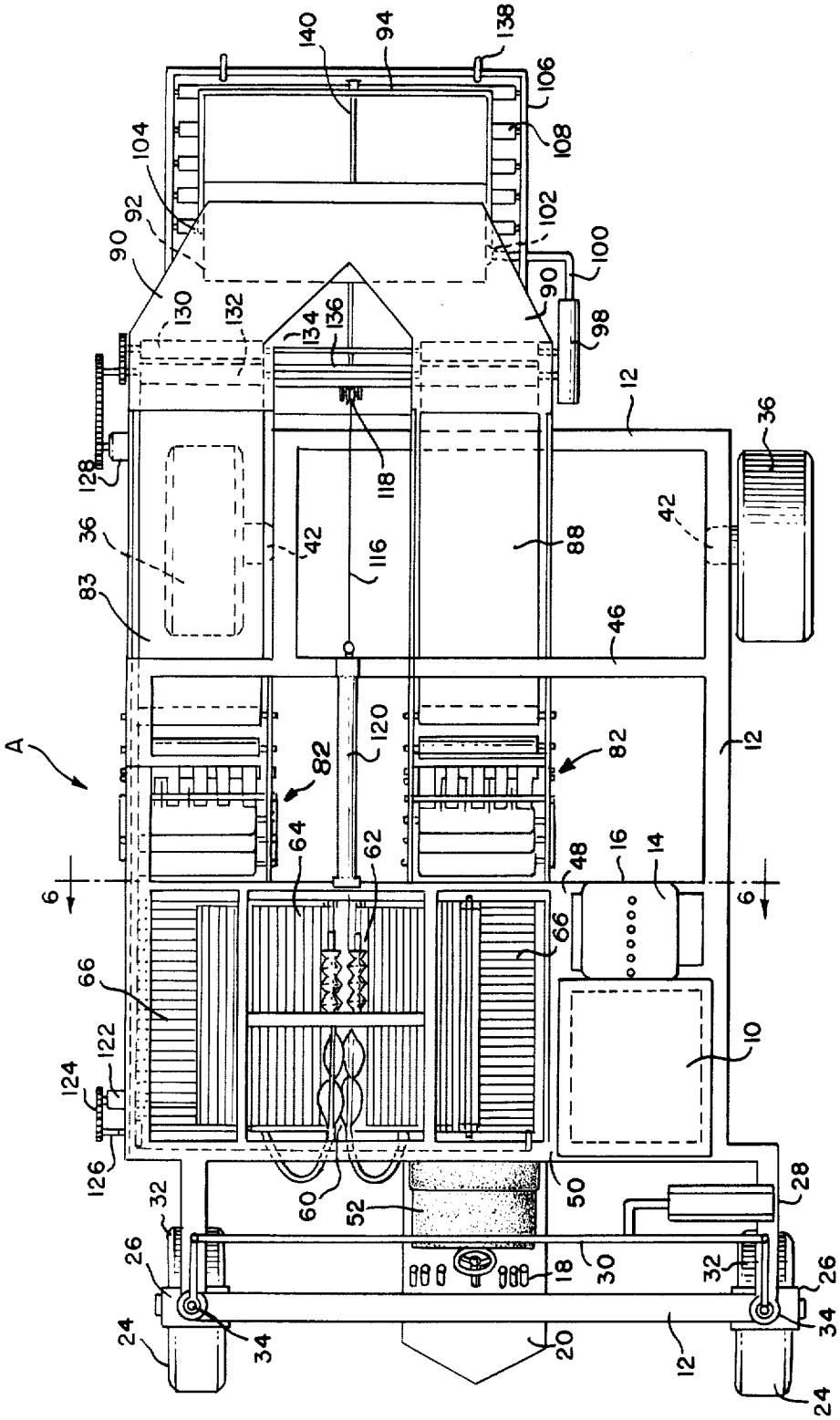
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FIG. 4.

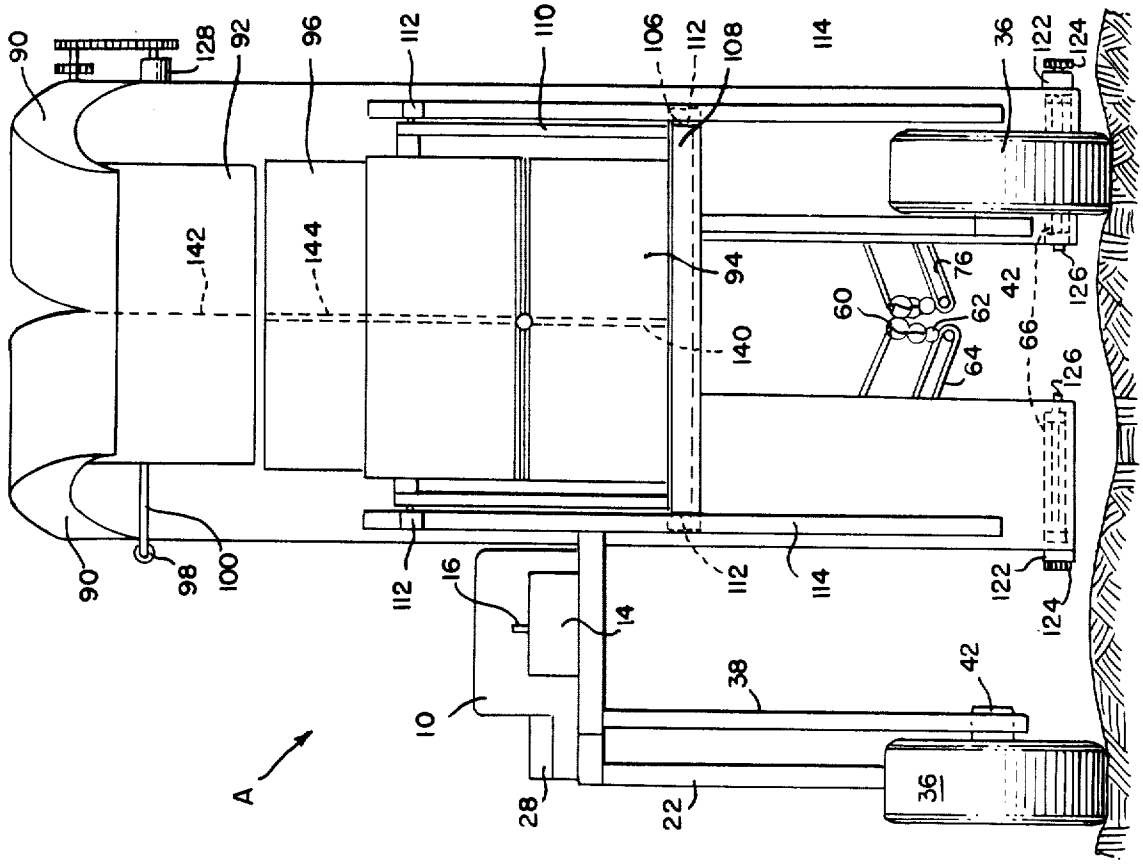
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FIG. 3.

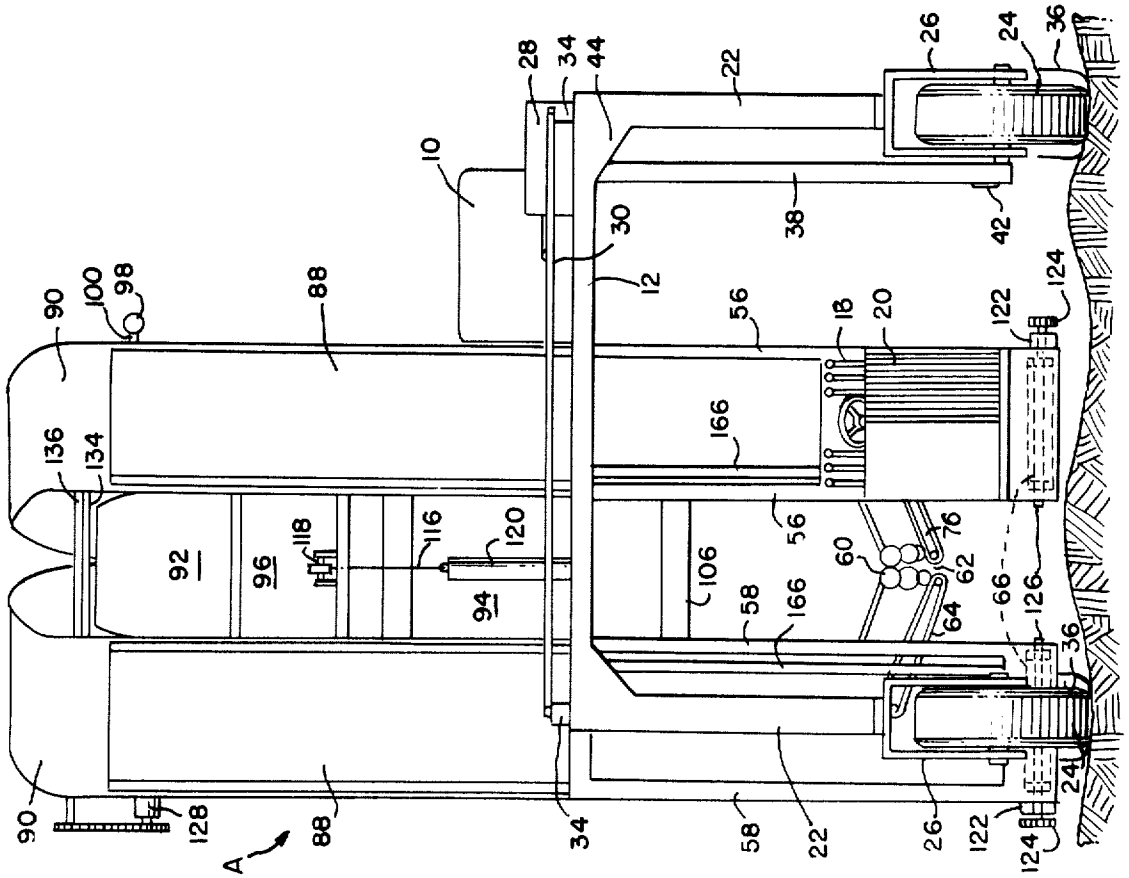
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FIG. 5.

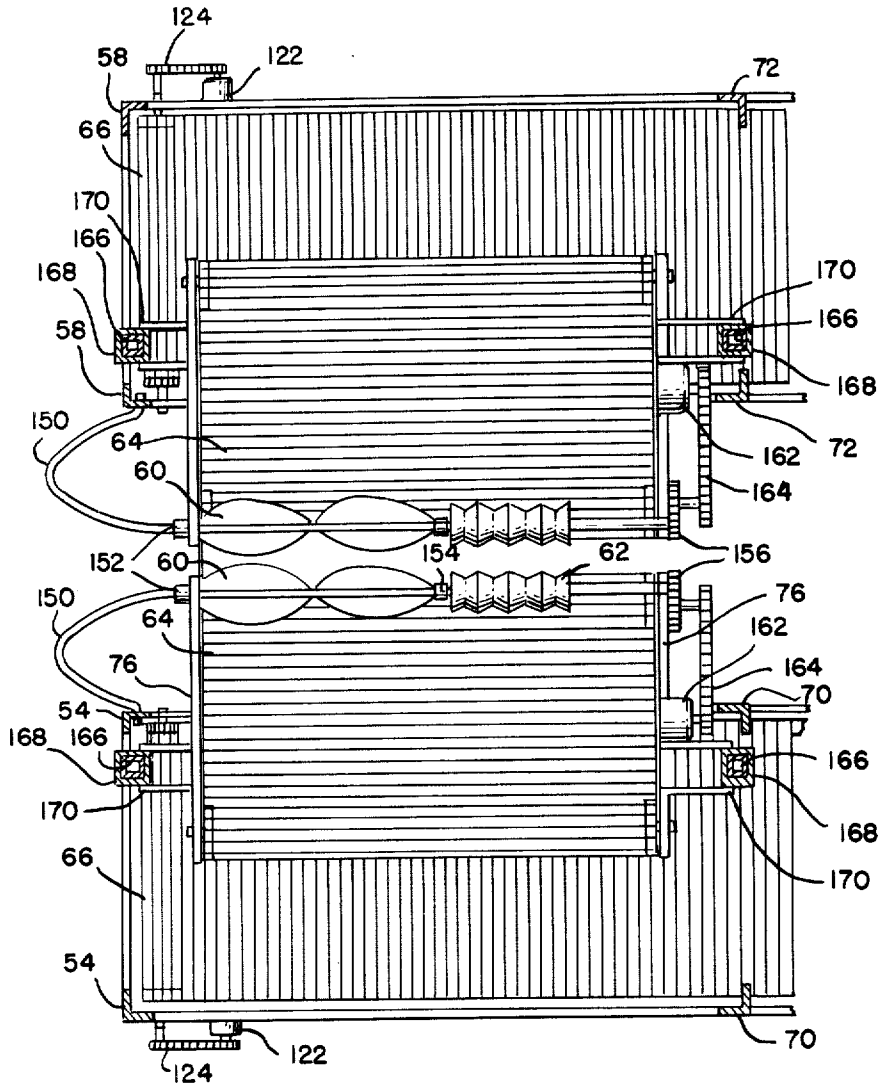
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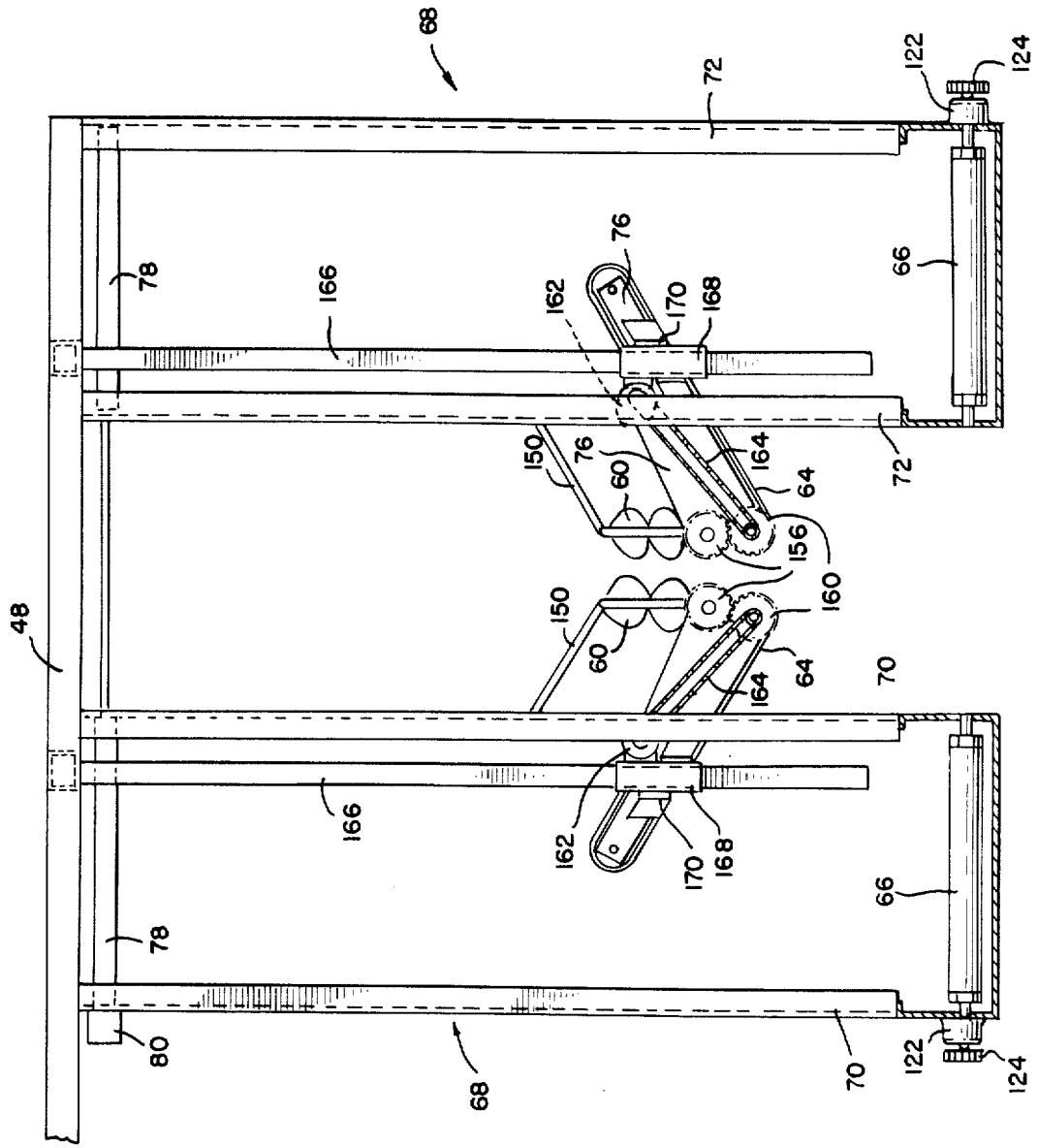
FIG. 6.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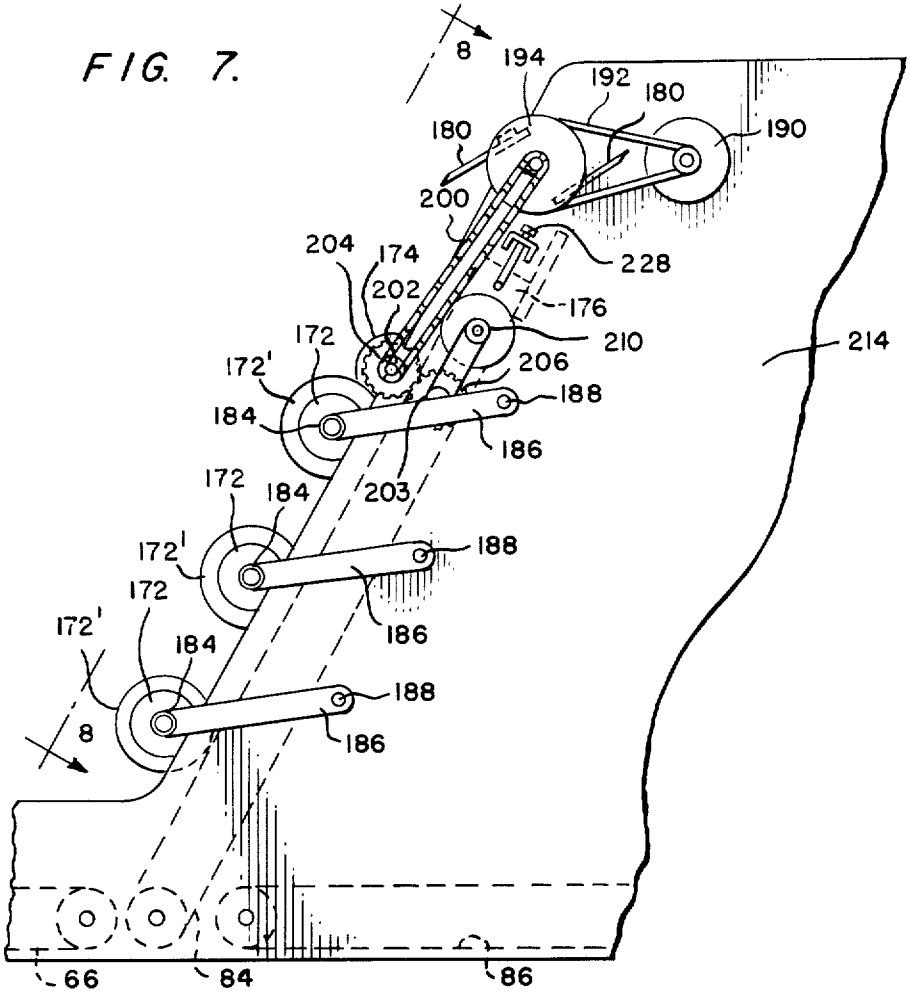
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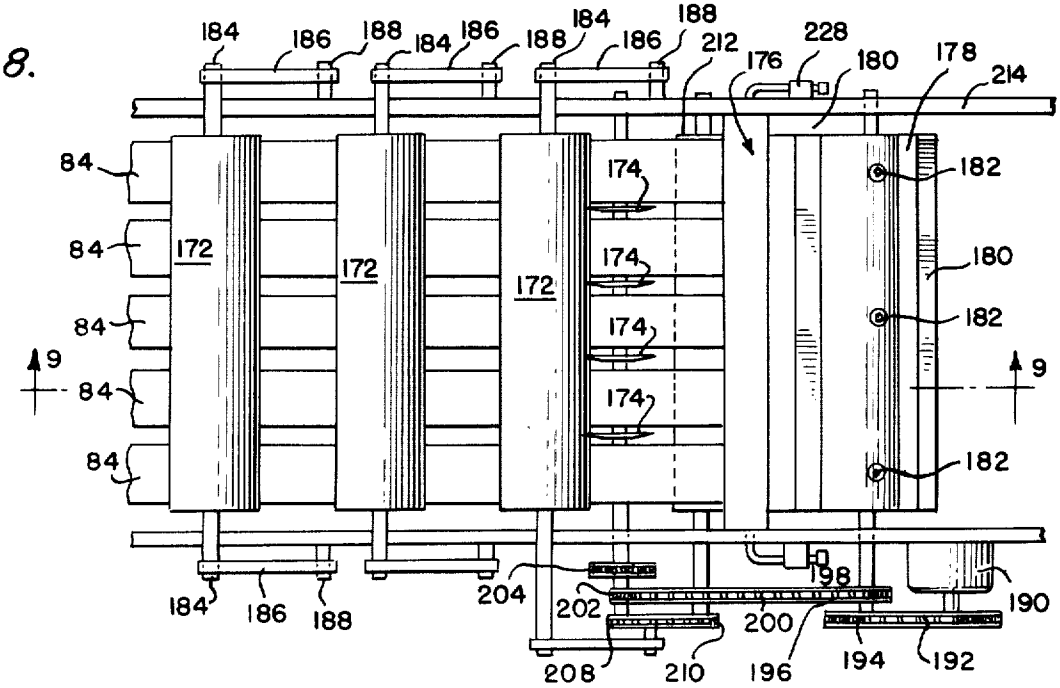
FIG. 8.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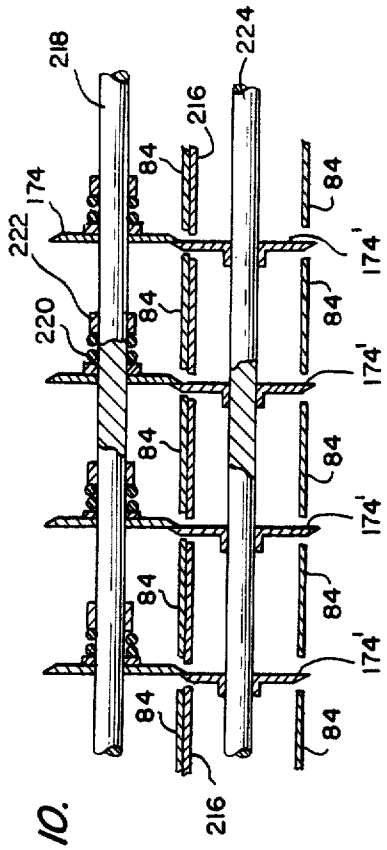


FIG. 10.

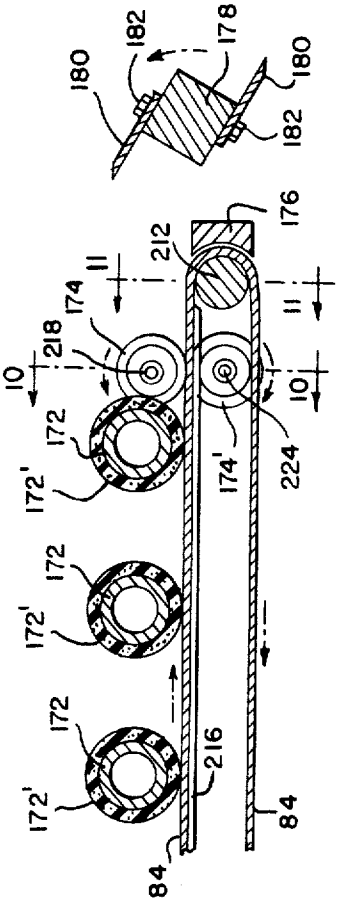


FIG. 9.

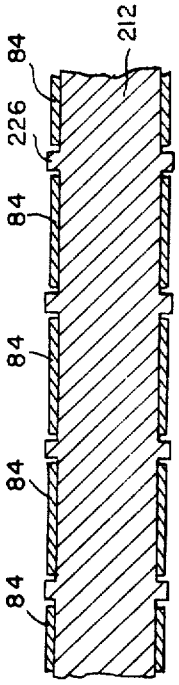
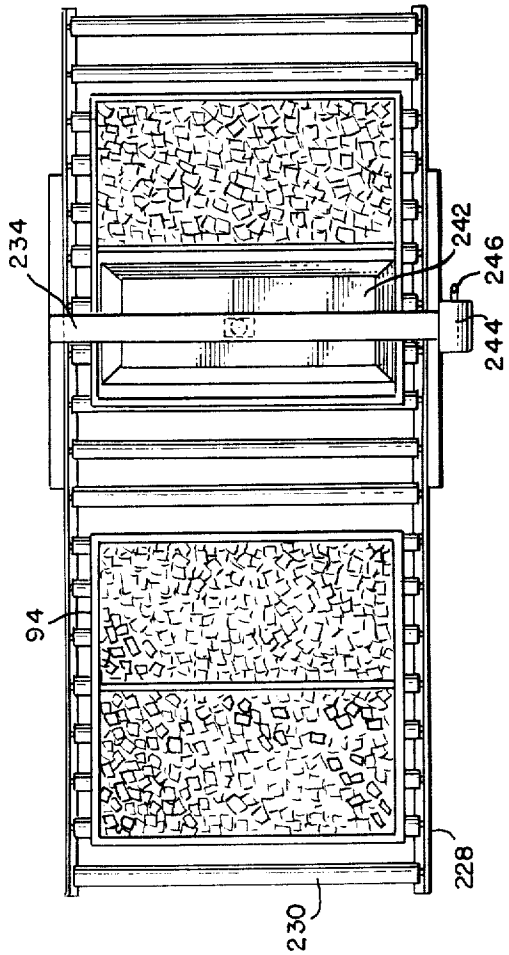


FIG. 11.

FIG. 14.



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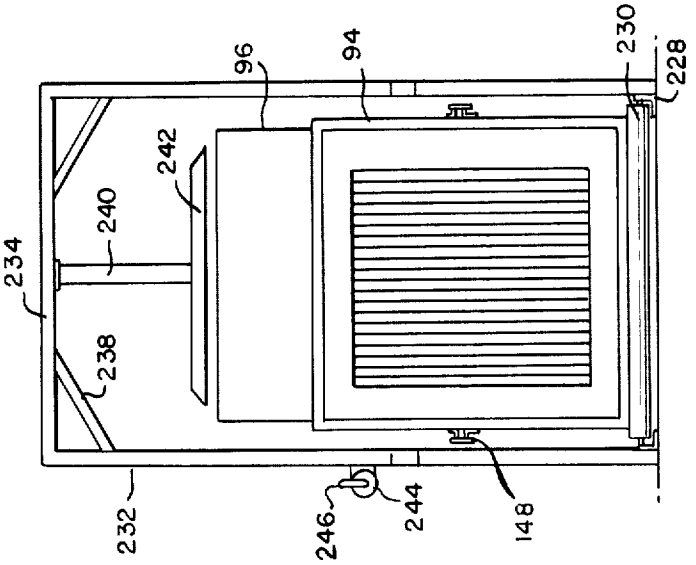

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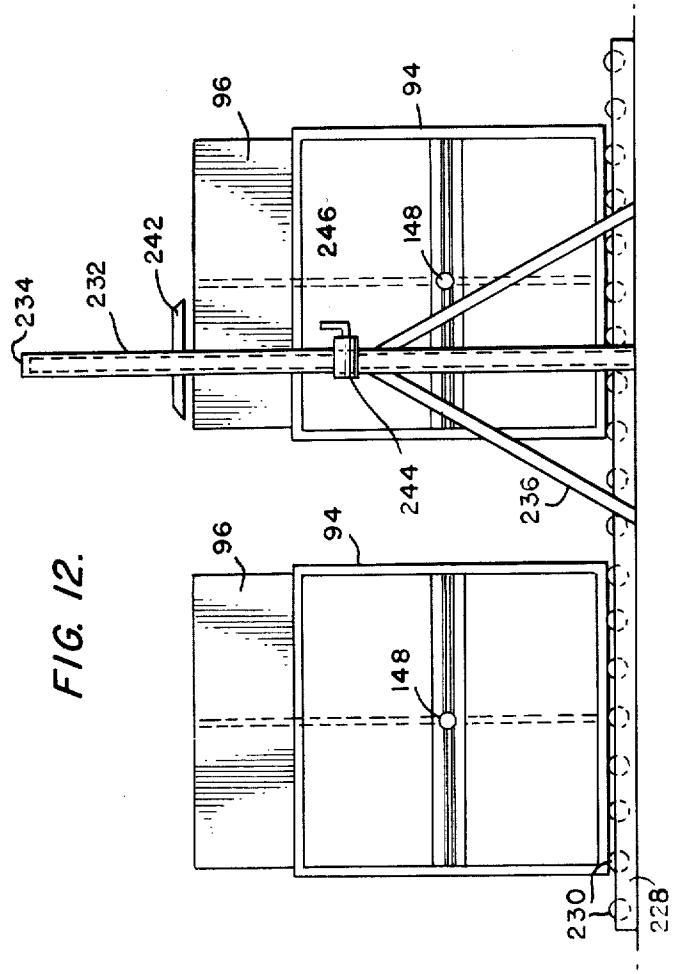

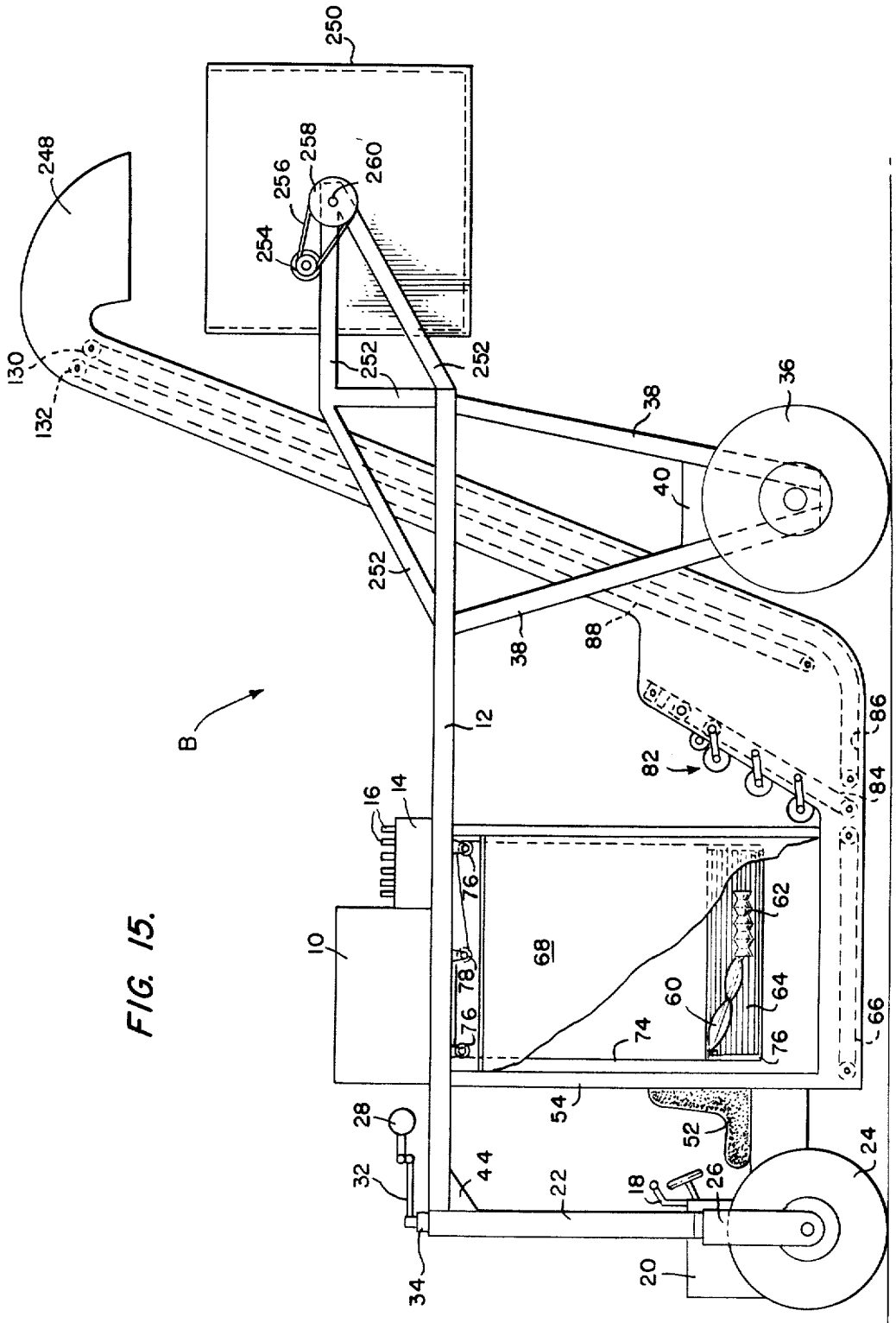
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FIG. 15.

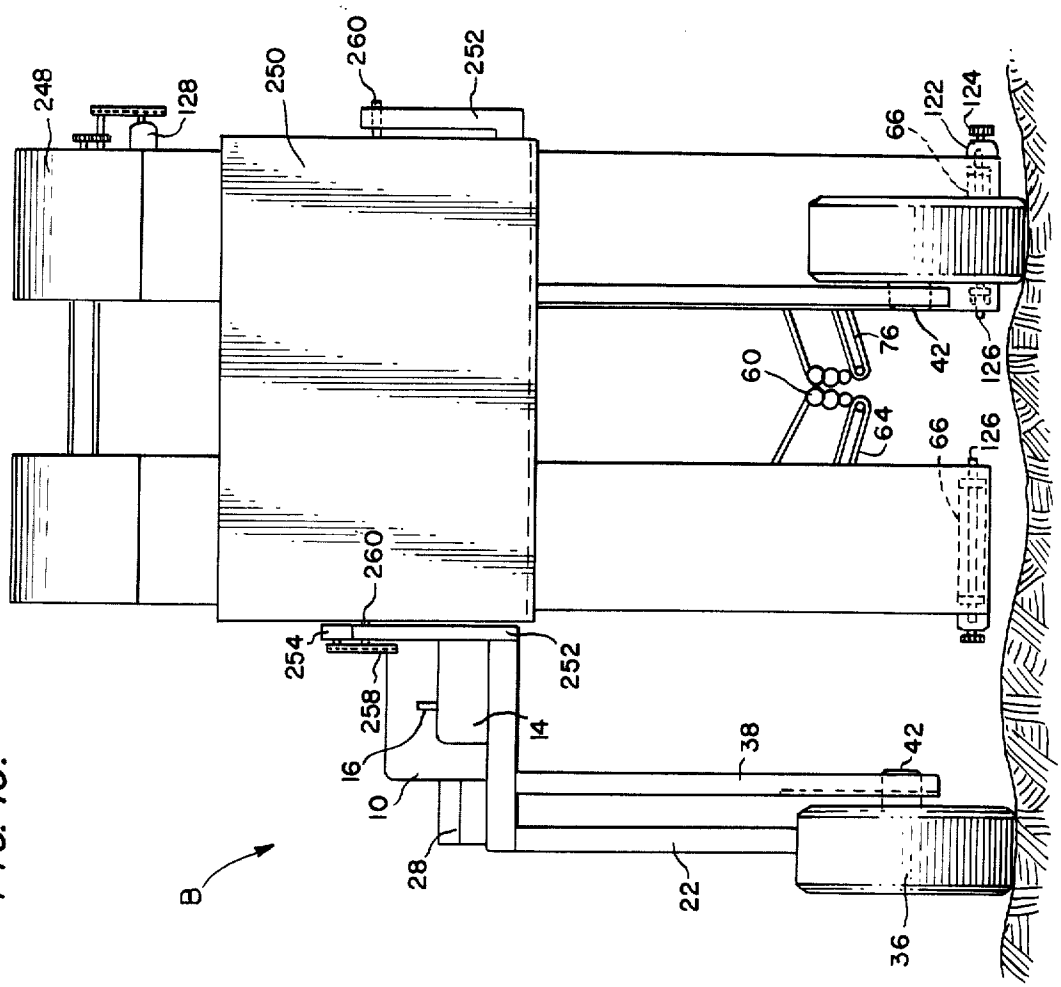
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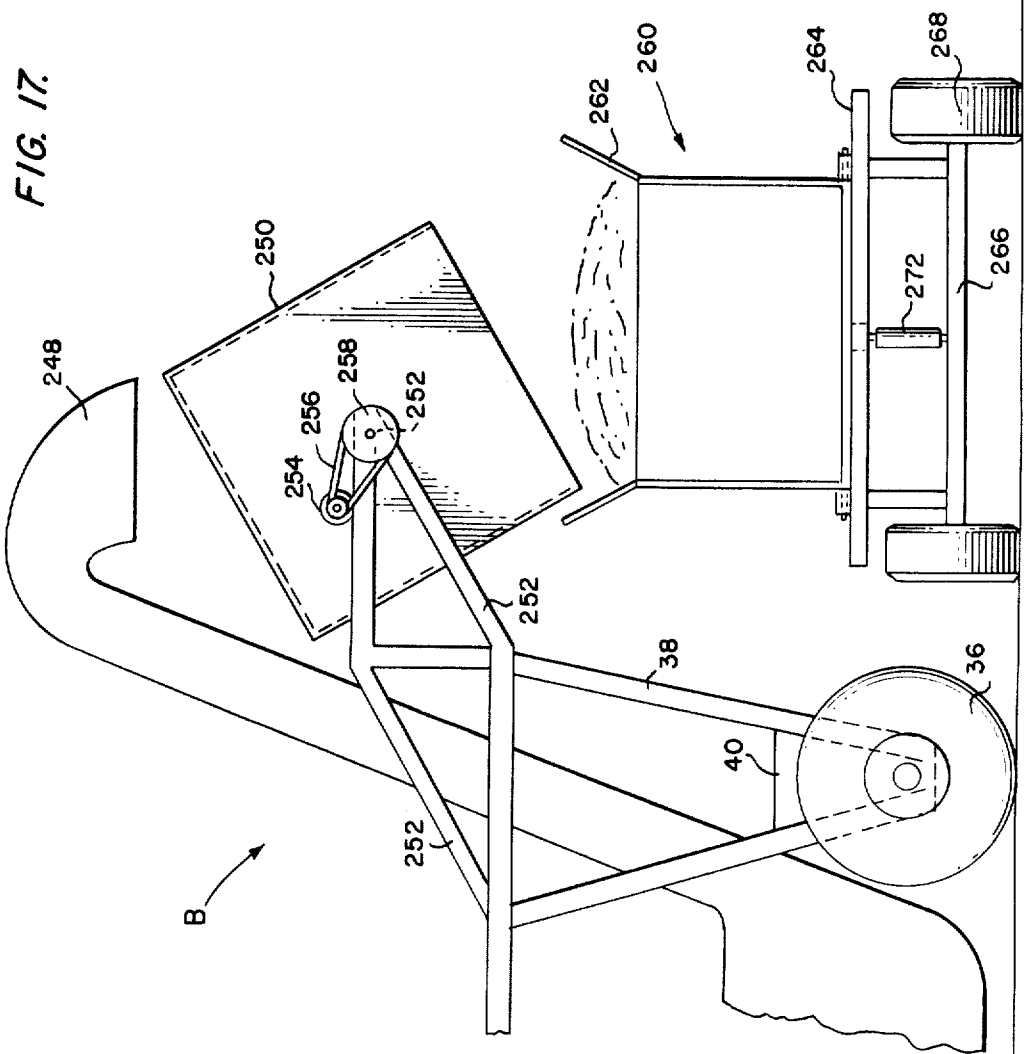
FIG. 16.

FIG. 17.



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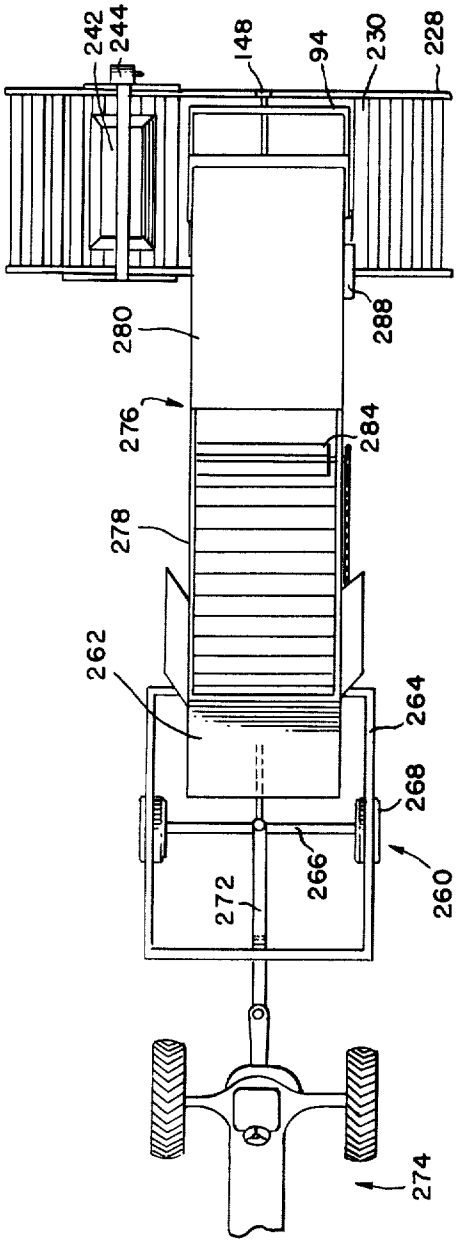
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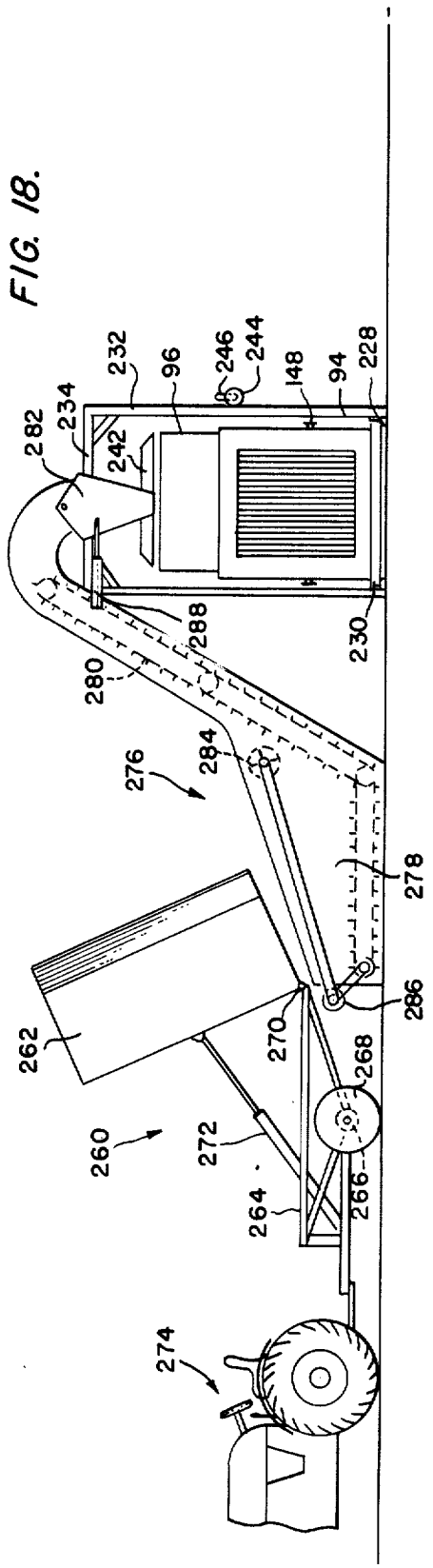
FIG. 18.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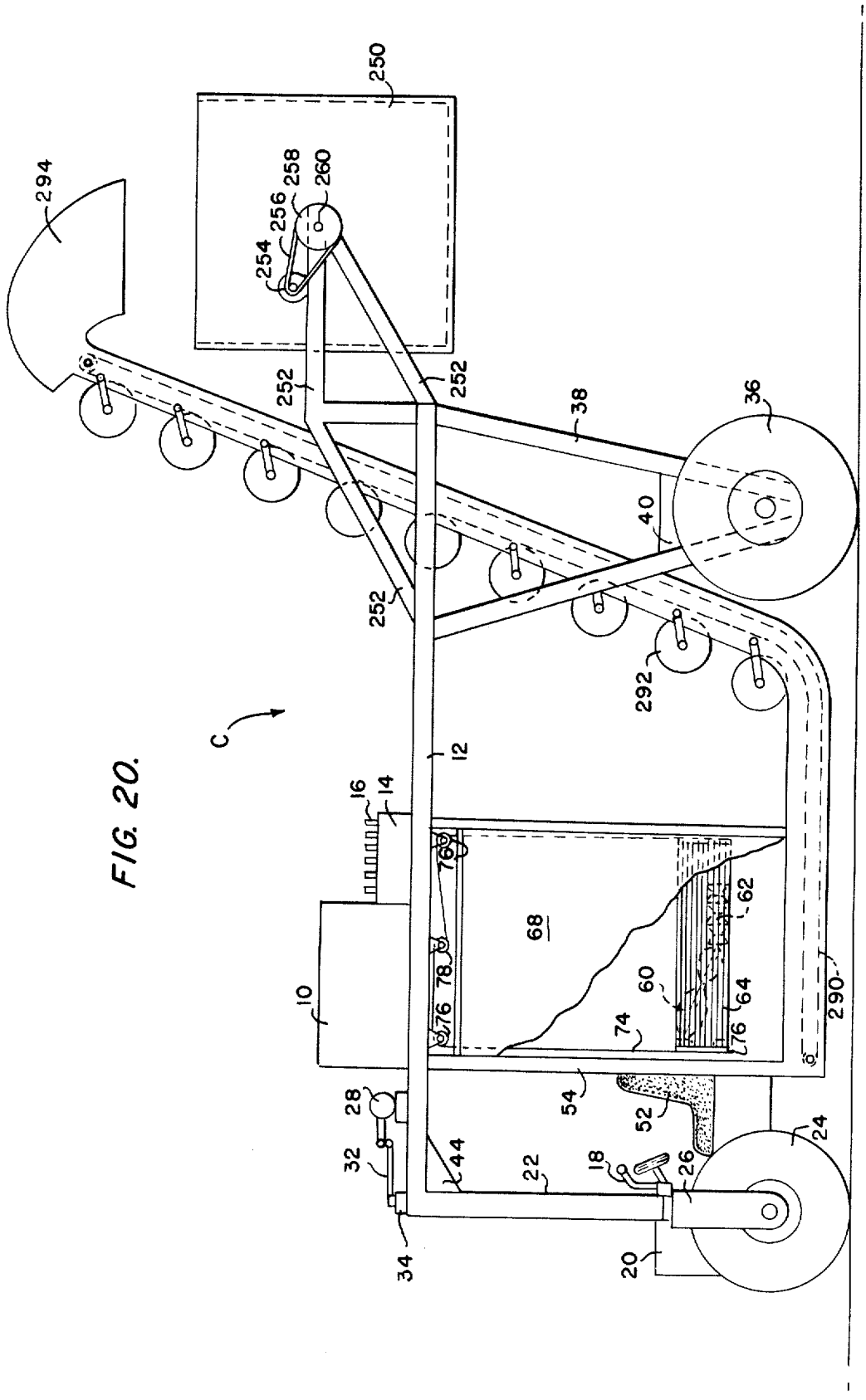
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FIG. 20.

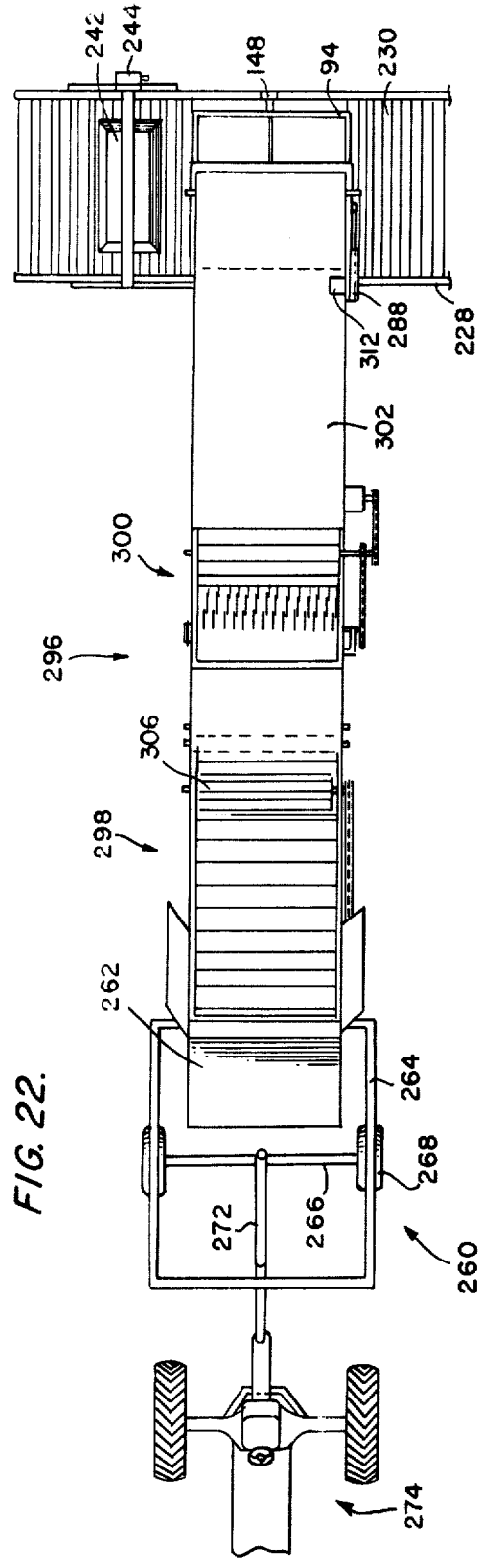
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FIG. 22.

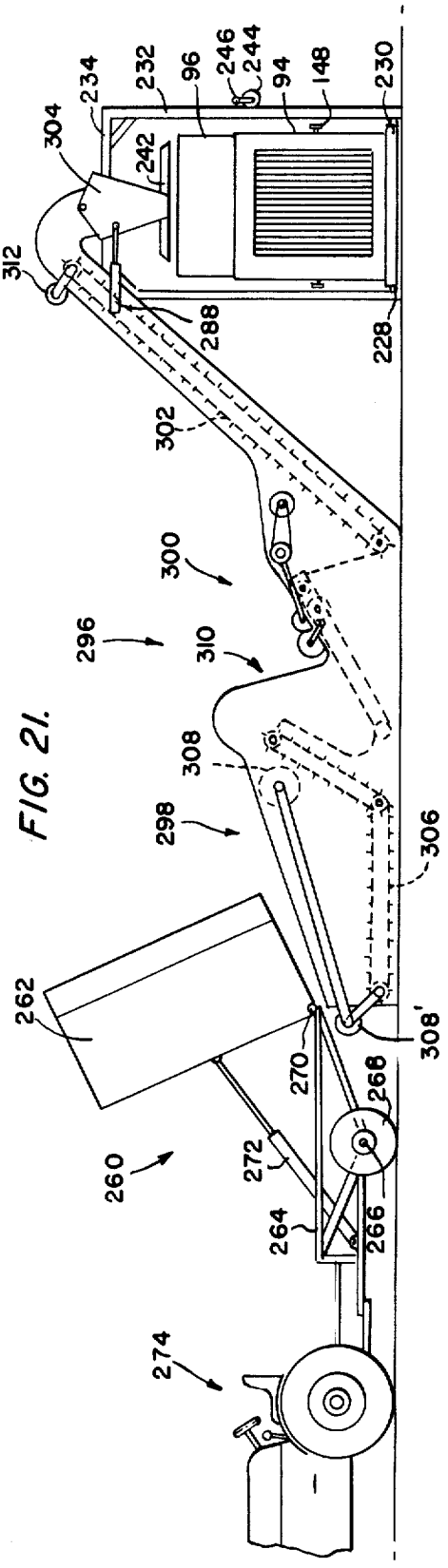
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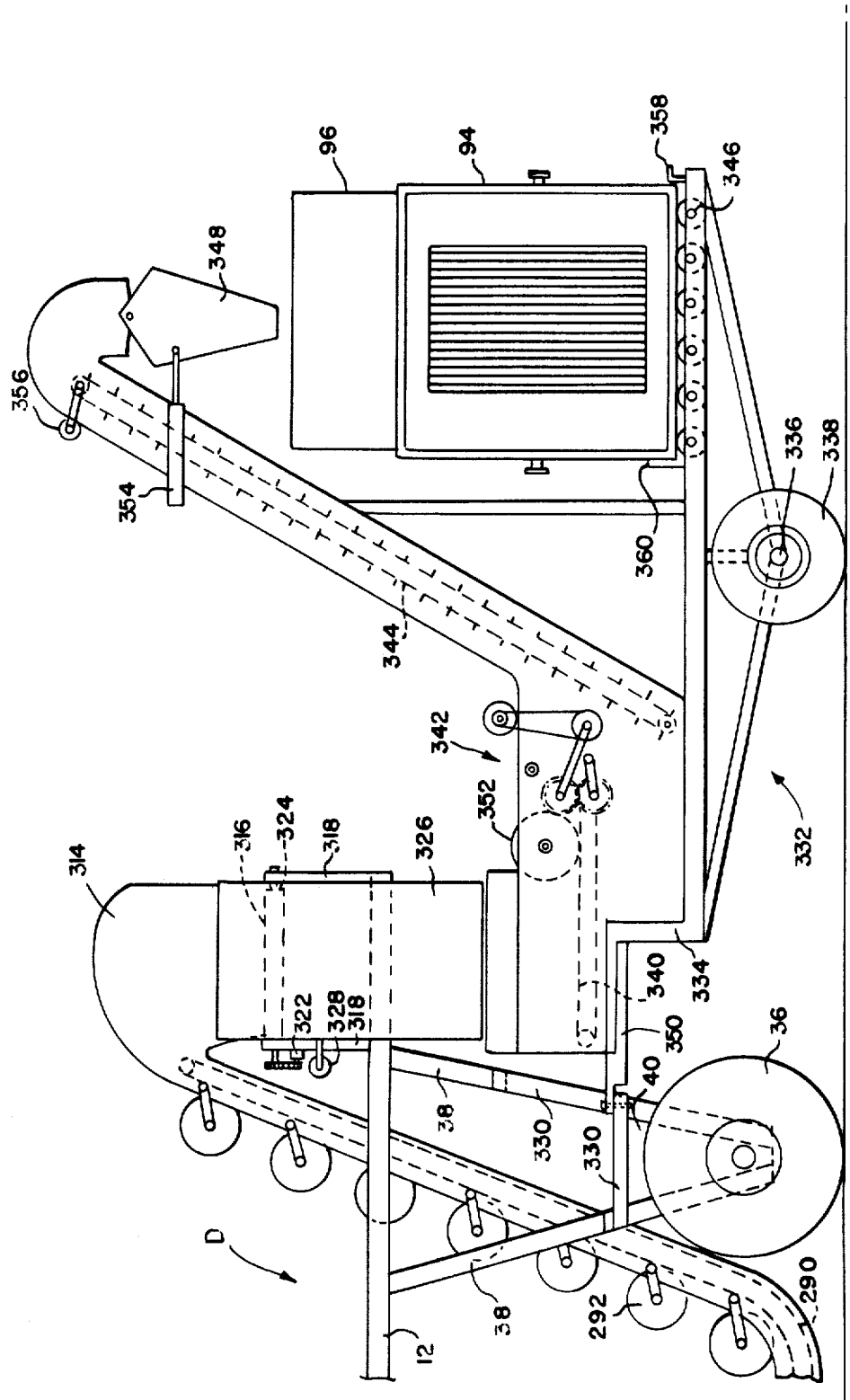
FIG. 21.

FIG. 23.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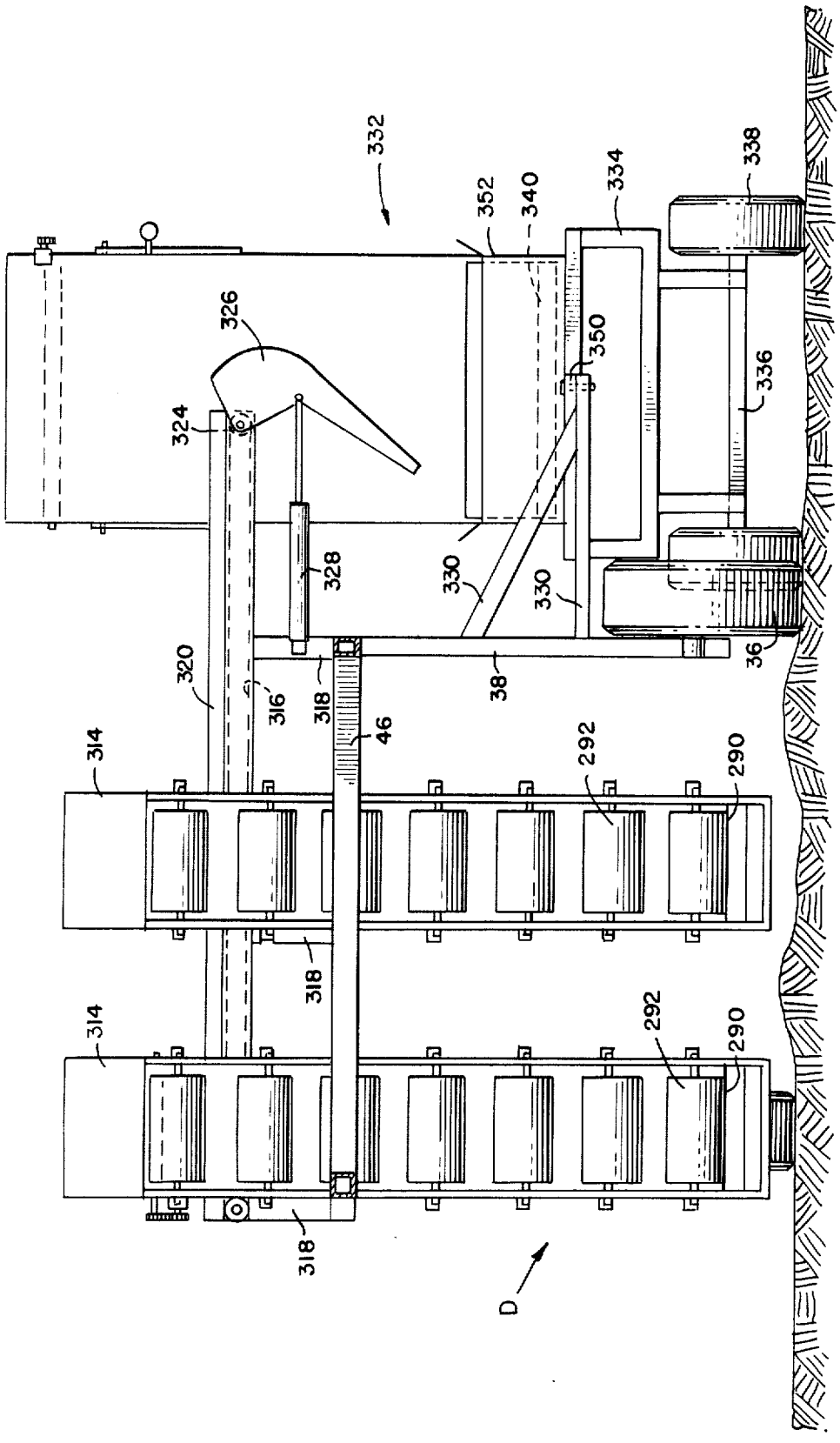
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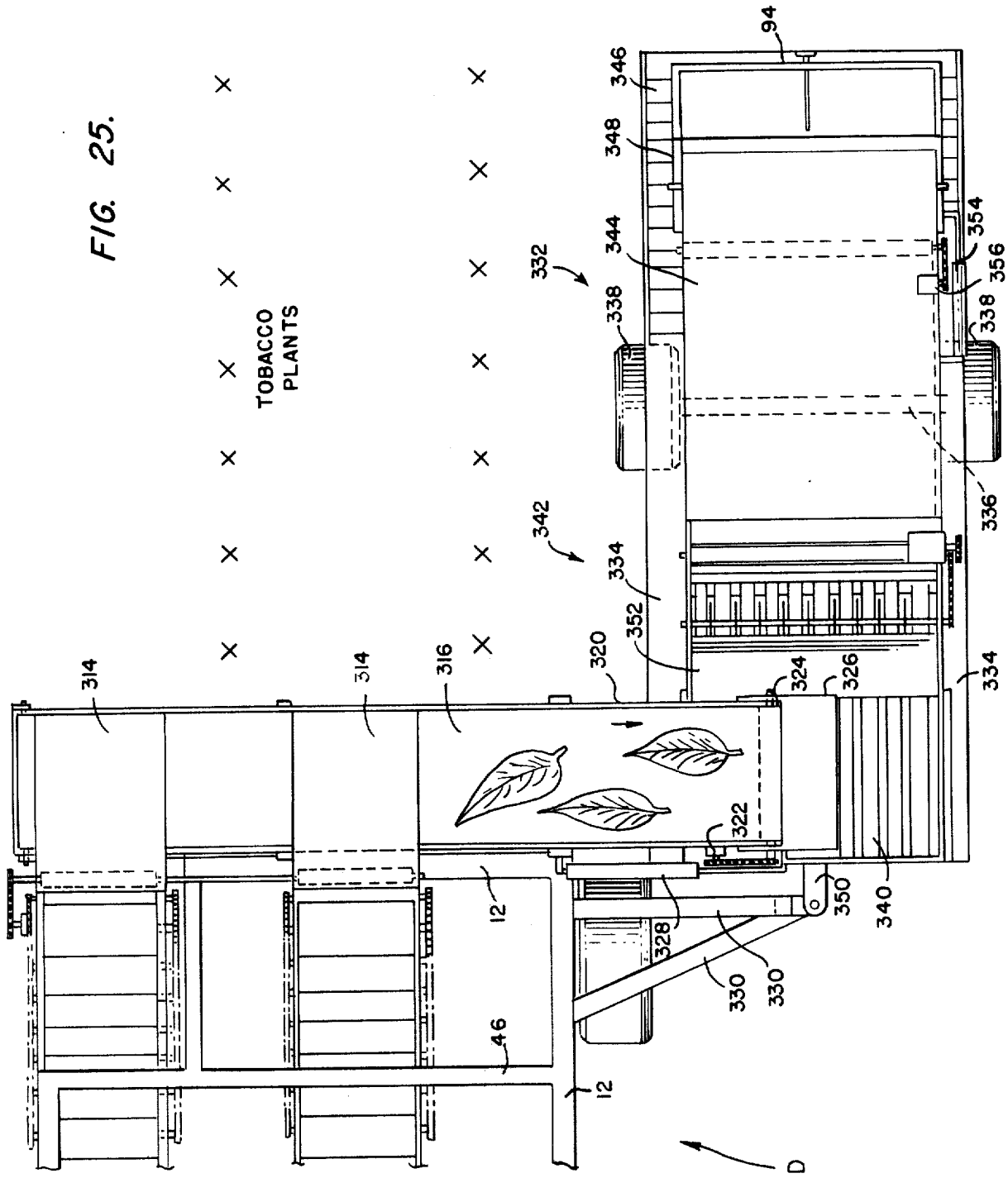
FIG. 24.

FIG. 25.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TOBACCO PROCESSING SYSTEM AND METHOD

Related subject matter is disclosed and claimed in my co-pending U.S. Pat. application Ser. No. 288,028 filed Sept. 11, 1972.

BACKGROUND OF THE INVENTION

Operations that must be performed in a flue-cured tobacco harvesting and curing system are: (1) harvesting ripe tobacco leaves, (2) preparing tobacco for curing, (3) loading the curing facility, (4) curing and conditioning, (5) unloading the cured tobacco, and (6) leaf preparation for marketing.

Traditionally these operations have been done manually with correspondingly high labor requirements. During the past two decades, several advances have been made which have substantially reduced labor requirements, and hence a number of harvesting and curing systems have evolved. The conventional hand harvest, hand stringing and conventional curing system requires approximately 250 man-hrs/acre; for example in man-hrs/acre, priming, 44.3; hauling, 18.5; handing and stringing, 109.0; loading barn, 18.3; curing, 6.7; removing from barn, 11.6; and looses-leaf preparation for market, 41.2.

In their Economics Information Report "Alternative Tobacco Harvesting and Curing Systems for the North Carolina Coastal Plains", EIR-12, Dept. of Economics, N.C. State University, October, 1969, Davis and Chappell presented comparative labor requirements for various harvesting and curing systems, including market preparation. Hand harvest and use of an automatic tying machine at the curing barn reduced labor to 177.3 man-hrs. The use of tractor-drawn or self-propelled harvesting aides which carried the primers through the field gave labor estimates of from about 177 to 191 man-hrs or about the same as the hand harvest-tying machine system. Hand harvest with walking primers and bulk racking for bulk curing gave an estimated 125.9 man-hrs. The use of a harvesting aide which permitted field racking reduced this slightly to 122.7 man-hrs. The use of a mechanical harvester for the removal of leaves from the plant in conjunction with bulk curing further reduced labor to 89.8 man-hrs/acre. Of this amount, 42.9 man-hrs were required for harvesting, preparing tobacco for curing, and loading the curing facility; 6.7 man-hrs were required for curing; and 40.2 man-hrs were required for removal from the curing facility and looseleaf preparation for marketing.

A major problem which exists today for the current mechanical harvesting-bulk curing system is the enormous materials-handlng problem. Consider, for example the typical operation in which a harvester moves through the field, straddling two rows, and defoliates leaves from one row. The defoliators enter the canopy of leaves and remove, by their rotating action, from about three to six leaves per plant and normally, three to six harvests are required over a 6-week period to harvest all leaves. After defoliation, the leaves are conveyed to the top of the harvester and deposited into a bin or containers which are periodically taken to the curing barns. There it is necessary to remove the tobacco by hand from the containers and place it into bulk racks in preparation for curing. Manual placement of the random interlaced leaves into proper position for racking is laborious and time-consuming, requiring a crew of three to six people per harvester. In addition,

there is considerable labor required for moving racks into and out of the bulk curing barn, unloading racks of cured leaf, and sheeting tobacco for market. A harvester, operating at capacity, can now harvest up to 30,000 pounds of uncured leaf per day. This requires hand racking of about 240 racks or two large bulk barns per day. For a 50 acre operation, at least 3500–4500 man-hours are still required in harvesting, curing, and market preparation.

My co-pending U.S. patent application Ser. No. 288,028, "Modular Tobacco Handling and Curing System", describes a new and improved system which materially simplifies certain aspects of the materials handling problems of harvesting and curing. The system provides for the handling and curing of large batches of tobacco in special curing containers, or modules, each of which may hold up to, for example, 1500 or more pounds of tobacco. The modules may be filled with either intact or cut strip tobacco; and the tobacco, after placement into the module, is not physically handled until after curing. Furthermore, the modules are designed for mechanized handling and rapid unloading.

THE PRESENT INVENTION

The present invention relates to new and improved harvesting-handling systems which permit complete mechanical handling of tobacco directly into the curing module, without physically handling the tobacco itself. Studies on the filling of modules with both intact and cut-strip tobacco have indicated distinct advantages to the use of cut strips for conveying and to uniform filling of modules. Intact leaves, because of their size and shape, can not be easily handled through distribution equipment for completely mechanized filling of containers. Also uncut leaves pose problems in the filling of corners, and because of folding or lodging during free fall, create areas which are more difficult to dry during curing.

OBJECTS OF THE PRESENT INVENTION

To provide a mechanized harvesting-handled system which enables direct, uniform placement of cut-strip tobacco into curing modules holding up to, for example, 1500 or more pounds of tobacco.

To provide a harvesting-handling system whereby tobacco leaves are defoliated on a mechanical harvester; conveyed through longitudinal and transverse cutting equipment to produce approximately rectangular strips and which are further conveyed through an oscillating distributor directly into a curing module.

To provide a harvesting-handling system whereby tobacco leaves are defoliated on a mechanical harvester; conveyed through longitudinal and transverse cutting equipment to produce approximately rectangular strips, which are conveyed to a holding container on the harvester; further to provide fur unloading of the container to a transport trailer which carries the cut-strip tobacco to the curing facility; unloading of the transport trailer to a conveyor and oscillating distributor which places the cut-strip uniformly into the module at the curing site.

To provide a harvesting-handling system whereby intact leaves carried to the curing facility are mechanically conveyed through longitudinal and transverse cutting equipment and the cut strips are further conveyed to and through an oscillating distributor into a curing module.

To provide a harvesting-handling system whereby tobacco leaves stripped by a harvester are conveyed to a cutting-distribution apparatus on a trailer connected to the harvester for direct placement of cut-strip tobacco into a curing module.

To provide longitudinal and transverse cutting means which produce approximately rectangular pieces of tobacco with minimal bruising or edge effect from the cutting action.

To provide a distribution means for cut-strip tobacco which enables uniform placement of the material into a curing module in a completely mechanized operation.

To provide a means for mechanical pressing tobacco into the curing module to achieve a more uniform density distribution, which serves to provide more uniform drying during curing, and to increase capacity per module.

To provide a completely mechanized harvesting and handling system, which used in conjunction with modular curing, reduces hand labor, provides improved product uniformity, and ultimately reduces the cost of tobacco production.

These and other objects and advantages will become apparent to those skilled in the art from the following discussions of the invention in detail.

BRIEF DESCRIPTION OF THE INVENTION

FIG. 1 is a side elevation view of one embodiment of the harvester of the present invention;

FIG. 2 is a top plan view of the harvester of FIG. 1;

FIG. 3 is a front elevation view of the harvester of FIG. 1;

FIG. 4 is a rear elevation view of the harvester of FIG. 1;

FIG. 5 is a sectional view taken through lines 5—5 of FIG. 1 showing the defoliating and initial conveying mechanisms;

FIG. 6 is a sectional view taken through lines 6—6 of FIG. 2 illustrating the drive and lifting means for the defoliator mechanism;

FIG. 7 is an enlarged side elevation view of the leaf cutting mechanism of the present invention;

FIG. 8 is a sectional view taken through lines 8—8 of FIG. 7 illustrating more completely the cutting mechanism;

FIG. 9 is a sectional view taken through lines 9—9 of FIG. 8;

FIG. 10 is a sectional view taken through lines 10—10 of FIG. 9 illustrating more specifically the disc cutters of the cutting mechanism;

FIG. 11 is a sectional view taken through lines 11—11 of FIG. 9 illustrating the drive roller for parallel belts which feed tobacco into the cutting mechanism;

FIG. 12 is a side elevation view of the press apparatus of the present invention for pressing the cut-strip tobacco into the curing module;

FIG. 13 is an end elevation view of the press apparatus of FIG. 12;

FIG. 14 is a top plan view of the press apparatus of FIG. 12;

FIG. 15 is a side elevation view of a second embodiment of the harvester of other present invention;

FIG. 16 is a rear elevation view of the harvester of FIG. 15;

FIG. 17 is a side elevation view of a portion of the harvester of FIG. 15 illustrating unloading of cut-strip tobacco into a transport trailer;

FIG. 18 is a side elevation view of conveying, distribution, and press apparatus at the curing facility for mechanized filling of the module;

FIG. 19 is a top plan view of the apparatus of FIG. 18;

FIG. 20 is a side elevation view of a mechanical harvester which elevates harvested leaves to a bin for rapid unloading;

FIG. 21 is a side elevation view of handling apparatus of the present invention illustrating operations performed at the curing facility;

FIG. 22 is a top plan view of the handling apparatus of FIG. 21;

FIG. 23 is a side elevation view of a harvester portion and side-connected trailer for performing operations of the present invention;

FIG. 24 is a front elevation view of the apparatus of FIG. 23; and

FIG. 25 is a top plan view of the apparatus of FIG. 23.

DESCRIPTION OF THE INVENTION

As hereinbefore set forth, this invention relates to new or improved harvesting and handling systems for tobacco which permit direct, uniform preparation and loading of cut-strip tobacco into curing modules holding relatively large quantitiets of tobacco. The essential processing steps include (A) harvesting leaves; (B) conveying or transporting of harvested leaves through longitudinal and transverse cutting equipment, (C) conveying or transporting the cut strips to and through an oscillating distributor for uniform placement into a curing module and (D) pressing the tobacco strips into the curing module to achieve grater uniformity of bulk density throughout the module and to increase loading capacity. After pressing, the modules are capped, lifted mechanically and rotated by 90° to position the laminae in a generally vertical plane and positioned onto a plenum for curing as more fully set forth in my application Ser. No. 288,028.

Four harvesting-handling systems are described below which illustrate alternative ways of carrying out the operational sequence.

Referring to particularly to FIGS. 1 through 4 the machine A as depicted is powered by a gasoline engine 10 which is mounted on the upper structural frame 12 of the harvester. The motor in turn drives a hydraulic unit 14 which supplies hydraulic fluid under pressure to various hydraulic motors, cylinders, etc. to be more fully described hereinafter. Supply lines 16 are controlled by means of hydraulic levers 18 on the driver's panel 20.

Front vertical frame support members 22 support the upper deck members while providing means for steering the machine. Front wheels 24 are suitably mounted on the front support members 22, and steering is accomplished by rotation of the wheel yoke or support frame 26 which is connected through supports 22 to a hydraulic cylinder 28 located on the top of the harvester. Connecting rods 30 and 32 transmit power from the cylinder 28 through shafts 34 journaled through the vertical frame members 22.

The rear wheels 36 are journaled for rotation and connected to the rear frame supports 38 which provide a sturdy mounting support 40 for the wheels. The rear wheels are driven by two hydraulic motors 42, the speed of which are regulated by the driver and generally providing ground speeds up to 6 mph under field operating conditions.

The structural frame of the machine is strengthened by suitable braces, such as illustrated at **44** and by cross-members in the top frame as **46, 48** and **50.** For clarity, certain structural members for supporting elevators, etc. are not shown.

The drivers seat **52** and control panel **20** are suspended from the front top frame **12** and cross support **50** by means of vertical members **54** and **56.** Similarly the vertical support members **54** and **58** connected to the top structural frame **50** serve to support the front portion of the harvest-conveying apparatus. Other support members for this apparatus are not shown, for clarity of presentation; however they may in practice be easily installed to connect with other members of the top framework such as **12, 46** and **48.**

Looking now at the general harvesting operating of the machine, as the harvester moves forwardly through the field, the defoliating mechanism **60** enters the canopy of the plant with the spiral wipers, driven as hereinafter disclosed, rotating to sweep downwardly on each side of the stalk to remove the leaves. Gleaner rolls **62** further aid to remove leaves that are partially detached. The leaves are then moved away from the plant by the transverse conveyors **64.** The defoliating section of the machine may be of any conventional design such as illustrated by the Wilson U.S. Pat. No. 2,816,411.

Tobacco leaves next are directed to fall on the two conveyors **66** which move the leaves backward from the defoliator section. Vertical screens **68** mounted between the exterior support members **54** and **70** and between members **58** and **72** prevent the leaves from falling outside of the conveyor section.

As shown in FIG. **1,** and to be described later in greater detail in FIG. **6,** the defoliators and transverse conveyors are suitably mounted to permit adjustment of the vertical height and swath of defoliation. Raising and lowering of the defoliator mechanism is accomplished by the steel cables **74** which re connected to defoliator - conveyor support frames **76.** The cables **74** pass around pulleys **76** connected to a top support member and then wind on a top center connected roller **78** driven by hydraulic motor **80.**

The leaves then move into and through the cutting apparatus shown generally at **82** which produces both logitudinal and transverse cutting actions to yield approximately rectangular shaped pieces of cut-strip tobacco. Parallel belt conveyors **84** move the intact leaves first through parallel disc cutters and the long strips are then cross-cut with a rotary blade cutter. The cutting apparatus is further illustrated with reference to FIGS. **7–11,** described later.

The cut strips next fall onto the belt or chain conveyors **86** and are conveyed upwardly between conveyors **86** and **88** to the upper rear portion of the harvester. The strips are deposited into the upper distributor housings **90** which permit convergence of the material. The strips then fall into the curing module **94.** A sleeve **96** resting on the top of the module **94** permits overfilling such that the tobacco can later be pressed tightly into the module. The distributor is oscillated by periodic motion of the hydraulic cylinder **98,** the shaft **100** of which is pin connected **102** to the distributor **92.** The distributor **92** is connected to the upper distributor housing **90** for free rotation at the bearing joint **104.**

The module rests on a rear platform **106** equipped with rollers **108** to permit ease of moving empty or filled modules onto or off the harvester while a removable stop pin **138** holds the module in position during harvesting. The platform **106** is further designed for raising or lowering, since the platform bottom must clear the top of tobacco plants during passage of the harvester through the field. A vertical lifting frame **110** rigidly connected to the platform **106** is equipped with four bearing wheels **112** which move in the track of the U-shaped members **114** which guide the movement of the platform. A steel cable **116** connected to the top of the lifting frame **110** passes over a pulley **118** and on to a hydraulic cylinder **120** which provides power for operating the rear lift platform **106.**

For simplicity of discussion, certain of the drives, gears or power units for the defoliators, elevators, cutters, etc. are not illustrated; however, the mechanisms are best driven by hydraulic motors mounted for the specific function. FIGS. **1–4** do illustrate, for example, that the front conveyors **66** may be driven by the hydraulic motor **122** which is chain or belt connected as at **124** to the conveyor drive shaft **126.** Similarly conveyors **86** and **88** may be driven by the hydraulic motor **128** which is gear connected to the top drive rollers or sprockets **130** and **132.** Both parallel units of the conveyors **86** and **88** may be driven by the same hydraulic motor **128,** interconnected with shafts **134** and **136.**

The module **94** is fully described in my co-pending U.S. patent application Ser. No. 288,028; however it is to be noted here that the module is positioned such that the perforate partition **140** is located parallel to the direction of oscillation of the distributor **92.** Furthermore it is advantageous to provide interior partitions **142** and **144** within the distributor housing **92** and distributor **96,** respectively, which are in alignment with the module partition **140.** This will aid in assuring more uniform filling and in proper pressing within the separate compartments of the module. Note also is made of the perforate side wall **146** with baffle plates and of the side lugs **148** used for mechanically lifting the module.

Referring now to FIGS. **5** and **6,** there is illustrated further detail of the defoliators and transverse conveyors with drive and lifting means. In operation, tobacco plants are guided into the apparatus by the curved guide rods **150** which are adjustable in height by holes located in the support members **54** and **58.** Suitable bearing supports **152** permit connection of the spiral wiper defoliators **60.** These defoliators are further connected in the rear to universal joints **154** and to gleaner rolls **62** which are in turn shaft connected to gears **156** mounted on the defoliator support frame **76.** A second set of gears **160,** geared directly with gears **156,** is driven by the hydraulic motors **162** through the chain drives **164.** The defoliators **60,** gleaner rolls **62** and transverse conveyors **64** are driven in such a direction that the defoliators and gleaner rollers wipe downwardly on the stalk, while the transverse conveyors move the defoliated leaves away from the stalk.

The defoliated leaves are deflected downwardly to conveyors **66** by means of the outside screens **68** as shown generally in FIG. **6.**

Lifting means for the defoliating apparatus is shown best in FIG. **6.** Four vertical guide members **166** of square tubing, rigidly connected to the top cross braces **48** and **50,** two in the rear and two in the front, respectively, provide for horizontal alignment of the defoliator and transverse conveying mechanisms. Short sections of square tubing **168,** sleeved over the tubing **166**

and mounted rigidly to the front and rear of the defoliator-transverse conveyor mechanism by the brackets **170**, permit raising of the entire mechanism, uniformly. Steel cables **74** connected to the defoliator support frame **76**, lift the entire mechanism for adjustments between successive harvests. The cables **74** are wound on roller **78** driven by the hydraulic motor **80**. Other suitable means for raising the defoliator-transverse conveyor mechanism can also be used.

Support for the lower conveyors **66** by means of the members **70** and **72** is also shown in FIG. **6**.

Referring now to FIGS. **7–11**, the cutting mechanism of the present invention is illustrated and as shown in FIGS. **7–9**, intact leaves from conveyor **66** are transported upwardly by conveyor **84**, which consists of parallel belt conveyors, which moves the leaves by the aid of press rollers **172** into and through the parallel disc cutters **174** to produce longitudinal strips of tobacco. The cut strips are further conveyed across the bed knife **176** where the rotary knife cutter, consisting of a main square shaft **178** and two or four blades **180**, transversely cuts the strips. The blades **180** are mounted onto shaft **178** by means of bolts **182**. The cut strips fall downwardly to conveyor **86** which conveys them to the oscillating distributor **92**.

It is to be noted that the press rollers **172** should preferably be covered with a soft, resilient material **172'** such as foam rubber to minimize bruising to the tobacco and further, that the cutters **174** be of high carbon steel for long wear resistance and maintenance of a sharp edge. Furthermore, the cutting blades **180** should be of tempered, high carbon steel and the shaft **178** mounted to produce a scissor cutting action with respect to the bed knife **176**.

The press rollers **172** are mounted, as shown, to roll by frictional effects between the tobacco and conveyor **84**. Each end of the rollers **172** is mounted to a suitable journal connector **184** for free rotation and hinged by connecting bars **186** to journaled connection pins **188**. Gravity holds the rollers **172** in contact with tobacco moving to the circular disc cutters **174**.

The complete cutting mechanism **82** is driven by means of the hydraulic motor **190**. The motor **190** is linked by chain or belt **192** to a sheave **194** which drives the rotary knife cutter with direct connection to the square shaft **178**.

A secondary sprocket **196** on the end shaft **198** of the knife cutter is chain connected **200** to the sprocket **202** which drives the upper bank of disc cutters **174**. A gear **204** on he shaft to the upper bank of disc cutters is directly geared to gear **206** which drives the lower bank of disc cutters in the opposite direction. A further sprocket **208** on the same drive shaft as gear **206** is chain connected to sprocket **210** which drives conveyor **84** through the driving roller **212**.

The framework **214** for the cutting mechanism **82** may be of heavy gage metal, reinforced as necessary with steel bracing nembers.

FIG. **9** illustrates a sectional view of the cutting mechanism showing the manner of feeding leaves into and through both circular disc cutters **174** and the rotary blade cutter. Note that the plural conveyors **84** are preferably supported by a flat plate **216** having openings at one end for the passing of the cutters **174**. Alignment of the belts can be easily assured by metal strips located between the belts **84** and attached to the support plate **216**. It is further pointed out that the upper bank of disc cutters **174** is mounted closely with respect to the adjacent press roller **172**, and preferably the cutters penetrate into grooves of the covering of the adjacent roller. This aids in assuring uniform movement of tobacco into and through the disc cutters. It may also be advantageous to mount a press roller, not shown, between the disc cutters **174** and the rotary blade cutter.

FIG. **10** illustrates a vertical sectional view of the disc cutters **174**, showing their location with respect to the parallel conveyors **84**. The top bank of disc cutters is mounted on a main shaft **218** with each disc cutter spring loaded, for example, with spring **220** which thrusts against the collar **222** attached by set screw to the shaft **218**. Each of the top disc cutters can slide on the shaft **218** and maintain firm contact with the corresponding bottom disc cutters **174'** each of which is mounted firmly by set screw to the bottom shaft **224**. The top and bottom banks of disc cutters rotate in opposite directions at the same rotational speed. Furthermore, the tangential velocity of the cutters should be equal to or slightly higher than the linear velocity of the conveyor belts **84** such that tobacco leaves move smoothly through the cutters without any retarding frictional forces.

As shown in FIG. **11**, the driven roller **212** for conveyor **84** should be shaped to provide ridges **226** between which the belts **84** run and maintain proper alignment. Tension and adjustment of the conveyor belts can be provided by suitable end roller adjusting means, not shown.

As shown in FIGS. **7**, **8** and **9**, the bed knife **176** should be provided with side adjustment means to permit proper alignment with respect to the blade cutters **180**. Also the bed knife is preferably shaped to minimize the space between it and the conveyor belts **84** and drive roller **212**.

It has been mentioned earlier that certain advantages are inherent in the materials handling of cut-strip tobacco in contrast with intact leaves. Any cutting action which tends to reduce the average size of the pieces handled appears advantageous to conveying and uniform filling of modules, as compared with intact leaves which may range from about 14 to 30 inches in length and 8 to 14 inches wide.

There appear, however, to be certain distinct advantages to preparing cut strips in the neighborhood of about 3 × 3 inches to about 5 × 5 inches. Below about 3 × 3 inches, greater cutting action is required per unit of material and for high capacity harvesting, the cutters must operate at high speeds to maintain throughput. There also are indications that more difficulty may be experienced by the manufacturer in separating midrib from very small pieces. On the other hand, with pieces larger than about 5 × 5 inches, there is increased possibility for pieces to fold over as they fall into the modules, which may decrease uniformity of drying during curing. Also, it is more difficult to fil lthe corners of modules, the larger the cut strip. Potential advantages to the manufacturer of cut-strip tobacco in contrast to intact leaf include (1) greater ease of bulk feeding into the threshing operation, (2) improved bulk blending of different tobaccos, (3) partial separation of free lamina prior to threshing, and (4) greater uniformity of strip size after threshing. The potential for partial separation of free lamina prior to threshing arises from the fact that many of the strips do not include midrib, hence

may be separated by air separation. This could improve throughput through the threshing lines of the processing plant.

The field harvesting equipment described above has now included the handling of cut-strips directly into the module **94.** When the module is filled, it is lowered hydraulically by lowering the platform **106** to a level to permit rolling the module from the platform onto a transport trailer or tractor drawn dolly such as described in application Ser. No. 288,028, "Modular Tobacco Handling and Curing System and Method". The modules are then transported to the curing facility for final preparation for curing.

FIGS. **12–14** illustrate an apparatus for pressing the tobacco strips into the curing module at the curing facility. It is considered that this operation can be handled most easily at the curing station, since after pressing a cap is installed on each module. A worker at the curing facility, furthermore, has the time to receive, press, cap and position the modules for curing thereby better utilizing his time. A press apparatus may be installed on the harvester, however this would increase the weight and complexity of the harvester, would require an additional man on the machine, and would probably increase the down-time of the harvester since modules would have to be shifted to beneath the press from the filling position.

As shown in FIGS. **12–14,** the press apparatus is simple in construction and operation. A roller conveyor **228** is provided with spaced rollers **230** upon which the module **94** rests. When the modules arrive at the curing facility, they may be rolled directly onto the roller conveyor **228** or placed by forklift, chain hoist, or other mechanical lift onto the conveyor. The module **94** may be easily rolled by hand into position for pressing, or to the exit side after pressing. The press frame is provided which includes two vertical supports **232** of channel iron, or the like, connected to the sides of the conveyor **228,** and a top horizontal support **234** connected to the vertical supports **232.** Steel braces **236** and **238** provide additional structural rigidity and strength to the press frame. A hydraulic cyliner **240** is mounted to the horizontal support **234,** and is provided with a press plate **242** attached to the shaft of the hyraulic cylinder. The press plate **242** is rectangular in shape and sized to move downwardly within a compartment of the sleeve resting on the module **94** with a small clearance on the sides. The cylinder **240** is powered by hydraulic fluid under pressure from the hydraulic pump **244** with control lever **246.** The pump **244** may be operated by a suitable electric motor, not shown. The stroke of the cylinder **240** should be sufficient to completely press the tobacco in the sleeve **96** into the module **94,** preferably at least **3** or **4** inches below the top of the module. Tobacco after pressing tends to rise somewhat after the press plate **242** is lifted.

In operation, the module is simply moved into proper position and the tobacco compressed within the module by successive compartments. After pressing, the sleeve is removed and a cap is installed on the module. The module is then mechanically lifted, rotated by 90° to position the lamina vertically, and positioned on the curing plenum. The design and sizing of the module, the sleeve, and the press apparatus may be varied over a wide range, to accommodate various quantities of tobacco per module. With, for example, 4 × 4 × 4 feet modules having two compartments, and an 18 inches high sleeve, the filled and pressed module will contain about 16 to 18 pounds/ft.^{3} A larger sleeve would be utilized for higher packing densities.

As hereinbefore set forth the final steps of passing the cut leaves through an oscillating distributor and pressing the tobacco strips into a curing module may be carried out at a curing facility. Apparatus for carrying out said functions is shown in FIGS. **15** through **19** and referring thereto it will be seen that the harvester B is of similar design layout as harvester A of FIGS. **1–3,** except that the rear portion of the machine is modified to include a collection hopper in which the cut strips are temporarily placed. Distribution of cut strips into the module and pressing are conducted at the curing facility with separate equipment.

As in the previous form of the invention, the tobacco leaves are defoliated and then moved through the cutting apparatus **82.** The cut strips in the present embodiment are now conveyed by conveyors **86** and **88** to the top rear portion of the harvester where they move through the discharge duct **248** directly into a collection hopper **250.** A hopper support frame **252** is provided which is attached to the upper harvester frame **12** and provides for rotation of the hopper **250** extending rearwardly from the harvester. A shaft **260'** located centrally at the ends of the hopper and rigidly connected to the hopper is journaled for rotation through the hopper support frame **252.** The hopper may be constructed of galvanized metal, sheet steel or the like suitably reinforced to support a load tobacco and is of a box1like construction with open top. Rotation of the hopper for dumping tobacco is provided by means of the hydraulic motor **254** mounted to the support frame **252.** The motor **254** may be belt connected **256** to the pulley **258** mounted on the hopper shaft **260'.**

FIG. **17** illustrates the manner of unloading a filled hopper of tobacco directly to a transport dump wagon. With the harvestter ready for unloading tobacco at the end of the field, a dump wagon, shown generally at **260** is pulled by tractor to a position as shown in FIG. **17** to receive the cut-strips. The harvester operator then dumps the load of tobacco from hopper **250** into the wagon bin **262.**

As shown in FIGS. **17** and **18,** the dump wagon **260** includes a platform **264** upon which rests the wagon bin **262.** The platform is suitably mounted for transport via the axle **266** and wheels **268.** The wagon bin **262** is further provided with hinges **270** at the rear to permit raising and dumping of the bin contents by means of the hydraulic cylinder **272** mounted to the underframe of the wagon.

A conventional tractor as shown generally at **274** may be used to pull the dump wagon **260** to the curing facility. As shown now in FIGS. **18** and **19,** the tobacco is dumped from the bin **262** into a module loader for cut-strip tobacco, shown generally at **276.** The dump bin includes a removable rear side to permit the tobacco to fall from the bin. The module loader **276** includes a receiving hopper **278,** a flight conveyor **280** and an oscillating distributor **282.** Tobacco dumped into the receiving hopper **278** is moved back along a horizontal portion of the flight conveyor **280** then up an inclined portion. Excess tobacco on the flights is retained within the hopper **278** by the rotating paddle wheel **284.** Both the paddle wheel **284** and the flight conveyor **280** may be driven by means of the electric motor **286** and suitable sprocket or belt drives. To-

bacco is deposited from the flight conveyor **280** into an oscillating distributor **282**, driven by a suitably powered reciprocating unit such as the hydraulic cylinder **288**. The separate hydraulic power unit with reciprocating controls is not shown, however this may be of conventional design. The tobacco is distributed into both compartments of the module **94** which includes a top sleeve **96** for overfilling prior to pressing. The module rests on the roller conveyor portion **228** of a press apparatus of the same design as illustrated in FIGS. **12–14**. After filling of the sleeve **96** to the desired level with tobacco, the module **94** is rolled into position beneath the press plate **242** and pressed as described previously. Capping and rotation of the module **94**, and setting it into position for curing completes the operation.

Referring now to FIGS. **20** through **22** a modified form of the invention is illustrated employing a harvester C which comprises a basic harvester for intact leaves, modified to include only a collection hopper, while all operations of cutting into sized strips, conveying into and through an oscillating distributor into the module, and pressing are conducted at the curing facility. Therefore, in the harvester of FIG. **20**, the tobacco leaves after defoliation are deposited onto conveyors **290** where they are then conveyed back and up to the top rear portion of the machine. Press rollers **292** hold the leaves in contact with conveyors **290** as they are elevated. The leaves are then discharged through the discharge duct **294** which directs the leaves to fall into the collection hopper **250**. The collection hopper **250** is designed for rotation, support, etc. the same as that illustrated in FIG. **15** and discussed previously.

Unloading of the filled hopper **250** of intact leaves into a transport dump wagon **260** is exactly as described earlier with reference to FIG. **17**.

Referring now to FIGS. **21** and **22**, there is shown therein the operations of preparing and handling the cut-strip tobacco at the curing facility. In this case the tractor **274** backs the transport dump wagon **260** into a position for unloading, then by means of the hydraulic system of the tractor, raises the dump bin **262** to permit the tobacco to fall from the bin into the bulk cutting-load apparatus, shown generally at **296**. The design of the dump wagon may be the same as described with reference to FIGS. **17–19**. The bulk cutting-loading apparatus **296** includes a receiving hopper, shown generally at **298**, a cutting apparatus, shown generally at **300**, a flight conveyor **302**, and an oscillating distributor **304**. The receiving hopper **298** includes a flight conveyor **306** which moves the intact leaves backward and up an inclined portion such that a thinner layer of leaves are fed on into the cutting apparatus. As the leaves move up the inclined portion, excess leaves are swept back into the hoppere **298** by the counter rotating paddle wheel **308**. Both the paddle wheel **308** and the flight conveyor **306** may be driven by the electric motor **308'** and suitable sprocket or belt drives. The intact leaves from flight conveyor **306** are deposited into the feed supply bin shown generally at **310**, where they are fed into the cutting apparatus **300**. The specific design of the cutting apparatus may be the same as depicted previously in FIGS. **7–11** and will not be further discussed here. Suitable electric motors are mounted to drive the corresponding conveyor and cutting apparatus and the cut strips fall onto flight conveyor **302** which deposits them into the oscillating distributor **304** for filling of the module **94**. The flight conveyor **302** is driven by a suitable electric motor shown at **312** and the oscillating distributor **304**, as before, is driven by a suitably powered reciprocating unit such as the hydraulic cylinder **288**, having separate hydraulic power unit with reciprocating controls, not shown. The tobacco is distributed into both compartments of the module **94** which includes a top sleeve **96** for overfilling prior to pressing. The module rests, as before, on the roller conveyor portion **288** of a press apparatus of the form of FIGS. **12–14** and pressing, capping, etc. are carried out as hereinbefore set forth.

A further modified form of the present invention will be described in reference to FIGS. **23** through **25** wherein the basic harvester D for intact leaves is modified on the rear portion to convey the leaves to a side connected trailer which includes equipment for cutting, elevating and distributing into the module.

The harvester portion, as illustrated in FIGS. **23–25**, is similar to that of FIG. **20** in that the harvested intact leaves are conveyed upwardly on the rear of the machine by means of conveyor **290** and the press rollers **292**. The leaves are, however, deposited in this case from the discharge ducts **314** directly onto a cross conveyor **316**. In order to support the cross conveyor **316**, the top frame support members **12** of the harvester are extended to the rear and are provided with several vertical support members **318** at three locations along each side of conveyor **316**. The conveyor frame **320** may be constructed of any suitable sheet metal, reinforced as necessary, and providing a wall height above the conveyor belt **316** sufficient to contain the leaves during their passage to the side trailer.

The conveyor **316** is driven by a hydraulic motor **322** suitably connected by chain or belt drive to the end roller **324** of the conveyor. The intact leaves from conveyor **316** fall through an oscillating distributor vane **326** which places leaves uniformly onto the receiving belt conveyor of the side attached apparatus. This vane **326** is preferably driven by the hydraulic cylinder **32'** powered from the main hydraulic source on the harvester, including an oscillating control unit. The cylinder **328** is mounted as shown to the support member **318** and linked to the distributor vane **326**.

In order to pull the connected trailer with the harvester, it is necessary to provide for side connection with the trailer moving in the skip row. Since the illustrated harvester straddles two rows, for simplicity of operation, the tobacco to be harvested using apparatus of this form of the invention should be planted with the pattern of 2 rows and a skip row. A side connector frame **330** is therefore provided which may be removably attached or welded securely to the harvester frame members **38**. A hole is provided near the outer end of the connector frame **330** to permit attachment of the trailer.

The side-connected harvest-trailer is shown generally at **332** and includes a frame or platform **334** suitably rotatably mounted via axle **336** and wheels **338**. The platform **334** provides means for mounting the receiving conveyor **340**, cutting apparatus shown generally at **342** and the flight conveyor **344**. The rear portion of the platform **334** includes several elongated rollers **346** such that a module **94** can be simply rolled into position, beneath the oscillating distributor **348**, from a module transport trailer.

The harvest-trailer **332** includes a front connecting bar **350**, rigidly mounted to the platform **334**, which permits connection to the harvester connector frame **330**, by means of a suitable belt or pin.

In operation, the intact leaves from the cross conveyor **316** are deposited onto the receiving conveyor **340**. The leaves move backwardly on conveyor **340**, beneath the press roll **352**, and on into and through the cutting apparatus **342**. The details of the cutting apparatus is generally the same as described in reference to FIGS. **7–11**.

Suitable hydraulic motors are mounted to drive the conveyor **340** and the cutting apparatus **342** and the cut strips fall onto flight conveyor **344** which deposits them into the oscillating distributor **348** for filling of module **94**. As previously discussed the distributor **348** is driven by a suitably powered reciprocating unit such as the hydraulic cylinder **354**, powered through the harvester hydraulic system. Also, the conveyor **344** is powered, for example, by the hydraulic motor **356**, having suitable chain or belt drive to the top roller of the conveyor. Tobacco is distributed into both compartments of module **94** which includes a top sleeve **96** for overfilling prior to pressing. The filled module is transported by separate trailer means to the curing facility where the press operation is conducted, utilizing equipment such as described previously in FIGS. **12–14**. The removable pin **358** at the rear of the harvest-trailer **332** retains the module **94** in proper position during filling with the front side of the module resting against the stop **360**.

From the foregoing general and detailed description of the various embodiments of the invention it will be seen that the aims and objects hereinbefore set forth and others are fully accomplished.

I claim:

1. A tobacco processing machine comprising a tobacco leaf defoliating means; means for transporting the defoliated leaves from said leaf defoliating means to an elevated position, first and second leaf cutters, means mounting said first and second leaf cutters in structural association with said leaf transporting means for cutting the leaves along mutually perpendicular planes as said defoliated leaves are being transported; and means for directing the cut leaves to bulk container filling means.

2. The tobacco processing machine as defined in claim **1**, including an oscillating distributor at said bulk container filling means to provide uniform distribution of the cut tobacco in the bulk container.

3. The tobacco processing machine as defined in claim **2**, wherein the bulk container comprises a tobacco curing module.

4. The tobacco processing machine as defined in claim **3** including a container filling sleeve having its lower end connected to the open end of the curing module.

5. The tobacco processing machine as defined in claim **4** including means for pressing the tobacco in said sleeve into the curing module.

6. The tobacco processing machine as defined in claim **1**, wherein the first leaf cutter comprises a plurality of spaced side-by-side disc cutters and said second leaf cutter comprises a rotating blade knife.

7. The invention defined in claim **1** wherein the means for transporting the defoliated leaves through the first and second leaf cutters comprise conveyor flights.

8. The invention defined in claim **7**, including leaf pressing means for holding the leaves to the surface of the conveyor flights of the transporting means for the defoliated leaves.

9. The tobacco processing machine as defined in claim **1**, wherein bulk container at the bulk container filling means comprises a temporary cut tobacco holding means.

10. The tobacco processing machine as defined in claim **1**, wherein any one of the transporting means includes bulk tobacco transporting means.

* * * * *