United States Patent [19]

Kolk et al.

[11] **3,872,805**

[45] **Mar. 25, 1975**

[54] **PLANTING MACHINE**

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[21] Appl. No.: **218,698**

[52] **U.S. Cl.** **111/2,** 111/91, 111/77

[51] **Int. Cl.** **A01c 5/00**

[58] **Field of Search** 111/77, 2, 3, 89, 90, 91

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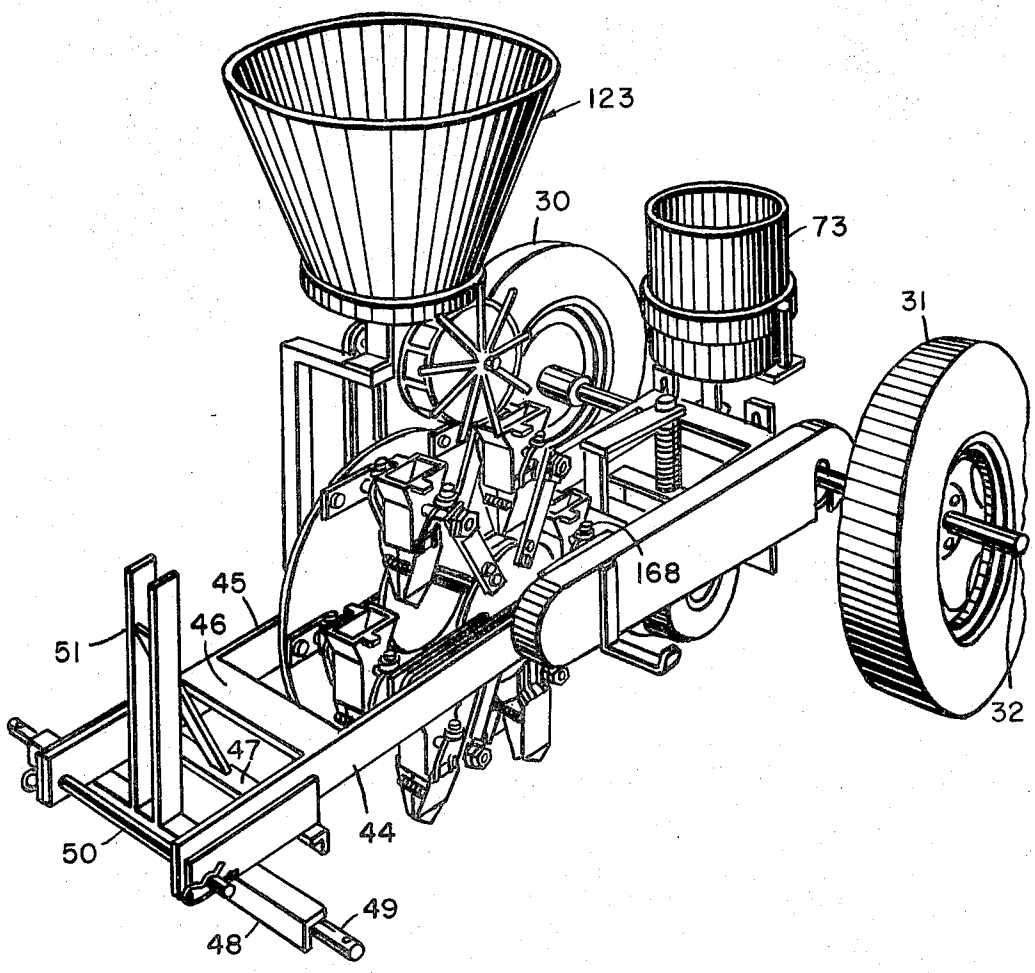
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Primary Examiner—Stephen C. Pellegrino

[57] **ABSTRACT**

A machine capable of planting earth-seed mixture, potted plants, and rooted plants has a group of receptacles for receiving items for planting. These receptacles are provided with discharge chutes movable from a pointed closed position to an open discharge position. The receptacles are mounted on a carrier mechanism that maintains a vertical orientation of the receptacles, and forces the discharge chutes to penetrate the ground surface as the machine holds the relative horizontal speed of the receptacles at zero with respect to the ground.

5 Claims, 21 Drawing Figures



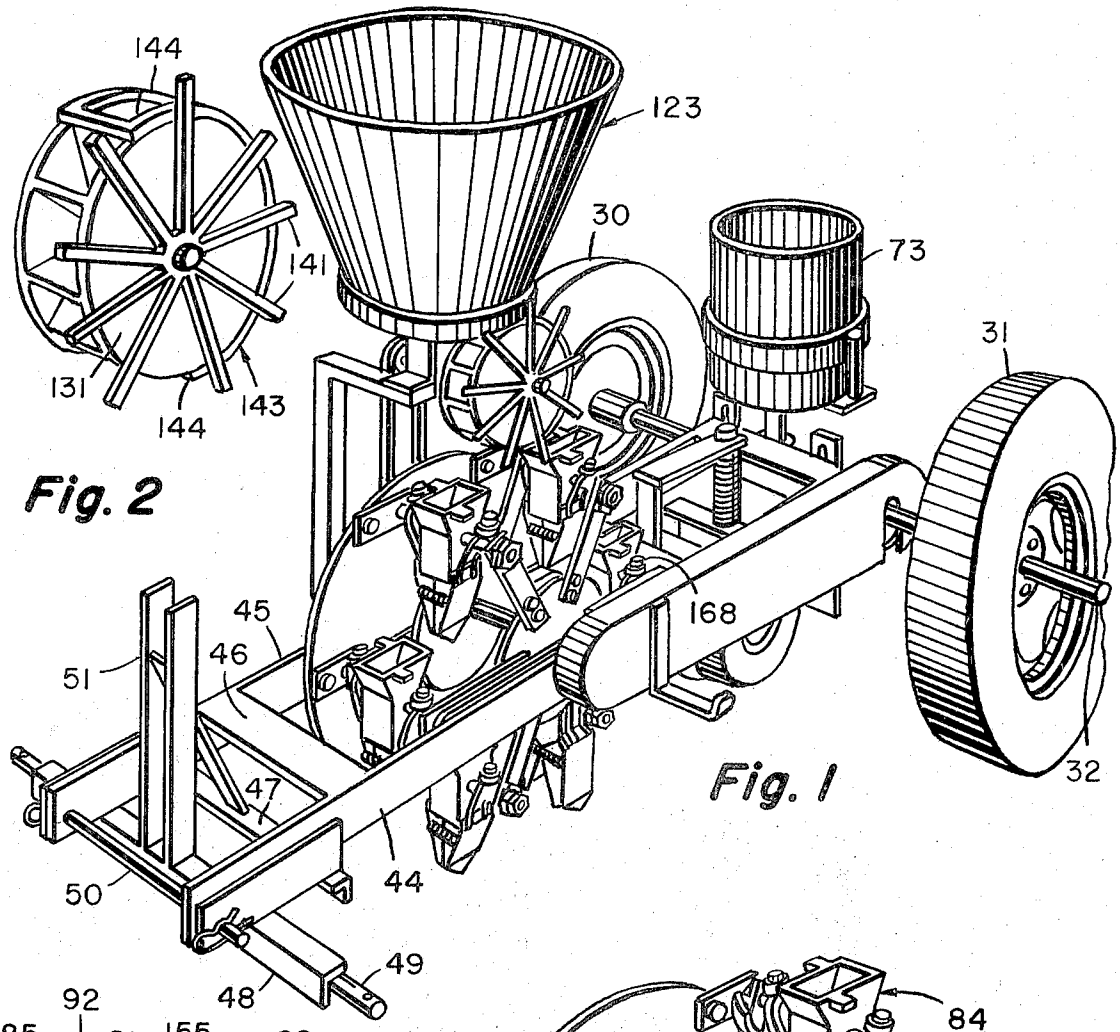


Fig. 2

Fig. 1

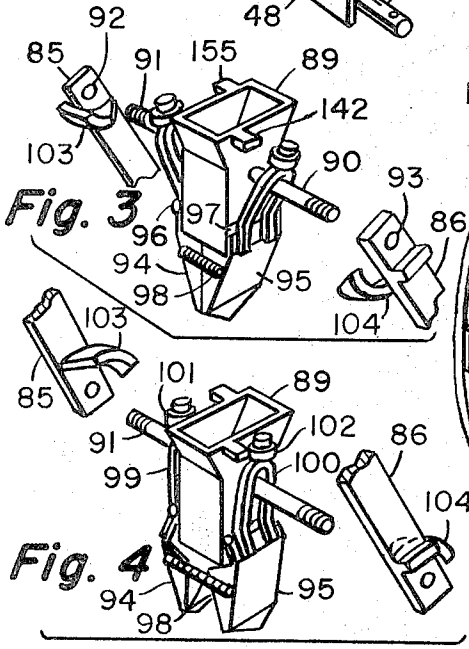


Fig. 3

Fig. 4

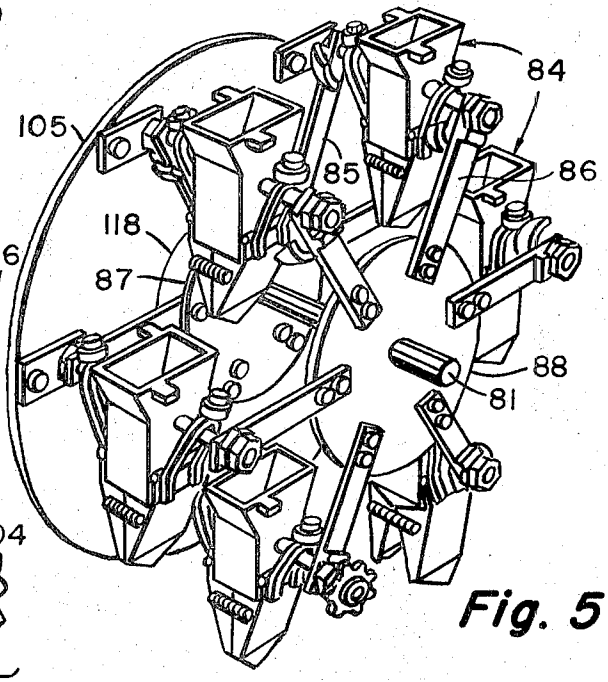


Fig. 5

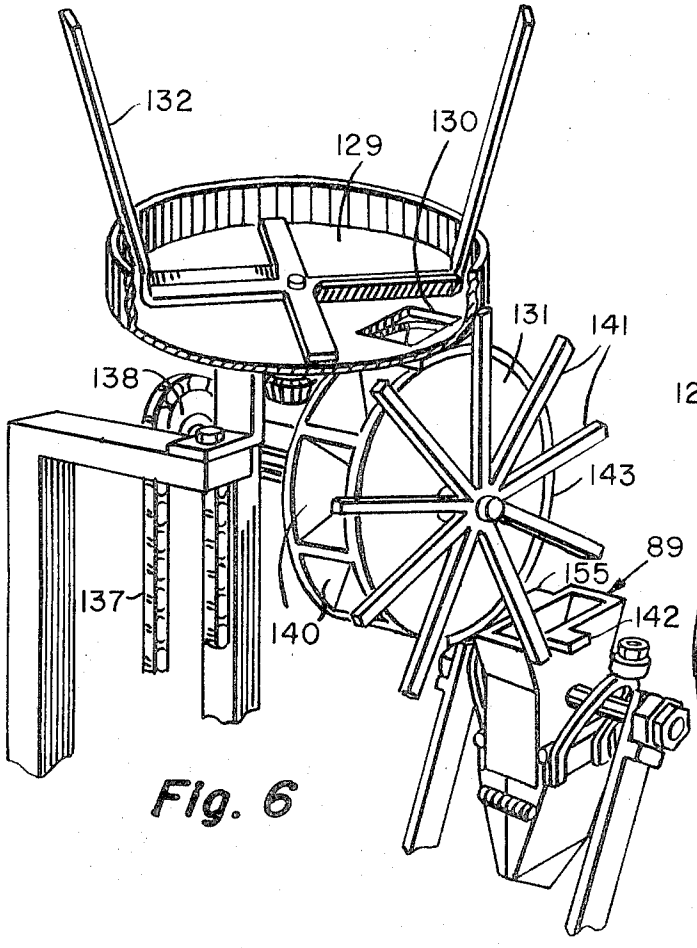


Fig. 6

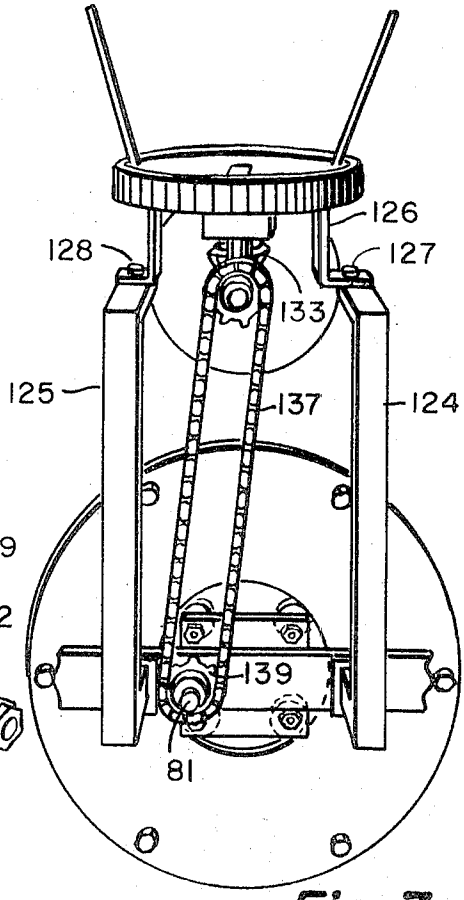


Fig. 7

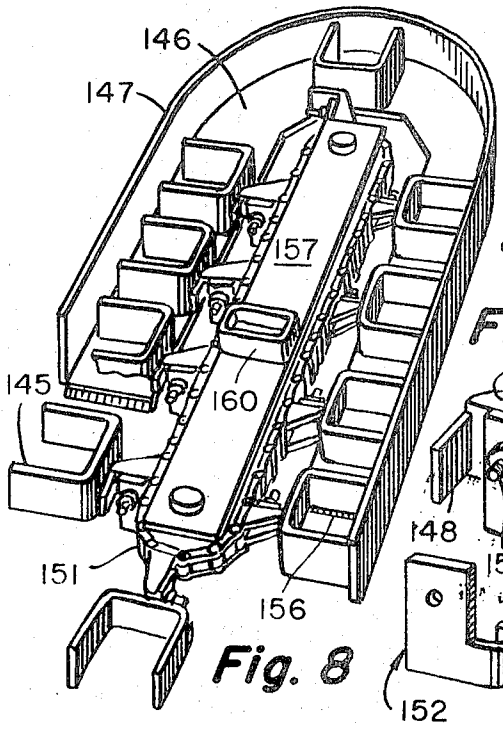


Fig. 8

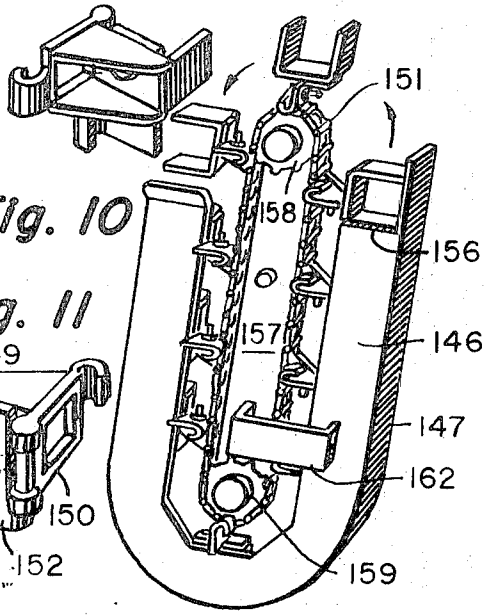


Fig. 9

Fig. 10

Fig. 11

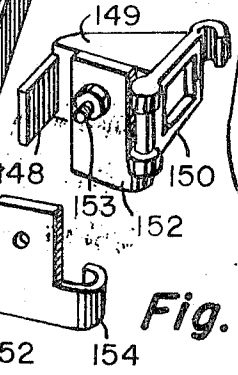


Fig. 12

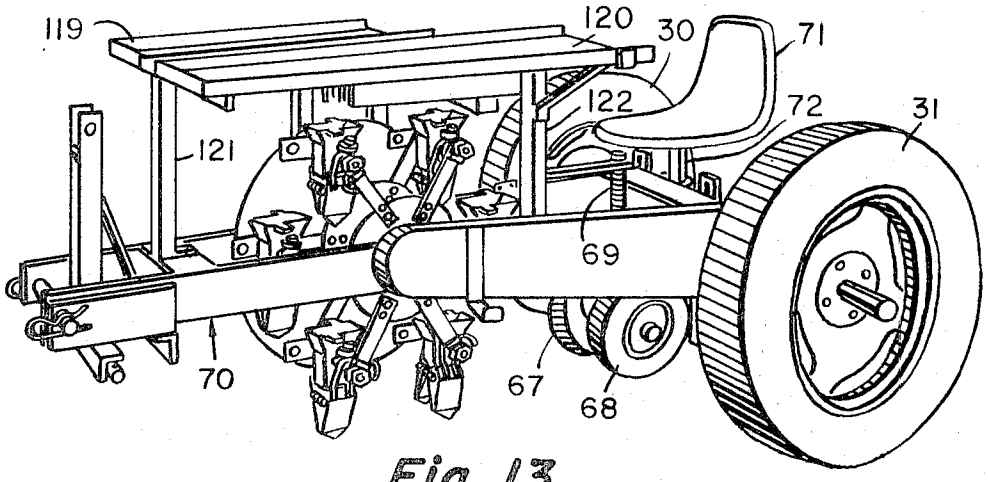

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Fig. 13

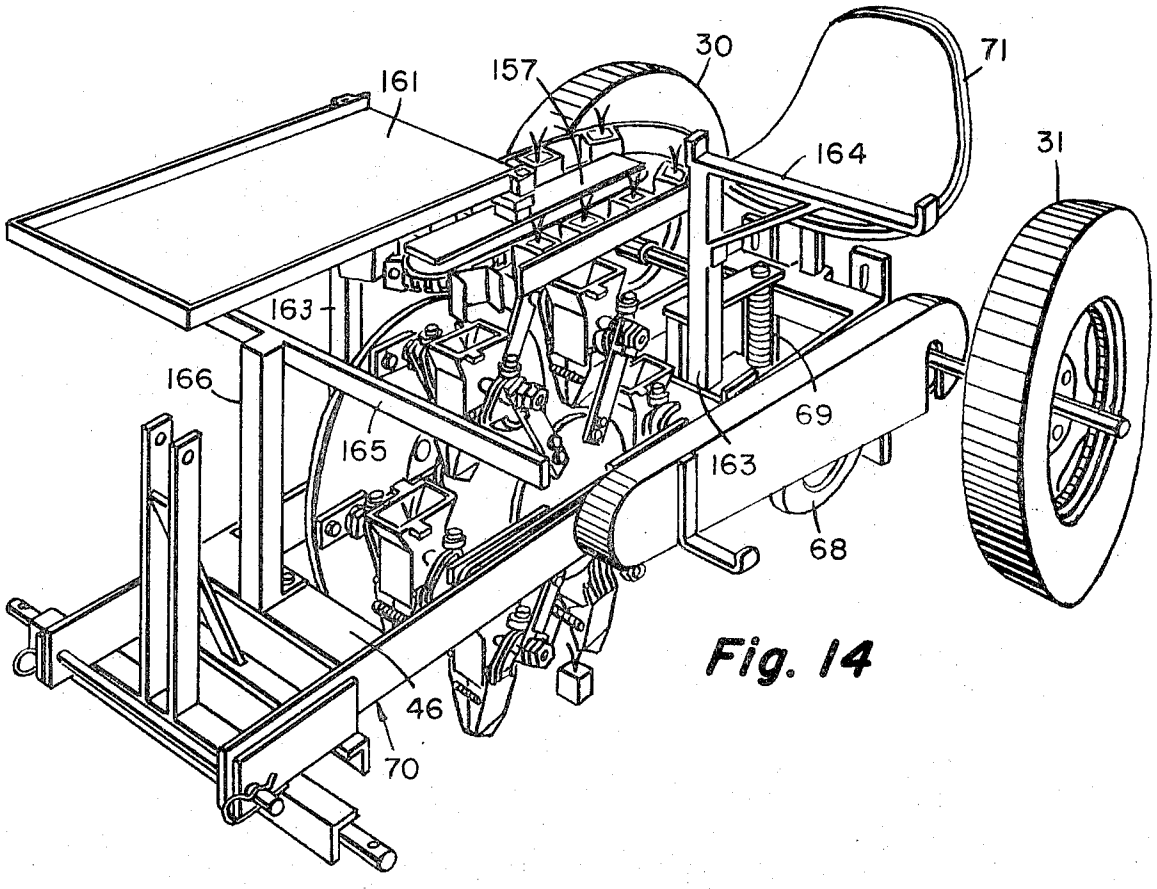

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Fig. 14

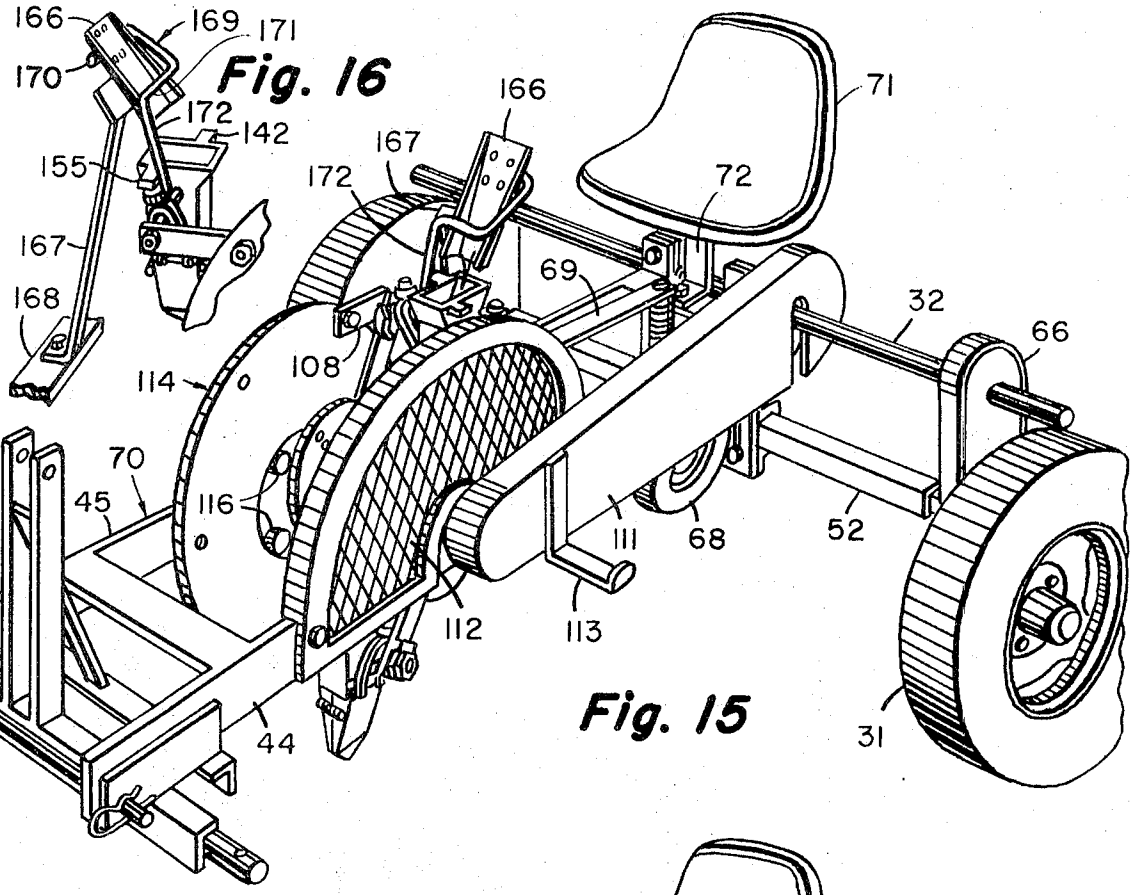


Fig. 16

Fig. 15

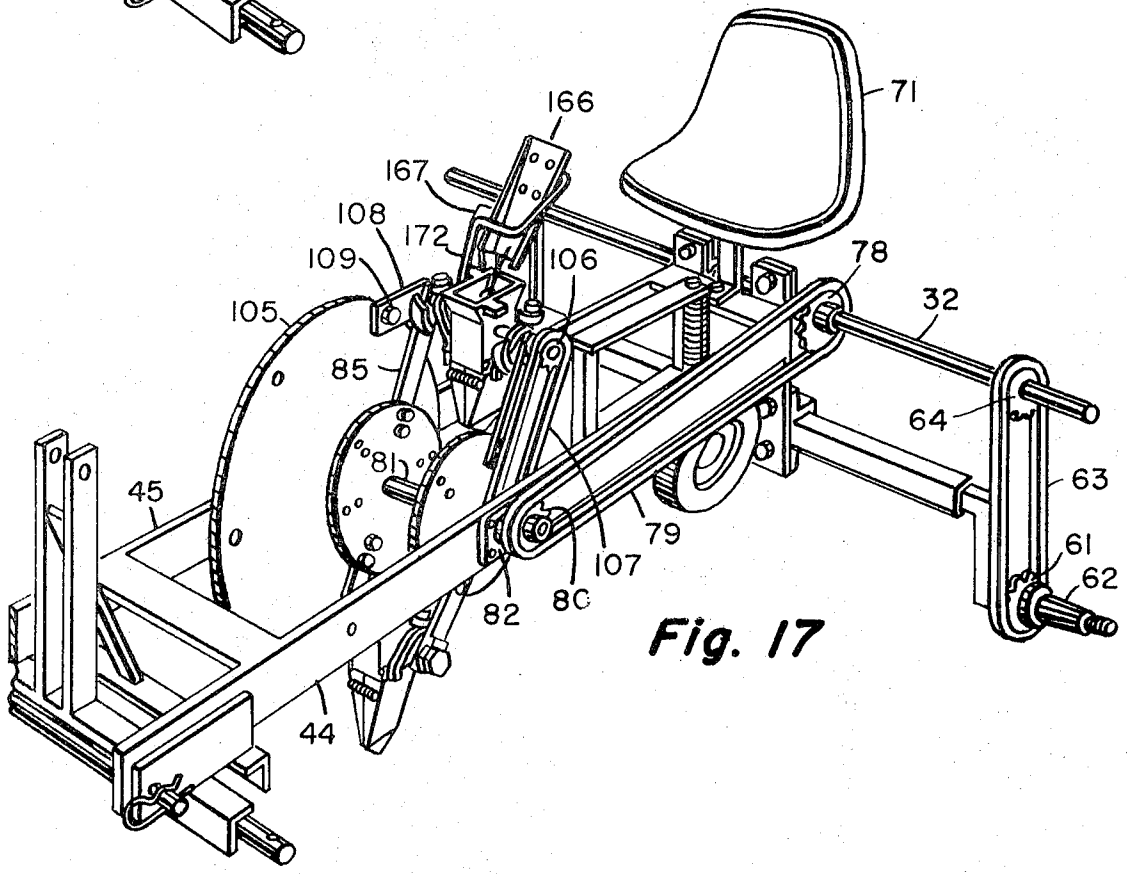


Fig. 17

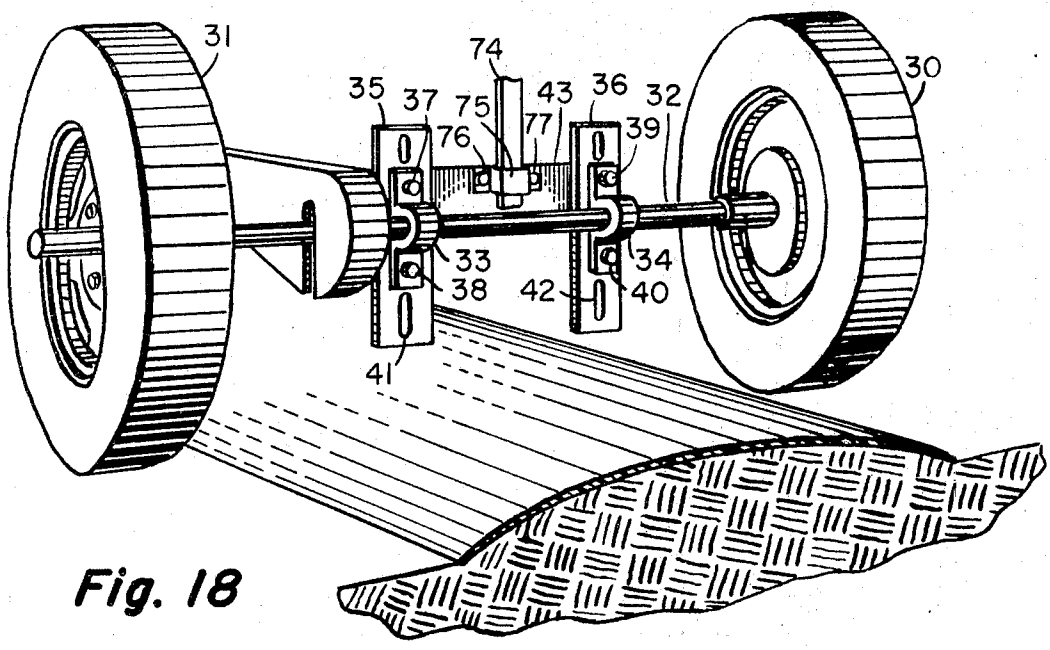

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Fig. 18

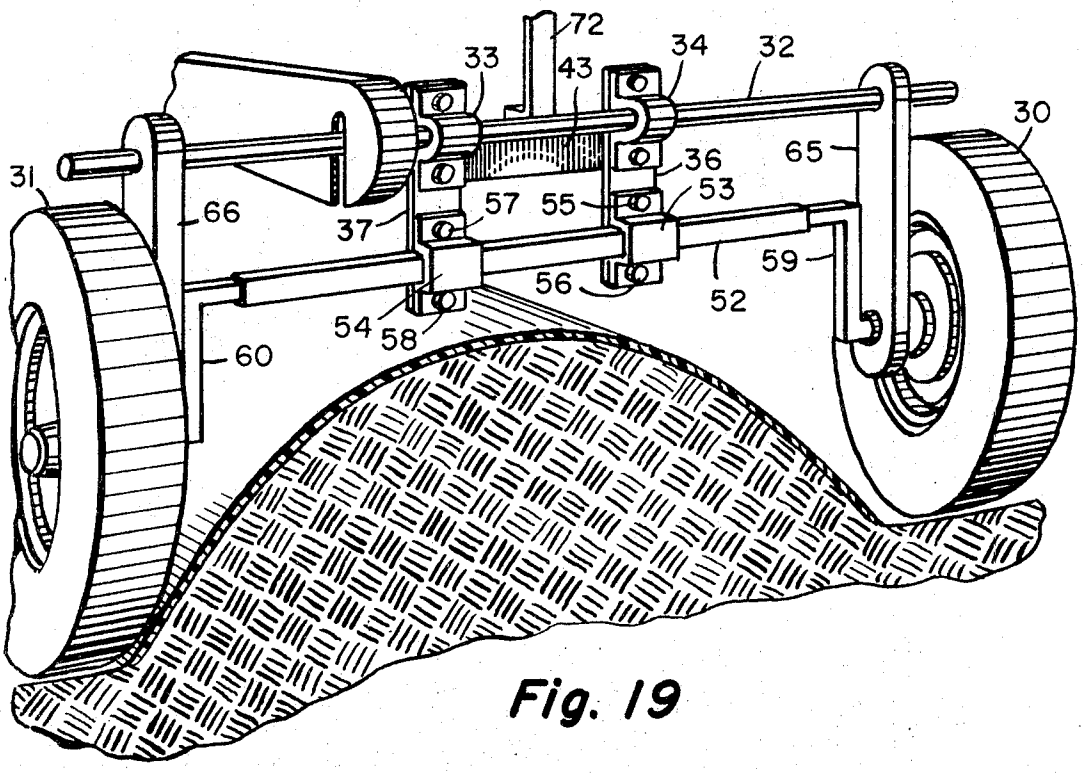

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Fig. 19

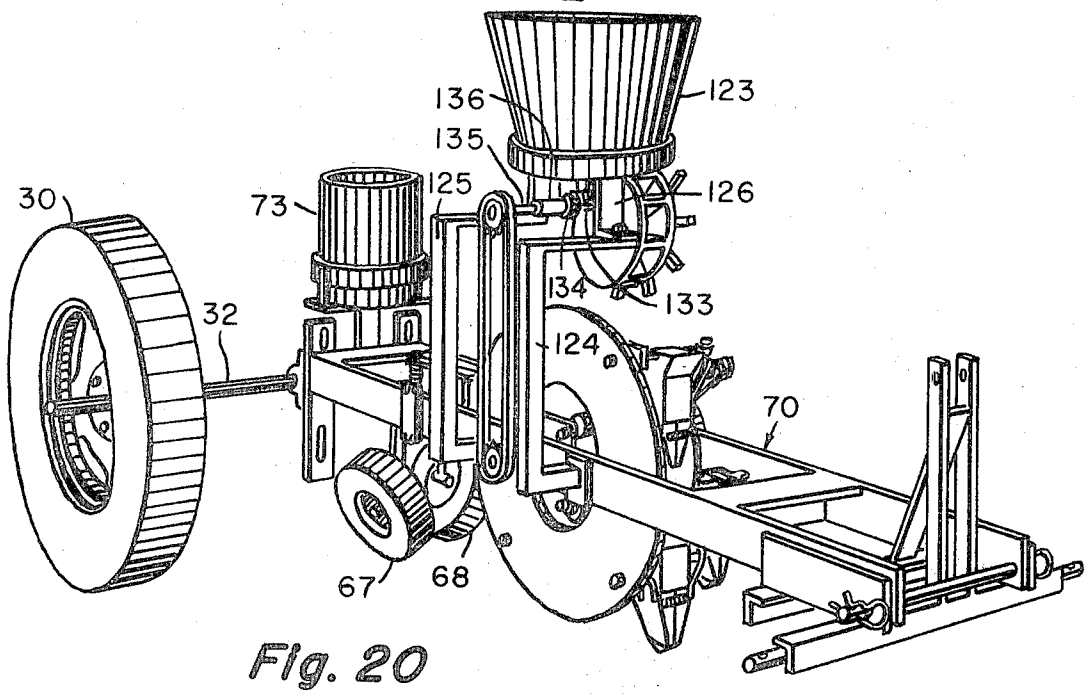

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Fig. 20

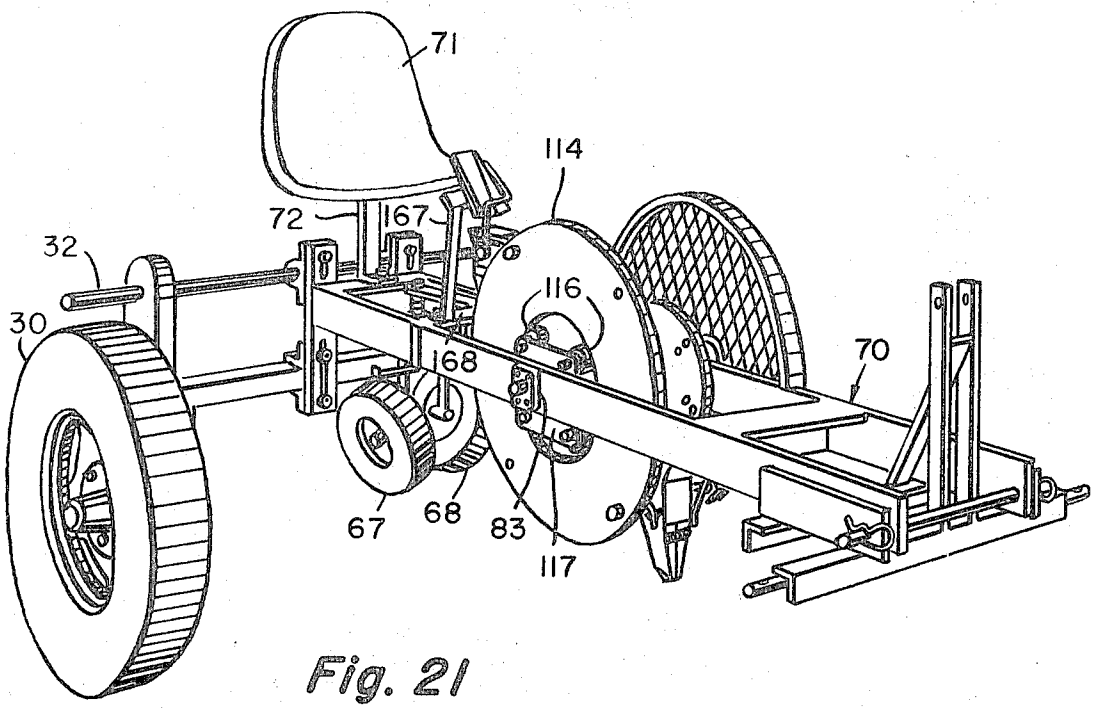

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Fig. 21

PLANTING MACHINE

BACKGROUND OF THE INVENTION

The general tendency toward the automation of all agricultural operations has resulted in a variety of planting machines. Seed planters normally include a mechanism for extracting seeds from a hopper, and planting them at even spacing along one or more straight lines. Machines for planting growing plants are more accurately described as transplanters, and the most widely used of these machines utilizes a group of plantcarrying arms that are individually loaded by an operator, the machine being adapted to place the plants in position as the machine moves forward. Conventional seed planters and plant transplanters normally utilize a plow or diverging blades to open a furrow to receive the planting, followed by a closure device to fill in the earth behind the planting action.

One of the relatively new developments in agricultural procedures is the practice of covering the earth with long and relatively wide strips of plastic material a few thousandths of an inch thick at the most, with the nature of this material being selected to control the degree of light transmission and the tendency to generate heat. The general purpose behind this practice is to shield the soil from the evaporation of moisture, as well as control the erosion effect from heavy rain storms and high winds. In the use of this agricultural technique, it is the usual practice to form the surface of the ground into long parallel ridges having a sine-wave configuration in cross-section. The height from trough to crest may vary, but will usually be on the order of a foot or less. Water then tends to accumulate in the trough areas, and to seep into the surrounding ground in a desirable manner, particularly if the width of the plastic sheets is such as to cover the crest areas, and overlap in the trough areas. It has been found desirable to prepare the ground in this manner, and to perform the planting operations directly through the sheets of plastic material. This arrangement obviously obsoletes the general practice of planting in conjunction with opening and closing a furrow.

Other comparatively recent developements in agricultural procedures, or rather the relatively recent emphasis on practices that have been known for quite some time, include the planting of seeds in a previously-prepared seed mix of earth, seed, and fertilizer. Another such practice is the planting of rooted plants with the inclusion of some of the earth within which the plant grew from seed. None of these agricultural procedures appear to be effectively accomodated by planting machines in current use.

SUMMARY OF THE INVENTION

A planting machine embodying the present invention includes one or more receptacles in which the planted items are deposited, and a mechanism for positioning and actuating these receptacles so that the planted item is discharged at regular intervals along the line of movement of the machine. The receptacles are each provided with a discharge chute movable from a pointed closed position to an open discharge position. This discharge chute is stabbed downwardly by the normal operation of the machine so that it penetrates ground level, and is then actuated to open position to permit the release of its contained item. This is followed by closure and withdrawal of the discharge chute as the machine continues in its operation. An orienting mechanism maintains the vertical position of the receptacles as they move from loading to the planting station just described. In the preferred form of the invention, the carrier for the receptacles is a rotary assembly, and the movement of the receptacles may be considered as orbital and non-rotative with respect to the horizon. This relationship is maintained preferably by either of two arrangements, one of these involving a link means relating the receptacles to one master receptacle, which is positioned by a sprocket maintained in fixed angular relationship with the horizon by a chain drive associated with a fixed sprocket coaxial with the rotor. The alternative arrangement involves the use of a control plate rotating on an axis eccentric with respect to that of the carrier rotor, with the receptacles being positioned by the interengagement of crank arms with points of connection on the eccentric plate.

The deposit of items for planting into the receptacles takes place under the action of three different types of mechanism. The first of these includes a hopper-fed system for depositing selective quantities of seed mix in each of the receptacles at the loading station. A second modification includes a device for selectively depositing potted plants in their receptacles, and the third arrangement involves an automatically released holding system for the placement of rooted plants in the receptacles. The arrangement involving the hopper supply for seed mix is entirely automatic, with the other two arrangements requiring the services of an operator.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the first modification of the machine, which is adapted for hopper-fed planting of seed mix.

FIG. 2 is a view on an enlarged scale of the transfer device for shifting the hopper material from the hopper over to the receptacles.

FIG. 3 is an exploded view showing the components of one of the receptacles, and its associated support and actuating members.

FIG. 4 is a view of the components shown in FIG. 3, with the discharge chute of the receptacle actuated to the open position.

FIG. 5 is a perspective view of the rotor assembly.

FIG. 6 is a fragmentary view on an enlarged scale showing the components of the machine responsible for the transfer of material within the hopper over to the receptacles.

FIG. 7 is a side elevation of the mechanism shown in FIG. 6.

FIG. 8 illustrates a modification of the invention, incorporating a device for successively depositing potted plants in the receptacles.

FIG. 9 is a perspective view, partially in section, of the underside of the mechanism shown in FIG. 8, on a slightly reduced scale.

FIG. 10 is a view on an enlarged scale of the bracket mounted on the chain of the mechanisms shown in FIGS. 8 and 9 for supporting the plant-locating members.

FIG. 11 illustrates the attachment of the FIG. 10 device to the conveying chain.

FIG. 12 is a perspective view showing the actuating member associated with each of the FIG. 10 subassemblies for cooperation with the receptacles mounted on the rotor.

FIG. 13 is a perspective side elevation of a modified form of the invention adapted for use in conjunction with the planting of potted plants.

FIG. 14 is a perspective view of a machine similar to that shown in FIG. 13, with a storage tray removed.

FIG. 15 is a perspective view of portions of the planting machine, illustrating the relationship of the FIG. 16 mechanism and the remainder of the machine.

FIG. 16 is a perspective fragmentary view showing a further modification of the invention adapted to accomodate the planting of rooted plants.

FIG. 17 illustrates a further modification of the invention with regard to the receptacle-orienting mechanism.

FIG. 18 is a fragmentary perspective view showing the relationship of the machine's wheel assembly with respect to the ground formation.

FIG. 19 is a view similar to FIG. 18, showing the wheel assembly in conjunction with a ground formation having a higher degree of curvature, illustrating the application of an auxiliary power-transfer system to accomodate the necessary offset axle system.

FIG. 20 is a perspective view of the hopper-fed modification of the machine, from the opposite side of the machine from that of FIG. 1, and illustrating a modified form of the receptacle-orienting components.

FIG. 21 is a perspective view of the mechanism shown in FIG. 15, from the opposite side of the machine.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The machine illustrated in FIG. 1 is incorporated in a trailer vehicle having the ground wheels 30 and 31 mounted on the transverse axle 32. This axle is rotatively supported by the bearing blocks 33 and 34 (refer to FIG. 18) mounted respectively on the brackets 35 and 36. These bearing blocks may be placed at various vertical positions by engaging the mounting bolts 37–38 and 39–40 with certain of the holes 41 or 42. The brackets are preferably welded to the rear member 43 of the vehicle frame, which also includes the side members 44 and 45, and the transverse members 46–48. The rods 49–50 and the vertical structure 51 cooperate with the standard coupling structure of a towing vehicle (not shown).

Where the vehicle frame must accomodate particularly high configurations of ground contour, as shown in FIG. 19, the rear portion of the frame is modified by the inclusion of an offset axle assembly including the central tube 52 secured to the brackets 36 and 37 by the clamps 53 and 54 held, respectively, by the bolts 55–56 and 57–58. The offset sections of the axle assembly indicated at 59 and 60 are secured in any convenient manner to the tube 52, and conventional axle fittings (not shown) are mounted at the outer extremities of the axle sections 59 and 60 for rotatably supporting the wheels 30 and 31. The effect of this arrangement is obviously a greater accomodation of the vehicle to ground contour between the wheels 30 and 31, and it is preferable that the spacing between the wheels be variable by providing a freedom of adjustment in an axial direction between the offset end members 59 and 60 and the central tube 52. Since the operating mechanism of the machine is driven by the wheels 30 and 31, the FIG. 19 arrangement is provided with a power take-off best illustrated in FIG. 17. Sprockets 61 are affixed with respect to the stub shaft assemblies 62 supporting the wheels 30 and 31, and chains 63 transfer power to the shaft 32 through the sprockets 64 secured to this shaft. These chains and sprockets are preferably covered by the guard housings 65 and 66 shown in FIG. 19. The associated structure of the vehicle may also be considered to include the compacting wheels 67 and 68 mounted on a vertically resilient assembly generally indicated at 69 secured to the frame of the vehicle indicated at 70. These wheels have the function of pressing the earth together after the planting action has taken place. The seat 71 is also a desirable part of the vehicle structure, except in the modification illustrated in FIG. 20. This seat is secured to the bracket 72 mounted on the cross member 43 of the frame. In the FIG. 20 modification, the area occupied by the seat 71 is utilized by the ballast tank 73, which may be loaded with whatever material is convenient to increase the traction of the wheels 30 and 31. The tank is supported on the strut 74 secured to the cross member 43 of the frame by the clamp 75 held by bolts as shown at 76 and 77 in FIG. 18.

The active mechanism of the machine is provided with power from the shaft 32 through the sprocket 78 and the chain 79, which engages the sprocket 80 of the rotor shaft 81 mounted in the bearing brackets 82 and 83 secured respectively to the side members 44 and 45 of the frame 70. This shaft traverses suitable openings in these frame members. The rotor assembly shown in FIG. 5 includes a plurality of the receptacle sub-assemblies 84. These are disposed at an even angular spacing around the axis of the shaft 81, and are pivotally supported between radially extending pairs of arms as shown at 85 and 86 secured respectively to the end plates 87 and 88, which are fixed with respect to the shaft 81 in any convenient manner. The receptacle sub-assemblies are similar in construction, and are best shown in FIGS. 3 and 4. An open-topped box structure 89 is preferably outwardly flared, and is provided with the coaxial stub shafts 90 and 91 extending from opposite sides, and rotatably received by the arms 85 and 86 at the holes indicated respectively at 92 and 93. The clam shell sections 94 and 95 are hinged to the box portion 89 at 96 and 97, respectively, to form a discharge chute capable of swinging from the pointed closed position shown in FIG. 3 to the open discharge position of FIG. 4 against the action of the closure spring 98. The "U"-shaped arms 99 and 100 are secured respectively to the chute sections 94 and 95, and are provided with cam follower rollers 101 and 102 cooperating respectively with the cams 103 and 104 mounted on the radial arms 85 and 86. In the inverted condition of the arms, as shown in FIG. 4 (corresponding to the placement of the receptacle sub-assemblies at the lowermost position on the rotor assembly shown in FIG. 5) the cams 103 and 104 interact with the follower rollers 101 and 102 to induce the opening of the chute sections to the FIG. 4 position. The passage of the particular receptacle sub-assembly beyond this position brings the follower rollers 101 and 102 beyond the point of influence by the cams 103 and 104, permitting the spring 98 to return the chute sections to the closed position of FIG. 3.

Orientation of the receptacle sub-assemblies is provided, in the FIG. 5 modification, by the link plate 105 and a master receptacle sub-assembly having a sprocket 106 (refer to FIG. 17) interrelated with a fixed sprocket, secured to the side-member 44 of the

frame, by the chain **107**. The sprocket **106** and the fixed sprocket (not shown) are the same pitch diameter, resulting in an orbital movement of the master receptacle sub-assembly which is nonrotative with respect to the horizon. The stub shafts **91** of each of the receptacle sub-assemblies is provided with a crank arm **108** pivotally connected to the link plate **105** by a bolt **109** interengaged with one of the holes **110**. These holes in the link plate are evenly spaced about the center of the plate, with a number corresponding to the number of the receptacle sub-assemblies. In the modification illustrated in FIG. **17**, the link plate is not supported by any structure other than the interengagement with the crank arms **108**. The function of this plate is exactly the same as if each of the crank arms was connected to an adjacent crank arm by a separate link. This linkage effect results in the remainder of the receptacle sub-assemblies being conformed in orientation to the position of the master receptacle sub-assembly controlled by the chain **107**. It is preferable that the principal moving parts of the machine be covered by the chain guard **111** and the screened rotor guard **112** secured in any convenient fashion to the frame structure **70** of the machine. The step bracket **113** is also preferably incorporated to assist the operator in taking his position in the seat **71**.

An alternative arrangement for maintaining the vertical orientation of the receptacle sub-assemblies is shown in FIGS. **15, 20,** and **21**. In this modification, the plate **114** is also pivotally connected to the crank arms **108** in the same manner as is the the link plate **105**. The plate **114**, however, is rotatively supported on a fixed axis by the interengagement of the central opening **115** with a set of four rollers **116** rotatively mounted on stub shafts secured to the plate **117** attached to the side member **45** of the machine. The axis of rotation of the plate **114** is displaced forwardly with respect to the frame from the axis of the rotor shaft **81** by an amount equal to the distance between the axis of the receptacle shafts **91** and the holes in the crank arms **108** receiving the connecting bolts **109**. With this arrangement, the orientation of the receptacle sub-assemblies is provided without the use of the sprocket **106** and the chain **107**. A central hole **118** in the link plate **105** is provided for clearance only, as it is traversed by the shaft **83**. (See FIG. **5**)

In the modification illustrated in FIG. **13**, potted plants are arrayed on the trays **119** and **120** supported by the columns **121** and **122** secured to the frame structure **70**. Plants placed on these trays are manually removed by an operator in the seat **71**, and successively placed in the receptacle sub-assemblies as the rotor is controlled by the power-transfer system between the wheels **31-32** and the shaft **81** so that the velocity of the lowermost receptacle sub-assembly on the rotor has substantially zero velocity with respect to ground. The vertical placement of the axis of the rotor shaft **81** is such as to cause the pointed configuration of the chute sections **94** and **95** to penetrate ground level and deposit the contents of the receptacle in the resulting opening in the ground.

In the modifications shown in FIGS. **1, 6, 7,** and **20**, the functioning of the rotor is the same, but the receptacles are loaded by the system beginning with the hopper **123**. This unit is supported on the structure provided by the vertical beams **124** and **125** and the bracket **126**. The feet of this "U"-shaped bracket structure are secured to the horizontal upper extremities of the members **124** and **125** by bolts shown at **127** and **128**. the bottom **129** of the hopper **123** has a discharge opening **130** directly above the transfer reel **131**. The agitator **132** is driven by the bevel gear **133** receiving torque from the mating bevel gear **134** mounted on the shaft **135**. This shaft is rotatively supported in a bearing **136** fixed with respect to the hopper structure, and is driven by the chain **137** and the sprocket **138**. This power-transfer structure for the operation of the hopper mechanism originates with the sprocket **139** mounted on the shaft **81**.

The output of the hopper system is received within the pockets **140** of the transfer reel **131**, through the opening **130**. The reel **131** is moved intermittently by a Geneva mechanism including the spokes **141** and the projections **142** associated with each of the receptacle sub-assemblies. At each passage of one of these projections **142**, the reel **131** is indexed by an angular amount corresponding to the spacing between the spokes **141**. Each of these movements brings the contents of one of the pockets **140** within the pockets over a sector of approximately 180° from the opening **130** down to a point opposite the path of movement of the top of the receptacles **89**. The rotation of the transfer reel is clockwise, as viewed in FIGS. **1, 2,** and **6**. the arcuate shield **143** has a top opening, as shown at **144** registering with the discharge opening **130** in the hopper unit. FIG. **2** illustrate the relationship between the rotatable transfer reel **131** and the fixed arcuate shield **143**, the lower extremity of this shield being indicated at **144**.

FIGS. **8** through **12** illustrate the modification of the invention adapted to accomodate potted plants, these normally having a quantity of earth surrounding the root structure. An operator riding in the seat **71** will normally place these plants within one of the "U"-shaped conveying receivers **145** moving along the shelf **146** surrounded by the fence **147**. The receivers **145** are secured to the tabs **148** of the brackets **149** mounted on selected links **150** of the conveying chain **151**. The actuating members **152** are secured to the brackets **149** by bolts as indicated at **153**, and the portions **154** of the actuators are disposed in the path of movement of the tabs **155** associated with each of the receptacles **89**. With the receptacle provided with both tabs (**142** and **155**), a machine can be adapted very easily to the use of either the hopper arrangement shown in FIG. **1**, or the conveyor system shown in FIGS. **8–12** and **14**. Each passing receptacle assembly will index the conveying chain **151** by one space, and move the contents of one of the receivers **145** beyond the edge **156** of the shelf **146**. The central beam **157** of the conveyor assembly rotatably supports the sprockets **158** and **159** positioning the conveying chain **151**, and this central beam is connected by the short post **160** extending from the structure supporting the tray **161**. The cross-tie **162** (refer to FIG. **9**) on the underside of the assembly interrelates the beam **158** with the shelf **146**, the fence **147** also being connected to the post **163** (refer to FIG. **14**) mounted on the framework **70** of the vehicle. The structure supporting the tray **161** is similar to that shown at the right side of FIG. **14** at the top of the post **163**. A tray similar to the tray **161** will normally be received by the beam **164** at the top of the post **163**, and by the right-hand extremity of the beam **165** mounted on the top of the post **166** secured to the transverse member **46** of the frame **70**. Normally, a

case of potted plants can be placed on the trays **161**, with the contents being placed by the operator within the confines of the conveyor receivers **145** as the machine continues its operation.

FIG. **15–17** illustrate a further modification in the arrangement for delivering planted items into the rotor receptacles. A chute plate **166** is secured to a strut **167** mounted on the transverse member **168** of the frame **70.** A holding member **169** is bent to the configuration shown in FIG. **16** from rod material, and has a journal portion **170** rotatively received in a suitable bearing mounted on the underside of the plate **166.** A holding portion **171** of the member **169** extends across the top of the chute plate **166,** with the force of gravity on the member **169** normally being sufficient to hold a rooted plant in position until one of the tabs **155** contacts the portion **172,** rotating the holding member **169** in a counterclockwise direction as viewed in Fig. **16,** to release the restraining action on a rooted plant held in the chute **166.** The placement of this chute is directly above the path of movement of the receptacles, and the timing is such as to deposit the plant directly in the receptacle as it passes by. The operator will normally manually load the chute **166,** accompanied by suitable actuation of the holding member **169** to place the plant in condition for operation of the machine.

We claim:

1. A planting machine including vehicle means having a normal direction of movement over a ground surface, a rotary assembly having a frame rotatably mounted on said vehicle means on a horizontal axis of rotation transverse to said direction of movement, and drive means for said rotary assembly, wherein the improvement comprises: at least one receptacle rotatably mounted on said rotary assembly, said receptacle having trap door means at the bottom thereof at least in part defining a downwardly pointed configuration at the lower extremity of the rotary path of movement of said receptacle, said axis of rotation being disposed to cause penetration of ground by said pointed configuration;

orienting means mounted on said vehicle means interrelating said receptacle and said vehicle means, and maintaining a substantially constant position of said receptacle during the rotation of said rotary assembly;

synchronizing means incorporated in said drive means interrelating the movement of said vehicle means and said rotary assembly to establish a substantially zero velocity of said receptacle means with respect to ground at the lower extremity of said rotary path of movement;

actuating means having components mounted on said vehicle means and receptacle means, respectively, and operative to induce said trap door means to open exclusively at an adjacent said lower extremity;

hopper means mounted on said vehicle and located generally above said rotary assembly; and

transfer means operative to remove a predetermined quantity of material from said hopper means and transfer the same to said receptacle means in an upper portion thereof, said transfer means including a rotary member having end-plates and mounted for rotation on a horizontal axis, and also having a plurality of outwardly-open pockets between said end-plates, said rotary transfer member being vertically interposed between said outlet and the path of movement of the top of said receptacle at the upper positions thereof, said transfer means further including a shield disposed to close off the opening of said pockets around a section of rotation of said rotary transfer member sufficient to induce said pockets to dump the contents thereof exclusively into said receptacle, and means synchronizing said transfer means and said rotary assembly, said synchronizing means including a Geneva mechanism incorporating a portion of said receptacle and angularly spaced arms extending from said rotary transfer member.

2. A planting machine, comprising:

a main frame;

at least one set of ground-engaging wheels supporting said main frame;

a rotary assembly carried by said main frame and including a subframe connected to said main frame for rotation about a horizontal axis perpendicular to the direction of travel of said machine, a plurality of open topped receptacles each having a normally closed trap door at the bottom thereof and rotatably carried by said subframe, orienting means maintaining said receptacle in a vertical position and actuating means opening said trap door as said receptacle reaches the lower extremity of its path of movement;

drive means interconnecting at least one of said wheels and said rotary assembly effecting rotation of said rotary assembly in synchronization with vehicle movement;

a supply hopper having a discharge opening at the lower end thereof, mounted on said main frame and located generally above said rotary assembly; and

a transfer assembly mounted on said main frame and operable to transfer predetermined quantities of material from said supply hopper to said receptacle, said transfer assembly including a transfer wheel having a plurality of outwardly opening pockets, said wheel being located between said supply hopper and said receptacle whereby material may be transferred from said supply hopper to the uppermost of said pockets and from the lowermost of said pockets to the one of said receptacles at the uppermost limit of its travel, non-rotating shield means overlying the pockets intermediate said uppermost and lowermost pockets, and a plurality of radically extending spokes secured to and rotating with said transfer wheel and projecting so as to engage said receptacles as said receptacles move through the upper portions of their paths of travel.

3. The planting machine of claim **2** wherein said orienting means includes a first sprocket fixed with respect to said main frame, a second sprocket fixed with respect to one of said receptacles, and endless chain means interconnecting both of said sprockets, said rotary assembly further including a crank arm associated with each receptacle and fixed with respect thereto, said crank arms being interconnected by link means.

4. A machine as defined in claim **3** wherein said link means is a single plate.

5. A machine as defined in claim **4,** wherein said rotary assembly is mounted on a shaft, and said plate has a central clearance opening traversed by said shaft in all normal positions of said plate.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,872,805

DATED : March 25, 1975

INVENTOR(S) : Howard A. Kolk and Robert D. Kolk

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 53 --the (second occurrence)-- should be --these--

Column 6, line 29 - 30 --illustrate-- should be --illustrates--

Column 6, line 45 --receptacle-- (second occurrence) should be --receptacles--

Claim 2, line 49 --radically-- should be --radially--

Signed and sealed this 17th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks