United States Patent

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[45] Patented Aug. 10, 1971

[54] MACHINE FOR HARVESTING ONIONS AND THE LIKE

3 Claims, 13 Drawing Figs.

[52] U.S. Cl. ..... 56/327 R, 146/83, 171/11, 171/28, 171/36, 171/41
[51] Int. Cl. A01d 45/00
[50] Field of Search ..... 56/1, 327 R; 171/11, 20, 26, 28, 31, 36, 40, 41, 42; 146/81, 83, 85

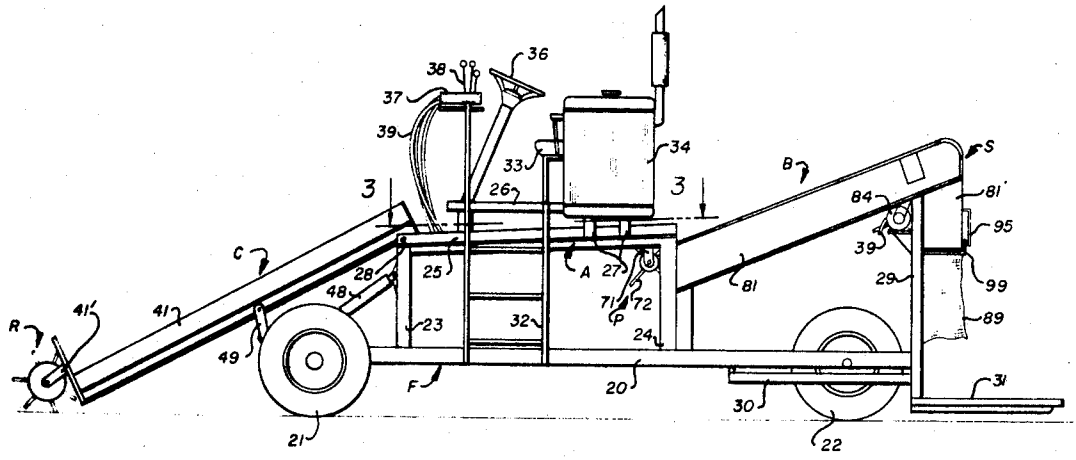
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ABSTRACT: The machine includes an alignment section, such as including oppositely rotating pairs of spiral rolls, which receive the onions from a front conveyor and move the onions toward a cutter for removing the tops and placing the onions, top down, during such movement. a paddle wheel having flexible blades, beneath the alignment rolls, urges the tops toward the cutter, while a flexible skirt is engaged by the blades to wipe the onion tops off the blades. A conveyor, which receives the topped onions from the cutter, is used as a picking table, for culling purposes, while the onions are delivered through hollow, upright chutes into sacks, with reversible plates in the chutes for directing the onions to alternate sacks, and handle-operated bars for moving a sack off hooks, at the lower edge of the chute opposite the operator.



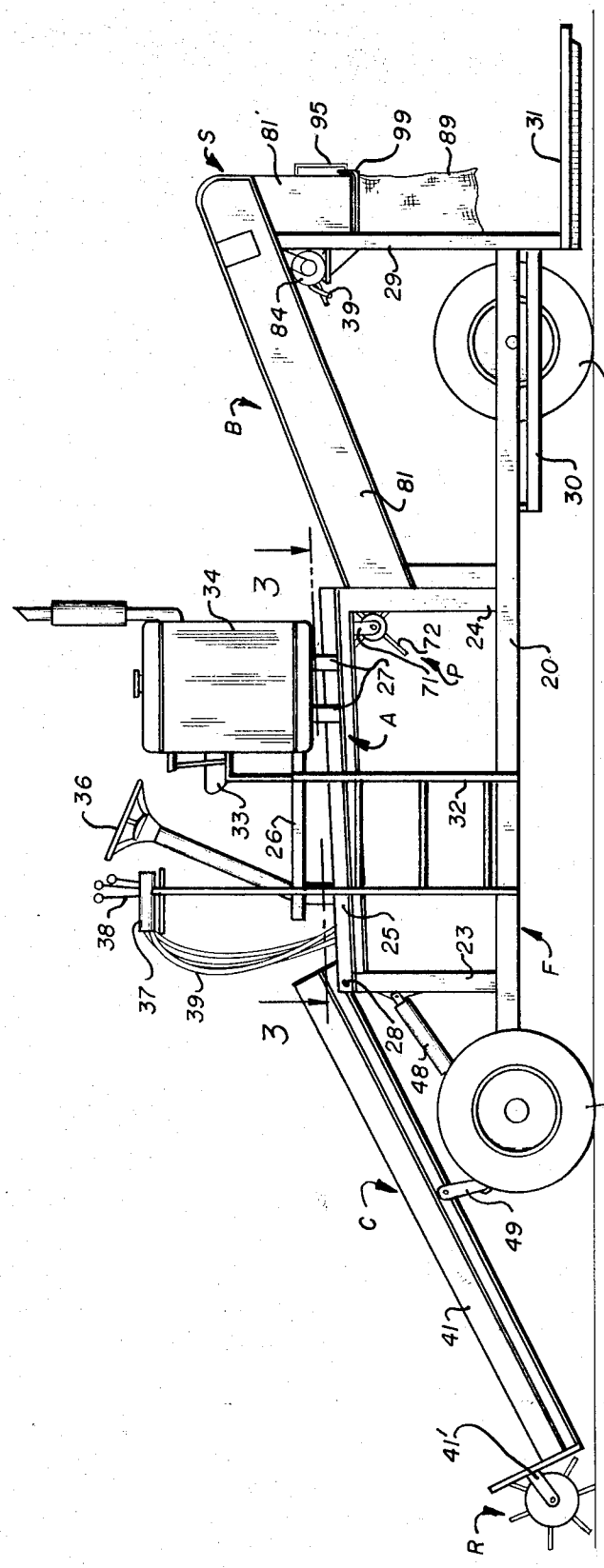


FIG. 1

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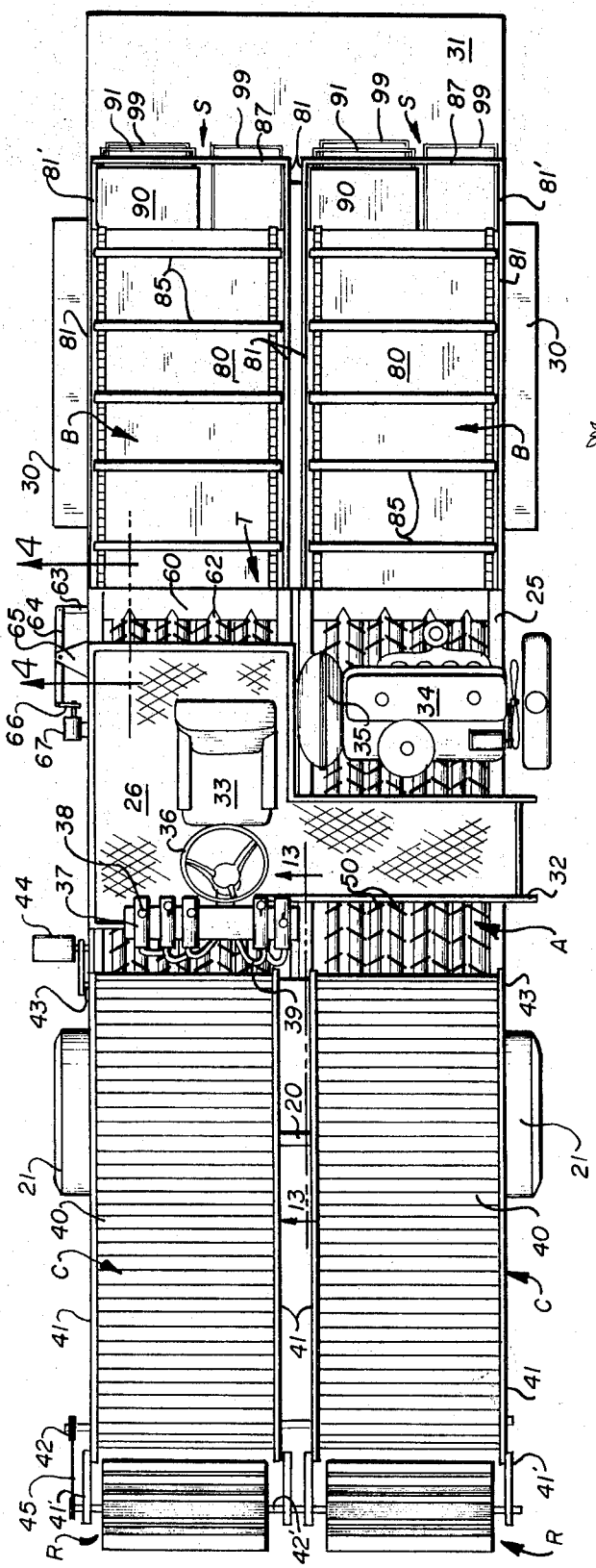


Fig. 2

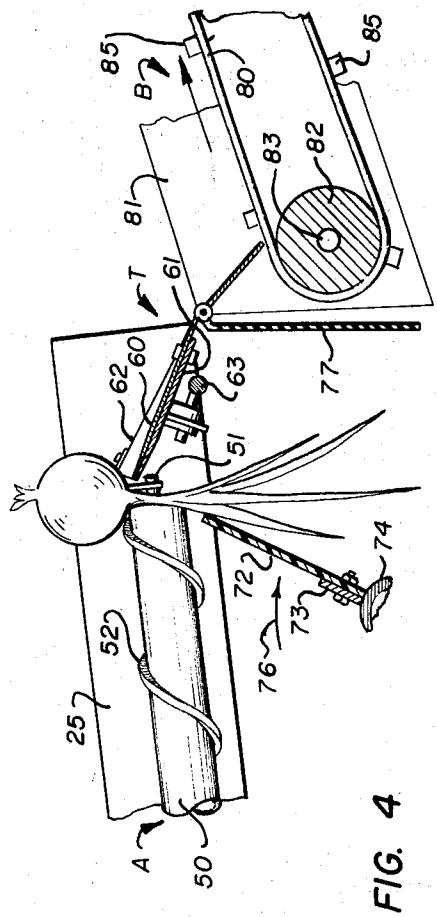


FIG. 4

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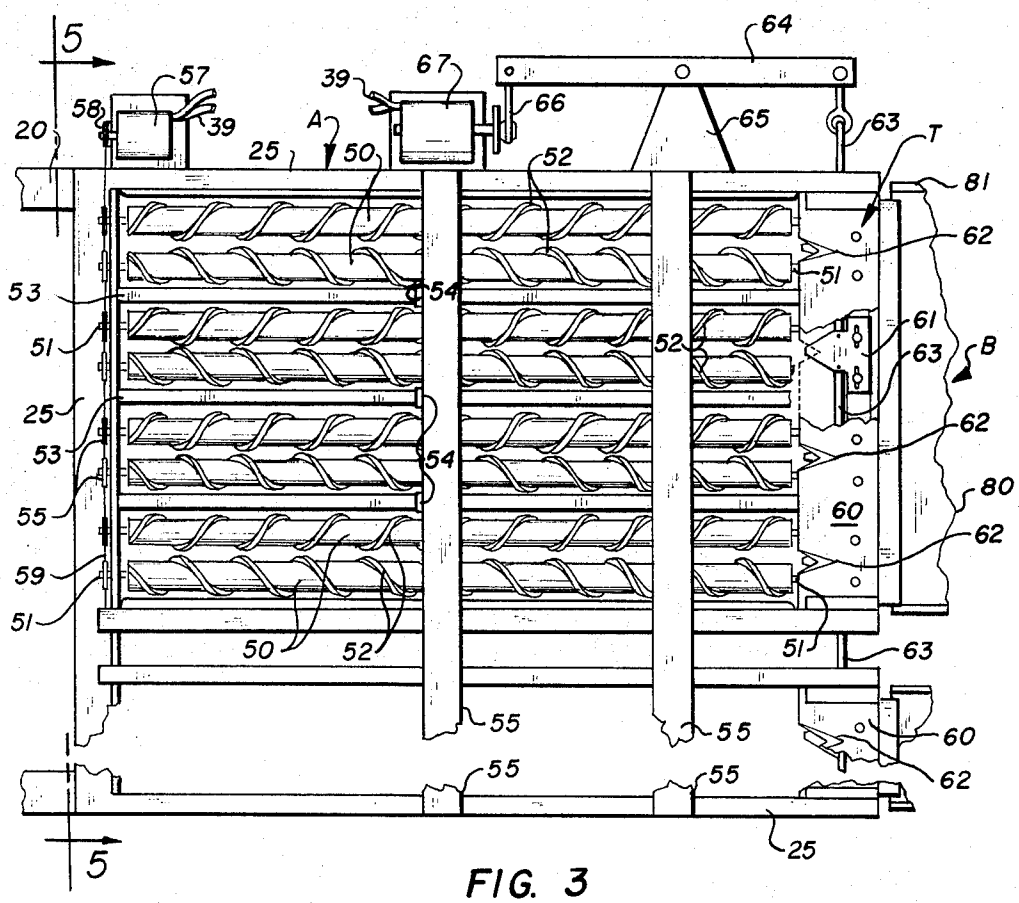


FIG. 3

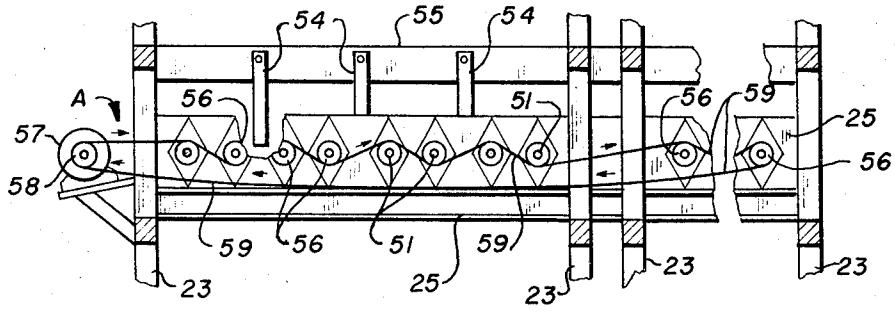


FIG. 5

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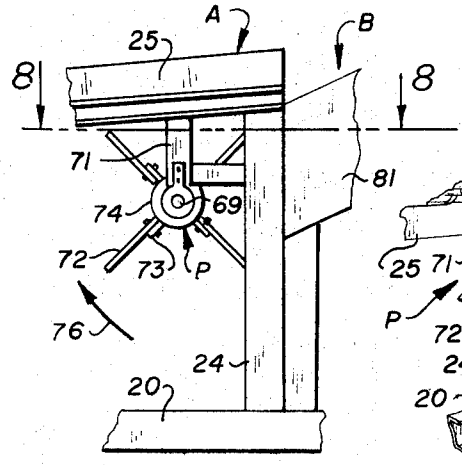


FIG. 6

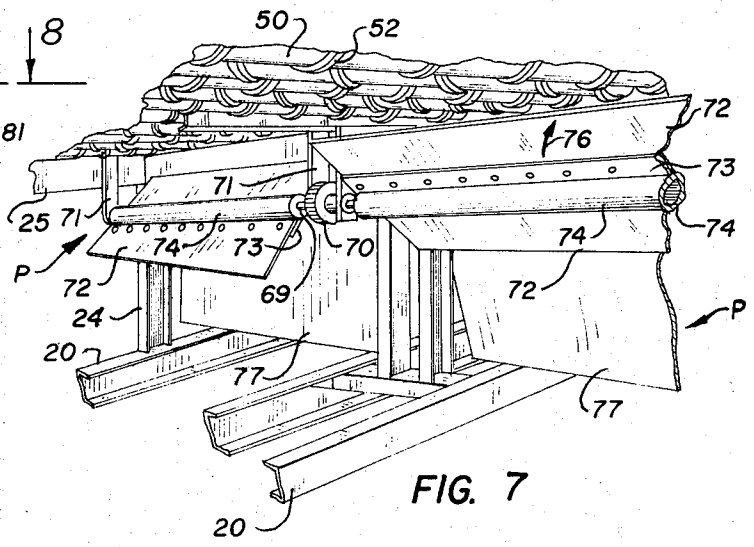


FIG. 7

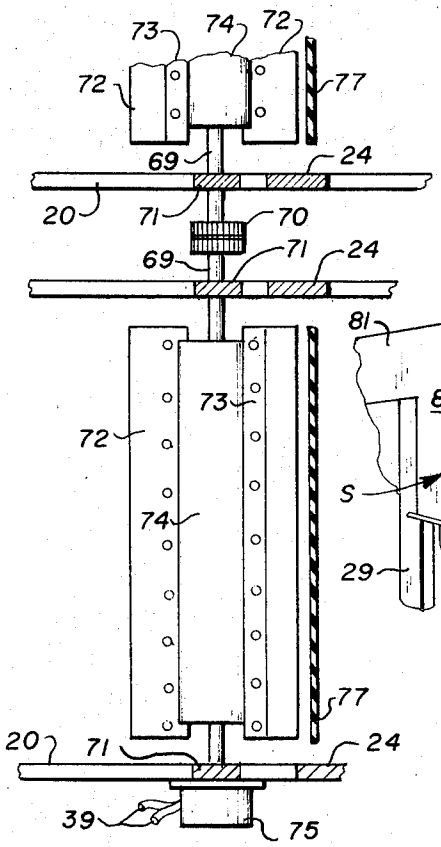


FIG. 8

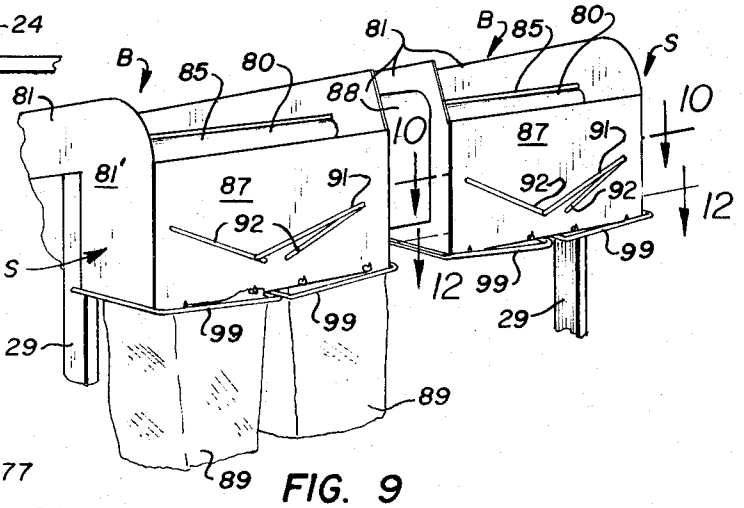


FIG. 9

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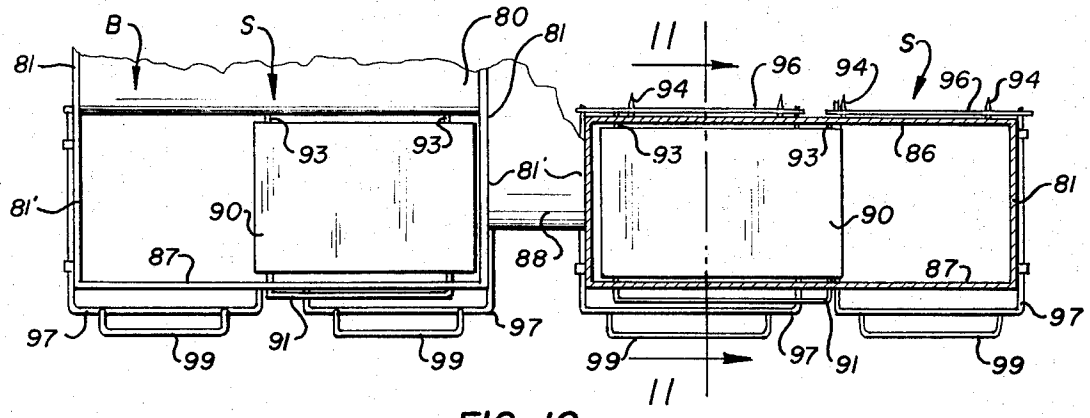


FIG. 10

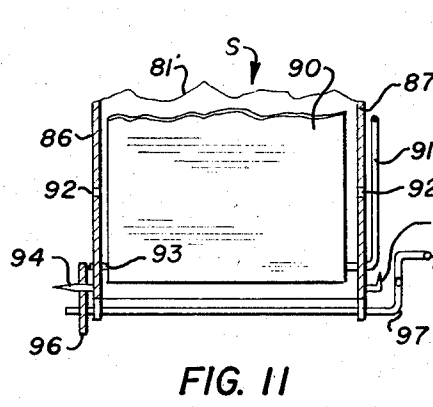


FIG. 11

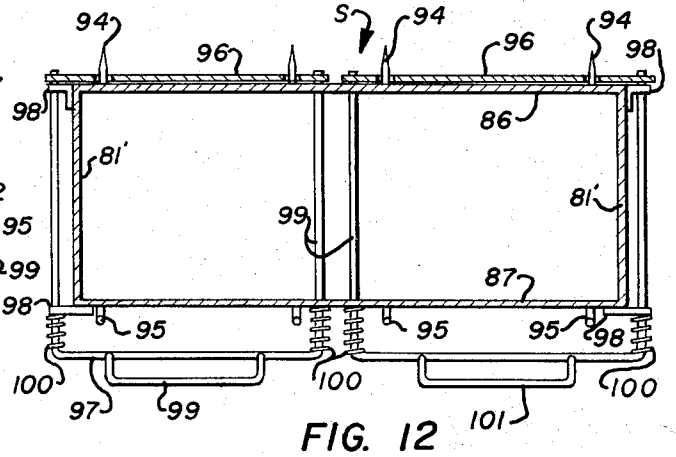


FIG. 12

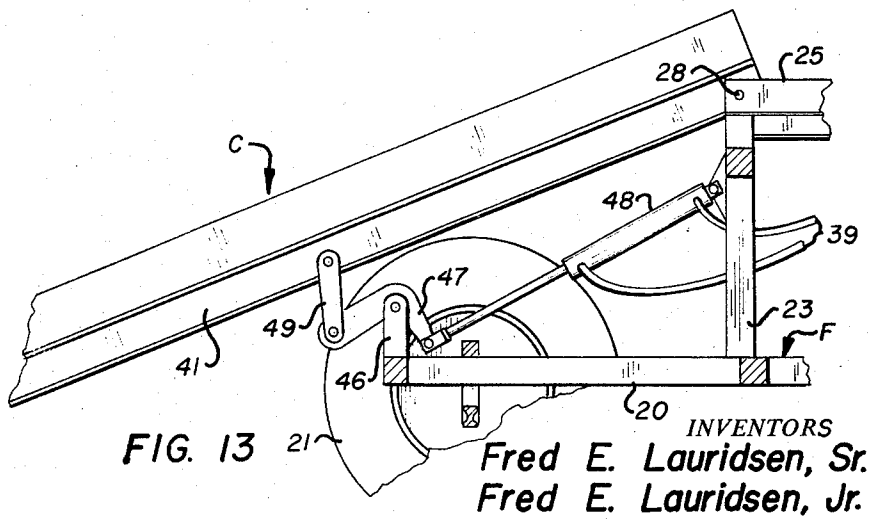


FIG. 13

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MACHINE FOR HARVESTING ONIONS AND THE LIKE

This invention relates to apparatus for harvesting harvesting vegetables having tops, such as onions, and more particularly to harvesting apparatus which will facilitate the operations of picking up, cleaning, topping, culling and sacking of freshly dug vegetables. The apparatus is especially adapted for use with field onions which are to be harvested while the tops may still be green and, accordingly, it will be hereinafter referred to as an onion harvesting machine.

An object of the invention to to provide a novel and improved onion-harvesting machine which is a mobile unit adapted to move along rows of freshly dug onions to pick them up, cut off the tops, momentarily expose them for culling and then sack the onions for market.

Another object of the invention is to provide a novel and improved mobile onion harvesting machine having a longitudinally extended array of components from the front to the rear of the machine which provide for a continuous movement of onions and a sequence of operations for topping, culling and sacking as fast as the onions are picked up from the field.

Another object of the invention is to provide, in an onion-harvesting machine, a novel and improved mechanism for cutting off the tops which includes a tablelike section adapted to receive onions in a random manner as they are picked up from the field, to shift them across the table section, from the leading and towards the trailing end of the apparatus, and to orient the onions as they move across the table to a common position with the tops hanging downwardly, for movement into a top-severing mechanism.

Another object of the invention is to provide, in an onion-harvesting machine having a cutter for severing onion tops as they move from an alignment table with the tops being positioned downwardly a novel and improved feeding arrangement adapted to hold the tops in their downward position to facilitate the movement of the onions from the table and into the cutter and to subsequently move the tops away from the cutting device.

Another object of the invention is to provide, in an onion-harvestiing machine, a novel and simplified arrangement of a conveyor belt adapted to receive onions after the tops have been cut away and to transport such onions along an open reach in a manner which permits the same to be inspected and culled of undesirable objects and spoiled onions.

A further object of the invention is to provide, in an onion-harvesting machine adapted to move topped, selected onions into a sacking chute, a novel and improved chute construction which permits the movement of onions from one sack to another as the first sack is filled without slowing down, stopping or interrupting the flow of onions.

Other objects of the invention are to provide, in an onion-harvesting machine, a simply arranged, neat appearing, economical, rugged and durable apparatus.

With the foregoing and other objects in view, as will hereinafter appear, our invention comprises certain constructions, combinations and arrangement of parts and elements, as hereinafter described and illustrated in the accompanying drawings in which:

FIG. 1 is a side elevation of a machine for harvesting onions and the like, constructed in accordance with this invention.

FIG. 2 is a top plan view of the machine shown in FIG. 1,.

FIG. 3 is a condensed, horizontal section, taken along line 3–3 of FIG. 1, but on an enlarged scale, and illustrating the aligning and topping section of the machine.

FIG. 4 is a fragmentary vertical section, taken along line 4–4 of FIG. 2, but on an enlarged scale and showing an onion in an aligned, top-down position, the top of which is urged against a topping cutter by a flexible paddle, in accordance with this invention.

FIG. 5 is a somewhat diagrammatic vertical section, taken along line 5–5 of FIG. 3, illustrating a drive mechanism for and certain other components of the alignment section.

FIG. 6 is a fragmentary side elevation of structural components supporting the paddle assembly beneath the end of the alignment section at the topping cutter.

FIG. 7 is a fragmentary perspective view taken from the underside of the alignment section, further illustrating the flexible paddle assembly.

FIG. 8 is a fragmentary top plan view of the flexible paddle assembly.

FIG. 9 is a rear perspective view of a portion of the harvester, illustrating a sacking station at the rear of the apparatus.

FIG. 10 is a top plan view of the sacking station, showing particularly sacking chutes with one side thereof in section along line 10–10 of FIG. 9.

FIG. 11 is a fragmentary vertical section, taken along line 11–11 of FIG. 10, but on a slightly enlarged scale.

FIG. 12 is a horizontal section of one of the sacking chutes, taken along line 12–12 of FIG. 9, but on a somewhat enlarged scale.

FIG. 13 is a fragmentary vertical sectional detail of a front portion of the carriage frame, taken along line 13–13 of FIG. 2, but on an enlarged scale and illustrating means for controlling the elevation of the conveyor which extends from the forward end of the machine. Referring more particularly to FIGS. 1 and 2 of the drawings, the improved onion harvester is preferably a dual unit, having two complete sets of components in a side-by-side, longitudinally extended arrangement which operate in unison and which are carried upon a wheel mounted framework F. The dual arrangement not only enhances the lateral stability of the apparatus, but also permits it to move across a field to harvest two rows, or two groups of rows, of onions simultaneously by picking up freshly dug onions through pickup rolls R at the leading or front end of the apparatus, The rolls R, of conventional construction, deposit the onions upon the respective conveyors C, which move the onions upwardly and towards the rear of the apparatus. From the conveyors C, the onions are deposited on alignment sections A which continue to move the onions rearwardly but orient them to a top-down position. As the onions leave the alignment sections, they are moved against topping cutters T. A transversely disposed, rotating paddle assembly P beneath the alignment sections cooperate with 175 topping cutters T. to push the onions into the cutters and hold the opts in a downward position. Subsequently, the paddles brush the cut tops away from the apparatus to discharge them upon the ground. The topped onions are then deposited upon rearwardly extended culling belt conveyors B where operators, standing upon platforms at both sides of the machine, may pick out and throw away undersized, damaged or spoiled onions. Finally, the onions are discharged from the rearward end of the conveyors B into sacking chutes S at the rearward end of the machine, where an operator, standing upon a platform at the rear of the machine, directs the onions into sacks and changes sacks as they are filled with onions.

The framework F may include a rectangular base 20 of longitudinal and transverse structural members. Front steering wheels 21 and rear drive wheels 22 render the framework mobile. The framework also includes a forward and a rearward set of vertical struts 23 and 24 above the central portion of the bed to support an elevated, rectangular frame 25 for housing components forming the alignment section A, while a deck 26 and an engine mount 27 are supported upon the frame 25, THe rearward end of each conveyor C is pivotally connected to the forward end of the table frame 25 by picot pin 28, to extend forwardly therefrom and overhang the forward end of the framework F, while height adjustment mechanisms connected to the central portion of the conveyor are hereinafter described. THe forward end of each culling belt conveyor B is supported upon the rearward set of struts 24 immediately below the table frame, while the rearward end of each culling belt and the sacking chutes S are supported upon vertically extending struts 29 at the rear of the framework. Side platforms 30 outstand from each side of the framework alongside the culling belt conveyors B and a rear platform 31 outstands from

the rear of the framework, as heretofore mentioned. A ladder **32** at one side of the framework is provided for easy access to the deck and a seat **33** is placed on the deck for the operator.

The onion harvester is a self-automated unit and an engine **34** and master pump **35** connected thereto are carried upon the engine mount **27** above the frame **25**, at one side of the apparatus. The operator's seat **33** is mounted upon the deck **26** at the other side of the apparatus and in an elevated position, to enable the operator to easily view all of the operative components of the unit. A steering wheel **36** is located in front of the operator's seat and is operatively linked to the front wheels **21** by steering linkages which are conventional and therefore not illustrated. Located in front of the operator's seat is a manifold **37** of valves operated by control levers **38** to cause pressure fluid from the master pump to be supplied through selected lines **39**, which lead to respective hydraulic actuators and motors in the apparatus, as hereinafter described.

Each conveyor C includes a conventional, open rod-type flight **40**, such as formed by hooked links, which permits dirt from the onions or otherwise deposited on the conveyor to fall through the rods and thus provide a preliminary cleaning step in the onion-harvesting operation. Each conveyor flight is carried between side boards **41** upon sprockets, not shown, which in turn are mounted upon a common forward shaft **42** and a common rear drive shaft **43**. A hydraulic motor **44** is connected by a chain drive, as shown, to the drive shaft **43** to drive the conveyors and to also drive the pickup rolls R at the front of the conveyors, through a belt and pulley drive **45** connecting with the forward shaft **42** of the conveyor C. The elevation of the front end of the conveyors is necessarily adjustable to hold the pickup rolls R at proper ground positions and to retract the same to a position above the ground as when the unit is being moved from one field to another. Thus, the rearward end of each conveyor is connected to pivot pin **28** at the forward crossmember of the frame **25**. An adjustable support mechanism at the center of each conveyor is mounted upon short front struts **46**, as illustrated in FIG. **13**, and includes a bellcrank lever **47** pivotally connected to the strut **46**, with one arm being connected to the piston rod of a hydraulic cylinder actuator **48** pivotally mounted upon a vertical frame strut **23**. The other arm of the lever **47** is pivotally connected to one end of a link **49**, while the other end of the link is pivotally connected to a conveyor sideboard **41**. In the arrangement so described, both conveyors operate in unison; however, a simple duplication of mechanisms which need not be described would permit them to operate individually.

Each pickup roll R at the front end of each conveyor is mounted between extensions **41'** of the sideboards of the conveyor on a common shaft **42'**. The function of the rolls R is to pick up onions lying upon the ground and to deposit them upon the conveyor. Such a roll is a conventional component and need not be described further. Furthermore, the rolls R may be replaced by scoops, diggers or similar devices commonly available which also function to dig, if necessary, and to deposit onions upon the conveyors C as the apparatus moves along the onion rows.

The alignment section A, as in FIGS. **3** and **5**, includes an array of parallel, longitudinally disposed, spiral tubes **50** arranged as opposing pairs having a clearance space of about 1 inch between the rolls of each pair. Each end of each tube terminates in an axial stub shaft **51** which is mounted in suitable bearings at the front and rear transverse members of the frame **25** and each is adapted to rotate in its bearings in a direction opposite to the direction of rotation of its mate. These directions of rotation are such that the surface of each tube of a pair moves from the top, towards its mate and downwardly between them. Rotating thus, the tube at the left hand of an observer will rotate clockwise and the tube at the right hand of the observer will rotate counterclockwise, as viewed in FIG. **3** with the observer at the position of FIG. **5**. A spiral flute **52** outstands from the surface of each tube, with each flute winding oppositely to the wind of the flute of its mate and with both being pitched the same to drag an object, such as an onion, resting in the trough between the pair, towards the rear end of the section. Accordingly, whenever an onion falls upon the tubes and into the trough between a pair of spiralled tubes, it is dragged rearwardly and, at the same time, the top of the onion is pulled downwardly into the space between the tubes, as in the manner indicated in FIG. **4**. Spiral flutes **52** may be formed of lengths of V-belting, secured to the corresponding tube **50** by a strong adhesive To assure the proper placing of onions upon the tubes and to prevent them from falling into the trough spaces between tubes of different pairs, the space between each pair of tubes may be occupied by longitudinal bars **53**, while a set of depending separator strips **54** of resilient material are suspended from a crossbar **55** and extend downwardly to each of the bars **53**, so as to flip any onion which moves from between a mating pair of tubes back between a mating pair of the tubes. For the tubes **50** at each side of the alignment section, the sides of frame **25** may extend above the tubes a sufficient distance to prevent any onions from falling to the outside.

In FIG. **5** is shown, somewhat diagrammatically, the manner in which the spiral tubes **50** are driven. The drive stub shaft **51** of tube **50** projects through its forward bearing in the frame **25** to carry a sprocket **56**. A hydraulic motor **57**, mounted at the side of the frame, carries a similar sprocket **58** in alignment with the shaft sprockets and a chain **59** extends across the shaft sprockets with the top reach of the chain being threaded about the sprockets in an over and under manner, as illustrated, to produce the opposing directions of rotation as hereinabove described, with the upper and lower reaches of the chain moving in the direction of the arrows adjacent thereto.

As the onions move in the troughs between opposing tubes **50** and to the rearward end of the alignment section A, the downturned tops are pushed rearwardly by a paddle assembly P to push the onions from the troughs and into a topping cutter T. This cutter may be a pair of conventional reciprocable-type mower blades, each including a notched support plate **60** and a closely fitted toothed blade **61** slidably positioned against the undersurface of the support plate. Each cutter is mounted across the rear end of half of frame **25** with the cutting edge of the plate being adjacent to the rearward ends of the spiralled tubes, and with a notch **62** being aligned with each trough between the mating tubes **50**. Each cutter plate is sloped downwardly and rearwardly from its cutting edge, as in FIG. **4**, so that a topped onion thereon will roll rearwardly away from the table and onto the culling belt conveyor.

The drive for both cutters is a transverse rod **63** attached to the underside of both of the blades, as in FIG. **4**, and extending to one side of the apparatus, as in FIG. **3**. A rocker arm **64** is attached to a fulcrum plate **65**, mounted upon the frame **25**, with one end of the rocker arm pivotally connected to the extended end of the rod **63** and the other end pivotally connected to a crank **66** which is reciprocated by a hydraulic motor **67**, also mounted upon the frame **25**. Accordingly, when the apparatus is in operation, the tops of onions moving in the troughs between opposing tubes will be pulled downwardly. The onions then move from the troughs and into the notches of the cutters, so that the reciprocating blades cut away the tops and permit the onions to roll rearwardly from the cutter and onto the culling belt conveyor B.

A paddle assembly P, as in FIGS. **7** and **8**, is mounted underneath each half of the alignment section, with both paddle assemblies including a transversely disposed shaft **69** substantially underneath the leading edge of the topping cutter T and connected at the center by a coupling **70**, as of the sprocket and chain type. Each shaft **69** is carried in bearings which, in turn, are mounted upon frame legs **71** which depend from the sides and center of the frame **25**, as in FIGS. **6** and **7**. Each paddle assembly includes a pair of rectangular flaps **72** of resilient and tough but comparatively stiff material, secured to a flange **73** to outstand radially in opposite directions.

Preferably, the flaps 72 of one paddle assembly are oriented at right angles with respect to the flanges of the other section, to equalize the load on the paddle assemblies. Each flange 73 is mounted on a tube 74 which surrounds and is attached to a shaft 69. A hydraulic motor 75 is mounted at one side of the frame to rotate the paddle flaps 72 in a direction which produces a rearward movement of a flap when it is above the shaft, as in the direction of the arrow 76 of FIGS. 4, 6 and 7. Each paddle is positioned so that the outer edge of the flap 72 will thus be comparatively close to the underside of the spiralled tubes 50 and the underside of the topping cutter T. A vertical skirt 77 is suspended at the rearward edge of the topping cutter, as in FIG. 4, being formed of resilient but comparatively stiff material and struck and deflected by each paddle flap 72 as it rotates therepast. In operation, the paddle flaps 72 will contact and hold onion tops in their desirable downward position and push them past the topping cutter. Ordinarily, these onion tops would drop downwardly the downwardly past the frame members and onto the ground. However, the juices of green onion tops may cause sticking and piling up of onion tops on the topping cutter or on the paddle flaps 72, but by striking the paddle flaps against the skirts as they are rotated, the cut tops will be more effectively released to drop to the ground. By orienting the flaps of one paddle at 90° with respect to the flaps of the other paddle, as shown in FIG. 7, the holding, pushing and striking actions of the paddles will occur at alternating, spaced intervals to produce smoother operation and a minimum load on the hydraulic drive motor.

Each culling belt conveyor B, as in FIGS. 2 and 4, is essentially a conventional unit consisting of a flat conveyor belt 80 which extends between sideboard frame members 81. The belt is carried upon rolls 82 of FIG. 4, which are mounted upon transverse shafts 83 at each end of the conveyor, and is driven at a selected rate by a hydraulic motor 84 of FIG. 1. The culling belt conveyors B are supported upon the rearward intermediate struts 24 and upon the rear vertical struts 29, as heretofore mentioned. Preferably, the belts are inclined upwardly towards the rear of the apparatus to lift the onions high enough to provide adequate clearance for the sacking chutes S and sacks below them. Accordingly, spaced cleats 85 are attached to the belts to space the onions apart and to prevent them from rolling backwards as they move upwards along the belt. As will be evident, a workman standing on each side platform 30 may remove culls as the onions are moved upwardly and rearwardly by the adjacent belt conveyor.

Each sacking chute S is formed as a rectangular box-shaped structure having an open top and an open bottom. The sides 81' are essentially downward continuations of the conveyor sideboards 81 and are completed by a front wall 86 and a rear wall 87. Each chute S is reinforced by a connector 88 extending therebetween and the combined pair is mounted upon the rear vertical struts 29 at a position immediately below the terminal of the respective conveyor belt B, so that onions discharged from the conveyor belt will drop into the chute. The size of each chute is such that two sacks 89 can be placed across the bottom opening of the cute in a side-by-side, open mouth position to receive the onions, as illustrated in FIG. 9. These sacks are held by suitable hooks outstanding from the lower edges of the front and rear walls 86 and 87, as will be hereinafter further described.

A rectangular deflector plate 90 is shiftably mounted within each cute S to overlie one sack 89 or the other with the plate 90 being inclined to cause onions falling into the chute and striking the plate to be deflected to and through the open portion of the chute and into one sack only. The shifting action of the deflector plate 90 is e effected by a U-shaped handle 91, the ends of which extend through complementary inclined slots 92 in the rear wall 87 of the chute, as illustrated in FIGS. 9 and 10, for attachment to the adjacent corners of plate 90. Short rods 93 are attached to the opposite corners of plate 90 and extend through similarly inclined slot s in front wall 87 to support and guide the plate. Handle 91 permits an operator standing on the rear platform to shift the deflector plate 90 from one side to the other of the chute. Accordingly, whenever a sack at one side of the chute is filled with onions, the deflector plate is simply shifted to overlie that sack and expose the other sack for filling. Then, the first sack may be removed and another empty sack positioned on the holding hooks at the bottom edge of the chute.

Four hooks are required to hold each sack in its open position underneath the chute and these include a pair of outstanding, straight release hooks 94 on the forward wall and a pair of outstanding, upturned holding hooks 95 on the rear wall, as in FIGS. 10—12. These hooks are arranged to permit a quick, easy removal of a sack from the chute once it is filled with onions, by releasing the sack from the release hooks 94 to permit it to be swung rearwardly to a position where the filled sack may be removed by the operator, after release from hooks 95. To effect this removal, a push bar 96 for each sack is positioned at each side of the lower edge of the forward wall. The push bar has a hole near each end, as in FIG. 12, through which one of its pair of outstanding hooks 94 projects. This push bar is attached to the ends of the legs of a U-shaped rod 97 which extends through slide holes in the front and rear walls and in brackets 98 at the outer sides of the chute. The crotch of the U-rod 97 is mounted on it to permit it to be pushed toward the rear wall of the chute. This movement causes the push bar 96 to move forwardly from the forward wall and beyond the end of the hooks 94 to release a sack held by the forward hooks. Springs 100 on the legs of each U-rod 97 urge the push bar 96 against the forward wall 86, so that the push bar will be moved back over hooks 94 when handle 91 is released, to permit the operator, after removal of the filled sack, to hang another sack on the hooks. As will be evident, a filled sack may be removed and replaced with an empty sack, while the next sack is filling.

We have now described a preferred embodiment of our invention in considerable detail; however, it is evident that other embodiments may exist and various changes may be made without departing from the spirit and scope of the present invention.

What we claim is:

1. In apparatus for harvesting onions and the like:
   a. alignment means for moving onions from a leading end thereof across to a discharge end thereof and at the same time orient and turn said onions to a top-down position with the onion tops depending from the alignment means;
   b. cutter means at the discharge end of the alignment means for severing the onion tops;
   c. means beneath said alignment means adjacent to said cutter means for urging said depending onion tops toward said cutter means, said top urging means being mounted upon a rotatable shaft disposed parallel to the discharge end of said alignment means and including blade sections radially outstanding from the shaft for movement underneath and adjacent to both said alignment means and said cutter means and toward said cutter means as an incident of rotation of the shaft; and
   d. a depending skirt formed of resilient but relatively stiff material and disposed in position to be engaged by said blade sections after movement thereof beneath said cutter means.

2. In the apparatus defined in claim 1, wherein:
said blade sections are flat, rectangular sheets of comparatively stiff but resilient material.

3. An apparatus for harvesting vegetables, such as onions, by picking up such vegetables, topping the same and thereafter conveying the same for sacking, including:
   a sacking chute having walls forming a rectangular boxlike structure open at the top and bottom and through which vegetables may move, said chute being proportioned so that two open-mouth sacks may be placed at the bottom thereof to receive vegetables falling into the chute and each of two opposing walls of said chute having a pair of disjoined, oppositely inclined, downwardly converging slots;

a deflector plate within said chute adapted to overlie one sack and to deflect vegetables falling thereon into the other sack;

supporting means extending from each corner of the deflector plate and through a corresponding slot;

a handle connected to said supporting means at one wall of said chute for shifting the deflector plate from one side of the chute to the other to deflect vegetables into a selected sack; and

means for releasably holding the respective sacks in position for filling.