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(54) Title: A DE-WEEDING APPARATUS

(57) Abstract: The present disclosure relates to a weeding apparatus (10) for removing a weed from the soil. The weeding apparatus (10) comprises a de-weeding tool (12) configured for uprooting a targeted weed and a tool support assembly (28) being configured with the de-weeding tool (12). The tool support assembly (28) comprises a linear actuation mechanism configured for the movement of the de-weeding tool (12) in the vertical direction between an engaged position and a disengaged position from a ground surface. A first actuation mechanism (14) is adapted to rotate the de-weeding tool (12). A conveyor (16) is configured to collect the weeds from the de-weeding tool (12) and transfer it to a sink (30). The weeding apparatus (10) as disclosed in the present disclosure has been developed for targeting and removal of weeds.

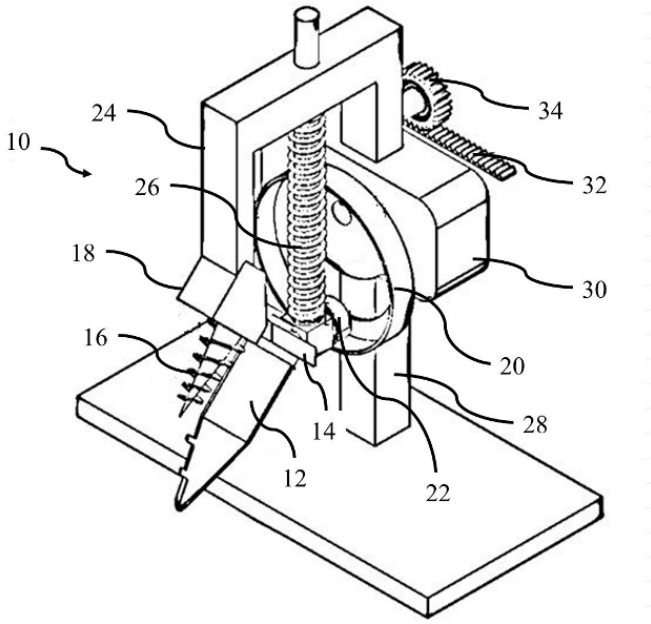

Figure 1

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A DE-WEEDING APPARATUS

2. APPLICANT(S)

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification describes the invention and the manner in which it is to be performed

DESCRIPTION

TECHNICAL FIELD

[0001] The present disclosure is related, in general, to the farming or gardening apparatus. Particularly, but not exclusively, the present disclosure relates to a weeding apparatus for extracting a weed from the soil.

BACKGROUND OF THE INVENTION

[0002] The information in this section merely provides background information related to the present disclosure and may not constitute prior art(s).

[0003] A common problem with poorly tended vegetable patches, flower beds, seedbeds, plant transport beds, and the like are the growth of weeds and unwanted grasses. It is known that one of the most important aspects of agriculture and crop cultivation is the effective management of weeds. Weeds compete aggressively for limited resources in terms of space, water, sunlight, and nutrients. Consequently, the emergence of weeds has a marked adverse impact on crop yield and quality. Moreover, due to their relatively fast growth rates compared to crops, if weeds are not eliminated or effectively managed, particularly during the early stages after crop planting, they can quickly dominate entire fields and result in serious yield losses. These problem growths develop roots that extend to a depth of 2 to 6 inches or more. Lack of cultivation for instance may lead to an overrun of said growths which tend to deprive the crop plant of growth space, food, moisture, sunlight, and aeration.

[0004] The removal of unwanted plant materials, such as weeds, is a time-consuming and tedious task. One way to remove unwanted weeds is through the use of poisons. Poisons, however, are messy and cumbersome to apply. Also, other plants beside the intended target of the poison may be killed. Furthermore, it is impossible to maintain an organic garden when they must resort to these poisons. Therefore, to remove weeds without the use of harmful chemicals, farmers must use various tools.

[0005] Devices of the prior art for use in extracting weeds and other vegetation from the soil have involved certain shortcomings and disadvantages. Many of these require slow, tedious uses of a device to remove one weed or plant at a time. Most devices provide no means for

picking up or removing a weed or plant after it is removed from the soil, and this must be done manually. Most prior devices require the operator or person using the device to bend over, kneel or squat in order to employ the device in weed or plant extraction from the soil. Furthermore, string trimmers can be used to remove weeds, but they only sever a weed at or above the root line leaving the root of the weed in the ground. If the root is not completely removed, the weed can grow back. Also, string trimmers are difficult to use near other plants, are noisy and, in the case of gas-powered string trimmers, produce a variety of air pollutants.

[0006] The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the prior art.

SUMMARY OF THE INVENTION

[0007] The present disclosure overcomes one or more drawbacks of conventional arrangements as described in the prior art and provides additional advantages through an arrangement as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

[0008] In one non-limiting embodiment of the present disclosure, a weeding apparatus for removing weeds is disclosed. The apparatus comprises a de-weeding tool configured for uprooting a targeted weed and a tool support assembly being configured with the de-weeding tool. The tool support assembly comprises a linear actuation mechanism for the movement of the de-weeding tool in a vertical direction between an engaged position and a disengaged position from a ground surface. A first actuation mechanism is provided to rotate the de-weeding tool. A conveyor extends upwardly and is adapted to collect the weeds from the de-weeding tool and transfer the weeds to a sink. The conveyor has a second actuation mechanism to actuate the conveyor.

[0009] In an embodiment of the present disclosure, the engaged position is when the de-weeding tool is in contact with the ground surface for uprooting the weed and the disengaged position is when the de-weeding tool is retracted from the ground surface.

[0010] In an embodiment of the present disclosure, the linear actuation mechanism comprises a cam and a follower for the movement of the de-weeding tool in a vertical direction.

[0011] In an embodiment of the present disclosure, the weeding apparatus comprises a resilient bias mechanism configured to resiliently urge the de-weeding tool downwardly into operative contact with the ground surface.

[0012] In an embodiment of the present disclosure, the resilient bias mechanism comprises one or more mechanical springs configured to dampen the shocks and vibrations generated at the de-weeding tool

[0013] In an embodiment of the present disclosure, the first actuation mechanism and the second actuation mechanism comprise a motor and a bearing.

[0014] In an embodiment of the present disclosure, the conveyor is a spiral conveyor configured to collect the weeds from the de-weeding tool and transfer it to the sink

[0015] In an embodiment of the present disclosure, the weeding apparatus comprises a rack and pinion mechanism configured to actuate the tool support assembly in a horizontal direction.

[0016] In an embodiment of the present disclosure, the weeding apparatus comprises a sensing system configured for identifying the location of targeted weeds for uprooting.

[0017] In an embodiment of the present disclosure, the apparatus is adapted to be propelled by a prime mover.

[0018] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF DRAWINGS

[0019] The novel features and characteristics of the disclosure are set forth in the appended description. The disclosure itself, however, as well as a preferred mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying figures. One or more embodiments are now described, by way of example only, with reference to the accompanying figures wherein like reference numerals represent like elements and in which:

[0020] **Figure 1** illustrates a schematic view of a weeding apparatus at an engaged position in accordance with an embodiment of the present disclosure.

[0021] **Figure 2** illustrates a schematic view of a weeding apparatus at a disengaged position in accordance with an embodiment of the present disclosure.

[0022] **Figure 3** illustrates a cross-sectional view of a weeding apparatus having a conveyor in accordance with an embodiment of the present disclosure.

[0023] **Figure 4** illustrates a flowchart of a sensing system in accordance with an embodiment of the present disclosure.

[0024] The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the assemblies and methods illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION

[0025] While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiment thereof has been shown by way of example in the figures and will be described below. It should be understood, however, that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternatives falling within the scope of the disclosure.

[0026] It is to be noted that a person skilled in the art would be motivated from the present disclosure and modify a system and method for extracting a weed from the soil as disclosed herein. However, such modifications should be construed within the scope of the disclosure. Accordingly, the drawings show only those specific details that are pertinent to understand the embodiments of the present disclosure, so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

[0027] The terms "comprises", "comprising", or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system and method that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such system, method, or assembly, or device. In other words, one or more elements in a system or device proceeded by "comprises… a" does not, without more constraints, preclude the existence of other elements or additional elements in the system or device.

[0028] A weeding apparatus (10) as disclosed in the present disclosure has been developed primarily for targeting and removal of weeds and will be described predominantly in this context. It should be appreciated, however, that the invention is not limited to this field of use, being potentially also adaptable for feeding or watering plants, harvesting produce, pollinating plants, trimming, pruning or thinning foliage, or other analogous purposes wherein the targeting and end-effector positioning systems may be effectively utilized. The following paragraphs describe the present disclosure with reference to FIGs. 1 - 4. In the figures, the same element or elements which have similar functions are indicated by the same reference signs.

[0029] FIG. 1 illustrates a schematic view of the weeding apparatus (10) at an engaged position in accordance with an embodiment of the present disclosure. The weeding apparatus (10) for controlling the weeds comprises a de-weeding tool (12) configured for uprooting targeted weeds as the de-weeding tool (12) is drawn along a planted row or seedbed. A tool support assembly (28) is configured with the de-weeding tool (12). The tool support assembly (28) comprises a linear actuation mechanism that is configured for the movement of the de-weeding tool (12) in the vertical direction between an engaged position and a disengaged position from a ground surface. It is to be noted that in the engaged position, the de-weeding tool (12) is in contact with the ground surface for uprooting the weed and in the disengaged

position, the de-weeding tool (12) is retracted from the ground surface. Fig. 1 shows the de-weeding tool (12) configured to contact or penetrate the ground surface for removal or disruption of the targeted weeds in the engaged position. Fig. 2 shows an upwardly oriented disengaged position wherein the de-weeding tool (12) is substantially retracted from the ground surface in the disengaged position.

[0030] In an embodiment, the linear actuation mechanism comprises a cam (20) and a follower (22) for the movement of the de-weeding tool (12) in the vertical direction. The cam and follower arrangement is provided with a bracket and an auxiliary motor (not shown) to rotate the cam (20). When the auxiliary motor gets actuated the cam (20) starts rotating and accordingly the follower (22) reciprocates in the vertical direction. The follower (22) is fixed with the bracket containing a motor, assembled with the de-weeding tool (12). When the follower (22) is at the lowermost position, i.e. when the de-weeding tool (12) gets inserted into the ground, the motor in the bracket attached to the tool support assembly (28) rotates the de-weeding tool (12). This rotation causes the de-weeding tool (12) to clutch the weed and associated soil. The vertically upward motion of the follower (22) continues till the de-weeding tool (12) reaches the disengaged position as it takes the extracted weed to the topmost position of the follower (22).

[0031] In an embodiment, the de-weeding tool (12) is able to pull a weed or other plant material in its entirety, including the root, from an unwanted area. As used herein, a weed is any plant that is in an area when it is not wanted. The weeding apparatus (10) of the present disclosure includes the de-weeding tool (12) that comprises a plurality of edges that help to grab the weed without cutting it, thus removing all of a weed, including the root. The plurality of edges, preferably, do not have any sharp edges because the de-weeding tool (12) is manufactured to remove the weed in its entirely. In operation, when the de-weeding tool (12) is moved across the soil, the plurality of edges grabs the root of the weed along with the soil. This allows for the root of the weed to be grabbed at or near the base (where the tooltip and soil meet) and the weed is removed with the root. By removing the root, the weed is permanently removed. In addition, the whole root is removed in such a way that disruption of the surrounding ground is minimized. This avoids disrupting the flowerbed or other area where the weed growth occurs, minimizing the time needed to fix the flowerbed after weeding. In an embodiment, the de-weeding tool (12) is conical in shape and is coupled to the tool support assembly (28).

[0032] The tool support assembly (28) comprises a first actuation mechanism (14) configured to rotate the de-weeding tool (12) about its rotational axis. In an embodiment, the first actuation mechanism (14) comprises a first electric servomotor (not shown) disposed within the tool support assembly (28) and adapted to rotate the de-weeding tool (12) about its rotational axis. In an embodiment, a gearbox is used in combination with an electric motor in order to control the de-weeding tool (12) in order to increase the torque from the motor. Such gearboxes can include spur, planetary bevel, harmonic, etc. Other means for increasing the force or torque from the first actuation mechanism (14) include the use of belts, pulleys, levers, hydraulic pistons, and the like. It should be appreciated, however, that in other embodiments, the actuation mechanisms may alternatively include hydraulic, pneumatic, electromechanical, or other suitable forms of actuation.

[0033] The weeding apparatus (10) further includes a resilient bias mechanism (26) configured in the engaged position to resiliently urge the de-weeding tool (12) downwardly into operative contact with the ground surface, with a positive bias force. In this way, the de-weeding tool (12) is able to penetrate the ground surface to a degree sufficient to effectively remove or disrupt the targeted weeds, while allowing retraction of the de-weeding tool (12) against the bias force to automatically accommodate obstacles such as rocks, soil clumps, irrigation lines or other obstacles. The resilient bias mechanism (26) thereby acts as a form of suspension for the de-weeding tool (12), maintaining optimal functional contact between the de-weeding tool (12) and the cultivated soil in the engaged position, with sufficient compliance to accommodate obstacles and undulations in the surface terrain. In one embodiment, the resilient bias mechanism (26) takes the form of one or more mechanical springs, positioned to urge the tip of the de-weeding tool (12) downwardly so as to penetrate the ground surface in the engaged position. In other embodiments, the resilient bias mechanism may include pneumatic or electromagnetic spring mechanisms. In one form, the de-weeding tool (12) itself is formed from a material incorporating a degree of elasticity or resiliency, such as spring steel, whereby the resilient bias mechanism (26) is inherent in the shape, configuration, and material composition of the de-weeding tool (12) itself.

[0034] In some embodiments, the profile of the de-weeding tool (12) is designed in a way such that it dampens the shock and vibrations. In certain embodiments, a spring and dampener mechanism can be installed in series, or parallel to the de-weeding tool (12), thereby providing

the desired damping characteristics. In other embodiments, the spring mechanism may be fixed, statically adjustable, or dynamically adjustable to accommodate different degrees of soil hardness or compaction, different varieties of weeds or crops, different configurations of tools, and other relevant factors. Complementary damping elements (not shown) may also be incorporated into the resilient bias mechanism (26), and again in terms of damping characteristics, these elements may be fixed, statically adjustable, or dynamically adjustable.

[0035] The weeding apparatus (10) further comprises a conveyor system (e.g. belts, buckets, rollers) or other transfer means (e.g. vacuum, peristaltic pumps, etc.) whereby the removed weeds can be taken from the de-weeding tool (12) and then moved to a more suitable destination (e.g. a storage basket, tub, bin, incinerator, composter, or on the ground). In a preferred embodiment, the conveyor system includes a conveyor (16), a housing (24), and a spiral conveyor (36) as shown in FIG. 3 of the present disclosure. As shown, the conveyor (16) is extending upwardly and configured to collect the weeds from the de-weeding tool (12) and transfer it to a sink (30). The housing (24) is configured to house the spiral conveyor (36). In an embodiment, the housing (24) contains the spiral conveyor (36) is configured to move the uprooted weeds to point A and then the gravity pulls the uprooted weeds inside the sink (30). The conveyor system further comprises a second actuation mechanism (18) configured to actuate the conveyor system (16). The second actuation mechanism (16) comprises a second electric servomotor (not shown) and a bearing disposed within the housing (24) and configured to rotate the conveyor (16) about its rotational axis.

[0036] The apparatus may be propelled by any suitable form of prime mover and may also be mounted to a stationary platform. In an embodiment, the apparatus may be attached directly to or integrated with ground-based vehicles. In an embodiment, the weeding apparatus (10) comprises a rack (32) and pinion (34) mechanism. The rack (32) and pinion (34) mechanism is configured to actuate the tool support assembly (28), thereby to effect the side-to-side movement of the de-weeding tool (12) in the horizontal direction while in the engaged position in contact with the ground.

[0037] In an embodiment, the weeding apparatus (10) comprises a sensing system (not shown) configured to identify target weeds, and optionally also non-targets such as plants or crops, within the environment and generating data indicative thereof. In some embodiments, the sensing system includes a camera adapted to generate a 2-D image of the environment. In

an embodiment, a plurality of sensors may be used in the sensing system for the mapping and localization of the weed.

[0038] In a preferred embodiment, FIG. 4 shows a flowchart showing different stages between the initial stage of inputting the images and the final stage of detecting weed. A classification system is provided to identify target weeds, and optionally also non-targets such as plants or crops, within the environment, based on the data from the sensing system and appropriate classification criteria. In an embodiment, the apparatus uses machine learning algorithms to determine what is a target and what is not a target. In other embodiments, known information can be used to improve the accuracy of the classification algorithms. Such an example is the structure of the crop pattern, which can be modeled based on the method of operation of the planting machine.

[0039] In an embodiment, the de-weeding tool (12) incorporates or supports a supplementary fluid conduit, which may be adapted to convey a liquid pesticide, herbicide, fertilizer, or other agricultural chemical or additive to the targeted weeds, or alternatively to targeted crops. For example, in one variation of this embodiment, the tip of the de-weeding tool (12) may be used to mechanically dislodge weeds, while the fluid conduit associated with the same de-weeding tool (12) may be used with similarly precise targeting to add chemical fertilizer, irrigation water or other supportive agricultural chemicals to plants or crops under cultivation. In another variation, multiple fluid conduits may be integrated with or supported by the de-weeding tool (12), for example, one conduit to direct an herbicide toward targeted weeds, and another conduit to direct a fertilizer toward targeted plants.

[0040] It is to be understood that a person of ordinary skill in the art may develop a system of similar configuration without deviating from the scope of the present disclosure. Such modifications and variations may be made without departing from the scope of the present invention. Therefore, it is intended that the present disclosure covers such modifications and variations provided they come within the ambit of the appended claims and their equivalents.

[0041] Equivalents:

[0042] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to

the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0043] It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation, no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances, where a convention analogous to "at least one of A, B, or C, etc." is used, in general, such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to

contemplate the possibilities of including one of the terms, either of the terms or both terms. For example, the phrase “A or B” will be understood to include the possibilities of “A” or “B” or “A and B.” While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

WE CLAIM:

1. A weeding apparatus (10) for removing weeds, the apparatus comprising:

a de-weeding tool (12) configured for uprooting a targeted weed;

a tool support assembly (28) being configured with the de-weeding tool (12), the tool support assembly (28) comprises a linear actuation mechanism for the movement of the de-weeding tool (12) in vertical direction between an engaged position and a disengaged position from a ground surface;

a first actuation mechanism (14) being provided to rotate the de-weeding tool (12);

a conveyor (16) extending upwardly and adapted to collect the weeds from the de-weeding tool (12) and transfer the weeds to a sink (30), the conveyor (16) having a second actuation mechanism (18) to actuate the conveyor (16).

2. The weeding apparatus (10) as claimed in claim 1, wherein in the engaged position, the de-weeding tool (12) is in contact with ground surface for uprooting the weed and in the disengaged position, the de-weeding tool (12) is retracted from the ground surface.

3. The weeding apparatus (10) as claimed in claim 1, wherein the linear actuation mechanism comprises a cam (20) and a follower (22) for the movement of de-weeding tool (12) in vertical direction.

4. The weeding apparatus (10) as claimed in claim 1, comprises a resilient bias mechanism (26) configured to resiliently urge the de-weeding tool (12) downwardly into operative contact with the ground surface.

5. The weeding apparatus (10) as claimed in claim 4, wherein the resilient bias mechanism (26) comprises one or more mechanical springs configured to dampen the shocks and vibrations generated at the de-weeding tool (12).

6. The weeding apparatus (10) as claimed in claim 1, wherein the first actuation mechanism (14) and the second actuation mechanism (18) comprise a motor and a bearing.

7. The weeding apparatus (10) as claimed in claim 1, wherein the conveyor (16) is a spiral conveyor (36) configured to collect the weeds from the de-weeding tool (12) and transfer it to the sink (30).

8. The weeding apparatus (10) as claimed in claim 1, comprises a rack (32) and pinion (34) mechanism configured to actuate the tool support assembly (28) in a horizontal direction.

9. The weeding apparatus (10) as claimed in claim 1, comprises a sensing system configured for identifying the location of targeted weeds for uprooting.

10. The weeding apparatus (10) as claimed in claim 1, wherein the apparatus (10) is adapted to be propelled by a prime mover.

Dated this 11th Day of October 2022

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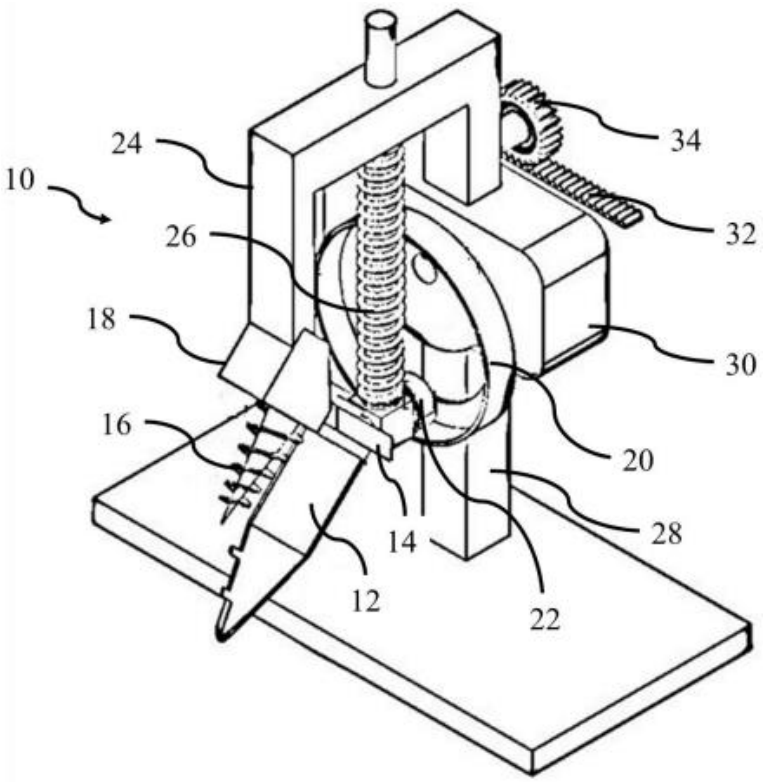
ABSTRACT

A DE-WEEDING APPARATUS

The present disclosure relates to a weeding apparatus (10) for removing a weed from the soil. The weeding apparatus (10) comprises a de-weeding tool (12) configured for uprooting a targeted weed and a tool support assembly (28) being configured with the de-weeding tool (12). The tool support assembly (28) comprises a linear actuation mechanism configured for the movement of the de-weeding tool (12) in the vertical direction between an engaged position and a disengaged position from a ground surface. A first actuation mechanism (14) is adapted to rotate the de-weeding tool (12). A conveyor (16) is configured to collect the weeds from the de-weeding tool (12) and transfer it to a sink (30). The weeding apparatus (10) as disclosed in the present disclosure has been developed for targeting and removal of weeds.



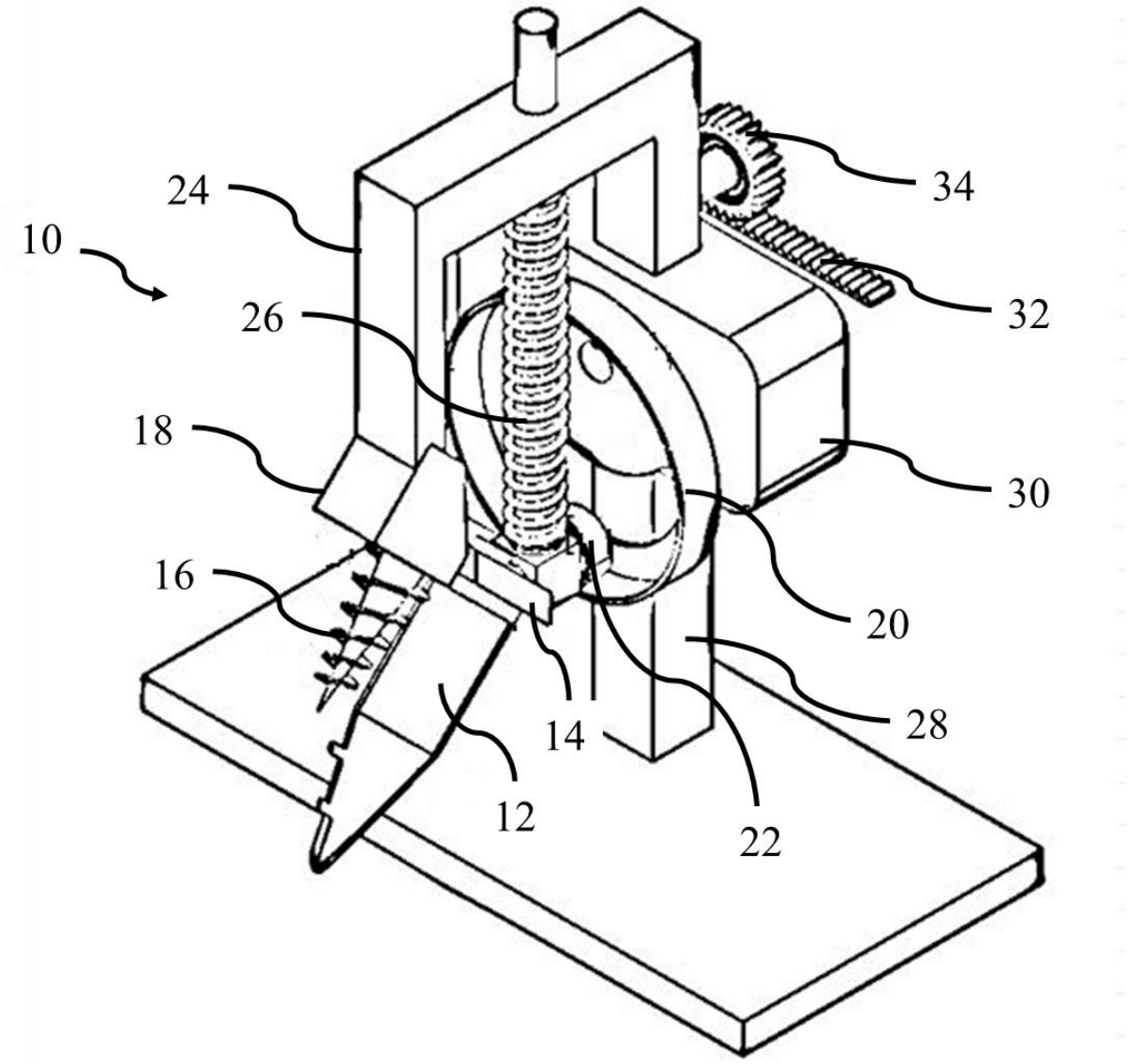


Figure 1

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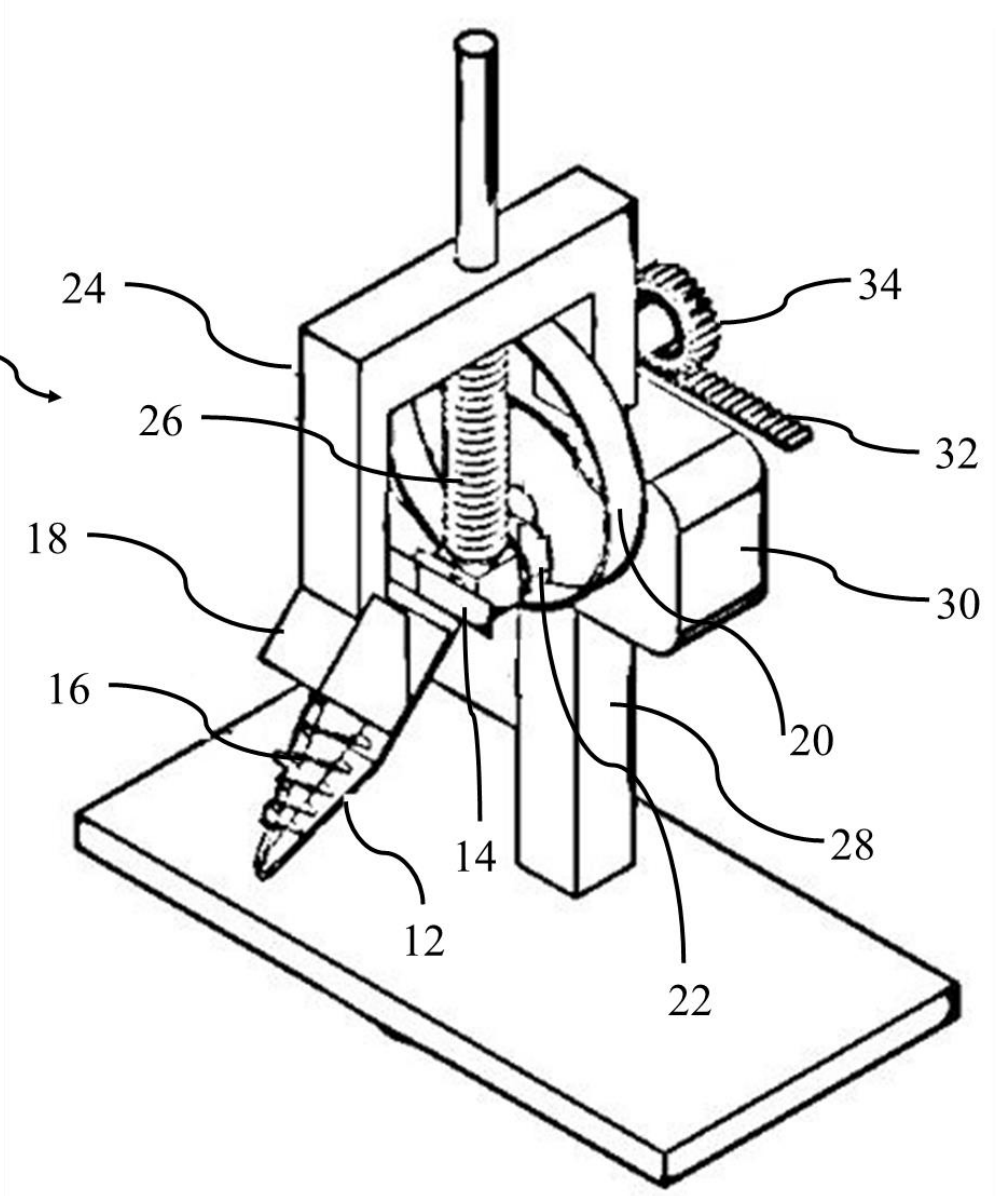

Figure 2

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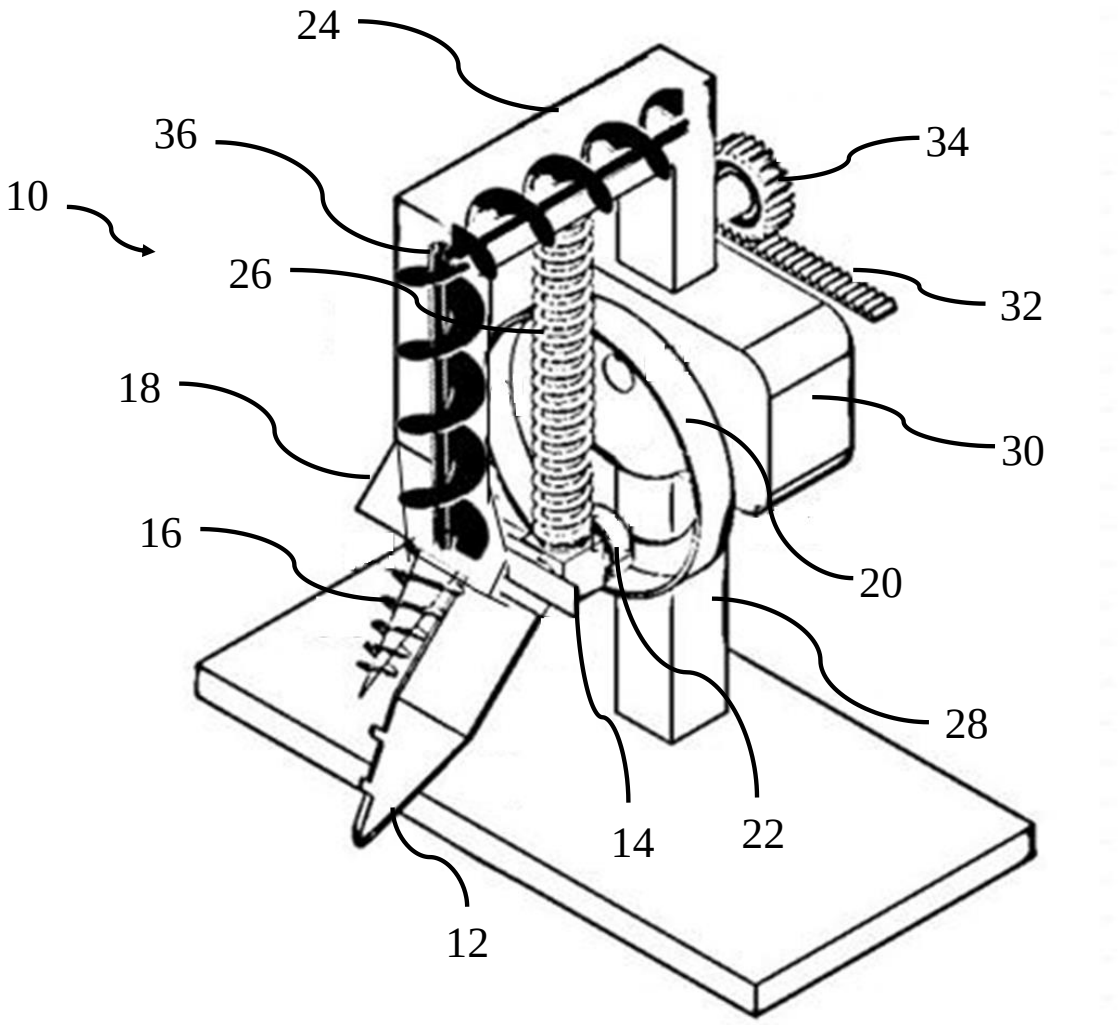

Figure 3

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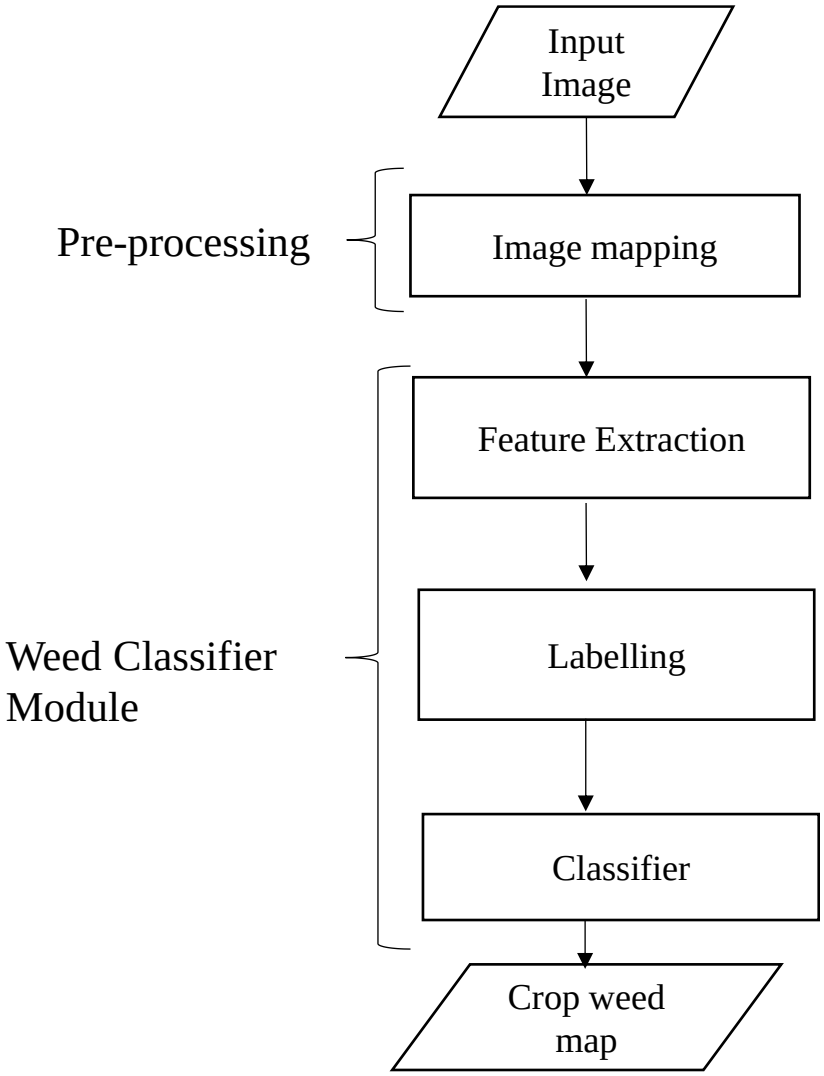

Figure 4

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