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Inventor(s)

Stubbs; Stacy

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### THORN EXTRACTOR APPARATUS

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#### Abstract

A thorn extractor apparatus has a frame, a roller, a screen that surrounds the roller, and a collection bin for receiving the thorny seeds. The frame includes a first and second side member, frame couplers, and a plurality of horizontal beams. The roller and screen work together to pick up and convey the thorny seeds to the collection bin to be discarded. The thorn extractor apparatus may feature a plurality of rollers coupled to a plurality of screens. The thorn extractor apparatus may also feature a vacuum, a kickstand, added weights, and a hitch mechanism configured to be pulled by a vehicle. Two or more frames may be coupled together in sequence to multiply the number of rollers clearing the ground of thorny seeds. The thorn extractor apparatus, in some examples, may feature an automatic drive system or be couplable to a vehicle.

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**Inventors:** Stubbs; Stacy (Colorado City, AZ)

**Applicant:** BURZ, LLC (Colorado City, AZ)

**Family ID:** 88240798

**Assignee:** BURZ, LLC (Colorado City, AZ)

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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. application Ser. No. 18/315,440, filed on May 10, 2023, which was a continuation-in-part of U.S. application Ser. No. 16/944,374, filed on Jul. 31, 2020, now U.S. Pat. No. 11,678,611, which claimed the benefit of U.S. Provisional Application Ser. No. 62/882,262, filed on Aug. 2, 2019, all of which are incorporated herein by reference. Further, U.S. application Ser. No. 18/315,440, filed on May 10, 2023, also claimed the benefit of U.S. Provisional Application Ser. No. 63/387,658 filed on Dec. 15, 2022, U.S. Provisional Application Ser. No. 63/382,758 filed on Nov. 8, 2022, and U.S. Provisional Application Ser. No. 63/340,041 filed on May 10, 2022, each of which are also incorporated herein by reference.

### TECHNICAL FIELD

[0002] The present disclosure relates to a thorn removal apparatus. More particularly, the present disclosure relates to a roller apparatus for the removal and collection of thorns.

### BACKGROUND

[0003] *Tribulus terrestris*, commonly referred to as goathead weeds or puncture vines, is a noxious weed that is aggressive and difficult to control. Goathead weeds are found in warm climates throughout the world. For example, goathead weeds may be found in Africa, North America, and Australia. Goathead weeds have long vines that produce many thorny seeds, which can lie dormant for years before a goathead weed emerges. The thorny seeds are known to cause pain to any person or animal that comes into contact with them. They are also notorious for puncturing bike tires and soles of shoes, causing frustration for many individuals.

[0004] These thorny seeds are often distributed to other locations by puncturing the skin of humans and animals. This distribution process is effective and often leads to many yards and fields becoming overwhelmed with the thorny seeds. Further, the thorny seeds are small and hard to pick up because of their sharp thorns. Due to the goathead weeds having a difficult and aggressive nature, many yards, fields, and native plant species are consumed each year. In fact, many individuals find that their efforts at removing the goathead weed from their land to be futile.

[0005] Many methods of removing goathead weeds are inefficient. Some of these methods include burning the weeds with propane, spraying to inhibit new growth, or using various approaches to collect the thorns. Specifically, when burning the goathead weeds, they must be burned while still alive and before they are dry. If not, the seeds may be dispersed leading to more goathead weed growth. Even burning the goathead weeds when they are alive may still not fully address the issue. The previously described methods take a lot of time, and even if persistent in the removal process, may not lead to any desired results.

[0006] When using any approach to remove the goathead weeds, there still remains the problem of the thorny seeds that have been dispersed on the ground. Spraying and burning may kill the weed, but may not kill all the seeds, which can then lead to future growth of the goathead weed. Typically, by the time goathead weed growth is readdressed after burning or spraying, there are more dried-out thorny seeds on the ground. To prevent future goathead weed growth, it is essential that seeds

are not dispersed and that any dried out thorny seeds are collected and discarded. As previously discussed, the seeds are small, sharp, and difficult to pick up by hand. There have been several attempts to create devices that are capable of removing numerous seeds. However, these devices are expensive, not widely available for individual use, and have many other shortcomings. [0007] Accordingly, there remains a need for an apparatus that removes and collects thorns in an easy, efficient, and cost-effective manner. The present disclosure seeks to solve these and other problems.

## SUMMARY OF EXAMPLE EMBODIMENTS

[0008] In some embodiments, a thorn extractor apparatus comprises a frame, a roller, a screen that surrounds the roller, and a collection bin for receiving the thorny seeds. The frame may comprise a plurality of frame couplers, a plurality of side members, and a plurality of horizontal beams.

[0009] In some embodiments, a thorn extractor apparatus may further comprise an automatic drive system for driving the roller(s) and collection bin(s). In some embodiments, the thorn extractor apparatus may further comprise a vacuum assembly.

[0010] In some embodiments, a thorn extractor apparatus further comprises a hitch mechanism configured to be pulled by a vehicle. In some embodiments, the thorn extractor apparatus comprises a plurality of rollers and a plurality of screens that surround the plurality of rollers, thereby reducing the drag on the vehicle while increasing the efficiency of collecting the thorny seeds.

[0011] In some embodiments, a method of using a thorn extractor apparatus comprises a user holding a handle beam and pushing the thorn extractor apparatus to collect thorny seeds. In particular, as a user pushes the thorn extractor apparatus, a roller and a screen rotate. The roller makes contact with the thorny seeds, where they become stuck in the roller. The user then continues to push the thorn extractor apparatus. When the roller turns with the thorny seeds attached, the screen detaches the thorny seeds as the screen lifts off and moves away from the roller towards the collection bin. The thorny seeds are then deposited into the collection bin as the screen continues to move around the roller. The roller continues to pick up thorny seeds and the process continues until the collection bin is filled. With the collection bin being filled, the user can detach the collection bin and discard the thorny seeds.

[0012] In some methods, a user may couple an automatic drive system to a thorn extractor apparatus for automatic use and collection of thorns.

[0013] In some methods, a user may couple a thorn extractor apparatus to a vehicle for pulling through a field.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 illustrates a front, side perspective view of a thorn extractor apparatus;

[0015] FIG. 2 illustrates a top, side perspective view of a thorn extractor apparatus;

[0016] FIG. 3 illustrates a detailed, side perspective view of a thorn extractor apparatus with a weight coupled to the frame;

[0017] FIG. 4 illustrates a top perspective view of a roller, a screen, and a collection bin of a thorn extractor apparatus;

[0018] FIG. 5 illustrates a detailed, side perspective view of a roller, a screen, and a tensioner of a thorn extractor apparatus;

[0019] FIG. 6 illustrates a detailed, side perspective view of a roller, a screen, a tensioner, and a collection bin of a thorn extractor apparatus;

[0020] FIG. 7 illustrates a side, top perspective view of a thorn extractor apparatus with a collection bin decoupled therefrom;

[0021] FIG. **8** illustrates a top, side perspective view of a thorn extractor apparatus;  
[0022] FIG. **9** illustrates a top, side perspective view of a thorn extractor apparatus comprising a kickstand;  
[0023] FIG. **10** illustrates a top perspective view of a thorn extractor apparatus configured for towing by an automatic drive system or a vehicle;  
[0024] FIG. **11** illustrates a side perspective view of a thorn extractor apparatus being towed by an automatic drive system;  
[0025] FIG. **12** illustrates a top, side perspective view of a thorn extractor apparatus being towed by a vehicle;  
[0026] FIG. **13** illustrates a perspective view of a thorn extractor apparatus being towed by an automatic drive system;  
[0027] FIG. **14** illustrates a perspective view of a thorn extractor apparatus comprising a vacuum and coupled to an automatic drive system;  
[0028] FIG. **15** illustrates a rear perspective view of a thorn extractor apparatus;  
[0029] FIG. **16** illustrates a bottom perspective view of a thorn extractor apparatus;  
[0030] FIG. **17** illustrates a top perspective view of a first thorn extractor apparatus coupled to a second thorn extractor apparatus;  
[0031] FIG. **18** illustrates a detailed, side perspective view of a spring coupled between a lower frame and an upper frame of a thorn extractor apparatus; and  
[0032] FIG. **19** illustrates a detailed, side perspective view of a strap coupled between a collection bin and a collection bin beam of a thorn extractor apparatus.

#### DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0033] The following descriptions depict only example embodiments and are not to be considered limiting in scope. Any reference herein to “the invention” is not intended to restrict or limit the invention to exact features or steps of any one or more of the exemplary embodiments disclosed in the present specification. References to “one embodiment,” “an embodiment,” “various embodiments,” and the like, may indicate that the embodiment(s) so described may include a particular feature, structure, or characteristic, but not every embodiment necessarily includes the particular feature, structure, or characteristic. Further, repeated use of the phrase “in some embodiments,” or “in an embodiment,” do not necessarily refer to the same embodiment, although they may.

[0034] Reference to the drawings is done throughout the disclosure using various numbers. The numbers used are for the convenience of the drafter only and the absence of numbers in an apparent sequence should not be considered limiting and does not imply that additional parts of that particular embodiment exist. Numbering patterns from one embodiment to the other need not imply that each embodiment has similar parts, although it may.

[0035] Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the invention, which is to be given the full breadth of the appended claims and any and all equivalents thereof. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation. Unless otherwise expressly defined herein, such terms are intended to be given their broad, ordinary, and customary meaning not inconsistent with that applicable in the relevant industry and without restriction to any specific embodiment hereinafter described. As used herein, the article “a” is intended to include one or more items. When used herein to join a list of items, the term “or” denotes at least one of the items, but does not exclude a plurality of items of the list. For exemplary methods or processes, the sequence and/or arrangement of steps described herein are illustrative and not restrictive.

[0036] It should be understood that the steps of any such processes or methods are not limited to being carried out in any particular sequence, arrangement, or with any particular graphics or interface. Indeed, the steps of the disclosed processes or methods generally may be carried out in various sequences and arrangements while still falling within the scope of the present invention.

The term “coupled” may mean that two or more elements are in direct physical contact. However, “coupled” may also mean that two or more elements are not in direct contact with each other, but yet still cooperate or interact with each other.

[0037] The terms “comprising,” “including,” “having,” and the like, as used with respect to embodiments, are synonymous, and 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.).

[0038] The terms “thorny seeds,” “goathead seeds,” and the like as used herein are meant to include all thorns, thistles, nettles, barbs, briars, seeds, and otherwise unwanted, sharp or pointed objects found on the ground.

[0039] As previously discussed, there remains a need for an apparatus that removes and collects thorny seeds in an easy, efficient, and inexpensive manner. The present disclosure seeks to solve these and other problems.

[0040] Thorny seeds, especially goathead seeds, are a prevalent ecological threat that often consumes a pristine tract of land. Thorny seeds not only damage yards and fields but can also cause physical pain to humans and animals. There have been many attempts at removing thorny seeds, with many of these attempts having shortcomings. For example, individuals often burn goathead weeds. However, burning weeds does not always destroy the thorny seeds. In fact, many seeds may survive the heat produced by the fire, and because these thorny seeds are not removed from the land, additional goathead weeds may grow.

[0041] A thorn extractor apparatus described herein assists a user in removing the thorny seeds from their land. Generally, the thorn extractor apparatus may comprise a frame with a roller that contacts the ground to pick up and remove thorny seeds that are spread across a tract of land. The thorny seeds are lifted from the roller and deposited into a collection bin via a screen. It will be appreciated that the thorn extractor apparatus allows a user to permanently remove thorny seeds from any tract of land, thereby preventing future weed growth.

[0042] In some embodiments, as shown in FIGS. 1-3, the thorn extractor apparatus **100** comprises a frame **102**, a roller **104**, a screen **106** that surrounds the roller **104**, and a collection bin **108** couplable to the frame **102**, configured to receive the thorny seeds. The frame **102** may be polyvinyl chloride (PVC). However, it could be envisioned that other materials may be used, such as steel, aluminum, wood, plastics, etc. The frame **102** may comprise a first and a second side member **110A**, **110B**; however, it may be understood that the frame **102** could comprise one or a plurality of side members. The frame **102** also comprises a plurality of horizontal beams **112** that couple the side members **110A**, **110B** together, adding structure and strength to the thorn extractor apparatus **100**. The frame **102** further comprises frame couplers **114** that may couple the side members **110A**, **110B** and the plurality of horizontal beams **112** together. The frame couplers **114** may comprise corner couplers **116**, beam couplers **118**, and angled couplers **120** to couple the first and second side members **110A**, **110B** and the plurality of horizontal beams **112** into a single unit.

[0043] The plurality of horizontal beams **112** may comprise a handle beam **122**, a structure beam **124**, a roller beam **126**, a screen beam **128**, and a collection bin beam **130**. The handle beam **122** is positioned at a top portion of the thorn extractor apparatus **100**, while the structure beam **124**, the roller beam **126**, the screen beam **128**, and the collection bin beam **130** are positioned at a bottom portion of the thorn extractor apparatus **100**. The roller beam **126** is inserted through a roller aperture **132** on the roller **104**.

[0044] Referring to FIG. 5, the roller **104** may be made of an inner material **135** that is hard, such as plastic, and a soft outer material **137**, such as neoprene, that is removably couplable to the inner material. However, other rollers may be used comprising rubber, vinyl, soft plastic, foam, natural and synthetic polymers, or any other materials and combinations thereof that can be easily punctured by a thorny seed. While the soft outer material **137** may be durable indefinitely or

otherwise intended to endure for the life of the thorn extractor apparatus **100**, it is contemplated that the soft outer material **137** may alternatively be removed periodically and replaced with a new soft outer material having a renewed affinity for adhering to thorny seeds. The roller **104** may be of varying sizes ranging between a small diameter and a large diameter. It will be appreciated that the roller **104** accumulates the thorny seeds from the ground through engagement with the soft outer material **137** on the roller **104**, thereafter depositing the thorny seeds into the collection bin **108** via the screen **106**.

[0045] In some embodiments, the roller **104** may be a hard, hollow drum fillable with a liquid or a solid to increase a weight of the roller **104**, leading to more pressure applied to the ground surface and a higher propensity to retrieve the dispersed thorny seeds. Likewise, additional weight may also be added to the thorn extractor apparatus **100** by filling inner channels and compartments of the frame **102** with water. The frame **102** may comprise an inlet valve and an outlet valve. Both the inlet valve and the outlet valve may be threaded in a manner configured to be couplable to a hose. The additional water may be added, for example, through attaching a garden hose to the inlet valve on the frame **102** and then subsequently placing a cap on the inlet valve to contain the water. After use, the water may then be removed through an outlet valve at a base of the frame **102** closer to the ground, allowing gravity to siphon out the water.

[0046] In some embodiments, as shown in FIG. 3, the thorn extractor apparatus **100** may further comprise one or more weights **143** couplable to the frame **102**, configured to increase the pressure applied by the roller **104** across the ground and thereby improve the collection of thorny seeds. The one or more weights **143** may be cylindrical plates or any shape with a center aperture for coupling to the structure beam **124** or other horizontal beam **112**. To add or remove the one or more weights **143**, for example, the beam coupler **118** may first be removed and the center aperture of the one or more weights **143** slid over the structure beam **124**. In some embodiments, the one or more weights **143** may alternatively be secured to any part of the frame **102** by a fastening mechanism such as a clamp or a hook and loop.

[0047] Referring to FIG. 4, the screen **106** may be a window screen. Alternatively, the screen **106** may be mesh or any thin material that can be punctured so as to allow thorny seeds to penetrate the roller **104**. The screen **106** may be positioned to encompass the screen beam **128** and the roller **104**. The screen **106** rotates with the roller **104**, removing the thorny seeds, in a conveyor belt-like fashion, from the roller **104**. In operation, the thorn extractor apparatus **100** picks up thorny seeds when the seeds become either enmeshed in the screen **106** or otherwise puncture the roller **104** and become stuck. As the screen **106** moves around the roller **104**, the screen **106** lifts the thorny seeds off of the roller **104** and are ultimately deposited in the collection bin. It will be appreciated that the thorn extractor apparatus **100**, with the screen **104**, removes all of the thorny seeds that attach to the roller **106**. The screen **104** is able to lift all thorny seeds that have penetrated the roller **104** and deposit them into the collection bin **108**.

[0048] As shown in FIGS. 5-6, a tensioner **133** may increase the tension or tightness of the screen **106**. The tensioner **133** may function by utilizing a nut **136** and bolt **138**. In other words, as the nut **136** is moved along the bolt **138**, the screen beam **128** and the collection bin beam **103** move relative to the movement of the nut **136** and the bolt **138**. If the nut **136** allows more of the bolt **138** to be exposed (i.e., extended), then more tension is placed on the screen **106**. On the other hand, if less of the bolt **138** is exposed, then less tension is placed on the screen **106**. While the tensioner **133** shown utilizes a nut **136** and bolt **138**, it will be appreciated that other tensioners may be used, such as push-button poles having apertures and spring-loaded pins, twist and lock mechanisms, linear actuators, or any other extending/retractable mechanism.

[0049] The collection bin **108** may be rectangular and plastic. Alternatively, it may be a bag or any other bin for collection and storage. The collection bin **108** may be of the same length as the roller **104** so as to collect all the thorny seeds picked up by the roller **104**. The collection bin **108** comprises a securement mechanism such as one or more hooks **134** that hook on collection bin

beam **130**; however, it will be appreciated that the securement mechanism may comprise, for example, straps and hook and loop fasteners (shown in FIGS. 5-6), snaps, tongues and grooves, or other mechanisms so as to be couplable to the collection bin beam **130**. It will be appreciated that other securement mechanisms may be used, such as wire hooks (shown in FIG. 3), bolts and nuts, hinges, locking pins, etc. It will further be appreciated that the securement mechanism **134** can quickly be attached and released, which makes discarding the thorny seeds simple. Further, the collection bin **108** is positioned beneath the screen beam **128** to be able to receive the thorny seeds from the screen **106**.

[0050] In some embodiments, as shown in FIGS. 7-8, the securement mechanism of the collection bin **108** comprises a first rail **140A** on a first side, opposite a second rail **140B** on a second side. In turn, the frame **102** may comprise a first channel **142A** on a first side, opposite a second channel **142B** on a second side, wherein the first and second rails **140A-B** are couplable respectively to the first and second channels **142A-B**, such as by sliding them together.

[0051] The first and second rails **140A-B** may comprise a base that projects upwards from a top of a mouth of the collection bin **108** and an extension member that curves outwards perpendicularly to the base that slides along the first and second rails **140A-B** and locks into place. In some embodiments, the first and second channels **142A-B** may be U-channels, Hat channels, H-bars, or other alternative fastening mechanisms configured to enable the first and second rails **140A-B** to be inserted and removed therefrom.

[0052] The thorn extractor apparatus **100** may comprise a first configuration wherein the collection bin **108** is removed from the frame **102**. The first configuration enables a user to dispose of any and all accumulated thorny seeds from the collection bin **108** and other materials collected during operation of the thorn extractor apparatus **100**. Subsequently, as shown in FIG. 8, the thorn extractor apparatus **100** may comprise a second configuration wherein the collection bin **108** is coupled to the frame **102** along the first and second channels **142A-B**. The second configuration enables a user to accumulate thorny seeds and other materials deposited within the collection bin **108** during use of the thorn extractor apparatus **100**. Throughout use of the thorn extractor apparatus over a large field or area, a user may repeatedly remove or insert the first and second rails **140A-B** from the first and second channels **142A-B**, thereby easily discarding thorns collected therein. While the screen **106** is not shown in several figures (for ease of viewing other components), it will be understood that the screen **106** surrounds each roller and screen beam in each embodiment.

[0053] In some embodiments, as shown in FIG. 9, the thorn extractor apparatus **100** may further comprise a kickstand **144** couplable to the frame **102** or, more particularly, one of the plurality of horizontal beams **112**, such as the structure beam **124**. The kickstand **144** may comprise a textured base **146** at a distal end of an elongated member **148**, and a clamp **150** or other fastener configured to rotatably secure the kickstand **144** to the frame **102**. The textured base **146** may be a rubber cap or plastic stopper at an end of the elongated member **148**. The kickstand **144** may further comprise a spring or detent mechanism that is stretched when the kickstand **144** is partway deployed and less stretched when the kickstand **144** is stowed or all the way deployed, allowing the kickstand **144** to lock in place. It will be appreciated that positioning the kickstand **144** towards a rear center of the frame **102**, as shown in FIG. 9, enables the thorn extractor apparatus **100** to stand on its own when stationary without tipping over and provides added stability when stored on uneven ground. As discussed earlier, it will be appreciated that the kickstand **144** may hold the thorn extractor apparatus **100** steady during filling and/or removal of water from the frame **102** and during removal of the bin **108** for emptying the thorny seeds.

[0054] In some embodiments, a method of using a thorn extractor apparatus **100** comprises a user holding the handle beam **122** and pushing the thorn extractor apparatus **100**. As a user pushes the thorn extractor apparatus **100**, a roller **104** and a screen **106** turns, making contact with, and securing, thorny seeds to the roller **104**. The user then continues to push the thorn extractor

apparatus **100**. When the roller **104** turns with the thorny seeds, the screen **106** detaches the thorny seeds as it lifts off and moves away from the roller **104** towards the collection bin **108**. The thorny seeds are then dropped into the collection bin **108** as the screen **106** continues to rotate about the roller **104** and screen beam **128**. In turn, the roller **104** continues to pick up thorny seeds and the process continues until the collection bin **108** is filled. The user can then detach the collection bin **108** and discard the thorny seeds.

[0055] As shown in FIGS. **10-11**, a thorn extractor apparatus **200** may comprise a frame **202**, a roller **204**, a screen **206** that surrounds the roller **204**, and a collection bin **208** for receiving the thorny seeds. The frame **202** may comprise first and second side members **210A**, **210B**; however, it may be understood that the frame **202** could alternatively comprise either one or a plurality of side members. The frame **202** may also comprise a plurality of horizontal beams **212** that couple the first and second side members **210A**, **210B** together, adding structure and strength to the thorn extractor apparatus **200**.

[0056] The frame **202** may further comprise frame couplers that may couple the first and second side members **210A**, **210B** and the plurality of horizontal beams **212** together through corner couplers, beam couplers, and angled couplers. Alternatively, the horizontal beams **212** may be coupled to the first and second side members **210A**, **210B** through welding, riveting, compression fitting, threaded bolts, or any other mechanical fasteners. The plurality of horizontal beams **212** may comprise one or more structure beams **214A**, **214B**, a roller beam **216**, a screen beam **218**, and a collection bin beam **220**. The first and second side members **210A**, **210B** may curve downwardly so as to form a lower or bottom portion. The roller beam **216**, the screen beam **218**, and the collection bin beam **220** are positioned at a bottom portion of the thorn extractor apparatus **200**. The roller beam **216** is inserted through a roller aperture **222** on the roller **204**.

[0057] The first side member **210A** may begin parallel to the second side member **210B** for a first length and then converge together at a hitch mechanism **224**. The hitch mechanism **224** may comprise apertures couplable to a vertical or horizontal member, a ball and trailer hitch assembly, a gooseneck hitch, a hook and ring assembly, or any other hitch or fastening mechanism known in the art configured to permit the frame **202** to both pivot about, and trail behind, a vehicle or automatic drive system **226**, as seen in FIG. **11**.

[0058] The automatic drive system **226** may comprise an electronic control module having a microprocessor and a semiconductor operative using DRAM, SRAM, or other memory processes, wherein the electronic control module is autonomously in control of one or more of the following systems: a powertrain control module, a transmission control module, a brake control module, a central control module, a central timing module, a general electronic module, and/or a suspension control module. The automatic drive system **226** may further comprise offroad wheels or tracks configured to maneuver over uneven terrain, a global positioning system (GPS) module, and one or more front and rear sensors **227** configured to enable autonomous driving. The one or more front and rear sensors **227** may comprise infrared photocells, radar, LiDAR, ultrasonic sensors, camera-based optical vision, or other alternative means to autonomously navigate around the ground that are in communication with the electronic control module.

[0059] In some embodiments, the automatic drive system **226** may be operative using an internal combustion engine or an electric powertrain and battery. In the embodiments having an electric powertrain and battery, the automatic drive system **226** may also comprise a dock or charging station couplable to an electrical outlet and configured to recharge the battery during off use. Examples of similar automatic drive systems include iRobot® vacuums and robotic lawn mowers, such as the Automower®. The thorn extractor apparatus **200** may operate either via a remote-control receiving user input or through autonomous control within a predetermined boundary area. The predetermined boundary area may be set using a software interface, such as on a paired smartphone, or by physical indicators readable by the sensors **227**.

[0060] In some embodiments, the automatic drive system **226** further comprises a wireless



transceiver, allowing the automatic drive system **226** to communicate with a smartphone application or other user software using known protocols, such as Wi-Fi, Bluetooth®, etc. A user may program the automatic drive system **226** using the smartphone application and may also see device history, usage, effectiveness (weight of bin, camera aimed at bin, etc.), errors, battery status, and other features. It will be appreciated that this autonomous control enables the thorn extractor apparatus **200** to make multiple passes around the user's yard or ground each day and season-round to consistently reduce the incidence of thorny seeds present.

[0061] The automatic drive system **226** may be fully-autonomous or remotely-controlled (either by specific physical remote or through a remote control interface on software usable on a phone or tablet). In some embodiments, a vehicle may be used to tow the thorn extractor apparatus **200**. For example, an all-terrain vehicle (ATV), a tractor, a truck, a car, a riding lawnmower, or other vehicle with the capacity to tow the frame **202** may be used (as shown in FIG. **12**).

[0062] In some embodiments, a method of using the thorn extractor apparatus **200** comprises a user coupling the hitch mechanism **224** to an automatic drive system **226**, operating the automatic drive system **226** either remotely or autonomously to pull the frame **202** of the thorn extractor apparatus **200** thereby engaging the roller **204** and causing the screen **206** to rotate about the roller **204**. The method further comprises the roller **204** engaging the thorny seeds along the ground and rotating them, via the screen **206**, towards the collection bin **208**, the screen **206** lifting the thorny seeds off the roller **204** and depositing them into the collection bin **208**. The process may continue until the collection bin **208** is filled; whereafter, the user may detach the collection bin **208** and discard the thorny seeds. In some embodiments, the hitch mechanism **224** may be coupled to a vehicle for towing.

[0063] Referring to FIGS. **12-17**, in some embodiments, a thorn extractor apparatus **300** comprises a lower frame **302**, a plurality of rollers **304A**, **304B**, **304C**, a plurality of screens **306A**, **306B**, **306C** (FIGS. **12-14**) that surrounds the plurality of rollers **304A**, **304B**, **304C**, and a plurality of collection bins **308A**, **308B**, **308C** for receiving the thorny seeds. The plurality of screens **306A**, **306B**, **306C** may be coupled correspondingly to a plurality of screen beams **330A**, **330B**, **330C**. It will be understood, however, that the lower frame **302** could alternatively comprise any number of rollers, screens, and collection bins either respectively or in combinations thereof. The plurality of screens **306A**, **306B**, **306C** are not shown in FIGS. **15-17** for clarity in viewing other components.

[0064] The larger the embodiment of the thorn extractor apparatus **300**, for example, including self-propelled applications for clearing a large acreage of land, the greater the quantity of the plurality of rollers **304A**, **304B**, **304C**, the plurality of screens **306A**, **306B**, **306C**, and the plurality of collection bins **308A**, **308B**, **308C**, may be incorporated within the lower frame **302** in order to provide more contoured surface area to match the topography of the ground profile, thereby picking up more thorny seeds.

[0065] The lower frame **302** may comprise a plurality of side members **310**, wherein a respective side member **310** is positioned on each side of each of the plurality of rollers **304A**, **304B**, and **304C**, respectively. The plurality of side members **310** may be telescoping or otherwise extendable and retractable to adjust the leverage and drag across the plurality of screens **306A**, **306B**, **306C**. The plurality of side members **310** may be couplable to an upper frame **312** via a plurality of hinges **326**, as best seen in FIGS. **15-16**. The plurality of hinges **326** may be configured to permit the lower frame **302** to pivot in relation to the upper frame **312**, again, allowing for contour changes in terrain, among other uses.

[0066] The upper frame **312** may be coupled to a tongue **314** for coupling to a vehicle. Additionally, the upper frame **312** may comprise a plurality of apertures **323** (FIG. **13**) along a vertical adjustment member **324**. Movement of the tongue **314** on the upper frame **312** along the plurality of apertures **323** enables the thorn extractor apparatus **300** to be fitted at the appropriate angle and height to be coupled to a tow vehicle **316** of varying sizes, as shown in FIG. **13**. The tow vehicle **316** may be an automatic drive system, a riding lawnmower, an all-terrain vehicle (ATV),

tractor, truck, car, or any other suitable towing device.

[0067] The upper frame **312** may also comprise an accessory frame **311** comprising a tab **313** having an aperture, flap, loop, clasp, or other fastening mechanism that projects rearwardly (in an opposite direction of the tongue **314**) and is configured to permit the thorn extractor apparatus **300** to tow additional equipment or attachments, or to couple additional thorn extractor apparatuses **300** thereto (such as by coupling the hitch mechanism of one thorn extractor apparatus **300** to the tab **313**, as shown in FIG. 17).

[0068] The tongue **314** may further comprise a basket **318** or other housing structure configured to fasten an overflow container such as a bucket **319** (FIG. 13) or a vacuum **320** (FIG. 14) to the tongue **314**. The overflow container may receive the thorny seeds accumulated in the collection bins **308A**, **308B**, **308C** once full without having to empty the thorny seeds into a trash receptacle during use. For example, the vacuum **320** may be used manually to siphon thorny seeds and thistles from the plurality of collection bins **308A**, **308B**, **308C** for storage and disposal away from the land that has been recently cleared. In some embodiments, the vacuum **320** may comprise a hose **322** couplable directly to the plurality of collection bins **308A**, **308B**, **308C** whereby the thorny seeds are immediately transferred to a depository within the vacuum for contained storage. In other embodiments, as shown, the hose **322** may be stored on the vacuum until used by a user.

[0069] Referring back to FIG. 13, the tongue **314** may further comprise a hitch **328** or alternative fastening mechanism, as previously outlined above, whereby the tongue **314** is couplable to the tow vehicle **316** which may comprise a self-propelled vehicle or other vehicle, as previously discussed. In some embodiments comprising an automatic drive system, an antenna **317** may be used for wireless communication with a user device for operating and maneuvering the automatic drive system. The antenna **317** may be in wireless communication with a remote control for manual driving as well, if desirable. However, it will be appreciated that antenna **317** is not required.

[0070] Additionally, in some embodiments, the thorn extractor apparatus **300** may comprise at least one controller, at least one motor, and at least one sensor, for automatically maneuvering the thorn extractor apparatus **300**.

[0071] In some embodiments, a method of using a thorn extractor apparatus **300** comprises a user coupling the hitch **328** to the tow vehicle **316**. The user may also adjust the angle of the tongue **314** by adjusting its positioning along the plurality of apertures **323** on the vertical adjustment member **324**. The user then drives or operates the tow vehicle **316** pulling the upper frame **312** and lower frame **302**, thereby engaging the plurality of rollers **304A**, **304B**, **304C** and causing the plurality of screens **306A**, **306B**, **306C** to rotate about the plurality of rollers **304A**, **304B**, **304C**. The plurality of rollers **304A**, **304B**, **304C** then make contact with thorny seeds along the ground, where the screen **306A**, **306B**, **306C** then lifts the thorny seeds upwards and towards the plurality of collection bins **308A**, **308B**, **308C**, dropping the thorny seeds into the plurality of collection bins **308A**, **308B**, **308C**. The process continues until the plurality of collection bins **308A**, **308B**, **308C** are filled. In some embodiments, the method further comprises emptying the bins **308A**, **308B**, **308C** in a container (e.g., bucket **319**) or siphoning the thorny seeds from the plurality of collection bins **308A**, **308B**, **308C** using a vacuum **320** for storage and disposal.

[0072] In some embodiments, as shown in FIG. 17, the extractor apparatuses **300** may comprise a first thorn extractor apparatus **332** coupled to a second thorn extractor apparatus **334**. The hitch **328B** on the tongue **314B** of the second thorn extractor apparatus **334** may be coupled to the tab **313** of the accessory frame **311A** of the first thorn extractor apparatus **332**. The above coupling process, as described, may thereafter be repeated as desired by a user. As contemplated, but without limitation, six thorn extractor apparatuses **300**, for example, may be couplable together in sequence and pulled behind the tow vehicle **316**. It will be appreciated that said embodiments allow for sequential apparatuses **300** to pick up any thorns missed by the prior apparatus **300**.

[0073] In some embodiments, the thorn extractor apparatus **100**, **200**, **300** may further comprise a disposable bag couplable within the collection bin **108**, **208**, **308**. The disposable bag may be

spread out over the corners of the collection bin **108**, **208**, **308** or otherwise be couplable to the collection bin beam **118**, **220** or other frame members. In some embodiments, the disposable bag may replace the collection bin **108**, **208**, **308**. After using the thorn extractor apparatus **100**, **200**, **300**, a user may fasten the disposable bag shut using a built-in draw string or other fastener, dispose of the disposable bag, and then replace it with a new disposable bag. The disposable bag may comprise a puncture-resistant material including plastics and other polymers, such as a low-density polyethylene, that will resist tearing when exposed to the thorny seeds.

[0074] Referring to FIG. **18**, in some embodiments, the thorn extractor apparatus **300** further comprises a spring **336** coupled between the lower frame **302** and the upper frame **312**. As depicted, the lower frame **302** may comprise a first post **338** about which a first end of the spring **336** is coupled while the upper frame **312** comprises a second post **340** about which a second end of the spring **336** is coupled. The spring **336** may be a helical compression spring or alternative form of spring that compensates for uneven ground surfaces. The spring enables a surface area of the plurality of rollers **304A**, **304B**, **304C** to more closely conform to and approximate the profile of the ground. This is additionally beneficial when a plurality of rollers **304A-C** are utilized, as it allows each roller to move independently to compensate for the terrain. It will be appreciated that the increased responsiveness of the plurality of rollers **304A-C** enables the thorn extractor apparatus **300** to pick up and collect more thorny seeds distributed across the ground regardless of whether the ground is flat or uneven. While the spring **336** is shown in use with the thorn extractor apparatus **300**, the spring **336** may also be used with the other embodiments of the thorn extractor apparatus **100**, **200** discussed herein. Additionally, while a spring **336** is shown, other mechanisms may be used, such as shock absorbers (e.g., hydraulic cylinders, coilovers, etc.), dampers, or similar mechanisms known in the art of vehicle suspension systems.

[0075] Referring to FIG. **19**, in some embodiments, the thorn extractor apparatus **100** may comprise a strap **152** coupled between the collection bin **108** and the collection bin beam **130** or alternatively between the collection bin **108** and any member of the frame **102**. The strap **152** may comprise leather, nylon, related polymers, or alternative materials. The strap **152** may be secured to the collection bin **108** and the collection bin beam **130** via a screw, snap, hook and loop, buckle, or alternative fastening mechanism. It will be appreciated that the strap **152** may securely hold the collection bin **108** to the collection bin beam **130** during use of the thorn extractor apparatus **100** and also easily decoupled when needed to remove the collection bin **108** from the frame **102** to discard the thorny seeds that were collected. The strap **152** may be used separately from, or in conjunction with, the first and second rails **140A-B** and corresponding first and second channels **142A-B**, as described earlier in FIGS. **7-8**.

[0076] It will be appreciated that systems and methods according to certain embodiments of the present disclosure may include, incorporate, or otherwise comprise properties or features (e.g., components, members, elements, parts, and/or portions) described in other embodiments. Accordingly, the various features of certain embodiments can be compatible with, combined with, included in, and/or incorporated into other embodiments of the present disclosure. Thus, disclosure of certain features relative to a specific embodiment of the present disclosure should not be construed as limiting application or inclusion of said features to the specific embodiment unless so stated. Rather, it will be appreciated that other embodiments can also include said features, members, elements, parts, and/or portions without necessarily departing from the scope of the present disclosure.

[0077] Moreover, unless a feature is described as requiring another feature in combination therewith, any feature herein may be combined with any other feature of a same or different embodiment disclosed herein. Furthermore, various well-known aspects of illustrative systems, methods, apparatus, and the like are not described herein in particular detail in order to avoid obscuring aspects of the example embodiments. Such aspects are, however, also contemplated herein.

[0078] Exemplary embodiments are described above. No element, act, or instruction used in this description should be construed as important, necessary, critical, or essential unless explicitly described as such. Although only a few of the exemplary embodiments have been described in detail herein, those skilled in the art will readily appreciate that many modifications are possible in these exemplary embodiments without materially departing from the novel teachings and advantages herein. Accordingly, all such modifications are intended to be included within the scope of this invention.

## Claims

1. A thorn extractor apparatus, comprising: a frame comprising: at least one roller beam, and at least one screen beam; a hitch mechanism coupled to the frame; at least one roller coupled to the at least one roller beam and configured to rotate about a longitudinal axis and retrieve thorny seeds from an area of ground through impaling the thorny seeds into the at least one roller; at least one screen surrounding both the at least one roller and the at least one screen beam, the at least one screen configured to remove the thorny seeds from the at least one roller and deposit them into at least one collection bin.
  2. The thorn extractor apparatus of claim 1, wherein the hitch mechanism is coupled to an automatic drive system.
  3. The thorn extractor apparatus of claim 2, wherein the automatic drive system is autonomously controlled.
  4. The thorn extractor apparatus of claim 1, wherein the hitch mechanism is coupled to a vehicle.
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