(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
9 December 2010 (09.12.2010)

PCT

(10) International Publication Number
WO 2010/141736 A1

(51) International Patent Classification:
A63B 69/00 (2006.01)

(21) International Application Number:
PCT/US2010/037278

(22) International Filing Date:
3 June 2010 (03.06.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/217,900 5 June 2009 (05.06.2009) US
12/793,232 3 June 2010 (03.06.2010) US

(72) Inventor; and
(71) Applicant : **MIHALJEVIC, Shane, P.** [US/US]; 2394 Cripple Creek Dr., St. Louis, MO 63129 (US).

(74) Agent: **KLUG, Kevin, L.**; 11237 Concord Village Ave., St. Louis, MO 63123-6903 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

[Continued on next page]

(54) Title: BALL PROJECTING AND TRAINING APPARATUS AND METHOD OF USE

(57) Abstract: A ball projecting and training apparatus and method of use having a base, a throwing arm, an adjustable ball mount on said throwing arm, and one or more energy storage elements connected between an end of the throwing arm and an accelerator. The ball mount pivots in a direction parallel with, perpendicular to, or a combination thereof relative to the throwing arm and also locks to provide repeatable trajectories and spins. The accelerator provides additional energy to the ball when depressed by a user. A release holds the throwing arm when the apparatus is cocked and allows a user to launch a ball when desired.

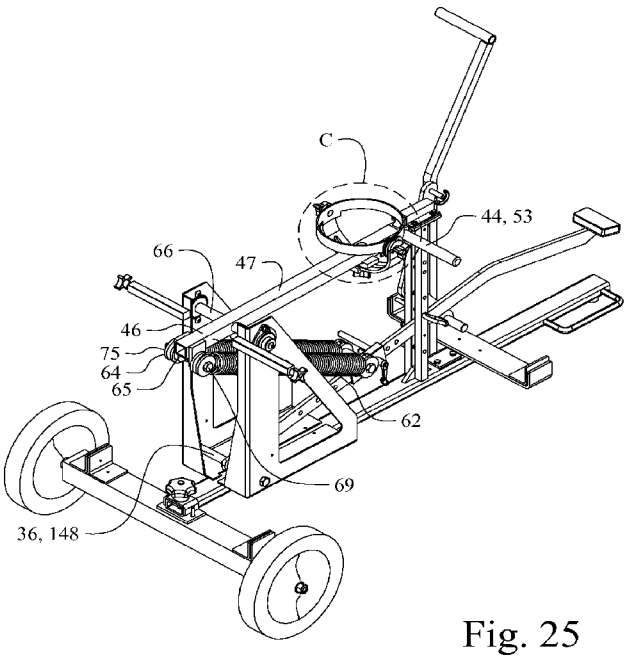


Fig. 25

WO 2010/141736 A1

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

BALL PROJECTING AND TRAINING APPARATUS AND METHOD OF USE

This application claims priority of U.S. Provisional Patent Application #61/217,900, filed June 5th, 2009, entitled *Ball Projecting and Training Apparatus and Method of Use* and U.S. Patent Application #12/793,232 filed June 3rd, 2010, entitled *Ball Projecting and Training Apparatus and Method of Use*.

BACKGROUND OF THE INVENTION

The art of the present invention relates to game or ball training equipment in general and more particularly to an apparatus and method of use which launches a soccer or other type of ball and provides a plurality of user controllable ball pitches, distances, trajectories, spins, angles, cants, or swerves in a compact and portable form. The present art is also useful with volleyball, American football, rugby, baseball, softball, futsal, and cricket. The apparatus and method of use is especially useful for aiding, improving, and developing the skills of a soccer player, regardless of his or her skill level. The apparatus and method of use improves player and goalie shooting and trapping skills by providing ball projections which mimic real game situations. The present art may be utilized as an ultimate finishing solution for players desiring to hone their technique. The term "soccer" is typically utilized within North America, South Africa, Japan, Australia, New Zealand and Zimbabwe to describe the game more formally known as "Association Football" in other countries around the world. The game is also known as Football, Futbol, or Footy/Footie.

The present art accepts, accelerates, and launches a ball with user desirable motion characteristics, such as linear acceleration, angular acceleration, spin, or a combination thereof. The apparatus provides adjustments for elevation, yaw, pitch, and spin which affect the exiting ball trajectory. When adjusted as desired, the exiting ball trajectory or path is highly repeatable.

Soccer players and goalies, as well as other types of game players which interface with a ball, must master a plurality of skills for effective play, including but not limited to ball control, ball possession, ball passing, ball blocking, and ball shooting. As understood within the soccer arts, players utilize their feet, legs, chest, shoulder, and head to receive, control, and redirect the ball with goalies utilizing their hands in addition to the aforesaid. The aforesaid skills are mastered through repetitive training whereby an unconscious muscle memory is created within the player and allows the player to react instantaneously when a ball arrives at any specific angle,

velocity or speed, or trajectory. During training, it is essential that the moving ball or ball service be presented in a repeatable fashion whereby said player may develop said muscle memory. The aforesaid unconscious muscle memory is also found within a plurality of other sports including but not limited to baseball, basketball, football, volleyball, and tennis.

The present art apparatus and method of use allows user adjustment whereby a repeatable ball service is provided for a plurality of ball types, including but not limited to soccer balls, volleyballs, footballs, baseballs, softballs, rugby balls, cricket balls, and basketballs. The apparatus provides user adjustability for ball velocity, exiting elevation, trajectory, angular velocity or yaw, and spin. Ball velocity and trajectory are further quickly adjustable or user adjustable on the fly via a foot actuated accelerator or power pedal. The unique ball mount of the present art has the ability to adjust the spin on a vertical axis and at the same time on a horizontal axis. The vertical axis control is secured by two serrated or grooved mating and adjustable locking disks on a left and right side of a ball mount. This adjustment controls the spin and height of the ball thrown and also dictates at what angle the ball projects on the vertical axis. The ball mount is also formed in such a fashion as to control left to right spin and or curve of the ball being thrown. This aspect of the apparatus also dictates the amount of side spin a user can put on the ball. When both of the aforesaid features are used in conjunction with one another, a bending dip may be placed upon the ball. The dip is as seen on free kicks and placed shots and also on corner kicks. The unique features of the present apparatus are especially useful for goalie training such as bending a ball around a wall of players and dipping the ball into the goal proximately near the goal.

The apparatus further includes a ball storing and feeding structure which allows quick and easy loading of balls. The method of use allows a player to receive balls at a plurality of angles, velocities, trajectories, and spins whereby the player may develop the desired muscle memory for game play. The apparatus and method of use is especially useful for coaches and trainers whereby a repeatable set of ball angles, velocities, trajectories, and spins may be utilized during a course of player training and to assess the skills of any individual player.

Accordingly, it is an object of the present invention to provide a ball projecting and training apparatus and method of use which is safe and capable of launching a ball in a predictable and repeatable fashion with a plurality of user desirable and adjustable velocities, elevations, trajectories, angular velocities or yaws, and spins.

Another object of the present invention is to provide a ball projecting and training apparatus and method of use which easily allows a player or goalie to improve their shooting and trapping skills by providing ball projections which mimic real game situations.

Another object of the present invention is to provide a ball projecting and training apparatus and method of use which imparts desirable ball motion characteristics, such as linear acceleration, angular acceleration, spin, or a combination thereof and provides adjustments for ball trajectory elevation, yaw, pitch, and spin.

SUMMARY OF THE INVENTION

To accomplish the foregoing and other objects of this invention there is provided a ball projecting and training apparatus and method of use having a base, a throwing arm, and an adjustable ball mount attached with said throwing arm near a first end. The apparatus and method of use are especially useful during the training of soccer players but may be utilized with plethora of other sports. Unlike prior art ball throwing devices, the present art apparatus and method of use is capable of imparting user desirable, repeatable, and adjustable velocities, elevations, trajectories, angular velocities or yaws, and spins to a ball.

For the present art, the throwing arm is pivotally attached with a throwing arm support which is attached with said base. One or more energy storage elements are connected between a second end of the throwing arm and an accelerator. The pivotal connection of the throwing arm is between said first and second ends of the throwing arm. As described, the energy of the energy storage elements is fully depleted when the apparatus is utilized and the energy storage elements come to a resting non-displaced position. The accelerator adds additional energy to the ball when depressed, preferably by a user's foot. The accelerator has multiple adjustment positions which allow varied and controlled amounts of energy to be imparted to the ball.

Upon cocking the apparatus, a release or latch holds the throwing arm in a cocked position. The release or latch is connected with a release linkage which is operated by the user and allows a ball to be launched. For the preferred embodiment, a safety assembly is mounted near the release linkage and prevents unintended or accidental discharge.

Especially unique to the present apparatus is the adjustable ball mount. The ball mount has a mount support bracket which allows for yaw or windage trajectory adjustment and a ball retainer which allows for elevation or pitch trajectory adjustment. The combination of the two

adjustments further allows the user to place a spin, curve, or non-linear trajectory upon the ball. For the preferred embodiment, the support bracket and ball retainer have a serrated or grooved pair of locking disks there between which lock the respective positions of the two in place when tightened by a fastener. This unique locking feature provides repeatable ball launching characteristics and trajectories.

The apparatus is substantially surrounded with guards which isolate the throwing arm space from the user space in order to promote user safety.

The art of the present invention may be manufactured from a variety of materials provided that said materials are able to withstand the stresses applied during operation of the apparatus. Said materials include but are not limited to various metals and their alloys, woods, rubbers, plastics, or composites.

BRIEF DESCRIPTION OF THE DRAWINGS

Numerous other objects, features and advantages of the invention should now become apparent upon a reading of the detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a left rear perspective view of an alternative embodiment ball projecting and training apparatus in a cocked or set position.

FIG. 2 is a right rear perspective view thereof.

FIG. 3 is a right front perspective view thereof.

FIG. 4 is a left plan view thereof.

FIG. 5 is a left rear perspective view thereof in a released position.

FIG. 6 is a front left perspective view thereof.

FIG. 7 is a front plan view thereof.

FIG. 8 is a left plan view thereof.

FIG. 9 is a left rear perspective view thereof in a cocked or set position with a ball placed therein and ready for projection.

FIG. 10 is a right rear perspective view of an alternative embodiment ball projecting and training apparatus in a cocked or set position showing the alternative embodiment ball mount.

FIG. 11 is a left plan view thereof.

FIG. 12 is a bottom rear perspective view thereof.

FIG. 13 is a bottom plan view thereof.

FIG. 14 is a left rear perspective view of an alternative embodiment ball projecting and training apparatus in a released position with guards and a ball storing and feeding structure installed. FIG. 15 is a left front perspective view thereof.

FIG. 16 is a right rear perspective view of a preferred embodiment ball projecting and training apparatus in a cocked or set position with guards in place.

FIG. 17 is a right front perspective view thereof.

FIG. 18 is a left rear perspective view thereof.

FIG. 19 is a left bottom perspective view thereof.

FIG. 20 is a right plan view thereof which is substantially a mirror image of a left plan view.

FIG. 21 is a top plan view thereof.

FIG. 22 is a front plan view thereof.

FIG. 23 is a rear plan view thereof.

FIG. 24 is a right rear perspective view of a preferred embodiment ball projecting and training apparatus in a cocked or set position without the guard in place.

FIG. 25 is a right front perspective view thereof.

FIG. 26 is a left rear perspective view thereof.

FIG. 27 is a right plan view thereof.

FIG. 28 is a left plan view thereof.

FIG. 29 is an enlarged fragmentary view as taken along section A of Fig. 28.

FIG. 30 is a top plan view of a preferred embodiment ball projecting and training apparatus in a cocked or set position without the guard in place.

FIG. 31 is a front plan view thereof.

FIG. 32 is a rear plan view thereof.

FIG. 33 is an enlarged fragmentary view as taken along section B of Fig. 24 showing the ball mount.

FIG. 34 is an enlarged fragmentary view as taken along section C of Fig. 25 showing the ball mount.

FIG. 35 is an enlarged fragmentary view as taken along section D of Fig. 30 showing the ball mount.

FIG. 36 is an enlarged fragmentary view as taken along section E of Fig. 27 showing the ball mount.

DETAILED DESCRIPTION

The preferred embodiment of the present art ball projecting and training apparatus **10** first comprises a base **11** having a front portion **12**, a rear portion **18** and one or more wheels **14** pivotally mounted near or with said front portion **12**. Alternative embodiments may forego use or not utilize said wheels **14** or utilize said front portion **12** without said wheels **14**. For the preferred embodiment, the front portion **12** is a structural member attached with said base **11** via a bolt or screw with one or more indexed positions whereby the front portion **12** may be rotated, removed, and/or secured relative to said base **11**. That is, the front portion **12** has one or more indexing holes **170** into which one or more pins **174** from a U-clamp **172** fitted over the base **11** extend into the holes **170** of the front portion **12** and lock the front portion **12** into position when a bolt or screw is tightened there through.

One or more guards **70** are preferably removably mounted with said base **11** upon or with one or more guard mounts **16** near said front portion **12** and one or more guard mounts **20** near said rear portion **18**. Alternative embodiments may forego use of said guard mounts **20** or place said guard mounts **20** at a plurality of locations on said apparatus **10**. Also for the preferred embodiment, a release support **22** is attached with said base **11**, preferably closer to said rear portion **18** than said front portion **12**, and projects upward, away from, or substantially perpendicularly from a plane substantially defined by said base **11**. One or more throwing arm supports **38**, each having a lower portion **39** and an upper portion **41**, are attached with said base **11** near or at said lower portion **39**. Said throwing arm supports **38** are preferably positioned closer to said front portion **12** than said rear portion **18**, and also extend upward, away from, or substantially perpendicularly from a plane substantially defined by said base **11**. Also for the preferred embodiment, one or more support braces **43** are attached between the throwing arm supports **38** and said base **11** and provide additional strength and support for said throwing arm supports **38**. For the preferred embodiment, said supports **38** and said braces **43** are formed from a single sheet metal portion on each side which is bent and formed into a structure which mounts with the base **11**. Alternative embodiments may utilize throwing arm supports **38**, with or without said support braces **43**, and release supports **22** which have a plurality of cross sectional

shapes, sizes, and orientations.

A directing arm **40** is further attached with said base **11** and provides user control of the ball **74** projection direction for the apparatus **10** via a pivot or rotation of the apparatus **10** or base **11** on said wheels **14**. That is, the rear portion **18** may be raised via said directing arm **40** and the apparatus **10** may be pivoted on the wheels **14**. For the preferred embodiment, the directing arm **40** is mounted with said base **11** near or at said rear portion **18** and is an upright structural member which is bent or cants toward said rear portion **18** of said base **11** with a lateral extension for the user to grasp. A carrying or transportation handle **168** or extension is further mounted with said base **11** near or at said rear portion **11** in the form of a loop whereby the user may move the apparatus **10** as desired. As described herein, the term "attached" includes a plurality of generally accepted connecting and joining techniques as understood within the mechanical arts, including but not limited to welds, bolts, screws, pins, press fits, sweat fits, and removable mating and joining techniques.

For the preferred embodiment, a throwing arm **42** is pivotally mounted with said one or more throwing arm supports **38** near or at said upper portion **41** of the throwing arm supports **38**. The throwing arm **42** preferably comprises a first end **44**, a second end **46**, and an arm pivot **66** between said first end **44** and second end **46**, preferably closer to said second end **46**. Said arm pivot **66** is a shaft which extends from said throwing arm **42** and pivotally mounts or interfaces with said throwing arm supports **38** in the preferred embodiment. For the preferred embodiment, said arm pivot **66** mates on each side with bearings **37** mounted with each of said arm supports **38**. The bearings **37** in conjunction with said supports **38** retain the rotational or pivoting motion of the throwing arm **42** during operation and use of the apparatus **10**. Alternative embodiments may utilize a plurality of mechanically accepted methods in order to provide a pivotal mount or interface of said throwing arm **42** with said arm supports **38**, including but not limited to bearing interfaces, torsion bars, spring supports, and through shafts. Also, one or more spacers may be placed onto or over said pivot **66** to assure placement and positioning of the throwing arm **42** between the throwing arm supports **38**.

A throwing arm handle **53** is mounted onto said throwing arm **42** near or at said first end **44**. The throwing arm handle allows for easy and convenient cocking or retraction of the throwing arm **42**, especially when stressed or biased by the energy storage elements **62**. Said handle **53** preferably extends away from the throwing arm **42** at a location which is easily

reachable by a user. The handle **53** may be attached to said throwing arm **42** via a plurality of methods including but not limited to welds, bolts, pins, or integral formation with the throwing arm **42**.

A ball mount **48** is adjustably mounted with said throwing arm **42** near or at said first end **44** and is sized to accept or fit the ball **74** size utilized or desired by the user or player for a type of game. For the preferred embodiment, the ball mount **48** comprises a mount support bracket **50** which is pivotally or slidably connected with a ball retainer **60**. The support bracket **50** is of an arcuate shape and preferably has one or more slots **51** there within through which a bracket fastener **58**, such as a bolt, pin or clip, may be placed and by which the bracket **50** may be attached, adjusted or partially canted relative to the lengthwise axis of the throwing arm **42**. Said slot **51** may also take the form of one or more holes within said bracket **50**. The lengthwise axis is described as a line between the first end **42** and the second end **46** and the cant may be parallel with, perpendicular to, or a combination thereof relative to the lengthwise axis. For the preferred embodiment, the bracket fastener **58** clamps or compresses and attaches the support bracket **50** with said throwing arm **42**. The support bracket **50** preferably has an arcuate shape or form whereby the bracket **50** substantially follows or is sized to accommodate the contours of the ball **74** and the throwing arm **42** is mounted within or external to the arcuate shape or form. Alternative embodiments of the support bracket **50** may take a plurality of forms including but not limited to linear, partial or full elliptical, and other partial or full polygonal forms. Also for the preferred embodiment, a spacer **56** having a radius side or arcuate portion **57** and a flat side or substantially flat portion **59** is sandwiched between the throwing arm **42** and the support bracket **50**, all on the back side **49** of the throwing arm **42**. The spacer **56** assures a positive mate of the support bracket **50** and the throwing arm **42** when the bracket fastener **58** is tightened or engaged. That is, for a screw or bolt bracket fastener **58**, the bolt or screw is mated with female threads on the throwing arm **42** and rotated to sandwich the spacer **56** between the support bracket **50** and throwing arm **42**, thereby holding the three elements **42**, **50**, **56** together. Also for the preferred embodiment, a notch or groove equivalent to or greater than the width of the throwing arm **42** is optionally placed onto the flat portion **59** of the spacer **56** in order to assure a positive mating with the throwing arm **42**. Alternative embodiments may place said support bracket **50** and spacer **56** on the front side **47** of the throwing arm **42**

The preferred embodiment support bracket **50** also has an outer clamp **52** which is placed

between said bracket **50** and said bracket fastener **58** whereby said support bracket **50** is sandwiched between said spacer **56** and said outer clamp **52** as said fastener **58** holds the sandwich. Said outer clamp **52** is preferably of a "U" shaped form with a distance between the legs of the "U" of equal or greater distance than a width of the portion of the mount support bracket **50** between the spacer **56** and said outer clamp **52**. Alternative embodiments may utilize a substantially flat outer clamp **52** or an outer clamp **52** having a plurality of shapes which mate and contour to said support bracket **50**.

The ball retainer **60** is held or retained with the support bracket **50** via one or more ball retainer fasteners **61**. In its preferred form, the ball retainer **60** also represents an arcuate shape or form which substantially follows or is sized to accommodate the contours of the ball **74**. For the preferred embodiment, the ball retainer fasteners **61** allow the ball retainer **60** to pivot around an axis which is substantially perpendicular to, parallel with, or a combination thereof relative to the lengthwise axis of the throwing arm **42**. When tightened or secured, the fasteners **61** fix the position of the ball retainer **60** and prevent further pivoting. As can be surmised from a review of the drawings in conjunction with the aforesaid description, the canting adjustability of the support bracket **50** in conjunction with the pivot adjustability of the ball retainer **60** allows a plurality of lateral and longitudinal or linear forces to be placed upon the ball **74** when the arm is activated (i.e. the ball **74** is accelerated by the apparatus **10**). The location and extent of the placed forces affect ball **74** trajectory, elevation, yaw, pitch, and spin as the ball **74** exits the apparatus **10**. That is, by allowing the vectorial summation of the aforesaid forces which are placed upon the ball **74** to be outside of the center of gravity of the ball **74**, the trajectory and spin of the ball **74** is affected in a repeatable fashion.

For the preferred embodiment, the ball mount **48** has a serrated or grooved interface **33** between the mount support bracket **50** and the ball retainer **60** which allows the ball retainer **60** to be locked into position or retained in a position with said mount support bracket **50**. Said interface **33** comprises a first locking disk **35** mounted with said support bracket **50** and a second locking disk **45** mounted with said ball retainer **60**. Each locking disk **35**, **45** has a plurality of serrations or grooves which are cut or formed to mate or bind with each other and lock the ball retainer **60** in a fixed position relative to the mount support bracket **50** when the retainer fastener **58** is tightened. Each locking disk **35**, **45** is preferably attached with the respective bracket **50** or retainer **60** via screws or other fasteners with alternative embodiments utilizing a plurality of

fastening forms including but not limited to welds, solders, integral formations, or pins.

The ball retainer **60** may take a plurality of forms including but not limited to a round or circular form, a partially circular form, an elliptic form, a partially elliptic form, or any other form which retains the ball **74** in position during the process of launching the ball **74**. In the preferred embodiment, the ball retainer **60** and the mount support bracket **50** are formed from a flat stock material which is rolled, bent, or formed into the aforesaid forms. Alternative embodiments may form said ball retainer **60** and the mount support bracket **50** in a plurality of fashions, including but not limited to casting, machining, molding, or rapid prototyping techniques such as stereolithography.

An alternative embodiment ball mount **48** comprises a ball mount **48** mounted on the front side **47** of the throwing arm **42** near or at the first end **44**. The alternative embodiment comprises a spacer **56** which has the form of a disk with an arcuate portion **57** and a substantially flat portion **59** between the throwing arm **42** and the mount support bracket **50**. The spacer **56** disk allows the support bracket **50** or cradle to fit or mate with said arcuate portion **57** and be rotated or adjusted a full 360° for enhanced ball **74** trajectory control. The support bracket **50** is held with a bracket fastener **58** as with the preferred embodiment with the exception that the bracket fastener **58** transitions from the back side **49** through the throwing arm **42** to the front side **47** where it fastens with a nut, retainer, or other threaded portion of the support bracket **50**. The support bracket **50** is geometrically equivalent to the preferred embodiment support bracket **50** with the variation as observed within the drawings. That is, it is of an arcuate shape, with one or more slots **51**, and sized or shaped to accommodate the contours of the ball **74**.

The alternative embodiment also has a ball retainer **60** held or retained with the support bracket **50** via one or more ball retainer fasteners **61**. The alternative embodiment ball retainer **60** is also of a substantially arcuate shape or form which substantially follows or is sized to accommodate the contours of the ball **74**. The alternative embodiment shown utilizes a substantially arcuate shape in the form of a circular ring. The alternative embodiment ball retainer **60** pivots, cants, and functions as the preferred embodiment to provide a plurality of lateral and longitudinal or linear forces upon the ball **74** when the arm **42** is activated (i.e. the ball **74** is accelerated by the apparatus **10**). The location and extent of the placed forces affect ball **74** trajectory, elevation, yaw, pitch, and spin as the ball **74** exits the apparatus **10**. For all embodiments, one or more graduations, markers, or indices **63** are placed upon one or more of

the following: the spacer **56**, the throwing arm **42**, or the support bracket **50** or other elements as desired by the user. The graduations, markers, or indices **63** allow the user to set the apparatus **10** at a repeatable trajectory, yaw, pitch, and spin setting. This repeatability allows a coach or trainer to follow a guidebook with specific settings directed to a practice routine for a particular player or set of players and also record specific settings which are desirable.

For the preferred embodiment, near or at said second end **46** of said throwing arm **42** one or more energy storage elements **62** (such as a spring) are pivotally or flexibly mounted or connected between the accelerator **28** and said throwing arm **42**. For the preferred embodiments, the energy storage elements **62** fully dissipate any stored energy into the throwing arm **42** via pivotal displacement of the throwing arm **42** and do not provide any tension to the throwing arm **42** when the apparatus **10** is not in a cocked or set position. The energy storage element **62** is mounted with an arm connector **64** such as a shaft through or on the throwing arm **42** or with a hook, loop, or hole mounted with the throwing arm **42**. For the preferred embodiment, the arm connector **64** comprises one or more ears **65**, preferably two, extending from the back side **49** of the throwing arm **42** with one or more holes **67** therein through which a bolt **69** may be placed. The bolt **69** is placed through the ends of the energy storage elements **62** with washers **75** on each side of the ends of the energy storage elements **62**. Preferably said washers **75** or at least a portion of said connectors **64** are of an acoustic, vibration, or energy absorbent material such as a rubber or polymer material. Said material includes but is not limited to polyoxymethylene (i.e. Delrin®), natural and synthetic rubbers, or any other material which has vibration absorbing properties. Alternative embodiments may utilize washers **75** of any metallic or rigid material which is able to withstand the energy storage element **62** forces. Further alternative embodiments may utilize one or more arm connectors **64** of an arbitrary shape and material which is capable of securing an end of the energy storage elements **62** with the throwing arm **42**.

The energy storage element **62** transitions to and pivotally mounts with an accelerator **28** (or power pedal accelerator) storage element connector **32** in the form of a shaft or a hook, loop, or hole through or on the accelerator linkage **30**. For the preferred embodiment, the accelerator storage element connector **32** comprises a slide assembly **135** having an internal passage **136** or bore which is able to slidably mount around or onto the accelerator linkage **30**. The slide assembly **135** has a slide pin **138** which interfaces and attaches or secures the slide assembly **135** with the accelerator **28** or accelerator linkage **30** speed adjustment connection locations **34**,

preferably in the form of holes within the linkage **30**. The preferred embodiment of the slide assembly **135** has a hole **137** through the assembly through which said slide pin **138** may be placed and an extending slide handle **140** which allows easy adjustment or movement of the slide assembly **135**. A slide connector **141** having a through hole is mounted or connected with said slide assembly **135**, preferably via welding, and a bolt or pin **144** is placed there through to secure the energy storage elements **62** to the slide assembly **135**. Said slide connector **141** may take a plurality of forms including but not limited to holes within said slide assembly **135**, "U" bolts mounted with said slide assembly **135**, or other elements having a through hole or area which are attached to said slide assembly **135** via an integral formation, fasteners, welds, or adhesives. Preferably said energy storage elements **62** have two or more washers **143** at said slide assembly which sandwich the ends of the elements **62** and through which said bolt or pin **144** is placed to connect the elements **62** with said slide connector **141**. Preferably, said washers **143** or a portion of said slide connectors **141** are also of an acoustic, vibration, or energy absorbent material such as a rubber or polymer material. Said material includes but is not limited to polyoxymethylene (i.e. Delrin®), natural and synthetic rubbers, or any other material which has vibration or energy absorbing properties. Alternative embodiments may utilize washers or slide connectors **141** of any metallic or rigid material which is able to withstand the energy storage element **62** forces. Alternative embodiments may utilize a plurality of energy storage element **62** forms, including but not limited to elastic bands, bungee type cords, pneumatic cylinders or air bags, and leaf, coil, or torsional springs. Where bolts **69**, **144**, are described relative to the energy storage elements **62** within the present application, as understood by one of ordinary skill within the art, pins, hooks, holes, or other extensions may be utilized to connect the energy storage elements **62** to the respective other elements.

The accelerator **28** provides additional force to the throwing arm **42** when the user desires such and also makes cocking or setting of the apparatus **10** easier as the energy storage element(s) **62** presents a smaller force when not fully extended or stretched. That is, as expressed by Hooke's law, an elastic energy storage element exhibits a force represented as $F = kx$ where k is the spring constant of the elastic energy storage element and x represents the displacement from nominal or equilibrium. Thus, when the energy storage element(s) **62** is displaced less, a smaller cocking or setting force is presented to the user.

The accelerator **28** comprises a linkage **30** pivotally connected or attached with the

throwing arm supports **38**, the base **11**, or other structural elements of the apparatus **10** and has one or more speed adjustment connection locations **34**. Said linkage **30** extends toward said rear portion **18** of said base **11**. Said accelerator **28** is preferably pivotally mounted between said base **11** and said throwing arm **42**. For the preferred embodiment, a pivot **36** in the form of a shaft **146** is placed through the lower portion **39** of the throwing arm support(s) **38** and the linkage **30**. Said shaft **146** is in the form of a bolt in the preferred embodiment but may take a plurality of shaft forms as understood within the arts, including but not limited to round stock, square stock, pins, or tubes. The preferred embodiment further has one or more spacers **148** on each side of the accelerator **28** between the accelerator **28** and the throwing arm supports **38** in order to ensure positioning. Alternative embodiments may utilize accelerators **28** or pivots **36** with a plurality of shapes and forms as recognized within the mechanical arts provided the displacement of the energy storage element(s) **62** is adjustable by the user when desired. The speed adjustment connection locations **34**, preferably one or more holes within the accelerator **28** linkage **30**, allow the energy storage element(s) **62** to be mounted with the accelerator **28** at one or more positions which provide a greater or lesser displacement to the energy storage element(s) **62**, and thereby a greater or lesser throwing arm **42** force or energy. The speed adjustment connection locations **34** of said accelerator **28** may take a plurality of forms, including but not limited to holes, hooks, arms, notches, or compression holds. Preferably one or more removable pins **144** are utilized through said speed adjustment connection locations **34** to secure said energy storage element(s) **62**, with alternative embodiments utilizing a plurality of accepted joining or connection methods including but not limited to bolts, catches, and detents. Also for the preferred embodiment, the accelerator **28** is foot adjustable or actuated. Foot adjustability allows the substantial leg force available from the user to impart a significant amount of energy to the energy storage element(s) **62** as said energy storage element(s) **62** is/are displaced. Alternative embodiments may utilize a plurality of methods to displace said energy storage element(s) **62** including but not limited to pneumatic and hydraulic actuators, motors, and worm screws.

For the preferred embodiment, the release support **22** represents a structure which guides the linkage **30** and has one or more accelerator holes **150** within or there through for accelerator **28** height adjustment. An accelerator pin **152** is placed within or there through in order to control or adjust the accelerator **28** height or displacement. As discussed relating to Hooke's law, the more displacement allowed onto the energy storage elements **62**, the more energy imparted to the

ball **74** upon release. The accelerator pin **152** limits the displacement of the accelerator **28** by limiting its displacement relative to the base **11** and thereby limits the potential amount of energy imparted to the ball by the accelerator **28**. The release support **22** structure is preferably formed from two square steel posts between which is located the linkage **30** within the preferred embodiment but may take a plurality of upright structural forms which guide the linkage **30** such as rounds, squares, tubes, or posts and which may be formed from a plurality of materials including but not limited to metals, composites, polymers, and woods. The preferred embodiment release support **22** further has a base support **176** in the form of a trapezoidal member at the interface between the base **11** and the support **22** and between the steel posts which, when attached with the base **11** and support **22**, provides further strength and support. The accelerator **28** height or displacement may be controlled by a plurality of other mechanical elements or techniques including but not limited to latches, stops, screws, or rails.

A release **23** or latch is mounted with said release support **22** and, for the preferred embodiment, comprises a slidable release block **24** or sear which fits over or with and holds said throwing arm **42** when the throwing arm **42** is in a cocked or set position. Also for the preferred embodiment, a release linkage **26** is pivotally mounted with said release support **22** and attached with said release block **24**. The linkage **26** extends the release block **24** actuation or apparatus **10** triggering to near or at the user's foot. That is, near the base **11** of the apparatus. For the preferred embodiment, the release linkage **26** has a release extension **27** opposite said release block **24** near said base **11** which is contacted by said accelerator **28** linkage **30** when said accelerator **28** is fully depressed. That is, the accelerator is able to impart energy to the energy storage elements **62** and trigger the apparatus **10** in a single movement or stroke. One or more release springs **29** or energy storage elements are placed between the release linkage **26** and the release support **22** in order to bias the release **23** closed and prevent accidental discharge. A spring or storage element may also or in lieu of said release spring **29** be mounted internal to the release **23** or latch. Alternative embodiments may utilize a plurality of release methods for holding said throwing arm **42** in a cocked position and triggering the apparatus **10**, including but not limited to pins, latches, magnetic latches, cords, or hooks. Alternative embodiments may further utilize a plurality of linkage **26** forms which are mounted at a plurality of locations on said apparatus **10** or utilize a cord in lieu of said linkage **26**.

Also for the preferred embodiment, a safety assembly **154** or lock is pivotally mounted

with said release support **22** and serves to prohibit unintended discharge of the apparatus **10** until such time as the accelerator **28** is depressed or displaced. The safety assembly **154** comprises a safety arm **156** pivotally mounted upon a pivot shaft **160** attached with said release support **22**. The safety arm **156** has a safety spring **162** or other elastic element connected thereto and to the release support **22**. The safety arm **156** also has one or more safety arm extensions **158** which extend from said arm **156** and block movement of the release linkage **30**. That is, the safety spring **162** biases or positions the safety arm **156** whereby said extension **158** blocks the triggering movement of said release linkage **26**. When the accelerator **28** linkage **30** is displaced toward the base **11**, the linkage **30** contacts said extension **158** or safety arm **156** and moves the safety assembly **154** out of a blocking position relative to said release linkage **26**. This allows the release linkage **26** to be displaced and trigger a launching of the ball **74**. Placement of the extension **158** on said safety arm **156** is away from or substantially opposite said pivot shaft **160** in such a position that said safety arm **156** is capable of blocking movement of the release linkage **30**. Alternative embodiments of the safety assembly **154** may utilize a plurality of generally accepted forms, including but not limited to latches, catches, hooks, or frictional contacts provided said safety assembly **154** prohibits unintended discharge of the apparatus **10**.

As described, the preferred embodiment has one or more attachable and removable safety guards **70** which substantially cover the sides, rear, and front of the apparatus **10** and prevent unwanted, inadvertent, or unsafe interference with the apparatus **10** or throwing arm **42** operation. For the preferred embodiment, the guards **70** are of a rigid sheet material such as a polymer, fiberglass, composite, metal, or wood which are cut into a shape which substantially isolates the user from the mechanisms of the apparatus **10**. The guards **70** are attached with the base **11** via one or more guard mounts **16** in the form of slots formed with the front portion **12** of the apparatus **10** and guard mounts **20**, also in the form of slots, formed with or near the rear portion **18** of the apparatus **10**. The guards **70** are attached with the throwing arm supports **38** via one or more guard extensions **164** which are attached with and extend from the throwing arm supports **38** and allow a guard fastener **166** to be placed through the guard **70** and into the guard extension **164** or simply in the form of a nut attached with the guard extension **164** as it protrudes through the guard **70**. The guard fastener **166** is in the form of a bolt or nut within the preferred embodiment but may take a plurality of other forms including but not limited to pins, latches, magnetic holders, screws, or frictional fits. For the preferred embodiment, the guard mounts **16**,

20 are formed from two or more bends or substantially bent members placed closely together to form a slot which is the same or greater than the thickness of the guard **70** material. Nearest the front portion **12**, said guard **70** is preferably a flexible mesh material which is attached with the remaining rigid guard **70** material and flexes when or if impacted by said throwing arm **42**. Nearest the rear portion **18**, said guard **70** is preferably attached with the remaining guard **70** material via one or more hinges with slots for the linkage **30** and the directing arm **40**. This allows for easy and convenient removal of the guard **70** from the apparatus **10** when desired or necessary. For an alternative embodiment, the guards **70** preferably comprise a frame **71** with a flexible covering **73** which mounts within the guard mounts **16**, **20**. Alternative embodiments may utilize guards **70** having a plurality of shapes, styles, and constructions including but not limited to meshes, screens, vinyl coverings, or solid panels.

For an alternative embodiment, a ball storing and feeding structure **72** is mounted with a frame of said guards **70** and extends laterally from the apparatus **10**. The ball storing and feeding structure **72** allows a plurality of balls **74** to be stored adjacent the apparatus **10** for quick and easy access by the user. The preferred ball storing and feeding structure **72** comprises two parallel members **80** which are sloped or canted slightly towards the apparatus **10** with extending legs **78** which mount with a frame of said guards **70** and rest upon the surface adjacent said apparatus **10**. A ball stop **76** prevents the balls **74** from rolling into or onto the apparatus **10** and interfering with apparatus use **10**.

In operation, the user first adjusts the ball throwing distance by moving the portion of the energy storage element **62** at the accelerator storage element connector **32** to the speed adjustment connection location **34** desired. For the preferred embodiment, this is achieved by removing the slide pin **138** from the slide assembly **135** and accelerator **28** linkage **30**, sliding the slide assembly **135** to a desired location, and placing said slide pin **138** through the slide assembly **135** and linkage **30**. For an alternative embodiment this is achieved by removing a pin from a hole within the accelerator **28** linkage **30** and moving it to another location. The user then begins the ball **74** yaw or roll adjustment by loosening the bracket fastener **58**, moving the mount support bracket **50** to a desired orientation, and re-tightening the bracket fastener **58**. The alternative embodiment mount support bracket **50** as shown allows the mount support bracket **50** to rotate substantially 360° and thereby be positioned at a plurality of angles (by utilizing said slot **51**) which are either in line, perpendicular to, or a combination thereof relative to the

throwing arm **42**. This allows user creation of a direct ball **74** shot, a high lobbing ball **74** shot, or any combination thereof.

The user then loosens the ball **74** retainer fastener **61**, adjusts the ball retainer **60** for a desired pitch or trajectory, and re-tightens the ball **74** retainer fastener **61**. The serrated or grooved interface **33** locks together after said fastener **61** is tightened, thereby assuring a positive and repeatable ball **74** trajectory. (It is important to note that the pitch and cant or swerve adjustments may be found on either the mount support bracket **50** or the ball retainer **60** depending upon the orientation of the attachment of the ball mount **48** with the throwing arm **42**, i.e. inline, perpendicular, or a combination thereof.) The user will obviously utilize the graduations, markers, or indices 63 in order to reproduce a previously documented ball **74** shot or to record a desired ball **74** shot. The user may at any time utilize the directing arm **40** to position the apparatus **10** toward a desired launch direction.

Once fully adjusted, the user cocks, sets, or preloads the throwing arm **42** of the apparatus **10** by rotating the throwing arm **42** on the arm pivot **66** until it engages and is held by the release block **24** or sear. The ball **74** is then loaded into the ball mount **48** and the apparatus **10** is ready for ball **74** launch. If the user desires a greater velocity or distance shot, he or she presses the accelerator **28** or power pedal, preferably with his or her foot. For the preferred embodiment, when the accelerator **28** is depressed, the safety assembly **154** releases and allows the accelerator **28** linkage **30** to trigger ball **74** launch when fully depressed. When ball **74** launch is desired, the user activates the release linkage **26**, preferably with his or her foot or via the accelerator **28**, the release block **24** or sear disengages from the throwing arm **42**, and the energy storage elements **62** dissipate their stored energy into ball movement by moving the throwing arm **42** through an arc. The user repeats the aforesaid process through the practice or drill session.

The art of the present invention may be manufactured from a plurality of materials including but not limited to metals and alloys thereof, plastics, composites, or ceramics without departing from the scope and spirit herein intended. The apparatus may further be manufactured via molding, machining, casting, forging, pressing, laminating, carving, or utilization of stereo-lithographic or electro-dynamic milling or other techniques which are appropriate for the material utilized. For the preferred embodiment, the base **11** is manufactured from a steel material and the throwing arm **42** and ball mount **48** are manufactured from an aluminum material.

Although described for enablement purposes, the lengths, widths, geometric shapes, and

other dimensional attributes may depart significantly from those specified. The shape, size, location, component numbers, and mounting methods utilized for the components described may take a plurality of forms as recognized within the pertinent arts without departing from the scope and spirit of the present invention.

Having described the invention in detail, those skilled in the art will appreciate that modifications may be made to the invention and its method of use without departing from the spirit herein identified. Therefore, it is not intended that the scope of the invention be limited to the specific embodiments illustrated and described. Rather, it is intended that the scope of this invention be determined by the appended claims and their equivalents.

What is claimed is:

1. A ball projecting and training apparatus, comprising:

a base having a front portion, a rear portion, a release support attached with and projecting from said base, and one or more throwing arm supports attached with and projecting from said base; and

said throwing arm supports having a lower portion nearest said base and an upper portion; and

a throwing arm having a first end, a second end, a front side, a back side, and an arm pivot; and

said arm pivot pivotally mounted with said throwing arm supports at or near said upper portion; and

an accelerator pivotally positioned between said base and said throwing arm; and

said accelerator having an accelerator linkage extending toward said rear portion of said base; and

one or more energy storage elements attached with and between said accelerator and said throwing arm at or near said second end of said throwing arm and capable of providing an energy to said throwing arm; and

a release attached with said release support capable of holding said throwing arm in a cocked or set position; and

a ball mount having a mount support bracket and a ball retainer; and

said ball mount sized to accept a ball; and

said mount support bracket pivotally or slidably attached with said throwing arm near or at said first end of said throwing arm with one or more bracket fasteners; and

said ball retainer having a shape which can accept said ball; and

said ball retainer pivotally attached with said mount support bracket with one or more retainer fasteners; and

said ball retainer retained in a fixed position relative to said mount support bracket via said retainer fasteners; and

said ball mount imparting a linear acceleration, an angular acceleration, a spin, a yaw, or a pitch to said ball when said energy storage elements provide said energy to said throwing

arm.

2. The ball projecting and training apparatus as set forth in claim 1, further comprising:

a serrated or grooved interface between said mount support bracket and said ball retainer which allows a locking of a position of said ball retainer with said mount support bracket.

3. The ball projecting and training apparatus as set forth in claim 2, whereby:

said serrated or grooved interface comprises a first locking disk mounted with said support bracket and a second locking disk mounted with said ball retainer.

4. The ball projecting and training apparatus as set forth in claim 3, further comprising:

one or more slots within said mount support bracket by which said mount support bracket may pivot or slide on said bracket fasteners relative to said throwing arm.

5. The ball projecting and training apparatus as set forth in claim 1, further comprising:

one or more slots within said mount support bracket by which said mount support bracket may pivot or slide on said bracket fasteners relative to said throwing arm.

6. The ball projecting and training apparatus as set forth in claim 4, further comprising:

said mount support bracket having an arcuate shape; and

a spacer having a radius side sandwiched between said throwing arm and said support bracket whereby a positive mate is formed when said bracket fastener is tightened or engaged.

7. The ball projecting and training apparatus as set forth in claim 5, further comprising:

said mount support bracket having an arcuate shape; and

a spacer having a radius side sandwiched between said throwing arm and said support bracket whereby a positive mate is formed when said bracket fastener is tightened or engaged.

8. The ball projecting and training apparatus as set forth in claim 7, whereby:

said spacer is sandwiched between said backside of said throwing arm and said support bracket.

9. The ball projecting and training apparatus as set forth in claim 1, further comprising:

two or more speed adjustment connection locations on said accelerator; and

an accelerator storage element connector movably attached with one or more of said speed adjustment connection locations; and

said energy storage element attached with said accelerator via said accelerator storage element connector.

10. The ball projecting and training apparatus as set forth in claim 9, further comprising:

said accelerator storage element connector having a slide assembly with a passage which is able to slidably mount onto said accelerator linkage; and

said slide assembly having a slide pin which secures said slide assembly with one or more of said accelerator speed adjustment connection locations.

11. The ball projecting and training apparatus as set forth in claim 10, further comprising:

a pivot mounted with said throwing arm and said lower portion of said throwing arm supports whereby said accelerator is pivotally positioned between said base and said throwing arm.

12. The ball projecting and training apparatus as set forth in claim 7, further comprising:

two or more speed adjustment connection locations on said accelerator; and

an accelerator storage element connector in the form of a slide assembly movably attached with one or more of said speed adjustment connection locations; and

said energy storage element attached with said accelerator via said accelerator storage element connector; and

a pivot mounted with said throwing arm and said lower portion of said throwing arm supports whereby said accelerator is pivotally positioned between said base and said throwing arm.

13. The ball projecting and training apparatus as set forth in claim 1, further comprising:

a release linkage attached with said release and pivotally mounted with said release support; and

a safety assembly mounted with said release support; and

said safety assembly capable of a blocking of said release linkage and prohibiting said energy storage elements from providing said energy to said throwing arm unless said accelerator is displaced.

14. The ball projecting and training apparatus as set forth in claim 13, further comprising:

said safety assembly having a safety arm pivotally attached with said release support; and

a safety arm extension extending from said safety arm at a position to block said release linkage; and

said safety arm extension further at a position to contact said accelerator linkage if said accelerator is displaced and unblock said release linkage.

15. The ball projecting and training apparatus as set forth in claim 14, further comprising:

a release extension attached with said release linkage; and

said release extension positioned to contact said accelerator linkage if said safety arm extension is first contacted with said accelerator linkage; and

said release extension allowing said accelerator linkage to actuate said release via said release linkage thereby allowing said energy storage elements to provide said energy to said throwing arm.

16. The ball projecting and training apparatus as set forth in claim 11, further comprising:

a release linkage attached with said release and pivotally mounted with said release support; and

a release extension attached with said release linkage; and

a safety assembly having a safety arm pivotally attached with said release support; and

a safety arm extension extending from said safety arm at a position to block said release linkage; and

said safety arm extension further at a position to contact said accelerator linkage if said accelerator is displaced and unblock said release linkage; and

said release extension positioned to contact said accelerator linkage if said safety arm extension is first contacted with said accelerator linkage; and

said release extension allowing said accelerator linkage to actuate said release via said release linkage thereby allowing said energy storage elements to provide said energy to said throwing arm.

17. The ball projecting and training apparatus as set forth in claim 16, further comprising:

two or more wheels pivotally mounted with said front portion of said base; and

a directing arm mounted with said base near or at said rear portion; and

said directing arm allowing a control of said ball projection via a rotation of said base on said wheels.

18. The ball projecting and training apparatus as set forth in claim 17, further comprising:

one or more attachable and removable safety guards attached with said base; and

said safety guards positioned to prevent an unwanted, an inadvertent, or an unsafe interference with said throwing arm.

19. The ball projecting and training apparatus as set forth in claim 18, further comprising:

a slide connector attached with said slide assembly; and

said slide connector attached with one or more of said energy storage elements; and

an arm connector attached with said throwing arm second end; and

said arm connector attached with one or more of said energy storage elements; and

one or more portions of said arm connector or slide connector comprising an energy absorbing material.

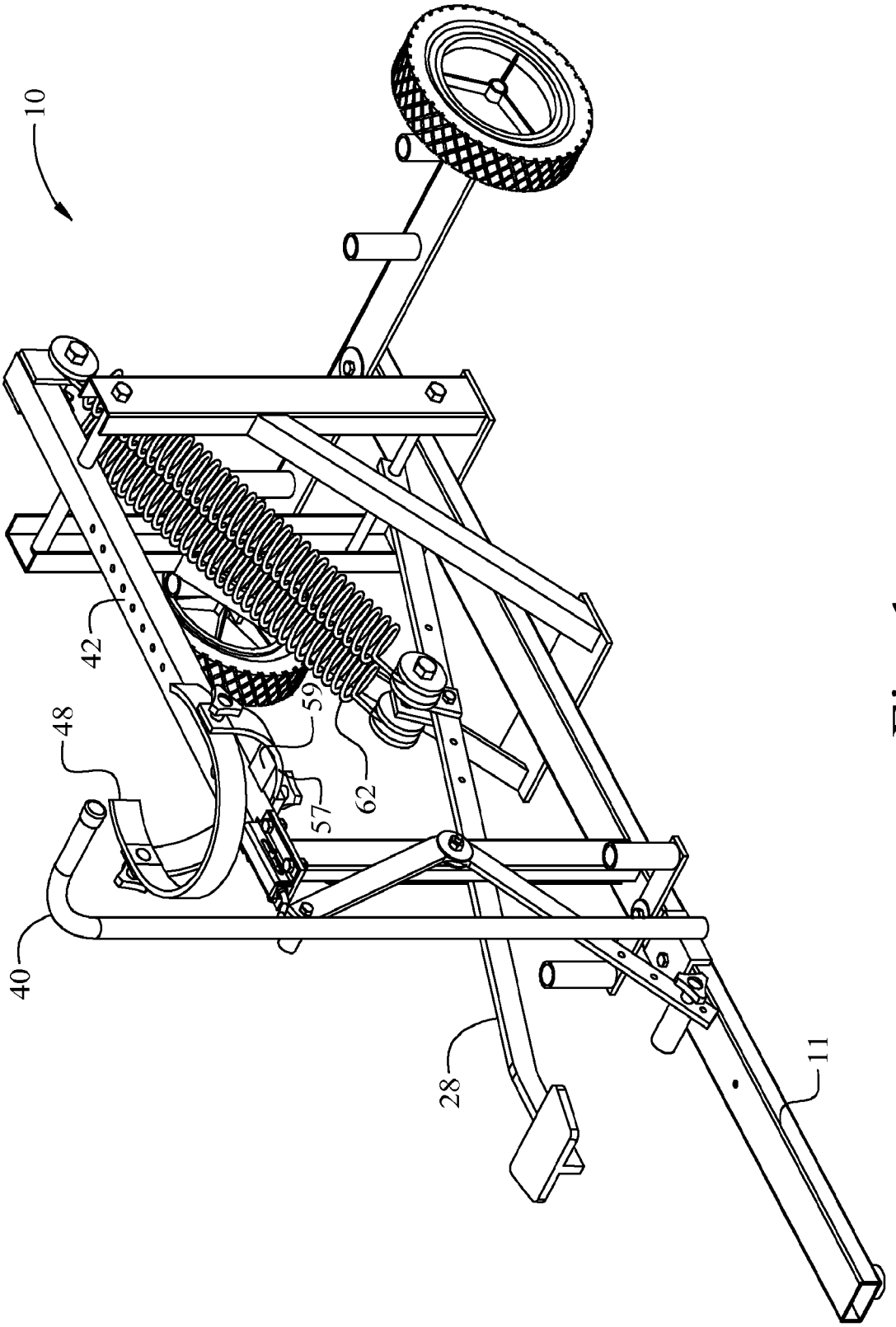


Fig. 1

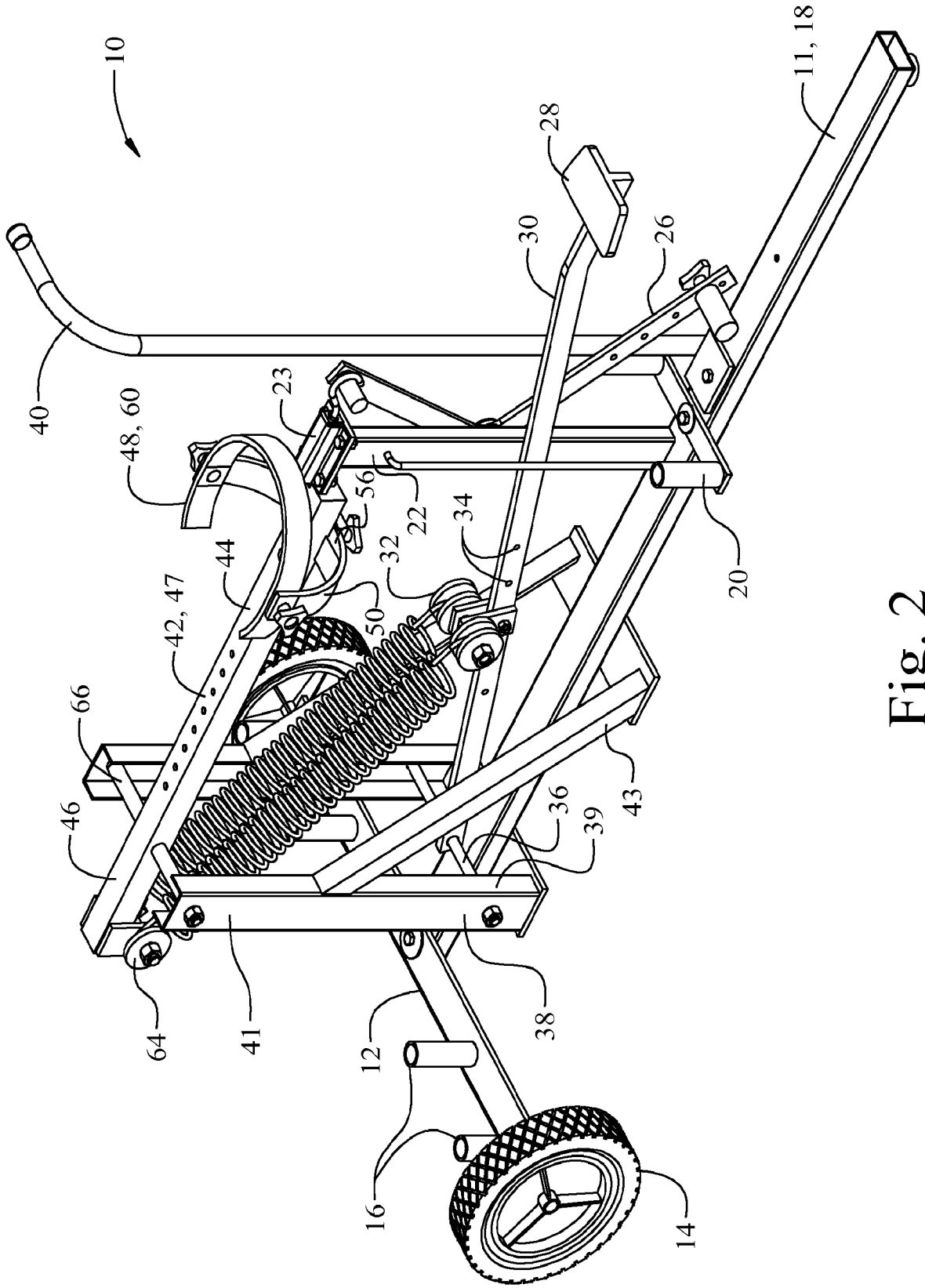

10
11, 18
28
30
26
40
48, 60
23
56
22
34
32
44
42, 47
50
20
66
46
43
36
39
64
41
12
38
16
14

Fig. 2

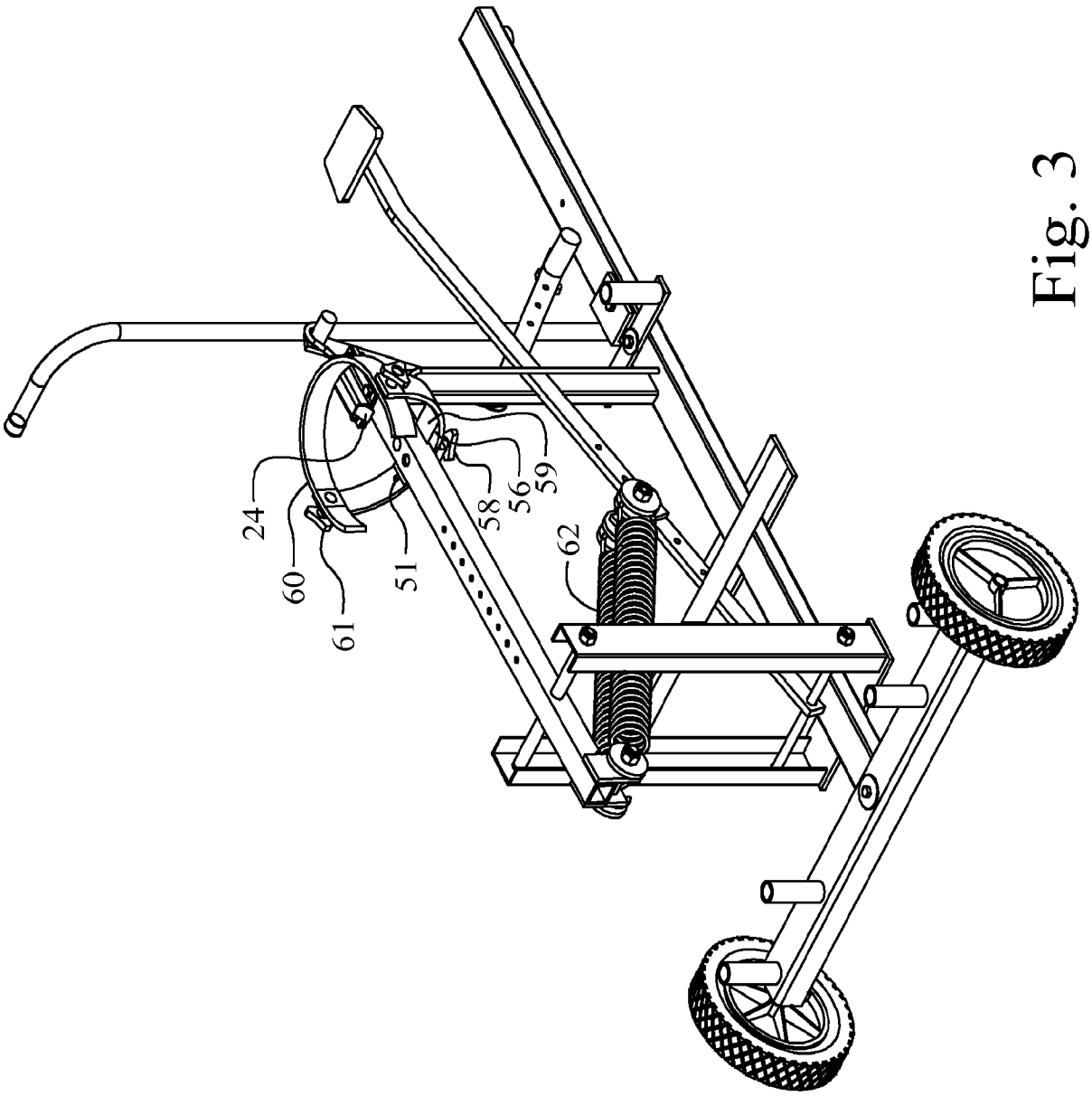


Fig. 3

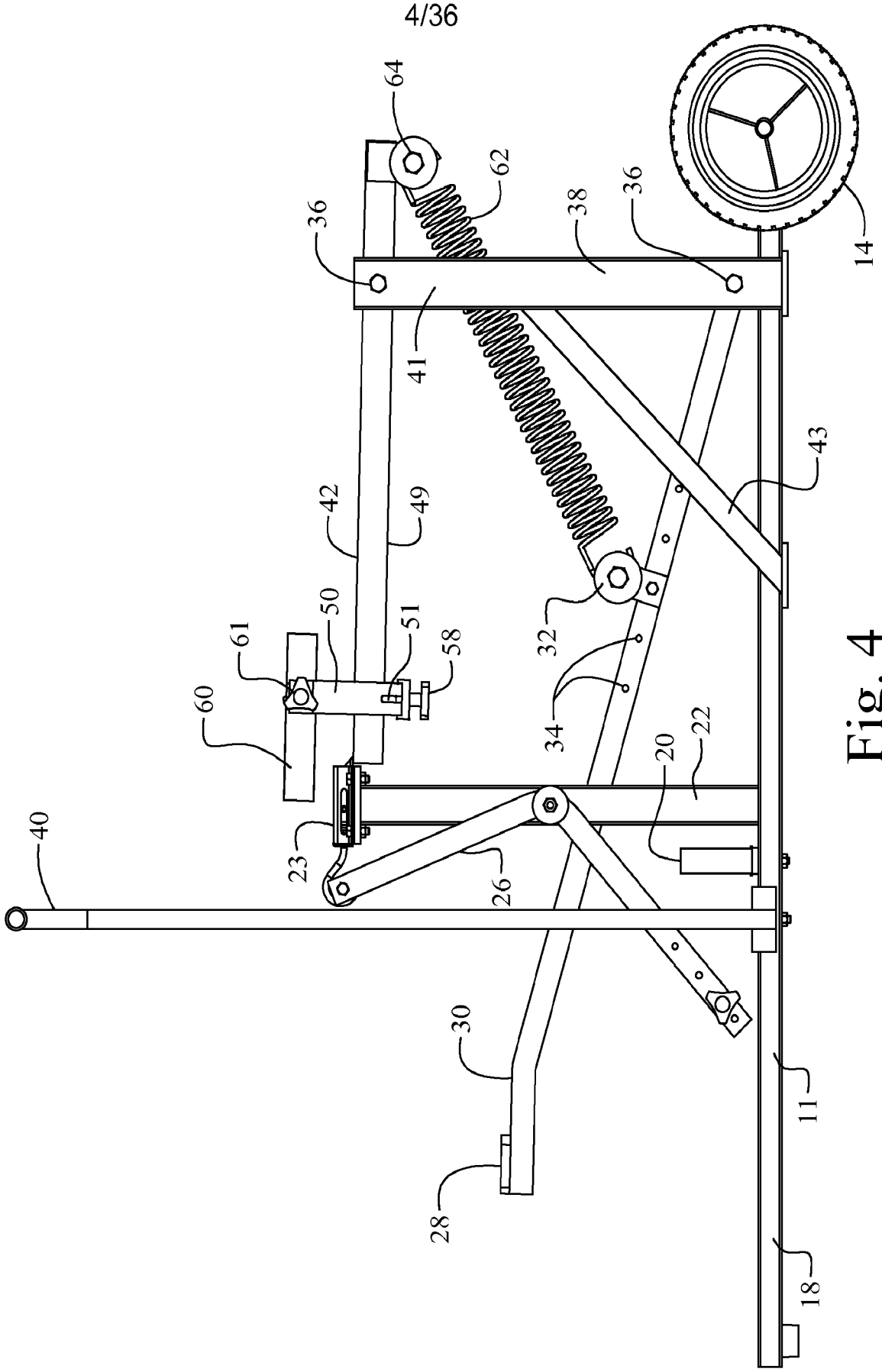

64
62
36
38
36
14
41
43
42
49
50
51
58
61
60
32
34
22
20
40
23
26
30
28
11
18

Fig. 4

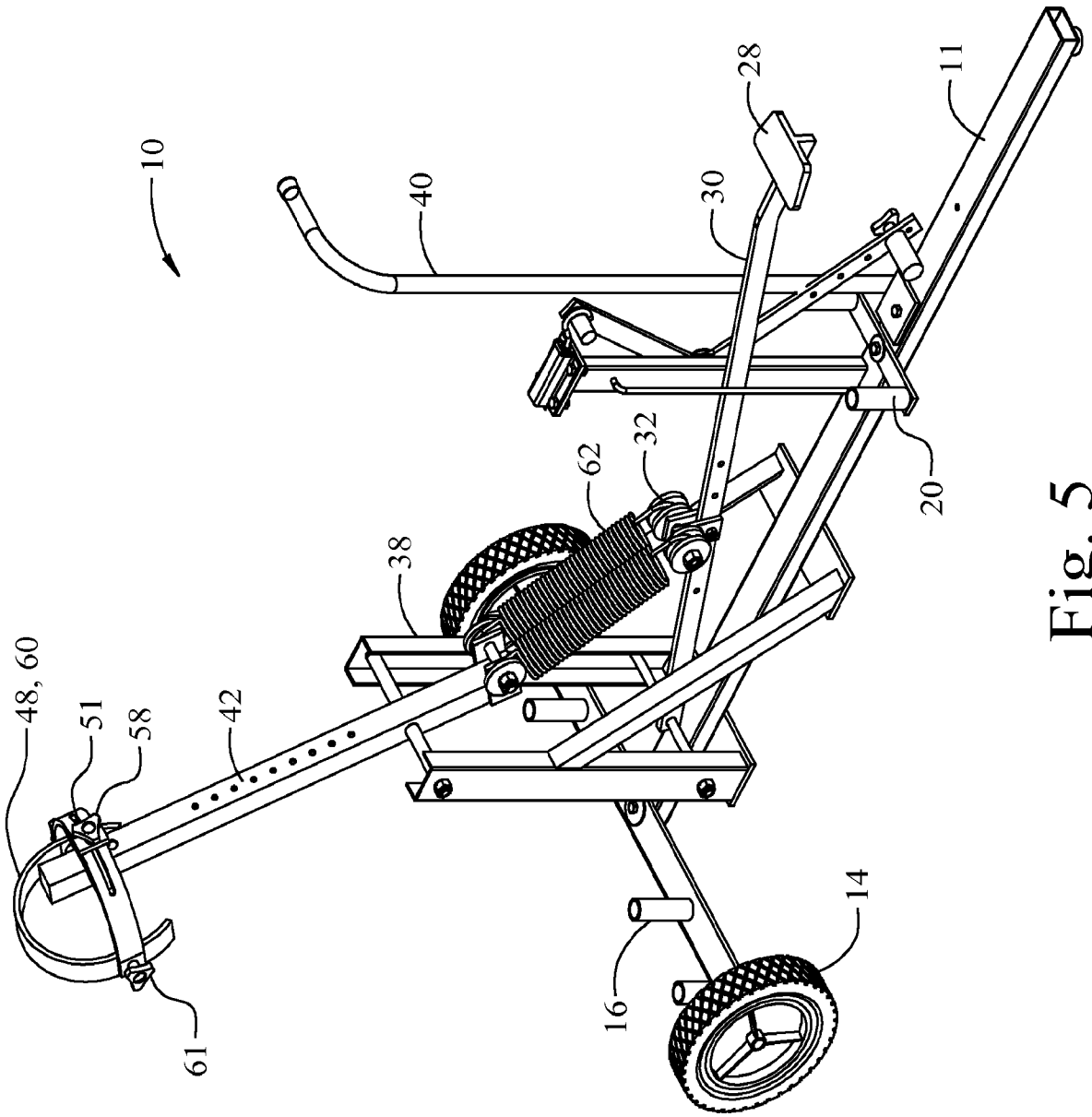


Fig. 5

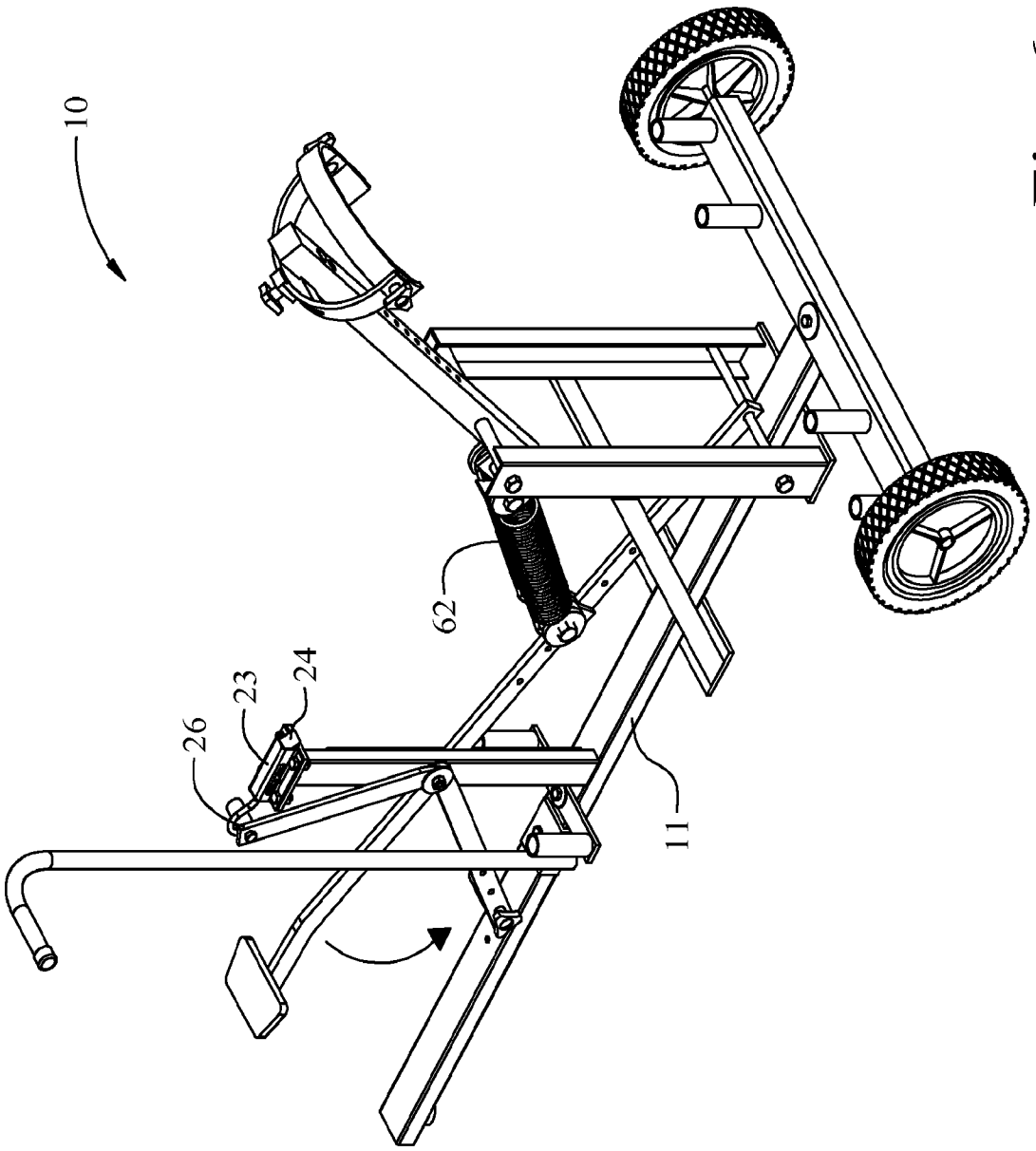
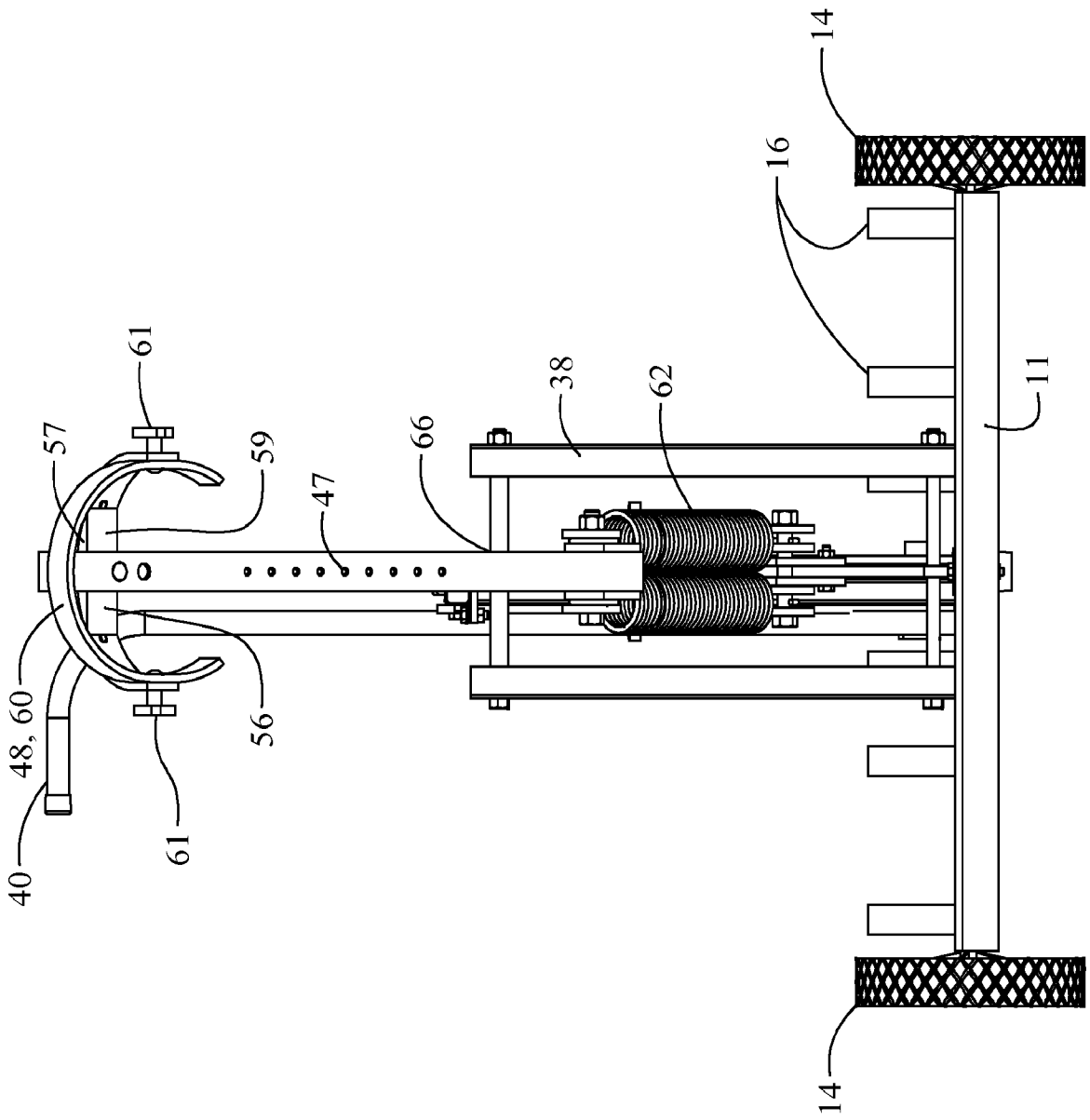


Fig. 6

Fig. 7



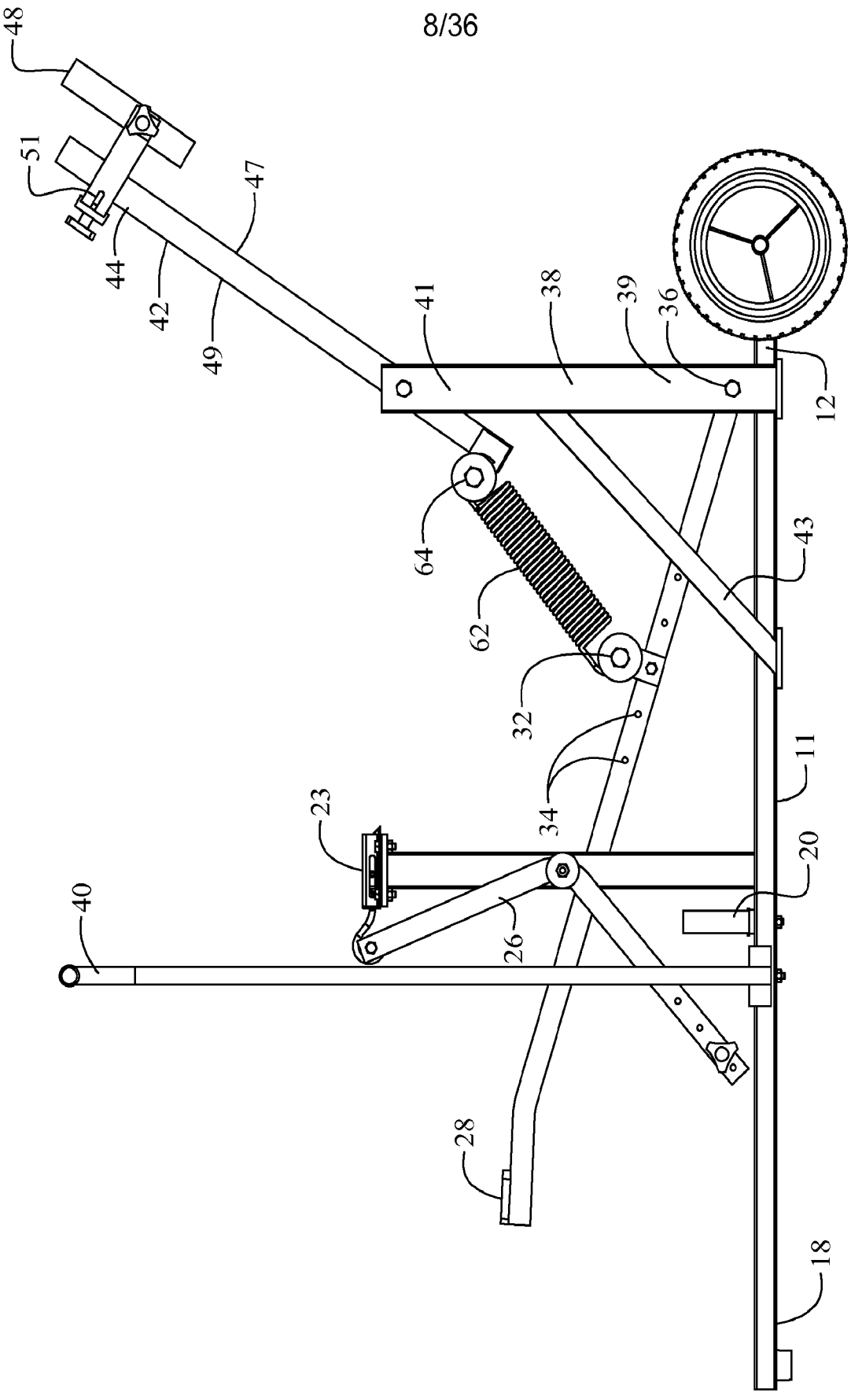


Fig. 8

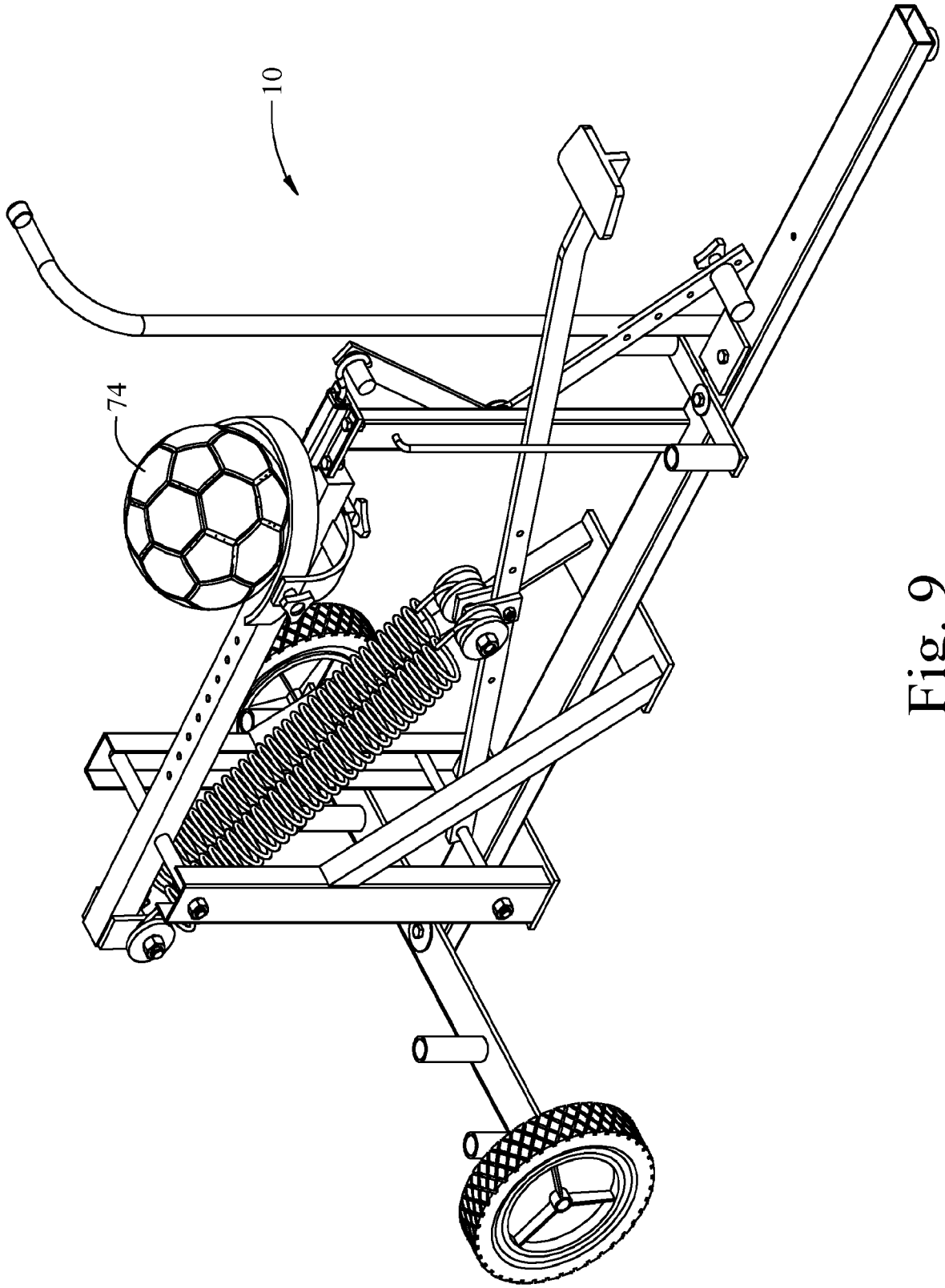


Fig. 9

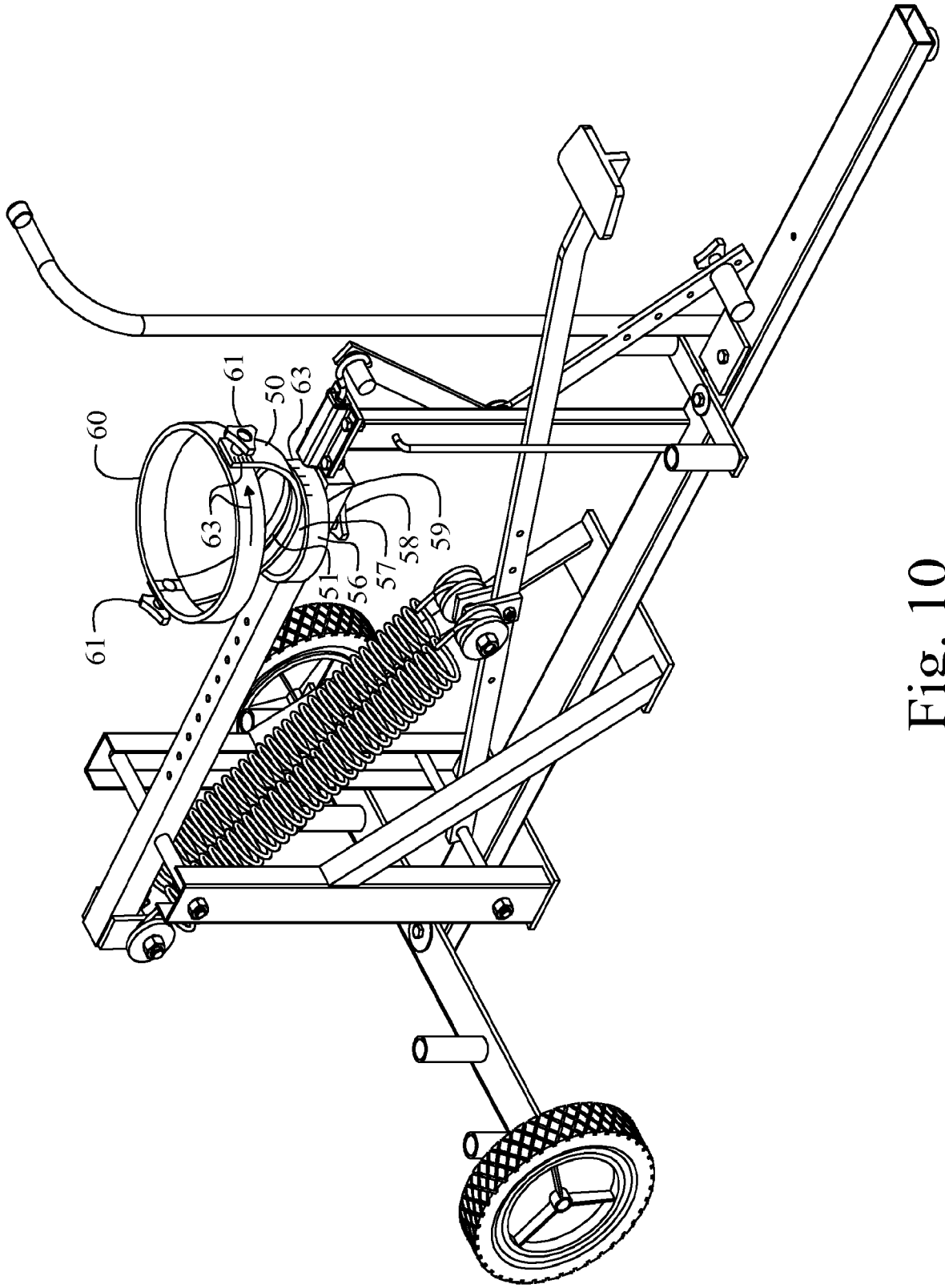


Fig. 10

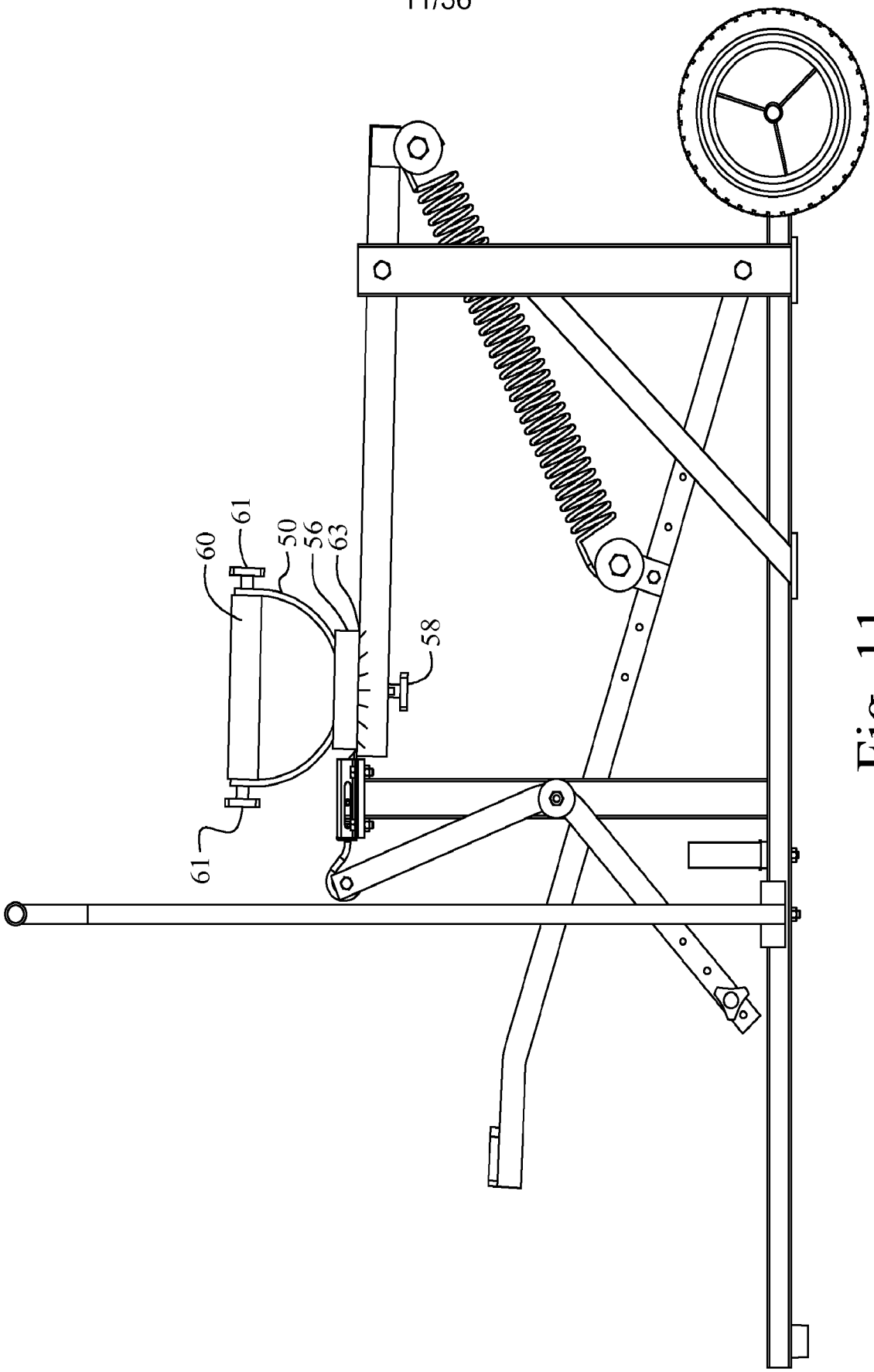


Fig. 11

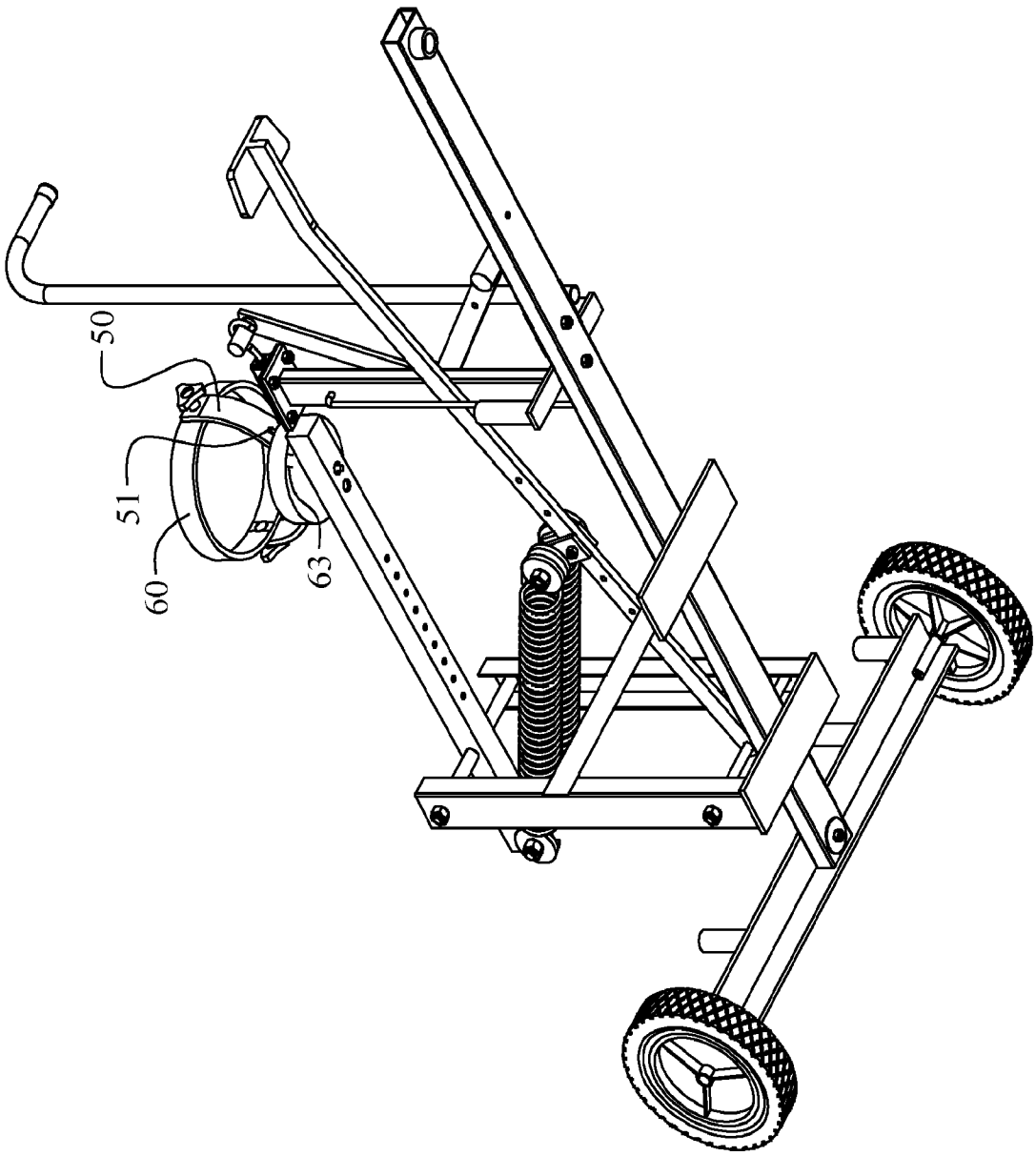
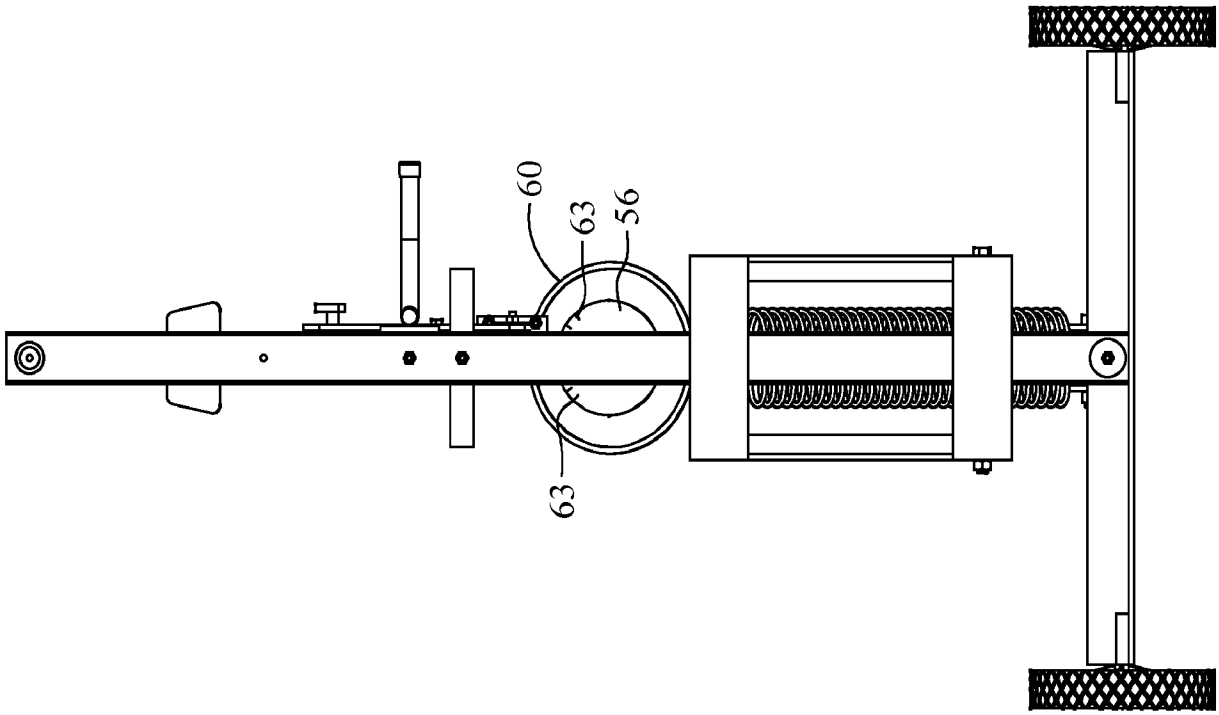


Fig. 12

Fig. 13



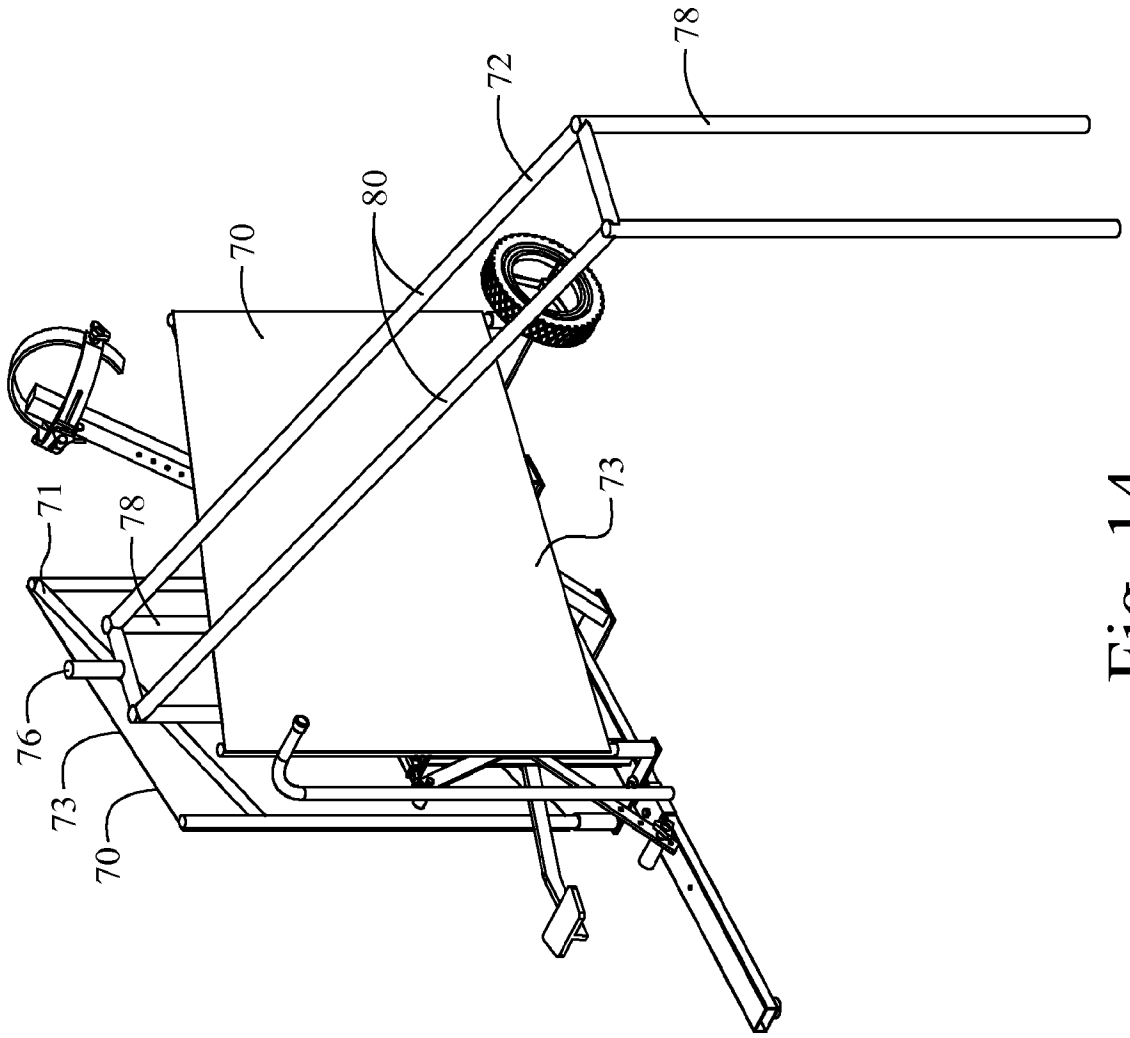


Fig. 14

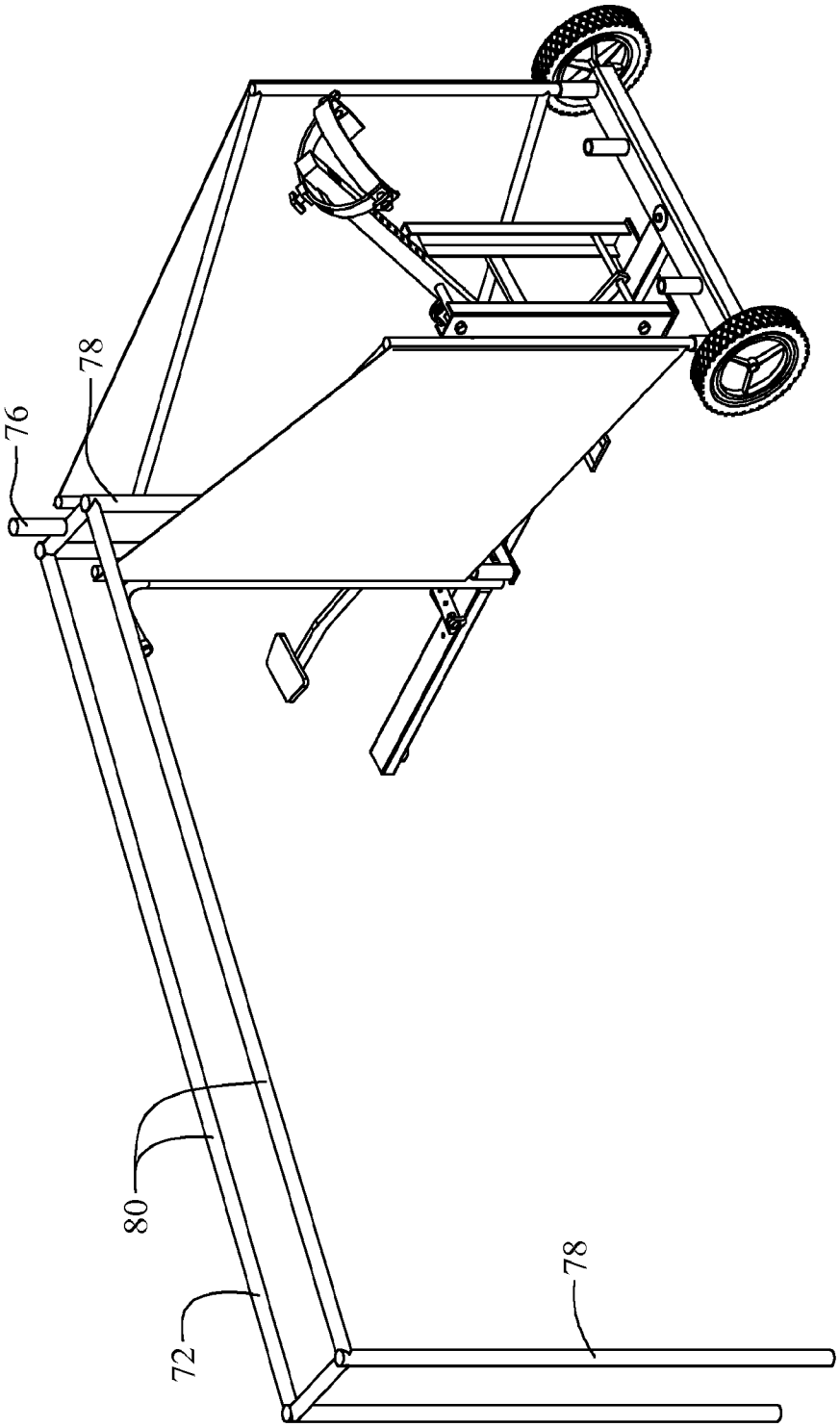


Fig. 15

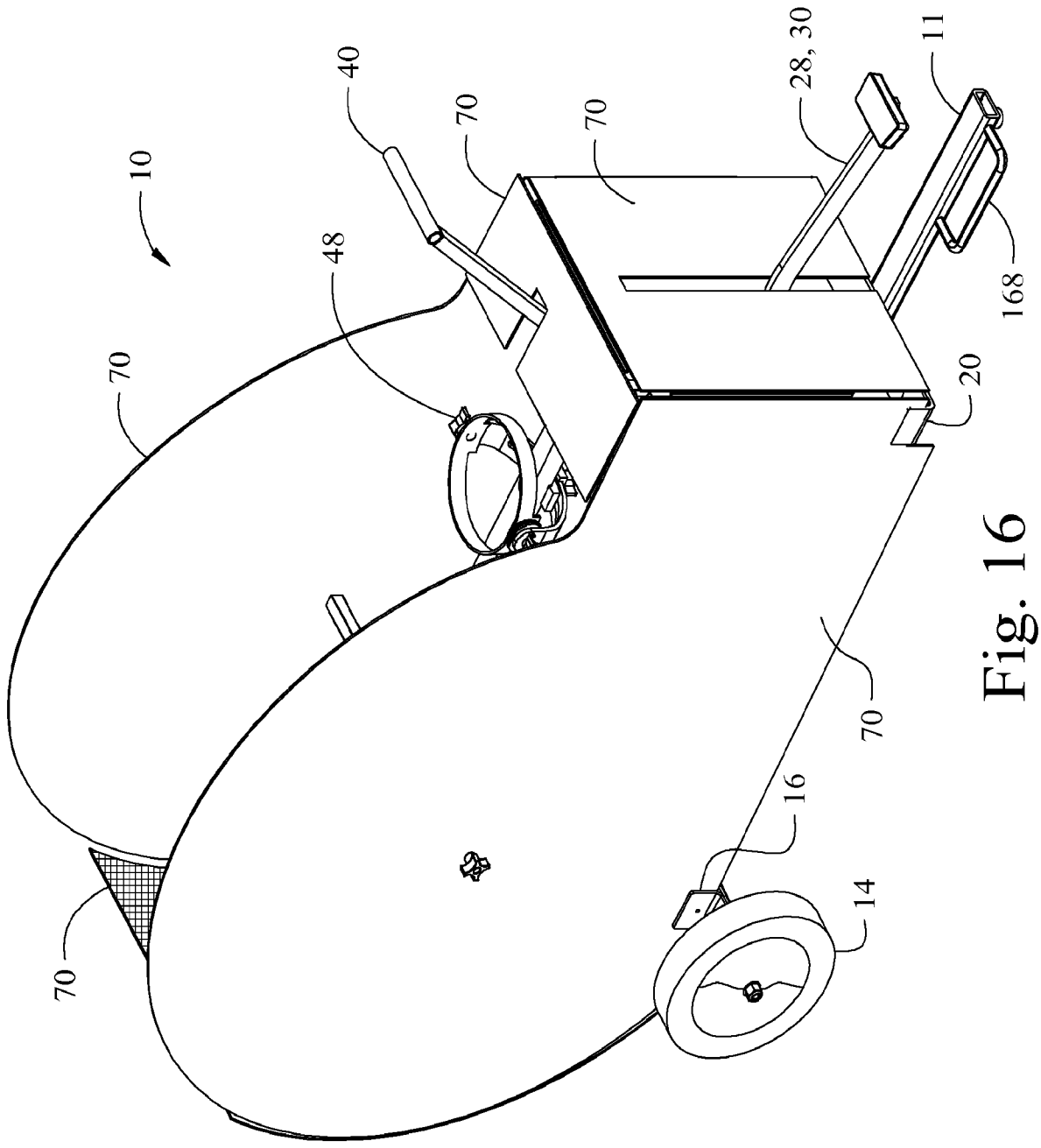


Fig. 16

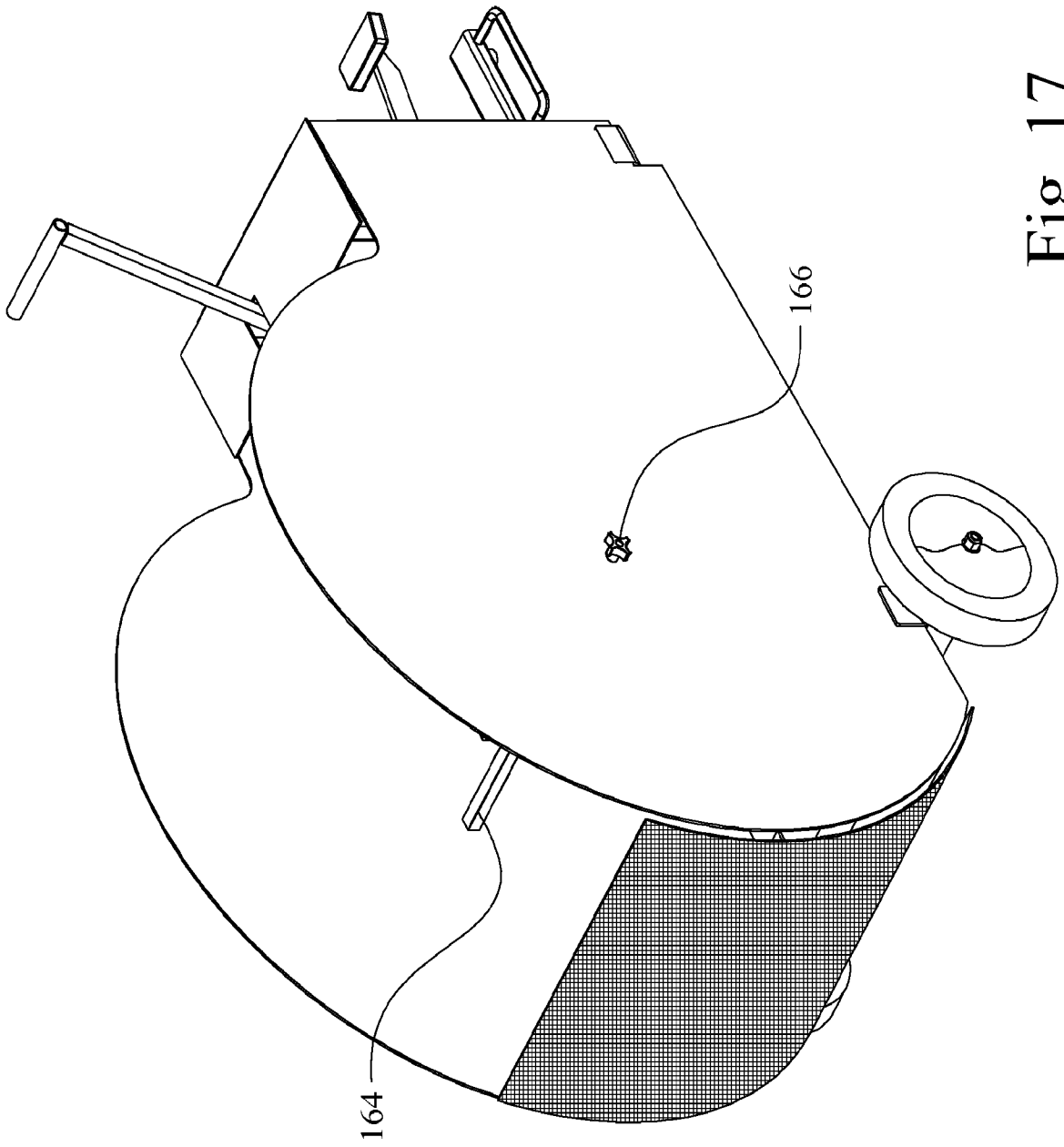


Fig. 17

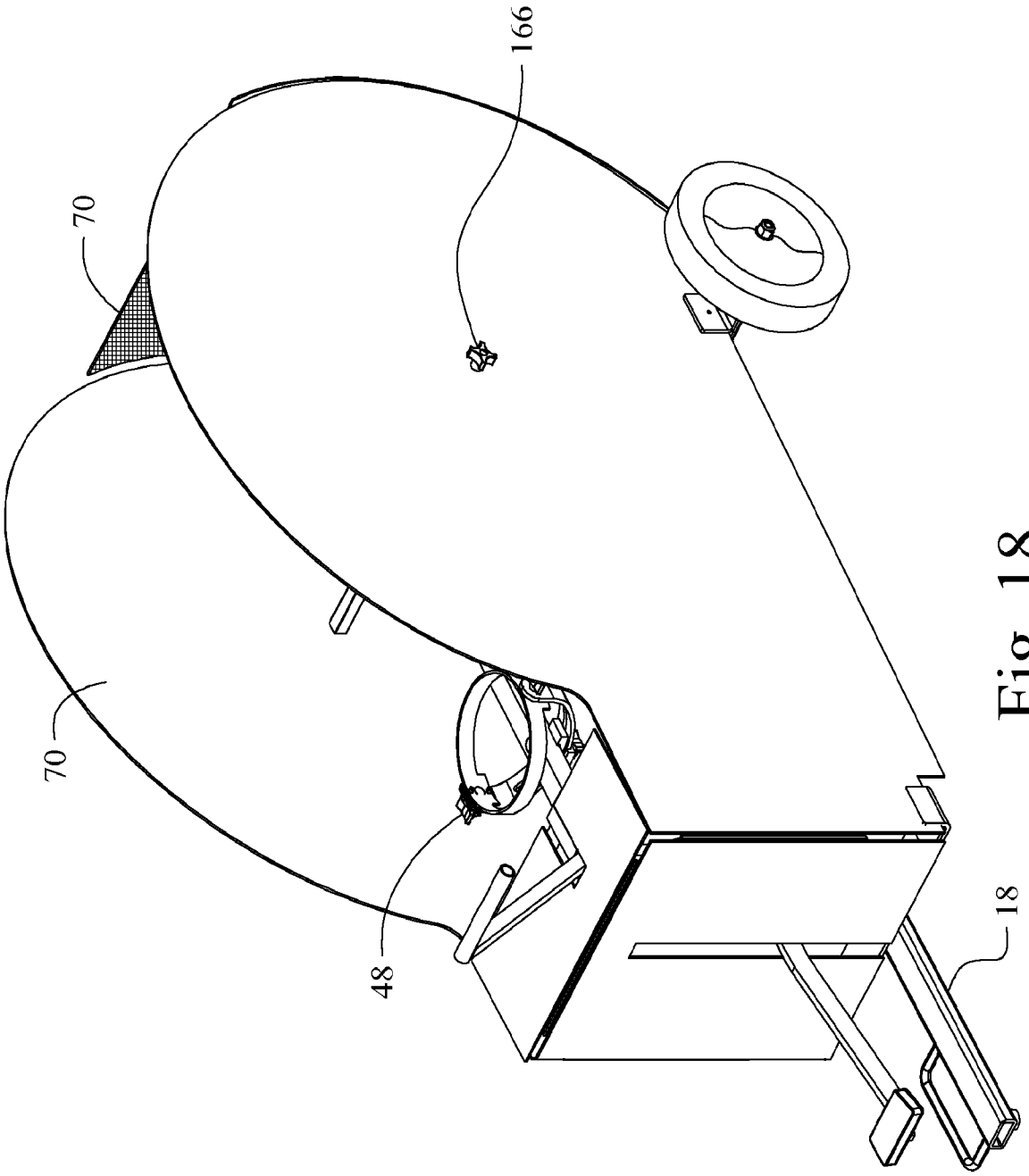


Fig. 18

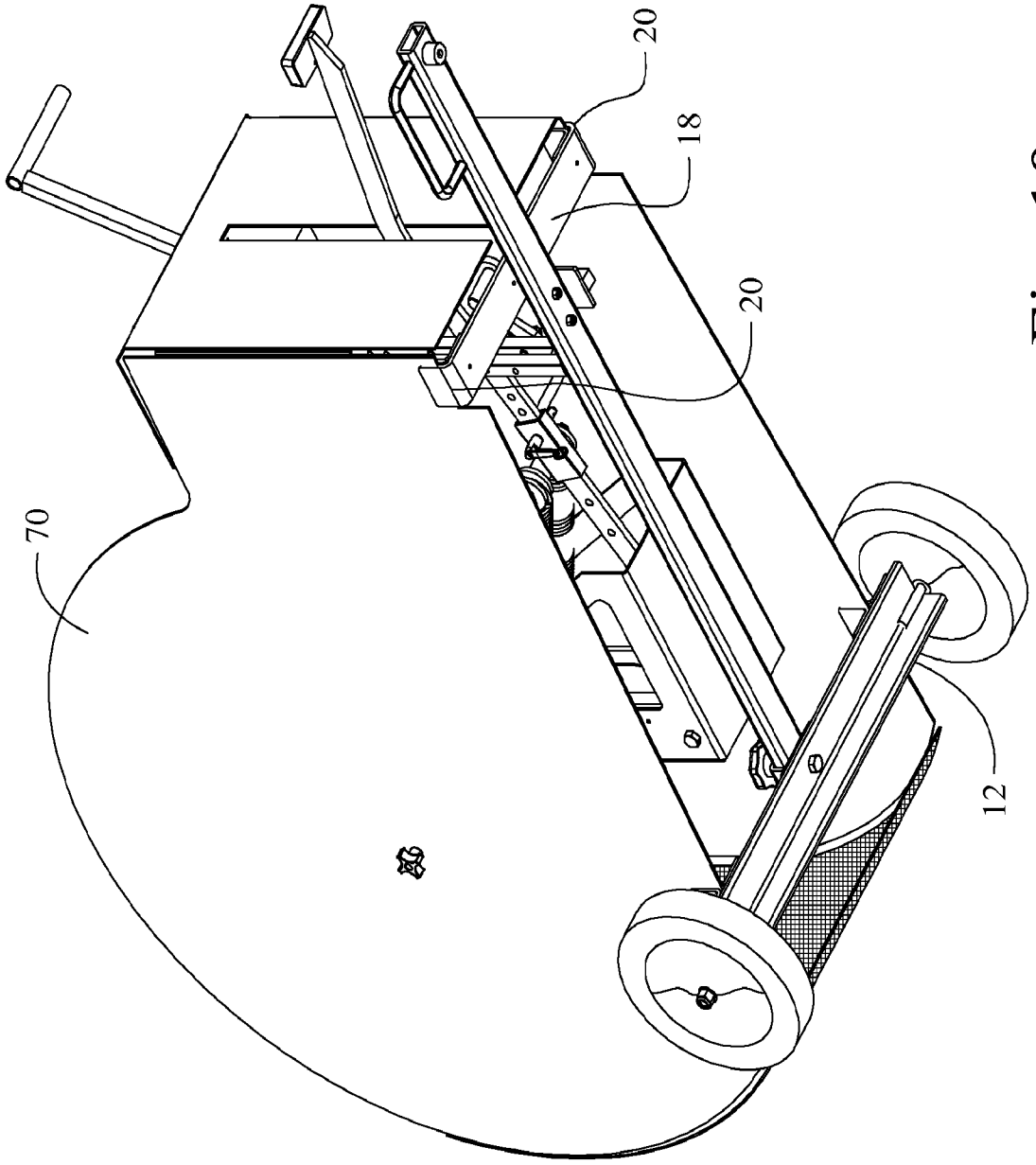


Fig. 19

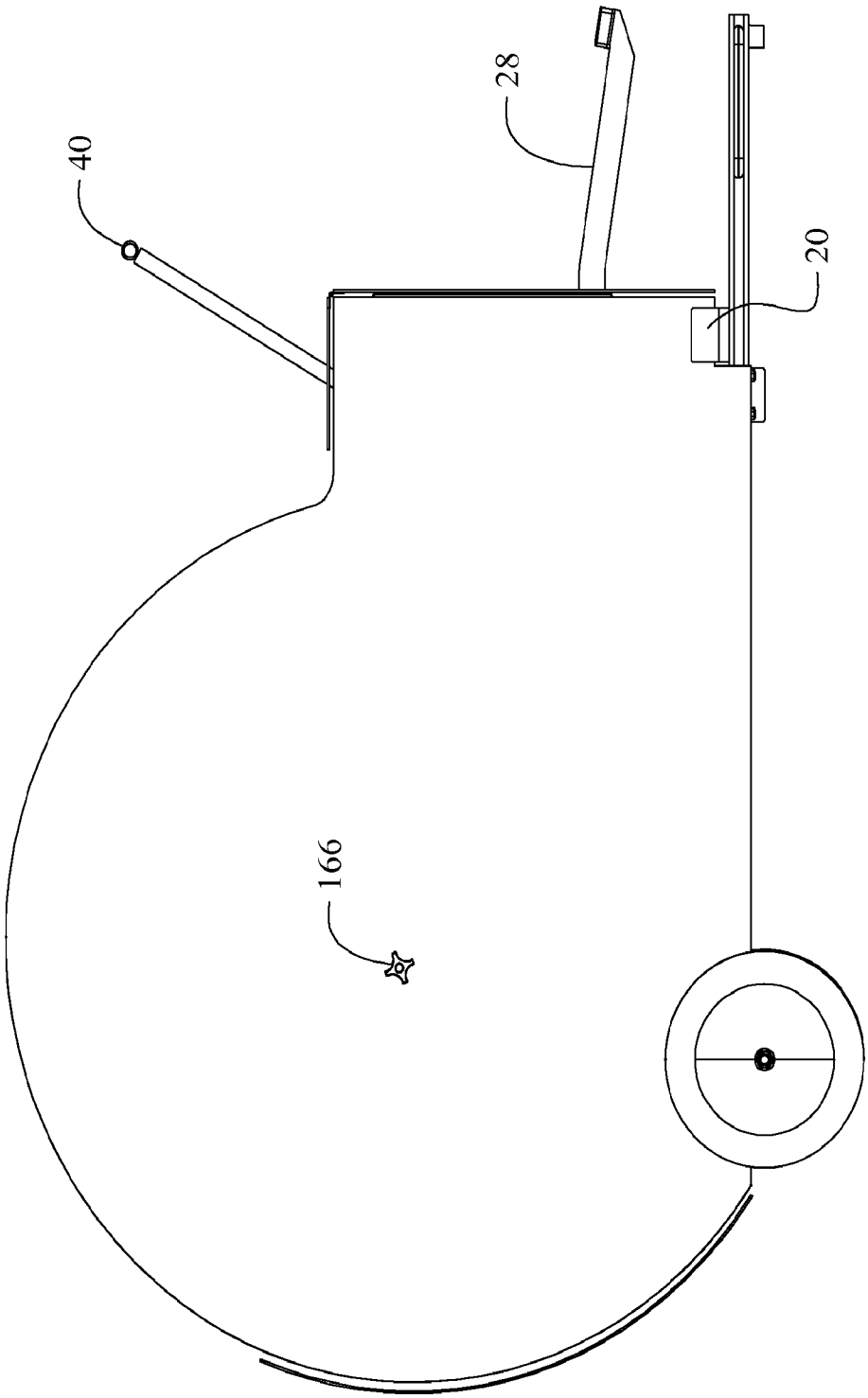


Fig. 20

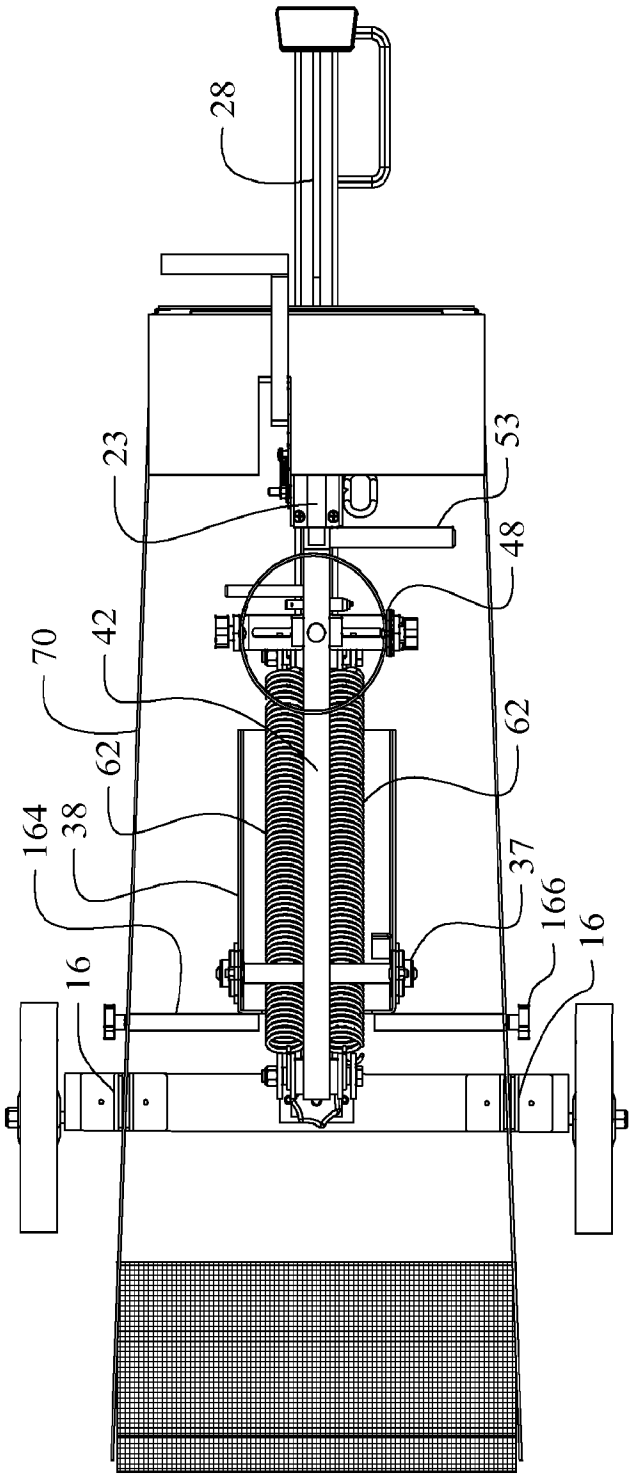


Fig. 21

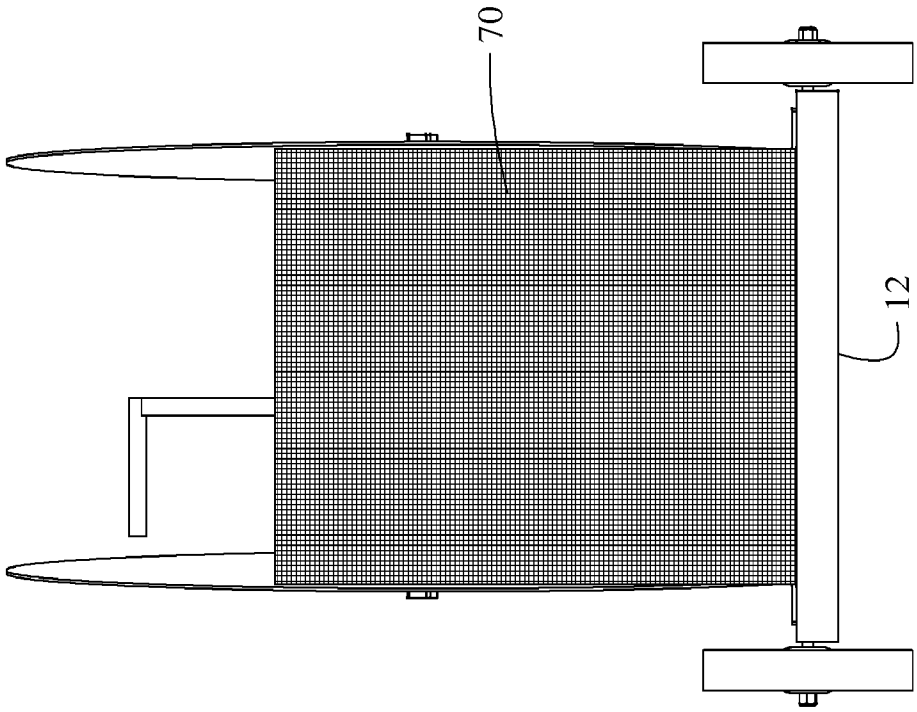


Fig. 22

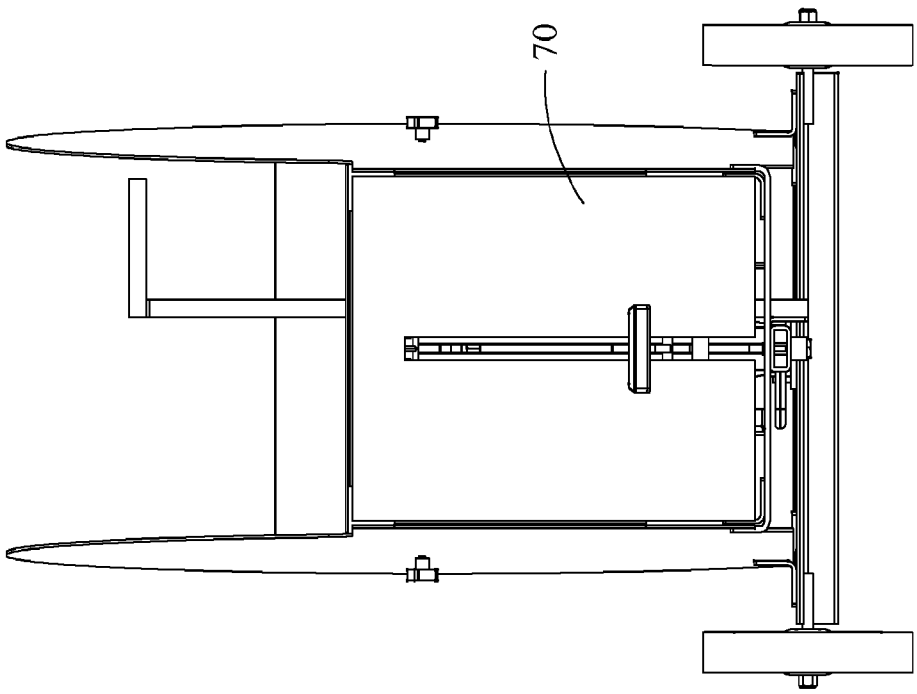


Fig. 23

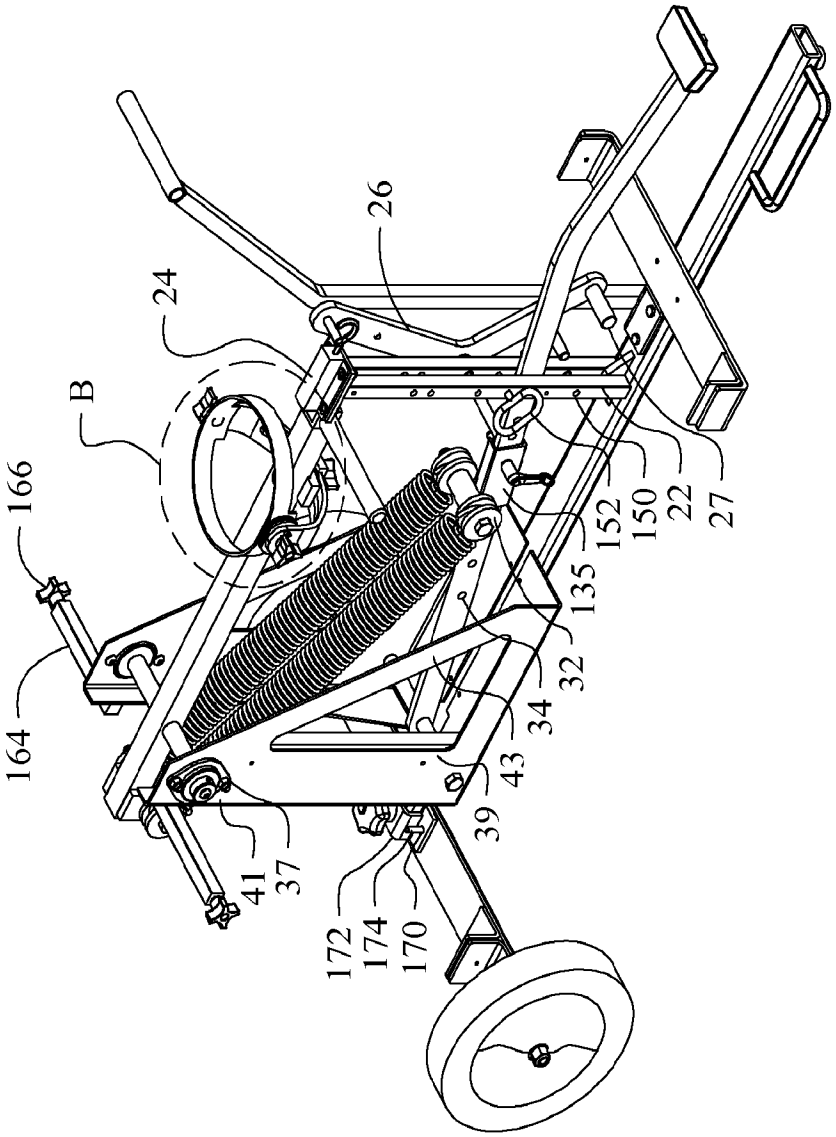


Fig. 24

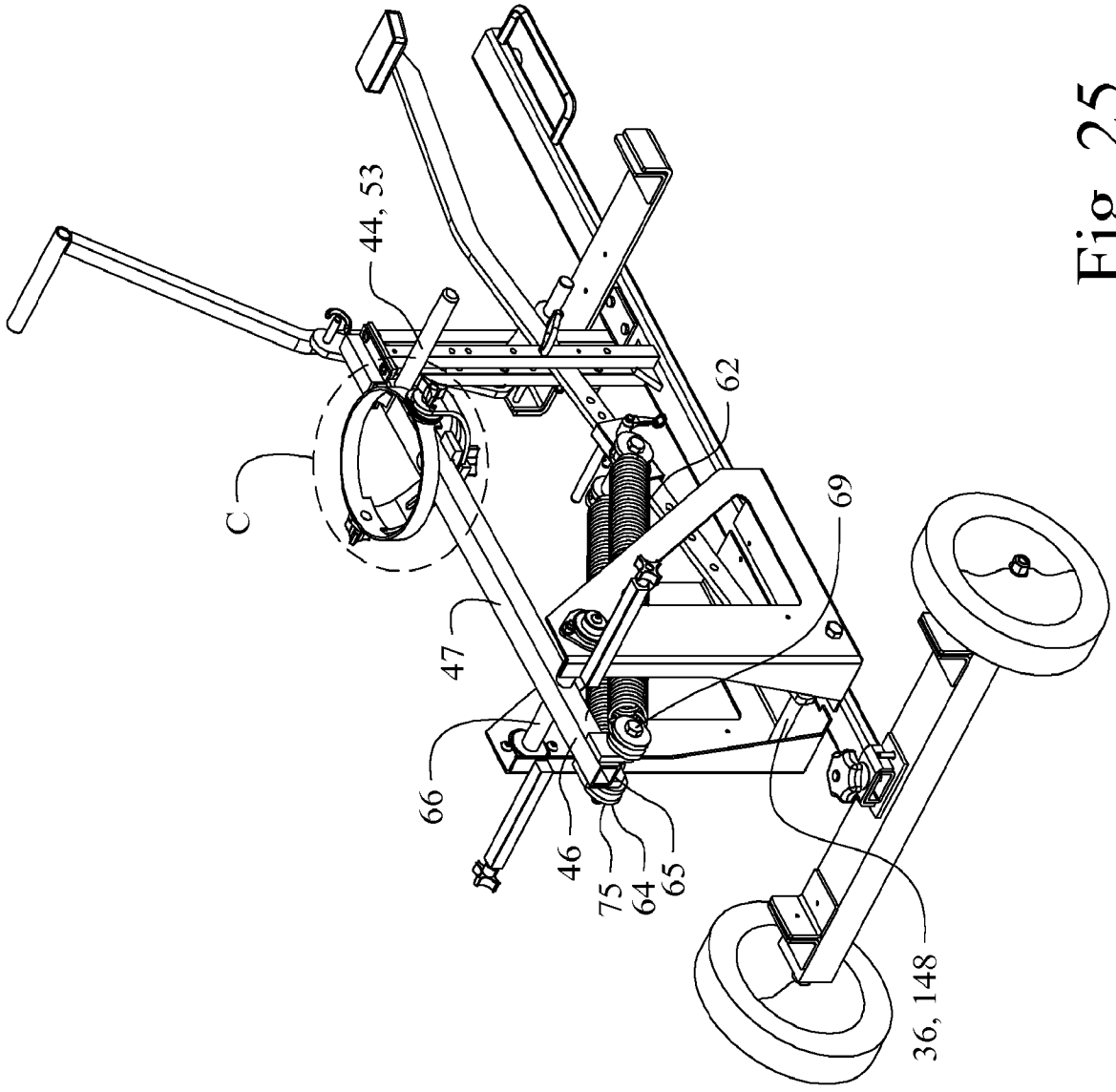


Fig. 25

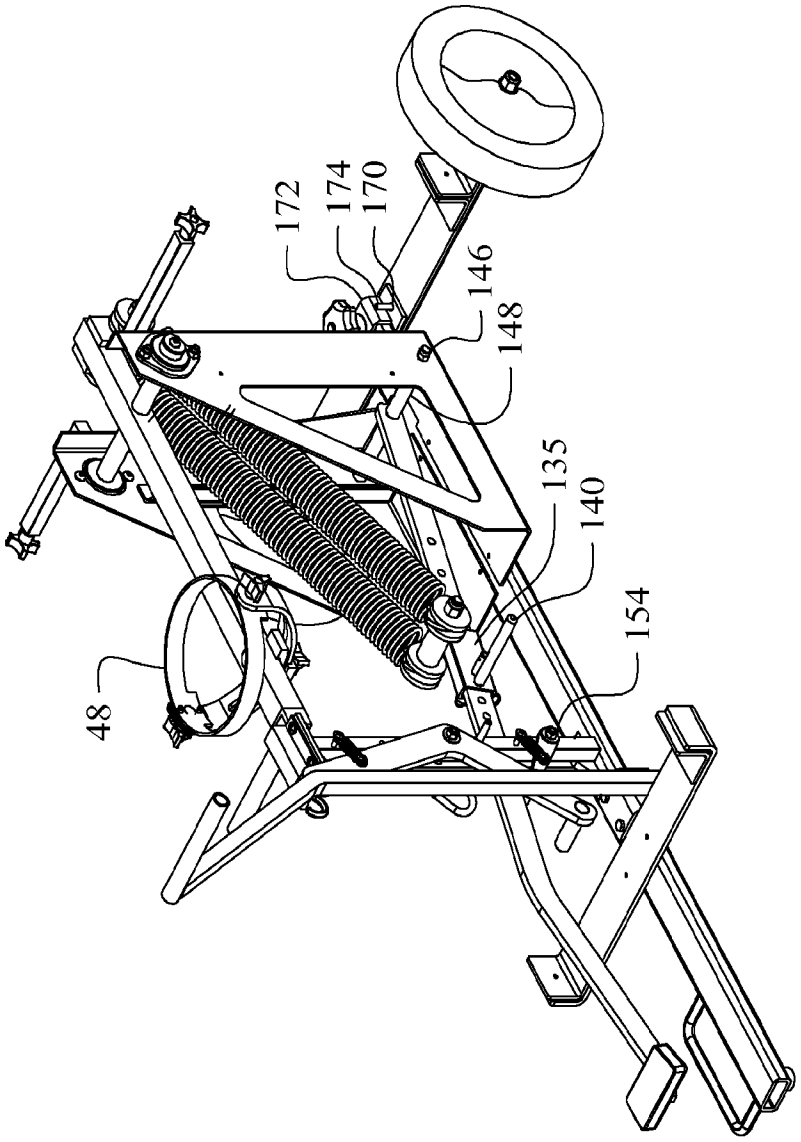


Fig. 26

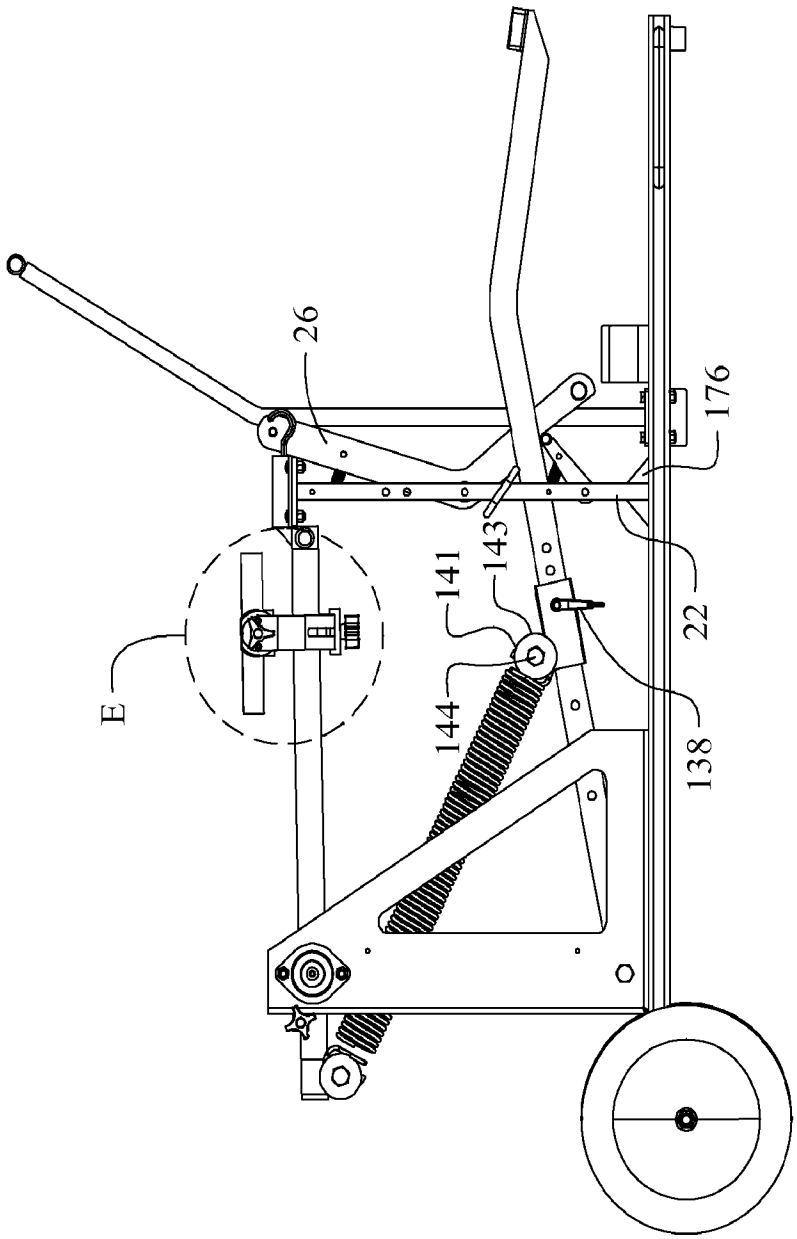


Fig. 27

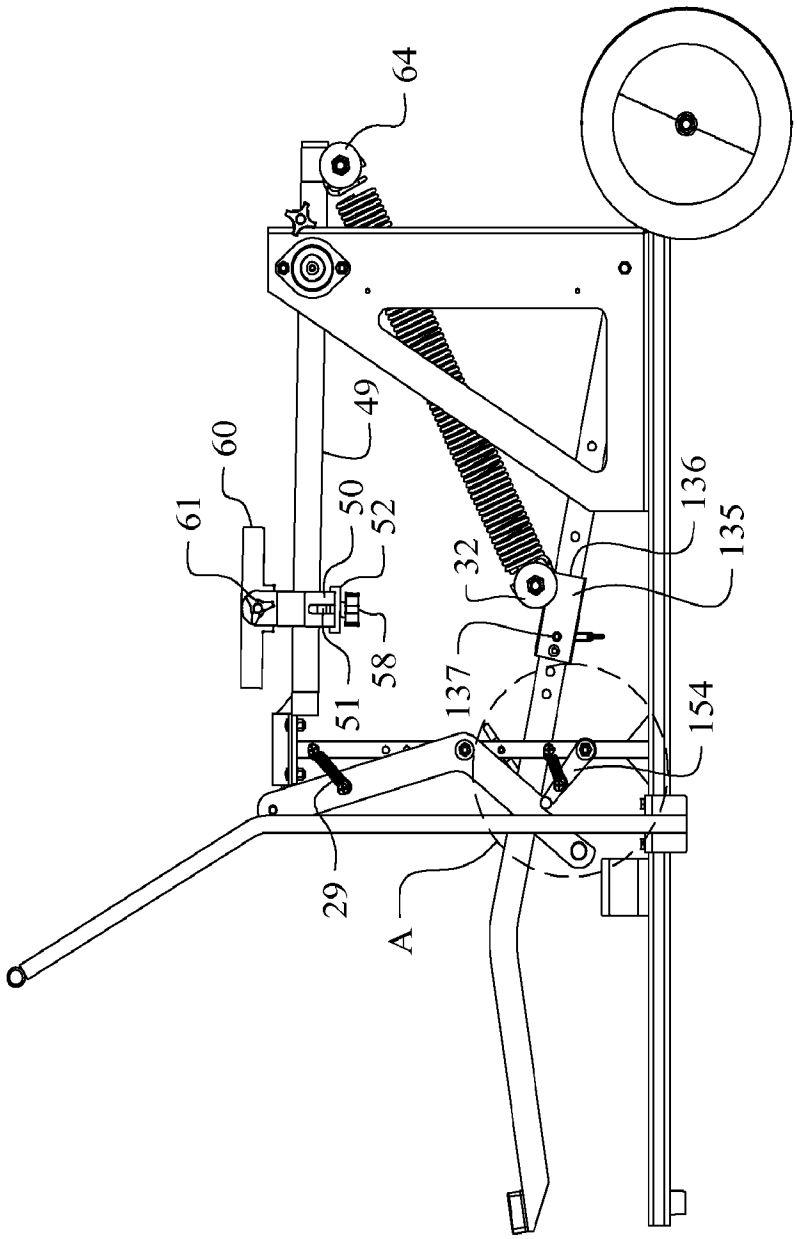


Fig. 28

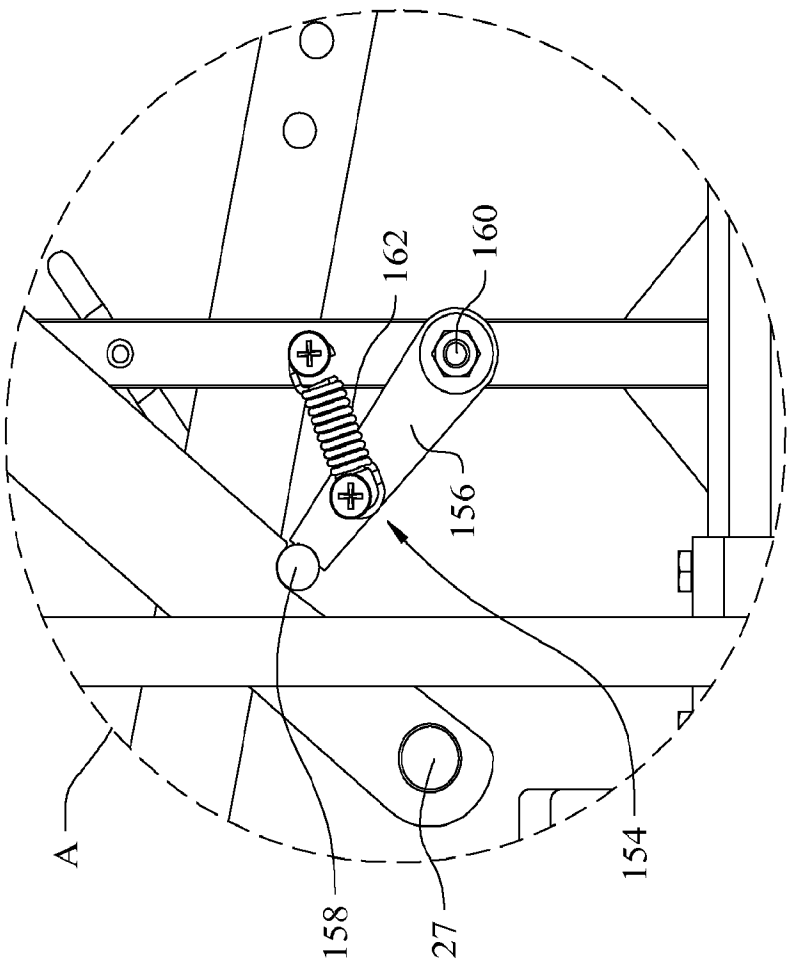


Fig. 29

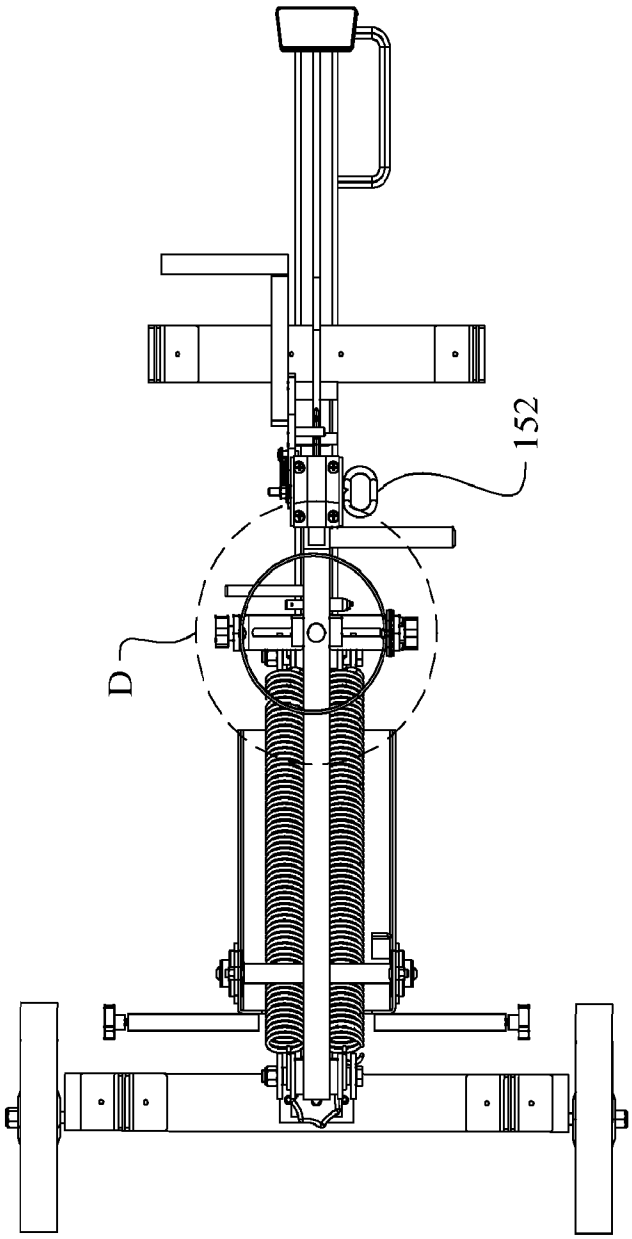


Fig. 30

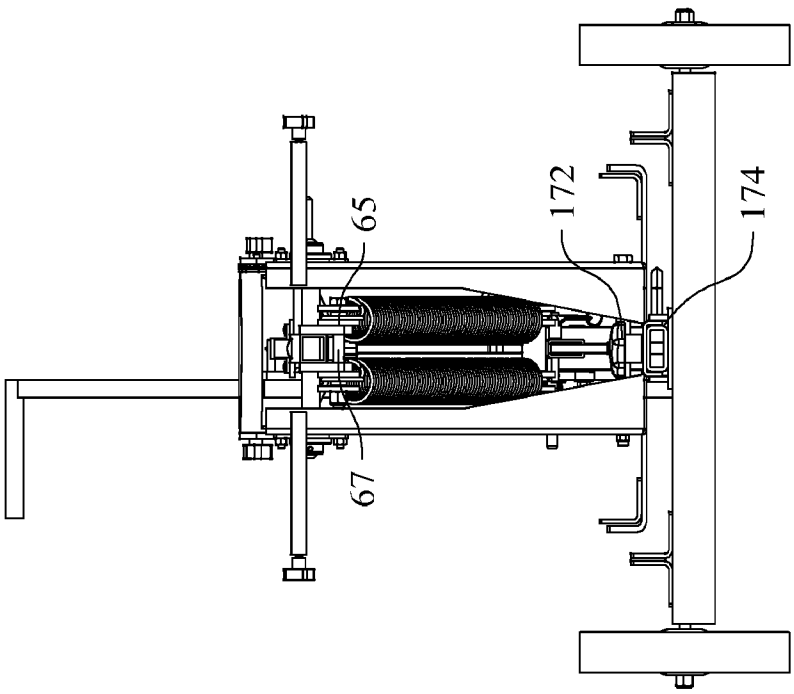


Fig. 31

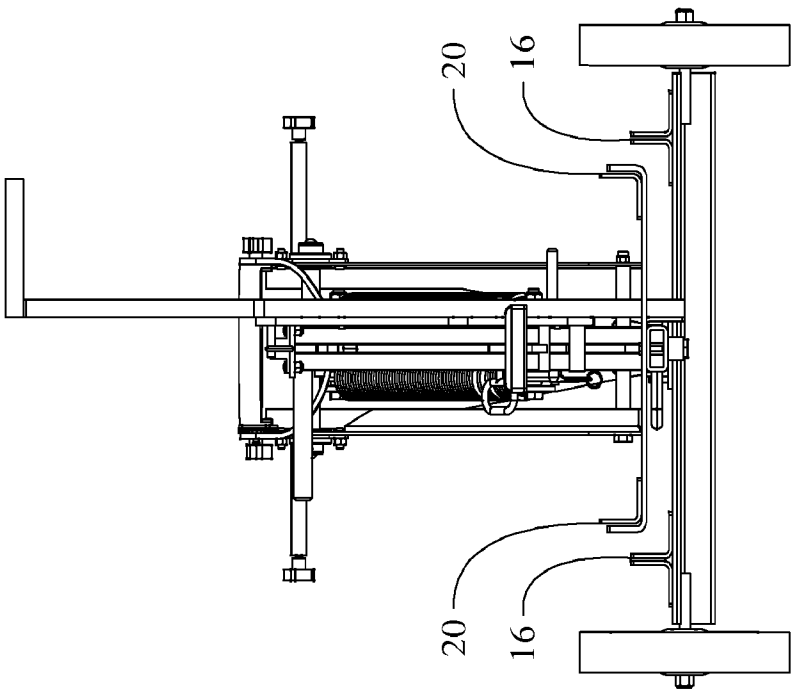


Fig. 32

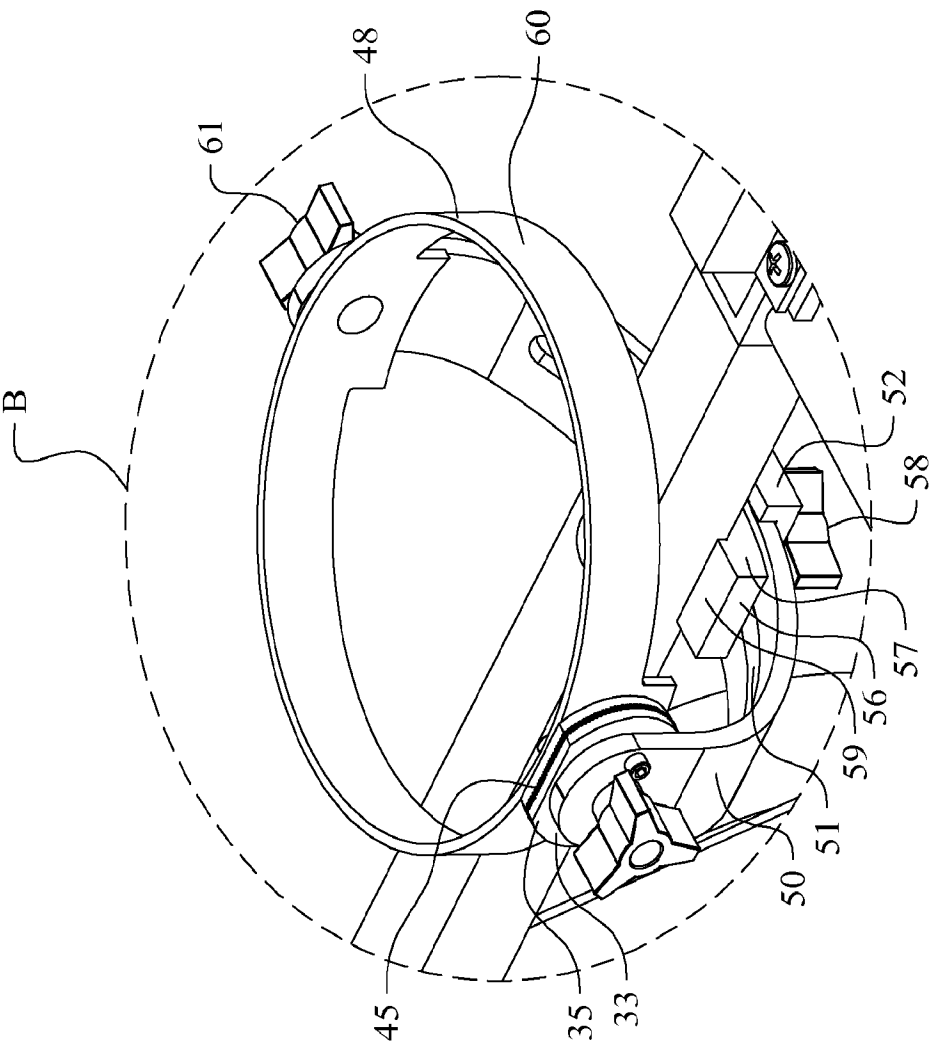


Fig. 33

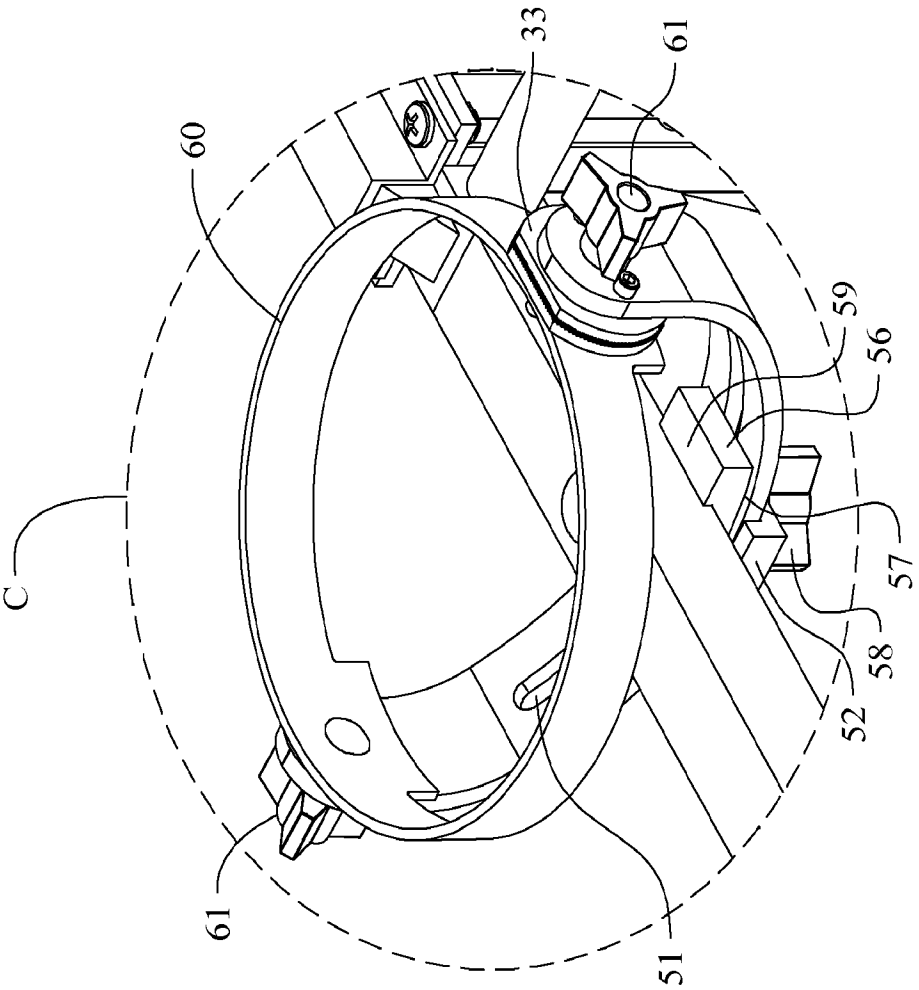


Fig. 34

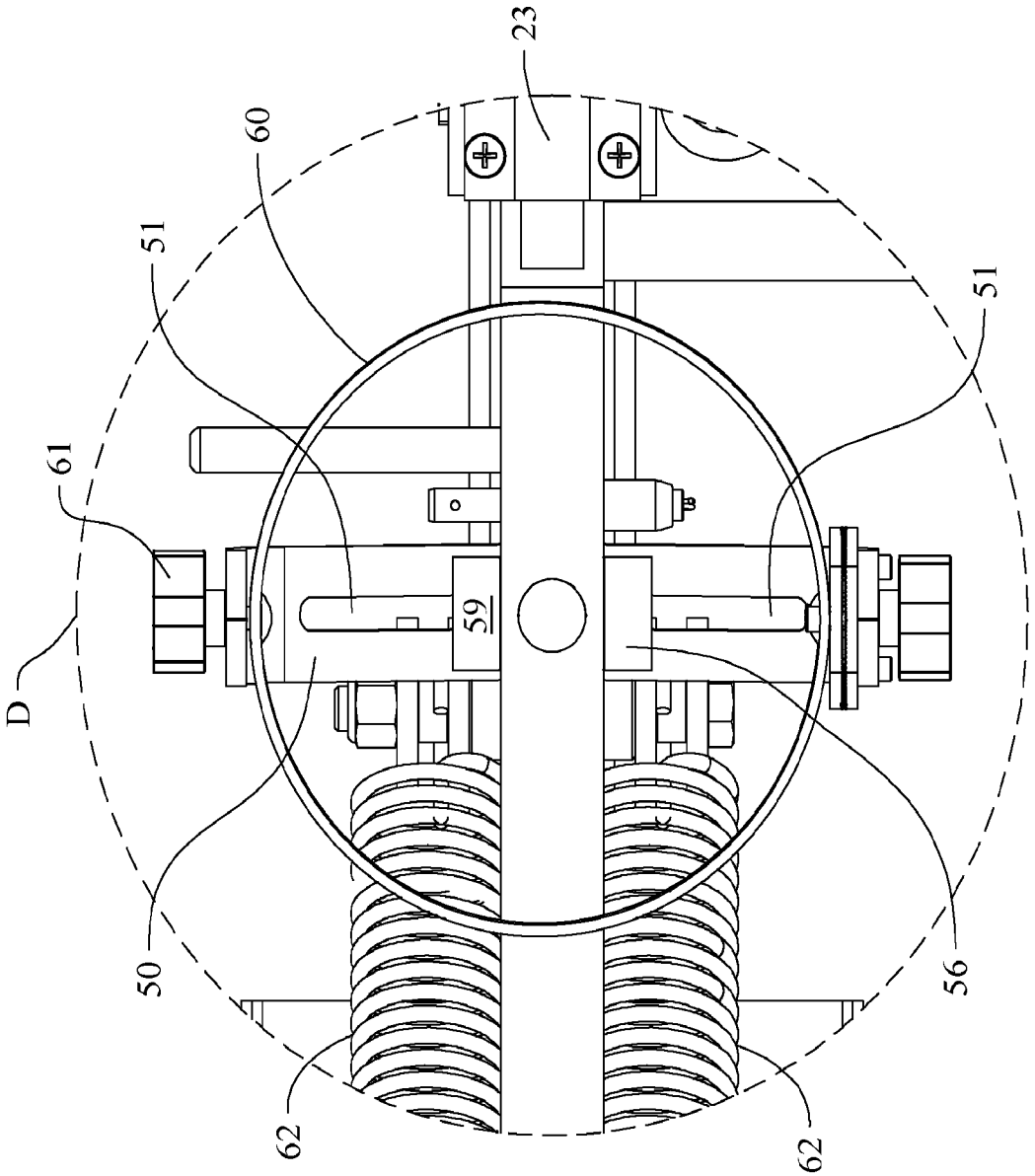


Fig. 35

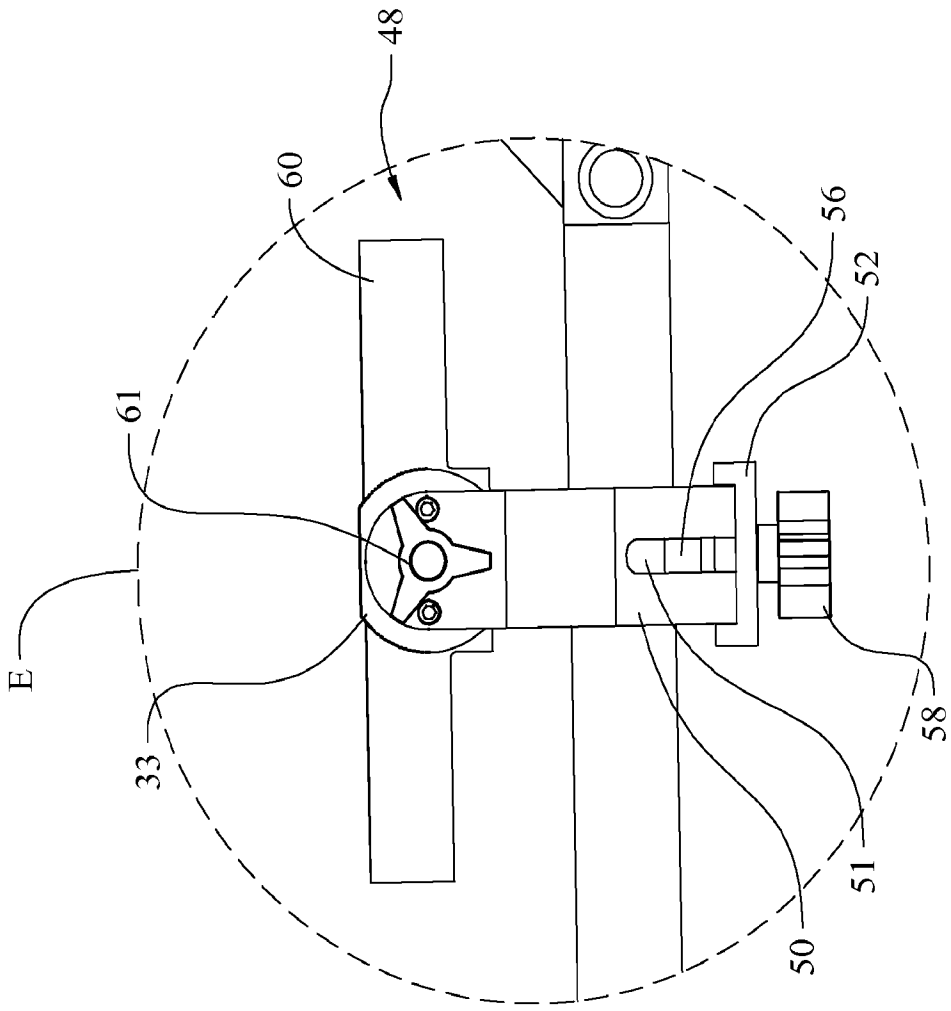


Fig. 36

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/037278

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A63B 69/00 (2010.01)
USPC - 124/7
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A63B 69/00 (2010.01)
USPC - 124/7, 16, 36; 273/317.7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MicroPatent, Google Patents

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,415,150 A (DALLAS) 16 May 1995 (16.05.1995) entire document	1-19
Y	US 6,546,923 B2 (ERICKSON) 15 April 2003 (15.04.2003) entire document	1-19
Y	US 3,977,386 A (MEYER) 31 August 1976 (31.08.1976) entire document	1-19
Y	US 3,926,170 A (DIXON) 16 December 1975 (16.12.1975) entire document	3-8
Y	US 6,182,649 B1 (BATTERSBY et al) 06 February 2001 (06.02.2001) entire document	9-12

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 July 2010	10 AUG 2010
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)