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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 April 2015 (30.04.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/059720 A2

(51) International Patent Classification:
A23N 5/00 (2006.01)

(21) International Application Number:
PCT/IN2014/000681

(22) International Filing Date:
27 October 2014 (27.10.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
4823/CHE/2013 25 October 2013 (25.10.2013) IN

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(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, BN, 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, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

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

— *of inventorship (Rule 4.17(iv))*

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2015/059720 A2

(54) **Title**: AN AUTOMATIC CASHEW-NUT DESHELLING MACHINE

(57) **Abstract**: An automatic de-shelling machine includes a frame, a picking and dispensing sub-assembly, a queuing and release sub-assembly and an orienting and cutting sub-assembly. The picking and dispensing sub-assembly picks and dispenses shelled articles one by one. The queuing and release sub-assembly receives and orients the shelled article in a desired, pre-determined orientation before releasing. The orienting and cutting sub-assembly ensures that the shelled article is in the desired, pre-determined orientation during shearing so that depth of cut on a pre-determined side of the shelled article is controlled. The orienting and cutting sub-assembly includes a rotating pulley arrangement, a first shearing blade and a spring loaded second shearing blade. The rotating pulley arrangement receives and supports shelled article along periphery thereof and moves shelled article radially as shelled article moves along periphery of the rotating pulley arrangement to topple shelled article for facilitating orienting of shelled article to desired, pre-determined orientation.

TITLE: AN AUTOMATIC CASHEW-NUT DESHELLING MACHINE

FIELD

The present disclosure relates to a system for de-shelling shelled articles. More specifically, the present disclosure relates to a system for removing a shell of a shelled cashew nut without damaging the cashew nut kernel.

BACKGROUND

A large number of dry fruits such as raw cashew-nuts, pistachios and walnuts are present in form of a kernel contained within a hull, pod, husk, or shell in which the same is naturally encapsulated. More specifically, the shell is having two parts exocarp and a mesocarp, the shell is joined at the line of dehiscence. Such dry-fruits are in great demand throughout the world and are exported in both shelled and de-shelled states. However, most of the dry-fruit wholesalers and retailers propose to package and sell dry-fruits in de-shelled state, wherein said shells are removed from the kernel. In the cashew-nut industry, most of the processes including the cashew-nut de-shelling process are manual processes. In case of manual de-shelling of cashew-nuts, a crushing force is applied on the cashew-nut to break open the shell, however, the crushing force may also damage the cashew-nut encapsulated in the shell. Further, in case of manual de-shelling of cashew-nuts, the speed of de-shelling is very slow and cannot be maintained at a desired speed. The de-shelling of large numbers of shelled kernels by hand is a tedious, time consuming and hence expensive operation. In accordance with another manual method for de-shelling cashew-nuts, the cashew-nut to be de-shelled is held below a cutting blade and force is manually applied on the cutting blade for piercing the shell of the cashew nut. However, in case of such manual method for de-shelling cashew-nuts, the force applied on cutting blade cannot be properly controlled and if the force is not appropriately applied, and the seed inside the shell may get damaged and ultimately leading to financial losses. Further, manual de-shelling of the raw cashew-nut requires skilled labour for making alignment of the raw cashew-nut and for striking the shearing blade at the line of dehiscence of the raw cashew-nut. Still further, manual de-shelling have been proven unsafe, labor-

intensive, complicated and expensive. The manual de-shelling of the shelled kernels require handling of sharp edged shearing tools that may cause injury to the workers, as such the working environments in case of manual de-shelling are not safe. Further, manual handling of the cashew-nuts is not advisable, as manual handling of the cashew-nuts by workers may lead to contamination of such food-products. The use of gloves for protecting the fingers of the workers hampers efficient handling of the cashew nuts and significantly reduces the speed and accuracy of the de-shelling operation.

Mechanical de-shelling machines have also been suggested in the prior art. In case of mechanical de-shelling machines, hopper supplies cashew nuts to be de-shelled one by one. The cashew-nut to be de-shelled is held in-between a pair of blade guides. The blade guides are notched for facilitating holding of the cashew-nut and a pair of sharp edged blades approaches the cashew-nut from the either sides, till both the blades guided through the blade guides pierce through the shell of the cashew-nut held between the pair of blade guides. In case of the conventionally known mechanical de-shelling machines, there is no provision for aligning the cashew nuts to be de-shelled for appropriately positioning or orienting the cashew nut as the shearing blade strikes the raw cashew-nut. This may cause the shearing blade to form an inappropriate cut on the cashew-nut shell. Further, in case of the conventionally known mechanical de-shelling machines, the orientation of the cashew-nut changes as it travels or as it is being handled, such changing of the orientation of the cashew-nut is also not desirable and may cause formation of inappropriate cuts. The conventionally known mechanical de-shelling machines can handle cashew-nuts of a given size range and adjustments are required for handling cashew-nuts of different size range. Accordingly in case of conventionally known mechanical de-shelling machines, the cashew-nuts are required to be graded according to size before feeding. The grading of the cashew-nuts before feeding to the mechanical de-shelling machine is done manually or with the help of an automatic grading machine and accordingly, the mechanical de-shellers of the prior art fail to minimize dependency on manual work. Also, it is hard to and non-value adding too to grade the cashew nuts to the extent of required precision either by size or by shape.

Accordingly, the conventionally known mechanical de-shelling machines are inaccurate and still require skilled labor for the operation thereof. More specifically, in case of the mechanical de-shelling machines, the shearing blades have to handle shelled cashew nuts or shelled articles in different orientations. Accordingly, the shelled article or cashew-nut is not appropriately positioned or oriented as the shearing blades strike the raw cashew-nut from the "hump side" and the "ends side" of the raw cashew nut. This may cause the shearing blade to form inappropriate cuts on both sides i.e. the "hump side" and the "ends side" of the cashew-nut and the shell of the cashew nut is either left uncut or provided with a much deeper cut than required on either one side. More specifically, if the shearing blade traverses more through the shell at the "hump side" it may cause damage to the kernel and if the shearing blade traverses less through the shell at the "hump side" it may leave the shell uncut. However, both instances are not desirable. More specifically, in case the cashew nut shell is left uncut, the breaking of the shell to access the kernel is difficult and in case the cut is deeper that required, the shearing blade may damage the kernel. Further, with the conventionally known configuration, the shearing blades approach the cashew nut shell from both sides and are adapted to travel by same distance and form same depth of cut on both sides of the cashew-nut shell. However, such a configuration also may cause the shearing blades to either leave the shell of the cashew nut uncut or provide a much deeper cut than required. More specifically, in case of manual de-shelling, about 2-25 percent of the kernels are damaged due to deeper cut of shearing blades striking and damaging the kernel. Further, in case of conventional de-shelling machines, about 10-60 percent of the shells of the cashew-nuts are left uncut due to inappropriate cuts. Due to inability of the conventional de-shelling machines to appropriately position the cashew nut to cause the shearing blades to strike the "hump side" and the "ends side" of the cashew-nut, the cuts formed by the shearing blades are inappropriate, thereby causing un-cut shell or damage to the kernel due to over-penetration of the shearing blades. Accordingly, the yield in case of the conventional de-shelling machines is low. In nut shell, the manual de-shelling as well as conventional mechanical de-shellers for de-shelling the nuts have several drawbacks associated there-with.

Accordingly, there is a need for a mechanical de-sheller for de-shelling the nuts that is simple and convenient to use. Further, there is a need for a mechanical de-sheller machine that eliminates the drawbacks associated with the conventionally known mechanical de-shelling machines. More specifically, there is a need for a mechanical de-shelling machine that enables appropriate positioning and orienting of the cashew nut to be de-shelled with respect to line of dehiscence for ensuring that the shearing blades strike the raw cashew nut along the line of dehiscence of the raw cashew-nut, thereby enabling the shearing blades to form appropriate cuts on both sides of the cashew-nut shell. Further, there is a need for a mechanical de-shelling machine that enables the shearing blades striking on sides of the cashew nut to form appropriate cuts on both sides of the cashew-nut shell, thereby reducing chances of un-cut shell or damage to the kernel due to over-penetration of the shearing blades. Further, there is a need for a mechanical de-shelling machine that increases yield and productivity. Furthermore, there is a need for a mechanical de-shelling machine that can handle different sized cashew-nuts and eliminates the need to grade the cashew-nuts according to size before feeding the cashew-nuts to the mechanical de-shelling machine.

Objects:

Some of the objects of the present disclosure which at-least one embodiment is able to satisfy, are described herein below:

It is an object of the present disclosure to ameliorate one or more problems of the prior art or to at least provide a useful alternative.

An object of the present disclosure is to provide an automatic de-shelling machine that enables appropriate positioning and orienting of a raw cashew nut to be de-shelled with respect to line of dehiscence for ensuring that a pair of shearing blades strike the raw cashew nut along the line of dehiscence of the raw cashew-nut at both sides i.e. the "hump side" and the "ends side", thereby enabling the shearing blades to form appropriate cuts on both sides of the cashew-nut shell.

Another object of the present disclosure is to provide an automatic de-shelling machine that forms appropriate cuts on both sides of the cashew-nut shell, i.e. the "hump side" and the "ends side" by strategically providing unequal depth of cuts at the "hump side" and the "ends side" of the cashew nut.

Still another object of the present disclosure is to provide an automatic de-shelling machine that forms appropriate cuts on both sides of the cashew-nut shell, i.e. the "hump side" and the "ends side", thereby reducing chances of un-cut shell or damage to the kernel due to over-penetration of the shearing blades.

Still another object of the present disclosure is to provide an automatic de-shelling machine that continuously de-shells cashew-nuts, irrespective of size of cashew-nuts fed there-to.

Another object of the present disclosure is to provide an automatic de-shelling machine that can handle cashew-nuts of any size, thereby eliminating the need to grade the cashew-nuts before feeding to the automatic de-shelling machine.

Another objective of the present disclosure is to provide an automatic de-shelling machine that automatically adjusts position and orientation of a "hump side" and an "ends side" of a cashew nut with respect to the shearing blades and according adjusts the depth of cut to be provided at the "hump side" and the "ends side" of the cashew nut.

Yet another object of the present disclosure is to provide an automatic de-shelling machine that requires less power for operation thereof.

Still another object of the present disclosure is to provide an automatic de-shelling machine that maximizes recovery of kernels naturally encapsulated within the shell and accordingly increases the yield.

Another object of the present disclosure is to provide an automatic de-shelling machine that eliminates manual handling of the nuts and the drawbacks associated with manual handling.

Still another object of the present disclosure is to provide an automatic de-shelling machine that optimizes and / or maximizes the yield.

Still another object of the present disclosure is to provide an automatic de-shelling machine that facilitates cracking and de-shelling action to be performed automatically and in continuous fashion.

Another object of the present disclosure is to provide an automatic de-shelling machine that reduces chances of damage to kernel held inside the shell due to uncontrolled piercing depth of blade in to the shell and uncontrolled piercing forces acting on the shell.

Yet another object of the present disclosure is to provide an automatic de-shelling machine that reduces financial losses occurring due to damage to the kernel held inside the shell due to uncontrolled piercing of the blades in to the shell during the de-shelling operation.

Another object of the present disclosure is to provide an automatic de-shelling machine that restrains handling of nuts by workers during processing thereof, thereby reducing chances of contamination.

Still another object of the present disclosure is to provide an automatic de-shelling machine that carries out the de-shelling operation in a fully automatic manner without much human intervention.

Still another object of the present disclosure is to provide an automatic de-shelling machine that is easy to use and maintain.

These and other objects of the present disclosure are dealt in great extent by the accompanying drawings and the descriptive matter, in which are illustrated exemplary embodiments of the disclosure.

SUMMARY

An automatic de-shelling machine for removing shell of a shelled article is disclosed in accordance with an embodiment of the present disclosure. The automatic de-

shelling machine includes a frame, a picking and dispensing sub-assembly, a queuing and release sub-assembly and an orienting and cutting sub-assembly. The picking and dispensing sub-assembly is supported on the frame and picks and dispenses shelled articles one by one. The queuing and release sub-assembly is disposed down-stream of the picking and dispensing assembly and receives and orients the shelled article in a desired, pre-determined orientation before releasing. The orienting and cutting sub-assembly ensures that the shelled article is in the desired, pre-determined orientation so that depth of cut on a pre-determined side of the shelled article is controlled. The orienting and cutting sub-assembly includes a rotating pulley arrangement, a first shearing blade and a spring loaded second shearing blade. The rotating pulley arrangement receives and supports the shelled article along periphery thereof and moves the shelled article radially as the shelled article moves along periphery of the rotating pulley arrangement to topple the shelled article for facilitating orienting of the shelled article to the desired, pre-determined orientation. The first shearing blade is disposed between the rotatable pulleys of the rotating pulley arrangement and is moved therewith for shearing the pre-determined side of the shelled article. The spring loaded second shearing blade is adjustably urged towards a side of the shelled article that is opposite to the pre-determined side depending upon size and orientation of the shelled article, thereby controlling depth of cut on both sides of the shelled article. The first shearing blade moves with the rotatable pulleys of the rotating pulley arrangement, wherein the rotating pulley arrangement derives torque from the ratchet wheel.

Typically, the picking and dispensing sub-assembly includes a hopper, a receiving chamber and at least one picking element. The hopper receives shelled articles to be de-shelled. The receiving chamber defines an enclosure for receiving and supporting a pre-determined quantity of the shelled articles received from the hopper. The at least one picking element is rotatably supported on a first rotating shaft and picks the shelled articles one by one from the receiving chamber and delivers the shelled articles one by one.

Further, the automatic de-shelling machine includes a directing roller disposed downstream of the hopper and upstream of the receiving chamber to direct the shelled articles from the hopper towards the receiving chamber.

Typically, the directing roller derives rotational power from the first rotating shaft via a power transmission drive selected from a group consisting of a chain drive, a pulley drive and a gear drive.

Generally, the receiving chamber includes a curved operative bottom support plate, a pair of side plates and a closing plate that are connected to each other to define the enclosure. The operative bottom support plate supports the shelled articles and has an opening configured thereon for receiving a pre-determined quantity of shelled articles inside the receiving chamber between the opening and the closing plate.

Typically, the queuing and release sub-assembly includes a pivotably supported tray, a ratchet wheel, a queuing door and a release door. The pivotably supported tray receives shelled articles one by one delivered thereto by the picking element. The ratchet wheel with teeth configured thereon rotates and intermittently interacts with the tray for vibrating the tray for facilitating orienting of the shelled article received thereby to the desired pre-determined orientation. The ratchet wheel derives rotational power from the first rotating shaft via a power transmission drive selected from a group consisting of chain drive, pulley drive and gear drive. The queuing door is disposed operatively above and movable with respect to the tray to retain said shelled article until the shelled article is oriented to the desired, pre-determined orientation. The queuing door moves away from the tray for releasing the shelled article when actuated by a first rocker arm that in turn is actuated by rotation of the ratchet wheel. The release door is disposed downstream of the queuing door and releases the shelled article received thereby from the queuing door when actuated by a second rocker arm that in turn is actuated by rotation of the ratchet wheel.

Typically, the first shearing blade rotates with the rotating pulley arrangement that in turn is actuated by rotation of the ratchet wheel.

In accordance with an embodiment of the present disclosure, the rotating pulley arrangement includes a pair of pulleys configuring a modified V-notch pulley having V-notch configured along the circumference thereof such that depth of the V-notch varies along circumference of the modified V-notch pulley, the V-notch receives and supports the shelled article and move the shelled article radially as the shelled article moves along periphery of the rotating modified V-notch pulley to topple the shelled article for facilitating orienting of the shelled article to the desired, pre-determined orientation.

Specifically, the first shearing blade is disposed between the rotating pulleys of the modified V-notch pulley.

In accordance with another embodiment of the present disclosure, the rotating pulley arrangement includes a pair of rotatable outer pulleys and a pair of rotatable inner pulleys. The rotatable outer pulleys receive and guide the shelled article along a curved path. The rotatable inner pulleys are disposed between the rotatable outer pulleys and are rotatable about an axis that is offset from axis of rotation of the pair of rotatable outer pulleys. The periphery of the rotatable inner pulleys support the shelled article and move the shelled article radially outwards to topple the shelled article for facilitating orienting of the shelled article to the desired, pre-determined orientation as the shelled article is guided between the pair of rotatable outer pulleys.

Typically, the first shearing blade is disposed between pair of rotatable inner pulleys.

Further, the automatic de-shelling machine includes a dislodging element that dislodges a shelled article accidently trapped between the rotating pulleys of the rotating pulley arrangement, wherein the dislodging element is actuated by a third rocker arm that in turn is actuated by rotation of the ratchet wheel.

Furthermore, the automatic de-shelling machine includes an adjustably urging sub-assembly that adjustably urges the second shearing blade towards opposite side of the shelled article depending upon size and orientation of the shelled article. The adjustably urging sub-assembly includes a sensing wheel, an engaging element and an urging element. The sensing wheel is provided with a plurality of angularly spaced

stepped platforms. The sensing wheel is angularly moved by a fourth rocker arm that in turn is actuated by rotation of the ratchet wheel based on size, configuration and orientation of shelled article held between the first and second shearing blades. The engaging element interacts with the angularly spaced stepped platforms to move gradually with respect to the sensing wheel. The urging element is connected to and moves with the engaging element to adjustably urge the second shearing blade towards the side that is opposite to the pre-determined side of the shelled article depending upon size and orientation of the shelled article, thereby controlling depth of cut on both sides of the shelled article.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWING

The automatic de-shelling machine of the present disclosure will now be described in relation to the accompanying drawings, in which:

Figure 1a illustrates a conventional mechanical de-shelling machine, wherein a pair of shearing cutters is guided through a pair of blade guides to strike a shelled cashew nut held between the blade guides with its "hump side" pointing operatively rightwards;

Figure 1b illustrates a conventional mechanical de-shelling machine, wherein the cashew-nut is held between the blade guides with its "ends side" pointing operatively rightwards;

Figure 1c illustrates a cross-sectional view of the pair of blade guides of the conventional mechanical de-shelling machine of **Figure 1a**, wherein the blade guides are provided with notches formed thereon to hold the cashew nut;

Figure 1d illustrates a top view of the conventional mechanical de-shelling machine of **Figure 1a**;

Figure 2a illustrates a front view of a modified v- belt pulley also referred to as the v-notch pulley for a mechanical de-shelling machine in accordance with an embodiment of the present disclosure, wherein depth of the v-notch configured along the periphery

varies along the periphery of the pulley, the v-notch receives the cashew nut with the "ends side" pointing operatively upwards;

Figure 2b illustrates a front view of a modified v-belt pulley of **Figure 2a**, wherein the v-notch receives the cashew nut with the "hump side" pointing operatively upwards;

Figure 2c illustrates a side view of the modified v-belt pulley of **Figure 2a** configured by assembling two portions;

Figure 2d illustrates a swinging door disposed over the modified v-belt pulley of the mechanical de-shelling machine;

Figure 2e illustrates one half configuring the modified v-belt pulley of **Figure 2c**;

Figure 3a – Figure 3f illustrates schematic representation depicting different stages during the operation of the mechanical de-shelling machine, wherein the cashew-nut to be de-shelled changes it's position with respect to a first shearing blade disposed between the pulleys of the modified v-belt pulley and a spring loaded second shearing blade;

Figures 4a – Figure 4f illustrates isometric views of the mechanical de-shelling machine during different stages of operation as illustrated in **Figure 3a – Figure 3f** respectively;

Figure 5 illustrates a one-by one feeder for the automatic mechanical de-shelling machine, wherein the one-by one feeder feeds the cashew nut one by one into the mechanical de-shelling machine;

Figure 6 illustrates a schematic representation of a blade guide of the pair of blade guides held between the half portions configuring the modified v-belt pulley of the mechanical de-shelling machine;

Figure 7 illustrates a schematic representation of a first shearing blade disposed between the pair of blade guides held between the half portions configuring the modified v-belt pulley; and

Figure 8a and **Figure 8b** illustrates schematic representation of a first shearing blade disposed between the pair of blade guides held between the half portions configuring the modified v-belt pulley

Figure 9 illustrates a schematic representation of an automatic mechanical de-shelling system having a picking and dispensing sub-assembly, a queuing and release sub-assembly and an orienting and cutting sub-assembly in accordance with an embodiment of the present disclosure;

Figure 10 illustrates a schematic representation of the automatic mechanical de-shelling system supported on a frame;

Figure 11 illustrates interaction between a pivotably supported tray and a ratchet wheel of the queuing and release sub-assembly of **Figure 9**;

Figure 12a illustrates a queuing door of the queuing and release sub-assembly of **Figure 9** in a closed configuration for retaining the shelled article thereby;

Figure 12b illustrates the queuing door of **Figure 12a** in an open configuration for releasing the shelled article thereby upon actuation by a first rocker arm and linkages;

Figure 13a illustrates a shelled article supported along periphery of rotatable inner pulleys disposed between the pair of outer pulleys, wherein the shelled article is supported in a configuration other than the desired pre-determined configuration;

Figure 13b illustrates a shelled article supported and toppled along the rotatable inner pulleys for facilitating orienting of the shelled article to the desired, pre-determined orientation;

Figure 14a and **Figure 14b** illustrates side view of the rotatable outer pulleys;

Figure 14c illustrates a side view of a rotatable inner pulley;

Figure 15a illustrates an assembled view of an assembly of the pair of rotatable outer pulleys, the pair of rotatable inner pulleys, the first shearing blade, the dislodging element, the first rocker arm and the second rocker arm;

Figure 15b illustrates an exploded view of the assembly of **Figure 15a**;

Figure 15c illustrates another exploded side view of the assembly of **Figure 15a**;

Figure 16 illustrates an assembled view of the rotatable inner pulleys assembled with the rotatable outer pulleys;

Figure 17a illustrates a dislodging element connected to a third rocker arm that in turn is actuated by rotation of the ratchet wheel;

Figure 17b - Figure 17c illustrates different positions of the dislodging element with respect to an assembly of rotatable inner pulleys and rotatable outer pulleys, particularly positions of the dislodging element before striking the shelled article and while dislodging the shelled article;

Figure 18a illustrates the shelled article just before being received between the first shearing blade disposed between the rotatable inner pulleys and a spring loaded second shearing blade that is adjustably urged towards a side of the shelled article that is opposite to the desired, pre-determined side depending upon size and orientation of the shelled article;

Figure 18b illustrates the shelled article received between the first shearing blade and the spring loaded second shearing blade;

Figure 19a illustrates a schematic representation depicting interaction between various elements i.e. a sensing wheel, an engaging element and an urging element of an adjustably urging sub-assembly;

Figure 19b illustrates a schematic representation of another view of the adjustably urging sub-assembly;

Figure 20 illustrates a schematic representation of the sensing wheel of **Figure 19a** and a fourth rocker arm mounted on a shaft; and

Figure 21 illustrates a top view of the automatic mechanical de-shelling system.

DETAILED DESCRIPTION

An automatic mechanical de-shelling machine of the present disclosure will now be described with reference to the embodiments which do not limit the scope and ambit of the disclosure. The description provided is purely by way of example and illustration. The embodiment herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

Figure 1a illustrates a conventional mechanical de-shelling machine **100**, wherein a pair of shearing cutters **10a** and **10b** are guided through a pair of blade guides **20a** and **20b** to strike a cashew nut "C" held between the blade guides **20a** and **20b** with its "hump side" pointing operatively rightwards. **Figure 1b** illustrates a conventional mechanical de-shelling machine **100**, wherein the cashew-nut "C" is held between the blade-guides **20a** and **20b** with the "ends sides" of the cashew nut "C" pointing operatively rightwards. **Figure 1c** illustrates a cross-sectional view of the pair of blade guides **20a** and **20b** of the conventional mechanical de-shelling machine **100**, wherein the blade guides **20a** and **20b** are provided with notches **21a** and **21b** formed thereon to hold the cashew nut "C". **Figure 1d** illustrates a top view of the conventional mechanical de-shelling machine **100**.

Figure 2a illustrates a front view of a modified v-belt pulley or the v-notch pulley **110** for a mechanical de-shelling machine in accordance with an embodiment of the present disclosure, wherein depth "X" of the v-notch "N" (illustrated in Figure 2c) configured along the periphery of the modified v-belt pulley **110** varies along the periphery of the modified v-belt pulley **110**. More specifically, the modified v-belt pulley **110** for a mechanical de-shelling machine **100** is formed by assembling together a first half portion **112** and a second half portion **114**. Referring to **Figure 2e,**

one half portion **112** configuring the modified v-belt pulley **110** is illustrated. With such configuration, at certain portion of the periphery, the v-notch "N" has a depth "X1" whereas at other portion of the periphery the v-notch "N" has a depth "X2".

The v-notch "N" either receives the cashew nut "C" with the "ends side" pointing operatively upwards as illustrated in **Figure 2a** or with the "hump side" pointing operatively upwards as illustrated in **Figure 2b**. If the cashew nut "C" is received inside the v-notch "N" in the configuration illustrated in **Figure 2b**, the cashew nut "C" is in stable configuration as it is having two-point support and remains in that configuration. If the cashew nut "C" is received inside the v-notch "N" in the configuration illustrated in **Figure 2a**, the cashew nut "C" is in unstable configuration as it is supported at single point and due to rotation of the modified v-belt pulley **110** and due to configuration of the V-notch, the cashew nut "C" overturns/ topples and is brought to the stable configuration as illustrated in **Figure 2b**. More specifically, a swinging door **140** as illustrated in **Figure 2e** acts as a stopper to hold the cashew nut "C" and as the modified v-belt pulley **110** rotates, the cashew nut moves from the unstable configuration to the stable configuration illustrated in **Figure 2b.**

Figure 3a – Figure 3f illustrates schematic representation depicting different stages during the operation of the mechanical de-shelling machine **200**, wherein the raw cashew-nut "C" to be de-shelled changes it's position with respect to the first shearing blade **116** mounted on the modified v-belt pulley **110** and a second shearing blade **122** mounted on arcuately extending v-notch **124** configured on the pressing arrangement **120.** Due to such configuration of the modified v-belt pulley **110** for the mechanical de-shelling machine, appropriate orienting of the raw cashew nut "C" to be de-shelled with respect to line of dehiscence is achieved. Further, such configuration ensures that shearing blades **116** and **122** (illustrated in **Figure 3a- Figure 3e**) strike the raw cashew nut "C" along the line of dehiscence of the raw cashew-nut "C" at both sides i.e. the "hump side" and the "ends side", thereby controlling the depth of cut on but sides and enabling the shearing blades **116** and **122** to form appropriate cuts on both sides of the cashew-nut shell. With such configuration, it is possible to control depth of cut at the "hump side" than at the "ends side". More specifically, such

configuration enables in strategically providing unequal depth of cuts at the "hump side" and the "ends side" of the cashew nut "C", thereby providing various advantages such as prevention of un-cut shell or damage to the kernel due to over-penetration of the shearing blades **116** and **122** and also resulting in less power consumption for operation of the mechanical de-shelling machine. Further, such configuration facilitates in adjusting position and orientation of the "hump side" and the "ends side" of the cashew nut "C" with respect to the shearing blades **116** and **122** and according adjusts the depth of cut to be provided at the "hump side" and the "ends side" of the cashew nut "C".

A first shearing blade **116** along with a pair of the blade guide **118** is held between the first half portion **112** and the second half portion **114** of the modified v-belt pulley **110**. **Figure 2 d** illustrates a swinging door disposed over the modified v-belt pulley **110** of the mechanical de-shelling machine to facilitate entry of the cashew nut "C" one at a time into the v-notch "N" of the v-belt pulley **110**. More specifically, as the cashew nut "C" is received over and advances over the v-notch "N", due to rotation of the v-belt pulley **110,** the contact between the cashew-nut "C" and the side walls of the v-notch "N" of the v-belt pulley **110** breaks and the cashew-nut "C" advances over and is supported by the pair of the blade guides **118** (illustrated in Figure 6) such that cashew nut "C" advances along the line of dehiscence of the cashew-nut "C" over the line of contact between of the blade guides **118**. As the cashew nut "C" advances over the blade guides **118** along the line of dehiscence, the first shearing blade **116** mounted between the rotating pulleys of the modified v-belt pulley **110** strikes the "ends side" of the cashew nut "C" and the second shearing blade **122** mounted on the arcuately extending v-notch of the pressing arrangement **120** strikes the "hump side" of the cashew nut "C", as specifically illustrated in **Figure 3f**. The first shearing blade **116** is adapted to form a cut having greater depth of cut than the cut configured by the second shearing blade **122**. Such a configuration enables in automatically adjusting position and orientation of the "hump side" and an "ends side" of a cashew nut "C" with respect to the first shearing blade **116** and the second shearing blade **122**, according controlling and adjusting the depth of cut to be provided at the "hump side" and the "ends side" of the cashew nut "C" is achieved. Referring to **Figure 3f**, an

enlarged view of the second shearing blade **122** mounted over the pressing arrangement **120** is illustrated. The second shearing blade **122** has an inverted y configuration, with such a configuration as the cashew nut "C" advances along the "line of dehiscence" of the cashew-nut "C" over the line of contact between of the blade guides **118**, a straight portion 123 of the second shearing blade **122** engages with the "ends side" of the cashew nut "C" along the "line of dehiscence" and a pusher pushes the cashew nut "C" from behind to cause the diverging arms **124** to split open the shell of the cashew nut "C" along the "line of dehiscence".

The cashew nut "C" is ultimately guided to be held between the first shearing blade **116** and the shearing blade **122**, wherein the first shearing blade **116** and the shearing blade **122** form cuts on the "ends side" and the "hump side" of the cashew nut "C". The second shearing blade **122** of the pressing arrangement **120** is pressed against the cashew nut "C" held in over the blade guides **118** by using a spring based arrangement **130**. More specifically, the spring based arrangement **130** applies more urging pressure on the second shearing blade **122** to apply more shearing force over the cashew nut "C" as the cashew nut "C" is sheared by the straight portion **123** of the second shearing blade **122** as compared to when the cashew nut "C" is sheared by the diverging arms **124** of the second shearing blade **122**

Figures 4a – Figure 4f illustrates isometric views of the mechanical de-shelling machine **200** during different stages of operation as illustrated in **Figure 3a – Figure 3f** respectively. **Figure 5** illustrates a one-by one feeder **300** for the automatic mechanical de-shelling machine **200**, wherein the one-by one feeder **400** feeds the cashew nut "C" one by one into the mechanical de-shelling machine **200**.

Figure 6 illustrates a schematic representation of a blade guide **118** of the pair of blade guides **118** held between the half portions **112** and **114** configuring the modified v-belt pulley **110** (illustrated in **Figure 2c**) of the mechanical de-shelling machine **200**. **Figure 7** illustrates a schematic representation of a first shearing blade **116** disposed between the pair of blade guides **118** held between the half portions **112** and **114** configuring the modified v-belt pulley 110.

Figure 8a and **Figure 8b** illustrates schematic representation of a first shearing blade 116 disposed between the pair of blade guides 118 held between the half portions 112 and 114 configuring the modified v-belt pulley 110. The mechanical de-shelling machine can also perform peeling operation on the kernels that are obtained after performing the de-shelling operation, wherein the first and second shearing blades are replaced with peeling brushes and the kernels are passed through the mechanical de-shelling machine with first and second shearing blades thereof replaced with peeling brushes.

Figure 9 illustrates a schematic representation of an automatic mechanical de-shelling system **400** having a picking and dispensing sub-assembly **410**, a queuing and release sub-assembly **420** and an orienting and cutting sub-assembly **430**. **Figure 9** and **Figure 10** illustrate a schematic representation of the automatic mechanical de-shelling system **400**, particularly, in **Figure 10** the automatic mechanical de-shelling system **400** is illustrated supported on a frame "**F**". The picking and dispensing sub-assembly **410** is supported on the frame "**F**". The picking and dispensing sub-assembly **410** picks and dispenses shelled articles one by one. The picking and dispensing sub-assembly **400** includes a hopper **412**, a receiving chamber **414** and at least one picking element **416**. The hopper **412** receives shelled articles to be de-shelled. The receiving chamber **414** defines an enclosure for receiving and supporting a pre-determined quantity of the shelled articles received from the hopper **412**. The receiving chamber **414** includes a curved operative bottom support plate **414b**, a pair of side plates **414a** and a closing plate **414c** that are connected to each other to define the enclosure. The operative bottom support plate **414b** supports the shelled articles and has an opening configured "O" (not illustrated) thereon for receiving a pre-determined quantity of shelled articles inside the receiving chamber **414** between the opening "O" and the closing plate **414c**. The shelled article is directed from the hopper **412** to the receiving chamber **414**, wherein a directing roller **441** disposed downstream of the hopper **412** and upstream of the receiving chamber **414** directs the shelled articles from the hopper **412** towards the receiving chamber **414**. The directing roller **441** derives rotational power from a first rotating shaft **418** via a power

transmission drive selected from a group consisting of a chain drive, a pulley drive and a gear drive.

The at least one picking element **416** is rotatably supported on the first rotating shaft **418** that is disposed operatively above the receiving chamber **414.** The at least one picking element **416** picks shelled articles "C" one by one from the receiving chamber **414** and delivers the shelled articles one by one. In accordance with an embodiment, each of the picking element **416** has a picker at end of thereof that receive one shelled articles "C" one by one from the receiving chamber **414**. **Figure 9** and **Figure 10** illustrate two picking elements.

Referring to Figure 9, the queuing and release sub-assembly **420** is illustrated. The queuing and release sub-assembly **420** is disposed down-stream of the picking and dispensing assembly **410** and receives and orients the shelled article in a desired, pre-determined orientation before releasing. The queuing and release sub-assembly **420** includes a pivotably supported tray **422**, a ratchet wheel **424**, a queuing door **426** and a release door **428**. **Figure 11** illustrates interaction between the pivotably supported tray **422** and the ratchet wheel **424** of the queuing and release sub-assembly. **Figure 12a** illustrates the queuing door **426** of the queuing and release sub-assembly **420** in a closed configuration for retaining the shelled article "C" thereby. **Figure 12b** illustrates the queuing door **426** in an open configuration for releasing the shelled article thereby upon actuation by a first rocker arm **437** and linkages **427**.

The pivotably supported tray **422** receives shelled articles one by one delivered thereto by the picking element **416**. The ratchet wheel **424** with teeth configured thereon rotates along direction "R" illustrated in Figure 12 and Figure 12b and intermittently interacts with the tray **422** for vibrating the tray **422** along the path "V" illustrated in Figure 12a for facilitating toppling of and orienting of the shelled article "C" received thereby to the desired, pre-determined orientation. More specifically, due to vibration of the tray **422**, the shelled article "C", particularly, cashew nut vibrates on the tray **422** and ultimately achieves the desired, pre-determined configuration in which the cashew nut rests with the ends side thereof resting on the tray **422** as in this configuration the cashew nut is stably supported as compared to the configuration of

the cashew nut with hump side thereof resting on the tray **422** that is an unstable state. Although, the automatic mechanical de-shelling system **400** of the present disclosure is shown to be used for de-shelling of cashew nuts, however, the automatic mechanical de-shelling system **400** can be used for de-shelling any other article, particularly having non- symmetrical structure. The ratchet wheel **424** derives rotational power from the first rotating shaft **418** via a power transmission drive selected from a group consisting of chain drive, pulley drive and gear drive. The queuing door **426** is disposed operatively above and movable with respect to the tray **422** to retain the shelled article "C" until the shelled article "C" is oriented to the desired, pre-determined orientation. The queuing door **426** moves away from the tray **422** for releasing the shelled article "C" when actuated by combined action of the first rocker arm **437** and the lever **427** that are actuated by rotation of the ratchet wheel **424**. The release door **428** (illustrated in Figure 9) is disposed downstream of the queuing door **426** and releases the shelled article received thereby from the queuing door **426** when actuated by a second rocker arm **446** arm (illustrated in **Figure 15b**) that in turn is actuated by rotation of the ratchet wheel **424**.

Referring to **Figure 18a** and **Figure 18b**, the orienting and cutting sub-assembly **430** is illustrated. The orienting and cutting sub-assembly **430** ensures that the shelled article is in the desired, pre-determined orientation during shearing operation so that depth of cut on a pre-determined side of the shelled article is controlled. The orienting and cutting sub-assembly **430** includes a pair of rotatable outer pulleys **432a** and **432b**, a pair of rotatable inner pulleys **434a** and **434b**, a first shearing blade **436** and a spring loaded second shearing blade **438**. Referring to **Figure 13a** and **Figure 13b**, the assembly of the rotatable outer pulleys **432a** and **432b**, rotatable inner pulleys **434a** and **434b**, the first shearing blade **436** and the second shearing blade **438** is illustrated. More specifically, in **Figure 13b**, the cashew nut "C" received over the periphery of the rotatable inner pulleys **434a** and **434b** is illustrated in the desired, pre-determined orientation in which the cashew nut "C" rests with the ends side C_e thereof resting on the periphery of the inner pulleys **434a** and **434b**. In the desired, pre-determined orientation, the pre-determined side C_e i.e. the ends side of the shelled cashew nut "C" is struck by the first shearing blade 436 that configures a deeper cut

and the other side of the cashew nut "C" i.e. the hump side C_h of the cashew nut is struck by the second shearing blade 438 that configures a comparatively shallow cut. Further, **Figure 14a** and **Figure 14b** illustrates side view of the rotatable outer pulleys **432a** and **432b**. **Figure 14c** illustrates a side view of a rotatable inner pulley **434a** and **434b**. **Figure 15a** illustrates an assembled view of an assembly of the pair of rotatable outer pulleys **432a** and **432b**, the pair of rotatable inner pulleys **434a** and **434b**, the first shearing blade **436** and the dislodging element **495** and the first and second rocker arms **437** and **446** respectively. **Figure 15b** illustrates an exploded view of the assembly illustrated in **Figure 15a**. **Figure 15c** illustrates another exploded side view of the assembly of **Figure 15a.**

Figure 16 illustrates an assembled view of the rotatable inner pulleys **434a** and **434b** assembled with the rotatable outer pulleys **432a** and **432b**. The rotatable outer pulleys **432a** and **432b** receive and guide the shelled article along a curved path. The rotatable inner pulleys **434a** and **434b** are disposed between the pair of rotatable outer pulleys **432a** and **432b** and are rotatable about an axis that is offset from axis of rotation of the pair of rotatable outer pulleys **432a** and **432b**, wherein periphery of the rotatable inner pulleys **434a** and **434b** support the shelled article "C" and move the shelled article "C" radially outwards to topple the shelled article "C" for facilitating orienting of the shelled article to the desired, pre-determined orientation as the shelled article "C" is guided between the pair of rotatable outer pulleys **432a** and **432b** along the curved path.

Figure 13a illustrates the shelled article "C" supported along periphery of rotatable inner pulleys **434a** and **434b** disposed between the pair of outer pulleys **432a** and **432b**, wherein the shelled article "C" is illustrated supported in a configuration other than the desired, pre-determined configuration. Particularly, the rotatable inner pulleys **434a** and **434b** are disposed so as to configure v-notch configuration along the periphery thereof. **Figure 13b** illustrates the shelled article supported and toppled along the rotatable inner pulleys **434a** and **434b** for facilitating orienting of the shelled article to the desired, pre-determined orientation. More specifically, as the shelled article "C" is guided on the periphery of the inner pulleys **434a** and **434b** between the

outer pulleys **432a** and **432b**, particularly, the cashew nut topples and ultimately achieves the desired, pre-determined configuration in which the cashew nut "C" rests with the ends side thereof resting on the periphery of the inner pulleys **434a** and **434b** as in this configuration the cashew nut "C" is stably supported as compared to the configuration of the cashew nut "C" with hump side thereof resting on the periphery of the inner pulleys **434a** and **434b** that is an unstable state. Such configuration ensures that the shelled article "C" is in the desired, pre-determined orientation during shearing operation so that depth of cut on the desired, pre-determined side of the shelled article is controlled.

The first shearing blade **436** is disposed between the rotatable inner pulleys **434a** and **434b** and is moved therewith as the rotatable inner pulleys **434a** and **434b** rotate, wherein the rotatable inner pulleys **434a** and **434b** derive rotating torque from the rotation of the ratchet wheel **424**. The first shearing blade **436** rotates along with the rotating pulleys, particularly, the rotatable inner pulleys **434a** and **434b** of the rotating pulley arrangement for shearing the pre-determined side of the shelled article "C". The first shearing blade **436** strikes the pre-determined side of the shelled article "C" while the second shearing blade **438** is urged against the side that is opposite side to the pre-determined side of the shelled article "C".

Figure 18a illustrates the shelled article "C" in the desired, pre-determined orientation just before being received between the first shearing blade **436** and the second shearing blade **438**. The first shearing blade 436 is disposed between the rotatable inner pulleys **434a** and **434b** and strikes a pre-determined side of the shelled article and a spring loaded second shearing blade **438** is adjustably urged towards a side of the shelled article "C" that is opposite to the desired, pre-determined side depending upon size and orientation of the shelled article "C". With such configuration the depth of cut on both the predetermined side of the shelled article and the side opposite to the pre-determined side is controlled and accordingly, the damage to the article, for example cashew inside the shelled cashew nut due to over piercing of the shearing blades and also shearing the article is prevented. **Figure 18b** illustrates the shelled article "C" received between the first shearing blade **436** and the spring loaded second

shearing blade **438**. More specifically, with such configuration the ends side of the cashew nut is sheared by first shearing blade 436 and as such the depth of cut on the predetermined side of the shelled article, i.e. the depth of cut on the ends side of the cashew nut is more than that of the depth of cut on the hump side of the cashew nut that is sheared by shearing blade 438 that configures is small depth cut. Accordingly, the automatic de-shelling system 400 ensures that the high depth of cut is at the ends side of the shelled cashew nut and low depth of cut is at the hump side of the shelled cashew nut "C", thereby preventing higher depth of cut on the hump side that may cause damage to the cashew and also lead to more power consumption.

The orienting and cutting sub-assembly **430** includes an adjustably urging sub-assembly **440**. **Figure 19a** illustrates a schematic representation depicting interaction between various elements i.e. a sensing wheel **450**, an engaging element **442** and an urging element **439** of the adjustably urging sub-assembly **440**. **Figure 19b** illustrates a schematic representation of another view of the adjustably urging sub-assembly **440**. **Figure 20** illustrates a schematic representation of the sensing wheel **450** and a fourth rocker arm **444** mounted on a shaft The adjustably urging sub-assembly **440** adjustably urges the second shearing blade **438** towards opposite side of the shelled article depending upon size and orientation of the shelled article "C". The sensing wheel **450** is provided with a plurality of angularly spaced stepped platforms **450**a, **450b**..... **450n**. The sensing wheel **450** is angularly moved by the fourth rocker arm **444** that in turn is actuated by rotation of the ratchet wheel **424** based on size, configuration and orientation of shelled article "C" held between the first shearing blade **436** and second shearing blade **438**. The engaging element **442** interacts with either one of the angularly spaced stepped platforms **450**a, **450b**..... **450n,** one by one to move gradually with respect to the sensing wheel **450**. The urging element **439** is connected to and moves with the engaging element **442** to adjustably urge the second shearing blade **438** towards the side of the shelled article "C" that is opposite to the pre-determined side of the shelled article "C" depending upon size and orientation of the shelled article "C", thereby controlling depth of cut on both sides of the shelled article "C".

Further, the automatic de-shelling machine includes a dislodging element **495** that dislodge a shelled article "C" accidently trapped between the pair of rotatable outer pulleys **432a** and **432b**, wherein the dislodging element **495** is actuated by a third rocker arm **496** that in turn is actuated by rotation of said ratchet wheel **424**. **Figure 17a** illustrates a dislodging element **495** connected to the third rocker arm **496**. **Figure 17b - Figure 17c** illustrates different positions of the dislodging element **495** with respect to an assembly of rotatable inner pulleys **434a** and **434b** and rotatable outer pulleys **432a** and **432b**, particularly positions of the dislodging element **495** before striking the shelled article "C" and while dislodging the shelled article "C". **Figure 21** illustrates a top view of the automatic mechanical de-shelling system **400**.

TECHNICAL ADVANCEMENTS AND ECONOMIC SIGNIFICANCE

The automatic mechanical de-shelling machine for facilitating recovery of a kernel naturally encapsulated within a shell of a cashew nut in accordance with the present disclosure has several technical advantages including but not limited to the realization of:

- an automatic de-shelling machine that enables appropriate positioning and orienting of a raw cashew nut to be de-shelled with respect to line of dehiscence for ensuring that a pair of shearing blades strike the raw cashew nut along the line of dehiscence of the raw cashew-nut at both sides i.e. the "hump side" and the "ends side", thereby enabling the shearing blades to form appropriate cuts on both sides of the cashew-nut shell;
- an automatic de-shelling machine that forms appropriate cuts on both sides of the cashew-nut shell, i.e. the "hump side" and the "ends side" by strategically providing unequal depth of cuts at the "hump side" and the "ends side" of the cashew nut;
- an automatic de-shelling machine that forms appropriate cuts on both sides of the cashew-nut shell, i.e. the "hump side" and the "ends side", thereby reducing chances of un-cut shell or damage to the kernel due to over-penetration of the shearing blades;

- an automatic de-shelling machine that continuously de-shells cashew-nuts, irrespective of size of cashew-nuts fed there-to;
- an automatic de-shelling machine that can handle cashew-nuts of any size, thereby eliminating the need to grade the cashew-nuts before feeding to the automatic de-shelling machine;
- an automatic de-shelling machine that automatically adjusts position and orientation of a "hump side" and an "ends side" of a cashew nut with respect to the shearing blades and according adjusts the depth of cut to be provided at the "hump side" and the "ends side" of the cashew nut;
- an automatic de-shelling machine that requires less power for operation thereof;
- an automatic de-shelling machine that maximizes recovery of kernels naturally encapsulated within the shell and accordingly increases the yield;
- an automatic de-shelling machine that eliminates manual handling of the nuts and the drawbacks associated with manual handling;
- an automatic de-shelling machine that optimizes and / or maximizes the yield;
- an automatic de-shelling machine that facilitates cracking and de-shelling action to be performed automatically and in continuous fashion;
- an automatic de-shelling machine that reduces chances of damage to kernel held inside the shell due to uncontrolled piercing depth of blade in to the shell and uncontrolled piercing forces acting on the shell;
- an automatic de-shelling machine that reduces financial losses occurring due to damage to the kernel held inside the shell due to uncontrolled piercing of the blades in to the shell during the de-shelling operation;
- an automatic de-shelling machine that restrains handling of nuts by workers during processing thereof, thereby reducing chances of contamination;

- an automatic de-shelling machine that carries out the de-shelling operation in a fully automatic manner without much human intervention;
- an automatic de-shelling machine that is easy to use and maintain.

Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression "at least" or "at least one" suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the disclosure to achieve one or more of the desired objects or results.

Wherever a range of values is specified, a value up to 10% below and above the lowest and highest numerical value respectively, of the specified range, is included in the scope of the disclosure.

The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

CLAIMS:

1. An automatic de-shelling machine for removing shell of a shelled article, said automatic de-shelling machine comprising:

    - a frame;
    - a picking and dispensing sub-assembly supported on said frame adapted to pick and dispense shelled articles one by one;
    - a queuing and release sub-assembly disposed down-stream of said picking and dispensing assembly and adapted to receive said shelled article and orient said shelled article in a desired, pre-determined orientation before releasing;
    - an orienting and cutting sub-assembly adapted to ensure said shelled article is in said desired, pre-determined orientation during shearing operation so that depth of cut on a pre-determined side of said shelled article is controlled, said orienting and cutting sub-assembly comprising:
        - a rotating pulley arrangement adapted to receive and support said shelled article along periphery thereof and moves said shelled article radially as the shelled article moves along periphery of the rotating pulley arrangement to topple said shelled article for facilitating orienting of said shelled article to said desired, pre-determined orientation;
        - a first shearing blade disposed between said rotatable pulleys of said rotating pulley arrangement and adapted to be moved with the rotating pulley arrangement for shearing said pre-determined side of said shelled article; and
        - a spring loaded second shearing blade adjustably urged towards a side of the shelled article that is opposite to said desired pre-determined side depending upon size and orientation of said

shelled article, thereby controlling depth of cut on both sides of said shelled article.

2. The automatic de-shelling machine as claimed in Claim 1, wherein said picking and dispensing assembly comprising:

   - a hopper for receiving shelled articles to be de-shelled;
   - a receiving chamber adapted to define an enclosure for receiving and supporting a pre-determined quantity of the shelled articles from said hopper; and
   - at least one picking element rotatably supported on a first rotating shaft and adapted to pick shelled articles one by one from said receiving chamber and deliver said shelled articles one by one.

3. The automatic de-shelling machine as claimed in claim 2, further comprising a directing roller disposed downstream of said hopper and upstream of said receiving chamber and adapted to direct the shelled articles from said hopper towards said receiving chamber.

4. The automatic de-shelling machine as claimed in claim 3, wherein said directing roller derives rotational power from said first rotating shaft via a power transmission drive selected from a group consisting of a chain drive, a pulley drive and a gear drive.

5. The automatic de-shelling machine as claimed in claim 2, wherein said receiving chamber comprising a curved operative bottom support plate, a pair of side plates and a closing plate adapted to be connected to each other to define said enclosure, said operative bottom support plate adapted to support said shelled articles and has an opening configured thereon for receiving a pre-determined quantity of shelled articles inside the receiving chamber between said opening and said closing plate.

6. The automatic de-shelling machine as claimed in claim 2, wherein said queuing and release sub-assembly comprising:

- a pivotably supported tray adapted to receive shelled articles one by one delivered thereto by said picking element;
- a ratchet wheel with teeth configured thereon adapted to rotate and intermittently interact with said tray for vibrating said tray for facilitating orienting of said shelled article received thereby to said desired, pre-determined orientation, said ratchet wheel derives rotational power from said first rotating shaft via a power transmission drive selected from a group consisting of chain drive, pulley drive and gear drive;
- a queuing door disposed operatively above and movable with respect to said tray to retain said shelled article until said shelled article is oriented to said desired, pre-determined orientation, said queuing door adapted to move away from said tray for releasing said shelled article when actuated by a first rocker arm that in turn is actuated by rotation of said ratchet wheel; and
- a release door disposed downstream of said queuing door and adapted to release said shelled article received thereby from said queuing door when actuated by a second rocker arm that in turn is actuated by rotation of said ratchet wheel.

7. The automatic de-shelling machine as claimed 6, wherein said first shearing blade rotates with the rotating pulley arrangement that in turn is actuated by rotation of said ratchet wheel.

8. The automatic de-shelling machine as claimed in claim 1, wherein said rotating pulley arrangement comprising a pair of rotating pulleys configuring a modified V-notch pulley having V-notch configured along the circumference thereof such that depth of said V-notch varies along circumference of said

modified V-notch pulley, said V-notch adapted to receive and support said shelled article and move said shelled article radially as the shelled article moves along periphery of the modified V-notch pulley to topple said shelled article for facilitating orienting of said shelled article to said desired, pre-determined orientation.

9. The automatic de-shelling machine as claimed in claim 9, wherein said first shearing blade is disposed between said rotating pulleys of said modified V-notch pulley.

10. The automatic de-shelling machine as claimed in claim 1, wherein said pulley arrangement comprising:

- a pair of rotatable outer pulleys adapted to receive and guide said shelled article along a curved path;
- a pair of rotatable inner pulleys disposed between said pair of rotatable outer pulleys and rotatable about an axis that is offset from axis of rotation of said pair of rotatable outer pulleys, wherein periphery of said rotatable inner pulleys are adapted to support said shelled article and move said shelled article radially outwards to topple said shelled article for facilitating orienting of said shelled article to said desired, pre-determined orientation as said shelled article is guided between said pair of rotatable outer pulleys;

11. The automatic de-shelling machine as claimed in claim 11, wherein said first shearing blade is disposed between pair of rotatable inner pulleys.

12. The automatic de-shelling machine as claimed in claim 6, further comprising a dislodging element adapted to dislodge a shelled article accidently trapped between rotating pulleys of said rotating pulley arrangement, wherein said dislodging element is actuated by a third rocker arm that in turn is actuated by rotation of said ratchet wheel.

13. The automatic de-shelling machine as claimed in claim 6, further comprising an adjustably urging sub-assembly adapted to adjustably urge said second shearing blade towards opposite side of the shelled article depending upon size and orientation of said shelled article, said adjustably urging sub-assembly comprising:

- a sensing wheel provided with a plurality of angularly spaced stepped platforms, said sensing wheel adapted to angularly move by a fourth rocker arm that in turn is actuated by rotation of said ratchet wheel based on size, configuration and orientation of said shelled article held between said first and second shearing blades;
- an engaging element adapted to interact with said angularly spaced stepped platforms to move gradually with respect to said sensing wheel; and
- an urging element connected to and adapted to move with said engaging element to adjustably urge said second shearing blade towards the side that is opposite to said pre-determined side of said shelled article depending upon size and orientation of said shelled article, thereby controlling depth of cut on both sides of said shelled article.

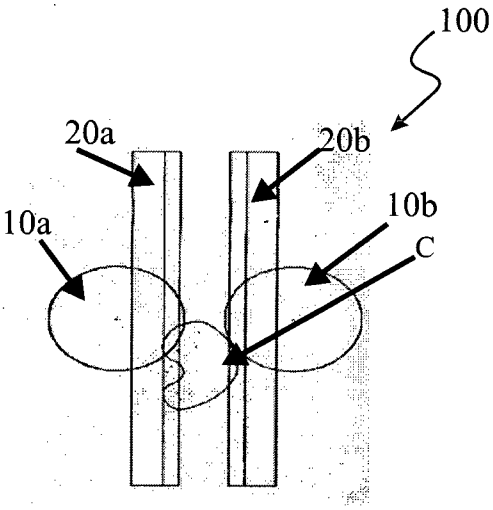

FIGURE 1a
(PRIOR ART)

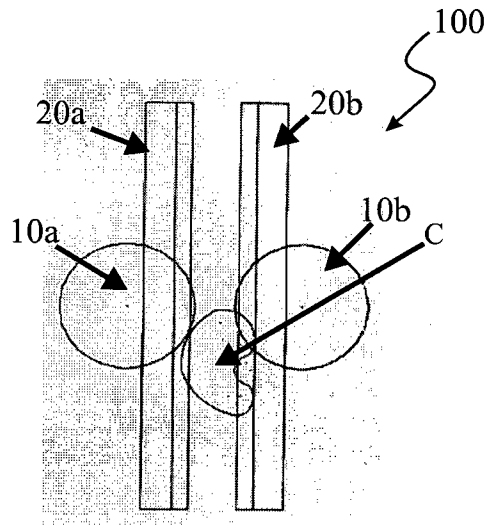

FIGURE 1b
(PRIOR ART)

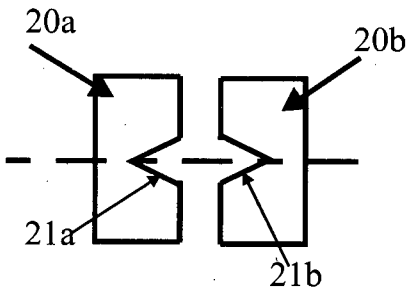

FIGURE 1c
(PRIOR ART)

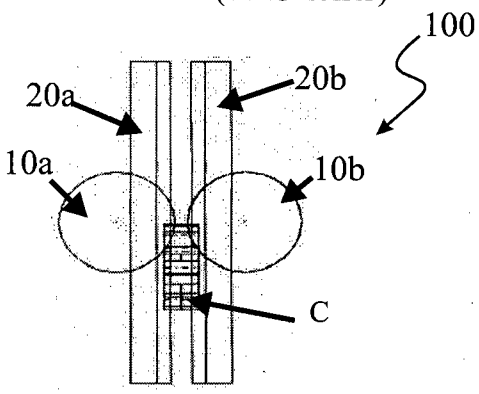

FIGURE 1d
(PRIOR ART)

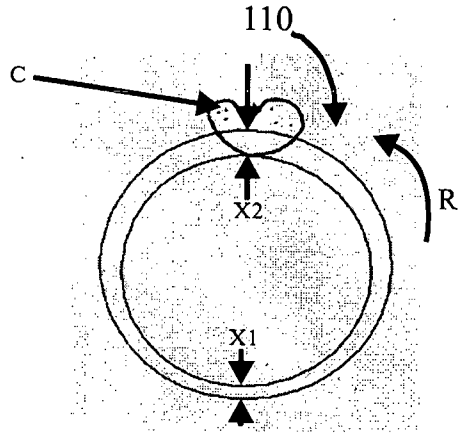

FIGURE 2a

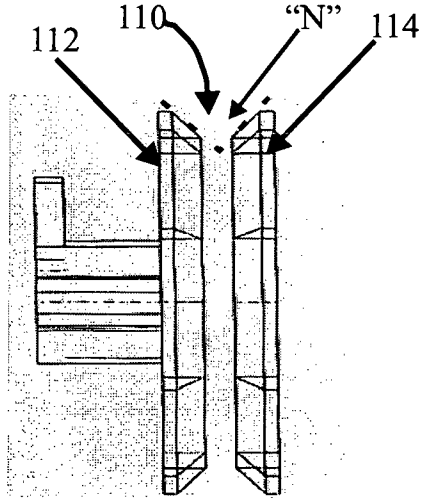

FIGURE 2c

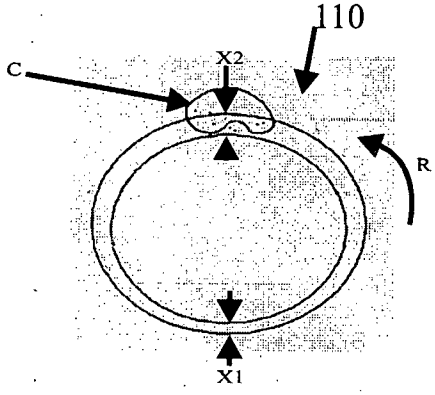

FIGURE 2b

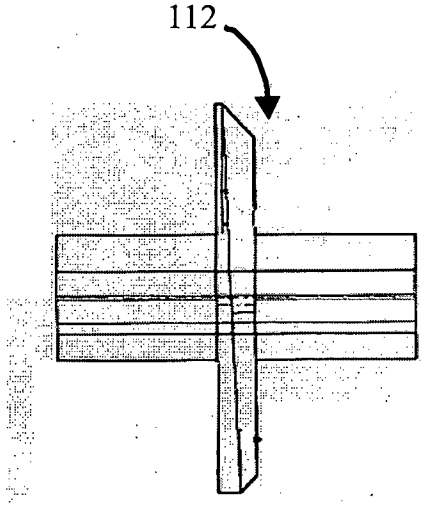

FIGURE 2e

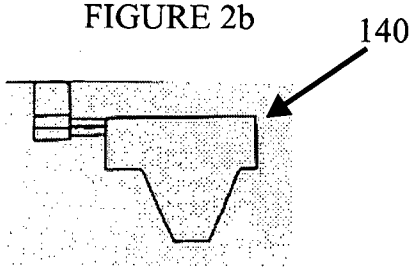

FIGURE 2d

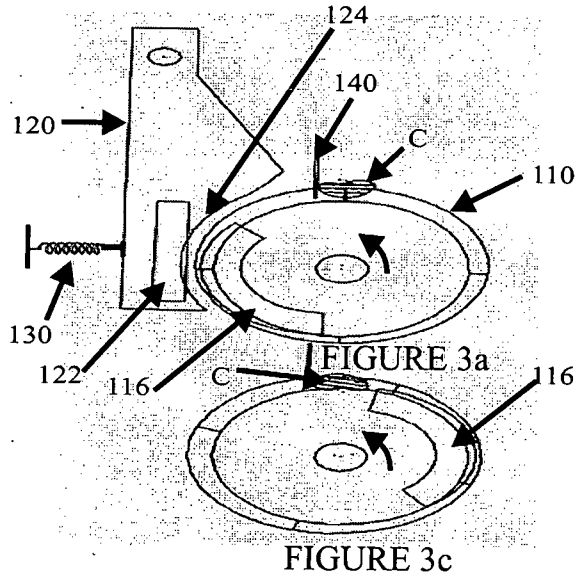

FIGURE 3a

FIGURE 3c

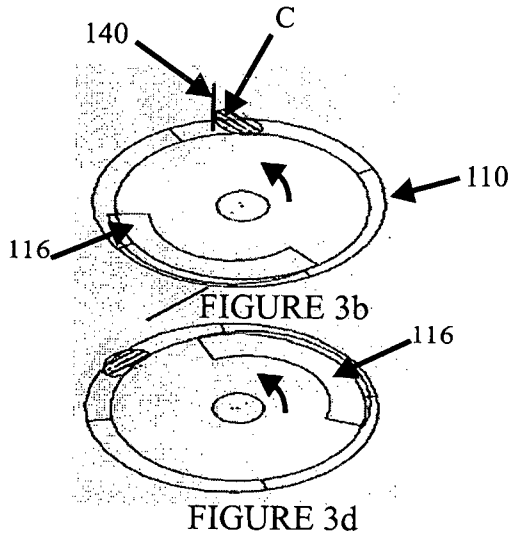

FIGURE 3b

FIGURE 3d

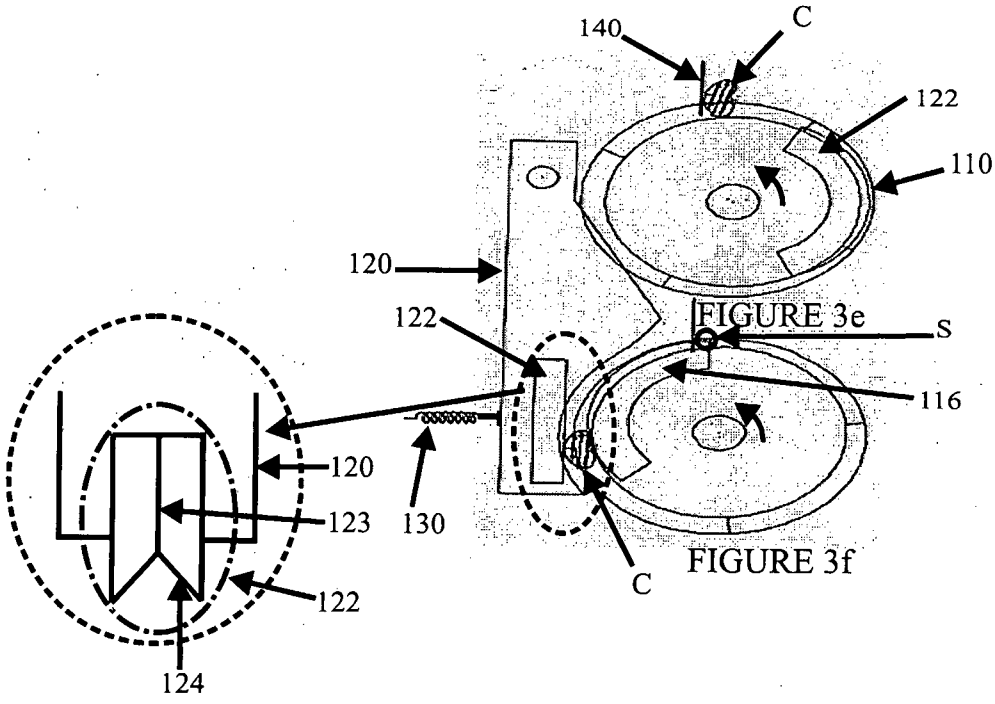

FIGURE 3e

FIGURE 3f

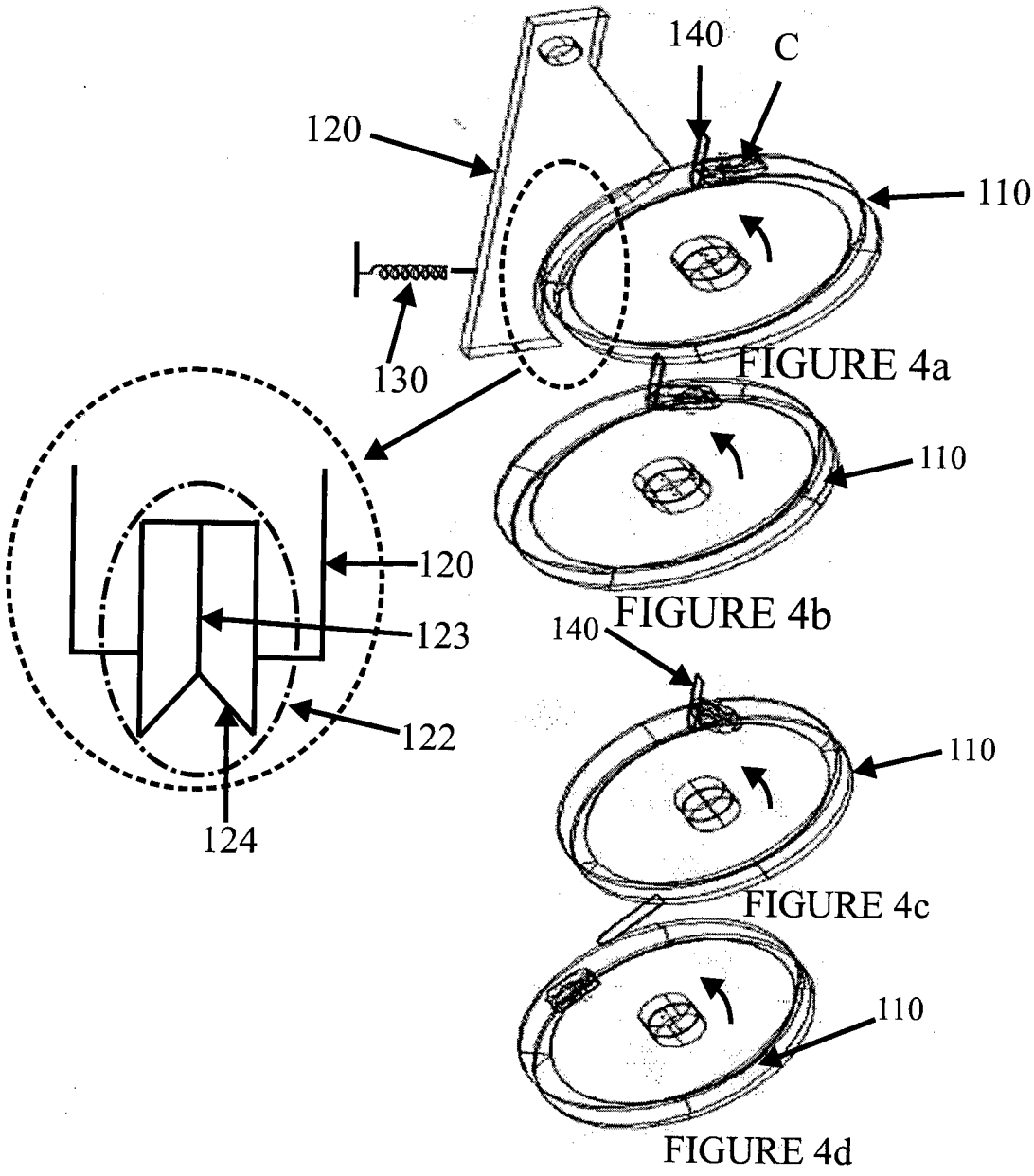

FIGURE 4a

FIGURE 4b

FIGURE 4c

FIGURE 4d

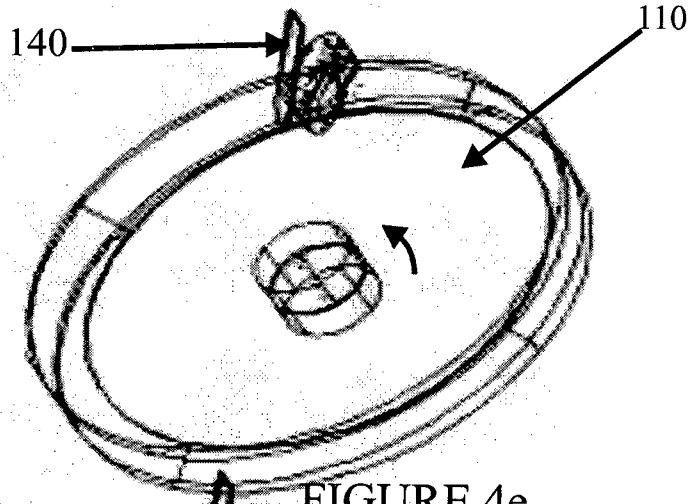

FIGURE 4e

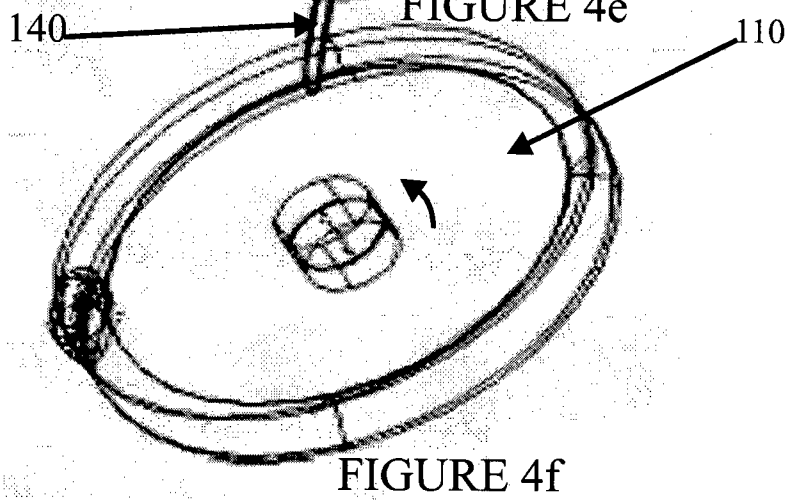

FIGURE 4f

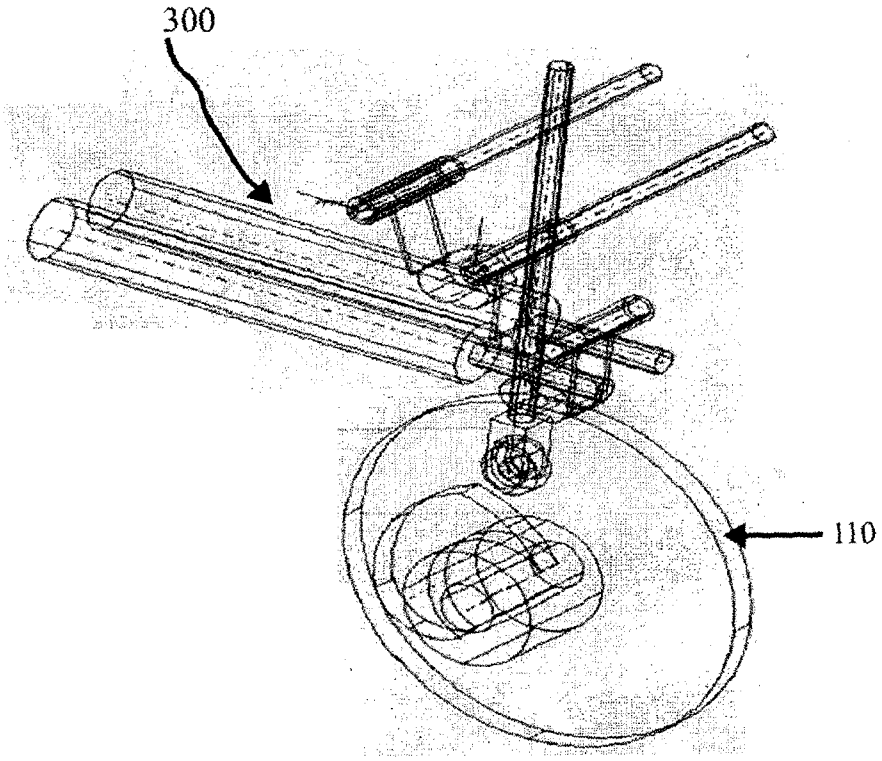

FIGURE 5

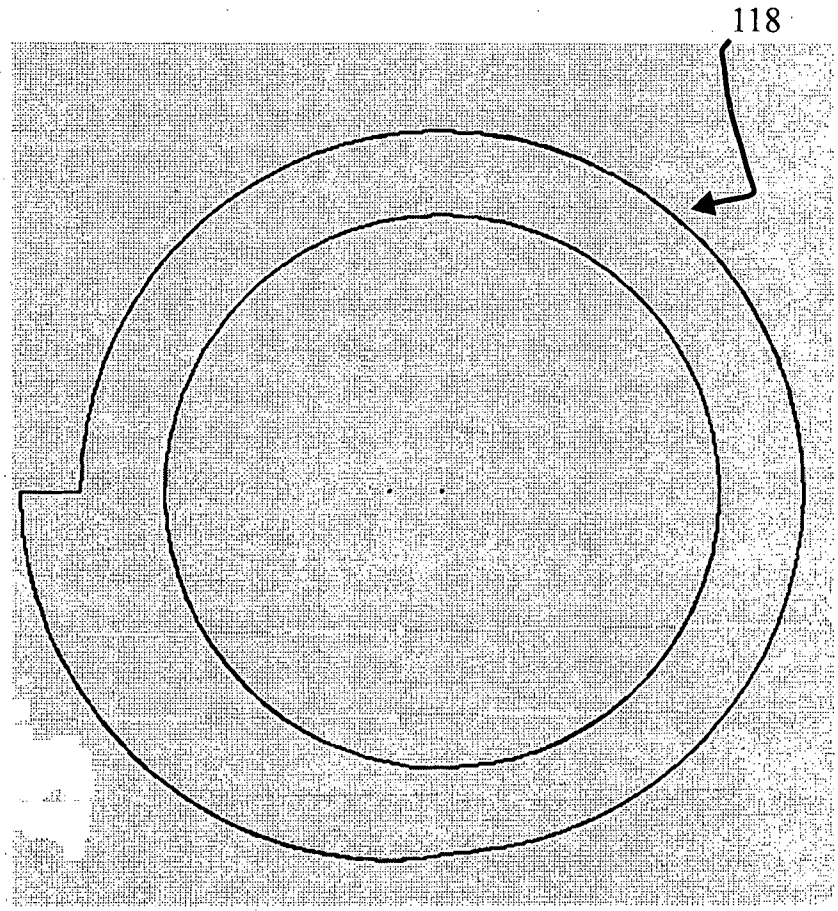

FIGURE 6

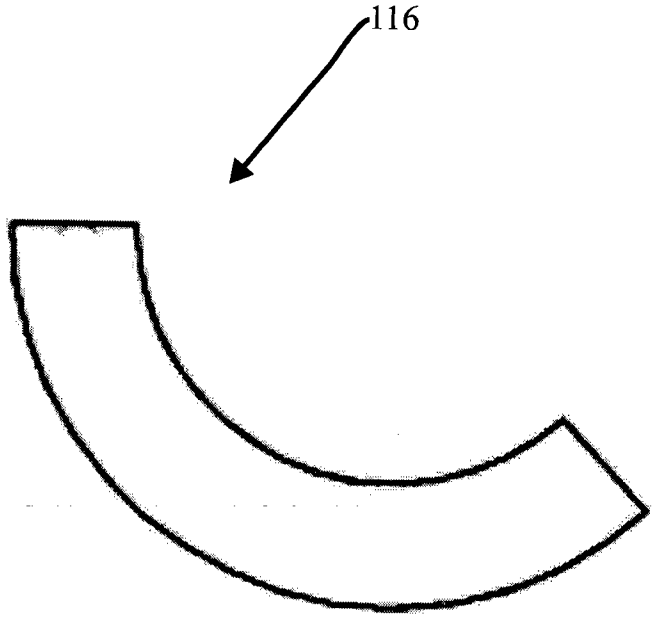

FIGURE 7

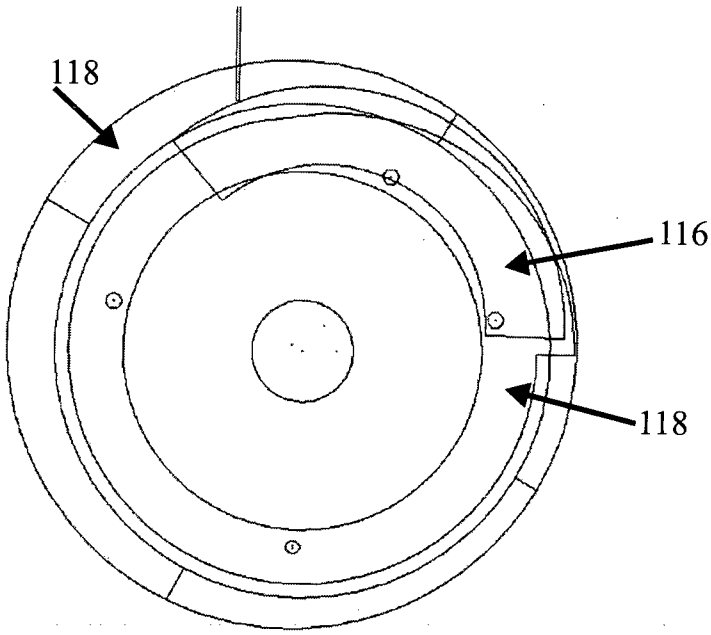

FIGURE 8a

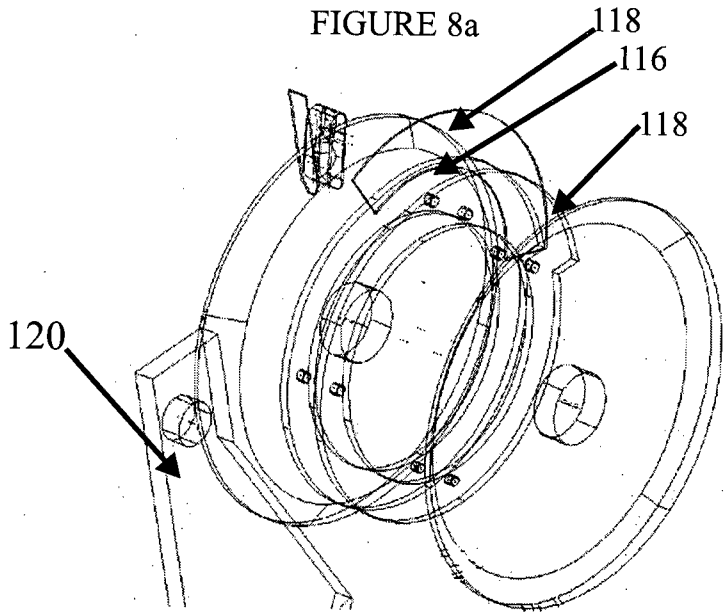

FIGURE 8b

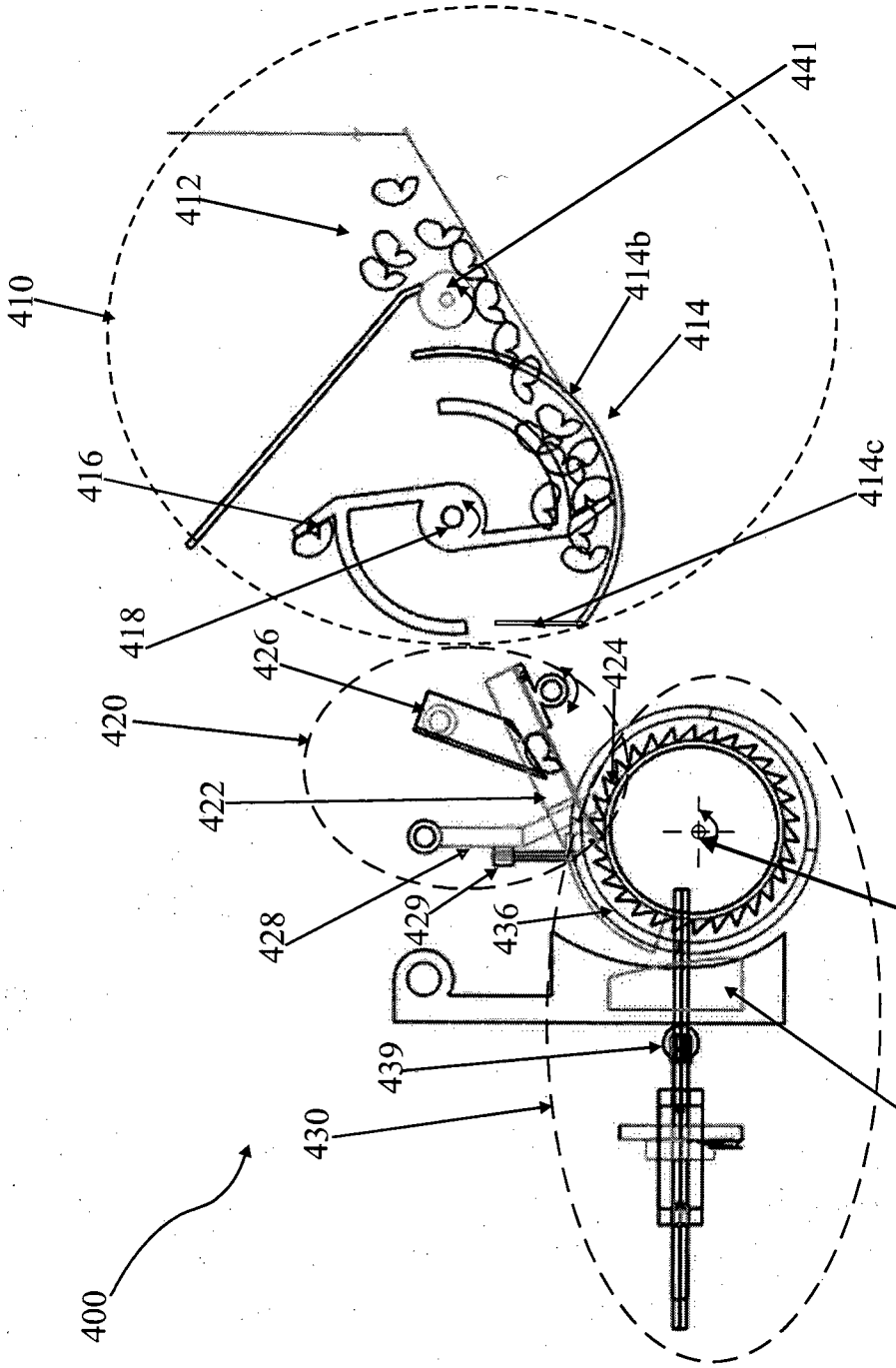
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FIGURE 9

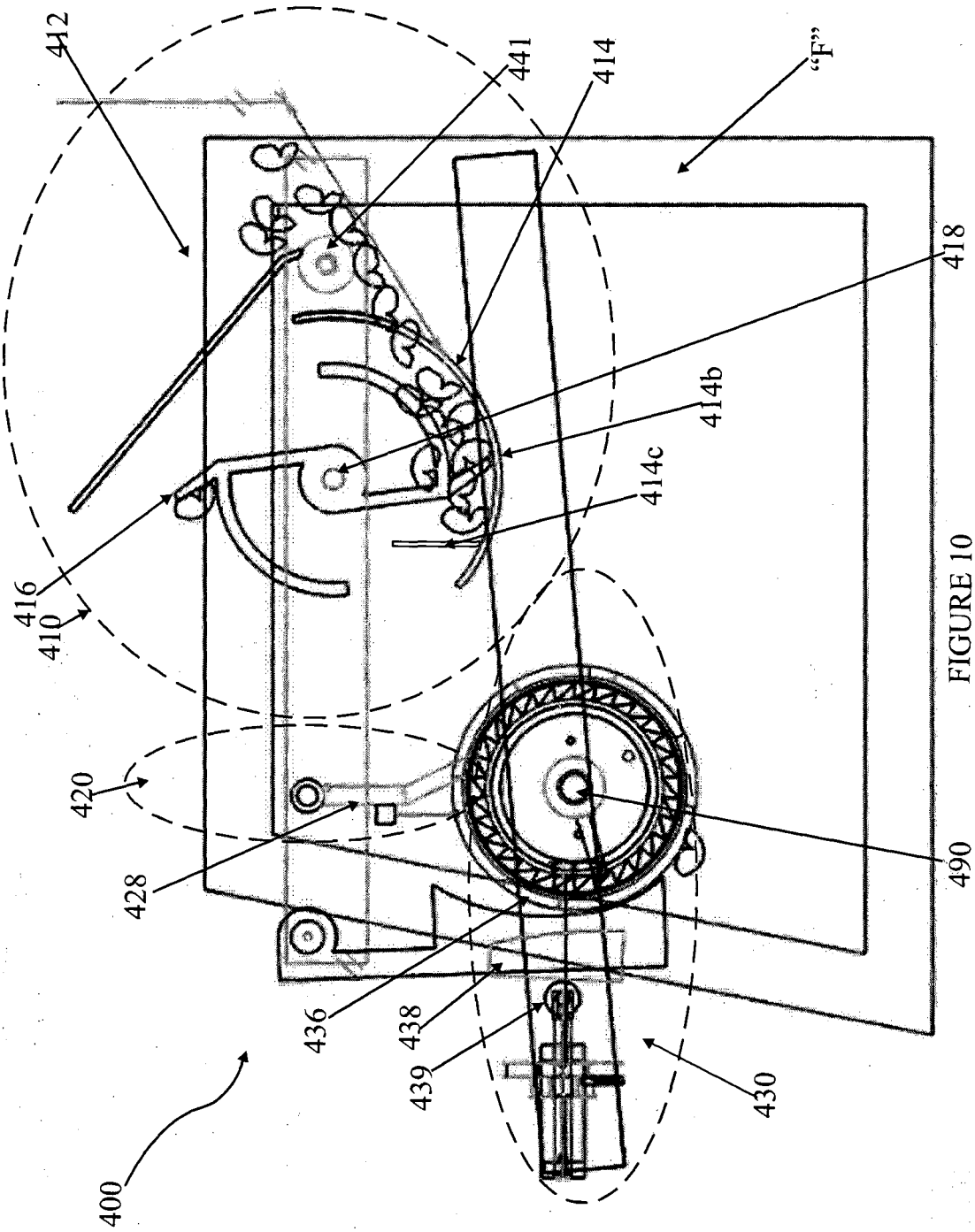
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FIGURE 10

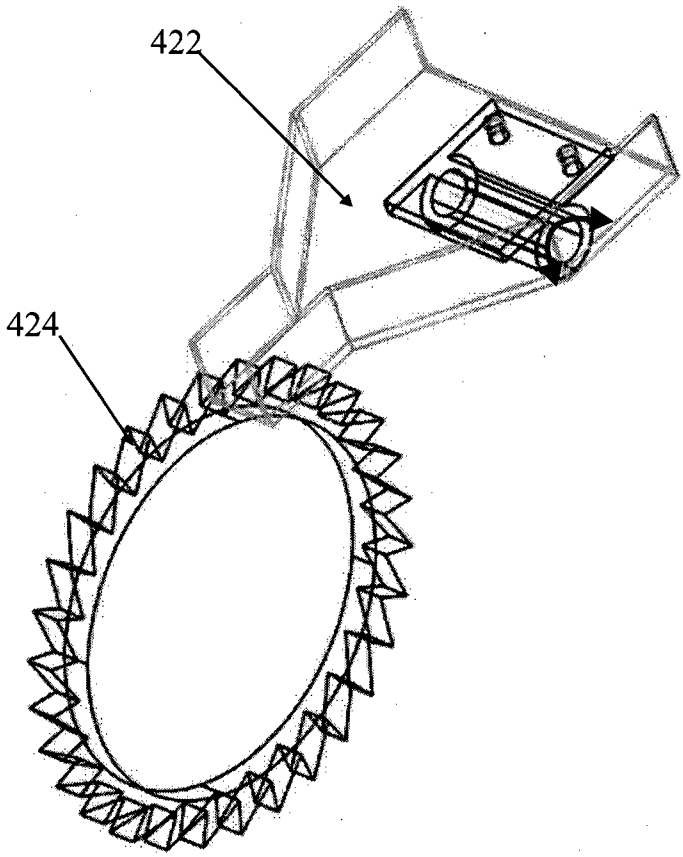

FIGURE 11

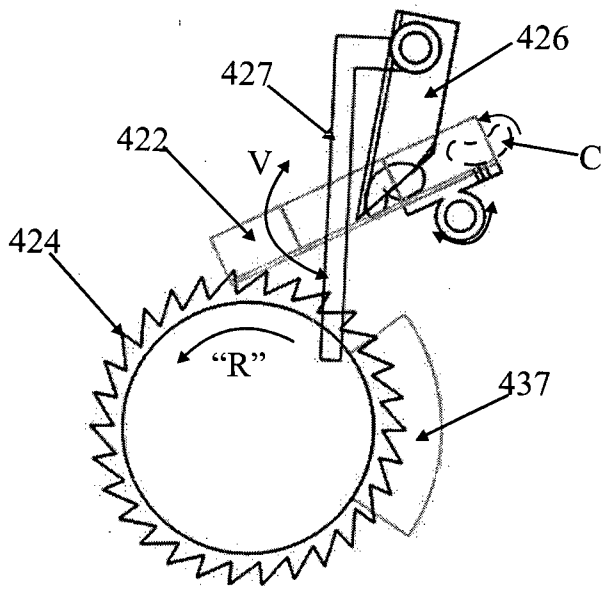

FIGURE 12a

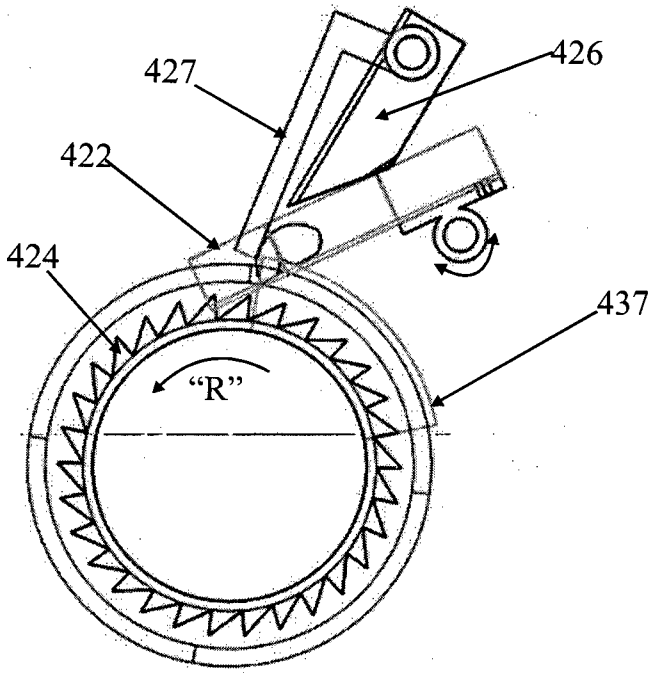

FIGURE 12b

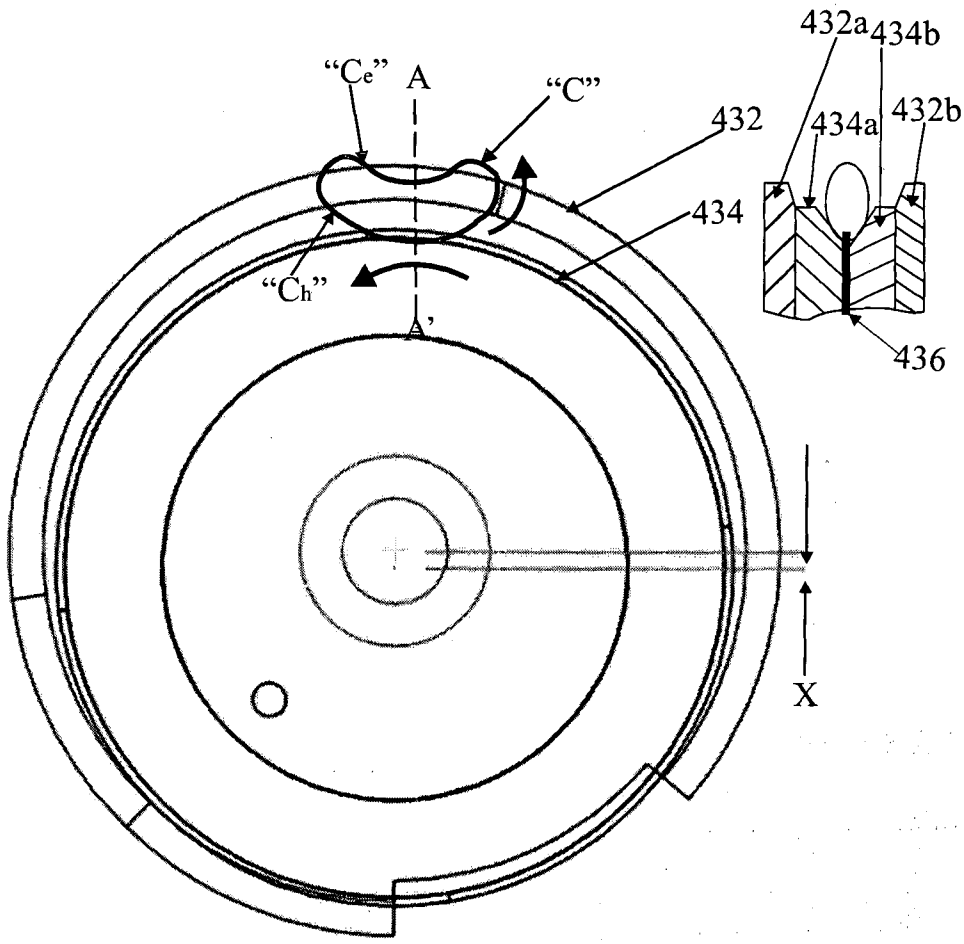

FIGURE 13a

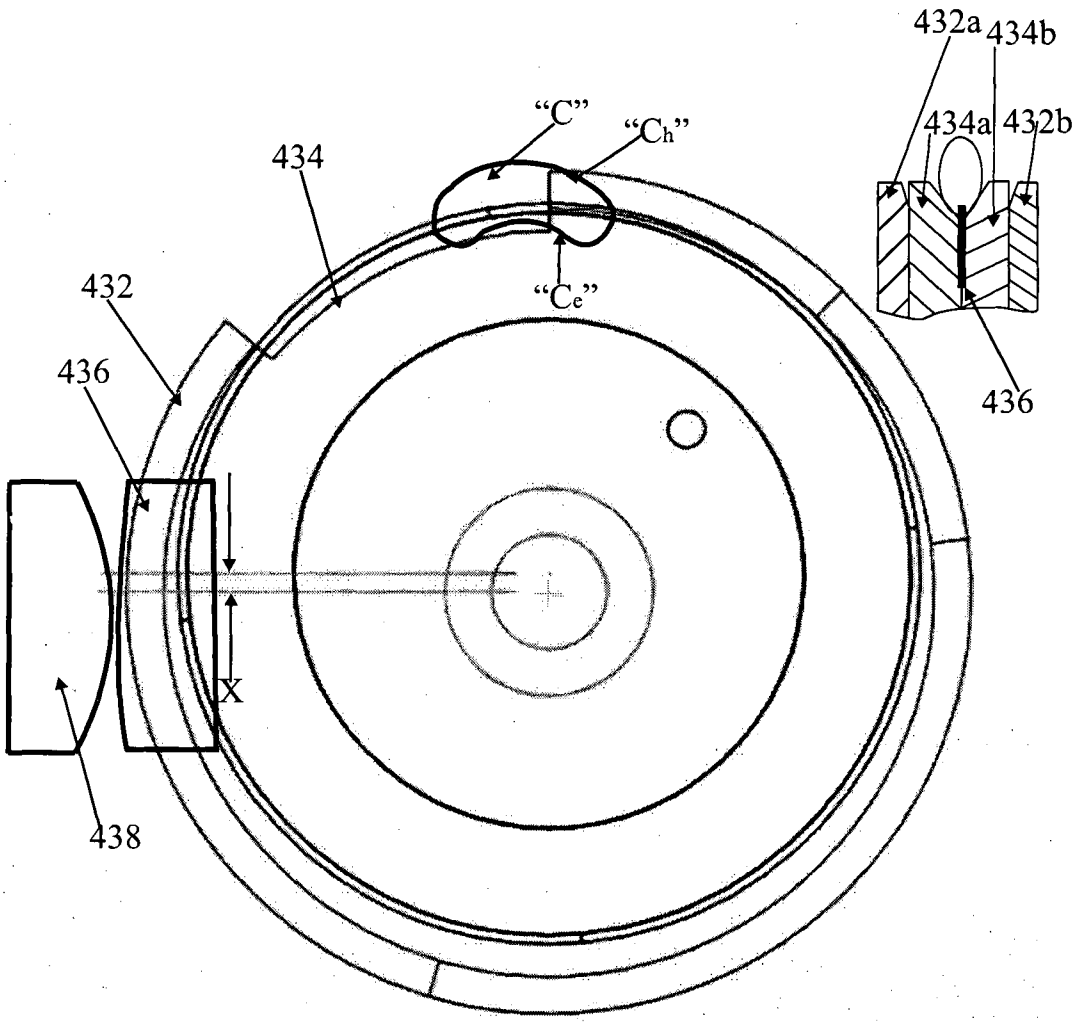

FIGURE 13b

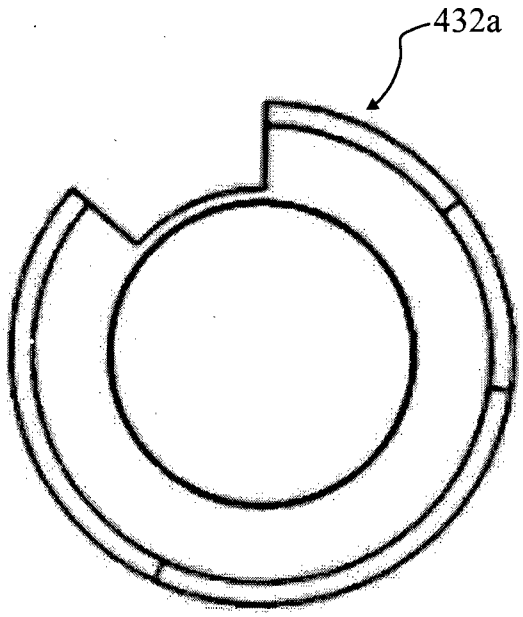

FIGURE 14a

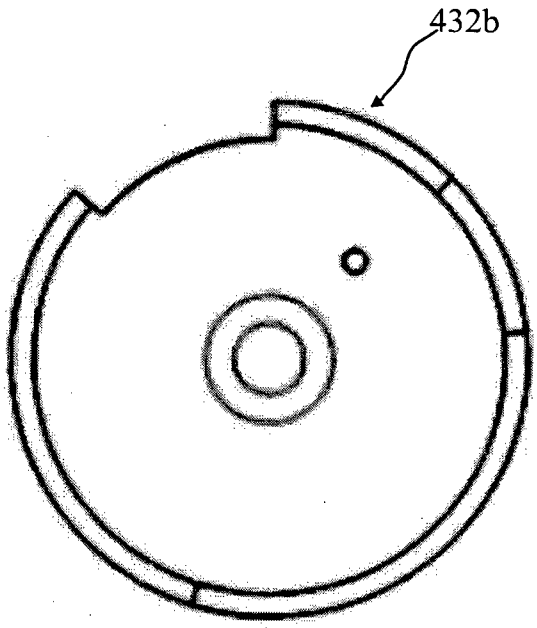

FIGURE 14b

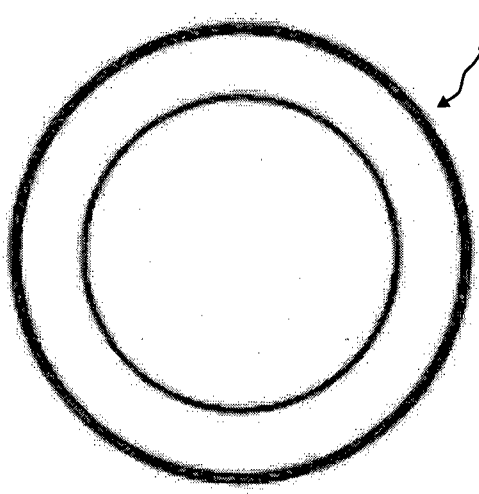

FIGURE 14c

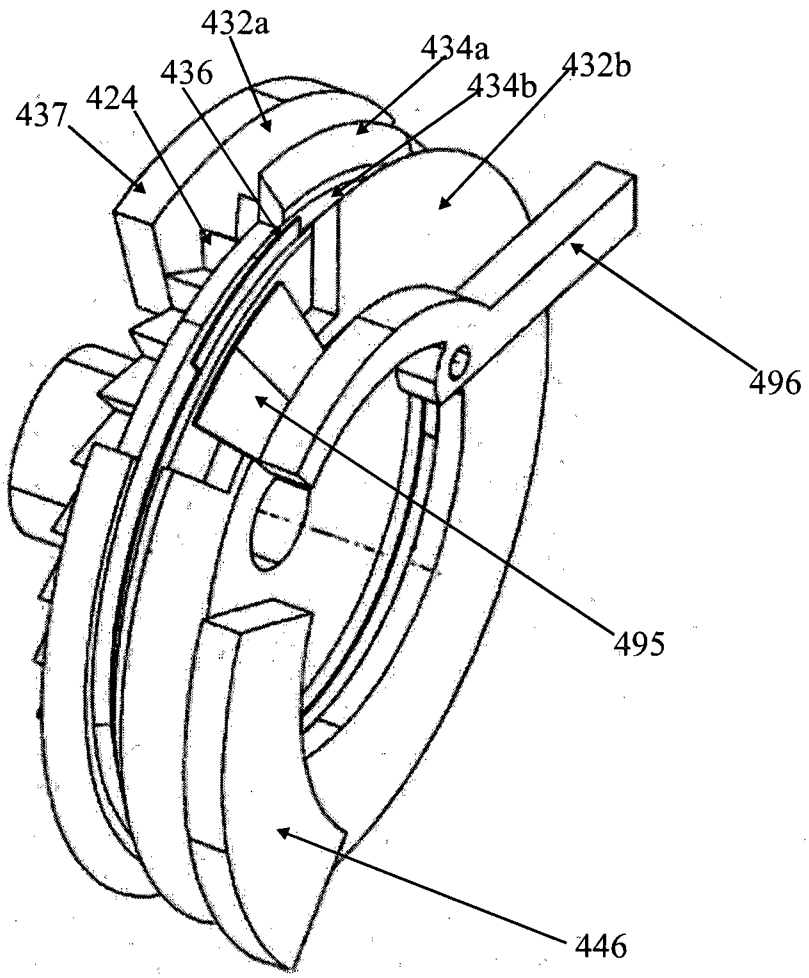

FIGURE 15a

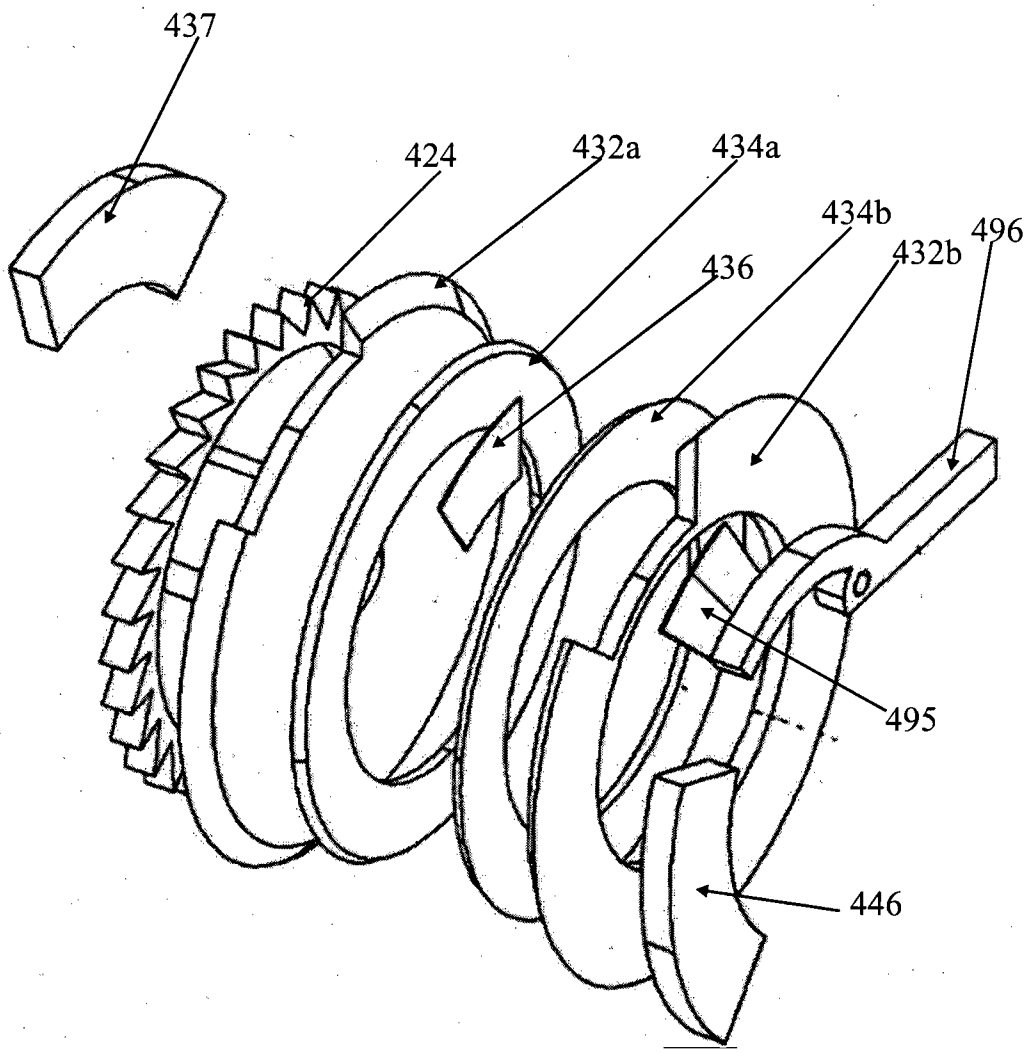

FIGURE 15b

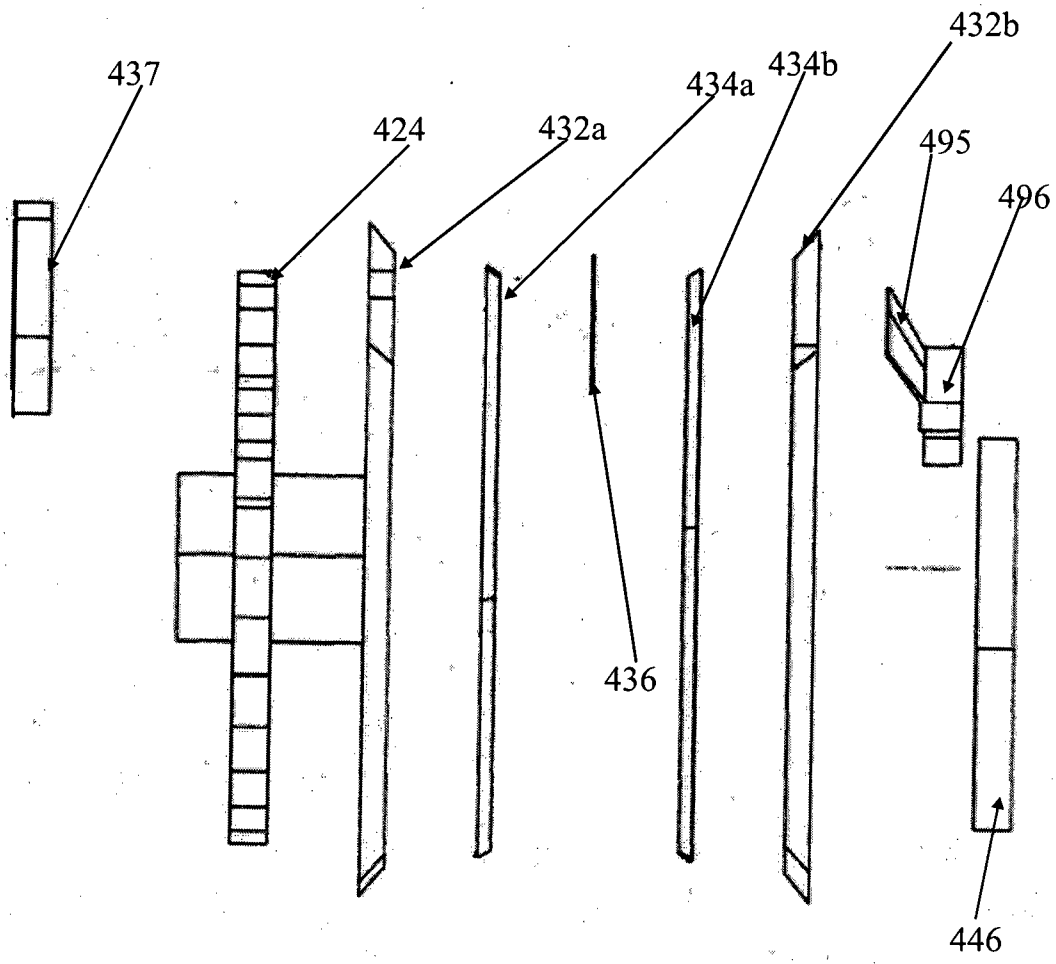

FIGURE 15c

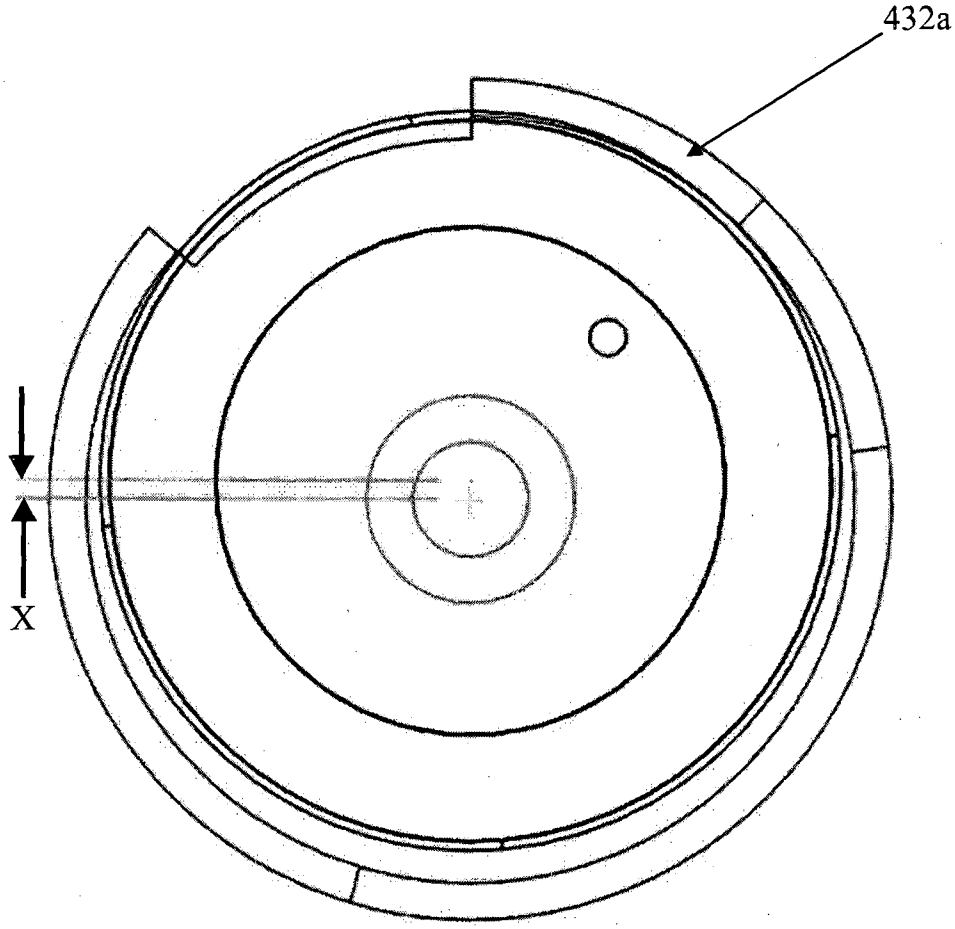

FIGURE 16

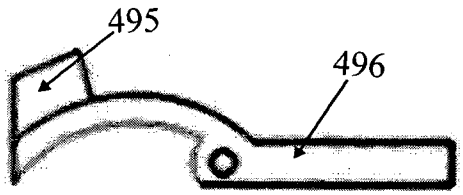

FIGURE 17a

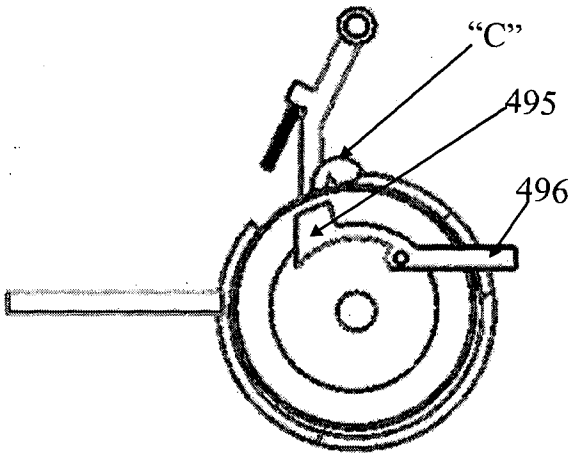

FIGURE 17b

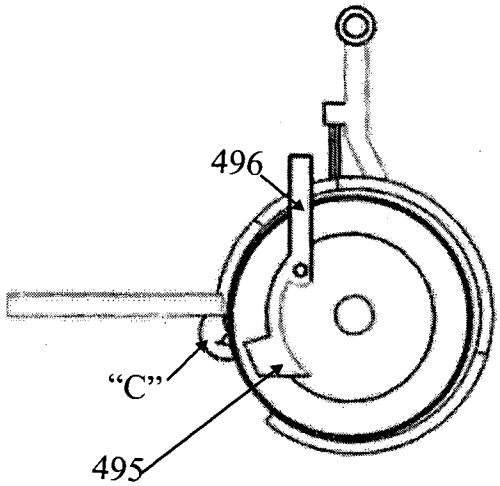

FIGURE 17c

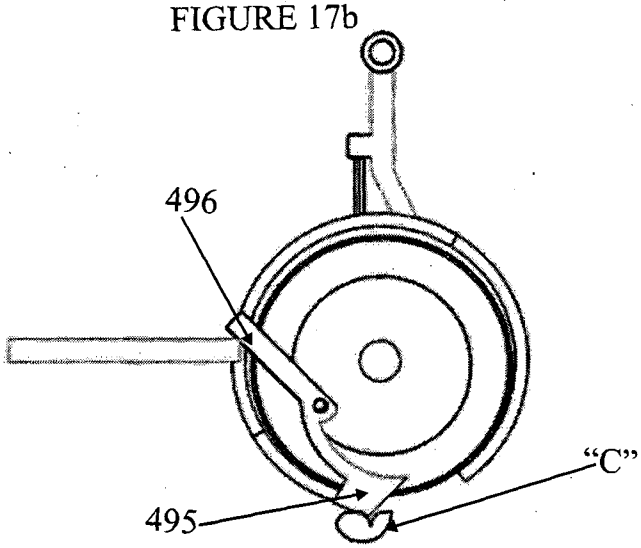

FIGURE 17d

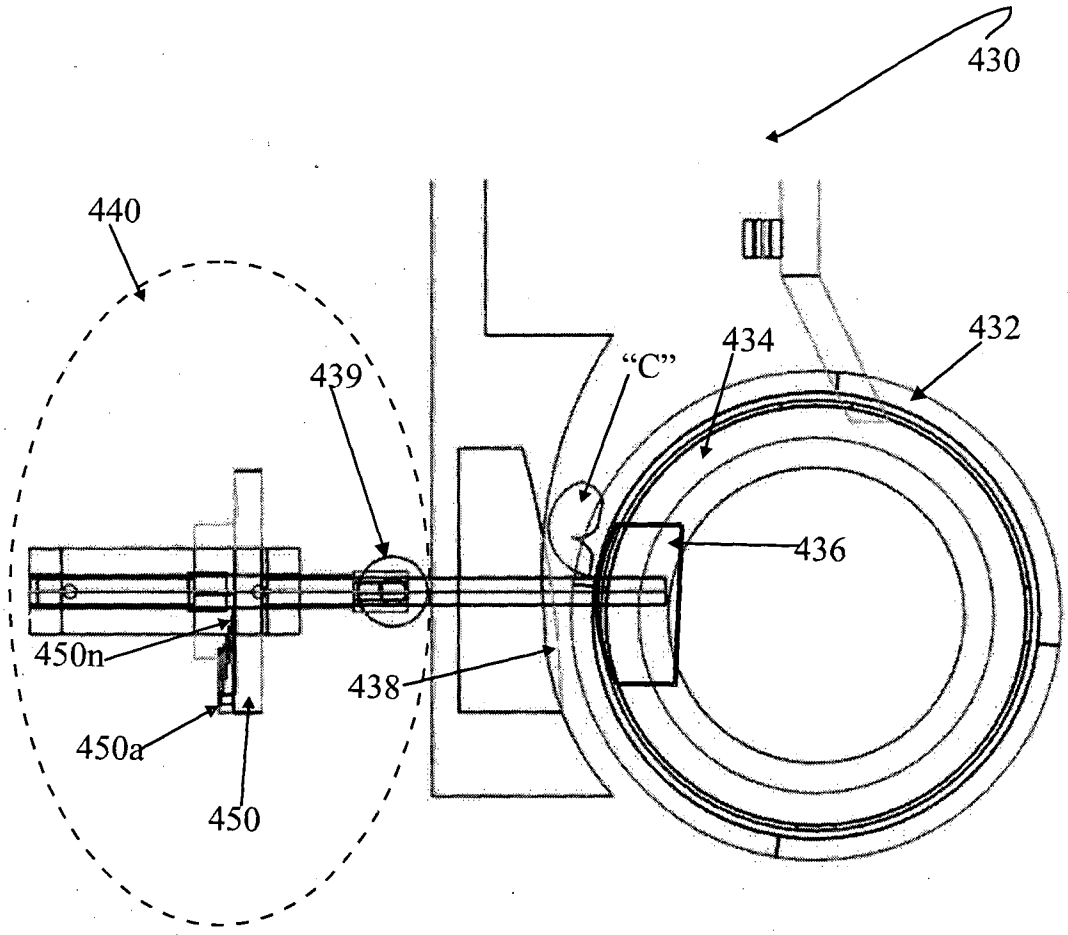

FIGURE 18a

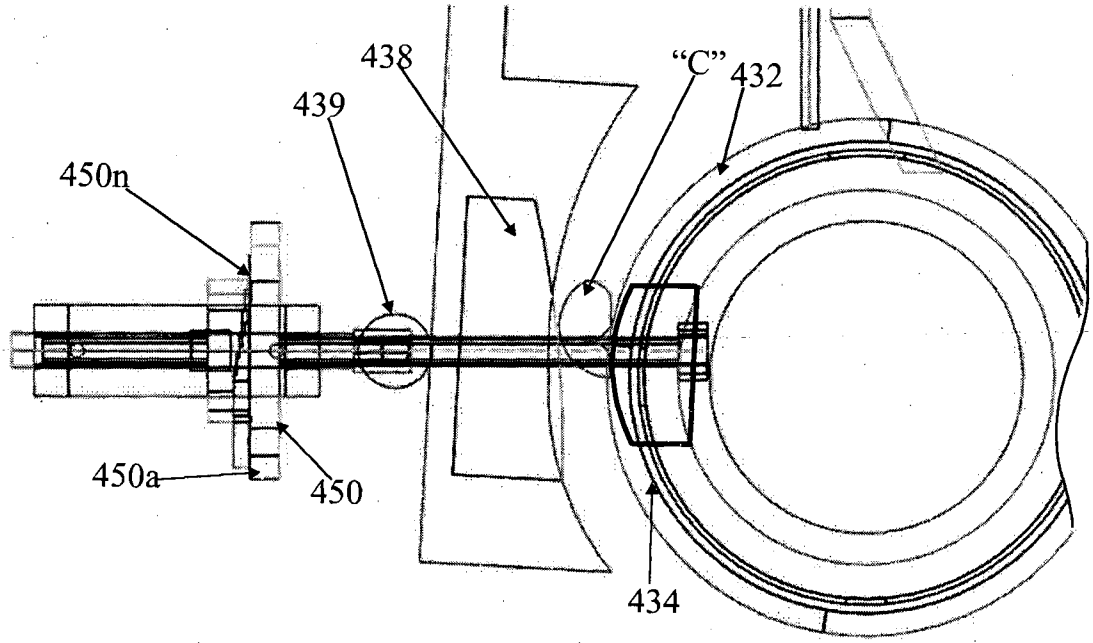

FIGURE 18b

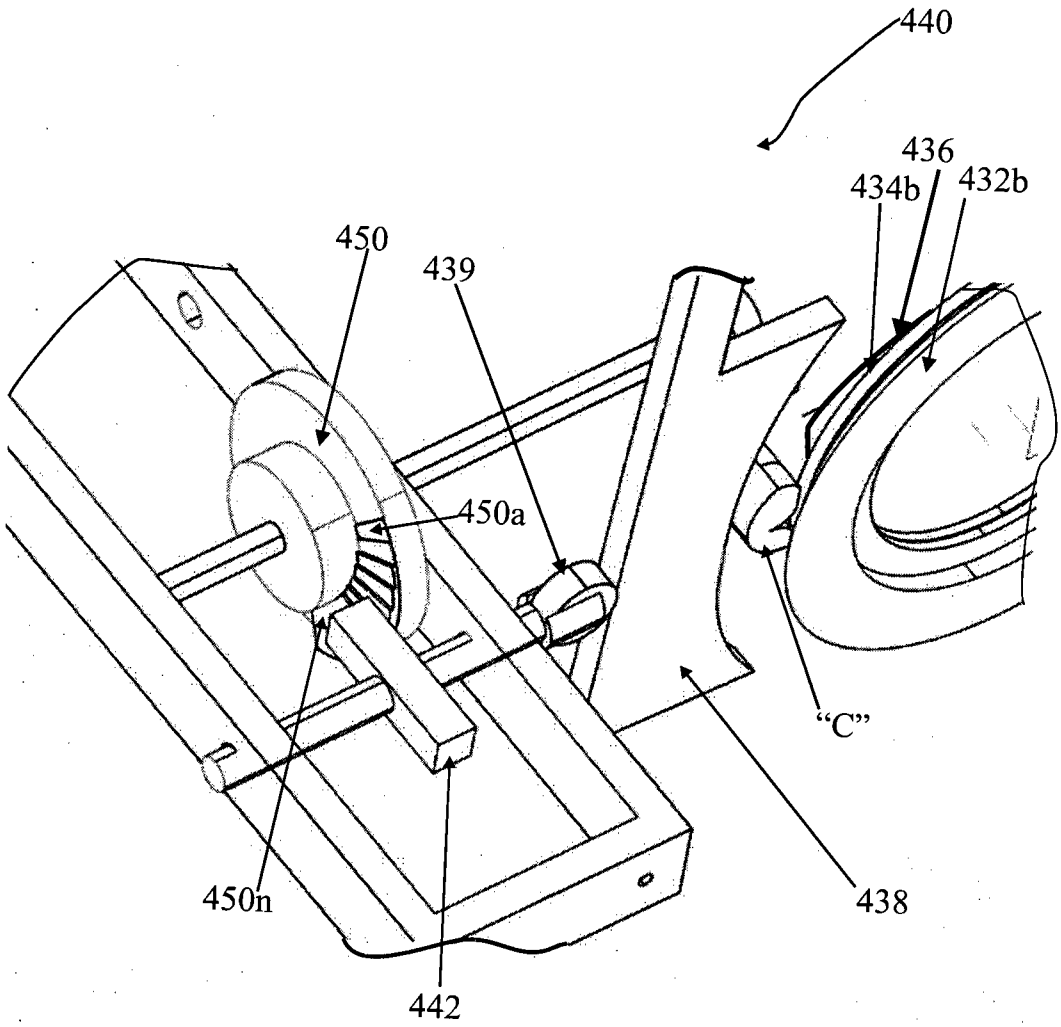

FIGURE 19a

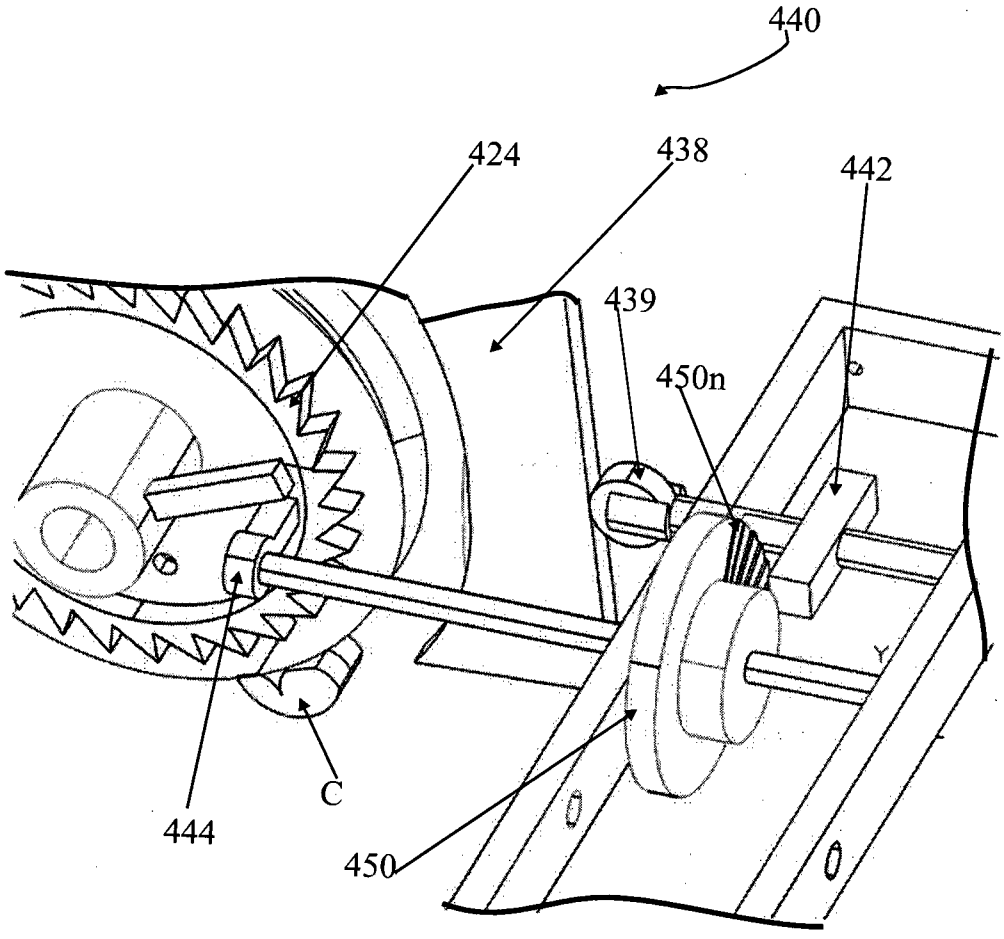

FIGURE 19b

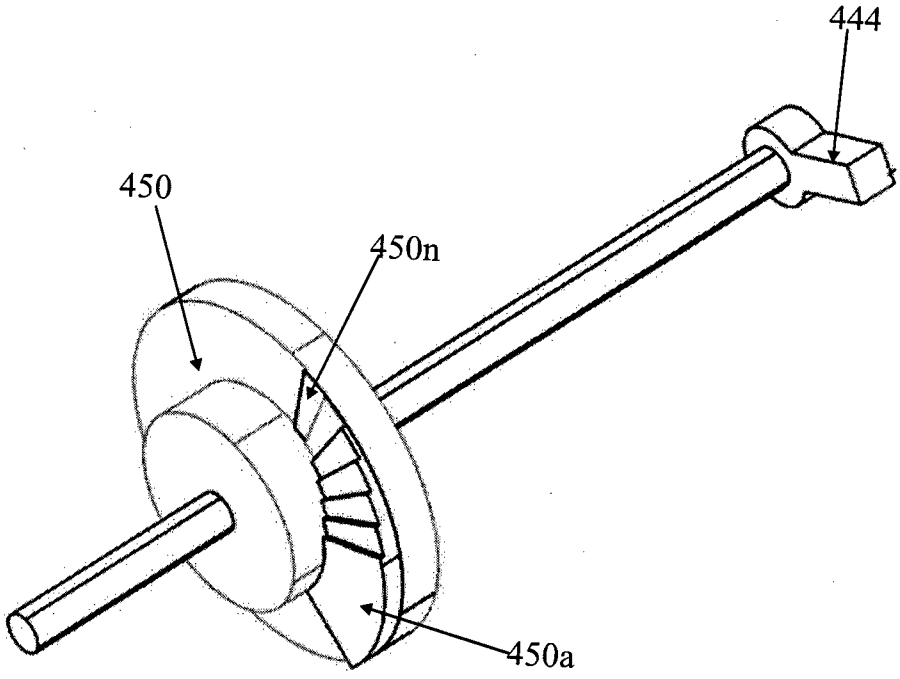

FIGURE 20

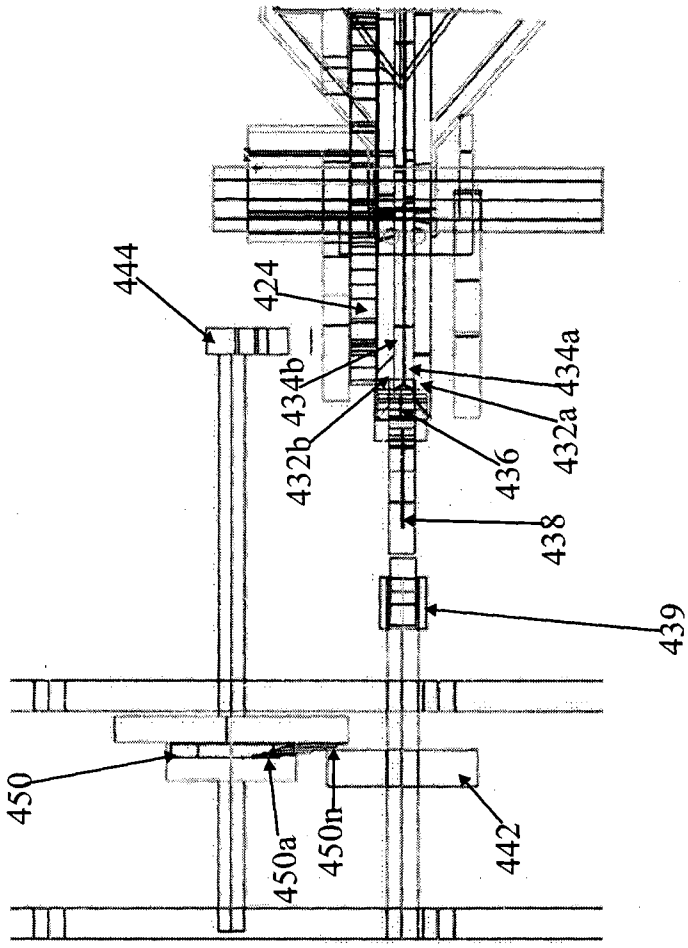

FIGURE 21