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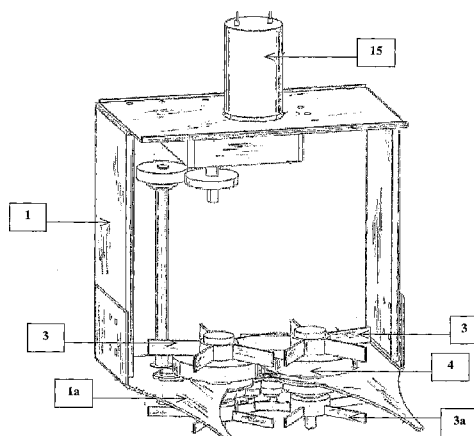


Fig.1

(57) Abstract: The present invention relates to mechanization of harvesting process and more particularly relates to a mechanized alternative to enhance productivity by supporting the workers in plucking activity. The present invention provides for a harvesting machine to separate and collect shoots from a plant bush and a method thereof.

A HARVESTING MACHINE AND A METHOD THEREOF

5 FIELD OF THE INVENTION

The present invention relates to mechanization of harvesting process and more particularly to a mechanized alternative to enhance productivity in plucking activity of plantations by supporting the workers.

10

BACKGROUND OF THE INVENTION AND PRIOR ARTS

Mechanization in harvesting process of tea processing facilitated the timely harvesting of all shoots, but they had limitations in terms of their usability under varied conditions of tea plantation due to different terrain characteristics, plantation layouts and harvesting practices. Also, another striking limitation of these machines is that they have characteristics like weight and appearance which banished more than half of the workforce, which consisted of women, from using them.

20 Thus, there was a need of a product solution to address all these challenges and eliminate the limitations of existing alternatives. With this strong need, an Ultra light hand held tea harvester was designed which proposes a drastic change in reducing weight and extents of the product when compared to already existing alternatives keeping the productivity levels as same. The design is the product that will be easily usable by both men and women and would invite users by its friendly and non machine like features. The design apart from having a novel shoot separation and transfer mechanism, it totally eliminates all the issues arising due to the uneven terrain, by means of the proposed intermittent usage pattern and encourages more intuitive control and usage practices.

30 There are machines that are designed that use the principle of shearing between two reciprocating blades as the separation mechanism for separation of tea shoots from the bush. For an example; a machine with moving reciprocating shear blades is a tea harvester by TAFE, India. Another means of using a sharp edge is by means of a rotating cutter at a speed sufficient to cut the plantation. This cutting of plantation is carried-out in

machines like K Tech Tea Harvester. This is primarily because of the proven mechanics of shearing using reciprocating and rotating blades in other fields of application.

For conveying the separated shoots into the collection area, there are different principles used, like conveyors, air stream as used in the already existing alternatives. Most of these

5 mechanized alternatives are powered by internal combustion engines or electric motors. The means of carrying the hand held alternatives are mainly in arms and the others include self standing or supported by means of air cushion like a hovercraft. The handheld machines weigh from 3.5 Kgs to 17 Kgs. The one time collection in machines varies from 4 Kgs to 25 Kgs and total collection in the day varying from 80 Kgs- 300 Kgs
10 in field conditions.

OBJECTS OF THE INVENTION

The principal object of the invention is to develop a harvesting machine to separate and collect shoots from plants.

15 Still another object of the invention is to provide for a method of harvesting shoots from plants.

STATEMENT OF THE INVENTION

20 Accordingly, the invention provides for a harvesting machine to separate and collect shoots from plants, comprising; a frame (1) comprising at least four sides having a predetermined shape to mount functional components of the machine; a mounting plate(1a) attached at bottom of the frame (1); plurality of roller shafts (2, 2a) comprising plurality of radial protruding fingers (3, 3a), rollers (4, 4a), and gear (11), wherein said
25 radial protruding finger (3) and roller (4) are placed at top of the mounting plate (1a) and said gear (11) and the radial protruding finger (3a) are placed at bottom of the mounting plate (1a); plurality of cutter shafts (6, 6a) comprising rotary cutters (12, 12a) and spacers (8, 8a) connected to the gear (11); and a drive source (15) mounted at top of the frame (1) connected to the gear (11) on the roller shaft (2a) by means of an intermediate
30 transmission shaft (13), and also provides for a method for harvesting shoots from plants comprises acts of; holding harvesting machine at a predetermined level such that mounting plate (1a) of the machine is aligned with the plant bush bed; rotating radial

fingers (3, 3a) of the machine by a drive source (15) to carry the plant shoots towards cutters (12, 12a); gripping plant stems by rollers (4, 4a) for pushing the plant shoots against the cutters (12, 12a); cutting shoots by the cutters (12, 12a) and thereby separating the shoots from the plant; and moving the cut shoots into chute of a collecting bag by the radial fingers (3, 3a).

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Fig 1 shows the complete embodiment.

Fig 2 shows the embodiment of cutters and rollers.

Fig 3 shows the complete embodiment of the gear train.

DETAILED DESCRIPTION OF THE INVENTION

List of elements and referral numerals:

Frame: 1

Mounting Frame: 1a

Roller shafts: 2, 2a

Protruding fingers: 3, 3a

Rollers: 4, 4a

Cutter shafts: 6, 6a

Rotary cutters: 12, 12a

Spacers: 8, 8a connected to gear (11) and

Spacers: 7, 9

Drive source: 15

Intermediate transmission shaft: 13

The main embodiment of the present invention provides for a harvesting machine to separate and collect shoots from plants, comprising; a frame (1) comprising at least four sides having a predetermined shape to mount functional components of the machine; a mounting plate (1a) attached at bottom of the frame (1); plurality of roller shafts (2, 2a) comprising plurality of radial protruding fingers (3, 3a), rollers (4, 4a), and gear (11),

wherein said radial protruding finger (3) and roller (4) are placed at top of the mounting plate (1a) and said gear (11) and the radial protruding finger (3a) are placed at bottom of the mounting plate (1a); plurality of cutter shafts (6, 6a) comprising rotary cutters (12, 12a) and spacers (8, 8a) connected to the gear (11); and a drive source (15) mounted at
5 top of the frame (1) connected to the gear (11) on the roller shaft (2a) by means of an intermediate transmission shaft (13).

In still another embodiment of the present invention the frame (1) is made of plastic or metal selected from a group comprising alloys of aluminum or steel, preferably
10 aluminum.

In yet another embodiment of the present invention the frame (1) has predetermined geometric shape, preferably rectangular shape.

15 In yet another embodiment of the present invention the mounting plate has a curved shape adapted to facilitate gentle entry of plant towards cutters (12, 12a).

In yet another embodiment of the present invention the radial protruding fingers (3, 3a) have rectangular or curved profiles, preferably rectangular.

20 In yet another embodiment of the present invention said rollers (4, 4a) are preferably rubber padded rollers.

In yet another embodiment of the present invention the gear (11) is selected from a group
25 comprising spur gear, helical gear, and bevel gear, preferably spur gear.

In yet another embodiment of the present invention said machine has spacers (7, 8 and 9) placed in between the roller shaft (2, 2a), cutter shaft (6, 6a) and intermediate transmission shaft (13) respectively.

30 In yet another embodiment of the present invention the drive source is selected from a group comprising internal combustion engine, electric motor, and manual power, preferably electric motor.

In yet another embodiment of the present invention said machine has weight ranging from about 0.5 kg to about 1 kg, preferably 1 kg.

In yet another embodiment of the present invention said machine has handle and control buttons at top of the frame (1).

5

In yet another embodiment of the present invention the handle comprises a motor, when the machine is electricity based.

10 In yet another embodiment of the present invention said machine comprises an operating lever, which rotates main gear train through bevel gear chain within the handle, when the machine is manually powered.

15 In yet another embodiment of the present invention said machine is fixed with collecting bag at bottom of the frame (1) and said collecting bag is optionally worn at waist of an operator.

In yet another embodiment of the present invention said machine optionally comprises belts for transmission of power from the drive source (15).

20 In yet another embodiment of the present invention gap in between the rotary cutters (12, 12a) and the radial protruding fingers (3, 3a) is varied depending upon nature of the plant.

25 In yet another embodiment of the present invention the machine is used to harvest shoots of a plant selected from a group comprising herbs and shrubs, preferably tea, mint, basil, hibiscus, tulsi and brahmi.

30 The main embodiment of the present invention provides for a method for harvesting shoots from plants comprises acts of; holding harvesting machine at a predetermined level such that mounting plate (1a) of the machine is aligned with the plant bush bed; rotating radial fingers (3, 3a) of the machine by a drive source (15) to carry the plant shoots towards cutters (12, 12a); gripping plant stems by rollers (4,4a) for pushing the plant shoots against the cutters (12, 12a); cutting shoots by the cutters (12, 12a) and

thereby separating the shoots from the plant; and moving the cut shoots into chute of a collecting bag by the radial fingers (3, 3a).

5 In still another embodiment of the present invention said holding of the harvesting machine is manual for cutting the shoots.

In yet another embodiment of the present invention the plant is selected from a group comprising herbs and shrubs, preferably tea, mint, basil, hibiscus, tulsi and brahmi.

10 In yet another embodiment of the present invention said moving of cut shoots from the chute of the collecting bag into the collecting bag is by gravity and arm agitation during harvesting.

Fig.1, illustrates a harvesting machine. The machine is hand held unit consisting of a
15 frame (1) for mounting of different components of the machine. The frame (1) consists of motor and gearbox at top of the frame (1). The frame (1) is made of preferably aluminum sheet to keep it lightweight. The drive from the gearbox shaft (17) is transferred to lower plate of the frame (1) by means of a gears (10) and (11), transmission shaft (16), and gears (10a) and (11a) on the bottom part of the mounting plate (1a). All the transmission
20 parts are held to the top part of the frame (1) by means of a supporting plate, which has holes for allowing shafts to pass through. The position and size of the protruding part of the mounting plate (1a) is widely varied. The gear train at bottom of the mounting plate is held in position over which spacers (7, 8, and 9) sits to act as bearing members for roller shaft (2a), cutter shaft (6a) and intermediate transmission shaft (13) respectively. The
25 roller shaft (2) facilitates mounting of rubber padded roller (4), radial fingers (3), and supporting shoulders to mount all of them on mounting plate (1a). The cutter shafts (6, 6a) are shafts integral with rotary cutters (12, 12a) (as shown in Fig. 2).

The drive transmitted to gear train mounted on mounting plate (1a) is used to drive the
30 two rollers (4, 4a) in opposite direction i.e., in a direction that facilitates inward pulling of slender vegetation towards the gap maintained between the rollers (4, 4a) as shown in Fig. 3. Surface roughness of the rollers (4, 4a) helps in the process of inward pulling of the vegetation. The radial fingers (3, 3a) act as physical pushing elements to drag in the

slender vegetation during the relative motion between the frame (1) and the vegetation. The radial protruding fingers (3, 3a) also facilitates the selective directing of only the slender vegetation to gap and pushing them against the rotary cutters (12, 12a). The rollers (4, 4a) also grip the vegetation after its upper part is separated by pushing against the rotary cutters (12, 12a).

In yet another embodiment, the variations are tried by changing speed of rotation of rotary cutters (12, 12a) to optimize power requirements and separation energy. In addition, the energy from the drive source (15) for rotating members is widely varied. For example, the drive source (15) is an electric motor or an internal combustion engine or a means by using human power. Further, the means of transferring motion and power in the above discussed embodiment is by using spur gears. However, the means is widely varied for example using belt drives dependence on geometric proximity is eliminated.

The gap in-between rollers (4, 4a) is varied which is dependent on slenderness and thickness of vegetation to optimize the gripping of the vegetation by the rollers (4, 4a) in the process of moving the cut shoots into chute if collecting bag.

Example: Harvesting of shoots of tea plants.

The present invention differs from the existing alternatives in the following aspects:

- The principle of separating and collecting the tea shoots uses the concept of gripping and pushing the shoot against a cutting edge of the cutters (stationary or rotating) by means of rollers and fingers. This is different from the existing alternatives that use the principle of shearing between two reciprocating blades or by using rotary moving blades to separate tea shoots from the bush.
- The machine separates the shoot from the bush in three steps. First step includes the seclusion of shoot from the bush to be pushed against the cutting edge. Second step includes gripping of the shoot by virtue of friction between shoot and two rollers rotating in opposite direction. Third step includes pushing of the gripped shoot against the cutting edge and in sequence transferring it to the collection bag using the same grip. None of the existing alternatives performs the first step wherein the

seclusion of shoot from the bush to be pushed against the cutting edge is carried-out. In addition, for the separation and collection, independent sub systems are used as opposed to the use of same elements for performing both in the proposed design. This is the reason drastic reduction of weight in its embodiment.

5

- The machine uses gravity assisted flow of separated shoots for transferring them to the collection bag. This eliminates the need of any separate external system to create a forced flow for collection as used in existing alternatives for example compressor are used for creating a directed air flow, flaps to push shoots by their geometry and motion.

10

- The machine being ultra light (less than one kilogram), extends its usage by women workforce in contrast to the much heavier existing alternatives (four to seventeen kilograms).

15

- The weight distribution of the machine is such that, the weight of the separated shoots is transferred to the shoulders and waist which have more physiological load bearing capacity. The weight carried by the hands is kept constant during the harvesting and equals only the weight of the separating module. In the existing alternatives, the physiological loads coming on various parts of the body exceed the recommended values.

20

- The machine eliminates the problems arising from uneven terrain by being light weight and suggested usage pattern which includes intermittent operation for harvesting in which the user stands at one location and moves the separation unit into the tea bushes. This problem is not eliminated by the existing alternatives as they require a continuous movement of the user while harvesting.

25

- The earlier arts were not a commercial success because of not being acceptable by the tea harvesting workforce, especially women. This non-acceptance of those machines was due to the difficulty in using them because of their high weight and usage pattern on uneven terrain. In addition, the existing alternatives consist of complicated designs which have different parts that require frequent maintenance.

30

The technical value arises from the simplicity of the proposed solution and its embodiment which overcomes the shortcomings of all the existing alternatives by giving
5 a new direction of thought in the process of harvesting. This solution can be applied with distinction in scenarios where the separation of vegetation has to be damage free both for the separated vegetation (shoot) and the base vegetation from which it has to be separated (tea bush), and where the process of harvesting has to be more careful. This is not carried-out by using existing alternatives as these only concentrate on separation and pay
10 no heed to damage caused to the vegetation. Further, it is a solution that uses the minimal number of components to achieve multiple functions and hence reduces the number of independent subsystems.

The proposed design is a minimalist embodiment, thus bringing out a huge material
15 saving. Also, the moving members are lightweight and small sized as compared to existing alternatives for the same rate of harvesting and hence result in a huge saving on energy front. Consisting of standard parts makes the design easy to maintain and replace parts, if needed. In terms of enhancing productivity, the machine is a hand held unit that engages only one hand while in operation. Hence, the productivity is dependent on the
20 number of hands available. This means that there is a potential of doubling the productivity of the workers by making them use the machine in both hands.

The machine at this stage is applied to tea harvesting process. However, the same principle can be applied to vegetation of similar nature and in harvesting of which, the
25 challenges are similar. The boundary at this stage extends to slender vegetation that has sufficient flexibility to be gripped in between the rollers and which is close to cylindrical shape.

Herbs are used for medicinal and culinary applications. Herb harvesting is a delicate and
30 labor intensive process in India. Some mechanized harvesters abroad are heavy, wheel mounted, unsuitable for Indian context. The machine under consideration can be used as it is or with minor alterations to accommodate herb specific variations. Its applicability is

suitable for not only in India but in all places especially for unstructured plantations of uneven heights as is the prevalent practice in herb plantations. The single point gathering and severing in the present design facilitates visual selection and mechanical isolation of the shoots which is essential for herb harvesting. Some herbs for which the device can be
5 used include but not limited to the following examples: Tulsi, Basil, Mint, Brahmi, Dill, Horehound, Lemon balm, Rue, Catnip etc.

The invention has been described in connection with its preferred embodiments. However, it is not limited thereto. Changes, variations and modifications to the basic
10 design may be made without departing from the inventive concepts in this invention. In addition, these changes, variations and modifications would be obvious to those skilled in the art having the benefit of the foregoing teachings. All such changes, variations and modifications are intended to be within the scope of this invention. The technology of the instant Application explained with the examples should not be construed to limit the
15 scope of the invention.

CLAIMS:

1. A harvesting machine to separate and collect shoots from plants, comprising;
 - a. a frame (1) comprising at least four sides having a predetermined shape to mount functional components of the machine;
 - b. a mounting plate(1a) attached at bottom of the frame (1);
 - c. plurality of roller shafts (2, 2a) comprising plurality of radial protruding fingers (3, 3a), rollers (4, 4a), and gear (11), wherein said radial protruding finger (3) and roller (4) are placed at top of the mounting plate (1a) and said gear (11) and the radial protruding finger (3a) are placed at bottom of the mounting plate (1a);
 - d. plurality of cutter shafts (6, 6a) comprising rotary cutters (12, 12a) and spacers (8, 8a) connected to the gear (11); and
 - e. a drive source (15) mounted at top of the frame (1) connected to the gear (11) on the roller shaft (2a) by means of an intermediate transmission shaft (13).
2. The harvesting machine as claimed in claim 1, wherein the frame (1) is made of plastic or metal selected from a group comprising alloys of aluminum or steel, preferably aluminum.
3. The harvesting machine as claimed in claim 1, wherein the frame (1) has predetermined geometric shape, preferably rectangular shape.
4. The harvesting machine as claimed in claim 1, wherein the mounting plate has a curved shape adapted to facilitate gentle entry of plant towards cutters (12, 12a).
5. The harvesting machine as claimed in claim 1, wherein the radial protruding fingers (3, 3a) have rectangular or curved profiles, preferably rectangular.
6. The harvesting machine as claimed in claim 1, wherein said rollers (4, 4a) are preferably rubber padded rollers.
7. The harvesting machine as claimed in claim 1, wherein the gear (11) is selected from a group comprising spur gear, helical gear, and bevel gear, preferably spur gear.

8. The harvesting machine as claimed in claim 1, wherein said machine has spacers (7, 8 and 9) placed in between the roller shaft (2, 2a), cutter shaft (6, 6a) and intermediate transmission shaft (13) respectively.
- 5 9. The harvesting machine as claimed in claim 1, wherein the drive source is selected from a group comprising internal combustion engine, electric motor, and manual power, preferably electric motor.
10. The harvesting machine as claimed in claim 1, wherein said machine has weight
10 ranging from about 0.5 kg to about 1 kg, preferably 1 kg.
11. The harvesting machine as claimed in claim 1, wherein said machine has handle and control buttons at top of the frame (1).
- 15 12. The harvesting machine as claimed in claim 11, wherein the handle comprises a motor, when the machine is electricity based.
13. The harvesting machine as claimed in claim 11, wherein said machine comprises an operating lever, which rotates main gear train through bevel gear chain within the
20 handle, when the machine is manually powered.
14. The harvesting machine as claimed in claim 1, wherein said machine is fixed with collecting bag at bottom of the frame (1) and said collecting bag is optionally worn at waist of an operator.
- 25 15. The harvesting machine as claimed in claim 1, wherein said machine optionally comprises belts for transmission of power from the drive source (15).
16. The harvesting machine as claimed in claim 1, wherein gap in between the rotary
30 cutters (12, 12a) and the radial protruding fingers (3, 3a) is varied depending upon nature of the plant.

17. The harvesting machine as claimed in claim 1, wherein the machine is used to harvest shoots of a plant selected from a group comprising herbs and shrubs, preferably tea, mint, basil, hibiscus, tulsi and brahmi.

- 5 18. A method for harvesting shoots from plants comprises acts of;
- a. holding harvesting machine at a predetermined level such that mounting plate (1a) of the machine is aligned with the plant bush bed;
 - b. rotating radial fingers (3, 3a) of the machine by a drive source (15) to carry the plant shoots towards cutters (12, 12a);
 - 10 c. gripping plant stems by rollers (4, 4a) for pushing the plant shoots against the cutters (12, 12a);
 - d. cutting shoots by the cutters (12, 12a) and thereby separating the shoots from the plant; and
 - e. moving the cut shoots into chute of a collecting bag by the radial fingers (3, 3a).

15 19. The method as claimed in claim 18, wherein said holding of the harvesting machine is manual for cutting the shoots.

20 20. The method as claimed in claim 18, wherein the plant is selected from a group comprising herbs and shrubs, preferably tea, mint, basil, hibiscus, tulsi and brahmi.

21. The method as claimed in claim 18, wherein said moving of cut shoots from the chute of the collecting bag into the collecting bag is by gravity and arm agitation during harvesting.

25 22. A harvesting machine to separate and collect shoots from plants and a method as herein described in the description and substantiated along with drawings.

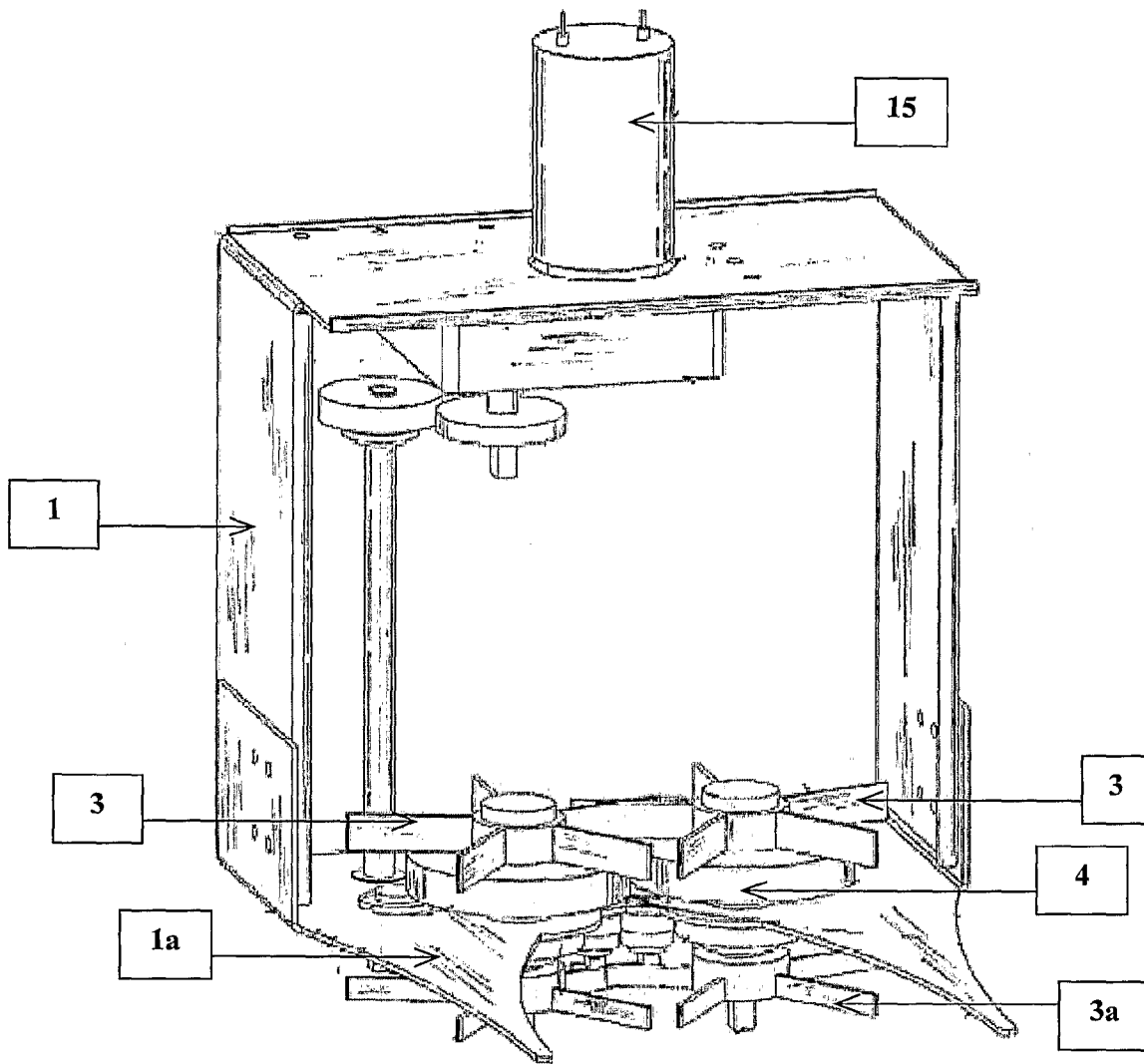


Fig.1

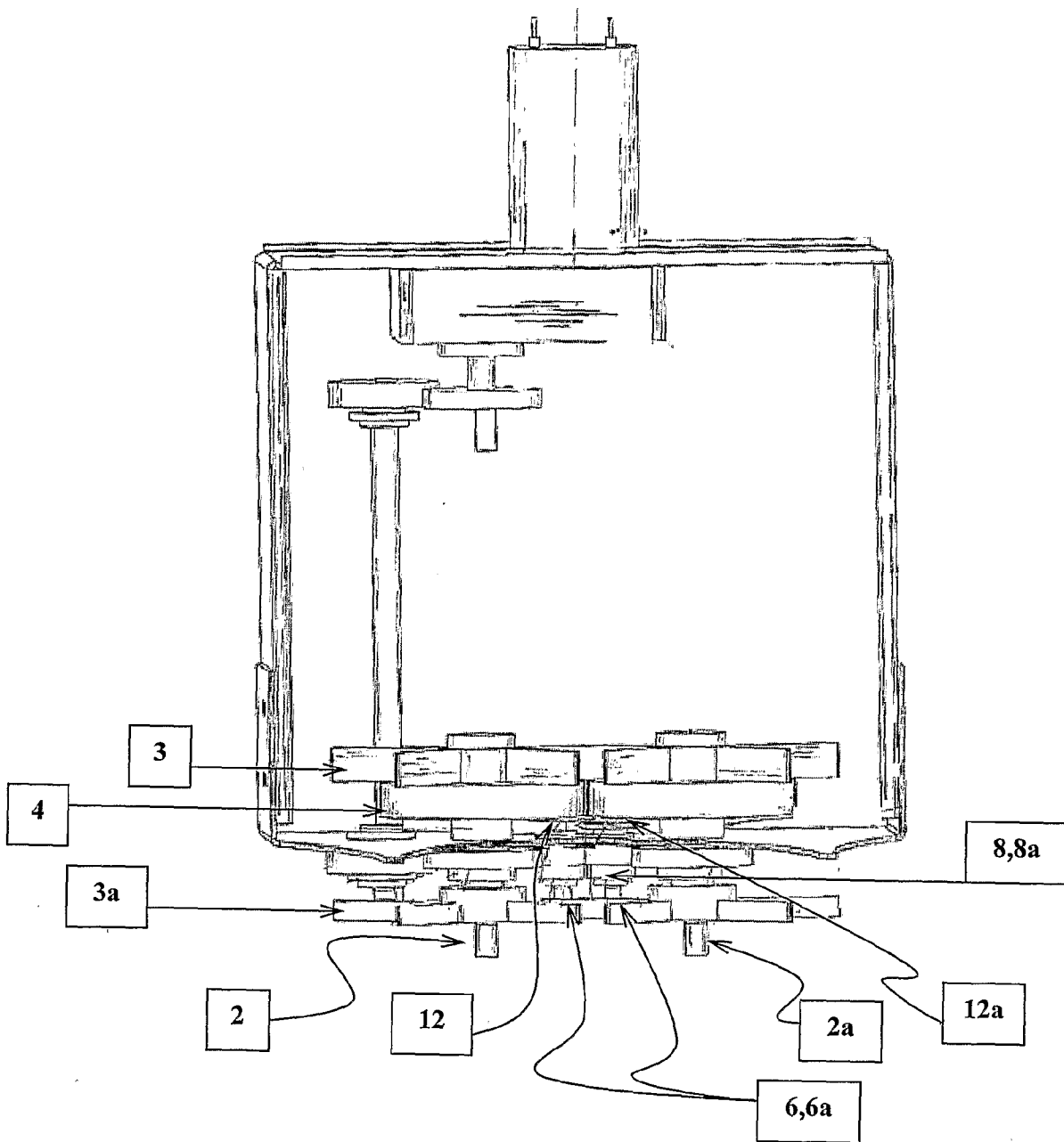


Fig.2

