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(72) Inventors; and
(71) Applicants : **OTARAN, Ahmet, Bahadir** [TR/TR]; Yogurtcu Cayiri Cad. Arkac Apt. 68/7, Kadikoy, 34710 Istanbul (TR). **EKENEL, Ali** [TR/TR]; Hilal Apt. No:3/6 Bige Sok., Kirmizitoprak Mah., 26000 Eskisehir (TR).

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(54) **Title**: A COMPACT APPARATUS AND PROCESS FOR FAST AND CONTINUOUS PRODUCTION OF BAKLAVA DOUGH

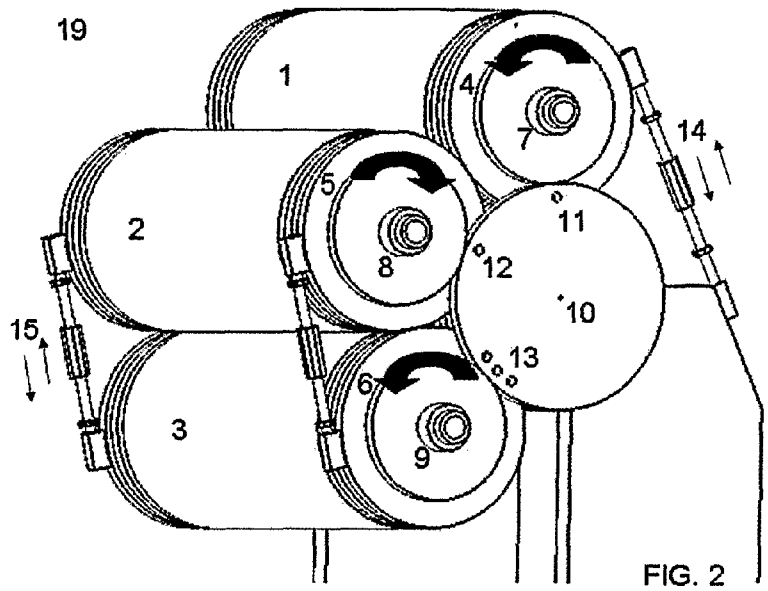


FIG. 2

(57) **Abstract**: A compact apparatus and method for forming a continuous and very thin sheet of composite material of dough, required by conventional food products such as baklava, rice-paper and the like. The invention consists of three stations, of a feeder-sheeter-stretching conveyor assembly arranged consecutively. 1. a feeder hopper with two initial shaping rollers. 2. three sheeting rollers that are arranged around a circular frame (19). The nip gap of sheeting rollers in the second station can be adjusted via adjustment screws. Sheeting rollers have relatively different angular speeds and specially treated surfaces. 3. a stretching conveyor assembly consisting of three conveyor belts, that are so arranged to be positioned one over the other and running at opposite directions at different relative speeds.

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TITLE

A COMPACT APPARATUS AND PROCESS FOR FAST AND CONTINUOUS PRODUCTION OF BAKLAVA DOUGH

TECHNICAL FIELD

The present invention relates to an apparatus for forming a continuous uniform sheet of very thin dough, used for conventional food products that require a very thin layer of dough such as baklava, rice paper and the like. The method disclosed herein describes a method and apparatus for production of very thin dough, however by adjustments disclosed herein, it is obvious that thicker dough bands or dough sheets, to be used in other dough products can easily be manufactured by the same.

BACKGROUND OF THE PRIOR ART

Sheeting of dough is a well-known art historically since the initial manual application; where a dough batch is laid on a flat table and thinned by use of pressing and rolling a cylindrical shape – a roller – repetitively, through manual labor. Manual application requires the years of experience and dexterity of a complex, learning and advanced control system such as a human being, which is difficult to replace with machines. Manual application also takes considerable time to achieve a thin flat dough piece.

Many automated applications have been developed in time, where human effort is replaced by the use of motors – generally electric – driven by different mechanical systems, such as drive chains, direct motor drives, and conveyor belts. These mechanical systems, although based on the well known prior art of rolling a cylindrical apparatus on a flat table, or alternatively on another cylinder/roller - thus forcing a dough portion through a nip and thinning the dough by pressure - had to solve specific problems that arouse with the mechanical system used. Examples of such technical problems were choice of roller material, control of pressure between the rolls, speed of production, deflection of the rolls, sticking of the dough material on the roller surfaces, and solutions to these problems have been granted with patents.

Current state of the art employs a number of methods to achieve a dough band. These are;

- Passing the dough between two rollers with a set or adjustable nip: To achieve thin dough bands, multiple rollers (i.e. DE1432989 / WO2005027645A1 / GBA860154)

or consecutive stations of twin rollers one after the other connected by a conveyor belt (i.e. WO9528087), are employed.

- Instead of directly touching the dough surface with the rollers, conveyor belts with attached two rollers at each end, to apply pressure on the dough band has also been used (i.e. EP0251138 / EP2454762 / WO9528843)
- A plurality of rollers static or moving along a path parallel to a static table or conveyor belt (i.e. EP0140458) or plurality of rollers arranged in a circular fashion to be applied on the dough, opposing a wider diametre roller or a flat surface (i.e. EP 0309005 / WO 0011958 / US 4631017 / EP1203533A1/ FR2569334A1)

It has been possible to achieve thin dough sheets as detailed in the prior art, by applying the double roller sheeter – the sheeting station, time after time along a sheeting line. Dough would have to travel from one sheeting station to the other through conveyor belts, getting thinner after each station, until desired thickness was achieved. As the dough travels from one station to the other it looses part of its moisture naturally and some moisture has to be removed by flour adding – dusting stations – or heaters that are applied to help the dough to withstand the process and not to rip or break. Owing to the required length of the process, such a machine is fairly long, occupying a great deal of floor space, which often brings some disadvantages:

- Restriction of floor space
- Initial higher cost of the long apparatus and repeated sheeting stations
- Greater running cost of multiple motor and belt assemblies
- Servicing difficulties due to bigger and complex machining
- Dough loosing most of the essential humidity characteristics due to evaporation within the long line and dusting before or after the sheeter stations
- Loss of moisture is undesirable in many traditional thin dough products such as baklava.

It is desirable to achieve a very thin dough sheet in a single sheeting station, to eradicate all these technical difficulties at once. However, the pressure dough would exert on the sheeting rollers was so great it would often cause the rollers to deflect in the middle part, that is further away from the supporting mechanism at both sides. The result would be an uneven spread of thickness across the dough band.

Other methods of thinning the dough band such as stretching the dough in addition or alternative to rolling, has been used by grabbing the sides of the dough band in the transverse direction to its travel direction through the conveyor belt and stretching by diverging (i.e.

US4789325 / US3991220 / US3186359). The additional process to achieve thinner dough added substantially to the total floor space and cost of said machinery.

Alternative approach to similar problem was offered by inventors in the non-food industries, namely plastics and paper sheeting, where sheeting assembly was made shorter – but higher – by applying one roller station over the other. These systems – generally called calendar stacks – that possess big rollers with large diametres and are aimed to reduce the roll deflection (i.e. US1989038 / US242856). Never the less it has not been possible to apply said methods of the plastic industry directly to the food industry, due to differences in material properties, working temperatures and motor assembly loads and more importantly cost/benefit considerations. Another method used in the plastic sheeting industry is to crown the rollers to be at a larger diametre in the centre part to compensate for the roller deflection (i.e. US3060843). Certain crowning corresponds to a certain set of parametres such as material pressure, sheeting speed, and mechanical properties of the sheeter rollers, thus once these parametres of the material is changed, crowning value also has to be adjusted.

To transfer said methods to the food industry, mechanical application, material and apparatus needed to be altered considerably, novel approaches need to be developed to cater for the necessities of different material properties, drive mechanisms, control and adjustment systems and cost considerations, which still will have to find their appearance in patent applications.

Prior art as given above claims to achieve minimum thicknesses of 200microns at best, which is again claimed to be not sufficient for the likes of baklava dough, claimed to be in the order of 40 microns. Consecutively in the current application, the dough needs to be manually handled after the mechanized production, before it reaches the desired thickness.

OBJECTS AND BRIEF SUMMARY OF THE INVENTION

The object of the current invention is to provide an apparatus of novel type which brings a significant improvement over the prior art to achieve a continuous thin sheet of dough to the order of 40microns, within a compact sheeting apparatus, not occupying more than 3metres of floor space. By the methods described below it also aims to achieve a cost effective solution, owing to the novel methods and reduced bill of material used.

The invention resides in a broad sense of a dough sheeter, having a hopper with two initial rollers that are counter rotating at the same rpm, that are so arranged to convert a lump of dough into a continuous web of dough whose thickness is circa 1cm, as constant supply to the

sheeting rollers. Three sheeting rollers are arranged around a circular frame, two of which are rotationally adjustable on a pivot by means of adjustment screws tangentially attached to their side plates. Rollers are made of special material by centrifugal casting to achieve robustness and arranged tangentially pressing each other - both with the aim of withstanding deflection caused by dough pressure. The surface of first roller is coated/double layered with relevant plastic material to the thickness of at least 5mm, to achieve non-stickiness thus the dough slips through instead of ripping. The surface of at least the last two rollers, are also specially crowned towards the centre, to compensate deflection and hardened to resist the sticking inclination of certain composition of dough, for example consisting eggs. Three rollers are arranged in a series, that each set of two counter rotating rollers form a gauging nip for the dough to pass through, the middle roller being common to both the first and the last. Within the first two rollers, the rotational speed (rpm) of the first being slower than the second is and the second being slower than the third. By this said method of passing dough between two counter rotating differential speed rollers, dough is both pressed and stretched in the direction of the flow, thus causing an additional kneading action. Said pivotal movement of the first two adjustable rollers, enabling the two gauging nips to be set to the desired thicknesses once for each different dough composition; namely first in the order of 3mm and the second circa 40 microns or less. Also the effect of crowning and the adjustment of the nip between the sets of rollers are methods used to achieve the uniformity of the dough thickness, even with changing compositions and sheeting speeds. The complete assembly has the advantage of withstanding both deflection and adherence forces the dough creates on the rollers.

The dough sheets leaving the initial rollers of the hopper, enters the first set of gauging rollers and following the natural curve in the direction of the flow and gravitational force, moves to the second set of gauging rollers. As the dough band leaves the last set of gauging rollers it is separated from the roller by the use of a blade tangentially touching the roller as known in the previous art. The dough band flows down on to the stretching conveyor assembly after the gauging rollers. The three roller assembly, are driven by a single electrical motor through a drive chain and gearwheels in connection to each other, exacting the rpm of the three rollers and giving further advantage of space saving and cost reduction.

Stretching conveyor assembly comprises of three conveyor belts positioned one over the other, running in opposing directions and running at increased flow speeds, latter in reference to the prior. The improvement comprises of this arrangement in causing the dough to further stretch and reduce in thickness, as it stretches between the consecutive conveyor belts. Three conveyor stretching assembly is also driven by a separate single drive chain and electric motor, creating

additional advantages of reduced space and material cost, while improved uniform reduction in thickness of dough band.

Positioned above the conveyor belt assembly, there is a rotational dusting container, driven by the same drive chain and motor as the conveyor belt assembly, enabling further dusting of the dough band where required. Additionally above the first conveyor belt positioned at the top portion of the conveyor belt assembly, there is a heater unit to reduce the moisture content and pre-cook the dough band where required.

At the end of the conveyor belt assembly, there is either a folding mechanism or cylindrical docking roller to collect the dough band in the preferred arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1. is a side elevation view that shows the detail of a hopper (60) with a pair of rollers (61) and (62)

Figure 2. is a side perspective view of one side of the sheeter apparatus (19) that shows a set of three rollers (4),(5) and (6)

Figure 3. is a cut-out view of the detail of the roller assembly (1) where each roller assembly (4) embraces the circular frame item (10) at the pivot point (11) they intersect.

Figure 4. is a side elevation view of the sheeter assembly (19) and the gearwheels driven by a single drive chain.

Figure 4(a) and Figure 4(b) are details of the gearwheels

Figure 5. is a side elevation view that shows the conveyor mechanism (50) with three conveyors, duster (58), heater element (59) and two alternative dough band collectors (56) and (57).

DETAILED DESCRIPTION OF THE PREFERED EMBODIMENTS

Figure 1. is a side elevation view that shows the detail of a hopper (60) with a pair of rollers (61) and (62), forming an adjustable set nip. Two nip adjusting screw elements (63) on each side of the rollers (61) and (62) are attached on the side frame members of the rollers. The

kneaded dough is fed directly to the hopper (60) and consecutively passes through the first set of rollers (61) and (62), leaving the rollers having a set thickness in the order of 10mm. Speed of the hopper rollers are so arranged to match the desired sheeting speed of the following sheeter assembly, for improved elimination of dough accumulation in the sheeter.

Figure 2. is a side perspective view of the sheeter apparatus (19) that shows a set of three rollers (1),(2) and (3), gearwheels and drive chain are omitted from the Figure ure for clearer focus on the roller assembly. Each roller have circular shaped side plate items (4), (5) and (6) consecutively at each end of the rollers. The sheeting roller (1) is mounted on a shaft (7) which is rotate able in a bearing block (not shown) secured on the side plate item (4). Side plate item (4) is capable of angular movement together with the whole sheeter assembly of roller (4), on a pivot point (11). Adjustment screw (14) is fixed, on one side tangent to the circular side plate item (4) and on the other side fixed to the frame element (10) which also has a circular form. This way side plate item (4) can move to either direction with the use of adjustment screws (14) indicated by the arrows, thus adjusts the nip distance between the rollers (1) and (2). This nip distance is to be arranged larger than the nip distance between rollers (2) and (3) to reduce the thickness of the dough in a consecutive manner. Likewise, the sheeting roller (2) is similarly mounted, where as the adjustment screw (15) is fixed, on one side tangent to the circular side plate item (5) and on the other side fixed tangent to the circular side plate item (6). Adjustment screw (15) can be wound or unwound in both directions, thus changing the nip distance between both sheeters (1) and (2), at the same time between the rollers (2) and (3). Circular side plate item (6) is fixed and stationary by three pins (13) located in the intersection of the circular part of the frame item (10). Once the pins (11), (12) and (13) are removed, the roller assembly can simply be demounted.

Rollers (1), (2) and (3) are manufactured via centrifugal casting / rotocasting to achieve desired hardness and material density and thus better withstand deflection forces with smaller diametre rollers whose diametre is in the order of 10 to 15cm . First roller (1) is coated/double layered with plastic material to enable the dough material to slip while sheeting reducing the possibility of tear. Second (2) and third (3) rollers' surfaces are hardened to Vickers hardness in the order of 500 to 600 Hv to give them better stability, wear resistance and to withstand sticky-ness of the dough material. Rollers (2), and (3) are crowned towards the centre or enlarged at the cross sectional area towards their axial middle, to compensate for the roll deflection of the pairs of rollers. The uniformity of the dough is adjusted only once for a set of parametres based on the composition of dough, using the adjustment screws (14) and (15).

Figure 3. is a cut-out view of the detail of the roller assembly (1) that is rotational on a central shaft housed in bearings (not shown) on both sides in circular frames (10), whose diametres are smaller than the cylindrical diametre of the rollers. Side plate item (4) is attached

pivot to the circular part of the frame member (10). These circular side plates and circular frame have at least two set of grooves and three high parts each on their circumstantial surfaces and they are mounted such that the grooves correspond to the opposite high parts of the opposing member, to embrace each other at the pivot point they intersect. By the use of adjustment screws (14) this assembly is able to touch sheeting surfaces of the rollers (1) and (2), if needed, leaving a zero nip gap. Additionally this construction is designed to give improved stability against forces in the direction of the axis. This arrangement is devised to give further stability against the deflection forces acting on the side plates, the shafts and the rollers.

The adjustment screws (14) and (15) also exist at the opposite end of the rollers, to align the rollers' axis always parallel to each other. The pressure the dough exerts on the rollers is a function of the dough material, its ingredients and the speed of sheeting. Changes in these values are compensated by adjusting the nip between the sheeting rolls. An automated system can also alternatively be arranged to adjust these set screws automatically by servomotors, driven by a microcomputer programmed to adjust running an adaptive algorithm. In such a case, the thickness of the dough is sensed by magnetic or infrared thickness sensors while leaving the rollers (1) and (2). Positioning of such servo motors and sensors are obvious to the persons skilled in the previous art, thus they are not detailed here in.

Attached to the last sheeter roller (3) is a scraper mechanism to enable easy detachment of the dough band from the roller, whose details are not disclosed in detail here, as it exists in prior art.

Figure 4. is a side elevation view of the sheeter assembly. Attached to the rotation shaft of each roller on one side, there are gearwheels driven by a single drive chain-gear mechanism: The gear (41) fixed on the shaft (7) of the first roller (1) is chosen with a larger diametre than the corresponding gear (42) that is fixed to the shaft (8) of the second roller (2). Such selection of the gear diametres, create a difference in rpm of the roller (1) against roller (2). Roller (2) rotating faster than the roller (1) gives further stretch and a kneading action on the web material. Gear wheels (41) and (42) are unconventionally cut, where the gear cut has larger depth, giving the gearwheels the ability to touch and drive each other even when the distance between them is changed to be closer or farther, as illustrated in Figure 4.(a) and Figure 4.(b). Roller (3) is driven by a drive chain fixed on its shaft (9). This drive force is carried via gearwheels on each roller causing a precise single driving mechanism. On the reverse side of the sheeter assembly (19) rollers (2) and (3) are connected and driven together with exacting similar arrangement of gearwheels, where gearwheel diametre of roller (2) is larger than the gearwheel diametre of roller (3), causing the roller (3) to rotate faster than the roller (2). Numbers of gears on each

wheel are calculated in detail, based on the speed increase of the web material due its elongation in the direction of the flow.

Figure 5. is a side elevation view that shows the conveyor mechanism (50) that is so constructed to carry and stretch the dough band in the direction of dough movement. The conveyor belt assembly (51) receives the dough band from the last roller set of (2) and (3) as the dough band drops naturally by gravity on the conveyor belt (51). The speed of the conveyor belt in the direction (54) is selected faster than the speed of dough leaving the last roller assembly. This gives a further stretch to the dough band and helps it to thin uniformly. As the dough reaches the end of the conveyor belt assembly (51) it drops naturally to conveyor belt assembly (52) by gravity. Conveyor belt assembly (52) which moves in opposite direction (55) of and faster than the conveyor belt assembly (51), to give further stretch to the dough band and make it thinner. Conveyor belt assemblies (51), (52) and (53) are arranged one over the next in the direction of movement in such a manner that, as the dough leaves one assembly it drops to the next naturally, which moves in opposite direction and each assembly band speed is faster than prior to give further stretch to thin the dough without forming stress. At the end of the conveyor belt assembly (53) there is alternatively a folder mechanism (56) or a collector mechanism (57) to either fold the dough in a set longitudinal length on a tray or to wind on a roller. Attached over the first conveyor belt (51) assembly there are a hollow roller duster element (58) and a heater element (59). Roller duster spills starch, flour, farina or the like, dusting the dough band, through a rotating action achieved by the same drive chain that drives the conveyor assembly (51), where required. Heater element is used where required to remove humidity from the dough band. The whole mechanism is driven by a single drive-chain (not shown).

CLAIMS

We claim;

1. A sheeter with a counter rotating pair of rollers (1) and (2), where the rotational speed (rpm) of the first roller (1) is slower than the second (2) forcing the composite material such as dough, through a nip to form a thin band of composite material and characterized in its ability to press and stretch the material in a kneading action in addition to the sheeting action to improve thickness reduction in the dough band.

2. A sheeter according to Claim 1, wherein the first roller made of metal is coated or double layered with plastic material, characterized in the ability of the embodiment to slip over the dough band under certain pressure, improving the ability of the sheeter on not tearing the dough band.

3. A sheeter roller (1) mounting assembly, having circular side plates (4) housing the rotational shaft (7) of the roller mounted in a bearing block, whose (4) diametre is smaller than the sheeting roller (1), attached at a single pivot point (11) on a circular frame member (10) wherein:
   - Both circular side plates (4) circular frame member (10) have at least two set of grooves and three high parts each and are mounted such that the grooves correspond to the opposite high parts of the opposing member, to embrace each other at the pivot point they intersect.
   - Side plate item (4) is capable of angular movement together with the whole sheeter assembly of roller (1) on a pivot point (11).
   - characterized in that the sheeter roller (1) moves adjustably towards or away from the corresponding sheeter roller (2) to set the nip distance between the rollers (1) and (2) as low as to close the gap totally
   - and characterized by improved stability of the assembly to withstand pressures exerted by the composite web material and ability of the rollers to approach or distance each other, causing a change in the nip distance.

4. A Three roller sheeter assembly wherein (19);
   - three rollers (1), (2) and (3) working in a common workload, bringing opposing deflection forces between first set of rollers (1) (2) and the second set of rollers (2) (3) to counteract each other, characterized in their improved ability to withstand deflection forces

- two position adjustable rollers (1) and (2) characterized in their improved ability to adjust the thickness of the web material between both nip gaps between the three rollers, to achieve very thin web material in an improved compact space

5. A sheeter roller mounting assembly according to Claim 3 wherein:
   - the adjusting screws (14) (15) moves the sheeting roller in either direction, characterized in improved ability to adjust the nip gap between the rollers.
   - the adjusting screw attached to the last set of rollers (2) and (3) is adjusted in both directions characterized in its ability to set the thickness of the web material between both rollers (1) to (2) and (2) to (3) in one single operation.

6. A sheeter roller mounting assembly according to Claim 3 wherein a the gearwheel (41) fixed on the shaft of roller (1) with a larger diametre than the gearwheel (42) fixed on the shaft of roller (2), having deeper gear depths, characterized in their ability to convey rotational power even when they are moved away from each other or brought closer within a certain range.

7. A sheeter according to Claim 1 wherein:
   - the rollers (1) and (2) are manufactured by centrifugal / rotocasting characterized by their improved ability to withstand deflection forces

8. A sheeter roller mounting assembly according to Claim 3 and Claim 4 wherein:
   - Sheeter roller pair (2) and (3) are crowned towards the axial centre, together with the adjustment screws, characterized by the ability to set the web material thickness uniformly, compensating the roll deflection for different web material properties with the use of those two properties used together
   - the rollers' surfaces are hardened, characterized by their improved ability to withstand adherence of the web material and improved wear-resistance

9. A hopper mechanism (60) with two counter rotating position adjustable rollers (61) (62) situated at the narrow end of the hopper, characterized in converting lumps of dough and supplying a uniform web of material in the desired thickness and amount per duration to corresponding stations, such as roller sheeters.

10. A conveyor mechanism (50), having three conveyors (51)(52)(53) arranged one over the other, running the web material in opposite directions (54)(55)(56), with increased speed

later in relation to the prior, characterized in giving the composite web material further stretch in the direction of the flow, thus achieving improved uniform thickness reduction.

11. A conveyor mechanism (50), according to Claim 10 wherein:
    - A rotating duster member (58) is positioned above the first conveyor belt (51) made of hollow cylindrical shape with holes on the surface being characterized in improved dusting ability in a compact space
    - A heater member (59) is positioned above the first conveyor belt (51) characterized in improved ability to dehumidify and improve the durability of the web material in a compact space

12. A complete compact dough sheeter apparatus according to Claims 1 to 11 wherein:
    - Lumps of dough is fed directly to a hopper (60) according to Claim 9, characterized in converting uneven lumps of dough into a uniform controllable web material
    - Followed by a three roller sheeter (19) according to Claim 8 using methods in Claims 1 to 7, characterized in reducing the thickness of the web uniformly in a compact space
    - Followed by a stretcher conveyor assembly (50) according to Claim 10 and 11, characterized in that the web is further stretched in the direction of the flow to achieve improved thickness reduction of the web, including the ability to dust and heat the web in a compact floor space
    - Thus a complete automated system characterized in improved floor space reduction, thickness reduction of the web

13. A method for sheeting composite elastic material such as dough comprising the steps of:
    a) Providing a hopper with a pair of gauging rollers
    b) Providing a three roller kneading gauging sheeter
    c) Providing a conveyor assembly stretching the web material in the flow direction of the flow
    d) Arranged one after the other in an automated manner

DRAWINGS

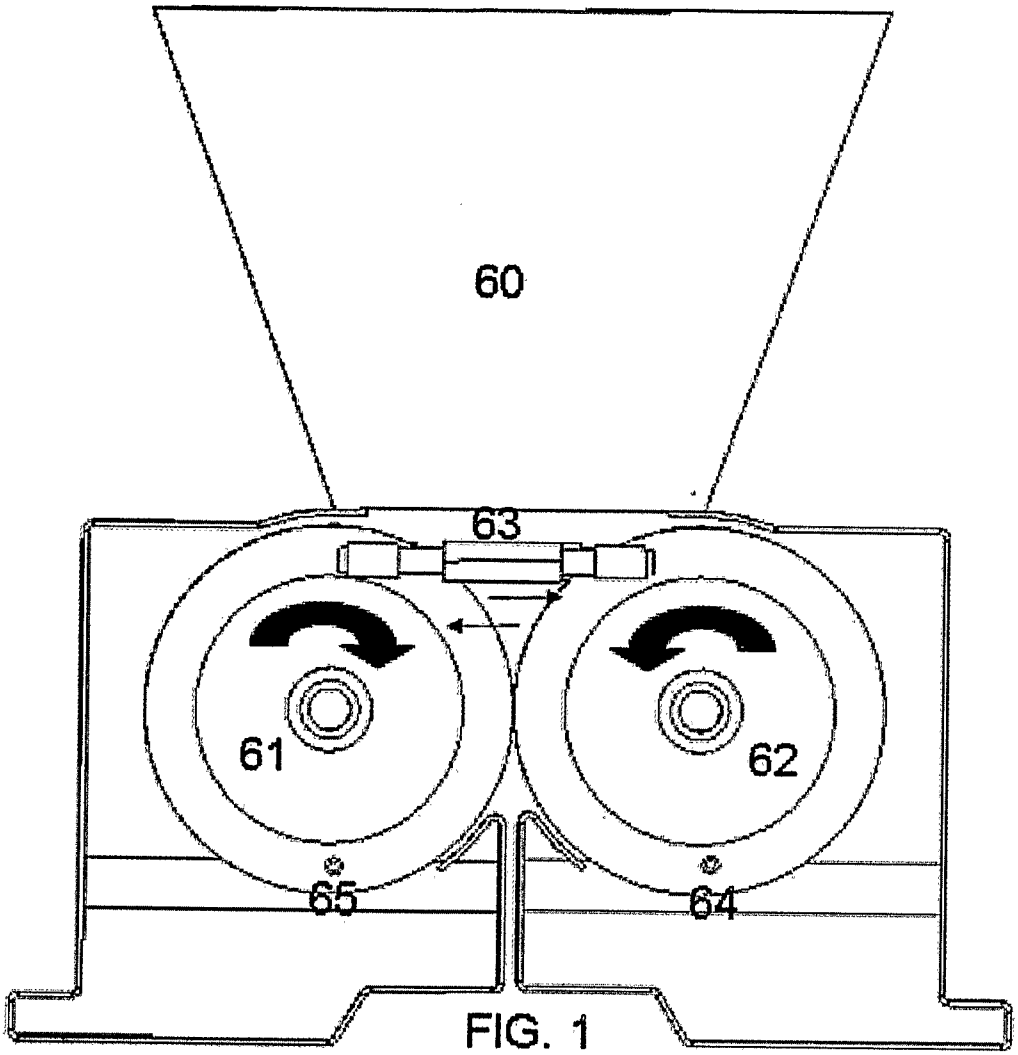


FIG. 1

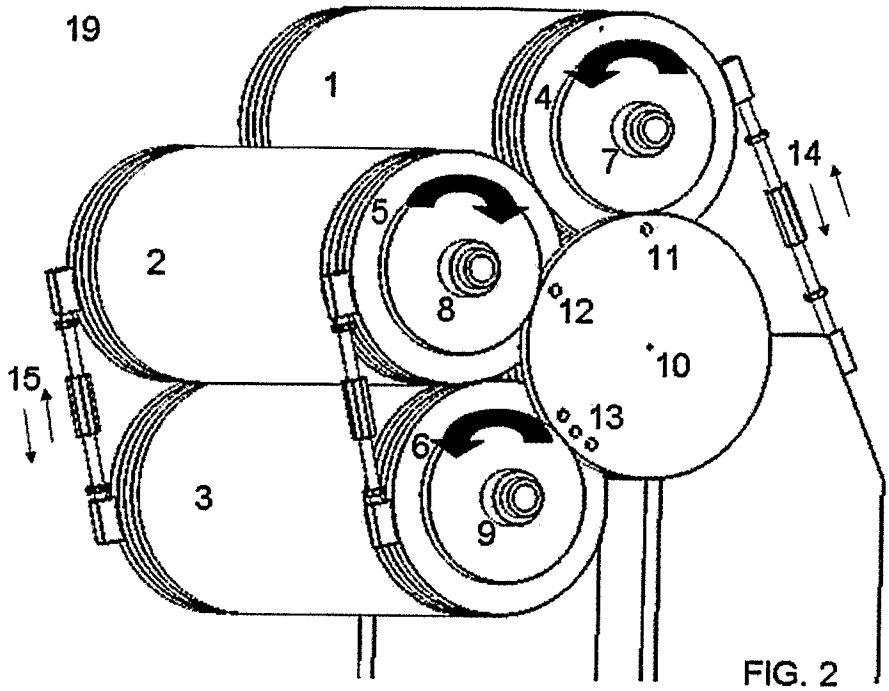


FIG. 2

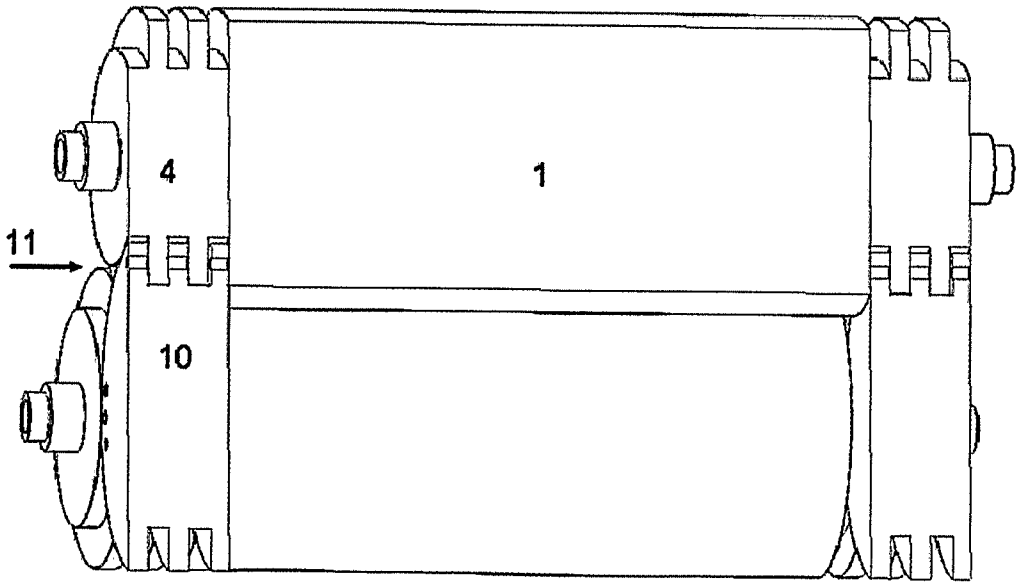


FIG. 3

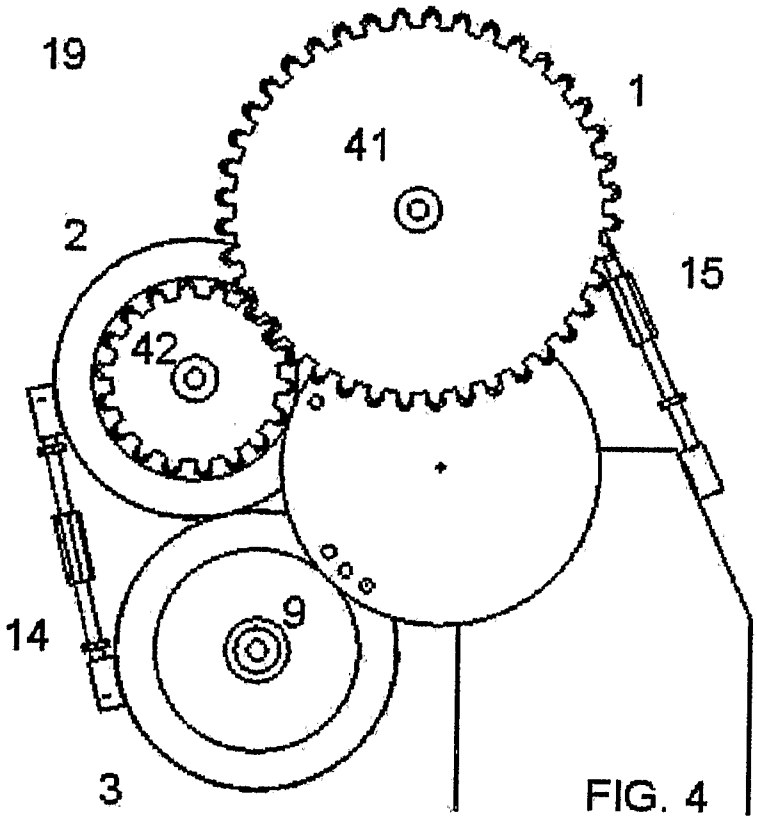


FIG. 4

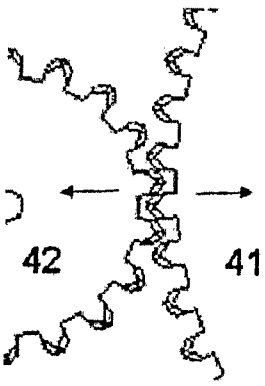


FIG. 4(a)

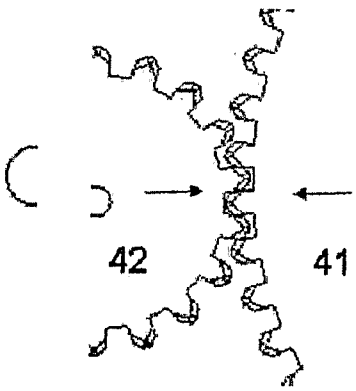


FIG. 4(b)

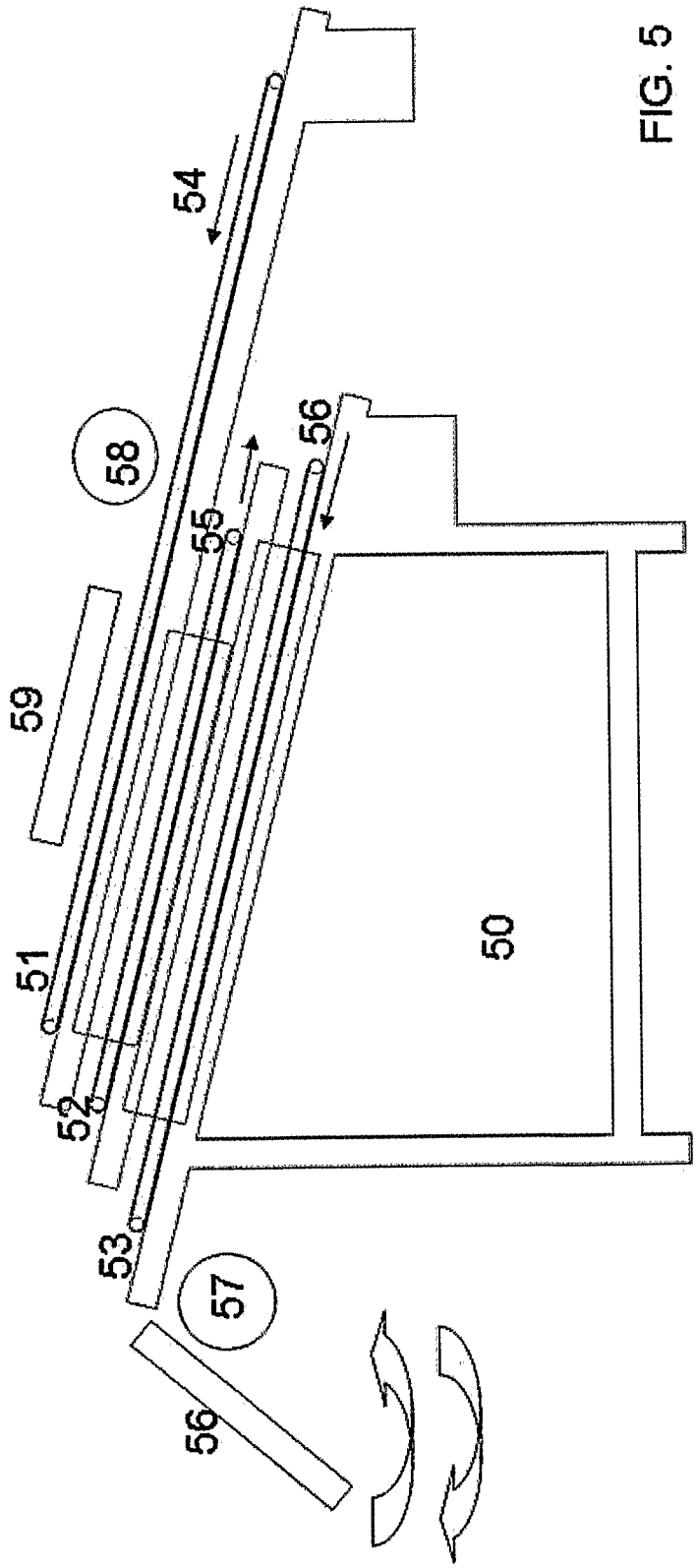


FIG. 5