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CA 2556534 C 2010/09/21

(11)(21) 2 556 534

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2005/02/16
(87) Date publication PCT/PCT Publication Date: 2005/09/01
(45) Date de délivrance/Issue Date: 2010/09/21
(85) Entrée phase nationale/National Entry: 2006/08/16
(86) N° demande PCT/PCT Application No.: US 2005/004912
(87) N° publication PCT/PCT Publication No.: 2005/080071
(30) Priorité/Priority: 2004/02/18 (US10/780,846)

(51) Cl.Int./Int.Cl. *B31B 19/88* (2006.01), *B31B 1/78* (2006.01), *B31B 1/80* (2006.01)

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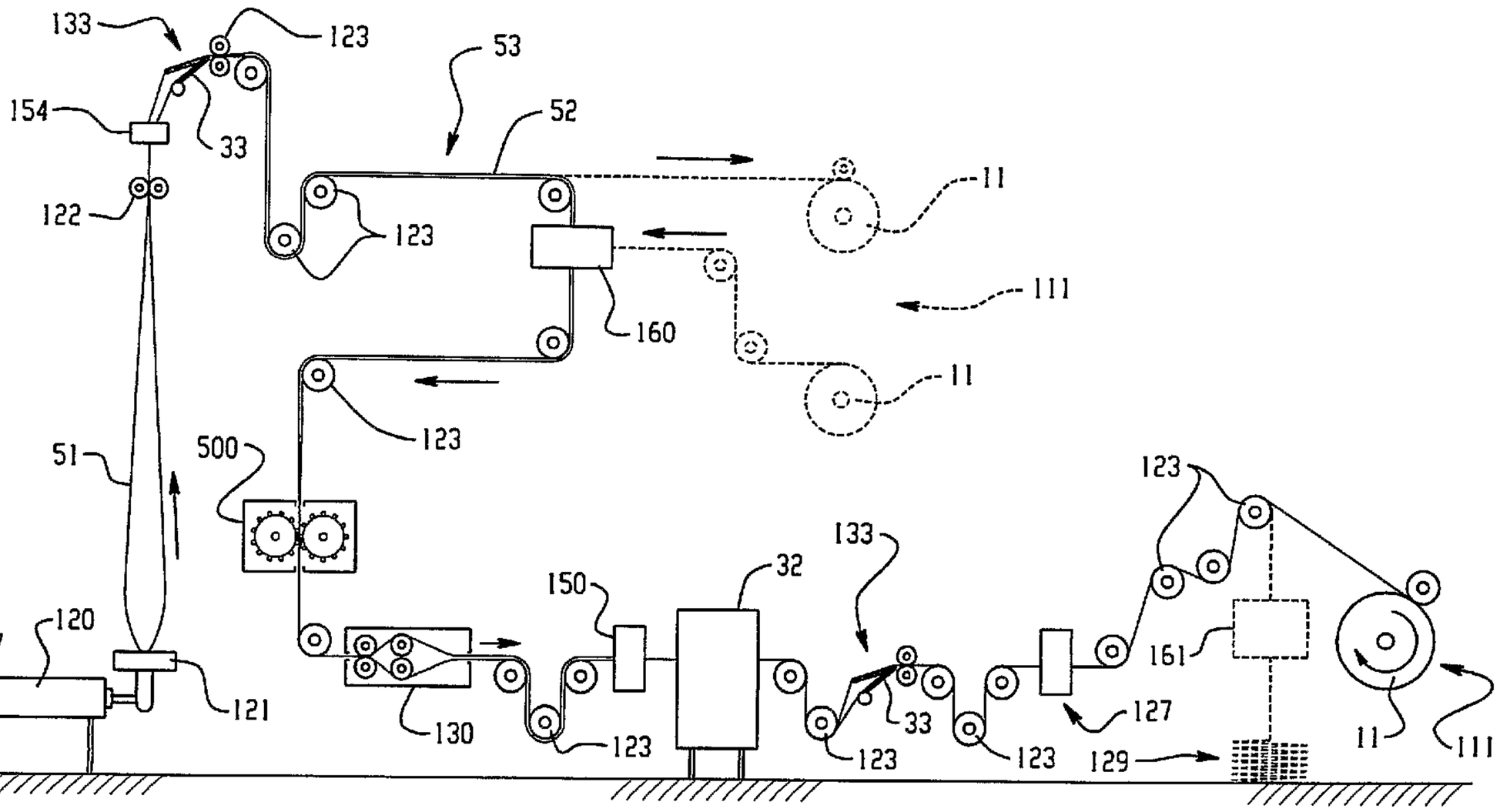
(54) Titre : PROCEDE ET APPAREIL DE FABRICATION D'ARTICLES FLEXIBLES PRESENTANT UN COMPORTEMENT DE TYPE ELASTIQUE ET DES PARTIES VISUELLEMENT DISTINCTES

(54) Title: METHOD FOR MAKING FLEXIBLE BAGS HAVING ELASTIC-LIKE BEHAVIOUR COMPRISING REGIONS FORMED INTO PLEAT ELEMENTS



(57) Abrégé/Abstract:
A method of forming flexible bags (10) having elastic-like behavior, wherein a sheet material (52) is introduced having one portion of the sheet material overlapping another portion of the sheet material. The sheet material (52) is formed into a strainable network. The strainable network includes a plurality of first regions (64) and a plurality of second regions (66). The first regions (64) are substantially un-deformed and the second regions (66) are formed into disengageable pleat elements (74). As the overlapped portions of the sheet material are formed they engage each other at the pleat elements. The pleat elements of each overlapped portion become engaged within each other and resist disengagement because of the frictional forces of the sheet material. The overlapped portions of the sheet material are separated using a disengaging means (130) so that the overlapped portions become disengaged and are separated from each other while riding on the disengaging means (130). The disengaging means is in the form of either air knife, static opening bar, dynamic opening bar, or suction means, and any combinations thereof.

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 September 2005 (01.09.2005)

PCT

(10) International Publication Number
WO 2005/080071 A3

(51) International Patent Classification[7]: B31B 19/88, 1/78, 1/80

(21) International Application Number: PCT/US2005/004912

(22) International Filing Date: 16 February 2005 (16.02.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/780,846 18 February 2004 (18.02.2004) US

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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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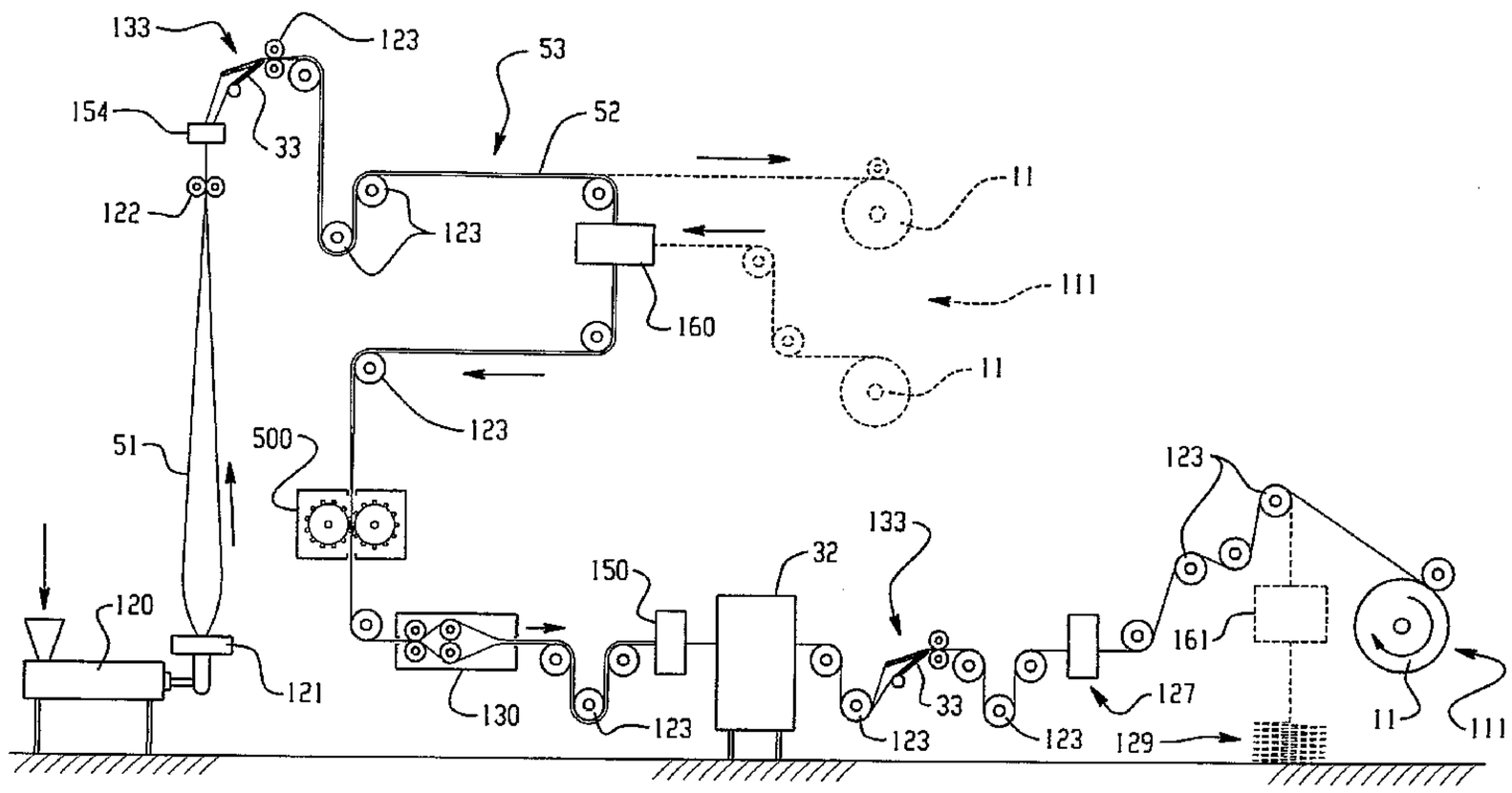
(54) Title: METHOD FOR MAKING FLEXIBLE BAGS HAVING ELASTIC-LIKE BEHAVIOUR COMPRISING REGIONS FORMED INTO PLEAT ELEMENTS



(57) Abstract: A method of forming flexible bags (10) having elastic-like behavior, wherein a sheet material (52) is introduced having one portion of the sheet material overlapping another portion of the sheet material. The sheet material (52) is formed into a strainable network. The strainable network includes a plurality of first regions (64) and a plurality of second regions (66). The first regions (64) are substantially un-deformed and the second regions (66) are formed into disengageable pleat elements (74). As the overlapped portions of the sheet material are formed they engage each other at the pleat elements. The pleat elements of each overlapped portion become engaged within each other and resist disengagement because of the frictional forces of the sheet material. The overlapped portions of the sheet material are separated using a disengaging means (130) so that the overlapped portions become disengaged and are separated from each other while riding on the disengaging means (130). The disengaging means is in the form of either air knife, static opening bar, dynamic opening bar, or suction means, and any combinations thereof.

WO 2005/080071 A3

WO 2005/080071 A3

Published:
— *with international search report*

(88) Date of publication of the international search report:
1 December 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD FOR MAKING FLEXIBLE BAGS HAVING ELASTIC-LIKE BEHAVIOUR COMPRISING REGIONS FORMED INTO PLEAT ELEMENTS

Technical Field

[0001] The present invention relates to a method and apparatus for the production of flexible articles from a continuous web; and more particularly, a method and apparatus for the making of flexible bags having elastic-like behavior is disclosed.

Background of the Invention

[0002] Flexible articles, particularly flexible bags made of comparatively inexpensive plastic materials, have been widely employed for the containment and/or disposal of various items. As utilized herein, the term "flexible" refers to materials that are capable of being flexed, stretched, or bent, especially repeatedly, such that they are pliant and yieldable in response to externally applied forces. Accordingly, "flexible" is substantially opposite in meaning to the terms inflexible, brittle, or unyielding. Materials and structures that are flexible, therefore, may be altered in shape and structure to accommodate external forces and to conform to the shape of objects brought into contact with them without losing their integrity. Flexible bags of the type commonly available are typically formed from materials having consistent physical properties throughout the structure of the flexible bag including such properties as stretch, tensile, and/or elongation properties. Typically, such flexible bags are utilized as trash bags, body bags, Christmas tree disposal bags, colostomy bags, dry cleaner bags, laundry bags, stock pick bags, and shopping bags. Methods for making such bags are well known in the art. Typical of such prior art is that disclosed in U.S. Pat. No. 4,867,735 issued to Wogelius on September 19, 1989 that discloses a method and apparatus for continuous fabrication of bags from a multilayer thermoplastic film web.

[0003] Some flexible bags have also been made from thin films that have deformations formed in them. A known method of forming such films is by passing a continuous web between a pair of matched forming rollers to form an intentional pattern of deformations on the film. One problem that arises when making flexible bags from a

film formed in this manner is that, if the film has at least one overlapped layer or is made in a tubular manner, when having deformations formed therein, one layer becomes engaged within the other and is difficult to separate for subsequent processing. A similar problem arises when films such as thermoplastic elastomeric films exhibit excessive blocking characteristics. Blocking is the tendency of a film to adhere to itself. One approach to resolving this problem for continuous webs made in a tubular manner is to inflate the tube of film with air to separate the two formed layers. For example, U.S. Pat. No. 3,857,144 issued to Bustin on December 31, 1974 discloses making a flexible bag in which a polyethylene film is passed between a pair of matched forming rollers and the continuous formed web is then inflated or an air bubble is trapped within the web to separate the two formed layers. Also, illustrative of the state of the art with regard to flexible bags and continuous webs with intentional patterns of deformations formed in them are, for example, U.S. Pat. No. 5,554,093 issued to Porchia et al. on September 10, 1996, U.S. Pat. No. 5,575,747 issued to Dais et al. on November 19, 1996, U.S. Pat. No. 5,723,087 issued to Chappell et al. on March 3, 1998, and U.S. Pat. No. 6,394,652 issued to Meyer et al. on May 28, 2002.

[0004] It is frequently difficult to separate the overlaying or overlapping layers of film in which deformations have been formed which can cause problems during subsequent processing. This problem is even more acute when the continuous web from which the flexible bags are made is not in a tubular configuration that can be easily inflated using air. In particular, many flexible bags are made by simply laying at least one thin plastic sheet over another or by folding a sheet or a continuous web over onto itself in an overlapped or "C" fold configuration. In these instances, inflating the continuous web using air is not a practical method to separate the overlapping layers since the air has a tendency to escape through the open edge opposite the fold. Even when a tubular configuration of continuous web is used, an air bubble can have a tendency to leak air out through the deformations or creases formed in the continuous web. Consequently, it is desirable to identify a process for easily separating overlapped layers of a continuous web after patterns of deformations have been formed in the continuous web.
Additionally, it is desirable to provide such a process and apparatus capable of producing flexible bags from a continuous web at high speeds in a consistent manner.

Summary of the Invention

[0005] The present invention provides a method and apparatus for making flexible articles such as flexible bags and the like from a continuous web of sheet material.

[0006] In one embodiment of the present invention, a continuous process for making flexible articles having elastic-like behavior is provided. The process comprises several steps. A sheet material is introduced having one portion of the sheet material overlapped onto another portion of the sheet material. The sheet material is formed into a strainable network. The strainable network includes a plurality of first regions and a plurality of second regions. The first regions are substantially un-deformed and the second regions are formed into disengageable pleat elements. As the overlapped portions of the sheet material are formed they engage each other in the pleat elements. The pleat elements of each overlapped portion become trapped within each other and resist disengagement because of the frictional forces and attractive forces of the sheet material. The overlapped portions of the sheet material are separated using a disengaging means so that the overlapped portions become disengaged and separated from each other upon riding on the disengaging means. Preferably, the disengaging means is in the form of a static opening bar, a dynamic opening bar, or a suction means. More preferably, the flexible article is a flexible bag that is formed from the sheet material.

Brief Description of the Drawings

[0007] While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed that the present invention will be better understood from the following description in conjunction with the accompanying drawing figures, in which like reference numerals identify like elements, and wherein:

Figure 1 is a perspective view of a flexible bag made in accordance with the present invention;

Figure 2 is a schematic illustration of a process to manufacture flexible bags in accordance with the present invention;

Figure 3 is a simplified perspective illustration of a forming apparatus in accordance with the present invention;

Figure 4 is a simplified side view of an alternative forming apparatus with the continuous web in accordance with the present invention;

Figure 5 is a partial plan view illustration of the continuous web of sheet material resulting from the present invention in a partially tensioned condition;

Figure 6 is a perspective illustration of a static opening bar in accordance with the present invention;

Figure 7 is an illustration of a static opening bar and continuous web taken at section line 7-7 of Fig. 6;

Figure 8 is a perspective illustration of one embodiment of a dynamic opening bar in accordance with the present invention;

Figure 9 is a perspective illustration of another embodiment of a dynamic opening bar in accordance with the present invention;

Figure 10 is a side view illustration of a dynamic opening bar with the continuous web of the present invention;

Figure 11 is a perspective illustration of one embodiment of an end cap in accordance with the present invention;

Figure 12 is a perspective illustration of a preferred embodiment of a dynamic opening bar in accordance with the present invention;

Figure 13 is a side view illustration of a preferred dynamic opening bar with the continuous web of the present invention;

Figure 14 is a perspective illustration of yet another embodiment of a dynamic opening bar in accordance with the present invention;

Figure 15 is a perspective illustration of the dynamic opening bar of Fig. 13 captured within a cage in accordance of the present invention;

Figure 16 is a side view illustration of an alternative embodiment of a dynamic opening bar and a cage;

Figure 17 is a perspective illustration of an alternative embodiment of a disengaging means in accordance with the present invention with vacuum manifold disconnected for clarity;

Figure 18 is a side view illustration of yet another alternative embodiment of a disengaging means in accordance with the present invention; and

Figure 19 is a perspective view of a roll of flexible bags made in accordance with the present invention.

Detailed Description of the Invention

[0009] Referring now to Fig. 1 in which is illustrated a preferred embodiment of a flexible bag 10 made according to the present invention. Flexible bag 10 includes bag body 20, an opening along top edge 28, a sealed first seam 21, a sealed second seam 23, and a closed bottom formed at bottom fold 22. Preferably, flexible bag 10 includes first regions 64 and second regions 66 forming a strainable network across bag body 20. In one embodiment of flexible bag 10, first regions 64 are in a substantially criss-crossing pattern across bag body 20. In this embodiment, flexible bag 10 is tubular in shape and has an interior 12. Flexible bag 10 is illustrated with optional closure means 30 located at or adjacent to top edge 28. Optional closure means 30 can be used to close flexible bag 10 forming a fully enclosed container to assure the contents contained in its interior 12 do not escape through the opening at top edge 28.

[0010] Preferably, flexible bag 10 is constructed from a sheet material 52 that is suitable for containing and protecting a wide variety of items and/or objects contained within interior 12 of flexible bag 10. The term "sheet material" as used herein is the composition or substance from which the articles described herein are made. Various materials known in the art are suitable for constructing sheet material 52 used in flexible bags 10 made in accordance with the present invention. For example, some typical sheet materials 52 for making such flexible bags 10 can be substantially impermeable materials including any polymeric material. Exemplary, but non limiting, polymeric materials can include polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), and any polyolefin such as linear low density polyethylene (PE), low density PE, high density PE or polypropylene (PP). Other types of materials may include aluminum foil, thin sheet metal, coated (waxed, etc.) and uncoated paper, coated nonwovens, or can even be

substantially permeable materials including any scrims, meshes, wovens, nonwovens, or perforated or porous films, whether predominantly two-dimensional in nature or formed into three-dimensional structures. Such sheet materials 52 may comprise a single composition or layer or may alternatively be a composite or laminate structure of disparate materials or multiple layers, or any combinations thereof.

[0011] In yet another embodiment of the present invention, sheet material 52 can be formulated to include a slip agent. Slip agents can bloom to the surface of sheet material 52. In addition to having slip agents incorporated in the composition of sheet material 52, additional slip agents can be applied to the surface of at least a portion of sheet material 52. A slip agent is a compound or composition that can help to reduce the coefficient of friction on the surface of sheet material 52 thereby making the sheet material 52 easier to disengage and separate from any overlapping portion. Slip agents may even prevent portions of sheet material 52 from adhering to each other. Some exemplary slip agents can include, for example, talc (hydrated magnesium silicate), diatomaceous earth, ceramic microspheres, N-Ethylenebisstearammide, erucamide, acrawax C, graphite, or the like. Ceramic microspheres useful herein are commercially available from 3M Corporation under the name Zeeospheres™ ceramic microspheres.

[0012] Various articles other than flexible bags 10 can be produced using the present invention including, for example, cartons, cans, containers, bottles, boxes, jars, packages, pouches, plates, wraps, webs, films, sheets, and the like. Some of the numerous product applications for flexible bags 10 made as disclosed herein include, for example, sandwich bags, food storage bags, trash bags, body bags for containment of human or animal remains, Christmas tree disposal bags, colostomy bags, dry cleaning and/or laundry bags, bags for collecting items picked from warehouse inventory (stock pick bags), shopping bags, and the like.

[0013] In one embodiment of the present invention, flexible bags 10 can be made from raw materials in that the process begins with the manufacture of a continuous web 53 of sheet material 52 from which a multiplicity of flexible bags 10 is produced. The term "continuous web" as used herein is an integral length of sheet material 52 sufficient

to fabricate a multiplicity of flexible bags 10 connected in an edge-to-edge configuration. In another embodiment of the present invention, flexible bags 10 can be made from a previously produced roll or discrete piece of sheet material 52 which is then introduced into the process defined herein.

[0014] Referring now to Fig. 2, one method for making flexible bag 10 is by creating sheet material 52 and converting it into multiple flexible bags 10 through a continuous or discontinuous process. A raw plastic material can be formed by blowing or casting a continuous web 53 of sheet material 52 as is well known in the art. For example, a continuous web 53 can be blown from a raw stock of plastic material introduced in pellet form into an extruder 120, from which a tubular structure such as a tube 51 of thin plastic material is extruded through tubular die 121. Tube 51 is inflated by blowing or capturing an air bubble within tube 51. Typically, this tube 51 is cooled as it rises. Tube 51 can be pressed together through a set of pinching rollers 122. Pinching rollers 122 collapse the air bubble and compress the walls of tube 51 together into a flattened continuous web 53 of sheet material 52 having at least one overlapped portion. Overlap or overlay as used herein includes, without limitation, any ply, layer, web, film or sheet laid on any portion of another. For example, overlapped can include multiple layers, multiple-ply, laminates, tubes, folded sections, gussets, or any two sheets laying on any part of another sheet or even on any part of the same sheet. Consequently, sheet material 52 can be overlapped in a manner that the overlapped portions are placed into contact with each other. It is when the overlapped portions of sheet material 52 are in contact that they can thereafter be disengaged and separated such that they are no longer in contact with each other. One method for making a continuous web 53 of sheet material 52 is disclosed in U.S. Pat. No. 3,857,144 issued to Bustin on December 31, 1974. Another way to make a continuous web 53 of sheet material 52 is by casting the continuous web 53 and one such casting method is disclosed in U.S. Pat. No. 4,428,788 issued to Kamp on January 31, 1984.

[0015] In a preferred embodiment of the present invention, continuous web 53 can pass through or over cutting station 154 after passing through pinching rollers 122. Cutting station 154 can simply be a blade or a set of blades that can cut or slit continuous web 53 longitudinally as it passes over cutting station 154. In one embodiment of the

present invention, a single continuous web 53 can be cut into two or more continuous webs 53 which can then be wound into rolls 11 and stored for future use or, alternatively, one or more of such continuous webs 53 are introduced into additional converting station as described herein. For example, continuous web 53 can be cut by cutting station 154 so as to separate continuous web 53 into four separate continuous webs 53 such that two of the resulting continuous webs 53 are substantially curved having a substantially "C" shaped transverse cross-section and the other two continuous webs 53 are substantially flat. The two flat continuous webs 53 can then be passed through separate folding stations 133 to fold sheet material 52 in order to overlap at least one portion over another and then these continuous webs 53 can be wound onto rolls 11. Alternatively, the two flat continuous webs 53 can be wound into rolls 11 without folding. Likewise the two substantially curved continuous webs 53 can be passed through separate folding stations 133 to overlap at least one portion of sheet material 53 onto another. The substantially "C" shaped cross-section is formed by overlapping or overlaying at least a portion of the sidewalls of sheet material 52 over each other. Thereafter the sidewalls are referred to as being connected through a folded region, which in the present embodiment is bottom fold 22. Alternatively, two flat continuous webs 53 or other discrete pieces of sheet material 53 can be laid into contact with each other and sealed together along a longitudinal edge forming the region referred to as bottom fold 22. Each continuous web 53 of sheet material 52 can then be independently wound into rolls 11 for future use or can be immediately processed according to the present invention.

[0016] Once sheet material 52 is produced, it can be introduced into a continuous or discontinuous process for making articles such as flexible bags 10 through transport rollers 123. In this same manner, sheet material 52 can be introduced into multiple converting stations for immediate processing. At various points along the process described herein, continuous web 53 of sheet material 52 can be wound into a roll 11 and stored for future use in this or another process as is known by those of ordinary skill in the art. "Continuous process" as used herein means repetitive, ongoing or continuing steps that are not intended to stop or cease until multiple flexible bags 10 are produced. As used herein, "introduce" can mean pass, feed, insert, engage, flow or push sheet material 52 into the next converting station. At winding station 111 , sheet material 52 is

wound into rolls 11 of sheet material 52 as is known by those of ordinary skill in the art. Sheet material 52 can be introduced into any one of the numerous converting station by unwinding a previously wound roll 11 of sheet material 52 and introducing it through transport rollers 123.

[0017] The processing of continuous web 53 of sheet material 52 continues as sheet material 52 passes through the next converting station which can be an alternative or optional step. This optional step can be closure station 160 which incorporates or forms closure means 30 onto sheet material 52. Closure means 30 is formed at edge 28 and is used to seal or close off interior 12 after flexible bag 10 is filled with contents. Under some circumstances a closure means 30 formed by a lesser degree of encirclement (such as, for example, a closure means disposed along only one side of edge 28) may provide adequate closure integrity. Closure means 30 can be made from a strip of flexible plastic material in accordance with U.S. Pat. No. 4,624,654 issued to Boyd et al. on November 25, 1986.

[0018] Other types of closure means 30 may alternatively be utilized including, for example, drawstring-type closures, tieable handle tabs or flaps, twist tie or interlocking strip closures, adhesive-based closures, interlocking mechanical seals with or without slider-type zipper closure mechanisms, removable ties or strips made of plastic or other materials, heat seals, or any other suitable closure means 30 can be used. Such closure means 30 are well known in the art as are methods of manufacturing and making them. Alternatively, closure means 30 of any design and configuration suitable for its intended purpose may be utilized in constructing flexible bags 10 according to the present invention. In yet another alternative embodiment, closure means 30 can be omitted from flexible bag 10. After closure means 30 is incorporated into continuous web 53 of sheet material 52, continuous web 53 of sheet material 52 can be introduced to the next converting station through transport rollers 123.

[0019] Now referring to Fig. 3, forming apparatus 500 includes a pair of rollers 502, 504. First roller 502 includes a plurality of toothed regions 506 and a plurality of grooved regions 508 that extend across cylindrical roller 502. Toothed regions 506 include a

plurality of teeth 507. Second roller 504 includes a plurality of teeth 510 which mesh with teeth 507 on roller 502. An alternative embodiment of intermeshing first roller 502 and second roller 504 is illustrated in Fig. 4 along with a continuous web 53 of sheet material 52. Continuous web 53 of sheet material 52 can be introduced into forming apparatus 500 to form a strainable network having at least two visually distinct regions 64, 66. As continuous sheet material 52 is passed between intermeshing rollers 502 and 504, grooved regions 508 will leave portions of continuous web 53 of sheet material 52 unformed producing first regions 64. The portions of continuous web 53 of sheet material 52 passing between toothed regions 506 and teeth 510 will be formed by teeth 507 and 510, respectively, into a plurality of disengageable pleat elements 74 in second regions 66.

[0020] As sheet material 52 passes between first forming roller 502 and second forming roller 504, disengageable pleat elements 74 are formed into the overlapped portions of sheet material 52. The overlapped portions of sheet material 52 are pressed into contact with each other at first regions 64 and are pressed into engaging contact with one another in second regions 66 where the raised pleat elements 74 are formed. Regions 66 can comprise rows of deeply formed deformations in sheet material 52 of continuous web 53, while regions 64 can comprise intervening un-deformed portions of continuous web 53.

[0021] Forming apparatus 500 can form discrete areas having an increased frequency of pleat elements 74 or discrete areas having a decreased frequency of pleat elements 74 in sheet material 52 by increasing or decreasing the concentration of teeth 507 along the circumference of forming roller 502 and along the width of forming roller 502. Likewise, the height of teeth 507 on forming roller 502 can vary within a particular toothed region 506 and along the circumference of forming roller 502 in order to vary the height of corresponding pleat elements 74. Such a configuration of forming apparatus 500 allows pleat elements 74 to be formed in sheet material 52 having predetermined elongation characteristics. As used herein, the term "formed" refers to the creation of a desired three-dimensional structure or geometry upon sheet material 52 that will substantially retain its shape when it is not subjected to any externally applied elongation or other

forces. The term "pleat" refers to a formation having a major axis and a minor axis wherein the major axis is equal to or preferably greater than the minor axis.

[0022] In accordance with the present invention as illustrated in Fig. 5, these first regions 64 and second regions 66 impart bag body 20 of flexible bag 10 with an elastic-like behavior. As used herein, the term "elastic-like" describes the behavior of flexible materials which when subjected to an applied elongation force, the flexible materials extend in the direction of the applied elongation and when the applied elongation is released the flexible materials return, to a substantial degree, to their untensioned condition. In particular, sheet material 52 includes a "strainable network" of distinct regions 64, 66. As used herein, the term "strainable network" refers to an interconnected and interrelated plurality of first regions 64 and second regions 66 which enable the elastic-like behavior. This strainable network can be extended to some useful degree in a predetermined direction, such as along axis "T", in response to the applied and subsequently released elongation force. In particular, pleat elements 74 are able to unbend, unfold or geometrically deform in a direction substantially perpendicular to their first axis 76 to allow extension of sheet material 52 in response to such an applied axial elongation. Sheet material 52 made in accordance with the present invention is configured such that the un-deformed first regions 64 are visually distinct from the substantially deformed second regions 66. As used herein, the term "visually distinct" refers to features of sheet material 52 which are readily discernible to the normal naked eye when sheet material 52 or articles incorporating sheet material 52, such as flexible bags 10, are observed.

[0023] Additionally, while it is presently preferred to construct substantially the entire bag body 20 from a sheet material 52 having the structure and characteristics made in accordance with the present invention, it may be desirable under certain circumstances to provide such elastic-like behavior in only one or more portions or zones of bag body 20 rather than its entirety. For example, bag body 20 of flexible bag 10 can have discrete areas where first regions 64 and second regions 66 exist and the strainable network is evident while also having discrete areas of bag body 20 without any such strainable network. These discrete areas can be produced when forming rollers 502, 504 that

produce pleat elements 74 are intermittently retracted or removed from being in contact with sheet material 52 as continuous web 53 passes through forming apparatus 500. This intermittent removal or opening of forming rollers 502, 504 allows discrete areas of un-deformed sheet material 52 to be created. Such intermittent removal can be synchronized to create a repeating pattern of discrete areas that are un-deformed while also providing discrete areas that are formed of first regions 64 and second regions 66 in a strainable network. Sealing land 26, first seam 21, bottom fold 22, and second seam 23 (shown in Fig. 1) are each an example of areas that can be wholly void of any such strainable network. Sealing land 26, first seam 21, and second seam 23 can be un-deformed areas that help assure proper sealing.

[0024] Sheet materials 52 such as those illustrated and described herein as suitable for use in accordance with the present invention are described in greater detail in commonly assigned U.S. Pat. No. 5,518,801 issued to Chappell et al. on May 21, 1996; U.S. Pat. No. 5,691,035 issued to Chappell et al. on November 25, 1997; and U.S. Pat. No. 5,650,214 issued to Anderson et al. on July 22, 1997; and U.S. Pat. No. 5,723,087 issued to Chappell et al. on March 3, 1998. A flexible bag 10 made from sheet material 52 including the strainable network for use with the present invention is illustrated and described in greater detail in commonly assigned U.S. Pat. No. 6,394,652 issued to Meyer et al. on May 28, 2002. While continuous web 53 has been described in this process along with forming rollers 502, 504, it is understood that a discrete piece of sheet material 52 can be substituted for such continuous web 53 and reciprocating forming plates or any other device can alternatively be used to form the strainable network having first regions 64 and second regions 66. The term "discrete piece" as used herein is an integral length of sheet material 52 sufficient to fabricate only a portion of or only a few flexible bags 10 connected in an edge-to-edge configuration.

[0025] Another method of forming sheet material 52 suitable for use in the present invention is vacuum forming. An example of a vacuum forming method is disclosed in commonly assigned U.S. Pat. No. 4,342,314 issued to Radel et al. on August 3, 1982. Alternatively, the sheet material 52 may be hydraulically formed in accordance with the teachings of commonly assigned U.S. Pat. No. 4,609,518 issued to Curro et al. on

September 2, 1986. After the strainable network is incorporated into sheet material 52, it can be introduced to the next converting station through transport rollers 123.

[0026] After forming continuous web 53 in the manner described, it is frequently difficult to separate overlaying or overlapping layers of sheet material 52 in which pleat elements 74 have been formed. This problem is even more acute when continuous web 53 is not in a tubular configuration that can be easily inflated using air. A similar problem with overlapped layers adhering to each other occurs with continuous webs 53 that are highly blocked. Consequently, in one embodiment of the present invention a means for disengaging pleat elements 74 and/or separating overlapped portions of sheet material 52 is provided. Preferably, continuous web 53 is introduced into pre-opening or disengaging means 130 prior to sheet material 52 being introduced into bag-making machine 32.

[0027] Referring now to Fig. 6, disengaging means 130 in the form of an opening bar 200 is illustrated as a static opening bar 201 having a static leading edge 203. The term "static" as used herein means without movement or fixed in once place. In this embodiment, static leading edge 203 is static relative to the other components of disengaging means 130. Preferably, static leading edge 203 has a substantially rounded configuration. One example of a static opening bar 201 can include a support arm 205 that extends from and is supported at only one end by a mount 209 in a cantilevered manner. Extending outwardly from support arm 205 in a manner that can be substantially horizontal is forward extension 207. Preferably, forward extension 207 has a substantially cylindrical or rounded leading edge 203.

[0028] As illustrated in Fig. 7, the cantilevered configuration of static opening bar 201 allows insertion of static opening bar 201 between the overlapped portions of continuous web 53 of sheet material 52. Preferably, static opening bar 201 can extend at least partially across the width of sheet material 52. More preferably, static opening bar 201 is smooth and, in one embodiment, cylindrical allowing sheet material 52 to flow over an outer surface thereof without encountering any sharp corners that would disrupt the movement of sheet material 52. The forwardly extending portion of static opening

bar 201 is oriented substantially planar with the path of sheet material 52 immediately upstream of static leading edge 203. Static leading edge 203 encounters the overlapped portions of sheet material 52 causing the overlapped portions to separate from each other as static opening bar 201 is forced between the overlapped portions. In this manner, static opening bar 201 is used to disengage pleat elements 74 (not shown) and separate the overlapped portions of sheet material 52 as sheet material 52 rides over static opening bar 201. "Ride" as used herein means to come into physical contact with or to be carried on something or supported on or by the thing contacted. To "Ride" or "Riding" indicates that an item has come into contact with or against the thing over which it is being conveyed. As static leading edge 203 encounters the overlapped portions of sheet material 52, the frictional forces engaging pleat elements 74 of sheet material 52 are overcome. As sheet material 52 rides on static opening bar 201, the amount of force encountered as pleat elements 74 are disengaged increases as the rate at which sheet material 52 rides over static opening bar 201 increases.

[0029] In another embodiment of the present invention illustrated in Fig. 8, separating the overlapped portions of sheet material 52 includes the use of a disengaging means 130 in the form of an opening bar 200 that is a dynamic opening bar 202 having a dynamic leading edge 204. Dynamic, as used herein, means that leading edge 204 is not static relative to the other components of disengaging means 130. Dynamic leading edge 204 includes a pair of adjacent idler rollers 206, 208 extending in a cantilevered manner from base 210. Adjacent, as used herein, means that the pair of idler rollers 206, 208 are placed next to each other with only a small interval of space between them. Preferably, idler rollers 206, 208 are made of a high strength, lightweight materials to resist deflection forces such as, for example, aluminum, copper, carbon fiber or titanium. For improved handling of sheet material 52 without slippage and to assist in pulling continuous web 53 over idler rollers 206, 208, preferably idler rollers 206, 208 have high friction surfaces, such as with a plasma coating, for example, a PC12036 plasma coat commercially available from Plasma Coatings of TN, Inc. The axis of both idler rollers 206, 208 are preferably aligned parallel to each other and idler rollers 206, 208 are oriented transverse to the flow of sheet material 52. Alternatively, idler rollers 206, 208 can be arranged in unaligned configurations, for example, in an offset or nonparallel

configuration. Idler rollers 206, 208 revolve around axles that are supported by high-speed bearings mounted in base 210. In this embodiment, idler rollers 206, 208 form a dynamic leading edge 204 in that idler rollers 206, 208 rotate when contacted by sheet material 52.

[0030] In a preferred embodiment of dynamic opening bar 202, illustrated in Fig. 9, idler rollers 206, 208 can be supported by high-speed bearings mounted in base 210 at one end and in end cap 230 at the other end. In this preferred embodiment, end cap 230 is mounted on support arm 211 but alternatively, end cap 230 can be made integral with support arm 211. Optionally, end cap 230 and support arm 211 can be omitted as previously described. Support arm 211 is mounted on base 210 and spans between base 210 and end cap 230 just behind idler rollers 206, 208. The down stream trailing edge 238 of support arm 211 is positioned so as not to interfere with the flow of sheet material 52. Dynamic opening bar 202 extends at least partially across the width of sheet material 52 in a cantilevered manner. In this configuration, end cap 230 is positioned to allow the C folded region of continuous web 53 to ride upon outer surface 235.

[0031] As illustrated, idler rollers 206, 208 are constructed in a configuration in which each idler roller 206, 208 is made up of two separate intermediate rollers attached end to end. In particular, idler roller 206 includes first intermediate roller 251 connected end to end with a second intermediate roller 253. Similarly, idler roller 208 is of the same configuration having a first intermediate roller 252 connected end to end with a second intermediate roller 254. Bracket 250 is mounted between first intermediate rollers 251, 252 and second intermediate rollers 253, 254 forming a junction between first intermediate rollers 251, 252 and second intermediate rollers 253, 254. Bracket 250 is shaped somewhat like a "figure 8" and is recessed from the outer diameter of each corresponding roller 251, 252, 253, 254. In this manner, continuous web 53 of sheet material 52 can ride over idler rollers 206, 208 without contacting bracket 250. This configuration enables a wider dynamic opening bar 202 for handling wider continuous webs 53.

[0032] An end cap 230 is configured with rounded edges to allow the overlapped portion of sheet material 52 to pass over outer surface 235 without encountering any sharp edges. In one embodiment, end cap 230 is substantially hemispherical at a forward portion and tapers toward rear end 239 in a somewhat "tear drop" shape. End cap 230 is attached to support arm 211 using fasteners that pass through fastener recesses 237 in outer surface 235. Preferably, end cap 230 is aligned with opposite outer segments 216, 218 of idler rollers 206, 208 to assure that no misalignment exists between the ends of idler rollers 206, 208 and end cap 230. Any such misalignment can result in tearing, ripping or disfiguring of sheet material 52 as continuous web 53 rides over dynamic opening bar 202. Consequently, in a most preferred embodiment, end cap 230 is slightly recessed below opposite outer segments 216, 218 of idler rollers 206, 208 and a trailing edge 238 of support arm 211 does not extend beyond rear end 239 of end cap 230.

[0033] As illustrated in Fig. 10, inner segments 219, 220 of the set of idler rollers 206, 208 is the area where idler rollers 206, 208 come into close proximity with each other and opposite thereto are outer segments 216, 218. Preferably, idler rollers 206, 208 are positioned such that a plane containing their centerlines is substantially perpendicular to the path of sheet material 52 just upstream of dynamic opening bar 202 and idler rollers 206, 208 are preferably, equal-distant from the plane defined by the path of sheet material 52 just upstream of dynamic opening bar 202. The overlapped portions of sheet material 52 ride over opposite outer segments 216, 218 of idler rollers 206, 208 thus causing pleat elements 74 to disengage and overlapped portions of sheet material 52 to separate from each other. Location "U" is the point at which overlapped portions of sheet material 52 naturally begin disengaging and separating from each other. The distance from dynamic leading edge 204 to location U varies depending on the rate at which continuous web 53 is traveling, and the tension of continuous web 53 and adherence between the overlapped portions of sheet material 52. Location U may oscillate in the machine direction or in a cross direction. This oscillation can be toward and away from dynamic leading edge 204 even when continuous web 53 is moving at a constant rate of speed.

[0034] Referring now to Fig. 11, in an alternative embodiment, end cap 230 can have dimples 236 in outer surface 235 in order to enable continuous web 53 of sheet material

52 to ride over end cap 230 with less friction than when outer surface 235 is smooth. Preferably, dimples 236 in outer surface 235 are substantially hemispherical. Fastener recesses 237 are also illustrated in outer surface 235 of end cap 230. To assure that sheet material 52 and the overlapped portions thereof smoothly flow as they ride over end cap 230, end cap 230 preferably has a highly polished outer surface 235. Preferably outer surface 235 has a low coefficient of friction such as with a plasma coating. One exemplary plasma coating is PC-14015-02 plasma coating commercially available from Plasma Coatings of TN, Inc.

[0035] In one preferred embodiment of the present invention as illustrated in Fig. 12, dynamic opening bar 202 includes two sets of adjacent idler rollers 206, 208, 212, 214. Second set of idler rollers 206, 208 forming dynamic leading edge 204 (not shown) and having end cap 230 are substantially the same as described in reference to Figs. 8 through 10. In this embodiment, first set of adjacent idler rollers 212, 214 is added and positioned immediately upstream of second set of idler rollers 206, 208 across the entire width of continuous web 53. First set of adjacent idler rollers 212, 214 are supported by frame 221 having high-speed bearings mounted on both ends of idler rollers 212, 214. Frame 221 can be constructed of multiple components or as one unitary component. Second set of idler rollers 206, 208 are preferably supported at only one end by high-speed bearings mounted on base 210 in a cantilevered manner and having end cap 230 affixed on the ends opposite base 210. Additionally, support arm 211 is mounted on base 210 and spans between base 210 to end cap 230 just behind idler rollers 206, 208. Alternatively, second set of idler rollers 206, 208 and support arm 211 can be mounted on a portion of frame 221 that is positioned so second set of idler rollers 206, 208 are just behind first set of idler rollers 212, 214.

[0036] Now referring to Fig. 13, when disengaging means 130 is in the form of two sets of adjacent idler rollers 206, 208, 212, 214, the overlapped portions of sheet material 52 are disengageable as they pass between first set of idler rollers 212, 214. Thereafter the overlapped portions of sheet material 52 are disengaged and separated from each other as each overlapped portion encounters and moves toward opposite outer segments 216, 218 of second set of idler rollers 206, 208. Sheet material 52 rides between first set

of idler rollers 212, 214 and then the overlapped portions of sheet material 52 are pulled away from each other in a manner that disengages pleat elements 74 and separates the overlapped portions of sheet material 52 as sheet material 52 moves toward and rides on second set of idler rollers 206, 208. Sheet material 52 rides on inner segments 227, 228 of first set of idler rollers 212, 214 and rides over outer segments 216, 218 of second set of idler rollers 206, 208. These two sets of adjacent idler rollers 206, 208, 212, 214 are configured such that first set of idler rollers 212, 214 is spaced apart from second set of idler rollers 206, 208 to assure a fixed location U for separation of the overlapped portions of sheet material 52. In a preferred configuration, spacing Z between first set of idler rollers 212, 214 and second set of idler rollers 206, 208 is less than about the distance between naturally occuring location U and second set of rollers 206, 208.

[0037] In still another embodiment of the present invention as illustrated in Fig. 14, dynamic opening bar 202 is shown including an end cap 230 at either end. Often continuous webs 53 of sheet material 52 are extruded and blown and further processed without cutting of continuous web 53 and without folding to overlap any portions of continuous web 53. In these instances, continuous web 53 remains in a substantially tubular configuration without any open edges. During processing, overlapped portions are formed simply by collapse of the tubular walls. Consequently, there are no open edges to insert and maintain the support of disengaging means 130 in even a cantilevered manner. In order to separate such continuous webs 53 an alternative embodiment of disengaging means 130 is utilized. Dynamic opening bar 202 includes a pair of idler rollers 206, 208 that form dynamic leading edge 204. The axis of both idler rollers 206, 208 are aligned parallel to each other and idler rollers 206, 208 are positioned adjacent to each other. Idler rollers 206, 208 revolve around axles that are supported by end caps 230. Opposing end caps 230 are used to support idler rollers 206, 208 at both ends of idler rollers 206, 208. Support arm 211 spans between both opposing end caps 230 and is positioned just behind idler rollers 206, 208. Each end cap 230 is attached to support arm 211 at opposite ends of support arm 211 using fasteners that pass through fastener recesses 237 in outer surface 235 in the same manner as previously discussed. During use, this configuration of dynamic opening bar 202 can be wholly surrounded by overlapped portions of sheet material 52.

[0038] Now referring to Fig. 15, dynamic opening bar 202 is capable of movement between upper support rollers 280, 282, 284, 286 and lower support rollers 281, 283, 285, 287 which form a cage 290 around dynamic opening bar 202 so that dynamic opening bar 202 is captured within cage 290. In this embodiment, dynamic opening bar 202 is illustrated as being horizontally disposed within cage 290. Upper support rollers 280, 282, 284 have corresponding lower support rollers 281, 283, 285 that are preferably arranged in pairs spaced longitudinally adjacent and on opposite sides of dynamic opening bar 202. At a forward end of cage 290 are positioned a set of adjacent support rollers 280, 281. Support roller 280 is aligned in an upper position while support roller 281 is aligned in a lower position. Forward support rollers 280, 281 are spaced apart to allow continuous web 53 to pass between them while preventing the forward migration of dynamic opening bar 202. At this forward location dynamic leading edge 204, idler rollers 206, 208 and support rollers 280, 281 are all positioned the same relative to each other as the two sets of adjacent idler rollers illustrated in Fig. 12. Positioned just behind and outboard of idler rollers 206, 208 and outboard of a mid-portion of dynamic opening bar 202 are middle support rollers 282, 283. Middle support rollers 282, 283 are positioned on opposite sides of dynamic opening bar 202 in order to maintain dynamic opening bar 202 in its horizontal position parallel to the flow of continuous web 53. In a preferred configuration two sets of middle support rollers 282, 283, 286, 287 are provided to maintain dynamic opening bar 202 in its horizontal position. Middle support rollers 282, 286 are spaced apart adjacent an upper side of dynamic opening bar 202 while middle support rollers 283, 287 are spaced apart adjacent a lower side of dynamic opening bar 202. Rear support rollers 284, 285 are positioned to assure dynamic opening bar 202 does not migrate rearward from its desired position. In this manner dynamic opening bar 202 is captured within cage 290.

[0039] In order to insert and extract dynamic opening bar 202 from within cage 290, middle support rollers 282, 286 in the upper position can be removed so that dynamic opening bar 202 can be lifted out of cage 290. Alternatively, middle support rollers 282, 286 in the upper position can be attached to a hinged frame. In this manner, the hinged frame could be opened moving middle support rollers 282, 286 away from dynamic

opening bar 202 for maintenance or other purposes. For example, during start up of continuous web 53 dynamic opening bar 202 can be inserted within the tubular walls when middle support rollers 282, 286 are moved out of position. Middle support rollers 282, 286 are moved back into position in order to maintain dynamic opening bar 202 captive.

[0040] In this configuration, continuous web 53 of sheet material 52 can wholly enclose dynamic opening bar 202 which floats within the tubular walls of continuous web 53. The overlapped portions of sheet material 52 ride between forward support rollers 280, 281 of cage 290 and over opposite outer segments 216, 218 of idler rollers 206, 208 on dynamic opening bar 202 thus causing pleat elements 74 to disengage and overlapped portions of sheet material 52 to separate from each other. In this manner, continuous web 53 is threaded between dynamic opening bar 202 and cage 290. The overlapped portions of continuous web 53 of sheet material 52 can ride over opposite sides of dynamic opening bar 202.

[0041] Referring now to Fig. 16 in which is illustrated, an alternative dynamic opening bar 202 within cage 290 with continuous web 53 threaded between dynamic opening bar 202 and cage 290. In this alternative configuration of dynamic opening bar 202, an additional pair of upper idler rollers 292, 294 are positioned on an upper portion of dynamic opening bar 202 down stream of idler roller 206 and an additional pair of lower idler rollers 293, 295 are positioned on a lower portion of dynamic opening bar 202 down stream of idler roller 208. Upper idler rollers 292, 294 and lower idler rollers 293, 295 can be mounted at both ends in end caps 230. Upper idler rollers 292, 294 and lower idler rollers 293, 295 assist in supporting and guiding continuous web 53 of sheet material 52 as continuous web 53 is threaded between middle support rollers 282, 286 that are spaced adjacent an upper side of dynamic opening bar 202 and middle support rollers 283, 287 that are spaced adjacent a lower side of dynamic opening bar 202. Upper idler rollers 292, 294 and lower idler rollers 293, 295 cooperate with corresponding upper middle support rollers 282, 286 and lower middle support rollers 283, 287 respectively to assist in maintaining the smooth flow of continuous web 53 as continuous web rides over dynamic opening bar 202 while also maintaining dynamic opening bar 202 in a horizontal

position. Optionally, upper idler rollers 292, 294 and lower idler rollers 293, 295 can be spherical ball bearings instead of cylindrical rollers.

[0042] In another alternative embodiment of the present invention as illustrated in Fig. 17, the step of separating the overlapped portions of sheet material 52 (not shown) includes the use of a disengaging means 130 in the form of a suction means 550. Suction means 550 is used to disengage and separate the overlapped portions of sheet material 52 as sheet material 52 rides on suction means 550. In this embodiment, suction means 550 can be an integral part of forming roller 502, 504 and can include apertures 575 in at least one of forming rollers 502, 504. A plurality of small apertures 575 on each tooth 507 are connected with a vacuum manifold 570 through passageways internal to forming rollers 502, 504. Openings 576 are depicted on a faceplate at one end of rollers 502, 504. Vacuum manifold 570 is attached to openings 576 in a manner that allows rotation of rollers 502, 504. As sheet material 52 passes between forming rollers 502 and 504 wherein pleat elements 74 are formed, suction is also applied to the overlapped portions of sheet material 52 through apertures 575. A vacuum, indicated generally by arrow "V", is created and suction applied through vacuum manifold 570 extending through openings 576 into passageways and apertures 575 in teeth 507. This vacuum allows a suction force to be applied to the overlapped portions of sheet material 52 thereby disengaging pleat elements 74 immediately after they are formed by forming rollers 502 and 504. In particular, the suction applied through apertures 575 pulls the overlapped portions of sheet material 52 apart. In that manner, pleat elements 74 are disengaged and the overlapped portions of sheet material 52 are separated.

[0043] In yet another alternative embodiment, as illustrated in Fig. 18, suction means 550 can be in the form of opposing plenums 579 that are situated in close proximity to sheet material 52 just after continuous web 53 passes through forming apparatus 500. A vacuum, as indicated generally by arrows "V", can be applied through each plenum 579 sufficient to pull the overlapped portions of continuous web 53 of sheet material 52 apart in order for pleat elements 74 to become disengaged from each other. The vacuum also provides sufficient suction to separate the overlapped portions of sheet material 52 from each other. After pleat elements 74 are disengaged and overlapped portions of sheet

material 52 are separated from each other, continuous web 53 can be introduced to the next converting station through transport rollers 123.

[0044] In an alternative embodiment of the present invention, disengaging means 130 can be in the form of an air knife used to disengage and separate overlapped portions of sheet material 52. Air knives are well known by those of ordinary skill in the art in that air can be blown between the overlapped portions of sheet material 52 to disengage pleat elements 74. In still another alternative embodiment, disengaging means 130 can include an air bearing. For example, an air bearing can be a surface disposed between the overlapped portions of sheet material 52 and wherein a layer of air is introduced onto the surface such that sheet material 52 rides on the layer of air. Air bearings of this type are well known in the art. Alternatively, such surfaces can utilize any gas, liquid, gel or flowable solid to form the layer on which sheet material 52 traverses including, for example, nitrogen, oil, glycerol, graphite, grease, water, and any combinations thereof.

[0045] Referring back to Fig. 2, optionally, a pair of opposing gussets 54 can be formed in continuous web 53 at an optional converting station using methods well known in the art. Such an optional gusseting station 150 is illustrated as being just before bag-making machine 32 but alternatively gussets can be inserted into continuous web 53 in various other sequences as is known by those of ordinary skill in the art.

[0046] The processing of continuous web 53 can continue by introducing continuous web 53 into a bag-making machine 32. Continuous web 53 passes through bag-making machine 32 to form flexible bag 10 including a strainable network having at least two visually distinct regions. For example, flexible bags 10 can be formed from continuous web 53 such that said continuous web 53 has a perforated or tear section adjacent to a sealed section which extends transversely across a width of said continuous web 53. A perforated section adjacent to sealed section can be spaced apart longitudinally from a next pair of similarly configured perforated section and sealed section. One such method of forming such a flexible bag 10 is disclosed in U.S. Pat. No. 4,867,735 issued to Wogelius on September 19, 1989. After flexible bags 10 are incorporated into continuous

web 53, continuous web 53 can be introduced to the next converting station through transport rollers 123.

[0047] Alternatively, converting station, just ahead of bag-making machine 32 can be a calender station 150 used to process continuous web 53 by flattening or pressing together at least a portion of continuous web 53 to improve bonding or sealing capabilities of sheet material 52. In particular, discrete areas of continuous web 53 should stay in close contact with each other to insure effective sealing, bonding and forming of sheet material 52. Consequently, continuous web 53 can be pretreated by uniformly flattening pleat elements 74 via the application of pressure and heat upon sheet material 52. To form these discrete portions onto continuous web 53 at the required locations, a set of rolls can be used. Continuous web 53 passes between smooth rollers as they are pressed into contact with each other to flatten sheet material 52. In a preferred embodiment, smooth rollers are heated using steam or some other method of heating smooth rollers. As sheet material 52 passes between smooth rollers, pleat elements 74 of second region 66 become substantially planar with the un-deformed first region 64. Smooth rollers flatten or collapse pleat elements 74 while not changing the functional structure of the strainable network. After continuous web 53 passes through this converting station, continuous web 53 can be introduced to the next converting station through transport rollers 123.

[0048] The processing of continuous web 53 continues as continuous web 53 is introduced to a folding station 133. Continuous web 53 passes through folding station 133 that is preferably positioned after bag-making machine 32. Folding of continuous web 53 is in a manner that reduces the transverse width of continuous web 53 by overlapping portions of continuous web 53 upon each other. Folding bars 33 comprise folding station 133 and are used in a manner known by those of ordinary skill in the art. After the folding is completed, continuous web 53 can be introduced to the next converting station through transport rollers 123.

[0049] The processing of continuous web 53 continues as continuous web 53 is introduced into rewinding station 111 that is preferably positioned after all of the

processing of continuous web 53 is completed. Rewinding station winds continuous web 53 into rolls 11 of flexible bags 10. These flexible bags 10 are wound in a manner such that upon unwinding a section of continuous web 53 allows flexible bags 10 to be severed from each other for individual use. Rewinding can include continuous web 53 being wound around a cylindrical core to form rolls 11 of flexible bags 10. Cylindrical cores can be utilized or omitted using winding methods that are known in the art.

[0050] Alternatively, once the desired sheet materials 52 are manufactured, comprising all or part of the components to be utilized for bag body 20, flexible bag 10 may be constructed in any known and suitable fashion such as those known in the art for making such flexible bags 10 in a commercially available form. Heat, mechanical, ultrasonic, or adhesive-sealing technologies may be utilized to join various components or elements of flexible bag 10 to themselves or to each other. In addition, bag body 20 may be folded or bonded to construct flexible bag 10 from a single continuous web 53 or a singular discrete piece of sheet material 52 or any combinations thereof.

[0051] A further alternative embodiment of the present invention can include taking a roll 11 of previously formed disposable bags or a roll 11 of sheet material 52 and unwinding roll 11 and introducing continuous web 53 from such roll 11 into a process as previously described above. Optionally many additional processing steps can be added either before or after the forming or separating of flexible bags 10 as described herein. Other processing steps can be completed such an alternative converting station illustrated as processing station 127 which can include, for example, printing labels, additional folding, cutting, forming or sealing or any combination of these or other converting processes.

[0052] While the process for making flexible bags 10 from a sheet material 52 has been described in a particular order, it is known that these steps can be performed in various orders. For example, a preferred sequencing of the process for making such flexible bags 10 can be to introduce the raw material into an extruder and then blow or cast form continuous web 53. Thereafter, continuous web 53 can be processed through a number of converting station or, alternatively, continuous web 53 of sheet material 52 can

be wound onto a roll 11 at any stage during the process. Such a roll 11 of sheet material 52 can then be set aside or introduced into any step of the process desirable. A particularly preferred process involves taking a pre-existing roll 11 of overlapped sheet material 52 and introducing this sheet material 52 into closure station 160. Next sheet material 52 can be introduced into forming apparatus 500 in order to form pleat elements 74 in sheet material 52. Then, sheet material 52 is introduced into separating station 130 in order to disengage pleat elements 74 and to separate the overlapped portions of sheet material 52. Thereafter, sheet material 52 is introduced into bag-making machine 32 to make flexible bags 10.

[0053] While particular examples and exemplary methods to introduce continuous web 53 and sheet material 52 have been described, numerous variations of such examples are well know in the art. For example, continuous web 53 or an individual or discrete sheet of precut sheet material 52 having a single-ply can be introduced into forming apparatus 500 and then folded in a folding station 133 and introduced into bag-making machine 32. Alternatively, multiple continuous webs 53 or multiple discrete sheets of sheet material 52 in a flat configuration can be introduced into forming apparatus 500 and then folded in a folding station 133 and introduced into bag-making machine 32. Alternatively, the overlapped portions can be multiple continuous webs 53 or multiple discrete sheets of sheet material 52 sealed at one longitudinal edge to form bottom fold 22. Another alternative can be the introduction of at least one or more continuous webs 53 or discrete sheets of sheet material 52 that are overlapped upon themselves and having pleat elements 74 formed therein that are introduced into disengaging means. Yet another alternative method of introducing continuous webs 53 can be one or more tubes 51 that have pleat elements 74 formed therein can be introduced into disengaging means 130. Still another alternative can be to introduce one or more tubes 51 having pleat elements 74 formed therein that can then be cut, disengaged, separated, folded and then introduced to bag-making machine 32. As illustrated herein it should be apparent to those of ordinary skill in the art that the converting stations and steps described herein can be sequenced in various orders other than those described herein without any undue experimentation.

[0054] Fig. 19 illustrates the results of one embodiment of the present invention, a roll 11 of flexible bags 10. In this embodiment, multiple flexible bags 10 are joined in end-to-end fashion forming continuous web 53 from which a multiplicity of individual flexible bags 10 can be separated. In the embodiment illustrated, sheet material 52 has a perforation or frangible zone 25 between sealed edge 21 and sealed edge 23. Closure means 30 is shown in the form of a draw tape 31 which can be attached by inserting a strip of draw tape 31 into the continuous web 53 of sheet material 52 through a hem or channel 34 formed along top edge 28. A scalloped area 17 can also be cut out of top edge 28 to provide access to a portion of draw tape 31. Since flexible bags 10 in their pre-use condition may be externally smaller than typical bags of lesser stretch capability, the dimensions of roll 11 may be likewise smaller since flexible bags 10 can expand in use to the desired size. Such a reduced size roll 11 may be particularly useful for dry cleaning bags.

[0055] In yet still another converting station, continuous web 53 of sheet material 52 can be divided, separated, severed or torn apart into individual flexible bags 10 at finishing station 161. Dividing continuous web 53 of sheet material 52 into individual flexible bags 10 can be accomplished by tearing each flexible bag 10 away from continuous web 53 along frangible zone 25. Alternatively, each flexible bag 10 can be separated from continuous web 53 by cutting across the width of continuous web 53 during a severing and sealing step at the location of frangible zone 25. In particular, after flexible bags 10 have been formed, a sever-sealing device can be provided that creates sealed edge 21 and sealed edge 23 using heat or some other means while simultaneously severing or cutting continuous web 53 between sealed edge 21 and sealed edge 23 along frangible zone 25. Cutting continuous web 53 in this manner separates individual flexible bags 10 from the remainder of continuous web 53. Flexible bags 10 can then be stacked together or folded in an interleaved manner. This allows stack 129 of interleaved flexible bags 10 to be placed into a package from which a consumer may extract each individual flexible bag 10 one by one without having to tear one flexible bag 10 from another.

[0056] While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various additional

changes and modifications can be made without departing from the spirit and scope of the present invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A method of making an article having elastic-like behavior, the method characterized by the steps of:

introducing a sheet material having at least one overlapped portion;

the sheet material having a c-shaped cross section, wherein said sheet material is formed by overlapping sidewall portions of two separate webs of material;

forming said overlapped portion of sheet material into a strainable network including a plurality of first regions and a plurality of second regions, said first regions being substantially un-deformed and said second regions being formed into disengageable pleat elements; and

disengaging said pleat elements using a disengaging means.

2. The method of making an article according to claim 1, wherein said disengaging means is selected from the group consisting of air knife, static opening bar, dynamic opening bar, and suction means, and combinations thereof.

3. The method of making an article according to claim 1, further comprising the step of overlapping one portion of said sheet material over another portion of said sheet material.

4. The method of making an article according to claim 2, further comprising the step of separating said overlapped portions of said sheet material using said disengaging means.

5. The method of making an article according to claim 2, wherein said dynamic opening bar comprises at least one first set of rollers and said pleat elements are disengaged from each other while at least one portion of said sheet material rides over an opposite outer segment of at least one roller.

6. The method of making an article according to claim 5, wherein said dynamic opening bar includes an end cap.

7. The method of making an article according to claim 5, wherein said dynamic opening bar is wholly surrounded by said overlapped portions of said sheet material.

8. The method of making an article according to claim 5, wherein said dynamic opening bar comprises a second set of rollers and said pleat elements remain engaged as said sheet material passes between a first set of rollers and thereafter said pleat elements are disengaged while at least a portion of said sheet material is riding over at least one opposite outer segment of a second set of rollers.

9. The method of making an article according to any one of claims 1 to 8, further characterized in that said disengaging step comprises riding said sheet material on said disengaging means.

10. The method of making an article according to any one of claims 1 to 9, further characterized in that the step of forming comprises forming said pleat elements as said sheet material passes between a pair of forming rollers, at least one forming roller having toothed regions and grooved regions.

11. The method of making an article according to claim 1, wherein said disengaging step further comprises riding said sheet material on said disengaging means.

12. The method of making an article according to claim 2, wherein the step of forming further comprises forming said pleat elements as said sheet material passes between a pair of forming rollers, at least one forming roller having toothed regions and grooved regions.

13. The method of making an article according to claim 2, wherein said disengaging

step further comprises the step of applying a vacuum to at least one overlapped portion of said sheet material.

14. The method of making an article according to claim 1, further comprising the step of winding said sheet material onto a roll.

15. The method of making an article according to claim 1, further comprising the step of incorporating a closure means into said sheet material.

16. The method of making an article according to claim 1, further comprising the step of unwinding a continuous web of sheet material from a roll.

17. The method of making an article according to claim 1, further comprising the step of extruding a raw plastic material and converting the extruded plastic material into a continuous web of sheet material.

18. The method of making an article according to claim 1, further comprising the step of forming flexible bags from said sheet material.

19. The method of making an article according to claim 18, further comprising the step of sealing at least one edge of said flexible bag, and severing said sheet material across a width thereof at said sealed edge to separate said sheet material into individual flexible bags.

20. The method of making an article according to claim 18, further comprising the step of sealing at least one edge of said flexible bag, and perforating said sheet material across a width thereof at said sealed edge.

21. The method of making an article according to claim 16, further comprising the step of interleaving said individual flexible bags.

22. A method of making an article having elastic-like behaviour comprising the steps of:

introducing at least one sheet material having at least one overlapped portion;

the sheet material having a c-shaped cross section, wherein said sheet material is formed by overlapping sidewall portions of two separate webs of material;

forming said overlapped portion of sheet material into at least one region of disengageable pleat elements; and

disengaging said pleat elements using a disengaging means selected from the group consisting of air knife, static opening bar, dynamic opening bar, and suction means, and combinations thereof.

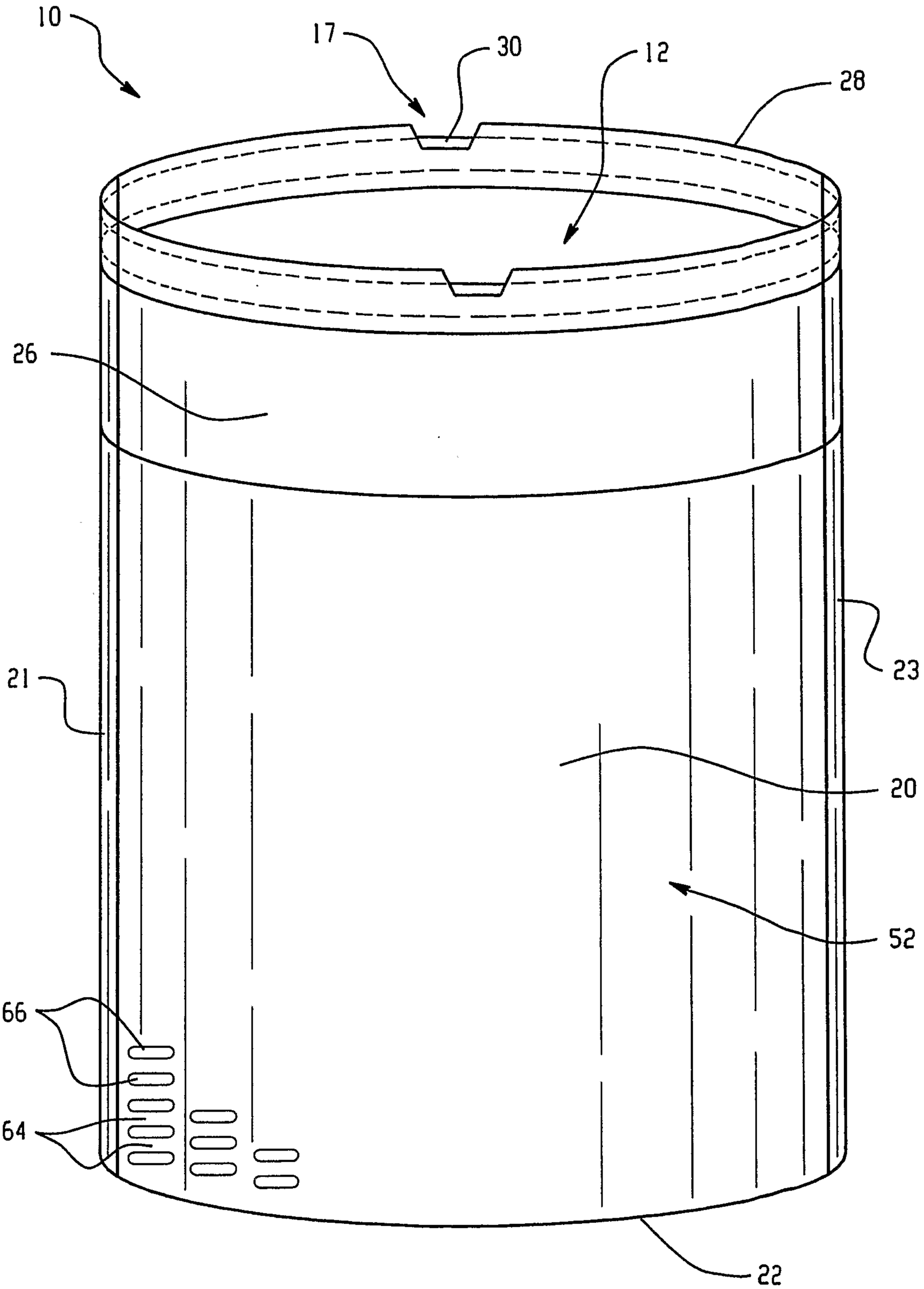


Fig. 1

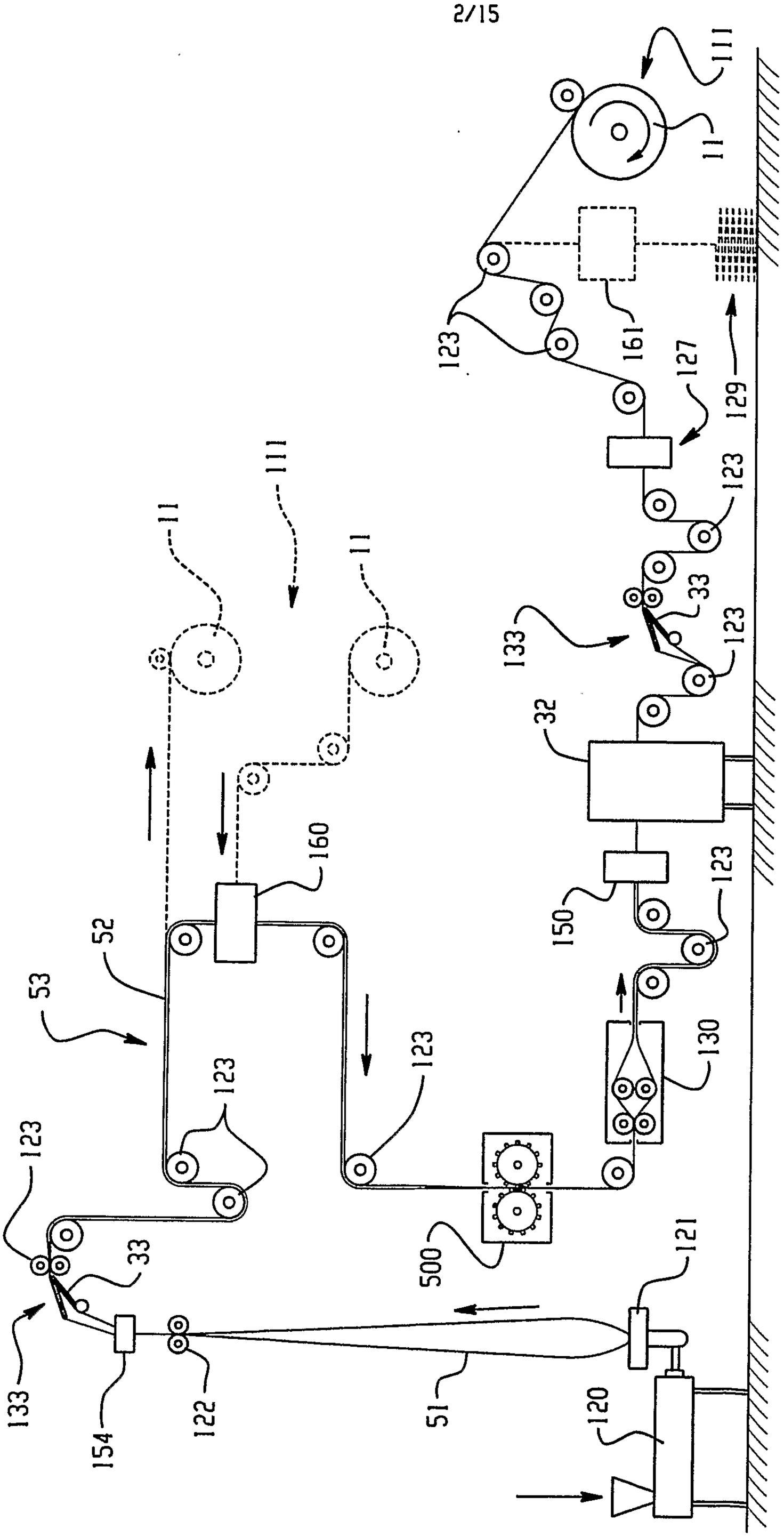

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Fig. 2

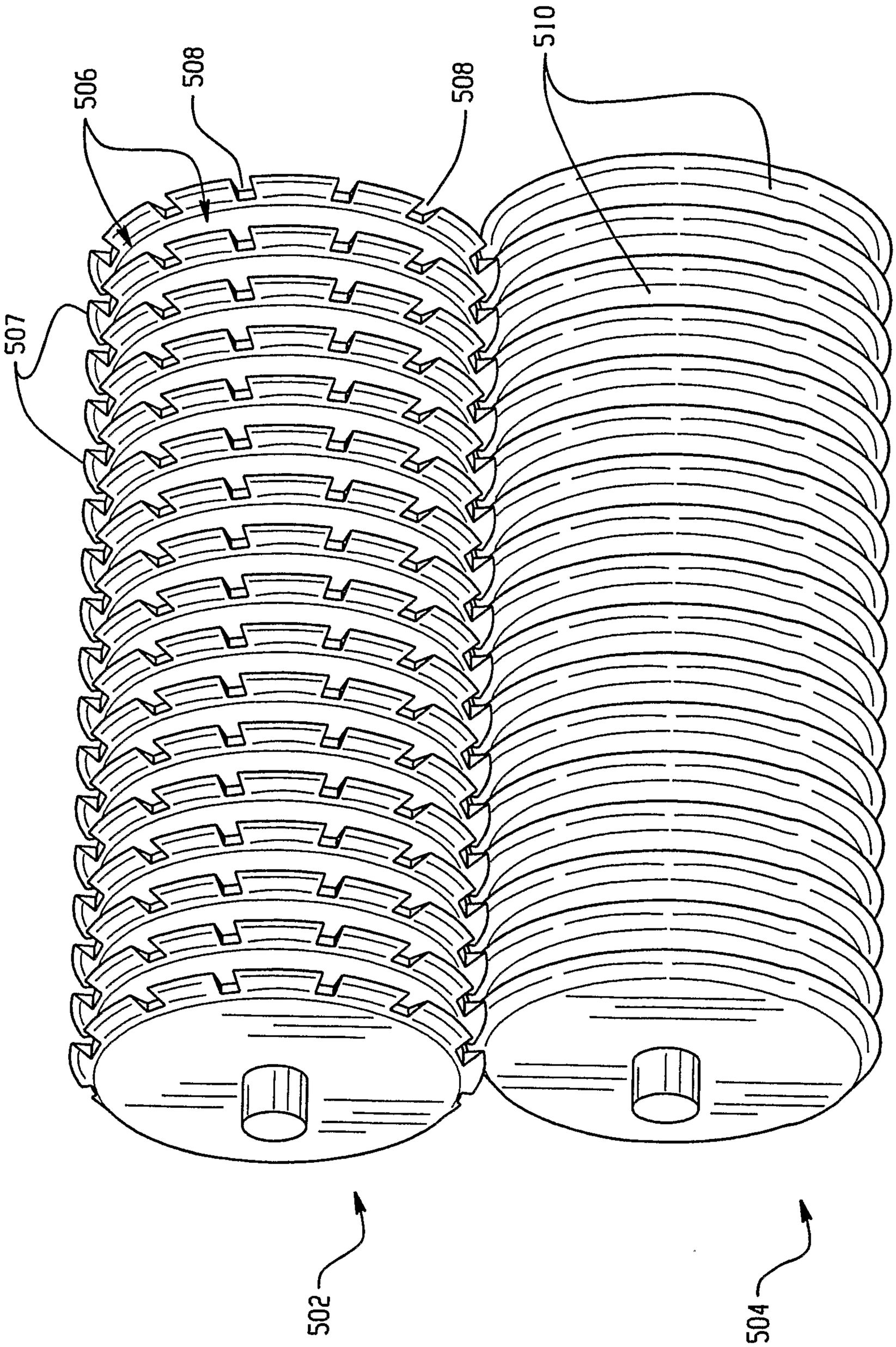
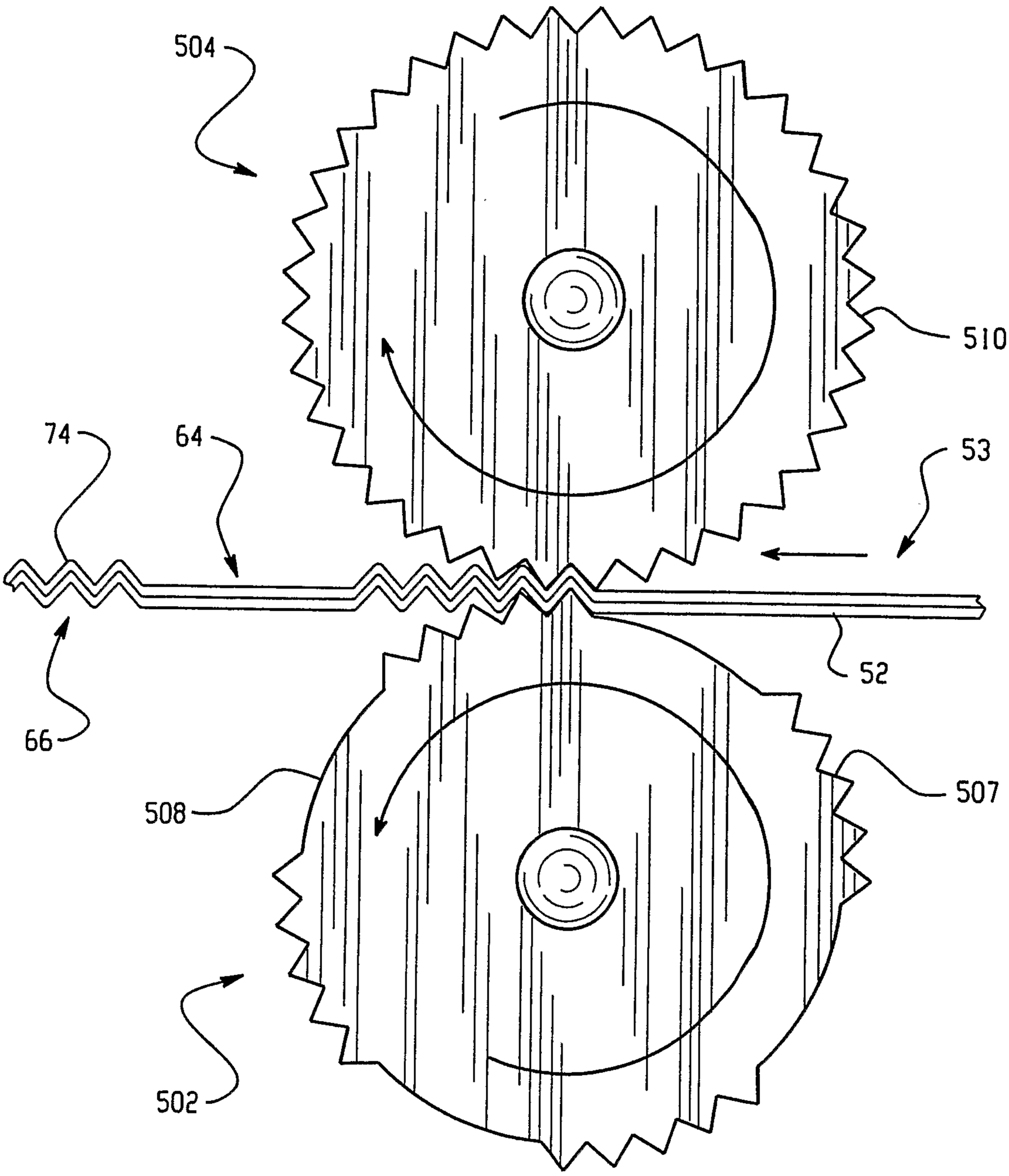


Fig. 3



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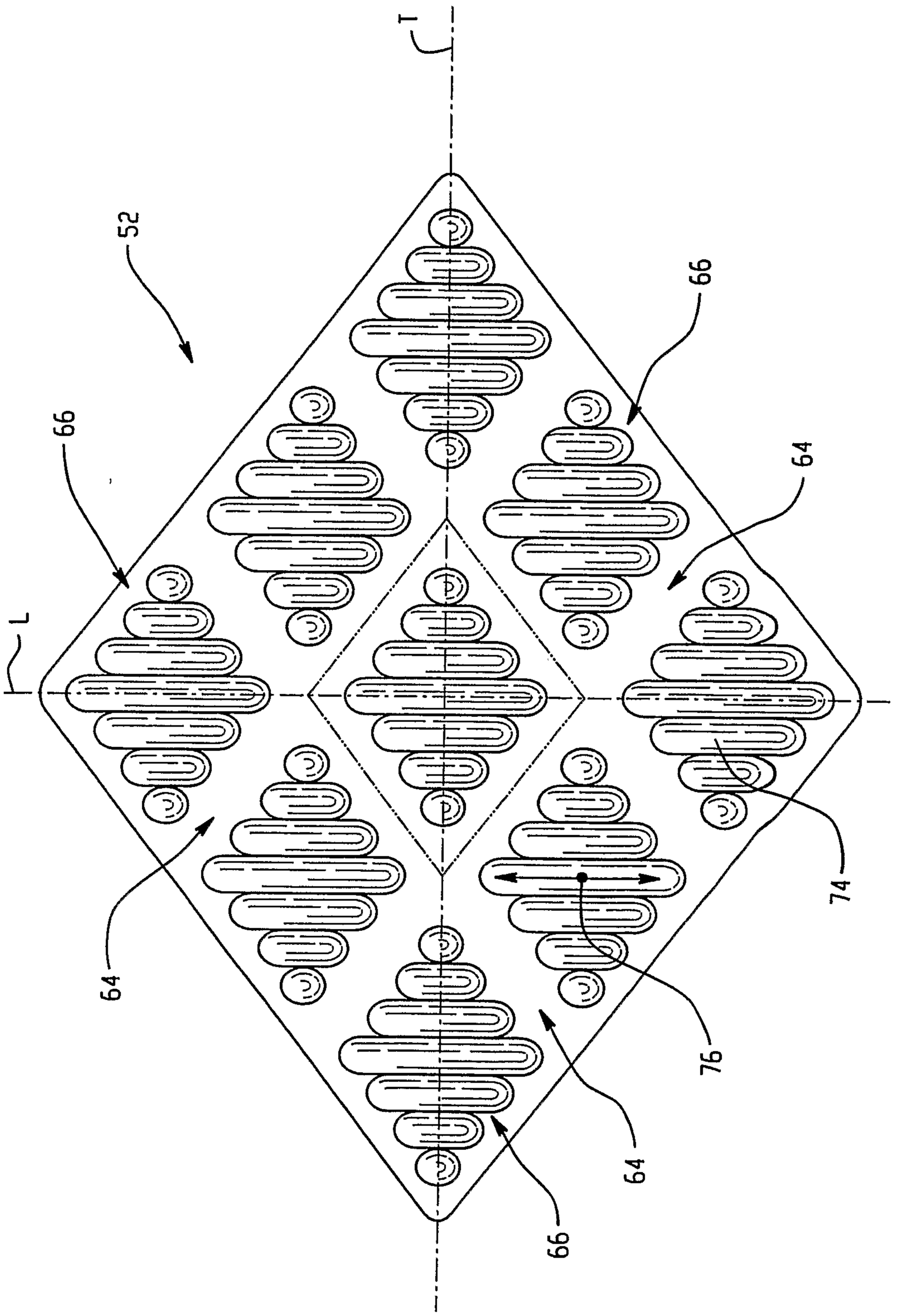

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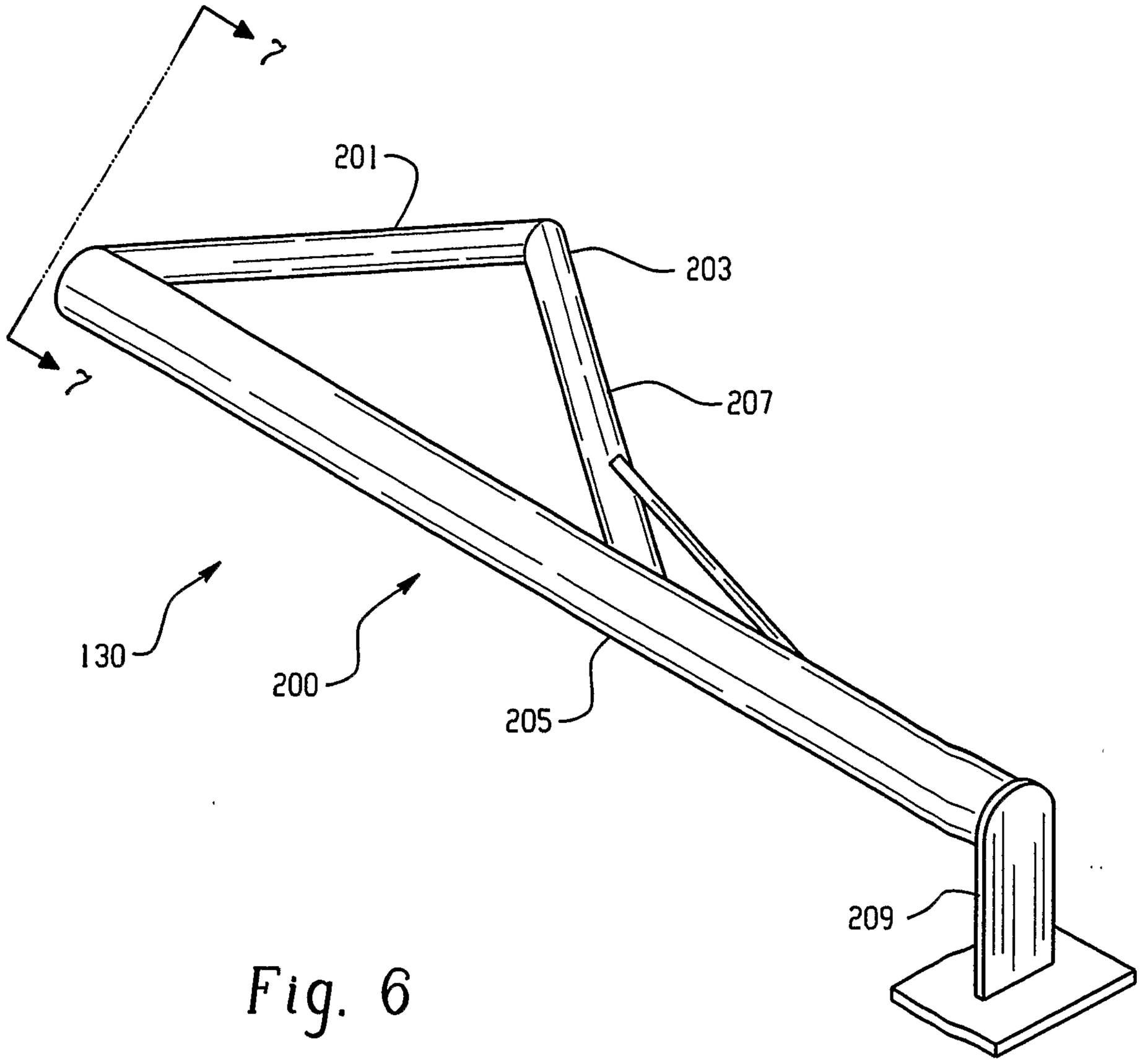

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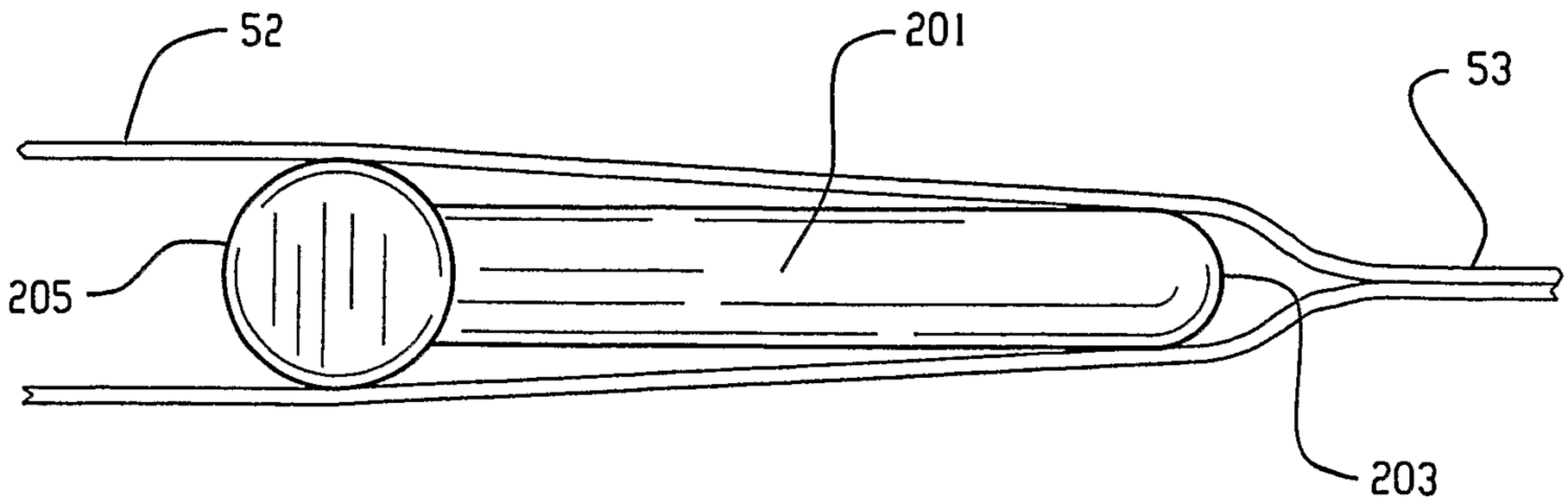
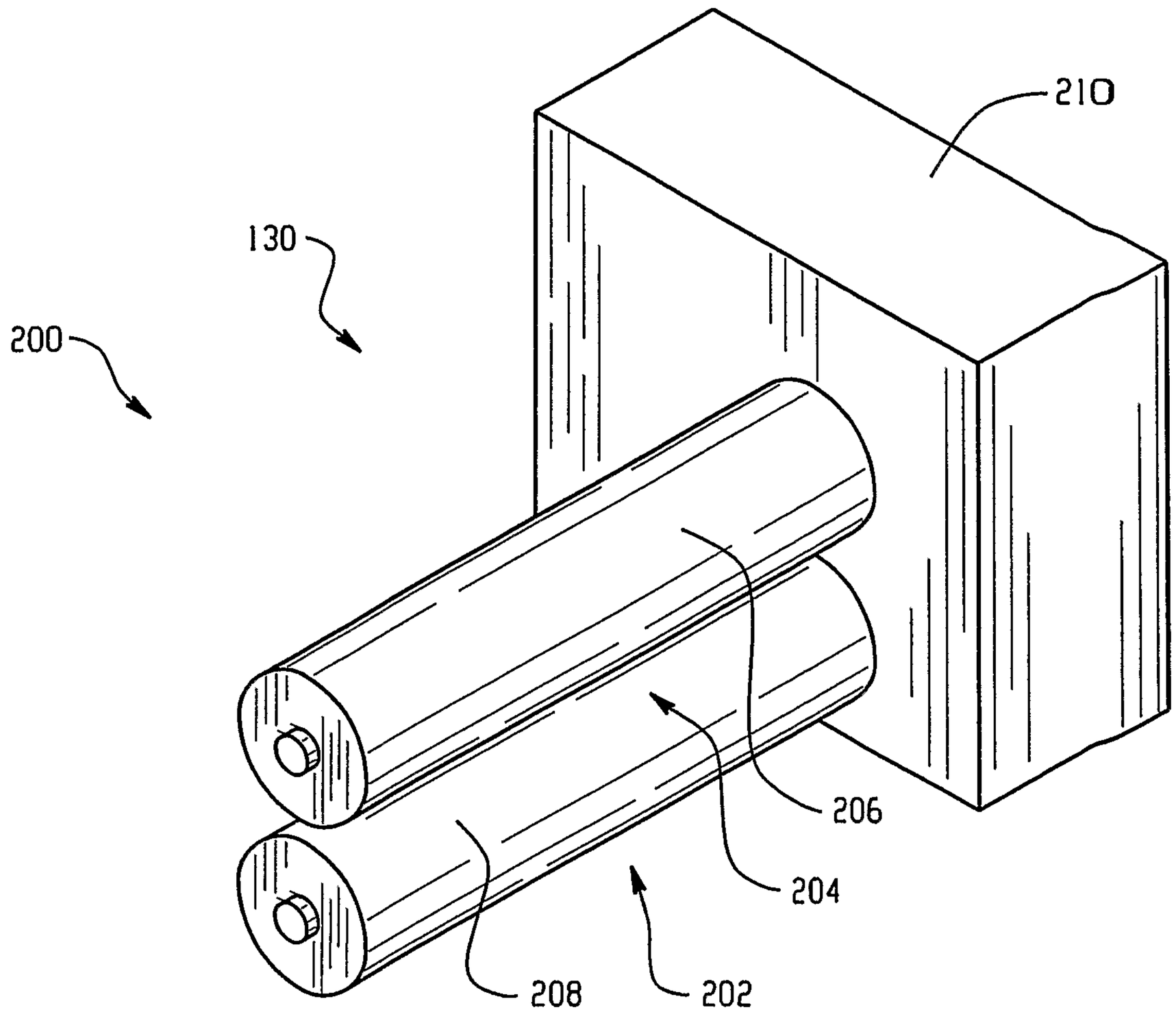


Fig. 7



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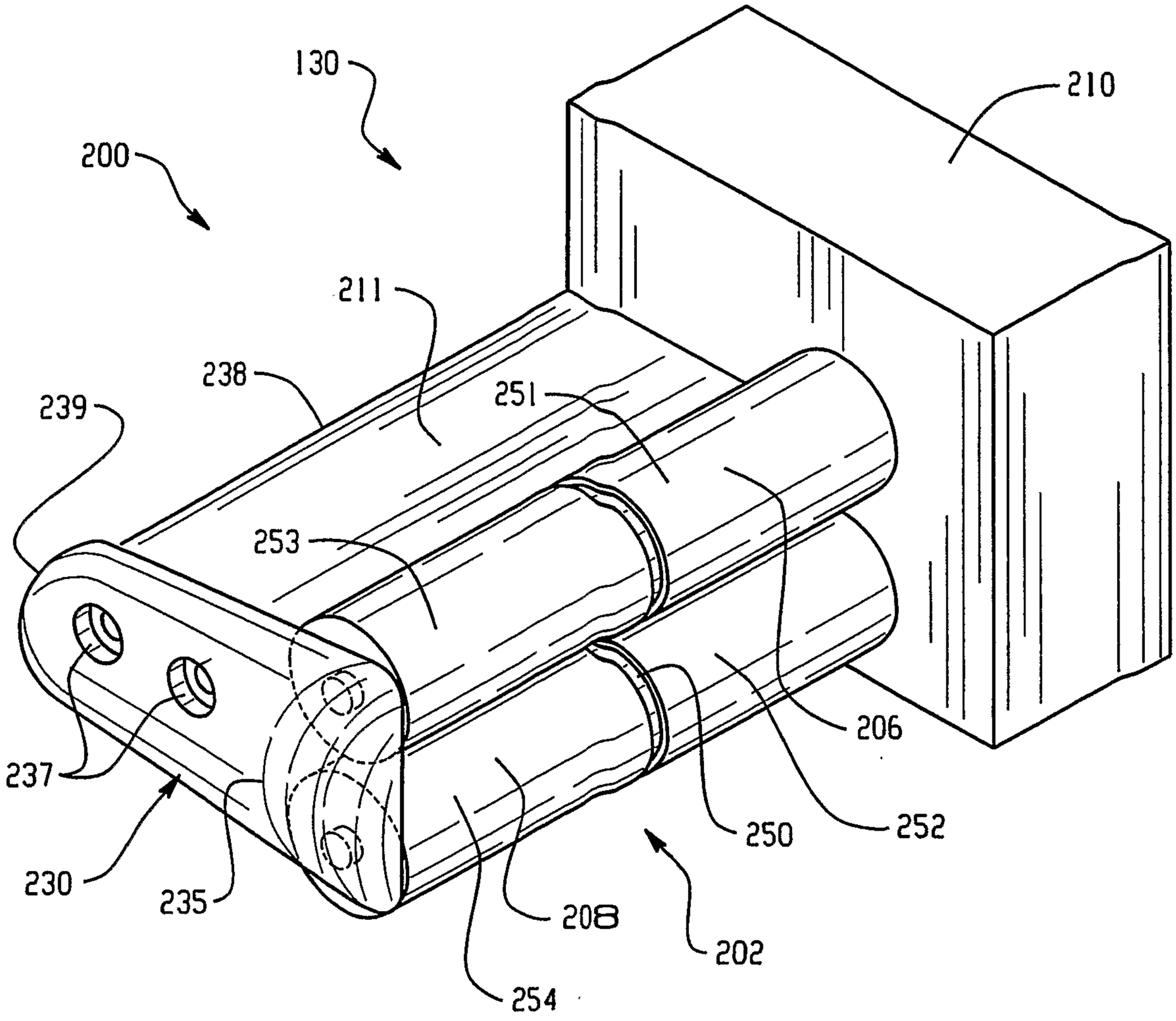
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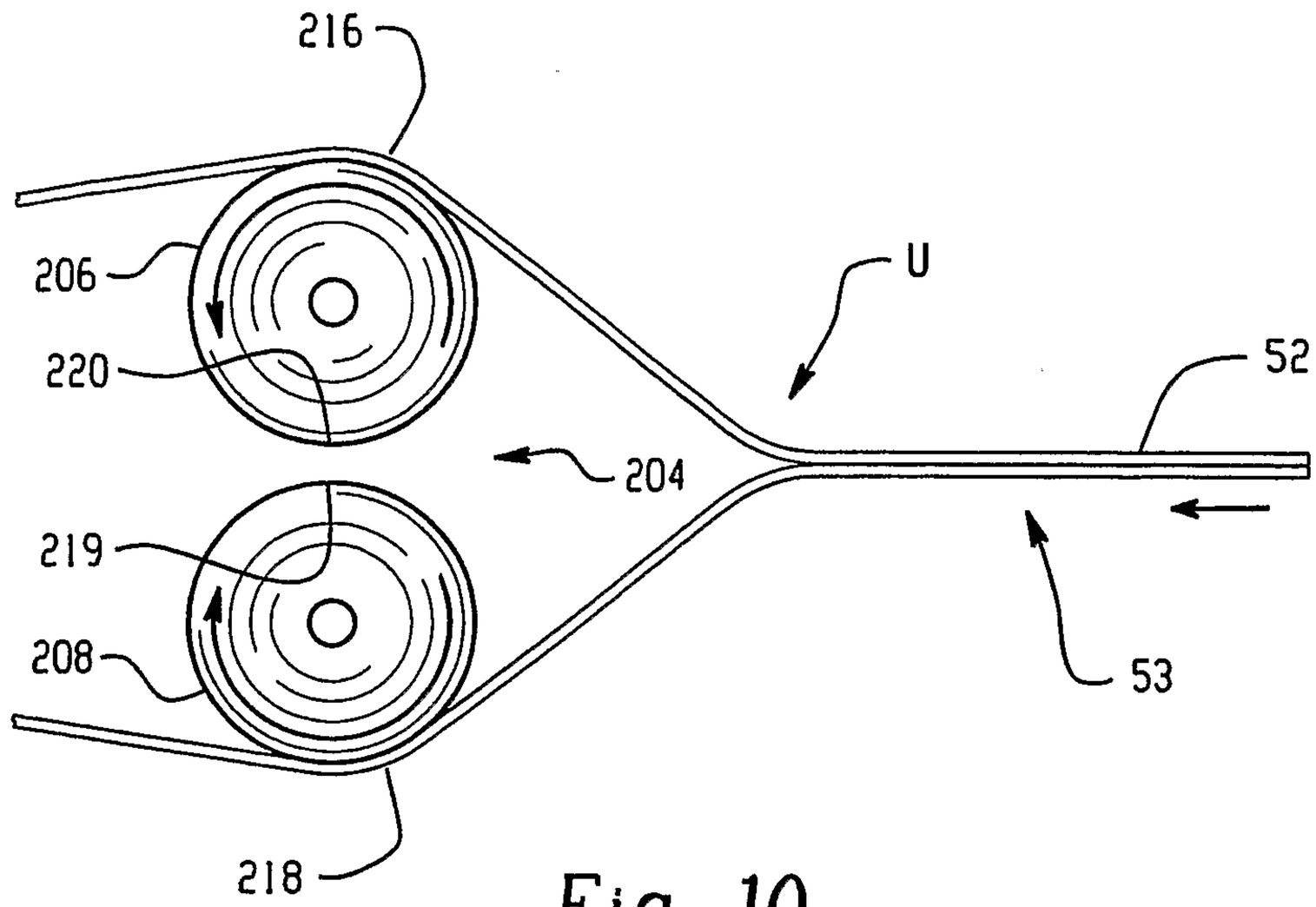
Fig. 9



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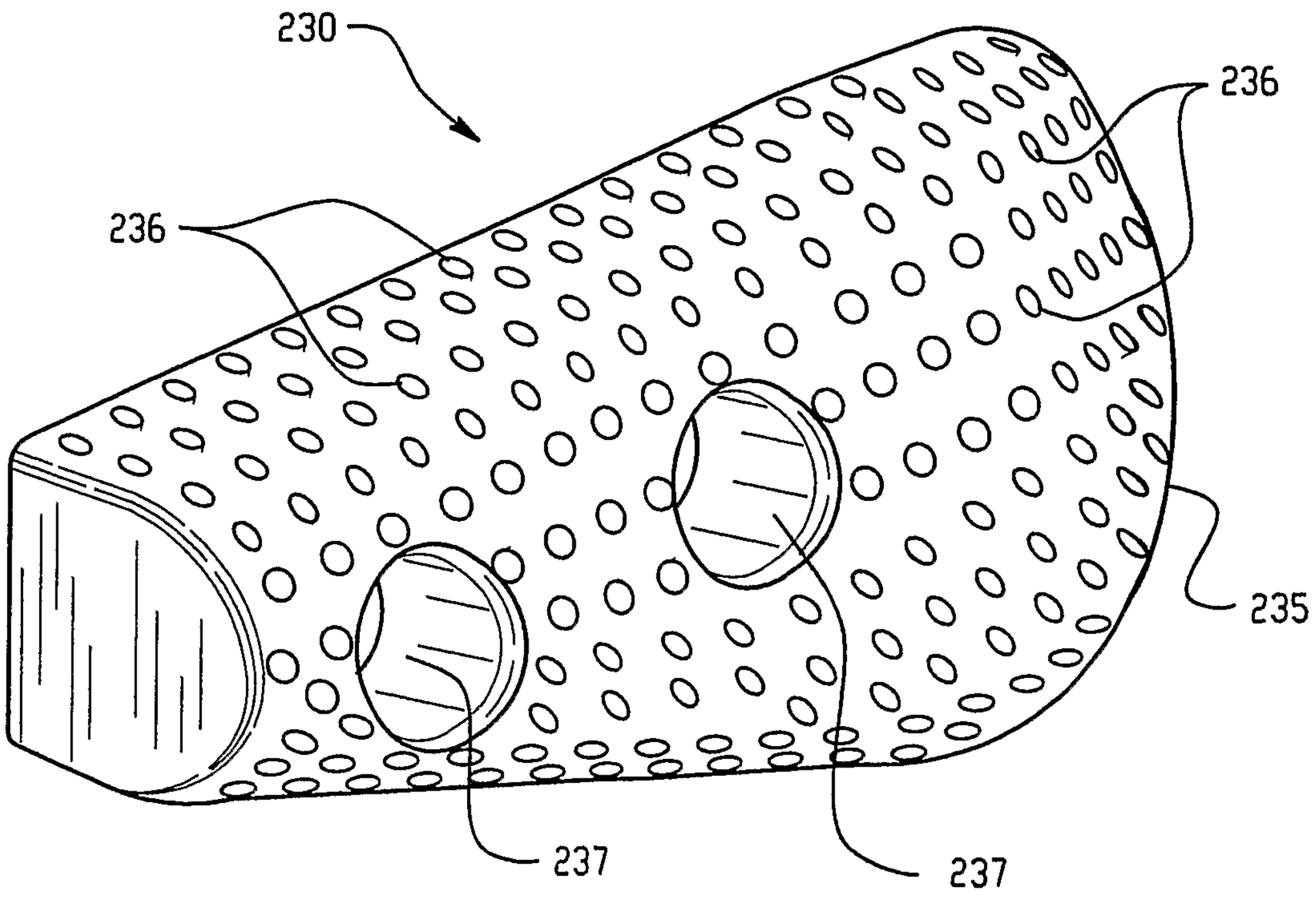

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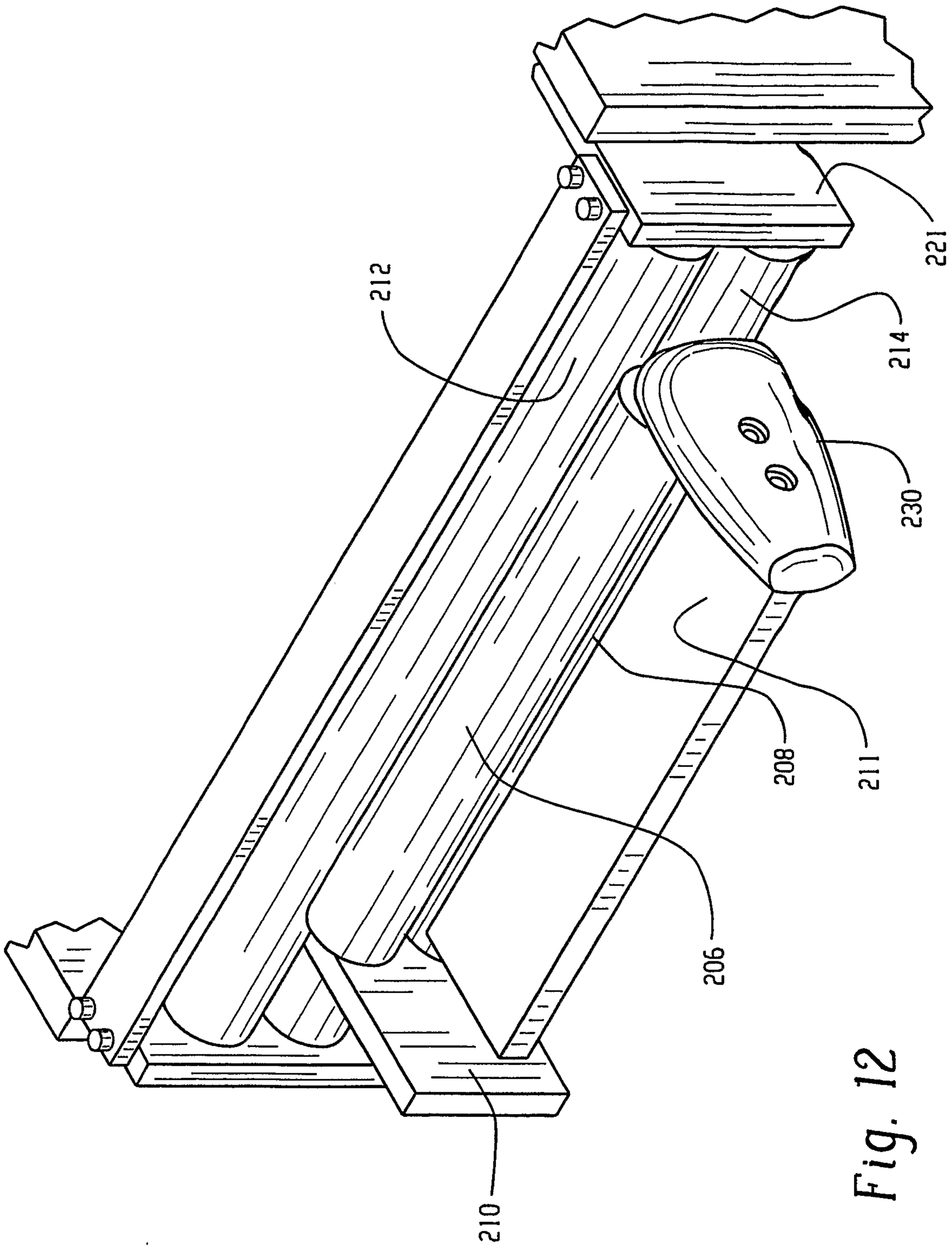

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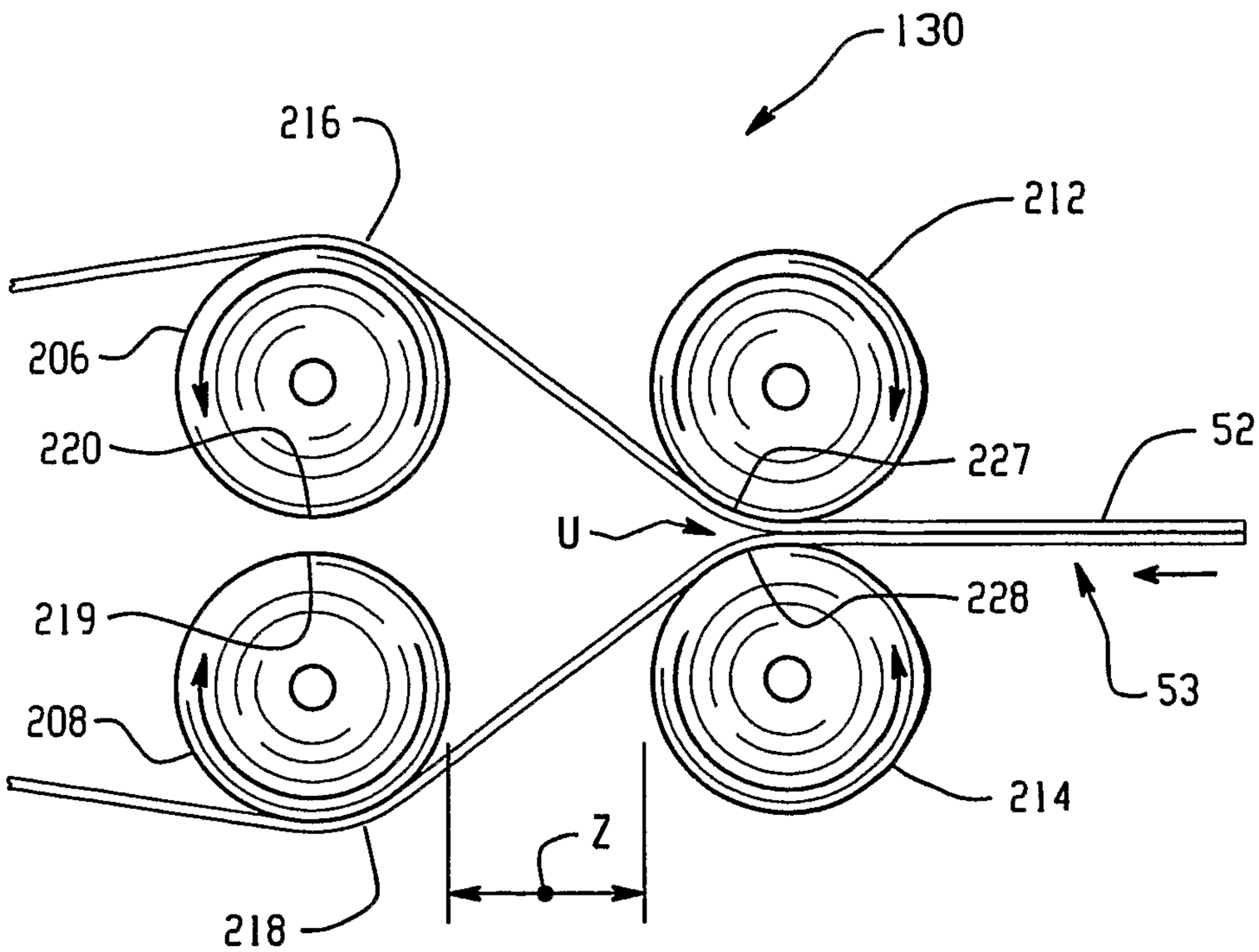
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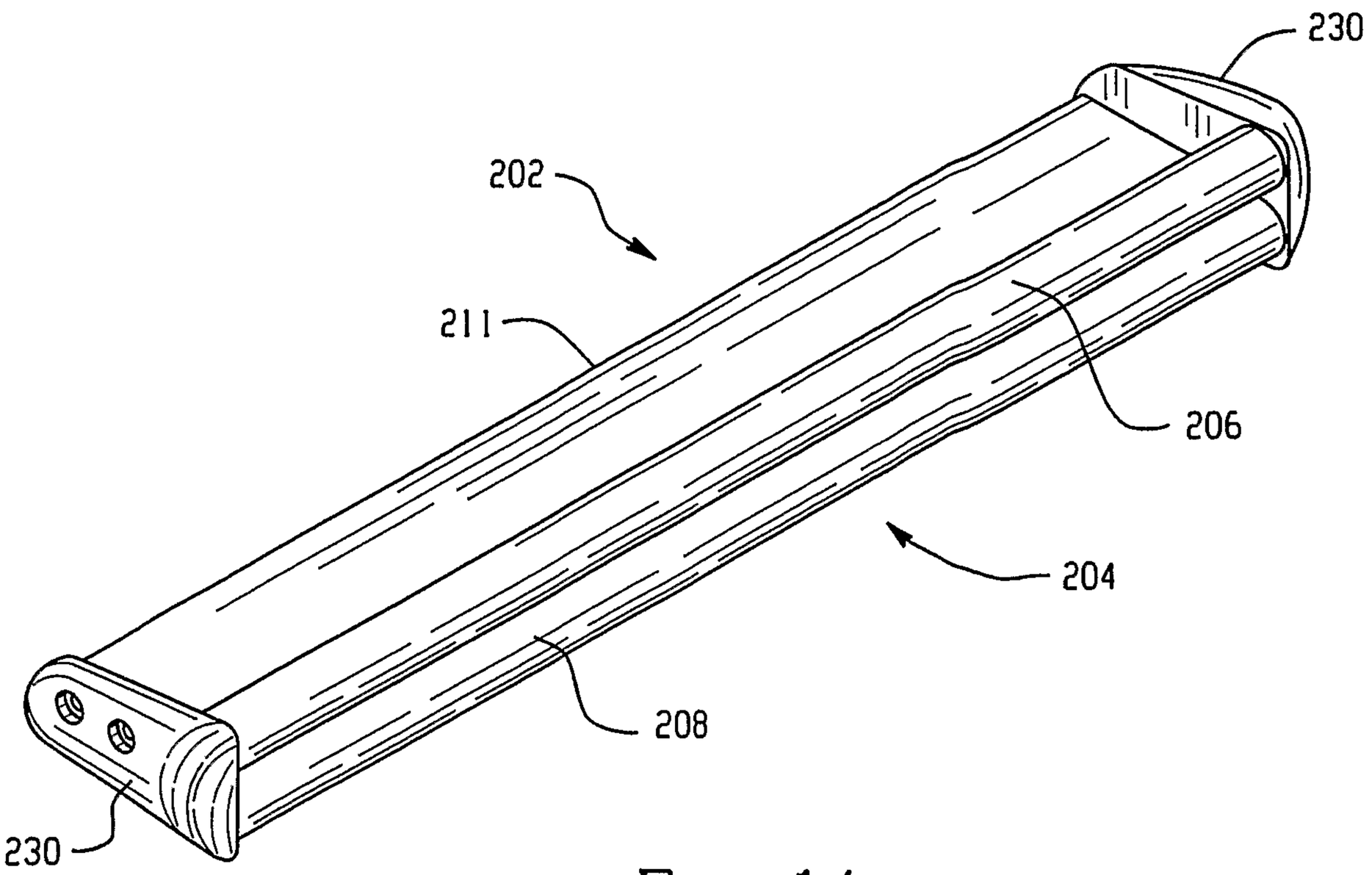
Fig. 13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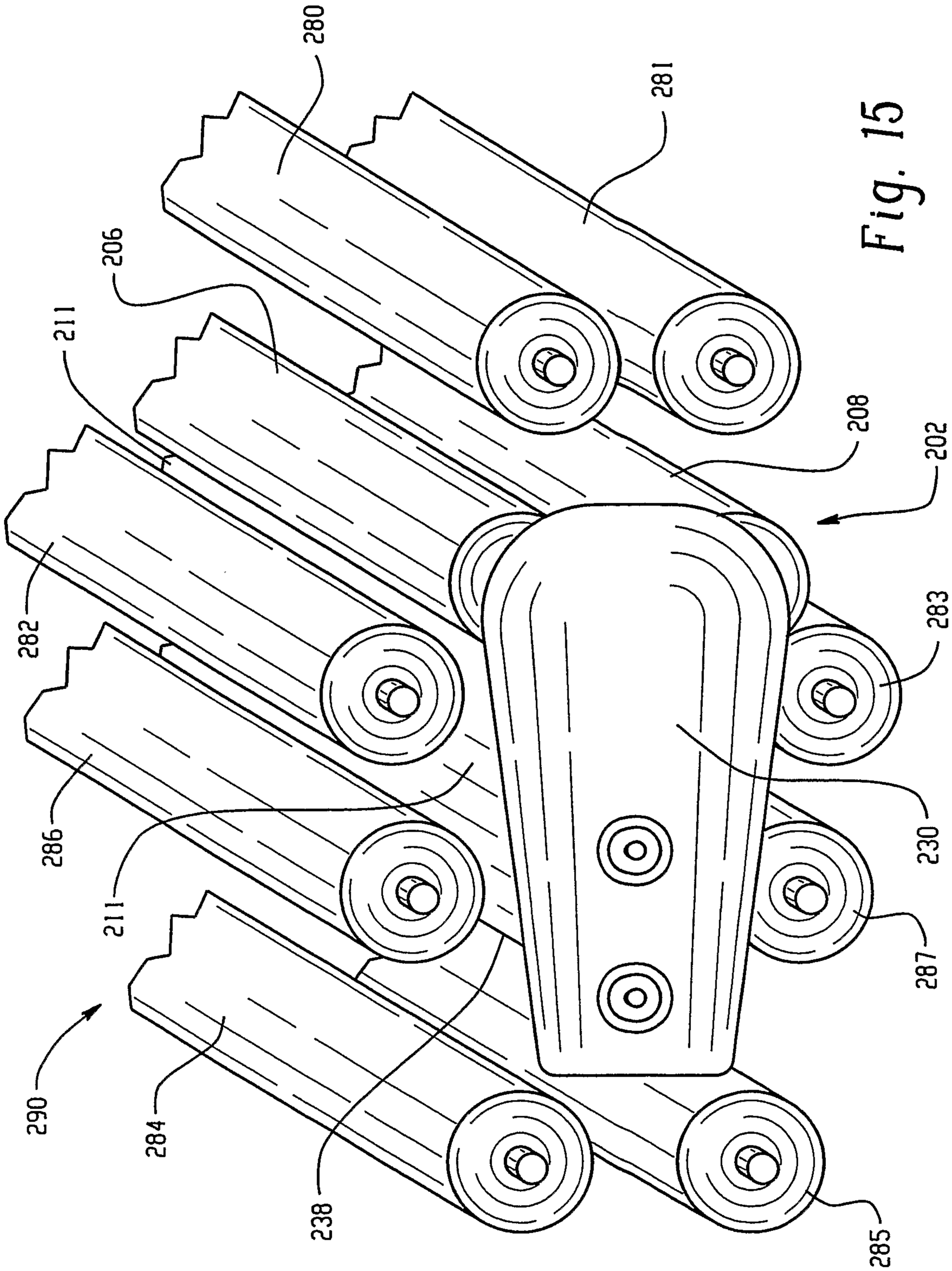

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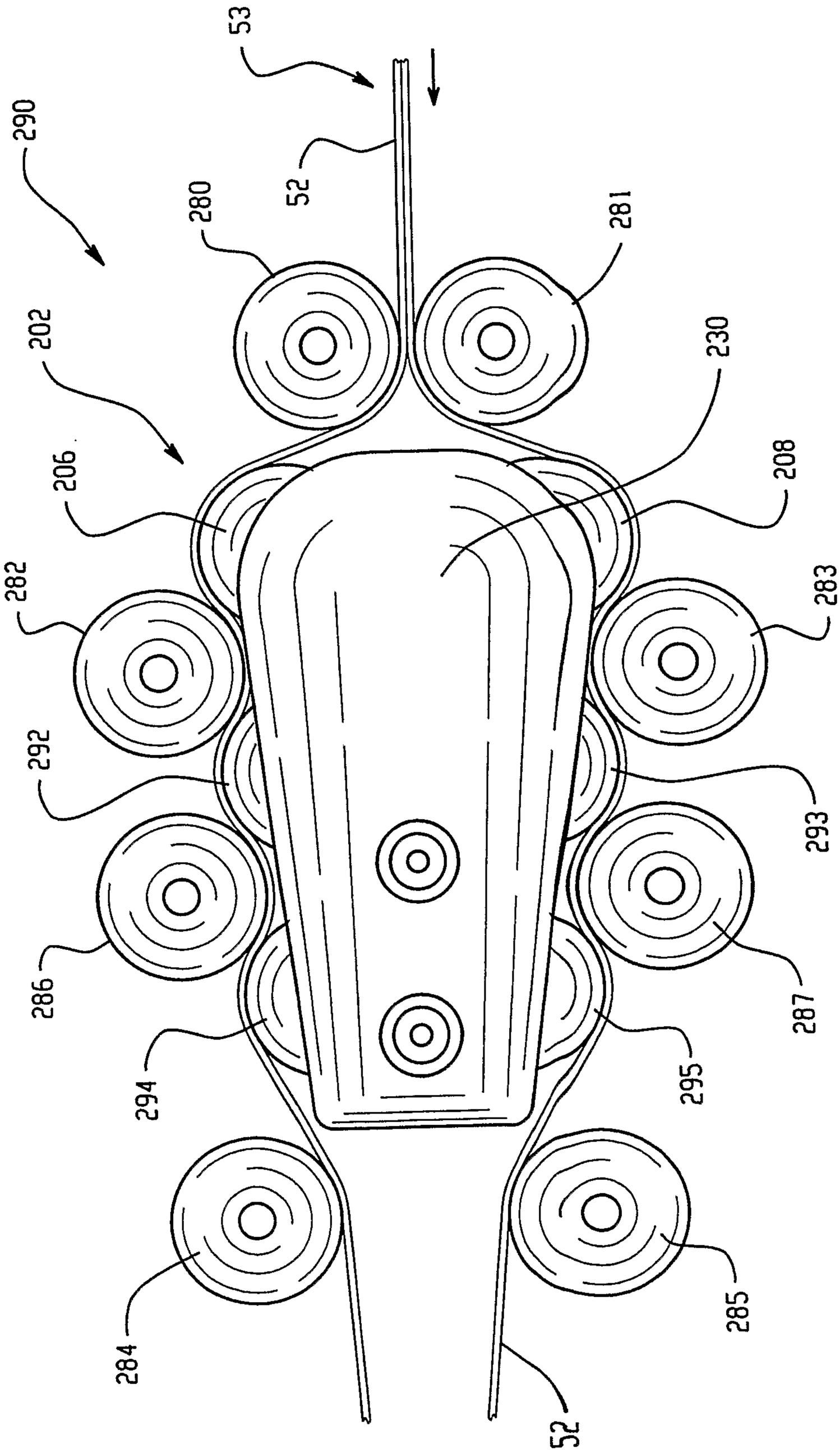
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Fig. 16

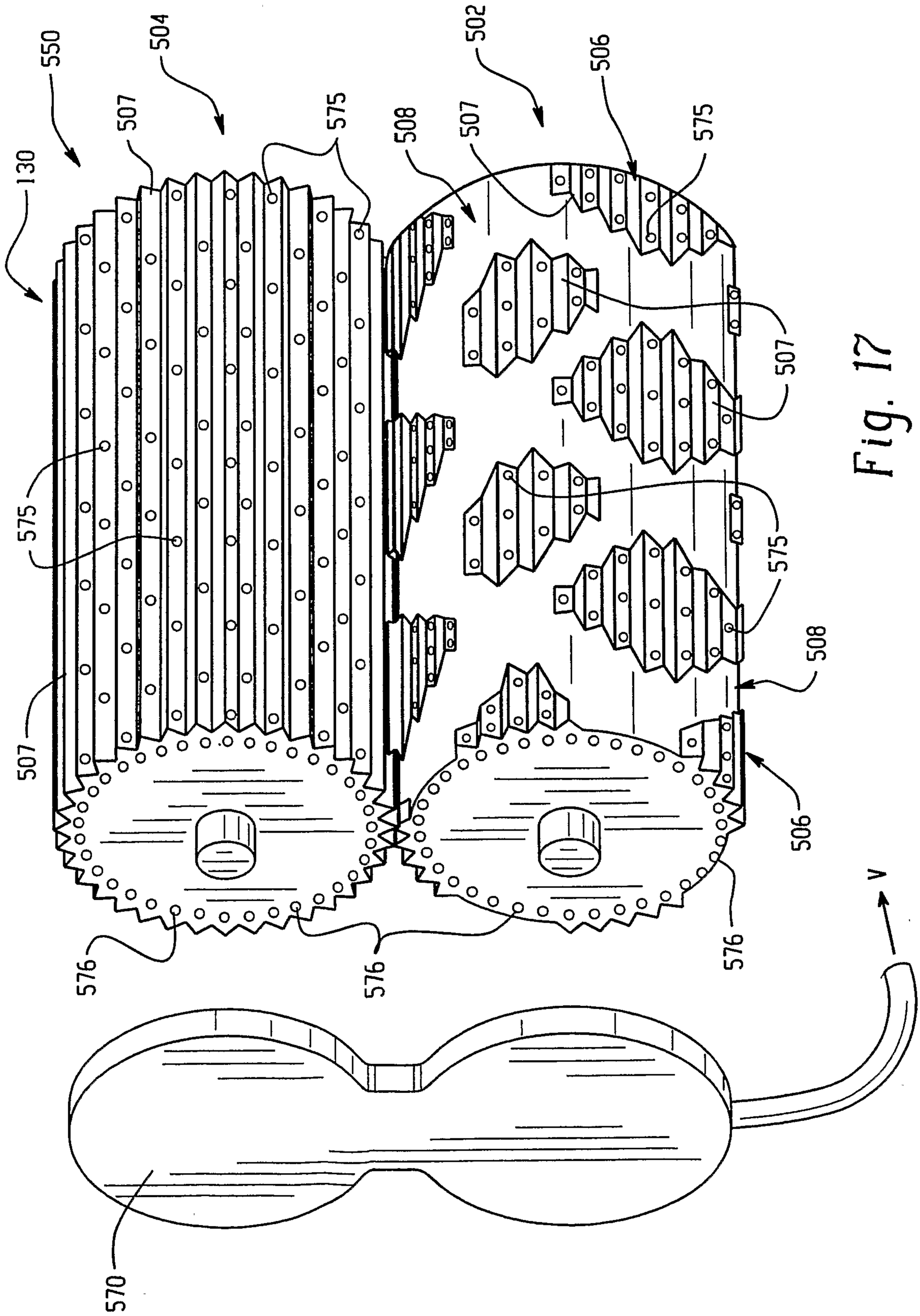
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Fig. 17

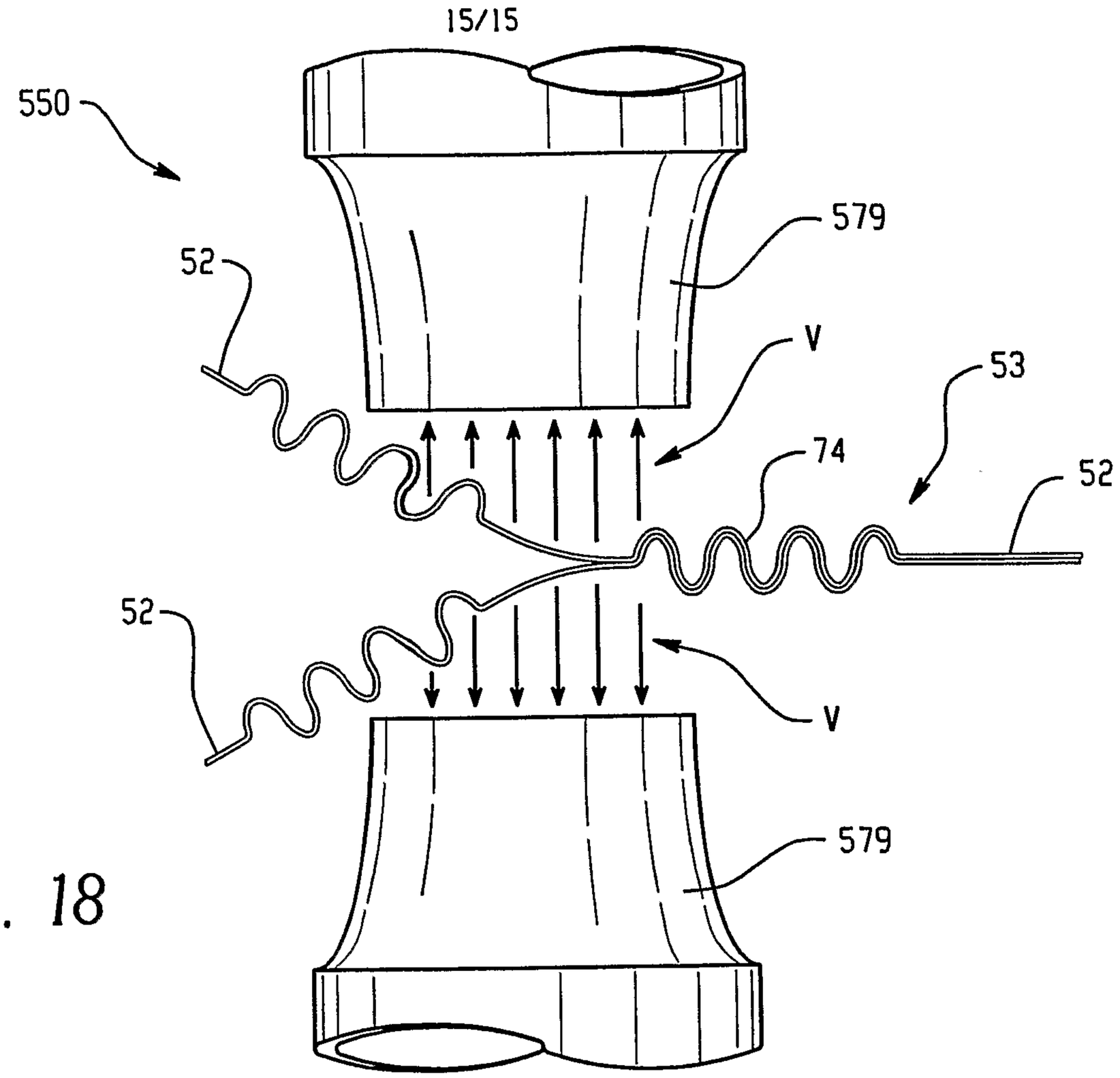
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Fig. 18

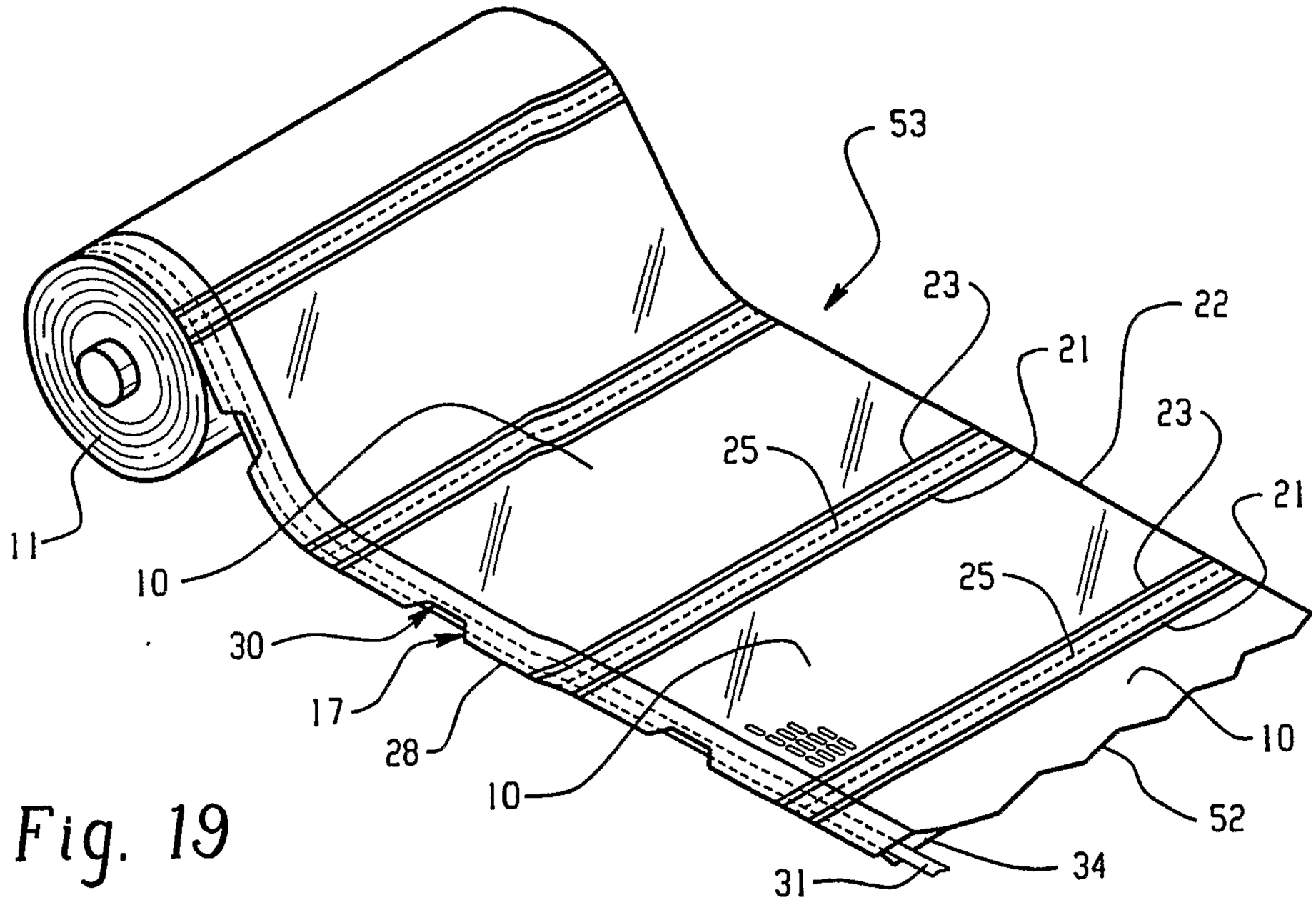
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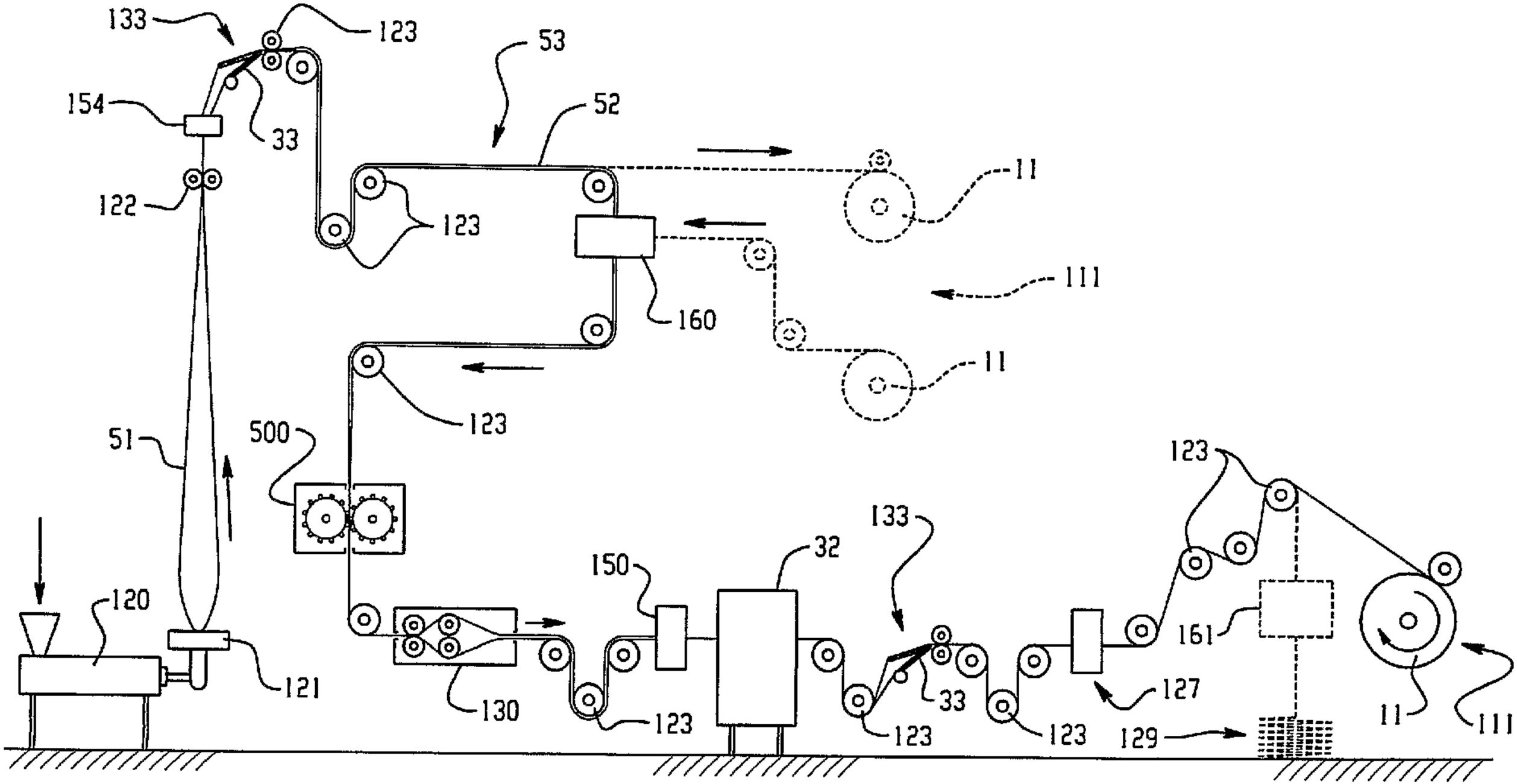
Fig. 19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