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- (73) Patenthaver: **Curt G. Joa, Inc., 100 Crocker Avenue, Sheboygan Falls, Wisconsin 53085, USA**
- (72) Opfinder: **Ferguson, Ryan, 1009 Carver Avenue, Howards Grove, WI Wisconsin 53083, USA**
Faucher, Dennis, 2415 North 34th Street, Sheboygan, WI Wisconsin 53083, USA
Andrews, Robert, E., N7488 Sunset Circle Drive, Sheboygan, WI Wisconsin 53083, USA
Hohm, Gottfried, J., 210 Westridge Drive, Sheboygan Falls, WI Wisconsin 53085, USA
- (74) Fuldmægtig i Danmark: **Potter Clarkson A/S, Havnegade 39, 1058 København K, Danmark**
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US-A- 4 491 045

DESCRIPTION

Background of the Invention

[0001] This invention relates to precise repositioning of a knife surface relative to an anvil surface. Although the invention is described as most useful to deactivate elastic portions in stretch laminates containing elastic, the precise repositioning of two rotating surfaces can be applied in other manufacturing techniques and environments.

[0002] Disposable diapers are typically equipped with elastic strands in different areas of the product. Some applied elastics, such as leg elastics, encircle the leg-holes. Other elastics are applied across waistbands. These strands of elastic are typically captured with adhesive between two layers of non-woven materials. In areas where adhesive is applied during the laminate formation, elastic adheres to the laminate and is retained in position to provide a stretchable quality to the laminate. In areas where elastics are applied, but no adhesive is applied, the elastic is free to snap back in the laminate and provide areas of relative inelasticity in the laminate. In this fashion, disposable products can be applied with alternating areas of elasticity and inelasticity, for instance across a waistband.

[0003] In one method of manufacture, the diapers are produced in an orientation whereby product flow is in the form of a single continuous web and the direction of travel is at a right angle with respect to what would be described as the crotch line of the diaper, i.e., the normal direction of product flow is parallel to the waist as opposed to parallel to the crotch.

[0004] The shirring effect created by elastic strands when laminated with any flexible fabric is well known. However, to have this shirring effect applied to the crotch of a pant-type garment can be undesirable. The elastics create a contractile force, which tends to distort the garment at this location, thereby reducing the garment's aesthetic appeal, effectiveness and comfort. Thus, various methods of reducing or eliminating the effects of the elastic tension normally occurring at the crotch have been attempted. These methods include the elimination of the adhesive bond between the strands and the liner materials described in U.S. Patent 5,745,922 as "unsecured space" as well as various methods of cutting the strands to eliminate their effects.

[0005] As mentioned, one method of eliminating the undesired effects of the elastic strands which cross the crotch region is to sever them. This method is described in U. S. Patent 5,660,657. Unfortunately, such severing usually requires the introduction of a transversely extending cut, which can result in a loss of web tension in the severed part of the carrier web. This also creates an undesirable opening in the diaper backsheet. A proposed solution for this problem is taught in U. S. Patent 5,707,470, wherein an ultrasonic device is used to sever the elastic members, while the carrier webs which encapsulate the elastics are left intact. See, also, U. S. Patent 5,643,396. Another problem associated with such severing lies in the

tendency of the unsecured severed ends of elastic to retract to some point beyond the limits of any adhesive pattern. Thus, the elastic strands are not controlled or anchored near the ends of the adhesion pattern and may snap back to further into the adhesive pattern. This results in an incomplete elastic pattern and poor product characteristics.

[0006] US 2009/0235800 discloses an apparatus according to the preamble of claim 1.

Summary of the Invention

[0007] The present invention provides an apparatus according to claim 1 and a method according to claim 10.

[0008] Elastic strands, ribbon, or scrim is laid down in a machine direction. Adhesive is applied either to the elastic material or a layer of a two-layer non-woven sandwich around the elastic in areas where elasticity is desired in an end product. Areas with desired inelasticity have no adhesive applied so the elastic is free to snap out of place. Elastic and inelastic zones can be formed in a non-woven, elastic, non-woven sandwich in front and rear portions of a diaper as a laminate.

[0009] A unit is capable of deactivating stretched elastics, preferably without cutting the material that the elastic is sandwiched between. A unit is disclosed to provide precise repositioning of a fast rotating knife surface relative to a fast rotating anvil surface. In particular, the elastic deactivation unit is a device built to deactivate stretched elastic that is sandwiched between two materials. This unit deactivates the elastics preferably without cutting the material.

[0010] This invention accomplishes deactivation by interacting with the material using a profiled blade and variable interference anvil. This profiled knife edge allows for sufficient force to deactivate the elastic while preferably not cutting the material. The amount of interference required for proper performance of the unit varies with many factors such as speed and material, and is electronically controlled.

[0011] An apparatus according to the present invention includes a knife blade supported for revolution in a first direction about a knife axis and an anvil supported for revolution in a second direction about an anvil axis. The anvil has a working anvil surface facing away from the anvil axis. A nip occurs, having a nip gap formed at a nip position of the knife blade and working anvil surface during respective revolutions, the nip adapted to receive a web material. The nip gap is selectively variable by changing respective revolutional phase positioning of the knife and the anvil. That is, by changing the position of the knife about its revolution with respect to the anvil position or the position of the anvil about its revolution with respect to the knife position, or both. The first and second directions are preferably opposite (i.e., clockwise and counter-clockwise when viewed from the same angle).

[0012] According to one embodiment, the knife axis and anvil axis may be at least substantially

parallel to each other.

[0013] According to another embodiment, the anvil surface may include a working anvil surface length measured tangentially to the second direction, the working anvil surface length extending between a leading end and a trailing end.

[0014] In one embodiment, the knife blade is closest to the anvil axis in the nip position. The knife blade may have a blade edge extending parallel to the knife axis. The blade edge may have a cross-section perpendicular to the knife axis, the cross-section comprising a radius, of about 0.25 mm to about 10 mm with about 0.25 mm to about 6 mm being more preferred.

[0015] The working anvil surface is sloped toward the anvil axis from the leading end toward the trailing end.

[0016] In a system having a revolving knife and a revolving anvil cooperating to form a nip, a method according to the present invention includes the step of changing a nip gap spacing between the knife and anvil by changing respective revolutional phase positioning of the knife and the anvil. The method may further comprise the steps of receiving a composite web in the nip, the web comprising at least three layers, and completely severing a middle layer (disposed between at least a first and second layer) without severing a first layer that contacts the knife and without severing a second layer that contacts the anvil.

Brief Description of the Drawings

[0017]

Fig. 1 is a top view of a pant type diaper during production, with elastic strands laid down over areas with and without adhesive in what will become front and rear portions of the diaper;

Fig. 2 is a view of a laminate sandwich entering a rotating profiled knife edge/variable interference anvil roll unit;

Fig. 3 is a side cross sectional view of the laminate before and after entering the rotating profiled knife edge/variable interference anvil roll unit;

Fig. 4 is a top view of a pant type diaper during production, with elastic strands activated to create a shirring effect to create elasticized zones in what will become front and rear portions of the diaper;

Fig. 5 is a closeup side view of a rotating profiled knife edge/variable interference anvil roll unit with a larger provided gap between the knife edge and anvil roll;

Fig. 6 is a closeup side view of a rotating profiled knife edge/variable interference anvil roll unit with a smaller provided gap between the knife edge and anvil roll;

Fig. 7 is a perspective view of a knife roll carrying a pair of knife inserts, each knife insert carrying a knife, with the knife inserts aligned in the machine direction;

Fig. 8 is a perspective view of a knife roll carrying a pair of knife inserts, each knife insert carrying a knife, with the knife inserts offset in the machine direction.

Description of the Preferred Embodiment

[0018] Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention. While the preferred embodiment has been described, the details may be changed without departing from the invention.

[0019] Referring now to Fig. 1 a top view of a pant type diaper during production is shown. Elastic strands 14 are laid down over areas with adhesive 12 and without adhesive between areas of adhesive 12, in what will become front and rear portions of the diaper. Typically, adhesive 12 is laid down with an intermittent adhesive applicator which is turned on and off as the web 22 migrates downstream, to create the zones of adhesive 12. As is typical, an absorbent core 16, leg cut outs 18, and side seam cuts 20 are provided to achieve the final diaper product after folding (not shown). Strands 14, ribbon, scrim, or a continuous layer of elastic can all be employed interchangeably.

[0020] Referring now to Fig. 2, a side view of a laminate comprising nonwoven layers 22 sandwiching elastic 14 is shown entering into a rotating profiled knife roll unit 40 and variable interference anvil roll unit 50. Knife roll 40 carries knife 42 on knife insert 44. Anvil roll 50 carries a variable interference anvil 52. In the pictured embodiment, the knife roll 40 rotates in a counterclockwise direction, and the anvil roll 50 rotates in a clockwise direction. The force of the knife 42 on the variable interference anvil 52 is enough to sever the elastic 14, but preferably not enough to sever nonwovens 22. As shown in Figs. 3 and 4, the elastic 14 snaps out of zones without adhesive 12 leaving severed elastic 14', but elastic 14 remains in place in zones with adhesive 12 to provide elasticity in those zones.

[0021] Referring now to Fig. 5, the rotating profiled knife 42 is shown, preferably with a relatively blunt tip or edge 43 to avoid or minimize severing nonwoven 22. For instance, a radius R_1 of approximately 0.25 - 10.0 mm can be used at the knife tip or blade edge 43, but more preferably, a radius R_1 of approximately 0.25 - 6.0 mm may be used. Variable interference anvil 52 has a working anvil surface 51 is sloped between a lower trailing end 53 and a higher leading end 55. Between the ends 53,55, the working anvil surface has a length 57 measured parallel to a tangent of the rotational path of the anvil 52. The slope of the anvil 52 preferably forms a linear relationship with the nip gap between knife 42 and anvil 52. For instance, for every millimeter along the length 57, a change in approximately 0.0005" of a nip

gap (Δ) between knife 42 and anvil 52 is provided. That is, when the knife edge 43 is closest to the anvil axis, the knife 42 and anvil 52 may be said to be in a nip position.

[0022] By changing the position of the knife 42 relative to anvil surface 51, the gap $\Delta 1$ can be varied. For instance, as shown in Fig. 5, the knife 42 is positioned relatively near the trailing end 53 of the anvil 52, creating a larger gap $\Delta 1$. By positioning knife 42 relatively near the leading end 55 of the anvil 52, a smaller gap $\Delta 2$ is provided as shown in Fig. 6. At higher rotation speeds of the knife roll 40 and the anvil roll 50, it may be desirable to have a slightly larger gap $\Delta 1$ because less interference is required to deactivate elastic 14. At slower speeds, a smaller gap $\Delta 2$ may be desired. In other words, deactivation of elastics 14 requires less force at higher speeds, so the slightly larger gap $\Delta 1$ is preferred to minimize disruption of the nonwoven layers 22. Phase adjustments (relative rotational positioning) between knife 42 and anvil 52 can be varied to provide the right impact at a given speed.

[0023] Rotational positioning of the knife roll 40 (and thus the knife blade 43) relative to the anvil surface 51 is done programmatically, by controlling servo drive motors that drive the rolls 40,50 respectively. Adjustments may be made based on thickness 32 of elastics 14 or a thickness 34 of a composite web including the material members to be severed. In this way, accommodations may be made for machine speed or even variations or wear of components. For instance, if the blade 42 is wearing some, the knife 42 can be shifted to a relatively higher point on anvil 52 to return to the desired gap Δ .

[0024] Referring now to Fig. 7, a perspective view of a knife roll 40 carrying a pair of knife inserts 44 is shown. Knife inserts 44 carry knives 42. An operator side and a drive side knife insert 44 are provided, in order to create the severs in elastic 14, for instance near the side seam cuts 20 of Fig. 1, but preferably between adhesive 12 zones on both the front and rear of the diaper product. In the embodiment shown in Fig. 7, the inserts 44 can be aligned in the machine direction. In contrast and as shown in Fig. 8, the knife inserts 44 can be offset in the machine direction by a distance $\Delta 2$ in order to contact the elastics 14 at different times during the manufacturing process, if desired.

[0025] The foregoing is considered as illustrative only of the principles of the invention and it is not desired to limit the invention to the exact construction and operation shown and described. While the preferred embodiment has been described, the details may be changed without departing from the invention, which is defined by the claims.

REFERENCES CITED IN THE DESCRIPTION

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- US5660657A [0005]
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FREMGANGSMÅDE OG INDRETNING TIL ELASTISK DEAKTIVERING I ET 5 LAMINAT

PATENTKRAV:

10 1. En indretning omfattende:

en klingerulleenhed (40) understøttet til rotation i en første retning omkring en første akse, hvor klingerulleenheden (40) er udstyret med en profileret klinge (42) derpå, som roterer med klingerulleenheden (40);

15 en amboltrulleenhed (50) understøttet til rotation i en anden retning omkring en anden akse, hvor amboltrulleenheden (50) er udstyret med en arbejdsamboltoverflade (51), og hvor klingerulleenheden og amboltrulleenheden er anbragt således, at rotation deraf bringer den profilerede klinge nær hen til arbejdsamboltoverfladen til at bestemme et gab derimellem til at modtage a vævsmateriale,

20 karakteriseret ved, at arbejdsamboltoverfladen (51) hælder i retning af den anden akse fra en højere fremadrettet ende (55) mod en lavere bagudrettet ende (53) og ved, at indretningen omfatter servomotorer konfigureret til at: (i) rotere klingerulleenheden (40) i den første retning og amboltrulleenheden (50) i den anden retning, og (ii) styre omdrejningsstillingen af klingerulleenheden (40) i forhold til amboltrulleenheden (50),
25 hvorved den bestemmer indstillingen af den profilerede klinge (42) i forhold til arbejdsamboltoverfladen (51) og en bredde af gabet mellem den profilerede klinge og arbejdsamboltoverfladen.

2. Indretningen fra krav 1 konfigureret således, at ved brugen har den profilerede klinge (42)
30 en omdrejningsstilling, hvor den er tættest på arbejdsamboltoverfladen (51), så den kan påføre en kraft på arbejdsamboltoverfladen (51), når den profilerede klinge (42) og arbejdsamboltoverfladen (51) roterer forbi hinanden.

3. Indretningen fra krav 2, hvor servomotorerne styrer indstillingen af den profilerede klinge (42) i forhold til arbejdsamboltoverfladen (51) til at styre størrelsen af kraften påført af den profilerede klinge (42) på arbejdsamboltoverfladen (51), når den profilerede klinge (42) og arbejdsamboltoverfladen (51) roterer forbi hinanden.

5

4. Indretningen fra krav 2 egnet til anvendelse med et materiale, som omfatter elastiske strenge (14) indlagt mellem et par ikke-vævede lag (22).

5. Indretningen fra krav 4 konfigureret således, at ved brugen er kraften påført af den profilerede klinge (42) på arbejdsamboltoverfladen (51) tilstrækkelig at overskære de elastiske strenge (14), mens parret af ikke-vævede lag (22) efterlades intakt.

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6. Indretningen fra krav 1, hvor arbejdsamboltoverfladen (51) er tangentiel til amboltrulleenhedens (50) omdrejningsforløb.

15

7. Indretningen fra krav 1, hvor den første akse og den anden akse er i det mindste i det væsentlige parallelle med hinanden.

8. Indretningen fra krav 1, hvor servomotorerne ved brug til styring af omdrejningsstillingen af klingerulleenheden (40) i forhold til amboltrulleenheden (50) giver en fasejustering mellem klingerulleenheden (40) og amboltrulleenheden (50).

20

9. Indretningen fra krav 1, hvor klingerulleenheden (40) bærer et par profilerede klinger (42) omfattende en profileret klinge (42) på operatørsiden og en profileret klinge (42) på drevsiden, med parret af profilerede klinger (42) anbragt side om side og enten rettet ind i retning af maskinen eller forskudt i maskinens retning.

25

10. En fremgangsmåde til brug af et system med: en klingerulleenhed (40) roterende i en første retning omkring en første akse og udstyret med en profileret klinge (42) derpå; og en amboltrulleenhed (50) roterende i en anden retning omkring en anden akse og udstyret med en arbejdsamboltoverflade (51), som vender bort fra den anden akse, hvor klingerulleenheden og amboltrulleenheden er anbragt således, at rotation deraf bringer den profilerede klinge nær hen til arbejdsamboltoverfladen for dermed at bestemme et gab derimellem til at modtage et laminat omfattende strækplastik lagt ind mellem to stoflag,

30

karakteriseret ved, at fremgangsmåden omfatter:

anvendelse af en arbejdsamboltoverflade, som hælder i retning mod den anden akse fra en højere fremadrettet ende (55) mod en lavere bagudrettet ende (53);

5 anvendelse af servomotorer til at drive klingerulleenheden (40) i den første retning og amboltrulleenheden (50) i den anden retning; og

brug af servomotorerne til at styre omdrejningsstillingen af klingerulleenheden (40) i forhold til amboltrulleenheden (50) for at kunne styre indstillingen af den profilerede klinge (42) i forhold til arbejdsamboltoverfladen (51) og derved bestemme en bredde af gabet mellem den profilerede klinge (42) og arbejdsamboltoverfladen (51), når den profilerede klinge (42) og
10 arbejdsamboltoverfladen (51) roterer forbi hinanden.

11. Fremgangsmåden fra krav 10, hvor styring af bredden af gabet mellem den profilerede klinge (42) og arbejdsamboltoverfladen (51) styrer kraften påført laminatet, som passerer mellem den profilerede klinge (42) og arbejdsamboltoverfladen (51), når den profilerede klinge
15 (42) og arbejdsamboltoverfladen (51) roterer forbi hinanden.

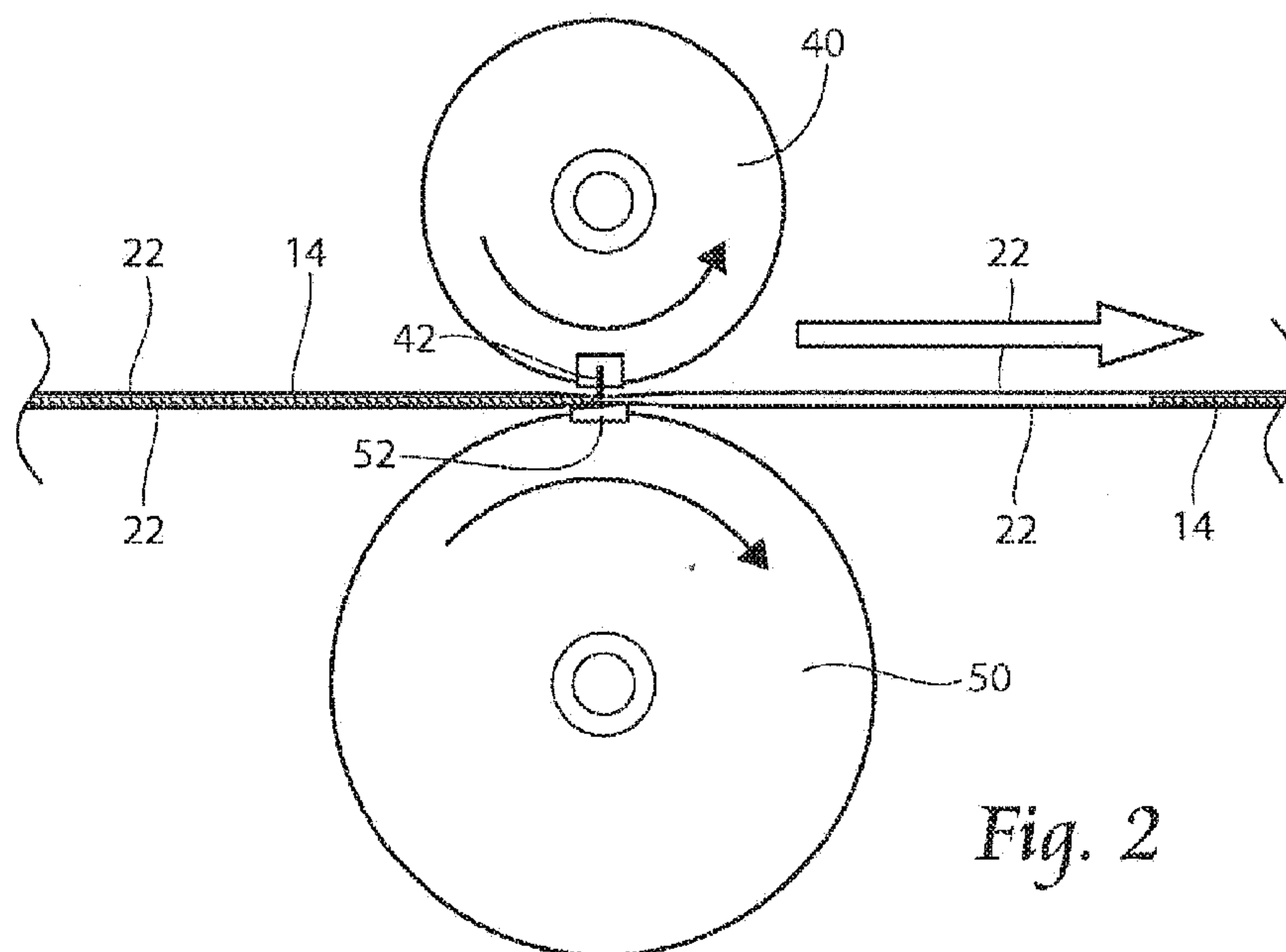
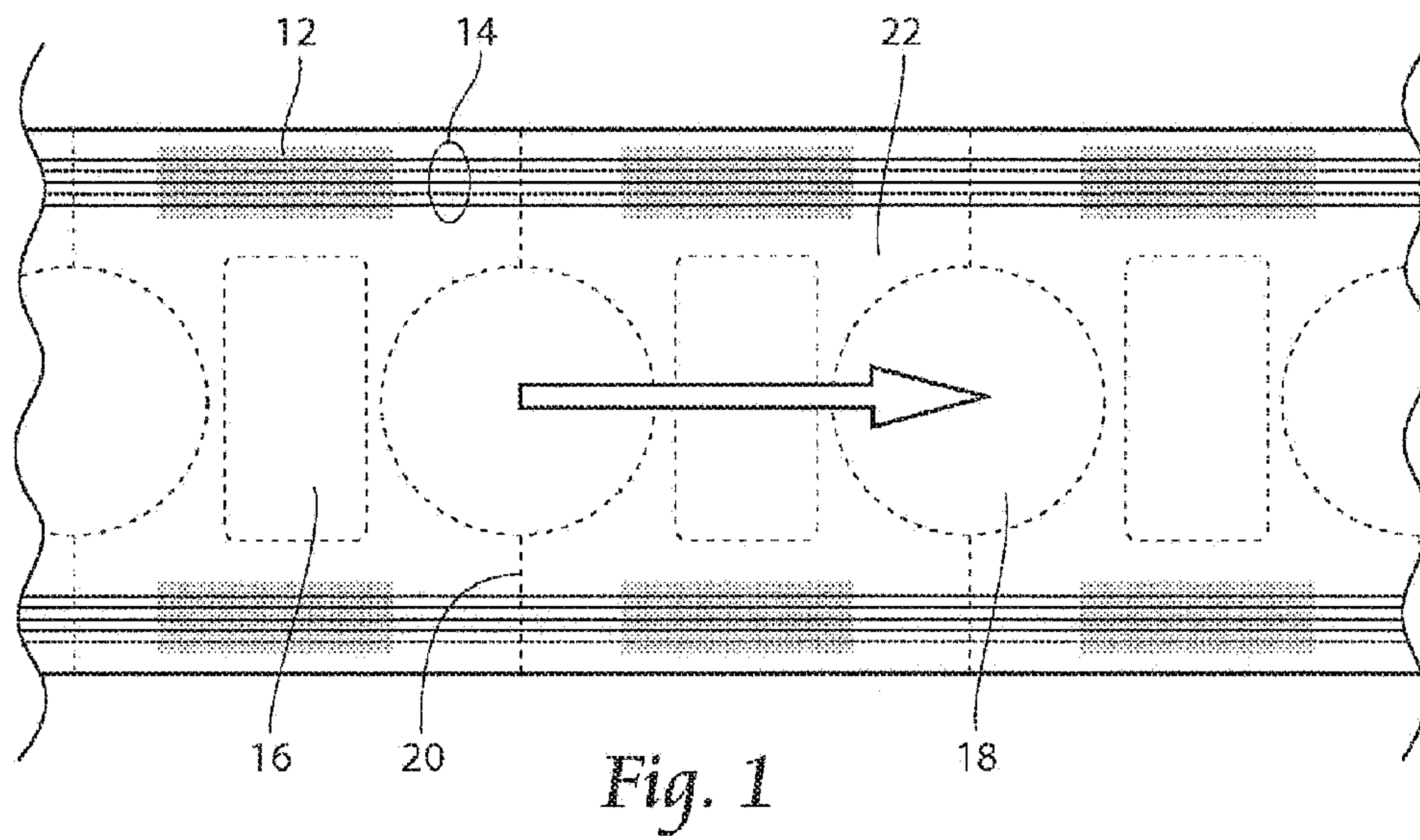
12. Fremgangsmåden fra krav 11 omfattende føring af et laminat mellem klingerulleenheden (40) og amboltrulleenheden (50), hvor laminatet omfatter et par af ikke-vævede lag (22) med elastiske strenge (14) derimellem.

20 13. Fremgangsmåden fra krav 12 omfattende brug af servomotorerne således, at kraften påført af den profilerede klinge (42) på arbejdsamboltoverfladen (51) er tilstrækkelig at overskære de elastiske strenge (14), men efterlade parret af ikke-vævede lag (22) intakt.

25 14. Fremgangsmåden fra krav 12 yderligere omfattende varierende indstilling af den profilerede klinge (42) i forhold til arbejdsamboltoverfladen (51) på grundlag af mindst én af en laminattykkelse, klingerulleenhedens (40) og amboltrulleenhedens (50) omdrejningshastigheder, og sliddet på den profilerede klinge (42).

30 15. Fremgangsmåden fra krav 10, hvor styring af klingerulleenhedens (40) omdrejningsstilling i forhold til amboltrulleenheden (50) omfatter brug af servomotorerne til at give en fasejustering mellem klingerulleenheden (40) og amboltrulleenheden (50).

DRAWINGS



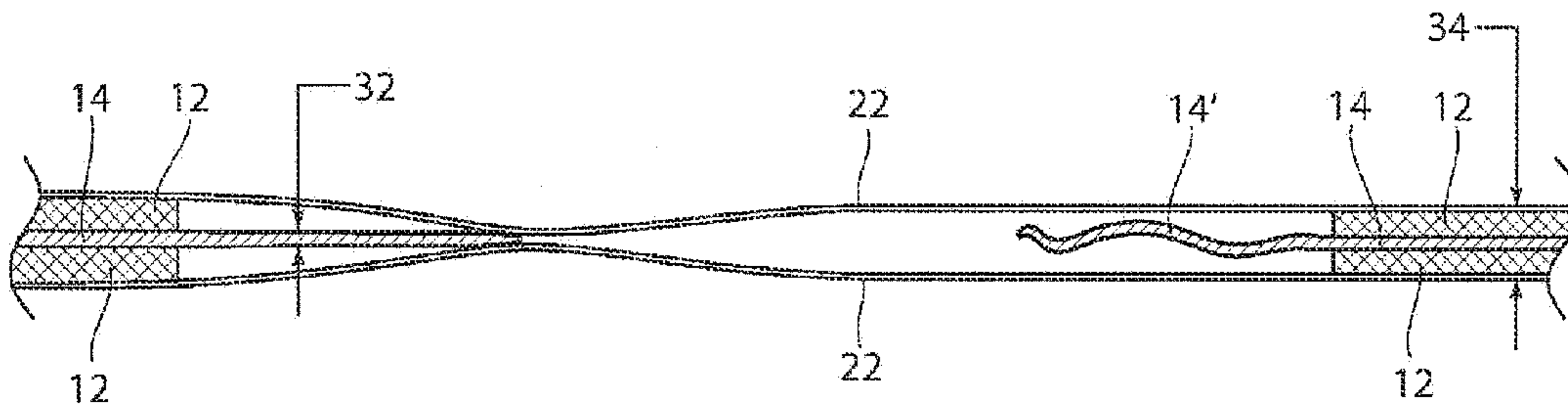


Fig. 3

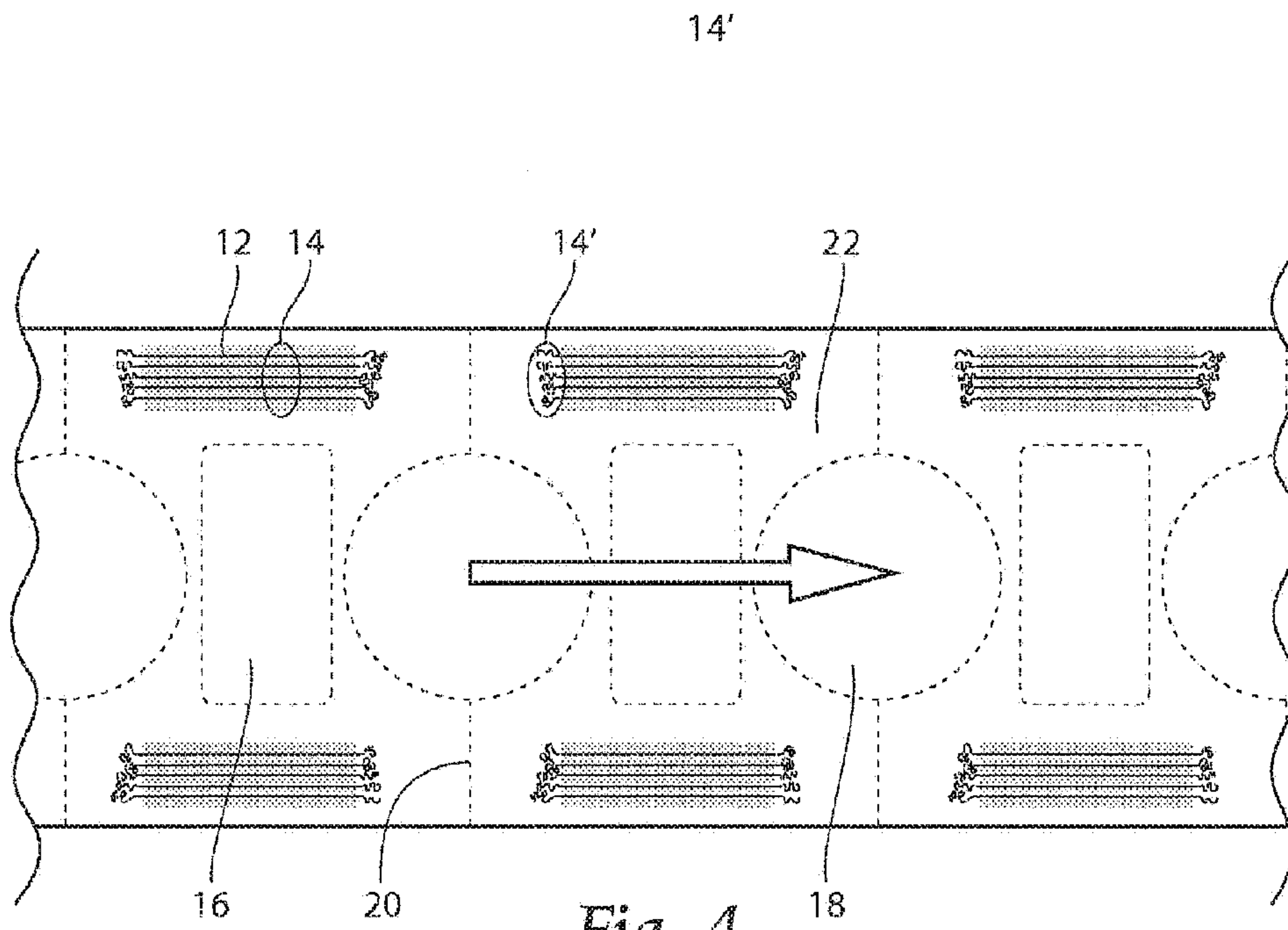
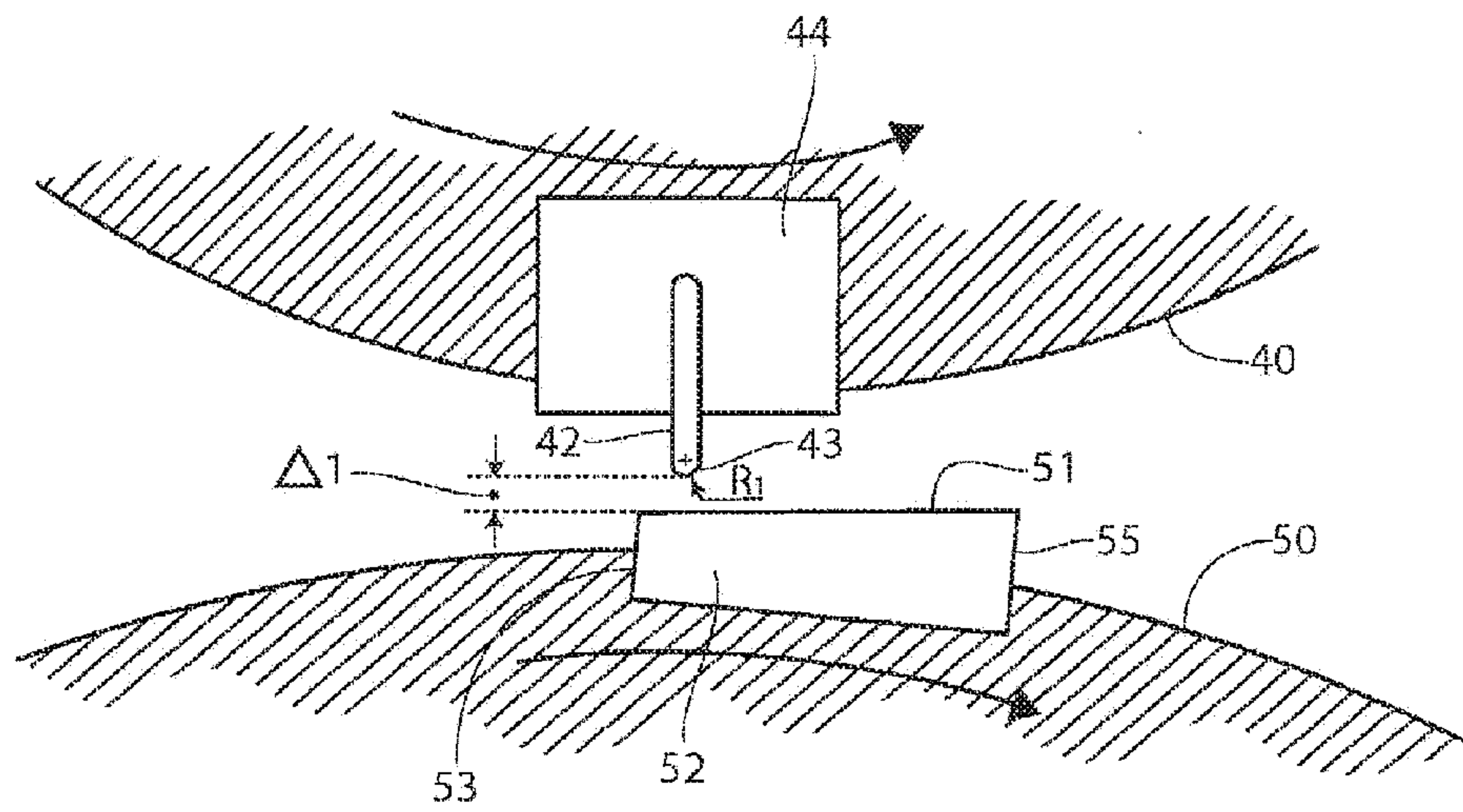
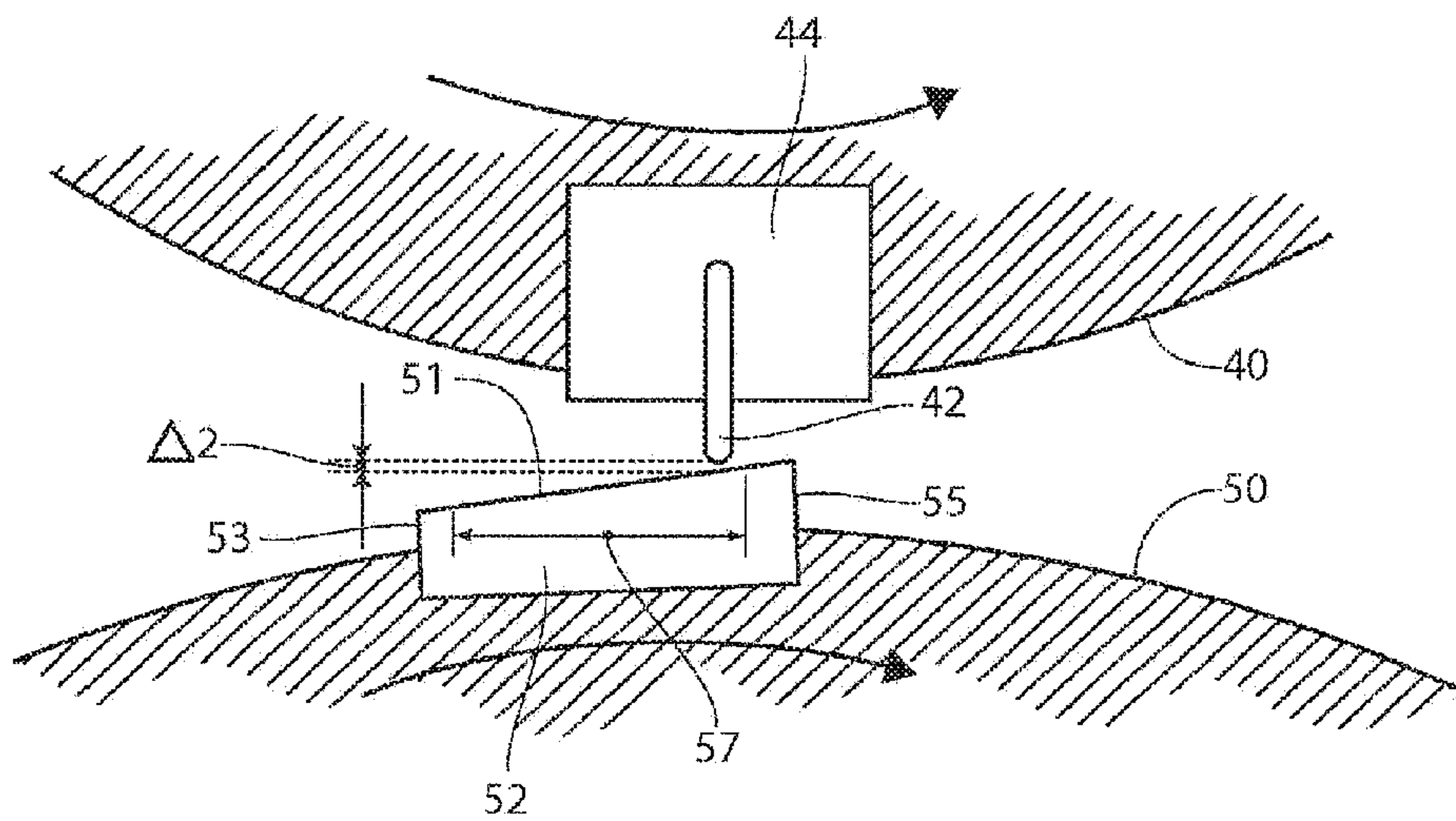


Fig. 4

*Fig. 5**Fig. 6*

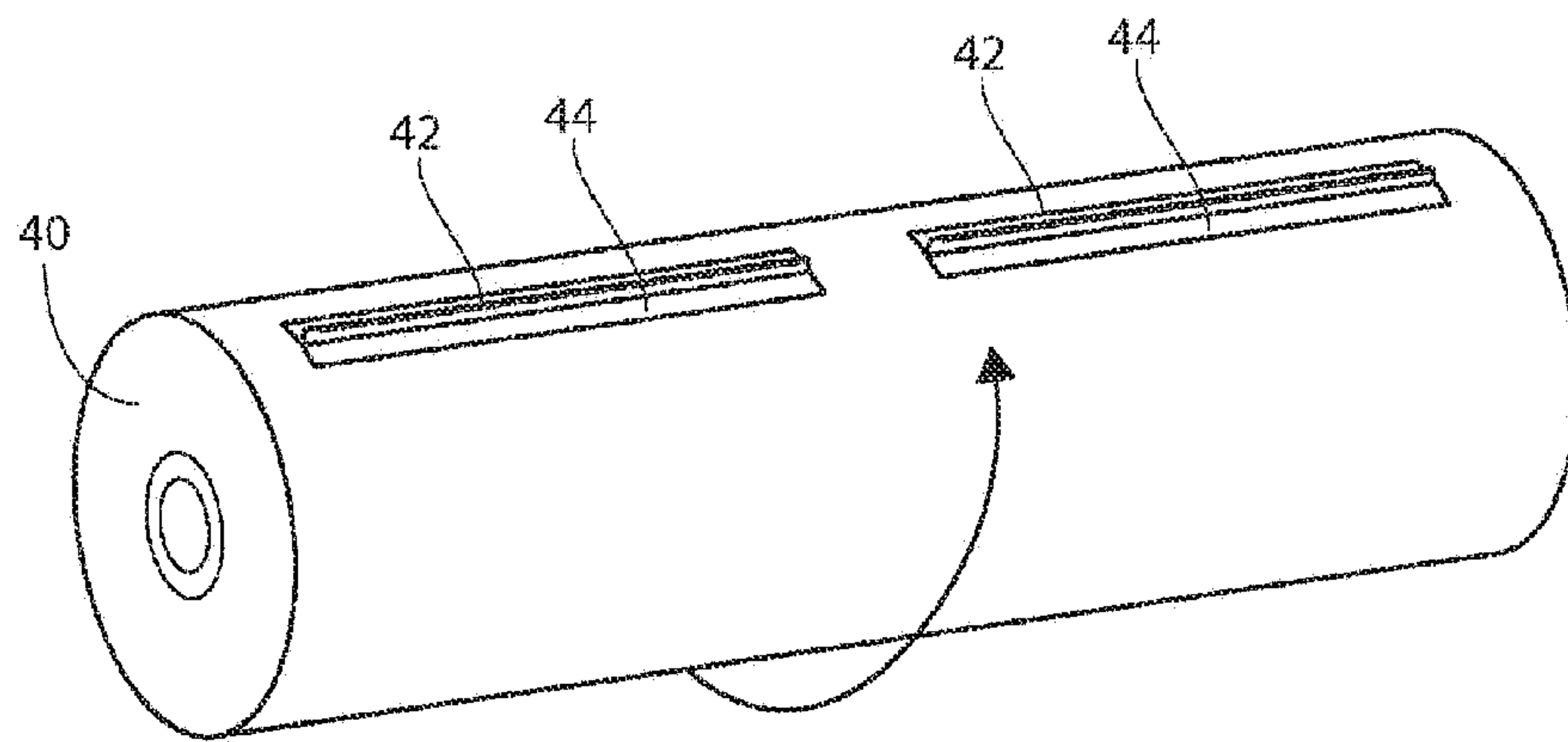


Fig. 7

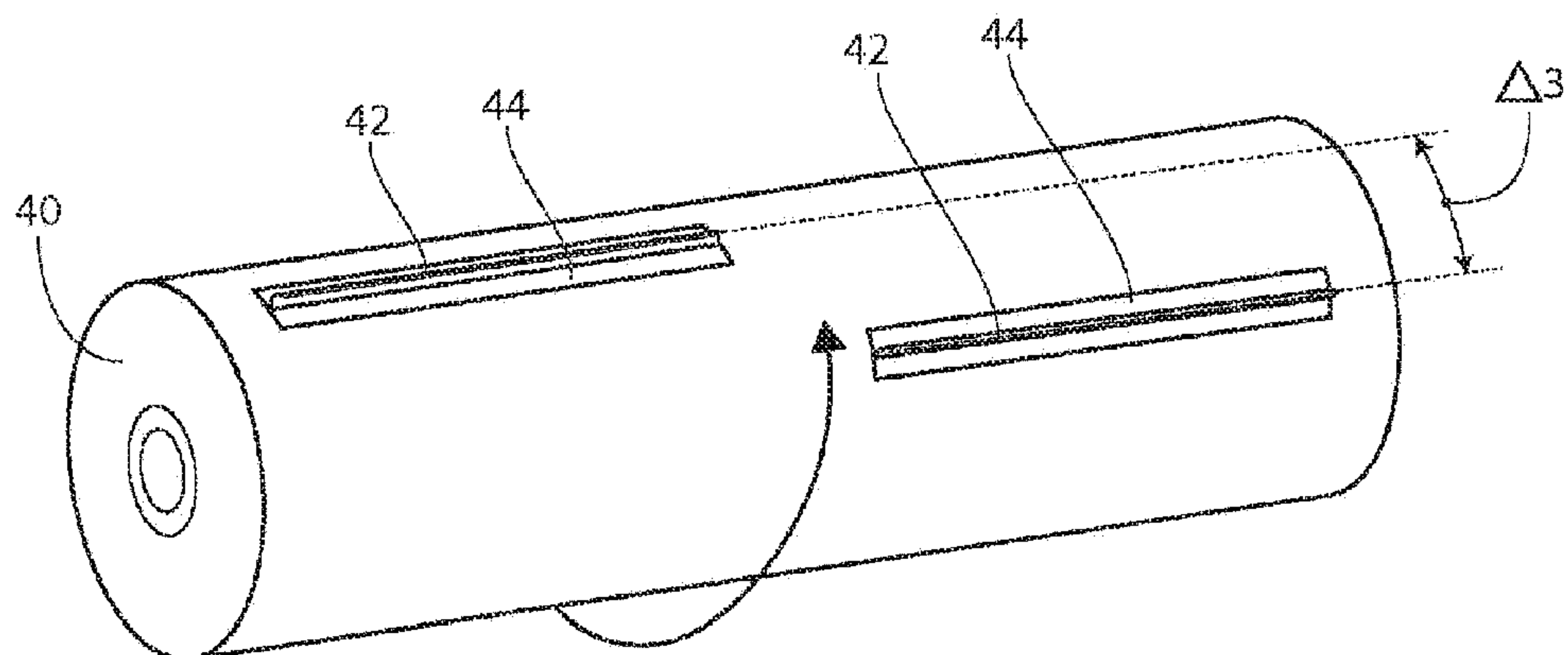


Fig. 8