(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 978 372 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
03.01.2007 Bulletin 2007/01

(51) Int Cl.:
B31D 5/00 *(2006.01)*

(21) Application number: **99115817.1**

(22) Date of filing: **12.09.1994**

(54) **Apparatus for producing individual rolls of packing material**

Vorrichtung zur Herstellung von individuellen Rollen für Verpackungsmaterialien

Appareil pour la production de rouleaux sépares de matériau d'emballage

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **10.09.1993 US 119472**
07.06.1994 US 255062

(43) Date of publication of application:
09.02.2000 Bulletin 2000/06

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
94928574.6 / 0 717 714

(73) Proprietor: **Liberopax LLC**
Boca Raton, Florida 33487 (US)

(72) Inventors:
- **Goodrich, David P.**
  Newtown, CT 06470 (US)
- **Hurwitz, Michael C.**
  South Salem, NY 10590 (US)
- **Jester, Roger E.**
  Newtown, CT 06470 (US)
- **Devine, James P.**
  Bethlehem, CT 06751 (US)

(74) Representative: **Harrison, David Christopher et al**
Mewburn Ellis LLP
York House
23 Kingsway
London WC2B 6HP (GB)

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Description

[0001] The present invention relates in general to apparatus to manually or automatically expand a slit paper type of packaging material and to apparatus for forming the expanded slit paper into spiral cylinders of cushioning materials to be used in packaging.

[0002] The present invention provides an apparatus according to claim 1.

Brief Description of the Drawings

[0003] The objects and advantages of the instant invention will be apparent when the specification is read in conjunction with the drawings, wherein:

FIGURE 1 is an end view of a representation of a spiral cylinder;
FIGURE 2 is a partial end view of the expanded paper forming the spiral cylinder;
FIGURE 3 is a side elevation of an alternate apparatus for spiraling expanded sheet material into cylinders for use as void fill material;
FIGURE 4 is a top view to the expansion machine of the instant invention;
FIGURE 5 is a side view of the expansion machine of FIGURE 4;
FIGURE 6 is a side view of the dual paper positioning in conjunction with the expansion machine of FIGURE 4;

Discussion of the Prior Art

[0004] U.S.-A-5,207,756 (Alhamad) shows apparatus for making an expanded metal mesh for use in firefighting and the like. It discloses expanding the mesh by passing it through two sets of rollers, with the second rotating at a faster speed than the first. The apparatus is said also to be useful in the packaging industry. The mesh is despatched in rolls in unexpanded form, for compactness.

[0005] U.S.-A-3,431,613 (Acker et al) shows a machine for slitting and expansion of sheet stock, according to the preamble of claim 1, where the sheet stock is expanded by being passed over a roller going at a faster speed than the slitting rollers. It is disclosed that a cork sleeve may be used to increase grip of the rollers.

[0006] U.S.-A-1,205,299 (White) shows a machine for slitting and expanding metal. The machine drives all of its feed rollers for expanded metal at equal speed, but has gripping projections which progressively and successively engage the expanded metal.

Detail Description of the Invention

[0007] The instant disclosure relates to equipment for the expansion of an expandable material, preferably slit, recycled paper, as a packing material.

[0008] The paper, once expanded, creates semi-rigid peaks or lands. These peaks are similar to a spring in that once force is applied and removed, they return to their original positioning, providing the elastic limit is not exceeded. The elastic force created by the resistance of the paper fibers slows the acceleration of the force. The work performed by movement of the semi-rigid peaks, as a force is applied by an article, is the elastic potential energy of the expanded material. The yield point is the point beyond stress when a large increase in strain occurs with almost no increase in stress.

[0009] Expanded paper in widths of 13mm [1/2 inch] increments from 13mm to 152mm [1/2 inch to 6 inches] and unrolled, unexpanded paper lengths varying from 76mm to 610mm [3 to 24 inches] was tested as a void fill. The material was found to retract to some degree if not bound at the ends, or wrapped around an article, making optimum expansion difficult to achieve. The slit pattern can be varied with optimum results being obtained with patterns which form hexagonal cells. With the identical paper, load bearing capacity is dramatically increased with the hexagonal pattern, as compared with a diamond cell yielding slit pattern. By winding the paper in the form of a cylinder, the tension on the expanded paper can be maintained without the use of adhesives or the like since the cells "interlock", thus preventing unwinding of the completed cylinders. The sheet material decreases in width during the expansion step and the dimensions of the cylinder are in terms of final dimension of the finished cylinder. Cylinders less than 25mm [1 inch] in length have a tendency to unravel, due to insufficient interlocking of cells, with the problem increasing with decreasing length. Cylinders under 25mm [1 inch] in diameter offer insufficient cushioning effect for general applications. In terms of the correlation between unexpanded flat sheet material and finished cylinders, 0.093m^2 [1 square foot] of sheet material will provide about two and three quarter finished cylinders, as one 50 x 50 mm [2 x 2 in] cylinder equals 0.035m^2 [0.376 square feet] of sheet material. Obviously, the more tightly the cylinder is wound, the greater the amount of sheet material required to form a cylinder. Thus, the aforenoted correlation between sheet material area and cylinder diameter and length is a measure of how tightly the cylinder is wound. Although the tighter the cylinder, the firmer the cushion effect which is achieved, winding the cylinder too tightly will have the effect of removing air from the cylinders and lessening their cushioning qualities. Hence, winding forces on the slit paper material and the quantity of slit paper material used to produce a cylinder are critical. Thus, the cylinders can be customized to meet specific system requirements.

[0010] Expanded paper cylinders were attached to hand-made cardboard cores and wound around the cores. Cylinders ranging in size from about 25mm x 25mm [1 x 1 inch] to 150mm x 150mm [6 x 6 inches] were tested. All sizes worked, with the 50mm x 50mm [2 x 2 inch] size being most effective. The solid core presented a rigid surface and lacked cushioning for side impact.

[0011] Coreless cylinders were formed using hand powered winders. The coreless cylinders were better at absorbing impact at the sides and edges of the cylinders, than the rigid core centered cylinders. However, the number of square meters [square feet] of sheet material required to produce cubic meters [cubic foot] of coreless cylinders was higher than optimally desired, from a cost standpoint. On the other hand, the coreless cylinders was higher than optimally desired, from a cost standpoint. On the other hand, the coreless cylinders provided highly effective cushioning characteristics.

[0012] Using a small hand winder, cylinders were produced with a hollow core and characterized by a 3.72 square meter [40 square feet] of unexpanded sheet material to 0.028 m^3 (1 cubic foot) of cylinder. The hollow core cylinders provided excellent impact and vibration protection. The hollow center spiral wound expanded paper provided a. greater degree of soft cushioning than was provided by the tightly wound coreless cylinders of expanded paper. The cylinder of expanded paper with a hollow core center provided an excellent compromise between excessive use of raw material in the tightly wound cores and lack of side impact protection and added expense associated with the production of expanded paper cylinders with a rigid core.

[0013] To form the cylinder of the instant disclosure the slit paper is expanded and rolled into a cylindrical spiral, having a predetermined diameter and length based on end use. As disclosed, as the paper is expanded, it forms raised cells which, when rolled, interlock with cells in adjacent layers as the paper spirals outward. The interlocking of the cells eliminates the need to secure the cylinders, thereby making them immediately ready for use. The spiral cylinder 40 of Figure 1 is a conceptual illustration of an end view, showing the concept of the interlocking cells raised from the land, however for clarity, rectangles are used to depict the cells formed by the row spacing 44 and the slit spacing 42. Detailed description and illustration of the expanded and unexpanded paper are disclosed in WO 93/18911 published 30 September 1993.

[0014] In Figure 2, a portion of the spiral cylinder 10 is illustrated which more accurately depicts the formation of the cells. The actual cells cannot be seen in the side view of Figure 2, however the material forming the cells is depicted. The row spacing 38a and 38b and the slit spacing 36 are warped, thereby forming the peaks and valleys which interlock with one another.

[0015] The self-locked cylinder provides maximum protection of an article by absorbing the energy created by the impact. The absorbency is achieved by placing the layers in a position to force interaction between the cells. The positioning of the paper in a spiral prevents the paper from turning back on itself or twisting, which lessens the cushioning effect from the cell interaction. The spiral configuration is not only the most economical and easy to produce, it is structurally the most effective. The force applied to the cylindrical elastic body compresses in toward the center, with each interior layer creating an elastic force to return to its original position. The interaction of the cells additionally distributes the impact force through the entire cylinder, thereby providing increased protection of edge or corners of the object being shipped. This is unlike the commonly used styrofoam peanuts which act independently. With the styrofoam peanuts, if the corner of an item receives the main force of impact, the peanuts separate, thereby allowing the item to slide within the box. The interlocking of the cells of the cylinders not only interlocks each individual cylinder but locks the cylinders to one another, preventing slippage of the item within the box.

[0016] The spiral cylinder 10 can be varied in size dependent upon the intended use. The preferable size is approximately 50mm [2 inches] in length and 38mm [1 1/2 - 2 inches] in diameter. The hollow core cylinders provide good packaging protection from all angles of impact and utilize the square footage within the core most efficiently. Desired results are obtained with paper weight of 31.5Kg [70 pound] per 279 m^2 [3000 square feet] of recycled Kraft, 100% post consumer recycled paper, and 81mm x 406mm [3.2 inches by 16 inches] (3.72 m^2 [52 square inches] of expanded slit paper) produces one hollow core cylinder. One hundred twenty cylinders, representing 3.72 m^2 [40 square feet] of unexpanded paper, filled 0.0283 m^3 [one cubic foot] volume as opposed to 210 tightly wound coreless cylinders being required to fill the same volume. Cylinders with a rigid cardboard core required 110 cylinders to fill 0.0283 m^3 [one cubic foot]. 0.0283 m^3 [One cubic foot] of unexpanded slit 31.5Kg [70 pound] paper per 279 m^2 produces 1.05 m^3 [37.2 cubic feet] for void filling purposes when utilizing the hollow core method

[0017] Figure 3 is only exemplary and not part of the claimed invention.

[0018] Figure 3 is a side elevation of an apparatus for spiraling expanded sheet material into cylinders for use as void fill material. In the apparatus of Figure 3, expanded sheet material 800 is fed between the upper moving belt 802 and the lower moving belt 804. The upper moving belt 802 is driven and carried by the upper belt drive roll 806 in the counter clockwise direction, as indicated by directional arrow 801. The lower belt drive roll 808 carries and powers the lower moving belt 804 in the clock wise direction, as indicated by directional arrow 803. The upper belt 803 is tensioned between the drive roll 806 and the cooperative roll 805. The tension plate 810 is biased against the belt 802 by the tension springs 814. Similarly, the lower belt 804 is tensioned between the drive roll 808 and the cooperative roll 809. The tension plate 812 is biased against the belt 804 by the tension springs 816.

[0019] The lower belt 804 rotates opposite the upper belt, thereby driving the forming cylinder 820 in the direction indicated by directional arrows 819. The upper belt 802 is rotated at seven times the speed of the lower belt 804, thereby causing the leading edge 824 of the expanded sheet 800 to drag and curl under. As the sheet

progresses in the direction of arrow 819, the curling effect is continued forming partly formed cylinder 820. The curling or spiraling effect continues until a fully formed cylinder 822 is produced and delivered to a receiving region, not shown.

[0020] Figures 4 and 5 illustrate the expansion machine 700 which rapidly produces optimum expansion of the slit paper 750. The paper is fed from a storage roll, not shown, to the upper and lower drive rollers 706 and 708, where it is placed between the rollers 706 and 708. The paper storage roll can be placed at any point along a 100° arc from the drive rollers 706 and 708, using the point directly perpendicular from the drive rollers 706 and 708 as the 0° point. Both the upper drive roller 706 and the lower drive roller 708 are covered with a friction material, such as shrink tubular material made of a heat shrinkable polymer, as for example polyvinyl chloride. Alternatively, a rubber spray or painted coating can be used. Additionally vinyl tape covered rollers and rubber rollers can be used. Abrasive coatings tended to produce some scratching of the paper and formation of dust due to the action of the abrasive material on the paper.

[0021] There is no theoretical upper limit to the amount of friction caused by the roller fiction covering, except that damage to the paper must be avoided. Therefore, the use of a coarse material is to be avoided.

[0022] The tension between the drive rollers and the expansion rollers must be sufficient to open, or expand the slit paper, but not sufficient to tear the paper. Typically, with paper weighing 13.5Kg per 279 m^2 [30 pound paper] 2.8 Kg/meter, [2.5 oz. of force per linear inch], can be applied and with paper weighing 31.5 lb per 279m^2 [70 pound paper], 5.6Kg per linear meter [5 oz. per linear inch] of force can be applied. The expansion should be sufficient to not only expand the paper, but also to crack some of the fibers, thereby decreasing the tendency of the paper to return to its unexpanded form. With the aforenoted 13.5Kg per 279 m^2 [70 pound paper], it required an 8w [.011 hp] motor to deliver paper at a rate of 7.6 m [300 inches] per minute, expanded 25 linear mm [one linear inch].

[0023] Utilizing a 508mm x 762 mm [20 by 36 inch] sheet of the aforenoted unexpanded 31.5Kg per 279m^2 [70 pound] paper, with one end secured in a rigid fixture across its entire width, the paper was suspended vertically and a force was applied to expand the paper. A force of about 1.4Kg [50 ounces] that is, 2.8 Kg/m [2.5 oz. per inch], initiated the expansion of the paper and 3.3Kg per linear meter [3 oz. per linear inch] opened all of the paper cells. 5.5Kg per linear meter [5 oz. per linear inch] opened all cells fully and yielded cell wall fiber tearing which aids cell walls to remain open after the expanded paper is released in the open position A force of 8.3Kg per linear meter [7.5 oz] expanded the paper and tore it after 10 seconds of continued stress. 11Kg per linear meter [10 oz. per linear inch] opened the cells and immediately tore the paper. The use of about 5.5Kg per linear meter [5 oz] was thus shown to provide the optimum results.

[0024] The lower drive roller 708 is driven by the motor 726 through the rotation of the motor gear 716 and drive gear 714. The rotation created by the motor 726 is transmitted along motor shaft 724 to the motor gear 716 where it drives the drive belt 718, which in turn rotates the drive gear 714. The motor gear 720, also connected to the motor shaft 724, drives the expansion belt 722, which in turn rotates the expansion gear 710. Due to the spacing of the motor gear 716 and the motor gear 720 along the motor shaft 724, an expansion shaft 712 is generally provided between the expansion gear 710 and the upper expansion roller 702 and lower expansion roller 704. The drive gear 714 is provided with 20 teeth as compared to the expansion gear 710 which has 14 teeth. The difference in the number of teeth changes the rotation speed of the upper expansion roller 702 and lower expansion roller 704 as compared to the upper drive roller 706 and lower drive roller 708, allowing the motor shaft 724 to rotate at a single speed. The differential can be obtained by a number of methods known in the prior art and the foregoing is not intended to limit the scope of the invention. The speed differential between the upper and lower expansion rollers 702 and 704 and the upper and lower drive rollers 706 and 708 is critical as it provides the expansion of the slit paper 750. The slit paper 750 is being removed from the expansion machine 700 faster than it is entering, thereby forcing the slit paper 750 to expand. The speed differential between the expansion rollers 702 and 704 and the drive rollers 706 and 708 must be calculated to provide the required amount of expansion based on the weight of paper and end use. In the gear assembly as illustrated in Figures 4 and 5, the expansion gear 710 and drive gear 714 can be changed to provide a increase or decrease in the speed differential. Other methods of changing the speed differential can be obtained and are known in the prior art.

[0025] The spacing of the expansion rollers a distance of about 150mm [6 inches] from the drive rollers produced some binding in the middle of the paper, apparently due to the contraction of the paper which coincides with the expansion of the paper in thickness and length. A space between the expansion and drive rollers of about 292mm [11.25 inches] worked well for 494mm [19.5 inch] rolled paper. With 76mm [3 inch] wide paper, a minimum of 102mm [4 inches] of separation between the roller sets worked. The distance between the drive rollers and the expansion rollers varies proportionally with the width of the unexpanded paper.

[0026] The expansion device can be used to produce expanded product for use directly as a wrapping material. The automated roll dispenser provides for immediate use of the expanded paper minimizing space requirements while yielding maximum packaging usage by allowing the user to pull tightly during the wrapping process by stopping or braking when needed. At the end of wrapping, prior to tearing, the foot pedal is released and the automated expander brakes for final pulling and tearing. This

leaves the process of maximum stretch intact for greatest packaging protection. An electronic unit can be employed to deliver measured quantities of expanded paper. Braking at the end of the delivery provides for the user to tear the desired length of paper from the roll of paper. Alternatively, a cutting blade can be used to sever the delivered quantity of paper from the remainder of the roll.

[0027] The upper expansion roller 702 and the lower expansion roller 704 are covered with a material selected from bristles and hooted bristles. The covering must grip the unopened slit paper 750, without ripping the paper, and pull it open through use of the differential speed between the expansion rollers 702 and 704 and the driver rollers 706 and 708. The use of soft rubber covered rollers works to produce even expansion over the width of the paper. However, deformation of the paper can be experienced, in the form of crushed cells. That is, at the point of contact with the pair of expansion rollers, the expanded cells can be crushed by the rollers. The use of open cell and light foam can work to provide the required expansion. However, low density, open cell foam has a life span which is shorter than optimally desired. When soft bristled brushes of the type employed in photocopy machine, were used, some difficulty was experienced in starting the expansion process. Harder bristled brushes cause some trouble in releasing the paper. Optimum results were obtained with medium stiff bristles cut to approximately 3mm [1/8 inch] in length. Bristles can be made of metal wire, such as carbon steel, stainless steel, brass, bronze and a variety of bristle dimensions are commercially available.

[0028] The preferred material is a nylon hook fiber of the type found in hook and loop fasteners of the type sold under the trademark VELCRO. The use of a set of rollers faced with hook ended fibers provided the required expansion without distortion of the expanded paper or deterioration of the rollers. Unlike relatively firm foam covered rollers, the hook fibers did not crush the expanded cells as they passed between the expansion rollers. It should be understood that the role of the expansion rollers is critical in that they must be able to grip and pull the paper so as to impart a speed of travel to the paper which is greater than the speed of the paper when it passes through the drive rollers. This requirement is in conflict with the need to permit the expanded paper to pass between the rollers without the expanded cells being crushed.

[0029] An alternate embodiment to the expansion device of Figures 4 and 5 is illustrated in Figure 6. The multi roll expander 600 operates on the same basis as the expansion device 700. The expander 600 is provided with a paper support unit 630 which is provided with at least one retaining area 638 to receive the paper roll 634. The retaining area 638, as illustrated herein, is a notched portion which receives a bar 636 which is placed through the core of the paper roll 634. The expander 600, as illustrated, holds two rolls of paper 632 and 634 in retaining areas 638 and 640, however additional rolls can be added. The paper 642 from roll 632 is fed into the bottom roller set 620 and the paper 644 from roll 634 is fed into the top roller set 610. The top roller set 610 and bottom roller set 620 are each designed as described in Figures 4 and 5.

[0030] It is to be understood that the filling material sheets of the present Invention may be formed of any desirable and suitable dimensions depending upon the hollow spaces to be filled in packaging materials. While the description of the filling material sheet member of the present invention describes one example with respect to size and thickness, this is not intended to limit the scope of the invention. Where the slit pattern and paper characteristics have interacted to form a hexagonal cell, the slit paper has sufficient resistance to expansion, to permit the sheet material in roll form, to be rewound without expansion. This is not the case for slit pattern/material characteristic combinations which fail to produce the hexagonal pattern. Where the legs of the cells are insufficiently rigid to form the hexagonal shape, the cells are also excessively easy to open. In such cases, the sheets have to have the slit patterns cut on a flat press, for the sheets to be shipped unexpanded, since the conventional rewind rolling action would expand the slit sheets.

[0031] Once expanded by the apparatus, the sheet material has a sufficient load bearing capacity and sufficient elastic potential energy to protect an article in transit against impact damage, by cushioning the article.

Claims

1. An apparatus for forming a cushioning material for use as a packaging material from a source of flexible material in its unexpanded form (632), said material having:

a plurality of spaced parallel rows of individual slits extending transversely from one end of the sheet material to the opposing end of said sheet material, each of said rows having interval spaced between consecutive slits;
said slits in each row being positioned adjacent the interval space between consecutive slits in the adjacent parallel row of slits;
the flexible material in its expanded form having an array of openings, each opening being generally similar in shape and size;

said apparatus comprising:

a first pair of drive rolls (706,708),
a second pair of expander rolls (702,704),
whereby said flexible material is adapted to extend from said source to said pair of drive rolls, and pass between said drive rolls to said expander rolls, **characterized in that** it further has :

at least one of said expander rolls (702) having slit material gripping means on its surface selected from the group consisting of bristles and hooked bristles, whereby rotation of said drive rolls draws material from its source and rotation of said expander rolls at a rotational speed greater than the rotational speed of said drive rolls expands the material, said gripping means on said expander rolls engaging said material.

2. The apparatus of claim 1, wherein said slit material gripping means is a plurality of moderately firm bristles uniformly distributed along the surface of at least one expander roll (702).

3. The apparatus of claim 1, wherein said slit material gripping means is a plurality of moderately firm bristles uniformly distributed along the surface of at least one expander roll (702), said bristles having hook means on its outer end, the barb of said hook being oriented to engage the slits in said material during the rotation of said expander rolls.

4. The apparatus of claim 1, wherein said slit material gripping means is a plurality of moderately firm bristles uniformly distributed along the surface of at least one expander roll, said bristles having hook means on its outer end, the barb of said hook being oriented in the leading position whereby said barbs engage the slits in said material during the rotation of said expander rolls.

5. The apparatus of claim 1, wherein said expander rolls apply an expansion force of in the range from about 3.3 Kg to about 8 Kg per linear meter [3 oz to about 7 oz per linear inch] to said slit material.

6. The apparatus of claim 1, wherein said slit material gripping means is a plurality of moderately firm bristles uniformly distributed along the surface of a first expander roll in a spiral pattern (1606), and a plurality of moderately firm bristles uniformly distributed along the surface of a second expander roll in a spiral pattern (1608), the first and second expander rolls being spaced apart a distance such that bristles of each roll engage openings in said slit material when expanded.

7. The apparatus of claim 6, wherein said bristles of said first expander roll (1606) oppose said bristles of said second expander roll (1608) during a portion of the rotation cycle, thereby grabbing said unexpanded paper and are unopposed during the remainder of said rotation cycle, thereby engaging expanded slit sheet material without crushing.

Patentansprüche

1. Vorrichtung zur Ausbildung eines Polsterungsmaterials zur Verwendung als Verpackungsmaterial aus einer Quelle flexiblen Materials in dessen nicht ausgedehnter Form (632), wobei das Material Folgendes umfasst:

eine Vielzahl parallel beabstandeter Zeilen aus Einzel-Schlitzen, die sich von einem Ende des Bahnmaterials quer zum gegenüberliegenden Ende des Bahnmaterials erstrecken, wobei jede der Zeilen einen Abstand zwischen aufeinanderfolgenden Schlitzen aufweist;
die Schlitze in jeder Zeile angrenzend an die Zwischenräume zwischen aufeinanderfolgenden Schlitzen in der angrenzenden parallelen Schlitzzeile positioniert sind;
das flexible Material in seiner ausgedehnten Form eine Matrix an Öffnungen umfasst, wobei alle Öffnungen im Allgemeinen ähnliche Formen und Größen aufweisen;

die Vorrichtung, umfassend:

ein erstes Paar Antriebswalzen (706, 708),
ein zweites Paar Dehnungswalzen (702, 704),
wobei das flexible Material ausgebildet ist, um sich von der Quelle zum Antriebswalzenpaar zu erstrecken und zwischen den Antriebswalzen zu den Dehnungswalzen hindurchzutreten, **dadurch gekennzeichnet, dass** es ferner umfasst:

zumindest eine der Dehnungswalzen (702) ein Schlitzmaterial-Greifmittel auf seiner Oberfläche aufweist, welches aus einer Gruppe bestehend aus Borsten und hakenförmigen Borsten ausgewählt ist, wobei die Drehung der Antriebswalzen Material aus dessen Quelle zieht und die Drehung der Dehnungswalzen, welche bei einer Umdrehungsgeschwindigkeit erfolgt, die größer als die Umdrehungsgeschwindigkeit der Antriebswalzen ist, das Material ausdehnt, wobei das auf den Dehnungswalzen angebrachte Greifmittel in das Material eingreift.

2. Vorrichtung nach Anspruch 1, worin das Schlitzmaterial-Greifmittel eine Vielzahl an mäßig festen Borsten ist, die gleichmäßig entlang der Oberfläche zumindest einer Dehnungswalze (702) verteilt sind.

3. Vorrichtung nach Anspruch 1, worin das Schlitzmaterial-Greifmittel aus einer Vielzahl an mäßig festen Borsten besteht, die gleichmäßig entlang der Oberfläche zumindest einer Dehnungswalze (702) verteilt angeordnet sind, wobei die Borsten Hakenmittel an

deren äußeren Enden aufweisen, wobei der Widerhaken dieses Hakens so ausgerichtet ist, dass er während der Drehung der Dehnungswalzen in die Schlitze im Material eingreift.

4. Vorrichtung nach Anspruch 1, worin das Schlitzmaterial-Greifmittel eine Vielzahl an mäßig festen Borsten ist, die gleichmäßig entlang der Oberfläche zumindest einer Dehnungswalze verteilt angeordnet sind, wobei die Borsten Hakenmittel an deren äußeren Enden aufweisen, wobei der Widerhaken des Hakens in der Führungsstellung ausgerichtet ist, wodurch die Widerhaken während der Drehung der Dehnungswalzen in die Schlitze im Material eingreifen.

5. Vorrichtung nach Anspruch 1, worin die Dehnungswalzen eine Ausdehnungskraft von etwa 3,3 kg bis etwa 8 kg pro Laufmeter (3 oz bis etwa 7 oz pro Laufzoll) auf das Schlitzmaterial anlegen.

6. Vorrichtung nach Anspruch 1, worin das Schlitzmaterial-Greifmittel eine Vielzahl an mäßig festen Borsten ist, die gleichmäßig entlang der Oberfläche einer ersten Dehnungswalze in einem spiralförmigen Muster (1606) verteilt angeordnet sind und eine Vielzahl an mäßig festen Borsten umfasst, die gleichmäßig entlang der Oberfläche einer zweiten Dehnungswalze in einem spiralförmigen Muster (1608) angebracht sind, wobei die erste und die zweite Dehnungsrolle in einem derartigen Abstand voneinander beabstandet sind, dass die Borsten jeder Rolle bei Ausdehnung des Schlitzmaterials in die Öffnungen desselben eingreifen.

7. Vorrichtung nach Anspruch 6, worin die Borsten der ersten Dehnungswalze (1606) den Borsten der zweiten Dehnungswalze (1608) während eines Teils des Drehungszyklus gegenüberliegen, wodurch das nicht ausgedehnte Papier ergriffen wird und diese einander während des verbleibenden Teils des Drehungszyklus nicht mehr gegenüberliegen, wobei in das ausgedehnte Schlitz-Bahnmaterial eingegriffen wird, ohne dieses dabei zu zerdrücken.

Revendications

1. Appareil pour former un matériau de bourrage pour utilisation en tant que matériau d'emballage à partir d'une source de matériau flexible sous sa forme non expansée (632), ledit matériau ayant :

une pluralité de rangées parallèles espacées de fentes individuelles s'étendant transversalement depuis une extrémité du matériau de feuille à l'extrémité opposée dudit matériau de feuille, chacune desdites rangées ayant un intervalle espacé entre des fentes consécutives ;
ladites fentes dans chaque rangée étant en position adjacente à l'espace d'intervalle entre des fentes consécutives dans la rangée parallèle adjacente de fentes ; le matériau flexible sous sa forme expansée ayant une matrice d'ouvertures, chaque ouverture étant généralement similaire en forme et en taille ;

ledit appareil comprenant :

une première paire de rouleaux d'entraînement (706, 708), une seconde paire de rouleaux expanseurs (702, 704),
de telle manière que ledit matériau flexible soit adapté pour s'étendre de ladite source à ladite paire de rouleaux d'entraînement, et passer entre lesdits rouleaux d'entraînement vers lesdits rouleaux expanseurs, **caractérisé en ce qu'**il comprend en outre :

au moins l'un desdits rouleaux expanseurs (702) ayant des moyens de prise de matériau à fentes sur sa surface choisis dans le groupe constitué de soies et de soies à crochet, de telle manière que la rotation desdits rouleaux d'entraînement entraîne le matériau depuis sa source et la rotation desdits rouleaux expanseurs à une vitesse de rotation supérieure à la vitesse de rotation desdits rouleaux d'entraînement expanse le matériau, lesdits moyens de prise sur lesdits rouleaux expanseurs engageant ledit matériau.

2. Appareil selon la revendication 1, dans lequel lesdits moyens de prise de matériau à fentes sont une pluralité de soies modérément fermes uniformément distribuées le long de la surface d'au moins un rouleau expanseur (702).

3. Appareil selon la revendication 1, dans lequel lesdits moyens de prise de matériau à fentes sont une pluralité de soies modérément fermes uniformément distribuées le long de la surface d'au moins un rouleau expanseur (702), lesdites soies ayant des moyens formant crochet sur leurs extérieurs externes, l'ardillon dudit crochet étant orienté de manière à engager les fentes dans ledit matériau durant la rotation desdits rouleaux expanseurs.

4. Appareil selon la revendication 1, dans lequel lesdits moyens de prise de matériau à fentes sont une pluralité de soies modérément fermes uniformément distribuées le long de la surface d'au moins un rouleau expanseur, lesdites soies ayant des moyens formant crochet sur leurs extrémités externes, l'ardillon dudit crochet étant orienté dans la position

avant de telle manière que lesdits ardillons engagent les fentes dans ledit matériau durant la rotation desdits rouleaux expanseurs.

5. Appareil selon la revendication 1, dans lequel lesdits rouleaux expanseurs appliquent une force d'expansion dans la plage d'environ 3,3 kg à environ 8 kg par mètre linéaire [3 onces à environ 7 onces par pouce linéaire] audit matériau à fentes.

6. Appareil selon la revendication 1, dans lequel lesdits moyens de prise de matériau à fentes sont une pluralité de soies modérément fermes uniformément distribuées le long de la surface d'un premier rouleau expanseur dans un motif en spirale (1606), et une pluralité de soies modérément fermes uniformément distribuées le long de la surface d'un second rouleau expanseur dans un motif en spirale (1608), les premier et second rouleaux expanseurs étant espacés d'une distance telle que les soies de chaque rouleau engagent des ouvertures dans ledit matériau à fentes lorsqu'il est expansé.

7. Appareil selon la revendication 6, dans lequel lesdites soies dudit premier rouleau expanseur (1606) sont opposées auxdites soies du second rouleau expanseur (1608) durant une partie du cycle de rotation, de manière à collecter ledit papier non expansé et sont non opposés durant le reste dudit cycle de rotation, de manière à engager le matériau de feuille à fentes expansé sans écrasement.

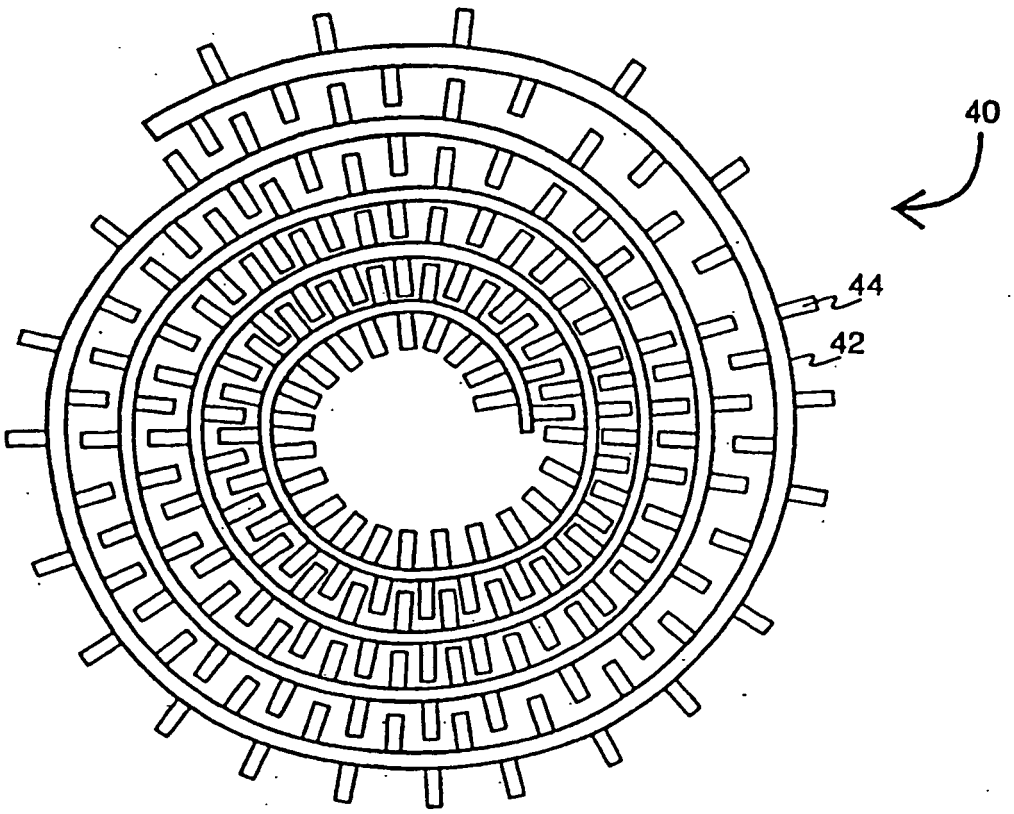


Fig. 1

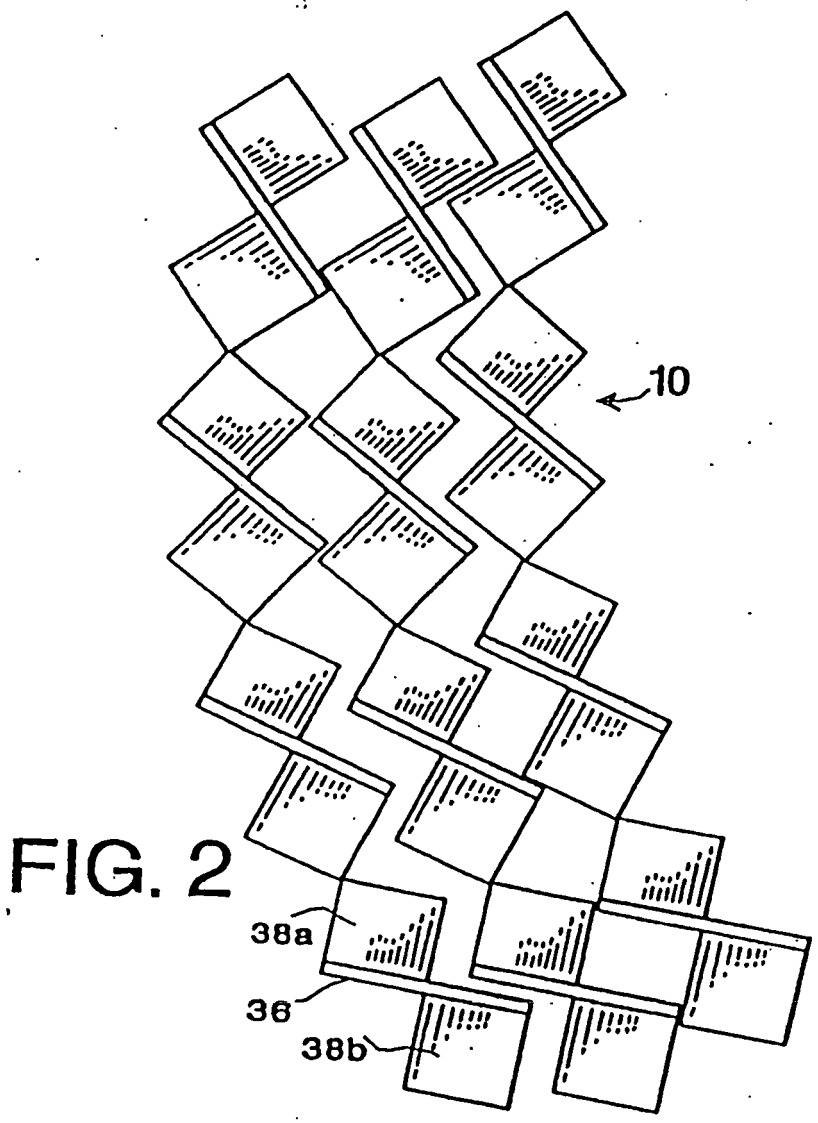
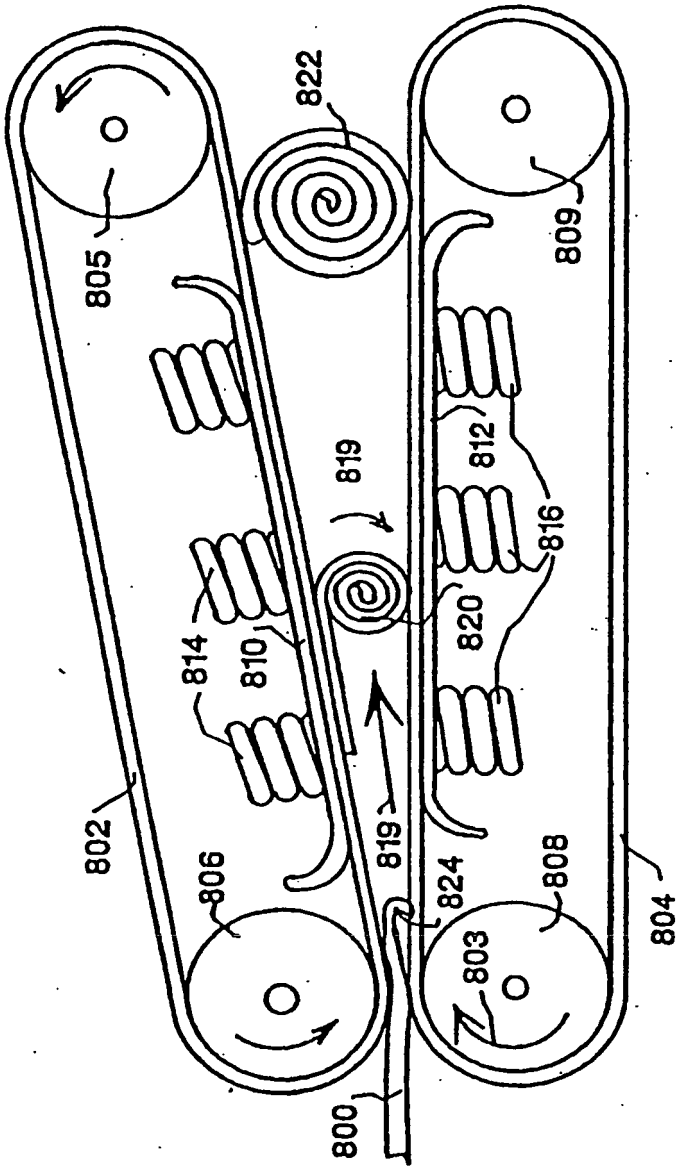


FIG. 2


822
805
809
812
819
816
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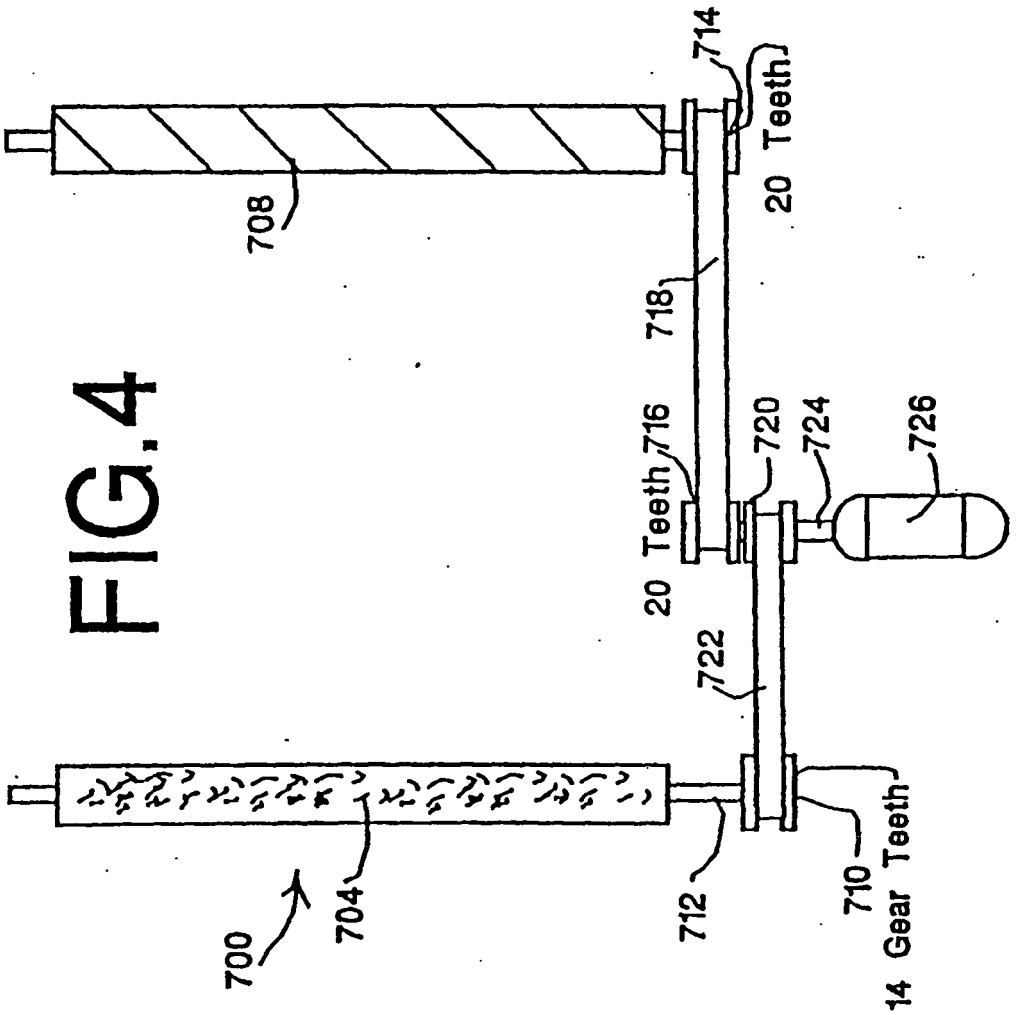
804
803
800

FIG.3

FIG.4


708
714
20 Teeth
718
716
20 Teeth
720
724
726
722
700
704
712
710
14 Gear Teeth

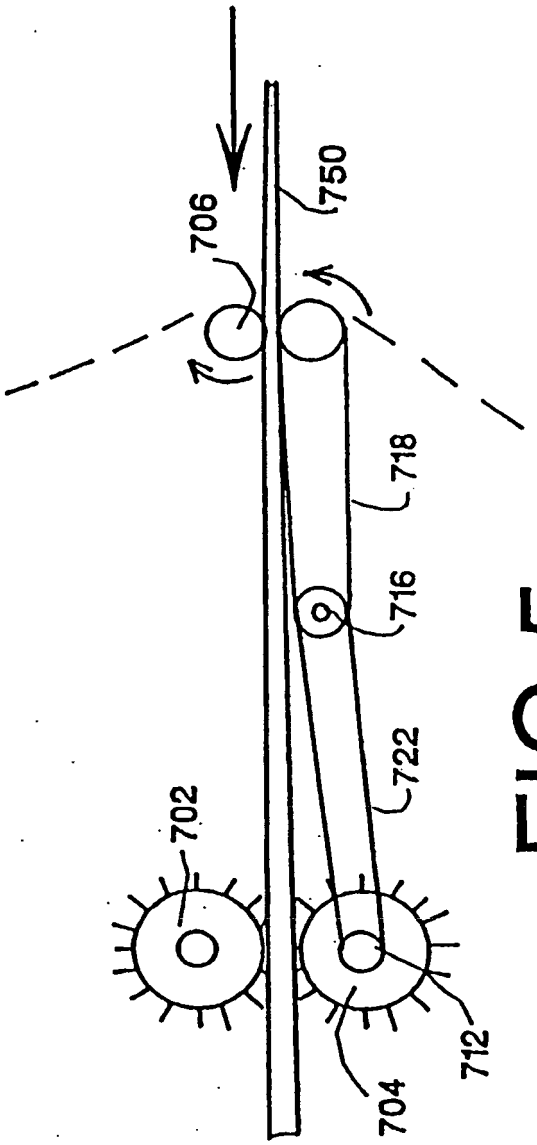


FIG.5

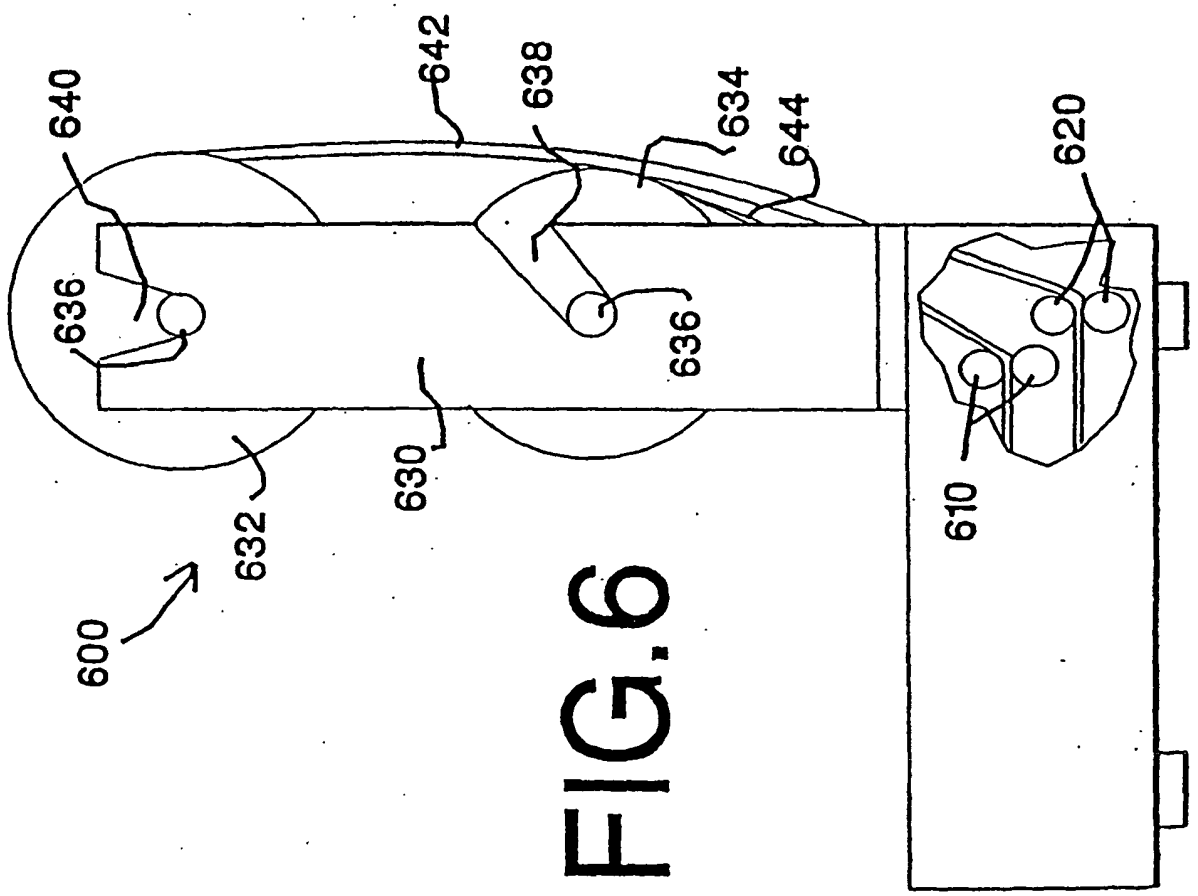


FIG.6