Method and apparatus for manufacturing paper cushioning members.

Disclosed are a method and apparatus for manufacturing paper cushioning members, which ensure continuous mass-production of paper balls, made by crumpling a sheet or sheets of work paper, and permit the use of the paper balls as cushions or packings for transporting objects. The method and apparatus are designed to form circumferential recesses (3) and projections (4) each of a given width on and around a surface of each of a pair of elongated roller members (1, 2) and engaging the recesses (3) and projections (4) of one of the roller members (1, 2) with the projections (4) and recess (3) of the other roller member respectively; form link-portion forming recesses (6) each in a part of a circumferential surface of each of the projections (4) in a horizontal direction or at a predetermined angle (φ) to the horizontal direction; insert a single sheet or plural sheets of work paper (P') to be processed between the pair of roller members (1, 2) and alternately forming cuts (7) and link portions (71, ..., 7n) along the circumferential recesses (3) and projections (4) on the sheet or sheets of work paper (P'), by using circumferential edges of the circumferential recesses (3) and projections (4) of the roller members (1, 2); and stretch the sheet or sheets of work paper (P) after alternate formation of the cuts (7) and link portions (71, ..., 7n) in a direction perpendicular to a cutting direction, thus forming a net (7').

FIG. 2
BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method and apparatus for manufacturing paper cushioning members, and more particularly, to a method and apparatus for cutting a single sheet or plural sheets of work paper to be processed, such as unused paper or unnecessary newspaper, used copying paper, paper printed by an OA (Office Automation) equipment or used corrugated cardboard, to plural rows of thin intermittently-cut bands, stretching the resultant sheet or sheets of work paper to form a net, and crumpling the net-like sheet or sheets into an air-containing ball which has an adequate softness to thereby ensure continuous mass-production of such paper balls and permit the use of the paper balls as cushions or packings for transporting objects.

Description of the Related Art

There are cushions made of synthetic resin, which are to be placed between transporting objects and a box to protect the transporting objects against any damage. To avoid any pollution problem, however, there are paper cushions used for the same purpose instead of the synthetic-resin cushions. The simplest type of the paper cushions is a sheet of newspaper crumpled into a ball or paper torn to pieces which are then crumpled, or a corrugated cardboard cut into pieces as an intervening material depending on the usage.

Another known cushion is a strong kraft paper processed to have short cuts and link portions by press working and then stretched to yield a fine almost beehive-like net.

Of those paper cushions, the first type, namely balls made of newspaper, involve a troublesome work and are to vary in quality. Although the torn and crumpled pieces of paper, the second type, are soft to serve as good cushions, they are independent piece by piece and are easy to scatter, resulting in a lower working efficiency. In addition, since it is difficult to use the torn and crumpled pieces of paper directly, they are normally placed in a paper bag or a poly bag when in use. If the bag is torn or broken, however, the crumpled pieces of paper undesirably come out of the bag through the torn section.

Although a corrugated cardboard, when cut to pieces, ensure an even thickness, those pieces are still hard and are not so suitable as cushions.

With regard to the pressed kraft paper or the last type of cushion, when the processed kraft paper is stretched, a fine beehive-like net is formed due to the cuts and link portions. When the net is crumpled, soft and spongy feeling to some degree would be attained. Due to the press working, however, the processing size of a single sheet of kraft paper is limited and it is not possible to simultaneously process plural sheets of kraft paper. Further, as the resultant net is finely formed, the horizontal stretching ratio is small, so that the net, when crumpled into a ball, contain less air. Furthermore, as the link portions are short, the link portions are easily cut when stretched unless the kraft paper is very strong. In addition, as the net is finely formed, the material should be a thin sheet of paper and the net should be formed sheet by sheet.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a method and apparatus for manufacturing paper cushioning members, which will overcome the above-described conventional shortcomings.

To achieve the above object, according to one aspect of this invention, there is provided a method of manufacturing paper cushioning members, comprising the steps of forming circumferential recesses and projections each of a given width on and around a surface of each of a pair of elongated roller members and engaging the recesses and projections of one of the roller members with those of the other roller member respectively; forming link-portion forming recesses each in a part of a circumferential surface of each of the projections in a horizontal direction or at a predetermined angle to the horizontal direction; inserting a single sheet or plural sheets of work paper to be processed between the pair of roller members and alternately forming cuts and link portions along the circumferential recesses and projections on the sheet or sheets of work paper, by using circumferential edges of the circumferential recesses and projections of the roller members; and stretching the sheet or sheets of work paper after alternate formation of the cuts and link portions in a direction perpendicular to a cutting direction, thus forming a net.

According to another aspect of this invention, there is provided an apparatus for manufacturing paper cushioning members, comprising a pair of elongated roller members having circumferential recesses and projections each of a given width thereon and therearound; cutting blades formed at peripheral edges of surfaces of the circumferential projections; and link-portion forming recesses formed each in a part of a circumferential surface of each of the projections in a horizontal direction or at a predetermined angle to the horizontal direction, whereby with the recesses and projections of
one of the roller members engaged with those of the other roller member respectively, when a single sheet or plural sheets of work paper to be processed are inserted in the engaging portion between the roller members, cuts and link portions are alternately formed along the cutting blades by using circumferential edges of the circumferential recesses and projections of the roller members, and the sheet or sheets of work paper after alternate formation of the cuts and link portions in a direction perpendicular to a cutting direction, thus forming a net.

The apparatus according to the second aspect of this invention may be designed in such a way that the link-portion forming recesses are formed, all facing in one direction, in the circumferential projections.

The apparatus according to the second aspect of this invention may also be designed in such a way that the link-portion forming recesses are formed in facing surfaces of those of the circumferential projections which are adjacent to each other.

Alternatively, the apparatus according to the second aspect of this invention may be designed in such a way that the link-portion forming recesses are formed entirely across the circumferential projections in a horizontal direction.

The apparatus according to the second aspect of this invention may further be designed in such a way that the link-portion forming recesses are formed entirely across the circumferential projections, inclined at a predetermined angle to a horizontal direction.

According to a different aspect of this invention, there is provided a container for paper cushioning members, comprising a paper-retaining container body having an openable/closable cover; and a take-out port formed in a front or side of the container body and having such a size as to allow insertion of a hand, whereby processed net-like paper cushioning members obtained by forming cuts and link portions in each work paper to be processed are retainable in the container body with that side of the net-like paper cushioning members along a cutting direction facing perpendicular to the take-out port and a desired number of sheets of the net-like paper cushioning members can be pulled out through the take-out port, so that when each of the net-like paper cushioning members is pulled out, a net is formed.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a front view of one example of an apparatus for manufacturing paper cushioning members according to the present invention; Fig. 2 is a perspective view of a pair of elongated roller members in Fig. 1; Fig. 3 is a cross-sectional view taken along the line 2-2 in Fig. 1; Fig. 4 is a cross-sectional view showing how work paper in Fig. 3 is processed; Fig. 5 is a plan view showing that intermittent thin bands having cuts and link portions are formed on the work paper by the roller members in Fig. 1; Fig. 6 is a perspective view showing the intermittent thin bands in Fig. 5 stretched to form a net; Fig. 7 is a front view of another example of the apparatus for manufacturing paper cushioning members according to the present invention; Fig. 8 is a perspective view of a pair of elongated roller members in Fig. 7; Fig. 9 is a front view showing a further example of the apparatus for manufacturing paper cushioning members according to the present invention; Fig. 10 is a front view showing a still further example of the apparatus for manufacturing paper cushioning members according to the present invention; Fig. 11 is a cross-sectional view taken along the line 11-11 in Fig. 7; Fig. 12 is a cross-sectional view showing how work paper in Fig. 11 is processed; Fig. 13 is a plan view showing that intermittent thin bands having cuts and link portions are formed on the work paper by the roller members shown in Figs. 7 and 9; Fig. 14 is a perspective view showing the intermittent thin bands in Fig. 13 stretched to form a net; Fig. 15 is a perspective view showing processed paper cushioning members retained in a box-shaped container having a take-out port; and Fig. 16 is a center vertical cross-sectional view of the container in Fig. 15.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

Preferred embodiments of the present invention will now be described referring to the accompanying drawings.

In Figs. 1, 7, 9 and 10, reference numerals "1" and "2" denote a pair of elongated steel roller members whose shaft portions 1i and 2i at both ends supported on a frame F by means of bearings.

Cutting blades 1' and 2' are formed at the peripheral edges of the circumferential surfaces R of circumferential projections formed on the roller members 1 and 2.
Reference numerals "3" and "4" respectively denote rectangular, circumferential recesses and projections a given width (allowed to be about 5 mm), which are formed on each of the roller members 1 and 2. The circumferential recesses 3 of one roller member engage with the circumferential projections 4 of the other roller member, while the circumferential projections 4 of the former roller member engage with the circumferential recesses 3 of the latter roller member.

Reference numeral "5" is a plate-shaped barrier provided on that side of the roller member pair 1 and 2 where work paper to be processed is to be discharged. The barrier 5 is disposed in a box-shaped container 10 in such a manner that its forward and backward movements are adjusted via a shaft 52 by a spring 51.

Each projection 4 of each roller member has link-portion forming recesses 6 each formed in a part of its circumferential surface in the horizontal direction or at a predetermined angle \( \theta \) to the horizontal direction (about 1 to 10 degrees in Fig. 10). The length \( L \) of each projection 4 and the length \( G \) of each link-portion forming recess 6 can be set arbitrarily; in the example of Fig. 1, the length \( L \) is set to 50 mm while the length \( G \) is set to 7 mm. In this case, when the link-portion forming recess 6 of one, reference projection 3 of the lower roller member 1 comes to the top, the link-portion forming recesses 6 of the adjoining projections 3 come to the bottom.

In the examples of Figs. 7, 9 and 10, if the lengths between the link-portion forming recesses of one roller member are set to 75 mm, the lengths between the associated link-portion forming recesses of the other roller member are set to 25 mm.

Fig. 1 illustrates the link-portion forming recesses 6 of the circumferential projections 4 of each roller member formed to all face in one direction. The link-portion forming recesses 6 shown in Fig. 7 are formed in the opposite surfaces of the adjacent circumferential projections 4. The link-portion forming recesses 6 in Fig. 9 are formed entirely across the circumferential projections 4 in the horizontal direction. The link-portion forming recesses 6 in Fig. 10 are formed in the circumferential projections, slightly inclined at a predetermined angle \( \theta \) (about 1 to 10 degrees in the illustrated example) to the horizontal direction.

Reference numeral "7" denotes cuts formed in work paper \( P' \) at a given width \( W \) (5 mm in the illustrated examples) by the pair of roller members 1 and 2. Reference numerals "71," "72," "73," ... "7n," denote link portions which link the associated cuts 7 together. The cuts 7 and the link portions 71 to 7n are set by the intermittent recesses of the circumferential recesses and projections 3 and 4 of the roller members 1 and 2 and the lengths between the intermittent recesses.

In the example of Fig. 5, under the aforementioned condition, two adjoining thin bands 11 and 12 are linked by the cutting length for the work paper \( P' \), \( L = 50 \) mm, and the length of the link portions \( 71-7n, G' = 7 \) mm.

In the example of Fig. 13, if the length between the long cuts in the work paper \( P' \) is set to 75 mm, the length between the short cuts is set to 25 mm, and three adjoining thin bands 11, 12 and 13 are linked by the length \( G' \) of the individual link portions \( 71-7n, G' \) set to 7 mm.

That is, Fig. 5 shows two thin bands linked by single link portions \( 71, ..., 7n \) while Fig. 13 shows three thin bands linked by two link portions \( 71 \) and \( 71, ..., 7n \) and \( 7n \).

In the diagrams, reference numerals "8" and "9" are gears, which are attached to the shafts 1 and 2 of the roller members 1 and 2 and are engaged with each other to transmit power. Power from a motor (not shown) is transmitted to one of the gears, 8, through a belt or a chain.

Alphabet "C" indicates a cutter provided on the work-paper supplying side of the roller members 1 and 2 to cut the work paper \( P' \), fed by those roller members 1 and 2, to a given length.

Reference numeral "15" denotes a box-shaped container for retaining processed, net-like paper cushioning members. The container 15 has a take-out port 15i formed in the front to have such a size as to allow insertion of one hand, and retain many processed, net-like paper cushioning members with that side of the net-like paper cushioning members along the cutting length facing perpendicular to the take-out port 15i.

Specific examples of the paper-cushioning member manufacturing steps of this invention will now be described. In the first embodiment shown in Figs. 1 through 5, the cutting blades 1' and 2' of a given width are formed on the roller member pair 1 and 2, the link-portion forming recesses 6 are formed in the circumferential surface \( R \) of each projection 4 in the same direction, and the recesses 3 and projections 4 of one roller member are engaged with the projections 4 and recesses 3 of the other roller member respectively. When a single sheet or plural sheets of work paper \( P' \), such as unused paper or unnecessary newspaper, used copying paper, paper printed by an OA equipment or used corrugated cardboard, are inserted in the engaging portion between the roller members 1 and 2, the cuts 7 and link portions \( 71, (72, ..., 7n) \) are alternately formed along the cutting blades 1' and 2', so that one row of cuts 7 and single link portions \( 71, (72, ..., 7n) \) are formed for two rows of thin bands 11 and 12. Then, the resultant sheet or sheets of work paper are stretched in a direction perpendicular to the cutting direction, thus provid-
ing a net 7" corresponding to the cutting length as shown in Fig. 6.

A number of processed, net-like paper cushioning members P having those cuts and link portions are retained one on another in the container 15 through an openable/closable cover 15c at the top. In this case, the net-like paper cushioning members P are retained with the lengthwise direction of the cuts 7 set perpendicular to the take-out port 15i.

When a desired number of net-like paper cushioning members P are pulled out of the container 15 by one hand inserted through the take-out portion 15i, the cuts 7 are stretched with the net-like paper cushioning members P slightly tightened at the take-out port 15i, thus yielding the net 7" having the cuts 7 widened to the size as shown in Fig. 6 (or Fig. 14). In this case, the wastes of the net-like paper cushioning members P contacting the take-out port 15i fall downward into a paper waste room 15f through a mesh 15g provided immediately in front of the take-out port 15i. A lot of paper wastes retained in the room 15f will be discharged out of the container 15 by opening an openable/closable cover 15c provided at the front bottom portion of the container 15. As the net-like paper cushioning members P are placed one on another on a table 16 and the net-like paper cushioning members P are pulled in the direction of the arrows when in use, with parts of the net 7" hooked on fixed shafts 17, the widened net will be yielded.

In the second embodiment shown in Figs. 7 through 10, the cutting blades 1' and 2' of a given width are formed on the roller member pair 1 and 2, the link-portion forming recesses 6 are formed across the circumferential surfaces R of the adjoining projections 4 in the horizontal direction.

In the third embodiment shown in Fig. 13, the cutting blades 1' and 2' of a given width are formed on the roller member pair 1 and 2, the link-portion forming recesses 6 are formed in the circumferential surfaces R of the adjoining projections 4 in the horizontal direction.

With the above-described structure, according to the present invention, various types of paper members, when cut, will not be scattered around and no chemicals are used to provide necessary paper cushioning members, thus overcoming the conventional problem of pollution.

As paper cutting is done by a pair of elongated roller members, a stack of sheets of ordinary work paper, such as newspaper, used copying paper, or printed paper, can be processed together to provide a relatively large net.

The processed, bundles of net-like paper cushioning members when in use may be retained one on another in the units of 10 kg per bundle, making the transpiration and storage of the paper cushioning members convenient. Further, the cuts are widened to form a net by simply pulling a desired number of paper cushioning members out from the take-out port at the front of the container. The resultant nets have only to be crumbled with hands to continuously mass-produce cushions or packings with adequate softness.

When the net-like paper cushioning members intermittently cut by a pair of roller members are crumbled into paper chunks by the barrier, the crumbled paper cushioning members absorb a
larger amount of air, so that the paper cushioning members become softer.

Furthermore, a mechanism for cutting the processed paper cushioning member, already intermittently cut by a pair of roller members, to a predetermined length may be provided to always produce paper cushioning members with the same volume and constant quality.

In addition, if the link-portion forming recesses are formed, inclined at a predetermined angle with respect to the horizontal direction as shown in Fig. 14, the link-portion forming recesses obliquely come in contact with the recess surfaces of the associated link-portion forming recesses, preventing overstrain from being applied to the paper members. This design suppresses the wearing of the blades and is very advantageous.

Claims

1. A method of manufacturing paper cushioning members, comprising the steps of:
   forming circumferential recesses (3) and projections (4) each of a given width on and around a surface of each of a pair of elongated roller members (1, 2) and engaging said recesses (3) and projections (4) of one of said roller members (1, 2) with said projections (4) and recesses (3) of the other roller member respectively;
   forming link-portion forming recesses (6) each in a part of a circumferential surface of each of said projections (4) in a horizontal direction or at a predetermined angle (\( \theta \)) to said horizontal direction;
   inserting a single sheet or plural sheets of work paper (P') to be processed between said pair of roller members (1, 2) and alternately forming cuts (7) and link portions (7_1, ..., 7_n) along said circumferential recesses (3) and projections (4) on said sheet or sheets of work paper (P'), by using circumferential edges of said circumferential recesses (3) and projections (4) of said roller members (1, 2); and
   stretching said sheet or sheets of work paper (P) after alternate formation of said cuts (7) and link portions (7_1, ..., 7_n) in a direction perpendicular to a cutting direction, thus forming a net (7').

2. An apparatus for manufacturing paper cushioning members, comprising:
   a pair of elongated roller members (1, 2) having circumferential recesses (3) and projections (4) each of a given width thereon and therearound;
   cutting blades (1', 2') formed at peripheral edges of surfaces (R) of said circumferential projections (4); and
   link-portion forming recesses (6) formed each in a part of a circumferential surface of each of said projections (4) in a horizontal direction or at a predetermined angle (\( \theta \)) to said horizontal direction,
   whereby with said recesses (3) and projections (4) of one of said roller members (1, 2) engaged with said projections (4) and recesses (3) of the other roller member respectively, when a single sheet or plural sheets of work paper (P') to be processed are inserted in the engaging portion between said roller members (1, 2), cuts (7) and link portions (7_1, ..., 7_n) are alternately formed along said cutting blades (1', 2') by using circumferential edges of said circumferential recesses (3) and projections (4) of said roller members (1, 2), and said sheet or sheets of work paper (P) after alternate formation of said cuts (7) and link portions (7_1, ..., 7_n) in a direction perpendicular to a cutting direction, thus forming a net (7').

3. The apparatus according to claim 2, wherein said link-portion forming recesses (6) are formed, all facing in one direction, in said circumferential projections (4).

4. The apparatus according to claim 2, wherein said link-portion forming recesses (6) are formed in facing surfaces of those of said circumferential projections (4) which are adjacent to each other.

5. The apparatus according to claim 2, wherein said link-portion forming recesses (6) are formed entirely across said circumferential projections (4) in a horizontal direction.

6. The apparatus according to claim 2, wherein said link-portion forming recesses (6) are formed entirely across said circumferential projections (4), inclined at a predetermined angle (\( \theta \)) to a horizontal direction.

7. A container for paper cushioning members, comprising:
   a paper-retaining container body (15) having an openable/closable cover (15i); and
   a take-out port (152) formed in a front or side of said container body (15) and having such a size as to allow insertion of a hand,
   whereby processed net-like paper cushioning members (P) obtained by forming cuts (7) and link portions (7_1, ..., 7_n) in each work paper (P') to be processed are retainable in said container body (15) with that side of said net-like paper cushioning members (P) along a
cutting direction facing perpendicular to said take-out port (15₂) and a desired number of sheets of said net-like paper cushioning members (P) can be pulled out through said take-out port (15₂), so that when each of said net-like paper cushioning members (P) is pulled out, a net (7') is formed.
### DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims:

Place of search: THE HAGUE  
Date of completion of the search: 15 March 1994  
Examiner: Philpott, G

**CATEGORY OF CITED DOCUMENTS**

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