Dec. 17, 1963 D. H. JOHNSON 3,114,666

METHOD OF AND MEANS FOR MAKING HONEYCOMB UTILIZING HELICAL PRINTING ROLLER

Filed May 6, 1960 2 Sheets-Sheet 1

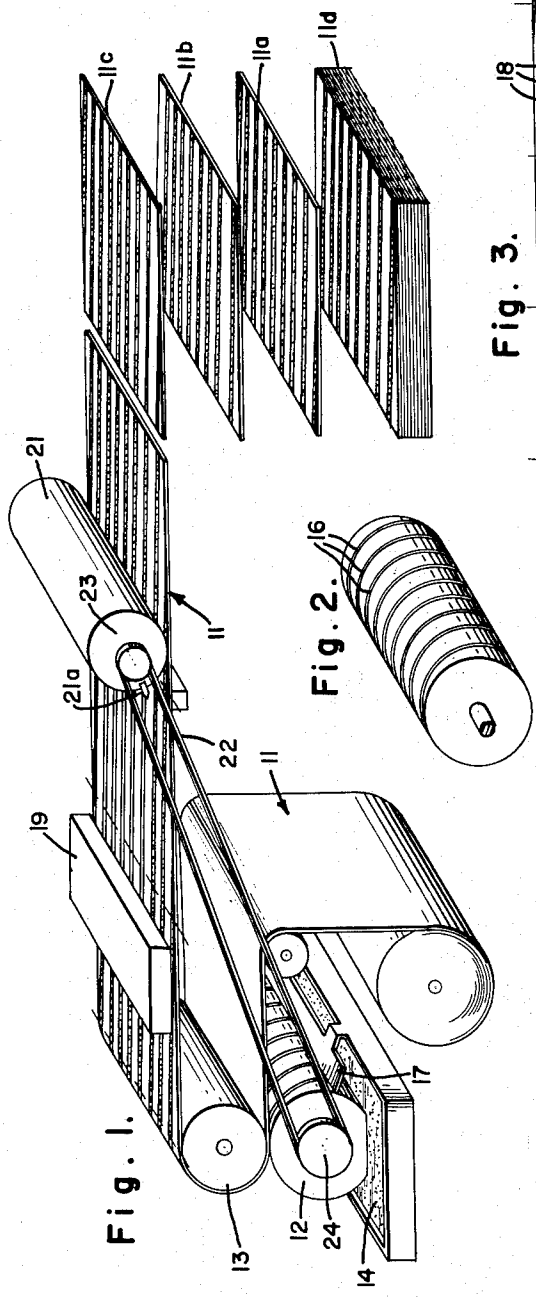



Fig. 1.




Fig. 2.

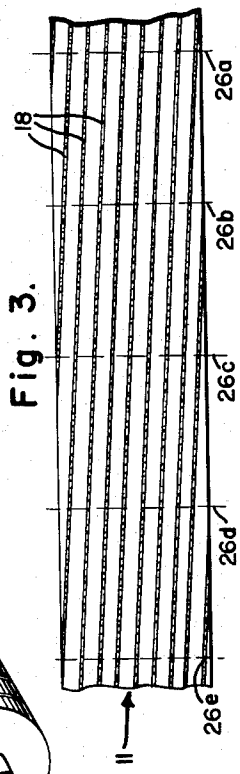



Fig. 3.

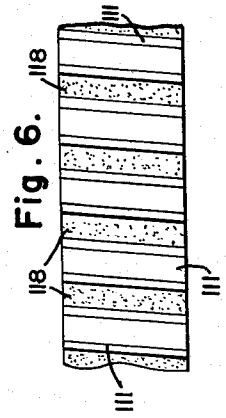



Fig. 6.

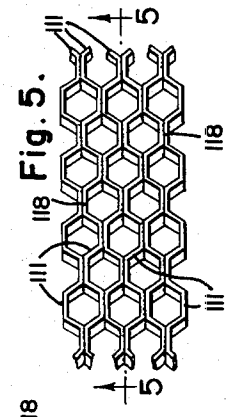



Fig. 5.

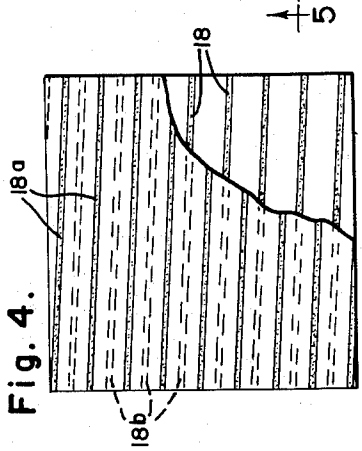



Fig. 4.

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METHOD OF AND MEANS FOR MAKING HONEYCOMB UTILIZING HELICAL PRINTING ROLLER

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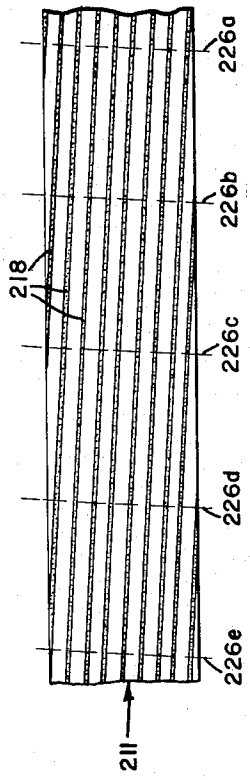



Fig. 7.

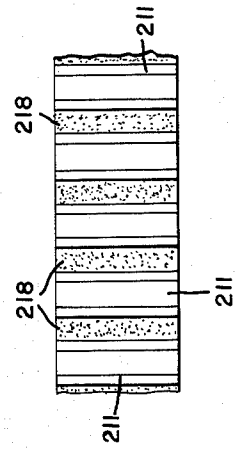



Fig. 8.

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3,114,666

# METHOD OF AND MEANS FOR MAKING HONEYCOMB UTILIZING HELICAL PRINTING ROLLER

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This invention relates to the art of honeycomb. More specifically the invention relates to a novel means for printing adhesive lines on continuous web material from which sections are cut, stacked and adhered together to form unexpanded honeycomb. Said invention also relates to a novel method of making honeycomb.

Heretofore it has been proposed to provide a machine for making stacks of unexpanded honeycomb by utilizing a rotary adhesive printer for applying adhesive lines to continuous web material in conjunction with a cutter for cutting sections of equal length from the web subsequent to the application of the glue lines thereto. By providing suitable stacking means the sections cut from the web material can be superposed one upon the other in such manner that the adhesive lines of adjacent sheets are staggered relative to one another, and whereby when all the sheets are adhered together, the stack can be expanded to form open cell honeycomb material. For specific prior art teaching in this art, reference is made to prior U.S. Patent No. 2,734,843, to Steele, dated February 14, 1956.

The improvement which is the subject of the present invention comprises a printing roll mounted transversely of the moving web of material and in contact therewith for the purpose of applying glue lines thereto. The printing roll is provided with a helical printing line pattern spirally circumscribing the body of the roll from one end toward the other thereof, and resembling the thread pattern on a screw or threaded shaft of uniform diameter. The rotation of the said printing roll is correlated with the operation of the cutter in such manner that the cutter will successively cut sections of equal length from the continuous web at equidistant spaced points disposed longitudinally of the web and offset 180° to one another in reference to the rotation of said printing roll, whereby the adhesive lines of adjacent sheets cut from said web and successively stacked one upon the other will be staggered from one another an amount equal to one-half the pitch between the helical printing lines of the roller.

According to the method of the present invention, equidistantly spaced parallel lines of adhesive are applied to a continuous web in such manner that the lines are angularly displaced from parallel to the longitudinal axis of the web as, for example, from about 1½° to 5°, or more if desired. After the lines are applied, the web is transversely cut into sections of equal length along equidistantly spaced cut lines coincident with each point along the web where the adhesive lines are laterally offset one-half pitch from the adhesive lines of the preceding cut. The said cut sections are superposed one on the other in successive order in which they are cut from the web whereby the result is to stagger the adhesive lines of adjacent sheets one-half pitch from one another.

A principal object of the invention is to provide in a honeycomb-making machine a single printing roll which when properly correlated with the operation of the cutter can be utilized to print glue lines on sheets capable of stacking in an appropriate pattern to define unexpanded honeycomb. An advantage and feature of the helical printing roller described herein is that the lines of adhesive are applied continuously and without interruption whereby there occurs no end trim-off losses such as experienced in



utilizing other types of proposed single roll printing mechanisms of which I have knowledge and in which the lines are not applied continuously but in interrupted pattern of one type or another.

Another object and advantage of the invention is that the same provides an extremely accurate and simple way of applying a uniform adhesive line pattern to the web and for cutting and registering the lines in exactly proper honeycomb-forming pattern within the stack. For example, utilizing a printing roll having a 50-inch circumference and where the cutter is correlated with the rotation of the printing roll to cut the sheets at every half cycle of rotation of the roller or into 25-inch lengths, a sheeting error of 1/16 of an inch will represent less than .001 inch in lateral misposition between the glue lines of successively stacked sheets. It is a fairly simple task with modern printing and sheeting equipment to maintain the margin of error in length between successively cut sheets of 25 inches or thereabouts within a very small fraction of an inch.

Another feature of the invention is that the circumference of the printing roller does not place a maximum limitation on the length of sheets cut from the web. In this regard, longer sheet lengths may be obtained by correlating the cutter to actuate at less frequent intervals than each half cycle rotation of the printing roller, as, for example, the cutter may be actuated at each 1½, 2½, 3½, etc., cycles of rotation of the roller with the results being the same. It is only necessary to actuate the cutter to cut the sections in equal length and with successive cuts being offset 180° to one another in reference to the rotation of the printing roller.

Another object of the invention is to teach a novel method of manufacturing honeycomb.

Other objects and advantages of the present invention will become apparent upon reading the following specification and referring to the accompanying drawing in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. 1 is a generally diagrammatic view of a machine constructed in accordance with the present invention;

FIG. 2 is a view in perspective of a printing roll to which the helical glue line printing surfaces have been engraved;

FIG. 3 is a top plan fragmentary view of a continuous web to which adhesive lines have been applied showing the location of equidistantly spaced cut lines thereon;

FIG. 4 is a top plan view of a stack of unexpanded honeycomb made in accordance with the invention and showing the top sheet partially broken away and exposing the undersheet;

FIG. 5 is a top plan view of an expanded section of honeycomb made in accordance with the invention;

FIG. 6 is a sectional view taken substantially on line 5—5 of FIG. 5;

FIG. 7 is similar to FIG. 3, but shows the cut lines disposed perpendicular to the axes of the printed adhesive lines; and

FIG. 8 is a vertical section of a honeycomb product made in accordance with the web printing and cutting technique of FIG. 7.

Referring now to FIG. 1 in the drawings the reference character 11 illustrates a continuous web of material, such as paper, resin impregnated fabric, or metal foil, being fed from its roll source between a printing roll 12 and a back-up roll 13. The printing roll 12 (more fully illustrated in FIG. 2) is mounted in conventional fashion for rotation of its lower periphery within an adhesive tank 14. The roll 12 may be of the rotogravure type and is engraved or etched with a continuous helical

printing line surface 16 which spirally circumscribes the body of the roll from one end toward the opposite end thereof. Liquid adhesive picked up from the tank 14 by the lower roll periphery is rotated past a doctor blade 17 whereat liquid adhesive is wiped off from the surfaces of the roller, except where it is retained in the etched helix printing line surfaces 16.

As the printing roll rotates in contact with the adjacent surface of continuous web 11 (under pressure of back-up roll 13) equidistantly spaced parallel glue lines 18 are applied to the web. It may be here remarked that the width and spacing between the etched printing surfaces 16 as well as the amount of angular displacement existing between the axes of the etched line surfaces 16 and the diametral plane of the printing roll 12 may be varied according to the type and cell size of honeycomb material to be produced by the process. By way of example, it is possible in actual practice, to angularly displace the helical lines on the rollers as little as 1½° from the diametral plane of the printing roll. By the same token, in actual practice, the lines 18 that would be printed by such a roller onto the web material would be angularly displaced from the longitudinal axis the same amount—e.g., about 1½° in the instance cited.

The reference numeral 19 illustrates an oven zone which may be employed to dry the adhesive lines in instances where a thermoplastic adhesive is used or in instances where a three-stage thermosetting-type adhesive is used and which can be dried or advanced to a dry non-tacky condition prior to final curing. The use of dry-line type of adhesives in the art of manufacturing honeycomb is well known as exemplified by the teachings of said prior Steele Patent No. 2,734,843.

The reference numeral 21 indicates a rotary cutter, the operation of which may be assumed to be correlated to the rotation of the printing roll 12 so as to cut the web 11 into sections of equal length upon every 180° of rotation of said printing roll. In the drawings, the printing roll and rotary cutter are shown as mechanically linked together by an endless chain or belt 22 at a 2 to 1 ratio whereby the rotary cutter will revolve twice for each complete cycle of rotation of the printing roll.

The rotary cutter will thereby operate to cut sections of equal length such as indicated at 11*a*, *b* and *c* in the drawings along cut lines 26*a–e*, inclusive (FIG. 3), and whereby the length of each section will be equal to one-half the circumference of the printing roll and whereby further, the cut lines are made coincident with each point where the adhesive lines become laterally offset one-half pitch from the adhesive lines of the immediately preceding cut. As a consequence, when the sections 11*a–c* are superposed in a stack 11*d* in the successive order from which they are cut from the web, the adhesive lines of adjacent sheets will be staggered from one another in an amount equal to one-half the pitch between the glue lines applied to the sheet by the helical printing roller. This is demonstrated in FIG. 4, wherein its is seen that the glue lines 18*a* applied to the top sheet are staggered in reference to the glue lines 18*b* of the adjacent under-sheet.

After the glue lines have been caused to firmly adhere all of the sheets together in the stack, either the entire stack or slices cut therefrom may be expanded and opened out to form a honeycomb configuration such as shown in FIG. 5. The individual webs of honeycomb are designated by the numeral 111 and they are shown as bonded together at their adjoining nodes by blue lines 118.

FIG. 6 is a sectional view of FIG. 5 and shows the bonding lines 118 angularly displaced to a small degree from perpendicular to the planar face surfaces of the honeycomb sheet. In this connection the amount of angular displacement between the axes of the node bonds 118 and the planar face surfaces of the honeycomb core will be determined by the amount of angular displacement from perpendicular between the axes of the glue lines 18 applied to the moving web and the axis of the cut lines 26*a–e* by which the web is cut into sections of equal length. Thus, as shown in FIG. 3 the cut lines 26*a–e* are disposed perpendicular to the longitudinal axis of the web 11, but approximately 5° from perpendicular to the axes of the glue lines 11 applied to the web. Therefore, the node bond lines 118 as shown in FIG. 6 also will be disposed the 5° from the planar surfaces of the honeycomb section. However, any oblique angular displacement between the node bonds of the core and the face surfaces thereof may be eliminated entirely by orienting the cutter to cut the web perpendicular to the axes of the glue lines applied to the web rather than perpendicular to the axis of the moving web itself. This latter situation is illustrated in FIGS. 7 and 8 wherein it is seen that by cutting a continuous web (to which angularly displaced glue lines 218 have been applied by a helical roller as previously described) along parallel lines of cut 226*a–e* disposed perpendicular to the glue lines rather than perpendicular the longitudinal axis of the web, the resultant honeycomb core product as shown in FIG. 8 will incorporate node bonds 218 that are perpendicular to the planar surfaces of the core material itself.

In the previously described embodiment of the invention, it has been mentioned how the cutter can be correlated to rotation of the helical printing roller whereby the cutter cuts the moving web corresponding to each half cycle, or 180° of rotation, of the printing roller. By cutting the web corresponding to successive half cycles of the printing roller, three things are apparent: (1) the web will be cut into sections of equal length, (2) each cut section will equal one-half the circumference of the printing roller, and (3) the lines of adhesive of successively cut sections will be osffet one-half pitch relative to one another when superposed in a stack as shown in FIG. 1. It is unnecessary, however, to correlate the action of the cutter so as to cut the web at each 180° of rotation of the printing roller, and instead, it may be desired to actuate the cutter at less frequent intervals than every half cycle of the printing roller. This is entirely feasible provided that the cutter is actuated to cut sections from the web in any selected multiple of half cycles of rotation of the printing roller so long as successive cuts are 180° offset from one another and so long as the cycle of cutting operation is arranged to cut the web into sections of equal length. In this connection, the cutter may be correlated in reference to the printing roller so as to cut the web at every half, 1½, 2½, 3½, etc., cycles of rotation of the printing roller.

It is also observed that the lengths of the sections cut from the web will be equal to the number of half cycles made by the printing roller between successive cuts multiplied by the circumference of the printing roller. Thus, in the example earlier given, if cuts are made corresponding to each half cycle of the printing roller, and the roller is 50 inches in circumference, the length of the sections cut from the web would be determined by the formula:

$$\frac{1}{2} \times 50 = 25 \text{ inches sheet length}$$

Similarly, if the cutter is correlated to operate at each 1½ cycles of the prining roller of the same size, the lengths of sections cut from the web would be:

$$1.5 \times 50 = 75 \text{ inches sheet length}$$

A particular advantage of the present arrangement is that the size or circumference of the printing roller does not place a maximum limitation on the length of the sections that can be cut from the web. Consequently, it is possible to make a relatively small diameter printing roller (which is much less expensive to make than a large diameter roller) and to regulate the length of web sections by actuating the cutter at less frequent intervals than each half cycle of rotation of the printing roller—i.e., at each 1½, 2½, 3½, etc., cycles of rotation. Stated otherwise, the cutter 21 can be adapted to cut web 11 at every 180° of rotation of printing roll 13,

or at any odd integral multiple of 180° of printing roll rotation.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be practiced within the spirit of the invention as limited only by the scope of the appended claims.

What is claimed is:

1. In a machine for making a stack of unexpanded honeycomb formed from sheets cut from a continuous web and wherein said machine is of the type utilizing a rotary adhesive printer for applying substantially parallel adhesive lines to one surface of said continuous web and a cutter for cutting sections of equal length from said web subsequent to the application of glue lines thereto, the improvements comprising: a printing roll mounted transversely of the moving web and in contact therewith and defining an uninterrupted helical printing line pattern spirally circumscribing the body of said roll from one end toward the other end thereof operable to print on only one side of the web spaced parallel lines of adhesive extending at an oblique angle in reference to the lengthwise axis of the web; means for cutting the web transverse to the direction of travel of said web; means for correlating the rotation of said roller with the operation of said cutting means for causing the cutting means to actuate and cut successive sections of equal length from said web at equidistant points disposed longitudinally of the web and offset an odd integral of 180° to one another in reference to rotation of said printing roller, and means for successively stacking said cut sheets one upon the other with the lines of adhesive of adjacent sheets arranged in staggered relation to one another.

2. The combination of claim 1 and wherein the axis of said cutter is disposed to cut said web along parallel cut lines disposed perpendicular to the lengthwise axis of said web and at an oblique angle in reference to the axes of said parallel adhesive lines.



3. The combination of claim 1 and wherein the axis of said cutter is disposed to cut said web along parallel cut lines disposed perpendicular to said parallel lines of adhesive and at an oblique angle in reference to the lengthwise axis of said web.

4. A method of making honeycomb comprising the steps of applying to one surface of a continuous web equidistantly spaced apart parallel uninterrupted lines of adhesive angularly displaced from parallel to the longitudinal axis of said web; transversely cutting said web into sections of equal length along equidistantly spaced cut lines coincident with each point where the adhesive lines are laterally offset one-half pitch from the adhesive lines of the preceding cut; and superposing said cut sections one on the other in successive order in which they are cut from the web with cut edges thereof in substantial alignment, whereby the adhesive lines of adjacent sheets cut from said web and successively stacked one upon the other will be staggered from one another in an amount equal to one-half the pitch between the adhesive lines applied to the web.

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