ABSTRACT

A ply-bonded, embossed product and apparatus, and method wherein at least two nested-embossed webs are advanced between a pair of wheels and anvil surfaces to subject the webs to ply-bonding compressive forces.

2 Claims, 5 Drawing Figures
PLY-BONDED, EMBOSSED PRODUCT AND APPARATUS

This application is a continuation in part of my co-pending application Ser. No. 294,628 filed Oct. 3, 1972, now U.S. Pat. No. 3,834,286 and also constitutes an improvement on co-owned U.S. Pat. No. 3,556,907.

BACKGROUND AND SUMMARY OF INVENTION

For many years, workers in the paper art have sought a reliable, inexpensive way of bonding sheets or plies together. The drawbacks characteristic of the prior art were overcome by the invention in the above-identified application wherein elongated, superposed webs are advanced between a notched, edge-beveled wheel and two beveled anvil surfaces so as to subject the webs to a pair of transversely aligned, intermittent compressive forces.

I now find that the ply-bonding technique can be applied most advantageously to webs which are "nested-embossed," viz., have the general character of those taught in the above-mentioned patent — with the significant difference that no longer is it necessary to employ an adhesive. This provides significant advantages, not only in manufacturing but also in use. The resultant product is significantly "fluffier" whereby substantially lower quantities of web material are used by the consumer — whether it be toilet tissue, towelling or like products — with a meritorious reduction of sewage or other waste disposal, consistent with current attitudes on ecology.

DETAILED DESCRIPTION OF THE INVENTION

The invention is described in conjunction with an illustrative embodiment in the accompanying drawing, in which:

FIG. 1 is a fragmentary elevational view, partially in cross section, of apparatus incorporating teachings of this invention;

FIG. 2 is an enlarged fragmentary sectional view such as would be seen along the sight line 2—2 applied to FIG. 1;

FIG. 3 is a still further enlarged fragmentary cross-sectional view representing an enlargement of the encircled portion designated 3 in FIG. 2;

FIG. 4 is a fragmentary plan view of web materials wherein the plies thereof have been bonded according to the teachings of this invention; and

FIG. 5 is a sectional view taken along the sight line 5—5 applied to FIG. 4.

Referring first to FIG. 1, the numeral 10 represents generally a frame provided in a web handling machine.

The frame 10 supports two sets of embossing rolls 11, 12, and 13—14. In the illustration given, the rolls 11 and 13 are steel engraved rolls, while the rolls 12 and 14 are rubber covered. It will be appreciated that the rolls may be reversed in each set, steel rolls substituted for the rubber rolls, or the locating of the sets of rolls relative to each other changed (see example U.S. Pat. No. 3,556,907).

The set containing rolls 11, 12 embosses web W1, while the set 13, 14 embosses the web W2, the webs ultimately being joined to form web 15 by the action of an edge-beveled, notched wheel 16 operating in conjunction with grooved roll 17.

Reference is now made to FIG. 2 wherein fragmentary portions of the wheel 16 and roll 17 are depicted. The roll 17 is advantageously driven (by means not shown), while the wheel 16 can be considered an idler. It will be seen that the wheel 16 has beveled edges as at 19 and 20. On the other hand, the roll 17 has a slot 21 defined by insert rings 22 and 23 maintained in spaced apart relation by means of a spacer 24. The outer confronting edges of the plates 22 are beveled, as at 25 and 26, so as to conform to the confronting beveled surfaces 19 and 20 on the bonding wheel 16. It is believed that this can be even more readily appreciated from a consideration of FIG. 3 where the engagement of the beveled surfaces 20 and 26 is shown in further enlarged scale.

This results in a unique bonding of the plies of elongated web material. The sheets, when bonded, have a surface appearance such as that detailed fragmentarily in the upper right hand portion of FIG. 4 where nested embossments are seen in part and the plies are equipped with two series of longitudinally spaced, relatively elongated depressions 27 and 28. Interposed between the successive pairs of depressions 27, 28 and 27', 28' is a relatively undepressed, unbounded area 29.

The length of the depressions (or compressed areas) 27, 28 and the corresponding "length" dimension of the unbounded area 29 are determined by the character of the teeth on the bonding wheel 16. For example, a wide variety of tooth sizes and spacings may be employed. The number of teeth in a 3-inch diameter wheel may vary from 0 to 70. The spacing 29 may have an arcuate length of 0.02 to 0.10 inch or more, depending upon the work and apparatus employed. Wheels of this general character have been employed in the past for longitudinal perforating where they operate against hardened anvils and have required special steels because of the high pressures involved. However, according to the invention, this drawback is avoided — insofar as the use of relatively exotic materials of construction is concerned.

For apparatus used in bonding tissue and light weight toweling, I have found that a thickness of the spacer 24 of the order of about 0.02 inch is advantageous. In such a case, the angular extent of the beveled surfaces 25 and 26, viz., the dimension A in FIG. 3, is about 0.005 inch. Still further, I find it advantageous to use a wheel wherein the included angle between the beveled edge surfaces, viz., the dimension B in FIG. 2, is from about 45° to about 90° and with the relative angularity of the bevel surfaces 25 and 26 corresponding thereto. With an arrangement with only 14 pounds pressure on the wheel 16 (the means for which to be described hereinafter), and with an included angle B of 60°, I develop a large unit force on the web material, i.e., of the order of 50,000 psi. I have found it advantageous to use arrangements whereby the compressive force on each pair of confronting, mating beveled surfaces is of the order of from about 40,000 psi to about 80,000 psi. This results in a "glassining" which I have attempted to illustrate schematically in FIG. 5. I have found that the web material is not slit or severed, but, however, is compressed to such an extent that it has the translucency characteristic of a glassine — heretofore used frequently as bread wrap, etc.

For toweling and other 2, 3, and 4 ply products, where relatively large areas are involved, it may be desirable to have ply-bonding along lines adjacent to the two edges, as illustrated in FIG. 4.

In FIG. 4, the numeral 30 designates a plurality of embossments provided in the web W2, and the emboss-
ments in the web \(W\), are designated 31. These correspond essentially to those described in greater detail in previously mentioned U.S. Pat. No. 3,556,907. Advantageously the embossments may number from about 10 to 200 per square inch per web, and may project upwardly or downwardly, as the case may be, from the essentially planar surface 32 of the web from about 0.01 inch to about 0.05 inch whereby approximately 10 percent to about 75 percent of the surface of each web is embossed.

It will be appreciated that a variety of nested emboss patterns may be utilized, and that the fragmentary showing herein is merely for the sake of illustrating one possible arrangement. As mentioned previously, this is advantageously achieved through the use of steel and rubber-covered rolls 11, 12 or 13, 14, and I further find it advantageous to pivotally mount the rubber-covered or mating rolls 12, 14 on pivot arms represented schematically at 33. Still further, the degree of loading of the mating embossing rolls may be varied by air cushions or other loading devices schematically represented and designated by the numeral 34.

In the practice of the invention, and to illustrate the substantial bulk afforded in a product embodying ply-bonded nested embossing, a roll of toilet tissue wound on the usual 1\% inches diameter cardboard core and having a length of wound web of 101 feet, 3 inches (corresponding to 270 conventional 4\% inches squares) had an outside diameter of 5\% inches. With the presence of substantial amounts of embossment, entrapped air, and lack of adhesive, the absorbent capacity is materially increased so that substantially less webbing is used.

1. In a method of producing a multi ply web especially useful for toilet tissue or toweling, the steps of separately embossing two elongated webs each with a pattern of projections of about 10 to about 200 psi and a height of about 0.01 to about 0.05 inch, orienting said webs so that the projections face each other and interlace with each other so as to provide air spacing in the interlacing, and thereafter subjecting said webs to a pair of transversely-spaced, convergently-related compressive forces along longitudinally extending lines to cause the plies to bond without application of adhesive.

2. The method of claim 1 in which said forces are applied intermittently.