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[54] METHOD OF MANUFACTURING A FOIL MATERIAL EMBOSSED ON BOTH SIDES, A ROLL NIP AND A MACHINE FOR CARRYING OUT THE METHOD

[72] Inventors: **Ole Nielsen**, 72A, Hellerup, Hellerupvej; **Max Beidil**, Sortedam Dossering 25, Copenhagen, both of Denmark

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[52] **U.S. Cl.** **72/196**, 72/379, 264/282

[51] **Int. Cl.** **B44b 5/00**

[58] **Field of Search** ..... 72/191, 196, 379, 385; 113/116 Z; 264/282, 284

[56] **References Cited**

UNITED STATES PATENTS

2,441,476	5/1948	Ewald	72/196
2,290,608	7/1942	Evans	72/385
3,191,418	6/1965	Modine	72/196
2,856,323	10/1958	Gordon	264/284
1,602,049	10/1926	Somers	72/196

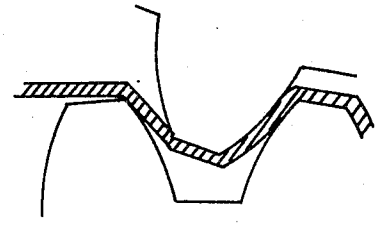
Primary Examiner—Lowell A. Larson

Attorney—Ernest A. Greenside

[57] **ABSTRACT**

A method for embossing foil material by inserting the foil material in the roll nip between two rolls being provided with projections, each projection of a roll being surrounded on all sides by projections of the other roll, each projection of a roll is axially offset relative to the peripherally adjacent projections on the same roll, the projections of one roll form lines oblique to an axial line and so that the foil material from each projection peak on each roll is stretched to the surrounding projection peaks of the other roll.

7 Claims, 5 Drawing Figures



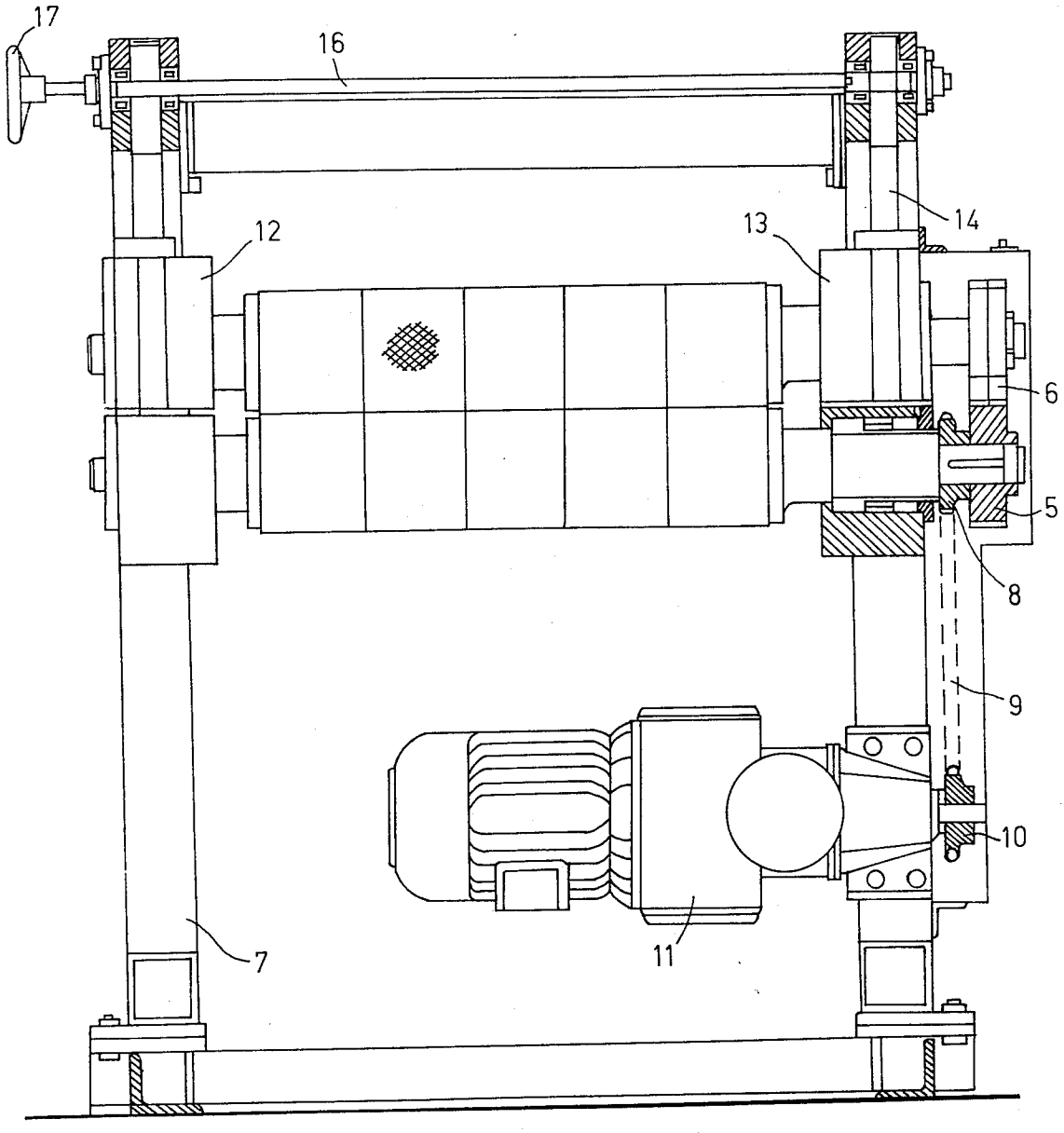


Fig.1

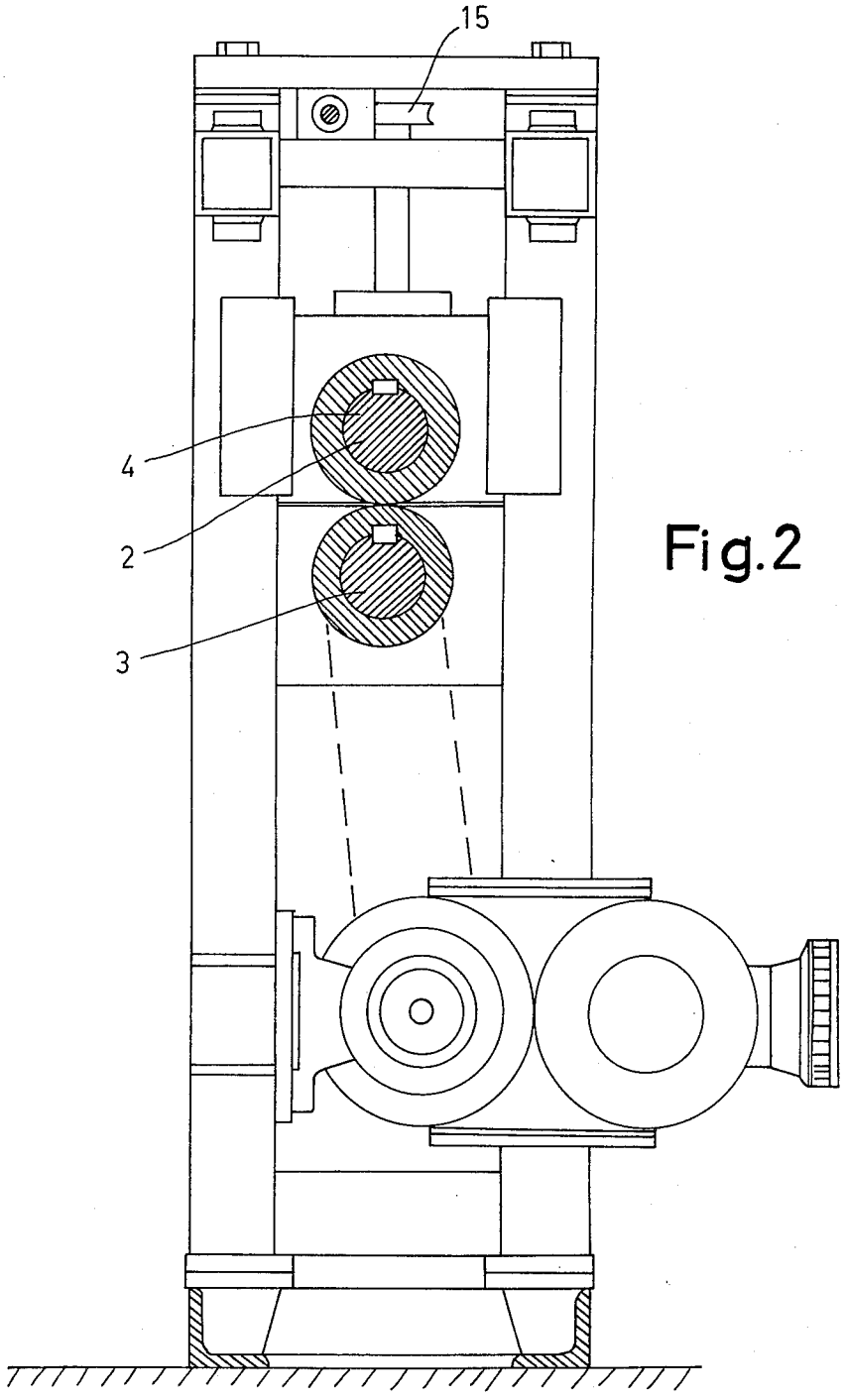


Fig.2

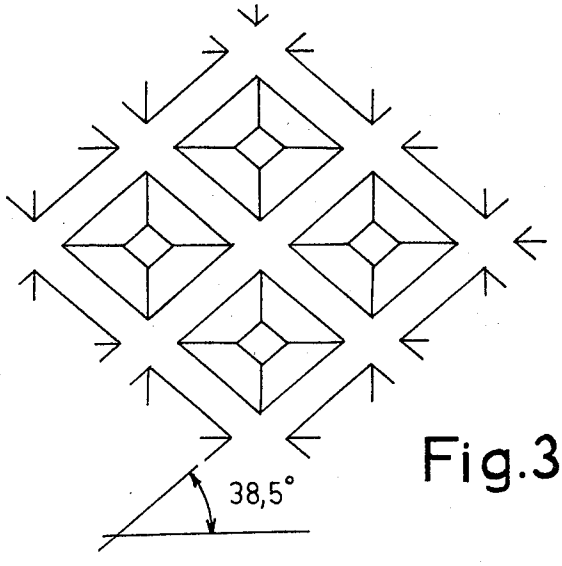


Fig.3

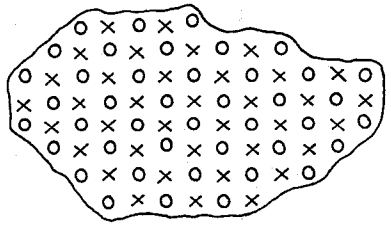


Fig.4

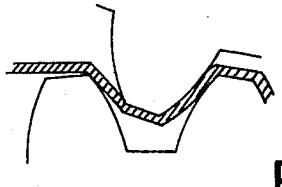


Fig 5

METHOD OF MANUFACTURING A FOIL MATERIAL EMBOSSED ON BOTH SIDES, A ROLL NIP AND A MACHINE FOR CARRYING OUT THE METHOD

The invention relates to a method of manufacturing a foil material embossed on both sides by inserting the original foil material in the roll nip between two rolls, the surfaces of the latter being provided with projections in such a manner that a projection on each of the rolls is, in the roll nip, surrounded on all sides by projections of the other roll, and where each of the projections on a roll is axially displaced relative to the peripherally adjacent projections on the same roll, and where projections on one roll together with alternating corresponding projections on the other roll from straight lines substantially parallel to the axes of the rolls.

A method of the type hereinbefore referred to is known from Danish Pat. No. 61292. The projections are approximately hemispherical, and in the spaces between them there are provided hemispherical hollows. Before the foil material is inserted in the roll nip between the two rolls it is caused to pass between a considerable number of roll couples having peripheral ridges and grooves whereby the material becomes grooved and its width is reduced. In the rolls with projections and hollows the material is clamped between the peak of a projection and the bottom of a corresponding hollow and bulges are formed on both sides of the foil material. In this process no stretching of the original material takes place. Thereby there is obtained a material which may be expanded in all directions.

The object of the invention is to provide a method of the type hereinbefore referred to by means of which a cheaper and simpler machine may be employed.

Furthermore, it is an object of the invention to devise a method of the type hereinbefore referred to by means of which there may be obtained such a distribution of material that the foil material has considerable strength and impact absorption capacity at right angles to the plane of the foil material.

It is a further object of the invention to devise a method of the type hereinbefore referred to by means of which there may be obtained a soft and textile-like texture when treating paper or some other fibrebased material.

The characterizing features of the method according to the invention are that the embossing is carried out by stretching the foil material from each projection peak on each roll to the surrounding projection peaks on the other roll. This method may be carried out by means of only one roll couple and, accordingly, by means of a very cheap and simple machine. The method may be carried out entirely without any special preliminary treatment such as moistening of paper material. By means of the stretching there may, furthermore, be obtained such a distribution of material that the material has become thinner in the vicinity of the peaks while it completely or essentially has retained its thickness at the middle of the stretch between the peaks at both sides so that a relatively large strength and impact absorption capacity is obtained. When the method is carried out with paper or some other fibrebased material, there may be obtained a soft, textile-like texture.

According to the invention, the embossing may be carried out in such a manner that the foil material abutting each projection peak is not touched by the other roll. By these means the material abutting the projection peaks may move and be stretched. Thereby there is obtained an advantageous material distribution, as the material becomes relatively thin in the peaks projecting outwards from both sides while it essentially has retained its thickness at the middle of the stretch between the peaks at both sides. When the method is applied to paper or some other fibrous material the stretched peaks projecting to both sides will have a good moisture absorption capacity so that the material will be well-suited as napkins or for similar purposes.

The invention furthermore relates to a roll couple for carrying out the method, and the characterizing features of the roll couple according to the invention are that the projections have an essentially flat top surface and a well defined, though rounded transition region to the projection's lateral surface. Hereby there is obtained a good retention of the material during the embossing operation, namely a complete or partial locking of the material in its position on the cooperating projections on the two rolls, so that there may be obtained the desired stretching from the projection peaks on one roll to the projection peaks on the other roll as movement of the material is avoided during the start of the engagement between the two rolls. The rounded shape of the transition region should not be too large as otherwise considerable friction will arise during the embossing operation. The top surface does not have to be completely plane, or rather a part of a cylinder surface, namely a portion of the roll's surface before it is machined so as to provide the projections: said top surface may to the contrary advantageously be slightly vaulted upward although having a larger radius of curvature than the transition area to the lateral surface of the projection.

According to the invention the angle between the top surface and at least the upper portion of the lateral surface of the projections may be larger than 90°. During the embossing operation there is hereby obtained a support of the material in the oblique direction from one peak on one side to another peak at the other side so that intensive embossing may be carried out without tearing the material apart.

According to the invention the lateral surface of the projections may, at least on their upper portions, be shaped approximately like an involute. By these means the projections will cooperate in a manner similar to involute cogs of a cog wheel. There is obtained a gentle treatment of the material so that an intensive embossing may be carried out without ripping the material apart. The two rolls may be arranged in such a manner relative to each other that there is obtained a rolling-off under pressure downwards from each projection peak whereby there is obtained a gentle treatment of the opposite side of the material projection when the roll projections engage each other at this point.

The lateral surface may, according to the invention, be shaped, at least at its upper part, as the lateral surface of a cog with an angle of engagement of 20°. It has turned out that it is particularly advantageous to employ rolls with such projections.

In a roll couple where the projections are formed by making parallel grooves in two directions intersecting each other, at least one of said directions may, according to the invention, be oblique. This is a simple way of obtaining the mentioned axial offset of the projections of one roll relative to the peripherally adjacent projections of the same roll. Preferably, both directions should be oblique and preferably have the same angle of inclination.

According to the invention the angle between each of the two directions and the axial direction may be less than 45°. It has turned out that thereby there is obtained a more gentle treatment than with an angle of 45°. According to the invention said angle may be in the range of 38° to 41°, preferably 38.5°.

According to the invention, the extent of the peak of the projection may be smaller than the height of the projection. Hereby there may be obtained such a relation between the tensile stresses in the material in the region of the peak and in the region of the lateral surfaces that there is obtained a considerable stretching of the material on the top surface and the upper part of the lateral surfaces. The extent of the peak in relation to the height of the projection may advantageously be the same as in ordinary cog wheels.

The rolls may, according to the invention, have the same diameter. Hereby is obtained an advantageously regular engagement from both sides.

In the drawings

FIG. 1 shows a machine for carrying out the method according to the invention, seen schematically along a longitudinal section,

FIG. 2 a vertical cross section of same,

FIG. 3 the segment of the roll indicated in FIG. 1, shown in larger scale and folded out,

FIG. 4 a schematic illustration of the engagement between the two rolls in FIG. 1, and

FIG. 5 a section through the roll nip of the two rolls.

The machine shown in FIG. 1 and 2 has two rolls 1 and 2 which are identical and in their longitudinal direction are subdivided into 5 sections which are unturnably retained on two shafts 3 and 4. The latter at one end have a cog wheel 5 and 6, the cog wheel 6 being subdivided into two portions which may be rotatably set in relation to each other so as to eliminate any play. The shaft 3 is journalled in a frame 7 and is connected to a gear motor 11 by means of a sprocket wheel 8, a chain 9 and a sprocket wheel 10.

The shaft 4 is journalled in slides 12 and 13 which are displaceable up and down on columns of the frame. Each of the slides 12 and 13 have an upwardly projecting spindle 14 which engages a nut 15, and said nuts have external worm gear teeth which engage a spindle 16 which is journalled in the frame and carries a manually operatable wheel 17 by means of which the spindle 16 may be turned so as to turn the nuts 15 which are arranged undisplaceably and therefore move the spindles 14 and, accordingly, the slides 12 and 13 up and down when they are turned. By these means the roll 2 may be adjusted in relation to the fixedly journalled roll 1.

In FIG. 1 there is indicated a surface portion of the roll 2. This portion is shown in FIG. 2. in larger scale and folded out, it being noted that preferably the entire surface is designed in this manner, and that goes for the roll 1 also. The rolls are manufactured from cylindrical work pieces by machining grooves at angles of 38.5° and having a shape corresponding to the shape of helical cog wheels.

By letting two sets of grooves intersect each other, approximately pyramidical projections are formed, the sides of which preferably are shaped like involute teeth with an angle of engagement of 20°. The transition between the approximately plane top surface and the lateral surfaces is rounded as indicated in FIG. 5. Furthermore, the edges between the four lateral surfaces may be rounded.

When mounting the rolls 1 and 2 they are arranged in such an angular position relative each other that each projection on one roll, in the roll nip between the rolls, is placed between four projections of the other roll with its corners close to the corresponding corner of each of the four projections. Thereby there is obtained a pattern of engagement as shown in FIG. 4 where the small circles indicate projections on one roller and the crosses indicate projections on the other roll.

The rolls are caused to rotate, and plane strip material is inserted in the roll nip between the rolls. Thereby there is obtained an engagement as indicated in FIG. 5.

In the shown embodiment all the teeth are identical, but the height and shape of the teeth may just as well vary, for instance so as to obtain a particular patterned effect. For instance it will be possible to make some of the projections with a relatively large surface, which may be of importance when the embossed product is to be glued to a flat sheet. The material may consist of paper, fibrous material, metal or thermoplastic material. In the shown embodiment the two sets of grooves are arranged with the same angle of inclination, but they may just as well have different angles of inclination. Possibly, one of the sets of grooves may extend in the axial direction while the other set extends in an oblique direction.

The embossed product may be used for packaging, either directly or after being glued to one or two plane sheets, for resilient supporting purposes or for many other purposes. When it consists of paper of fibrous material a cloth-like effect will be obtained, as the product is easily flexible in all directions. A preliminary treatment is normally not necessary but the material may just as well be subjected to such a treatment, for instance moistening.

We claim:

1. A method of embossing a foil material on both sides thereof, comprising feeding a foil material into a roll nip between a pair of rolls each provided with a plurality of projections, a projection on each roll, during operation of said rolls, being surrounded on all sides by projections on the other roll and each projection on a roll being axially offset relative to the peripherally adjacent projections on the same roll, the projections on one roll together with alternating corresponding projections on the other roll forming straight lines substantially parallel to the axes of the rolls, the projections on each roll being defined by a peak surface from which extend lateral oblique surfaces, at least the upper portions of which are of substantially involute shape, securing the foil material at said involute oblique surfaces of mating projections while leaving free for stretching the material at the peak surfaces of each projection, and stretching, as an incidence of the embossing operation, said material substantially only at said peak surfaces of said projections while securing said material against movement at said involuted surfaces.

2. Apparatus for embossing a foil material and comprising a pair of rolls defining a nip within which said material is adapted to be fed, each roll being provided with a plurality of projections, a projection on each roll, during operation of said rolls, being surrounded on all sides by projections on the other roll, and each projection on a roll being axially offset relative to the peripherally adjacent projections on the same roll, the projections on one roll together with alternating corresponding projections on the other roll forming straight lines substantially parallel to the axes of the rolls, each projection on each roll being defined by a peak surface from which extend lateral oblique surfaces at an angle with respect thereto greater than 90°, at least the upper portion of said oblique surfaces of each projection on each roll being involuted for engagement of complementary mating involuted surfaces of said projections on said rolls, the peak surface of each projection on each roll being of smaller extent than the lateral oblique surfaces.

3. Apparatus according to claim 2, characterized in that the complementary involuted surfaces of mating projections engage at an angle of 20°.

4. Apparatus according to claim 3, wherein the projections are formed by providing parallel grooves in two mutually intersecting directions, at least one of the two directions being oblique.

5. Apparatus according to claim 4, wherein the angle between each of the two directions and the axial direction is less than 45°.

6. Apparatus according to claim 5, wherein the angle is in the range of 38° to 41°.

7. Apparatus according to claim 3, wherein the peak surface of each projection is essentially flat, there being a well defined and rounded transition from said peak surface to said lateral oblique surfaces of each projection.

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