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(54) Corrugating apparatus

(57) Corrugating apparatus in which a continuous single faced board (10) consisting of a corrugated sheet glued on one face to a further flat sheet and with glue applied to the exposed tips on the opposite face of the board is to be brought together while continuously advancing through the apparatus, with a second flat sheet (12) to be adhered to the exposed tips, the apparatus comprising transport means (C) to advance the corrugated board and the second flat sheet simultaneously

in the same direction through the apparatus and a dielectric heating means (B) to cure the glue to form a bond between the board and the sheet, initial bonding preferably being provided by a pre-heating section (A) in which the board travels across a hotplate surface (31), the board being held uniformly and in contact therewith by a series of fluid filled flexible vessels (32). Radio frequency generated in the heating section (B) considerably reduces the length of or obviates the need for a pre-heating section (A).

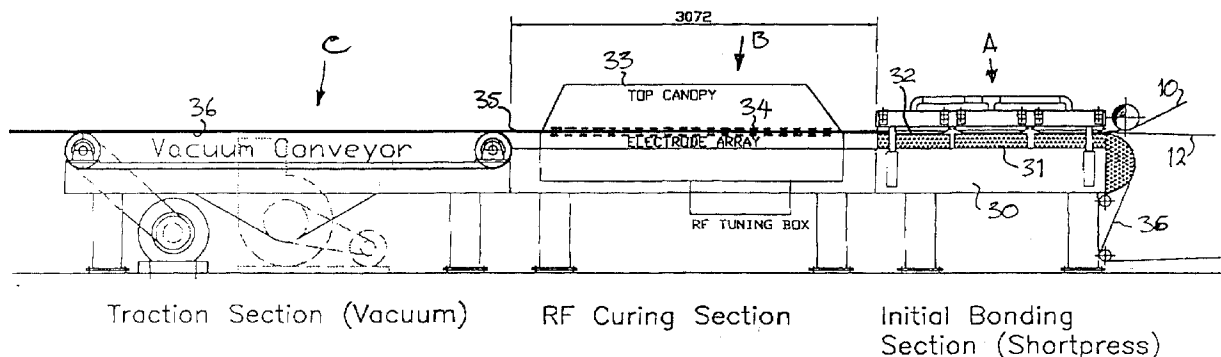


Fig. 3

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Description

[0001] THIS INVENTION relates to corrugating apparatus in which a continuous single-faced board consisting of a corrugated sheet with glue applied to the exposed tips of the corrugations is to be brought together with a liner sheet which is thus bonded to the glued tips to form a double-faced board, and the composite board is carried through the apparatus whilst heat is applied to cure the glue to form a bond between the liner and the corrugated tips of the single-faced board.

[0002] Conventionally, a system of this kind incorporates a series of hot plate surfaces over which the continuous composite board is conveyed and means are required to hold the board down firmly against the heated surfaces to ensure substantially constant heat transfer into the board. Such a system occupies a considerable amount of floor space to accommodate a sufficiently long line of heaters for adequate heat transfer to be ensured.

[0003] According to the present invention there is provided corrugating apparatus in which a continuous single-faced board consisting of a corrugated sheet glued on one face to a first flat sheet and with glue applied to the exposed tips on the opposite face of the corrugated board, is to be brought together while continuously advanced through the apparatus, with a second flat sheet to be adhered to said exposed tips, the apparatus comprising transport means to advance the corrugated board and the second flat sheet simultaneously and in the same direction through the apparatus, guide means to bring them together in face-to-face abutment, and a dielectric heating means to cure the glue to form a bond between the board and the sheet.

[0004] Preferably, though not exclusively, the apparatus causes the combined board and sheet to be transported over a hot plate surface prior to heating by the dielectric heating means.

[0005] Still further, in the apparatus the combined board and sheet are maintained in close relationship with the heated surface by a flexible loading means disposed on the side of the board remote from the heated surface and adapted to bear upon the board and to maintain it in contact with the heated surface.

[0006] An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a side elevation of conventional apparatus for bonding a liner sheet to a single-faced and glued corrugated board;

Fig. 2 is a view similar to Fig. 1 of a modified apparatus for bonding a liner sheet to a single-faced and glue corrugated board; and

Fig. 3 is a view of apparatus embodying the invention for receiving and transporting the combined

corrugated board and sheet.

[0007] Referring now to **Fig. 1**, in the conventional system a single-faced corrugated board 10 with glue applied to the tips of the corrugations is brought together, beneath a roller 11 with a continuous liner sheet 12. The double-faced board so formed then travels in the direction of arrow 13 across a number of steam chests 14 providing a continuous upper hot plate surface 15.

[0008] Also passing around roller 11 and riding in superimposed relationship on the double-faced board is a continuous conveying belt 16.

[0009] A series of weight rollers 17 bears against the upper surface of belt 16 as it passes over the hot plate surface 15 to maintain contact between the latter and the liner 12.

[0010] Referring now to **Fig. 2**, in a modified apparatus the weight rollers 17 are replaced by a series of flexible vessels or bags 20 which are at least partially filled with a fluid medium such as water or a gas. Each vessel 20 bears upon a thin plate 21 which is loosely pivotable about a transverse rod 22 at its upstream end in relation to the direction of travel of the board. The flexibility of the vessels 20 ensures that the board 10, 11, is maintained in contact with the hot plate surface 15 irrespective of any undulation or distortion thereof, thus ensuring efficient heat transfer to the board. In some cases the plates 21 are replaced by a linked and flexible "matting".

[0011] A line of the steam chests 14 and vessels 20, of some considerable length, is required to ensure adequate heat transfer to the board in order to cure the glue and form a permanent and strong bond. A machine constructed as described may extend in a single line over a distance of some 30 metres or more thus occupying a considerable length of factory floor space.

[0012] Referring now to **Fig. 3**, apparatus made in accordance with one embodiment of the invention comprises a machine base 30 upon which are located three operating sections A, B and C. Section A is a short version of the device illustrated in Fig. 2 i.e. a steam chest of approximately 3 metres in length with flexible vessels 32 thereabove adapted to maintain the board 10, 12 in superimposed close relationship over the hot plate surface of chest 31 for initial curing of the glue. Thereafter, the combined board is fed beneath a canopy 33 beneath which is an array 34 of electrodes providing radio frequency dielectric heating. Radio frequency generates heat within the water content of a product, so giving higher concentration of energy in the areas where it is required.

[0013] Water molecules have negative and positive poles and will align with an electrostatic field. By alternating this field, molecular agitation is achieved. It is this molecular agitation which creates heat to evaporate the water. The rate of agitation is directly in relation to the AC frequency used. The dryer uses a frequency of 27.12MHz which conforms with International Regulations for this type of equipment.

[0014] A vacuum conveyor 36 forms the transport section C of the apparatus, pulling the board through Sections A and B without the need for a top blanket belt running along the full length of the apparatus.

[0015] Owing to the effect of the dielectric (RF) heating in Section B, adequate heat transfer is ensured to form a complete bond between the board 10 and liner sheet 12, resulting in a much shorter conventional preheating Section A. Indeed, in some applications section A may be omitted and Section B providing adequate heat transfer into the combined board.

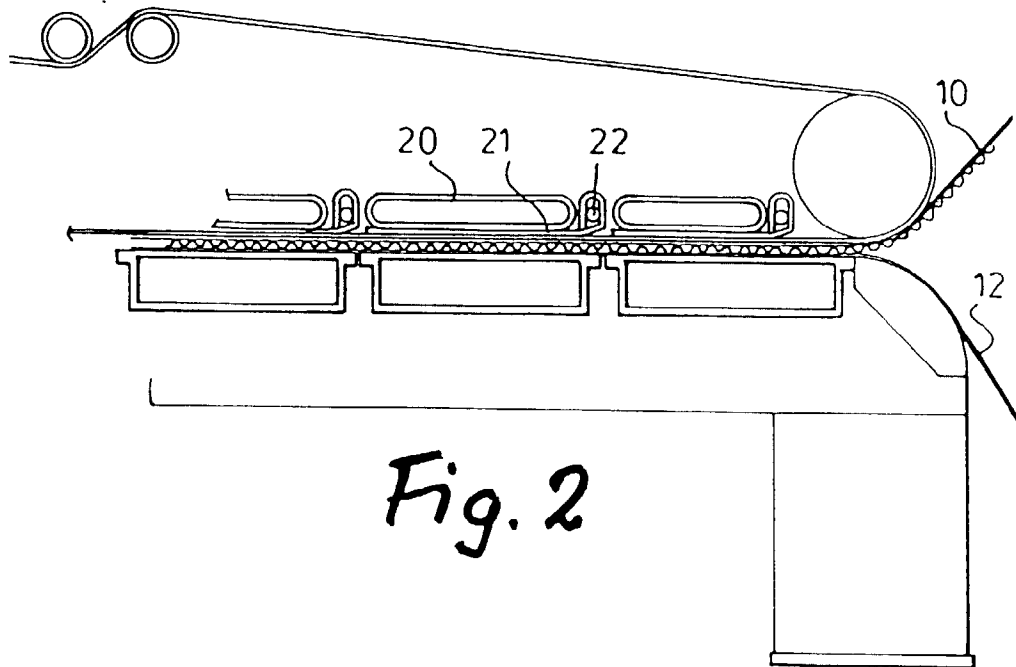
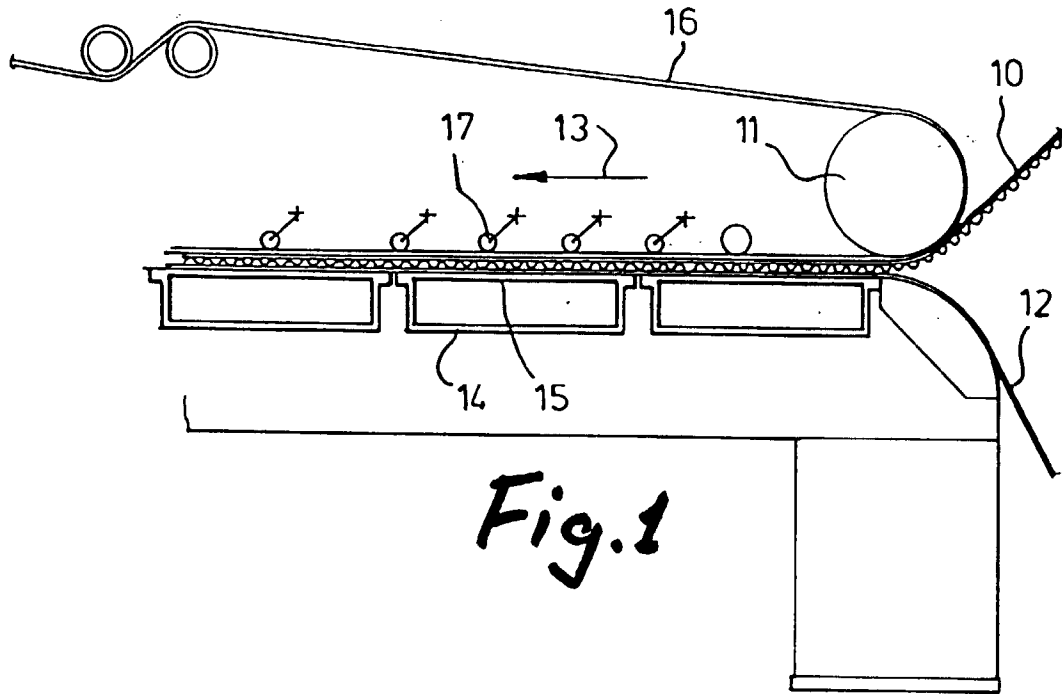
[0016] RF heating not only enables a considerable reduction in the length of any conventional preheating system but also imposes a lower temperature on the board thus largely overcoming a tendency of the board to warp or shrink. The process is economical because only water molecules are heated, not the substrate, and heating is uniform through the combined flutings of the board.

[0017] It is not intended to limit the invention to the above example only. For example, another form of dielectric heating such as microwave may be used in place of radio frequency heating.

Claims

- 1. Corrugating apparatus in which a continuous single faced board consisting of a corrugated sheet glued on one face to a first flat sheet and with glue applied to the exposed tips on the opposite face of the corrugated board, is to be brought together while continuously advanced through the apparatus, with a second flat sheet to be adhered to said exposed tips, the apparatus comprising transport means to advance the corrugated board and the second flat sheet simultaneously and in the same direction through the apparatus, guide means to bring them together in face-to-face abutment and a dielectric heating means to cure the glue to form a bond between the board and the sheet.
- 2. Corrugating apparatus according to Claim 1, including a hotplate surface over which the combined board and sheet is transported prior to heating by the dielectric heating means.
- 3. Corrugating apparatus according to Claim 2, including a flexible loading means to maintain the board and sheet in close relationship with the hotplate surface and disposed on the board remote from said surface and adapted to bear upon the board thus to maintain it in contact with the hotplate surface.
- 4. Corrugating apparatus according to Claim 3, wherein the flexible loading means includes one or more fluid containing vessels positioned to bear upon the board.

- 5. Corrugating apparatus according to Claim 3, wherein the flexible loading means comprises a linked and flexible matting.
- 6. Corrugating apparatus according to Claim 1, wherein the dielectric heating means includes a canopy beneath which is located an array of electrodes providing radio frequency dielectric heating of a corrugated board passing adjacent the array of electrodes.
- 7. Corrugating apparatus according to Claim 6, wherein the frequency of the dielectric heating is at or adjacent 27.12MHz.
- 8. Corrugating apparatus according to Claim 1, wherein said transport means comprises a vacuum conveyor located downstream of the dielectric heating means thus to pull the corrugated board there-through.
- 9. Corrugating apparatus according to Claim 1, wherein the dielectric heating means operates within the microwave frequency range.



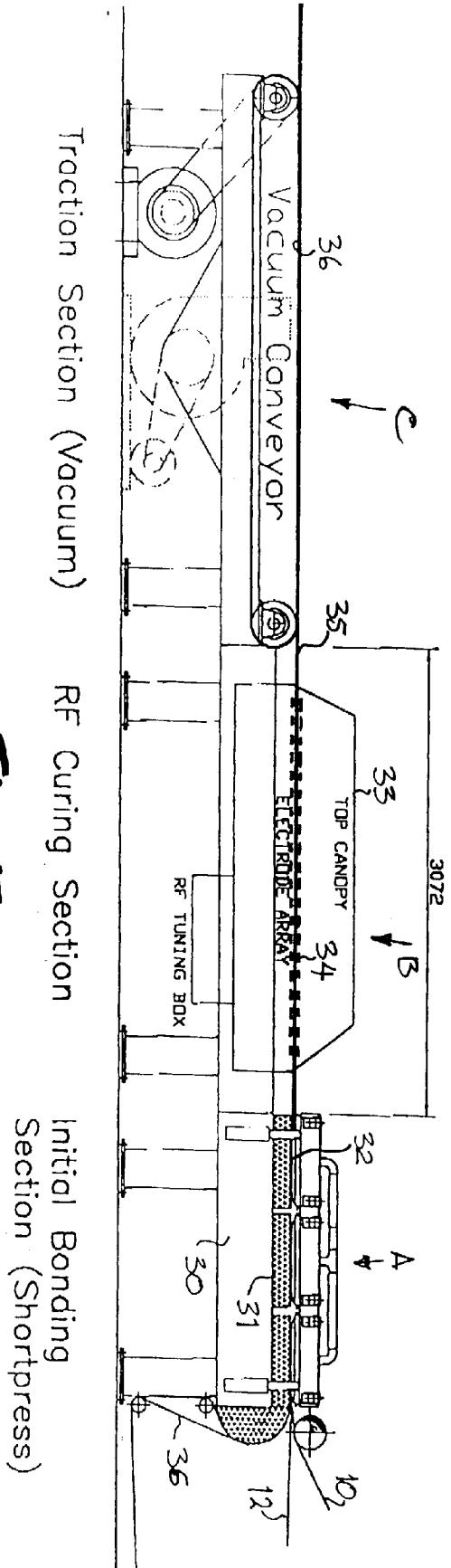


Fig. 3