Claims

1. An apparatus for manufacturing a tissue paper product, such as toilet paper or household towel, the apparatus comprising:

an embossing unit comprising a first counter roll, a first heatable embossing roll, a second counter roll, and a second heatable embossing roll, and a marrying roll,

wherein the apparatus is configured to emboss a first ply between the first heatable embossing roll and the first counter roll, and to emboss a second ply between the second heatable embossing roll and the second counter roll, and to ply-bond the first ply and the second ply between the first heatable embossing roll and the marrying roll, and

the apparatus is configured to process at a ply speed in a range of 400 m/min to 700 m/min,

wherein the first heatable embossing roll is configured to be heated to a steady-state temperature in the range of 100°C to 120°C, and/or

wherein the second heatable embossing roll is configured to be heated to a steady-state temperature in the range of 100°C to 120°C.

2. The apparatus for manufacturing a tissue paper product of claim 1,

wherein the embossing unit is configured to receive the first ply with the first counter roll, to convey the first ply between the first counter roll and the first heatable embossing roll, and to further convey the first ply with the first heatable embossing roll, and

wherein the embossing unit is configured to receive the second ply with the second counter roll, to convey the second ply between the second counter roll and the second heatable embossing roll, and to further convey the

second ply with the second heatable embossing roll,

wherein the embossing unit is configured to convey the first ply and the second ply between the first heatable embossing roll and the marrying roll.

3. The apparatus for manufacturing a tissue paper product of claim 1 or 2,

wherein the embossing unit comprises an adhesive supplying unit for applying adhesive, such as lamination glue, to the first ply and/or to the second ply,

the apparatus optionally being configured to supply the adhesive to at least a part of the tips of embossments formed on the first ply or the second ply,

wherein the adhesive supplying unit is optionally configured to supply adhesive to the first ply while the first ply is being conveyed by the first heated embossing unit prior to the ply-bonding, and/or wherein the adhesive supplying unit is optionally configured to supply adhesive to the second ply while being conveyed by the second heated embossing unit prior to the ply-bonding.

4. The apparatus for manufacturing a tissue paper product of claim 3, wherein the adhesive supplying unit comprises an applicator roll for transferring adhesive to the first ply or the second ply, and an anilox roll for dosing adhesive and transferring the adhesive to the applicator roll,

wherein the anilox roll is engraved with cavities for receiving respective dosages of adhesive.

5. The apparatus for manufacturing a tissue paper product of any one of the preceding claims, wherein the first heatable embossing roll and the second heatable embossing roll are synchronizeable for ply-bonding the first ply and the second ply with a nested embossment structure or a tip-to-tip bonding structure.

6. The apparatus for manufacturing a tissue paper product of claim 3 or 4, wherein the adhesive supplying unit is configured to supply adhesive to the first ply while the first ply is being conveyed by the first heatable embossing roll.

7. The apparatus for manufacturing a tissue paper product of any one of the preceding claims, wherein the first counter roll, the second heatable embossing roll, and the marrying roll are rotatable in one direction and the second counter roll and the first heatable embossing roll are rotatable in another direction, opposite to the one direction.

8. The apparatus for manufacturing a tissue paper product of any one of the preceding claims, wherein the first heatable embossing roll is configured to form first embossments with a height in a range of 0.2 mm to 2.0 mm on the first ply, and the second heatable embossing roll is configured to form second embossments with a height in a range of 0.2 mm to 2.0 mm on the second ply, and wherein the first heatable embossing roll is optionally configured to also form third embossments with a height that is smaller than the height of the first embossments, and/or wherein the second heatable embossing roll is optionally configured to also form fourth embossments with a height that is smaller than the height of the second embossments.

9. The apparatus for manufacturing a tissue paper product of claim 8, wherein the first heatable embossing roll is configured to form the first embossments with a height of 0.1 mm to 1.2 mm on the first ply, and the second heatable embossing roll is configured to form the second embossments with a height of 0.2 mm to 2.0 mm on the second ply, wherein the height of the second embossments

is larger than the height of the first embossments.

10. The apparatus for manufacturing a tissue paper product of any one of the preceding claims, the apparatus further comprising at least one multi-ply-bonding unit configured to ply-bond a two-ply product formed by the embossing unit with at least one additional ply.

11. The apparatus for manufacturing a tissue paper product of any one of the preceding claims, the apparatus further comprising at least one wetting unit configured to wet at least one ply before the at least one ply is received by the embossing unit,

the wetting unit optionally being configured to provide a liquid, such as water, to the at least one ply with an amount of liquid in the range of 2% to 12% of the basis weight of the at least one ply, or optionally 4% to 10% of the basis weight of the at least one ply.

12. The apparatus for manufacturing a tissue paper product of any one of claims 1 to 10, the apparatus lacking a wetting unit for providing a liquid to any of the plies.

13. A machine for manufacturing a roll of a tissue paper product, the machine comprising the apparatus of any one of the preceding claims,

the machine further comprising a roll forming unit for winding up a final product and forming a roll of absorbent sheet product, the roll forming unit optionally comprising a mandrel that is axially elastic, the material of the mandrel optionally being flexible and elastic.

14. A method of manufacturing a tissue paper product, such as toilet paper or household towel, comprising at least two plies, comprising the steps of:

- feeding at least a first ply and a second ply, with

a basis weight in a range of 13 to 30 g/m^2, optionally from 16 to 28 g/m^2, or from 18 to 24 g/m^2 or from 18 to 22 g/m^2, respectively;

- receiving the first ply and the second ply by an embossing unit comprising a first counter roll, a first heatable embossing roll heated to a steady-state temperature in a range of 100°C to 120°C, a second counter roll, a second heatable embossing roll heated to a steady-state temperature in a range of 100°C to 120°C, and a marrying roll;

- embossing the first ply between the first heatable embossing roll and the first counter roll and embossing the second ply between the second heatable embossing roll and the second counter roll;

- ply-bonding the first ply and the second ply between the first heatable embossing roll and the marrying roll;

wherein the plies are processed at a speed in a range of 400 m/min to 700 m/min.

15. The method of manufacturing a tissue paper product of claim 14, comprising the steps of:

- receiving the first ply with the first counter roll;
- conveying the first ply between the first counter roll and the first heatable embossing roll;
- further conveying the first ply with the first counter roll;
- receiving the second ply with the second counter roll;
- conveying the second ply between the second counter roll and the second heatable embossing roll;
- further conveying the second ply with the second counter roll; and
- conveying the first ply and the second ply between the first heatable embossing roll and the marrying roll to ply-bond the first ply and the second ply with each other;

wherein the first counter roll, the second heatable embossing roll, and the marrying roll are rotated in one direction and the second counter roll and the first heatable embossing roll are rotated in another direction, opposite to the one direction.

16. The method of manufacturing a tissue paper product of claim 14 or 15, the method further comprising the step of applying an adhesive, such as lamination glue, to the first ply and/or to the second ply, prior to the step of ply-bonding the first ply and the second ply,

wherein the adhesive is optionally supplied to at least a part of the tips of embossments formed on the first ply or the second ply,

wherein the adhesive is optionally supplied to the first ply while the first ply is being conveyed by the first heated embossing unit prior to the ply-bonding, and/or wherein the adhesive supplying unit is optionally configured to supply adhesive to the second ply while being conveyed by the second heated embossing unit prior to the ply-bonding.

17. The method of manufacturing a tissue paper product of claim 16, wherein the adhesive is transferred from an anilox roll, engraved with cavities for receiving respective dosages of adhesive and for dosage of adhesive to an applicator roll, and is supplied from the applicator roll to the first ply or the second ply.

18. The method of manufacturing a tissue paper product of any one of claims 14 to 17, wherein the first heatable embossing roll and the second heatable embossing roll are synchronized and the first ply and the second ply are ply-bonded with a nested embossment structure or a tip-to-tip bonding structure.

19. The method of manufacturing a tissue paper product of any one of claims 14 to 18, wherein the adhesive is supplied to the first ply while the first ply is being conveyed by the first heatable embossing roll.

20. The method of manufacturing a tissue paper product of any one of claims 14 to 19,

wherein the first ply is made of one of the materials selected from the group consisting of: CWP and structured tissue such as creped TAD, uncreped TAD, eTAD, NTT, and ATMOS; and

wherein the second ply is made of one of the materials selected from the group consisting of: CWP and structured tissue such as creped TAD, uncreped TAD, eTAD, NTT, and ATMOS.

21. The method of manufacturing a tissue paper product of any one of claims 14 to 20, the method comprising the steps of:

- feeding a third ply, optionally made of one of the materials selected from the group consisting of: CWP and structured tissue such as creped TAD, uncreped TAD, eTAD, NTT, and ATMOS; and
- ply-bonding the third ply with the first ply or the second ply, prior to or after the steps carried out in the embossing unit.

22. The method of manufacturing a tissue paper product of any one of claims 14 to 21, the method comprising a step of wetting the first ply and/or the second ply with a liquid prior to embossing the first ply and/or second ply in the embossing unit,

the step of wetting optionally comprising adding the liquid, such as water, to the first ply and/or the second ply with an amount of liquid in the range of 2% to 12% of the basis weight of the first ply and/or the second ply,

or optionally 4% to 10% of the basis weight of the first ply and/or the second ply.

23. The method of manufacturing a tissue paper product of any one of claims 14 to 22, the method lacking a step of wetting a ply with a liquid.

24. The method of manufacturing a tissue paper product of any one of claims 14 to 23, wherein an embossing load during the embossing of the first ply and/or the second ply is in a range of 1 to 50 kg/cml, optionally in a range of 5 to 40 kg/cml.

25. The method of any one of claims 14 to 24, wherein the first ply is provided with first embossments with a height in a range of 0.2 mm to 2.0 mm and/or with third embossments with a height in a range of 0.1 mm to 1.2 mm, and/or

wherein the second ply is provided with second embossments with a height in a range of 0.2 mm to 2.0 mm and/or with fourth embossments with a height in a range of 0.1 mm to 1.2 mm.