According to a second aspect of the present invention, there is provided a method for embossing micro- or nanostructures in an embossing material, wherein a mobile embossing element, by an action of a force on a structured stamp, embosses the micro- or nanostructures in the embossing material, wherein the action of the force on the structured stamp is provided by an embossing element suspension system for suspending the mobile embossing element, the embossing element suspension system is constituted such that the force acting on the structured stamp or a carrier of the structured stamp can be adjusted by a counterforce, wherein a removal of the structured stamp from the embossing material is controlled in a targeted manner, wherein a clamping bar for holding the structured stamp can be moved along a removal curve, wherein the removal curve is one of the following function selected from the group consisting of: polynomial, root function, logarithmic function, trigonometric function, and step function.

According to a third aspect of the present invention, there is provided a stamp system, including: a structured stamp for embossing micro- or nanostructures, a carrier connected to the structured stamp, and an embossing element suspension system for suspending a mobile embossing element, the embossing element suspension system is constituted such that a force acting on the structured stamp or the carrier of the structured stamp can be adjusted by a counterforce, wherein the structured stamp and the carrier are constituted elastically, in such a way that they can be deformed by an embossing element, wherein a clamping bar for holding the structured stamp can be moved along a removal curve, wherein the removal curve is one of the following function selected from the group consisting of: polynomial, root function, logarithmic function, trigonometric function, and step function.

According to a fourth aspect of the present invention, there is provided a removal means for separating a structured stamp from embossing material for the above apparatus, wherein the removal means are constituted for effecting a linear movement of a side of the structured stamp.

Claims

1. An apparatus (24, 24‘) for embossing micro- or nanostructures (31) in an embossing material (6, 6’), comprising:

a structured stamp (1),

a mobile embossing element (8), and

an embossing element suspension system (21, 21’, 21”, 21’’’) for suspending the mobile embossing element (8), the embossing element suspension system (21, 21’, 21”, 21’’’) is constituted such that a force (F, F’) acting on the structured stamp (1) or a carrier (17) of the structured stamp (1) can be adjusted by a counterforce (F_A, $F_{A'}$),

wherein a removal of the structured stamp (1) from the embossing material (6, 6’) can be controlled in a targeted manner, and

wherein a clamping bar (4, 4’) for holding the structured stamp (1) is provided, the clamping bar (4, 4’) can be moved along a removal curve, wherein the removal curve is one of the following function selected from the group consisting of:

- polynomial,
- root function,
- logarithmic function.
- trigonometric function, and
- step function.

2. The apparatus (24, 24‘) according to claim 1, wherein the polynomial is a straight line or parabola.

3. The apparatus (24, 24‘) according to claim 1 or 2, wherein the trigonometric function is a sine function.

4. The apparatus (24, 24‘) according to any one of the preceding claims, wherein the apparatus (24, 24‘) is designed for step-and-repeat operation.

5. The apparatus (24, 24‘) according to any one of the preceding claims, comprising removal means (19) for separating the structured stamp (1) from the embossing material (6, 6’).

6. The apparatus (24, 24‘) according to claim 5, wherein the removal means (19) are constituted for effecting a linear movement of a side of the structured stamp (1).

7. The apparatus (24, 24‘) according to claim 6, wherein the linear movement of the removal means (19) of the side of the structured stamp (1) is directed normal to an embossing surface (6o).

8. The apparatus (24, 24‘) according to any one of claims 5 to 7, wherein the removal means (19) comprise rods.

9. The apparatus (24, 24‘) according to claim 8, wherein the rods comprise mounted linear elements.

10. The apparatus (24, 24‘) according to any one of claims 5 to 9, wherein the removal means (19) are connected to the structured stamp (1).

11. The apparatus (24, 24‘) according to any one of the preceding claims, wherein the embossing element suspension system (21, 21’, 21”, 21’’’) is constituted as a rotatably mounted rocker (21) or carrier (21’) or as a spiral (21”).

12. The apparatus (24, 24‘) according to any one of the preceding claims, wherein the structured stamp (1) is fixed by at least one clamping

bar (4, 4’), wherein the at least one clamping bar (4, 4’) can be moved perpendicular to an embossing surface (6o) or in a Z-direction.

13. The apparatus (24, 24‘) according to claim 12, wherein the structured stamp (1) is laterally fixed by the at least one clamping bar (4, 4’).

14. The apparatus (24, 24‘) according to claim 12 or 13, wherein the at least one clamping bar (4, 4’) is moved by means of a lifting system (32).

15. The apparatus (24, 24‘) according to any one of the preceding claims, wherein the clamping bar (4, 4’) is mounted rotatably.

16. The apparatus (24, 24‘) according to claim 15, wherein the clamping bar (4, 4’) is rotatable about a rotation axis.

17. The apparatus (24, 24‘) according to claim 16, wherein the rotation axis is arranged parallel to the embossing surface (6o) or perpendicular to the Z-direction or perpendicular to the movement direction of the embossing element (8) or parallel to the Y-direction.

18. The apparatus (24, 24‘) according to claim 12, wherein the at least one clamping bar (4, 4’) can be moved in a second direction.

19. The apparatus (24, 24‘) according to claim 18, wherein the at least one clamping bar (4, 4’) is a lifting system (32).

20. The apparatus (24, 24‘) according to claim 19, wherein the at least one clamping bar (4, 4’) and the lifting system (32) can be moved simultaneously.

21. The apparatus (24, 24‘) according to claim 18, 19 or 20, wherein the at least one clamping bar (4, 4’) can be moved in the x-direction or parallel to the embossing surface (6o) or parallel to the movement direction of the embossing element (8).

22. The apparatus (24, 24‘) according to any one of the claims 5 to 10, wherein the translational speed of the removal means (19) lies between 0.1 mm/s and 100 mm/s.

23. The apparatus (24, 24‘) according to claim 22, wherein the translational speed of the removal means (19) lies between 1 mm/s and 75 mm/s.

24. The apparatus (24, 24‘) according to claim 22, wherein the translational speed of the removal means (19) lies between 5 mm/s and 50 mm/s.

25. A method for embossing micro- or nanostructures (31) in an embossing material (6, 6’),

wherein a mobile embossing element (8), by an action of a force (F, F’) on a structured stamp (1), embosses the micro- or nanostructures (31) in the embossing material (6, 6’),

wherein the action of the force (F, F’) on the structured stamp (1) is provided by an embossing element suspension system (21, 21’, 21”, 21’’’) for suspending the mobile embossing element (8), the embossing element suspension system (21, 21’, 21”, 21’’’) is constituted such that the force (F, F’) acting on the structured stamp (1) or a carrier (17) of the structured stamp (1) can be adjusted by a counterforce (F_A, $F_{A'}$),

wherein a removal of the structured stamp (1) from the embossing material (6, 6’) is controlled in a targeted manner,

wherein a clamping bar (4, 4') for holding the structured stamp (1) can be moved along a removal curve, wherein the removal curve is one of the following function selected from the group consisting of:

- polynomial,
- root function,
- logarithmic function,
- trigonometric function, and
- step function.

26. The method according to claim 25, wherein the polynomial is a straight line or parabola.

27. The method according to claim 25 or 26, wherein the trigonometric function is a sine function.

28. A stamp system (5), comprising:

a structured stamp (1)for embossing micro- or nanostructures (31),

a carrier (17) connected to the structured stamp (1), and

an embossing element suspension system (21, 21', 21", 21''') for suspending a mobile embossing element (8), the embossing element suspension system (21, 21', 21", 21''') is constituted such that a force (F, F') acting on the structured stamp (1) or the carrier (17) of the structured stamp (1) can be adjusted by a counterforce (F_A, $F_{A'}$),

wherein the structured stamp (1) and the carrier (17) are constituted elastically, in such a way that they can be deformed by an embossing element (8),

wherein a clamping bar (4, 4') for holding the structured stamp (1) can be moved along a removal curve, wherein the removal curve is one of the following function selected from the group consisting of:

- polynomial,
- root function,

- logarithmic function,
- trigonometric function, and
- step function.

29. The stamp system (5) according to claim 28, wherein the structured stamp (1) is a soft stamp.

30. The stamp system (5) according to claim 28 or 29, wherein the carrier (17) is made of glass.

31. The stamp system (5) according to any one of claims 28 to 30, wherein the carrier (17) is connected to the structured stamp (1) in a planar manner.

32. The stamp system (5) according to any one of claims 28 to 31, wherein the polynomial is a straight line or parabola.

33. The stamp system (5) according to any one of claims 28 to 32, wherein the trigonometric function is a sine function.

34. A removal means (19) for separating a structured stamp (1) from embossing material (6, 6') for an apparatus (24, 24') according to any one of the preceding claims, wherein the removal means (19) are constituted for effecting a linear movement of a side of the structured stamp (1).

35. The removal means (19) according to claim 34, wherein the linear movement of the removal means (19) of the side of the structured stamp (1) is directed normal to an embossing surface (6o).