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(54) **TROUGH FOR AN IRONING DEVICE**

(57) The invention provides a trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another, preferably by means of weld spots (6) and/or weld seams (7), and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between the two plates (2, 3), wherein the surface of the first heat-conducting plate facing the cavity (5) is convex; and is provided with recessed elements (4), wherein the recessed elements (4) are blind holes.

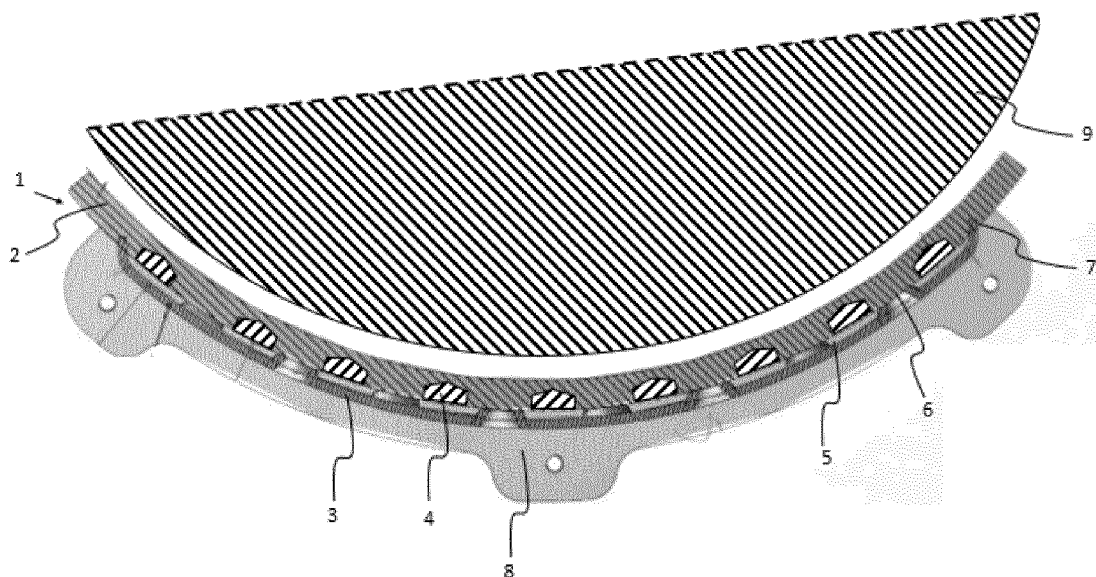


Fig. 2B

EP 4 105 377 A1

Description**TECHNICAL FIELD**

5 **[0001]** The invention relates to a trough for an ironing device. The invention also relates to an ironing device comprising a trough. The invention also relates to a method for producing a trough. The invention also relates to a method for drying and/or ironing flat material.

TECHNOLOGICAL BACKGROUND OF THE INVENTION

10 **[0002]** An industrial ironing machine, also referred to here as an ironing device, is often used in industrial laundries and consists of a cylindrical ironing roller and a trough (a heated ironing bed), between which the moist flat material, such as bed linen or table linen, is introduced. The trough and/or the ironing roller are heated to the temperatures required to iron and/or to dry the flat material. The trough usually consists of a heavy steel plate which has to closely adjoin the
15 ironing roller in order to achieve a good ironing result. Usually, the trough is heated: this is achieved by welding steam chambers or a steam space onto the trough. By introducing a heating liquid or gas into these steam chambers or steam space, the trough will reach the desired temperatures. The trough is pressed against the ironing roller and the flat material is passed in between. Then, the flat material is ironed and dried while the ironing roller is rotating.

20 **[0003]** Patent application BE1005950 describes an industrial ironing machine consisting of an ironing cylinder and a trough which extends around virtually half of this ironing cylinder. Patent application BE1018329 describes an ironing roller for an ironing device. Patent application BE1018069 describes a feed-in device for an ironing device.

25 **[0004]** Since ironing devices consume large quantities of heat, there is a demand to make ironing devices more energy efficient. The demand for energy efficiency is great especially for steam-heated ironing devices. It follows from this that there is a need for a trough for an ironing device with increased efficiency. It follows from this that there is a need for a trough for an ironing device with an increased throughput rate. It follows from this that there is a need for a trough for an ironing device with an increased capacity.

SUMMARY

30 **[0005]** In order to meet the demands and needs mentioned above, the invention comprises a trough for an ironing device, comprising a first heat-conducting plate, wherein the first heat-conducting plate comprises protruding elements and/or recessed elements. The protruding elements and/or recessed elements increase the contact surface between the first heat-conducting plate and the heating liquid or gas, preferably steam, which can flow in the cavity or steam chamber of the trough. This increases the energy efficiency and/or increases the capacity of the ironing device.

35 **[0006]** The invention provides a trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

40 wherein both heat-conducting plates (2, 3) are coupled to one other, preferably by means of weld spots (6) and/or weld seams (7), preferably over the surface of the heat-conducting plates (2, 3); and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between both plates (2, 3),

45 wherein the surface of the first heat-conducting plate facing the cavity (5) is provided with protruding elements and/or recessed elements (4).

[0007] More specifically, the invention provides a trough (1) for an ironing device, comprising:

- 50
- a first heat-conducting plate (2); and
 - a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another, preferably by means of weld spots (6) and/or weld seams (7), and

55 wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between both plates (2, 3), wherein the surface of the first heat-conducting plate facing the cavity (5) is convex; and is provided with recessed elements (4), wherein the recessed elements (4) are blind holes.

[0008] In one embodiment, the protruding elements and/or recessed elements (4) are selected from the list of blind

holes, wells, fins, depressions, corrugations, cuts and/or projections; preferably blind holes.

[0009] In one embodiment, the first heat-conducting plate (2) has a thickness of at least 10.0 mm to at most 50.0 mm, preferably at least 12.0 mm to at most 40.0 mm, preferably at least 14.0 mm to at most 35.0 mm, preferably at least 16.0 mm to at most 32.0 mm, preferably at least 18.0 mm to at most 30.0 mm, preferably at least 20.0 mm to at most 28.0 mm, preferably at least 24.0 mm to at most 25.0 mm.

[0010] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 1.0 mm to at most 12.0 mm, is preferably at least 2.0 mm to at most 10.0 mm, is preferably at least 3.0 mm to at most 10.0 mm, is preferably at least 5.0 mm to at most 10.0 mm, is preferably at least 7.0 mm to at most 10.0 mm, is preferably at least 9.0 mm to at most 10.0 mm.

[0011] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 5.0% to at most 90.0%, preferably at least 10.0% to at most 80.0%, preferably at least 15.0% to at most 70.0%, preferably at least 20.0% to at most 60.0%, preferably at least 25.0% to at most 55.0%, preferably at least 30.0% to at most 50.0%, preferably at least 35.0% to at most 45.0%, of the thickness of the first heat-conducting plate (2).

[0012] In one embodiment, the diameter of the protruding elements (4) and/or recessed elements (4), preferably the blind holes, is at least 1.0 mm, preferably at least 2.0 mm, preferably at least 5.0 mm, preferably at least 10.0 mm, preferably at least 15.0 mm, preferably at least 20.0 mm, preferably at least 24.0 mm.

[0013] In one embodiment, the diameter of the protruding elements (4) and/or the recessed elements (4) is at least 5.0% to at most 500.0%, preferably at least 10.0% to at most 400.0%, preferably at least 20.0% to at most 300.0%, preferably at least 30.0% to at most 250.0%, preferably at least 40.0% to at most 200.0%, preferably at least 50.0% to at most 150.0%, preferably at least 60.0% to at most 125.0%, of the thickness of the first heat-conducting plate (2).

[0014] In one embodiment, the protruding elements (4) and/or recessed elements (4) are arranged in a pattern, preferably a repeating pattern.

[0015] In one embodiment, the pattern is made up of rows of protruding elements and/or recessed elements, preferably rows having a repeating distance (X) between two centres of successive elements of at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

[0016] In one embodiment, the distance (Y) between the rows in the pattern is at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

[0017] In one embodiment, the bottom of the blind hole is flat.

[0018] In one embodiment, the bottom of the blind hole is conical, at least in part. This shape makes it easier to create the blind holes, since these can be created using a drill with a conical point.

[0019] In one embodiment, the blind holes comprise a cylindrical part and a conical part.

[0020] In one embodiment, the bottom of the blind hole is flat. Simulations have shown that a blind hole having only a cylindrical part has a heat transfer that is 5% higher than blind holes of the same depth having a cylindrical part and a conical part.

[0021] The invention provides a method for producing a trough (1) according to one embodiment described herein, comprising the following steps:

- providing protruding elements and/or recessed elements (4) on one side of a first heat-conducting plate (2);
- welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with protruding elements and/or recessed elements (4) faces the second heat-conducting plate (3);
- deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
- optionally deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).

[0022] More specifically, the invention provides a method for producing a trough (1) according to one of Claims 1 to 11, comprising the following steps:

- providing recessed elements (4) on one side of a first heat-conducting plate (2), wherein the recessed elements are blind holes;

- welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with recessed elements (4) faces the second heat-conducting plate (3);
- deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
- deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).

[0023] The invention provides an ironing device comprising a trough (1) according to one embodiment described herein, further comprising a cylindrical ironing roller (9). In one embodiment, the cylindrical ironing roller comprises a shell. In one embodiment, the trough (1) extends over at least one third of the circumference of the shell of the cylindrical ironing roller, preferably over at least half the circumference of the shell of the cylindrical ironing roller (9).

[0024] In one aspect, the invention also comprises a method for drying and/or ironing moist flat material, for example bed linen or table linen, using an ironing device as described above, comprising the following steps:

- heating the trough (1) preferably up to a temperature of at least 100°C, preferably at least 150°C, more preferably at least 170°C, by introducing a heated liquid or gas, preferably steam or thermal oil, into the cavity (5) between both heat-conducting plates (2, 3);
- rotating the cylindrical ironing roller (9) with respect to the trough (1); and
- introducing the flat material between the trough (1) and the cylindrical ironing roller (9) while the cylindrical ironing roller (9) is rotating with respect to the trough (1);
- optionally, pressing the trough (1) against the cylindrical ironing roller (9).

DESCRIPTION OF THE FIGURES

[0025]

Figure 1A illustrates a trough (1) according to one embodiment of the invention, showing the first heat-conducting plate (2), the second heat-conducting plate (3), protruding and/or recessed elements, in this case blind holes (4), the cavity (5), the weld spots (6) and the weld seams (7). The rectangular box illustrates the portion of the trough (1) that is illustrated in detail in Figure 1B.

Figures 1B and 1C illustrate a detail view and cross section of the trough (1) according to Figure 1A.

Figure 2A illustrates an ironing device according to the prior art. **Figure 2b** illustrates an ironing device according to one embodiment of the invention. The figures comprise the indications of the trough (1), the first heat-conducting plate (2), the second heat-conducting plate (3), protruding and/or recessed elements, in this case blind holes (4), the cavity (5), the weld spots (6), the weld seams (7), a fastening flange (8) and the ironing roller (9), which is only partially illustrated in this case.

Figure 3A illustrates a detail of a trough (1) according to the prior art. **Figure 3b** illustrates a detail of a trough (1) according to one embodiment of the invention. The figures comprise the indications of the trough (1), the first heat-conducting plate (2), the second heat-conducting plate (3), protruding and/or recessed elements, in this case blind holes (4), the cavity (5) and the weld spots (6).

Figure 4A illustrates the results of the simulation of the relative improvement of the heat transfer in dependence on the distances X and Y in the pattern of the blind holes. **Figure 4B** illustrates the results of the simulation of the average linen temperature in dependence on the distances X and Y in the pattern of the blind holes.

Figure 5A illustrates the results of the simulation of the relative improvement of the heat transfer in dependence on the diameter of the blind holes. **Figure 5B** illustrates the results of the simulation of the average linen temperature in dependence on the diameter of the blind holes.

Figure 6A illustrates the results of the simulation of the relative improvement of the heat transfer in dependence on the depth of the blind holes. **Figure 6B** illustrates the results of the simulation of the average linen temperature in dependence on the depth of the blind holes.

Figure 7 illustrates the pattern of the blind holes used in the simulations. The distances X and Y are indicated and the dashed line shows a zone at the edge in which no blind holes have been made.

DETAILED DESCRIPTION

[0026] As used hereinbelow in this text, the singular forms "a", "an" and "the" comprise both the singular and the plural, unless the context clearly denotes otherwise.

[0027] The terms "comprise", "comprises" as used hereinbelow are synonymous with "inclusive", "include" or "contain", "contains" and are inclusive or open and do not exclude additional items, elements or method steps which have not been mentioned. The terms "comprise", "comprises" are inclusive of the term "contain".

[0028] The enumeration of numerical values by means of ranges of figures comprises all values and fractions included in these ranges as well as the cited end points.

[0029] The term "approximately" as used when referring to a measurable value, such as a parameter, a quantity, a time period and so on, is intended to include variations of $\pm 10\%$ or less, preferably $\pm 5\%$ or less, more preferably $\pm 1\%$ or less, and still more preferably $\pm 0.1\%$ or less, of and from the specified value, in so far as the variations are applicable in order to function in the disclosed invention. It should be understood that the value to which the term "approximately" refers per se has also been disclosed.

[0030] All documents which are cited in the present specification are incorporated herein in full by way of reference.

[0031] Unless otherwise defined, all terms disclosed in the invention, including technical and scientific terms, have the meanings which those skilled in the art usually give them. As a further guide, definitions have been incorporated in order to further explain terms which are used in the description of the invention.

[0032] The invention provides a trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one other, preferably by means of weld spots (6) and/or weld seams (7), preferably over the surface of the heat-conducting plates (2, 3); and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between the two plates (2, 3),

wherein the surface of the first heat-conducting plate facing the cavity (5) is provided with protruding elements and/or recessed elements (4).

[0033] More specifically, the invention provides a trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another, preferably by means of weld spots (6) and/or weld seams (7), and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between the two plates (2, 3), wherein the surface of the first heat-conducting plate facing the cavity (5) is convex; and is provided with recessed elements (4), wherein the recessed elements (4) are blind holes.

[0034] The protruding elements and/or recessed elements increase the contact surface between the first heat-conducting plate and the heat transfer medium, preferably steam, which can flow in the cavity of the trough. This increases the energy efficiency and/or increases the capacity of the ironing device.

[0035] In one embodiment, the cavity (5) is a steam chamber. In one embodiment, the trough (1) is a steam-heated trough.

[0036] In one embodiment, the first heat-conducting plate (2) is provided with recessed elements (4). The recessed elements ensure local thinning of the first heat-conducting plate. This reduces the thermal resistance of the first heat-conducting plate, as a result of which heat is transferred from the heat transfer medium to the ironing bed more efficiently. This increases the energy efficiency and/or increases the capacity of the ironing device.

[0037] In one embodiment, the protruding elements and/or recessed elements (4) are selected from the list of blind holes, wells, fins, depressions, corrugations, cuts and/or projections; preferably blind holes.

[0038] In one embodiment, the protruding elements and/or recessed elements (4) are blind holes.

[0039] The term "blind holes" as used herein refers to holes made in the surface of the first heat-conducting plate, but the holes do not go all the way through the first heat-conducting plate. The depth of the blind holes is therefore less than

the thickness of the first heat-conducting plate. It is not possible for any heating liquid or gas to exit the cavity (5) through the blind holes (4).

[0040] In one embodiment, the first heat-conducting plate (2) has a thickness of at least 10.0 mm to at most 50.0 mm, preferably at least 12.0 mm to at most 40.0 mm, preferably at least 14.0 mm to at most 35.0 mm, preferably at least 16.0 mm to at most 32.0 mm, preferably at least 18.0 mm to at most 30.0 mm, preferably at least 20.0 mm to at most 28.0 mm, preferably at least 24.0 mm to at most 25.0 mm.

[0041] In one embodiment, the first heat-conducting plate (2) has a thickness of at least 10.0 mm, preferably at least 12.0 mm, preferably at least 14.0 mm, preferably at least 16.0 mm, preferably at least 18.0 mm, preferably at least 20.0 mm, preferably at least 24.0 mm.

[0042] In one embodiment, the first heat-conducting plate (2) has a thickness of at most 50.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 32.0 mm, preferably at most 30.0 mm, preferably at most 28.0 mm, preferably at most 25.0 mm.

[0043] In one embodiment, the second heat-conducting plate (2) has a thickness of at least 1.0 mm to at most 20.0 mm, preferably at least 2.0 mm to at most 18.0 mm, preferably at least 3.0 mm to at most 16.0 mm, preferably at least 4.0 mm to at most 14.0 mm, preferably at least 5.0 mm to at most 12.0 mm, preferably at least 6.0 mm to at most 10.0 mm, preferably at least 7.0 mm to at most 8.0 mm.

[0044] In one embodiment, the second heat-conducting plate (2) has a thickness of at least 1.0 mm, preferably at least 2.0 mm, preferably at least 3.0 mm, preferably at least 4.0 mm, preferably at least 5.0 mm, preferably at least 6.0 mm, preferably at least 7.0 mm.

[0045] In one embodiment, the second heat-conducting plate (2) has a thickness of at most 20.0 mm, preferably at most 18.0 mm, preferably at most 16.0 mm, preferably at most 14.0 mm, preferably at most 12.0 mm, preferably at most 10.0 mm, preferably at most 8.0 mm.

[0046] In one embodiment, the thickness of the second heat-conducting plate (2) is at most 90.0%, preferably at most 80.0%, preferably at most 70.0%, preferably at most 60.0%, preferably at most 55.0%, preferably at most 50.0%, preferably at most 45.0%, of the thickness of the first heat-conducting plate.

[0047] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 1.0 mm to at most 12.0 mm, is preferably at least 2.0 mm to at most 10.0 mm, is preferably at least 3.0 mm to at most 10.0 mm, is preferably at least 5.0 mm to at most 10.0 mm, is preferably at least 7.0 mm to at most 10.0 mm, is preferably at least 9.0 mm to at most 10.0 mm.

[0048] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate facing the cavity is at least 1.0 mm, is preferably at least 2.0 mm, is preferably at least 3.0 mm, is preferably at least 5.0 mm, is preferably at least 7.0 mm, is preferably at least 9.0 mm, is preferably at least 10.0 mm.

[0049] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate facing the cavity is at most 15.0 mm, is preferably at most 12.0 mm, is preferably at most 10.0 mm, is preferably at most 8.0 mm, is preferably at most 6.0 mm, is preferably at most 5.0 mm.

[0050] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 5.0% to at most 90.0%, preferably at least 10.0% to at most 80.0%, preferably at least 15.0% to at most 70.0%, preferably at least 20.0% to at most 60.0%, preferably at least 25.0% to at most 55.0%, preferably at least 30.0% to at most 50.0%, preferably at least 35.0% to at most 45.0%, of the thickness of the first heat-conducting plate (2).

[0051] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate facing the cavity is at least 5.0%, preferably at least 10.0%, preferably at least 15.0%, preferably at least 20.0%, preferably at least 25.0%, preferably at least 30.0%, preferably at least 35.0%, of the thickness of the first heat-conducting plate.

[0052] In one embodiment, the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate facing the cavity is at most 90.0%, preferably at most 80.0%, preferably at most 70.0%, preferably at most 60.0%, preferably at most 55.0%, preferably at most 50.0%, preferably at most 45.0%, of the thickness of the first heat-conducting plate.

[0053] In one embodiment, the diameter of the protruding elements (4) and/or recessed elements (4), preferably the blind holes, is at least 1.0 mm, preferably at least 2.0 mm, preferably at least 5.0 mm, preferably at least 10.0 mm, preferably at least 15.0 mm, preferably at least 20.0 mm, preferably at least 24.0 mm.

[0054] In one embodiment, the diameter of the protruding elements (4) and/or recessed elements (4), preferably the blind holes, is at least 1.0 mm to at most 50.0 mm, preferably at least 2.0 mm to at most 40.0 mm, preferably at least 5.0 mm to at most 35.0 mm, preferably at least 10.0 mm to at most 50.0 mm, preferably at least 15.0 mm to at most 30.0 mm, preferably at least 20.0 mm to at most 27.0 mm, preferably at least 24.0 mm to at most 25.0 mm.

[0055] In one embodiment, the diameter of the protruding elements and/or recessed elements (4), preferably the blind holes, is at most 50.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm, preferably at most 25.0 mm, preferably at most 20.0 mm, preferably at most 15.0 mm.

[0056] In one embodiment, the diameter of the protruding elements (4) and/or the recessed elements (4) is at least 5.0% to at most 500.0%, preferably at least 10.0% to at most 400.0%, preferably at least 20.0% to at most 300.0%, preferably at least 30.0% to at most 250.0%, preferably at least 40.0% to at most 200.0%, preferably at least 50.0% to at most 150.0%, preferably at least 60.0% to at most 125.0%, of the thickness of the first heat-conducting plate (2).

[0057] In one embodiment, the diameter of the protruding elements and/or the recessed elements (4) is at least 5.0%, preferably at least 10.0%, preferably at least 20.0%, preferably at least 30.0%, preferably at least 40.0%, preferably at least 50.0%, preferably at least 60.0%, of the thickness of the first heat-conducting plate.

[0058] In one embodiment, the diameter of the protruding elements and/or the recessed elements (4) is at most 500.0%, preferably at most 400.0%, preferably at most 300.0%, preferably at most 250.0%, preferably at most 200.0%, preferably at most 150.0%, preferably at most 125.0%, of the thickness of the first heat-conducting plate.

[0059] In one embodiment, the protruding elements (4) and/or recessed elements (4) are arranged in a pattern, preferably a repeating pattern.

[0060] In one embodiment, the pattern is made up of rows of protruding elements and/or recessed elements (4), preferably rows having a repeating distance (X) between two centres of successive elements of at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

[0061] In one embodiment, the pattern is made up of rows of protruding elements and/or recessed elements (4), preferably rows having a repeating distance (X) between two centres of successive elements of at least 5.0 mm, preferably at least 10.0 mm, preferably at least 20.0 mm, preferably at least 30.0 mm, preferably at least 35.0 mm, preferably at least 40.0 mm, preferably at least 45.0 mm, preferably at least 50.0 mm.

[0062] In one embodiment, the pattern is made up of rows of protruding elements and/or recessed elements (4), preferably rows having a repeating distance (X) between two centres of successive elements of at least 5.0 mm to at most 100.0 mm, preferably at least 10.0 mm to at most 90.0 mm, preferably at least 20.0 mm to at most 80.0 mm, preferably at least 30.0 mm to at most 70.0 mm, preferably at least 35.0 mm to at most 60.0 mm, preferably at least 40.0 mm to at most 55.0 mm, preferably at least 45.0 mm to at most 50.0 mm.

[0063] In one embodiment, the distance (Y) between the rows in the pattern is at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

[0064] In one embodiment, the distance (Y) between the rows in the pattern is at least 5.0 mm, preferably at least 10.0 mm, preferably at least 20.0 mm, preferably at least 30.0 mm, preferably at least 35.0 mm, preferably at least 40.0 mm, preferably at least 45.0 mm, preferably at least 50.0 mm.

[0065] In one embodiment, the distance (Y) between the rows in the pattern is at least 5.0 mm to at most 100.0 mm, preferably at least 10.0 mm to at most 90.0 mm, preferably at least 20.0 mm to at most 80.0 mm, preferably at least 30.0 mm to at most 70.0 mm, preferably at least 35.0 mm to at most 60.0 mm, preferably at least 40.0 mm to at most 55.0 mm, preferably at least 45.0 mm to at most 50.0 mm.

[0066] In one embodiment, the bottom of the blind hole is conical, at least in part.

[0067] In one embodiment, the blind holes comprise a cylindrical part and a conical part.

[0068] The term "ironing device" comprises industrial ironing machines. These comprise a trough (1) and an ironing roller (9), in between which the flat material is introduced.

[0069] The term "trough" comprises the ironing bed for an ironing device (1). This ironing bed is usually heated. The trough (1) can be pressed against the ironing roller (9) by means of mechanical, hydraulic, pneumatic or electrical pressure. This makes it possible to achieve an optimum evaporation effect of the moisture in the flat material. This also makes it possible to achieve an optimum ironing effect of the flat material. This also makes it possible to achieve an optimum conveying effect of the flat material between the ironing roller (9), which usually rotates, and the trough (1).

[0070] In one embodiment of the invention, the trough (1) comprises several perforations distributed over the surface, or a part of the surface, of the trough (1). The perforations in the trough (1) may form any desired pattern. Preferably, the perforations in the trough (1) form a regular pattern. More preferably, the perforations in the trough (1) form a triangular, rectangular or rhombic pattern over the surface, or a part of the surface, of the trough (1).

[0071] In one embodiment, the first heat-conducting plate and/or the second heat-conducting plate comprises non-alloy steel.

[0072] In one embodiment, the first heat-conducting plate and/or the second heat-conducting plate consists of steel having the following composition:

- iron;

- carbon;
- at most 0.3% by weight of aluminium;
- at most 0.0008% by weight of boron;
- at most 0.3% by weight of cobalt;
- 5 - at most 0.4% by weight of copper;
- at most 0.4% by weight of lead;
- at most 1.65% by weight of manganese;
- at most 0.08% by weight of molybdenum;
- at most 0.3% by weight of nickel;
- 10 - at most 0.06% by weight of niobium;
- at most 0.6% by weight of silicon;
- at most 0.05% by weight of titanium;
- at most 0.3% by weight of tungsten;
- at most 0.05% by weight of zirconium;
- 15 - at most 0.4% by weight of lead; and
- at most 0.1% by weight of other elements which have not been mentioned above (except for iron, carbon, sulfur and phosphorus).

[0073] In one embodiment, the invention comprises a trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another by means of weld spots (6) and/or weld seams (7) over the surface of the heat-conducting plates (2, 3), and wherein the heat-conducting plate (2) is deformed in such a way that a cavity (5) is provided between both plates (2, 3).

[0074] The term "weld spot" comprises the common contact surface between two plates (2, 3) which are coupled to one another by a welding technique, wherein the contact surface is local. Such weld spots (6) are usually round. In one embodiment of the invention, such weld spots (6) are distributed evenly over the entire surface of the plates (2, 3), as a result of which the cavity (5) between two plates (2, 3) comprises chambers, such as those in a padded cushion. Such weld spots (6) can be formed by means of a laser-welding technique, as known in the prior art.

[0075] The term "weld seam" comprises the common contact surface between two plates (2, 3) which are coupled to one another by a welding technique, wherein the contact surface is continuous in one dimension. Such a weld seam (7) is usually applied along the circumference of the two plates (2, 3), thus closing the cavity (5) between the two plates (2, 3). Such weld seams (7) can also be made parallel to one another, as a result of which the cavity (5) between two plates (2, 3) comprises elongate chambers. Such weld seams (7) can be formed by means of a laser-welding technique, as known in the prior art.

[0076] In one embodiment of the invention, the trough (1) comprises a weld seam (7) running along the circumference of the plates (2, 3) and the trough (1) comprises weld spots (6) which are situated at equal distances from one another over the surface of the trough (1), preferably as a padded cushion. The weld spots (6) may form any desired pattern. Preferably, the weld spots (6) form a regular pattern. More preferably, the weld spots (6) form a triangular, rectangular or rhombic pattern on the surface of the plates (2, 3). Between the weld spots (6) and/or the weld seams (7), flow passages for the heating liquid or the heating gas are created.

[0077] The term "ironing roller" comprises the cylindrical ironing roller (9) for an ironing device (1). This ironing roller (9) comprises a shell, which shell comprises a diameter and a circumference (2).

[0078] The term "ironing path" comprises the contact distance between the trough (1) and the shell of the ironing roller (9). The term "free drying length" comprises the distance over which the shell of the ironing roller (9) is not surrounded by the trough (1). The sum of the ironing path (3) and the free drying length (4) corresponds to the circumference (2) of the shell of the ironing roller (9).

[0079] The term "flat material" comprises any kind of fabric which can be introduced into an ironing device (1) in order to be dried and/or ironed. Preferably, the flat material has a minimum width of 1.0 m. Preferably, the flat material has a maximum width of 3.3 m. Preferably, this flat material comprises bed linen or table linen. The term "bed linen" comprises sheets, fitted sheets, drawsheets, bedspreads, duvet covers and pillow cases. The term "table linen" comprises tablecloths and napkins.

[0080] In one embodiment, the invention comprises a trough (1) as described above, in which the heat-conducting plates (2, 3) comprise flexible metal. In one embodiment of the invention, the heat-conducting plates (2, 3) comprise steel, preferably stainless steel.

[0081] In one embodiment, the invention comprises a trough (1) as described above, in which the trough (1) has a

diameter of between 200 mm and 2000 mm, for example a diameter of 300 mm, 500 mm, 600 mm, 800 mm, 900 mm, 1200 mm, or 1600 mm.

[0082] The term "diameter of a trough" comprises the diameter of the arc which the trough (1) describes. This diameter corresponds approximately to the diameter of a cylindrical ironing roller (9) which fits inside the trough (1). The diameter of the trough (1) will determine the drying and ironing path (3) of the flat material in the ironing device (1). The larger the diameter of the trough (1), the longer this ironing path (3) can be.

[0083] The invention provides a method for producing a trough (1) according to one embodiment described herein, comprising the following steps:

- providing protruding elements and/or recessed elements (4) on one side of a first heat-conducting plate (2);
- welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with protruding elements and/or recessed elements (4) faces the second heat-conducting plate (3);
- deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
- optionally deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).

[0084] More specifically, the invention provides a method for producing a trough (1) according to one of Claims 1 to 11, comprising the following steps:

- providing recessed elements (4) on one side of a first heat-conducting plate (2), wherein the recessed elements are blind holes;
- welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with recessed elements (4) faces the second heat-conducting plate (3);
- deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
- deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).

[0085] In one embodiment of the invention, the steps of the method as described above are carried out in the above-mentioned order. In an alternative embodiment of the invention, the above-mentioned steps are carried out in a different order. In an alternative embodiment of the invention, both plates (2, 3) are first deformed and only then welded.

[0086] In one embodiment of the invention, the plates (2, 3) are initially pressed against one another and are then connected to one another by weld spots (6) and/or weld seams (7). In order to provide a cavity (5) between the plates (2, 3), a gas or a liquid will preferably be injected at high pressure. Preferably, this liquid or gas comprises water or steam. In one embodiment of the invention, this liquid or gas is injected between the plates (2, 3) at a pressure of approximately 30 bar. In this way, flow passages for the heating liquid or the heating gas are created between the weld spots (6) and/or weld seams (7). Due to the very small cavity (5), the circulation of the heating liquid or the heating gas is not associated with the same problems which are inherent to conventional steam chambers.

[0087] In one embodiment, the invention comprises a method for producing a trough (1) as described above, in which the maximum cavity (5) between the plates (2, 3) has a thickness of between 1 mm and 7 mm. In one embodiment, the invention comprises a trough (1) as described above, in which the maximum cavity (5) between the plates (2, 3) has a thickness of between 1 mm and 7 mm. Preferably, the maximum cavity (5) between the plates (2, 3) has a thickness of between 2 mm and 4 mm, more preferably the maximum cavity (5) between the plates (2, 3) has a thickness of approximately 3 mm. This cavity (5) depends on the thickness of the plates (2, 3), the distance between the weld spots (6) and/or weld seams (7) and the quantity of heating liquid or heating gas which has to flow between the plates (2, 3) in order to keep the plates (2, 3) at the desired temperature.

[0088] The invention provides an ironing device comprising a trough (1) according to one embodiment described herein, further comprising a cylindrical ironing roller (9). In one embodiment, the cylindrical ironing roller comprises a shell. In one embodiment, the trough (1) extends over at least one third of the circumference of the shell of the cylindrical ironing roller, preferably over at least half the circumference of the shell of the cylindrical ironing roller (9).

[0089] In an alternative embodiment of the invention, the trough (1) extends over at least three quarters, preferably over at least four fifths, more preferably over at least 90%, most preferably over at least 95% of the circumference (2)

of the shell of the cylindrical ironing roller (9). The length of the ironing path (3) corresponds to this percentage of the circumference (2) of the shell of the ironing roller (9).

[0090] The degree to which the trough (1) surrounds the ironing roller (9) can also be described using a contact angle, in which a contact angle of 0° corresponds to no contact between the trough (1) and the ironing roller (9), and a contact angle of 360° corresponds to complete enclosure of the shell of the ironing roller (9) by the trough (1). In one embodiment of the invention, the contact angle is between 120° and 330°, for example 130°, 140°, 150°, 160°, 170°, 180°, 190°, 200°, 210°, 220°, 230°, 240°, 250°, 260°, 270°, 280°, 290°, 300°, 310° or 320°. Preferably, the contact angle is at least 150°, more preferably at least 180°, more preferably at least 210°, more preferably at least 240°, more preferably at least 270°, more preferably at least 300°.

[0091] The more the trough (1) extends over the circumference (2) of the shell of the cylindrical ironing roller (9), the longer the ironing path (3) of the flat material, but the shorter the free drying length (4) of the cylindrical ironing roller (9). It is possible to use ironing rollers (9) and troughs (1) with a larger diameter or to place several smaller ironing devices (1) in series one after the other in order to produce a longer ironing path (3). In one embodiment of the invention, the free drying distance is reduced to a minimum.

[0092] In one embodiment, the invention comprises an ironing device (1) as described above, characterized in that the shell of the cylindrical ironing roller (9) comprises a layer of moisture-absorbing material (23) around the shell of the cylindrical ironing roller (9).

[0093] The term "moisture-absorbing material" comprises any material which can absorb moisture from the flat material during ironing. Preferably, the moisture-absorbing material (23) is felt, for example felt of 4000 g/m². In one embodiment of the invention, the moisture-absorbing material (23) is coupled to the shell of the cylindrical ironing roller (9) by means of springs (24). As a result thereof, the moisture-absorbing material (23) is pressed against the trough (1) and/or the flat material. This moisture-absorbing material (23) has to be able to dry to a sufficient degree, hence the need for a free drying length (4) which is increased in the invention to the complete circumference (2) of the shell of the ironing roller (9). The springs (24) also ensure that uneven patches are pressed away. The springs (24) also ensure that an air cushion is created between the moisture-absorbing material (23) and the ironing roller (9).

[0094] In one embodiment, the invention comprises an ironing device (1) as described above, in which the trough (1) is flexible and is pressed against the shell of the cylindrical ironing roller (9). This has the advantage that, independent of the thickness of the flat material, the flat material will always be pressed tightly against the shell of the ironing roller (9) and against the trough (1). This may be effected by mechanical, hydraulic, pneumatic or electrical means. Large ironing cylinders, i.e. having a diameter greater than 1200 mm, often suffer from the problem that the trough (1) does not closely adjoin the ironing roller (9).

[0095] In one aspect, the invention also comprises a method for drying and/or ironing moist flat material, for example bed linen or table linen, using an ironing device as described above, comprising the following steps:

- heating the trough (1) preferably up to a temperature of at least 100°C, preferably at least 150°C, more preferably at least 170°C, by introducing a heated liquid or gas, preferably steam or thermal oil, into the cavity (5) between both heat-conducting plates (2, 3);
- rotating the cylindrical ironing roller (9) with respect to the trough (1); and
- introducing the flat material between the trough (1) and the cylindrical ironing roller (9) while the cylindrical ironing roller (9) is rotating with respect to the trough (1);
- optionally, pressing the trough (1) against the cylindrical ironing roller (9).

[0096] Preferably, the flat material is introduced in a moist state. Preferably, the trough (1) is pressed against the ironing roller (9), which may, for example, be effected by hydraulic, pneumatic or electrical means.

[0097] The heated liquid or the heated gas serves as heating liquid or heating gas. This heating liquid or this heating gas can be selected from the list comprising: steam, thermal oil and hot air. Preferably, this is steam or thermal oil. The heating liquid or the heating gas can be heated by means of a gas boiler or a thermal boiler. Preferably, the trough (1) is heated to a temperature of at least 100°C, more preferably to a temperature of at least 150°C, most preferably to a temperature of at least 170°C.

[0098] In one embodiment, the invention comprises a method for drying and/or ironing moist flat material as described above, in which the heat of the excess moisture is partly recovered in order to heat up the trough (1). The heat can be recovered by means of a heat exchanger.

[0099] The invention is encompassed inter alia in the following statements:

1. A trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another, preferably by means of weld spots (6) and/or weld seams (7), and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between the two plates (2, 3), characterized in that the surface of the first heat-conducting plate facing the cavity (5) is provided with protruding elements and/or recessed elements (4).

2. The trough (1) according to statement 1, wherein the protruding elements and/or recessed elements (4) are selected from the list of blind holes, wells, fins, depressions, corrugations, cuts and/or projections; preferably blind holes.

3. The trough (1) according to statement 1 or 2, wherein the first heat-conducting plate (2) has a thickness of at least 10.0 mm to at most 50.0 mm, preferably at least 12.0 mm to at most 40.0 mm, preferably at least 14.0 mm to at most 35.0 mm, preferably at least 16.0 mm to at most 32.0 mm, preferably at least 18.0 mm to at most 30.0 mm, preferably at least 20.0 mm to at most 28.0 mm, preferably at least 24.0 mm to at most 25.0 mm.

4. The trough (1) according to one of statements 1 to 3, wherein the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 1.0 mm to at most 12.0 mm, is preferably at least 2.0 mm to at most 10.0 mm, is preferably at least 3.0 mm to at most 10.0 mm, is preferably at least 5.0 mm to at most 10.0 mm, is preferably at least 7.0 mm to at most 10.0 mm, is preferably at least 9.0 mm to at most 10.0 mm.

5. The trough (1) according to one of statements 1 to 4, wherein the height of the protruding elements (4) and/or the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 5.0% to at most 90.0%, preferably at least 10.0% to at most 80.0%, preferably at least 15.0% to at most 70.0%, preferably at least 20.0% to at most 60.0%, preferably at least 25.0% to at most 55.0%, preferably at least 30.0% to at most 50.0%, preferably at least 35.0% to at most 45.0%, of the thickness of the first heat-conducting plate (2).

6. The trough (1) according to one of statements 1 to 5, wherein the diameter of the protruding elements (4) and/or recessed elements (4), preferably the blind holes, is at least 1.0 mm, is preferably at least 2.0 mm, is preferably at least 5.0 mm, is preferably at least 10.0 mm, is preferably at least 15.0 mm, is preferably at least 20.0 mm, is preferably at least 24.0 mm.

7. The trough (1) according to one of statements 1 to 6, wherein the diameter of the protruding elements (4) and/or the recessed elements (4) is at least 5.0% to at most 500.0%, preferably at least 10.0% to at most 400.0%, preferably at least 20.0% to at most 300.0%, preferably at least 30.0% to at most 250.0%, preferably at least 40.0% to at most 200.0%, preferably at least 50.0% to at most 150.0%, preferably at least 60.0% to at most 125.0%, of the thickness of the first heat-conducting plate (2).

8. The trough (1) according to one of statements 1 to 7, wherein the protruding elements (4) and/or recessed elements (4) are arranged in a pattern, preferably a repeating pattern.

9. The trough (1) according to one of statements 1 to 8, wherein the pattern is made up of rows of protruding elements and/or recessed elements, rows having a repeating distance (X) between two centres of successive elements of at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

10. The trough (1) according to one of statements 1 to 9, wherein the distance (Y) between the rows in the pattern is at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.

11. The trough (1) according to one of statements 1 to 10, wherein the bottom of the blind hole is flat.

12. The trough (1) according to one of statements 1 to 11, wherein the blind holes comprise a cylindrical part and

a conical part.

13. A method for producing a trough (1) according to one of statements 1 to 12, comprising the following steps:

- providing protruding elements and/or recessed elements (4) on one side of a first heat-conducting plate (2);
- welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with protruding elements and/or recessed elements (4) faces the second heat-conducting plate (3);
- deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
- optionally deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).

14. An ironing device comprising a trough (1) according to one of statements 1 to 12 and a cylindrical ironing roller (9).

15. A method for drying and/or ironing moist flat material using an ironing device according to statement 14 comprising the trough (1) according to one of statements 1 to 12, comprising the following steps:

- 1) heating the trough (1) by introducing a heated liquid or gas into the cavity (5) between both heat-conducting plates (2, 3);
- 2) rotating the cylindrical ironing roller (9) with respect to the trough (1);
- 3) introducing the flat material between the trough (1) and the cylindrical ironing roller (9) while the cylindrical ironing roller (9) is rotating with respect to the trough (1); and
- 4) optionally, pressing the trough (1) against the cylindrical ironing roller (9).

Example simulations:

[0100] In the following text, the effect of the protruding elements and/or recessed elements on the heat-conducting plate is demonstrated by means of simulations. Blind holes were used as recessed element in the simulations.

[0101] A first heat-conducting plate has a length of 2500 mm, a width of 995 mm and a thickness of 20 mm, and is made of steel. The first heat-conducting plate is curved such that the plate forms a part of the shell of a cylinder. The hollow side can function as part of the ironing bed, and a second heat-conducting plate which is also curved is welded to the convex side of the first heat-conducting plate, such that a cavity through which steam can flow at a pressure of between 7 and 12 bar is created between the first heat-conducting plate and the second heat-conducting plate.

[0102] The heat transfer of the first heat-conducting plate to the linen that is located on the hollow side of the first heat-conducting plate during ironing was simulated using ANSYS 2020 R1. In this case, the curve of the first heat-conducting plate was ignored because it has no or barely any effect on the heat transfer.

[0103] For the simulations of the heat transfer rate, the temperature T_{steam} on the convex side (the steam side) of the first heat-conducting plate was considered to be 187.96°C (which corresponds to steam at approximately 12 bar). The temperature T_{linen} of the first heat-conducting plate on the hollow side (linen side) depends on the heat transfer rate $\dot{Q}$ [W] and the thermal resistance of the first heat-conducting plate R [K/W] as illustrated in equation (1):

$$\dot{Q} = \frac{T_{\text{steam}} - T_{\text{linen}}}{R} \quad (1)$$

[0104] If blind holes are made in the convex side of the heat-conducting plate, the thermal resistance of the first heat-conducting plate will decrease because the contact surface between the steam and the first heat-conducting plate increases and the thickness of the plate decreases locally. If a constant temperature difference is applied over the plate, the heat transfer rate will only depend on the thermal resistance R , which is itself dependent on the geometry of the heat-conducting plate. Consequently, the relative increase of the heat transfer rate of the first heat-conducting plate with blind holes with respect to the first heat-conducting plate without blind holes is independent of the selected T_{linen} , see equation (2). Therefore, the influence of the textured surface of the first heat-conducting plate on the heat transfer rate is expressed herein as a relative increase with respect to the smooth surface of the first heat-conducting plate, see equation (2). For the simulations of the heat transfer rate, T_{linen} was selected to be equal to 80°C.

$$\dot{Q}_{rel} = \frac{\dot{Q}_2}{\dot{Q}_1} = \frac{\frac{\Delta T_2}{R_2}}{\frac{\Delta T_1}{R_1}} = \frac{R_1}{R_2} \quad (2)$$

1. Control experiment (no blind holes (non-textured surface))

1.1 Heat transfer rate with constant T_{linen}

[0105] For comparison purposes, simulation of a first heat-conducting plate without blind holes on the convex side was performed. Here, too, $T_{steam} = 187.96^\circ\text{C}$ and $T_{linen} = 80^\circ\text{C}$. In this case, the thermal resistance of the first heat-conducting plate (R) is 0.000494 K/W . It is with respect to this value of R that the improvements by the blind holes in the first heat-conducting plate are expressed.

1.2 Average linen temperature

[0106] In the foregoing, the heat transfer rate was simulated with respect to a selected $T_{linen} = 80^\circ\text{C}$. However, the actual average temperature of the linen can be calculated.

[0107] For this, the heat transfer rate of the trough to the linen should be calculated when the inlet temperature of the washed linen is 21°C and the temperature of the linen after ironing is 165°C . Such a heat transfer rate is the sum of the latent heat for evaporating the water in the linen, the heat required for heating the water in the linen from 21 to 100°C and the heat required for heating the linen itself from 21 to 165°C , which gives a heat transfer rate of 166.2 kW .

[0108] Using equation (1), the average T_{linen} can then be calculated, which is 106°C for the heat-conducting plate without blind holes, which is logically between the inlet temperature (21°C) and the outlet temperature (165°C).

2. First heat-conducting plate with blind holes: influence of the pattern

[0109] The convex side of the first heat-conducting plate is possibly provided with blind holes. In this simulation, the blind holes have a diameter of 13 mm and a depth of 6 mm . The blind holes are arranged in rows along the length direction of the first heat-conducting plate, having the distance X between the centres of two successive blind holes, and having the distance Y between two successive rows (distance between the axes), as indicated in Figure 7. No blind holes were provided over a distance of 50 mm from the edges of the first heat-conducting plate. The blind holes are considered to be cylinders in the simulations. Table 1 illustrates various values of X and Y that were used in the 3D heat transfer simulations. The results of the simulations are reported in Figure 4a and Figure 4b. Figure 4a illustrates the relative improvement in the heat transfer with respect to a first heat-conducting plate without blind holes, for various combinations of X and Y . Figure 4b illustrates the average temperature of the linen for various combinations of X and Y . It follows from the results that the smaller the distance between the blind holes, the higher the heat transfer rate and the higher the average linen temperature. However, an excessive number of blind holes has an adverse effect on the mechanical strength of the first heat-conducting plate.

distance X [mm]	distance Y [mm]	number of holes in 1 row (N_h)	number of rows (N_r)
30	40	79	44
40	30	59	59
30	50	79	35
50	30	47	59
40	50	59	35
50	40	47	44
30	30	79	59
40	40	59	44
50	50	47	35

3. First heat-conducting plate with blind holes: influence of the diameter of the blind holes

[0110] The influence of the diameter of the blind holes was simulated for three different patterns ($X = 30$ mm, $Y = 30$ mm), ($X = 30$ mm, $Y = 40$ mm) and ($X = 30$ mm, $Y = 50$ mm). In this case, the holes were considered to be cylinders, having a depth of 6 mm. The results of the simulations are reported in Figure 5a and Figure 5b. Figure 5a illustrates the relative improvement in the heat transfer with respect to a first heat-conducting plate without blind holes, for various diameters of the blind holes (13 to 24 mm). Figure 5b illustrates the average temperature of the linen for various diameters of the blind holes (13 to 24 mm). It follows from the results that the larger the diameter of the blind holes, the higher the heat transfer rate and the higher the average linen temperature. However, excessively large blind holes have an adverse effect on the mechanical strength of the first heat-conducting plate.

4. First heat-conducting plate with blind holes: influence of the depth of the blind holes

[0111] The influence of the depth of the blind holes was simulated for two different patterns ($X = 30$ mm, $Y = 30$ mm, with blind holes having a diameter of 13 mm) and ($X = 30$ mm, $Y = 50$ mm, with blind holes having a diameter of 24 mm). In this case, the holes are considered to be cylinders. The results of the simulations are reported in Figure 6a and Figure 6b. Figure 6a illustrates the relative improvement in the heat transfer with respect to a first heat-conducting plate without blind holes, for various depths of the blind holes (5 to 10 mm). Figure 6b illustrates the average temperature of the linen for various depths of the blind holes (5 to 10 mm). It follows from the results that the deeper the blind holes, the higher the heat transfer rate and the higher the average linen temperature. However, excessively deep blind holes have an adverse effect on the mechanical strength of the first heat-conducting plate.

5. Conclusion

[0112] The depth of the blind holes has the greatest influence on the heat transfer rate, and it is therefore recommended to use a depth of at least 10 mm. According to the simulation, an optimized first heat-conducting plate having a thickness of 20 mm and with cylindrical blind holes having a diameter of 20 mm and a depth of 10 mm and a pattern in which $X = 37.5$ mm and $Y = 39$ mm would afford a heat transfer rate that is 40% better than a first heat-conducting plate having a thickness of 20 mm without blind holes. The average linen temperature for the optimized first heat-conducting plate mentioned herein would be 129°C, which is 23°C hotter than for a first heat-conducting plate having a thickness of 20 mm without blind holes. This would correspond to an at least 10% increase in the capacity of the ironing device.

Claims

1. Trough (1) for an ironing device, comprising:

- a first heat-conducting plate (2); and
- a second heat-conducting plate (3),

wherein both heat-conducting plates (2, 3) are coupled to one another, preferably by means of weld spots (6) and/or weld seams (7), and

wherein the first heat-conducting plate (2) and/or the second heat-conducting plate (3) are/is deformed in such a way that a cavity (5) is provided between both plates (2, 3),

characterized in that

the surface of the first heat-conducting plate facing the cavity (5) is convex; and is provided with recessed elements (4), wherein the recessed elements (4) are blind holes.

2. Trough (1) according to Claim 1, wherein the first heat-conducting plate (2) has a thickness of at least 10.0 mm to at most 50.0 mm, preferably at least 12.0 mm to at most 40.0 mm, preferably at least 14.0 mm to at most 35.0 mm, preferably at least 16.0 mm to at most 32.0 mm, preferably at least 18.0 mm to at most 30.0 mm, preferably at least 20.0 mm to at most 28.0 mm, preferably at least 24.0 mm to at most 25.0 mm.

3. Trough (1) according to Claim 1 or 2, wherein the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 1.0 mm to at most 12.0 mm, is preferably at least 2.0 mm to at most 10.0 mm, is preferably at least 3.0 mm to at most 10.0 mm, is preferably at least 5.0 mm to at most 10.0 mm, is preferably at least 7.0 mm to at most 10.0 mm, is preferably at least 9.0 mm to at most 10.0 mm.

4. Trough (1) according to one of Claims 1 to 3, wherein the depth of the recessed elements (4) with respect to the surface of the first heat-conducting plate (2) facing the cavity (5) is at least 5.0% to at most 90.0%, preferably at least 10.0% to at most 80.0%, preferably at least 15.0% to at most 70.0%, preferably at least 20.0% to at most 60.0%, preferably at least 25.0% to at most 55.0%, preferably at least 30.0% to at most 50.0%, preferably at least 35.0% to at most 45.0%, of the thickness of the first heat-conducting plate (2).
5. Trough (1) according to one of Claims 1 to 4, wherein the diameter of the recessed elements (4), preferably the blind holes, is at least 1.0 mm, is preferably at least 2.0 mm, is preferably at least 5.0 mm, is preferably at least 10.0 mm, is preferably at least 15.0 mm, is preferably at least 20.0 mm, is preferably at least 24.0 mm.
6. Trough (1) according to one of Claims 1 to 5, wherein the diameter of the recessed elements (4) is at least 5.0% to at most 500.0%, preferably at least 10.0% to at most 400.0%, preferably at least 20.0% to at most 300.0%, preferably at least 30.0% to at most 250.0%, preferably at least 40.0% to at most 200.0%, preferably at least 50.0% to at most 150.0%, preferably at least 60.0% to at most 125.0%, of the thickness of the first heat-conducting plate (2).
7. Trough (1) according to one of Claims 1 to 6, wherein the recessed elements (4) are arranged in a pattern, preferably a repeating pattern.
8. Trough (1) according to Claim 7, wherein the pattern is made up of rows of recessed elements, rows having a repeating distance (X) between two centres of successive elements of at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.
9. Trough (1) according to Claim 8, wherein the distance (Y) between the rows in the pattern is at most 100.0 mm, preferably at most 90.0 mm, preferably at most 80.0 mm, preferably at most 70.0 mm, preferably at most 60.0 mm, preferably at most 50.0 mm, preferably at most 45.0 mm, preferably at most 40.0 mm, preferably at most 35.0 mm, preferably at most 30.0 mm.
10. Trough (1) according to one of Claims 1 to 9, wherein the bottom of the blind hole is flat.
11. Trough (1) according to one of Claims 1 to 10, wherein the blind holes comprise a cylindrical part and a conical part.
12. Method for producing a trough (1) according to one of Claims 1 to 11, comprising the following steps:
 - providing recessed elements (4) on one side of a first heat-conducting plate (2), wherein the recessed elements are blind holes;
 - welding together the first heat-conducting plate (2) and a second heat-conducting plate (3) by means of a laser technique, wherein that side of the first heat-conducting plate (2) which is provided with recessed elements (4) faces the second heat-conducting plate (3);
 - deforming the first heat-conducting plate (2) and the second heat-conducting plate (3) in order to form a trough (1) of the desired radius; and
 - deforming the first heat-conducting plate (2) by injecting a pressurized liquid or gas between the heat-conducting plates (2, 3), as a result of which a cavity (5) is formed between both heat-conducting plates (2, 3), but in which case both heat-conducting plates (2, 3) remain connected by means of the weld spots (6) and/or the weld seams (7).
13. Ironing device comprising a trough (1) according to one of Claims 1 to 11 and a cylindrical ironing roller (9).
14. Method for drying and/or ironing moist flat material using an ironing device according to Claim 14 comprising the trough (1) according to one of Claims 1 to 11, comprising the following steps:
 - 1) heating the trough (1) by introducing a heated liquid or gas into the cavity (5) between both heat-conducting plates (2, 3);
 - 2) rotating the cylindrical ironing roller (9) with respect to the trough (1);
 - 3) introducing the flat material between the trough (1) and the cylindrical ironing roller (9) while the cylindrical ironing roller (9) is rotating with respect to the trough (1); and
 - 4) optionally, pressing the trough (1) against the cylindrical ironing roller (9).

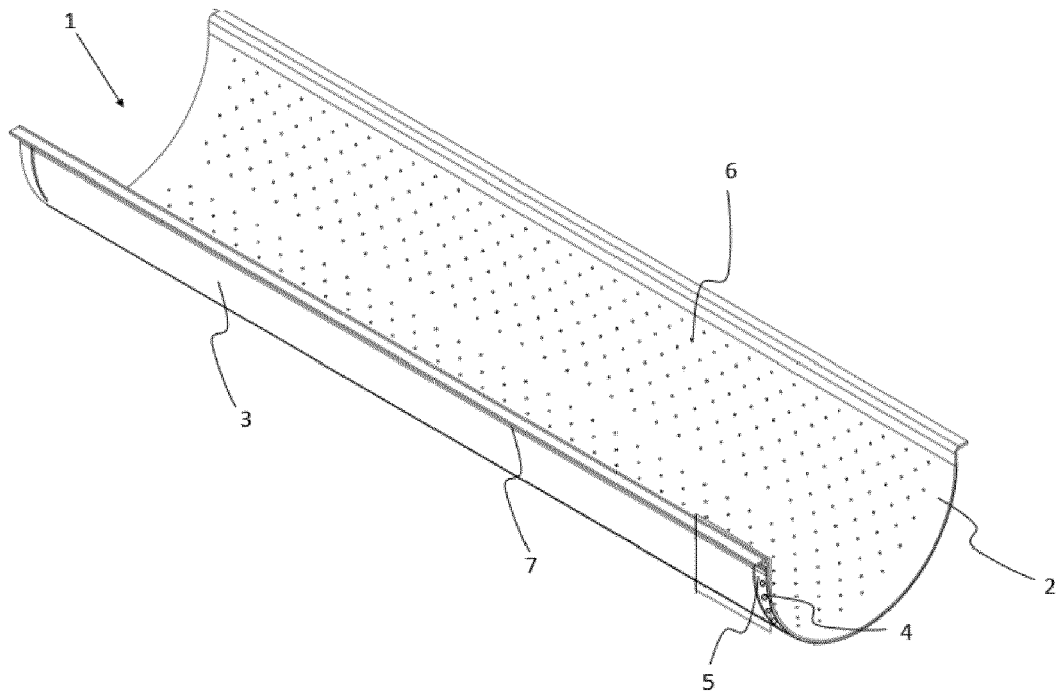


Fig. 1A

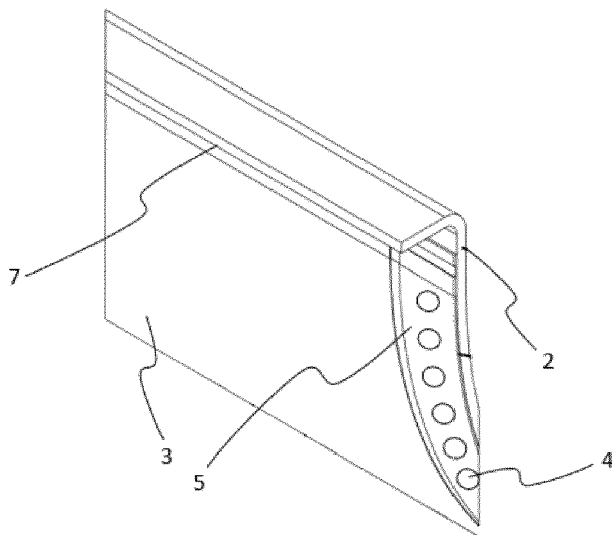


Fig.1B

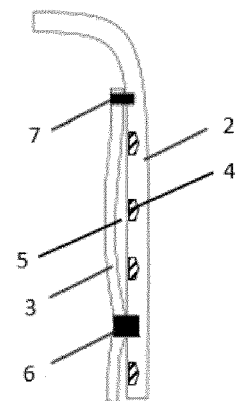
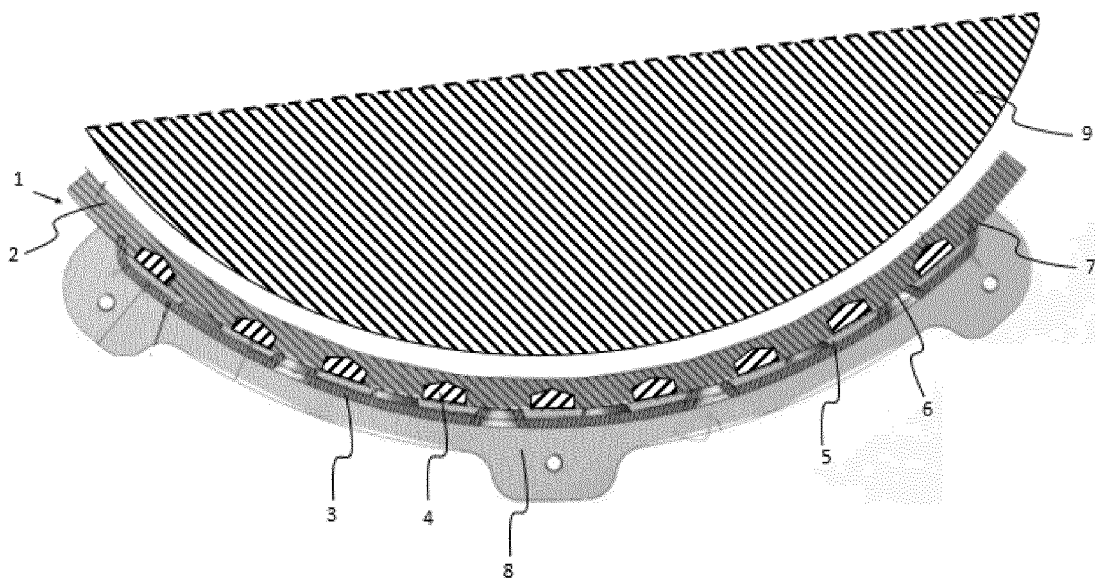
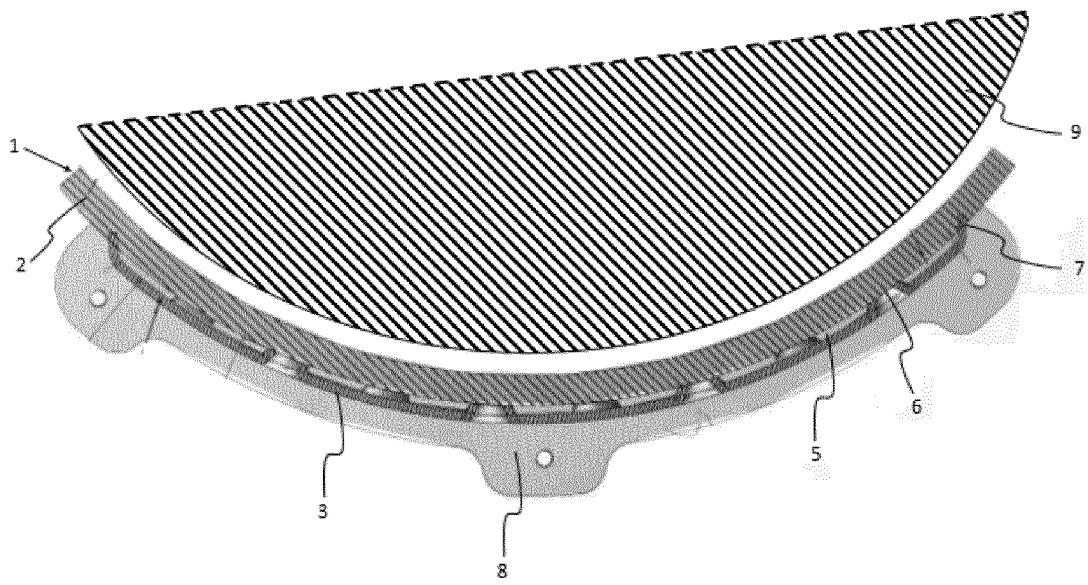


Fig. 1C



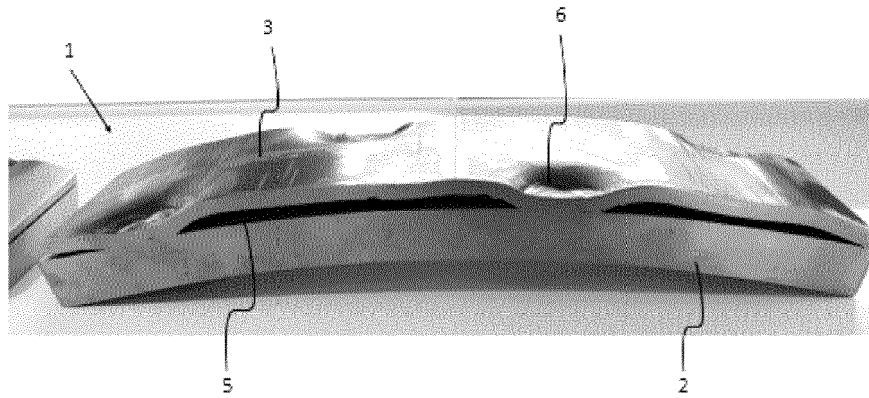


Fig. 3A: PRIOR ART

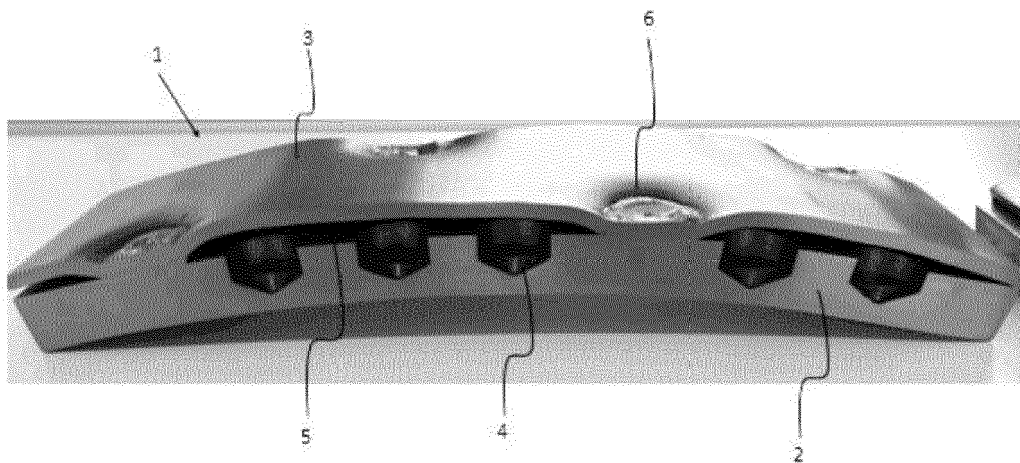


Fig. 3B

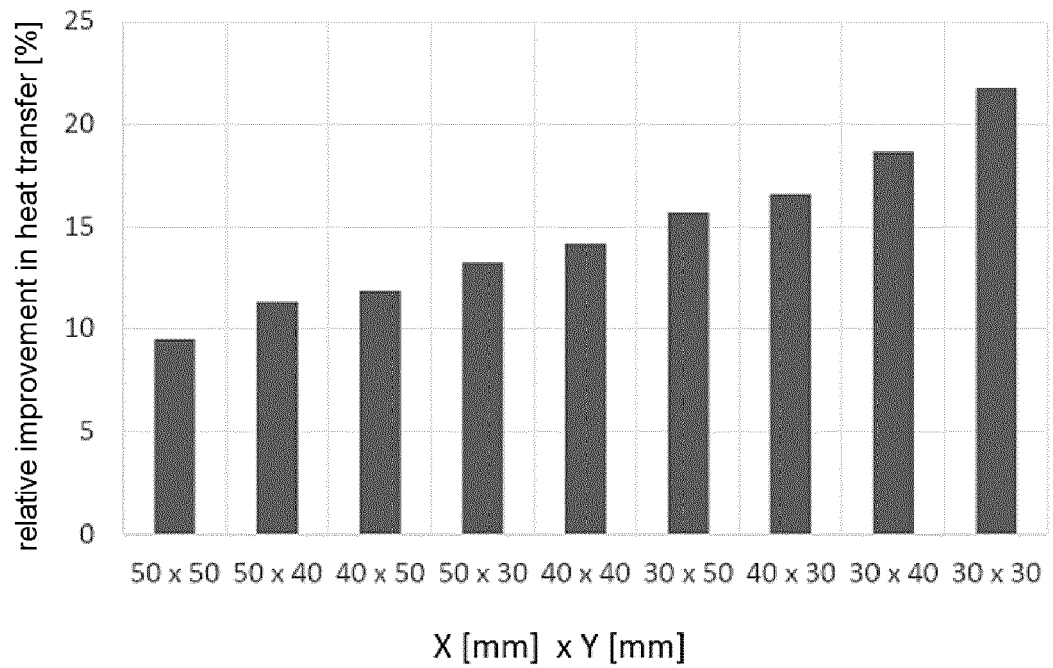


Fig. 4A

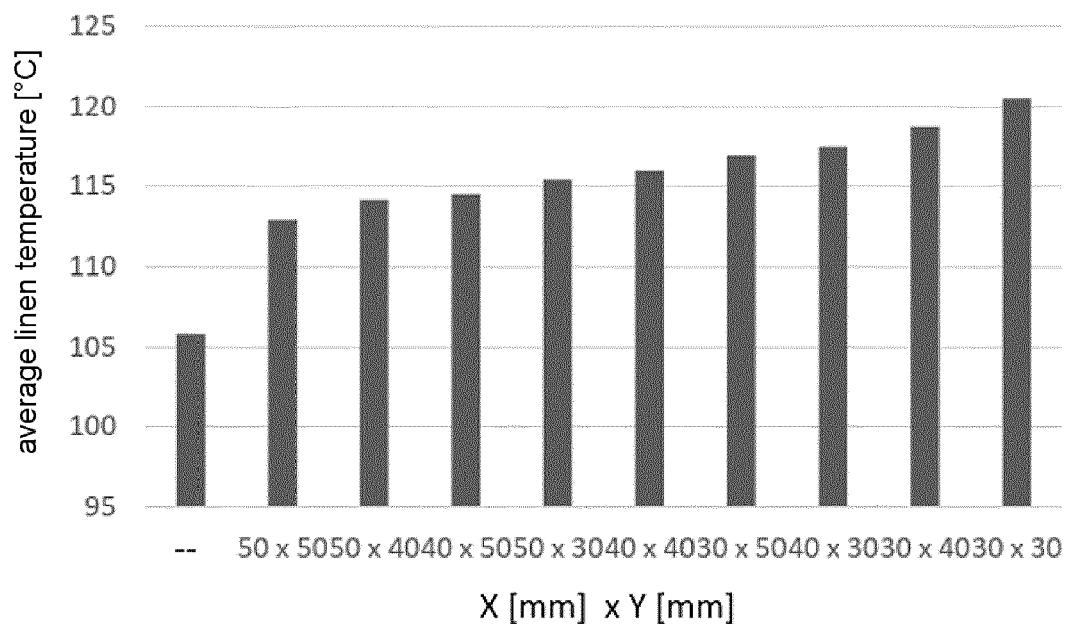


Fig. 4B

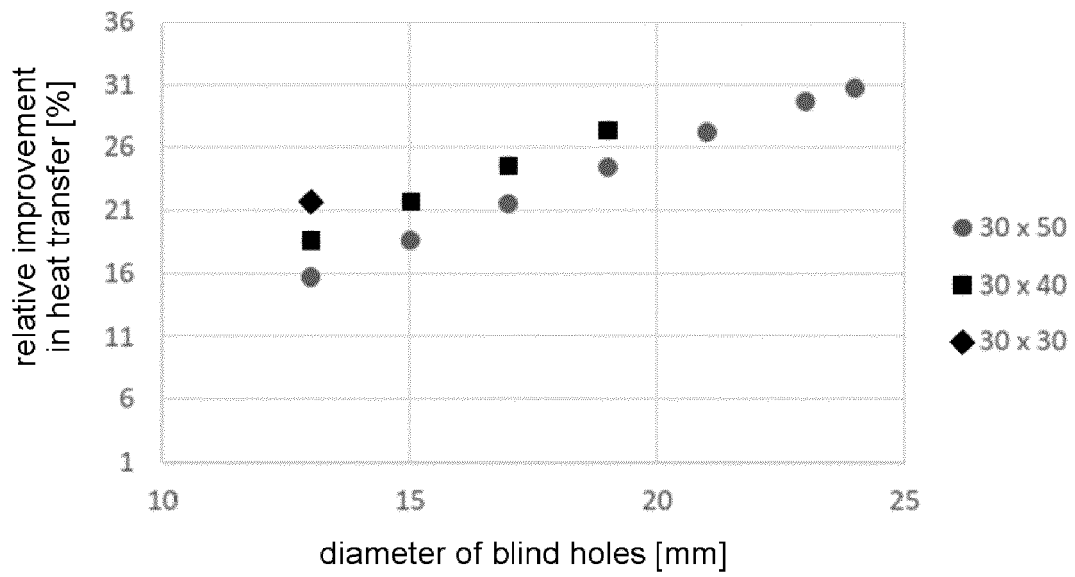


Fig. 5A

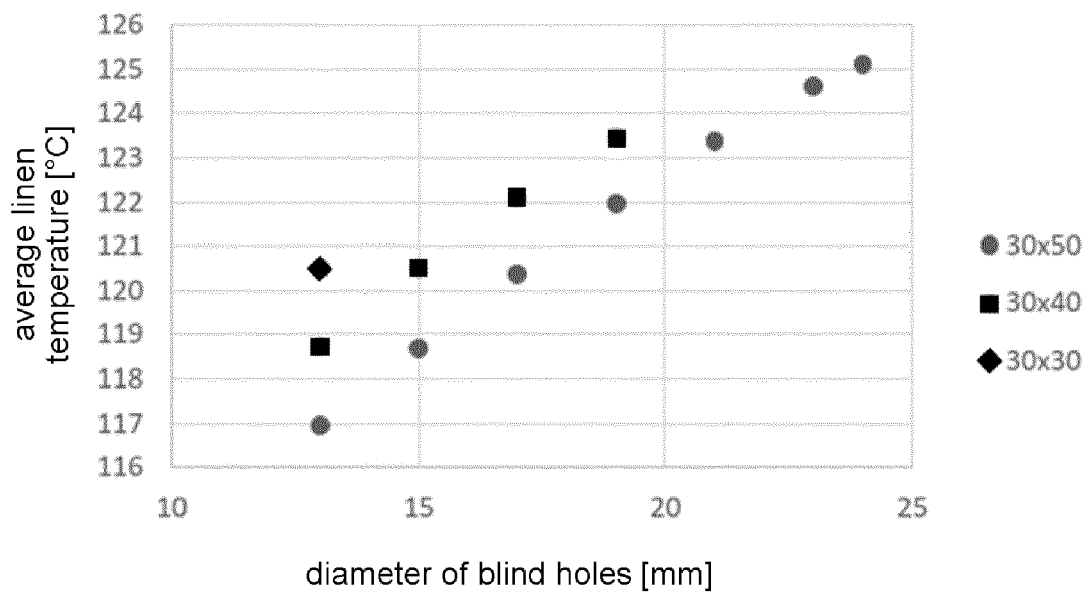


Fig. 5B

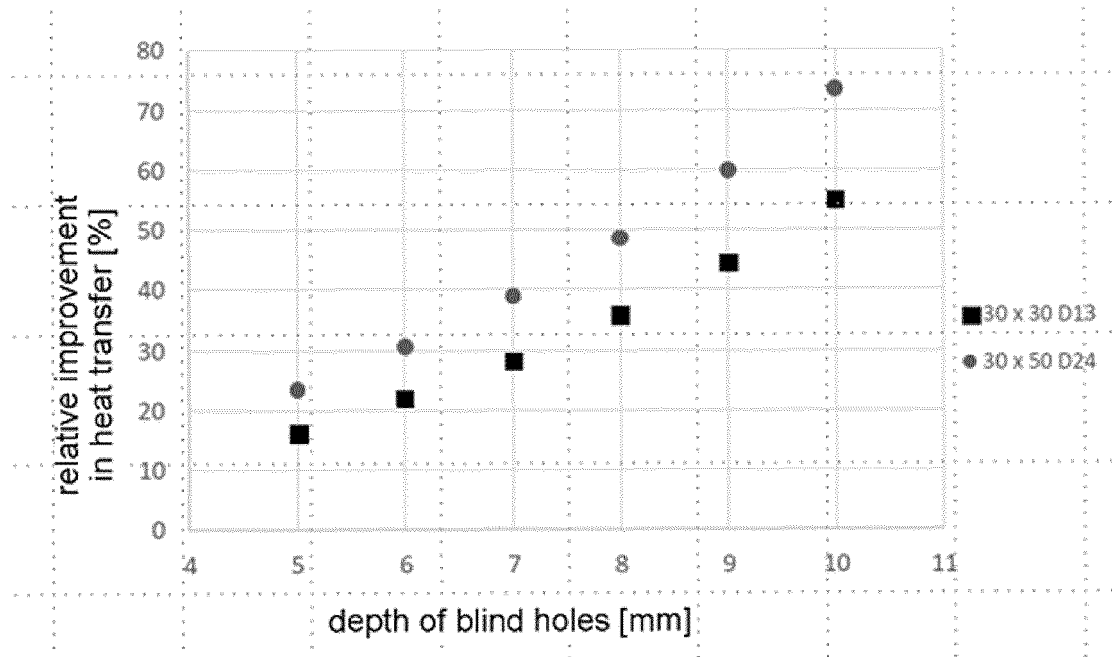


Fig. 6A

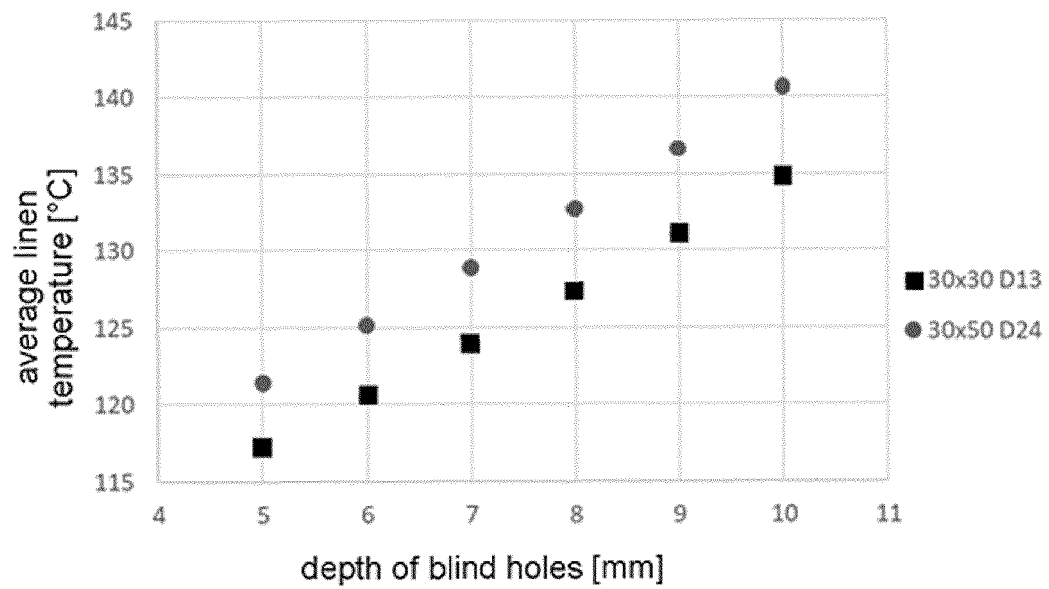


Fig. 6B

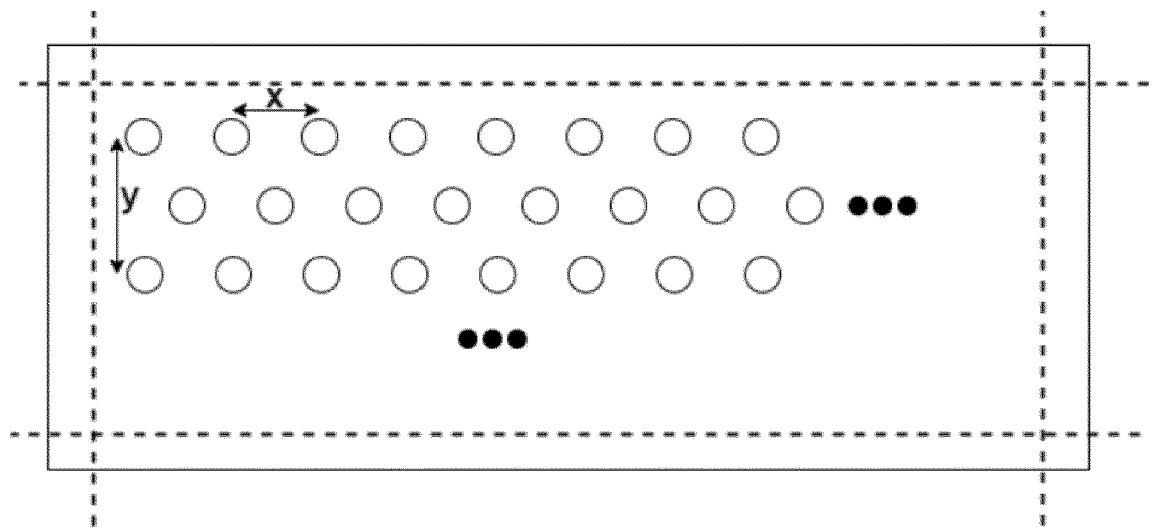


Fig. 7



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 9506

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EPO FORM 1503 03.82 (P04C01)

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A	EP 2 628 847 A1 (LACO MACHINERY NV [BE]) 21 August 2013 (2013-08-21) * figures 1-2 * * paragraph [0001] * * paragraph [0005] - paragraph [0008] * * claims 8-12 * -----	1-14	INV. D06F67/08 ADD. D06F65/02
A	GB 225 699 A (EUSTACE ALEXANDER ALLIOTT; MANLOVE ALLIOTT & CO LTD) 11 December 1924 (1924-12-11) * figure 5 * * claim 1 * -----	1-14	
A	US 2017/121901 A1 (D'HEYGERE PHILIPPE [BE] ET AL) 4 May 2017 (2017-05-04) * figure 1 * * paragraph [0021] * -----	1-14	
			TECHNICAL FIELDS SEARCHED (IPC) D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 November 2022	Examiner Werner, Christopher
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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