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(54) **Device and method for thermal printing on a target**

(57) Provided is a heating member that is a multi-zone and/or a resilient heating member. The heating member is part of a thermal transfer printing device or it may be designed to be included into a thermal transfer printing device. In use the heating member is allowed to contact target matter and/or a source of matter to be

transferred to the target matter. Each heating zone of the multi-zone heating member is allowed to independently transfer a preselected thermal energy to contacted target matter. The resilient heating member is allowed to conformably contact target matter and/or a source of matter to be transferred to the target matter.

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Description

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to the thermal transfer of matter onto a target material. In particular, devices and methods are disclosed for thermal transfer printing.

BACKGROUND

[0002] The following discussion of the background of the disclosure is merely provided to aid the reader in understanding the invention and is not admitted to describe or constitute prior art to the present invention.

[0003] Printing graphics or text onto a target, in particular clothing such as T-shirts, is typically performed in the art using a hot-pressing process, in which the target to be printed on is positioned onto a base plate. The thermal transfer process employed is used since about 1970. As a typical example of printing on fabric, a donor film such as a foil or a paper, which includes a pigmented layer, is placed on the area of the textile to be printed on, and a top plate is placed onto the donor film. Generally the fabric is thereby sandwiched between the base and the top. The top plate generally includes a heating device to generate the desired temperature of the hot-pressing process. The pigments of the pigmented layer are then transferred onto the fabric by means of pressure between the top and the base plate at elevated temperature. In order to fix the pigments on the fabric generally a hot-melt adhesive is used, which may be included in the donor film.

[0004] Often target material includes surface irregularities, such as seams, button borders or zippers of clothes. Target material may also have areas that differ in their surface material, or different matter may be desired to be transferred to different areas of the target material. Plastic as a further example of target material may also have an uneven shape or contain surface elements. In case of an uneven surface, to allow even pressure and contact during the hot-pressing process the target material fabric needs to be arranged into a position where no irregularities are being sandwiched, or alternatively adapting means need to be included in order to compensate the surface irregularities of the textile. In case of different surface material present, a compromise may have to be found in terms of thermal transfer conditions, which are suitable for all surface materials present.

[0005] International patent application WO 2014/082133 relates to a method of printing onto a textile material that has loose fibres on at least one surface. The method involves preshrinking the textile material in a thermal press and transferring an image onto the preshrunk textile material.

SUMMARY OF THE DISCLOSURE

[0006] Provided herein are means, devices and methods that can be used for thermally transferring matter onto a target material. A method, use or device as described herein allows in some embodiments selecting individual temperature conditions for individual areas of target material. In some embodiments a method, use or device as described herein allows thermally transferring matter onto a target material that contains surface irregularities and/or uneven surface portions. In some embodiments a method, use or device as described herein allows both selecting individual temperature conditions for individual areas of target material and thermally transferring matter onto a target with contains surface irregularities and/or uneven surface portions.

[0007] In a first aspect there is provided a thermal transfer printing device. The thermal transfer printing device includes a base, a top and a multi-zone heating member. The base is adapted to support target matter positioned thereon. The multi-zone heating member is in some embodiments adapted to contact target matter. In some embodiments the multi-zone heating member is adapted to contact a source of matter to be transferred. In use this source of matter to be transferred may be positioned adjacent to the target matter. The multi-zone heating member is in some embodiments adapted to contact both target matter and the source of matter to be transferred. Furthermore the multi-zone heating member is adapted to transfer thermal energy to contacted matter such as target matter. The multi-zone heating member includes a plurality of heating zones. At least one heating zone of the plurality of heating zones is adapted to be capable of transferring a particular magnitude of thermal energy to contacted target matter. In some embodiments the heating zones is adapted to be capable of transferring a preselected magnitude of thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to be capable of transferring a particular magnitude of thermal energy to contacted target matter. The top of the thermal transfer printing device is moveable between an idle position and a press position. In the press position the multi-zone heating member is sandwiched between the base and the top.

[0008] In some embodiments at least one heating zone of the multi-zone heating member of the thermal transfer printing device according to the first aspect is adapted to be capable of providing a particular temperature to a region of matter contacted therewith. In some embodiments the heating zone is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith. In some embodiments each heating zone of the multi-zone heating member of the thermal transfer printing device according to the first aspect is adapted to be capable of providing a particular temperature to a region of matter contacted therewith.

[0009] In some embodiments the multi-zone heating member of the thermal transfer printing device according

to the first aspect is in communication with the top. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is connected to the top. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is in communication with the base. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is connected to the base.

[0010] In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is removably connected to the top. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is removably connected to the base. In some embodiments of the thermal transfer printing device according to the first aspect the target matter is a textile material. In some embodiments the target matter essentially consists of a textile material. In some embodiments the target matter includes a textile material.

[0011] In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect includes from about 2 to about 20 heating zones. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect includes from about 2 to about 16 heating zones.

[0012] In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect is resilient. Such a resilient multi-zone heating member may be adapted to conformably contact the target matter. A respective resilient multi-zone heating member may be adapted to conformably contact the source of matter to be transferred. A resilient multi-zone heating member is in some embodiments adapted to conformably contact both target matter and the source of matter to be transferred. In some embodiments a multi-zone heating member is inflatable. A resilient multi-zone heating member may for example be inflatable.

[0013] In some embodiments a portion of a resilient multi-zone heating member includes a circumferential elastic cover. In some embodiments an entire resilient multi-zone heating member includes a circumferential elastic cover. A respective elastic cover may be a flexible cover. Such an elastic cover may include a circumferential elastic membrane. A respective elastic cover may essentially consist of a circumferential elastic membrane. In some embodiments the elastic cover may be a circumferential elastic membrane.

[0014] In typical embodiments the top of the thermal transfer printing device according to the first aspect is coupled to the base. In some embodiments the top of the thermal transfer printing device according to the first aspect is pivotally connected to the base. In some embodiments the base of the thermal transfer printing device according to the first aspect is moveable relative to the top. In some embodiments the top of the thermal transfer printing device is pivotally connected to a body. In such

embodiments the base is generally in communication with the respective body. The base may in some embodiments be connected to the respective body. In some embodiments the base is slidably connected to the body.

[0015] In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect includes a heating element. This heating element is capable of transmitting thermal energy. In some embodiments the heating element of the multi-zone heating member contains one or more carbon fibers.

[0016] In a second aspect there is provided a thermal transfer printing device. The thermal transfer printing device includes a base, a top and a resilient heating member. The base is adapted to support target matter positioned thereon. This resilient heating member is in some embodiments adapted to contact target matter. A respective resilient heating member may be adapted to conformably contact the source of matter to be transferred.

A resilient heating member is in some embodiments adapted to conformably contact both target matter and the source of matter to be transferred. In use the source of matter to be transferred may be positioned adjacent to the target matter. Furthermore the resilient heating member is adapted to transfer thermal energy to contacted matter such as target matter. The top of the thermal transfer printing device is moveable between an idle position and a press position. In the press position the resilient heating member is sandwiched between the base and the top. The resilient heating member is in some embodiments inflatable.

[0017] In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is in communication with the top.

In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is connected to the top. In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is in communication with the base. In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is connected to the base.

[0018] In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is removably connected to the top. In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect is removably connected to the base. In some embodiments of the thermal transfer printing device according to the second aspect the target matter is a textile material. In some embodiments the target matter essentially consists of a textile material. In some embodiments the target matter includes a textile material.

[0019] In typical embodiments the top of the thermal transfer printing device according to the second aspect is coupled to the base. In some embodiments the top of the thermal transfer printing device according to the second aspect is pivotally connected to the base. In some

embodiments the base of the thermal transfer printing device according to the second aspect is moveable. In some embodiments the top of the thermal transfer printing device is pivotally connected to a body. In such embodiments the base is generally in communication with the respective body. The base may in some embodiments be connected to the respective body. In some embodiments the base is slidably connected to the body.

[0020] In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect includes a heating zone. The heating zone is adapted to transfer a particular magnitude of thermal energy to contacted target matter. In some embodiments the heating zones is adapted to transfer a preselected magnitude of thermal energy to contacted target matter. In some embodiments the heating zone of the resilient heating member is adapted to be capable of providing a particular temperature to a region of matter contacted therewith. In some embodiments the heating zone of the resilient heating member is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith.

[0021] In some embodiments the resilient heating member contains a plurality of heating zones. At least one heating zone of the plurality of heating zones may be adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments at least one heating zone of the plurality of heating zones is adapted to independently transfer a preselected thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones may be adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith.

[0022] A respective resilient heating member with a plurality of heating zones may in some embodiments include from about 2 to about 20 heating zones. In some embodiments the resilient heating member with a plurality of heating zones includes from about 2 to about 15 heating zones.

[0023] In some embodiments a portion of a resilient heating member of the thermal transfer printing device according to the second aspect includes a circumferential elastic cover. In some embodiments an entire resilient heating member includes a circumferential elastic cover. A respective elastic cover may be a flexible cover. Such an elastic cover may include a circumferential elastic membrane. A respective elastic cover may essentially consist of a circumferential elastic membrane. In some embodiments the elastic cover may be a circumferential elastic membrane.

[0024] In some embodiments the resilient heating member of the thermal transfer printing device according to the second aspect includes a heating element. This heating element is capable of transmitting thermal energy. In some embodiments the heating element of the re-

silient heating member contains one or more carbon fibers.

[0025] In a third aspect there is provided a multi-zone heating member, which can be used in heat-transfer printing. The multi-zone heating member includes a plurality of heating zones. At least one heating zone of the plurality of heating zones is adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments at least one heating zone of the plurality of heating zones is adapted to independently transfer a preselected thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to independently transfer a preselected thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to independently provide a particular temperature to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to independently provide a preselected temperature to contacted target matter.

[0026] The multi-zone heating member may be adapted to contact matter such as target matter. The multi-zone heating member may also be adapted to contact a source of matter which is to be transferred to the target matter. In some embodiments the multi-zone heating member is adapted to contact both target matter and a source of matter to be transferred to the target matter. In use the source of matter to be transferred to the target matter may be positioned adjacent to the target matter.

[0027] In some embodiments at least one heating zone of the multi-zone heating member according to the third aspect is adapted to be capable of providing a particular temperature to a region of matter contacted therewith. In some embodiments at least one heating zone of the multi-zone heating member according to the third aspect is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith. In some embodiments each heating zone of the multi-zone heating member according to the third aspect is adapted to be capable of providing a particular temperature to a region of matter contacted therewith. In some embodiments each heating zone of the multi-zone heating member according to the third aspect is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith.

[0028] In some embodiments the multi-zone heating member according to the third aspect includes from about 2 to about 20 heating zones. In some embodiments the multi-zone heating member includes from about 2 to about 16 heating zones.

[0029] In some embodiments the multi-zone heating member according to the third aspect includes means to allow communication with a top of a thermal transfer printing device. In some embodiments the multi-zone heating

member according to the third aspect includes means to allow connectivity to a top of a thermal transfer printing device. In some embodiments the multi-zone heating member according to the third aspect includes means to allow communication with a base of a thermal transfer printing device. In some embodiments the multi-zone heating member according to the third aspect includes means to allow connectivity to a base of a thermal transfer printing device.

[0030] In some embodiments the multi-zone heating member according to the third aspect includes means to allow removable connectivity to a top of a thermal transfer printing device. In some embodiments the multi-zone heating member according to the third aspect includes means to allow removable connectivity to a base of a thermal transfer printing device. In some embodiments of the multi-zone heating member according to the third aspect the target matter is a textile material. In some embodiments the target matter essentially consists of a textile material. In some embodiments the target matter includes a textile material.

[0031] In some embodiments the multi-zone heating member according to the third aspect includes from about 2 to about 20 heating zones. In some embodiments the multi-zone heating member according to the third aspect includes from about 2 to about 16 heating zones.

[0032] In some embodiments the multi-zone heating member according to the third aspect is resilient. Such a resilient multi-zone heating member may be adapted to conformably contact target matter. A respective resilient multi-zone heating member may be adapted to conformably contact the source of matter to be transferred. A resilient multi-zone heating member is in some embodiments adapted to conformably contact both target matter and the source of matter to be transferred. In some embodiments a portion of a resilient multi-zone heating member includes a circumferential elastic cover. In some embodiments an entire resilient multi-zone heating member includes a circumferential elastic cover. A respective elastic cover may be a flexible cover. Such an elastic cover may include a circumferential elastic membrane. A respective elastic cover may essentially consist of a circumferential elastic membrane. In some embodiments the elastic cover may be a circumferential elastic membrane. A resilient multi-zone heating member according to the third aspect is in some embodiments inflatable.

[0033] In some embodiments the multi-zone heating member according to the third aspect includes a heating element. This heating element is capable of transmitting thermal energy. In some embodiments the heating element of the multi-zone heating member contains one or more carbon fibers.

[0034] In some embodiments the multi-zone heating member according to the third aspect is for incorporation into a thermal transfer printing device, to provide a thermal transfer printing device according to the first aspect.

[0035] In a fourth aspect there is provided the use of a multi-zone heating member in heat-transfer printing.

The multi-zone heating member includes a plurality of heating zones. At least one heating zone of the plurality of heating zones is allowed to independently transfer a particular thermal energy to contacted target matter. In some embodiments at least one heating zone of the plurality of heating zones is allowed to independently transfer a preselected thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is allowed to independently transfer a particular thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is allowed to independently transfer a preselected thermal energy to contacted target matter. The multi-zone heating member may be allowed to contact target matter. The multi-zone heating member may also be allowed to contact a source of matter which is to be transferred to the target matter. In some embodiments the multi-zone heating member is allowed to contact both target matter and a source of matter to be transferred to the target matter. The source of matter to be transferred to the target matter may be positioned adjacent to the target matter.

[0036] In some embodiments at least one heating zone of the multi-zone heating member of the use according to the fourth aspect is adapted to be capable of providing a particular and/or preselected temperature to a region of matter contacted therewith. In some embodiments each heating zone of the multi-zone heating member of the use according to the fourth aspect is adapted to be capable of providing a particular temperature to a region of matter contacted therewith. In some embodiments each heating zone of the multi-zone heating member of the use according to the fourth aspect is adapted to be capable of providing a preselected temperature to a region of matter contacted therewith.

[0037] In some embodiments the multi-zone heating member of the use according to the fourth aspect includes from about 2 to about 20 heating zones. In some embodiments the multi-zone heating member of the use according to the fourth aspect includes from about 2 to about 16 heating zones.

[0038] In a fifth aspect there is provided a resilient heating member, which can be used in heat-transfer printing. The resilient heating member is adapted to conformably contact target matter and/or a source of matter to be transferred to the target matter. Thus in some embodiments the resilient heating member is adapted to conformably contact target matter. In some embodiments the resilient heating member is adapted to conformably contact the source of matter to be transferred. In some embodiments the resilient heating member is adapted to conformably contact both target matter and the source of matter to be transferred to the target matter. The source of matter to be transferred to the target matter may be positioned adjacent to the target matter. The resilient heating member is adapted to transfer thermal energy to contacted target matter. In some embodiments the resilient heating member according to the fifth aspect

is inflatable.

[0039] In some embodiments the resilient heating member according to the fifth aspect includes means to allow communication with a top of a thermal transfer printing device. In some embodiments the resilient heating member according to the fifth aspect includes means to allow connectivity to a top of a thermal transfer printing device. In some embodiments the resilient heating member according to the fifth aspect includes means to allow communication with a base of a thermal transfer printing device. In some embodiments the resilient heating member according to the fifth aspect includes means to allow connectivity to a base of a thermal transfer printing device.

[0040] In some embodiments the resilient heating member according to the fifth aspect includes means to allow removable connectivity to a top of a thermal transfer printing device. In some embodiments the resilient heating member according to the fifth aspect includes means to allow removable connectivity to a base of a thermal transfer printing device. In some embodiments of the resilient heating member according to the fifth aspect the target matter is a textile material. In some embodiments the target matter essentially consists of a textile material. In some embodiments the target matter includes a textile material.

[0041] In some embodiments the resilient heating member according to the fifth aspect includes a heating zone. The heating zone is adapted to transfer a particular magnitude of thermal energy to contacted target matter. In some embodiments the heating zone of the resilient heating member is adapted to transfer a preselected magnitude of thermal energy to contacted target matter. In some embodiments the heating zone of the resilient heating member is adapted to be capable of providing a particular and/or a preselected temperature to a region of matter contacted therewith. In some embodiments the resilient heating member contains a plurality of heating zones. At least one heating zone of the plurality of heating zones may be adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments at least one heating zone may be adapted to independently transfer a preselected thermal energy to contacted target matter.

[0042] In some embodiments at least one heating zone of the plurality of heating zones is adapted to be capable of providing a particular and/or preselected temperature to a region of matter contacted therewith. In some embodiments each heating zone of the plurality of heating zones may be adapted to independently transfer a particular thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones may be adapted to independently transfer a preselected thermal energy to contacted target matter. In some embodiments each heating zone of the plurality of heating zones is adapted to be capable of providing a particular and/or preselected temperature to a region of matter contacted therewith.

[0043] A respective resilient heating member with a plurality of heating zones may in some embodiments include from about 2 to about 20 heating zones. In some embodiments the resilient heating member with a plurality of heating zones includes from about 2 to about 16 heating zones.

[0044] In some embodiments a portion of a resilient heating member according to the fifth aspect includes a circumferential elastic cover. In some embodiments an entire resilient heating member includes a circumferential elastic cover. A respective elastic cover may be a flexible cover. Such an elastic cover may include a circumferential elastic membrane. A respective elastic cover may essentially consist of a circumferential elastic membrane. In some embodiments the elastic cover may be a circumferential elastic membrane.

[0045] In some embodiments the resilient heating member according to the fifth aspect includes a heating element. This heating element is capable of transmitting thermal energy. In some embodiments the heating element of the resilient heating member contains one or more carbon fibers.

[0046] In some embodiments the resilient heating member according to the third aspect is for incorporation into a thermal transfer printing device, to provide a thermal transfer printing device according to the second aspect.

[0047] In a sixth aspect there is provided the use of a resilient heating member in heat-transfer printing. The resilient heating member is allowed to conformably contact target matter and/or a source of matter to be transferred to the target matter. Thus in some embodiments the resilient heating member is allowed to conformably contact target matter. In some embodiments the resilient heating member is allowed to conformably contact the source of matter to be transferred. In some embodiments the resilient heating member is allowed to conformably contact both target matter and the source of matter to be transferred to the target matter. The source of matter to be transferred to the target matter may be positioned adjacent to the target matter. The resilient heating member is allowed to transfer thermal energy to contacted target matter. In some embodiments the resilient heating member of the use according to the sixth aspect is inflatable.

[0048] In a seventh aspect there is provided a method of thermally transferring matter onto a target material. The method includes positioning the target material onto a base. The method also includes positioning a source of the matter to be transferred to the target material onto the base. The base includes a heating member. The heating member is in some embodiments a multi-zone heating member. The multi-zone heating member includes a plurality of heating zones. Each heating zone is adapted to independently transfer a particular thermal energy to the target material. In some embodiments each heating zone is adapted to independently transfer a preselected thermal energy to the target material. In some embodi-

ments the heating member is a resilient heating member. In some embodiments the heating member is an inflatable heating member. In some embodiments a resilient heating member is an inflatable heating member.

[0049] The resilient heating member is allowed to conformably contact the target material. In some embodiments the heating member is a resilient multi-zone heating member. The method further includes positioning a top onto the source of matter to be transferred and the target material. As a result the target material is allowed to be sandwiched between the top and the base. The heating member provides communication with the base. The method also includes applying thermal energy to the target material via the heating member. Where a multi-zone heating member is employed, at least one heating zone of the multi-zone heating member is allowed to transfer a particular thermal energy to the target matter. In some embodiments at least one heating zone of the multi-zone heating member is allowed to transfer a preselected thermal energy to the target matter. In some embodiments each heating zone of a multi-zone heating member is allowed to independently transfer a preselected thermal energy to the target matter. Furthermore the method includes applying pressure to the target material.

[0050] In some embodiments of the method according to the seventh aspect where a multi-zone heating member is employed, at least one heating zone of the multi-zone heating member is allowed to provide a particular temperature to a region of the target matter. In some embodiments at least one heating zone of the multi-zone heating member is allowed to provide a preselected temperature to a region of the target matter. In some embodiments each heating zone of a multi-zone heating member is allowed to independently provide a particular and/or a preselected temperature to a region of the target matter.

[0051] In some embodiments of the method according to the seventh aspect where a multi-zone heating member is employed, at least one heating zone of the multi-zone heating member corresponds to a portion of the target matter. In some embodiments each heating zone of a multi-zone heating member corresponds to a portion of the target matter.

[0052] If in a method according to the seventh aspect a multi-zone heating member is employed, this multi-zone heating member may in some embodiments include from about 2 to about 20 heating zones. In some embodiments a multi-zone heating member used in a method according to the seventh aspect includes from about 2 to about 16 heating zones.

[0053] In some embodiments of the method according to the seventh aspect, where thermal energy is applied to the target matter via the multi-zone heating member, applying thermal energy includes applying thermal energy of independently selected magnitude via each heating zone of a multi-zone heating member.

[0054] In some embodiments of the method according to the seventh aspect applying thermal energy to the tar-

get matter comprises exposing at least a portion of the target matter to a particular constant elevated temperature. In some embodiments applying thermal energy to the target matter comprises exposing at least a portion of the target matter to a preselected constant elevated temperature.

[0055] In some embodiments of the method according to the seventh aspect where a resilient heating member is employed, applying pressure to the target material comprises allowing a fluid to enter the resilient heating member.

[0056] In an eighth aspect there is provided a method of thermally transferring matter onto a target material. The method includes positioning the target material onto a base. The method also includes positioning a source of the matter to be transferred to the target material onto the base. The method also includes positioning a top onto the target material and onto the source of matter to be transferred to the target material. Furthermore the method includes positioning a heating member onto the target material and onto the source of matter to be transferred to the target material. The heating member is in some embodiments a multi-zone heating member. The multi-zone heating member includes a plurality of heating zones. At least one heating zone is adapted to independently transfer a particular thermal energy to the target matter. This particular thermal energy may be a preselected thermal energy. In some embodiments each heating zone is adapted to independently transfer a particular thermal energy to the target matter. In some embodiments each heating zone is adapted to independently transfer a preselected thermal energy to the target matter

[0057] In some embodiments the heating member is a resilient heating member. In some embodiments the heating member is an inflatable heating member. In some embodiments a resilient heating member is an inflatable heating member. The resilient heating member is allowed to conformably contact the target material. In some embodiments the heating member is a resilient multi-zone heating member. By positioning the heating member onto the target material, the target material is allowed to be sandwiched between the top and the base. The heating member provides communication with the top. The method also includes applying thermal energy to the target material via the heating member. Where a multi-zone heating member is employed, at least one heating zone of the multi-zone heating member is allowed to transfer a particular thermal energy to the target matter. In some embodiments at least one heating zone of the multi-zone heating member is allowed to transfer a preselected thermal energy to the target matter. In some embodiments each heating zone of the multi-zone heating member is allowed to independently transfer a particular and/or preselected thermal energy to the target matter. Furthermore the method includes applying pressure to the target material.

[0058] In some embodiments of the method according to the eighth aspect where a multi-zone heating member

is employed, at least one heating zone of the multi-zone heating member corresponds to a region of the target matter.

[0059] In some embodiments of the method according to the eighth aspect where a multi-zone heating member is employed, at least one heating zone of the multi-zone heating member is allowed to provide a particular and/or preselected temperature to a region of the target matter. In some embodiments each heating zone of the multi-zone heating member is allowed to independently provide a particular temperature to a region of the target matter. In some embodiments each heating zone of the multi-zone heating member is allowed to independently provide a preselected temperature to a region of the target matter.

[0060] In some embodiments of the method according to the eighth aspect where a multi-zone heating member is employed, the multi-zone heating member includes from about 2 to about 20 heating zones. In some embodiments the multi-zone heating member of the thermal transfer printing device according to the first aspect includes from about 2 to about 16 heating zones.

[0061] In some embodiments of the method according to the eighth aspect, where thermal energy is applied to the target matter via the multi-zone heating member, applying thermal energy includes applying thermal energy of independently selected magnitude via each heating zone of the multi-zone heating member.

[0062] In some embodiments of the method according to the eighth aspect applying thermal energy to the target matter comprises exposing at least a portion of the target matter to a particular and/or a preselected constant elevated temperature.

[0063] In some embodiments of the method according to the eighth aspect where a resilient heating member is employed, applying pressure to the target material comprises allowing a fluid to enter the resilient heating member.

[0064] In a ninth aspect there is provided a kit for equipping a thermal transfer printing device with a multi-zone heating member. The kit includes a multi-zone heating member according to the third aspect. The kit further includes means for connecting the multi-zone heating member to the top or to the base of a thermal transfer printing device.

[0065] In some embodiments the kit according to the ninth aspect further includes a control module for controlling the multi-zone heating member. The control module is generally connectable to the multi-zone heating member. The control module may be capable of setting and/or adjusting the amount of thermal energy provided by the multi-zone heating member, for example by a heating element that is included in the multi-zone heating member. In some embodiments the control module is connectable to a heating element that is included in the multi-zone heating member.

[0066] In a tenth aspect there is provided a kit for equipping a thermal transfer printing device with a resilient

heating member. The kit includes a resilient heating member according to the fifth aspect. The kit further includes means for connecting the resilient heating member to the top or to the base of a thermal transfer printing device.

[0067] In some embodiments the kit according to the tenth aspect further includes a control module for controlling the resilient heating member. The control module is generally connectable to the resilient heating member. The control module may be capable of setting and/or adjusting the amount of thermal energy provided by the resilient heating member, for example by a heating element that is included in the resilient heating member. In some embodiments the control module is connectable to a heating element that is included in the resilient heating member.

[0068] The foregoing and other objects, features and advantages of the invention will be more apparent from the following detailed description, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0069]

Figure 1 depicts a thermal transfer printing device with a resilient heating member (41). The device further includes a top (42), a base (43) and a body (44), which includes an arm (44a). Top (42) and base (43) are connected to a body (44). **Fig. 1A:** a resting/start position; **Fig. 1B:** the position of the base (43) is adjusted; **Fig. 1C:** the top (42) is positioned above the base (43) such that the heating member (41) is sandwiched between the top and the base; **Fig. 1D:** the heating member (41) is being inflated, thermal energy and pressure can be applied; **Fig. 1E:** the heating member (41) is deflated, and the top (42) is lifted from the base (43); **Fig. 1F:** the device is brought into the resting/start position.

Figure 2 depicts a multi-zone heating member. **Fig. 2A:** The heating member has two zones (1) and (2). **Fig. 2B:** The heating member has three zones (1), (3), and (4). **Fig. 2C:** The heating member has four zones (1), (5), (6) and (7). **Fig. 2D:** The heating member has five zones (8), (9), (10), (11) and (12). **Fig. 2E:** The heating member has nine zones (13), (14), (15), (16), (17), (18), (19), (20), and (21). **Fig. 2F:** The heating member has ten zones (22), (23), (24), (25), (26), (27), (28), (29), (30) and (31).

Figure 3 shows the arrangement and usage of zones of a multi-zone heating member for imprinting lettering onto a T shirt (32). The design of the heating zones corresponds to the design of Fig. 2C. Inactive heating zones are depicted as hatched, and active heating zones as clear areas. **Fig. 3A** depicts the front of the T shirt (32), onto which the number "19" and the wording "copa mundial 2014" is to be printed.

Zones 35 and 39 are two active heating zones, which are independently used for applying an elevated temperature. Zones 33 and 37 are not being used for applying thermal energy. **Fig. 3B** depicts the back of the T shirt (32), onto which the word "striker" and the number "19" is to be printed. Zones 34, 36 and 38 are three active heating zones covering the area where lettering is to be printed. These three heating zones of the heating member are used for applying an elevated temperature. Zone 40 is not being used for applying thermal energy.

DETAILED DESCRIPTION

[0070] Disclosed herein are devices, methods and uses for the thermal transfer of matter onto a target material. In various embodiments means are provided that allow such transfer of matter under individualized temperature conditions for selected areas of the target material. Various embodiments also provide means that allow such transfer of matter to be performed with a target material that includes areas of different surface topology and/or areas of uneven surface topology.

Terms

[0071] Unless otherwise stated, the following terms used in this document, including the description and claims, have the definitions given below.

[0072] Singular forms such as "a", "an" or "the" include plural references unless the context clearly indicates otherwise. Thus, for example, reference to a "heating element" includes a single heating element as well as a plurality of heating elements, either identical - e.g. of the dimensions - or different. Unless otherwise indicated, the term "at least" preceding a series of elements is to be understood to refer to every element in the series. The terms "at least one" and "at least one of" include for example, one, two, three, four, or five or more elements. The terms "comprising", "including", "containing", "having" and grammatical variants shall be read expansively and without limitation.

[0073] The word "about" as used herein refers to a value being within an acceptable error range for the particular value as determined by one of ordinary skill in the art, which will depend in part on how the value is measured or determined, i.e., the limitations of the measurement system. For example, "about" can mean within 1 or more than 1 standard deviation, per the practice in the art. The term "about" is also used to indicate that the amount or value in question may be the value designated or some other value that is approximately the same. The phrase is intended to convey that similar values promote equivalent results or effects according to the invention. In this context "about" may refer to a range above and/or below of up to 10%. The word "about" refers in some embodiments to a range above and below a certain value that is up to 5%, such as up to up to 2%, up to 1%, or up

to 0.5 % above or below that value. In one embodiment "about" refers to a range up to 0.1 % above and below a given value.

[0074] The term "conformable" as used herein refers to the compliance property of a resilient heating member, which is the result of an adaptive behaviour of the surface of the same. When contacting target matter a resilient heating member is sufficiently compliant to conform to the surface of target material. Thereby an at least essentially uniform contact with target matter is provided.

[0075] As used herein, the term "in communication" refers to the possibility of mechanic and/or electric interaction between elements of a device or between devices. Typically a link is involved, which may involve additional elements and/or devices. In some embodiments elements and/or devices are in communication if they are adjacent, in the general vicinity, in close proximity, or next to each other. In some embodiments elements and/or devices in communication with each other are coupled to each other. In some embodiments elements and/or devices in communication with each other are connected to each other. As an example, where a heating member is in communication with the top or with the base of a thermal transfer printing device, the heating member may be connected to the top or the base, possibly additional elements may be arranged between heating member and top or base, as applicable. As a further example, if a base is in communication with a body of a thermal transfer printing device, the base may be coupled to the body, possibly via one or more elements that may for example serve in adjusting or modifying the position of the base relative to the body.

[0076] The term "resilient" as used herein refers to an adaptive behaviour of the surface of a heating member when contacting target matter. A resilient heating member tends to retain its shape and size when being deformed. When contacting an uneven surface or otherwise being subjected to a compression force the resilient heating member tends to recover its original shape and size when such force is removed. The resilient heating member can thus be re-used for transferring matter to target material.

[0077] The term "source of matter" as used herein may refer to material that includes the respective matter or to material that provides the respective matter upon exposure to an elevated temperature and/or elevated pressure. In some embodiments the source of matter is a material that is converted to the respective matter upon exposure to an elevated temperature and/or elevated pressure. Unless the context clearly indicates otherwise, a "source of matter to be transferred" refers to a material that includes the matter that is to be received by the target matter, or to material that provides matter that is to be received by the target matter.

[0078] The scope and meaning of any use of a term will be apparent from the specific context in which the term is used. Certain further definitions for selected terms used throughout this document are given in the appro-

prate context of the detailed description, as applicable. Unless otherwise defined, all other scientific and technical terms used in the description, figures and claims are used according to conventional usage as commonly understood by one of ordinary skill in the art.

[0079] Although many methods and materials similar or equivalent to those described herein can be used, particular suitable methods and materials are described in the following. The devices, uses, methods and examples provided herein are illustrative only and not intended to be limiting. It is furthermore understood that slight variations above and below the stated ranges can be used to achieve substantially the same results as values within the ranges. Also, unless indicated otherwise, the disclosure of ranges is intended as a continuous range including every value between the minimum and maximum values.

[0080] As noted above, the devices, methods and uses disclosed herein generally relate to thermal transfer of matter onto a target. Matter to be transferred includes, but is not limited to, a colouring compound such as a dye, a composition that includes a dye, matter such as a film or a fabric that includes a dye, and a rhinestone. A film that includes a dye may include a polymer. Matter such as a film or a fabric that includes a dye may for instance have a coating that includes the dye. In some embodiments the matter to be transferred includes a dye or a reflective substance as the matter to be transferred. The matter to be transferred may in some embodiments include an organic pigment or an inorganic pigment. A variety of such pigments are known in the art.

[0081] In some embodiments the matter to be transferred is included in a wax. In some embodiments the matter to be transferred is included in a resin, such as an acrylic resin, a rubber resin, a ketone resin, or a formaldehyde resin, for example. A large number of suitable resins are commercially available. In some embodiments the matter to be transferred is included in a paper. In some embodiments the matter to be transferred is included in a polymer film. Illustrative examples of a suitable polymer include, but are not limited to, a polyester, a copolyamide, or polyurethane.

[0082] The target may include any material as long as the target is capable of accepting the matter to be transferred under conditions of altered pressure, such as reduced pressure when compared to standard atmospheric pressure, and under conditions of elevated temperature when compared to room temperature. As examples of a suitable material, which the target may include, may serve, without being limited thereto, paper, fabric, plastic material, ceramic and wood. In some embodiments the target material may be a tile. In some embodiments the target material may be a doll. In some embodiments the target material may be a folding rule. In some embodiments the target material may be a metal plate. In some embodiments a method disclosed herein is or includes a method of printing onto a textile material. In some embodiments a method disclosed herein is or includes a

method of providing a barcode label. In some embodiments a method disclosed herein is included in a method of providing an article of clothing.

5 Printing device for Transferring Matter

[0083] A printing device disclosed herein includes a base, a top and a heating member. The top and the base may include any solid material capable of standing the conditions to be applied to the target material. A top and a base of any commercially available thermo transfer printer may be employed. The base may in some embodiments be capable of taking different positions, for example to facilitate positioning a target material thereon. The base may in some embodiments be moveable relative to the top. The top may in some embodiments be linked to the base. In some embodiments the top and the base may be in communication via a body. The top and the base may for instance both be connected to such a body. The base may in some embodiments be moveable relative to such a body. The top is in some embodiments pivotally connected to the base. In some embodiments the top is pivotally connected to the body, if present.

[0084] The heating member of the printing device is adapted to contact the target material. In typical embodiments a particular surface area of the heating member will contact the target material. In some embodiments the heating member has a surface that corresponds or is adapted to correspond to a region of the target matter. This region of the target matter is generally the region of the target matter that is known and/or expected to contact the heating member. A surface that corresponds to a region of the target matter is of a size that allows contact between the respective surface and the surface of the region of the target matter. In some embodiments a surface that corresponds to a region of the target matter has a topography that allows contact between the respective surface and the surface of the region of the target matter. In some embodiments a surface that corresponds to a region of the target matter may be of a size and/or of a topography that allows large-area contact with the respective area of the target material. As an example, more than 50 % of the surface area of the selected region of the target material may be in direct contact with the corresponding surface of the heating member. In some embodiments 70 % or more of the surface area of the selected region of the target material may be in direct contact with the corresponding surface of the heating member. In some embodiments 90 % or more of the surface area of the selected region of the target material may be in direct contact with the corresponding surface of the heating member. In some embodiments a surface that corresponds to a region of the target matter is of a size and or of a topography that at least essentially matches the size and/or of topography of the respective area of the target material. As noted, this area of the target material is typically the portion of the heating member that is known and/or expected to contact the target material

[0085] In some embodiments the heating member contains a resilient portion. This resilient portion is typically a surface portion. Such a resilient portion may be the portion of the heating member that is known and/or expected to contact the target material. In some embodiments the entire heating member has a resilient surface. In some embodiments the entire heating member is resilient.

[0086] Generally the heating member is removably connected to at least one of the top and the base. The heating member is in some embodiments a multi-zone heating member. A heating member may include any desired number of heating zones. In some embodiments a heating member may include 4 or more, including 5 or more heating zones. The multi-zone heating member may in some embodiments include from about 2 to about 12 heating zones. The multi-zone heating member may in some embodiments include two or more, including three or more heating zones. Into a heating zone, where a plurality of heating zones is present typically into each heating zone, there are generally one or more heating elements such as heating resistors incorporated. A heating zone may in some embodiments include two or more, including three or more heating elements.

[0087] In some embodiments a heating element includes a heating circuit. Any conventional resistance wire may be employed in this regard. As an illustrative example, a wirewound resistor, connected to a power source, may be employed. In embodiments where a plurality of heating zones is included in a heating member, each heating zone may include at least one heating circuit. Each of these heating circuits may be operated independent from the other heating circuits present in the heating member.

[0088] Illustrative examples of suitable heating elements are heating elements that are commercially available from Mickenhagen (Ludenscheid, Germany), for example elements Mica flat heaters BHP30 of stainless steel. Suitable Mica thermofoil® heaters are available from Minco (Minneapolis, MN, U.S.A.), for example model No. HM6800, which is available with a variety in lead length, resistance and insulation thickness.

[0089] In some embodiments the heating elements of a heating member may be connected to a controller. The controller may be configured to set the thermal energy provided by each heating element. Using a respective controller the temperature operation of a method disclosed herein may be configured in advance, and be adjusted while performing the method if desired. In embodiments where a multi-zone heating member is used, the controller may address each heating zone of the multi-zone heating member in an independent manner. The controller, also termed "control module" herein, may also be capable of setting and/or adjusting the period of time during which thermal energy is being provided by the heating member. Where a multi-zone heating member is used, the controller may control the period of heating time for each individual heating zone independent from

the heating time of any other heating zone.

[0090] The heating member may in some embodiments include one or more sensors. A respective sensor may detect the temperature of the surface of the heating member or the temperature of the surface of the target material. A sensor included in the heating member may be connected to a control unit and serve as a feed-back that allows adjusting the amount of thermal energy provided by the heating member, including by a heating element included in a heating member. Values provided by a sensor may also be verified by a control unit as to whether a critical value is being exceeded. In such a case the control unit may initiate a fast deactivation of a heating member, in case of a multi zone heating member deactivation of one or more, including all heating zones. A sensor included in a heating member

[0091] A sensor included in a heating member may also be a contact sensor. Such a contact sensor may serve in verifying that proper contact between heating member and target material is being achieved. Similar sensors may be included in other areas of the printing device. As an illustrative example, a contact sensor in the base may serve in verifying that target material has been properly positioned thereon.

[0092] If the heating member includes a plurality of heating zones, each heating zone can be addressed separately via control means. The intensity of radiation energy provided by each heating zone can be controlled on an individual basis. In some embodiments the temperature provided by each heating zone, for example the temperature provided to matter contacting the heating zone, can be controlled on an individual basis. As an illustrative example, the intensity of radiation energy provided by particular heating zones may be set as varying over time, while the radiation energy provided by particular heating zones may be set as constant over time. As a further example, the intensity of radiation energy provided by all heating zones may be set as constant over time, with the intensity of radiation energy provided by particular heating zones being different from one another. As yet a further example, the intensity of radiation energy provided by particular heating zones may be set to be identical to particular other heating zones but different from particular further heating zones. In some embodiments the temperature provided by particular heating zones may be set to be constant, whereas the temperature provided by particular other heating zones may be set to be varying over time. In some embodiments the temperature provided by all heating zones may be set to be constant over time, where the temperature provided by particular heating zones may be at least essentially identical to the temperature provided by particular other heating zones, however different from the temperature provided by yet further particular heating zones. In one embodiment the temperature provided by all heating zones may be set to be constant over time, and the temperature provided by all heating zones may be set to be the same.

[0093] The selection which thermal energy will be ap-

plied by which heating zone of a heating member with a plurality of heating zones will generally be taken according to the matter applied to target material, and in particular according to the areas of target material to which matter is to be applied. As an illustrative example, a graphic, a text, a logo or a design may be desired to be printed onto a plastic material or onto a fabric. The heating member may be designed to cover a large area or essentially the entire area of the respective plastic material or fabric. As illustrated in e.g. Fig. 3, the graphic, text, logo or design to be printed may only cover a certain fraction of the total number of the heating zones of the heating member. When using the heating member in a method described herein those heating zones that do not cover any areas where graphic, text, logo or design is to be printed may be left unused and accordingly remain deactivated when carrying out the method. As a result energy and time may be saved. Furthermore, those areas of the target material, e.g. plastic material or fabric, where no matter is to be transferred to, remain unexposed to elevated temperatures. This may be for instance be particularly advantageous in case of fabric that is to be stained by means of sublimation, for example fabric having a high content of polyester such as softshell fabric or knitwear. Activating only those heating elements that are indeed required will in such cases limit potential negative effects caused by heating to those areas that are to be printed on.

[0094] The dimensions of a heating zone, in embodiments with a plurality of heating zones the dimensions of an individual heating zone, may be selected as desired. In embodiments with a plurality of heating zones the dimensions of each individual heating zone may be selected independently from the dimensions of other heating zones. The width of a heating zone in a particular dimension in the plane in which target matter is contacted is generally selected in the range from about a millimetre to about 10 meters, depending on the intended purpose. In most typical embodiments of transferring matter to items of daily goods the dimensions of a heating zone will be selected in the centimetre range, such as in the range from about 0.5 to about 20 cm.

[0095] Furthermore, the width of a heating zone in one dimension may be different from the width of a heating zone in another dimension. In some embodiments a particular heating zone may be of circular shape, ellipsoid shape or the shape of an egg. In some embodiments a particular heating zone may have the shape of a letter such as e.g. letters V or U. An individual heating zone may have the shape of any oligoedron. In some embodiments a particular heating zone may have the shape of a triangle. In some embodiments a particular heating zone may have the shape of a rectangle or of a square. In some embodiments a particular heating zone may have the shape of a five-sided figure, i.e. a pentagon. In some embodiments a particular heating zone may have the shape of a hexagon. As two further examples, a particular heating zone may in some embodiments have the

shape of a heptagon or of an octagon. In some embodiments a particular heating zone may have the shape of a combination of one or more of the aforementioned examples.

[0096] In embodiments where more than one heating zone is included in a heating member, the shape and size of each individual heating member may be selected independent from the shape and size of any other heating member. In some embodiments all heating zones of a heating member are different in shape and size. In some embodiments certain heating zones of a heating member are different in shape and/or size from particular other heating zones, but at least essentially identical in shape and/or size to particular other heating zones. In some embodiments all heating zones of a heating member are different in shape but not in size. As an illustrative example, all heating members may have circular, rectangular or triangular shape, or any combination thereof, but have at least essentially the same area in terms of cm^2 , m^2 or mm^2 . In some embodiments all heating zones of a heating member are different in shape and size.

[0097] The heating member includes in some embodiments an area of an at least essentially smooth surface. In some embodiments the entire heating member has an at least essentially smooth surface. The heating member includes in some embodiments an area with an at least essentially elastic surface. In some embodiments the entire heating member has an at least elastic smooth surface. In some embodiments the heating member includes an area that is capable of conforming to the surface of target matter. An area of the heating member may for example be able to attune to the surface characteristics, in particular the topography, of target matter. The heating member may include a resilient area. In some embodiments the entire heating member may have a resilient surface.

[0098] In some embodiments the heating member is inflatable. The heating member may for example be uniformly inflatable in all its dimensions. In some embodiments the heating member may be inflatable in a direction that at least essentially corresponds to the direction in which target matter contacts the heating member. In some embodiments the heating member can be inflated by influx of a fluid such as a gas or a liquid. In some embodiments a respective fluid has a particular preselected temperature that differs from the temperature of the ambience. Such a fluid may for example have a particular preselected temperature that is higher than the temperature of the ambience. In some embodiments influx of a fluid into the heating member is achieved via a connection means such as tubing. The connection means may include an orifice. In some embodiments the connection means may include a valve. Respective connection means may be provided by a top or a base of a printing device disclosed herein. A reservoir containing the respective fluid used may be in communication with the inflatable heating member.

[0099] In some embodiments the heating member may

include a circumferential elastic film such as an elastic membrane. A heating member that is inflatable may for example include a circumferential elastic film. A respective elastic film may cover any desired portion of the heating member. In some embodiments the entire heating member may be enclosed in a circumferential elastic film, such as an elastic membrane. An elastic film may include a polymeric substance such as an elastomer. An elastic film may for instance include a gum or natural rubber. An illustrative example of a suitable elastic film is a silicone film.

[0100] In some embodiments the heating member includes a resilient area, such as a resilient pad or a resilient mat. The heating member may for example include a silicone (polysiloxane) pad or mat. In some embodiments the heating member includes a plurality of resilient areas, for instance a plurality of resilient pads. Each resilient area, including each resilient pad, may have an individually selected resilience. In some embodiments each resilient area, including each resilient pad, may have a resilience that differs from the resilience of one or more other resilient areas of the heating member.

[0101] In embodiments where a controller is used, a user interface may be provided. The user interface may allow a user to pre-select conditions and to configure individual steps of a method as disclosed herein. The user interface may allow configuring a controller in advance. The user interface may also allow configuring a controller during operation, i.e. while a method described herein is already being carried out.

Methods and Uses of Transferring Matter

[0102] In a method described herein target material is positioned on the base of the thermal transfer printing device used. The base may be any suitable element such as a conventional plate.

[0103] In a method described herein thermal energy is typically transferred from a heating member or a heating element to target matter. Thermal energy may also be transferred from a heating member or a heating element to target matter. In some embodiments the heating member includes a heating zone, in which an individually selected temperature can be established by providing thermal energy of appropriate intensity. In some embodiments the heating member includes two or more heating zones. In each of the two or more heating zones an individually selected temperature can be established by providing thermal energy of appropriate intensity. One or more, including all of the one more heating zones of a respective heating member may be in contact with the target material and/or the matter to be transferred to the target material.

[0104] In a method described in this document target material and/or the matter to be transferred is generally exposed to an elevated temperature by thermal energy provided by the heating member of a printing device described herein. In some embodiments the target material

and/or the matter to be transferred is exposed to a temperature of about 50 °C or more. In some embodiments the target material and/or the matter to be transferred is exposed to a temperature of about 100 °C or more. In some embodiments the target material and/or the matter to be transferred is exposed to a temperature of about 150 °C or more. In some embodiments the target material and/or the matter to be transferred is exposed to a temperature of 100 °C or more. In this regard the target material and/or the matter to be transferred may be subjected to a heating cycle while being subjected to an elevated pressure. In some embodiments the target material and/or the matter to be transferred may be subjected to a plurality of heating cycles. In some embodiments the matter to be transferred is exposed to an elevated temperature together with the target material.

[0105] An elevated pressure used in a method disclosed herein is a pressure above standard atmospheric pressure, which is a pressure of 101.325 kPa. Generally a pressure in the range from about 15 kPa to about 100 kPa, such as in the range from about 20 kPa to about 80 kPa is employed. Depending on the matter to be transferred, a combination of a particular pressure and a particular temperature will be taken. The skilled person is aware that the choice of the pressure and the temperature is typically a balance, where increasing one of the two factors pressure and temperature allows decreasing the other factor. Thus where a temperature of 170 °C is used in combination with a pressure of 30 kPa, it can be expected that increasing the pressure to a higher value such as 40 kPa will allow reducing the temperature to a lower value in order to be able to obtain the same result.

[0106] A method described herein is typically a digital printing method. In some embodiments a method described herein may be an offset printing method.

[0107] In embodiments where a heating member with a plurality of heating zones is employed each heating zone may be operated independent from any other heating zone, cf. above.

[0108] As noted above, in a method described herein an elastic and/or flexible heating member may be used. The heating member may be of an elasticity and/or flexibility to allow even contact with target material even where the target material includes surface unevenness. The elasticity and/or flexibility of a heating member may for example allow even contact already upon contacting the target material. Such a property may be taken to be compensating surface topography, e.g. surface irregularities. In some embodiments a heating member may be inflatable. Where an inflatable heating member is used, in the course of a method disclosed herein a fluid is being introduced into the heating member. Generally the heating member is thereby expanded from a relaxed to a stiff state. The equal distribution of pressure in the inflatable heating member results in a unitary interaction with target material. Regardless of the surface characteristics of the target material, the pressure applied by inflating the heating member acts on any surface portion

of the heating member/target material contact surface. This effect de facto evens up any surface irregularities. As long as the surface material of the heating member is extendible to a sufficient degree, no damage is done to the surface of the heating member.

[0109] In embodiments where the heating member is inflatable, for instance where it includes a circumferential elastic film, it may be filled with liquid such as air in the method. Filling an inflatable heating member may for example be carried out when a pressure is applied to the target material. As a result, the heating member expands in the direction where it contains elastic material. Generally the heating member expands in the direction of the target material. Thereby the heating member conforms with the surface properties of the target matter. Such a property is also termed an "intelligent deposition" in the art.

[0110] Provided herein are also a multi-zone heating member and a resilient heating member. These heating members have already been described in the context of a thermal transfer printing device with a multi-zone heating member, and with a resilient heating member, respectively, above.

[0111] Provided are furthermore a kit for forming a thermal transfer printing device with a multi-zone heating member and a kit for forming a thermal transfer printing device with a resilient heating member. In some embodiments the kit is a kit for forming a thermal transfer printing device with a resilient multi-zone heating member. A respective kit includes parts that allow turning a conventional thermal transfer printing device into a thermal transfer printing device as disclosed herein. The kit includes a multi-zone heating member and/or a resilient heating member. The kit further includes mounting for attaching the respective heating member to a conventional thermal transfer printing device. The kit may further include a controller as described above.

[0112] The listing or discussion of a previously published document in this specification should not necessarily be taken as an acknowledgement that the document is part of the state of the art or is common general knowledge.

[0113] The invention illustratively described herein may suitably be practiced in the absence of any element or elements, limitation or limitations, not specifically disclosed herein. Additionally, the terms and expressions employed herein have been used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by exemplary embodiments and optional features, modification and variation of the inventions embodied therein herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be

within the scope of this invention.

[0114] The invention has been described broadly and generically herein. Each of the narrower species and sub-generic groupings falling within the generic disclosure also form part of the invention. This includes the generic description of the invention with a proviso or negative limitation removing any subject matter from the genus, regardless of whether or not the excised material is specifically recited herein.

[0115] Other embodiments are within the appending claims. In addition, where features or aspects of the invention are described in terms of Markush groups, those skilled in the art will recognize that the invention is also thereby described in terms of any individual member or subgroup of members of the Markush group.

EXAMPLE: FORMATION AND USE OF A THERMAL TRANSFER PRINTING DEVICE

[0116] A thermal transfer printing device as shown in Fig. 1 was manufactured as follows.

Metal parts:

[0117] The body (44) was formed from 10 mm black steel ST-52. Side portions of the dimensions of approximately 450 mm length and 350 mm height were formed by laser cutting and subsequent folding and welding. They were finally equipped with boreholings, having sizes from 3 to 20 mm.

[0118] The top (42) and the base (43) were formed from aluminum plates in a milling center. They had dimensions of 400 x 500 mm and a thickness of 15 mm.

[0119] The press-arm (44a) of body (44) consisted of tool steel with profile of 30x40 mm and a length of 450 mm. It was processed in a CNC drilling center.

[0120] A cover plate on the body (44) for quick access was processed in a milling center, and consisted of alumina. It had dimensions of 135x150 mm, with a thickness of 15 mm. Further cover panels and screens of the printing device consisted of aluminium sheets of a thickness of 1.5 mm, and were formed by laser cutting and subsequent folding and welding.

[0121] Metal works were carried out by W&M Apparatbau GmbH (Cappeln, Germany)

Linear Guide:

[0122] The base (43) was a plate that included a linear guide. This linear guide was obtained from Schneeberger GmbH (Höfen/Enz, Germany). The system consisted of four carriages with dimensions of 46 x 27 mm as well as two hardened profile rails of stainless steel, having a length of 340 mm.

Pneumatic Cylinder/Interlocking Bent Lever:

[0123] The body (44) contained a compact cylinder

Festo (Esslingen-Berkheim, Germany) ADVU 50-100 with a swivel head of type SGS. At 6 bar of operating pressure is had a force of 1060 N. Its dimensions were 68 mm (length) x 68 mm (width) x 203 mm (height), when contracted, together with attached swivel head SGS. In expanded condition it had a height of 303 mm, together with attached swivel head SGS.

[0124] Valves for controlling the pneumatic were included in form of three upstream three/two-way valves.

Manufacture and attachment of the Multi-zone Heating Member:

[0125] To create a plurality of distinct heating zones, a heating conductor of carbon fiber was sewed onto a thin textile support of the dimensions ~ 350 x 450 mm. A temperature sensor of the NiCr-Ni type was integrated into each of the heating zones. Subsequently the obtained blank of the heating member was crimped under high pressure between two thin mats of heat resistant, elastic silicone of a thickness of ~ 0.75 to 1.00 mm. The finalized multi-zone heating members had dimensions of about 550x450 mm. Each heating member had a heating power of 1600 to 2000 watt.

[0126] Providing an airtight seal, the heating members were subsequently affixed to the top (42) and/or the base plate (43), and connected to the electric circuit and the pneumatics.

[0127] The multi-zone heating members were manufactured by Qpoint Composite GmbH (Dresden, Germany).

Controller:

[0128] The printed circuit board needed for the controller was developed by Radeke Energie GbR (Emtinghausen, Germany). Standard components available from local electric goods shops, such as relais etc., were implemented on the pcb for the control of temperature and time. A 7" display was connected to allow users controlling the printing device. The software and back-end domain for service and remote servicing was developed by Radeke Energie GbR (Emtinghausen, Germany).

[0129] Conventional bits and pieces were obtained from Berliner Schrauben GmbH & Co KG (Oer-Erkenschwick, Germany). Heat resistant silicone and sealant were obtained from weicon GmbH & Co KG (Münster, Germany). The silicone mat of dimensions ~ 450 x 350 mm was obtained from SFS Manufacturing Group Ltd. (Blackburn, UK).

Use of the Multi-zone Heating Member Printing Device:

[0130] In use, the printing device is being operated as follows.

[0131] A) On the base (43), in this example in form of a plate, target material such as a textile can be positioned by a user (not shown in Fig. 1A). In embodiment I a source

of matter to be transferred to the target material, for example a film, can be placed onto the target material.

[0132] B) As shown in Fig. 1B, a user may then manually push the base plate (43) out of the resting position depicted in Fig. 1A. Means for securing the base plate (43) in and into a working position may be included in the printing device. In this example a spring and a microswitch were employed (not shown), where the spring draws the base plate (43) in to reach the working position, namely on the last 5 cm. Thereby the microswitch is being operated. An optic and/or acoustic signal may then signalize that the working position has been reached.

[0133] C) The body (44) includes a double-acting cylinder, which is being actuated to extend. The extending cylinder lowers an arm (44a) of the body (44) and locks it in a final lowered position. As a result the top (42), which is in this example also a plate, and which is attached to the respective arm, is being positioned directly above the base plate (43), as depicted in Fig. 1C.

[0134] D) Locking the arm operates a further micro switch (not shown). A three/two-way valve is being activated, so that the inflatable heating member (41) is being filled with air (Fig. 1D). In embodiment I expansion of the inflatable heating member (41) is carried out for a time period that is preselected by the user.

[0135] In embodiment II (not shown) a pre-press function is included in a printing method. Expansion of the inflatable heating member (41) is carried out for a fixed pre-selected period of time, which is 5 seconds in the present example. Thereafter the three/two-way valve is being switched, such that air is being released from the inflatable heating member (41). The press defined by the thermal transfer printing device opens and the base plate (43) moves out of its working position. A source of matter to be transferred to the target material, e.g. a textile, such as a film, can be placed onto the target material, e.g. textile. In embodiment II the user pushes the base plate (43) in the direction of the working position, and the microswitch is again actuated. The press defined by the thermal transfer printing device closes and the inflatable heating member (41) is being filled with air for a period of time pre-selected by the user.

[0136] Due to the application of an elevated temperature and pressure transfer, of matter from the source of matter to the target material occurs. Temperature conditions of 140 °C, 150 °C and 160 °C have been tested using the device of the present Example. Various pressure conditions in the range from 0.2 to 0.8 bar, i.e. 20,000 to 80,000 Pa were tested.

[0137] E) Once the preselected period of time has expired, the three/two-way valve is being switched, such that air is being released from the inflatable heating member (41). The double-acting cylinder is being actuated to contract. The contracting cylinder lifts an arm (44a) of the body (44) and locks it in a final upper position.

[0138] F) The user now has the choice to either pull the base plate (43) entirely out of the working position into the resting position of Fig. 1A, or to push it back into

the direction of the working position to initiate a further pressing step.

Claims

1. A thermal transfer printing device comprising a base, a top and a multi-zone heating member; wherein the base is adapted to support target matter positioned thereon; wherein the multi-zone heating member is adapted to contact

- (i) target matter and/or
(ii) a source of matter to be transferred, positioned adjacent to the target matter,

and the multi-zone heating member is adapted to transfer thermal energy to contacted target matter; the multi-zone heating member comprising a plurality of heating zones, wherein at least one heating zone is adapted to transfer a preselected magnitude of thermal energy to contacted target matter; wherein the top is moveable between an idle position and a press position, wherein in the press position the heating member is sandwiched between the base and the top.

2. A thermal transfer printing device comprising a base, a top and a resilient heating member; wherein the base is adapted to support target matter positioned thereon; wherein the resilient heating member is adapted to conformably contact

- (i) target matter and/or
(ii) a source of matter to be transferred, positioned adjacent to the target matter,

and the heating member is adapted to transfer thermal energy to contacted target matter; the top being moveable between an idle position and a press position, wherein in the press position the resilient heating member is sandwiched between the base and the top.

3. The thermal transfer printing device of claim 2, wherein the resilient heating member is inflatable.
4. The thermal transfer printing device of any one of the preceding claims, wherein the heating member is connected to one of the top and the base.
5. The thermal transfer printing device of any one of the preceding claims, wherein the heating member is removably connected to one of the top and the base.

6. The thermal transfer printing device of any one of claims 2 to 5, wherein the resilient heating member comprises a heating zone, wherein the heating zone is adapted to transfer a preselected magnitude of thermal energy to contacted target matter.

7. The thermal transfer printing device of any one of claims 2 to 6, wherein the resilient heating member comprises a plurality of heating zones, wherein at least one heating zone is adapted to independently transfer a preselected thermal energy to contacted target matter.

8. The thermal transfer printing device of any one of claims 2 to 7, wherein the resilient heating member comprises a circumferential elastic membrane.

9. The thermal transfer printing device of any one of the preceding claims, wherein the heating member comprises a heating element, the heating element being capable of transmitting thermal energy.

10. The use of at least one of a multi-zone heating member and a resilient heating member in heat-transfer printing, wherein the multi-zone heating member comprises a plurality of heating zones, wherein at least one heating zone is allowed to independently transfer a preselected thermal energy to contacted target matter, and wherein the multi-zone heating member is allowed to contact target matter and/or a source of matter to be transferred to the target matter, and wherein the resilient heating member is allowed to conformably contact (i) target matter and/or (ii) a source of matter to be transferred to the target matter, the source of matter being positioned adjacent to the target matter, and wherein the resilient heating member is allowed to transfer thermal energy to contacted target matter.

11. A method of thermally transferring matter onto a target material, the method comprising

- (a) positioning onto a base: the target material and a source of the matter to be transferred to the target material, wherein the base comprises a heating member, wherein the heating member

- (i) is a multi-zone heating member comprising a plurality of heating zones, wherein at least one heating zone is adapted to independently transfer a preselected thermal energy to the target matter, and/or
(ii) is resilient, wherein the resilient heating member is allowed to conformably contact the target material; and

- (b) positioning a top onto the source of matter to be transferred and the target material; thereby allowing the target material to be sandwiched between the top and the base, wherein the heating member provides communication with the base; 5
- (c) applying thermal energy to the target material via the heating member, wherein at least one heating zone of the multi-zone heating member is allowed to independently transfer a preselected thermal energy to the target matter; and 10
- (d) applying pressure to the target material.
- 12.** A method of thermally transferring matter onto a target material, the method comprising positioning onto a base: the target material and a source of the matter to be transferred to the target material; 15
- positioning a top and a heating member onto the source of matter to be transferred and the target material, 20
- wherein the heating member
- (i) is a multi-zone heating member comprising a plurality of heating zones, wherein at least one heating zone is adapted to independently transfer a preselected thermal energy to the target matter, and/or 25
- (ii) is resilient, wherein the resilient heating member is allowed to conformably contact the target material; 30
- thereby allowing the target material to be sandwiched between the top and the base, wherein the heating member provides communication with the top; and 35
- applying thermal energy to the target material via the heating member, wherein at least one heating zone of the multi-zone heating member is allowed to independently transfer a preselected thermal energy to the target matter; and 40
- applying pressure to the target material.
- 13.** The method of claim 11 or 12, wherein at least one heating zone of the multi-zone heating member corresponds to a portion of the target matter. 45
- 14.** The method of any one of claims 11 to 13, wherein applying thermal energy to the target matter comprises exposing at least a portion of the target matter to a preselected constant elevated temperature. 50
- 15.** A kit for providing a thermal transfer printing device with at least one of a multi-zone heating member and a resilient heating member, the kit comprising at least one of a multi-zone heating member and a resilient heating member and means for connecting the multi-zone heating member to the top or to the base of a thermal transfer printing device, 55

wherein the multi-zone heating member comprises a plurality of heating zones, wherein at least one heating zone is adapted to transfer a preselected magnitude of thermal energy to contacted matter, and wherein the resilient heating member is adapted to conformably contact matter.

Fig. 1A

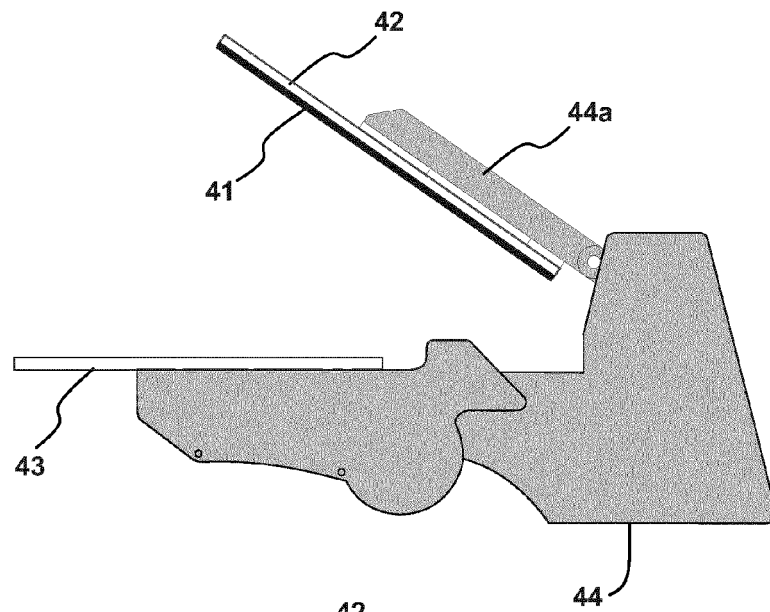


Fig. 1B

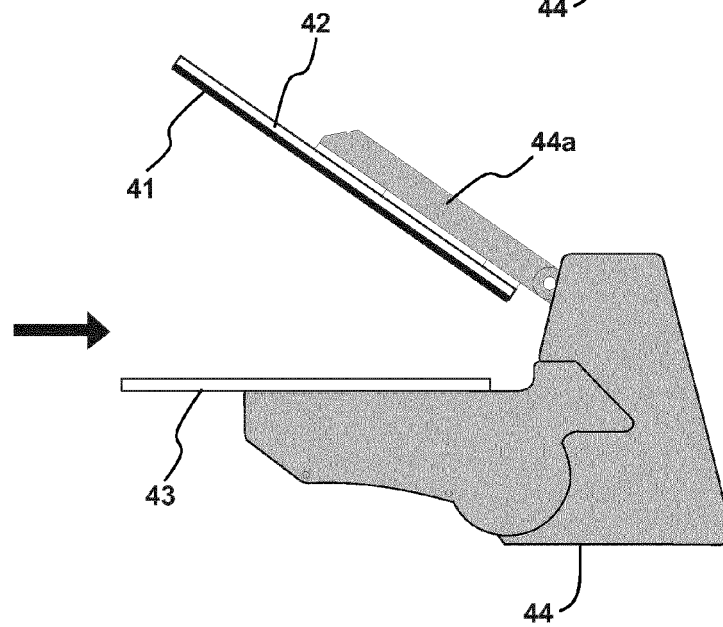
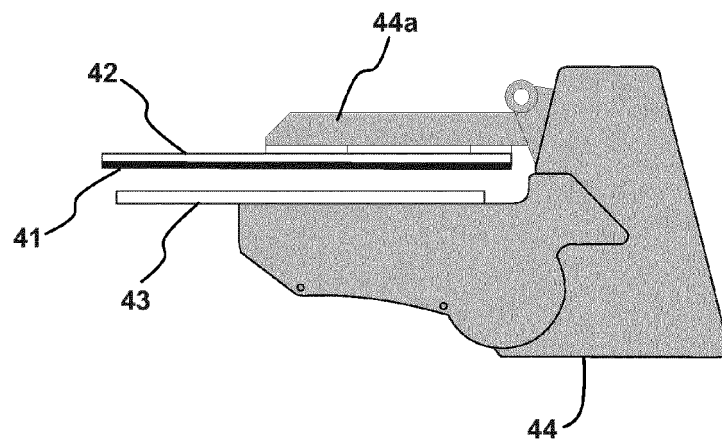
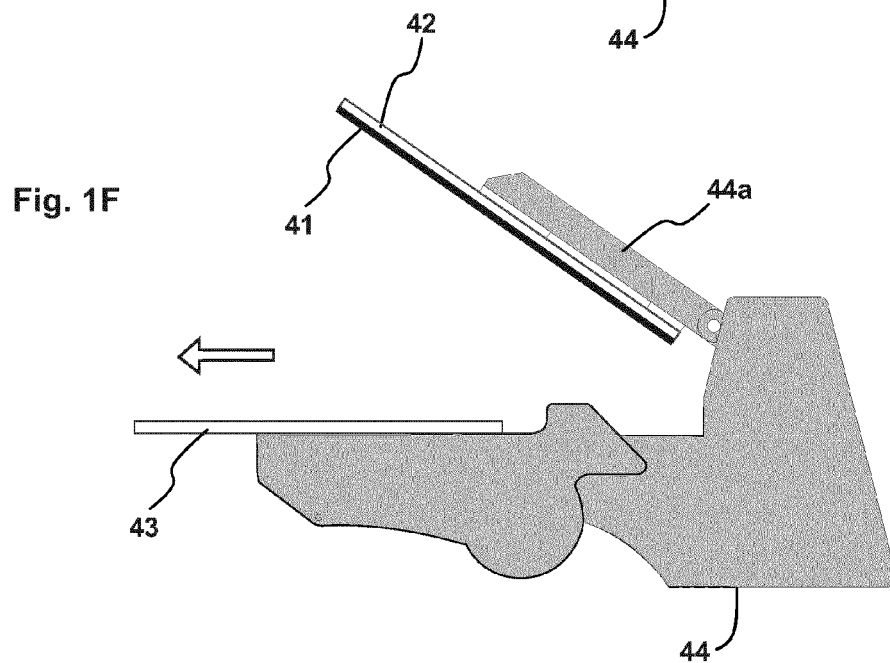
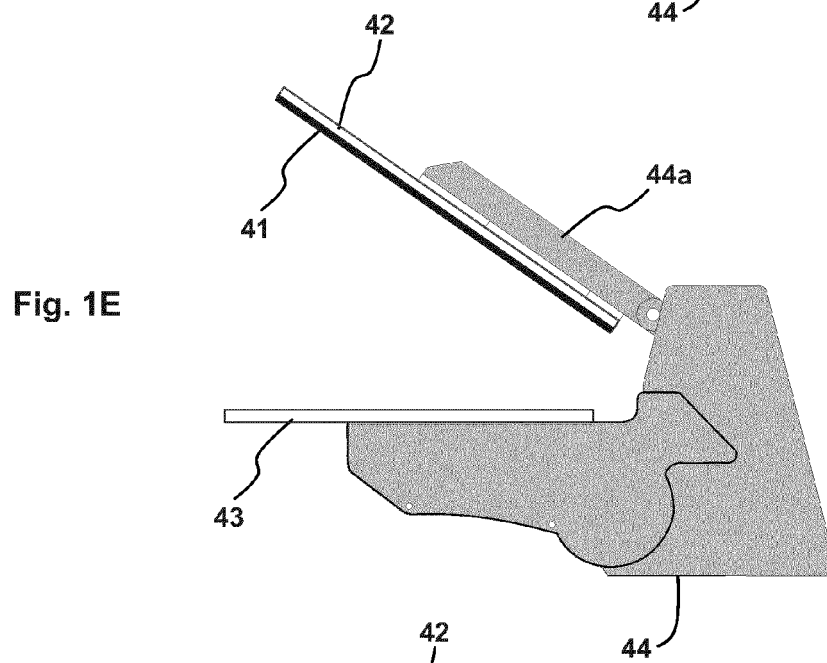
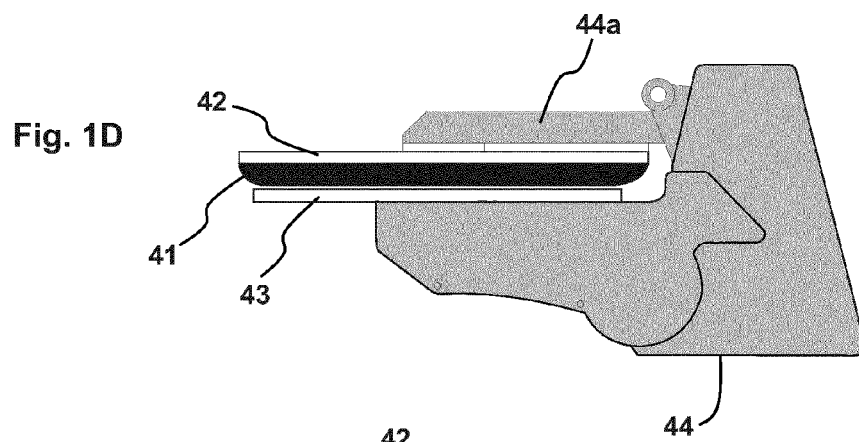


Fig. 1C





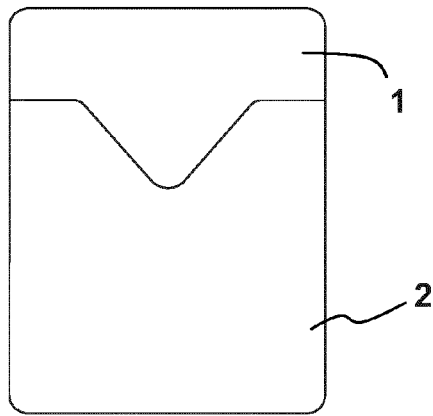


Fig. 2A

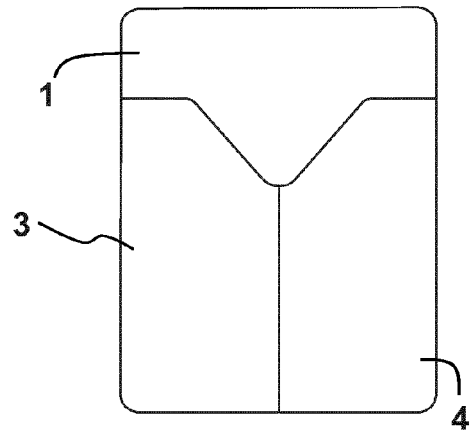


Fig. 2B

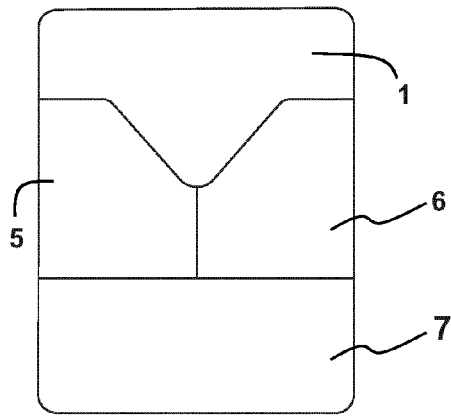


Fig. 2C

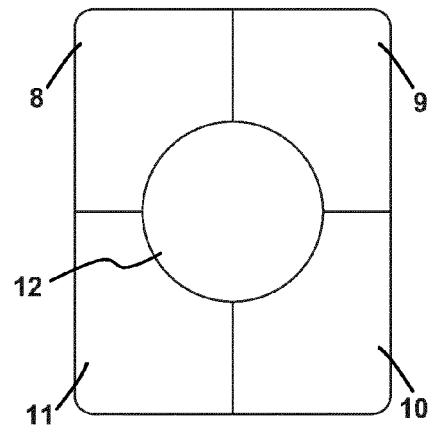


Fig. 2D

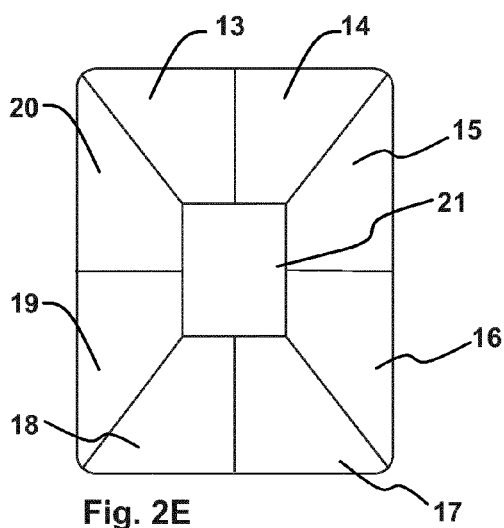


Fig. 2E

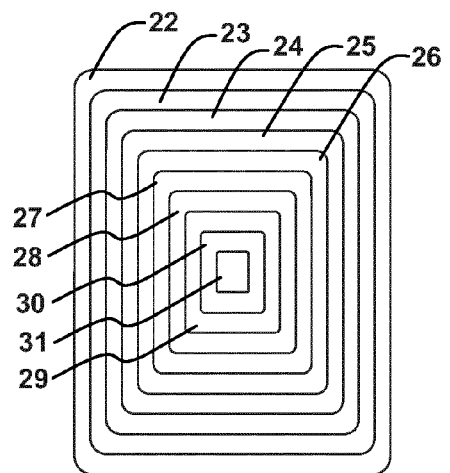
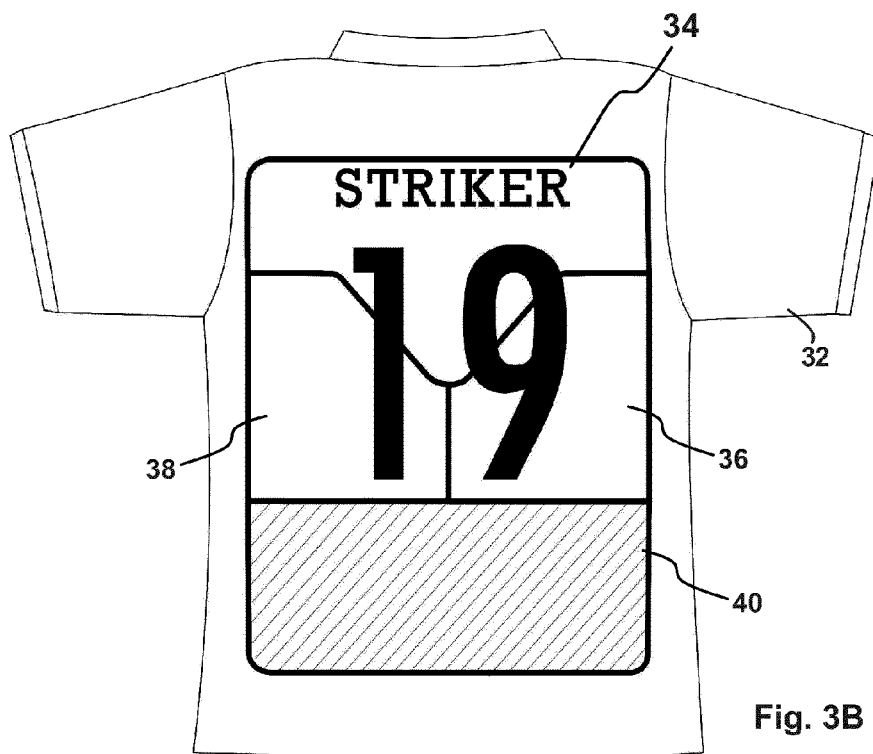


Fig. 2F





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EP 14 17 5869

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Place of search		Date of completion of the search	Examiner
The Hague		9 January 2015	Didenot, Benjamin
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