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(54) **DEVICE FOR CUTTING SHEET-LIKE MATERIALS AND ASSOCIATED METHOD**

(57) Device (100) for the cutting of a sheet-like material, comprising:

- a cutting head (110) movable along at least a first axis (X) and having a body (111) and a blade (112) movable with respect to said body (111),
- a striking surface (113) for said blade (112);
- a first actuator (114) for a movement of said blade (112) with respect to said body (111);

wherein said blade (112) is movable at least along a first auxiliary axis (Z) inclined with respect to said first axis (X), between a zeroing position (P0) in which it is in contact or substantial proximity of said striking surface (113) and at least a first cutting position (P1), different with respect to said zeroing position (P0) for the cutting of said sheet-like material,

said device (100) having:

- a configuration of calibration of the position of said blade (112), in which said blade (112) is moved with respect to said body (111) to be placed in said zeroing position (P0) and/or is retained in said zeroing position (P0),
- a cutting configuration, wherein said blade (112) is moved with respect to said body (111) to be placed in said at least a first cutting position (P1) and/or is retained in said at least a first cutting position (P1);

said device (100) comprising a sensor (115) operatively connected with said striking surface (113) and with said blade (112) and configured to identify in a substantially automatic way said contact or substantial proximity of said blade (112) with said striking surface (113);
said sensor (115) being configured to transmit, upon an identification of said contact or substantial proximity of said blade (112) with said striking surface (113), a control

signal destined to determine the stopping of said first actuator (114) and the reaching of said zeroing position (P0).

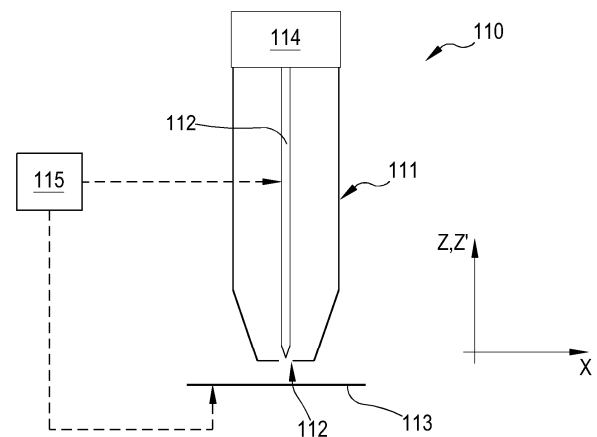


FIG.2

DescriptionField of the art

[0001] The present disclosure refers to the field of the cutting devices destined to cut sheet-like materials.

Known art

[0002] Sheet-like materials, typically extending over a surface of substantially greater dimension with respect to the thickness, are typically cut either manually or by means of at least partially automatic devices.

[0003] Such devices typically comprise a cutting head movable along at least one axis, and typically along at least two axes that define a working plane. The cutting head includes a blade, for cutting the sheet-like material.

[0004] In the specific field of electronic devices, devices of this type are typically used for the cutting of substantially transparent layers destined to become protective layers for screens of tablet or smartphone devices.

[0005] The sheet-like material is typically arranged on a support plane, that supports in use the sheet-like material.

[0006] It is further known that cutting devices are provided with a blade that is movable with respect to the cutting head, typically along an axis orthogonal to the working plane, and it is further known that it is important that a zeroing position be defined wherein the blade is arranged substantially in contact with a striking surface, in order to establish successive cutting positions in which the sheet-like material layer is cut in its entirety (entire thickness) and, possibly without affecting the underlying support plane.

[0007] CN 119 283 118 A discloses a sheet-like material cutting device comprising a cutting head provided with a blade, configured to allow to position the blade at a preset cutting distance and further provided with a cutting position adjustment device.

Summary

[0008] The Applicant has conceived a particular embodiment of a cutting device for sheet-like materials, that is herein described in some of its main aspects.

[0009] The Applicant has also conceived the method of arranging a cutting of sheet-like materials, that is herein described in some of its main aspects.

[0010] The method and the device advantageously allow to zero the position of the blade with respect to a predefined striking in order to promote the cutting accuracy of the sheet-like material, and in particular by reducing the risk that the cutting takes place for an insufficient or excessive depth.

[0011] The aspects herein described can be combined with each other or with portions of the detailed description.

[0012] In accordance with a first independent aspect, it is herein described a device (100) for the cutting of a sheet-like material, comprising:

- a cutting head (110) movable along at least a first axis (X) and having a body (111) and a blade (112) movable with respect to said body (111),
- a striking surface (113) for said blade (112);
- a first actuator (114) for a movement of said blade (112) with respect to said body (111);

wherein said blade (112) is movable at least along a first auxiliary axis (Z) inclined with respect to said first axis (X), between a zeroing position (P0) in which it is in contact or substantial proximity of said striking surface (113) and at least a first cutting position (P1), different with respect to said zeroing position (P0) for the cutting of said sheet-like material,

said device (100) having:

- a configuration of calibration of the position of said blade (112), in which said blade (112) is moved with respect to said body (111) to be placed in said zeroing position (P0) and/or is retained in said zeroing position (P0),
- a cutting configuration, wherein said blade (112) is moved with respect to said body (111) to be placed in said at least a first cutting position (P1) and/or is retained in said at least a first cutting position (P1);

said device (100) comprising a sensor (115) operatively connected with said striking surface (113) and with said blade (112) and configured to identify in a substantially automatic way said contact or substantial proximity of said blade (112) with said striking surface (113);

said sensor (115) being configured to transmit, upon an identification of said contact or substantial proximity of said blade (112) with said striking surface (113), a control signal destined to determine the stopping of said first actuator (114) and the reaching of said zeroing position (P0).

[0013] According to another non-limiting aspect, in said configuration of calibration of the position of said blade (112), said device (100) is configured to carry out a step of zeroing (2001-2003) comprising:

- activating (2001) said first actuator (114) determining a movement (1001a) of said blade (112) with respect to said striking surface (113) from a starting position (Pa) spaced with respect to said striking surface (113) up to said zeroing position (P0);

- stopping (2003) said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when said sensor (115), through the identification of said contact or substantial proximity of said blade (112) with said striking surface (113), transmits said control signal.

[0014] According to another non-limiting aspect, said device (100) is configured to enter into said cutting configuration only after a completion of said configuration of calibration of the position of said blade (112), in particular only after the transmission of said control signal.

[0015] According to another non-limiting aspect, said device (100) is configured to keep, when in said configuration of calibration of the position of said blade (112), the body (111) of said cutting head (110) in a predefined positional relationship, optionally at a predefined distance, with respect to said striking surface (113).

[0016] According to another non-limiting aspect, said first actuator (114) is an actuator of electrical type, and optionally is an electric motor, and/or wherein said device (100) is configured to move said blade (112) with respect to said body (111) through said first actuator (114) with a sub-millimeter accuracy.

[0017] According to another non-limiting aspect, said device (100) has a configuration of calibration of the position of said cutting head (110), wherein said device (100) is configured to carry out, and/or allow the execution of, a step of zeroing of a position of said cutting head (110), comprising a movement (1001) of a predefined portion of said body (111) proximal to the striking surface (113) with respect to said striking surface (113).

[0018] According to another non-limiting aspect, said step of zeroing comprises arranging (1001a, 1002), by effect of said movement, said predefined portion of said body (111), in contact or in substantial proximity with said striking surface (113) and/or retaining said predefined portion of said body (111) in contact or in substantial proximity with said striking surface (113).

[0019] According to another non-limiting aspect, said device (100) is configured to enable the configuration of calibration of the position of said blade (112) only after the enabling and completion of said configuration of calibration of the position of said cutting head (110).

[0020] According to another non-limiting aspect, said device (100) comprises a second actuator (116) for a movement of said predefined portion of said body (111) with respect to said striking surface (113).

[0021] According to another non-limiting aspect, in said configuration of calibration of the position of said cutting head (110), said device (100) is configured to carry out said step of zeroing wherein the movement of said predefined portion of said body (111) comprises:

- activating said second actuator (116) determining a movement (1001) of said predefined portion of said body (111) with respect to said striking surface (113) until said predefined portion of said body comes in

contact or in substantial proximity with said striking surface (113);

- stopping (1001a) said second actuator (116) determining a stopping of said predefined portion of said body (111) with respect to said striking surface (113), when (1002) said predefined portion of said body (111) is in said contact or substantial proximity with said striking surface (113).

[0022] According to another non-limiting aspect, said second actuator (116) is an actuator of electrical type, and optionally is an electric motor, and/or wherein said device (100) is configured to move said predefined portion of said body (111) with a sub-millimeter accuracy.

[0023] According to another non-limiting aspect, said step of zeroing of the position of said cutting head (110) is a manual step of zeroing.

[0024] According to another non-limiting aspect, said cutting head (110) comprises or is connected with a controlling organ, configured to be manually controlled by a user.

[0025] According to another non-limiting aspect, said controlling organ determines said movement of said predefined portion of said body (111).

[0026] According to another non-limiting aspect, said cutting head (110) is movable along a second auxiliary axis (Z'), preferably parallel to, and optionally coinciding with, said first auxiliary axis (Z).

[0027] According to another non-limiting aspect, said movement of said predefined portion of said body (111) with respect to said striking surface (113) takes place along said second auxiliary axis (Z').

[0028] According to another non-limiting aspect, said sensor (115) is configured to identify an electrical and/or magnetic contact existing between said blade (112) and said striking surface (113), and/or said striking surface (113) is an electrically and/or magnetically conductive surface.

[0029] According to another non-limiting aspect, said striking surface (113) is a surface having a higher ductility with respect to a ductility of said blade (112) and/or said striking surface (113) is a surface having a lower hardness with respect to a hardness of said blade (112).

[0030] According to another non-limiting aspect, in said configuration of calibration of the position of said cutting head (110), said blade (112) is kept in a predefined fixed position with respect to said body (111).

[0031] According to another non-limiting aspect, said predefined position is a position such that said blade (112) is substantially enclosed within said body (111) and/or does not protrude with respect to said predefined portion of said body (111) proximal with respect to said striking surface (113).

[0032] According to another non-limiting aspect, in said configuration of calibration of the position of said blade (112), said predefined portion of said body (111) proximal with respect to said striking surface (113) is kept

in said contact or substantial proximity with said striking surface (113).

[0033] According to another non-limiting aspect, said cutting head (110) comprises a blade-carrier for said blade (112).

[0034] According to another non-limiting aspect, said blade (112) is removably connected, preferably operatively removably connected, with said cutting head (110) on said blade-carrier.

[0035] According to another non-limiting aspect, said device (100) comprises a supporting base for said striking surface (113) and said striking surface (113) is removably connected with, in particular supported by, optionally operatively removably connected with, in particular supported by, said supporting base.

[0036] According to another non-limiting aspect, said cutting head (110) is movable along at least a second axis (Y) inclined, optionally orthogonal, with respect to said first axis (X).

[0037] According to another non-limiting aspect, said first axis (X) and said second axis (Y) define a working plane, in particular a cutting plane.

[0038] According to another non-limiting aspect, said cutting plane is a cutting plane for said sheet-like material.

[0039] According to another non-limiting aspect, in said configuration of calibration of the position of said blade (112) and/or in said configuration of calibration of the position of said cutting head (110), said cutting head (110) is kept in a fixed position on said first axis (X) and/or on said second axis (Y).

[0040] According to another non-limiting aspect, said device (100), in said cutting configuration, is configured to move said cutting head (110) along at least one between said first axis (X) and said second axis (Y) for carrying out a cutting of said sheet-like material along a predefined path, with at least a first predefined movement speed along at least one of said first axis (X) and said second axis (Y) or with at least a first predefined movement speed range along at least one of said first axis (X) and said second axis (Y).

[0041] According to another non-limiting aspect, said blade (112), in said cutting configuration, can be also moved in a second cutting position (P2), different with respect to said zeroing position (P0) and different with respect to said first cutting position (P1), for the cutting of said sheet-like material.

[0042] According to another non-limiting aspect, said device (100) is configured to electronically acquire data comprising one or more characteristics of said sheet-like material, said characteristics comprising at least one type of material and/or a thickness of said sheet-like material.

[0043] According to another non-limiting aspect, said device (100) is configured to adjust said first predefined movement speed or said first predefined movement speed range, in accordance with said data and/or to move said blade (112) in one of said first cutting position (P1) and said second cutting position (P2), in accordance

with said data, and/or to adjust an inclination of said first auxiliary axis (Z) with respect to said working plane, in accordance with said data.

[0044] According to another non-limiting aspect, said device is configured to keep said first cutting position (P1) or one of said first cutting position (P1) and said second cutting position (P2) for the whole duration of said cutting configuration, and/or is configured to electronically load movement path data of said cutting head (110) and to determine a movement of said cutting head (110) along at least one of said first axis (X) and said second axis (Y), or to move said cutting head (110), in said cutting configuration, on at least one of said first axis (X) and said second axis (Y).

[0045] According to another non-limiting aspect, said device (100) comprises a configuration of identification of a thickness of said sheet-like material comprising:

- activating said configuration of calibration of the position of said blade (112), and carrying out a step of zeroing (2000-2003), electronically storing, as a reference height the height at which there is the identification of said contact or substantial proximity of said blade (112) with said striking surface (113);
- subsequently, after a positioning of said sheet-like material on said striking surface (113):
 - activating again said first actuator (114) determining a movement (1001a) of said blade (112) with respect to said striking surface (113) and with respect to said sheet-like material from a starting position spaced with respect to said striking surface (113) and with respect to said sheet-like material, up to a position wherein said blade (112) is in contact or in substantial proximity with said sheet-like material;
 - stopping said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when there is an identification of said contact or substantial proximity of said blade (112) with said sheet-like material,
 - electronically storing, the height (h') at which there is the identification of said contact or substantial proximity of said blade (112) with said sheet-like material;
 - electronically assigning, as thickness of said sheet-like material, a differential between said height (h') and said reference height,
 - adjusting said at least one first cutting position (P1) in accordance with said thickness or selecting at least one cutting position among a plurality of cutting positions (P1,... Pn) in accordance with said thickness.

[0046] According to another non-limiting aspect, said device (100) comprises an identification configuration of a thickness of said sheet-like material comprising:

- activating said configuration of calibration of the position of said cutting head (110), and carrying out said step of zeroing of a position of said cutting head (110), comprising the movement of the predefined portion of said body (111) proximal to the striking surface (113) with respect to said striking surface (113) and comprising arranging by effect of said movement, said predefined portion of said body (111), in contact or in substantial proximity with said striking surface (113) and/or retaining said predefined portion of said body (111) in contact or in substantial proximity with said striking surface (113);
- subsequently, after a positioning of said sheet-like material on said striking surface (113):
 - activating again said second actuator (116) determining a movement of said predefined portion of said body (111) with respect to said striking surface (113) and with respect to said sheet-like material, from a starting position spaced with respect to said striking surface (113) and with respect to said sheet-like material, until said predefined portion of said body comes in contact or in substantial proximity with said sheet-like material;
 - stopping said second actuator (116) determining a stopping of said predefined portion of said body (111) with respect to said striking surface (113), when said predefined portion of said body (111) is in said contact or substantial proximity with said sheet-like material;
- electronically storing, the height (h') at which there is the identification of said contact or substantial proximity of said blade (112) with said sheet-like material;
- electronically assigning, as thickness of said sheet-like material, a differential between said height (h') and said reference height,
- adjusting said at least one first cutting position (P1) in accordance with said thickness or selecting at least one cutting position among a plurality of cutting positions (P1,... Pn) in accordance with said thickness.

[0047] In accordance with another independent aspect, it is herein described a method of arranging a cutting of a sheet-like material, comprising activating a device (100) for the cutting of a sheet-like material, comprising:

- a cutting head (110) movable along at least a first axis

(X) and having a body (111) and a blade (112) movable with respect to said body (111),

- a striking surface (113) for said blade (112);
- a first actuator (114) for a movement of said blade (112) with respect to said body (111),
- a sensor (115) operatively connected with said striking surface (113) and with said blade (112) and configured to identify in a substantially automatic way said contact or substantial proximity of said blade (112) with said striking surface (113);

wherein said blade (112) is movable at least along a first auxiliary axis (Z) inclined with respect to said first axis (X), between a zeroing position (P0) in which it is in contact or substantial proximity of said striking surface (113) and at least a first cutting position (P1), different with respect to said zeroing position (P0) for the cutting of said sheet-like material,

wherein said method comprises:

- starting a step of calibration of the position of said blade (112), comprising moving said blade (112) with respect to said body (111) and placing said blade (112) in said zeroing position (P0) and/or retaining said blade (112) in said zeroing position (P0),
- starting a step of arranging the cutting of said sheet-like material, comprising moving said blade (112) with respect to said body (111) and placing said blade (112) in said at least a first cutting position (P1) and/or retaining said blade (112) in said at least a first cutting position (P1);

and wherein said method comprises transmitting, through said sensor (115), a control signal destined to determine the stopping of said first actuator (114) and the reaching of said zeroing position (P0).

[0048] According to another non-limiting aspect, said control signal is transmitted at an identification, carried out through said sensor (115) of said contact or substantial proximity of said blade (112) with said striking surface (113).

[0049] According to another non-limiting aspect, in said method, in said step of calibration of the position of said blade (112), there is a step of zeroing (2000-2003) comprising:

- activating (1001) said first actuator (114) and moving (1001a), through said actuator (114), said blade (112) with respect to said striking surface (113) from a starting position (Pa) spaced with respect to said

striking surface (113) up to said zeroing position (P0);

- stopping (1002) said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when said sensor (115), through the identification of said contact or substantial proximity of said blade (112) with said striking surface (113), transmits said control signal.

[0050] According to another non-limiting aspect, said method comprises starting said step of arranging for the cutting only after a completion of said step of calibration of the position of said blade (112), in particular only after the transmission of said control signal.

[0051] According to another non-limiting aspect, said method comprises, when in said step of calibration of the position of said blade (112), keeping the body (111) of said cutting head (110) in a predefined positional relationship, optionally a predefined distance, with respect to said striking surface (113).

[0052] According to another non-limiting aspect, said first actuator (114) is an actuator of electrical type, and optionally is an electric motor, and/or said method comprises moving said blade (112) with respect to said body (111) through said first actuator (114) with a sub-millimeter accuracy.

[0053] According to another non-limiting aspect, said method comprises a step of calibration of the position of said cutting head (110), comprising carrying out a movement of a predefined portion of said body (111) proximal to the striking surface (113) with respect to said striking surface (113).

[0054] According to another non-limiting aspect, said method comprises arranging, by effect of said movement, said predefined portion of said body (111), in contact or in substantial proximity with said striking surface (113) and/or comprises retaining said predefined portion of said body (111) in contact or in substantial proximity with said striking surface (113).

[0055] According to another non-limiting aspect, said method comprises carrying out the step of zeroing of the position of the blade (112) after the execution and completion of the execution of the step of zeroing of the position of the cutting head (110).

[0056] According to another non-limiting aspect, said method comprises activating a second actuator (116) of said device (100) for a movement of said predefined portion of said body (111) with respect to said striking surface (113).

[0057] According to another non-limiting aspect, in said step of calibration of the position of said cutting head (110), the movement of said predefined portion of said body (111) comprises:

- activating said second actuator (116) and moving, through said second actuator (116), said predefined portion of said body (111) with respect to said striking surface (113) until said predefined portion of said

body comes in contact or in substantial proximity with said striking surface (113);

- stopping said second actuator (116) determining a stopping of said predefined portion of said body (111) with respect to said striking surface (113), when said predefined portion of said body (111) is in said contact or substantial proximity with said striking surface (113).

[0058] According to another non-limiting aspect, said second actuator (116) is an actuator of electrical type, and optionally is an electric motor, and/or said method comprises moving said predefined portion of said body (111) with a sub-millimeter accuracy.

[0059] According to another non-limiting aspect, said step of zeroing of the position of said cutting head (110) is a manual step of zeroing.

[0060] According to another non-limiting aspect, said method comprises manually commanding a controlling organ part of, or connected with, said cutting head (110), the command of said controlling organ determining said movement of said predefined portion of said body (111).

[0061] According to another non-limiting aspect, said method comprises moving said cutting head (110), preferably in said step of zeroing of the position of said cutting head (110), along a second auxiliary axis (Z'), preferably parallel to, and optionally coinciding with, said first auxiliary axis (Z).

[0062] According to another non-limiting aspect, said movement of said predefined portion of said body (111) with respect to said striking surface (113) takes place along said second auxiliary axis (Z').

[0063] According to another non-limiting aspect, in said method said sensor (115) is configured to identify an electrical and/or magnetic contact existing between said blade (112) and said striking surface (113), and/or said striking surface (113) is an electrically and/or magnetically conductive surface.

[0064] According to another non-limiting aspect, said method comprises identifying an electrical and/or magnetic contact existing between said blade (112) and said striking surface (113) for determining the stopping of the movement of said blade (112) when in contact or in substantial proximity with said striking surface (113) and/or said striking surface (113) is a surface having a ductility higher with respect to a ductility of said blade (112) and/or said striking surface (113) is a surface having a lower hardness with respect to a hardness of said blade (112).

[0065] According to another non-limiting aspect, in said step of calibration of the position of said cutting head (110), said blade (112) is kept in a predefined fixed position with respect to said body (111).

[0066] According to another non-limiting aspect, said predefined position is a position such that said blade (112) is substantially enclosed within said body (111) and/or does not protrude with respect to said predefined

portion of said body (111) proximal with respect to said striking surface (113).

[0067] According to another non-limiting aspect, in said step of calibration of the position of said blade (112), said predefined portion of said body (111) proximal with respect to said striking surface (113) is kept in said contact or substantial proximity with said striking surface (113).

[0068] According to another non-limiting aspect, said cutting head (110) comprises a blade-carrier for said blade (112) and said method comprises removably connecting, preferably operatively removably, said blade (112) to said cutting head (110) on said blade-carrier.

[0069] According to another non-limiting aspect, said device (100) comprises a supporting base for said striking surface (113) and said method comprises removably connecting, optionally operatively removably, said striking surface (113) to said supporting base, and in particular comprises supporting said striking surface (113) with said supporting base.

[0070] According to another non-limiting aspect, said method comprises moving the cutting head (110) along at least a second axis (Y) inclined, optionally orthogonal, with respect to said first axis (X).

[0071] According to another non-limiting aspect, said first axis (X) and said second axis (Y) define a working plane, in particular a cutting plane.

[0072] According to another non-limiting aspect, in said step of calibration of the position of said blade (112) and/or in said step of calibration of the position of said cutting head (110), said cutting head (110) is kept in a fixed position on said first axis (X) and/or on said second axis (Y).

[0073] According to another non-limiting aspect, in said step of arranging the cutting of said sheet-like material, said blade (112) can be moved in a second cutting position (P2), different with respect to said zeroing position (P0) and different with respect to said first cutting position (P1).

[0074] According to another non-limiting aspect, in said step of arranging the cutting said device (100) is pre-set to adjust a movement speed of said cutting head (110) along at least one between said first axis (X) and said second axis (Y) with at least a first predefined movement speed along at least one between said first axis (X) and said second axis (Y) or with at least a first predefined movement speed range along at least one between said first axis (X) and said second axis (Y).

[0075] According to another non-limiting aspect, said method comprises a step of electronic acquiring of data comprising one or more characteristics of said sheet-like material.

[0076] According to another non-limiting aspect, said characteristics comprise at least a type of material and/or a thickness of said sheet-like material.

[0077] According to another non-limiting aspect, said step of electronically acquiring taking place before the cutting of said sheet-like material.

[0078] In accordance with a further independent aspect it is herein described a method of cutting a sheet-like material, comprising a method according to one or more of the aspects herein described, said method comprising a step of cutting of said sheet-like material comprising a step of movement of said cutting head (110) along a predefined path on said at least a first axis (X) for cutting sheet-like material with said blade (112).

[0079] According to another non-limiting aspect, in said step of movement of said cutting head (110) along a predefined path, said blade (112) is kept, preferably for the whole predefined path, in one of said first cutting position (P1) or said second cutting position (P2).

[0080] According to another non-limiting aspect, said method comprises electronically loading movement path data of said cutting head (110) and comprises pre-setting a movement of said cutting head (110) along at least one between said first axis (X) and said second axis (Y) in accordance with said movement path data.

[0081] According to another non-limiting aspect, said method comprises electronically loading movement path data of said cutting head (110) and comprising moving, in said step of cutting of said sheet-like material, said cutting head (110), along on at least one between said first axis (X) and said second axis (Y), in accordance with said movement path data.

[0082] According to another non-limiting aspect, in said method of cutting said sheet-like material, it takes place first a step of definition of a movement speed of said cutting head (110) along at least one between said first axis (X) and said second axis (Y) with at least a first predefined movement speed along at least one between said first axis (X) and said second axis (Y) or with at least a first predefined movement speed range along at least one between said first axis (X) and said second axis (Y).

[0083] According to another non-limiting aspect, in said method, subsequently to said step of definition, there is a movement of said cutting head (110) along at least one between said first axis (X) and said second axis (Y) with a speed at least partially, optionally integrally, kept equal to said predefined movement speed or within said first predefined movement speed range, along at least one between said first axis (X) and said second axis (Y).

[0084] According to another non-limiting aspect, said method of arranging a cutting of said sheet-like material and/or said method of cutting said sheet-like material is at least partially automated.

[0085] According to another non-limiting aspect, the method of arranging a cutting of said sheet-like material and/or the method of cutting said sheet-like material comprises a step of identifying a thickness of said sheet-like material comprising:

- activating said configuration of calibration of the position of said blade (112), and carrying out a step of zeroing (2000-2003), electronically storing, as a reference height the height at which there is the

identification of said contact or substantial proximity of said blade (112) with said striking surface (113);

- subsequently, after a positioning of said sheet-like material on said striking surface (113):

- activating again said first actuator (114) determining a movement (1001a) of said blade (112) with respect to said striking surface (113) and with respect to said sheet-like material from a starting position spaced with respect to said striking surface (113) and with respect to said sheet-like material, up to a position wherein said blade (112) is in contact or in substantial proximity with said sheet-like material;

- stopping said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when there is an identification of said contact or substantial proximity of said blade (112) with said sheet-like material,

- electronically storing, the height (h') at which there is the identification of said contact or substantial proximity of said blade (112) with said sheet-like material;

- electronically assigning, as thickness of said sheet-like material, a differential between said height (h') and said reference height,

- adjusting said at least one first cutting position (P1) in accordance with said thickness or selecting at least one cutting position among a plurality of cutting positions (P1,... Pn) in accordance with said thickness.

[0086] According to another non-limiting aspect, the method of arranging a cutting of said sheet-like material and/or the method of cutting said sheet-like material comprises a step of identifying a thickness of said sheet-like material comprising:

- activating said configuration of calibration of the position of said cutting head (110), and carrying out said step of zeroing of a position of said cutting head (110), comprising the movement of the predefined portion of said body (111) proximal to the striking surface (113) with respect to said striking surface (113) and comprising arranging, by effect of said movement, said predefined portion of said body (111), in contact or in substantial proximity with said striking surface (113) and/or retaining said predefined portion of said body (111) in contact or in substantial proximity with said striking surface (113);

- subsequently, after a positioning of said sheet-like material on said striking surface (113):

- activating again said second actuator (116) determining a movement of said predefined portion of said body (111) with respect to said striking surface (113) and with respect to said sheet-like material, from a starting position spaced with respect to said striking surface (113) and with respect to said sheet-like material, until said predefined portion of said body comes in contact or in substantial proximity with said sheet-like material;

- stopping said second actuator (116) determining a stopping of said predefined portion of said body (111) with respect to said striking surface (113), when said predefined portion of said body (111) is in said contact or substantial proximity with said sheet-like material;

- electronically storing, the height (h') at which there is the identification of said contact or substantial proximity of said blade (112) with said sheet-like material;

- electronically assigning, as thickness of said sheet-like material, a differential between said height (h') and said reference height,

- adjusting said at least one first cutting position (P1) in accordance with said thickness or selecting at least one cutting position among a plurality of cutting positions (P1,... Pn) in accordance with said thickness.

[0087] According to another non-limiting aspect, adjusting said at least one first cutting position (P1) in accordance with said thickness or selecting at least one cutting position among a plurality of cutting positions (P1,... Pn) in accordance with said thickness comprises adjusting a protrusion of said blade (112) from a predefined portion of said cutting head (110) for a length substantially equal to said thickness.

[0088] In accordance with another independent aspect it is herein described a computer program, stored on a memory support; said computer program comprising software code portions that when executed cause the execution of the steps of the method of arranging a cutting of sheet-like materials and/or of the method of cutting sheet-like materials in accordance to one or more of the herein described aspects.

Figures

[0089] The following detailed description refers to the attached figures, a short description thereof is provided below.

Figure 1 shows schematically a device according to the present disclosure, in a perspective view. The device comprises a cutting head movable along a

first and a second axis orthogonal to each other.

Figure 2 shows a schematic representation in a side view (X-Z plane) of the cutting head.

Figure 3 shows a specific configuration of the device object of the present disclosure, wherein the cutting head has a proximal portion that may be spaced apart with respect to a striking surface but that is the one which in use is the closest with respect to the striking surface. A blade for the cutting of sheet-like materials is enclosed entirely within the body of the cutting head, and does not protrude from the proximal portion.

Figure 4 shows a specific configuration of the device object of the present disclosure, wherein the cutting head has a proximal portion placed in contact or in substantial proximity with the striking surface and wherein the blade is enclosed entirely within the body of the cutting head. It is noted that the proximal portion of the blade is positioned at a distance D from the striking surface.

Figure 5 shows a specific configuration of the device object of the present disclosure, wherein the cutting head has a proximal portion placed in contact or in substantial proximity with the striking surface and wherein the blade, in particular the proximal portion of the blade, is arranged in contact or in substantial proximity with the striking surface.

Figure 6 shows a specific configuration of the device object of the present disclosure. Such specific configuration is a cutting configuration. In such configuration there is the presence of a proximal portion of the blade that extends outside the body of the cutting head and is closer to the striking surface with respect to the proximal portion of the body of the cutting head.

Figure 7 shows a block diagram describing a step of zeroing of the cutting head and a step of zeroing of the blade.

Detailed description

[0090] The present disclosure refers first of all to a device, identified as a whole by the numeral reference 100, that is configured to carry out the cutting of sheet-like materials. As will become clear from the following description, the device herein described comprises zeroing configurations, for the cutting blade and for the cutting head, that contribute to reduce the risk of an insufficient or excessive cutting depth of the sheet-like material.

[0091] The activation of the device herein described involves the execution of a method. Such method is herein defined as a method of preparation of the cutting

of sheet-like materials. The present disclosure, however, refers to a method of cutting sheet-like materials that comprises the aforementioned preparation method.

[0092] In the present description, in order to avoid an excessive length of the text, the operative configurations of the device 100 that clearly outline a particular mode or sequence of operations are not always further described as steps of a method. It is nonetheless understood that operative configurations may correspond to equivalent steps of execution of a method and vice versa.

Structure of the device

[0093] The device 100 object of the present disclosure comprises a cutting head 110 that comprises:

- a body 111, suitable for supporting a blade 112 for the cutting of sheet-like materials,
- the blade 112.

[0094] As schematically represented in Figure 1, the device 100 object of the present disclosure further comprises a striking surface 113, with respect to which the cutting head 110 in use is moved. Preferably the striking surface 113 is substantially planar. As will be better clarified in the following portions of the description, the device 100 object of the present disclosure is configured to allow a calibration of the position assumed by the cutting head / blade with respect to the striking surface 113. In some embodiments, the striking surface 113 may be the sheet-like material itself.

[0095] In some embodiments, the striking surface 113 is realized in a substantially rigid material. Alternatively, the striking surface 113 may be realized in a relatively soft material, in particular a more ductile material and/or with a hardness lower with respect to the hardness of the blade 112.

[0096] As will become clear upon reading the following description, the blade 112 is configured to come into contact with the striking surface 113: if such striking surface 113 were of greater hardness or lower ductility with respect to the blade 112, there would be a concrete risk of damage to the part of the blade that comes into contact with the striking surface, and this would compromise the cutting performance of the blade.

[0097] In some embodiments, the striking surface 113 may be removable from the device 100. Optionally, such striking surface 113 may be operatively removable from the device 100. For the purposes of the present disclosure, as "operatively removable" is intended the possibility of removing the striking surface 113 from the device 100 without the need for complex operations and/or the use of tools, and therefore it is identified a technical feature such that the striking surface 113 is removable during conventional use of the device herein described.

[0098] The device 100 comprises a supporting base, also preferably planar, on which the striking surface 113 is

fixed - optionally in a removable way.

[0099] The blade comprises a proximal portion, that is the portion which in use is closer to the striking surface 113 and which in use is furthermore closer to and first comes into contact with the sheet-like material.

[0100] Repeated contacts between the proximal portion of the blade 112 and the striking surface 113 may cause a damage, even if minimal, to the striking surface 113. The replaceability of the striking surface 113 promotes a maintenance of consistent accuracy performance in the calibration of the position of the blade / cutting head.

[0101] In an embodiment, the cutting head 110 comprises a front portion 110f that is further the front portion of the body 111. Such front portion 110f can be considered as proximal portion of the cutting head, more in particular of the body 111 of the cutting head that is more distant with respect to the mono- or double-axial support, and is the portion that in use is the closest to the striking surface 113.

[0102] Preferably the body 111 comprises a cavity suitable for housing the blade 112 and has, in correspondence of the front portion 110f, an orifice 110r from which, in use, the blade 112 can protrude in accordance with one or more positions assumed in the modes described hereinafter.

[0103] The blade 112 is a blade destined to cut material layers destined to the realization of covers for electronic devices, in particular covers for smartphone devices and/or tablets. Such covers are preferably covers for displays.

[0104] The cited material is in thin layer, and conveniently can be a polymeric material. Preferably, albeit in a non-limiting extent, such material is a substantially transparent material, i.e. capable of allowing a substantial transmission of the optical radiation, at least within the visible spectrum.

[0105] For the purposes of the present disclosure, a thin layer can be considered a layer wherein the planar extension of the material is greater than at least 20 times or greater than 30 times or greater than 50 times the thickness of the material itself.

[0106] Some types of material destined to be cut by the blade 112 can be of a substantially elastic type.

[0107] The material destined to be cut by the blade 112 can be a multilayer or single layer material. In the case of multilayer material, the material can comprise an adhesive layer and a sacrificial layer suitable for being removed prior to the application of the material on the electronic device. In use, conveniently, the adhesive material layer can be the one in direct contact with the screen of the electronic device.

[0108] The blade 112 is a removable blade, preferably realized in a metallic material, for example stainless steel, and is fixed on a blade-carrier arranged in the body 111 of the cutting head 110. In a preferred embodiment, the blade 112 is operatively removably fixed to the blade-carrier. "Operatively" implies that the blade 112 can be

removed by the operator during a normal cycle of operation of the device 100, clearly when the cutting head 100 is kept still on all its axes of movement, and neither the use of complex tools or procedures, nor the intervention of skilled technicians, is necessary to remove the blade 112. Removing the blade 112 in operative configurations is preferable: certain sheet-like materials can have a significant hardness, and reduce the cutting performances of the blade 112 in few operative cycles. A rapid replaceability of the blade 112 allows to reduce the dead times and keep at the same time high the quality of cutting of the sheet-like material.

[0109] In an embodiment, the cutting head 110 is configured to move along a single axis (first axis X). However, conveniently, the cutting head 110 is preferably configured to move on a first axis X and on a second axis Y inclined to each other, preferably orthogonal, and arranged parallel to a working plane 190 upon which is in use placed the layer 200 of material to cut.

[0110] The cutting head 110 is moved by actuators, part of the device 100 object of the present disclosure, that allow its movement on the X-Y plane. Such actuators, conveniently, are actuators of electrical type, for example and in a non-limiting extent stepper motors. In order to ensure a sufficient cutting accuracy of the sheet-like material, the actuators that allow the movement of the cutting head on the X-Y plane allow a sub-millimeter movement.

[0111] The device 100 object of the present disclosure further comprises a data processing unit that can comprise a general-purpose processor, and/or a dedicated integrated circuit for the application (ASIC) and/or an FPGA. The data processing unit is operatively connected (electronically and/or electrically connected and/or optically connected) with a memory. The memory may be physically located on the device 100 or may alternatively be a memory arranged in a remote position with respect to the device 100. The data processing unit is intended to determine the execution of a method of arranging the cutting of sheet-like materials and a method of cutting sheet-like materials, as set out in the present description. It is therefore clear that the present disclosure further relates to a computer program, stored on a memory support accessible to the data processing unit; the computer program comprises portions of code that when executed determine the execution of the steps of a method of arranging a cutting of a sheet-like material, and of a method of cutting a sheet-like material as herein described.

[0112] The data processing unit is operatively connected to the actuators that allow the movement of the cutting head along the X-Y plane and controls their activation in order to determine a movement of the cutting head 110 along a predefined perimeter.

[0113] In an embodiment, the device 100 comprises a first actuator 114 that is configured to move the blade 112 along a first auxiliary axis Z. In particular, the first actuator 114 is configured to move the blade 112 with respect to

the body 111; such movement may occur with a translatory movement defined between a first end-stroke position and a second end-stroke position.

[0114] Preferably, but in a non-limiting extent, the first actuator 114 is an actuator of electrical type, operatively connected with, and in use controlled by, the data processing unit. Specifically, the first actuator 114 can be an electric motor, for example a stepper motor.

[0115] The first actuator 114 can be located in the cutting head 110, in particular being part of the body 111. Alternatively, the first actuator 114 can be located in, or be part of, a blade-carrier device, configured to removably retain the blade 112.

[0116] With respect to the X-Y plane, the first actuator 114 moves the blade 112 along a direction identified by a first auxiliary axis Z. Such axis is preferably orthogonal with respect to the X-Y plane.

[0117] In a non-limiting embodiment, the device 100 object of the present disclosure further comprises a second actuator 116 that is configured to move the cutting head 110 along a second auxiliary axis Z'. In particular, the second actuator 116 is configured to move the cutting head 110 with respect to the body 111; such movement may occur with a translatory movement defined between a first end-stroke position and a second end-stroke position.

[0118] Specifically, the second actuator 116 is configured to allow a movement of the cutting head 110 in approach or away with respect to the striking surface 113.

[0119] The second actuator 116, moving the cutting head 110 in approach or away with respect to the striking surface 113, further moves the blade 112 in approach and away as well. The latter, unless the first actuator 114 is activated, is moved integrally with the body 111 of the cutting head 110 in approach and away with respect to the striking surface 113, thus without relative movement with respect to the body 111.

[0120] Preferably, but in a non-limiting extent, the second actuator 116 is an actuator of electrical type, operatively connected with, and in use controlled by, the data processing unit. Specifically, the second actuator 116 can be an electric motor, for example a stepper motor.

[0121] Preferably, but in a non-limiting extent, the second auxiliary axis Z' is parallel, optionally coinciding with, the first auxiliary axis Z.

[0122] In another embodiment, the second actuator 116 can be absent; consequently, the movement of the cutting head 110 in approach or away with respect to the striking surface 113 takes place by means of a manual movement, carried out by the user. In this case the presence of the first actuator 114 with the characteristics described above is preserved.

[0123] The device 100 object of the present disclosure is configured to allow the detection of the contact of the blade 112 with the striking surface 113. In a preferred embodiment, the contact is detected by means of a sensor 115 that is part of the device object of the present disclosure. The sensor 115 is preferably a sensor of

electronic type, and is operatively connected with the data processing unit.

[0124] Specifically, the sensor 115 is destined to identify a contact, or substantial proximity, between the blade 112, in particular a proximal (end) portion of the blade 112 protruding from the body 111 of the cutting head 110 and the striking surface 113.

[0125] The sensor 115 is preferably a sensor configured to operate with electric and/or magnetic contact detection.

[0126] Conveniently, in this case, the striking surface 113 is an electrically and/or magnetically conductive surface.

[0127] In use, therefore, upon reaching the contact or substantial proximity of the proximal portion of the blade 112 with the striking surface 113, a circuit is closed and an alteration of electric potential or a passage of a weak electric current is determined; the sensor 115 detects such alteration of electric potential or such passage of such weak electric current, determining the reaching of the contact or substantial proximity and causing the sending of a control signal that determines the stopping of the movement of the blade 112 with respect to the striking surface. Such control signal is therefore a stopping signal.

[0128] In light of the above it is clear that the sensor 115 turns out to be operatively connected with the striking surface 113 and with the blade 112 in order to identify the reaching of the contact or substantial proximity previously described.

[0129] The position of substantial proximity can conveniently be a position such that the blade 112, in particular its proximal portion, is located at a distance of approximately a few tens or ten microns or 1/100 mm with respect to the striking surface 113.

[0130] Further, the accuracy with which the first actuator 114 and, where present, the second actuator 116, are capable of moving the blade 112 and, respectively, the cutting head 110, with respect to the striking surface 113 is in the same order of accuracy, i.e. a few tens or ten microns or 1/100 mm with respect to the striking surface 113.

[0131] In light of the two preceding paragraphs it is therefore clear that the movement accuracy of the body 111 with respect to the striking surface 113 and of the blade 112 with respect to the body 111, and consequently with respect to the striking surface 113, is sub-millimetric.

[0132] Such level of accuracy can be conveniently achieved by means of actuators operating with electric motors, for example of stepper type and with coupling between a worm screw and a circular toothed wheel (also known as "worm wheel gearing").

Cutting positions

[0133] The blade 112 can assume a plurality of cutting positions P1,...,Pn with respect to the body 111 of the cutting head 110. In particular, such positions can be

positions wherein the blade is more or less extended with respect to the front portion 110f of the cutting head 110 (in particular with respect to the orifice 110r) along the first auxiliary axis Z. It follows that in some preferred embodiments, the cutting positions P1,...,Pn are positions of axial extension (protrusion) of the blade 112 with respect to the body 111 of the cutting head 110.

[0134] The choice of a particular cutting position among the plurality of cutting positions P1,..., Pn is determined in accordance with one or more of the following parameters:

- inclination of the first auxiliary axis Z with respect to the X-Y plane;
- type of material;
- thickness of the material layer (thickness measured along a direction orthogonal to the X-Y plane).

[0135] In a simplified embodiment of the device 100, there is the presence of at least a first cutting position P1.

[0136] The cutting positions are positions wherein the sheet material layer is cut entirely, i.e. cut through its entire thickness. The thickness is clearly measured in a direction orthogonal with respect to the support plane of the sheet material layer.

[0137] The selection of an appropriate cutting position P1 is important, in particular in relation to the measure of the protrusion of the blade 112 with respect to the predefined portion of the body 111 of the cutting head along the first auxiliary axis Z.

[0138] An excessive protrusion of the blade can determine a cut of excessive depth, that can extend to the striking surface 113, if the cut of the sheet-like material takes place on the striking surface 113 or an incision of the support surface.

[0139] In any case, once it is determined which, among the plurality of cutting positions P1,... Pn, is selected, such cutting position is kept for the whole duration of the cutting.

Step of zeroing of the cutting head 110 (configuration of calibration of the position of the cutting head 110)

[0140] The present description describes some operative steps of the device 100 object of the present disclosure and refers also to the block diagram of figure 7.

[0141] The steps that are hereinafter described refer to a procedure of presetting of the device 100, that is destined to set the device 100 in an appropriate way to carry out the cutting of the sheet material.

[0142] The device 100 object of the present disclosure is configured first of all to carry out a step of movement of the cutting head 110. Such step is identified in the block diagram with the reference 1000.

[0143] The step of zeroing of the cutting head 110 may occur for example at each start-up cycle of the device

100, at each replacement of the blade 112, or alternatively whenever a user decides to proceed in this way by activating a zeroing command.

[0144] In the step of zeroing of the cutting head 110, the device 100 activates the second actuator 116 to move the cutting head 110 along the second auxiliary axis Z' so as to bring a predefined portion of the body 111 of the cutting head into contact or into substantial proximity with the striking surface 113 (block 1001).

[0145] Such predefined portion is conveniently a portion proximal to the striking surface 113.

[0146] In detail, figure 3 shows the cutting head in a position significantly spaced with respect to the striking surface 113. From the figure the blade 112 can be observed completely enclosed within the body 111 of the cutting head 110, not protruding from the proximal portion of the cutting head 110.

[0147] The movement along the second auxiliary axis Z' (block 1001a) is kept preferably in substantial temporal continuity until the predefined portion of the body 111 of the cutting head 110 comes in contact or in substantial proximity with the striking surface 113.

[0148] Figure 4, shows a configuration that takes place following the movement described in the previous paragraph. It is observed the cutting head with its proximal portion in substantial contact or proximity with the striking surface 113, and it is observed that the blade 112 is still completely enclosed in the body 111 of the cutting head. The relative position between the blade 112 and the body 111 of the cutting head is not changed.

[0149] The sensor 115 identifies the reaching of the position wherein the cutting head 110, in particular its front portion 110f, is in substantial proximity or in contact with the striking surface 113 (block 1002), and then the second actuator 116 is deactivated.

[0150] Clearly, if the cutting head 110, in particular its front portion 110f, were already located in correspondence with the striking surface 113, the step referred to in block 1001 is not necessary.

[0151] In the embodiments wherein the second actuator 116 is not present, the calibration of the position of the cutting head 110 takes place by means of a manual action, exerted by a user on a controlling organ arranged on the cutting head 110 or in any case operatively connected to the cutting head, so as to allow the movement of the cutting head 110 until a predefined portion of the body 111 proximal to the striking surface 113 comes into contact or substantial proximity with the striking surface 113.

[0152] In the case of manual zeroing, the contact or substantial proximity between the predefined portion of the body 111 proximal to the striking surface 113 and the striking surface 113 is determined manually or may be determined by means of the sensor 115.

[0153] Preferably, in the configuration of calibration of the position of the cutting head 110, the blade 112 is kept in a fixed position with respect to the body 111. In order to prevent the blade 112 from coming into contact with the striking surface 113 before the predefined portion of the

body 111 of the cutting head 110, the position assumed by the blade 112 during this calibration configuration is a position such that the blade is enclosed within the body 111, or in any case a position wherein it does not extend, along a direction substantially defined on the first and/or second auxiliary axis Z, Z', beyond the position detected by the predefined portion of the body 111 that is proximal to the striking surface 113.

Step of zeroing of the blade 112 (configuration of calibration of the position of the blade 112).

[0154] The device 100 object of the present disclosure is configured to carry out the step of zeroing of the blade 112 following the step of zeroing of the cutting head 110 (step 1000, blocks 1001-1002). Such step is identified in the block diagram with the reference 2000.

[0155] Conveniently the step of zeroing of the blade 112 is carried out automatically, without the need for user intervention. Thanks to this technical characteristic, the device 100 is easy to use, the personnel assigned to the cutting of the sheet-like material requires less training, and the consistency of cutting accuracy is improved.

[0156] In the step of zeroing of the blade 112, first of all (block 2001) the first actuator 114 is activated to move the blade 112 along the first auxiliary axis Z in such a way as to bring the blade 112 into the starting position Pa. The starting position Pa is a fully retracted position within the body 111 of the cutting head 110.

[0157] In correspondence with the starting position Pa, the blade 112 is at a distance D with respect to the striking surface 113. The distance D is measured along a direction substantially parallel to the axis Z.

[0158] Subsequently, (block 2002), when the blade 112 is in the starting position Pa, the first actuator 114 is activated to move the blade 112 along the first auxiliary axis Z, but in the opposite direction with respect to the movement direction of block 2001 (in the figures, therefore, downwards).

[0159] As a consequence, the relative position between the blade 112 and the body 111 of the cutting head 110 varies.

[0160] By effect of the activation of the first actuator 114, the blade 112 progressively moves until coming in correspondence with the front portion 110f of the cutting head 110, and in particular in correspondence with the orifice 110r. The movement of the blade along the first auxiliary axis Z (block 2002) is kept preferably in a substantially continuous manner until the blade 112 comes in contact with the striking surface 113.

[0161] Figure 5 shows the blade 112 whose proximal portion is in substantial contact with the striking surface 113. It is noted that also the front portion 110f of the cutting head 110 is in substantial contact with the striking surface 113.

[0162] By virtue of the contact or substantial proximity of the front portion 110f with the striking surface 113, when the blade comes in correspondence with the orifice

110r it also finds itself in contact or substantial correspondence with the striking surface 113.

[0163] At this point the sensor 115 identifies the presence of an electrical or magnetic contact (block 2002a) between the blade 112 and the striking surface 113, and sends an appropriate signal to the first actuator 114 so as to determine its stopping (block 2003).

[0164] At this point, the blade 112 is in the zeroing position P0.

Cutting step (cutting configuration)

[0165] In some embodiments, the cutting step can take place only following the step of zeroing of the cutting head and the step of zeroing of the blade. In other embodiments, it is not imperative that the cutting step be preceded by one of the two steps of zeroing in an operating cycle of the device 100.

[0166] If the device 100 object of the present disclosure carries out only the step of zeroing of the blade 112, or also the step of zeroing of the cutting head 110, it follows that the device 100 carries out a method of arranging a cutting of a sheet-like material. The word "arrangement" is herein used because the cutting of the sheet-like material has not yet taken place.

[0167] If the device 100 also carries out the cutting step that will be described hereinafter, then the device 100 describes a method of cutting a sheet-like material that comprises the aforementioned method of arrangement.

[0168] As will become clear from the portion of description that follows, the cutting step is a step that preferably is totally automated, and that therefore does not require operator intervention. In some embodiments, the device 100 may comprise a user interface with which it will be possible to confirm or stop the start of the cutting of the sheet-like material.

[0169] In the block diagram, the cutting step is identified by the number 3000. Figure 6 shows the blade 112 that protrudes from the front portion 110f of the body 111 of the cutting head 110.

[0170] In the cutting step, first the blade 112 is moved along the first auxiliary axis Z with respect to the cutting head 110, to a predefined cutting position that can be one among the n cutting positions P1,..., Pn determined in the ways above described.

[0171] The blade 112 is therefore moved from the position P0 to one among the positions P1,...,Pn herein described.

[0172] In an embodiment, the sheet-like material is arranged under the cutting head 110 and is leaning directly against the striking surface 113.

[0173] Subsequently, in the cutting step, the cutting head 110 is moved along a predefined path at least along the first axis X and, optionally, along the second axis Y to determine the cutting of the layer 200 along said predefined path.

[0174] The cutting path can be an open or closed, curved, with or without angular points path.

[0175] Conveniently, the path along which the cutting head 110 is moved is predetermined as a function of a template loaded from a memory. In particular, in a preferred embodiment, a data processing unit of the device herein described is configured to:

- load from a memory a template defining a cutting path to be carried out with the blade 112,
- move the cutting head along the axis X and/or the axis Y so as to replicate the cutting path defined in the template, so that the material layer is cut in accordance with the path itself, for example so that the perimeter of the material layer corresponds to the cutting path defined in the template.

[0176] Opportunely configured actuators are arranged so as to determine the movement of the cutting head 100 along the axis X and/or along the axis Y. Conveniently, such actuators are electric actuators, operatively controlled by the data processing unit.

[0177] In a preferred, but non-limiting embodiment, the data processing unit is configured to allow to adjust the translation speed of the cutting head 100 along the axis X and/or along the axis Y at a predetermined speed, which may for example be fixed during the cutting of a predefined path or vary between a minimum speed and a maximum speed during the execution of the cut.

[0178] In a non-limiting embodiment, the translation speed, whether fixed throughout the entire execution of the path, or variable during the execution of the path, may be established in its single value or in its range between the minimum speed and the maximum speed, in accordance with one or more of the following parameters:

- inclination of the first auxiliary axis Z with respect to the X-Y plane;
- type of material;
- thickness of the material layer (thickness measured along a direction orthogonal to the X-Y plane).

[0179] Therefore, in a non-limiting embodiment, the data processing unit is configured to receive electronic data relating to the type of material and/or to the thickness of the material layer, and to adapt the cutting speed in the manners described above in accordance with the aforementioned electronic data.

[0180] The electronic data may be conveniently retrieved from a visual identifier, for example a graphic pattern, or a barcode or a QR code, for example arranged on a protective or sacrificial film of the sheet-like material.

[0181] For example, the cutting speed may be increased as the angle of inclination of the first auxiliary axis Z with respect to the X-Y plane decreases, and/or may be increased as the thickness of the material layer

decreases.

[0182] In light of the description set forth above it is therefore clear that the device and the method described herein allow to obtain a precise zeroing of the position of the cutting head and of the blade with respect to the striking surface, and therefore contribute to improve the cutting accuracy of sheet-like materials.

[0183] The device of the present disclosure is destined to operate in a substantially automated manner. In particular, at least the steps described in figures 4, 5 and 6 may be carried out automatically, with a consequent reduction of the workload and of the attention required from the user.

[0184] The zeroing of the position of the blade 112 with respect to the striking surface 113 advantageously allows to compensate for any length difference between one blade and another (length measured along the axis Z or Z').

[0185] The adjustment of the cutting position, which may also occur automatically, allows the precise cutting of different types of sheet-like material, and reduces the risk of damage to the sheet-like material.

Automatic measurement of the thickness of the sheet-like material.

[0186] A peculiar characteristic of the device object of the present disclosure is the possibility of automatically measuring a thickness of the sheet-like material. This technical characteristic may advantageously allow a greater ease in deciding which, among the plurality of positions P1,..., Pn to adopt for cutting the sheet-like material.

[0187] The technical characteristic described above therefore contributes to reduce the risk that the selected cutting position is such that the cutting of the sheet-like material takes place with an insufficient thickness, thereby resulting in a portion of the thickness of the sheet-like material being uncut, or with an excessive thickness, resulting in an excessively deep cut, which causes the proximal portion of the blade 112 to incise upon the striking surface 113.

[0188] In a preferred, but non-limiting, embodiment, the measurement of the thickness of the sheet-like material is indirectly determined with the step of zeroing of the cutting head 110 and/or with the step of zeroing of the blade 112.

[0189] The cutting head 110, as already extensively described, is movable along an oblique axis, for simplicity of treatment orthogonal, with respect to the striking surface 113 that is here considered planar (lying on a plane parallel to the X-Y plane). The movement of the cutting head 110 along the second auxiliary axis Z' takes place by means of the second actuator 116 already described.

[0190] The plane on which the striking surface 113 lies is considered a plane at height zero (reference height). Consequently, the cutting head 110, in its movement along the second auxiliary axis Z', is located at a variable

height h with respect to the height zero.

[0191] It is assumed that the sheet-like material, substantially planar, is deposited directly on the striking surface 113, and that the cutting step takes place with the sheet-like material directly above the striking surface 113.

[0192] When the front portion 110f of the head is in contact or in substantial proximity of the striking surface 113 it is located at the reference height (height zero).

[0193] Repeating the operations previously described for the step of zeroing of the cutting head 110, the cutting head 110 is axially moved along the second auxiliary axis Z' starting from a spaced position with respect to the striking surface 113 and with respect to the sheet-like material overlying the latter, in such a way that the front portion 110f of the cutting head 110 is in contact or in substantial proximity of the sheet-like material, when such contact or substantial proximity takes place, the front portion 110f of the cutting head 100 is located at a height h' with respect to the reference height (height zero) that corresponds to the overall thickness of the sheet-like material.

[0194] In such case the device 100 object of the present disclosure is configured to store the height h' , and to set the cutting position among the plurality of cutting positions $P_1, \dots, P_n$ possible, so that the proximal portion of the blade 112 protrudes from the front portion 110f of the cutting head 100 for a length substantially equal to the height h' .

[0195] In a non-limiting embodiment, these operations take place by means of keeping the relative position between the blade 112 and the body 111 of the cutting head 110.

[0196] What is set out above is further achievable by means of a relative movement between the blade 112 and the body 111 of the cutting head 110, that takes place by means of the first actuator 114 already described; in this case, the body of the cutting head 110 will be kept at a fixed height with respect to the striking surface 113.

[0197] In this second variant, the body of the cutting head 110 is positioned at a predetermined height with respect to the striking surface 113; again, the height at which the striking surface 113 is arranged is identified as the reference height (zero height).

[0198] First, the blade 112 is moved by means of the first actuator 114 along the first auxiliary axis Z starting from a position spaced with respect to the striking surface 113 and further with respect to the sheet-like material, up to that the proximal portion thereof comes in contact or in substantial proximity of the striking surface 113.

[0199] When such contact or substantial proximity takes place, this means that the proximal portion of the blade 112 is located at the reference height (zero height).

[0200] By repeating the operation following the laying of the sheet-like material on the striking surface 113, when the proximal portion of the blade 112 is in contact or substantial proximity of the sheet-like material, the proximal portion of the blade 112 is at a height h' corre-

sponding to the overall thickness of the sheet-like material.

[0201] In such case the device 100 object of the present disclosure is configured to store the height h' , and to set the cutting position among the plurality of cutting positions $P_1, \dots, P_n$, so that the proximal portion of the blade 112 extends from the front portion 110f of the cutting head 100 by a length substantially equal to the height h' .

[0202] The indirect measurements of the thickness of the sheet-like material in the manners described above, advantageously allow to avoid that the thickness of the sheet-like material also needs to be stored in the electronic data relating to the type of material, and/or allow to perform a comparison with the thickness data retrieved from the electronic data, thereby electronically and automatically identifying any discrepancies.

[0203] The identification of the contact or substantial proximity between the predefined portion of the cutting head 110 with the sheet-like material and/or the identification of the contact or substantial proximity between the blade 112 and the sheet-like material may occur by means of the sensor already described or by means of another technique, for example by means of detection of a reduction of the force bearing on the supports of the cutting head 110.

[0204] The invention is not limited to the embodiments shown in the accompanying figures, and for this reason the reference numerals indicated in the accompanying figures are provided for the sole purpose of increasing the intelligibility of the claims, and are not to be construed as limiting.

[0205] Finally, it is clear that additions, modifications, or variations, obvious to an expert in the art may be applied to the present invention without thereby departing from the scope of protection provided by the attached claims.

Claims

1. Device (100) for the cutting of a sheet-like material, comprising:

- a cutting head (110) movable along at least a first axis (X) and having a body (111) and a blade (112) movable with respect to said body (111),
 - a striking surface (113) for said blade (112);
 - a first actuator (114) for a movement of said blade (112) with respect to said body (111);
- wherein said blade (112) is movable at least along a first auxiliary axis (Z) inclined with respect to said first axis (X), between a zeroing position (P_0) in which it is in contact or substantial proximity of said striking surface (113) and at least a first cutting position (P_1), different with respect to said zeroing position (P_0) for the cutting of said sheet-like material, said device (100) having:

- a configuration of calibration of the position of said blade (112), in which said blade (112) is moved with respect to said body (111) to be placed in said zeroing position (P0) and/or is retained in said zeroing position (P0);
- a cutting configuration, wherein said blade (112) is moved with respect to said body (111) to be placed in said at least a first cutting position (P1) and/or is retained in said at least a first cutting position (P1);

said device (100) comprising a sensor (115) operatively connected with said striking surface (113) and with said blade (112) and configured to identify in a substantially automatic way said contact or substantial proximity of said blade (112) with said striking surface (113); said sensor (115) being configured to transmit, upon an identification of said contact or substantial proximity of said blade (112) with said striking surface (113), a control signal destined to determine the stopping of said first actuator (114) and the reaching of said zeroing position (P0).

2. Device according to claim 1, wherein, in said configuration of calibration of the position of said blade (112), said device (100) is configured to carry out a step of zeroing (2001-2003) comprising:

- activating (2001) said first actuator (114) determining a movement (2002) of said blade (112) with respect to said striking surface (113) from a starting position (Pa) spaced with respect to said striking surface (113) up to said zeroing position (P0);
- stopping (2003) said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when said sensor (115), through the identification of said contact or substantial proximity of said blade (112) with said striking surface (113), transmits said control signal;

said device (100) being configured to enter in said cutting configuration only after a completion of said configuration of calibration of the position of said blade (112), in particular only after the transmission of said control signal.

3. Device according to claim 1 or claim 2, configured to keep, when in said configuration of calibration of the position of said blade (112), the body (111) of said cutting head (110) in a predefined positional relationship, optionally at a predefined distance, with respect to said striking surface (113); preferably wherein said first actuator (114) is an actuator of electrical type, and optionally is an electric motor, and/or wherein said device (100) is con-

figured to move said blade (112) with respect to said body (111) through said first actuator (114) with a sub-millimeter accuracy.

4. Device according to one or more of the preceding claims, having a configuration of calibration of the position of said cutting head (110), wherein said device (100) is configured to carry out, and/or allow the execution of, a step of zeroing of a position of said cutting head (110), comprising a movement (1001) of a predefined portion of said body (111) proximal to the striking surface (113) with respect to said striking surface (113) and comprising arranging (1001a, 1002), by effect of said movement, said predefined portion of said body (111), in contact or in substantial proximity with said striking surface (113) and/or retaining said predefined portion of said body (111) in contact or in substantial proximity with said striking surface (113), preferably said device (100) being configured to enable the configuration of calibration of the position of said blade (112) only after the enabling and completion of said configuration of calibration of the position of said cutting head (110).

5. Device according to claim 4, comprising a second actuator (116) for a movement of said predefined portion of said body (111) with respect to said striking surface (113), and wherein in said configuration of calibration of the position of said cutting head (110), said device (100) is configured to carry out said step of zeroing wherein the movement of said predefined portion of said body (111) comprises:

- activating said second actuator (116) determining a movement of said predefined portion of said body (111) with respect to said striking surface (113) until said predefined portion of said body comes in contact or in substantial proximity with said striking surface (113);
- stopping said second actuator (116) determining a stopping of said predefined portion of said body (111) with respect to said striking surface (113), when said predefined portion of said body (111) is in said contact or substantial proximity with said striking surface (113);

preferably wherein said second actuator (116) is an actuator of electrical type, and optionally is an electric motor, and/or wherein said device (100) is configured to move said predefined portion of said body (111) with a sub-millimeter accuracy.

6. Device according to claim 4, wherein said step of zeroing of the position of said cutting head (110) is a manual step of zeroing, and said cutting head (110) comprises or is connected with a controlling organ, configured to be manually controlled by a user, said

controlling organ determining said movement of said predefined portion of said body (111).

7. Device according to one or more of the preceding claims 4-6, wherein said cutting head (110) is movable along a second auxiliary axis (Z'), preferably parallel to, and optionally coinciding with, said first auxiliary axis (Z),
and wherein said movement of said predefined portion of said body (111) with respect to said striking surface (113) takes place along said second auxiliary axis (Z').
8. Device according to one or more of the preceding claims, wherein said sensor (115) is configured to identify an electrical and/or magnetic contact existing between said blade (112) and said striking surface (113), and/or wherein said striking surface (113) is an electrically and/or magnetically conductive surface;
and/or wherein said striking surface (113) is a surface having a higher ductility with respect to a ductility of said blade (112) and/or wherein said striking surface (113) is a surface having a lower hardness with respect to a hardness of said blade (112).
9. Device according to one or more of the preceding claims when depending on claim 4, wherein in said configuration of calibration of the position of said cutting head (110), said blade (112) is kept in a predefined fixed position with respect to said body (111),
preferably wherein said predefined position is a position such that said blade (112) is substantially enclosed within said body (111) and/or does not protrude with respect to said predefined portion of said body (111) proximal with respect to said striking surface (113),
and/or wherein in said configuration of calibration of the position of said blade (112), said predefined portion of said body (111) proximal with respect to said striking surface (113) is kept in said contact or substantial proximity with said striking surface (113).
10. Device according to one or more of the preceding claims, wherein said cutting head (110) comprises a blade-carrier for said blade (112) and wherein said blade (112) is removably connected, preferably operatively removably connected, to said cutting head (110) on said blade-carrier,
and/or wherein said device (100) comprises a supporting base for said striking surface (113) and wherein said striking surface (113) is removably connected with, in particular supported by, optionally operatively removably connected with, in particular supported by, said supporting base.

11. Device according to one or more of the preceding claims, wherein said cutting head (110) is movable along at least a second axis (Y) inclined, optionally orthogonal, with respect to said first axis (X), said first axis (X) and said second axis (Y) defining a working plane, in particular a cutting plane;

in said configuration of calibration of the position of said blade (112) and/or in said configuration of calibration of the position of said cutting head (110), said cutting head (110) being kept in a fixed position on said first axis (X) and/or on said second axis (Y);
said device (100), in said cutting configuration, being configured to move said cutting head (110) along at least one between said first axis (X) and said second axis (Y) for carrying out a cutting of said sheet-like material along a predefined path, with at least a first predefined movement speed along at least one between said first axis (X) and said second axis (Y) or with at least a first predefined movement speed range along at least one between said first axis (X) and said second axis (Y),
preferably wherein said blade (112), in said cutting configuration, can be also moved in a second cutting position (P2), different with respect to said zeroing position (P0) and different with respect to said first cutting position (P1), for the cutting of said sheet-like material,
and/or preferably wherein said device (100) is configured to electronically acquire data comprising one or more characteristics of said sheet-like material, said characteristics comprising at least one type of material and/or a thickness of said sheet-like material,
said device (100) being configured to adjust said first predefined movement speed or said first predefined movement speed range, in accordance with said data and/or to move said blade (112) in one of said first cutting position (P1) and said second cutting position (P2), in accordance with said data, and/or to adjust an inclination of said first auxiliary axis (Z) with respect to said working plane, in accordance with said data;
optionally, said device being configured to keep said first cutting position (P1) or one between said first cutting position (P1) and said second cutting position (P2) for the whole duration of said cutting configuration, and/or being configured to electronically load movement path data of said cutting head (110) and to determine a movement of said cutting head (110) along at least one between said first axis (X) and said second axis (Y), or to move said cutting head (110), in said cutting configuration, on at least one between said first axis (X) and said second axis (Y).

12. Device according to one or more of the preceding claims when depending on claim 2, having an identification configuration of a thickness of said sheet-like material comprising:

- activating said configuration of calibration of the position of said blade (112), and carrying out a step of zeroing (2000-2003), electronically storing, as a reference height the height at which there is the identification of said contact or substantial proximity of said blade (112) with said striking surface (113);
- subsequently, after a positioning of said sheet-like material on said striking surface (113):
 - activating again said first actuator (114) determining a movement (2002) of said blade (112) with respect to said striking surface (113) and with respect to said sheet-like material from a starting position spaced with respect to said striking surface (113) and with respect to said sheet-like material, up to a position wherein said blade (112) is in contact with or in substantial proximity with said sheet-like material;
 - stopping said first actuator (114) determining a stopping of said blade (112) with respect to said striking surface (113), when there is an identification of said contact or substantial proximity of said blade (112) with said sheet-like material,
- electronically storing, the height (h') at which there is the identification of said contact or substantial proximity of said blade (112) with said sheet-like material;
- electronically assigning, as thickness of said sheet-like material, a differential between said height (h') and said reference height,
- adjusting said at least one first cutting position (P1) in accordance with said thickness.

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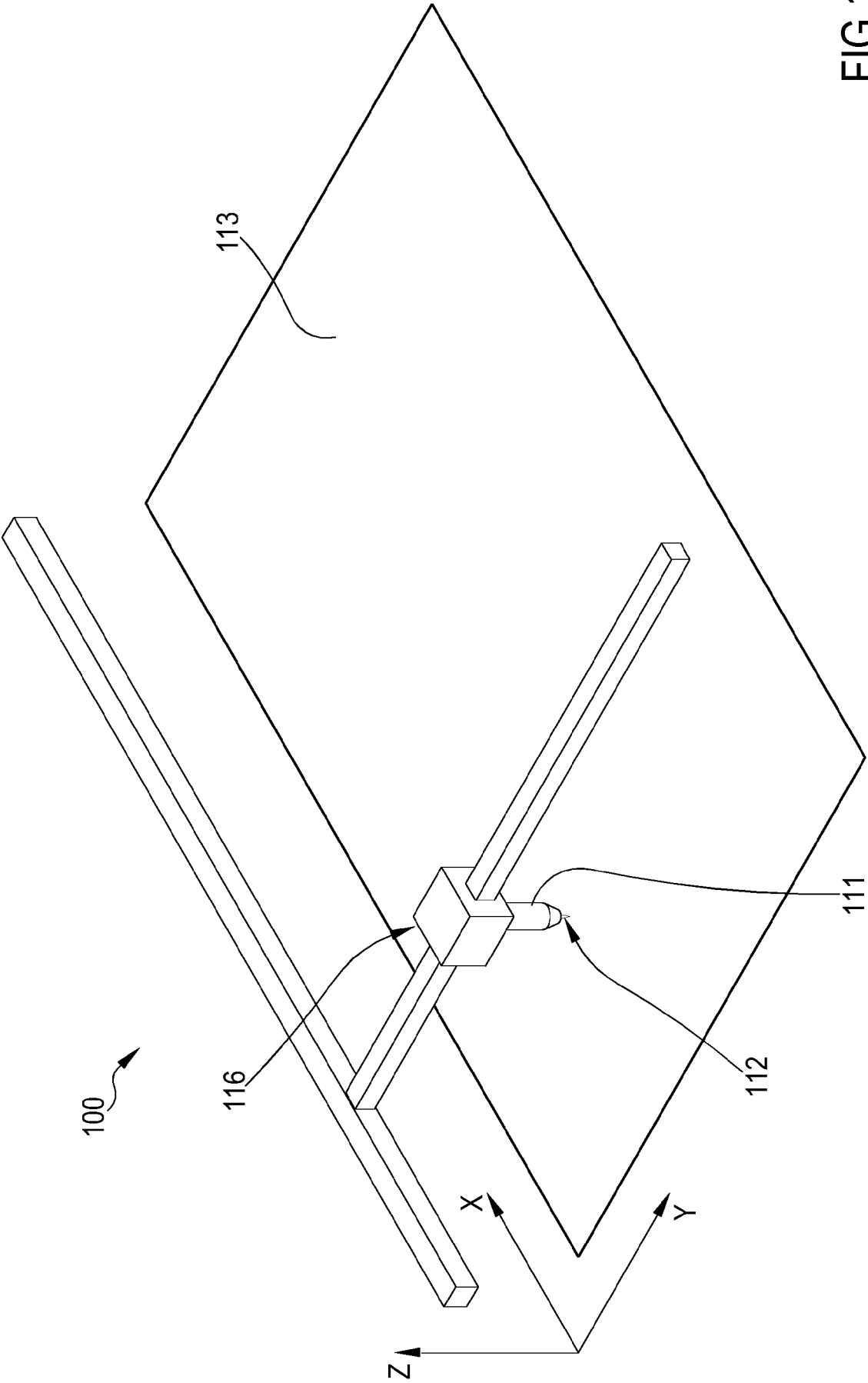


FIG. 1

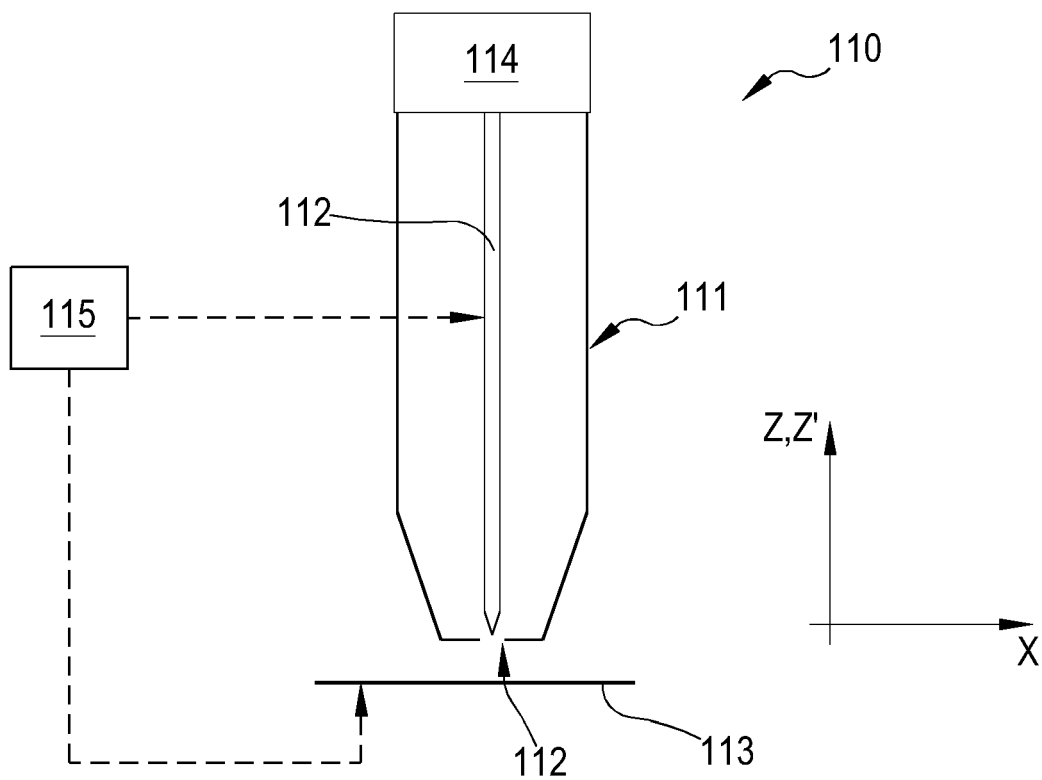


FIG.2

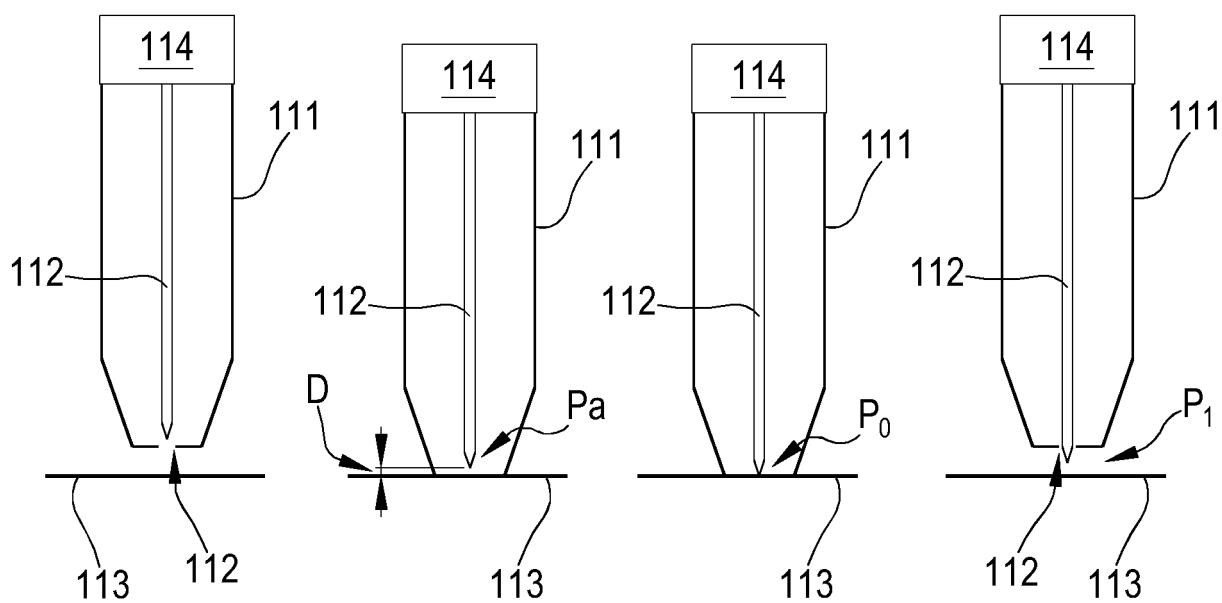


FIG.3

FIG.4

FIG.5

FIG.6

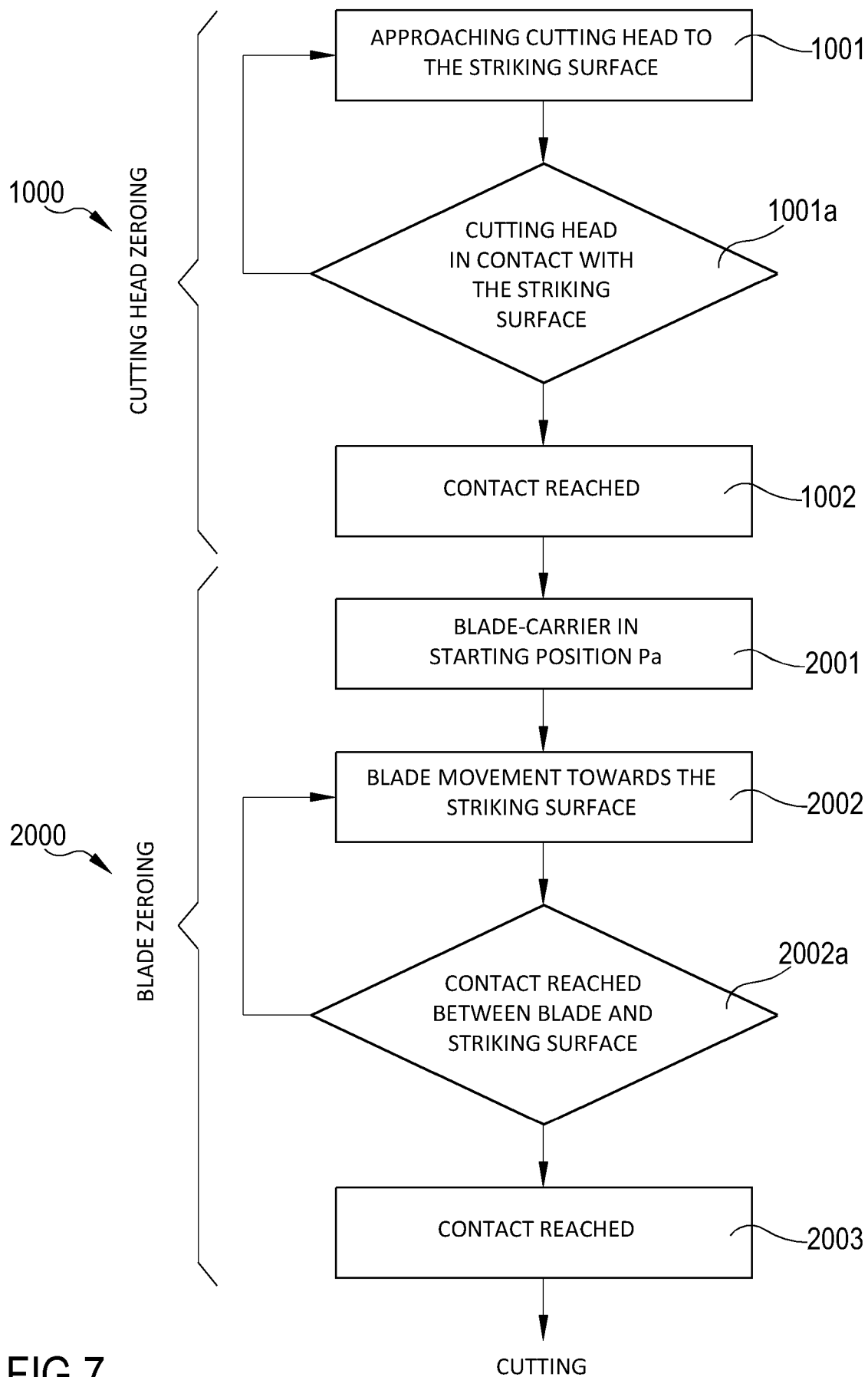


FIG.7



EUROPEAN SEARCH REPORT

Application Number

EP 26 17 0681

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Place of search			Examiner
Munich			Canelas, Rui
Date of completion of the search			
24 July 2026			
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