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(54) LASER MACHINE FOR TREATING TEXTILES

(57) Machine (1) for treating textiles which comprises a placement surface (20) for a textile (40) to be treated, a laser device (100) arranged for marking over said surface and a control device (50) for said laser device (100) which comprises a series of stored instructions corresponding to the path to be followed by the laser for the textile (40) to be treated, whereby the machine (1) further comprises at least one camera (102, 103) arranged so as to take an image of the placement surface (20) and an image processing module configured to identify the textile (40) to be treated on said placement surface (20) and to calculate the position and angle of said textile (40) with respect to a stored position of said textile (40), and said image processing module being connected to the control device (50), in such a way that the control device (50) is configured to modify the series of instructions on the basis of the aforementioned position and angle data determined by said image processing module.

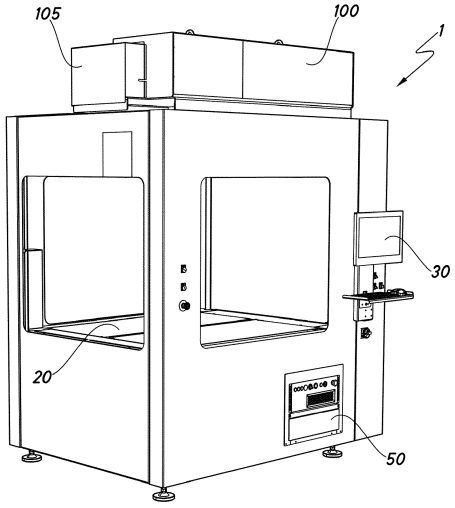

Fig.1

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Description

[0001] The present invention relates to a laser machine for treating textiles, whether cloth and/or garments.

[0002] Said machines comprise a surface for placing the textile to be treated and a laser device placed above and with the capacity to mark the surface. The textile to be marked is placed on the surface and, subsequently, the laser device causes the laser to strike the garment, such that the laser produces a marked and/or bleached and/or worn and/or burnt and/or cut effect, obtained depending on the material of the garment, the power of the laser and the time of exposure to the laser. Therefore, the textile must be placed correctly since, otherwise, the laser will not strike it in the right areas.

[0003] To prevent incorrect placement of the textile (in general, a garment), it is known practice to arrange a light projector above the placement surface, which projects on the surface the drawing to be marked, or a border of the area to be marked or, alternatively, the outline of the garment or area in which it must be placed in order to mark it correctly.

[0004] However, this solution is not without drawbacks. First, it is difficult to place the garment exactly at the location marked by the light projector owing to the nature of the garments themselves, which tend to have creases and irregularities. Moreover, owing to time pressures, the operator may leave the garment in position without noticing movement in the garment, or may move the garment slightly when releasing it, such that, when the laser is activated, the garment has been moved and is not in the correct place. Therefore, garments end up being incorrectly marked despite the presence of the projector. Furthermore, the process of adjusting the garment into the position indicated by the light projected on the placement surface takes time.

[0005] It is an aim of the present invention to disclose a laser machine for treating textiles which overcomes the abovementioned drawbacks.

[0006] The present invention discloses a machine for treating textiles which comprises a placement surface for a textile to be treated, a laser device arranged for marking over said surface and a control device for said laser device. Said laser device comprises a series of stored instructions corresponding to the path to be followed by the laser for the textile to be treated. The machine further comprises at least one camera arranged so as to take an image of the placement surface and an image processing module. Said module is configured to identify the textile to be treated on said surface and its size, and to calculate the position and angle of said textile with respect to a stored position of said textile. Said module is connected to the control device, in such a way that the control device is configured to modify the series of instructions on the basis of the aforementioned position and angle data determined by said module.

[0007] The presence of at least one camera arranged so as to take an image of the placement surface together with an image processing module make it possible to recognize the garment to be marked by the laser. Said recognition is performed, for example, by means of image recognition software, which identifies the model of textile to be marked and its size. For each model and/or size, the machine has a database or memory containing reference marking instructions which it accesses after identifying the garment. This means that the laser can mark different garments on the same production line without the need for the user to change the parameters, or the type of specific marking of each garment. In other words, the machine carries out the appropriate instructions for each garment automatically, therefore allowing a mix of garments to be supplied to the machine, without having to adjust the parameters for each garment or work with sets of identical garments in order to avoid having to change said parameters frequently. Moreover, as well as identifying or recognizing the garment to be marked, it also detects the position of the garment and, on the basis of this position, changes the reference instructions for the laser, so that the marking is adapted to the position detected. This feature also helps to automate the marking process and in particular facilitates or speeds up the process of placing the garment, which does not need to be placed so precisely to obtain the desired marking.

[0008] Preferably, the machine comprises means for measuring the focal distance.

[0009] The focal distance means the distance between the laser device and the work surface. Knowing the exact focal distance is advantageous when working or making marks with a laser, since this makes it possible to better focus the energy of the laser on the points necessary.

[0010] In a more preferred embodiment, the means for measuring the focal distance comprise said at least one camera and the image processing module.

[0011] The ability to measure the focal distance, using the camera which captures the image and the image processing module, makes it possible to perform the necessary operations to make the mark with the laser without the need to add more elements to the machine.

[0012] In an alternative embodiment, the measuring means comprise a laser distance sensor.

[0013] Having a laser distance sensor makes it possible to determine with great precision the focal distance, or any other distance which it is necessary to determine in the marking process. The use of said laser sensor may also serve as a method for checking or confirming the distance measured by means of other sensors or the at least one camera.

[0014] Preferably, the image processing module identifies the textile to be treated using image recognition.

[0015] The ability to identify the garment to be marked, by means of image recognition software, means that it is not necessary to depend on the visibility of any code, or other identification element, on the surface of said garment. It is thus possible to determine all the necessary information regarding the garment by means of the hardware already present in the machine, and the analysis,

using the image processing module, of what is captured by the at least one camera.

[0016] More preferably, the image recognition is performed on the basis of artificial intelligence algorithms.

[0017] Identifying the garment by recognition of the garment through an image by means of artificial intelligence helps obtain control over production, the treatment process and quality control that is more versatile. This can be achieved using neural network structures, feeding the latter with databases of images, various examples and information and thus providing them with prior training, such that they can learn to identify the various textiles in any kind of situation. As the volume of examples and production increases, the better and more versatile the identification of any type of textile becomes, and the same applies to the subsequent quality control. In addition, all this learning can be used, in turn, to feed into and improve various artificial intelligence models and algorithms for use in Industry 4.0.

[0018] Alternatively, the image recognition is performed on the basis of identification and calculation of parameters and physical characteristics of the garment.

[0019] Through the analysis of the image captured, the image processing module may extract certain parameters that facilitate identification of the textile. Some of the parameters may be, for example, the length or width of the textile, the ratio between said length and said height, angles between lines of intersection of the textile, the presence of elements, such as buttons or seams, etc. The identification and calculation of these parameters may also help to position and orient the garment in relation to its reference coordinate centre and axes of the machine. The calculation of these parameters facilitates identification of the garment. The capacity of the image processing module to calculate these parameters, or any other parameter necessary, also makes it possible to take various measurements that can be applied to various functions for production, such as quality control of the textiles or as described above, correct positioning thereof for marking.

[0020] Preferably, the image processing module identifies the surface of the textile to be treated.

[0021] The machine, through the image processing module, is able to identify which surface of the textile is facing the laser. This makes it possible to identify, for example, if the textile is face up or face down, and therefore if the surface to be treated is the front or back of the textile. One case in which this feature is advantageous would be in the treatment of trousers, as it can identify which leg, left or right, is facing the laser and which part, front or back. Depending on the reference provided, it is even possible to make this distinction with the trousers folded in half lengthwise.

[0022] Preferably, the machine performs quality control after treatment by means of the image processing module.

[0023] Through the image processing module, it is possible to determine whether the end result of the treatment complies with the quality parameters established. This process speeds up production and allows fast and rapid dual quality control, on the one hand by the machine after treatment and on the other hand by the operator. This quality control can be performed, for example, by comparing the final image obtained with a stored reference image. By means of the abovementioned methods, it is possible to verify the position, shapes and size of the markings at the same time as evaluating the depth of marking and/or the degree of contrast of the patterns. Another way of performing quality control of marking can be to use optical character recognition (OCR) software, making it possible to recognize the shapes of the different markings and assess the quality thereof by comparison to their reference shape.

[0024] Preferably, the machine identifies the size of the textile to be treated and adjusts the treatment to said size.

[0025] Having the capacity to identify the size of the textile to be treated makes it possible to treat each piece according to its size, whether by scaling or by positioning the treatment to be carried out.

[0026] Alternatively, the control module identifies the textile to be treated by automatic identification and data capture (AIDC), such as optical character recognition (OCR).

[0027] The textile to be treated, in other words the type of garment, specific model and even the size, may be located on a visible surface of the garment in encoded form, for example as a bar code, QR code, or any other type of code making it possible to provide this information. This facilitates precise identification of the garment to be marked.

[0028] Preferably, the machine comprises an illumination system for illuminating the placement surface for the garments to be treated.

[0029] In order for the camera to have an optimal view of the textile, it is advantageous to have a system for illuminating the surface on which the garments are placed. Thus, the camera can capture the clearest image possible, and illumination can be controlled on the textiles and on the surface, achieving illumination which is uniform and constant over time. This facilitates and simplifies image recognition by the image processing module. Moreover, having good illumination also makes it possible for the operator to see, just by looking, any flaws on the placement surface or on the actual garment when placed.

[0030] Preferably, the machine comprises a system for 3D scanning of the textile.

[0031] With a 3D scanning system, it is possible to digitally recreate the surface to be marked of the textile located above the surface in three dimensions. This makes it possible to obtain the position of all of the points on the textile in the form of, for example, a three-dimensional map or in topographical style. Knowing the location of all of the points on the surface to be marked is highly advantageous for various applications. One such applica-

tion would be the recognition of the textile, type, model, size and even the surface to be marked (front or back). Another possible application is the ability to detect the correct placement of each textile, detecting, for example, unwanted wrinkles. Another possible application is the ability to measure the distance from the laser at any point on the textile, making it possible to correct the laser control instructions suitably for more precise marking, which in turn can greatly facilitate the marking of any textile with a clearly three-dimensional surface, such as a cap, hat or footwear.

[0032] Preferably, the machine comprises at least two cameras with different optics.

[0033] Having more than one camera with different optics makes it possible to capture the textile from different points of view, which is advantageous with a view to performing better analysis of the image and identifying the garment more accurately. Moreover, having different optics also helps to obtain stronger or weaker focus and/or detail of the image, which can be useful with a view to performing more or less rapid calculations for cases in which stronger or weaker resolution or precision is required, adapting said parameters to production needs.

[0034] For a clearer understanding of the present invention, drawings illustrating an exemplary embodiment of the subject matter of the invention are attached by way of explanatory but non-limiting example.

Figure 1 is a perspective view of a laser machine for treating textiles.

Figure 2 is a detail view of an internal surface of the roof of an embodiment of a laser machine for treating textiles.

Figure 3 is a view in front elevation of Figure 1.

Figure 4a is a detail view of the capture and obtaining of a coordinate centre of a textile to be marked, by the image processing module.

Figure 4b is a detail view of the capture and recognition of a surface to be treated of a textile, by the image processing module.

Figure 5 is a detail view of the capture and obtaining of parameters by an image processing module of the laser machine for treating textiles.

Figure 6a is a detail view of the capture and obtaining of a 3D scan of a textile.

Figure 6b is a detail view of the capture and obtaining of another 3D scan of the same textile as Figure 6a.

Figure 7 is a diagram showing the interaction and exchange of information between elements of the machine.

[0035] Figure 1 shows a laser machine 1 for treating textiles according to the present invention. As can be seen in this figure, the machine 1 comprises a laser device 100, a surface 20 for the placement of textiles and a user interface 30. The laser device 100 in turn comprises a control device 50 and a scanning head 105.

[0036] Figure 2 shows the internal surface of the roof of the machine 1, viewed from the surface 20. in this figure, other components of the machine 1 can be seen. More particularly, it shows an opening 101 through which the laser beam exits. Said laser beam is modulated and controlled by the scanning head 105, which is in turn controlled by the control device 50 of the laser. Said control device 50 has the task of modifying the direction, focus and/or power of the laser as required for each mark by actuating the relevant elements, such as mirrors and lenses, to redirect and focus the laser. This figure also shows two cameras 102 and 103, which have the task of capturing the image of the textile placed on the surface 20. Said two cameras 102 and 103 may be used individually or together. Depending on the optics or resolution of each camera, it will be to some degree appropriate to use one or other of the cameras. Said cameras 102 and 103 may also be used to calibrate or determine the focal distance which is favourable for obtaining good adjustment of the laser and, therefore, good marking. Figure 2 also shows an illumination system 200 which comprises a set of lights 201, 202, 203, 204, 205 and 206 for appropriate illumination of the work surface where the textiles are placed and the textile itself, in such a way as to aid optimum capture of images by the cameras 102 and 103. it also shows a 3D scanning system 104. Said system makes it possible to capture the textile in three dimensions, such that the laser device can determine the distance to all points on the surface of the textile to be marked, allowing it to adjust the marking instructions accordingly, or detect unwanted wrinkles or positions of the textile which are incorrect for good marking.

[0037] Figure 3 shows the machine 1 in front elevation, making it possible to delimit a focal distance f between the laser device 100, more specifically the opening 101, and the surface 20 where the textiles are placed. It also shows the scanning head 105 of the laser 100, from the front and, in profile, the user interface 30 and the control device 50.

[0038] Figure 4a shows an example of the capture and analysis of an image of a textile by the image processing module. Said figure depicts a textile 40 which is captured by at least one camera 102 or 103. Said at least one camera 102 or 103 sends information, as a digital image, to the image processing module. Said module interprets the image, in such a way as to allow identification of the outline of the textile, which in turn makes it possible to frame the textile 40 in a rectangle 41 delimiting said textile 40, said rectangle 41 having a coordinate centre d_1 of said textile. Said coordinate centre d_1 is positioned at a point (x_1,y_1) of a reference coordinate centre 0 and axes (X,Y) of the machine. With the rectangle 41 it is not only

possible to obtain a coordinate centre d_1 relating to the textile 40, but also to define coordinate axes relating to the textile (d_{x1},d_{y1}) in the form of vectors referenced to said reference coordinate centre 0 and axes (X,Y), it being possible to obtain a horizontal coordinate and a vertical coordinate with respect to the textile. This information is sent to the control device of the laser. Based on the comparison between the actual coordinate centre d_1 and axes (d_{x1},d_{y1}) relating to the textile which is to be marked, and a reference coordinate centre d_0 and axes (d_{x0},d_{y0}) pre-recorded in its memory for said textile, the image processing module calculates appropriate correction factors to modify the instructions to be received by the control device in such a way that marking is matched to the actual position and orientation of the textile.

[0039] Figure 4b shows an example of the capture and analysis of an image of a textile in which the image processing module is capable of detecting, for the same model and size of textile 40, the surface to be marked. The top drawing shows an image captured by one of the cameras 102 or 103 of a type and model of textile, in which the visible surface is the front part of the right leg of a pair of trousers, whereas, in the bottom drawing, the visible surface, and therefore the surface captured by one of the cameras 102 or 103, is the front part of the left leg of the pair of trousers. As in Figure 4a, the module will delimit the textile 40 using a rectangle 41 and will determine a coordinate centre d_2 and axes (d_{x2},d_{y2}) relating to said textile and a centre d_3 and axes (d_{x3},d_{y3}) respectively for each surface of the textile captured. However, depending on which surface is captured, the image processing module will analyse and identify this surface, for which purpose it will access one series of saved reference instructions or another according to the surface identified by the image processing module. Subsequently, said series of reference instructions will be modified to adapt the marking to the actual position and orientation of the textile.

[0040] Figure 5 shows some of the key parameters which make it possible to identify the type, model and size of a textile 40 captured by one of the cameras 102 or 103. Through the analysis, by the image processing module, of the image captured, it is possible to extract certain parameters which facilitate the identification of the textile. In the example of Figure 5, in which the textile captured consists of long trousers, some of these parameters may be, for example, the width p of the leg at the hem, the length l of the trousers, the width c of the waist, the crotch depth t or distance between the crotch and the waist. The calculation of these parameters also helps to position and orient the garment in relation to the reference coordinate centre 0 and axes (X,Y) of the machine, and therefore an angle α of orientation of the garment can in turn also be obtained. The calculation of these parameters facilitates identification of the garment. The capacity of the image processing module to calculate these parameters, or any other parameter necessary, also makes it possible to take various measurements that can be applied to various functions for production, such as quality control of the textiles or as described above, correct positioning thereof for marking.

[0041] Figure 6a shows an example of obtaining a 3D map 42 of a garment 40. in the example of Figure 6, a 3D map 42 of topographical type is obtained, in which each point on the surface of the textile 40 is represented by a colour or value, depending on the distance to the height at which it is located with respect to the surface 20 where the textile 40 is situated. This type of 3D map is advantageous for various applications such as identifying the textile to be marked, detecting unwanted wrinkles, detecting the position and orientation of the textile, quality control of the textile, or even recalibrating the power or incision of the laser according to the actual distance of each point with respect to said laser.

[0042] Figure 6b shows another example of obtaining a 3D map 42 of the same garment 40. in this case, said figure shows how said 3D map may be used for detecting wrinkles and incorrect positioning of the textile 40.

[0043] Figure 7 shows a schematic diagram of the interaction between various elements of an embodiment of a machine for treating textiles. Said diagram shows the communication and exchange of information between said elements making it possible to achieve the operation of the machine described above. Optical sensors 1100, such as a camera 102 or 103, capture images, and have the task of sending this information to a first processing unit 31 of programmable type (FGPA) and/or to another graphics processing unit 32 (GPU). The two units 31 and 32 are also connected such that they can work together, if necessary, when obtaining and computing the information received by the sensors 1100. Moreover, the graphics processing unit 32 (GPU) is also connected to a first central processing unit 33 (CPU) which has the task of coordinating and processing the image information. In this diagram, which shows one possible embodiment of the machine, this first central processing unit 33 is connected to a second central processing unit 51 (CPU), such that they can exchange information and send orders to one another when required. The unit 51 is also in turn in communication with a digital signal processor 52 (DSP), which in turn is connected to a second processing unit 53 of programmable type (FGPA). Together, the digital signal processor 52 and the unit 53 have the task of interpreting the instructions in the form of a digital signal from the unit 51 and translating same into instructions suitable for controllers, sensors or actuators. The processor 52 has the task of performing the calculations to give the necessary orders to the second unit 53, which in turn translates and sends said orders as control parameters for the various devices to which it is connected. Said second unit 53 is connected to a programmable logic controller 54 (PLC), which has the task of general mechanical control of the machine 1, to the scanning head 105, to the laser 100 and to sensors and/or actuators 110, such as safety sensors of the type which stop or restart operation of the machine automat-

ically.

[0044] Although the invention has been described with reference to examples of preferred embodiments, these must not be considered as limiting the invention, which will be defined by the broadest interpretation of the following claims.

Claims

1. Machine for treating textiles which comprises a placement surface for a textile to be treated, a laser device arranged for marking over said surface and a control device for said laser device which comprises a series of stored instructions corresponding to the path to be followed by the laser for the textile to be treated, **characterized in that** the machine further comprises at least one camera arranged so as to take an image of the placement surface and an image processing module, said module being configured to identify the textile to be treated on said surface and to calculate the position and angle of said textile with respect to a stored position of said textile, and said module being connected to the control device, in such a way that the control device is configured to modify the series of instructions on the basis of the aforementioned position and angle data determined by said module.

2. Machine according to the preceding claim, **characterized in that** the image processing module identifies the textile to be treated using image recognition.

3. Machine according to Claim 1, **characterized in that** the control module identifies the textile to be treated by automatic identification and data capture (AIDC).

4. Machine according to the preceding claim, **characterized in that** the control module identifies the textile to be treated by optical character recognition (OCR).

5. Machine according to any of the preceding claims, **characterized in that** the control module identifies the surface of the textile to be treated.

6. Machine according to any of the preceding claims, **characterized in that** it identifies the size of the textile to be treated and adjusts the treatment to said size.

7. Machine according to any of the preceding claims, **characterized in that** it comprises means for measuring the focal distance.

8. Machine according to the preceding claim, **characterized in that** the means for measuring the focal distance comprise said at least one camera and the image processing module.

9. Machine according to Claim 7, **characterized in that** the measuring means comprise a laser distance sensor.

10. Machine according to any of the preceding claims, **characterized in that** it performs quality control after treatment by means of the image processing module.

11. Machine according to any of the preceding claims, **characterized in that** it comprises an illumination system for illuminating the placement surface for the garments to be treated.

12. Machine according to any of the preceding claims, **characterized in that** it comprises a system for 3D scanning of the textile.

13. Machine according to any of the preceding claims, **characterized in that** it comprises at least two cameras with different optics.

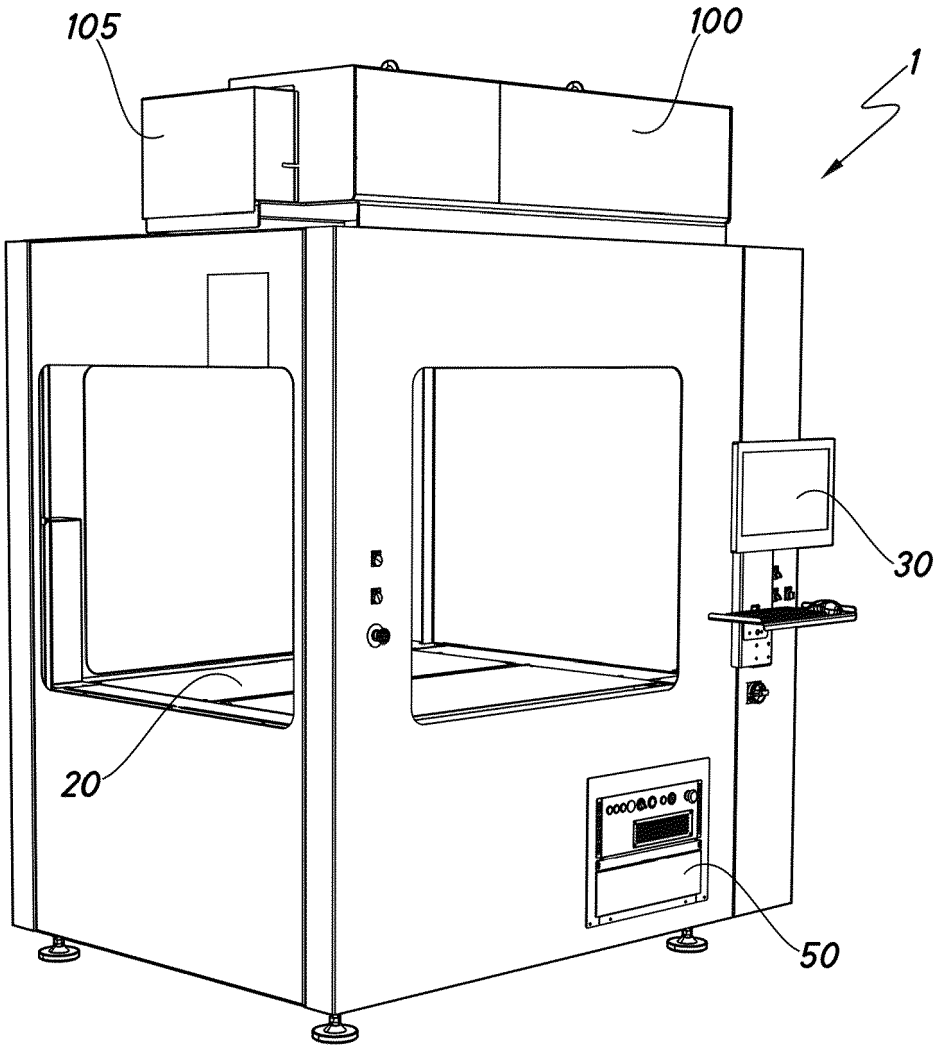


Fig.1

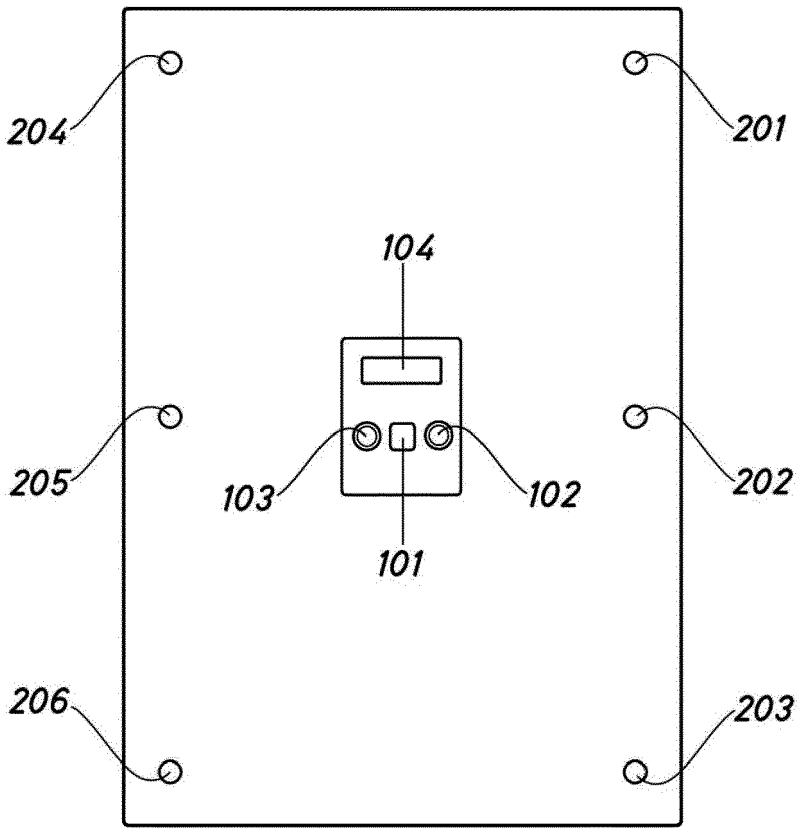


Fig.2

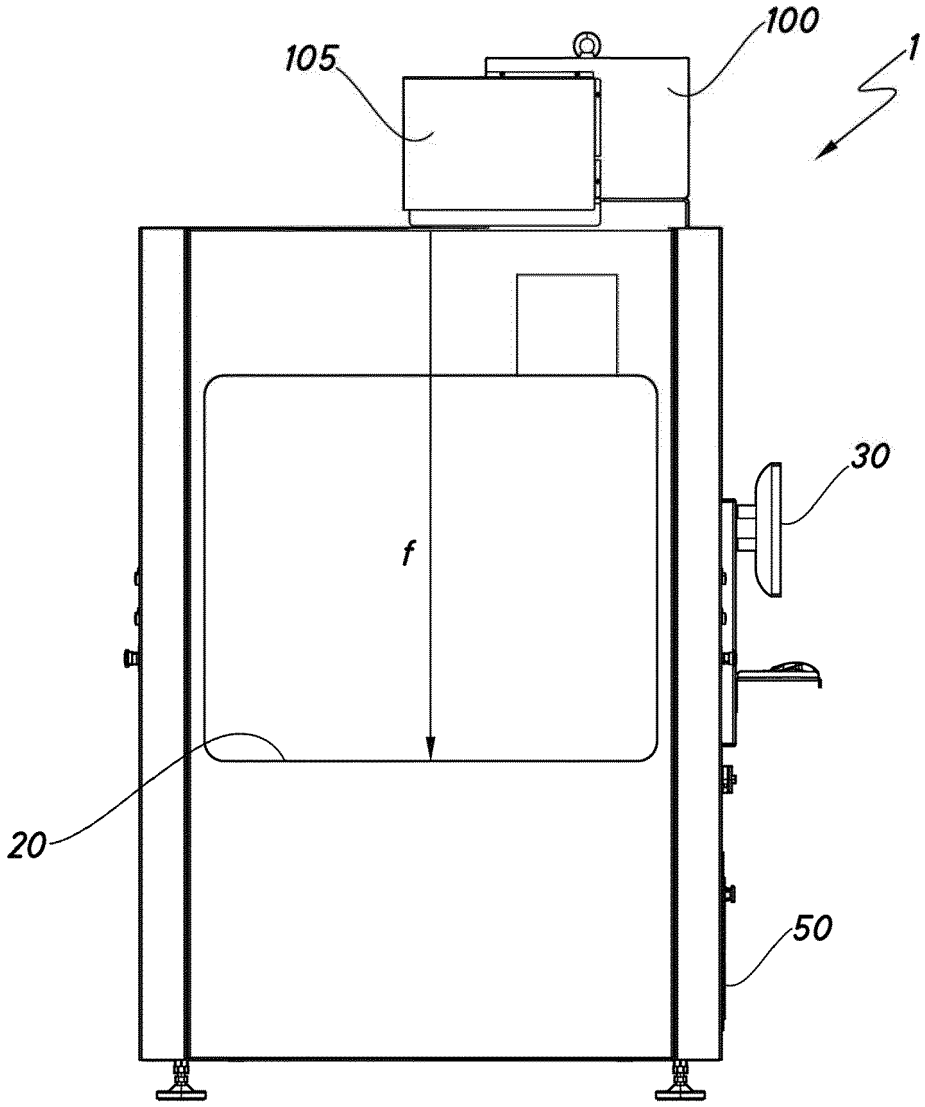
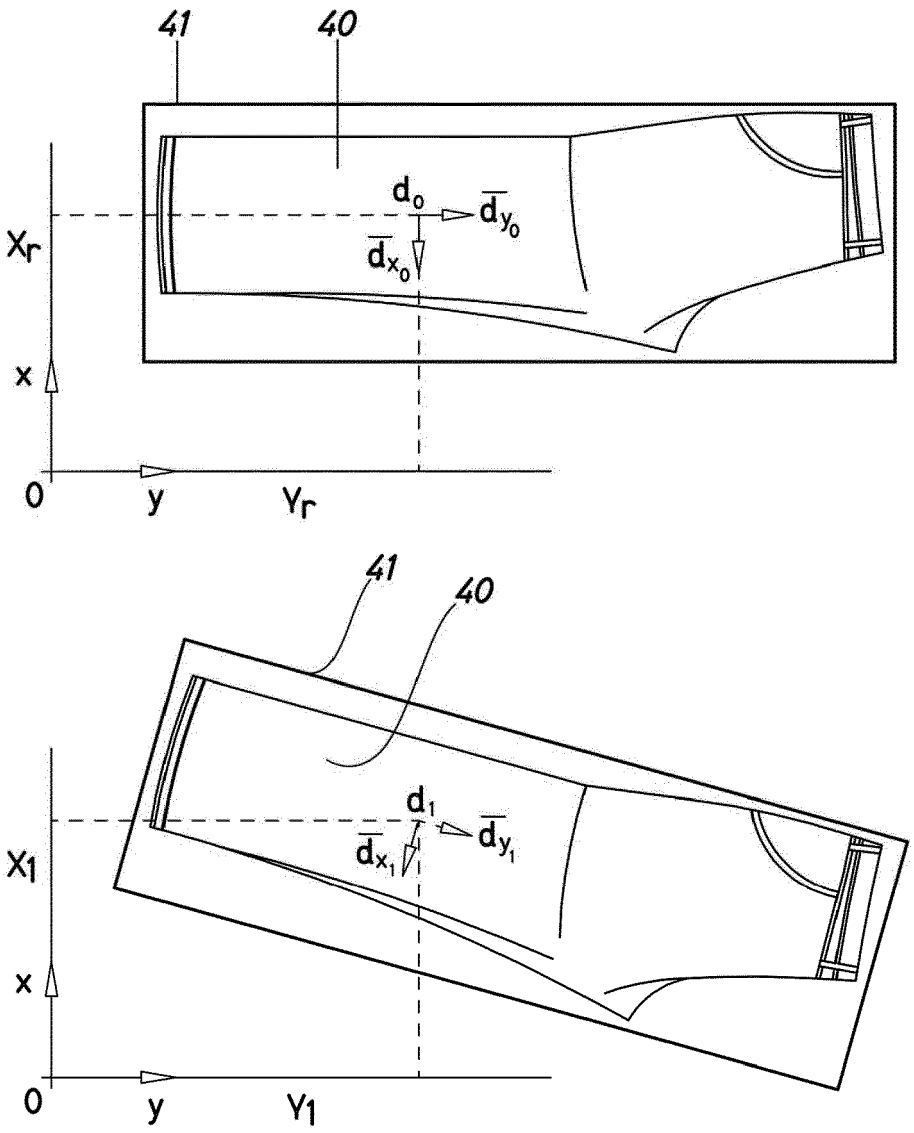


Fig.3


41
40
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X_r
x
0
y
Y_r
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Fig.4A

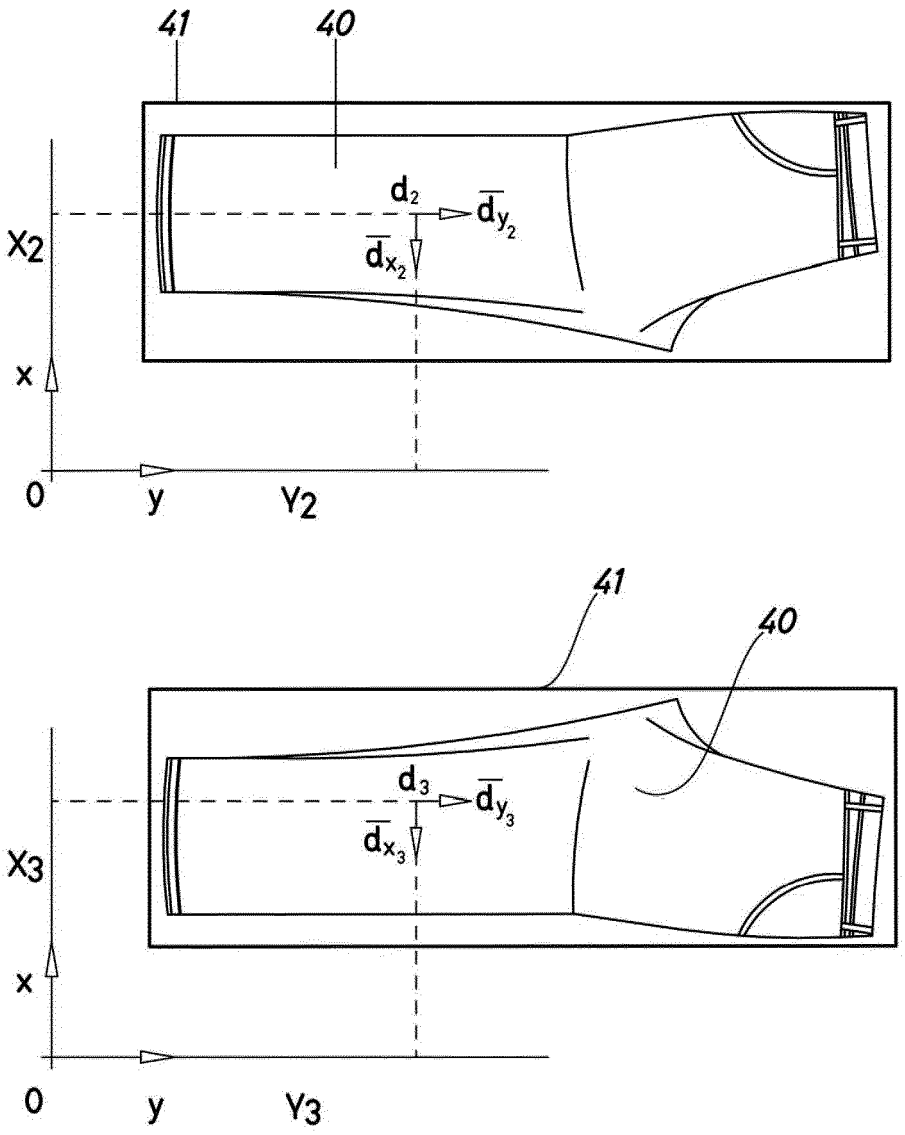

Fig.4B

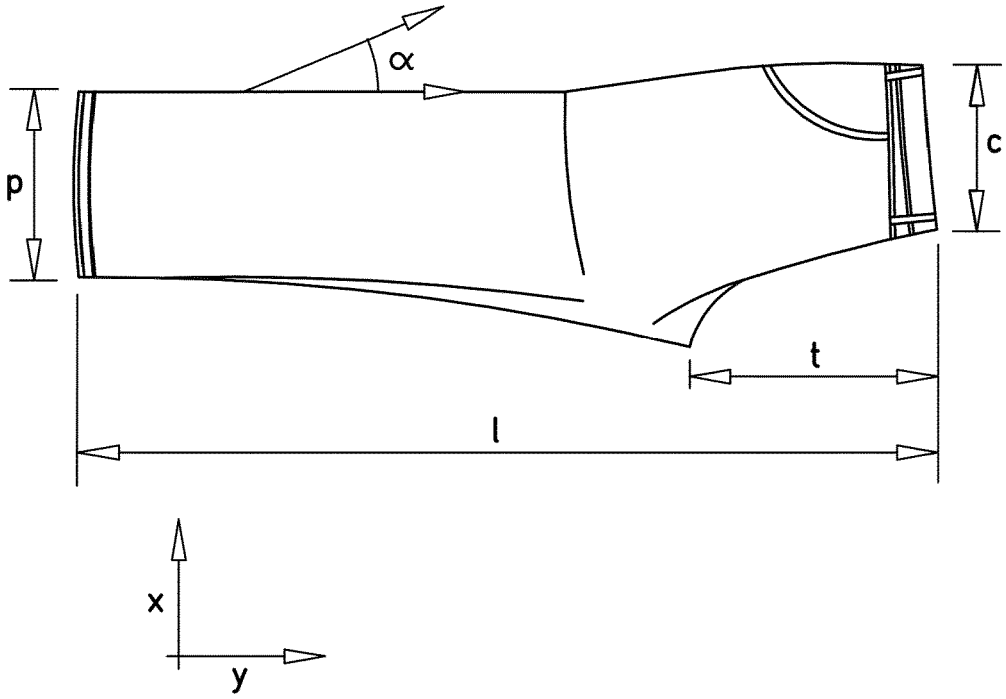

Fig.5

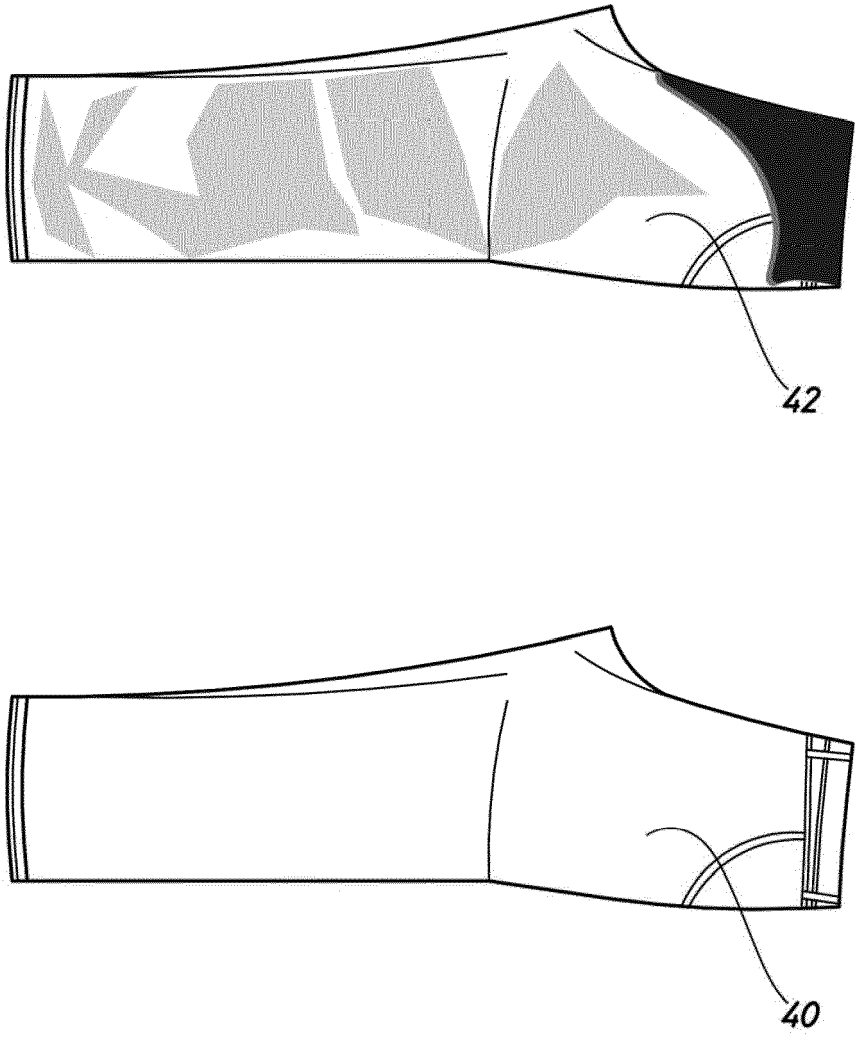

Fig.6A

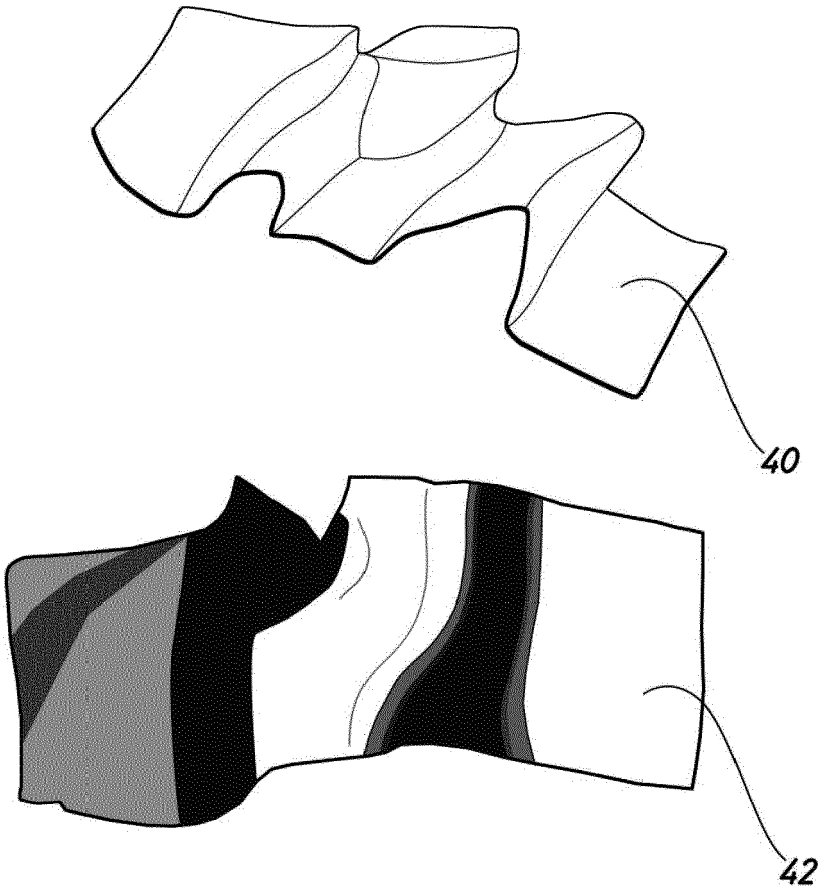

Fig.6B

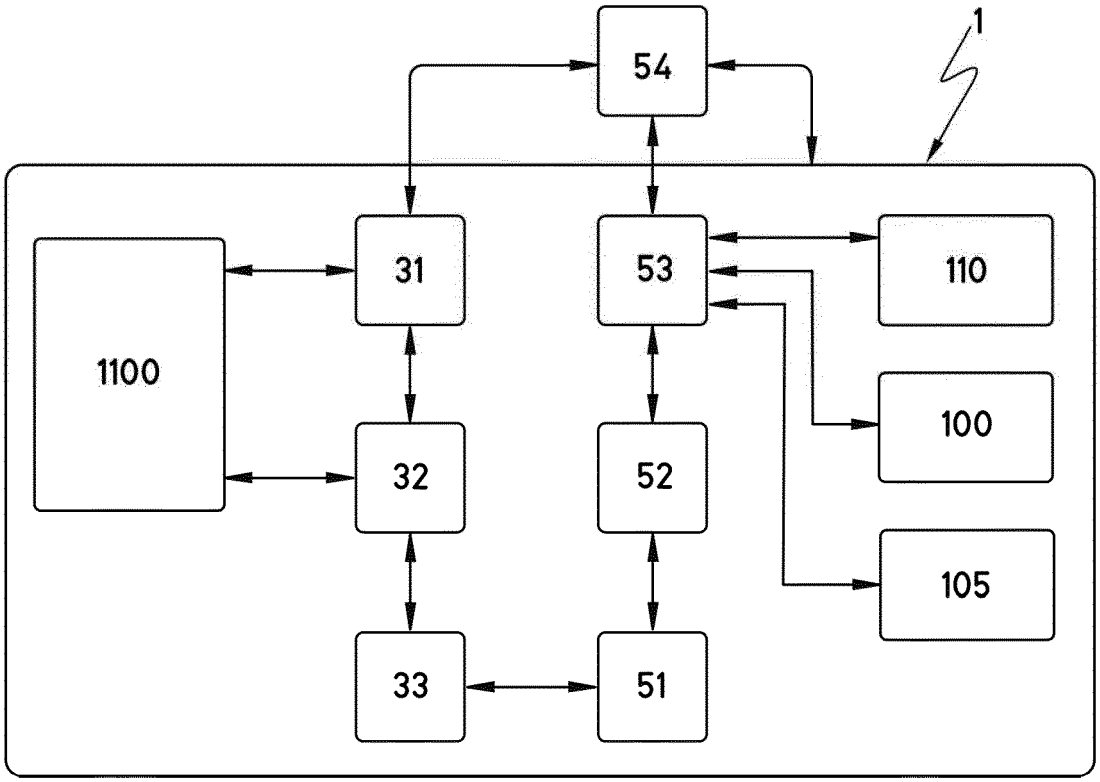

Fig.7

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EUROPEAN SEARCH REPORT

Application Number
EP 23 38 2219

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	US 6 090 158 A (MCLAUGHLIN RICHARD S [US]) 18 July 2000 (2000-07-18) * column 4, line 61 - column 5, line 55; column 8, line 31-60; claims; figures * -----	1-6,13 10,11 7-9,12	INV. D06B11/00 D06P5/20 ADD. B44C1/22
Y	EP 3 561 489 A1 (JEANOLOGIA SL [ES]; FYLA LASER S L [ES]) 30 October 2019 (2019-10-30) * paragraphs [0001], [0005], [0006], [0010], [0011], [0018], [0033]; claims; figures * -----	10,11	
A	WO 97/49062 A1 (STRAUSS LEVI & CO [US]) 24 December 1997 (1997-12-24) * column 1, lines 13-25; column 2, lines 39-67; column 3, lines 19-53; claims; figures * -----	1-13	
A	WO 01/25824 A2 (TECHNOLINES LLC [US]; MARTIN CLARENCE H [US]; COSTIN DARRYL J [US]) 12 April 2001 (2001-04-12) * the whole document * -----	1-13	TECHNICAL FIELDS SEARCHED (IPC) D06B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 July 2023	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons
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