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## (54) AUTOMATIC EQUIPMENT FOR PERFORMING A PERIMETER FINISH CUT OF SEMI-FINISHED LEATHER SHEETS

(57) The invention refers to automatic equipment, and a relative method, for continuously performing a perimeter finish cut of semi-finished leather sheets.

The method provides for at least the following phases of:

- detection of a digital image of the whole semi-finished leather product, through numerical control equipment provided with an inlet portion furnished with at least one digital image detector pointing towards the semi-finished product;
- processing of such digital image obtained from the scanning in a processing unit associated with the equipment and through a filtering algorithm that is liable to detect the perimeter edges of said semi-finished leather product;
- operation of at least one cutting head provided for in correspondence of the outlet portion of said equipment and active on opposite parts of the semi-finished leather product slaved to said processing unit to trim the perimeter edges of the semi-finished product on the basis of the digitalized image in said acquisition phase.

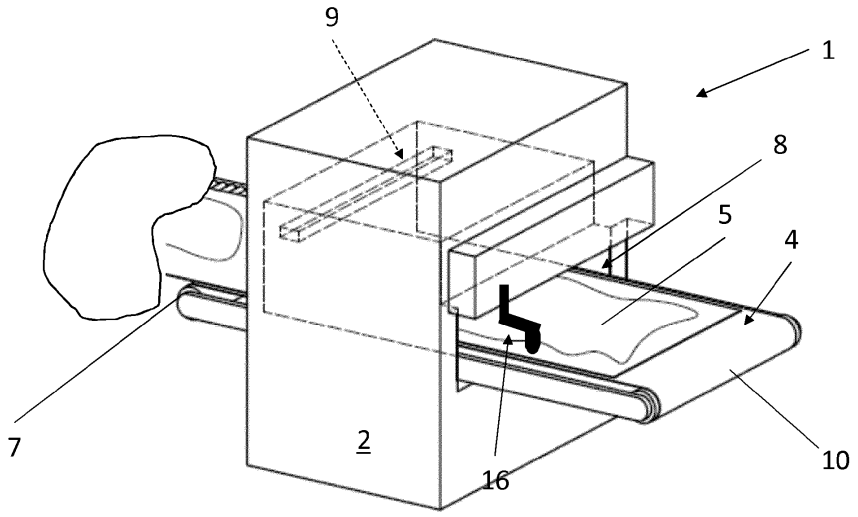


FIG. 2

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## Description

**[0001]** The present invention refers to automatic equipment for continuously performing a perimeter finish cut of semi-finished leather sheets.

**[0002]** More in particular, the invention applies to the industrial sector of tanneries or anyway to the trimming of the edges of semi-finished leather products that can undergo subsequent finish manufacturing to realize components for footwear, leather goods, clothing accessories, armchairs, sofas and the like.

### Technical field

**[0003]** As is well known in this technical field, bovine or other animal hides destined to the manufacturing of leather articles, such as shoes, bags, belts and the like, must undergo a long series of preventive manufacturing from which the quality and the relative price of the skins depend.

**[0004]** For example, the quantity and quality of the natural marks present on the hides when the slaughter occurs has repercussions on the surface uniformity of the skins obtained through said manufacturing.

**[0005]** Among the natural features that characterize animal hides there are open or close scars, insects or parasite stings, wrinkles or even hot brand marking. It is sought to solve some of these discontinuities in the course of the manufacturing of raw skins.

**[0006]** Skins, after the slaughter of the animal, are normally kept through curing. Subsequently, they are washed and they undergo a liming process to eliminate fats and other substances. During this phase the natural fur detaches due to the high acidity of the liming process.

**[0007]** At this point, the semi-finished leather product undergoes, through cutting called splitting, a sectioning that separates it into two or more layers of which the most external one, of finest quality, is called "grain", and the underlying or internal ones are called "split".

**[0008]** The fibers of the grain are much more compact with respect to the split layer and for this reason they are softer, more resistant to tears and are therefore finer and more expensive.

**[0009]** Only at this point is the tanning process performed, which consists on keeping the skin for a long time, avoiding the decomposition thereof, as well as the coloring, which consists on the immersion of the skin in penetrating colorants, both the surface and the section.

### Background art

**[0010]** As said, therefore, the skins are selected on the basis of the presence of surface features and are destined to different uses. Natural marks are often repaired on already pigmented skins through the use of plaster and grinding.

**[0011]** The splits, but sometimes also the full grain leather, require, instead, additional manufacturing that allows to ennoble them, covering them with a synthetic material film, for example polyurethane.

**[0012]** For this aim, there are equipment that continuously deposit a polyurethane film on a paper support in sheets, possibly providing for a first layer of transparent protective fixator and a second colored bottom layer.

**[0013]** After drying, on this multi-layer sheet thus obtained is made to adhere by gluing a so-called split, thus obtaining the so-called "Bycast" leather.

**[0014]** Downstream this equipment the skins must be at least inserted, removing the film in excess with respect to the skin and possible portions of leather, in particular near the edges, which present defects.

**[0015]** Nowadays, this operation is performed manually, employing staff that is partially specialized and through the use of electric cutters.

**[0016]** Although it has been applied for a long time in almost all tanneries, this manufacturing phase is not satisfying for a number of reasons.

**[0017]** In the first place, notwithstanding the staffs ability, the perimeter edges are discarded with sometimes excessive safety margins, which imply the waste of material and excessive scraps.

**[0018]** Further, the staff dedicated to this manufacturing must be coordinated on the opposite long sides of the leather, something that is not always easy or ergonomic.

**[0019]** Last, as the manufacturing occurs substantially in a continuous manner, with a feed through a conveyor belt, it often happens that there is the need to slow down the manufacturing flow because of problems that arise during the removal of the scraps or, alternatively, the manufacturing flow proceeds relatively slowly.

**[0020]** The technical problem that lies at the basis of the present invention is that of devising automatic equipment having such structural and functional features as to allow to continuously perform a perimeter finish cut of semi-finished leather products, overcoming the limits and the inconveniences of the current processes adopted by the prior art technique.

**[0021]** Furthermore, the invention proposes to make available automatic equipment that is liable to remove possible internal parts of the leather having defects.

### Disclosure of invention

**[0022]** The solution idea that lies at the basis of the present invention is that of making available equipment with a feed inlet portion in correspondence of which a digitalization phase is performed of the semi-finished leather product to be treated and a neighboring outlet and unload portion on which at least a cutting head insists, slaved to a controller and active on opposite parts of the semi-finished leather product to finish the perimeter edges on the basis of the digitalized image in said scanning phase.

**[0023]** On the basis of such idea of solution, the technical problem is solved by numerical control automatic

equipment for continuously performing a perimeter finish cut of semi-finished leather sheets, characterized in that it comprises:

- one feed inlet portion of the semi-finished leather products furnished with image detection means pointing towards the semi-finished products;
- a cutting area downstream said inlet portion and furnished with at least one cutting head;
- processing means for performing a digitalization phase of the image detected of the semi-finished leather product to be treated, with an associated film;
- said at least one cutting head being active slaved to an electronic controller of the numerical control equipment on opposite parts of the semi-finished leather product for film trimming associated with the semi-finished leather product and/or for finishing the perimeter edges of the semi-finished product on the basis of the image digitalized by said processing means.

**[0024]** Advantageously, said inlet portion is structurally independent and separated from said cutting area, as well as positioned upstream it, also at some meters of distance.

**[0025]** The image detection means comprise at least one digital video camera.

**[0026]** In an embodiment, the inlet portion is structured in a portal-like manner at the mouth of a conveyor belt and said detection means comprise a detection group with a plurality of digital video cameras that are likely to continuously perform the scan of the semi-finished leather product during the advancement of said conveyor belt.

**[0027]** Further, it is foreseen a processing unit of the images acquired by the image detector and that is liable to generate a digital copy of the semi-finished product undergoing scanning including virtual indicators representing defects on the surface of the skins.

**[0028]** Such processing unit is configured to associate the defects on the surface in view of the skins, highlighted through a warning element, with the image acquired of the semi-finished leather product, generating a report grid indicating at least the shape and the position of the defects on said semi-finished product.

**[0029]** It should be noted that the continuous scanning produces a complete digital image of said semi-finished leather product with which said report grid is associated that reports defects or possible surface discontinuities of said semi-finished product.

**[0030]** It should also be noted how the processing unit is operationally connected with a memory unit suitable for connecting at least the digitalized image of the semi-finished product undergoing scanning and also the report grid generated indicating the defects on such semi-finished product.

**[0031]** Further, the processing unit is configured to recognize the position, the shape and/or the entity of the defect of the surface of the semi-finished product on the basis of said coordinates of the movement of the warning element.

**[0032]** Advantageously, the memory unit is a cloud unit a user can access from remote through a specific application and/or a specific address.

**[0033]** The invention refers also to a method for performing automatically a perimeter finish cut and/or the trim of film associated with semi-finished leather products destined to the subsequent production of components for footwear, leather goods and the like, comprising at least the phases of:

- detection of a digital image of the whole semi-finished leather product, through numerical control equipment provided with an inlet portion furnished with at least one digital image detector pointing towards the semi-finished product;
- processing such digital image obtained by the scanning in a processing unit associated with the equipment and through a filtering algorithm that is liable to detect the perimeter edges of said semi-finished leather product;

operating at least one cutting head provided for in a cutting area of said equipment and active at least on opposite parts of the semi-finished leather product slaved to said processing unit for trimming the perimeter edges of the semi-finished product on the basis of the digitalized image in said acquisition phase.

**[0034]** The features and advantages of the equipment and the method according to the invention will become more fully apparent from the description below of an embodiment, given as an illustrative but non-limiting example with reference to the annexed drawings.

## Brief description of drawings

**[0035]**

- Figure 1 shows a perspective and schematic view of numerical control automatic equipment realized according to the present invention for continuously performing a perimeter finish cut of semi-finished leather sheets;
- Figure 1A shows a perspective and schematic view of numerical control automatic equipment realized according to a variant of realization of the present invention;
- Figure 2 shows a perspective view of a posterior part of the equipment of figure 1;
- Figure 3 shows a schematic view of a particular of

the equipment according to the invention;

- Figure 4 shows a top schematic view of a leather undergoing manufacturing on equipment according to the invention in accordance with the method of detection of the digital image of the leather;

- Figure 5 shows a schematic view of a digital image representative of a semi-finished leather product treated through the equipment of figure 1;

- Figure 6 shows a block scheme of a series of operational phases performed through the equipment of the present invention;

- Figure 7 shows a block scheme of an alternative series of operational phases carried out by means of the equipment of the present invention;

- Figure 8 shows a block view of a processing and control unit of the equipment according to the invention.

Detailed description

**[0036]** With reference to such figures, and in particular to the example of figure 1, with 1 is generally and schematically indicated numerical control automatic equipment realized in accordance with the present invention for continuously performing at least a perimeter finish cut of semi-finished leather products 5.

**[0037]** In a more general sense, for semi-finished leather products is intended any sheet of skins produced, for example, by a tannery to subsequently undergo further manufacturing in a different manufacturing plant. These semi-finished products 5 are known for having different shapes and sizes, having also an irregular perimeter outline and partially corresponding to the shape of the animal from which they have been extracted. Nevertheless, these semi-finished products are normally associated with a film 13 external to the leather, formed by a continuous sheet of coating material, which allows to feed in a nearly continuous manner the equipment 1 according to the invention.

**[0038]** The automatic equipment according to the present invention is preferably destined to the tannery sector in order to complete the manufacturing phases that conduct to the preparation of skin sheets to send to other industrial plants arranged for the manufacturing of leather articles, such as shoes, bags, belts and the like.

**[0039]** It should be preliminarily noted that the figures represent schematic views and are not drawn at scale, but are instead drawn so as to emphasize the important features of the invention. Furthermore, in the figures, the different elements are represented in a schematic manner, the shape thereof being able to vary according to the desired application. It should also be noted that in the figures, identical reference numbers refer to identical elements by shape or function. Last, particular devices described in relation to an embodiment illustrated in a figure can also be used for the other embodiments illustrated in the other figures.

**[0040]** As illustrated in the schematic view of figure 1, the automatic equipment of the present invention comprises a main body 2 that is held by a support frame.

**[0041]** More in particular, in an embodiment of the present invention, the main body 2 houses a cutting area 3 in which trimming operations of the semi-finished products 5 are performed with associated film 13. At least a cutting head 16 or 17 is provided for, active in such cutting area.

**[0042]** The cutting area 3 is extended between an inlet or load portion 6 and an opposite outlet or unload portion 8 and the semi-finished products 5 are supported by a fixed loading bed extended between the two load portion 6 and unload portion 8.

**[0043]** In an embodiment of the present invention the loading bed is structured in the form of a conveyor belt 4 for allowing the substantially continuous manufacturing of the semi-finished leather products 5 to be treated.

**[0044]** The body 2 of the equipment 1 that delimits the cutting area 3 therefore comprises a feed or load inlet portion 6 of the semi-finished leather products 5 that presents as an access portal 9 with a mouth from which an access end 7 of the conveyor belt 4 juts out. Nothing impedes, however, that the body 2 of the equipment 1 is open and that the cutting area is not completely closed in a portal-like manner, but that, for example, the cutting head or heads are supported in a bump-like manner.

**[0045]** This end 7 of the conveyor belt 4 is accessible to an operator for the load of a semi-finished product 5, that is to say, of a semi-finished leather sheet 5 to undergo, according to the invention, the finish manufacturing through the cutting area 3, in particular a trimming area, of the equipment 1.

**[0046]** As it has been said, the equipment 1 comprises also a neighboring outlet and unload portion 8 that is substantially opposite with respect to the inlet portion 6 and that we can call also posterior portion with respect to the inlet portion 6, called frontal.

**[0047]** This outlet and unload portion 8 is in substantially continuity with the inlet portion 6 and the working area 3, being defined by the part of the conveyor belt 4 opposite with respect to the access end 7.

**[0048]** Downstream a final end 10 of the conveyor belt 4 an accumulation bed of the semi-finished leather sheets 5 undergoing the perimeter cut can be provided for, according to the method of the present invention.

**[0049]** Basically, the conveyor belt 4 is extended horizontally between the access end 7 and the final end 10 and crosses the portal 9 of the equipment 1 supplied with the components that will be described herein below, and, in particular, of image detection means 18 pointing towards the semi-finished products 5.

**[0050]** Nevertheless, in a variant of realization the feed inlet portion 6 of the semi-finished products is located

upstream the conveyor belt 4, for example, at a pre-determined distance D, for instance, at least substantially equal to a semi-finished product 5 to be treated, as shown in figure 1.

**[0051]** In other words, considering the inlet portion 6 of the equipment 1 located at a pre-fixed distance upstream the cutting area 3, as shown schematically in figure 2, it is necessary to say that such an inlet portion is to be considered structurally independent and separated from said cutting area 3.

**[0052]** However, it is impossible not to consider the inlet portion 6 as not making part of the equipment 1 since, as we will see below, the technical means associated with such inlet portion are slaved to a processing unit 30 of the equipment 1.

**[0053]** In figure 2 with number 1' equipment has been indicated realized according to the invention with an inlet portion 6 of the semi-finished products located also at some meters of distance of the cutting area 3. In this variant of realization a portal indicated with number 9' is schematically shown. The portal 9 of figure 1 and the portal 9' support image detection means 18 described herein below and the portal-like structure is purely indicative since alternative forms of support can be adopted such as a single pillar and an arm extended in a bump-like manner.

**[0054]** Advantageously, according to the invention, both the portal 9' located at a pre-fixed distance D from the cutting area 3 and the portal 9 near the mouth 6 of the cutting area 3 of the equipment 1 is supplied with a digital image detector 18 pointing towards the semi-finished product 5 to be treated.

**[0055]** More in particular, said detector 18 comprises a detection group with a plurality of image detectors 12 which allow the capture of images of the surface of the semi-finished leather sheet 5, while this is moved by the conveyor belt 4. The detectors 12 can be at an equal distance among them, as shown in Figure 3.

**[0056]** In other words, the plurality of detectors 12 is arranged to perform a scan of the semi-finished leather sheet 5 during its transfer phase from the inlet portion 6 to the outlet and unload portion 8, obtaining a digital image 15 representative of such a semi-finished product 5.

**[0057]** More in detail, the image detectors 12 are photo cameras or video cameras destined to shoot images of the surface of the semi-finished sheet 5 to scan, such detectors 12 being arranged on the portal 9 pointing towards the conveyor belt 4. In case of video cameras the presence of at least one video camera is enough.

**[0058]** Illumination lights 40 of the detection zone underlying the video cameras are provided for as well, in such a way as to best light such a zone and allow a particularly accurate and high resolution image take. Such lights 40 can have, for example, LED lights arranged on the same side of the portal 9 on which the image detectors 12 are arranged in such a way as to light the surface of the semi-finished leather product in a uniform manner, for example the lights 40 are arranged between an image detector and the other one.

**[0059]** The image detectors 12 are preferably arranged on a line, or on a grid or a matrix element-like manner, to cover a zone or surface that spaces through all the width of the conveyor belt 4 and that substantially corresponds to the transverse dimension of the sheet of the semi-finished product 5 to scan, that is, a dimension that develops in a direction substantially perpendicular to the direction of advancement of the semi-finished product 5 on the conveyor belt 4, indicated in the figures as direction H-H.

**[0060]** In particular, as it will be illustrated in greater detail afterwards, the image detectors 12 allow to shoot continuously the surface of the semi-finished product 5 during the transfer thereof from the inlet to the outlet of the equipment 1, in such a way that an overlapping of the images acquired generates a complete digital image 15 and corresponding to the last detail to the real image. This scanning phase can therefore be defined as Visual Recognition (VR) of the semi-finished leather product to undergo the subsequent cut.

**[0061]** Each photo camera is of the digital type, for example CCD, and incorporates a processor that transforms and renders immediately available an image data file in a format processable by a processing and control unit 30, for example a JPEG format or the like.

**[0062]** The observations made with reference to the portal 9 can be repeated with reference to the other portal 9' provided for in the variant of realization at some meters of distance from the working area 3 of the equipment 1. Further, in an embodiment, the two different image detection positions are both provided for together with the equipment 1.

**[0063]** Advantageously, further, the equipment 1 comprises also at least one cutting head 16 slaved to a controller 20 of the equipment 1. The cutting head 16 is substantially supported in a bump-like manner on the work surface area or plan represented by the conveyor belt 4 and is activated by motorized means in the main directions "X" and "Y" on a horizontal plan. The head 16 can space on the whole working surface, basically on the 90% of the work surface plan, except for a perimeter section or edge that corresponds essentially to the structural encumbrance of the head 16, as projected on the work surface area or plan.

**[0064]** The head 16 is liable to be activated also along the axis "Z" with a more modest excursion with respect to that allowed along the axes X and Y.

**[0065]** The head 16 is anyway active by opposite parts of the semi-finished leather product 5.

**[0066]** In an alternative embodiment, non-limitative of the Applicant's rights, the equipment 1 is furnished with a pair of cutting heads 16, 17 that are slaved to a controller 20 of the equipment 1 and active on opposite parts of the semi-finished leather products 5 for finishing the perimeter edges 19 on the basis of the digital image 15 obtained in said scanning phase.

**[0067]** In figure 4 is shown schematically from the top,

for example, a semi-finished product 5 of the Bycast type with a film 13, external to the skin, of regular shape being formed by a continuous sheet and a discard perimeter edge represented by a zone 29. There are indicated, also, discard areas 11 or 21, depending on whether they are adjacent to the edge or they are internal to the skin; such areas have been indicated by an operator through an optical pen 50 or detected automatically.

**[0068]** Both the narrow zone 29 and the areas 11 or 17 represent the discard portions that are removed during the trimming phase of the edge of the semi-finished product 5.

**[0069]** The cutting heads 16, 17 are supported in the main body 2 in pre-fixed spaced relation with respect to the plan represented by the conveyor belt 4 and are extended in a bump-like and parallel manner between them along the advancement direction H-H. The heads 16, 17 are activated by motorized means slaved to the controller 20 of the equipment 1.

**[0070]** As it has been said before, the invention can be carried out also with a single cutting head 16 that covers with the movement thereof also the whole work surface plan; however, the skilled in the art will understand that the use of a pair of heads is more efficient and allows to activate the equipment 1 with greater yield in terms of units of time within which the manufacturing can be completed.

**[0071]** The cutting heads 16, 17 are guided in a mobile manner along three axes of the work surface plan represented by the sliding of the conveyor belt 4. Two axes Y and X are represented by the directions parallel and transverse to the conveyor belt 4. An axis Z represents the direction perpendicular to the conveyor belt 4 that is exploited by the reciprocal approach and departure of the operative head 16 or 17 towards the semi-finished product 5 to cut.

**[0072]** Advantageously, the two heads 16, 17 have each the faculty of intervention that allows to cover substantially the 90% of the work area and is not delimited by the two half planes that represent each slightly more of the center line 14 of the conveyor belt 4 in the direction of the axis Y.

**[0073]** It can be said, therefore, that each head can space on the whole work area except for the minimum encumbrance represented by the other head. It is admitted, therefore, a climbing area to render more efficient the movement slaved to the numerical control of the equipment 1 according to the shape of the semi-finished leather product 5 detected by the image detector.

**[0074]** As shown in the schematic view of figure 5, the semi-finished leather product 5 presents perimeter edges 19 of irregular shape that, according to the invention, are likely to be trimmed automatically by means of the cutting heads 16 and 17.

**[0075]** Each head 16 or 17 is operated by motorized means slaved to the controller 20 of the numerical control equipment 1 and on the basis of the digital image 15 detected by the digital video cameras associated with the inlet portal 9.

**[0076]** Each head is guided in a mobile manner in the directions X and/or Y and intervenes for outlining the perimeter edge 19 of the semi-finished product 5 with millimeter precision given by the comparison between the digital image 15, representative of the actual semi-finished product and the discard portions represented both by the narrow zone of the discard edge 29 and by the areas 11 and 21 that present defects. Obviously, the area external to the leather constituted by the polyurethane sheet made to adhere to the leather is discarded in time by means of the removal of the perimeter zone 29.

**[0077]** The trimming tolerance is programed according to the user's will.

**[0078]** The discard edge 29 resulting after the cutting edge is carried and discarded in correspondence of the final end 10 of the conveyor belt 4.

**[0079]** The movement of the cutting heads 16, 17 follows quickly the edge 19 of the semi-finished product 5 along the longitudinal opposite parts and as the conveyor belt 4 moves the semi-finished product 5 forward in the direction Y.

**[0080]** As for the trimming cut in the direction X, the two heads 16, 17 are activated in reciprocal approach and departure, substantially in transverse direction to the sense of advancement of the conveyor belt 4, in such a way as to result partially overlapped, but in programmatically distinct times, so as to sever the ends of head and tail of the semi-finished product 5 referred to the sense of advancement. Preferably, even if not exclusively, the left head cuts the left half of the leather starting from the half of the high part, that is, the part that first enters the machine; the right head cuts the right half, always starting from the half of the high part with a slight delay with respect to the left head to allow this last one to shift.

**[0081]** The numerical control equipment 1 comprises a data processing unit 30 provided with data and program memories furnished with said electronic controller 20 with relative data memories 31 and program memories 32. In the data memories 31 image storage is foreseen relative to the different shapes of the semi-finished leather products 5 acquired through the image detectors 12.

**[0082]** In the program memories are installed applicative programs that allow the realization of the method of the present invention according to what will be described below.

**[0083]** In an extreme synthesis, we can say that the equipment according to the invention allows to recognize the shape of the semi-finished leather product through the scanning video cameras, it memorizes it, defines the perimeter edges that must be trimmed through an appropriate processing program, operates with precision the single cutting head 16 or the heads 16, 17 as soon as the semi-finished product reaches the working position downstream the scanning video cameras by means of the advancement of the conveyor belt.

**[0084]** It is worth noting that the view area is not necessarily a separated area and/or an area upstream the

cutting area. A possible variant has as view area a partially or, possiblely, totally overlapped area with respect to the cutting area.

**[0085]** In its more general form, the equipment 1 allows to execute in a particularly efficient manner also the inspection of semi-finished leather products fed in an independent manner one after the other downstream a transfer machine 25 that is well known in the tannery field.

**[0086]** The semi-finished leather products the invention is applied to are not limited to the Bycast leather but can also be leathers of any type destined to subsequent manufacturing to realize components for footwear, leather goods, clothing, for the automotive industry and the like.

**[0087]** The equipment according to the present invention can also be used to trim the outline of normal skins (that is, without film applied), eliminating worn parts or parts with poor consistency that would not be destined for sale otherwise. In this case, apart from an possible automatic elimination of the discards, due to an irregular shape of the outline or to a fixed number of millimeters from the edge, it is foreseen to highlight parts to eliminate through the same process with which the defects are marked, that is, marking such parts with chalks (detectable in the digital image) or through a warning element 50, described below, both online and offline. The parts indicated as defects of a certain category will be then removed by the equipment in the trimming phase, as if they were edges.

**[0088]** Now, as particular reference to the example of figure 5, it will be illustrated in greater detail how the image 15 detectors 12 allow to acquire in a continuous manner images of the surface of the semi-finished leather product during the advancement thereof on the conveyor belt 4 in such a way that an overlapping of the images acquired generates a single complete digitalized image 15 of the semi-finished leather product to be detected and/or inspected.

**[0089]** Advantageously, according to the present invention, the equipment 1 comprises a processing unit 30 of the images acquired by the image detectors 12.

**[0090]** The processing unit 30 can be integrated inside the numerical control equipment 1, for example, it can be an appropriate processor integrated in the motherboard the equipment 1 is provided with. Alternatively, in an alternative embodiment of the present invention, the processing unit 30 is associated with an external unit with respect to the main body 2 and operationally connected with it. In this last case, the processing unit 30 can be connected to the processing and control unit housed in the main body 2 through various modalities, for example, a wire connection or a wireless one. In any case, both the main body 2 and the processing unit 30 are provided with TX transmission/reception means that allow a data exchange between them.

**[0091]** Adequately, the processing unit 30 is suitable for generating a digital copy of the semi-finished leather product. Specifically, the processing unit 3 is configured to receive the image data 15 acquired in a continuous manner by the image detectors 12 during the movement of the conveyor belt, such image data being united and overlapped by the processing unit 30 in such a way as to obtain a complete image of the semi-finished product 5. In other words, the processing unit 30, from the data furnished by the image detectors 12, is capable of generating a single file (for example, a single .pdf or .jpeg file) containing a high resolution image of the surface of the semi-finished leather product.

**[0092]** The processing program together with the processing unit 30 is liable to detect with extreme precision the outline or the perimeter edges of the semi-finished leather products 5, possiblely using background comparison modalities called "smart filters" to distinguish the leather from the possible polyurethane film associated with it. The unity 30 then generates the cutting course that coincides more or less with the outline, considering a pre-determined tolerance offset.

**[0093]** The example of Figure 5 illustrates in a schematic manner the outcome of the detection phase that can be realized also in a completely automatic manner by the software associated with the reading system of the leathers, reducing or possiblely eliminating the presence of the operator that marks the defects. The image of figure 5, in fact, shows a colored representation of the areas of the leather having a different quality; for example: the greater area Q 1 in red indicates the best quality, the area Q2 in yellow indicates a less precious area, while the areas Q3 in green and Q4 in blue indicate discard areas.

**[0094]** The equipment 1 of the present invention makes also use of a warning element 50 suitable for indicating defects on the surface of the semi-finished product 5, such warning element 50 being conformed in such a way as to be grabbed easily by an operator. The warning element 50 is therefore an instrument that allows the operator to report the defects identified on the surface of the semi-finished leather product 5 in a simple and efficient manner.

**[0095]** In particular, the warning element 50 is provided with an elongated body 51 that represents the grip and with a lighting element 52 of end, such as an ordinary light bulb, located at an end of the elongated body 51. The lighting element 52 is such that the light emission thereof is detected by the image detectors 12. In this manner, advantageously, according to the present invention, the coordinates of the movement of the lighting element 52, for example, the coordinates of the center of the light bulb, are detected by the processing unit 30, which processes the information coming from the image detectors 12.

**[0096]** The warning element 50 can, however, be based also on a different technology, for example, it could be provided with a radio waves warning system, the functioning of such warning element 50 not being limitative of the range of the present invention.

**[0097]** Through the warning element 50 the operator

is capable of reporting the presence of a defect without directly marking the surface of the semi-finished product 5, making a non-invasive inspection.

**[0098]** Furthermore, the warning element 50 is configured to recognize automatically specific gestures made by the user, for example in such a way as to operate the processing unit 30 through such gestures, for instance associating a pre-determined virtual form of defect reporting. In this case, the warning element 50 incorporates movement sensors, such as accelerometers, gyroscopes and the like capable of detecting a movement linked to a specific movement made by the user.

**[0099]** The digital images 15 obtained through the equipment 1 allow to acquire also the defects present on the leathers also through a digital identification obtained by means of a recognition software, analogously to the modalities with which the outline of the semi-finished product is acquired. If, instead, use is made of a physical identification with the element 50 (or with the colored chalks) the same software instrument that detects the outline will detect also the marks made with the chalks.

**[0100]** Alternatively, the identification is made directly on the video digital image 15, also subsequently to the acquisition of the outline, through an operator that is active for marking the defects on video. Some defects are recognized automatically by the software associated with the reading system of the digital image 15 of the leathers, reducing or possiblely eliminating the presence of the operator that marks the defects.

**[0101]** Once the defect is reported, a projector (not illustrated in the figures since it is optional) can project on the surface of the semi-finished product 5 the outline of the defect marked, in such a way as to provide the operator with visual feedback.

**[0102]** The processing unit 30, which is in communication with the image detectors 12, is therefore capable of detecting the presence of defects, not only by means of the digital scanning of the semi-finished product 5 but also on the basis of the movement of the warning element 50. The processing unit 30 is advantageously configured to associate the defects on the semi-finished leather product indicated by the warning element 50 with the image acquired of the semi-finished product 5, generating a report, a sort of virtual bi-dimensional grid indicating the type (that is, the shape) and the position of the defects on the semi-finished product 5, as well as the entity of such defects. Appropriately, such bi-dimensional grid report is generated automatically by the processing unit 30.

**[0103]** In other words, on the basis of what has been detected by the operator through the warning element 50, the processing unit 30 is capable of calculating automatically the type of defect and the entity thereof, and therefore of inserting in the report this information. In particular, advantageously, according to the present invention, the processing unit 30 identifies certain movements of the warning element 50 that correspond to certain types of defects, and reports these defects in the final report.

**[0104]** The coordinates of the pixels of the image acquired are referred to a pre-fixed bi-dimensional reference system, on the basis of which the coordinates of the defects reported are calculated.

**[0105]** In a variant of realization of the present invention it has been thought to separate the position arranged to the detection of the digital image of the leather with respect to the working area 3 and trimming area in which the cutting heads 16 and 17 are active.

**[0106]** This detection position 9' is located at some tenths of meters upstream the cutting area, near an operating position in which an operator associates the leathers on the synthetic material film. This distance can be variable but in general is quantifiable in some tenths of meters from the cutting and trimming area.

**[0107]** On this position 9' a video camera is provided for that shoots in a continuous manner the advancement of the leathers applied on the film.

**[0108]** In this way, it is possible to perform a digital transformation of the number and of the quality of the arriving leathers for the trimming phase in such a way as to perform a quite precise counting of the total surface of the leathers.

**[0109]** This solution has the great advantage of putting to manufacture the correct quantity of leathers on the basis of an order received, abandoning rudimentary methods that consisted in subdividing the total number of square meters of a certain order in the average area of a single leather, thus computing in an approximate manner the number of necessary leathers.

**[0110]** Since actually the area of the leathers can vary a lot and render the counting not particularly precise, the solution of the present invention allows to analyze in an automatized manner the video of the arriving leathers and to compute automatically the number of leathers, the area of each single leather and, above all, the total area.

**[0111]** The system can therefore advise the operator that it can load further leathers, if necessary.

**[0112]** Advantageously, this solution allows also to calculate the physical distance between leathers. This computation allows to position the leathers as close as possible to avoid the waste of the support film.

**[0113]** With the video take relative to the arrival train of the leathers it is possible to give the operator that leans the leathers an indicative value of the distance between leathers in such a way as to furnish it a clear indication for the subsequent placements. Further, the system can furnish return information about the correct centering of the leathers on the conveyor belt for a more correct right-left positioning.

**[0114]** The video take of the arriving leathers allows also to manage with a pre-determined anticipation the detection of the defects of the leather on video.

**[0115]** In fact, an operator is capable of marking the defects of the leather directly on the image taken from the video and not anymore on the leather in course of advancement. Since the take occurs meters before the final trimming phase, and therefore with a certain number

of leathers loaded on the conveyor belt (20-40 leathers), it is not necessary to proceed to mark the defects of the leathers at the speed of the belt.

**[0116]** It happens, in fact, that some leathers are defect-free, while they can be followed by leathers with a higher number of defects. In this case, the operator at the video position can manage, through temporal-masking, the cases with a high number of defects. The video marking, further, can be made by a single operator, while the manual marking of a leather on a conveyor belt is made by two operators on the opposite sides of the belt to result more efficient.

**[0117]** Further, the video marking can be from remote at a pre-determined distance from the machine.

**[0118]** It can, in fact, be conceivable to have a single operator in an active control position on scans of two machines, the whole adjusting the distance of the detection station upstream the trimming position in such a way as to generate optimal courses.

**[0119]** Appropriately, the processing unit 30 that receives the video images is operationally connected with the memory unit 31, which is configured to memorize at least the digitalized image of the semi-finished leather product, as well as the scanning report generated by the processing unit 30. In this manner, it is possible to keep a digital trace of the inspection made, rendering available the report generated to other users in a simple manner.

**[0120]** To that aim, in a preferred embodiment of the present invention, the memory unit is a cloud unit 60 a user can access from remote through a specific application and/or a specific address. The images acquired are therefore saved on a server a user is capable of accessing, through a device such as a PC or a smartphone, connecting to an Internet address or running a dedicated application installed on its device.

**[0121]** The processing unit 30 of the present invention therefore allows the digital storage of the semi-finished leather product, rendering available the digitalized image and the report to other users, such as the producer of the semi-finished product 5 or the company that receives and is in charge of the specific manufacturing on such semi-finished product 5. It is therefore evident that this system renders easier the traceability and the digital registration of all the production of the semi-finished leather products, allowing to compare possible instrumental objections made by the operators downstream the producer of the semi-finished leather product about the quality thereof. For example, being possible to access from remote, for example through cloud, to the image saved to view such semi-finished product and/or the report associated with it, it results easier to arrange possible divergences of opinion or of interpretation.

**[0122]** Obviously, it is possible also to save locally such information in a memory unit 31 integrated in the processing unit 30.

**[0123]** To each semi-finished product 5 is applied a specific identifier, such as a label or a bar code, such identifier being associated in a univocal manner with the digital image saved and with the corresponding report. To that aim, in an embodiment of the present invention, the processing unit 30 comprises means for the generation of said bar code and, optionally, means for the automatic application thereof on the semi-finished product.

**[0124]** The digitalization of the semi-finished product and the online storage thereof is particularly advantageous because, apart from facilitating the objections, it allows also to execute the pricing in a precise manner, as well as to automatize an possible future cutting phase (therefore avoiding the digitalization of the semi-finished product again), as it will be described below.

**[0125]** For this purpose, the processing unit 30 is also configured to define on the digitalized image a plurality of cutting areas, each one corresponding to a certain article to realize through the cut of said semi-finished product 5. The cutting areas are therefore portions of semi-finished leather product defined by a cutting perimeter that will be subsequently followed by a particular cutting instrument inside specifically dedicated numerical control machines. These cutting machines can be arranged in a cascade-like manner with respect to the inspection equipment 1 supplied with the processing unit 30 of the present invention, or can be arranged in a remote locality, such machines keeping in memory the digitalized image and the cutting paths thereon defined. The cutting machines are provided with appropriate readers capable of reading the identifier applied on the semi-finished leather product 5 during the inspection phase, so as to access easily to the digitalized image that has been inserted in the memory thereof.

**[0126]** Appropriately, the number and the position of the cutting and trimming areas defined on the semi-finished product are optimized on the basis of the information acquired by the processing unit 30, in particular on the basis of the defects detected. The processing unit 30, in fact, executes the instructions of a so-called nesting algorithm that allows to minimize the waste of leather, as well as to subdivide the semi-finished leather product into zones having different features in terms of quality and that are destined to house cutting areas corresponding to different portions of the article to realize or even to different articles.

**[0127]** The processing unit 30, following the digitalization of the image and the generation of the report, is therefore capable of executing, first of all, an estimate of the consumptions of the semi-finished leather product 5 based not only on dimensions and other theoretical information but also on dimensions and other real information (height, length, size, presence and number of defects, etc.).

**[0128]** Furthermore, as indicated above, the processing unit 30 is capable of associating the digital image 15 with a hypothetical virtual cut (in jargon, nesting) of the thus digitalized semi-finished leather product, taking into account all the elements (defects, surface quality of the leather, presence of marker, etc.), such digitalized semi-finished product therefore being subdivided on an offline

PC into an optimized number of cutting areas.

**[0129]** Actually, the nesting phase will be performed by another processing unit to which, however, can be transferred the digital images 15 of the leathers, even allowing to start to manage the nesting phase even before receiving the leathers. In this case, we do not speak any more of an approximate estimate but of an effective assessment before the actual cut, significantly saving time and costs, since the optimal cutting modality of the semi-finished product 5 is already known 5 before the placement thereof on a dedicated nesting machine.

**[0130]** Last, the processing unit 30 also comprises a user interface 70, such as a touch screen panel, by means of which the operator can enter the necessary information and manage the whole system. In the embodiment illustrated in the figures, the user interface 70 is arranged on the main body 2.

**[0131]** The present invention makes also reference to a method for the inspection of semi-finished leather products 5, destined, for instance, to subsequent manufacturing for realizing components for footwear, leather goods and clothing or articles for the automotive industry or similar application fields.

**[0132]** The method of the present invention provides for a preliminary phase in which the semi-finished leather product 5 is arranged on a conveyor belt 4 at the mouth of the equipment 1 described before.

**[0133]** Afterwards, the method provides for the phase of acquisition of images of the semi-finished product moved by the conveyor belt 4 through the image detectors 12, which allow to generate a digital copy of the semi-finished leather product 5 through a processing unit 30 of the images acquired, such processing unit being configured to receive the data acquired by the image detectors 12 and for processing such data.

**[0134]** The method then provides for the operation of cutting of the perimeter edges of the semi-finished leather product 5, both in connection with Bycast leather and in connection with other types of leather that only require the trimming of the perimeter edges.

**[0135]** The method of the invention provides for an optional phase that allows to mark defects on the surface of the semi-finished product 5 by means of a warning element 50 such as a digital pen provided with a lighting element that can be detected by the image detectors 12.

**[0136]** Advantageously, the method provides for a processing phase that allows to relate, through the processing unit 30, also the defects present on the semi-finished product 5 indicated by the operator through the warning element 50 and the digital image 15 acquired of the semi-finished product 5.

**[0137]** The method concludes, last, with the generation of a report indicating the type and the position of the defects on said semi-finished product.

**[0138]** In conclusion, the present invention furnishes an integrated system that makes available equipment capable of acquiring a complete digital image of the semi-finished product that is moved forward between a digital detection position and a neighboring cutting operating position. The system foresees, further, means for the detection of the defects. The defects can be detected automatically or manually.

**[0139]** As we have seen before, the defects are acquired in the following modalities or possiblely in a combination thereof:

- digital marking through the detection system of the digital marking instrument, which can also be the same instrument used for acquiring the outline;
- physical marking with the optical pen (or with colored chalks or the like). The same instrument that detects the outline will also detect the marks made with the chalks;
- video marking also after the acquisition of the outline with an operator that marks the defects on video before the skin arrives to the machine that trims, basically downstream the most remote portal 9'. This video can be positioned on the machine or in a remote location).
- no marking, in the sense that the defects are detected automatically by the processing unit that analyzes the images.

**[0140]** The main reason why the defects are marked is that of trimming them immediately. Basically, the equipment 1 according to the invention can trim just the outline of the leather but also a "modified" outline in such a way as to remove also the defective parts near the edge. Further, the machine 1 can also trim defective areas, for example the area 21 of figure 4, placed in the center of the leather.

**[0141]** It is worth highlighting that the mapping of the defects serves also to create reports in order to manage objections and/or to perform a correct pricing that takes into account also the defective areas. Further, the mapping consists also on performing an automatic placement, furnishing a file of the leather with the defects, thus avoiding the need to digitalize the leather again for a nesting phase of the shapes that will have to be cut from this leather.

**[0142]** In this last case, the defects can be marked on the leathers offline using chalks/pens or online by means of a virtual marking that does not affect minimally the surface of the leather. In such a way, the system of the present invention is capable of keeping in memory the image acquired of the semi-finished product together with a detailed report of the relative defects indicated by the operator, wherein for each defect is reported automatically the type, the entity and the exact position on the semi-finished product on the basis of the indications furnished by the operator or detected automatically by the software of the system. In many applications, such as the automatic placement, a vector file is substantially arranged, which is kept in memory and allows to have all the information on the digital map of the outline of the semi-finished product and of the relative defects.

**[0143]** Advantageously, according to the present invention, the system proposed allows a complete digitalization of the inspection process of a semi-finished leather product, the cut of the perimeter edges of Bycast leather and/or the trimming of other types of leather, with a significant improvement in terms of efficiency and reliability in the tannery field. In particular, the present invention allows to generate a digital map of the leather outline and of the defects, which are reported in a simple manner and without errors in the report generated by the processing unit.

**[0144]** The digitalization of the semi-finished leather product through the photo cameras occurs in a continuous manner in real time, generating a single image file that is stored, together with the report generated, in a cloud memory unit more users can access from remote, therefore rendering possible accusations and/or objections easier.

**[0145]** Consequently, the system of the present invention renders always available the high resolution digitalized image of the semi-finished leather product, as well as it renders always available the report that indicates with precision the position and also the shape and the entity of the defects.

**[0146]** All the information acquired in the inspection phase can then be used by the system to optimize a future cutting phase: basically, it is possible to execute a virtual cut of the digitalized semi-finished product and memorize this information for subsequently implement it on a specific machine. In this case, the processing unit can perform this analysis on the digitalized image before arranging the semi-finished product on a dedicated cutting machine, significantly saving time since the defects of the semi-finished leather product are known beforehand and therefore the best optimization and cutting modalities are already known. Obviously, also this information will be able to be included in the report generated by the system.

**[0147]** It is therefore evident that the present invention solves the technical problem and allows to obtain the significant advantages illustrated above, among which there is a much more efficient and quick inspection, and the generation of an error-free report.

**[0148]** Obviously, to the equipment and to the method described above a skilled in the art, in order to satisfy contingent and specific needs, will be able to devise further amendments and variants, all included in the scope of protection of the invention as defined by the following claims.

## Claims

1. Numerical control automatic equipment (1) for continuously performing a perimeter finish cut of semi-finished leather products (5), **characterized in that** it comprises:

   - one feed inlet portion of the semi-finished leather products (5) provided with image detection means (18) pointing towards the semi-finished products (5);
   - a cutting area (3) downstream said inlet portion and provided with at least one cutting head (16, 17);
   - processing means (30) for performing a digitalization phase of the image detected by the semi-finished leather product to be treated, with an associated film (13);
   - said at least one cutting head (16, 17) being active slaved to an electronic controller (20) of the numerical control equipment on at least opposite parts of the semi-finished leather product (5) for the film (13) trimming associated with the semi-finished leather product (5) and/or for finishing the perimeter edges (29) of the semi-finished product on the basis of the image digitalized (15) by said processing means (30).

2. Automatic equipment according to claim 1, wherein said inlet portion (6) is provided with at least one digital video camera that is liable to detect a digital image (15) of the semi-finished leather product.

3. Automatic equipment according to claim 1, wherein said inlet portion is structurally independent and separated from said cutting area (3), as well as positioned upstream it at a distance substantially equal to at least a semi-finished product (5) (4).

4. Automatic equipment according to claim 1, wherein said image detection means (18) are supported at a pre-fixed distance (D) from said cutting area.

5. Automatic equipment according to claim 4, wherein said distance is equal to at least the size of a semi-finished product (5).

6. Automatic equipment according to claim 1, wherein the semi-finished products are supported by a conveyor belt (4) extended between said inlet portion (6) and said cutting area (3).

7. Automatic equipment according to claim 1, **characterized in that** it comprises:

   - one processing unit (30) of the images acquired by said image detectors (12), said processing unit being suitable for generating a digital copy of the semi-finished product slaved to scanning; and
   - one warning element (50) that can be operated by an operator, suitable for indicating in a virtual manner defects on the surface of the semi-finished product,
   - wherein said processing unit is configured to

associate the defects on the semi-finished product (5) indicated by said warning element (50) with the image acquired of the semi-finished product, generating a report grid indicating at least the outline of the semi-finished product and the digital map of the defects on said semi-finished product.

**8.** Automatic equipment according to claim 7, wherein said at least one cutting head (16, 17) is activated slaved to an electronic controller (20) to trim areas (21) around said defects of the semi-finished product (5). Automatic equipment according to claim 1, wherein the detection means (18) are likely to perform a continuous scan that produces a complete digital image (15) of said semi-finished leather product (5) to which a report grid is associated that reports a digital map of the defects or possible surface discontinuities of said semi-finished product.

**9.** Automatic equipment according to claim 1, wherein the processing unit is operationally connected to a memory unit, suitable for containing at least the digitalized image, the outline and the digital map of the defects of the inspected semi-finished product.

**10.** Automatic equipment according to claim 1, wherein said processing unit is configured to recognize the position, the shape and/or the entity of the defect of the surface of the semi-finished product on the basis of said coordinates of the movement of the warning element.

**11.** Automatic equipment according to claim 5, wherein said memory unit is a cloud unit for a user remote access through a specific application and/or a specific address.

**12.** Automatic equipment for film trimming associated with a semi-finished leather product according to claim 1, **characterized in that** it is inserted downstream a transfer machine (25) of a tannery.

**13.** Method for automatically performing a perimeter finish cut and/or the film trimming associated with semi-finished leather products destined to the subsequent production of components for footwear, leather articles and the like, comprising at least the phases of:

- detection of a digital image of the whole semi-finished leather product, through numerical control equipment provided with an inlet portion furnished with at least one digital image detector pointing towards the semi-finished product;
- processing of such digital image obtained by the scanning in a processing unit associated with the equipment and through a filtering algorithm that is liable to detect the perimeter edges of said semi-finished leather product;
- operation of at least one cutting head provided for in a cutting area of said equipment and active at least on opposite parts of the semi-finished leather product slaved to said processing unit to trim the perimeter edges of the semi-finished product on the basis of the digitalized image in said acquisition phase.

**14.** Method according to claim 13, wherein a processing unit of the images acquired by the image detector is provided for, which is liable to generate a digital copy of the semi-finished product slaved to scanning and including virtual indicators representing defects on the surface of the skins.

**15.** Method according to claim 14, wherein said processing unit is configured to associate the defects on the surface in view of the skins, highlighted through a warning element, with the image acquired of the semi-finished leather product, generating a report grid indicating at least the shape and the position of the defects on said semi-finished product.

**16.** Method according to claim 14, wherein said phase of indication of possible defects of the semi-finished product includes also the definition of areas or portions of skins to be removed by operating said cutting head with analog modalities with respect to the trimming phase.

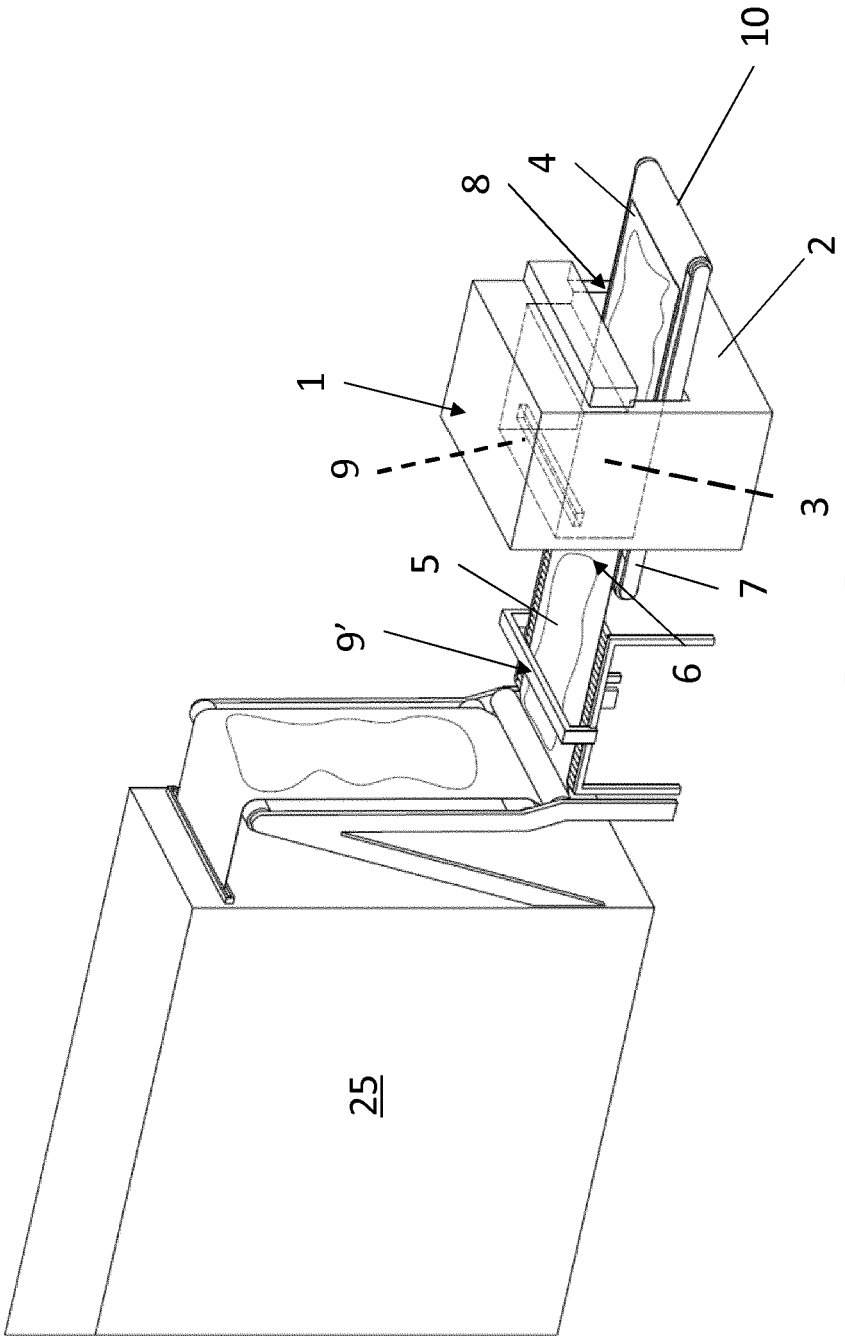



FIG. 1

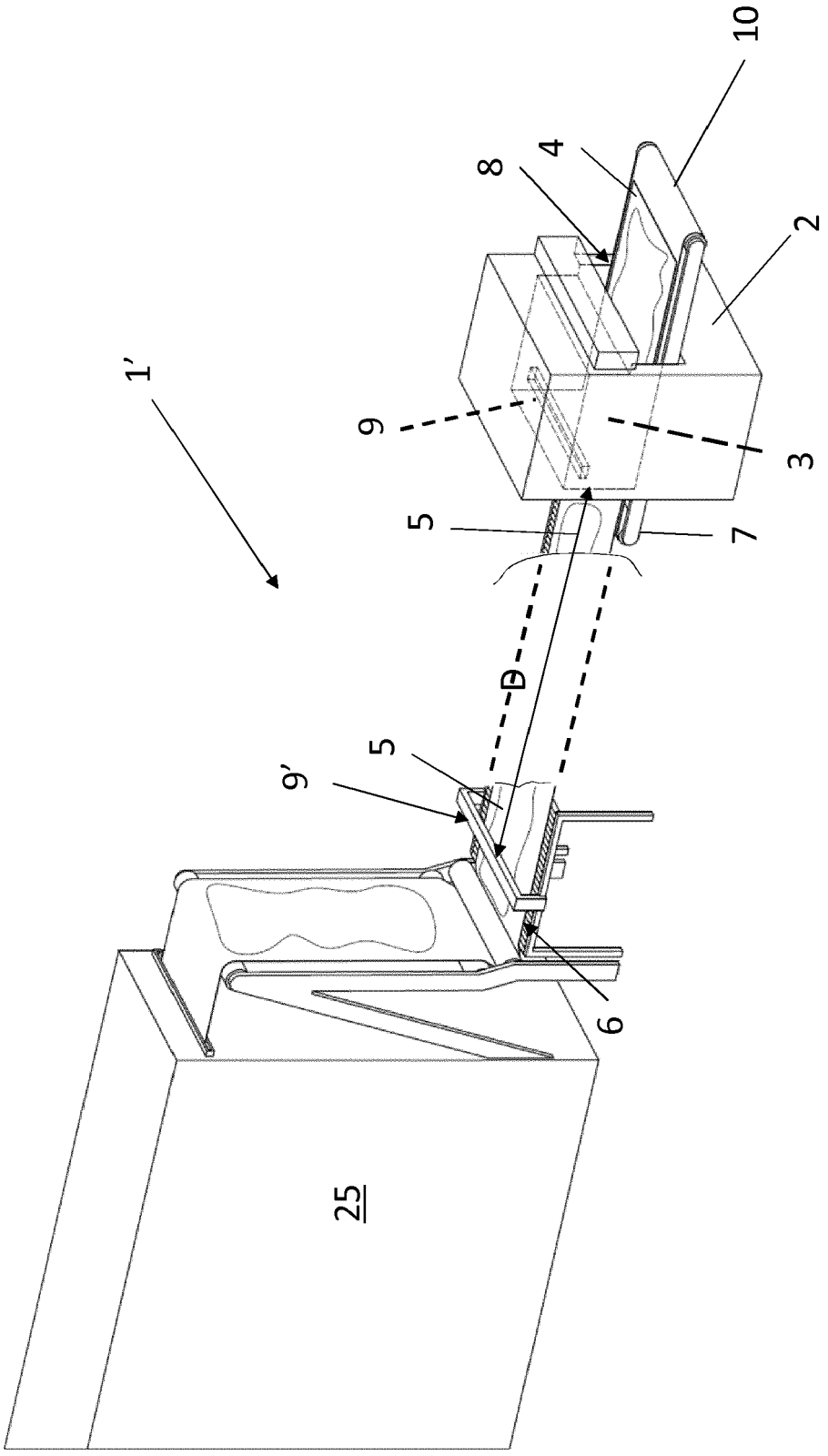



FIG. 1A

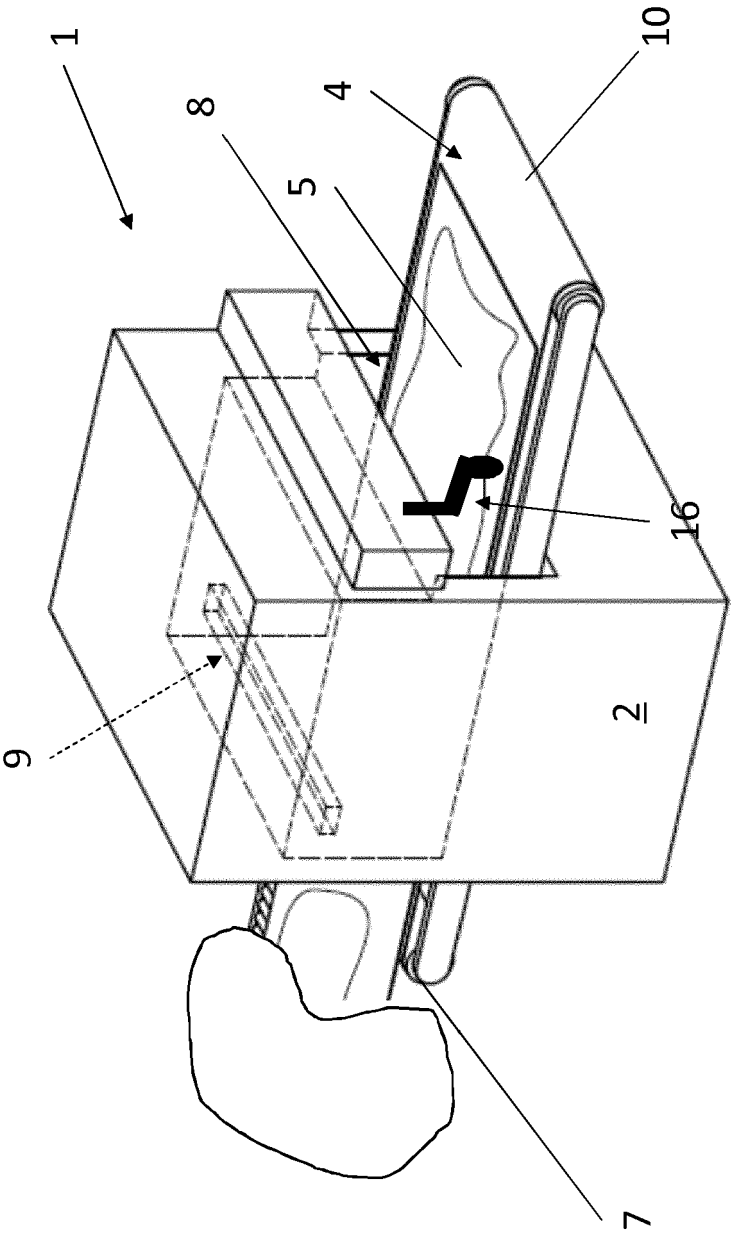



FIG. 2

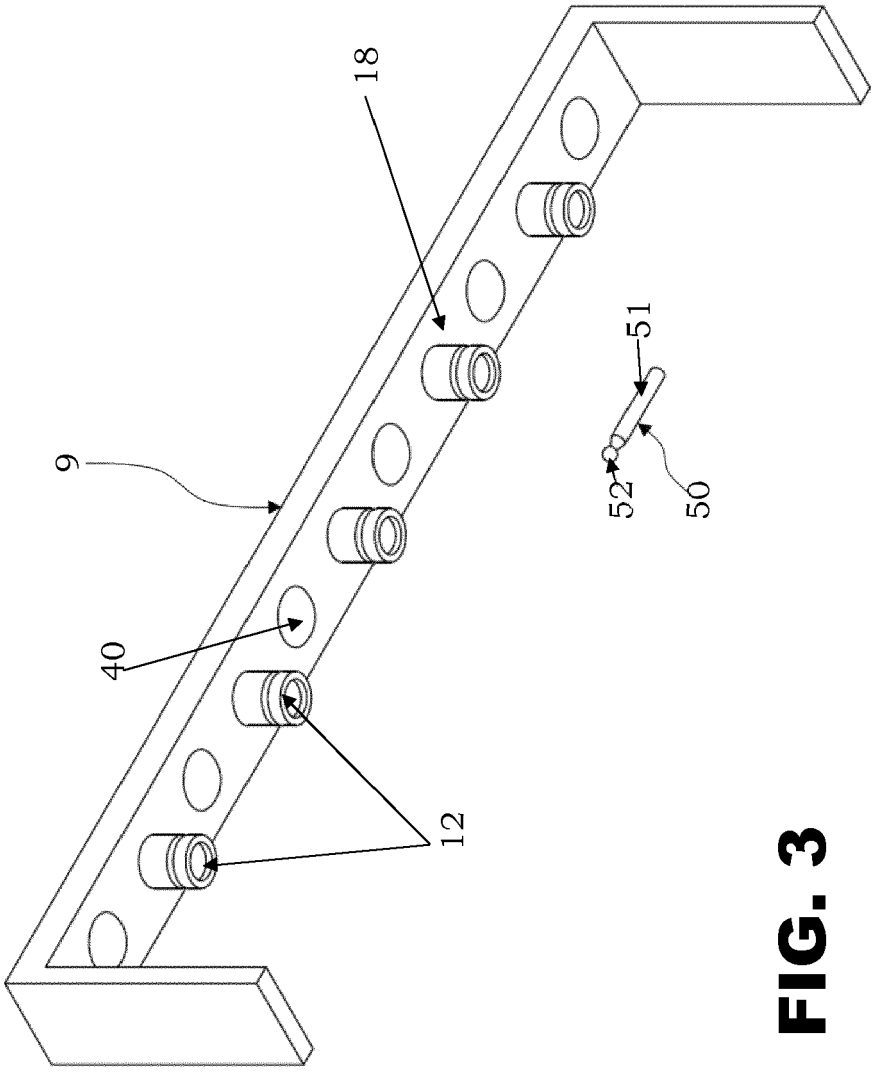



FIG. 3

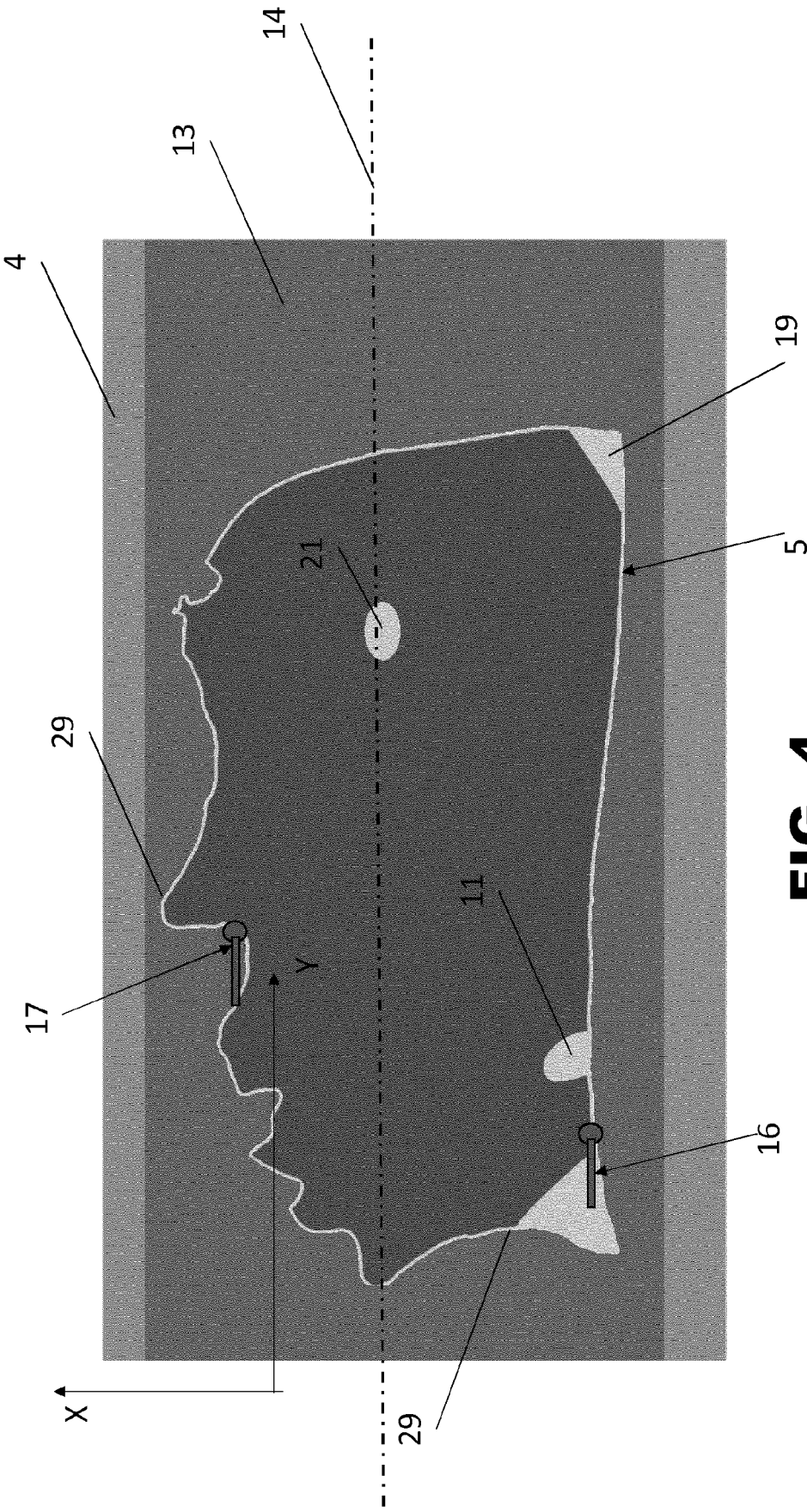



FIG. 4

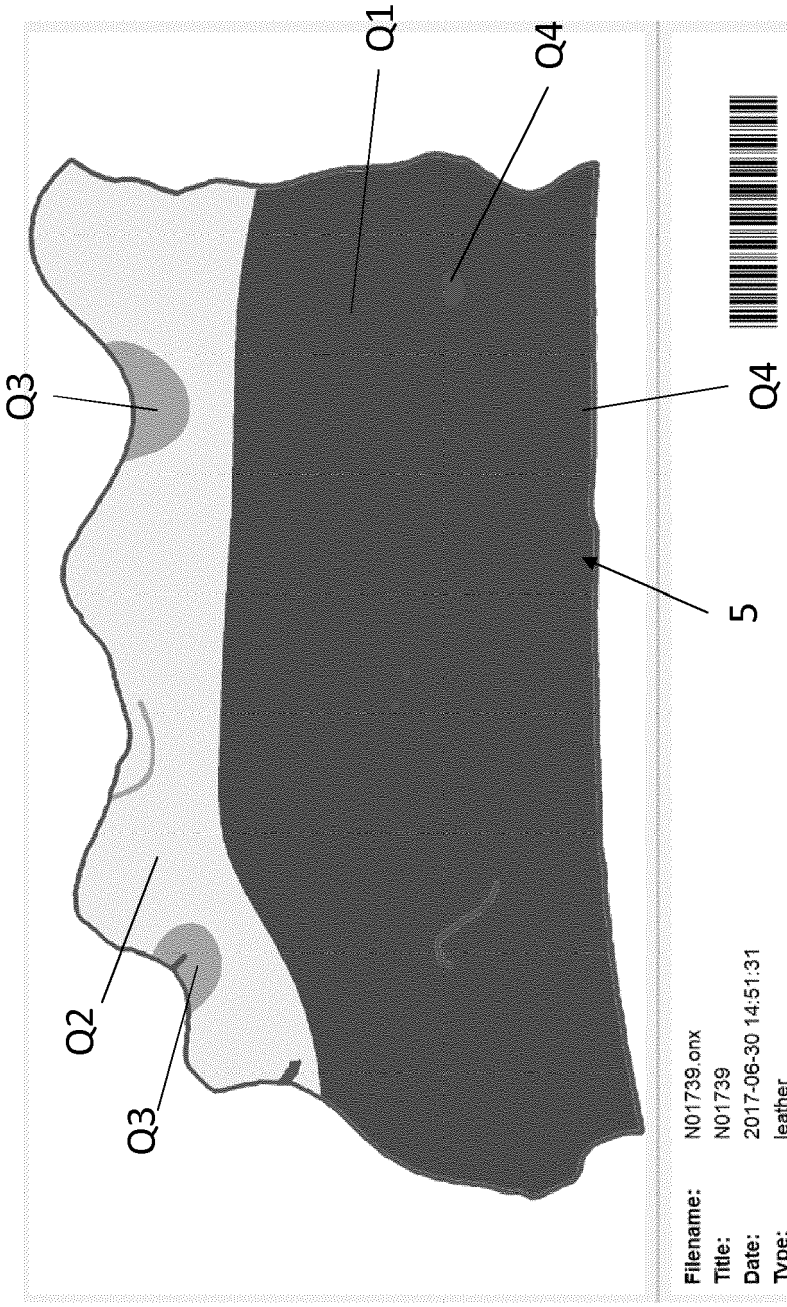

Q1
Q4
Q3
Q4
5
Q2
Q3
Filename: N01739.onx
Title: N01739
Date: 2017-06-30 14:51:31
Type: leather
Supplier area: 0.00 mm²
Area: 1.36 mm²

FIG. 5

FIG. 6

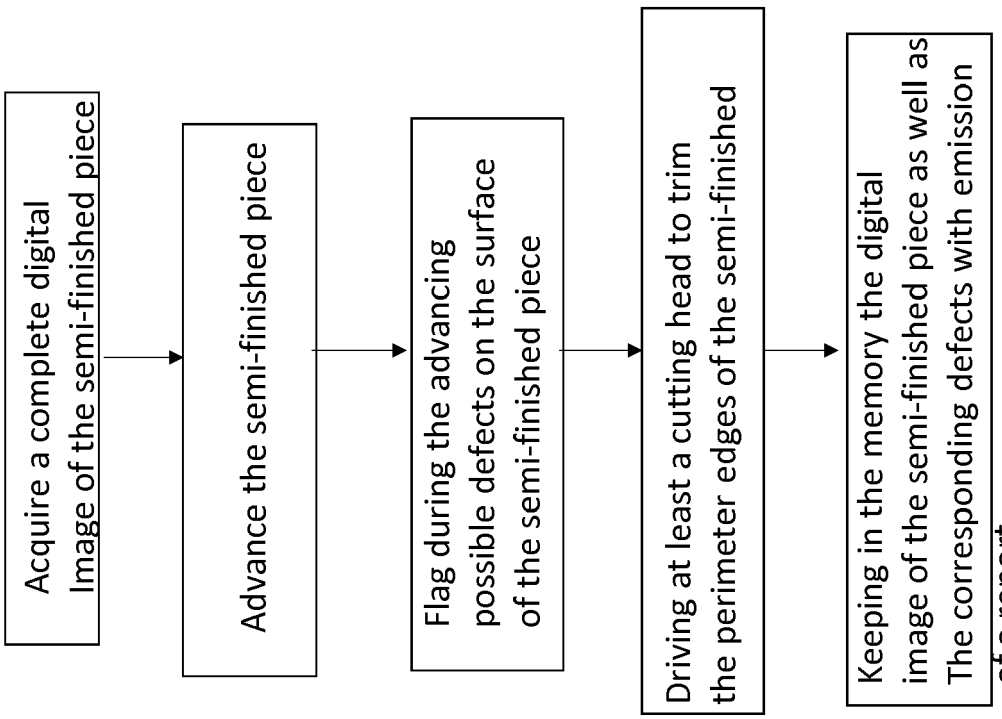
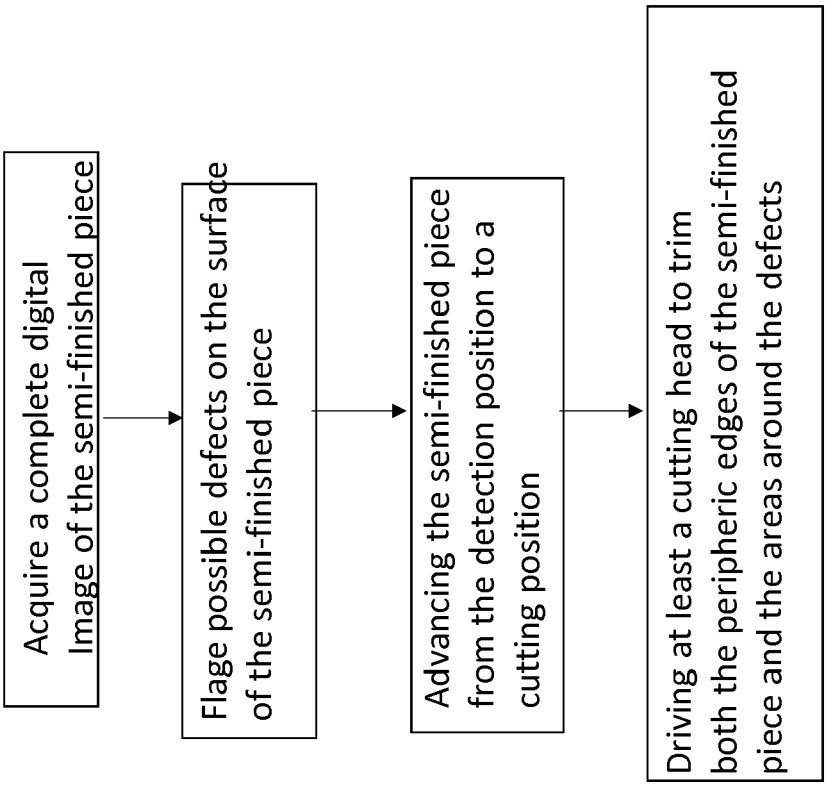

Acquire a complete digital Image of the semi-finished piece
Advance the semi-finished piece
Flag during the advancing possible defects on the surface of the semi-finished piece
Driving at least a cutting head to trim the perimeter edges of the semi-finished
Keeping in the memory the digital image of the semi-finished piece as well as The corresponding defects with emission of a report

FIG. 7


Acquire a complete digital Image of the semi-finished piece
Flage possible defects on the surface of the semi-finished piece
Advancing the semi-finished piece from the detection position to a cutting position
Driving at least a cutting head to trim both the peripheric edges of the semi-finished piece and the areas around the defects

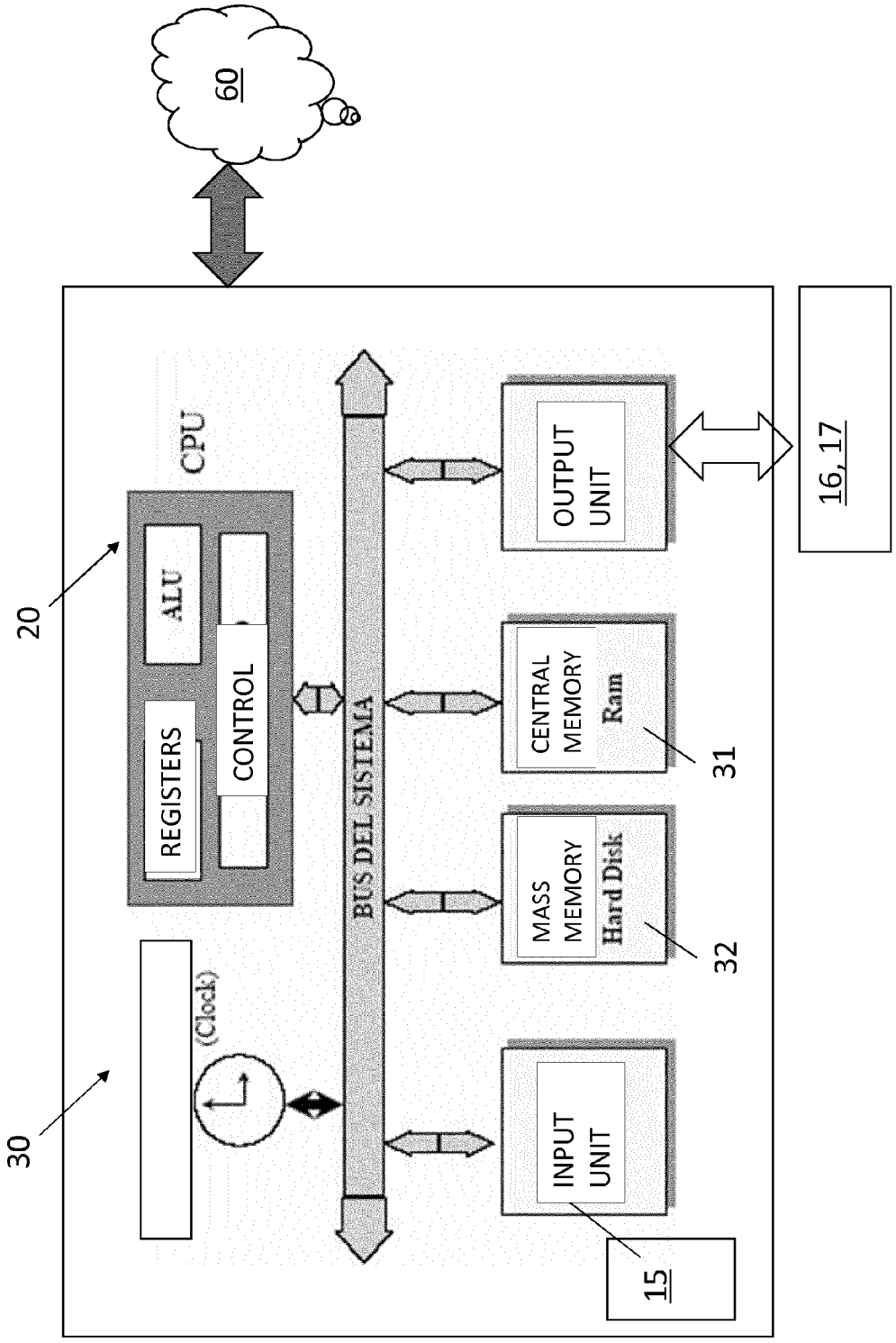

60
20
CPU
ALU
REGISTERS
CONTROL
BUS DEL SISTEMA
OUTPUT UNIT
16, 17
CENTRAL MEMORY
Ram
31
MASS MEMORY
Hard Disk
32
INPUT UNIT
15
30
(Clock)

FIG. 8

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# EUROPEAN SEARCH REPORT

Application Number
EP 19 15 8308

## 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 | EP 0 899 640 A1 (BALSIRA S A [CH]) 3 March 1999 (1999-03-03) * paragraphs [0005], [0009] - [0023]; figures 1,2 * | 1-16 | INV. C14B5/00 B26D5/00 D06H7/00 |
| X | WO 99/39867 A1 (FARLEY CUTTING SYST AUSTRALIA [AU]; FARLEY PETER ANTHONY [AU] ET AL.) 12 August 1999 (1999-08-12) * abstract; claim 1; figure 1 * | 1,13 | |
| X | US 5 089 971 A (GERBER HEINZ J [US]) 18 February 1992 (1992-02-18) * column 3, line 58 - column 8, line 11; figures 1-4 * | 1,13 | |
| X | CN 1 986 835 A (UNIV ZHEJIANG [CN]) 27 June 2007 (2007-06-27) * abstract; figure 1 * | 1,13 | |
| X | US 6 205 370 B1 (BLAIMSCHEIN GOTTFRIED [AT] ET AL) 20 March 2001 (2001-03-20) * column 4, line 29 - column 5, line 10; figure 1 * | 1,13 | TECHNICAL FIELDS SEARCHED (IPC) C14B B26F B26D D06H |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 5 September 2019 | Iamandi, Daniela |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 15 8308

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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05-09-2019

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 0899640 A1 | 03-03-1999 | AT 255239 T | 15-12-2003 |
| | | DE 69819980 T2 | 02-09-2004 |
| | | EP 0899640 A1 | 03-03-1999 |
| | | ES 2212211 T3 | 16-07-2004 |
| | | IT PD970186 A1 | 26-02-1999 |
| WO 9939867 A1 | 12-08-1999 | NONE | |
| US 5089971 A | 18-02-1992 | DE 4111304 A1 | 10-10-1991 |
| | | FR 2660668 A1 | 11-10-1991 |
| | | GB 2243102 A | 23-10-1991 |
| | | IT 1245041 B | 13-09-1994 |
| | | JP H0722909 B2 | 15-03-1995 |
| | | JP H04223895 A | 13-08-1992 |
| | | US 5089971 A | 18-02-1992 |
| CN 1986835 A | 27-06-2007 | NONE | |
| US 6205370 B1 | 20-03-2001 | AT 406464 B | 25-05-2000 |
| | | DE 59809546 D1 | 16-10-2003 |
| | | EP 0897992 A2 | 24-02-1999 |
| | | US 6205370 B1 | 20-03-2001 |

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82