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(71) Applicant: **Gozzini 1906 Turini Group S.r.l.**
56024 San Miniato Pisa (IT)

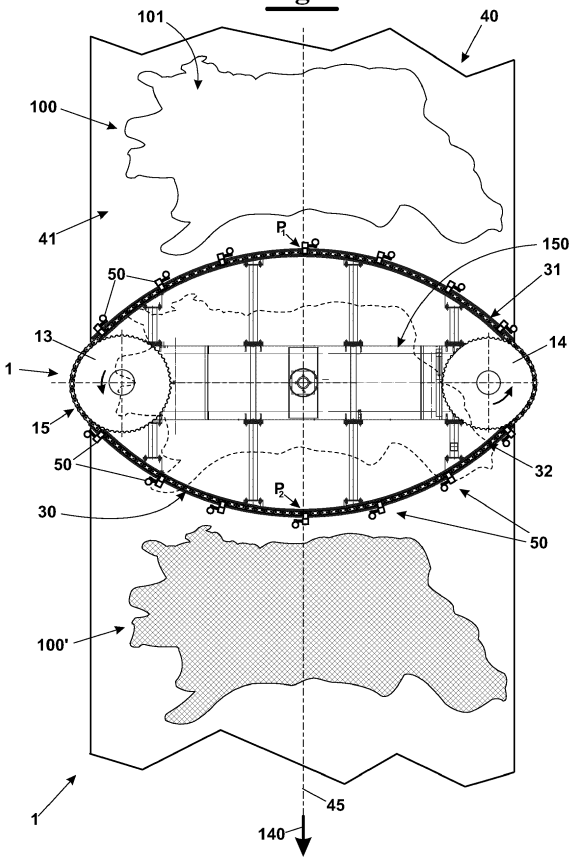
(72) Inventor: **TURINI, Marcello**
56020 Montopoli in Val D'Arno (IT)

(74) Representative: **ABM Agenzia Brevetti & Marchi**
Viale Giovanni Pisano, 31
56123 Pisa (IT)

(54) APPARATUS AND METHOD FOR SPRAYING PLANAR SEMIFINISHED PRODUCTS

(57) Apparatus for spraying (1) planar or substantially planar semi-finished products (100), comprises spray members (50) for spraying a covering and/or colouring product. The apparatus (1) comprises, furthermore, a device for moving forward (40) for causing the or each planar or substantially planar semi-finished product (100) to advance along a predetermined advancing direction (140), and a displacement group (10) comprising at least one flexible dragging element (15,15') to move the plurality of spray members (50) along a predetermined movement trajectory (ym). A guide group (30) is, furthermore, provided to guide the or each flexible dragging element (15,15') along a predetermined guide trajectory (yg). The guide group (30) comprises at least one first and one second curvilinear guide element (31,32) to guide the or each flexible dragging element (15) along at least a respective circular portion (21) of the guide trajectory (yg) having a predetermined radius of curvature (R1). The first and second curvilinear guide elements (31,32) comprise respective first and second parts (31a,32a;31b,32b) each of which comprises at least a first and a second circular portion (21a,21b) having respective radii of curvature (R1,R2) different from each other and decreasing going from an end (35a,35b;36a,36b) towards a respective central portion (35c,36c) of said first, or said second, curvilinear guide element (31,32).

Fig. 1



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Description

Field of the invention

[0001] The present invention relates to the field of spraying treatments of planar semi-finished products, and in particular it relates to an apparatus for spraying planar semi-finished products, such as, for example, skins of animal origin, in particular leathers, or synthetic fabrics, natural fabrics, but also artificial leather, or regenerated leather, and synthetic or natural products in general, for covering the same with a layer of product, in particular paint, pigments, resins, oils, etc.

[0002] The invention also relates to a method for spraying planar semi-finished products.

Description of the prior art

[0003] As known, many typologies of apparatus, normally called "booths", exist for spraying planar semi-finished products, in particular in the leather tanning field, which are used for spraying on the aforementioned planar semi-finished products one or more covering products of different type, in particular paints, pigments, but also resins and oils, and in general chemical and/or natural products.

[0004] In pratice, the spraying of the planar semi-finished products, in particular the painting of leathers, provides to apply a covering layer at least on one side of the same, or on both the sides. The covering layer is applied by spraying the selected product in a predetermined amount which depends on the desired thickness.

[0005] In order to avoid that the used products during the spraying can be freely dispersed in the surrounding environment, the spraying step is, normally, carried out within spray booths.

[0006] A first typology of spray booth is that one of the manual booths where an operator graspes a spray gun through which delivers the covering product on the semi-finished product, for example skins, or fabrics, which are laid on an inclined plane arranged within the booth. Another typology of spray booths is that one of the automatic spray booths where the semi-finished products move forward above a conveyor belt which is called in jargon "mat". More precisely, the automatic booths are closed with the exception of 2 slits which allow the movement of the tape with the planar semi-finished products laid on it for the spraying treatment and the following drying into an oven, or a drying tunnel. More in detail, the aforementioned conveyor belt is, generally, installed on carpentry structures arranged at the ends of the spraying line and has a continuous movement obtained by a series of rolls which are installed at an inlet and an outlet section.

[0007] Normally, an automatic spray booth provides a support frame on which a certain number of spray members, such as nozzles, or guns, which provide to deliver the aforementioned chemical or natural products, normally in a nebulized form on the treated planar semi-finished products. Therefore, in the case of automatic booths, a spraying line is formed by one inlet section, one or more alternative spray booths, one or more spraying tunnels and one outlet section at which the movement of the tape is inverted towards the inlet section. In the case of more spray booths and more drying tunnels, these, as anticipated above, are, advantageously, alternately positioned with respect to each other along the line, in such a way to progressively dry the product distributed on the worked semi-finished products.

[0008] The spray booths can be associated to fumes suction and abatement systems for sucking and filtering the products, in particular the suspensions, which are released in the atmosphere during the spraying step.

[0009] The automatic spray booths can be classified on the basis of the system for moving the spray guns in alternative-type booths, parallel-type booths and rotary-type booths.

[0010] In the case of alternative-type spray booths the spray guns are mounted on one or more carriages having reciprocating motion.

[0011] In the case of parallel-type spray booths, the guns are mounted on structure having continuous motion along a closed trajectory comprising 2 rectilinear portions linked at the end by 2 semi-circumferences.

[0012] The spray guns deliver the covering and/or colouring product on the semi-finished products which moves through the booth below the same displaced by a conveyor belt along a movement direction orthogonal to the aforementioned rectilinear portions. This typology of spraying booths, with respect to other existing typologies, has the great advantage to have a reduced encumbrance which allows, therefore, to install the same also at a place, which has not a large available area.

[0013] The alternative spray booths having reciprocating motion are provided with a reduced number of spray guns. This because when, at the ends of the tape, the movement is inverted, inertial phenomena occur due to the weight of the transmission members which comprise the spray guns, in movement, that do not allow to mount a high number of the same. This typology of booths is, in fact, normally, provided, at most, with 2 carriages with 2 guns each, which move in counter-phase, which means that when the first carriage is placed at a side of the mat with respect to the advancing direction of this, the second is placed at the opposite side. The alternative spray booths, due to the low velocity of application of the product, have, therefore, a low productivity.

[0014] For all the above, the alternative-type spray booths, or paint spray booths, are not able to guarantee a high qualitative level of the spraying of the covering and/or colouring products. In particular, both in the parallel spray booths and in the alternative ones, the cones of covering and/or colouring product delivered by the spray guns of the 2 portions overlap to each other of an angle with an amplitude that is difficult to foresee and that, however, unlikely reaches 6°. Therefore, the coverage of the semi-finished products with covering and/or

colouring products delivered by the spray guns is not satisfactory.

[0015] Another drawback which is directly linked to the previous one is that, in the case of malfunctioning of one spray gun, for example the obstruction of a nozzle, the different zones of the semi-finished product are covered in a different way that are visible to the naked eye and, therefore, cannot be accepted by the market.

[0016] On the other side, the rotary spray booths in addition to be structurally complex have the drawbacks to have a large size which greatly limit their use because large areas are needed for installing them.

[0017] An example of a continuous leather painting machine of the prior art with the aforementioned drawbacks is described in ES2003561. In this case, the spraying machine provides a conveyor belt for moving the painting members above which a frame is provided suppoting a rotary distributor connected to a series of spray members which are moved along a closed path above the conveyor belt. The frame comprises support and guide frame members having an arched shape on which a flexible band, which is made of a plastic antifriction material, runs and links the aforementioned spray members to each other. The flexible band is wound about a motorized pulley and a tensioner pulley arranged at the opposite ends of the aforementioned frame members. The shape of the frame members and of the pulleys is such that the aforementioned closed path has an oval geometry with the greater sides arranged substantially orthogonal to the development of the conveyor belt. In order to keep the flexible band adhering to the frame members, the aforementioned tensioner pulley is used connected to a piston which acts within a pneumatic cylinder that pushes the tensioner pulley along a direction transversal to the conveyor belt. In this way, the flexible band is arranged adherent to the guide frame members.

[0018] Even though the solution described in ES2003561 has a riduced dimension along the direction parallel to the movement direction of the skins to be painted, it has, anyway, some drawbacks. First of all, the solution of ES2003561 whose aim is to avoid vibrations during the displacement of the spray members, does not allow to obtain a high quality of the painting of the worked skins. This, on the one hand, because of the displacement of the spray members along an oval path, which means comprising only one radius of curvature R for all the spraying zone, and, on the other hand, of the type of mechanism which is provided for moving the flexible band. In fact, as anticipated above, the displacement of the flexible band is caused by tensioning the same by the aforementioned tensioner pulley which is moved by the aforementioned piston. This solution does not guarantee, in particular, neither that the spray members are accurately positioned with respect to the worked skins nor that the spray members are accurately positioned one with respect to another because of the elasticity of the flexible band. Therefore, it is not possible to guarantee an uniform spraying of the skins.

Summary of the invention

[0019] It is, therefore, an object of the present invention to provide an apparatus for spraying planar or substantially planar semi-finished products, in particular leathers, as well as natural or synthetic fabrics, but also artificial leather, or regenerated leather, which is able to overcome the above mentioned drawbacks of the prior art solutions.

[0020] It is also an object of the present invention to provide an apparatus for spraying planar or substantially planar semi-finished products which has a small size, in particular along a direction parallel to the movement direction of the planar semi-finished products, and that is, at the same time, able to guarantee a high quality of the spraying of the planar or substantially planar semi-finished products treated with a covering and/or colouring product.

[0021] It is, in particular, an object of the present invention to provide an apparatus for spraying planar or substantially planar semi-finished products which is able to guarantee to substantially uniformly cover the worked planar or substantially planar semi-finished products treated with a covering and/or colouring product also in the case of malfunctioning, in particular the obstruction of one of the spray members mounted on the apparatus.

[0022] It is, furthermore, an object of the present invention to provide a method for spraying planar or substantially planar semi-finished products having analogous advantages.

[0023] These and other objects are achieved by an apparatus for spraying planar or substantially planar semi-finished products, in particular leathers, or natural or synthetic fabrics, comprising:

- a plurality of spray members configured to spray a covering and/or colouring product on at least one planar or substantially planar semi-finished product;
- a device for moving forward provided with a supporting surface and configured to cause said or each planar or substantially planar semi-finished product which is positioned on said supporting surface to advance along a predetermined advancing direction;
- a displacement group configured to move the aforementioned plurality of spray members along a predetermined movement trajectory ym intersecting said advancing direction in a first and a second point of intersection P1 and P2, said displacement group comprising:
  - at least one flexible dragging element;
  - a plurality of engagement groups each of which configured to engage a spray member of said plurality a said or each flexible dragging element at a respective engagement portion;
  - a guide group arranged to guide said or each flexible element along a predetermined guide trajectory yg, and, therefore, the aforemen-

tioned plurality of spray members along the predetermined movement trajectory ym, wherein said guide group comprises a first and a second curvilinear guide element configured to guide said or each flexible dragging element along at least one respective circular portion of said predetermined guide trajectory yg having a predetermined radius of curvature R1 in such a way that said predetermined movement trajectory ym comprises a corresponding circular portion, and wherein the aforementioned plurality of spray members is arranged to spray the covering and/or colouring product on said or each planar or substantially planar semi-finished product during the crossing by said respective engagement portion of at least one portion of the first and second curvilinear guide elements;

whose main characteristic is that the aforementioned first and second curvilinear guide elements comprise respective first and second parts, that each of the aforementioned first and second parts of the first guide element and of the second guide element comprises at least a first and a second circular portion having respective radii of curvature R1 and R2, and that the radii of curvature R1 and R2 of the first and second circular portions are decreasing going from an end to a central portion of the first, or the second, guide element.

[0024] Other technical characteristics of the invention and relative embodiments are set out in the dependent claims.

[0025] In particular, each of the aforementioned first and second parts of the first guide element and of the second guide element comprises at least a first, a second and a third circular portion having respectively a first, a second and a third radius of curvature R1, R2 and R3. More in particular, the first, the second and the third radius of curvature R1, R2 and R3 of the first, of the second and of the third circular decrease going from an end to a central portion of the first or the second guide element.

[0026] In particular, the aforementioned first and second parts of the first and second curvilinear guide elements are symmetrically arranged with respect to a plane orthogonal to a centre line of the aforementioned supporting surface and passing through it.

[0027] In an alternative embodiment of the invention, the centres C1 of the first and second circular portions can be arranged, in use, along the centre line of the supporting surface.

[0028] In particular, the centres C1 of the circular portion of the first curvilinear element and of the second curvilinear element can be positioned at the side of the device for moving forward with respect to the centre line at which the component of the velocity vP of the spraying elements in the advancing direction is subtracted from the velocity vT of the device for moving forward.

[0029] More in particular, the first curvilinear guide element and the second curvilinear guide element are configured in such a way to be asymmetrically positioned with respect to a plane orthogonal to the centre line of the supporting surface and passing through the centre line same.

[0030] In particular, the first guide element and the second guide element can be provided with at least a respective circular lateral wall arranged to guide the flexible dragging element along the respective circular portion of the guide trajectory.

[0031] In an embodiment of the invention, the first and second guide elements are provided with a first and a second curvilinear lateral wall arranged to laterally contain the flexible element at opposite sides during its displacement along the aforementioned guide trajectory yg. More in particular, the first and second curvilinear lateral walls comprise at least a respective circular portion arranged to guide the flexible element along the aforementioned circular portion of said guide trajectory yg.

[0032] In particular, the displacement group can comprise a first and a second flexible dragging element arranged on respective planes parallel to each other. More in particular, the aforementioned guide group is configured, in this case, to guide the first and second flexible dragging elements respectively on a first and on a second guide trajectory parallel to each other.

[0033] In particular, each engagement group can comprise:

- a support element arranged to support at least one respective spray member of the aforementioned plurality;
- a first and a second engagement member arranged to engage said support element to said first and second flexible dragging element at a first and a second engagement portion, respectively.

[0034] More in particular, each support element can be positioned tangentially to the first and to the second guide trajectory yg and y'g.

[0035] In a preferred embodiment, the or each flexible dragging element can be a dragging chain, preferably a toothed dragging chain. Alternatively, the or each flexible element can be a dragging cable, or a dragging belt, preferably a toothed dragging belt.

[0036] In particular, the displacement group can comprise:

- at least one motor provided with a motor shaft arranged to rotate about a rotation axis;
- a motion transmission group arranged to transmit said rotation of said motor shaft to a first and a second toothed wheel positioned at opposite sides with respect to said first and second curvilinear guide elements.

[0037] In particular, a distribution device can be, fur-

thermore, provided configured to feed by at least a respective feeding duct a predetermined flow of said covering and/or colouring product to each spray member of said plurality of spray members.

[0038] Preferably, the aforementioned distribution device can be provided, for each spray member, with a first and a second supplementary duct arranged to supply, respectively, a first and a second air-flow at a predetermined pressure. In particular, the first supplementary duct can be adapted to feed to the spray member a first air-flow adapted to mix the product, and a second supplementary duct adapted to feed to the spray member a second air-flow adapted to operate the opening of a delivering nozzle of which the spray member is provided to deliver the mixed product on the semi-finished product, in particular the skin, or the fabric.

[0039] Advantageously, the distribution device is configured to move synchronously with the or each flexible dragging element in such a way that each feeding duct is adapted to follow the position of the spray member to which is connected to by the or each feeding duct during its movement along the predetermined movement trajectory.

[0040] In an embodiment foreseen, the distribution device is arranged to rotate about a rotation axis.

[0041] In particular, the distribution device can be operatively connected to the first or to the second toothed wheel by a transmission member, such as a belt, or a chain, in such a way that the rotation of the same is carried out synchronously with the displacement of the spray members.

[0042] According to another aspect of the invention, a method for spraying planar or substantially planar semi-finished products, such as leathers or natural or synthetic fabrics, comprises the steps of:

- causing at least one planar or substantially planar semi-finished product to advance along a predetermined advancing direction by a device for moving forward provided with a supporting surface on which said or each planar or substantially planar semi-finished product is arranged;
- moving a plurality of spray members configured to spray a covering and/or colouring product on said or each planar or substantially planar semi-finished product along a predetermined movement trajectory ym, said moving step being carried out by a displacement group comprising at least one flexible dragging element;
- engaging said plurality of spray members to said or each flexible dragging element at respective engagement portions;
- guiding said or each flexible dragging element along a predetermined guide trajectory yg and, therefore, said plurality of spray members along said predetermined movement trajectory ym, said guiding step being carried out by a first and a second curvilinear guide elements configured to guide said or each flexible dragging element along at least a respective circular portion having a predetermined radius of curvature R1 in such a way that said predetermined movement trajectory ym comprises a respective circular portion, and that said plurality of spray members is arranged to spray the covering and/or colouring product on said planar or substantially planar semi-finished product during the crossing by the respective engagement portion of at least one portion of the aforementioned first and the aforementioned second curvilinear guide element;

whose main characteristic is that the aforementioned first and second curvilinear guide elements comprise respective first and second parts, that each of the aforementioned first and second parts of the first guide element and of the second guide element comprises at least a first and a second circular portion having respective radii of curvature R1 and R2 different from each other, and that the radii of curvature R1 and R2 of the first and the second circular portion are decrescenti going from an end to a central portion of the first, or the second, guide element.

[0043] According to still another aspect of the invention, an apparatus for spraying planar or substantially planar semi-finished products, in particular leathers, or natural or synthetic fabrics, comprising:

- a plurality of spray members configured to spray a covering and/or colouring product on at least one planar or substantially planar semi-finished product;
- a device for moving forward provided with a supporting surface and configured to cause said or each planar or substantially planar semi-finished product positioned on said supporting surface to advance along a predetermined advancing direction;
- a displacement group configured to move the aforementioned plurality of spray members along a predetermined movement trajectory ym intersecting said advancing direction in a first and a second point of intersection P1 and P2, said displacement group comprising:
  - at least one flexible dragging element;
  - a plurality of engagement groups each of which configured to engage a spray member of said plurality to said or each flexible dragging element at a respective engagement portion;
  - a guide group arranged to guide said or each flexible element along a predetermined guide trajectory yg, and, therefore, the aforementioned plurality of spray members along the predetermined movement trajectory ym, said guide group comprising a first and a second curvilinear guide element configured to guide said or each flexible dragging element along at least a respective circular portion of said predetermined guide trajectory yg having a predetermined ra-

dius of curvature R1 in such a way that said predetermined movement trajectory ym comprises a corresponding circular portion, and that the aforementioned plurality of spray members is arranged to spray the covering and/or colouring product on said or each planar or substantially planar semi-finished product during the crossing by said respective engagement portion of at least one portion of the first and of the second curvilinear guide element;

whose main characteristic is that the first and second curvilinear guide elements are configured in such a way that the respective circular portion of the predetermined guide trajectory yg has only one radius of curvature R1 for all its length and that the centres C of each circular portion of the first curvilinear guide element and of the second curvilinear guide element are positioned at a predetermined distance d from the centre line of the supporting surface and, advantageously, at the same side with respect to it. Therefore, in this case, the first and second parts are arranged symmetrically with respect to the centre line.

[0044] In particular, the centres C1 of the circular portion of the first curvilinear element and of the second curvilinear element are positioned at the side of the device for moving forward with respect to the centre line at which the component of the velocity of the spray members vP in the advancing direction is subtracted from the velocity vT of the device for moving forward.

[0045] More in particular, the first curvilinear guide element and the second curvilinear guide element are configured in such a way to be asymmetrically positioned with respect to the plane orthogonal to the centre line of the supporting surface and passante per la centre line stessa.

Brief description of the drawings

[0046] The invention will now be shown with the following description of its exemplary embodiments, exemplifying but not limitative, with reference to the attached drawings in which:

- Fig. 1 diagrammatically shows a plan view of a first embodiment of the apparatus, according to the invention, for spraying planar or substantially planar semi-finished products in a working configuration;
- Fig. 2 shows the apparatus for spraying planar or substantially planar semi-finished products of figure 1 to highlight some structural characteristics;
- Fig. 3 shows an enlargement of a portion of the apparatus for spraying planar or substantially planar semi-finished products of figure 2 to highlight some technical characteristics;
- Fig. 4 diagrammatically shows the guide trajectory of an alternative embodiment of the apparatus for spraying planar or substantially planar semi-finished products of figure 3;
- Fig. 5 diagrammatically shows a further embodiment of the apparatus for spraying planar or substantially planar semi-finished products according to the invention;
- Fig. 6 diagrammatically shows a perspective side elevation view of a possibile embodiment of the apparatus for spraying planar or substantially planar semi-finished products according to the invention;
- Figures 7 and 8 diagrammatically show the apparatus of figure 6, respectively in a front elevation view partly sectioned and in a side elevation view partly sectioned.

Detailed description of some exemplary embodiments of the invention

[0047] With reference to figure 1, an apparatus 1 for spraying planar or substantially planar semi-finished products 100, in particular skins, advantageously leathers, or synthetic or natural fabrics, but also artificial leather, or regenerated leather, such as semi-finished products made of analogous materials, comprises a plurality of spray members 50 configured to spray a covering and/or colouring product, such as a paint, a pigment, a resins, an oil, etc. on at least one planar or substantially planar semi-finished product 100 at a time, in particular at least on one side 101 of this, advantageously, at least on the grain side in case of skins, to obtain a corresponding planar or substantially planar semi-finished product 100' provided with at least one layer of the aforementioned covering and/or colouring product 100' on at least one side 101.

[0048] In particular, the spray members 50 which can be used in the apparatus 1, according to the invention, can be of one of the known types. Generally, each spray member 50 can be provided with an inlet for the covering and/or colouring product to be sprayed, an inlet for the piloted air, which is the opening and closing pneumatic command of the nozzle through which the product is sprayed, and an inlet of air at a predetermined pressure for mixing and spraying the covering and/or colouring product. The apparatus for spraying 1, according to the invention, furthermore, comprises a device for moving forward 40 provided with a supporting surface 41 to cause at least one planar or substantially planar semi-finished product 100 at a time to advance, in the example of figure 1 a plurality of planar or substantially planar semi-finished products 100. These are positioned on the supporting surface 41 along a predetermined advancing direction 140. The supporting surface 41, for example of a conveyor belt or mat has a centre line 45.

[0049] A displacement group 10 is, furthermore, provided configured to move the aforementioned plurality of spray members 50 along a predetermined movement trajectory ym, in particular intersecting the aforementioned advancing direction 140 in a first and in a second point P1 and P2. More in detail, the displacement group 10

comprises at least one flexible dragging element 15 to which the aforementioned plurality of spray members 50 is engaged.

[0050] In a preferred embodiment, the or each flexible element 15, or 15' can be a dragging chain, in particular of the type constituted of a succession of links pivotally engaged to each other by a plurality of pins. Alternatively, the or each flexible element 15, or 15', can be a dragging cable, advantageously a metallic cable, or a dragging belt. The apparatus 1 comprises, furthermore, a plurality of engagement groups 80 each of which configured to engage a respective spray member 50 of the aforementioned plurality to the or each flexible dragging element 15, 15', at a respective engagement portion 55.

[0051] A guide group 30 is, also, provided configured to guide the or each flexible dragging element 15, 15', along a predetermined guide trajectory yg, and, therefore, the spray members 50 along the aforementioned movement trajectory ym for the presence of the aforementioned engagement group 80.

[0052] In an embodiment of the invention, diagrammatically shown in the figures 6 and 8, the displacement group 10 can be provided with at least one motor 11 having a motor shaft 12 arranged to rotate about a rotation axis 110. The displacement group 10 can, furthermore, comprise a motion transmission group, not shown in the figures for clarity, arranged to transmit the rotation of the motor shaft 12 to a first and to a second toothed wheel 13 and 14. In particular, the flexible element 15 is adapted to mesh with the first and second toothed wheels 13 and 14. More precisely, the first and second toothed wheels 13 and 14 are arranged in proximity of the opposite ends of the first and second guide elements 31 and 32. In particular, each flexible element 15, 15' can be provided with a plurality of teeth arranged to mesh with said toothed wheels 13 and 14.

[0053] According to what is foreseen by the present invention, the guide group 30 comprises a first and a second curvilinear guide element 31 and 32 configured to guide the or each flexible dragging element 15, 15', along at least a respective circular portion 21 of the aforementioned guide trajectory yg, advantageously a closed guide trajectory. In particular, the aforementioned circular portion 21 has a predetermined radius of curvature R1. More in particular, the guide trajectory is such that it progressively moves away from a longitudinal axis going from an end portion towards to the central portion and, then, to progressively approaches again to the longitudinal axis going from the central portion towards the other end portion. Therefore, also the aforementioned movement trajectory ym comprises a corresponding circular portion. The plurality of spray members 50 is arranged to spray the covering and/or colouring product on the planar or substantially planar semi-finished products 100 during the crossing by the respective engagement portion 55 of at least one portion of the first and second curvilinear guide elements 31 and 32. In particular, the aforementioned plurality of spray members 50, instead, is not arranged to spray the covering and/or colouring product on the planar or substantially planar semi-finished products 100 during the movement of the spray members 50 along the movement trajectory ym externally to the first and to the second curvilinear guide element 31 and 32.

[0054] In particular, the first guide element 31 and the second guide element 32 can be provided with a first and a second circular lateral wall 33a,33b and 34a,34b. These are arranged to laterally contain the flexible element 15 at opposite sides in such a way to guide the same along the aforementioned guide trajectory yg during the working of the displacement group which causes the spray members 50 to move along the movement trajectory ym. More in particular, the first and second curvilinear lateral walls 33a,33b and 34a,34b comprise at least one respective circular portion arranged to guide the flexible element 15 at the or each circular portion 21 of the guide trajectory yg.

[0055] As diagrammatically shown for example in figure 1, in a first embodiment of the invention, both the first and second curvilinear guide elements 31 and 32 comprise a first and a second part 31a, 31b and 32a, 32b. The first and second parts 31a and 31b of the first curvilinear guide element 31, as well as the first and second parts 32a and 32b of the second curvilinear guide element 32, are, advantageously, symmetrically arranged with respect to a plane orthogonal to the centre line 45 of the supporting surface 41 and passing through the same.

[0056] In particular, each of the aforementioned first and second parts 31a, 32a and 31b, 32b of the first curvilinear guide element 31 and of the second curvilinear guide element 32 comprises at least a first and a second circular portion 21a and 21b having respective radii of curvature R1 and R2 different from each other, and, in particular, decreasing going from an end 35a, 35b, or 36a, 36b, towards a respective central portion 35c, or 36c. In this case, the centres C1 and C2 of the circular portions 21a and 21b are positioned, in use, along the centre line 45 of the supporting surface 41.

[0057] As diagrammatically shown in figure 4, each guide element 31, 32 can be configured in such a way that the guide trajectory yg, at each of the aforementioned first and second parts 31a, 32a and 31b, 32b, has even a greater number of successive circular portions, for example 7 circular portions or successive arches of circumference 21a-21g. Also in this case, the radii of curvature R1-R7 of the circular portions 21a-21g decreases going from one end 35a, 35b, 36a, or 36b towards the centre 35c, or 36c of a guide element 31 or 32. Analogously to the case described above, furthermore, the centres C1-C7 are positioned along the transversal axis of simmetry which is coincident, during working conditions, with the centre line 45 of the supporting surface 41 on which the planar or substantially planar semi-finished products 100 are positioned. Even though, for clarity reasons, in figure 4 are shown the radii of curvature R1-R7 and the centres

C1-C7 of the guide trajectory only at the first part 31a of the first guide element 31, on the basis of what is described, a skilled person in the art will have no difficulty to individuate also the radii of curvature R1-R7 and the centres C1-C7 of the other circular portions 21a-21g at the other parts 31b, 32a, 32b.

[0058] The embodiment described above of the spraying apparatus 1, according to the invention, allows to have a resulting velocity v_R of the velocity V_T of the device for moving forward 40, for example a conveyor belt, and of the peripheral velocity V_P of the spray members 50 substantially constant along the movement trajectory at which the spray members 50 are arranged to deliver the covering and/or colouring product, for example the paint. This allows to obtain a spraying operation with a high quality, higher than the quality of the alternative parallel and rectilinear apparatuses of known type and also overcoming the main drawback of these, i.e. the absence of covering and/or colouring product on certain areas of the worked planar or substantially planar semi-finished products 100, which can be seen at naked eye, in case of obstruction or malfunctioning of one or more nozzle. This is obtained for the particular movement trajectory of the apparatus 1 according to the invention which allows to have crossing zones at which a partial overlapping of the cones of product 52 delivered by at least 2 nozzles is obtained thanks to which any malfuctioning of one nozzle is compensated. At the same time, the apparatus 1 according to the invention, allows to avoid also the main drawback of the rotary booths, that is their great size which involves to have large areas available for their installation.

[0059] In an embodiment alternative to the previous one, diagrammatically shown in figure 5, the first curvilinear guide element 31 and the second curvilinear guide element 32 can be configurated in such a way that the respective circular portion 21 of the predetermined guide trajectory yg defined by the same has only one radius of curvature R1 for all its length. In this case, the centres C1 of the circular portion of the first curvilinear element 31 and the second curvilinear element 32 are positioned at a predetermined distance d from the centre line 45 of the supporting surface 41 on which the planar or substantially planar semi-finished products 100 to be worked are positioned and at the same side with respect to the same. More precisely, the centres C1 of the circular portion 21 of the first curvilinear element 31 and of the second curvilinear element 32 are positioned at the side of the device for moving forward 40 with respect to the centre line 45 at which the component of the velocity vP of the delivering elements 50 in the advancing direction 140 is subtracted from the velocity vT of the device for moving forward, i.e. watching figure 5 at the right side. More in particular, the first curvilinear guide element 31 and the second curvilinear guide element 32 are configured in such a way to be symmetrically arranged with respect to the plane orthogonal to the centre line 45 of the supporting surface 41 and passing through the centre line 45 same.

[0060] As still diagrammatically shown in figure 5, furthermore, a first and a second diverting member 44a and 44b, can be provided, for example, a first and a second idler wheel, or a sliding block, in particular a cambered sliding block, arranged at opposite sides with respect to a plane longitudinal to the apparatus 1, in particular arranged at opposite sides with respect to the second toothed wheel 14. More in particular, the first and second diverting members 44a and 44b can be positioned, respectively, between the first, and the second guide element 31, 32, and the second toothed wheel 14. In particular, the first and second diverting member 44a and 44b are arranged to deviare the or each flexible element 15, 15', in such a way that with respect to a longitudinal axis 105 each guide element 31 and 32 has a respective first end 131a and 132a closer and a second end 131b and 132b farther. More precisely, at the first end 131a and 132a the first and second guide elements 31 and 32, are arranged at a first distance d1, and at the second end 131b and 132b, the first and second guide elements 31 and 32 are arranged at a second distance d2, with d2>d1.

[0061] As diagrammatically shown in figure 6, the displacement group 10 can comprise a first and a second flexible dragging element 15 and 15' arranged on respective planes parallel to each other. More in particular, the first and second flexible dragging elements 15 and 15' are arranged on respective guide trajectory yg and yg' parallel to each other. Each spray member 50 is, in this case, advantageously, engaged to the first and to the second flexible dragging element 15 and 15' in such a way to be moved along the aforementioned predetermined movement trajectory ym.

[0062] In particular, as shown for example in the figures 6 and 7, each engagement group 80, can comprise a support element 85 arranged to support, in use, a respective spray member 50. In a possible embodiment foreseen by the invention, in the case that the flexible dragging elements 15 and 15' are dragging chains formed by a respective plurality of links, the first engagement member 81 can be configured to engage the support element 85, for example a support bar tangential to the aforementioned guide trajectory, at a first engagement portion 55 to the first dragging chain 15 at a first engagement portion 55, and the second engagement member 81' can be configured to engage the same support element 85 to the second dragging chain 15' at a second engagement portion 55'.

[0063] In this case, the apparatus 1 comprises a third and a fourth curvilinear guide element 31' and 32' as described above with reference to the figures from 1 to 5. In particular, the third and the fourth curvilinear guide elements 31' and 32' are positioned respectively at the same side of the first and of the second guide element 31 and 32 and are arranged to guide the second dragging element 15' at least at a respective circular portion 21' along the aforementioned second guide trajectory yg'.

[0064] As diagrammatically shown in the figures from

6 to 8, the spraying apparatus 1, according to the invention, can comprise, furthermore, a distribution device 70 configured to feed by at least a respective feeding duct, not shown in the figures for simplicity, a predetermined flow of the covering and/or colouring product, for example paint, to each spray member 50 of the aforementioned plurality of spray members 50, and another duct, also this not shown in the figure for simplicity, to feed to the same spray member 50 an air-flow at a predetermined pressure. In particular, according to an embodiment of the machine according to the invention, each spray member can be fed with a chemical product, with a first air-flow for mixing the chemical product, and with a second air-flow adapted to operate the opening of the spraying nozzle of the spray member. Therefore, each spray member can be, preferably, provided with 3 different inlets. The distribution device 70 can be adapted to move synchronously with the or each flexible dragging element 15, 15', in such a way that each feeding duct is adapted to follow the position of the spray member 50 to which is connected during the movement of the same along the predetermined movement trajectory.

[0065] In an embodiment foreseen, the distribution device 70 is arranged to rotate about ad un rotation axis 170. In particular, the distribution device can be operatively connected to a toothed wheel of the displacement group 10, for example in figure 6 to the toothed wheel 14, in such a way that the rotation of the support device 70 and the movement of the spray members 50 along the predetermined movement trajectory are synchronized with each other.

[0066] In particular, the distribution device 70 can be operatively connected to the aforementioned toothed wheel 14 by a transmission member 16, such as a belt, or a chain.

[0067] The apparatus 1 as described above can be, advantageously, provided with a series of lateral containment walls, not shown in the figures for simplicity, in such a way to form a closed spray booth. In particular, the spray booth so formed will be provided with an inlet for the planar or substantially planar semi-finished products 100 to be subjected to the spraying operation by the apparatus 1 and an outlet for the planar or substantially planar semi-finished products trattati 100', i.e. provided with a layer of paint, or any other covering product, on the or each side on which the product is applied.

[0068] As diagrammatically shown for example in figure 6, l'apparatus 1 for spraying planar or substantially planar semi-finished products 100, according to the invention, can be, furthermore, provided with a support structure 150 configured to support the different parts of the same and, in particular, the first and second curvilinear guide elements 31 and 32, and, if present, the third and fourth curvilinear guide elements 31' and 32'.

[0069] The apparatus 1 for spraying planar or substantially planar semi-finished products, in particular skins, or natural or synthetic fabrics, as described above with reference to the figures from 1 to 8, allows, therefore, on the one hand, to go beyond the limits of the paralle-type spray booths, without, however, having the great dimensions of the rotary circular booths and, on the other hand, to obtain an uniformity of the spraying comparable to, if not even higher than, that obtained with rotaty booths of great size, and, therefore, to obtain products with high quality with reduced dimensions.

[0070] The foregoing description exemplary embodiments of the invention will so fully reveal the invention according to the conceptual point of view, so that others, by applying current knowledge, will be able to modify and/or adapt for various applications such embodiment without further research and without parting from the invention, and, accordingly, it is therefore to be understood that such adaptations and modifications will have to be considered as equivalent to the specific embodiments. The means and the materials to realize the different functions described herein could have a different nature without, for this reason, departing from the field of the invention. It is to be understood that the phraseology or terminology that is employed herein is for the purpose of description and not of limitation.

Claims

1. An apparatus for spraying (1) planar or substantially planar semi-finished products (100), in particular leathers or natural or synthetic fabrics, comprising:

    - a plurality of spray members (50) configured to spray a covering and/or colouring product on at least one planar or substantially planar semi-finished product (100) ;
    - a device for moving forward (40) provided with a supporting surface (41) and configured to cause said or each planar or substantially planar semi-finished product (100) positioned on said supporting surface (41) to advance along a predetermined advancing direction (140) ;
    - a displacement group (10) configured to move said plurality of spray members (50) along a predetermined movement trajectory (ym), said displacement group (10) comprising:

        - at least one flexible dragging element (15,15');
        - a plurality of engagement groups (80) each of which configured to engage a respective spray member (50) of said plurality to said or each flexible dragging element (15,15') at a respective engagement portion (55);
        - a guide group (30) arranged to guide said or each flexible dragging element (15,15') along a predetermined guide trajectory (yg) and, therefore, said plurality of spray members (50) along said predetermined movement trajectory (ym), wherein said guide

group (30) comprises at least one first and one second curvilinear guide elements (31,32) configured to guide said or each flexible dragging element (15) along at least one respective circular portion (21) of said predetermined guide trajectory (yg) having a predetermined radius of curvature (R1) in such a way that said predetermined movement trajectory (ym) comprises a corresponding circular portion, and wherein said plurality of spray members (50) is arranged to spray said covering and/or colouring product on said or each planar or substantially planar semi-finished product (100) during the crossing by the respective engagement portion (55) of at least one portion of said first and second curvilinear guide elements (31,32);

said apparatus (1) being **characterized in that** said first and second curvilinear guide elements (31,32) comprise respective first and second parts (31a,32a;31b,32b) **and in that** each of said first and second parts (31a,32a;31b,32b) comprises at least a first and a second circular portion (21a,21b) having respective radii of curvature (R1,R2) different from each other and decreasing going from an end (35a,35b;36a,36b) towards a respective central portion (35c,36c) of said first, or said second, curvilinear guide element (31,32).

2. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 1, wherein each of said first and second parts (31a,32a;31b,32b) of said first guide element (31) and of said second guide element (32) comprises at least a first, a second and a third circular portion having respectively a first, a second and a third radius of curvature (R1,R2,R3) and wherein said first, second and third radii of curvature (R1,R2,R3) of said first, second and third circular portions are decreasing going from an end to a central portion of the first, or of the second, guide element (31,32).

3. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein said first and second parts (31a,32a;31b,32b) are symmetrically arranged with respect to a plane orthogonal to a centre line (45) of said supporting surface (41) and passing through said centre line (45).

4. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein the centres (C1,C2) of said first and at least one second circular portion (21a,21b) are arranged, in use, along said centre line (45) of said supporting surface (41).

5. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 1, or 2, wherein the centres (C1,C2) of said first and said at least one second circular portion (21a,21b) of said first curvilinear guide element (31) and of said second curvilinear guide element (32) are positioned at a predetermined distance (d) from said centre line (45) of said supporting surface (41) whereby said first and second parts (31a,32a;31b,32b) are asymmetrically arranged with respect to said centre line (45).

6. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 5, wherein said centres (C1) of said circular portion (21) of said first curvilinear guide element (31) and of said second curvilinear guide element (32) are positioned at the side where the component of the velocity (vP) of the spray members (50) along said advancing direction (140) is subtracted from the velocity (vT) of said device for moving forward (40).

7. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein said first curvilinear guide element (31) and said second curvilinear guide element (32) are configured in such a way to be asymmetrically positioned with respect to said plane orthogonal to said centre line (45) of said supporting surface (41) and passing through said centre line (45).

8. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein said first curvilinear guide element (31) and said second curvilinear guide element (32) are provided with a first and with a second curvilinear lateral wall (33a,33b;34a,34b) arranged to laterally contain at opposite sides said flexible dragging element (15) during its displacement along said predetermined guide trajectory (yd), said first and second curvilinear lateral walls (33a,33b;34a,34b) comprising at least a respective circular portion arranged to guide said flexible dragging element (15,15') at said, or each, circular portion (21) of said predetermined guide trajectory (yd).

9. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein said displacement group (10) comprises a first and a second flexible dragging element (15,15') arranged on respective planes parallel to each other, said guide group (30) being configured to guide said first and second flexible dragging elements (15,15') respec-

tively on a first predetermined guide trajectory (yg) and on a second predetermined guide trajectory (yg') parallel to each other and wherein a third and a fourth curvilinear guide elements (31'32') are provided configured to guide said second flexible dragging element (15') at respective circular portions (21').

10. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 9, wherein each engagement group (80) comprises:

- a support element (85) arranged to support at least one respective spray member (50) of said plurality, said support element (85) being positioned tangentially to said first and second predetermined guide trajectories (yg, γg');
- a first and a second engagement member (81,81') arranged to engage said support element (85) to said first and to said second flexible dragging element (15,15') at a first and at a second engagement portion (55,55'), respectively.

11. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to one or more of the previous claims, wherein said displacement group (10) comprises:

- at least one motor (11) provided with a motor shaft (12) arranged to rotate about a rotation axis (110);
- a motion transmission group arranged to transmit said rotation of said motor shaft (12) to a first and to a second toothed wheel (13,14) on which a plurality of denti of said or each flexible dragging element (15,15') is arranged to mesh with, said first and second toothed wheels (13,14) being positioned at opposite sides with respect to said first and second curvilinear guide elements (31,32).

12. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 13, wherein said or each flexible dragging element (15,15') is arranged to mesh with said first and with said second toothed wheel (13,14) and is selected among:

- a toothed dragging chain;
- a toothed dragging belt.

13. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claim 1, wherein a first and a second diverting member (44a,44b) are, furthermore, provided positioned at opposite sides with respect to a longitudinal axis (105) and arranged to divert said or each flexible element (15,15') respectively between said first and second guide elements (31,32) in such a way that said first and second guide elements (31,32) have a respective first end (131a,132a) positioned at a first distance (d1) from a longitudinal axis (105) and a respective second end (131b,132b) positioned at a second distance (d2) from said longitudinal axis (105) greater than said first distance (d1), i.e. (d2) >(d1) .

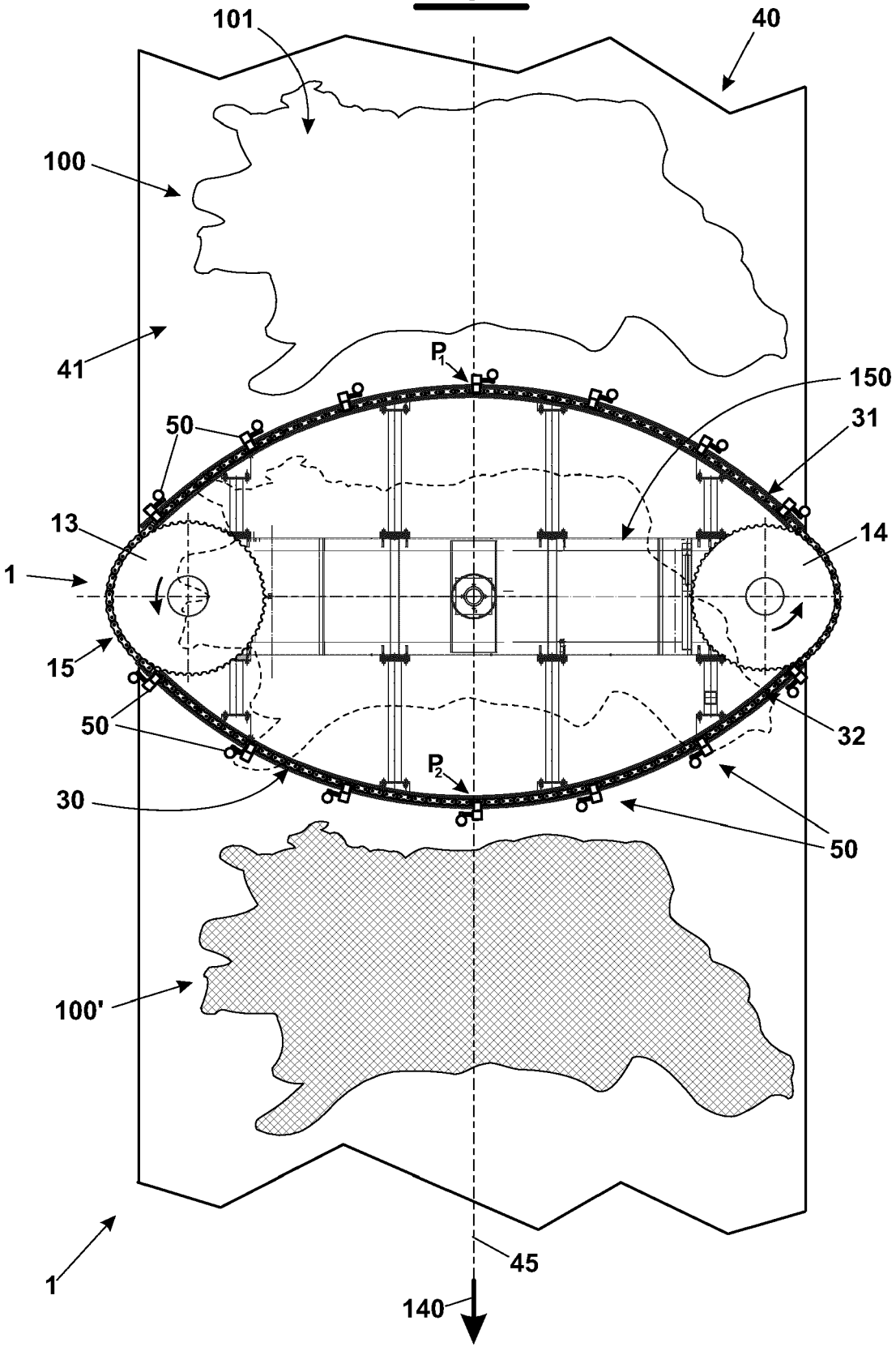
14. Apparatus (1) for spraying planar or substantially planar semi-finished products (100), according to claims 12 and 13, wherein said first and second diverting members (44a,44b) are positioned between said second ends (131b,132b) of said first and of said second guide element (31,32) and said second toothed wheel (14).

15. Method for spraying planar or substantially planar semi-finished products, in particular leathers or natural or synthetic fabrics, comprising the steps of:

- causing at least one planar or substantially planar semi-finished product (100) to advance along a predetermined advancing direction (140) by a device for moving forward (40) provided with a supporting surface (41) on which said or each planar or substantially planar semi-finished product (100) is arranged;
- moving a plurality of spray members (50) configured to spray a covering and/or colouring product on said or each planar or substantially planar semi-finished product (100) along a predetermined movement trajectory (ym), said moving step being carried out by a displacement group comprising at least one flexible dragging element (15,15');
- engaging each spray member (50) of said plurality to said or each flexible dragging element (15,15') at a respective engagement portion (55);
- guiding said or each flexible dragging element (15,15') along a predetermined guide trajectory (yg) and, therefore, said plurality of spray members (50) along said predetermined movement trajectory (ym), said guiding step being carried out by a first and a second curvilinear guide elements (31,32) configured to guide said or each flexible dragging element (15,15') along at least a respective circular portion having a predetermined radius of curvature (R1) in such a way that said predetermined movement trajectory (ym) comprises a respective circular portion, said plurality of spray members (50) being arranged to spray said covering and/or colouring product on said or each planar or substantially planar semi-finished product (100) during the crossing by the respective engagement portion (55) of at least one portion of said first and of said second curvilinear guide element (31,32);

said method being **characterized in that** said first and second curvilinear guide elements (31,32) comprise respective first and second parts (31a,32a;31b,32b), **and in that** each of said first and second parts (31a,32a;31b,32b) comprises at least a first and a second circular portion (21a,21b) having respective radii of curvature (R1,R2) different from each other and decreasing going from an end (35a,35b;36a,36b) towards a respective central portion (35c,36c) of said first, or said second, curvilinear guide element (31,32).

Fig. 1



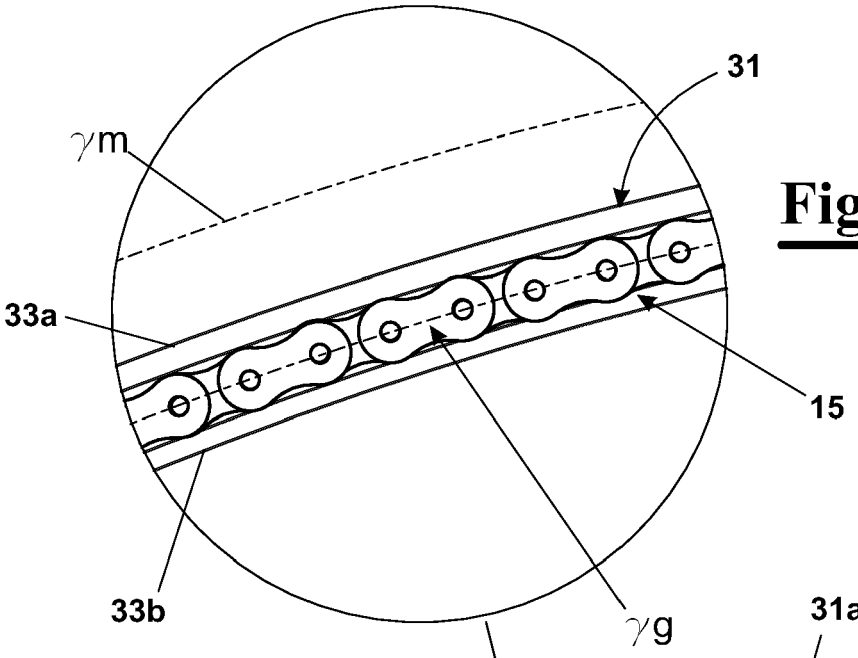
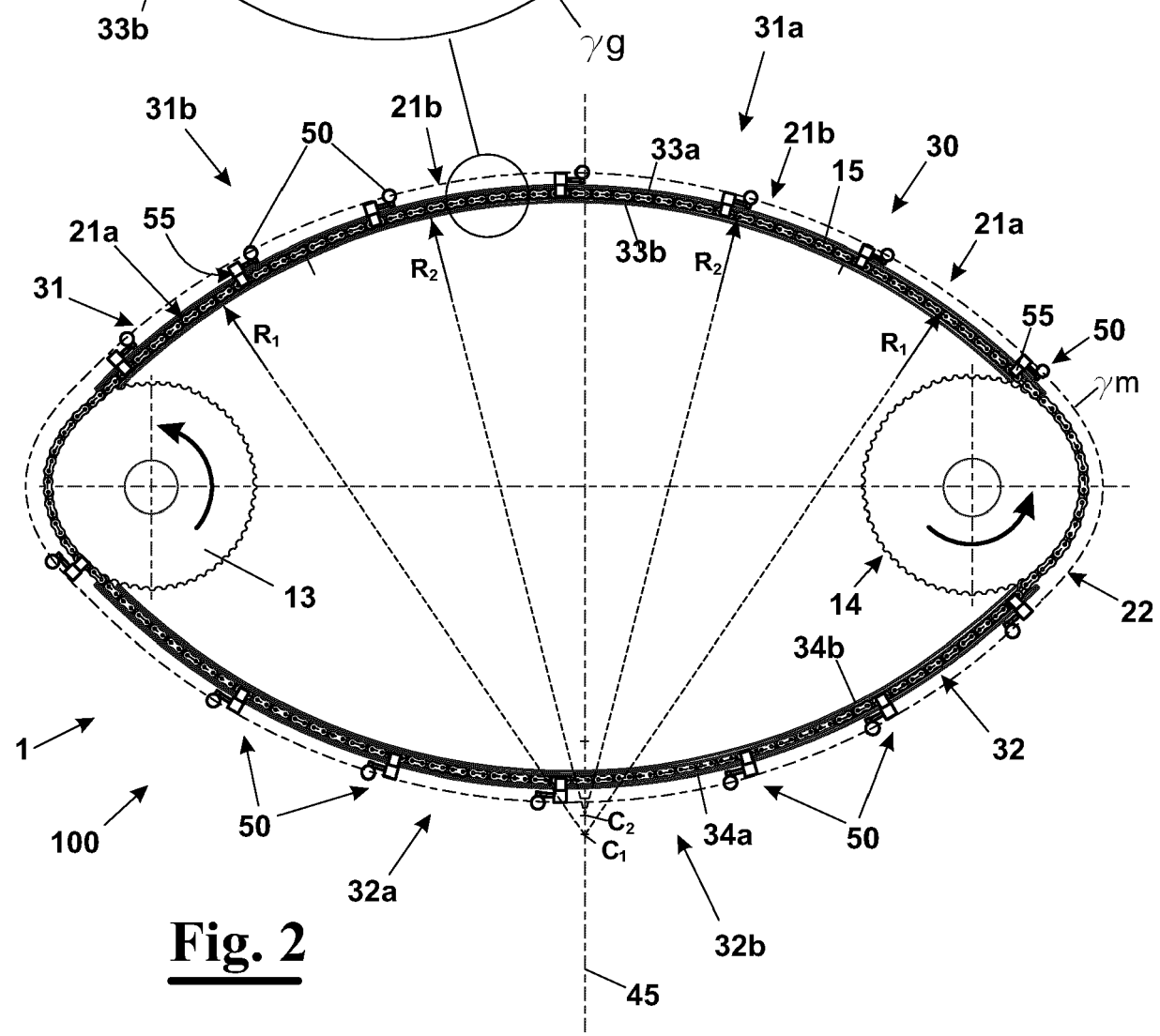

31
γm
33a
15
33b
γg

Fig. 3


31a
31b
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50
21b
33a
30
15
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55
21a
33b
R2
R2
31
R1
R1
55
50
γm
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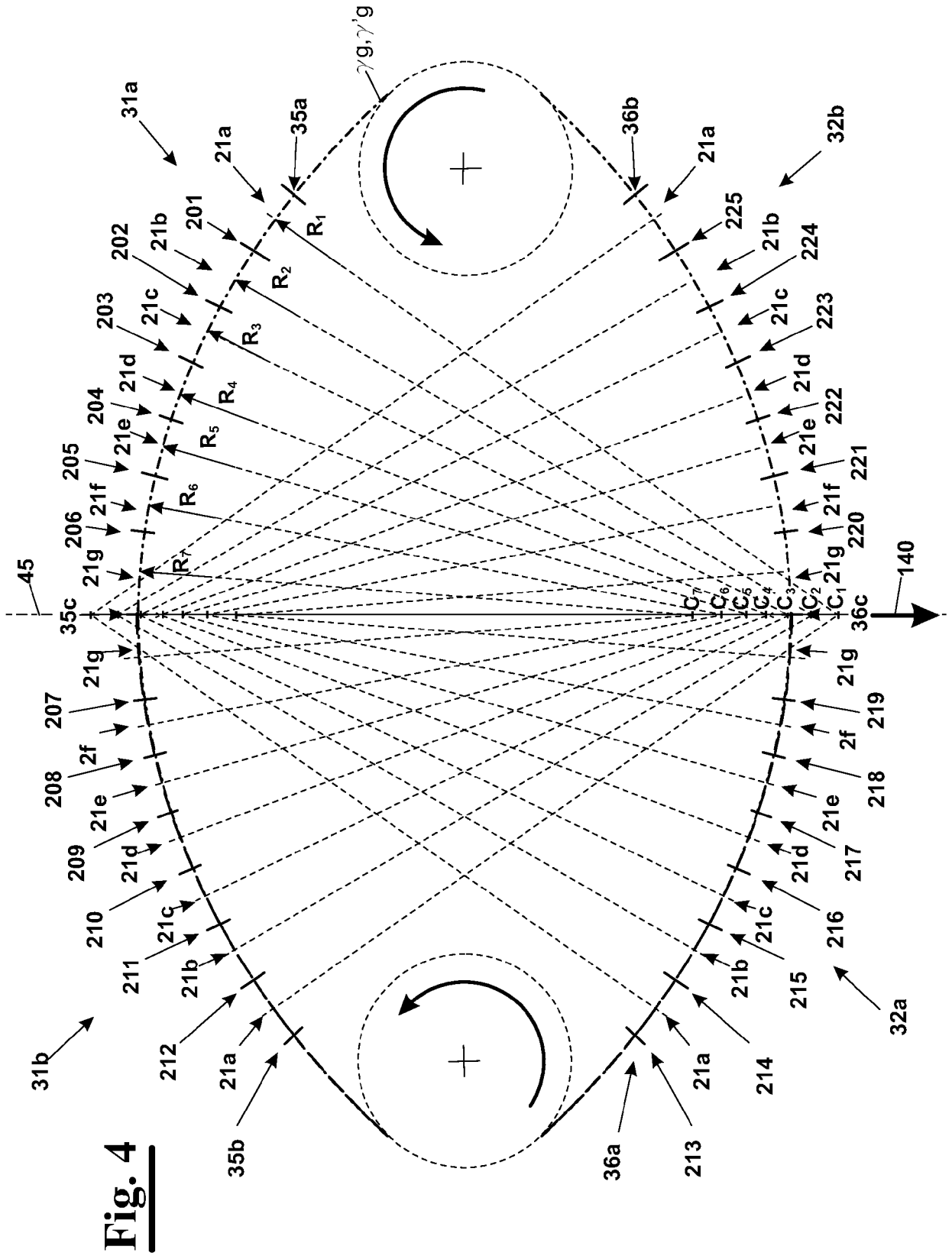
C2
C1
34a
50
32a
32b
45

Fig. 2


γg,γ'g
31a
21a
35a
36b
32b
201
202
21b
203
21c
204
21d
205
21e
206
21f
21g
45
35c
207
2f
208
209
210
211
212
35b
31b
R1
R2
R3
R4
R5
R6
R7
C7
C6
C5
C4
C3
C2
C1
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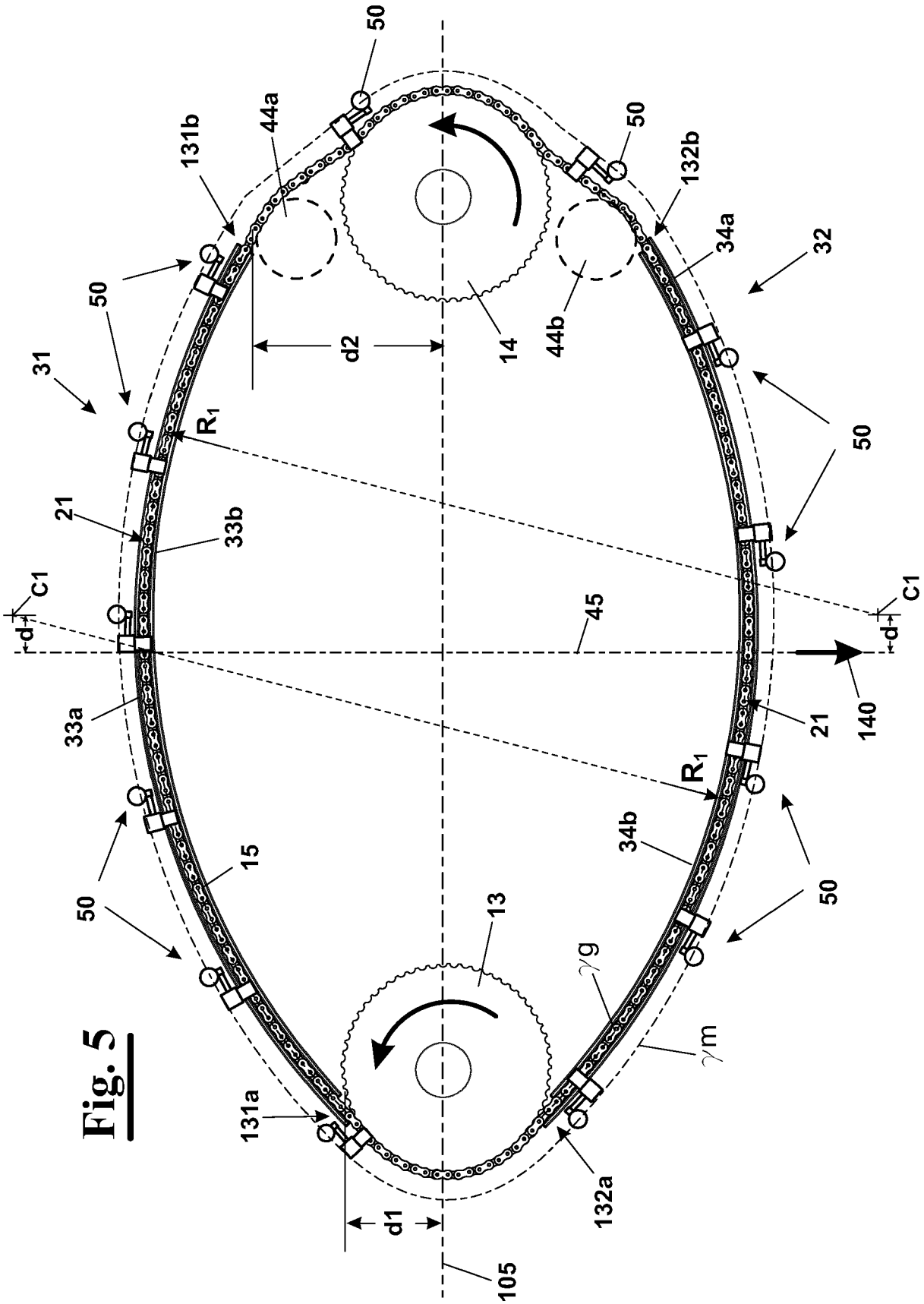
32a
220
221
222
223
224
225

Fig. 4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131b
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132b
34a
32
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31
d2
14
44b
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33b
C1
d
45
C1
d
33a
21
140
R_1
34b
15
50
13
50
γg
γm
131a
132a
d1
105

Fig. 5

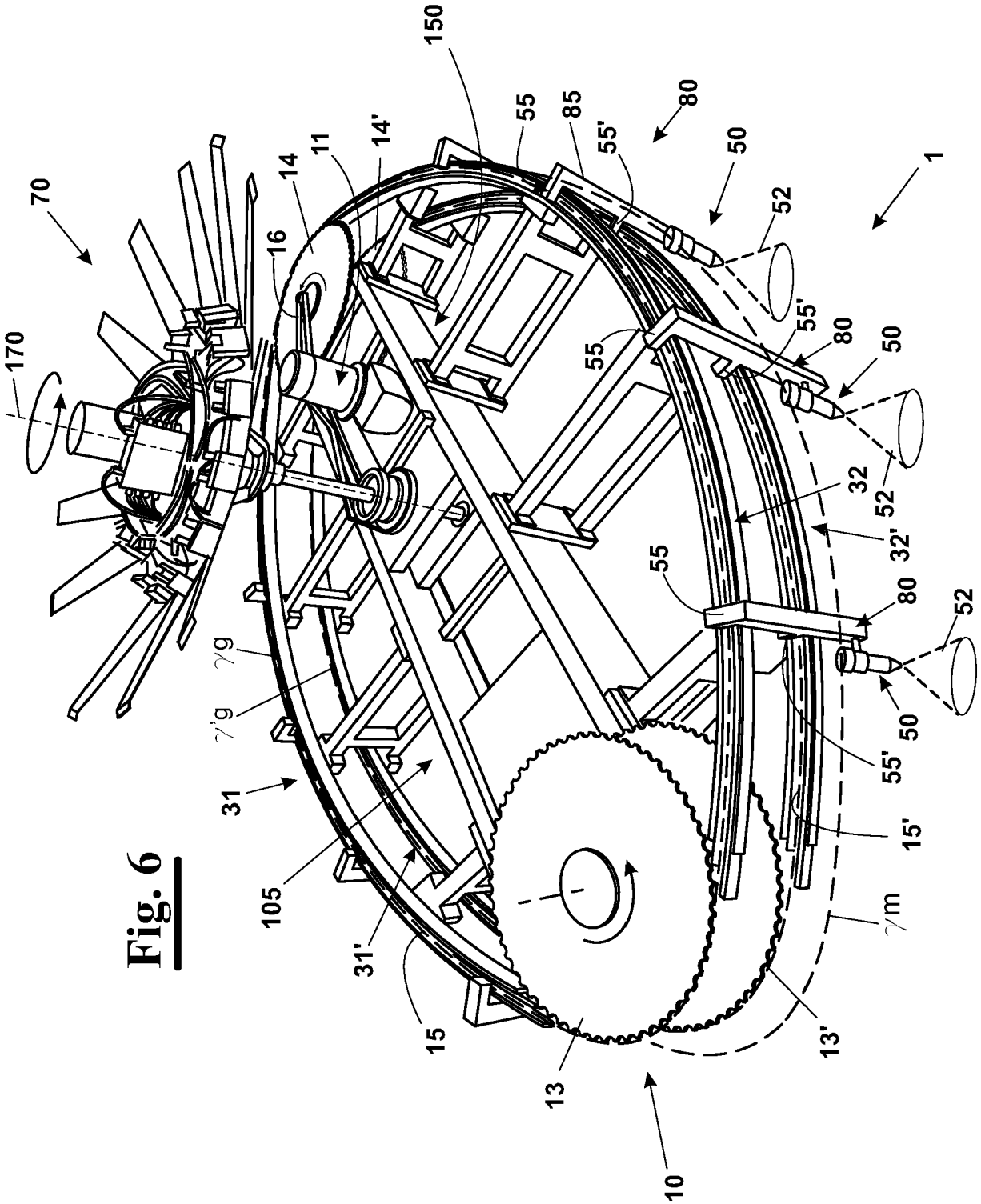
150
55
85
80
55'
50
1
52
70
14
11
14'
16
55'
80
50
170
55
52
32
32'
55
80
52
50
55'
15'
γm
γg
γ'g
31
105
31'
15
13
13'
10

Fig. 6

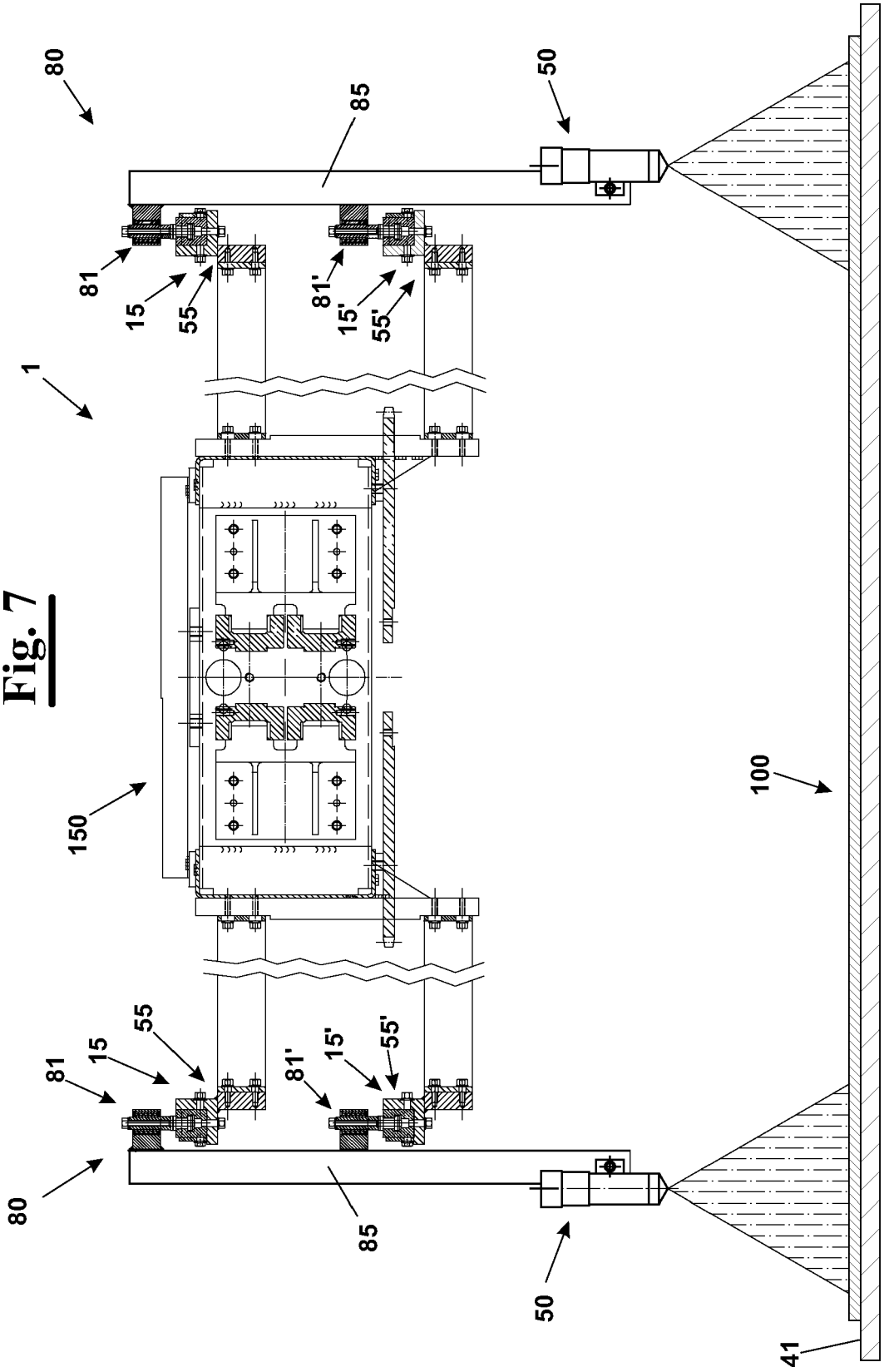

Fig. 7

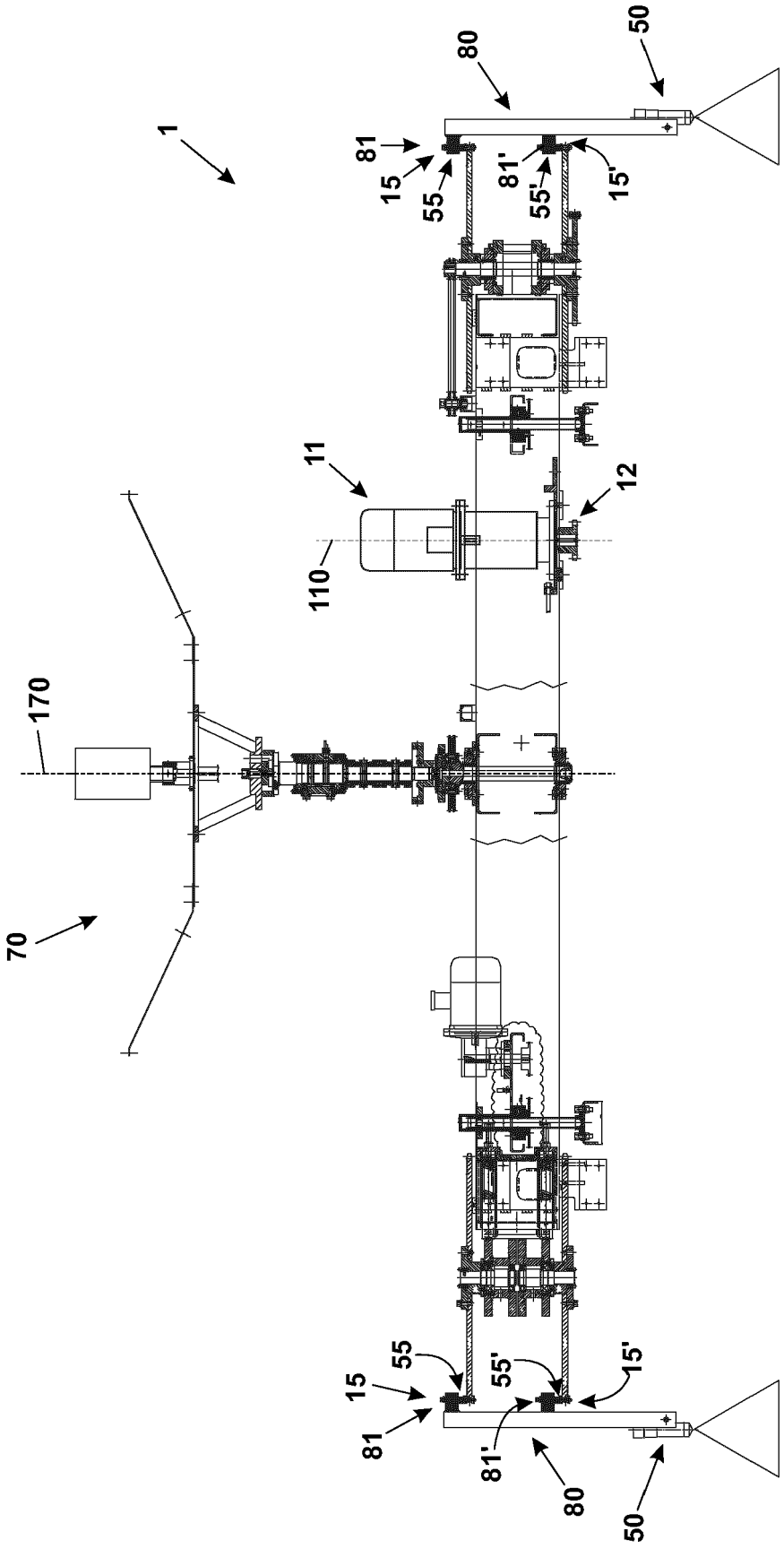

Fig. 8

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EUROPEAN SEARCH REPORT

Application Number
EP 24 15 7892

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	ES 2 003 561 A6 (VIPA STUDIO PROGETT RAPPRES [IT]) 1 November 1988 (1988-11-01) * figures 1,2 * -----	1-14	INV. B05B13/00

TECHNICAL FIELDS SEARCHED (IPC)

B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 June 2024	Eberwein, Michael

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons
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04-06-2024

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EPO FORM P0459

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

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Patent documents cited in the description

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