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(54) Method for painting parts of footwear

(57) The method involves acquiring, off-line, in digital form elements pertaining to the shape and size of a sole of footwear (F) and to obtain, with these, at least one painting path.

The soles (F) are fed by a conveyor (A) within a paint booth (C) where, in addition to advance, are rotated by 90° in successive steps. In the paint booth (C) it is operating at least one 6-axis anthropomorphic robotic arm provided with at least one paint spraying nozzle (U).

The painting path is input into a processor that controls the conveyor (A), the robotic arm (R) and the nozzle (U), and that, by interfacing the various data, calculates the succession and the phase of the various movements to follow the profile of each sole (F) and it paints the sides (FF) and the tread (FB), so that the nozzle (U) is kept almost at a constant distance from the surface being painted.

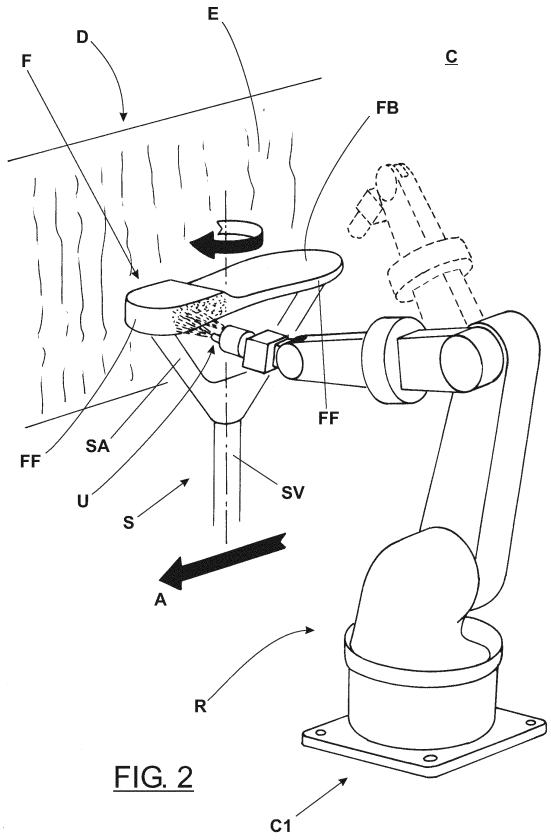

FIG. 2

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Description

TECHNICAL SECTOR

[0001] The present invention relates to the technical field of the footwear industry and specifically to a method for painting parts of footwear, in particular soles, made for example of moulded plastic material such as polyurethane and the like.

STATE OF THE ART

[0002] In some cases, the soles are given a specific colour directly during moulding, by adding the polymer with suitable pigments, so creating what is commonly referred to as "in mass" colouring .

[0003] In other cases, it is preferred to mould the soles in a neutral color, preferably a light color, then proceeding to a surface painting operation in the desired color.

[0004] This operation covers the tread and sidewall of the sole, while the upper face, intended to be joined to the upper, and then hidden from view, will not normally be painted.

[0005] To automate the above process, painting booths or tunnels C are used, a portion of which is schematically illustrated in Fig. 1 of the accompanying drawing tables.

[0006] In the paint booth C passes, in input and output, a conveyor, indicated by the arrow A, provided with a plurality of suitable supports S, each adapted to receive and retain one of said soles F, preferably with a horizontal arrangement and with the tread FB facing up.

[0007] Said supports S are usually constituted by a vertical stem SV, inferiorly connected to the conveyor A, which extends upwards and bears integral to it a connection member SA, suitably shaped to be able to hold the soles F.

[0008] At the beginning of the line, an operator shall load the soles F on the supports S, while another operator remove them at the end of the line; such operations of loading and removing can, of course, be automated by means of suitable devices.

[0009] In the spray booth C, along a side parallel to the direction of advance of the conveyor A, accessible by an operator, are arranged a number of paint spray guns P (usually seven / eight), carried by respective articulated supports X (one of which only partially shown) that allow the adjustment, in a fixed manner, of the position of each spray gun P.

[0010] In the section of the conveyor A between the inlet and the outlet of the spray booth C, suitable mechanical devices act on the stem SV of each of the supports S, in phase relation with the advancement of the conveyor A, so that it performs subsequent rotations in steps of 90°, up to perform a full revolution, together with the associated sole F.

[0011] This allows for orientation, in turn, each portion of the sides FF of the sole F to the side where there are the guns P intended for painting the sides FF themselves; at least another gun P, for example positioned near the exit of the booth C and suitably oriented downward, shall, during transit, to paint the tread FB.

[0012] A screen D is almost vertically arranged in the opposite side on which flows a falling film of water E, which is intended to collect the atomized paint that has not deposited on the surfaces to be treated.

[0013] As easily understood, the limits of such a procedure concern, firstly, the fact that the spray guns must be adjusted by hand one by one in an empirical way, based on experience and / or ability of the operator, with the need to test cycles and successive corrections, then with long downtimes.

[0014] Obviously, these adjustments must be revised whenever the model and / or the size of the sole is changed.

[0015] The roughness of the adjustment of the guns, constrained by their fixed position and resulting in adjustment give-and-take, inevitably means that the distance between these and the various areas of the surfaces to be painted will not be constant, consequently causing not homogeneous painting results, or production of waste items.

[0016] To limit as much as possible waste items, they are solved by spraying an excess of paint, with great consumption of expensive material and increasing problems related to pollution and disposal.

[0017] To reduce the aforesaid long periods of downtime due to spray guns adjustment, the production rate is increased, with the result that it becomes difficult for an operator who picks up the soles at the end of the line, to perform a valuable quality control.

SUMMARY OF THE INVENTION

[0018] The object of the present invention is therefore to propose an original method for the painting of parts of footwear designed so as to obviate the drawbacks of the known processes, in particular to overcome the limitations inherent in the fixed position of the spray guns and laborious adjustment operations of the same.

[0019] Another object of the invention is to obtain a very versatile method, which allows to easily modifying the execution of the phases at each change in size of the part to be painted, considerably reducing machine downtime.

[0020] Another object of the invention is to provide, in the proposed method, the operational steps that can be executed off line, which allow acquiring information pertaining to the shape and dimensions of the part to be treated, with said information usable in a following step for the translation into corresponding operating parameters.

[0021] A further object of the invention concerns the desire to provide a method that allows containing the number of guns present in the spray booth, compared to those required with conventional methods, so as to limit

the time required for the operations of maintenance and cleaning of the same.

[0022] Still another object of the invention aims to propose a method practicable with limited costs and investments, however such as to be convenient at least in the long period thanks to the advantages obtained in the production phases.

[0023] These and other objects are fully achieved by a method for painting parts of footwear, said painting providing steps to loading said parts of footwear on corresponding supports associated with a conveyor, able to move the same supports and parts of footwear through a paint booth, in which there are means for performing subsequent rotations of 90°, according to a horizontal plane, of each support and part of footwear, so that each of these performs at least one complete revolution between the input and the output of the same booth, in the above method being provided:

- the acquisition and storage in digital form of elements relating to the shape and size of said part of footwear;
- the processing of the above elements in order to obtain one or more painting paths, in digital form, of said part of footwear;
- the input of at least one of said digital painting paths in the electronic processor that presides over the movement of at least one 6-axis anthropomorphic robotic arm, associated to said paint booth, on one side of said conveyor, and provided with at least one paint spraying nozzle;
- the input, in the above electronic processor, of the movement parameters of the conveyor and the supports thereof, with the same electronic processor adapted, by means of a suitable program, for interfacing said parameters with the data of said digital painting path and to define a predetermined sequence of movements of the said robotic arm as well as a predetermined sequence of activations of said spraying nozzle;
- the positioning of the aforementioned parts of footwear on the supports thereof, with default arrangement;
- the operation of said conveyor and the start of said robotic arm with the associated spraying nozzle, driven by its electronic processor, to run the above sequence of movements and activation sequence, with a step relationship with the movement and the rotation of said parts of footwear, to paint them.

BRIEF DESCRIPTION OF DRAWINGS

[0024] The characteristics of the invention will become apparent from the following description of preferred embodiments of the method for painting parts of footwear, according to what reported in the claims and with the aid of the accompanying drawings, in which:

- Figure 1 schematically shows, in perspective view, the operational steps of a painting process according to the prior art;
- Figure 2 schematically shows, in perspective view, the operational steps of the method of the invention, in accordance with a first embodiment of the same;
- Figure 3 schematically shows, in plain view, the operational steps of the method of the invention, in accordance with a second embodiment of the same;
- Figure 4 shows a view according to the section plane IV-IV of Fig. 3.

[0025] In Figures 2 to 4, relating to the method according to the invention, have been used for similar parts, some references identical to those used in Fig. 1 of the prior art, in order to facilitate the comparison.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] Therefore, it has been indicated as a whole with C a corresponding paint booth or tunnel in which are implemented the main operating phases of the method.

[0027] A conveyor is associated with the painting booth C, for example a straight one schematically indicated with the arrow A, extended from a loading station (not shown) upstream the entrance into said booth C and, through the latter, up to a removing station (also not shown), downstream the outlet of the same booth C.

[0028] The conveyor A is provided with a plurality of supports, S, preferably equidistant, each adapted to receive and retain a part of footwear, composed, as a non-limiting example, of a sole, F, of the type made of moulded synthetic material.

[0029] The sole F is intended to be painted on the surface in areas of the tread, FB, and sides, FF, including the rounded areas of the toe and the heel, while it is excluded the upper face, which is subsequently joined to the upper and thus hidden to view.

[0030] Said supports S are constituted by a vertical stem, SV, inferiorly connected to the conveyor A, which extends upwards and bears integral to it a connection member, SA, suitably shaped to be able to hold the soles F.

[0031] In the section of the conveyor A between the inlet and the outlet of the spray booth C, suitable mechanical devices, not shown as known per sé, are adapted to act on the stem SV of each of the supports S, in step relation with the advancement of the conveyor A, so that it performs subsequent horizontal rotations in steps of 90°, up to perform at least a full revolution, together with the associated sole F.

[0032] This allows for orientating, in turn, each portion of the sides FF of the sole F towards one side, C1, of the spray booth C, parallel to the direction of conveyor A; A screen, D, is almost vertically arranged at the opposite side of the booth, on which flows a falling film of water, E, which is intended to collect the atomized paint that has not deposited on the surfaces to be treated.

[0033] A first embodiment of the painting method of

the invention provides, as a first step, the acquisition and storage in digital form of the elements concerning the shape and the size of said sole, performed off-line by an operator, by using suitable devices.

[0034] For this acquisition and storage, point-by-point detection systems can be used, by touching with a digitizer device, or optical systems such as cameras or the like, which are able to detect the whole profile, or others, based on other technologies, such as ultrasound.

[0035] A second step of the method provides for processing the above-mentioned series of elements to obtain one or more painting paths, in digital form, of said sole.

[0036] In the case of elements obtained through point-by-point detection, the path is reconstructed by interpolation, for example linear interpolation, by an appropriate processing unit.

[0037] A third step of the method provides for the input of at least one of said digital painting paths in the electronic processor which presides over the movement of at least one 6-axis anthropomorphic robotic arm, R, arranged at the aforementioned side C1 of the paint booth C, at one side of said conveyor A, and provided with at least one paint spraying nozzle, U (Fig. 2).

[0038] A fourth step of the method provides for the input, in said electronic processor, of the movement parameters of said conveyor A and the attached support S, concerning the advancement and rotation of the latter.

[0039] The same electronic processor provides, by means of a suitable program, for interfacing said parameters with the data of the painting digital path so as to define a predetermined sequence of movements of said robotic arm R and a predetermined sequence of activations of said spray nozzle U.

[0040] The fifth step of the method consists in positioning the soles F on respective supports S of the conveyor A, so as to supply with soles the section of the latter between said loading station and the entrance of the painting booth C.

[0041] As in the prior art, the soles F are arranged with a horizontal position and with the tread FB facing up.

[0042] The sixth step of the method involves the activation of said conveyor A and the start of said robotic arm R with the associated spray nozzle U, controlled by the relative electronic processor.

[0043] Obviously, the said fifth phase in which it is planned to "load" the soles F on the supports S must be repeated for the entire duration of the subsequent sixth step, to ensure the continuous supply of soles F towards the paint booth C.

[0044] For each sole F that enters the paint booth C, the robotic arm R executes the above sequence of movements, in combination with the activation sequence of the spray nozzle U, in phase relation with the advancement and rotation of the sole F itself, driven by the conveyor A and the associated mechanical devices, to make the painting of the sides FF and the tread FB.

[0045] In other words, the robotic arm R follows the profile of the sole F while it advances and rotates, so that the spray nozzle U is maintained advantageously at a substantially constant distance from the surface to be painted.

[0046] To obtain the proper synchronism between the movements of the robotic arm R and the conveyor A, the drive speed of the latter could be made not constant and / or stops can be provided.

[0047] These slowdown and / or stopping of the conveyor A can be controlled at the end of the paint operations of a sole F, to enable the return of the robotic arm R to the starting point of its sequence of movements.

[0048] A second embodiment of the method, which represents an evolution of the first, is illustrated in the accompanying Figs. 3 and 4.

[0049] In this second embodiment, the use of three 6-axis anthropomorphic robotic arms is provided, first, R1, second, R2, and third, R3, arranged in series at said side C1 of the paint booth C, in the order starting from the entrance into the latter, each of which provided with at least one paint spraying nozzle U.

[0050] In said second embodiment, which is the preferred, the corresponding first stage of the method remains unchanged, in which it is provided the acquisition and the storage of the parameters inherent to the sole.

[0051] In the corresponding second phase of the method, in which the said series of elements are processed to obtain painting paths, the latter may be suitably split and assigned to said robotic arms R1, R2, R3.

[0052] Said first and said second phase are advantageously carried out off-line, in a very rapid way, as already stated with reference to the first embodiment of the method.

[0053] In the third phase of the method, wherein there is provided the input of said digital painting paths, the said electronic processor is suitably arranged to control, at the same time and in appropriate synchronism, the movements of all the three robotic arms R1, R2 , R3.

[0054] In the fourth stage of the method, wherein there is provided the input of the movement parameters of said conveyor A and supports S, the said electronic processor is suitably arranged for interfacing said parameters with the data of the digital painting paths so as to define a predetermined and specific sequence of movements for each of the mentioned robotic arms R1, R2, R3, assigning to each robotic arm a path portion as well as predetermined and specific sequences of activations for each of the spray nozzles U thereof.

[0055] The corresponding fifth stage of the method, which consists in positioning the soles F on relative supports S, remains unchanged as described above.

[0056] The corresponding sixth stage of the method provides, in this variant, the actuation of said conveyor A and the start of the whole set of robotic arms R1, R2, R3 and of the associated spray nozzles U, controlled by said electronic processor, still in relation of phase with the advancement and subsequent rotations of the soles F simultaneously present within the paint booth C.

[0057] For each sole F that enters the paint booth C, the first robotic arm R1, with the associated nozzle U, follows it throughout a first section in which a first horizontal rotation of 90° occurs, and it carries out, for example, the painting of the sides FF, also including the rounded area of the heel.

[0058] Then, a second rotation of 90° in the same sense occurs that advantageously intervenes in an intermediate section between the first path portion pertaining to the first robotic arm R1 and a second path portion covered by the second robotic arm R2.

[0059] Following the second 90° rotation, the second robotic arm R2, with the associated nozzle U, follows each sole F passing through the second path portion in which a third horizontal rotation of 90° in the same sense of the first occurs, and it performs, for example, the painting of the remaining part of the sides FF, comprising the rounded zone of the tip, thereby completing the painting of the sides.

[0060] The third robotic arm R3, with the associated nozzle U, performs, for example, the painting of the tread FB, facing upwards (see in particular Fig. 4), by following the advancement of the sole F for a third path portion. The third feeding path portion, which is competence of the third robotic arm, is advantageously at least partially superimposed or overlaid to the first and / or second feeding path portions, pertaining to the first and second robotic arm R1, R2, respectively. In this way, the painting of the tread FB occurs simultaneously with the painting of the sides FF. Alternatively, the third feeding path portion could be previous to the first feeding path portion or next to the second feeding path portion, and therefore the painting of the tread FB may be earlier or later, respectively, to the painting of the sides FF.

[0061] Each robotic arm R1, R2, R3 performs the operation of its competence of the sole F while it advances and rotates, so that the spray nozzle U is maintained advantageously at a substantially constant distance from the surface to be painted.

[0062] The software of the said electronic processor can decide, even automatically, how to split the path between the two robotic arms R1, R2 and how to make it optimum according to the two angular positions of the sole F that it must cover.

[0063] Also in the second embodiment of the method the travel speed of the conveyor A can be made not constant and / or stops can be provided, as a function of the movements of the robotic arms R1, R2, R3 and return strokes of the same .

[0064] From what above said the advantageous characteristics of the method described can be clearly understood, which allows to paint each sole in an optimal manner, with the nozzles at a constant distance from the surfaces, thus obtaining a product qualitatively superior to those made according to the known process, who are affected by the fixed position of the spray gun and the long and laborious manual adjustment of the same.

[0065] The feature set out above advantageously allows to limit the waste of paint in a significant way, in comparison with the prior art, containing in that way both the direct cost of material and indirect costs related to the problems of pollution and disposal.

[0066] Providing the off-line execution of the steps of the method relating to the acquisition of the profile of the sole and the definition of the painting paths allow rapidity of execution, great operating flexibility and high precision in the measurements.

[0067] It must be underlined that thanks to this, the operations concerning the preparation of the robotic arms for the new parameters, when soles of a different size are to be painted, are achievable with a simple sending digital data, and with dramatically reducing the time for setting the painting facilities.

[0068] Another advantageous aspect of the method lies in the fact that even in the preferred embodiment of the same only three painting nozzles (or guns) are provided, compared to the seven / eight guns required by the known process, thereby limiting the time required for the operations of maintenance and cleaning.

[0069] The conveyor's advancement rate is reduced compared to the prior art according to the motion performance of the robotic arms, but they are proved to be advantageous to allow, at the removal station, to perform a visual check on the product.

[0070] The presence of one or three anthropomorphic robotic arms, for the implementation of the method of the invention, requires initial investments that thanks to technical developments are no longer to be considered prohibitive and also, considered in the usual depreciation times, however, are convenient, thanks to the advantages obtained in the production steps in terms of speed and quality.

[0071] It is understood however that what is described above has a value of non-limiting example, therefore, possible variants of detail which may be necessary in performing the steps described, for technical and / or functional reasons, are considered from now falling within the same protective scope defined by the claims reported below.

Claims

1. Method for painting parts of footwear, said painting providing steps of loading said parts of footwear (F) on corresponding supports (S) associated with a conveyor (A), able to move the same support (S) and part of footwear (F) through a paint booth (C), in which there are means for performing subsequent rotations of 90°, according to a horizontal plane, of each support (S) and part of footwear (F), so that each of these performs at least one complete revolution between the input and the output of the booth (C), the above-mentioned method being **characterised by** providing steps of:

- acquisition and storage in digital form of elements relating to the shape and size of said part of footwear(F);
- the processing of the above elements in order to obtain one or more digital painting paths of said part of footwear (F);
- input of at least one of said digital painting paths in the electronic processor that presides the movement of at least one 6-axis anthropomorphic robotic arm (R), associated to said paint booth (C), on one side of the conveyor (A), and provided with at least one paint spraying nozzle (U);
- input, in the above electronic processor, of the parameters of the movement of the conveyor (A) and the supports (S) thereof, with the same electronic processor adapted, by means of a suitable program, for interfacing said parameters with the data of said digital painting path and to define a pre-set sequence of movements of the anthropomorphic robotic arm (R) as well as a predetermined sequence of activations of said spraying nozzle (U);
- positioning of said parts of footwear (F) on the supports thereof, with default arrangement;
- operation of the conveyor (A) and the start of said anthropomorphic robotic arm (R) with the associated spraying nozzle (U), driven by the relative electronic processor, to run the above sequence of movements and activation sequence, with a step relationship with the movement and the rotation of said parts of footwear (F), to paint them.

2. Method according to claim 1, **characterized in that** three 6-axis anthropomorphic robotic arms, first (R1), second (R2) and third (R3), are used, which robotic arms are arranged in a series at a side (C1) of the above paint booth (C), each of which is provided with at least one paint spraying nozzle (U).

3. Method according to claim 1 or 2, **characterized in that** the first two steps, respectively providing the acquisition and storage in a digital form of elements relating to the shape and size of said part of footwear (F), as well as the processing of the above series of elements in order to obtain one or more digital painting paths of said part of footwear (F), are performed off-line and do not prevent the implementation of subsequent phases of the above method.

4. Method according to claim 1 or 2 or 3, **characterized in that** the first step, providing the acquisition and storage in a digital form of elements relating to the shape and size of said part of footwear (F), is made by a spot-by-spot acquisition system, in which a digitizer is brought in contact, in succession, with a series of reference points of the part of footwear (F).

5. Method according to claim 4, **characterized in that** in the second step, the processing of said elements obtained with said spot-by-spot acquisition, includes an auxiliary step of interpolation to obtain said one or more painting paths.

6. Method according to claim 2, **characterized in that** in the fourth step, providing the input of the parameters of the movement of said conveyor (A) and support (S), the above electronic processor is adapted to interfacing said parameters with the data of the digital painting paths so as to define a predetermined and specific sequence of movements for each of said anthropomorphic robotic arms (R1), (R2), (R3), assigning to each a portion of path of competence, as well as predetermined and specific sequences of activations for each of its nozzles (U).

7. Method according to claim 1 or 2 or 6, **characterised in that** it provides the above sequence of movements of said anthropomorphic robotic arms (R), (R1), (R2), (R3) and sequence of activation of said spraying nozzles (U) such that the spraying nozzles, in the respective active steps, are maintained at a substantially constant distance from the surfaces of said parts of footwear (F) being painted.

8. Method according to claim 1 or 2, **characterized in that** the fifth step, providing the act of placing said parts of footwear (F) on said support (S), is repeated for the duration of the following sixth step, to ensure the continuous supply of the same parts of footwear (F) to said paint booth (C).

9. Method according to claim 1 or 2, wherein said part of footwear consists of a sole (F), whose sides (FF) and tread (FB) have to be painted, arranged horizontal on said support (S), with said tread (FB) facing up, **characterized in that** said sixth step of the method includes: the operation of said conveyor (A) and the start of said three anthropomorphic robotic arms (R1), (R2), (R3) with the associated spraying nozzles (U); the entrance in said paint booth (C) of said sole (F); the painting of a portion of the sides (FF) by means of the first anthropomorphic robotic arm (R1), with its nozzle (U) that tracks the movement of the sole (F) for a first feeding path portion, said sole being also imparted a first horizontal rotation of 90°; a second rotation of the sole (F) of 90° in the first direction; the painting of the remaining part of the sides (FF) of the sole (F) by the second anthropomorphic robotic arm (R2), with its nozzle (U) that tracks the movement of the sole (F) for a second feeding path portion, said sole being also imparted a third horizontal rotation of 90° in the first direction; the painting of said tread (FB) by the third anthropomorphic robotic arm (R3), with the corresponding nozzle (U) that tracks the movement of the sole (F) for a third

feeding path portion.

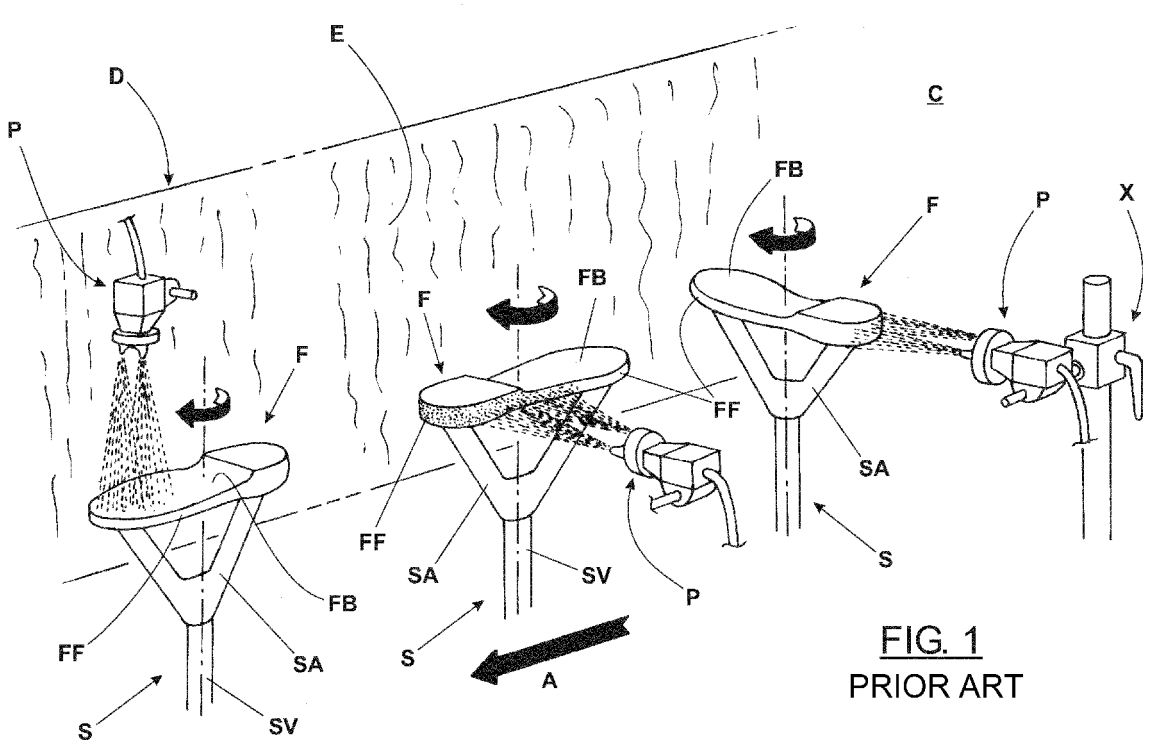


FIG. 1
PRIOR ART

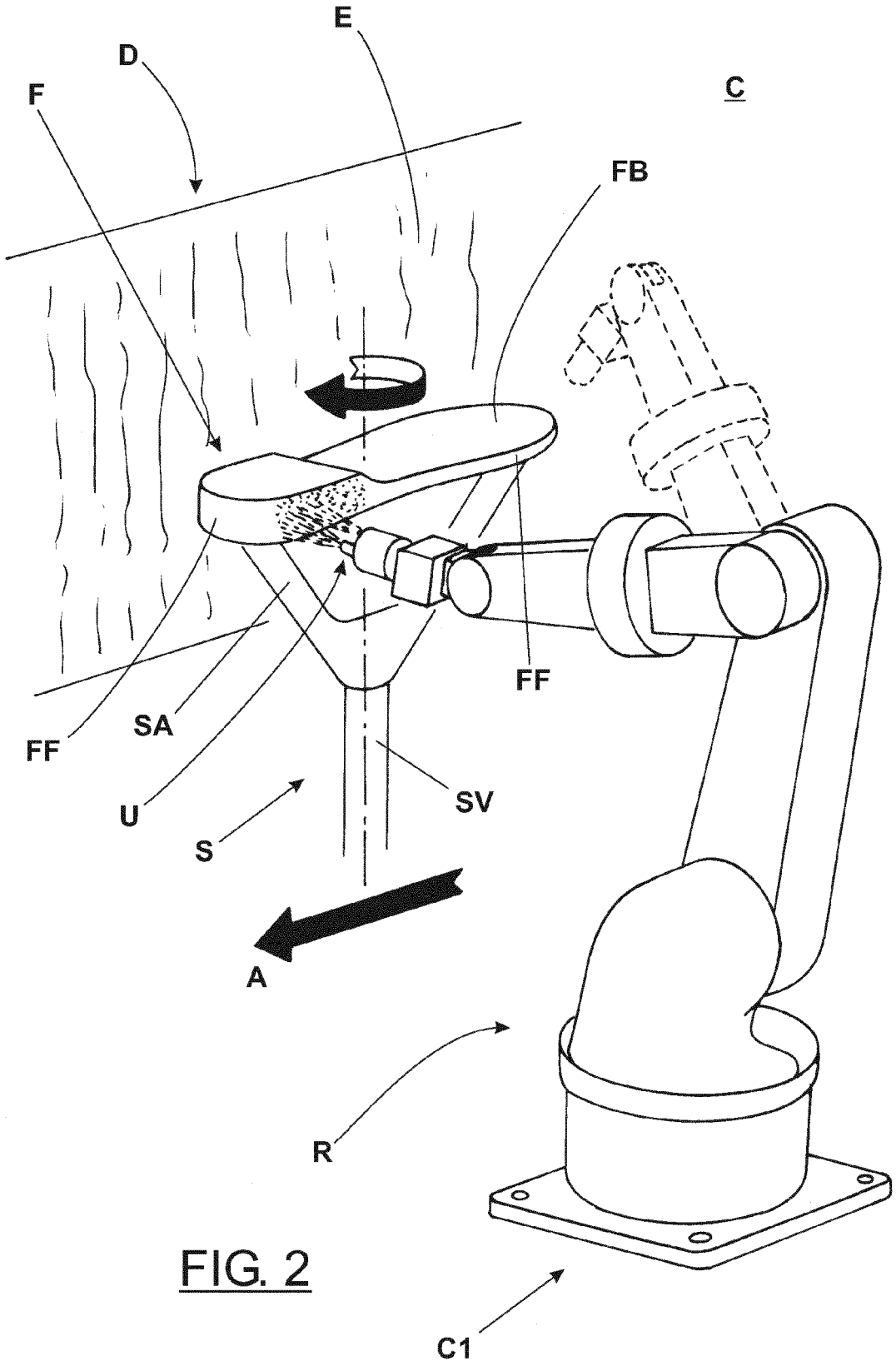


FIG. 2

FIG. 3

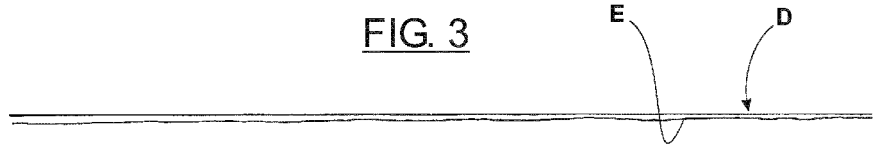
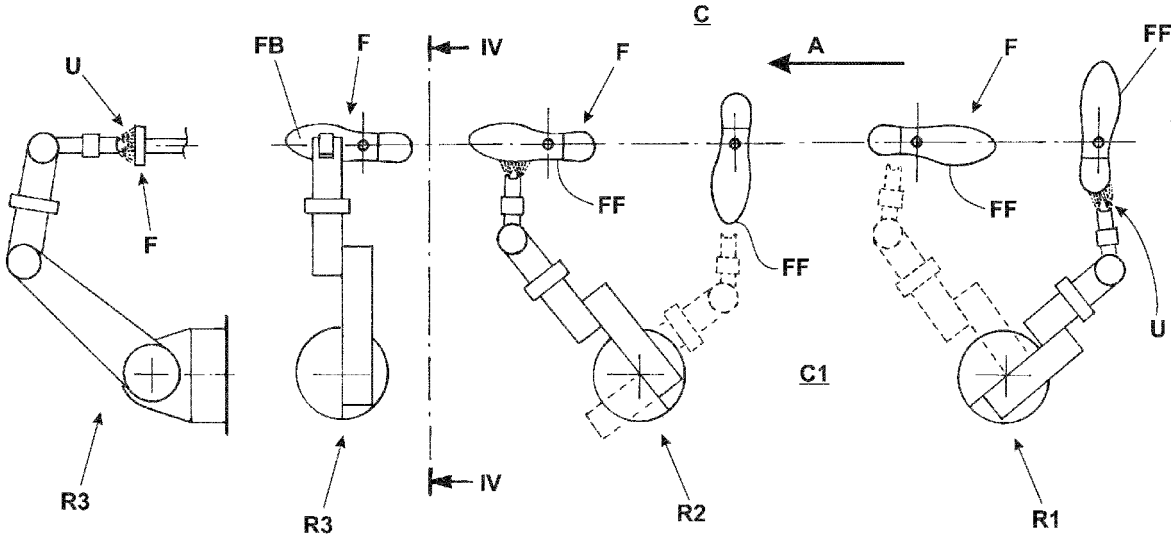


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 15 16 0308

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	KR 101 306 589 B1 (KAS INC [KR]) 10 September 2013 (2013-09-10) * the whole document *	1	INV. A43D95/06 B05B12/12 B05B13/02 B05B13/04 ADD. A43D119/00
A	US 5 968 297 A (HOOKER JEFFREY A [US] ET AL) 19 October 1999 (1999-10-19) * the whole document *	1	
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A	WO 2013/123662 A1 (ORISOL ASIA LTD [CN]; MAKOVER JAKOV [IL]; MARDLX BAR COCHVA [IL]; SADE) 29 August 2013 (2013-08-29) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (IPC)
A43D
B05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 September 2015	Millward, Richard

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 15 16 0308

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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