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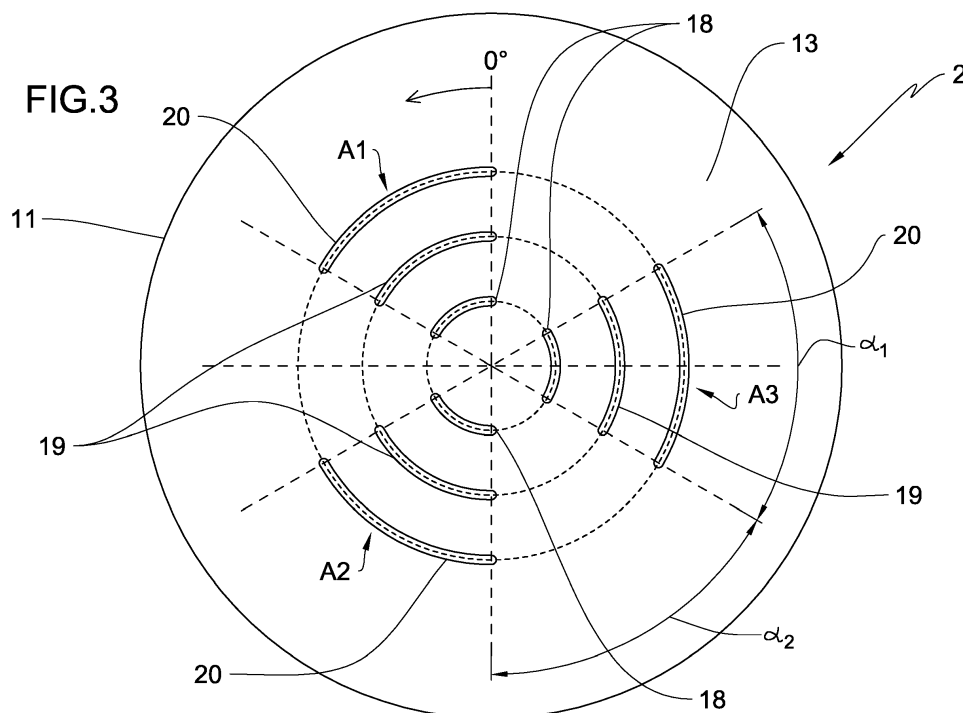
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(54) HORIZONTAL DRUM WASHING MACHINE WITH WASHING LIQUID RECIRCULATION SYSTEM

(57) The present invention is related to a top-loading washing machine comprising: a cabinet (C); a tub (T) installed in the cabinet (C); a sump (5) placed or fashioned at a bottom of the tub (T) and configured to receive washing liquid; a drum (2) rotatably mounted within the cabinet (C) about a horizontal axis (X-X); a recirculating system (6) in fluid communication with the sump (5) and comprising at least a sprayer (8) facing a wall (13) of the drum (2). The sprayer (8) comprises a plurality of nozzles

(15, 16, 17) facing the wall (13) of the drum (2) and this wall (13) presents a plurality of through passages (18, 19, 20). The nozzles (15, 16, 17) and the through passages (18, 19, 20) are disposed and configured such that, during the rotation of the drum (2), there is always at least one nozzle (15, 16, 17) aligned with at least a corresponding through passage (18, 19, 20) in the drum (2).

FIG.3**EP 3 309 290 A1**

Description

Field of the art

[0001] The present invention relates to a horizontal drum washing machine (and washer-dryer) comprising a cabinet, a tub mounted in the cabinet, a drum rotatably mounted within said tub about a horizontal axis. Preferably, the present invention relates to a top-loading washer comprising a tub mounted in the cabinet with an access opening, a perforated drum rotatably mounted within said tub about a horizontal axis and having an aperture on its cylindrical side, one or two drum door/s supported by the drum for opening or closing said. In particular, the present invention relates to a system for recirculating washing liquid in the rotating drum.

State of the art

[0002] It is known that washing machines, and in particular washing machines and washer-dryers, include a support cabinet, on which a washing tub is mounted, inside which rotates a drum, wherein the garments to be washed are placed. The tub has an opening through which the access to the drum is possible and clothes can be placed inside the drum. Such machines also comprise a controlled hydraulic system, which provides the water supply, suitably mixed with detergent substances, so that the garments are subjected to the washing process. It is also provided a recirculation circuit, which has the aim to facilitate the dissolution of the detergent in the water and to promote the circulation of water and detergent into the tub.

[0003] Public document EP 2 392 720 discloses a washing machine tub arrangement comprising: a tub having an inner surface and an outer surface, a pump housing for receiving a recirculation pump, wherein the pump housing comprises a pumping cavity, and a recirculation conduit connecting the pumping cavity of the pump housing to at least one nozzle for supplying washing liquid into the tub. The nozzle directs the flow of recirculated washing liquid in an axial direction from the side wall of the tub towards an outer side wall of the drum. In the side wall of the drum, corresponding circumferentially distributed holes are formed such that during the rotation of the drum the recirculated washing liquid can intermittently enter into the interior of the washing drum.

Object of the invention

[0004] The Applicant observed that known horizontal axis washing machines suffer from some drawbacks related to the recirculation of the washing liquid.

[0005] In fact, the washing machine described in the above cited document is characterized by the fact that most of the washing liquid sprayed against the drum does not enter said drum and does not facilitate the dissolution of the detergent in the water and does not promote any

circulation of water and detergent into the tub. Indeed, EP 2 392 720 itself recites that the washing liquid can only intermittently enter into the interior of the washing drum.

[0006] It should be noted that this implies a not effective and not efficient circulation and/or a waste of the energy used for moving the pump of the recirculation conduit.

[0007] It is the main object of the present invention to overcome the above-mentioned drawbacks by providing an efficient recirculation system for horizontal axis washing machines in order to improve the washing performances.

[0008] Another object of the present invention is to provide a recirculation system having a simple and reliable structure.

[0009] Another object of the present invention is to provide a horizontal axis washing machine provided with such efficient, simple and reliable recirculation system.

Summary of the invention

[0010] The Applicant has found that such objectives can be obtained by providing a sprayer that includes nozzles positioned according to a predetermined pattern, wherein these nozzles work in combination with corresponding apertures/through passages obtained in the drum so that, during the rotation of the drum, there is always at least one sprayer's nozzle aligned with the corresponding drum's aperture.

[0011] More specifically, according to one aspect, the present invention relates to a horizontal drum washing machine with washing liquid recirculation system, comprising: a cabinet; a tub installed in the cabinet; a sump placed or fashioned at a bottom of the tub and configured to receive washing liquid; a drum rotatably mounted within said cabinet about a horizontal axis; a recirculating system in fluid communication with the sump and comprising at least a sprayer facing a wall of the drum; wherein the sprayer comprises a plurality of nozzles facing the wall of the drum and said wall presents a plurality of through passages; wherein the nozzles and the through passages are disposed and configured such that, during the rotation of the drum, there is always at least one nozzle aligned with at least a corresponding through passage in the drum.

[0012] According to another aspect, the present invention relates to a method for recirculating washing liquid in a horizontal drum washing machine, preferably made according to the previous aspect, comprising: providing a drum rotatably mounted about a horizontal axis within a cabinet of the horizontal drum washing machine; providing a recirculating system in fluid communication with a sump and comprising at least a sprayer facing a wall of the drum; keeping always at least one sprayer's nozzle aligned with a corresponding drum's through passage during the rotation of the drum.

[0013] The term "substantially horizontal" means that the axis is parallel to a horizontal plane or inclined of few

degrees (0° - 20°) with respect to said horizontal plane. "Nozzle aligned with at least a corresponding through passage" means that the through passage is placed on a direction of the flow ejected by the nozzle so that the ejected flow crosses the through passage and enters the drum with no obstacles.

[0014] The Applicant verified that in such a way, the washing liquid is sprayed into the drum throughout the entire rotation of the drum, so allowing an improvement of the washing performances.

[0015] The Applicant also verified that the invention is structurally simple and reliable, since the sprayer may be motionless and hence said sprayer may be easily connected to the rest of the recirculation system.

[0016] The present invention, in at least one of the aforesaid aspects, can have one or more of the preferred characteristics that are described hereinbelow.

[0017] Preferably, the horizontal drum washing machine is a top-loading washer. Preferably, the drum is perforated and these perforations are preferably other than the through passages.

[0018] Preferably, the recirculation system comprises a pump placed on a recirculation conduit which is connected to the sprayer and to the sump.

[0019] Preferably, the sprayer is motionless.

[0020] Preferably, the sprayer is fixed to the tub.

[0021] Preferably, the through passages are elongated slots.

[0022] Preferably, the nozzles are substantially circular and/or shaped like dots. The nozzles eject jets of washing liquid into the slots as the drum and the slots move. Preferably, the wall of the drum comprises a cylindrical wrapper and at least an end wall closing at least one end of the cylindrical wrapper. Preferably, in a top-loading washer, another end wall closes the other end of the cylindrical wrapper. Preferably, the sprayer faces one of the end walls (front or rear end walls). Preferably, said through passages are fashioned in one of the end walls. Preferably, the sprayer is mounted on the rear of the tub. Preferably, the sprayer is coaxial to the drum.

[0023] In a different embodiment, said through passages are fashioned in the cylindrical wrapper and the sprayer faces the cylindrical wrapper.

[0024] Preferably, the plurality of through passages are arranged along circular paths coaxially disposed with respect to the horizontal axis.

[0025] Preferably, the through passages are arc shaped.

[0026] Preferably, the plurality of through passages comprises groups of through passages.

[0027] Preferably, the through passages of each group are positioned along a respective circular path.

[0028] Preferably, the circular paths are coaxially disposed with respect to the horizontal axis and concentric relative to each other.

[0029] Preferably, the through passages of all groups form radial arrays of through passages, wherein each array comprises a through passage of each group. Preferably,

the through passages of each group are angularly equidistant relative to one another.

[0030] Preferably, the through passages are positioned such that the center of mass of the end wall is placed substantially at the horizontal axis in order to assure the balance of the drum about the axis during rotation.

[0031] Preferably, the plurality of nozzles are each arranged along circular paths coaxially disposed with respect to the horizontal axis.

[0032] Preferably, the nozzles are angularly offset one with respect to the other such that always during the rotation of the drum at least one nozzle is aligned with at least a corresponding through passage in the drum.

[0033] Preferably, the plurality of nozzles comprises groups of nozzles, wherein the nozzles of each group are positioned along a respective circular path facing a respective circular path of the through passages.

[0034] Preferably, the nozzles of each group are positioned along a respective circular path.

[0035] Preferably, the nozzles are coaxially disposed with respect to the horizontal axis and concentric relative to each other.

[0036] Preferably, the nozzles of each group are angularly offset with respect to the nozzles of another group.

[0037] Preferably, the nozzles of each group are angularly equidistant relative to one another.

[0038] Preferably, always during the rotation of the drum, the nozzles of at least one group of nozzles are aligned with the corresponding through passages of at least one group of through passages.

[0039] Preferably, the number of groups of nozzles is equal to the number of groups of through passages.

[0040] Preferably, the number of nozzles per group is equal to the number of groups. Preferably, the number of through passages per group is equal to the number of groups. Preferably, the number of arrays of through passages is equal to the number of groups.

[0041] Preferably, each through passage extends over a first angle, preferably given by the following formula: $\alpha_1 = 180^\circ / \text{number of groups}$.

[0042] Preferably, the through passages of each group are angularly spaced of a second angle α_2 , preferably substantially equal to the first angle α_1 .

[0043] Preferably, the nozzles of each group are angularly spaced of a third angle α_3 , preferably given by the following formula: $\alpha_3 = 2 \times \alpha_1$.

[0044] Preferably, corresponding or homologous nozzles belonging to different groups are angularly spaced of a fourth angle α_4 , preferably given by the following formula: $\alpha_4 = \alpha_1 / (\text{number of groups} - 1)$. The corresponding or homologous nozzles belonging to different groups are the nozzles which, in a predetermined angular position of the drum, are all aligned with the same radial array of through passages. In other words, the corresponding or homologous nozzles belonging to different groups are arranged in radial curved arrays of nozzles.

[0045] Preferably, corresponding or homologous nozzles

zles belonging to different groups span over a fifth angle α_5 preferably equal to α_1 .

[0046] Preferably, the fifth angle α_5 is equal to or greater than the first angle α_1 .

[0047] Preferably, the number of groups of nozzles and the number of groups of through passages is of three, the number of nozzles per group and the number of through passages per group is of three, the first angle α_1 and the second angle α_2 are 60° , the third angle α_3 is 120° , the fourth angle α_4 is 30° , the fifth angle α_5 is 60° .

Brief description of the drawings

[0048] Further objects, features and advantages of the present invention will become apparent from the following detailed description and from the annexed drawings, which are supplied by way of non-limiting example, wherein:

Fig. 1 is a schematic side view of a horizontal drum washing machine according to the invention;

Fig. 2 is a schematic rear view of the horizontal drum washing machine of figure 1;

Fig. 3 is an enlarged view of rear wall of the drum of the machine of figures 1 and 2;

Fig. 4 is an enlarged front view of a sprayer of the machine of figures 1 and 2;

Figures 5A to 5D shows schematically respective angular positions of the rotating drum with respect to the sprayer;

Fig. 6 is a chart representing the relative positions of nozzles of the sprayer with respect to slots of the drum.

Detailed description of the preferred embodiments of the invention

[0049] Referring now to the annexed drawings, in Fig. 1 reference numeral 1 designates a top loading horizontal drum washing machine, according to the present invention.

[0050] A perforated drum 2 of the machine 1 comprises a stainless steel cylindrical wrapper 3 provided with a rectangular drum aperture provided with a door 4. The drum 2 is rotating within a plastic tub T mounted, with the interposition of known dampers, within a cabinet C. Such cabinet C is provided with a lid L for closing the access opening towards the drum 2.

[0051] The tub T is fixed to the cabinet C and the drum 2 is mounted within said cabinet C and within the tub T to rotate about a horizontal axis X-X.

[0052] A bottom of the tub T delimits a sump 5 configured to receive the washing liquid. A recirculating system 6 is in fluid communication with the sump 5 and it is configured to recirculate the washing liquid between the sump 5 and the rotating drum 4.

[0053] The machine 1 is provided with other elements which are commonly known and not described in the

present description.

[0054] The recirculating system 6 comprises a recirculation duct 7 having a first end in fluid communication with the sump 5 and a second end connected to a sprayer 8. A pump 9 is placed on the recirculation conduit 7 to pump the washing fluid from the sump 5 towards the sprayer 8. The sprayer 8 and preferably also the recirculation conduit 7 are installed and supported by the tub T or by the cabinet C and are motionless with respect to said tub T and cabinet C.

[0055] The drum 2 comprises a cylindrical wrapper 11, a front wall 12 and a rear wall 13 closing the ends of the cylindrical wrapper 11.

[0056] The sprayer 8 has a substantially cylindrical shape coaxial to the drum 2 and provided with a front face 14 facing the rear wall of the drum 2.

[0057] As shown in figure 4, the front face 14 of the sprayer 8 is provided with a plurality of nozzles in fluid communication with the recirculation conduit 7 and facing the rear wall 13 of the drum 2. The plurality of nozzles comprises three groups of nozzles. Each group of nozzles comprises three nozzles arranged along a respective circular path coaxially disposed with respect to the horizontal axis X-X. A first group of nozzles 15 is arranged along a first inner circular path, a second group of nozzles 16 is arranged along a second middle circular path, a third group of nozzles 17 is arranged along a third outer circular path. The nozzles 15, 16, 17 are substantially circular and/or shaped like dots. The nozzles 15, 16, 17 of each group are angularly equidistant relative to one another and the nozzles 15, 16, 17 of each group are angularly offset with respect to the nozzles of another group.

[0058] As shown in figure 3, the rear wall of the drum 2 is provided with a plurality of through passages 18, 19, 20 comprising three groups of through passages. Please note that these through passages are preferably other than the perforations in the drum 2.

[0059] Each group of through passages comprises three through passages arranged along a respective circular path coaxially disposed with respect to the horizontal axis X-X. A first group of through passages 18 is arranged along a first inner circular path, a second group of through passages 19 is arranged along a second middle circular path, a third group of through passages 20 is arranged along a third outer circular path.

[0060] The first circular path of nozzles 15, 16, 17 faces the first circular path of through passages 18, 19, 20, the second circular path of nozzles 15, 16, 17 faces the second circular path of through passages 18, 19, 20, the third circular path of nozzles 15, 16, 17 faces the third circular path of through passages 18, 19, 20. Each through passage 18, 19, 20 is an arch shaped elongated slot and extends along the respective circular path. The through passages 18, 19, 20 of each group are angularly equidistant relative to one another. The through passages 18, 19, 20 of the three groups are positioned in three radial rows to form three radial arrays A1, A2, A3 of

through passages.

[0061] Each through passage 18, 19, 20 extends over a first angle $\alpha_1 = 60^\circ$ and it is spaced from another through passage of the same group of a second angle $\alpha_2 = \alpha_1$. In other words, as shown in figure 3, the three radial arrays span over the first angle α_1 and are spaced one from the other of the second angle α_2 . The through passages 18, 19, 20 are positioned such that the center of mass of the rear wall 13 is placed substantially at the horizontal axis X-X in order to assure the balance of the drum 2 about the axis during rotation.

[0062] As shown in figure 4, the nozzles 15, 16, 17 of each group are angularly spaced of a third angle $\alpha_3 = 2 \times \alpha_1 = 120^\circ$. The through the nozzles 15, 16, 17 of the three groups are positioned in three radial rows to form three radial curved arrays of nozzles 15, 16, 17. The nozzles 15, 16, 17 of each curved array are angularly spaced one from the other of a fourth angle $\alpha_4 = 30^\circ$. The nozzles 15, 16, 17 of each curved array span over a fifth angle $\alpha_5 = \alpha_1 = 60^\circ$.

[0063] The nozzles 15, 16, 17 eject jets of washing liquid into the slots 18, 19, 20 as the drum 2 and the slots moves.

[0064] The nozzles 15, 16, 17 and the through passages 18, 19, 20 are disposed and configured such that, always during the rotation of the drum 2, at least three nozzles are always aligned with corresponding three through passages 18, 19, 20. Three sprayer's nozzles 15, 16, 17 are kept always aligned with three through passages 18, 19, 20 during the rotation of the drum 2.

[0065] Figures 5A - 5D show respective positions of the through passages 18, 19, 20 of the rotating drum 2 with respect to the nozzles 15, 16, 17 of the sprayer 8 during a rotation of the drum 2 of about 90° .

[0066] In figure 5A (taken as position 0°), all the nozzles 15, 16, 17 of all the groups are aligned with the respective through passages 18, 19, 20 and the washing liquid sprayed by all said nozzles enters the drum 2. The array A1 is the uppermost one. Figure 5B shows the drum 2 and the through passages 18, 19, 20 rotated counterclockwise of 30° with respect to the position of figure 5A. The nozzles 15 of the inner group are no more aligned with the respective through passages while the nozzles 16, 17 of the middle and outer groups are still aligned. Only the washing liquid sprayed by the nozzles 16, 17 of the middle and outer groups enters the drum 2.

[0067] Figure 5C shows the drum 2 and the through passages 18, 19, 20 rotated counterclockwise of 60° with respect to the position of figure 5A. The nozzles 16 of the middle group are no more aligned with the respective through passages while the nozzles 15, 17 of the inner and outer groups are aligned. Only the washing liquid sprayed by the nozzles 15, 17 of the inner and outer groups enters the drum 2.

[0068] Figure 5D the drum 2 and the through passages 18, 19, 20 rotated counterclockwise of 90° with respect to the position of figure 5A. The nozzles 17 of the outer group are no more aligned with the respective through

passages while the nozzles 15, 16 of the inner and middle groups are aligned. Only the washing liquid sprayed by the nozzles 15, 16 of the inner and middle groups enters the drum 2.

[0069] A further rotation of 30° (120° with respect to figure 5A) gives rise to the same configuration shown in figure 5A, wherein the array A3 is the uppermost one.

[0070] The chart of figure 6 shows the above described positions and the transitions between said positions. Dots and lines on the chart represent the alignment of the nozzles 15, 16, 17 with the three arrays A1, A2, A3 of through passages 18, 19, 20.

[0071] Between 0° and 30° , only the nozzles 16, 17 of the middle and outer groups are aligned. Between 30° and 60° , only the nozzles 17 of the outer group are aligned. Between 60° and 90° , only the nozzles 15 of the inner group are aligned. Between 90° and 120° , only the nozzles 15, 16 of the inner and middle groups are aligned. The washing liquid is sprayed into the drum 2 throughout the entire rotation of the drum 2.

[0072] The top-loading washing machine with recirculation system described herein by way of example may be subject to many possible variations without departing from the novelty spirit of the inventive idea.

[0073] For instance, the through passages may be fashioned in the cylindrical wrapper 11 and the sprayer may face the cylindrical wrapper 11.

[0074] It is also clear that in the practical implementation of the invention the illustrated details may have different shapes or be replaced with other technically equivalent elements.

[0075] It can therefore be easily understood that the present invention is not limited to the above-described top-loading washing machine but may be subject to many modifications, improvements or replacements of equivalent parts and elements without departing from the inventive idea, as clearly specified in the following claims.

Claims

1. A horizontal drum washing machine with washing liquid recirculation system, comprising:

- a cabinet (C);
- a tub (T) installed in the cabinet (C);
- a sump (5) placed or fashioned at a bottom of the tub (T) and configured to receive washing liquid;
- a drum (2) rotatably mounted within said cabinet (C) about a horizontal axis (X-X);
- a recirculating system (6) in fluid communication with the sump (5) and comprising at least a sprayer (8) facing a wall (13) of the drum (2);
- wherein the sprayer (8) comprises a plurality of nozzles (15, 16, 17) facing the wall (13) of the drum (2) and said wall (13) presents a plurality of through passages (18, 19, 20); wherein the

- nozzles (15, 16, 17) and the through passages (18, 19, 20) are disposed and configured such that, during the rotation of the drum (2), there is always at least one nozzle (15, 16, 17) aligned with at least a corresponding through passage (18, 19, 20) in the drum (2).
2. The machine of claim 1, wherein the through passages (18, 19, 20) are elongated slots and the nozzles (15, 16, 18) are substantially circular and/or shaped like dots. 10
 3. The machine of claim 1 or 2, wherein the wall (11, 12, 13) of the drum (2) comprises a cylindrical wrapper (11) and at least an end wall (12, 13) closing at least one end of the cylindrical wrapper (11); wherein the sprayer (8) faces the end wall (13). 15
 4. The machine of claim 3, wherein the through passages (18, 19, 20) and the nozzles (15, 16, 17) are arranged along respective circular paths coaxially disposed with respect to the horizontal axis (X-X). 20
 5. The machine of claim 4, wherein the through passages (18, 19, 20) are arc shaped. 25
 6. The machine of claim 4 or 5, wherein each through passage (18, 19, 20) extends over a first angle, preferably given by the following formula: $\alpha_1 = 180^\circ/\text{number of groups}$. 30
 7. The machine of any of claims 4 to 6, wherein the plurality of through passages (18, 19, 20) comprises groups of through passages, wherein the through passages (18, 19, 20) of each group are positioned along a respective circular path. 35
 8. The machine of claim 7, wherein the through passages (18, 19, 20) of all groups form radial arrays (A1, A2, A3) of through passages, wherein each array (A1, A2, A3) comprises a through passage of each group. 40
 9. The machine of claim 7 or 8, wherein the through passages (18, 19, 20) of each group are angularly equidistant relative to one another. 45
 10. The machine of any of claims 7 to 9, wherein the nozzles (15, 16, 17) are angularly offset one with respect to the other. 50
 11. The machine of any of claims 7 to 10, wherein the plurality of nozzles (15, 16, 17) comprises groups of nozzles, wherein the nozzles (15, 16, 17) of each group are positioned along a respective circular path facing a respective circular path of the through passages (18, 19, 20). 55
 12. The machine of claim 11, wherein the nozzles (15, 16, 17) of each group are angularly offset with respect to the nozzles (15, 16, 17) of another group.
 13. The machine of claim 11 or 12, wherein the nozzles (15, 16, 17) of each group are angularly equidistant relative to one another.
 14. The machine of any of claims 11 to 13, wherein, during the rotation of the drum (2), there are always the nozzles (15, 16, 17) of at least one group of nozzles aligned with the corresponding through passages (18, 19, 20) of at least one group of through passages.
 15. The machine of any of claims 1 to 14, wherein the sprayer (8) is motionless and it is preferably fixed to the tub (T).

FIG.1

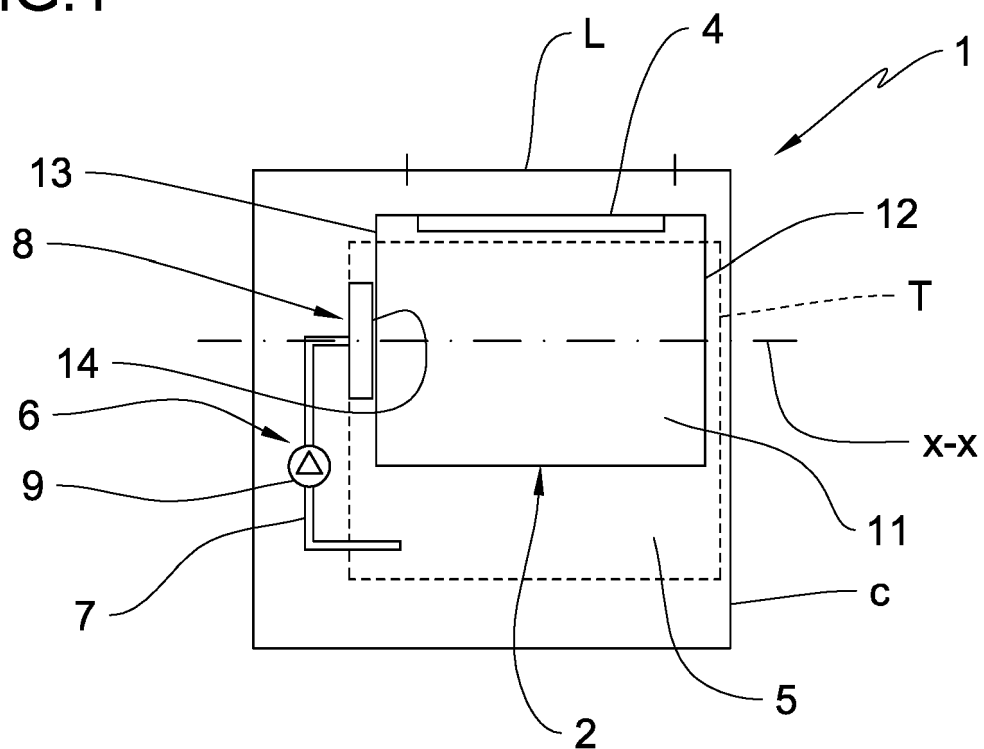
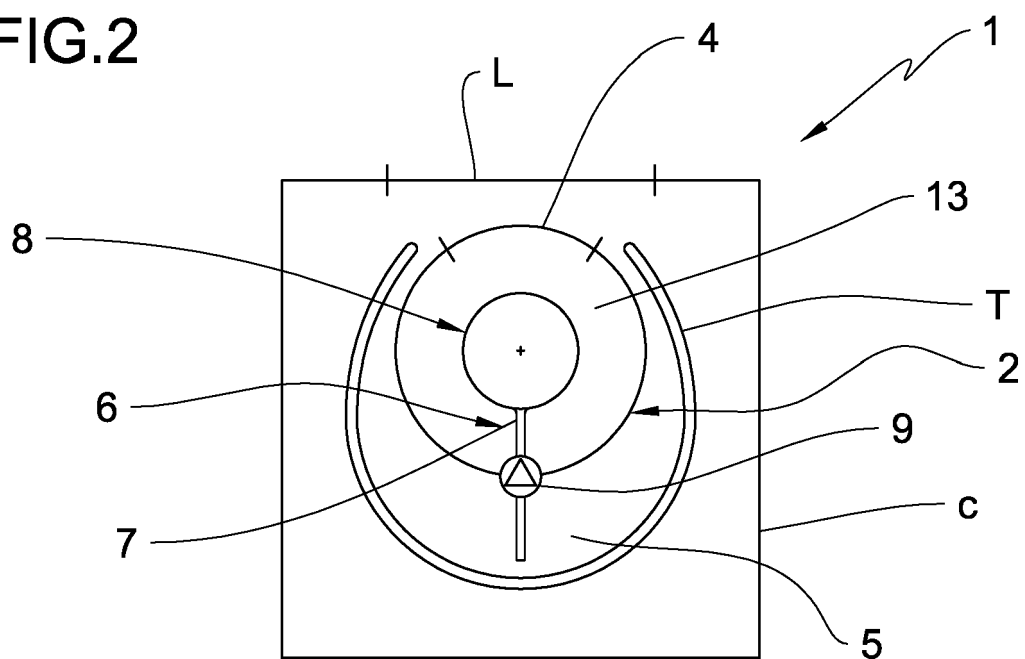


FIG.2



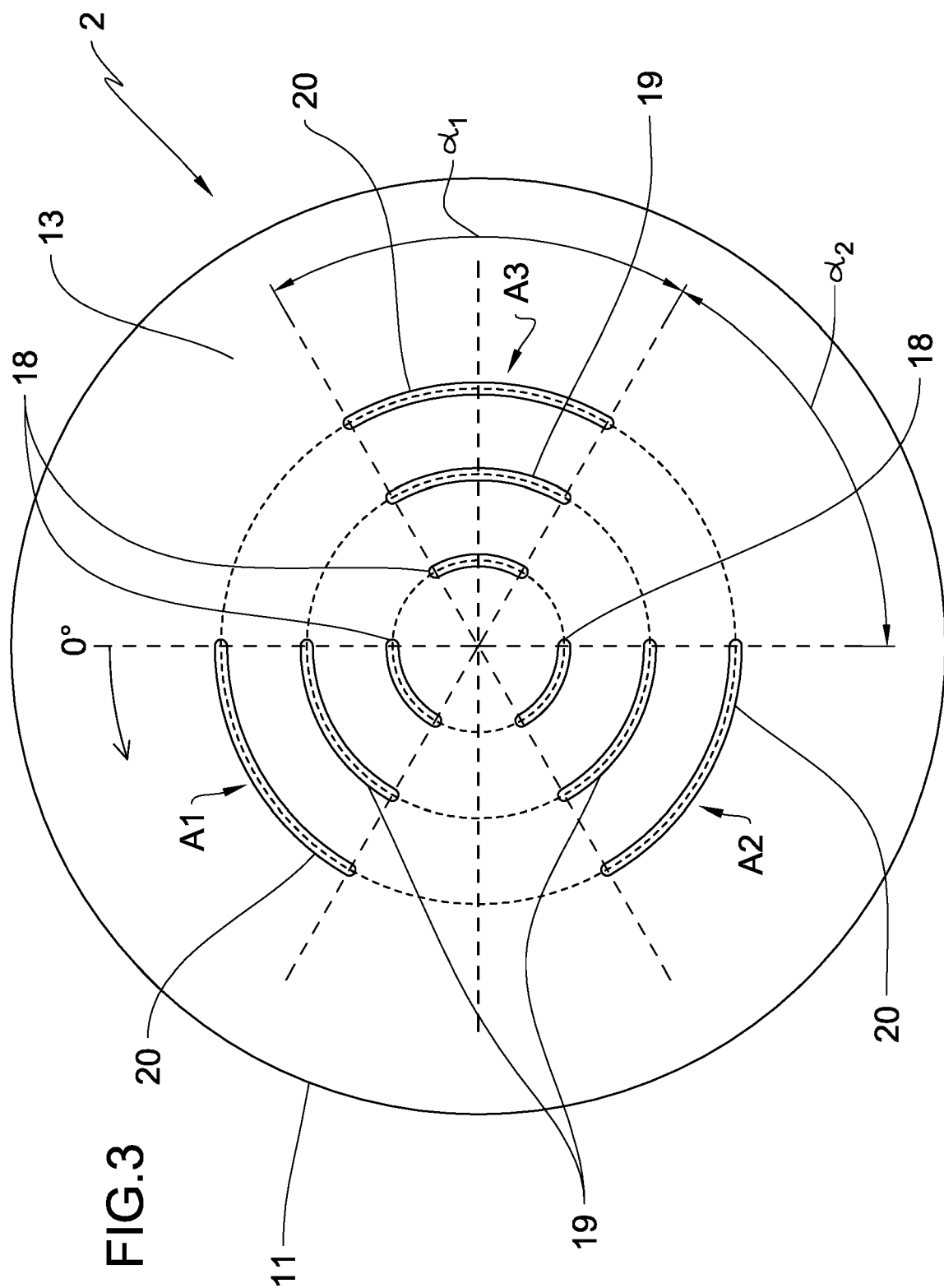
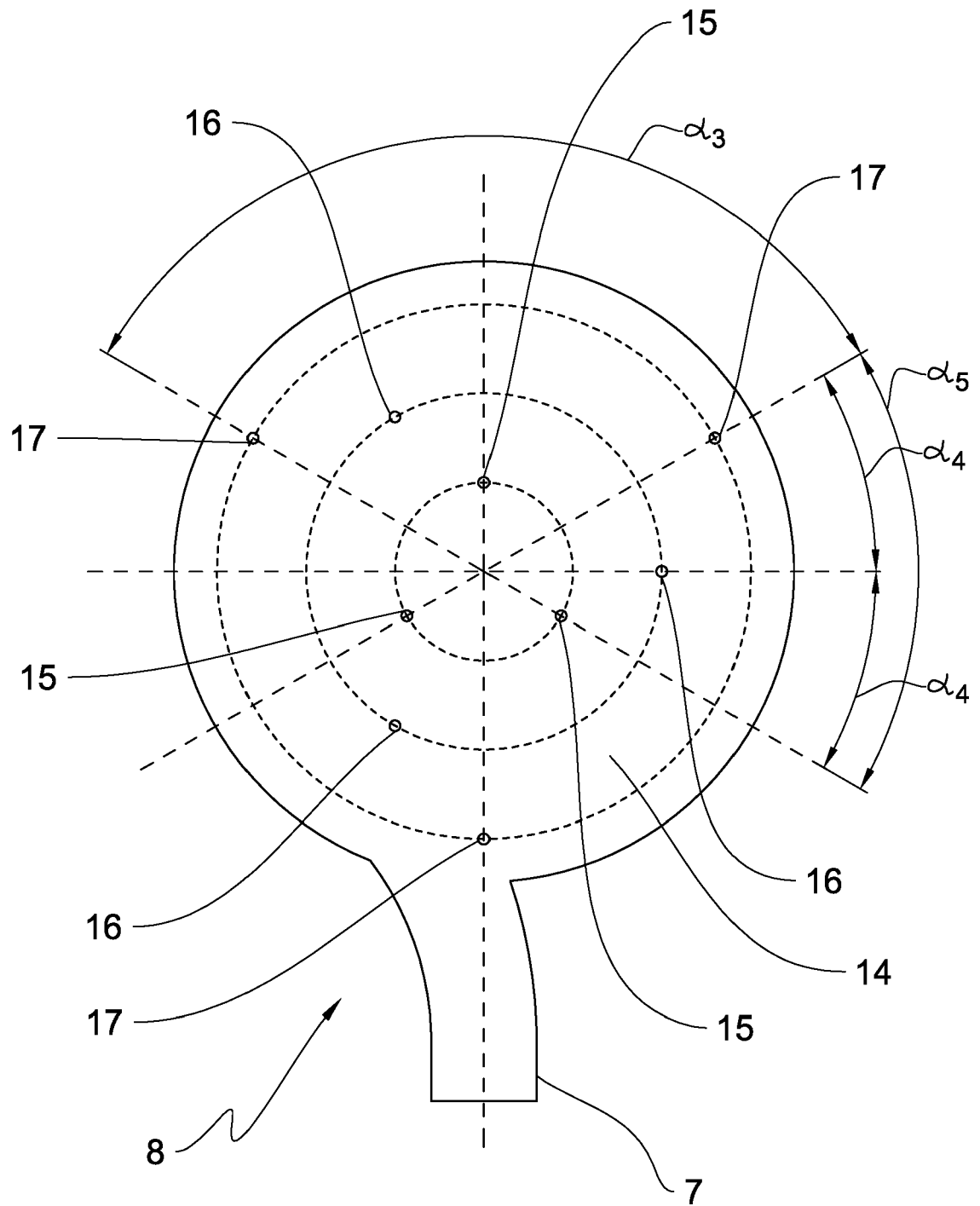


FIG.4



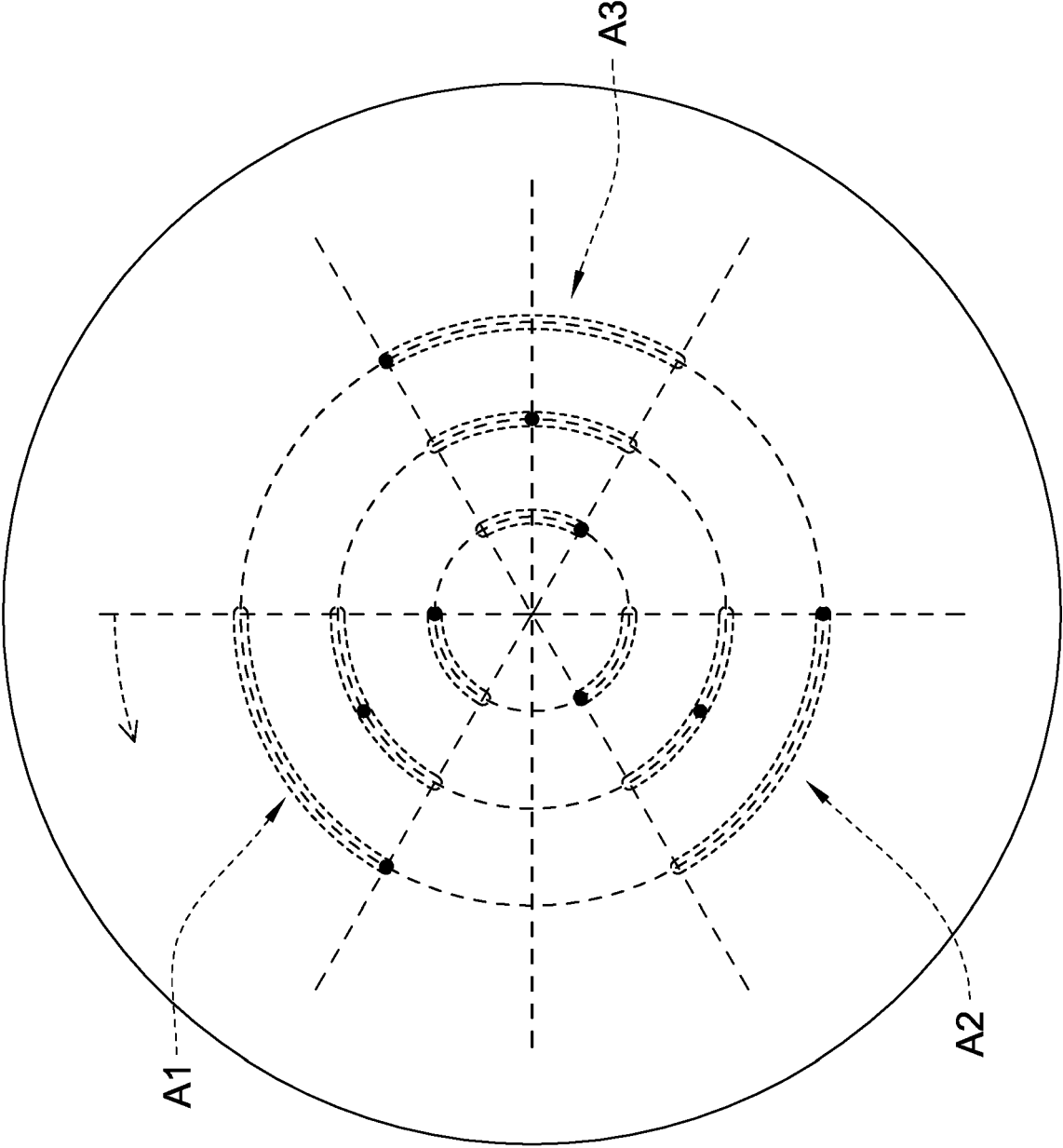


FIG. 5A

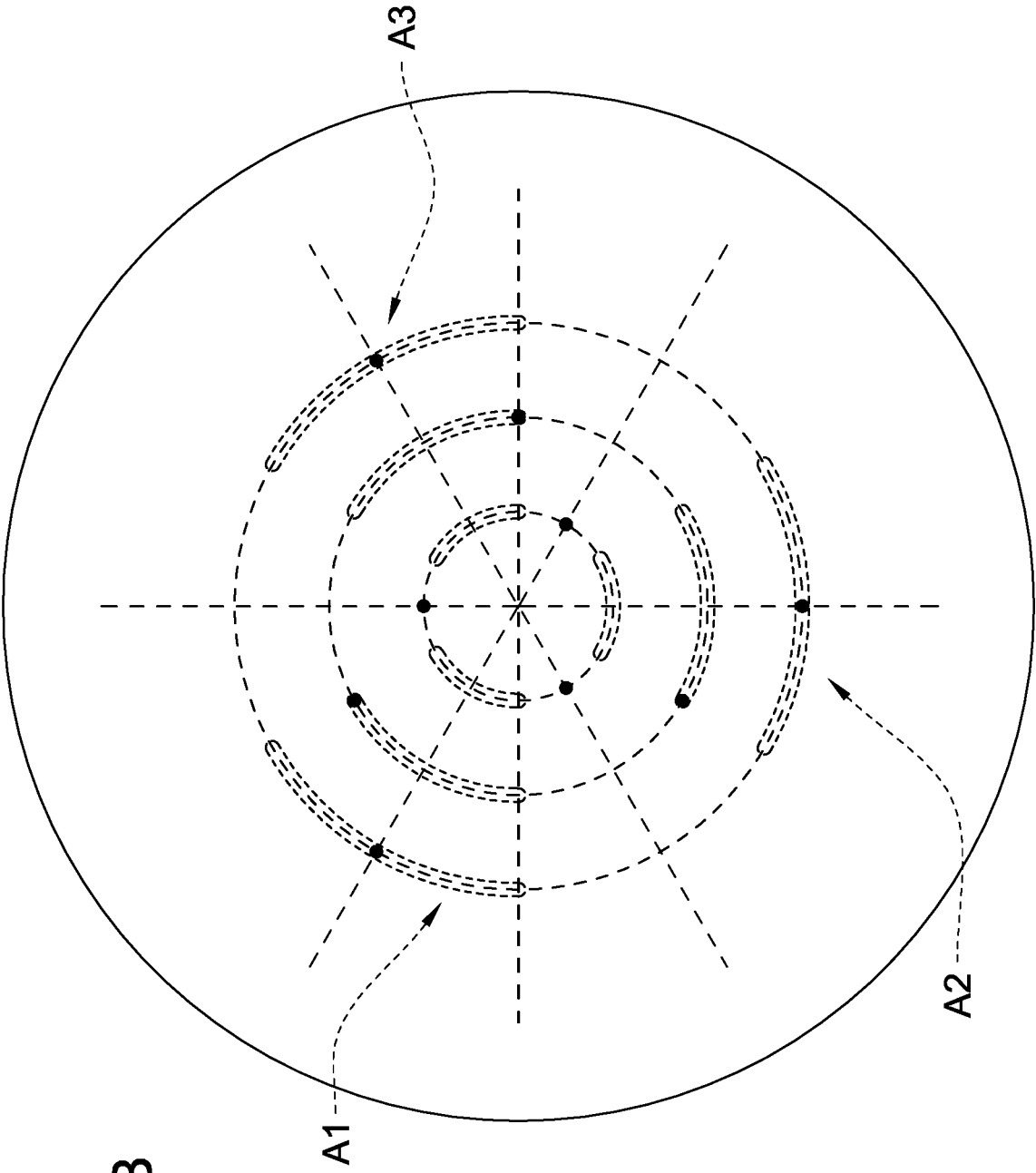


FIG. 5B

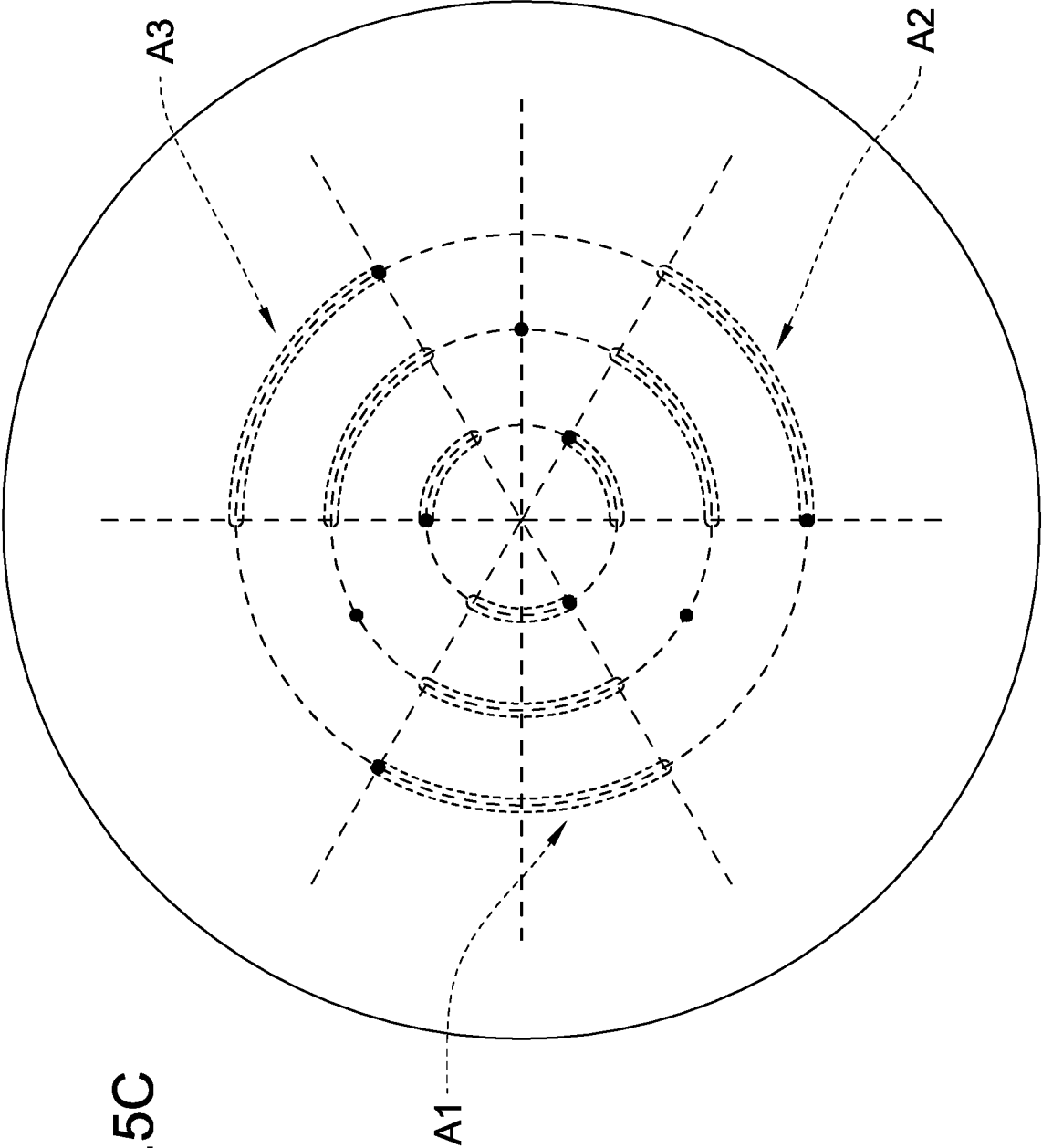


FIG. 5C

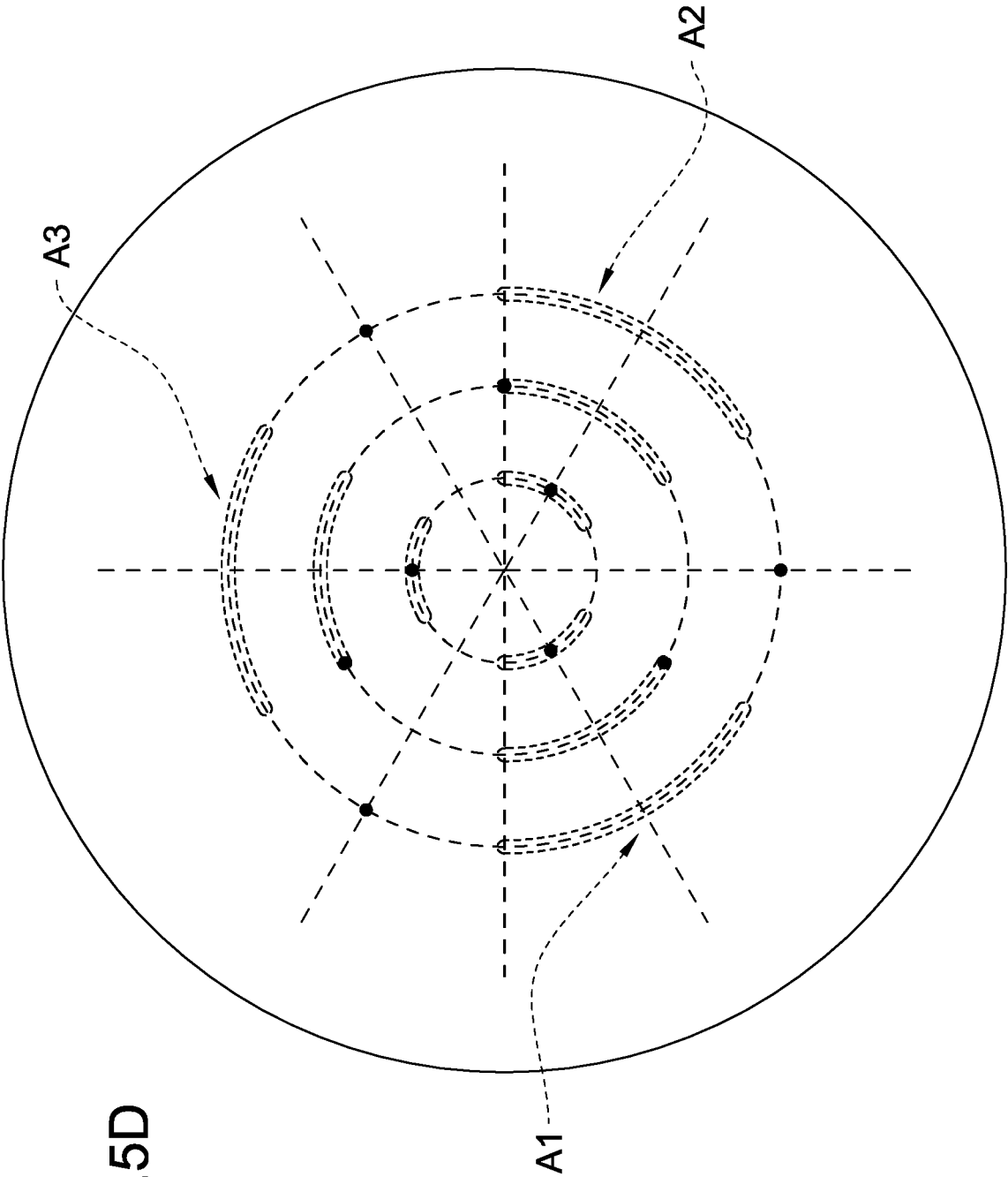
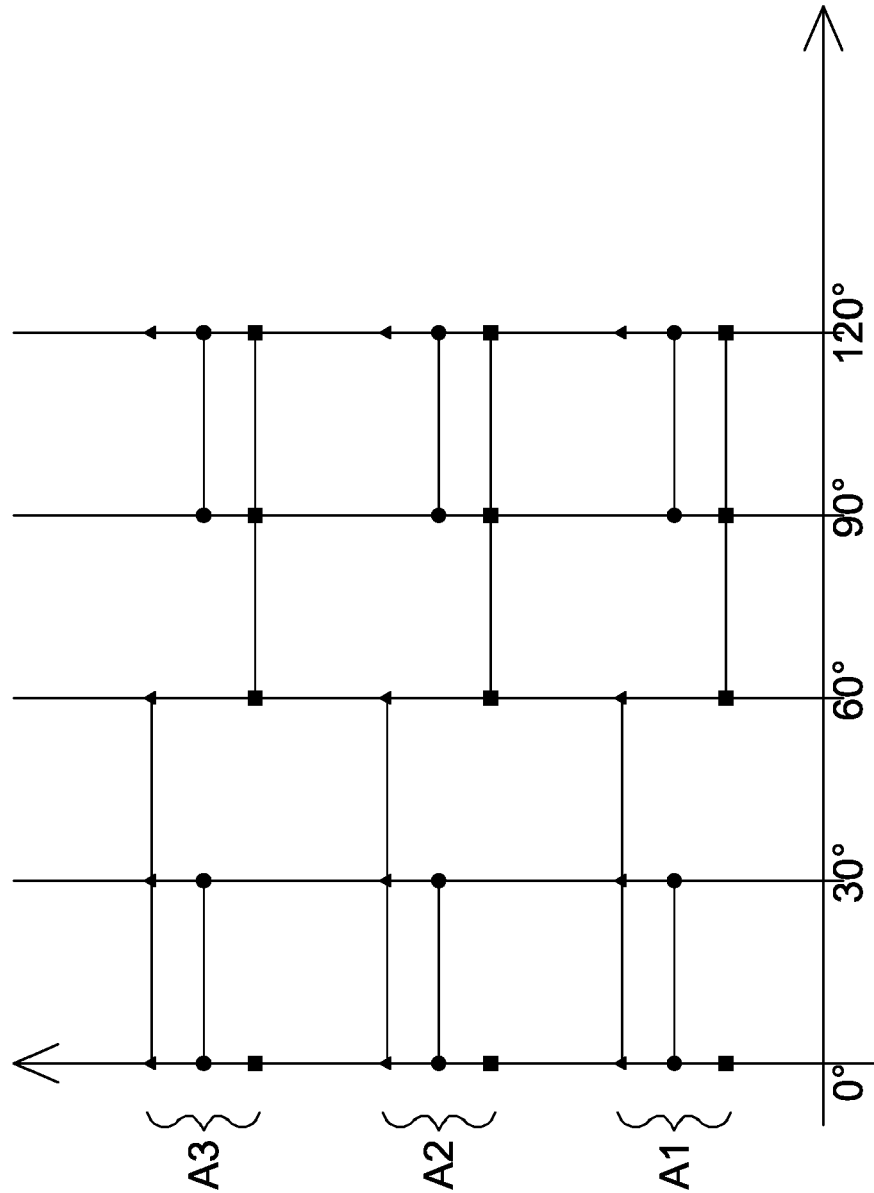


FIG. 5D

FIG.6





EUROPEAN SEARCH REPORT

Application Number
EP 16 19 3972

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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,D	EP 2 392 720 A1 (ELECTROLUX HOME PROD CORP [BE]) 7 December 2011 (2011-12-07) * paragraphs [0028] - [0031]; figure 1 * -----	1-15	INV. D06F39/08 D06F37/04 D06F37/26
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A	EP 2 719 814 A1 (CANDY SPA [IT]) 16 April 2014 (2014-04-16) * claim 1; figures 1-2 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 March 2017	Examiner Stroppa, Giovanni
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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