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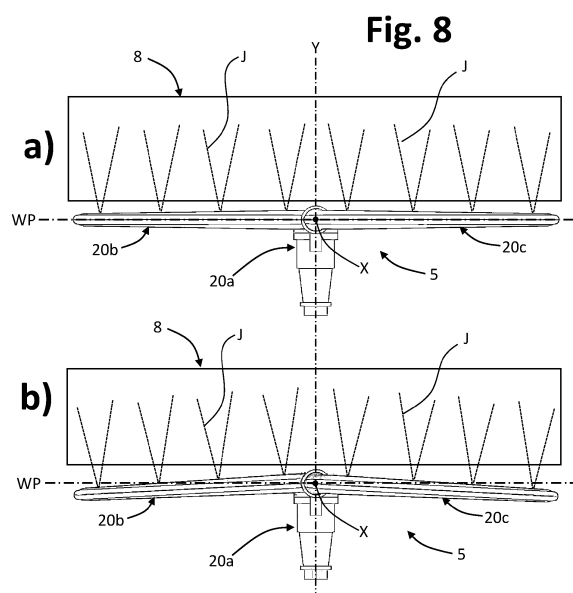
(54) **DISHWASHING MACHINE**

(57) A dishwashing machine (1) has:
- a control system (CS),
- a washing chamber in which at least one crockery basket (8) is housed,
- a hydraulic circuit for a washing liquid, which comprises:
at least one rotary spraying member (5), having a spraying member body (20a, 20b, 20c) which is rotatable about a respective axis of rotation (Y), and which comprises a first hollow body part (20c) and at least one second hollow body part (20b, 20c), the at least one second hollow body part (20b, 20c) having, at least in a face thereof generally facing the at least one crockery basket (8), a plurality of openings or nozzles for emission of jets (J) of the washing liquid,
an electric pump having at least one outlet connected in fluid communication with at least one supply duct for the supply of the washing liquid to the first hollow body part (20a).

The first hollow body part (20a) is mounted for rotating about around the axis of rotation (Y), and the at least one second hollow body part (20b, 20c) is coupled in a rotatable manner to the first hollow body part (20a), to be susceptible to rotate about a respective axis of revolution (X) which is generally transverse to the axis of rotation (Y).

The dishwashing machine has hydraulic means controllable by the control system to determine a variation in the pressure of the washing liquid supplied to the first hollow body part, to induce as a consequence an angular movement of the at least one second hollow body part (20b, 20c) about the axis of revolution (X), from a first

operating position to at least one second operating position.



Description

Field of invention

[0001] The present invention refers to dishwashing machines, in particular for domestic use, and has been developed with particular attention being paid to the spraying systems that equip these machines.

Prior art

[0002] Dishwashing machines usually comprise a structure that defines or has a washing chamber associated thereto, within which at least one crockery basket is housed, with a spraying member that directs the jets of a washing liquid towards the basket, and therefore on the dishes contained therein. For example, in the case of the most common dishwashers for domestic use, an upper loading basket and a lower loading basket are usually provided within the washing chamber, which are mounted for sliding on guides associated with opposite side walls of the same chamber, in order to allow their extraction from the washing chamber, for the purpose of loading and unloading dishes. Below each loading basket there is a respective spraying member which, by rotating about a substantially vertical axis, hits the dishes positioned in the relative basket with a plurality of jets of washing liquid under pressure. To this end, an electric washing pump, driven by a corresponding electric motor, provides to convey the washing liquid under pressure to the spraying members, through suitable ducts.

[0003] Each spraying member essentially consists of a single rotating arm, having a certain length and which, on one of the face thereof which faces the corresponding basket, has openings or nozzles of various geometries, in order to direct the said pressurized jets towards the dishes. In the machine's operation, these jets therefore rotate in a plane, generally substantially horizontal, and - being at different distances from the centre of rotation - enable to cover with the washing liquid a relatively large area of the corresponding basket. In general terms, the greater the area covered by the jets, the higher the quality of the washing, in terms of dirt removal.

[0004] In order to increase the area affected by the jets, and thus increase the removal of dirt, epicyclic-type solutions have been proposed, i.e., wherein a main rotating arm supports at least one rotating satellite sprayer (see for example WO 2019/086108 A and EP 1050263 A). These solutions, although allowing to cover with the jets of washing liquid a greater area than that obtainable with the more traditional single spraying arms, generally have greater overall height dimensions, and this penalizes the loading capacity of the dishwasher, for example by limiting the maximum diameters of the dishes that can be allocated in the baskets. Such solutions are also generally complicated and expensive.

Aim and summary of the invention

[0005] The present invention has basically the aim of eliminating this disadvantage. In this context, an aim of the invention is to obtain a dishwashing machine equipped with at least one rotating spraying member of simple and compact structure, but able to increase the area covered by the jets of the washing liquid, compared to the more traditional single spraying arms.

[0006] This aim is achieved, according to the present invention, by a dishwashing machine having the characteristics indicated in the attached claims. The claims form an integral part of the technical teaching provided herein in connection with the invention.

[0007] In summary, according to the invention, the dishwashing machine is equipped with at least one rotating spraying member, with a structure relatively similar to that of traditional single spraying arms, but designed to allow to vary the direction or inclination of the washing and/or rinsing jets facing a corresponding crockery basket, by varying the configuration of the same spraying member.

[0008] The aforementioned configuration change is determined through a variation in the pressure of the washing liquid that is being fed to the spraying member, in combination with a composition of the body of the member itself in at least two hollow parts, which are coupled so as to be able to move with respect to one another due to the aforementioned pressure variation. Preferably, a first body part is mounted for rotating about the aforementioned axis of rotation, and a second body part obtains an arm which is mounted for rotating with respect to the first body part, about an axis of revolution that is generally transverse to the axis of rotation, in particular substantially perpendicular thereto. The first body part essentially forms a vertical rotating support, and the second body part essentially forms a spraying arm that extends transversely with respect to the first body part. The spraying member preferably includes two generally opposite second body parts, which basically forms two half-arms. Preferably, the second body part, or each second body, which has openings or nozzles from which the jets of the washing liquid are sprayed, has at least one intermediate curvature or bending.

[0009] The second body part, or each second body part, is mounted for rotating about the axis of revolution between at least a first operating position and at least a second operating position, in which a distal end of the second body part is at respective height positions which differs from one another, such that the jets of the washing liquid are differently inclined: in this way, the jets can be directed differently, to cover different areas of the crockery basket, and thus increase the quality of the washing.

[0010] Between the first body part and the second body part, or each second body part, return means may be provided, with the passage from the first position to the second position occurring against the action of the return means, and the return from the second position to the

first position which occurs as a result of the action of the return means. Preferably, the return means comprise elastic means, for example a torsion spring.

[0011] Preferably, one of the two body parts has a supply outlet, and the other body part has a supply inlet, the outlet and the inlet being coupled in a rotatable way according to the axis of revolution, so that the second body part can make a limited angular movement with respect to the first body part, during the rotation of the latter, indicatively less than 10°. The extent of the angular movement may be established by means of mechanical stop means, for example first stop means identifying the first position, and second stop means identifying the second position.

Brief description of the drawings

[0012] Further aims, characteristics and advantages of the present invention will be clear from the detailed description that follows, made with reference to the attached drawings, which are intended to be provided purely as a non-limiting example, wherein:

- Figure 1 is a schematic representation in a schematic section of a dishwashing machine according to possible embodiments;
- Figure 2 is a side elevational view, partially exploded, of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 3 is a schematic view in plan of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 4 is a schematic section, substantially according to line IV-IV of Figure 3;
- Figures 5 and 6 are exploded views, respectively in front elevation and side elevation, of a first body part of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 7 is a side view of a second body part of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 8 is a schematic representation aimed at exemplifying two possible operating conditions of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 9 is a schematic representation similar to that of Figure 8, aimed at exemplifying a different possible operating condition of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 10 is a schematic representation aimed at exemplifying three possible operating conditions of a spraying member of a dishwashing machine according to possible embodiments;
- Figure 11 is a schematic representation aimed at exemplifying three possible operating conditions of a spraying member of a dishwashing machine according to possible embodiments;

- Figure 12 is a schematic view of a device for selective or alternating supply of the spraying members of a dishwashing machine according to possible embodiments; and
- Figure 13 shows two simplified diagrams "characteristic curve - operating point" of an electric pump, in the case of two different possible embodiments.

Description of preferred forms of implementation

[0013] The reference to "an embodiment" in this description indicates that a particular configuration, structure, or characteristic described in relation to the embodiment is included in at least one embodiment. Thus, phrases such as "in an embodiment" and the like, possibly present in different places in this description, do not necessarily refer to the same embodiment. In addition, particular conformations, structures or characteristics defined within this description can be combined in any appropriate way in one or more embodiment, even different from those depicted. The numerical and spatial references (such as "upper", "lower", "top", "bottom", etc.) used herein are for convenience only and therefore do not define the scope of protection or the scope of the embodiment. In this description and in the attached claims, the generic term "material" shall also include mixtures, compositions or combinations (e.g. multilayer film) of several different materials.

[0014] Referring initially to Figure 1, reference 1 designates as a whole a dishwashing machine according to possible embodiments of the invention. In the example, the dishwasher 1 is intended for domestic use, but the invention is also applicable to the case of industrial dishwashers or for professional use (e.g. dishwashers for catering establishments).

[0015] The machine 1 has a load-bearing structure 2, to which a tank or washing chamber 3 is associated, bounded by two opposite side walls, a rear wall, an upper wall and a bottom wall, only the latter being indicated with 3a. The front wall of the washing chamber 3 is obtained from an inner shell 2b, or counter-door, of a front door 2a of machine 1. The door 2a may be hinged in a lower region of the structure 2, so that it can rotate around a substantially horizontal axis between a closed position and an open position.

[0016] The machine has a hydraulic circuit WC, through which water loaded from an external water mains is recirculated inside the washing chamber 3, possibly mixed with a suitable washing agent (such as detergent or rinse aid), for the purpose of treating the dishes by means of at least one spraying member. For this purpose, the bottom wall 3a of the washing chamber 3 has a collection sump 3b associated thereto, preferably provided with a filtering system for the washing liquid. An inlet or suction branch P_{IN} of an electric pump P is connected in fluid communication to the sump 3b. In various embodiments, the electric pump P has an adjustable speed electric motor PM, preferably a brushless-type motor.

[0017] Through the inlet P_{IN} thereof, the electric pump P draws the washing liquid from the sump 3b and, through its outlet or delivery branch P_{OUT} , forces the same liquid into a part of the hydraulic circuit WC dedicated to the spraying of the dishes. In the case exemplified, this part of the hydraulic circuit WC comprises a first branch or duct 4, for the supply of a lower spraying member or arm 5, and a second branch or duct 6, for the supply of an upper spraying member or arm 7. A lower crockery basket 8 and an upper crockery basket 9 are supported in the tank 3, in a way known in itself, above each spraying member 5 and 7, respectively (in the following, for simplicity, the member or arms 5 and 7 will also be referred to as "sprayers"). It should be noted that the invention is also applicable in the case of dishwashers equipped with a single basket and/or a single rotary sprayer, as well as in the case of machines with more than two sprayers and two baskets.

[0018] Sprayers 5 and 7 are rotary sprayers, that is, mounted to rotate according to their respective axes of rotation Y which, in the example shown, are substantially vertical axes. The axes of rotation Y of the two sprayers 5 and 7 do not necessarily have to coincide, i.e., they can be staggered from each other. In the non-limiting example, the sprayer 5 is supported by a stationary tubular component 4a of the duct 4, while the sprayer 7 is supported directly by the upper basket 9, and for this purpose has a connecting duct 7a, having a respective inlet that can be coupled in fluid communication, in a releasable way, to the outlet of the duct 6, according to a technique known in itself. However, it is not essential that sprayer 7 is supported by basket 9 because, according to a technique in itself known, the duct 7a could be mounted permanently within chamber 3 and not bound to the basket 9. The body of each sprayer 5 and 7 is provided - at least on one side thereof facing the respective basket 8 and 9 - with openings or nozzles, for the emission of jets, indicated by J.

[0019] In various embodiments, the dishwasher 1 comprises valve means for controlling the supplying of the sprayers. These valve means are, for example, controllable for selectively supplying the sprayers 5, 7, for the purpose of carrying out treatment programs on a reduced load of dishes and/or for carrying out alternating washing and/or rinsing phases (i.e., performed by supplying only one or both sprayers, or alternately feeding one or the other sprayer). In the example, the valve means include a device D for selective or alternating supply of the sprayers, shown only schematically. This device D, like similar devices according to a known technique, may have a casing with an inlet intended for connection with the output P_{OUT} of the washing pump P, and at least two outlets, connected respectively to the supply duct 4 of the lower sprayer 5 and to the supply duct 6 of the upper sprayer 7; inside the casing of device D a shutter or distributor member is mounted movable, which can be operated by a corresponding electric actuator, isolated from the liquid, to assume at least a first position, wherein both

the aforementioned outlet are open, and at least a second position, wherein one inlet is open and the other outlet is closed, all according to a technique known in the field. This distributor member may, for example, have the shape of a disc or a circular sector, with one or more through holes, and be mounted movable in front of the aforementioned outlets.

[0020] The dishwasher 1 is equipped with a control system CS, which manages the overall operation of the machine. The control system CS may include, for example, an electronic board based on a microcontroller which, as far as it is of interest here, implements a driving circuit DC_1 of the electric pump P, i.e., of the motor PM thereof, and/or a driving circuit DC_2 of the electric actuator of the device D. In various preferential embodiments, the driving circuit DC_1 is configured for controlling the variation of the speed of the electric pump P, i.e., of the motor PM thereof. In various preferential embodiments, the driving circuit DC_2 is configured for controlling the switching of the device D between at least two different conditions, corresponding to different pressures of the washing liquid fed to a corresponding sprayer 5 and/or 7.

[0021] Of course, the machine 1 also includes additional electrical and/or hydraulic components (such as a heating resistor, one or more solenoid valves, a detergent dispenser, a control panel, etc.) necessary for the operation of a common dishwasher, whose description is however omitted as not of immediate interest for the purpose of understanding the invention. In any event, the abovementioned microcontroller of the control system CS may include or have associated thereto means of memory, in which there are encoded the various operating programs of the machine 1 and the instructions necessary for the performance by the latter of the various functions which it is capable of performing.

[0022] Figures 2-4 show a possible embodiment of one of the two sprayers 5 and 7, particularly the lower sprayer 5.

[0023] The sprayer 5 has a sprayer body that is mounted for rotating around the respective axis of rotation Y, and which comprises a first hollow body part 20a and at least one second hollow body part: in the example, the body of the sprayer 5 comprises two second hollow body parts, designated by 20b and 20c. The two second body parts 20b and 20c are preferably substantially similar to each other, but this is not an essential feature. In the remainder of this description, reference will often be made to both the above-mentioned second body parts 20b and 20c, it being understood that the sprayer may comprise only one second body part 20b or 20c, or that - even in the presence of two body parts 20b and 20c - only one of them is liable to be angularly displaced according to a respective axis of revolution, as described below.

[0024] In the following, for simplicity, the first hollow body part 20a will also be identified as "rotating support", and the second hollow body parts will also be identified as "half-arms".

[0025] Each half-arm 20b and 20c has a respective longitudinally extended body 21, which is provided with a respective supply inlet 21a, preferably substantially cylindrical, and which - at least in one of its faces intended to be generally facing the corresponding basket 8 - has a plurality of openings or nozzles, indicated with 21b in Figure 3, for the emission of the Jets J of the washing liquid.

[0026] Each half-arm 20b and 20c has a proximal end, at which its supply inlet 21a is defined, and a distal end 21c, and develops in length between these two ends. In various preferential embodiments, each half-arm 20b and 20c has at least one curvature or bending or elbow, in a position intermediate to the aforementioned proximal and distal ends. In essence, therefore, as appreciable in Figure 3, in various preferential embodiments the sprayer 5, when seen in plan, has substantially an "S" shape, with two hemi symmetrical portions corresponding to the half-arms 20b and 20c, each of which has a curved zone 21d.

[0027] The rotating support 20a, which extends vertically (and therefore transversely with respect to the half-arms) is intended to be mounted for rotating around the axis of rotation Y, in particular coupled in a rotatable way to the tubular component 4a of the duct 4 of Figure 1. According to a characteristic of the invention, at least one of the half-arms 20b and/or 20c, preferably both of them, is coupled in a rotatable manner to the rotating support 20a, in order to perform angular movements around a respective axis of revolution, indicated with X in Figure 2, where this axis of revolution Y extends in a direction generally transverse with respect to the axis of rotation Y, in particular substantially perpendicular thereto.

[0028] The machine 1 is provided with hydraulic means, which are controllable by the control system CS to determine a variation in the pressure of the washing liquid fed to the rotating support 20a, particularly an increase thereof, such that this pressure variation consequently induces an angular movement of each half-arm 20b and 20c around its axis of revolution X, from a first operating position to at least a second operating position.

[0029] In various preferential embodiments, the above hydraulic means comprise the electric pump P, whose electric motor PM is at adjustable speed, and the control system CS includes a driving circuit Di controllable for causing a controlled variation of the number of revolutions (rpm) of the motor PM with the electric pump P being active, with modalities known in themselves, and therefore a corresponding variation in the number of revolutions of the impeller of the electric pump P (for simplicity, it can be assumed that the impeller of the electric pump P is directly keyed to the shaft of the motor PM, that is, with a 1:1 ratio between impeller and motor, it being understood that between the two elements in question there can be provided a transmission system of a known design, such as a gearmotor).

[0030] In the above preferential embodiments, the aforementioned variation in the number of revolutions,

particularly an increase thereof, is controlled with the electric pump P being active, to cause the variation of the pressure of the washing liquid supplied to the rotating support 20a, in particular an increase thereof, such that this pressure variation consequently induces an angular movement of each half-arm 20b and 20c around the relative axis of revolution X, from a first operating position to at least a second operating position, in which the distal end of the half-arm or 20b and/or 20c is at respective different height positions.

[0031] The basic concept of the invention is exemplified in Figure 8, in relation to embodiments that involve the use of the electric pump P adjustable in speed.

[0032] Part a) of Figure 8 represents the condition that occurs when the motor MP is controlled by the control system, through the circuit DC₁, for rotating at a first lower speed, which here is assumed to be for example about 2750 rpm, which corresponds to a first pressure of the liquid supplied to the sprayer 5. In this condition, the washing liquid supplied to the sprayer 5 determines its rotation around the Y axis, in a way known in itself, with the two half-arms 20b and 20c that are in a first position with respect to the rotating support 20a, arranged substantially according to the same plane WP. Thus, the rotation of the sprayer 5 around the axis Y has the consequence that the jets J covers first areas of the basket 8, and hence first areas of the dishes contained in that basket.

[0033] Part b) of Figure 8 instead represents the condition that occurs when the control system CS, through the circuit DC₁ circuit, controls the MP motor to rotate at a second higher speed, which here is assumed to be for example about 3550 rpm, which corresponds to an increased pressure of the liquid supplied to the sprayer 5. Also in this case the washing liquid supplied to the sprayer 5 determines its rotation around the Y axis, but the aforementioned pressure increase has the direct effect of determining a clockwise angular movement of each half-arm 20b and 20c, which therefore assumes a second position relative to the rotating support 20a, with the corresponding distal end at a lower height than in the case of the part a) of Figure 8: as can be seen, in fact, in this condition, the half-arms 20b and 20c are now arranged inclined with respect to the plane WP (in the example, the half-arms form therebetween an angle between lower than 180°, on the side of the rotating support). In practice, the pressure of the jets J determines a downward thrust of the half-arms 20b, 20c, such as to cause their lowering. In this way, the rotation of the sprayer 5 around the axis Y has the consequence that the jets J now covers second areas of the basket 8, and therefore second areas of the dishes contained in that basket.

[0034] Note that the changes between the conditions referred to in parts a) and b) of Figure 8 can take place in constancy of rotation of sprayer 5, that is, without the need to stop the operation of the electric pump P. Note also that, during the transient between the first and sec-

ond positions, the inclination of the jets J will vary so as to affect areas intermediate to those shown in the two parts of Figure 8. It will also be appreciated that, advantageously, the control system CS can be configured to control, during the same washing or rinsing phase of a given treatment program of the dishwasher 1, multiple passages between the first and second position (i.e., several operating cycles of the motor MP at two speeds), with an improved treatment effect for the dishes.

[0035] The invention is based on the recognition of the fact that current dishwashing machines can be equipped with speed-controllable motors, such as brushless motors, which can be controlled within sufficiently extended operating ranges (indicatively, for the purpose of a possible implementation, the adjustable speed range of the motor PM of the electric pump P can be between 2500 and 3500 rpm). In this way, it is possible to modulate the speed of the electric pump, and consequently set for example an operating point at medium/low rpm, as in part a) of Figure 8, and subsequently control an increase in speed, thus determining an increase in pressure of the supplied liquid. This increase in pressure causes a greater counter-thrust of the jets J, which allows to directly induce the angular movement of the half-arms 20b and 20c relative to the rotating support 20a, as in part b) of Figure 8, and therefore a different inclination of the jets J, without the need for transmission mechanisms or gears for converting the rotation of the sprayer 5, or of the rotating support 20a, about the axis Y into the aforementioned angular movement about the axis X of the half-arms 20b and 20c. By alternating the two conditions, it is possible to expand the sprayed area, improving the washing result and reducing potential dead zones that cannot be reached directly if the half-arms 20b and 20c always rotate according to the plane WP.

[0036] As mentioned, in the example of Figure 8, in the first starting operating position, the half-arms 20b and 20c extend substantially according to the same laying plane WP, but this is not an essential feature. Figure 9 illustrates, for example, the case of a first initial position in which the half-arms 20b and 20c are already arranged raised or inclined with respect to the plane WP, in particular a position opposite to that of part b) of Figure 8 (i.e., in Figure 9, the half-arms form an angle greater than 180° therebetween, from the side of the rotating support). In such a variant implementation, the second operating position of the half-arms 20b and 20c may correspond to that of part a) of Figure 8. It will also be appreciated that there is nothing to prevent, in principle, a configuration of the spraying system such that the first operating position is the one of Figure 9, and the second operating position is the one of part b) of Figure 8. Such a solution implies a slight increase in the operating overall dimensions in height of the sprayer, but allows to further increase the extent of the variation of the inclination of the jets J between the first and second positions, to the advantage of the quality of the washing.

[0037] It is preferable that between the rotating support

20a and each half-arm 20b and 20c there are operatively arranged return means. With reference to the example shown, these return means are configured to urge the half-arms 20b and 20c in their first position, referred to in part a) of Figure 8 or Figure 9, and in such a way that passage of each half-arm 20b and 20c from the first operating position to the second operating position is against the action of the same return means, and on the other hand, the return to the first operating position takes place as a result of the action of the return means. Preferably, the return means comprise elastic means, such as a torsion spring. Of course, the return means are calibrated in such a way that, in the passage to the second operating condition, the increased counter-thrust of the jets J allows to overcome the reaction force of the return means, and therefore the angular movement of the half-arms around the respective axes X.

[0038] In the example depicted, the return means consist of helical torsion springs indicated by 24 in Figures 2-4, preferably made of metallic material (for example stainless steel), which are mounted in a position corresponding to the proximal end of the respective half-arm 20b and 20c. Each spring 24 is arranged so that one end thereof is against the rotating support 20a and the second end thereof is against the corresponding half-arm 20b or 20c, respectively. For this purpose, the rotating support 20a and each half-arm 20b and 20c can define suitable contact surfaces or seats for the respective end of the spring 24. Note that, for the sake of more immediate understanding of the drawings, in the example shown each spring 24 is fitted on the outside of the proximal end area of the half-arms, but in practice the springs 24 can be in a protected position, for example inside a corresponding housing defined at least in part in the rotating support 20a and/or in the corresponding half-arm 20b or 20c.

[0039] Note that the presence of return means is not essential, for example when the sprayer is installed in an upside-down condition compared to the case shown in Figures 8 and 9, for example in the case of a sprayer supported from above, which stands above a basket, such as the top sprayer 7' represented in hatch in Figure 1, which is fed through the extension 6' of the duct 6 and which stands above the basket 9 (for such a case, it can also be assumed the absence of the sprayer 7 and the duct 7a thereof).

[0040] This top sprayer 7' can be of a construction similar to that described so far with reference to sprayer 5, with its rotating support 20a which is, for example, coupled in a rotatable manner to the stationary tubular component 4a' of Figure 1, and supplied by it. In this case, however, the openings or nozzles 21b (Figure 3) for the jets J will be provided on the lower side of the half-arms 20b and 20c. Such a case is exemplified in figure 10.

[0041] Part a) of Figure 10 represents the condition that occurs when the motor MP rotates at a first lower speed, which corresponds to a first pressure of the liquid supplied to the sprayer 7', generated with the electric pump P being active. The two half-arms 20b and 20c are

in a first position with respect to the rotating support 20a, arranged substantially lowered or inclined with respect to the plane WP, to form an angle between them smaller than 180° on the side opposite the rotating support 20a. In this way, the rotation of the sprayer 7' around the axis Y has the consequence that the jets J covers first areas of the basket 9, and hence first areas of the dishes contained in that basket.

[0042] Part b) of Figure 10 represents the condition that occurs when the motor MP rotates at a second higher speed, which corresponds to an increased pressure of the liquid supplied to the sprayer 7', generated with the electric pump P being active. The aforementioned pressure increase has the direct effect of determining an anticlockwise angular movement of each half-arm 20b and 20c, which then assumes a second position relative to the rotating support 20a; in the example, the half-arms 20b and 20c are now arranged substantially according to the plane WP. In this case, therefore, the pressure of the jets J determines an upward thrust of the half-arms 20b, 20c, such as to cause their rise. In this way, the rotation of the sprayer 7' around the axis Y has the consequence that the jets J now covers second areas of the basket 9, and therefore second areas of the dishes contained in that basket.

[0043] Part c) of Figure 10 can be understood as equivalent to that of Figure 9, or intended as a possible alternative to the second operating position of Part b) of Figure 10. Moreover, also in this case, there is nothing to prevent provision of all three operating positions of Figure 10, that is, with parts a) and c) representing the two limit positions, and part b) representing an intermediate position. The maintenance of the operating position of part b) of Figure 10 can be achieved by driving the electric pump P at an intermediate speed compared to those used for the positions referred to in parts a) and c). As can be seen, also in the case of Figure 10, the distal ends of the half-arms 20b and 20c are in respective different height positions, in the different conditions.

[0044] Of course, also in this case it is valid what has already been indicated, in relation to the fact that the control system CS can be configured to control, during the same washing or rinsing phase, several passages between the two or three operating positions, with an improved treatment effect of the dishes contained in the basket 9.

[0045] It will be appreciated that the concepts presented in relation to Figures 8 and 9 are applicable in relation to the sprayer 7 and basket 9 of Figure 1.

[0046] As mentioned, each half-arm 20b and/or 20c has a supply inlet 21a, with the rotating support 20a therefore having a corresponding substantially cylindrical supply outlet, indicated with 23a in Figures 2-4. Preferably, the rotating support 20a and a respective half-arm 20b or 20c are coupled in a rotating way according to the axis of revolution X, at said inlet 21a and outlet 23a. The coupling is such that the half-arm 20b or 20c can perform an angular movement with respect to the rotating support

20a which is approximately less than 10°, preferably between 1 and 5°.

[0047] The two operating positions of each half-arm 20b or 20c can be determined by mechanical stop means of the angular movement about the axis of revolution X, which are preferably operating between the half-arm itself and the rotating support 20a. Mechanical stops can be defined by stop or end-of-stroke stroke surfaces of the two body parts; for this purpose, for example, the support 20A can define a first abutment surface with which a corresponding first abutment surface of the respective half-arm cooperates, to identify the first operating position, and a second abutment surface with which a corresponding second abutment surface of the half-arm cooperates, to identify the second operating position.

[0048] By the way, for example in the hypothesized case of a first position corresponding to that of Figure 9 and a second position corresponding to that of part b) of Figure 8, it is also possible to assume at least one intermediate operating position, for example corresponding to that of part a) of Figure 8, which is reached and maintained due to the sole speed control of the motor MP, and therefore of the pressure of the washing liquid supplied to the sprayer with the electric pump P in operation (i.e., at a speed intermediate to those that determine the first and second positions).

[0049] It will be appreciated that the concepts presented in relation to the sprayer 5 of Figures 8 and 9 are equally applicable to the sprayer 7 of Figure 1. Such a case is exemplified in Figure 11, wherein parts a), b) show conditions corresponding to those of the corresponding parts in Figure 8, and part c) shows a condition corresponding to that of Figure 9.

[0050] Figures 5 and 6 schematically show a possible realization of a rotating support 20a, here obtained by the sealed union of two plastic components 22 and 23, for example welded together, in order to give the support itself an overall substantially T-shaped.

[0051] In the example, the lower tubular component 22 defines an inlet 22a for the washing liquid, and preferably has at least one portion generally tapered, in order to exploit the venturi effect. This component 22 can define, in its upper part, couplings 22b for the rotatable engagement with the corresponding stationary support, here represented by the tubular component 4a of Figure 1. The second component 23 is, as mentioned, fixed in a sealed way (for example welded) on top of component 22, with its inlet mouth coupled to an upper outlet of the component 22. The body of the component 22 then defines the two outlets 23a, preferably opposed to each other.

[0052] Figure 7 shows the body 21 of a half-arm 20b and/or 20c, which can itself be defined by two half-shells 21', 212, for example made of plastic, joined together in a sealed manner, for example welded, with the body 21 that extends in length between the proximal end, defining the supply inlet 21a, and the distal end 21c. In variant embodiments, such as those shown in Figure 10, the half-arm, or the semi-shells thereof, may be made of me-

tallic material.

[0053] As indicated above, the hydraulic means controllable in order to determine the pressure variation necessary to cause the angular movement of the 2b and/or 20c half-arms about the axis of revolution X may be different from an adjustable speed electric pump. In possible variant embodiments, such hydraulic means may include a valve device for controlling the supply of a sprayer, such as a device of the type designated by D in Figure 1.

[0054] An example of such a device D is shown schematically in Figure 12. In the example, the device D has a casing 30 provided with an inlet 31, intended for connection with the outlet P_{OUT} of the pump P of Figure 1, and at least two outlets 32 and 33, connected respectively to the inlet of the supply duct 4 of the sprayer 5 and to the inlet of the supply duct 6 of the sprayer 6. Inside the casing 30 a shutter or distributor member 34 is mounted movable, operated by a corresponding electric actuator (not visible), to assume at least a first position, for example of opening of the two outlets 32 and 33, and at least a second position, for example of opening of the outlet 32 and of closing of the outlet 33, and/or vice versa. As mentioned, the aforementioned distributor member 34 can, for example, have the shape of a disc or circular sector, with at least one passage or hole, and be mounted movable in front of the outlets 32 and 33. Structures of this type are in any case well known in the field (see for example WO 2020/125995 A).

[0055] The device D is switchable, under the control of the control system CS, between at least a first condition and a second condition, which corresponds to different pressures of the washing liquid fed to a corresponding sprayer.

[0056] The different flow rates and pressures desired in the supply branches of the sprayers can be obtained in the design phase, by means of an appropriate sizing of the hydraulic circuit (areas of passage in the ducts, curves, possible restrictions, number and diameter of the spraying nozzles, characteristics of the filtering system, passages of device D, etc.), with modalities that are clear to the person skilled in the art.

[0057] In this way, under the two conditions the different pressures of the washing liquid supplied to the supply duct 4 or 6 (or 6+6a) of a corresponding sprayer 5 or 7 (or 7') can be obtained, and consequently induce the angular movement of the half-arms 20b, 20c around the axis X, similarly to what has been explained above, and without the need for transmission mechanisms or gears to convert the rotation of the sprayer 5, or of the rotating support 20a, about the axis Y into the aforementioned angular movement around the axis X of half-arms 20b and 20c.

[0058] In this perspective, for example, the control system SC can be prearranged to control the device D via the corresponding driving circuit DC_2 so that, in the first condition, with the pump P being active, both sprayers 5 and 7 (and/or 7') are supplied, with the hydraulic circuit

WC which is therefore low-resistant, and with the sprayer 5 (or 7') which is in the first operating position of parts a) of Figure 8 or 10; the control system SC can then control, through the driving circuit DC_2 , the device D so that, in the second condition, the hydraulic circuit WC is closed only on the sprayer 5 (or 7'), with the circuit itself becoming high-resistant and determines the necessary increase in pressure that directly causes the passage of the sprayer to the second operating position of parts b) of Figure 8 or 9, with the electric pump P being active. Also in this case the control system SC can be programmed to pass cyclically between the two indicated conditions, with the *duty cycle* deemed most appropriate.

[0059] It goes without saying that there is nothing to prevent the combination of both proposed pressure variation solutions - i.e., the speed control of the electric pump P and the switching of the device D - in order to optimise the operation of the hydraulic system.

[0060] Figure 13 schematically illustrates the effect that can be obtained in the case of implementation of the invention using an electric pump P with adjustable speed (part a) of the figure) and a valve device of the type indicated by D (part b) of the figure). In this figure, the abscissa axis represents the flow rate Q and the ordinate axis represents the head H.

[0061] In the case of part a) of Figure 13 the two curves CV_1 and CV_2 represent the operating curves of the electric pump P at two different speeds ($CV_1 > CV_2$), while the curve CC is the characteristic curve of the hydraulic circuit WC. The intersections A' and B' of the curves CV_1 and CV_2 with respect to the curve CC represent the two operating points. As can be seen, the variation of the operating point from A' to B' results in an increase of the head H, or in an increase in pressure in the circuit, which allows to obtain the desired angular movement of the half-arms 20b, 20c of a sprayer.

[0062] In the case of part b) of Figure 13 the curve CV represents the operating curve of an electric pump at constant speed (not adjustable), while the curves CC_1 and CC_2 are the characteristic curves of the hydraulic circuit WC in the case of the first and the second switching conditions of device D previously exemplified (DC_1 = supply of the two sprayers and DC_2 = supply of a single sprayer). The intersections A" and B" of the curve CV with respect to the curves CC_1 and CC_2 represent the two operating points, with the electric pump P being active. As can be seen, also in this case, the variation of the operating point from A" to B" results in an increase in the head H, or in an increase in pressure in the circuit, which allows to obtain the desired angular movement of the half-arms 20b, 20c of a sprayer.

[0063] From the given description, the characteristics of the present invention are clear, as well as are its advantages. The dishwasher according to the invention comprises a spraying member that, even if having an overall shape substantially similar to that of traditional single-arm sprayers, allows for increasing the area covered by the jets of the washing liquid, despite having lim-

ited height and a simple structure, and without the need for complex mechanisms or transmission gears to convert the rotation of the spraying member into an angular movement of a corresponding half-arm.

[0064] It is clear that numerous variations are possible for the person skilled in the art to the dishwashing machine described as an example, without leaving the scope of the invention as defined by the claims that follow.

[0065] It should be noted, for example, the possibility of providing spraying openings to generate additional jets, which open and close selectively according to the angular position of a half-arm with respect to the rotating support, or in the passage between the at least two operating positions. Such openings can be provided, for example, in the coupling zone between the support and the half-arm (for example, an outlet 23a of the support 20a may have a hole in its circumferential wall, which aligns with a corresponding hole in the circumferential wall of the inlet 21a of the corresponding half-arm 20b or 20c only when the half-arm itself reaches the second operating position). Such a measure can for example be useful to cause a sort of decreasing regulation of the pressure of the jets J.

[0066] In the embodiments exemplified, the shape of the body 21 of the half-arms 20b, 20c with an intermediate curve 21d has the advantage of allowing the rotation of the sprayer without having significant losses of washing liquid. This shape determines in fact a deviation (in the example of almost 90°) of the entire water flow in the half-arm itself, in a plane almost coinciding with the plane of rotation: this causes a change in the momentum of the washing liquid that gives rise to a balancing force on the sprayer, which causes its rotation in the opposite direction with respect to the curvature (in other words, the thrust to the rotation of the sprayer is determined by the fact that the washing liquid flowing into the sprayer is forced to change direction at the intermediate curves). This is advantageous because it allows to obtain the rotation of the sprayer 5 without necessarily having to provide special thrust holes, which would instead penalize the used flow rate, reducing it.

[0067] However, in possible less advantageous variant embodiments, the half-arms 20b and 20b could also be straight or substantially straight and, if necessary, equipped with at least one thrust nozzle.

[0068] The use of a brushless motor for the electric pump P, although particularly advantageous, is not an essential feature, as the purposes of the invention can be obtained with other types of electric pumps equipped with motors controllable in speed, for example as described in IT 1273149 B or IT 232353 U.

Claims

1. A dishwashing machine (1) having

- a control system (CS),

- a washing chamber (3) in which at least one crockery basket is housed (8, 9),
- a hydraulic circuit (WC) for a washing liquid, which comprises:

at least one rotary spraying member (5, 7), having a spraying member body (21) which is rotatable about a respective axis of rotation (Y), and which comprises a first hollow body part (20c) and at least one second hollow body part (20b, 20c), the at least one second hollow body part (20b, 20c) having, at least in a face thereof generally facing the at least one crockery basket (8, 9), a plurality of openings or nozzles (21b) for emission of jets (J) of the washing liquid, an electric pump (P) having at least one outlet (P_{OUT}) connected in fluid communication with at least one supply duct (4, 6) for the supply of the washing liquid to the first hollow body part (20a) of the spraying member body (21),

wherein the first hollow body part (20a) is mounted for rotating about around the axis of rotation (Y), and the at least one second hollow body part (20b, 20c) is coupled in a rotatable manner to the first hollow body part (20a), to be susceptible to rotate about a respective axis of revolution (X) which is generally transverse to the axis of rotation (Y), in particular substantially perpendicular thereto,

and wherein the dishwashing machine (1) has hydraulic means (P, D) controllable by the control system (SC) for supplying the washing liquid to the first hollow body part (20c) at a first lower pressure and at a second higher pressure, to induce an angular movement of the at least one second hollow body part (20b, 20c) about the axis of revolution (X), from a first operating position to at least one second operating position.

2. The dishwashing machine according to Claim 1, wherein:

- the controllable hydraulic means (P, D) comprise said electric pump (P), which is an adjustable speed electric pump (P), and
- the control system (CS) comprises a driving circuit (DC₁) which is controllable for causing a change in the number of revolutions of the electric pump (PM), and thereby determine said variation in the pressure of the washing liquid supplied to the first hollow body part (20c).

3. The dishwashing machine according to Claim 1 or 2, wherein:

- the controllable hydraulic means (P, D) comprise a valve device (D), in particular upstream of the at least one supply duct (4, 6), the valve device (D) being switchable between at least a first condition and a second condition, to which different pressures of the washing liquid supplied to the first hollow body part (20c) correspond, and
 - the control system (CS) comprises a driving circuit (DC₂) controllable for causing switching of the valve device (D) between the first and the second conditions, and thereby determine said variation in the pressure of the washing liquid supplied to the first hollow body part (20c).
4. The dishwashing machine according to any of Claims 1-3, wherein between the first hollow body part (20a) and the at least one second hollow body part (20b, 20c) return means (24) are operatively provided, configured for urging the at least one second hollow body part (20b, 20c) in the first operating position, in such a way that:
- a passage of the at least one second hollow body part (20b, 20c) from the first operating position to the at least one second operating position occurs against the action of the return means (24), and
 - a return of at the least one second hollow body part (20b, 20c) from the at least one second operating position to the first operating position occurs as a result of the action of the return (24).
5. The dishwashing machine according to Claim 4, wherein the return means (24) comprise elastic means, such as a torsion spring.
6. The dishwashing machine according to any of Claims 1-5, wherein the at least one second hollow body part (20b, 20c) develops in length, with an intermediate curve or bend (21c), between a proximal end (21a) and a distal end (21d) thereof.
7. The dishwashing machine according to any of Claims 1-6, wherein the first hollow body part (20a) has at least one supply outlet (23a), and the at least one second hollow body part (20b, 20c) has a supply inlet (21a), the supply outlet (23a) and the supply inlet (21) being rotatably coupled according to the axis of revolution (X), with the at least one second hollow body part (20b, 20c) that is suitable for performing one said angular movement with respect to the first hollow body part (20a), during the rotation of the latter about the axis of rotation (Y), which is less than 10°, preferably comprised between 1° and 5°.
8. The dishwashing machine according to any of
- Claims 1-7, comprising mechanical stop means operating between the first hollow body part (20a) and the at least one second hollow body part (20b, 20c), the mechanical stop means being configured for identifying at least one of the first operating position and the at least one second operating position.
9. The dishwashing machine according to any of Claims 1-8, wherein the spraying member body (21) comprises the first hollow body part (20a) and two said second hollow body parts (20b, 20c) substantially similar to each other, each second hollow body part (20b, 20c) being coupled in a rotatable manner to the first hollow body part (20a) for rotating about a respective one said axis of revolution (X).
10. The dishwashing machine according to Claims 7 and 9, wherein
- the first hollow body part (20a) has two said supply outlet (23a) generally opposite to each other, and
 - each second hollow body part (20b, 20c) has the supply inlet (21a) thereof coupled in a rotatable manner, according to the axis of revolution (Y), to a respective supply outlet (23) of the first hollow body part (20a).
11. The dishwashing machine according to any of Claims 1-10, wherein the electric motor (PM) of the electric pump (P) is a brushless motor.
12. The dishwashing machine according to any of Claims 1-11, wherein the control system (CS) is configured for controlling, during one and the same washing or rinsing step of a given treatment program, several passages of the at least one second hollow body part (20b, 20c) between the first operating position and the at least one second operating position.

Fig. 1

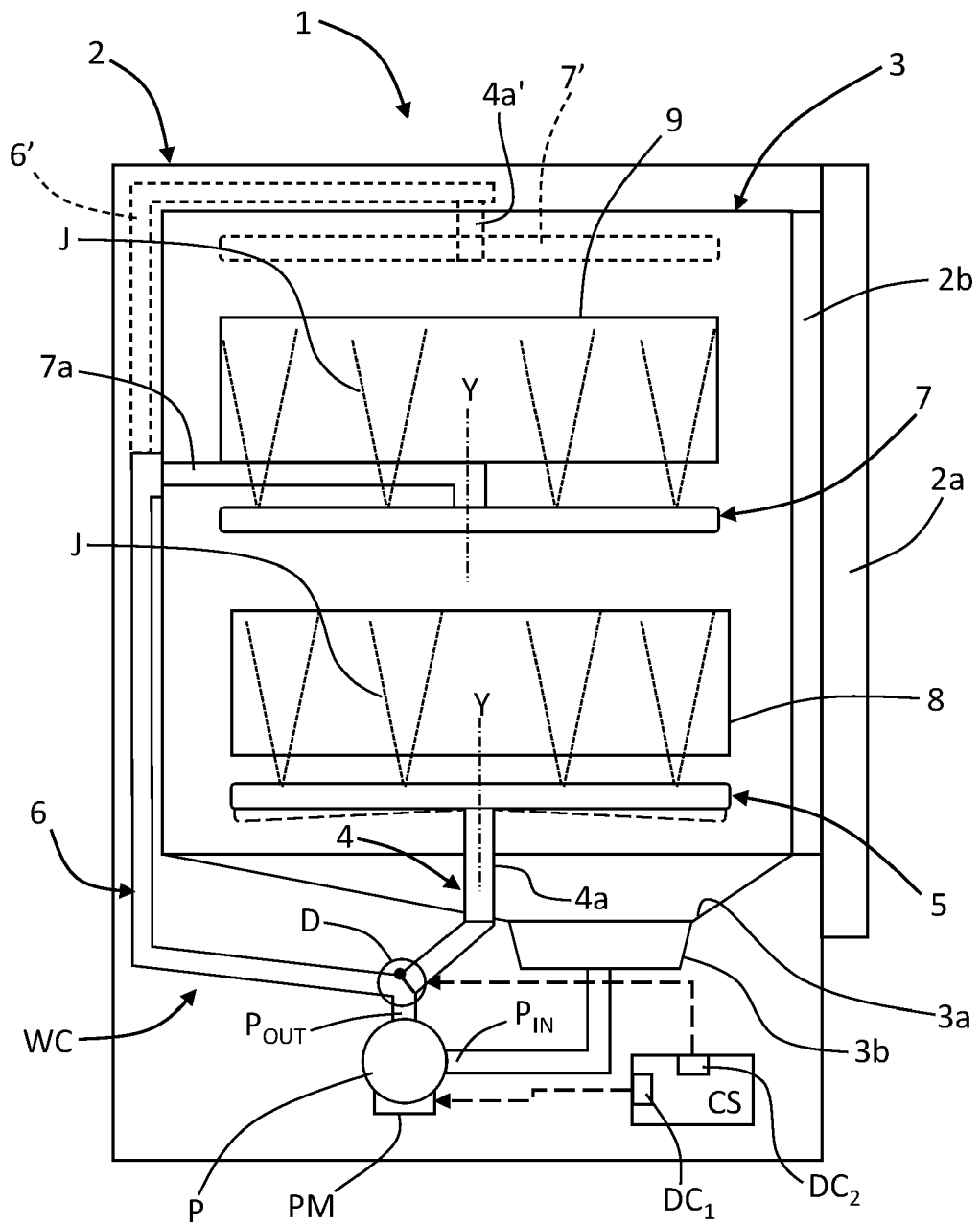


Fig. 2

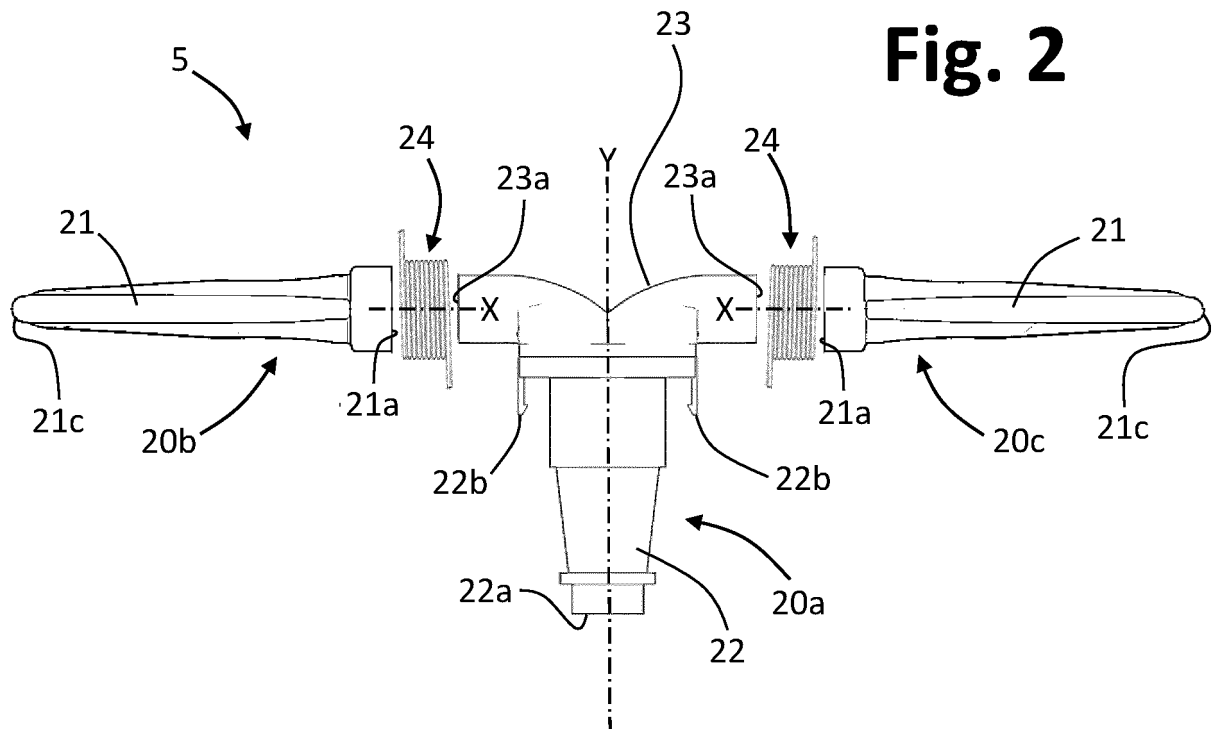
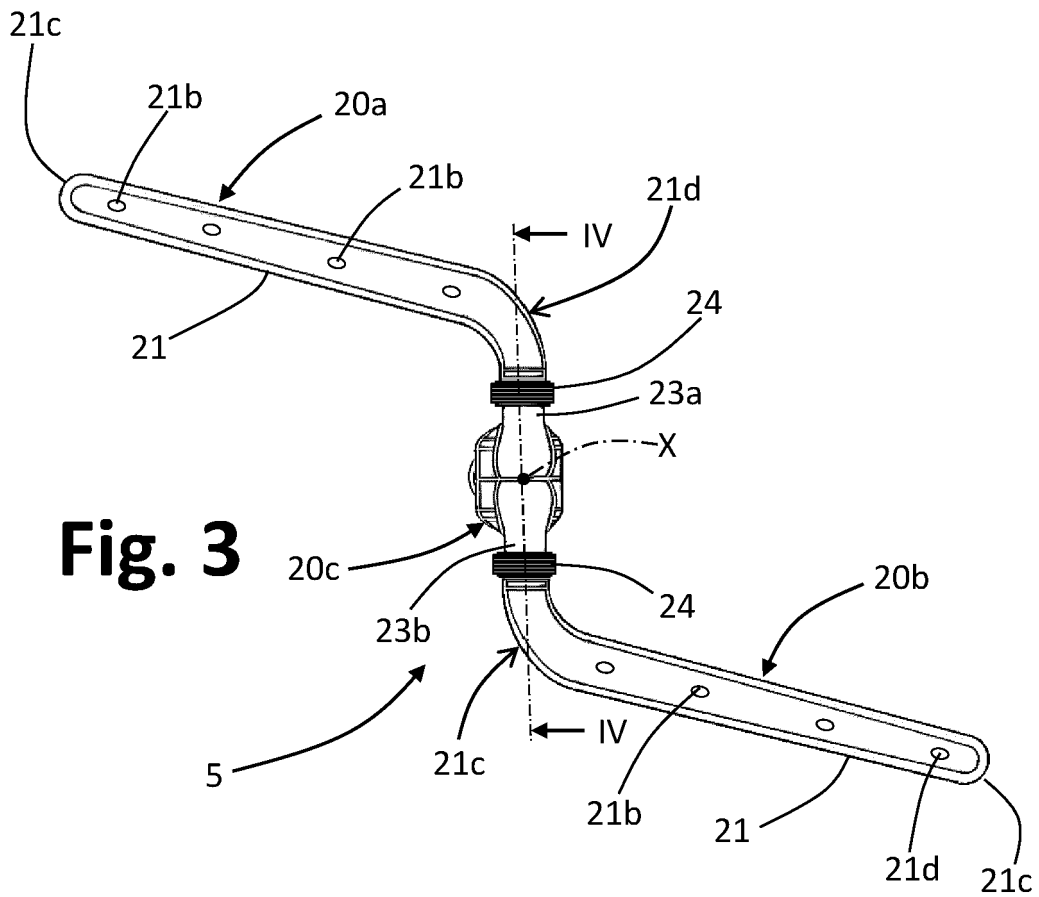


Fig. 3



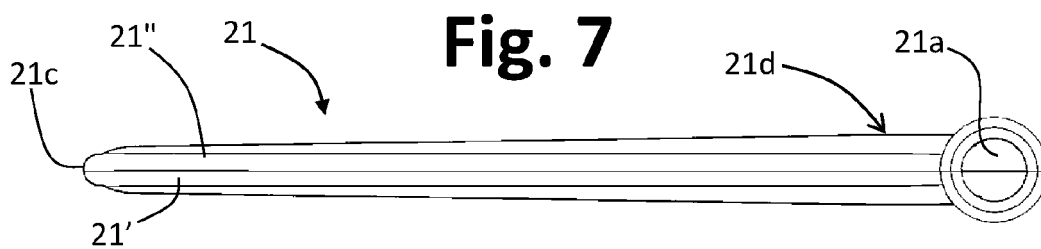
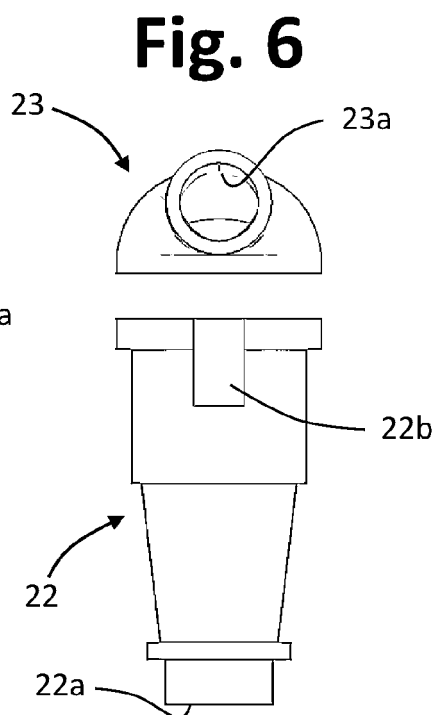
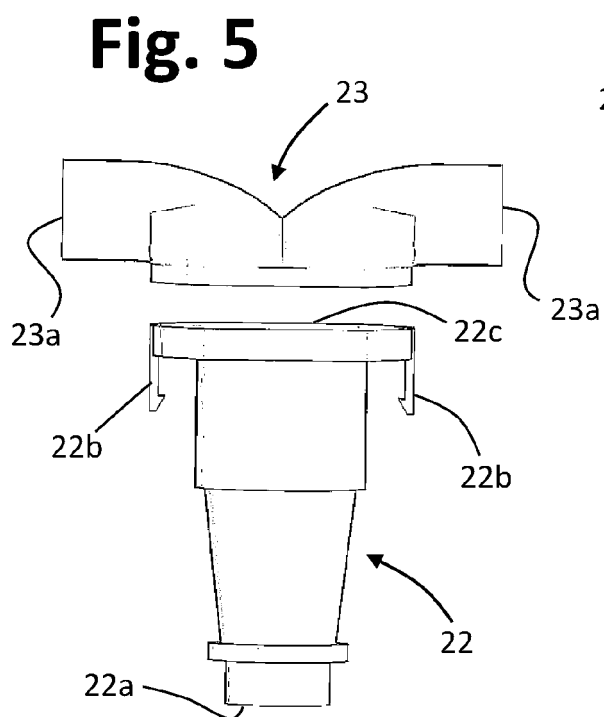
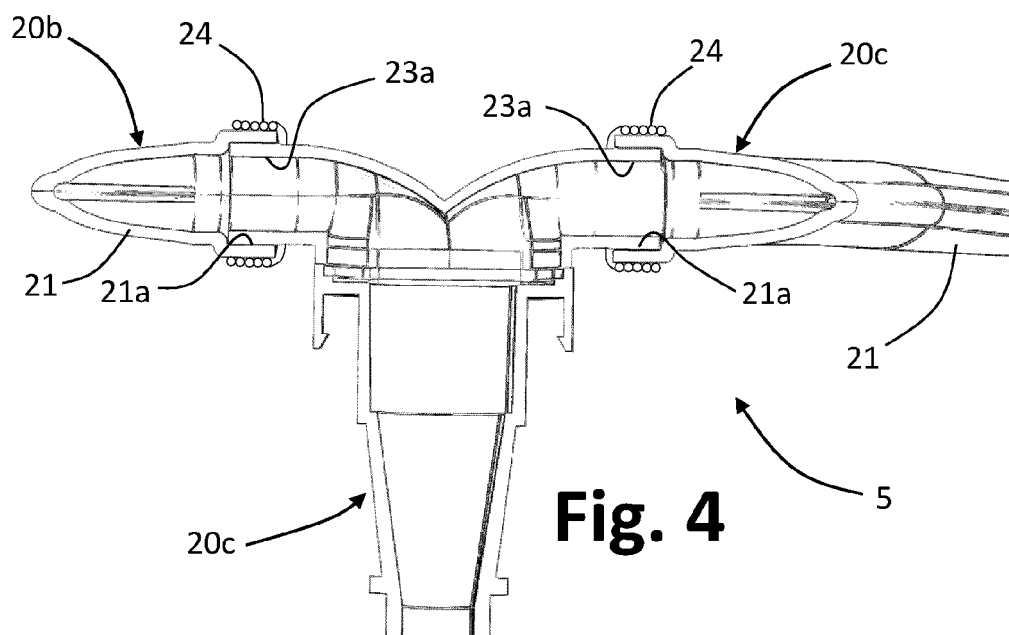


Fig. 8

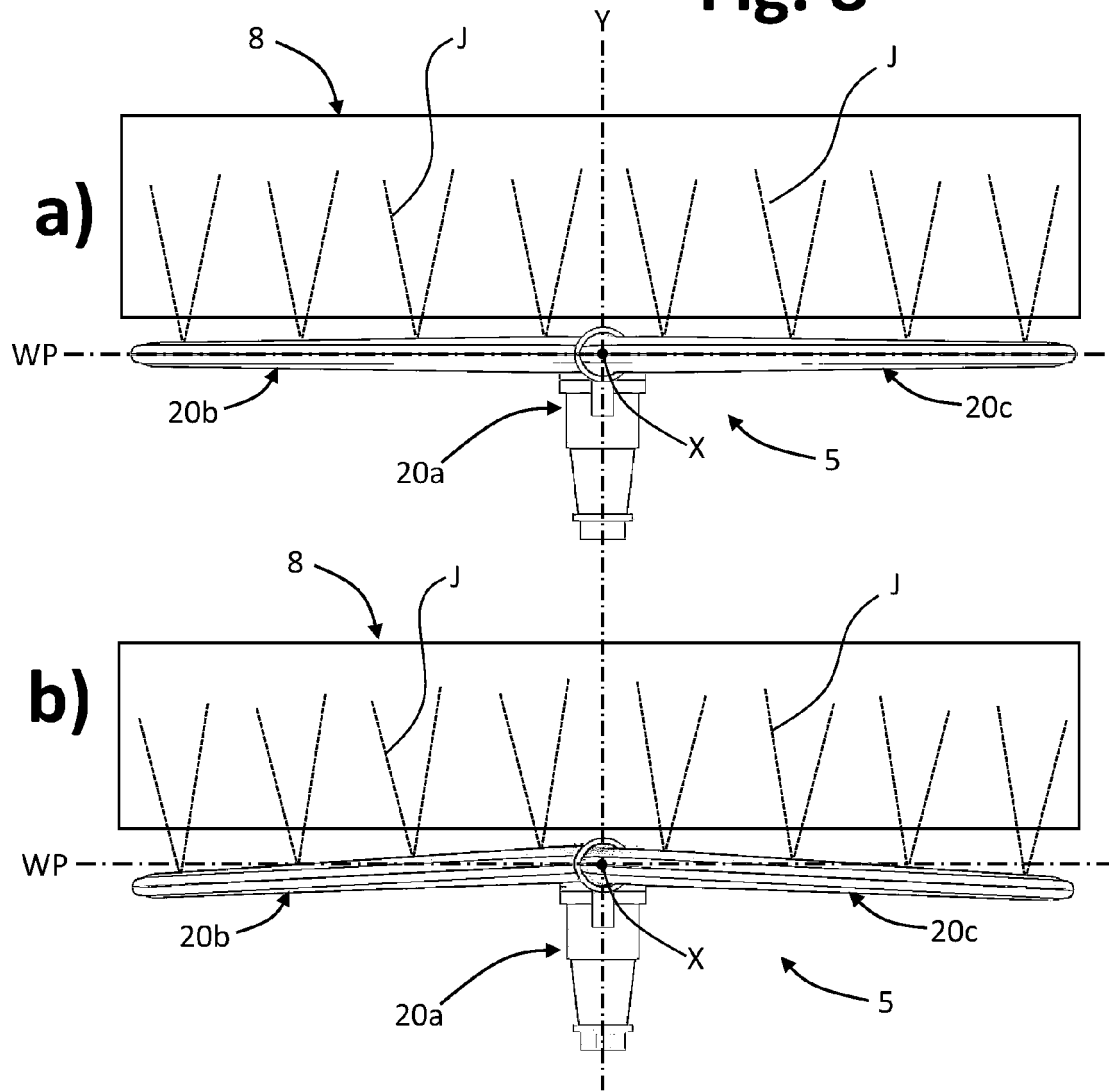


Fig. 9

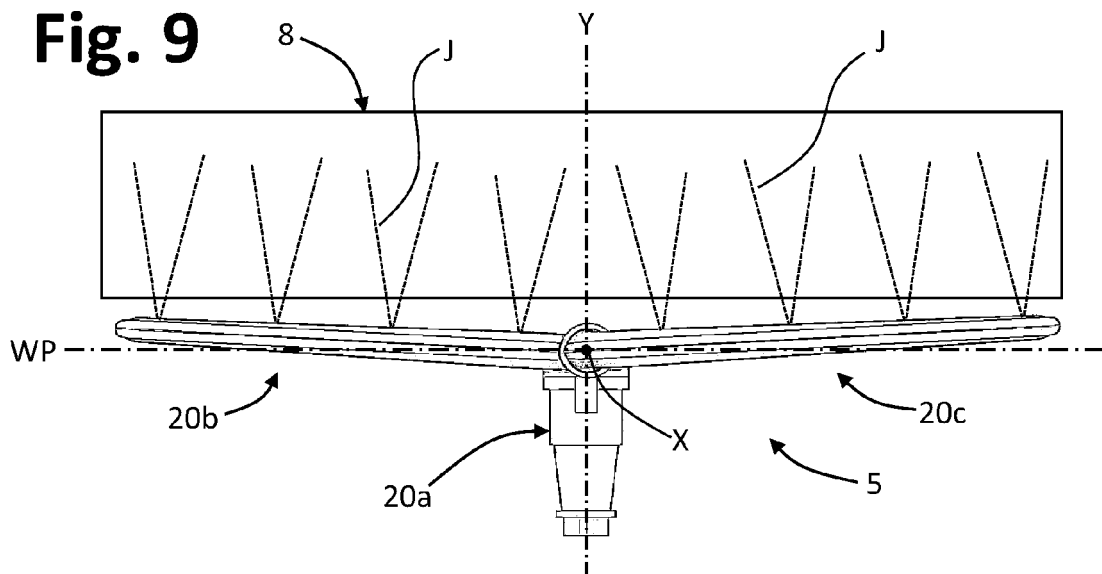


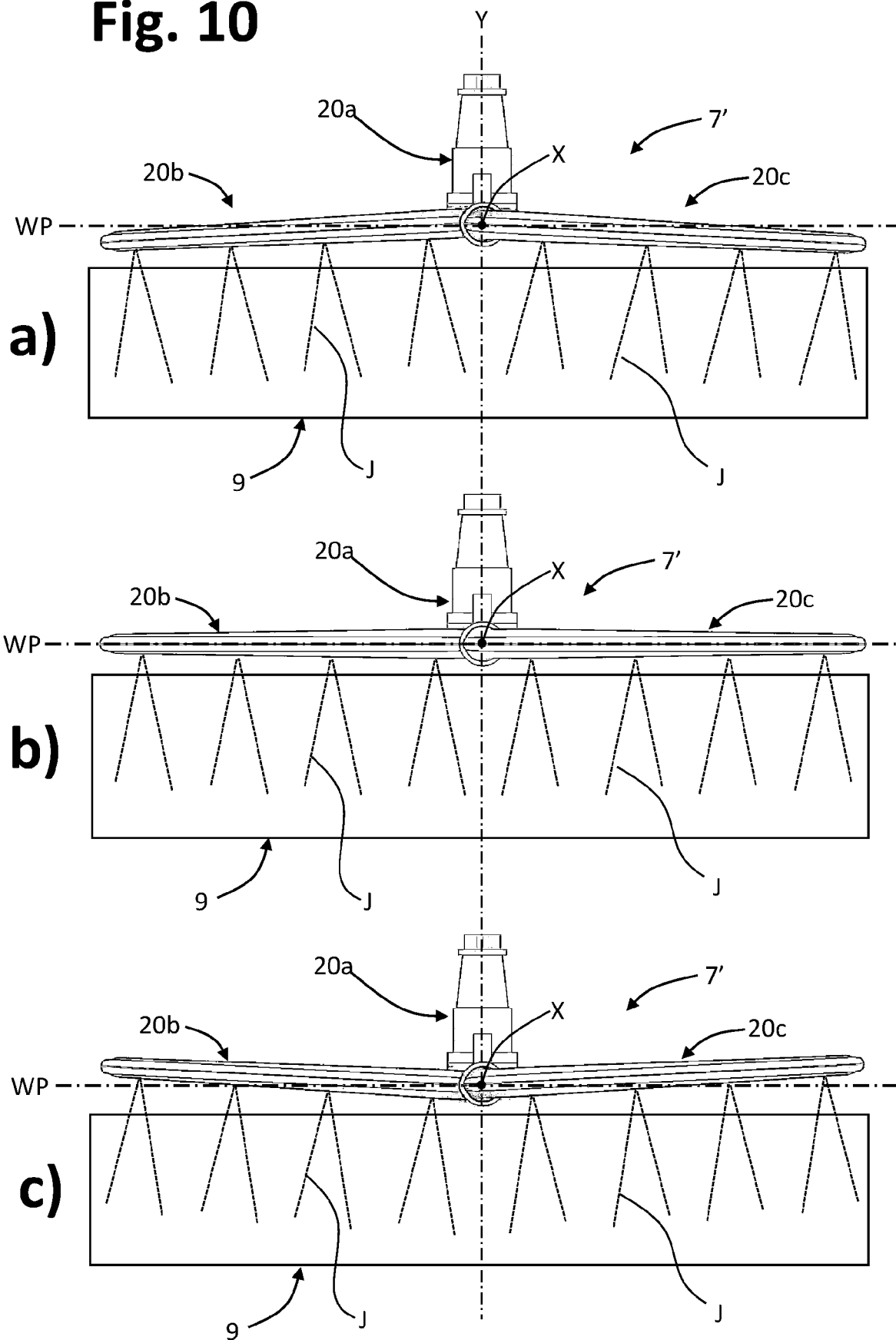
Fig. 10

Fig. 11

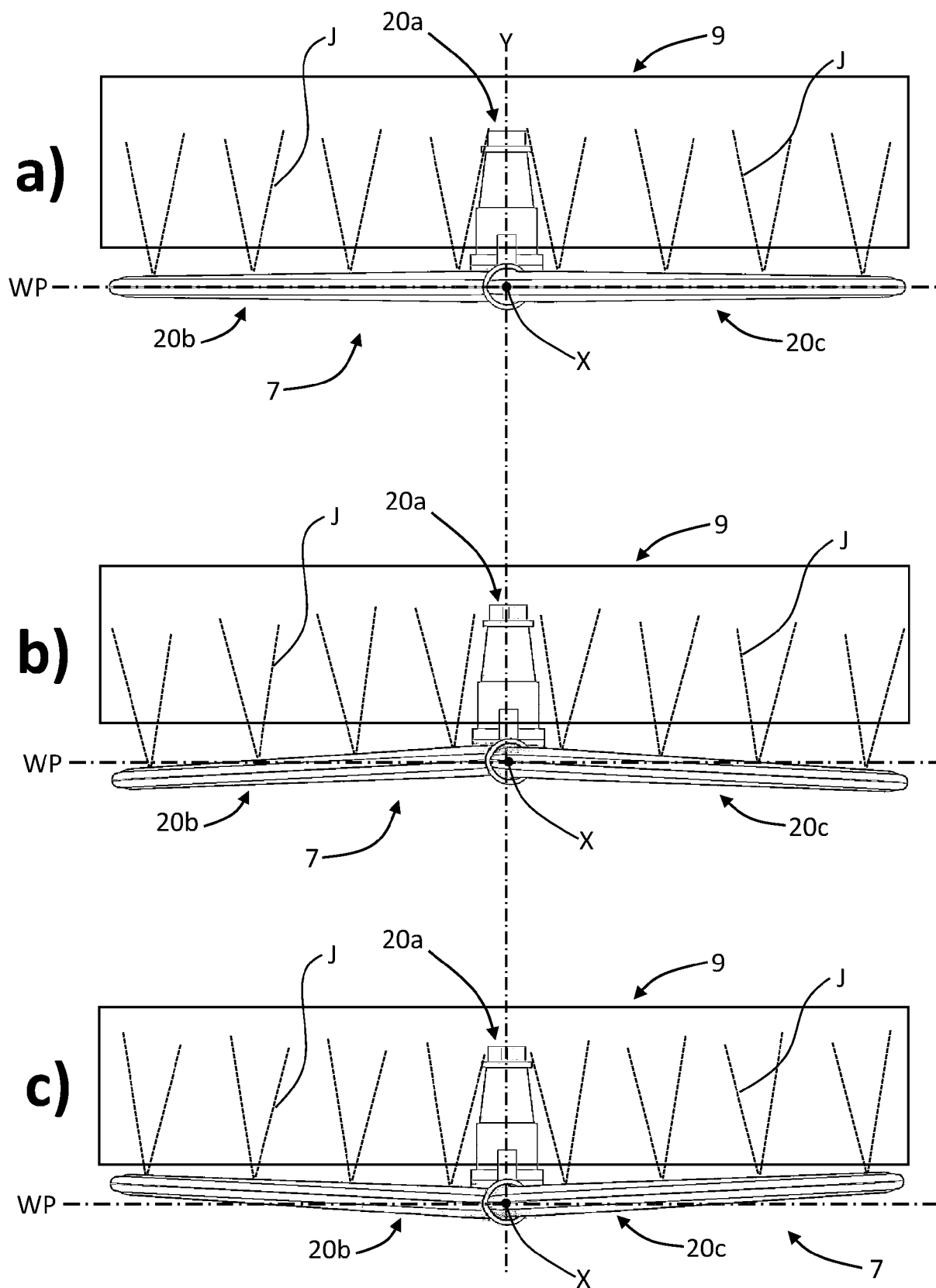
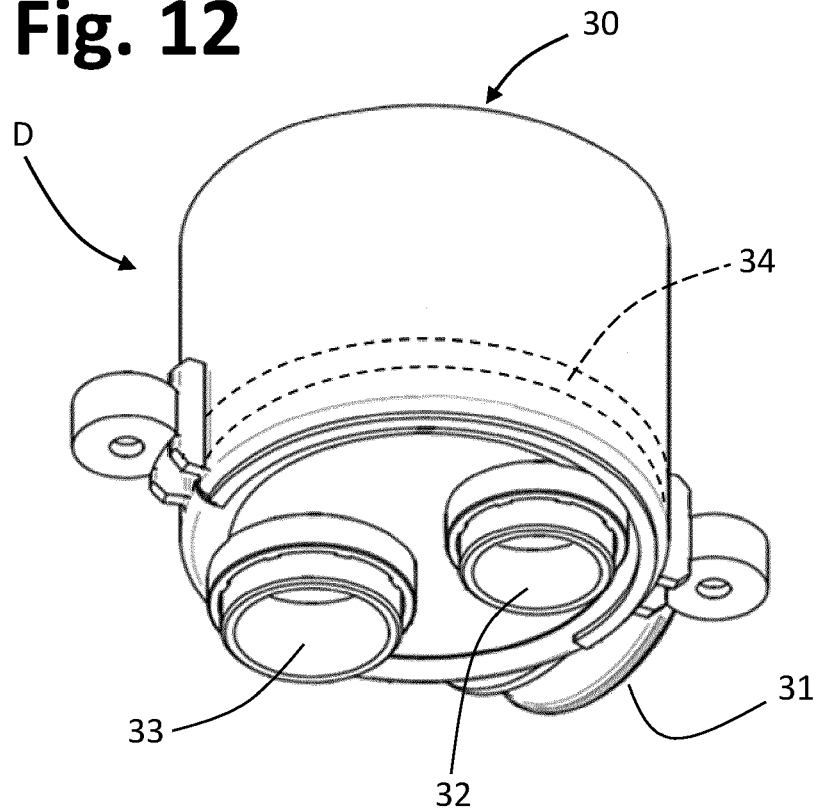
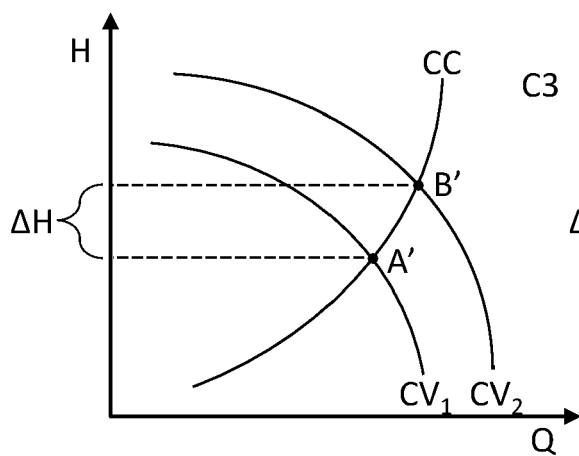
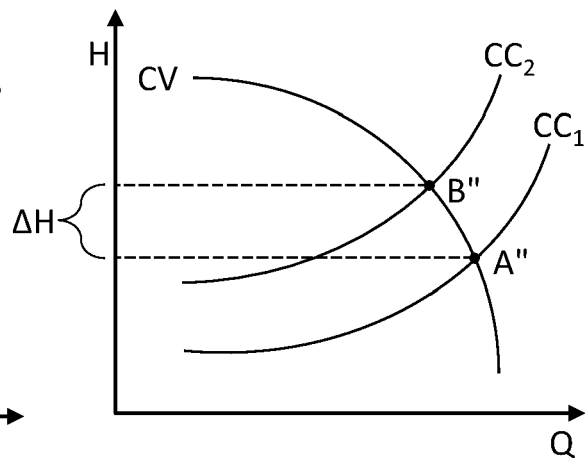


Fig. 12**Fig. 13****a)****b)**



EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 6 April 2023	Examiner Weinberg, Ekkehard
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