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(54) **Method and plant for water jet surface treatment of stony material elements**

(57) A method for surface working of items made of stone materials or the like, using abrasive-free liquid jets, comprises the steps of (a) providing a moving or stationary support base (2) for the items (P), (b) providing a plurality of nozzles (4, 4', 4'', ...) for generating jets (J) oriented toward the items (P), (c) feeding the nozzles (4, 4', 4'', ...) with a high-pressure liquid adapted to create cuts on the items (P) being worked, (d) forwardly moving

the items (P) relative to the nozzles (4, 4', 4'', ...) in a longitudinal direction (X), (e) staggering the relative positions of the nozzles (4, 4', 4'', ...) in a transverse direction (Y) with a predetermined pitch (p), for continuous adjustment of the projection of their pitch (p) on a vertical plane (π) substantially parallel to the transverse direction (Y), to change the transverse distance (d) between the longitudinal cuts made by the jets (J). A plant for liquid-jet surface working of items made of stone materials.

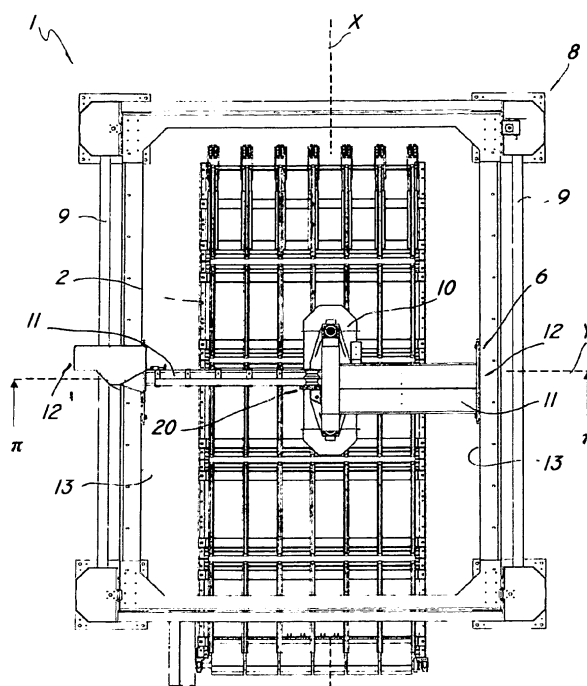


FIG. 1

Description

Field of the invention

[0001] The present invention generally finds application in the field of stone working and particularly relates to a method for surface working of items made of marble, granite, cementitious agglomerates and other stone materials using water jets.

Background art

[0002] Methods are known for surface working of semi-finished products made of stone materials or the like, such as slabs, blocks and the like, using one or more high-pressure and high-speed liquid jets directed toward the surface of the products.

[0003] The high-pressure and high-speed jets operate by mechanical material surface removal, to provide technical and/or aesthetic effects, such as abrasion, scratching, roughening, scraping, marking or surface alterations according to particular designs and shapes.

[0004] Particularly, it is known to use plants having a multi-jet head located above the surface of the product to be worked, which is moved in a plane substantially parallel to the surface of the product being worked.

[0005] In order to obtain the mechanical material removal effect, the liquid of the jets is generally mixed with suitable abrasives, preferably in powder form, which are propelled at high speed against the surface to be worked.

[0006] Thus, the removal action is mainly caused by the abrasive material that is mixed with the working liquid, which allows water feeding pressures to remain at relatively low levels, also due to the additional abrasive action of the mechanical parts of the pumps.

[0007] Furthermore, the use of abrasive materials involves a variety of problems, mainly associated with the management of the abrasive material, that has to be stored and recovered after use.

[0008] Also, during processing the particles of abrasive material should be prevented from dispersing in the environment, as this might constitute a serious hazard for the operators that control the apparatus.

[0009] Not the least, the abrasive material has a deteriorating effect on the parts of the plant contacted thereby, particularly with the mixture feeding line, and with the jet emitting nozzles.

[0010] Therefore, these prior art apparatus require frequent maintenance, involving downtimes and throughput losses, as well as replacement of the parts under stress.

[0011] In order to obviate these drawbacks plants have been proposed for surface working of products made of stone material that only use water jets, with no abrasive material therein.

[0012] US 5,291,694 discloses an apparatus for surface working of slabs of stone materials, comprising one or more multi-jet guns, each designed to emit a plurality of high-pressure water jets to be directed to the surface

to be worked. The jet emitting pressure, ranging from 200 bar to 800 bar is inadequate to obtain a surface working effect with satisfactory precision and definition. Indeed, this prior art apparatus is mainly used for finishing of pre-processed surfaces.

[0013] A further drawback is that a single rotational and translational motion is imparted to the nozzles, which causes repetitive and schematic reproduction of the working patterns, thereby affecting the aesthetic value of the final product.

[0014] European Patent EP1045742 discloses a further machine for fluid-jet surface working of stone products using only water. In this machine, one or more water jets are emitted toward the surface to be worked at an emission pressure ranging from 300 bar to 1500 bar. Nevertheless, this solution also proved to be inadequate, as these water jet pressures affect jet effectiveness and do not provide the desired surface effects.

[0015] Furthermore, also in this case, nozzles are displaced relative to the surface to be worked with repetitive movements that create identical patterns typical of industrial processing, with no random variation that would be characteristic of handmade products.

[0016] Not the least, the use of relatively low pressures requires operation at high flow rates, with nozzles having relatively large outlet diameters. As a result, the cuts that may be obtained rather coarse and do not afford the formation of fine designs.

Disclosure of the invention

[0017] The main object of this invention is to obviate the above drawbacks, by providing a method for water jet surface working of products made of stone or the like that is highly efficient and relatively cost-effective.

[0018] A particular object is to provide a method for surface working of products made of stone materials that provides particularly distinct surface effects, reproducing the effects of manual processing, only using water jets with no abrasive material therein.

[0019] Yet another object is to provide a method for surface working of products made of stone materials, that can create any decorative pattern, possibly of figurative type, or even texts, barcodes, QR codes, or the like, without particular limitation, and with a single jet tool driving cycle.

[0020] A further object is to provide a method for surface working of products made of stone materials, that affords high operational flexibility, with the possibility of changing the surface texture even while the head is moving.

[0021] Another important object of the present invention is to provide a plant for surface working of products made of stone materials that can provide multiple processing operations of high aesthetic value.

[0022] These and other objects, as better explained hereafter, are fulfilled by a method for surface working of semi-finished products, such as slabs made of a stone

material or the like, using liquid jets, which comprises the steps of providing a moving or stationary support base for the products to be worked, providing a plurality of nozzles for generating jets oriented toward such products for creating cuts on the product being worked, forwardly moving the products relative to the nozzles in a longitudinal direction.

[0023] The method is **characterized in that** the nozzles are disposed in mutually offset positions in a transverse direction with a predetermined pitch, and in that the projection of such pitch is continuously adjusted, during operation, on a vertical plane substantially parallel to the transverse direction,, to change the transverse distance between the longitudinal cuts made by the jets.

[0024] This particular combination of characteristics will allow the relative positions of cuts to be changed to create a multiplicity of processing effects and obtain decorative patterns that mimic manual operations, possibly figurative patterns.

[0025] Conveniently, the feeding pressure will be above 1500 bar to obtain an evident surface cutting effect.

[0026] Advantageously, the nozzles may have an outlet with a maximum diameter ranging from 0.20 mm to 0.40 mm, preferably of about 0.30 mm.

[0027] Also, a step may be provided for selective adjustment of the impact pressure of jets on such items being worked.

[0028] With this additional combination of characteristics, water jets of high strength and high concentration may be directed to the surface, to act like a tool bit, to form particularly sharp cuts.

[0029] Furthermore, the possibility of adjusting the impact pressure of the individual jets allows the cutting action to be limited or locally omitted to create decorative patterns, texts, codes and the like, at a high definition.

[0030] In a further aspect, the invention relates to a plant for abrasive-free liquid-jet surface working of objects made of stone materials, as defined in claim 6.

[0031] Advantageous embodiments of the invention are defined in accordance with the dependent claims.

Brief description of the drawings

[0032] Further features and advantages of the invention will be more apparent from the detailed description of a preferred, non-exclusive embodiment of a plant according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is a top view of the plant of the invention;
FIG. 2 is a perspective view of the block that is part of the plant and comprises the multi-jet head;
FIG. 3 is a front view of the block of Fig. 2;
FIG. 4 is a broken-away front view of the block of Fig. 2;
FIGS. 5 to 7 are bottom views of the block of Fig. 2

in three different operating conditions;

FIG. 8 is a perspective view of a nozzle head that is part of the plant of the invention, according to a first preferred configuration;

FIGS. 9 to 12 are views of a detail of the head of Fig. 8;

FIG. 13 is a sectional front view of the detail of Fig. 9;

FIG. 14 is a top view of the head of Fig. 8 in a particular operating mode;

FIGS. 15 and 16 are front views of the head of Fig. 8 in a second preferred configuration and in two distinct operating conditions;

FIG. 17 is a side view of the head of Fig. 8 in a third operating configuration;

FIG. 18 is a side view of the head of Fig. 8 in a fourth operating configuration.

Detailed description of a few preferred embodiments

[0033] Referring to the above mentioned figures, a liquid jet plant of the invention, generally designated by numeral 1, may be used for working items made of a hard material such as stone, marble, granite or stone materials in general, cementitious materials, conglomerates or the like, for surface working thereof.

[0034] The working process may be aimed at creating deformations on the surface S of an item P, possibly caused by material removal, thereby forming a predetermined pattern or texture, or an image, even a complex image. The item P may be in the form of a slab, a block or have a not necessarily regular three-dimensional shape.

[0035] As shown in Fig. 1, the plant 1 comprises a moving or stationary support base 2 for the items P to be worked and a head 3 facing the support base 2 and having a plurality of nozzles 4, 4', 4'', ... for generating jets J oriented toward the surface S of the product P to be worked.

[0036] In the illustrated configuration, the support base 2 is stationary and has a substantially horizontal orientation, such that the surface S to be worked may face upwards, the head 3 being movable above the base 2. Nevertheless, the plant 1 can also process inclined surfaces S, or surfaces lying on a support base that is inclined to the horizontal, possibly even vertical.

[0037] The plant 1 also comprises feed means 5 for feeding the nozzles 4, 4', 4'',... with a high-pressure liquid, preferably water with no abrasive material therein, adapted to generate high-pressure jets J to make cuts on the items P being worked.

[0038] While reference will be made herein, for simplicity, to a single nozzle, designated with numeral 4, unless otherwise stated all the parts related to such nozzle 4 shall apply in a substantially identical and operatively equivalent manner to the other nozzles 4', 4'',....

[0039] The head 3 is also associated with first drive means 6 for forward movement thereof in a longitudinal direction X relative to the support base 2, and hence rel-

ative to the items P thereon.

[0040] These first drive means 6 may be designed to longitudinally transfer the head 3 in the longitudinal direction X, like in the illustrated configuration, and/or may be associated with the support base 2, e.g. via a roller bed or a conveyor belt, for longitudinally transferring the item P.

[0041] As more clearly shown in Figs. 2 and 12, according to a peculiar feature of the invention, the nozzles 4 are mutually offset in a transverse direction Y with a predetermined pitch p.

[0042] Furthermore, the plant comprises adjustment means 7 associated with the nozzles 4 for continuous adjustment of the projection of their pitch p on a vertical plane π substantially parallel to the transverse direction Y during operation, to change the transverse distance d between the longitudinal cuts made by the jets J.

[0043] Particularly, Figs. 2 to 5 show three different operating conditions, in which the nozzles 4 are aligned in a direction W coplanar with the transverse direction Y but inclined thereto at three different angles α, β, γ , to change their projection relative to the vertical plane π .

[0044] Namely, in this configuration there will be a maximum distance d between cuts when the direction of alignment W of the nozzles 4 is parallel to the transverse direction Y and a minimum distance when it is orthogonal thereto, i.e. longitudinal. In this case, cuts will substantially overlap.

[0045] According to a further particularly advantageous aspect of the invention, the feed means 5 will be adapted to feed the working liquid at a minimum pressure above 1500 bar, with maximum values that may be continuously regulated without limitation, according to the material to be worked and to the thickness of the item P, particularly when the latter is a slab.

[0046] These feeding pressure values will provide the required definition of the cuts without the use of abrasive materials, thereby eliminating all the drawbacks associated with this operating condition.

[0047] In a particularly preferred embodiment, as shown in Fig. 1, the plant 1 comprises a stationary load bearing structure 8 that surrounds the support base 2 and has a pair of substantially longitudinal lateral shoulders 9.

[0048] The head 3 is supported by a substantially horizontal frame 10, as more clearly shown in Figs. 2 to 7, which is in turn mounted to a substantially transversely oriented beam 11, having opposite ends 12 that slide on respective longitudinal guides 13 associated with corresponding shoulders 9.

[0049] The figures also show that the frame 10 supports two additional multi-jet heads 14, 15, disposed at the sides of the first head 3, which heads may be configured as taught in Patent Applications EP1977867 and EP2105275 by the applicant hereof, and have nozzles, generally designated 16 and 17, disposed on respective rotating plates 18 and 19, and connected to the feed means 5 of the first head 3, which allows them to be fed

at the above mentioned feeding pressures.

[0050] The two lateral heads 14, 15 are supported by the frame 10, to be integral with the central head 2, such that they can follow its translational motion.

[0051] In this configuration, the first drive means 6 may be associated with the ends 12 of the beam 11 and may be of the carriage-driven type, allowing the longitudinal sliding motion of the beam 11.

[0052] The latter may also have second drive means 20, also possibly of the carriage-driven type, for imparting a longitudinal sliding motion to the frame 10 and hence to the nozzle heads 2, 14 and 15, thereby allowing the working process to be also carried out on surfaces S larger than the maximum transverse dimension of the head 2.

[0053] The plant 2 may further comprise electronic control means, not shown, which are adapted to interpolate the movements imparted by the first drive means 6 and the second drive means 20 and by the adjustment means 7, as well as any other movement as described hereinbelow, to obtain complex motions of the head 2.

[0054] The central head 2 comprises an elongate body 21 mainly extending in the direction L, with the nozzles 4 being mounted thereto in mutually offset positions and with jets J oriented toward the products being worked.

[0055] As more clearly shown in Figs. 8 to 12, the elongate body 21 is fixed to a support shaft 22, that is pivotally mounted to the horizontal frame 10 to rotate about an axis of rotation R that is substantially perpendicular to the elongate body 21.

[0056] As more clearly shown in Fig. 13, the feed means 5 may comprise a feed line 23 which is disposed at the periphery of the shaft 22, and is connected to a distribution channel 24 formed in the head 3 and connected to the nozzles 4.

[0057] The adjustment means 7 may act on the rotating shaft 22 to promote its rotation about the axis of rotation R, which will change the projection of the pitch p and the relative distance d between cuts. Furthermore, they may be designed to also allow the shaft 22 to rotate by 360°, as schematically shown in Fig. 14.

[0058] The rotation of the shaft 22 during processing may be either continuous or discrete, such that corrugated, helical or other complex cuts may be formed without stopping the plant 1.

[0059] Nevertheless, the angular orientation of the head 2 with respect to the transverse direction Y may be also obtained in a non-dynamic manner, i.e. by inclining the elongate body 2 relative to the transverse direction Y at an angle that is kept constant during processing.

[0060] In an alternative configuration, as shown in Figs. 15 and 16, the nozzles 4 are mounted to the head 3 via respective sections 25 that are movable relative to the elongate body 21 along its main extension axis L.

[0061] The adjustment means 7 comprise third drive means 26 which act on the sections 25 to change their mutual distance along the extension axis L, thereby adjusting the projection of the nozzles 4 on the vertical trans-

verse plane π and hence the transverse distance d between cuts.

[0062] The third drive means 26 in turn comprise interface means 27 for selectively actuating each section 25 relative to the others and changing the relative distance between at least one pair of nozzles 4. The interface means 27 may be of mechanical type, i.e. a rack, or of electromechanical or electronic type or the like, without limitation.

[0063] Furthermore, in both configurations of Fig. 8 and Fig. 14, the adjustment means 7 may comprise fourth drive means 28 for imparting an inclination χ to the axis of rotation R relative to the vertical, to change the distance of the nozzles from the support base 2. The fourth drive means 28 may be associated directly with the head or with the rotating shaft 22 or the frame 10.

[0064] In a particularly advantageous configuration, the nozzles 4 of the central head 3 may have an outlet 29 with a maximum diameter ϕ preferably ranging from 0,15mm to 0,60 mm and more preferably from 0,20 mm to 0,40 mm, e.g. of about 0,30 mm, to obtain jets J of small sizes. The outlets 29 may be of any shape, e.g. of circular, elliptical, square, rectangular, polygonal or the like shape, without limitation, to obtain cuts of various shapes.

[0065] Furthermore, pressure regulator means 30 may be provided, for selective adjustment of the impact pressure of jets J on the items P being worked. The pressure regulator means 30 are conveniently associated with electronic control means, not shown, for selective interaction of the pressure regulator means 30 with the nozzles 4, such that the intensity of the individual jets J may be adjusted independently of one another.

[0066] This additional feature, as well as the relatively small size of the out flowing jets J will allow not only abstract decorative patterns, but also figurative patterns, text, barcodes, QR codes and the like, to be formed on the surface S being worked.

[0067] In a first embodiment, as shown in Fig. 17, the pressure regulator means 30 comprise deflector members 31 located downstream from each nozzle 4 to intercept the jet J and change the impact force on the surface S to be worked.

[0068] The deflector members 31 may be of mechanical or electromechanical type and comprise a plate 32, which is designed to move between an inoperative position, external to the relevant jet J and an operative position in which the plate 32 at least partially faces the outlet 29 of the corresponding nozzle 4, to at least partially intercept its jet J and reduce or substantially eliminate its impact pressure.

[0069] In an alternative configuration, not shown, the deflector members may be of the compressed-air type, with respective nozzles arranged at the water jet nozzles 4, to blow a high-speed air flow to the jets J for deflecting them, such that they will not impact the surface S or will impact it at a reduced pressure that will not cause scratching thereof.

[0070] In yet another alternative configuration, also not shown, the pressure regulator means 30 may be associated with the feed means 5 and comprise a plurality of electronically controlled valves operatively connected to each nozzle 4 for selective adjustment of their feeding pressure.

[0071] Furthermore, the feed means 5 may be adapted to impart an electric charge of predetermined polarity to the water to be fed to the nozzles 4, and the pressure regulator means 30 may be in turn adapted to generate an electric or electromagnetic field at the nozzles 4, for deflecting the electrically charged jet J .

[0072] For example, the feed means 5 may be designed to charge the water to be fed to the nozzles 4 with a polarizing substance, such as an appropriately charged salt, which is adapted to interact with the downstream generated field to create a repulsive electric or electromagnetic force.

[0073] Advantageously, the feed means 5 may be designed to draw the abrasive-free water of the emitted jets J and recirculate it for reuse and convey it, possibly after filtration, to the nozzles 4, thereby defining a closed loop.

[0074] In yet another aspect of the invention, the pressure regulator means 30 may comprise fifth drive means, not shown, for selectively rotating the elongate body 21 about its main extension axis L and/or one or more of the nozzles 4, as schematically shown in Fig. 18, thereby allowing the jets J to be inclined to the vertical.

[0075] This configuration is particularly advantageous, as the jets J may be inclined to operate in the same direction as the longitudinal transfer direction X of the head 3, or in a direction opposite thereto, thereby further increasing the operativity of the plant 1.

[0076] All the above mentioned drive means may include mechanical, electromechanical, hydraulic, oil-hydraulic, pneumatic, manual or automated actuators or the like, possibly controllable in an independent manner, and with procedures that are typical for this type of plants, and known to those skilled in the art, that will not have to be described herein in further detail.

[0077] The invention also provides a method for liquid-jet surface working of items P made of a stone material or the like, that can be carried out, without limitation, using the above mentioned plant 1.

[0078] The method basically comprises a step a) of providing a moving or stationary support base for the items to be worked, a step b) of providing a plurality of nozzles for generating jets oriented toward the items to be worked, a step c) of feeding the nozzles with a high-pressure liquid adapted to create cuts on the items being worked, a step d) of forwardly moving the items relative to the head in the longitudinal direction, a step e) in which the relative positions of the nozzles are staggered in a transverse direction with a predetermined pitch, and the projection of their pitch is continuously adjusted on a vertical plane substantially parallel to a transverse direction, to change the transverse distance between the longitudinal cuts made by the jets.

[0079] Conveniently, the step c) of feeding the jets comprises feeding only water, without using abrasives, at a feeding pressure above 1500 bar.

[0080] The method may also comprise one or more additional steps of controlled displacement of the jets in one or more directions of translation and/or rotation, and a step of selective regulation of the impact pressure of jets, for carrying out all the operations as described above for the plant.

[0081] Particularly, the step e) of adjusting the pitch p of the nozzles 4 may comprise a step f) of joined rotation of the nozzles 4 about an axis of rotation R substantially orthogonal to the support base 2.

[0082] Alternatively, the pitch p may be adjusted by mutually transferring the nozzles 4 parallel to the transverse direction Y , possibly but not necessarily combining the above mentioned joined rotation about the axis R .

[0083] Furthermore, a step g) may be provided of selectively regulating the impact pressure of the jets J on the items P being worked, said step being carried out by deflecting the individual jets J such that they do not impact the surface S being worked or impact it with not enough energy to deform the material and/or by selectively stopping water feeding to the individual nozzles 4.

[0084] Furthermore, a step h) may be provided of inclining the jets J relative to the vertical to selectively change their distance from the support base 2.

[0085] Not the least, a step i) may be provided for recovering the feeding water of the emitted jets to recirculate and reuse it for feeding the nozzles 4, possibly after filtration, thereby creating a closed loop.

[0086] Thus, the use of simple water as a working fluid will not only ensure environmental friendliness of the method, but also provide the additional cost-saving advantage.

[0087] The above disclosure clearly shows that the plant and method of the invention fulfill the intended objects and particularly meet the requirement of allowing the formation of a multiplicity of well-defined decorative patterns on the surface of the item, which patterns may be of either abstract or figurative type, or possibly consist of text, barcodes, QR codes or the like.

[0088] The plant and method of the invention are susceptible to a number of changes or variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

[0089] While the plant and method have been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

Claims

1. Method for surface working of semi-finished products made of stone or the like base material using abrasive-free liquids jets, comprising the following steps:

- a) providing a moving or stationary support base (2) for the products (P) to be worked;
- b) providing a plurality of nozzles (4, 4', 4'',...) for generating jets (J) oriented toward the products (P) being worked;
- c) feeding said nozzles (4, 4', 4'',...) with a high pressure liquid adapted to create cuts on the products (P) being worked;
- d) moving the products (P) relative to said nozzles (4, 4', 4'',...) in a longitudinal direction (X); **characterized in that** said nozzles (4, 4', 4'',...) are arranged in mutually offset positions (e) in a transverse direction (Y) with a predetermined pitch (p) and **in that** the projection of their pitch (p) is continuously adjusted on a vertical plane (π) substantially parallel to said transverse direction (Y) during operation to change the transverse distance (d) between the longitudinal cuts of said jets (J).

2. Method as claimed in claim 1, wherein said pressure is higher than 1500bar.

3. Method as claimed 1 or 2, wherein said step (e) of adjusting the pitch (p) comprises a step (f) of rotating said nozzles about a rotation axis (R) substantially orthogonal to said support base (2).

4. Method as claimed in claim 1, wherein step (g) is provided for selectively adjusting the impact pressure of the jets (J) on the products (P) being worked.

5. Method as claimed in claim 1, wherein a step (h) is provided for inclining said jets (J) with respect to the vertical direction for selectively changing the distance thereof from said support base (2).

6. A plant for surface working products made of stony or the like base material with jets of abrasive-free liquids, comprising:

- a movable or stationary support base (2) for an product (P) to be worked;
- a head (3) facing said support plane (2) and provided with a plurality of nozzles (4, 4', 4'',...) for generating jets (J) oriented toward the surface of the product (P) being worked;
- feed means (5) for feeding said nozzles (4, 4', 4'',...) with a high pressure liquid adapted to generate cuts on the product (P) being worked;
- first drive means (6) for moving of the product

(P) relative to said head (3) in a longitudinal direction (X);

characterized in that said nozzles (4, 4', 4'',...) are mutually offset in a transverse direction (Y) with a predetermined pitch (p), adjustment means (7) being associated with said nozzles (4, 4', 4'',...) to continuously adjust the projection of their pitch (p) in a vertical plane (π) substantially parallel to said transverse direction (Y) during operation, in such a manner to change the transverse distance (d) between the longitudinal cuts of said jets (J).

7. Plant as claimed in claim 6, wherein regulation means (30) are provided to selectively adjust the impact pressure of the jets (J) on the products (P) being worked, said regulation means (30) comprising flow deflector members (31) placed downstream of each nozzles (4, 4', 4'',...) to partially intercept the jet (J) and change the impact force acting on the surface (S) being worked, said flow deflector members (31) being selected between the group comprising mechanical deflectors, compressed air deflectors or the like.
8. Plant as claimed in claim 7, wherein said regulation means (30) are associated with said feed means (5) and comprise a plurality of solenoid valve operatively connected with each of said nozzles (4, 4', 4'',...) to selectively adjust the feeding pressure thereof.
9. Plant as claimed in claim 7, wherein said feed means (5) are adapted to impact an electric charge of a predetermined polarity to the water to be fed to said nozzles (4, 4', 4'',...), said regulation means (30) being adapted to generate in said nozzles (4, 4', 4'',...) an electric field adapted to deflect the electrically charged jets (J).
10. Plant as claimed in claim 7, wherein said head (3) comprises an elongate body (21) on which said nozzles (4, 4', 4'',...) are mounted in mutually offset positions and with jets (J) oriented toward the products (P) being worked, said regulation means (30) comprising drive means for selectively rotating said elongate body (21) about its longitudinal extending axis (L) and/or one or more of said nozzles (4, 4', 4'',...) in such a manner to promote the inclination of the jets (J) with respect to the vertical direction.

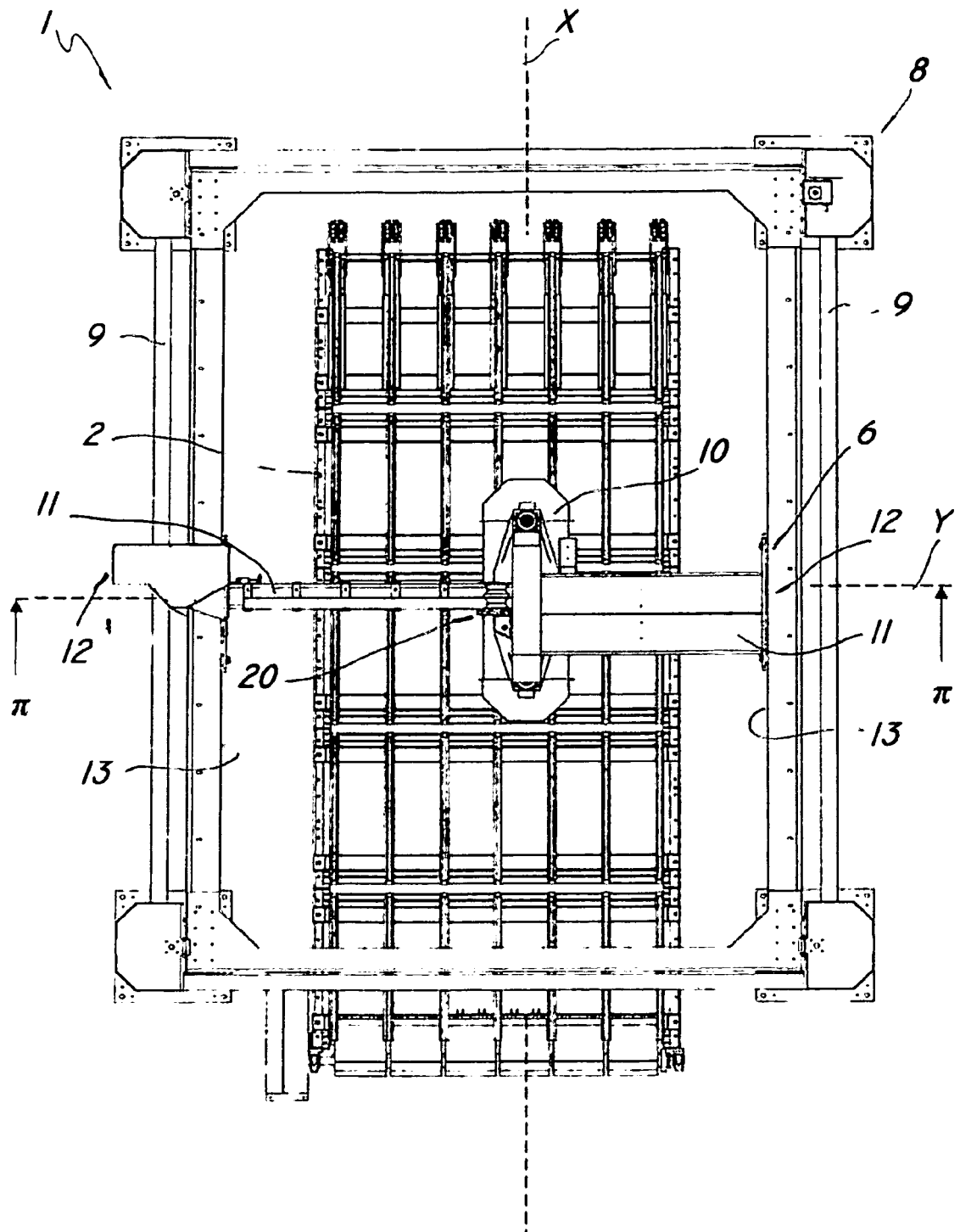


FIG. 1

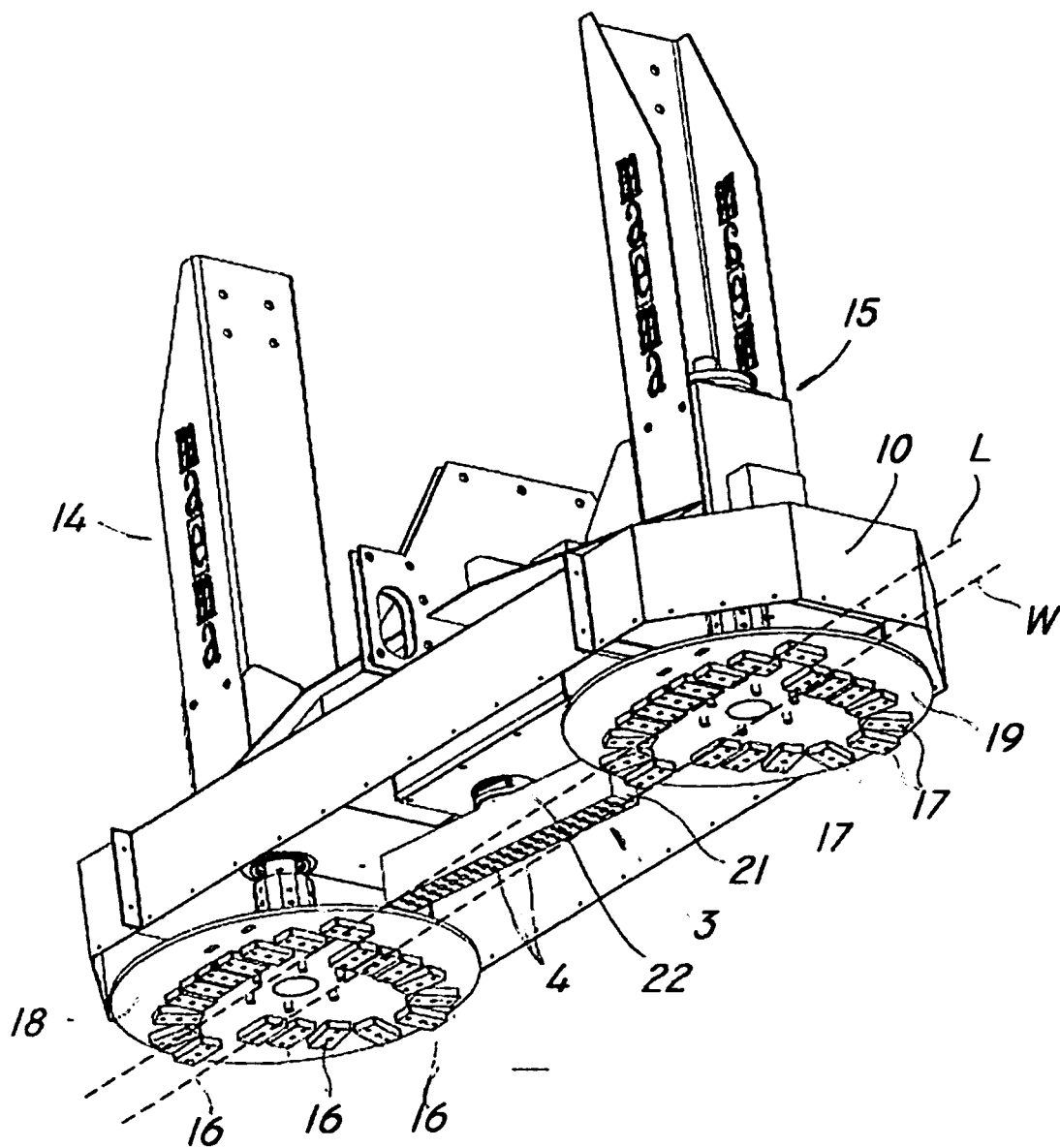


FIG. 2

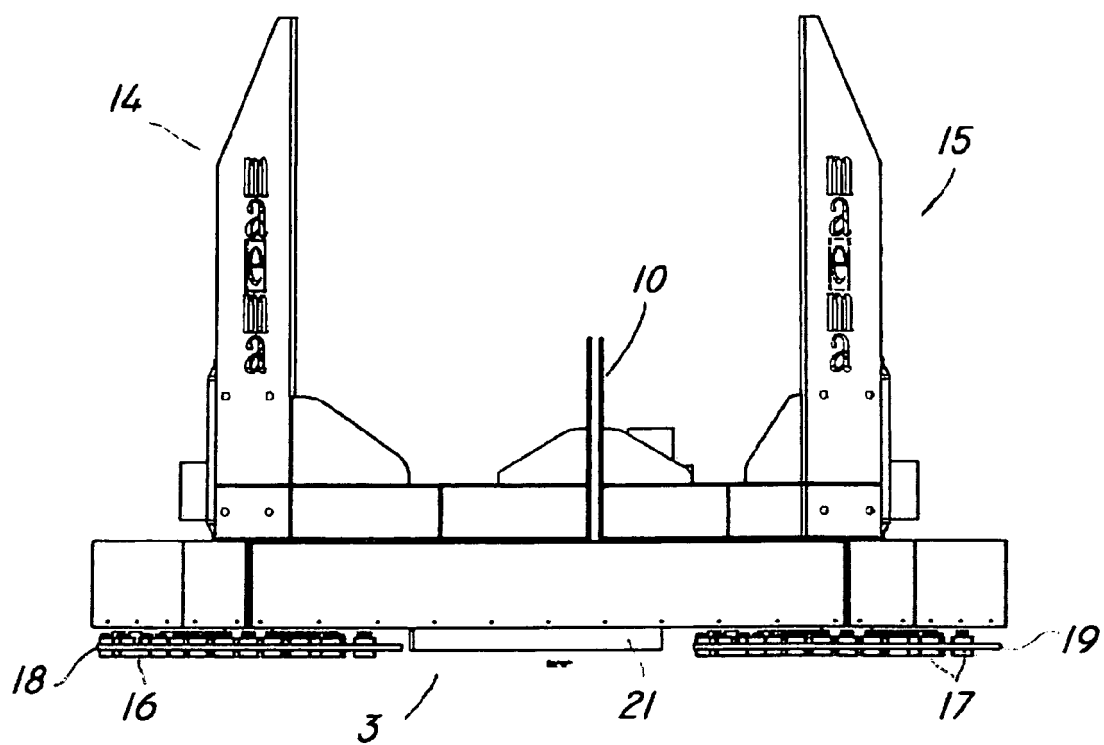


FIG. 3

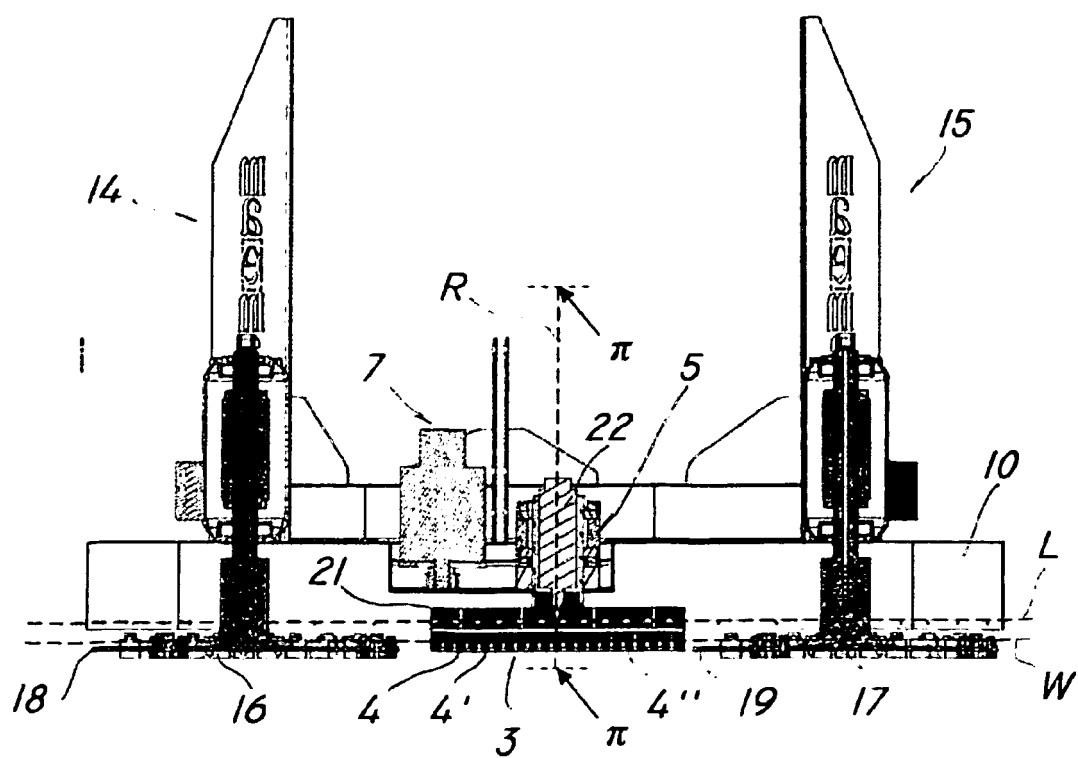


FIG. 4

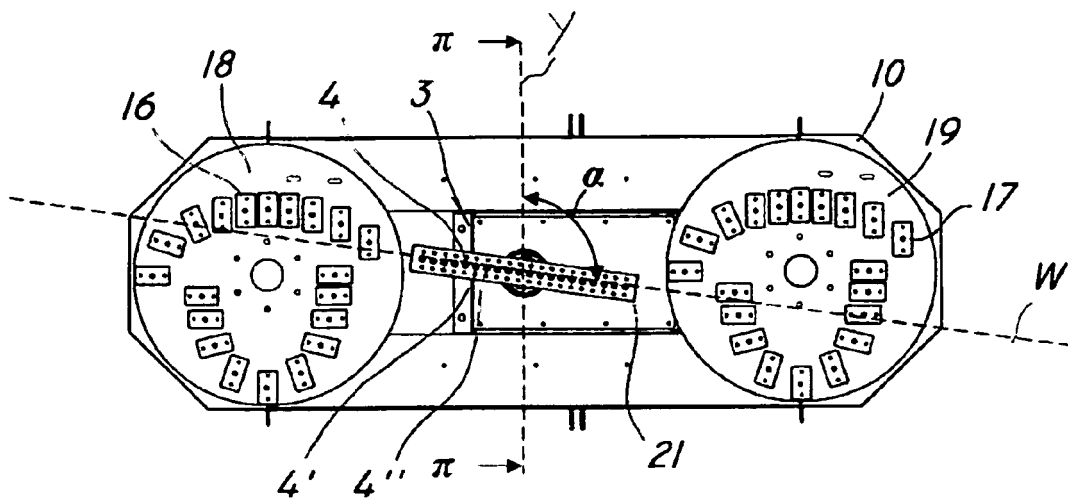


FIG. 5

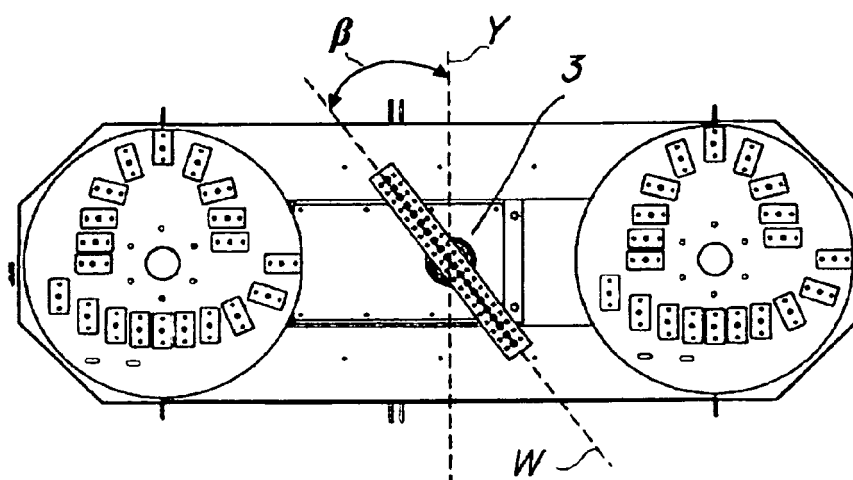


FIG. 6

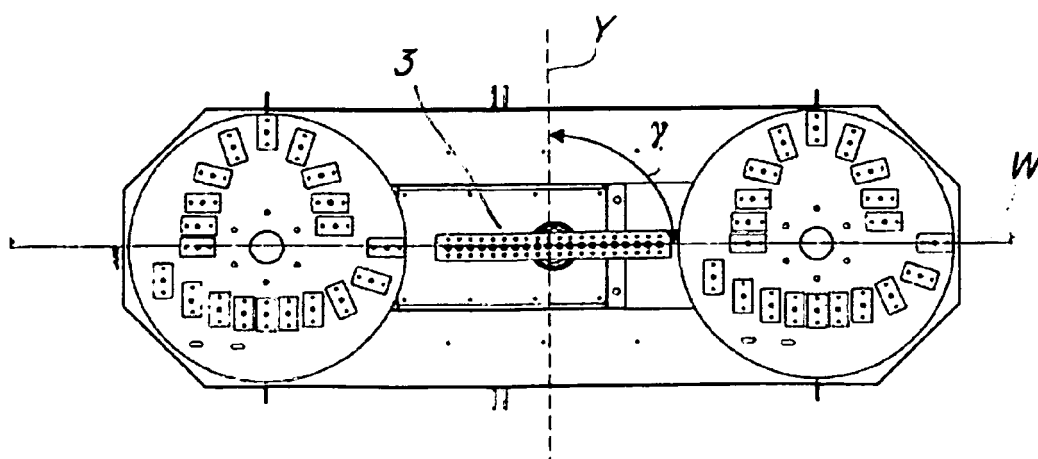


FIG. 7

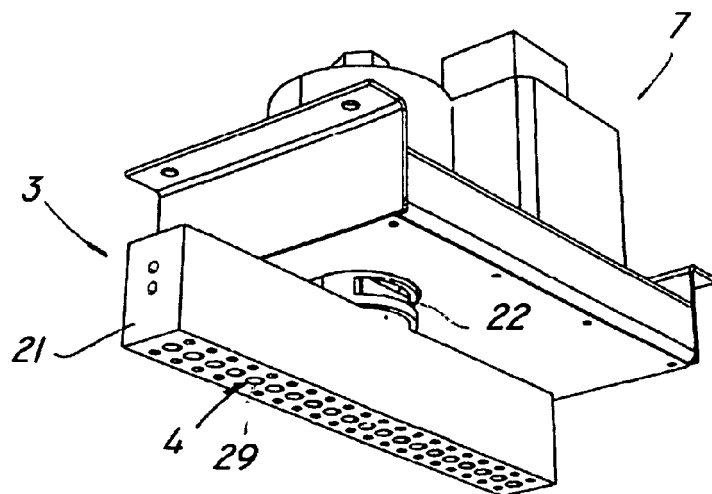


FIG. 8

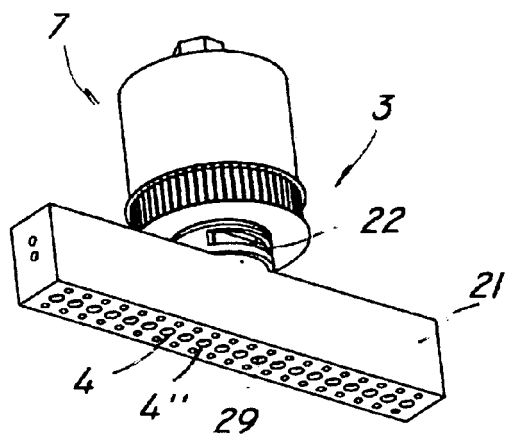


FIG. 9

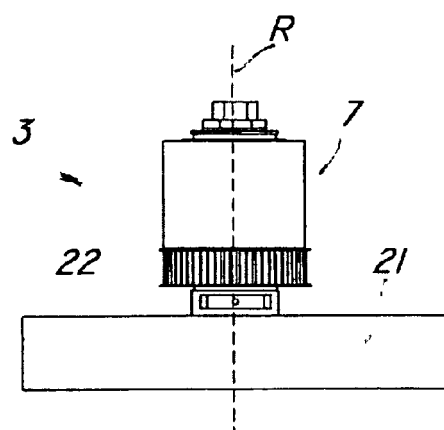


FIG. 10

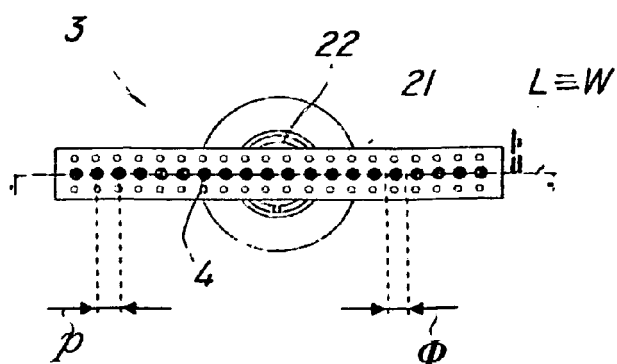


FIG. 11

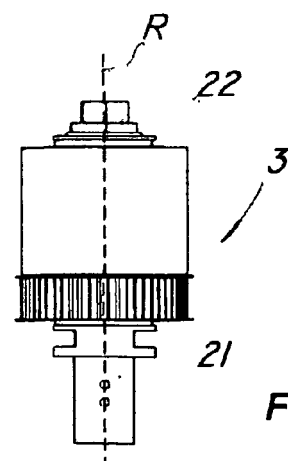


FIG. 12

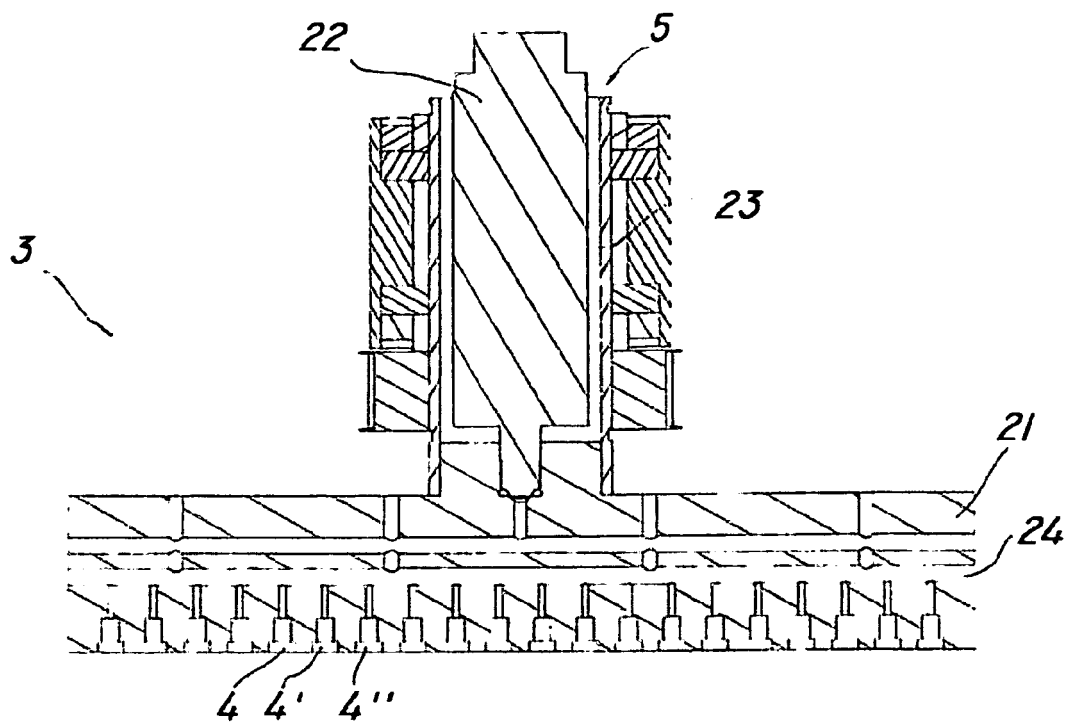


FIG. 13

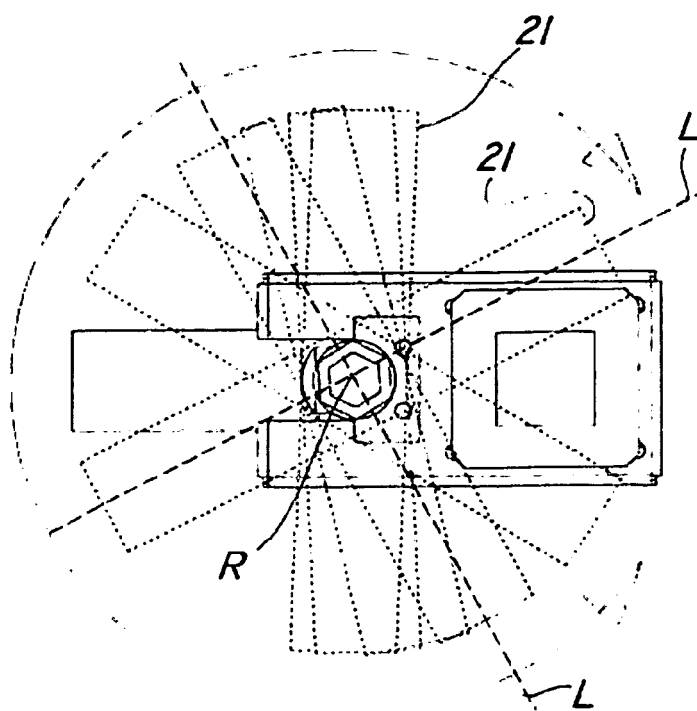


FIG. 14

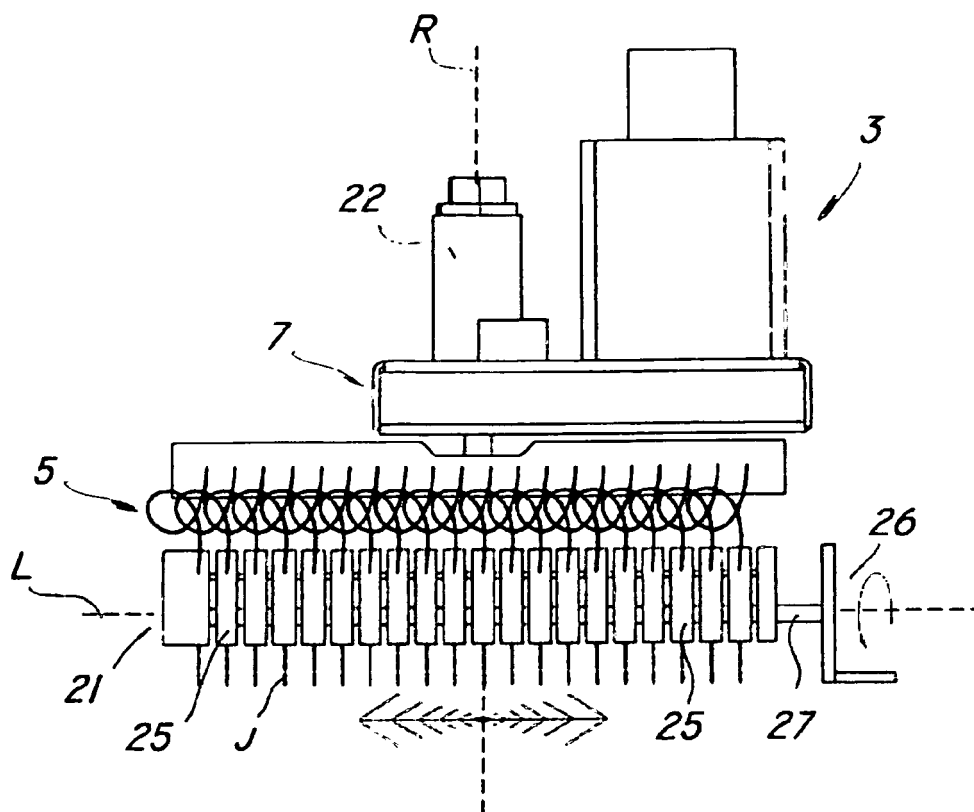


FIG. 15

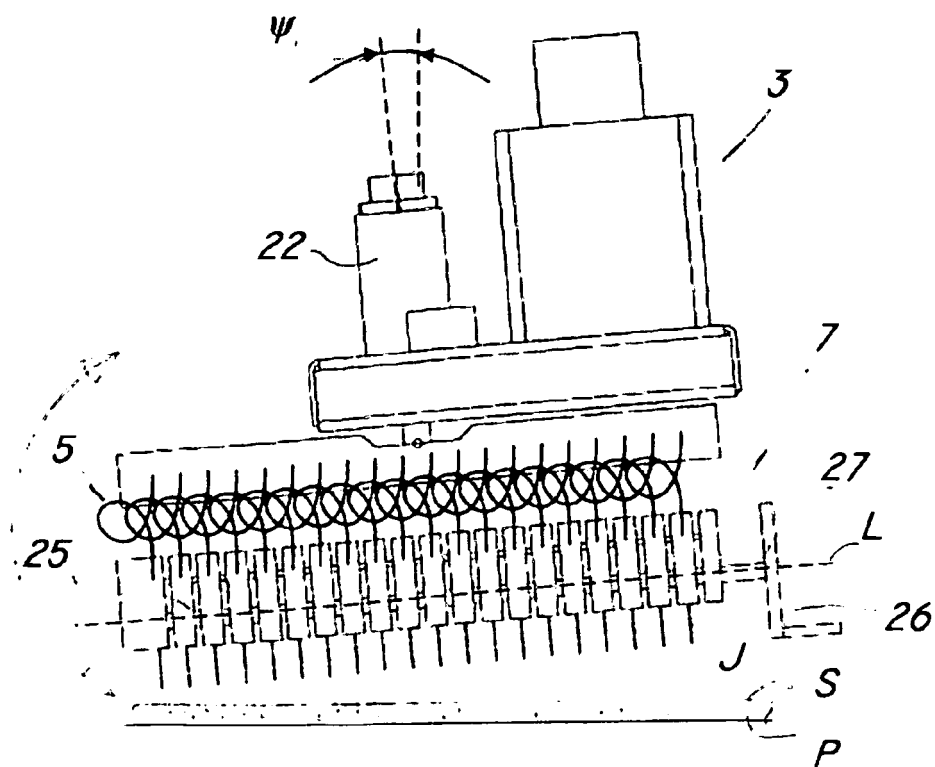


FIG. 16

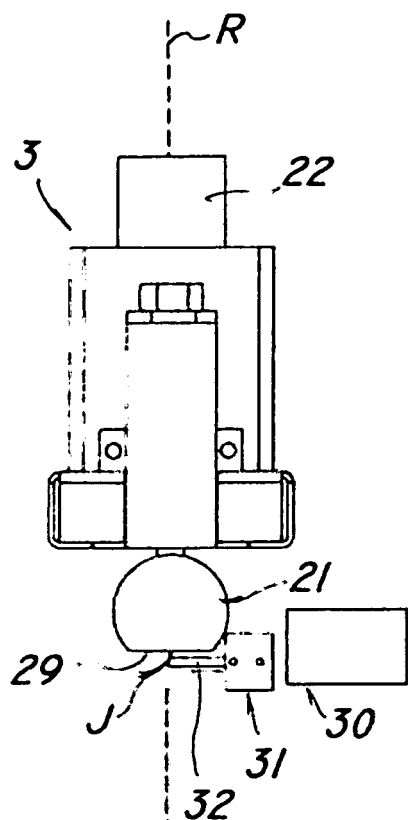


FIG. 17

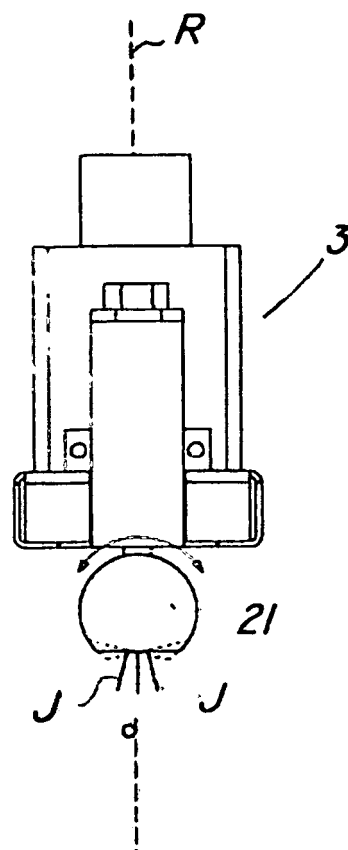


FIG. 18



EUROPEAN SEARCH REPORT

Application Number
EP 13 00 3656

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Place of search The Hague		Date of completion of the search 25 October 2013	Examiner Chariot, David
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