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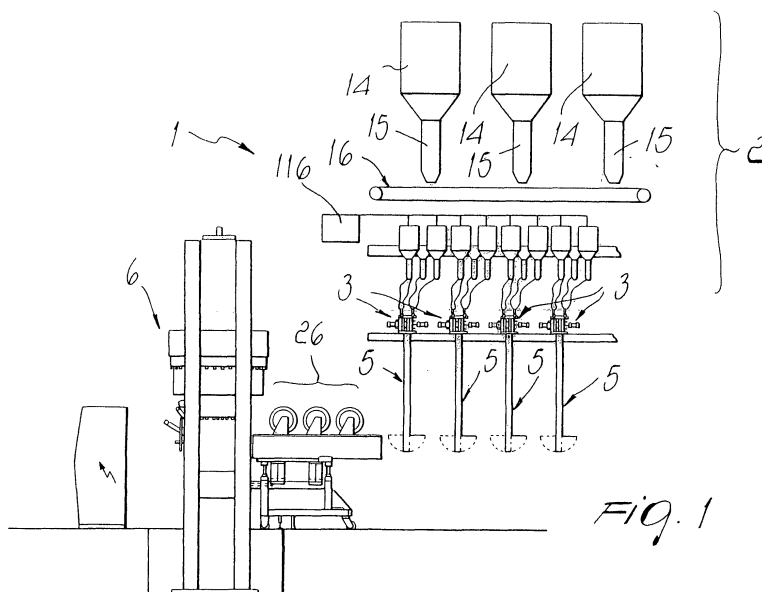
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(54) **Method and apparatus for manufacturing decorated plate-like ceramic articles**

(57) A method of manufacturing plate-like ceramic articles comprises the steps of: delivering, according to a predetermined sequence, calibrated doses of powdery/atomized material from a storage, supplying, according to a predetermined sequence, said calibrated doses into at least one pair of shaping moulds, forming an article in each pair of shaping moulds by compacting powdered/atomized material loaded into at least one seat in said shaping moulds, removing each shaped article from its respective seat, transferring it to a pressing station, and pressing the shaped article for causing its permanent stabilization.

An apparatus for carrying out such a method com-

prises a storage (14) for storing powdery/atomized materials and delivering metered quantities thereof, at least one shaping mould (10, 110; 11, 111) having at least one shaping seat (4, 104) provided in at least one shaping unit (3) arranged downstream of said storage (14) for receiving metered quantities of powdered/atomized material to be shaped to form at least one article (M) by being die-pressed therein, at least one press (6) located downstream of the or each shaping unit (3), and withdrawing means (5) located at each shaping unit (3) and designed to withdraw shaped articles (M) therefrom and to transfer them to a respective press (6) for permanent stabilization of said articles (M).



Description

[0001] The present invention relates to a method of and apparatus for producing decorated plate-like ceramic articles.

[0002] The ceramic industry is constantly seeking articles which are suitable for attracting market attention and keeping production costs at low levels, while having high-value organoleptic features.

[0003] In this contest, the manufacture of articles made of porcelainized grès, which is a material that, on the one side, can be easily worked on industrial scale for obtaining highly appreciated shapes and decorations and, on the other, is also highly chemicals-resistant and weatherproof

[0004] Accordingly, it would be desirable to be in a position of reproducing with such a material also manufactured articles that visually appear to have the same features as those of natural stones, such as marble and the like. Thus, research efforts are devoted in this direction.

[0005] One of the main features to be reproduced in a reproduction of a natural stony material is constituted by the veins of the natural material, veins that also extend without solution of continuity to the innermost portions of the material.

[0006] Moreover, while extending in a substantially continuous way, such veins have an odd shape and faithful reproduction of such features in industrially manufactured articles is one of the targets of major research in the ceramics field at present.

[0007] Besides the above mentioned features, the manufactured articles should also have a rough appearance, as if they had been manually obtained by skilled stonecutters while working natural materials.

[0008] Briefly stated, the more articles as manufactured according to industrial methods organoleptically resemble those obtained by hand, the more they are appreciated and sought after.

[0009] In order to achieve these results, manufacturing processes have been devised which, however, make it possible to manufacture articles which imitate with greater accuracy the outer features of natural materials but unmistakably reveal their mass production origin when inspected internally, i.e. just below their surface in sight.

[0010] Such articles are manufactured, e.g. by using a pre-shaped pad, usually made of high-strength plastics material, which constitutes a negative reproduction of the appearance of a natural stone and is inserted in a respective die in a mould on a forming press, thus giving their negative shape to a material to be shaped loaded into the die of the mould, which then takes a corresponding positive shape. Such a method makes also possible to vary the thickness of the various batches of material to be shaped, possibly by providing a bed of low-value material designed to become the laying face of the manufactured articles on which, through one or more successive loading operations, one or more layers

of materials designed to constitute the faces in sight of the articles are deposited and onto which the driven pads act during a pressing cycle.

[0011] However, the resemblance to articles directly obtained from natural materials is still very approximate, especially, as mentioned above, in so far as the internal portion of the article is concerned.

[0012] The main object of the present invention is to provide a method of and an apparatus for manufacturing plate-like ceramic articles with decorations extending throughout their thickness which allows ceramic articles having all the characteristic features of those directly obtained from natural materials to be obtained.

[0013] Another object of the present invention is to provide a method and an apparatus for manufacturing plate-like ceramic articles with decorations extending throughout their thickness which makes it possible to produce plate-like ceramic articles of any size and thickness on a mass production scale.

[0014] According to a first aspect of the present invention there is provided a method of manufacturing plate-like ceramic articles, comprising the steps of: delivering, according to a predetermined sequence, calibrated doses of powdery/atomized material from a storage, supplying, according to a predetermined sequence, said calibrated doses into at least one shaping mould arranged to form an article by compacting powdered/atomized material fed to at least one seat in said shaping mould, removing each shaped article from its respective seat, transferring it to a pressing station, and pressing the shaped article for causing its permanent stabilization.

[0015] According to a second aspect of the present invention there is provided an apparatus for manufacturing plate-like ceramic articles, which comprises a storage for storing powdery/atomized materials and delivering metered quantities thereof, at least one shaping mould having at least one shaping seat arranged downstream of said storage for receiving metered quantities of powdered/atomized material to be shaped by being die-pressed therein, at least one press located downstream of the or each shaping unit, and withdrawing means located at said shaping unit and designed to withdraw shaped articles therefrom and to transfer them to a respective press for permanent stabilization of said articles.

[0016] Further features and advantages of the present invention will become better apparent from the following detailed description of a preferred, although not exclusive, embodiment of an apparatus for manufacturing plate-like ceramic articles, illustrated by way of non-limitative example only in the accompanying drawings, in which:

Figure 1 is a diagrammatic general view of an apparatus for manufacturing plate-like ceramic articles according to the invention;

Figure 2 is a diagrammatic general view of the ap-

paratus of Figure 1 including a cutting station for the formed articles; and

Figure 3 is an enlarged-scale detail view of a modular unit for forming the articles by compaction which is part of the invention.

[0017] With reference to the above listed Figures, reference numeral 1 generally indicates an apparatus for manufacturing plate-like ceramic articles M.

[0018] The apparatus 1 comprises a storage system 2 for storing materials in powdery or atomized form and delivering them in calibrated amounts. Such a storing system comprises a plurality of modular units 3, which are arranged in parallel one with respect to the other and adapted to shape articles M by compaction. Each modular unit 3 has at least one shallow shaping seat or gap 4 and is connected downstream of a conveying means 5 arranged to convey compacted articles to a press 6 for final stabilization of the compacted articles M.

[0019] In a preferred embodiment shown in Figure 3, each modular unit 3 comprises a box-like frame 7 having an inlet opening 8 for loading therein component materials at the top thereof and an outlet opening 9 for unloading or releasing formed articles at the bottom. Two pairs of mould and counter-mould 10 - 110 and 11 - 111, respectively, are slidably mounted in each box-like frame 7, so that they can be moved close to, and spaced apart from, one another in a horizontal direction. A narrow gap or shallow seat 4, 104, respectively, is delimited between each pair of mould and counter mould and the inner walls of the box-like frame 7.

[0020] More particularly, the pairs of loading openings 8 and respective unloading openings 9 lie on mutually staggered vertical planes that are symmetrically arranged with respect to an intermediate vertical plane P. Moreover, the openings 9 for unloading formed articles M are in vertical alignment with a respective conveyor 5.

[0021] Each mould 10, 110 can be actuated by a respective actuators 12, 112 so as to be displaced inside the box-like frame 7, e.g. while sliding on a pair of guiding rods 7a, with respect to, and synchronously with, its counter-mould 11, 111 actuated by respective actuators 12', 112' so as to be moved between a first position at which its shaping seat or gap 4, 104 is in vertical alignment with a respective loading opening 8 and a second position where its shaping seat or gap 4 is in vertical alignment with its respective unloading opening 9 for a shaped or formed article M. Advantageously, actuators 12, 112 and 12', 112' are controlled by a program control unit CU.

[0022] Each loading opening 8 is arranged downstream of a respective small hopper 13 arranged to receive powder material supplied by the storage system 2.

[0023] Thus, each box-like frame 7 locates two pairs of moulds 10, 110 and counter-moulds 11, 111 and the same are alternately actuated, whereas displacements between the first and second position occur synchro-

nously and in opposite directions, thus each pair of moulds is supplied with powder material via its loading opening 8 and releases a shaped article M through its unloading opening 9.

[0024] Moreover, the shaping seats or gaps 4, 104 of each pairs of moulds 10, 110 and counter moulds 11, 111 can be positioned at alternating cycles, so that one pair is aligned with its respective loading opening 8 and the other with its unloading opening 9.

[0025] The feeding storage system 2 comprises modular silos 14 designed to store strictly monochrome powdery or atomized materials. Outlets 15 open onto a conveyor 16 for conveying calibrated doses of monochrome materials from the silos 14 to a mixing unit 116 from which the same materials are supplied to containers 17 as multi-colour mixed materials.

[0026] The conveying means 5 for conveying articles M comprises a pair of first conveyors 18 with facing work runs 19, between which a gap 20 is delimited which has a substantially constant width that in any case is smaller than the thickness of each formed article M. Articles M are conveyed while being engaged between the work runs 19. The first conveyors 18 have inlet fronts 18a substantially in vertical alignment with a respective unloading openings 9, and outlet fronts 21 are arranged facing, with no substantial discontinuities, adjacent inlet fronts 22 of second conveyors 23 to the presser means 6.

[0027] In a preferred embodiment of the invention the conveying means 5 is vertically arranged and the second conveyors 23 extend horizontally. Thus, between outlet fronts 21 and inlet fronts 22 intermediate portions or sections 24 of pairs of facing connecting conveyors 25 are provided which can be angularly displaced by means of any suitable actuating means AM, such as a jack or a pinion and rack arrangement controlled by a detecting means, e.g. a respective photocells PC, onto vertical planes by pivoting about horizontal axes from a position in which they are in alignment with the pairs of first conveyors 18 to a position in which they are aligned with second conveyors 23.

[0028] At least one station 26 for decorating the exposed faces of the formed articles M (i.e. the faces that, in use, are in view) can be provided in the apparatus 1 at a location between said conveying means 5 and the press 6.

[0029] Moreover, a station 27 for cutting the formed articles M into sections with predetermined dimensions, can be arranged upstream of the press 6.

[0030] The operation of the above described apparatus is as follows. Powder or atomized materials having basic organoleptic features, e.g. one colour, are stored in silos 14.

[0031] Apparatus 1 is controlled by program control unit CU, whereby predetermined doses of such materials are withdrawn from silos 14 and unloaded through outlets 15 onto the conveyor 16 that delivers them to mixing unit 116 to form multicoloured mixtures to be supplied to containers 17 and then to batteries of modular

units 3 where pairs of moulds 10, 110 and counter-moulds 11, 111 are arranged to press and shape the metered material fed to them to obtain articles M.

[0032] Just before the materials are loaded, the first pair of mould 10 and counter mould 11 is so arranged inside the box-like frame 7 that its gap 4 is vertically aligned with the loading opening 8 underneath hopper 13. At the same time, the second pair of mould 110 and counter-mould 111 is caused to slide on the rods 7a until its gap or seat 104 becomes vertically aligned with its respective unloading port 9.

[0033] After that, during standard cyclic operation gap or seat 4 delimited by the pair of mould 10 and counter-mould 11 and suitably aligned with its opening 8 is loaded with a metered dose of powdered material, and at the same time an article M already pressed and shaped in the other pair of mould 110 and counter mould 111 is unloaded or released, e.g. by gravity, through a respective unloading opening 9.

[0034] During loading of gap or seat 4 (or 104), powdery or atomized materials are supplied to it according to a predefined layering and thus with different colourings in each layer, whereby upon compaction, the same become inner decorative veins that extend throughout the thickness of articles M.

[0035] Once gap 4 (or 104) is fully loaded with powder material, actuator 12 presses mould 10 (or 110) against its counter mould 11 (or 111) in order to compact the powder material therein to form an article M. Of course, the pressing force must be sufficient to provide flat article M with adequate cohesive solidity.

[0036] Actuator 12, at the same time, causes mould 110 (or 10) to move away from counter-mould 111 (or 11), thus releasing formed article M that is supplied to underlying conveying means 5.

[0037] More particularly, each unloaded article M from gap or seat 4 or 104 is engaged between underlying runs 19 of the first conveyors 18 and is caused to descend in a controlled way until it reaches a corresponding section 24. Such a section is caused to be angularly displaced from a position, in which it is aligned with the runs 19, to a position in which it is co-planar with the second conveyor 23, onto which article M is to be transferred to be forwarded to the press 6 for permanent stabilization of its structure.

[0038] While being transferred towards the press 6,, article M can be decorated, if desired, by causing it to pass through a decorating station 26 advantageously arranged across the conveyor 23.

[0039] Alternately, each formed article M can be decorated on its exposed face while still inside the seats or gaps 4 or 104. As a matter of fact, such gaps can be loaded with additional material after a slight and calibrated reopening of the moulds 10, 110 without, however, releasing the article M already formed inside thereof, i. e. so as to delimit between the exposed face of article M and the moulds 10, 110 (or counter-moulds 11, 111) a small vertical gap designed to be filled with an addi-

tional load (or a plurality of additional loads) of powdered material to be compacted owing to a second (or a number of actuations corresponding to the number of additional loads) actuation of actuators 12. The second or additional load, after a new compaction operation has been carried out, becomes the exposed decorative surface of the article M before the article is released through an opening 9.

[0040] Moreover, if desired, formed articles M can also be subdivided into portions, e.g. by providing a cutting station 27 along said conveyor 23, preferably arranged upstream of the decoration station 26, if provided.

[0041] Likewise, inside the press 6 an inverse operation can be performed, i.e. arranging side by side a plurality of formed articles M in the pressing seat provided therein and pressing them together to obtain one article M only.

[0042] The above described invention is susceptible to numerous modifications and variations within the scope as defined by the claims.

[0043] The disclosure of Irish patent application no. 2001/0590 from which priority is claimed is incorporated herein by reference.

[0044] Any reference sign following technical features in any claim has been provided to increase intelligibility of the claim and shall not be construed as limiting the scope of the claim.

Claims

1. A method of manufacturing plate-like ceramic articles, comprising the steps of: delivering, according to a predetermined sequence, calibrated doses of powdery/atomized material from a storage, supplying, according to a predetermined sequence, said calibrated doses into at least one pair of shaping moulds, forming an article in each pair of shaping moulds by compacting powdered/atomized material loaded into at least one seat in said shaping moulds, removing each shaped article from its respective seat, transferring it to a pressing station, and pressing the shaped article for causing its permanent stabilization.
2. A method according to claim 1, **characterized in that** a decorating step for the exposed surfaces of formed articles is provided before said pressing for permanent stabilization.
3. A method according to claim 1, **characterized in that** during the transferring step to said pressing station said formed articles are subdivided into dimensionally predefined portions.
4. A method according to claim 1, **characterized in that** during the transferring step to said pressing

station a plurality of formed articles are packed together into one article of greater dimensions that is permanently stabilized at said subsequent pressing step.

5. A method according to claim 1, **characterized in that** it comprises loading said seat or seats with additional powder material after a slight and calibrated reopening of said shaping moulds after said article forming step, and compacting the said additional material with said formed article. 10
6. An apparatus for manufacturing plate-like ceramic articles, which comprises a storage (14) for storing powdery/atomized materials and delivering metered quantities thereof, at least one shaping mould (10, 110; 11, 111) having at least one shaping seat (4, 104) provided in at least one shaping unit (3) arranged downstream of said storage (14) for receiving metered quantities of powdered/atomized material to be shaped to form at least one article (M) by being die-pressed therein, at least one press (6) located downstream of the or each shaping unit (3), and withdrawing means (5) located at each shaping unit (3) and designed to withdraw shaped articles (M) therefrom and to transfer them to a respective press (6) for permanent stabilization of said articles (M). 20 25
7. Apparatus according to claim 6, **characterized in that** said shaping unit (3) comprises a frame (7) having at least one upper opening (8) for loading powdery/atomized materials and at least one lower opening (9) for unloading formed articles (M), at least one mould (10, 110) and a respective counter-mould (11, 111) delimiting a respective shaping seat (4, 104) therebetween and slidably mounted in said frame (7) thereby being mutually moved close to, and away from, one another, and a program control unit (CU). 30 35 40
8. Apparatus according to claim 7, **characterized in that** said loading and unloading openings (8, 9) are mutually staggered with respect to a vertical plane. 45
9. Apparatus according to claim 7 or 8, **characterized** the said unloading opening (9) is in substantial vertical alignment with inlet front (18a) of said conveying means (5). 50
10. Apparatus according to any claim 7 to 9, **characterized in that** each pair of mould (10, 110) and counter-mould (11, 111) comprises a respective actuator means (12, 112; 12', 112') controlled by said control unit (CU) and guide means (7a) along which each pair of mould and counter mould can slidably be displaced between a first position where one of said seats (4 or 104) is in substantial vertical align-

ment with a respective loading opening (8) and a second position where the other seat (104 or 4, respectively) is in substantial vertical alignment with a respective unloading opening (9) for a formed article (M).

11. Apparatus according to any claim 7 to 10, **characterized in that** it comprises a hopper (13) for collecting material fed by said storage (14), upstream of each loading opening (8).
12. Apparatus according to any claim 7 to 11, **characterized in that** it comprises two pairs of moulds (10, 110) and counter-moulds (11, 111) located in said box-like frame (7), each pair being designed to be supplied with powdered material by a respective loading and unloading opening (8, 9).
13. Apparatus according to any claim 6 to 12, **characterized in that** said storage system (14) comprises modular silos for containing powdery/atomized monochrome materials with outlets leading onto a conveyor means (16) arranged to supply calibrated doses of said monochrome powdery/atomized materials to a mixing unit (116).
14. Apparatus according to any claim 6 to 13, **characterized in that** said article conveying means (5) comprises pairs of runs (19) of first conveyors (18) delimiting a space having a substantially constant clearance smaller than the thickness of a formed article (M) and arranged to locate and convey articles (M), an inlet front end of said first conveyors (18) being vertically aligned with a respective unloading openings (9) of said box-like frame (7), whereas their outlet front ends being arranged so as to face contiguous inlet fronts of second conveyors (23) designed to forward articles (M) to said stabilization press means (6).
15. Apparatus according to claim 15, **characterized in that** portions or sections (24) of pairs of facing connection conveyors (23) are provided between the outlet fronts of said pairs of first conveyors (18) and the inlet fronts of said second conveyors (23) and arranged to be angularly displaced from a position in substantial alignment with said first conveyors (18) to a position at right angles thereto.
16. Apparatus according to any claim 6 to 15, **characterized in that** at least one station for decorating the exposed faces of the formed articles (M) is provided between said conveying means (5) and said press means (6).
17. Apparatus according to claim 6, **characterized in that** it comprises a cutting station for cutting the formed articles (M) into portions having predeter-

mined dimensions arranged upstream of said press means (6).

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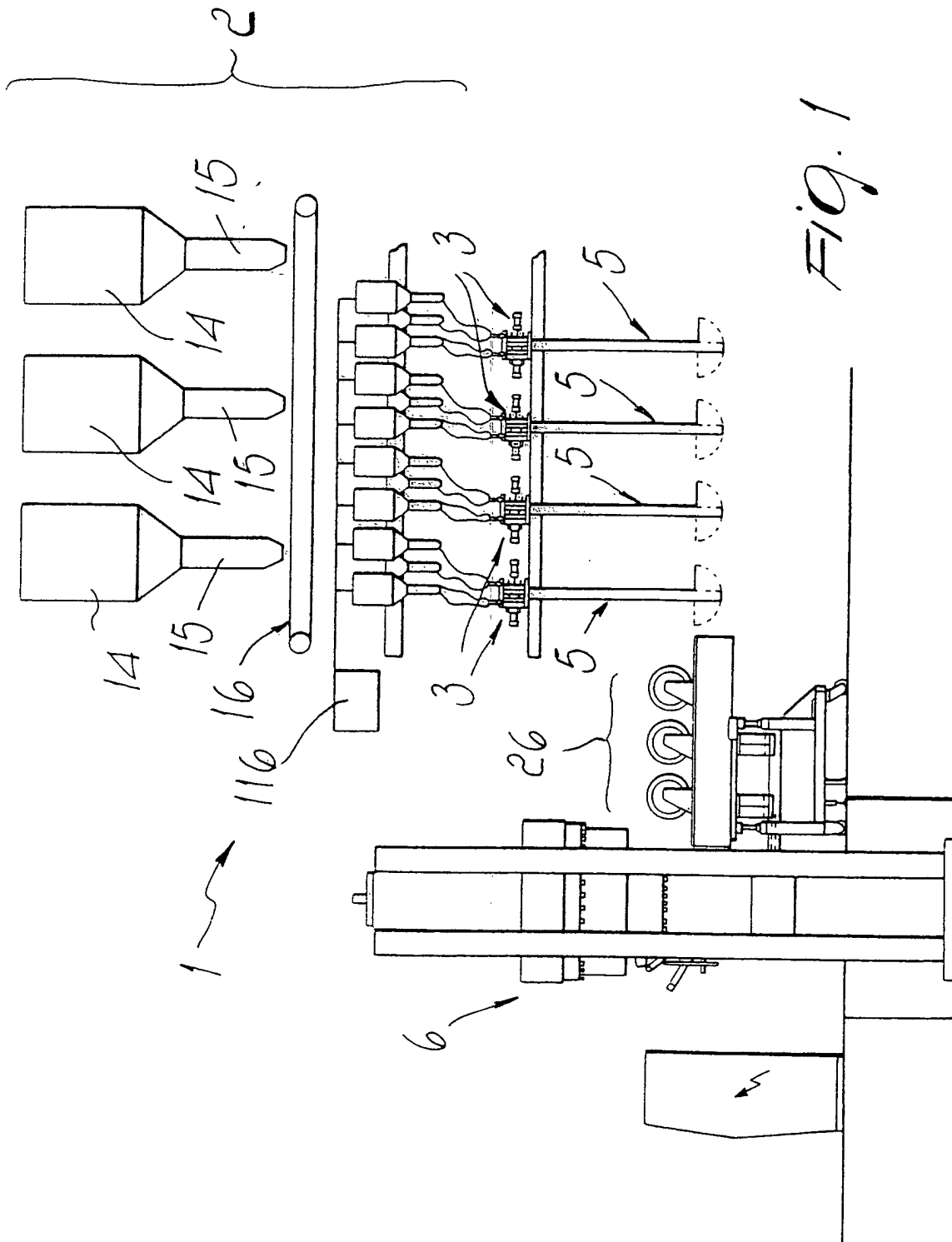
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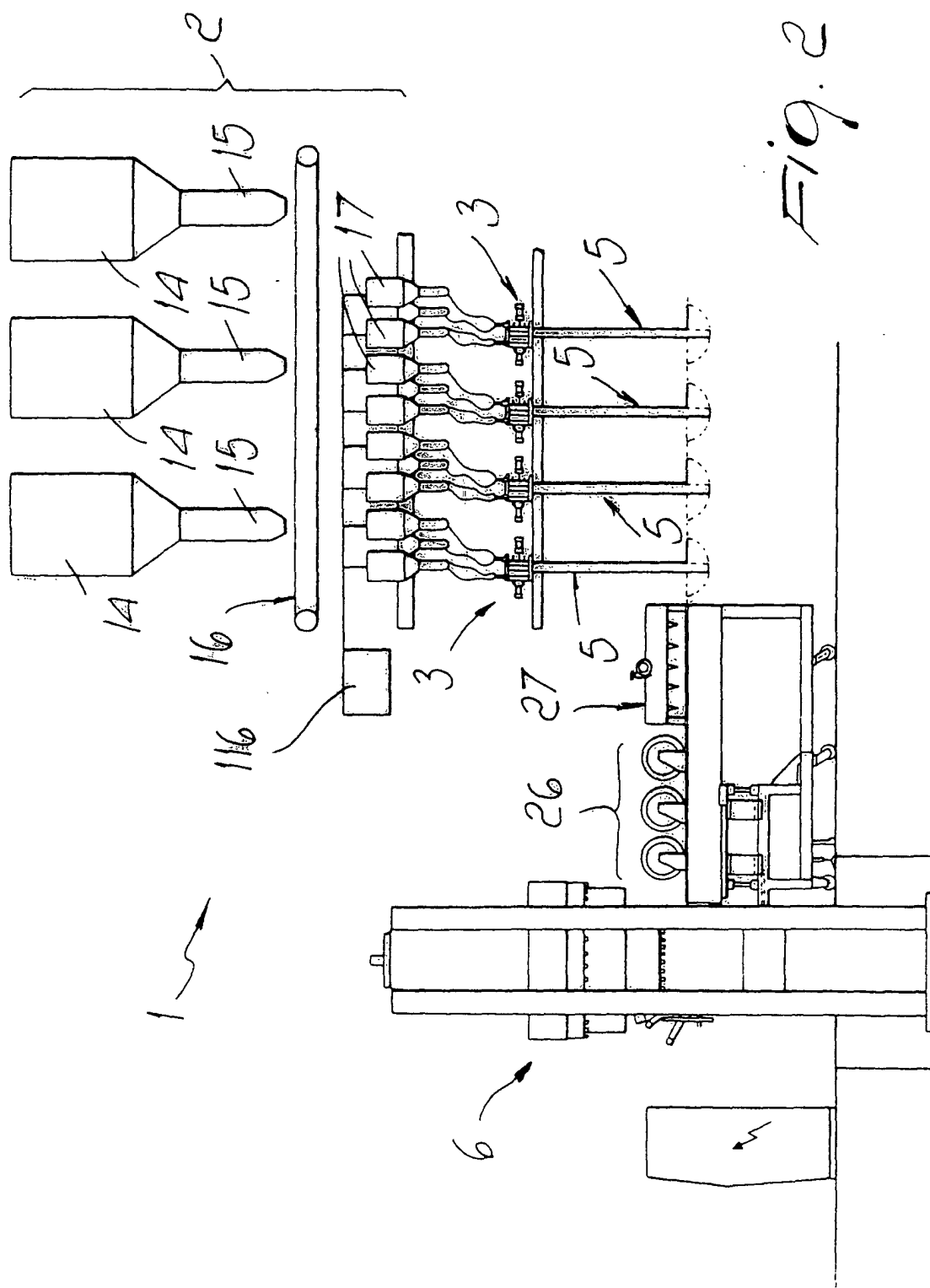
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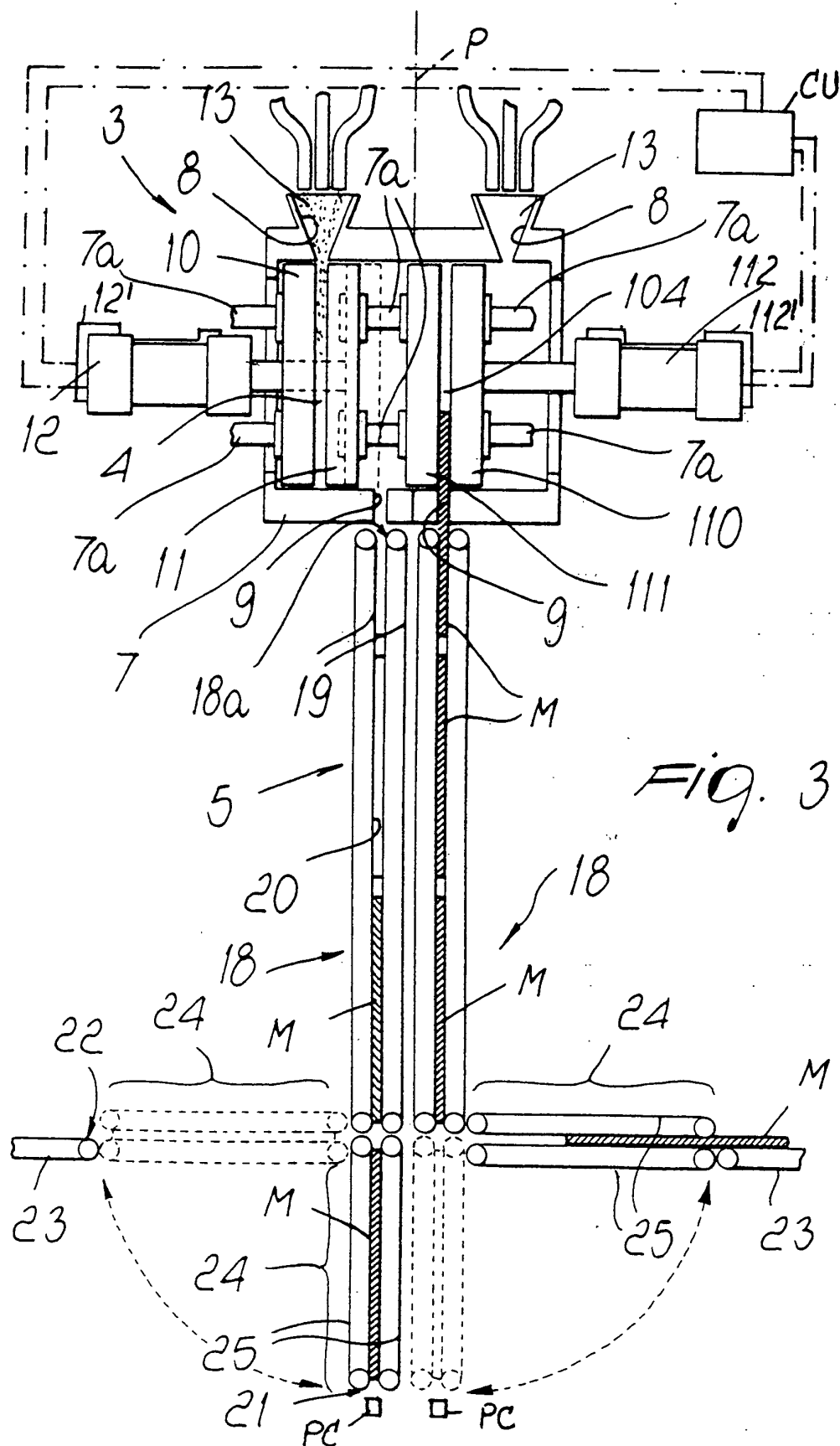
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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 3904

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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 23 October 2002	Examiner Westermayer, W
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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