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(54) **TABLET PRESS MACHINE AND METHOD FOR PRODUCING AND WEIGHING TABLET**

(57) A rotary tablet press machine includes a compression turret (2) rotating around a first axis (X1) with constant angular velocity and comprising a dies plate (3a) that is provided with a plurality of dies (3) and a plurality of upper compression punches and a plurality of corresponding lower compression punches for producing tablets (100), weighing devices (4) for weighing the tablets (100), transferring organs (10) for transferring the tablets (100) that are drawn from the compression turret (2) to weighing devices (4) and a control unit (50) for driving and controlling the transferring organs (10); the transfer-

ring organs (10) comprise at least one transferring element (5, 6) that is provided with at least one seat (15, 16) for a respective tablet (100) and mobile in rotation around a second axis (X2) in a respective cycle time (Tc) with variable angular velocity so as, in succession, to draw from the turret (2) at least one tablet (100), move the tablet (100) towards the weighing devices (4), release said tablet (100) to the latter ones for the weighing and go back at the turret (2) for drawing a successive tablet (100).

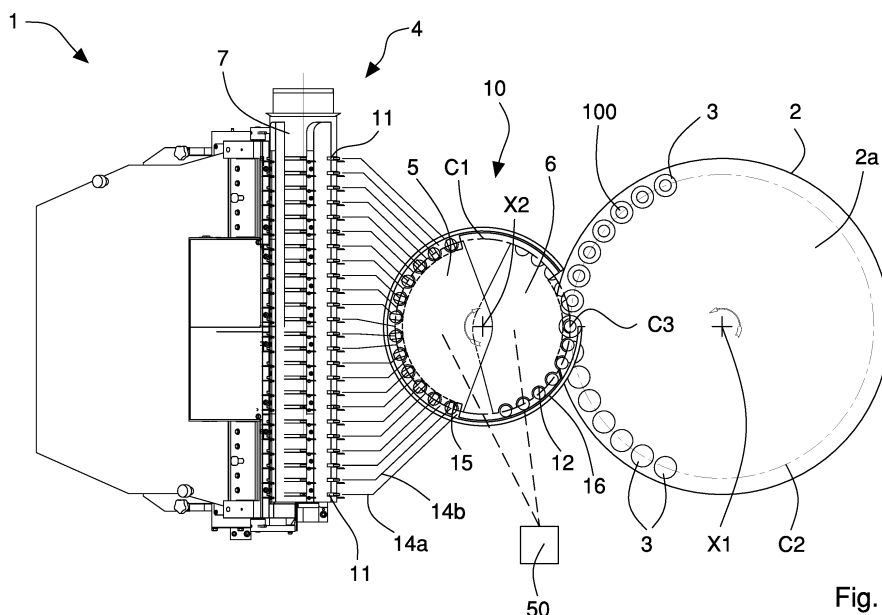


Fig. 1

Description

[0001] The present invention relates to tablet press machines for producing tablets, lozenges, pills, for example for pharmaceutical, food or chemical use, and in particular relates to a rotary tablet press machine provided with a weighing system of the produced tablets. The invention also relates to a method for producing and weighing tablets, lozenges, pills. The known rotary tablet press machines comprise a die plate rotating around a vertical axis and provided with a plurality of dies or cavities that are arranged angularly equidistant along a circumferential edge. An upper punch and a lower punch, which are vertically moved by eccentrics that are constituted by respective pressure rollers, are associated to each die. The punches compress the powder or granular product that is inserted in the dies in a dosing station so as to form tablets. The thus obtained tablets are extracted from the dies of the plate and conveyed to an exit chute. The various phases for carrying out a tablet are performed during one rotation turn of the dies plate that rotates with continuous motion.

[0002] The powder product is a pharmaceutical or food product. The tablets have to meet defined production requirements, such as size, hardness, porosity and weight.

[0003] Especially in the case of pharmaceutical products, weight checking of the tablets is necessary both for rejecting from the production the tablets that are out-of-spec because containing an exceeding or insufficient quantity of product with respect to a set quantity, and for adjusting possible excesses or defects in the dosing and compressing phases of the tablet press machine.

[0004] Indirect weight checking systems are known that measure the compression force that is exerted by the punches. Since the stroke of the latter ones inside the dies is predetermined, the compressing force is correlated to the amount of powder product in the dies. In particular, the compressing force proportionally increases with the amount of product that is contained in the dies. By measuring in real-time the compression forces and comparing the detected values with a reference value, it is thus possible to feedback control the product dosage so as to produce tablets having the desired weight. The document US 7,471,992 discloses a similar weighing method.

[0005] Furthermore, indirect weight checking systems are known that measure the height of the powder product dosed into the dies.

[0006] Other indirect weight checking systems measure the mass of the tablets by means of microwave sensors or sensors that are based on the magnetic resonance technology.

[0007] These checking systems are however very expensive and rather laborious and complex to be adjusted and used.

[0008] Usually, the indirect checking systems enable to check the weight of all the tablets that are produced by the tablet press machine, but have the drawback of

not ensuring the same measurement reliability and certainty of the direct checking systems.

[0009] The direct checking systems provide to use electronic scales comprising weighing or loading cells that are capable to directly weigh the tablets exiting from the compression table. The scales enable to weigh with high precision and accuracy the tablets, but require for a reliable measurement a suitable weighing time, during which the tablets have to rest and be motionless on a measurement plane, or support, of the scale. In particular, a minimum time interval is required between dropping the tablet on the support and measuring the tablet weight, that is necessary for making stable the scale, i.e. for damping vibrations generated by placing the tablet on said scale.

[0010] At high operating velocities of the existing tablet press machines (rotation velocity of the table) the average weighing time substantially corresponds to the time required for the turret to rotate from half turn to a full turn.

[0011] Therefore, the weighing systems with weighing scales have the drawback that they can be used only to execute a weight checking of statistical or partial type, which enables to weigh only a small part of the tablets produced by the machine. However, in the pharmaceutical field sometimes it is required checking all the produced tablets. Consequently, it is known to collect and weigh, out of the line, all tablets that are produced in a batch, and reject all tablets that are out-of-spec by weigh. Nevertheless, this procedure has the drawback to not prevent possible production errors, with the consequence that many products have to be rejected at the end of production.

[0012] The known tablet press machines usually comprise control devices that are suitable to control the operating parameters of the compression process and/or the physical characteristics of the produced tablets in order to identify out-of-spec tablets, not compliant with the production requirement. The control devices include indirect weighing devices or optical control devices.

[0013] Rejecting means is provided for rejecting the out-of-spec tablets according to signals that are received by the control devices. The rejecting means typically includes blowing nozzles that are positioned on the die plate downstream of the compressing stations and arranged to push into a storage container the out-of-spec tablets once extracted from their respective dies.

[0014] Such rejecting means has however some drawbacks.

[0015] The blowing nozzles, because of product powder inside the machine, are in fact subject to dirt and clogging and at high operating velocities cannot ensure a precise and reliable operation, with the risk to reject compliant products or not to reject out-of-spec products.

[0016] An object of present invention is to improve the known tablet press machines, in particular the tablet press machines provided with direct weight checking systems of the produced tablets.

[0017] Another object is to achieve a tablet press ma-

chine provided with a weighing system that enables to execute a total weight checking, i.e. to weigh all the produced tablets with high accuracy and precision.

[0018] A further object is to achieve a tablet press machine provided with a weighing system that enables to execute a weight checking in real-time and adjust in real-time the amount of product that is supplied to the dies.

[0019] A further object is to achieve a tablet press machine provided with a weighing system that enables to execute a statistical weight checking with high accuracy and precision on large number of tablets samples.

[0020] Still another object is to achieve a tablet press machine provided with a weighing system that is precise and reliable.

[0021] Another further object is to achieve a tablet press machine provided with simple and efficient rejecting means that enables to reject and eliminate in a precise and reliable manner the out-of-spec tablets.

[0022] A still further object is to provide a method for producing and weighing tablets that enables to execute with high accuracy and precision a total weight checking, i.e. to weigh all the produced tablets, or a statistical weight checking.

[0023] In a first aspect of the invention a tablet press machine is provided according to claim 1.

[0024] In a second aspect of the invention a method for producing and weighing tablets is provided according to claim 14.

[0025] The rotary tablet press machine according to the invention comprises a compression turret that rotates around a first axis with a constant angular velocity and is provided with a die plate having a plurality of dies and respective upper and lower compression punches for producing tablets and with weighing devices for weighing the tablets. The machine also comprises transferring organs for transferring the tablets from the turret to the weighing devices and a control unit for driving and controlling said transferring organs.

[0026] The transferring organs comprise at least one transferring element, which is provided with at least one seat for a tablet and driven in rotation around an axis, controlled by said control unit, in a respective cycle time with a variable angular velocity so as to be, in succession, rotated in a first phase with an almost constant first angular velocity for drawing from the turret one tablet, rotated in a second phase with a variable second angular velocity for transferring the tablet towards the weighing devices, maintained stopped in a third phase for releasing the tablet to the weighing devices for weighing the latter and rotated in a fourth phase with a third angular velocity that is variable and increasing up to the first angular velocity, for bringing the transferring element back at the turret and drawing a successive tablet.

[0027] Advantageously, the transferring organs comprise a first transferring element and a second transferring element, each of which adapted to transfer at least one tablet from the turret to the weighing devices and independently driven in such a manner that, in an oper-

ating interval of the tablet press machine, the transferring elements concurrently draw at least one tablet from the compression turret and release a further tablet to the weighing devices. The weighing devices comprise at least one, preferably at least two weighing cells for each seat of the transferring element.

[0028] Advantageously, the machine comprises deviating elements that are interposed between the transferring element and the weighing cells for directing a tablet coming from the seat at each turn of the transferring element alternately on one of the two weighing cells so as to have a weighing time, during which a weighing cell detects the weight of said tablet, that is substantially equal to said cycle time.

[0029] The transferring elements that are controlled by the control unit are capable to successively draw from the compressing turret all the tablets that are produced for a total weight checking. Furthermore, since the tablets are alternately released by the transferring elements to one of two weighing cells that are provided for each seat of the transferring elements, the weighing time available to the weighing cells enables the weighing cells to stabilize, i.e. to have an optimal damping of the vibrations generated by placing the tablet on the measurement plane of the said cells.

[0030] Therefore, it is possible with the tablet press machine of the invention to weigh in real-time with high precision and accuracy all the tablets that are produced. Possible weight non-compliances of the tablets are communicated by the weighing devices to a further control and driving unit of the machine that can feedback control a filling device of the dies for varying the amount of product inside the dies, i.e. for varying the weight of the tablets. The tablet press machine 1 further comprises control devices and rejecting devices that respectively enable to detect tablets that are out-of-spec, or non-compliant with the production requirements, and to reject said tablets. In particular, the rejecting devices include deflectors that are arranged along supplying ducts of the weighing cells for deviating the out-of-spec tablets towards a rejection magazine, or to a rejection chute, that is arranged to receive out-of-spec tablets that are kept on the transferring elements and not released to the weighing cells. Such rejecting devices operates with extreme precision and reliability and, compared to the traditional rejecting systems, ensure rejection of all the out-of-spec tablets even at high production velocity (rotation of the compression turret) of the tablet press machine.

[0031] The invention will be better understood and implemented with reference to the attached drawings, which illustrate some exemplifying and not limitative embodiments thereof, in which:

- Figure 1 is a schematic partial top plan view of a tablet press machine according to the invention;
- Figure 2 is a schematic side view, partially sectioned, of the machine of Figure 1;
- Figure 2A is an enlarged detail of Figure 2 illustrating

- in particular deviating means of the tablets;
- Figure 3 is a schematic side view, partially sectioned of a variant of the tablet press machine of the invention;
- Figure 4 is a phase diagram that illustrates rotation velocities of transferring elements of the tablet press machine of Figure 1 in an operating interval thereof;
- Figure 5 is a phase diagram that illustrates the rotation velocities of a transferring element of a variant of the tablet press machine of Figure 1 in an operating interval thereof;
- Figure 6 is a schematic side view, partially sectioned of another variant of the machine of Figure 1, illustrating in particular rejecting device of the out-of-spec tablets;
- Figure 7 is a schematic partial top plan view of a further variant of the tablet press machine of the invention

[0032] With reference to Figures 1 and 2, the rotary tablet press machine 1 according to the invention that is arranged to produce tablets, lozenges, pills comprises a compression turret 2, which is rotating around a first rotation axis X1 with constant angular velocity and includes a die plate 2a, which is provided with a plurality of dies 3 and respective compression means, such as a plurality of upper compression punches and a plurality of corresponding lower compression punches for producing tablets 100 by compressing a powder or granular product. The first axis X1 is substantially vertical.

[0033] The machine 1 also comprises weighing devices 4 for weighing the tablets 100, transferring organs 10 for transferring the tablets 100 from the compression turret 2 to the weighing devices 4 and a control unit 50 for driving and controlling at least said transferring organs 10.

[0034] The transferring organs 10 comprise at least one transferring element 5, 6 that is provided with at least one seat 15 for a respective tablet 100 and driven in rotation around a second axis X2, controlled by the control unit 50, in a respective time cycle Tc with variable angular velocity so as to be, in succession, rotated in a first phase A1 with a first angular velocity ω_1 , which is almost constant, for drawing from the compression turret 2 at least one tablet 100, rotated in a second phase A2 with a second angular velocity, which is variable, for moving the tablet 100 towards the weighing devices 4, maintained stopped in a third phase A3 for releasing the tablet 100 to the weighing devices 4 in order to measure the weight and then rotated in a fourth phase A4 with a third angular velocity that is variable and increasing up to the first angular velocity ω_1 to be brought back towards the turret 2 and to draw at least one successive tablet 100.

[0035] Advantageously, the second axis X2 is vertical and parallel to the first axis X1. The cycle time Tc is the time that is required for the transferring element 5, 6 to execute an operating cycle, i.e. a complete turn around the second axis X2, and comprises the four successive

operating phases A1, A2, A3, A4, which are better illustrated in the following description. In the embodiment shown in Figures 1 and 2, the transferring organs 10 comprise two transferring elements 5, 6, in particular a first transferring element 5 and a second transferring element 6, both rotating around the second axis X2 and controlled by the control unit 50, each transferring element being capable to transfer at least one tablet 100. The two transferring elements 5, 6 are independently operated by respective actuating means, for example by respective brushless electric motors, or cam devices, that is controlled by the control unit 50 so that, in an operating interval Tf of the machine 1, said transferring elements 5, 6 are capable at the same time as to draw at least one tablet 100 from the compression turret 2 and release a further tablet 100 to the weighing devices 4. Each transferring element 5, 6 has a circular sector shape and is provided, on a peripheral edge, with at least one seat 15, 16 that is adapted to receive a tablet 100. In particular, each transferring element 5, 6 is provided, on the respective peripheral edge, with a plurality of seats 15, 16, twelve in the illustrated embodiment, which are angularly spaced apart. In other words, in the operating interval Tf of the machine 1, a transferring element 5, 6 draws twelve tablets from the turret 2.

[0036] Advantageously, the weighing devices 4 comprise at least two weighing cells 11 for each seat 15, 16 of the transferring elements 5, 6, i.e. a number of weighing cells 11 that is equal to twice the number of seats 15, 16 of each transferring element 5, 6.

[0037] The tablet press machine 1 comprises deviating elements 17 that are interposed between the transferring elements 5, 6 and the weighing cells 11 and adapted to direct a tablet 100 coming from a seat 15, 16 at each turn of said gripping element 5, 6 alternately to one of the two respective weighing cells 11 so as to have a weighing time, during which a weighing cell 11 detects the weight of the tablet 100, that is substantially equal to the cycle time Tc, as better explained in the following description.

[0038] The transferring organs 10 comprise also a stationary abutment guide 12 that has a substantially annular shape, is coaxial with the second axis X2 and cooperates with the transferring elements 5, 6, more in particular with the seats 15, 16, for guiding the tablets 100 that are drawn from the compression turret 2 towards the weighing devices 4.

[0039] More precisely, the tablet 100, resting on a respective lower compression punch, is deviated, with respect to a circular path around the first axis X1 by the guide abutment 12 along a further circular path around the second axis X2. In practice, the tablet 100 is moved from the seat 15, 16 and guided by the guide abutment 12. A fixed supporting plane 13 is provided underneath the transfer elements 5, 6 to support the tablets 100 in the transfer to the weighing devices 4. Advantageously, below the supporting plane 13 suction means can be provided for sucking dust and debris coming from the compression turret 2.

[0040] The supporting plane 13 has a plurality of releasing openings 13a in number that is equal to the number of the seats 15, 16 of each transferring element 5, 6, or in number that is equal to twice the number of seats 15, 16 of each transferring element 5, 6. The releasing openings 13a are formed at openings of supplying ducts 14a, 14b of the weighing devices 4 that convey the tablets 100 to the below weighing cells 11. A selecting device 20 of known type, for example a couple of levers that are adapted to transfer one tablet 100 at a time, is provided for each supplying duct 14a, 14b for transferring the tablets 100 on the respective weighing cells 11, and then, after the weighing time, pushing said tablets towards a below exit duct 21. Further deviating elements 22 are provided inside the respective exit ducts 21 for directing in a rejection duct 23 the tablets 100, which are out-of-spec in weight and then to be rejected.

[0041] With particular reference to the embodiment of Figures 1- 2A, the supporting plane 13 has releasing openings 13a in a number that is equal to twice the number of seats 15, 16 of each transferring element 5, 6, which give access to first supplying ducts 14a and second supplying ducts 14b. In the shown embodiment, therefore, there are twenty-four releasing openings 13a, which give access to twelve first supplying ducts 14a and twelve second supplying ducts 14b.

[0042] The deviating elements 17 comprise a mobile plate that is slidable parallel to the supporting plane 13 so as to open the releasing openings 13a and, at each turn of the transferring elements 5, 6, directing alternately the tablets 100 into the first supplying ducts 14a or into the second supplying ducts 14b.

[0043] The releasing openings 13a are arranged circumferentially on the supporting plane 13. The releasing openings 13a are also arranged in such a manner that the first supplying ducts 14a are alternated to the second supplying ducts 14b.

[0044] In practice, the transferring elements 5, 6 are adapted to transfer the tablets 100 at the releasing openings 13a, alternately of the first supplying ducts 14a and of the second supplying ducts 14b, such that, when the mobile plate is driven, the tablets 100 fall into the first supplying ducts 14a or into the second supplying ducts 14b.

[0045] Pushing pistons can be provided for pushing the tablets 100 downward into the supplying ducts 14a, 14b.

[0046] The deviating elements 17 and the releasing openings 13a are also shaped so as to rotate the tablets so that the latter ones enter into, and slide along, the supplying ducts 14a, 14b with "edgeways" orientation, i.e. with a respective central symmetry axis that is horizontally arranged. In this way, the transversal dimensions of the supplying ducts 14a, 14b are smaller and the weighing cells 11 can be arranged aligned and side by side at a smaller distance.

[0047] In the embodiment that is illustrated in Figures 1 - 2A, the weighing devices 4 comprise a weighing unit

7 that is provided with weighing cells 11 (in a number that is equal to twice the number of seats 15, 16 of each transferring element 5.6) that are arranged side by side and aligned. Each weighing cell 11 is in communication with a respective releasing opening 13a through a respective (first or second) supplying duct 14a, 14b.

[0048] The operation of the tablet press machine 1 according to the invention provides that the

[0049] tablets 100, which are produced by the compression turret 2, are extracted from the dies 3 of the turret 2 by means of lifting means of known type and not illustrated in the figures, for example by means of the lower compression punches, are gripped at a drawing zone from the seats 15, 16 of the transferring elements 5, 6 and, by means of the abutment guide 12, are transferred to the releasing openings 13a.

[0050] During the rotation of the turret 2 in a respective cycle time T_c each transferring element 5, 6 is moved by the control unit 50 with different angular velocities according to the four successive operating phases A1, A2, A3, A4 as illustrated in the diagram of figure 4, which shows as the abscissae (time) the starting instants t_1, t_2, t_3, t_4 of the operating phases A1, A2, A3, A4 and as the ordinate (velocity) the angular velocities of each transferring element 5, 6.

[0051] Each transferring element 5, 6 in the respective cycle time T_c is, in succession, rotated in the first phase A1, having a first duration (t_1-0), with the first angular velocity ω_1 almost constant so as to draw the tablets 100 from the turret 2, rotated in the second phase A2, having a second duration (t_2-t_1), with a variable second angular velocity for transferring the tablets 100 from the turret 2 to the weighing devices 4, maintained stopped in the third phase A3, having a third duration (t_3-t_4), for releasing the tablets 100 to the weighing devices 4 and finally rotated in the fourth phase A4, having a fourth duration (t_4-t_3), with a third angular velocity that is variable and increasing up to the first angular velocity ω_1 .

[0052] At the first angular velocity ω_1 , the seats 15, 16 of each transferring element 5, 6 move along a circular transferring path C1 (first pitch circle C1) at the same linear velocity with which the tablets 100 moves that are in the turret 2 and move along a circular compression path C2 (second pitch circle C2) that is tangent at a drawing point C3 to the circular transferring path C1. In this way, each transferring element 5, 6 is capable to draw from the turret 2 a number of tablets 100 which is equal to the number of seats 15, 16 in the operating interval T_f of the machine 1 and go back, after another operating interval T_f of the machine 1, in drawing condition of further tablets 100 from the turret 2.

[0053] During the second operating phase A2 each transferring element 5, 6 is moved with variable angular velocity: in a first portion with increasing value (accelerated motion) and a second portion with a decreasing value (decelerated motion). The rotational velocity in the second phase A2 is such as to reduce the second duration (t_2-t_1) to a minimum value that is necessary to the

transferring element 5, 6 for moving the tablets 100 from the turret 2 to the weighing devices 4.

[0054] In the third operating phase A3, with the transferring element 5, 6 stationary, the deviating elements 17 are activated so as to direct the tablets 100 alternately into the first supplying ducts 14a or into the second supplying ducts 14b.

[0055] Once the tablets 100 are released, the transferring element 5, 6 is moved again, gradually accelerated during the fourth operating phase A4.

[0056] The two transferring elements 5, 6 rotate in an independent manner according to the same velocity profile that is divided into the four operating phases A1, A2, A3, A4, in particular temporally phase-shifted by a value that is equal to the first duration (t1-0) or equal to half of the cycle time Tc, as highlighted in the diagram of Figure 4. In this way, while a transferring element (for example the first transferring element 5) is stopped for releasing the tablets 100 on the weighing devices 4, the other transferring element (the second transferring element 6) is moving with constant angular velocity in order to draw the

[0057] tablets 100 from the compression turret 100 and vice versa.

[0058] In an operating interval Tf of the tablet press machine 1 with a duration that is equal to half of the cycle time Tc, the turret 2 produces a number of tablets 100 that is equal to the number of seats 15, 16 of the transferring elements 5, 6. In other words, in each operating interval Tf all the tablets 100 that are produced by the turret 2 are drawn alternately by the first transferring element 5 or by the second transferring element 6.

[0059] It should be noted that in this way in the regular operation of the machine both transferring elements 5, 6 are capable to successively draw from the compression turret 2 the respective

[0060] tablets 100, i.e. all the produced tablets 100 so as to allow a total or 100% weight checking. Furthermore, since the tablets 100 are released by transferring elements 5, 6 alternately to one of the two weighing cells 11 that are provided for each seat 15, 16 of the transferring elements 5, 6, i.e. alternately to the first supplying duct 14a or to the second supplying duct 14b, the weighing time, during which a weighing cell 11 detects the weight of the tablet 100, is substantially equal to the cycle time Tc, i.e. equal to twice the operating interval Tf of the machine 1. In this way, the weighing devices 4 have at their disposal a weighing time that enables the weighing cells 11 to stabilize, i.e. such as to have an optimal damping of the vibrations that are generated by placing the tablet on the supporting plane of said cell.

[0061] Thus, it is possible with the tablet press machine 1 of the invention to weigh with high precision and accuracy all the produced tablets 100.

[0062] It should be noted that during the operation of the machine 1 the first transferring element 5 gives the tablets 100 to the weighing cells 11 that are supplied by the first supplying ducts 14a, while the second transferring element 6 gives the tablets 100 to the weighing cells

11 that are supplied by second supplying ducts 14b.

[0063] The tablet press machine 1 according to the invention therefore allows performing a total or 100% weight checking of the tablets, i.e. to weigh all the produced tablets, with high accuracy and precision, since the weighing time has a duration that is high and substantially equal to twice the operation interval Tf.

[0064] The arrangement of the tablets 100 with "edge-ways" orientation in the supplying ducts 14a, 14b and on the weighing cells 11 also enables to reduce the overall dimensions of the weighing devices 4.

[0065] Figure 3 illustrates a variant of the tablet press machine 1 of the invention that differs from the above described embodiment that is illustrated in Figures 1 - 2A for the deviating elements 27 that rotate instead of translate as the deviating elements 17 of Figures 1-2A and for the weighing devices 4 that include two distinct weighing units 8, which are arranged side by side and opposite, each of which provided with a number of weighing cells 11 that is equal to the number of seats 15, 16 of each transferring element 5, 6.

[0066] The weighing cells 11 of a weighing unit 8 are supplied by the tablets 100 through first supplying conduits 24a, while the weighing cells 11 of the remaining weighing unit 8 are supplied by the tablets 100 through second supplying conduits 24b.

[0067] The first supplying conduits 24a form with the second supplying conduits 24b, in the shown embodiment, couples of supplying conduits that originate from a common releasing opening 13a.

[0068] The deviating elements 27 comprise, in the illustrated embodiment, a plurality of deflectors rotating around respective axes and capable to direct the tablets 100 released by the transferring elements 5, 6, and passing through the openings 13a of the supporting plane 13 alternately to the first supplying conduits 24a and to the second supplying conduits 24b. Alternatively, as in the embodiment shown in figures 1-2A, the first supplying conduits 24a and second supplying conduits 24b can originate from respective and distinct releasing openings 13a that are arranged circumferentially on an arc of the supporting plane 13.

[0069] The tablet press machine 1 also comprises a further control and driving unit, which is adapted to receive signals that are representative of the weight of the tablets 100 from the weighing devices 4 and to control, on the basis of these signals, a device for filling the dies 3 for changing the product amount inside the dies 3, i.e. for changing the weight of the tablets 100. The further control and driving unit can be included and/or integrated in the control unit 50 that drives and controls the transferring organs 10.

[0070] In another variant of the tablet press machine 1 of the invention the latter comprises control devices, of known type and not illustrated in the figures, that are arranged for controlling one or more operating parameters of the machine (compressing force of the product powders, height of a product dose) and/or characteristics of

the produced tablets 100 (weight, humidity, presence of foreign bodies, etc.) in order to locate out-of-spec tablets 100', i.e. not-compliant with the production requirements. The control devices are in fact capable to detect variations of the operating parameters and/or characteristics of the tablet and to emit corresponding signals for rejecting the out-of-spec tablets 100'. Advantageously, the control devices can be arranged on the compression turret 2 and comprise, for example, further weighing devices of indirect type. Alternatively, the control devices can be positioned at the transferring organs and comprise, for example, optical control devices.

[0071] The tablet press machine 1 also comprises rejecting devices or means 30 that are arranged to reject the out-of-spec tablets 100' on the basis of rejection signals that are received by the control devices. The rejecting devices 30 can be positioned upstream of the weighing devices 4.

[0072] As illustrated in particular in Figure 6, said rejecting devices 30 can comprise respective deflecting elements 31 that are interposed between the transferring elements 5, 6 and the weighing cells 11, in particular along the supplying ducts 14a, 14b and arranged for directing the out-of-spec tablets 100' toward a rejection magazine 32. Alternatively, the rejecting devices can comprise deviating pistons that are associated with the transferring elements 5, 6, or with the supporting plane 13, for rejecting the out-of-spec tablets 100' before being supplied to the supplying ducts 14a, 14b.

[0073] Still alternatively, as illustrated in Figure 7, the rejecting devices 30 can comprise a rejection chute 33 that is positioned downstream the releasing openings 13a for receiving the out-of-spec tablets 100' that are maintained on the transferring elements 5, 6 and not released by the deviating elements 17 to the weighing cells 11. In this case, the deviating elements 17 are driven or not on the basis of the signals that are emitted by the control devices.

[0074] Basically, the out-of-spec tablets 100' are not supplied to the weighing cells 11 by means of the deviating elements 17 which do not open the supplying ducts 14a, so that such out-of-spec products 100' are transferred by the transferring elements 5, 6 to the rejection chute 33.

[0075] It should be noted that the above-described rejecting devices operates with extreme precision and reliability. In particular, and with respect to the traditional rejecting systems, the above described rejecting devices guarantees the rejection of all the out-of-spec tablets even at high production velocity (rotation of the compression turret) of the tablet press machine 1.

[0076] Furthermore, such devices are not subject to the drawbacks and malfunctions due to product powder inside the machine.

[0077] A further variant of the tablet press machine 1 of the invention is provided that comprises only one transferring element 5 that, in the respective cycle time T_c , is controlled by the control unit 50 so as to be moved with

different angular velocities according to the four operating phases A1, A2, A3, A4 illustrated in the diagram of Figure 5, which illustrates as the abscissae (time) the starting instants t_1 , t_2 , t_3 , t_4 of said operating phases A1, A2, A3, A4 and as the ordinate (velocity) the angular velocities of the transferring element 5.

[0078] Also in this variant of the tablet press machine 1, the transferring element 5 is rotated in a first phase A1, having a first duration (t_1-0), with a first angular velocity ω_1 that is almost constant so as to draw the tablets 100 from turret 2, rotated in a second phase A2, having a second duration (t_2-t_1), with a variable second angular velocity for transferring the tablets 100 from the turret 2 to the weighing devices 4, maintained stopped in a third phase A3, having a third duration (t_3-t_2), for releasing the tablets 100 to the weighing devices 4, and then rotated in a fourth phase A4, having a fourth duration (t_4-t_3), with a third angular velocity that is variable and increasing up to the first velocity angular ω_1 .

[0079] This variant of the machine allows weighing only a part of the tablets 100 that are produced by the machine 1 and drawn in regular or random succession by the transferring element 5, i.e. to perform a so-called statistical weight checking.

[0080] The tablets 100 are released by the transferring element 5 alternately to one of two weighing cells 11 that are provided for each of the seats 15, i.e. alternately to the first supplying duct 14a or the second supplying duct 14b of the weighing devices. Since the weighing time is substantially equal to the cycle time T_c , also in this variant of the machine 1 the weighing devices 4 have at their disposal a weighing time that enables the weighing cells 11 to optimally stabilize for weighing the tablets 100 with high precision and accuracy. In particular, in this embodiment the time that is available for the weighing devices can be equal to twice the cycle time T_c by virtue of the presence of two weighing cells 11 for each seat 15 of the transferring element 5.

[0081] The two weighing cells 11 for each seat 15 enable the transferring element 5 to have a cycle time T_c that is not strictly linked to the weighing time, and then such as to enable to draw the tablets 100 from the compression turret 2 with a greater frequency.

[0082] In any case, it is possible to decrease the drawing frequency for increasing the weighing time of tablets 100.

[0083] The tablet press machine 1 according to the invention enables to perform a statistical weight checking with high precision and accuracy and with a large number of samples of tablets 100. In the embodiment with only one transferring element 5, it is then possible to perform a statistical weight checking of up to 50% of the tablets 100.

[0084] In a further variant of the tablet press machine 1 the weighing devices 4 can provide a weighing unit that is provided with a number of weighing cells 11 that is equal to the number of the seats 15 of the transferring element 5.

[0085] The method according to the invention for producing and weighing tablets 100 for pharmaceutical, food or chemical use, comprises the following steps:

- producing a plurality of tablets 100 in the rotary tablet press machine 1; 5
- moving the plurality of tablets 100 along a circular compression path C2 of the tablet press machine 1;
- arranging at least one transferring element 5, 6 of transferring organs 10 of the tablet press machine 1, which is provided with at least one seat 15, 16 for a respective tablet 100, along the circular compression path C2; 10
- driving in rotation the transferring element 5, 6 that is provided with the seat 15, 16 in such a manner that the latter is moved along a circular transferring path C1 in a respective cycle time Tc comprising four phases A1, A2, A3, A4; 15
- drawing, in a first phase A1, in a drawing point C3 of tangency of the circular compression path C2 and of the circular transferring path C1 at least one tablet 100 by means of the transferring element 5, 6 provided with the at least one seat 15, 16, during said drawing, in said first phase A1, the transferring element 5, 6 being rotated with a first angular velocity ω_1 that is substantially constant; 20 25
- transferring in a second phase A2 along the circular transferring path C1 said at least one tablet C1 100 from the drawing point C3 to the weighing devices 4, during said transferring, in the second phase A2, the transferring element 5, 6 being rotated with a variable second angular velocity; 30
- stopping the transferring element 5, 6 in a third phase A3 and releasing the tablet to the weighing devices 4;
- weighing the tablet 100 in the weighing devices 4; 35
- driving in rotation in a fourth phase A4 the transferring element 5, 6 along the circular transferring path C1 from the weighing devices 4 to the drawing point C3 with a third angular velocity that is variable, in particular increasing up to the first angular velocity ω_1 . 40

[0086] The method also provides to transfer the tablets 100 from the compression turret 2 to the weighing devices 4 through a first transferring element 5 and a second transferring element 6 of the transferring organs 10, each of the transferring elements 5, 6 being adapted to transfer at least one tablet 100 from the compression turret 2 to the weighing devices 4. The first transferring element 5 and the second transferring element 6 are independently operated in such a manner that in an operating interval Tf of the machine 1 the first transferring element 5 draws at least one tablet 100 from the compression turret 2 and at the same time as the second transferring element 6 releases at least one further tablet 100 to the weighing devices 4. 45 50 55

Claims

1. Rotary tablet press machine including:

- a compression turret (2) rotating about a first axis (X1) with constant angular velocity including a die plate (2a) provided with a plurality of dies (3) and a plurality of upper compression punches and a corresponding plurality of lower compression punches;
- weighing devices (4) for weighing said tablets (100); and
- transferring organs (10) for transferring tablets (100) from said compression turret (2) to said weighing devices (4)
- a control unit (50) for driving and controlling said transferring organs (10); **characterized in that** said transferring organs (10) include at least one transferring element (5, 6) provided with at least one seat (15, 16) for a respective tablet (100) and rotatably driven around a second axis (X2), controlled by said a control unit (50), in a respective cycle time (Tc) with angular velocity variable in such a way to be, in succession, rotated in a first phase (A1) with a first angular velocity (ω_1) almost constant for drawing from said compression turret (2) at least one tablet (100), rotated in a second phase (A2) with a variable second angular velocity for transferring said tablet (100) from said compression turret (2) to said weighing devices (4), stopped in a third phase (A3) for releasing said tablet (100) to be weighed to said weighing devices (4) and rotated in a fourth phase (A4) with a third angular velocity that is variable and increasing up to the first angular velocity (ω_1) to be brought back at said compression turret (2) and draw a successive tablet (100).

2. Machine according to claim 1, wherein said weighing devices (4) includes at least two weighing cells (11) for each seat (15, 16) of said at least one transferring element (5, 6), said machine (1) including deviating elements (17, 27) interposed between said at least one transferring element (5, 6) and said at least two weighing cells (11) to release a tablet (100), coming from said at least one seat (15, 16) at each turn of said at least one transferring element (5, 6), alternatively to one of said at least two weighing cells (11) so as to have a weighing time, during which said one of said at least two weighing cells (11) detects the weight of said tablet (100), that is substantially equal to said cycle time (Tc) of said at least one transferring element (5, 6).

3. Machine according to any preceding claim, further including:

- controlling devices to control operating parameters of said machine (1) and/or characteristics of said tablets (100) and to identify a possible out-of-spec tablet (100'), said controlling devices being adapted to emit a rejection signal to reject said out-of-spec tablet (100'); and
 - rejecting means (30) adapted to receive said rejection signal from said checking devices and to reject said out-of-spec tablet (100').
4. Machine according to claim 3, wherein said rejecting means (30) includes a rejection chute (33) adapted to receive from said at least one transferring element (5, 6) an out-of-spec tablet (100') that is maintained in a respective seat (15, 16) and not released to the weighing devices (4).
 5. Machine according to claim 3, wherein said rejecting means (30) includes deflecting elements (31) arranged between said at least one transferring element (5, 6) and said at least two weighing cells (11) to send an out-of-spec tablet (100') coming from a respective seat (15, 16) towards a rejection magazine (32).
 6. Machine according to claim 3, wherein said rejecting means (30) includes deviating pistons adapted to reject an out-of-spec tablet (100') and associated with said at least one transferring element (5, 6) and/or with a supporting plane (13) arranged below said at least one transferring element (5, 6) to support said tablets (100) during transferring to said weighing devices (4).
 7. Machine according to any preceding claim, wherein said at least one transferring element (5, 6) has a shape of a circular sector and is provided on a peripheral edge with at least one seat (15, 16) adapted to receive a tablet (100).
 8. Machine according to any preceding claim, wherein said at least one transferring element (5, 6) is provided on a peripheral edge with a plurality of seats (15, 16) mutually angularly spaced apart and said weighing devices (4) include a number of weighing cells (11) double of the number of said seats (15, 16).
 9. Machine according to any preceding claim, wherein said transferring organs (10) include a first transferring element (5) and a second transferring element (6), each of which adapted to transfer at least one tablet (100) from said compression turret (2) to said weighing devices (4), said first transferring element (5) and said second transferring element (6) being independently driven and controlled by said control unit (50) so that in a operating interval (Tf) of said machine (1) said first transferring element (5) draws at least one tablet (100) from said compression turret (2) and concurrently said second transferring element (6) releases a further tablet (100) to said weighing devices (4).
 10. Machine according to claim 9, wherein said operating interval (Tf) has a duration of time substantially equal to a half of the duration of time of said cycle time (Tc).
 11. Machine according to any preceding claim, wherein said weighing devices (4) include a weighing unit (7) provided with at least two weighing cells (11), arranged side by side and aligned, for each seat (15, 16) of said at least one transferring element (5, 6).
 12. Machine according to any preceding claim, wherein said weighing devices (4) includes two weighing units (8), each of which being provided with a weighing cell (11) for each seat (15, 16) of said at least one transferring element (5, 6).
 13. Machine according to any preceding claims, wherein said first axis (X1) is parallel to said second axis (X2).
 14. Method for producing and weighing tablets (100) comprising the following steps:
 - producing a plurality of tablets (100) in a rotary tablet press machine (1);
 - moving said plurality of tablets (100) along a circular compression path (C2) of said tablet press machine (1);
 - arranging at least one transferring element (5, 6) of transferring organs (10) of said tablet press machine (1), which is provided with at least one seat (15, 16) for a respective tablet (100), along said circular compression path (C2);
 - driving in rotation said transferring element (5, 6) that is provided with the seat (15, 16) so that the latter is moved along a circular transferring path (C1) in a respective cycle time (Tc) comprising four phases (A1, A2, A3, A4);
 - drawing, in a first phase (A1), in a drawing point (C3) of tangency of said circular compression path (C2) and of said circular transferring path (C1) at least one tablet (100) by means of said transferring element (5, 6) that is provided with the at least one seat (15, 16), during said drawing, in said first phase (A1), said transferring element (5, 6) being rotated with a first angular velocity (ω_1) almost constant;
 - transferring in a second phase (A2) along said circular transferring path (C1) said at least one tablet (100) from the drawing point (C3) to weighing devices (4), during said transferring, in said second phase (A2), said transferring element (5, 6) being rotated with a variable second angular velocity;

- stopping said transferring element (5, 6) in a third phase (A3) and releasing said tablet at said weighing devices (4);
- weighing said at least one tablet (100) in said weighing devices (4); 5
- driving in rotation in a fourth phase (A4) said transferring element (5, 6) along said circular transferring path (C1) from said weighing devices 4 to said drawing point (C3) with a third angular velocity that is variable, in particular increasing up to said first angular velocity (ω_1). 10

15. Method according to claim 14, wherein there is provided to transfer said tablets (100) from said compression turret (2) to said weighing devices (4) through a first transferring element (5) and a second transferring element (6) of said transferring organs (10), each of said transferring elements (5, 6) being adapted to transfer at least one tablet (100) from said compression turret (2) to said weighing devices 4, said first transferring element (5) and said second transferring element (6) being driven independently so that in an operating interval (T_f) of said machine 1 said first transferring element (5) draws at least one tablet (100) from said compression turret (2) and concurrently said second transferring element (6) releases at least one further tablet 100 to said weighing devices (4). 15
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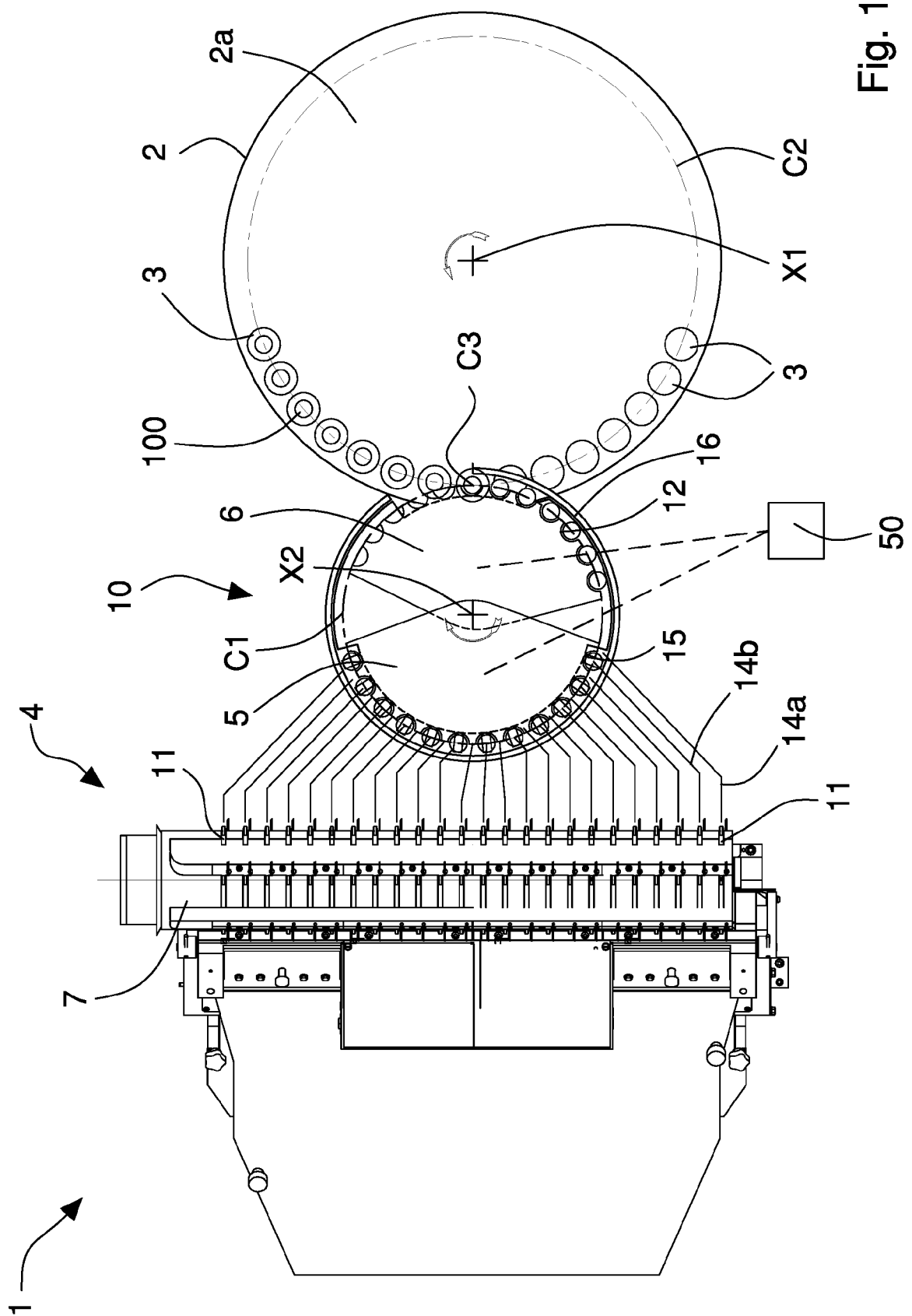


Fig. 1

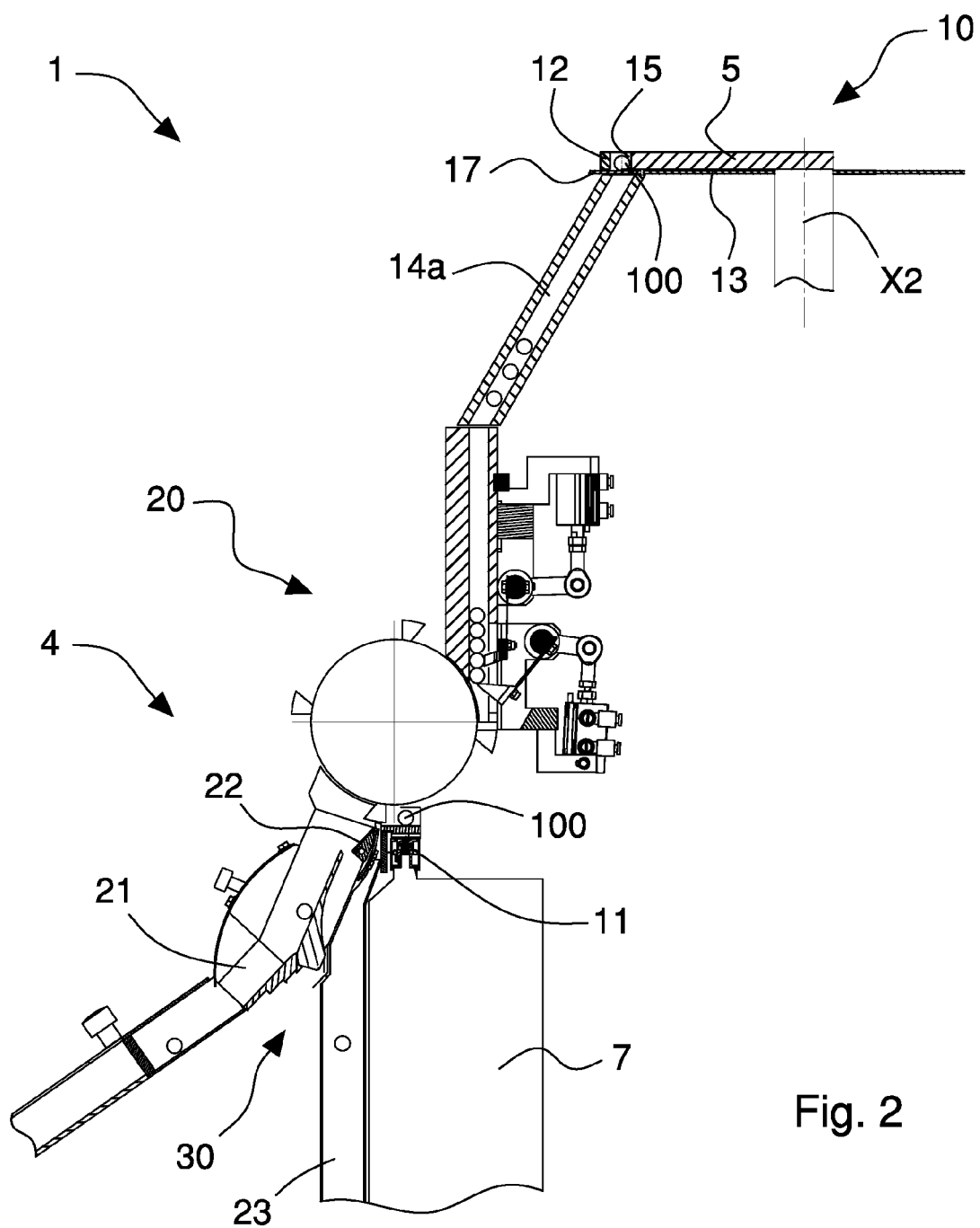


Fig. 2

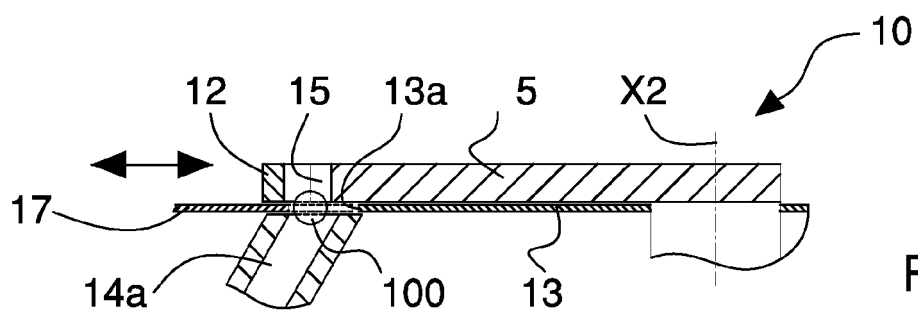


Fig. 2A

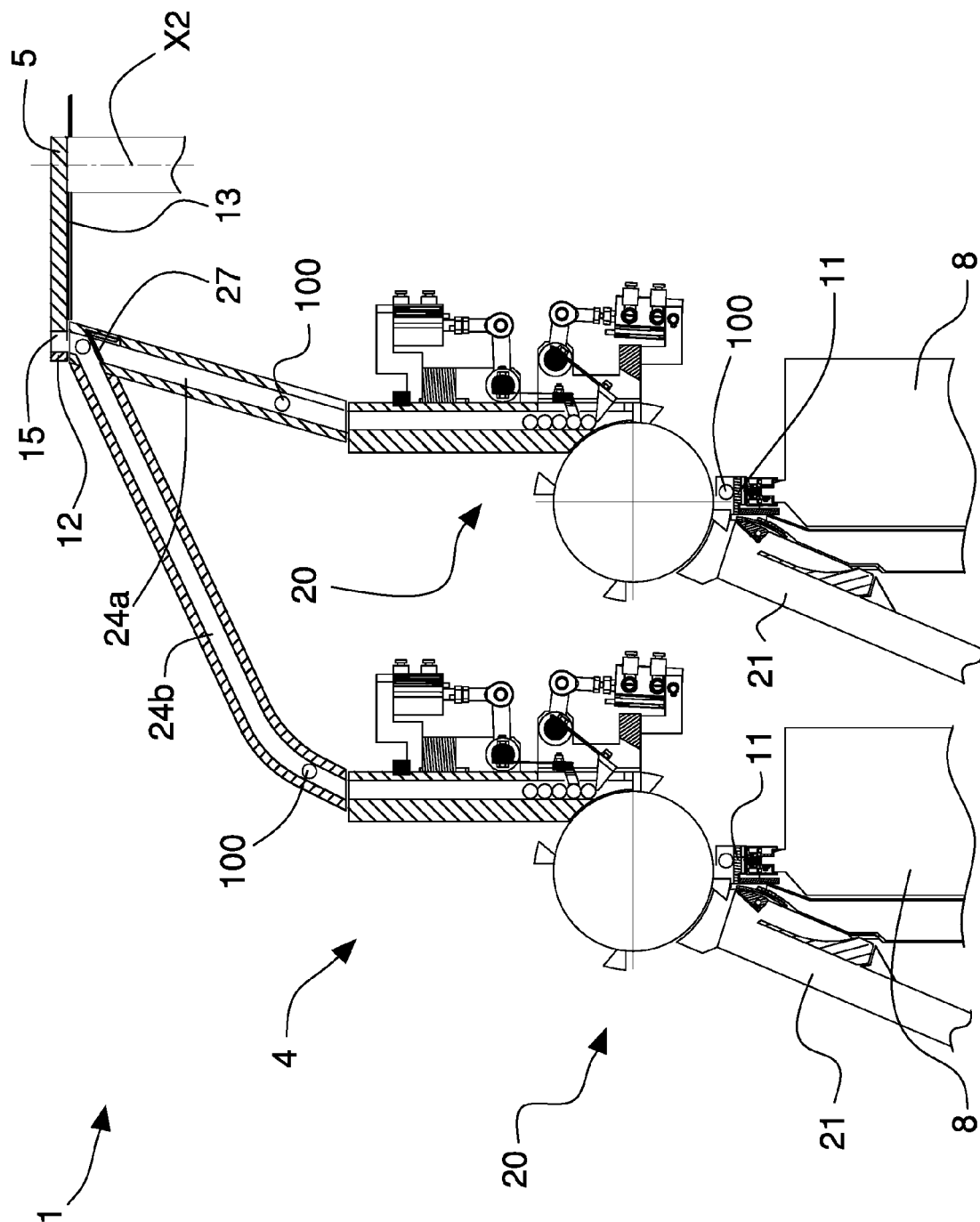


Fig. 3

Fig. 4

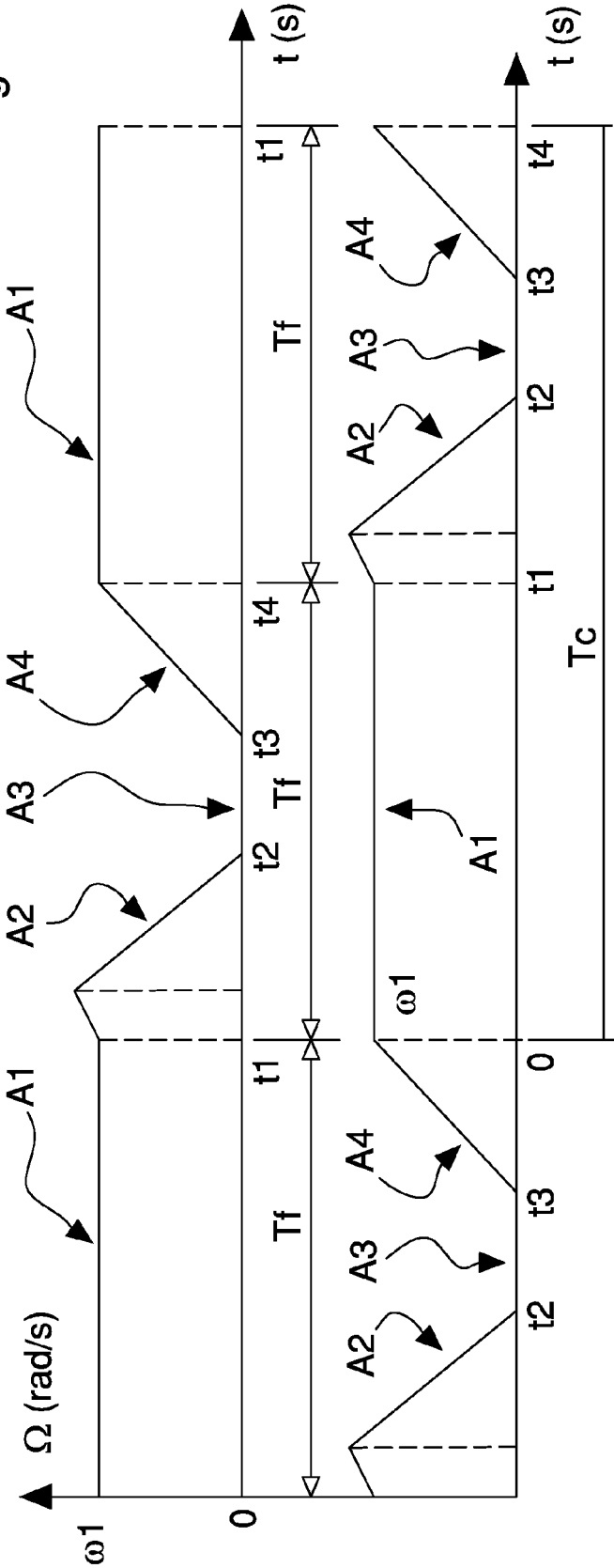
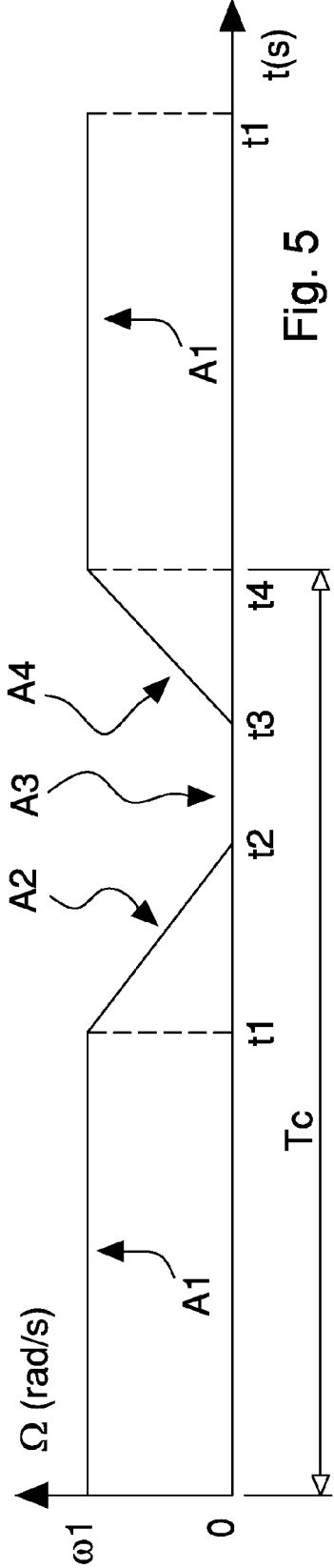


Fig. 5



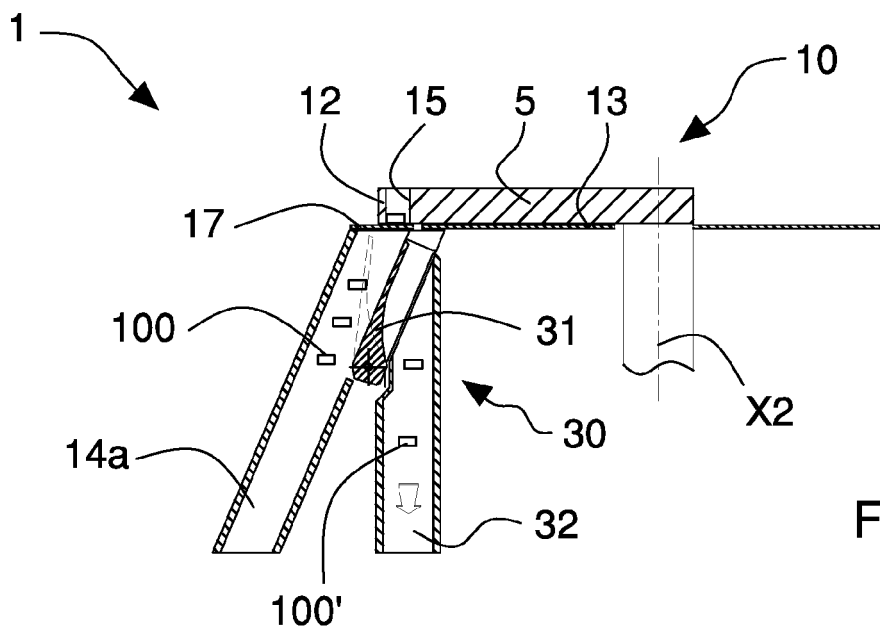


Fig. 6

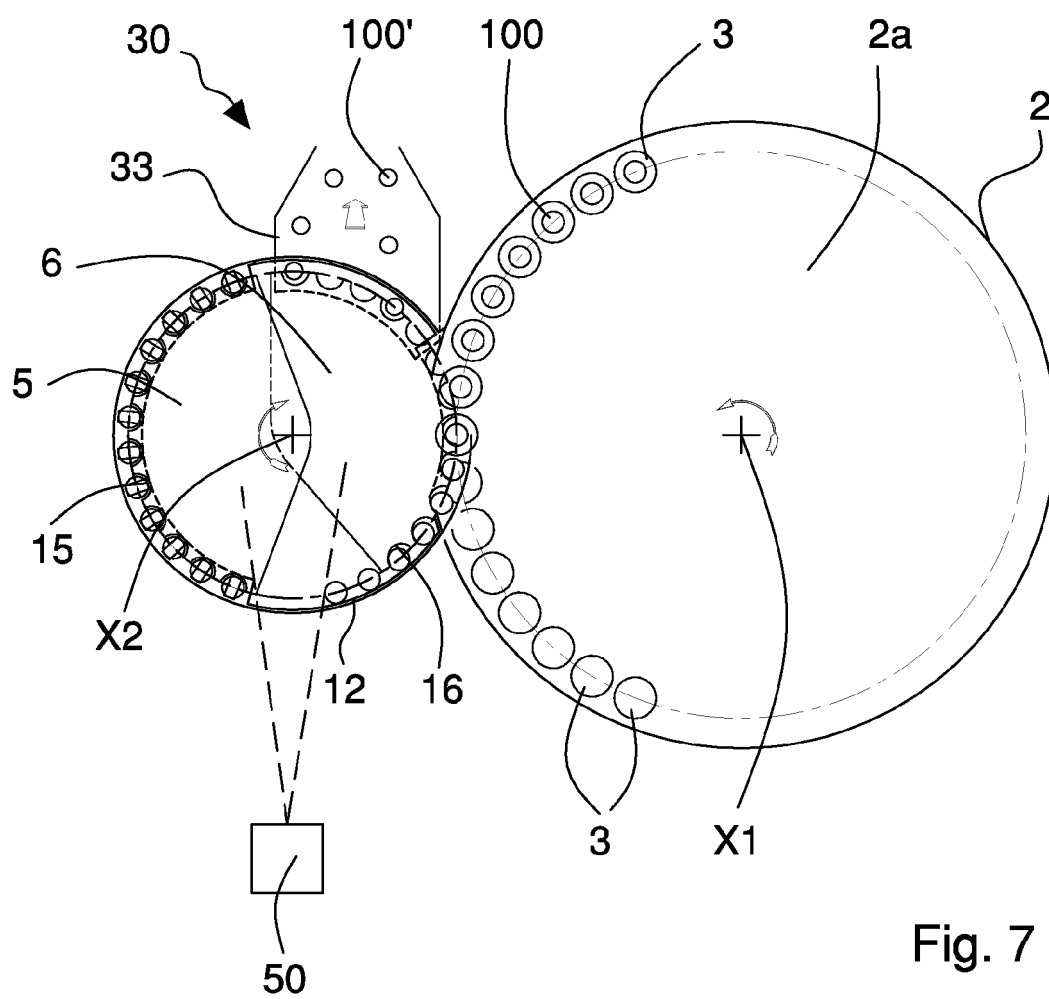


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 15 17 6126

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2012/153283 A1 (IMA KILIAN GMBH & CO KG [DE]; CARSTENS JENS [DE]; ZIETMANN UWE [DE]; S) 15 November 2012 (2012-11-15) * paragraphs [0014], [0035]; figures *	1-8, 11-14	INV. B30B11/08 B30B15/32
Y	US 2005/118260 A1 (BAILEY THOMAS W [GB] ET AL) 2 June 2005 (2005-06-02) * paragraphs [0038], [0129]; figures 7a, 7b *	1-8, 11-14	
A	JP 2011 156576 A (HATA IRON WORKS) 18 August 2011 (2011-08-18) * abstract; figures *	1	
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Place of search The Hague		Date of completion of the search 29 October 2015	Examiner Labre, Arnaud
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