



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.06.2013 Bulletin 2013/26

(51) Int Cl.:
B30B 11/08 (2006.01) B30B 15/06 (2006.01)

(21) Application number: **11250934.4**

(22) Date of filing: **21.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) **Punch for a tablet press**

(57) A punch 20 for a tablet press 10. A body portion 22 of the punch 20 comprises a plurality of cavities 32. The cavities 32 are located at a predetermined angular location about the longitudinal axis 26 of the body 22.

Each cavity comprises a key feature 34. Each key feature 34 has a root portion 35 which is shaped to fit tightly inside the volume defined by a respective cavity 32 so it can be held inside that cavity 32 only by friction.

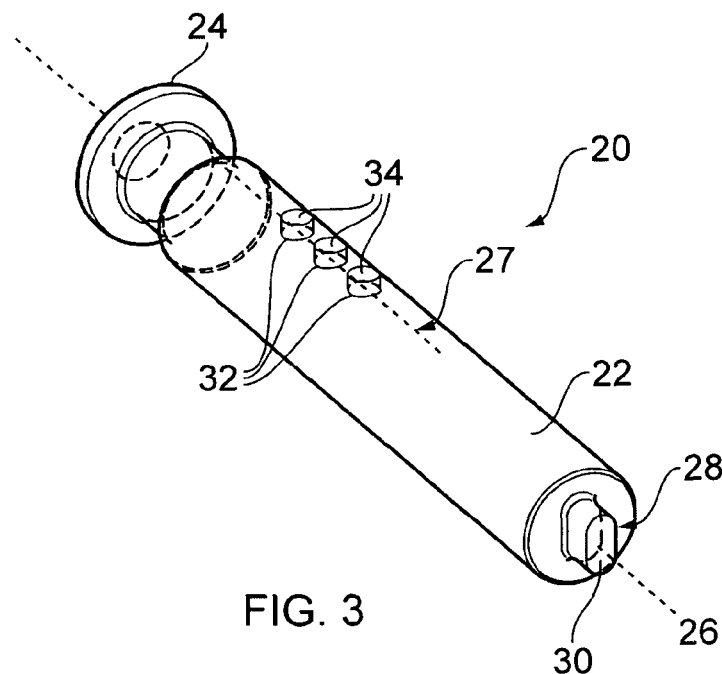


FIG. 3

Description

[0001] The present invention relates to tablet pressing, and particularly to punches for forming a tablet or the like, and to methods of manufacturing such punches.

[0002] Conventionally, tablets are formed by compressing granulated tablet material between two punches in a die. The two punches are generally aligned on a common axis. The aligned punches generally have a specific angular orientation relative to one another, particularly if the tablet is to have a design pressed into it, or a noncircular shape. Such a predefined relative angular orientation may be maintained by providing the punch with a key feature at a known angular location.

[0003] Generally, tablets are formed in a pressing apparatus comprising a plurality of such pairs of punches.

[0004] According to a first aspect of the present invention there is provided a punch for a tablet press, the punch comprising a body portion defining a longitudinal axis, wherein the punch comprises a key feature at a predetermined angular location with respect to the longitudinal axis, and wherein the key feature is fixed to the punch using a screw-less fixing.

[0005] The term 'screw-less fixing' is used herein to mean a fixing that does not include a separate fixing member such as a screw or bolt to fix the key feature to the punch. Examples of screw-less fixings include friction and glue.

[0006] Conventionally, key features are fixed to tablet punches by means of a screw fixing passing through the key feature and into the body of the punch. Such screw fixings provide sites for substances such as contaminants to collect, and can be difficult to clean. Fixing a key feature to a punch without using a screw fixing reduces the contaminant sites available on the punch, making the punch easier and cheaper to clean, and more hygienic.

[0007] One means of screw-less fixing is friction. For example, the key feature may comprise a root portion which is held in a cavity of the punch by a friction fit.

[0008] The use of a friction fit to hold the key feature to the punch results in a very tight fit between the key feature and the punch. This reduces the sites available for contaminants to accumulate, and makes the punch easy to clean.

[0009] The friction fit may comprise a shrink fit.

[0010] The punch may further comprise a plurality of key features at the predetermined angular location.

[0011] It is known to provide a punch having a single key feature at a predetermined angular location. Such a key feature is generally elongate (for example, substantially rectangular) in order to prevent the longitudinal axis of the punch from pivoting out of alignment when the punches in use.

[0012] A disadvantage of such elongate key features is that they can be difficult to manufacture and fit to the punch. In contrast, providing a plurality of aligned key features at substantially the same angular position allows key features of any cross-section to be used, whilst still

preventing the longitudinal axis of the punch from becoming misaligned.

[0013] The punch may comprise a compression surface, and the key features may be arranged to maintain the compression surface in a predefined angular orientation with respect to the longitudinal axis when the punch is in use. The compression surface is preferably provided at an end of the punch body.

[0014] The key features may be located at the same angular position about the longitudinal axis, such that the key features are aligned. The punch may comprise three key features.

[0015] At least one, and preferably each, key feature may comprise a root portion which is shaped to be received in a respective cavity of the punch, and in particular a cavity of the body of the punch. The root portion may be held inside the respective cavity by friction, without the use of a screw fixing.

[0016] The punch and the key features may have an operating condition, in which the root portions of the key features are received in the respective cavities, and an installation condition in which the root portions of the key features are insertable into the respective cavities. The root portion of a key feature is shaped to fit closely inside a volume defined by the cavity, and may be substantially identical in shape and volume to the cavity in which it is held, such that it can be pushed into the cavity under pressure in the installation condition but not easily removed in the operating condition.

[0017] In the operating condition, both the punch and the key features may be at substantially the same operating temperature. In the installation condition, the punch may be at a different temperature to the key features, for example the key features may be at a temperature which is lower than the operating temperature, such that the root portion may be held inside the cavity by a shrink fit.

[0018] The key features may be comprised of metal, for example stainless-steel.

[0019] The key features may comprise a substantially circular cross-section, and may be substantially cylindrical.

[0020] According to a second aspect of the present invention there is provided a punch for a tablet press, the punch comprising a body portion defining a longitudinal axis, wherein the punch is provided with a plurality of key features at a predetermined angular location with respect to the longitudinal axis.

[0021] At least one, and preferably each, key feature may comprise a root portion which is shaped to be received in a respective cavity of the punch, and in particular a cavity of the body of the punch. The root portion may be held inside the respective cavity by friction, without the use of a screw fixing.

[0022] The punch may comprise any of the features described with reference to the first aspect of the invention.

[0023] According to a third aspect of the invention there is provided a tablet press comprising a punch in accord-

ance with at least one of the first or second aspects of the invention.

[0024] The tablet press may comprise a plurality of such punches.

[0025] According to a fourth aspect of the invention there is provided a method of manufacturing a punch for a tablet press, the method comprising fixing a key feature to a punch using a screw-less fixing.

[0026] The fixing step may comprise inserting a root portion of a key feature into a cavity defined in a punch body, wherein the cavity defines a volume, and the root portion of the key feature is shaped to fit closely inside that volume, so as to be held inside the cavity only by friction.

[0027] The method may further comprise the steps of:

changing the cross-sectional dimension of at least one of the cavity and the key feature such that the key feature is insertable (i.e. can be inserted) into the cavity prior to the inserting step; and
changing the cross-sectional dimension of at least one of the cavity and the key feature following the inserting step such that an interference fit is created between the key feature and a wall of the cavity.

[0028] The first changing step may comprise shrinking the key feature so as to reduce the size of the cross-sectional dimension of the key feature with respect its size in the operating condition. The step of shrinking may comprise changing the relative temperatures of the key feature and the punch so as to increase the temperature differential, and may comprise, for example, reducing the temperature of the key feature.

[0029] The second changing step may comprise expanding the key feature so as to increase the size of the cross-sectional dimension of the key feature with respect its size in the inserting step. The step of expanding may comprise changing the relative temperatures of the key feature and the punch so as to reduce the temperature differential, and may comprise, for example, increasing the temperature of the key feature.

[0030] The method may comprise the step of forming one or more cavities in the punch body. Each cavity may define a shape, for example a cylinder.

[0031] The method may comprise the step of forming a key feature for the cavity, the key feature having a root portion which is substantially the same shape as the cavity.

[0032] The method may be repeated, so as to manufacture a punch comprising a plurality of key features.

[0033] The method may further comprise the step of assembling a plurality of such punches in a tablet press.

[0034] The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic sectional side view of an apparatus for forming tablets;

Figure 2 is a perspective view of a prior art punch; Figure 3 is a perspective view of a punch in accordance with the invention;

Figure 3a shows a detail of a key feature of the punch of Figure 3; and

Figure 4 schematically illustrates a method of manufacturing a punch.

[0035] Referring firstly to Figure 1, a tablet pressing apparatus 10 is shown. The apparatus 10 comprises upper and lower tracks 12 each of which defines a plurality of passages 14. A punch 20 is slidably held in each passage. The tracks 12 comprise cam surfaces 16 arranged in use to raise and lower the punches in a predefined sequence. A die member 17 is located between the two tracks.

[0036] The punches are arranged in pairs, such that the longitudinal axes 26 of the two punches in a pair are generally aligned. Each pair of punches is further aligned with a respective through hole or cavity provided in the die member 17 so that a compression face 30 of each of the pair of punches is able to slidably enter the respective through hole in the die member when the apparatus is in use.

[0037] The apparatus 10 further comprises two pairs of compression rollers 18 each having a compression surface 19. The apparatus additionally includes a material feeding system generally indicated at 15, for feeding granulated tablet material into the holes in the die member 17.

[0038] In use, the tracks move the punches 20 along a process path. On that path the cam surfaces 16 guide respective pairs of punches towards and away from one another in order to move the pairs of punches in and out of the holes in the die member 17. The compression rollers 18 are arranged to apply pressure to the punches when the punches are closest to one another, and in particular when the compression surfaces of both punches of a pair are received within the die hole. In this way, the granulated tablet material is compressed between the compression surfaces of the punches, so as to form a tablet.

[0039] In general, the tracks and die member are substantially circular when viewed in plan, so that tablets may be formed as part of a continuous process by rotating the tracks about a central axis.

[0040] Where it is desired to produce a tablet having a circular cross-section it will be appreciated that the relative angular orientation of the two punches in a pair (i.e. the angle made between a fixed point on one of the punches and a similar fixed point on the other punch) is often irrelevant. That is because the compression surface of each punch is substantially uniform when viewed from any angular orientation. Thus it does not matter if one punch is rotated with respect to another, because the resulting tablet will be substantially the same.

[0041] However, where it is desired to produce a tablet having a noncircular shape, the relative angular orienta-

tion of the two punches is important. For example, if it is desired to produce a triangular tablet, then it is important that the triangle shape formed by the compression surface of one punch of the pair is correctly aligned with the triangle shape formed by the compression surface of the other punch in the pair. In such cases it is important that the two punches are in angular alignment, i.e. that a fixed point on one punch is at a predetermined angular orientation with respect to a fixed point on the other punch.

[0042] It is known to maintain a punch in a desired angular orientation by providing a punch with a key feature. An example of such a prior art punch 100 is shown in Figure 2.

[0043] The punch 100 comprises a body 102 and a head 104. The body comprises a cavity 106 a predetermined angular position, which is shaped to receive a key feature 108. The key feature is held in the cavity by a screw or bolt 110. In the example shown, the punch 100 is provided with two key features on opposed sides of the punch, i.e. at different angular locations.

[0044] In use, the key features 108 are received within longitudinal grooves defined in a respective passage 14 of the pressing apparatus. Thus the punch 100 is prevented from rotating within the passage 14, and is held in the predetermined angular orientation.

[0045] One disadvantage of such a punch 100 is the use of a bolt to hold the key feature to the punch. Over time, granulated tablet material can accumulate in and around the bolt, and in gaps around the edges of the key feature, making the punch unhygienic. In order to clean the punch, it is necessary to remove it from the tablet press, remove the bolt and the key feature from the punch, and clean the separated components. This can be time consuming and difficult.

[0046] We have therefore determined that it is desirable not to use a bolt or similar fixing member to hold a key feature to a punch. A punch which does not comprise such a fixing member has fewer sites for contaminants to accumulate, and is easier to clean, and safer to use.

[0047] An alternative punch 20 which aims to address these problems is shown in Figure 3. Figure 3 shows a punch having a key feature comprising a screw-less fixing. In this example the screw-less fixing is friction, and the punch includes a push-fit key feature, and in particular three push-fit key features all at the same angular location. As used herein, a 'push-fit' key feature is one which presses into a cavity provided in the body of the punch, and is held there only by friction. Such key features can be pushed into the cavities in the punch to assemble the punch, and fit tightly without need for a bolt, and without leaving undesirable gaps around the edges of the key feature where contaminants might accumulate.

[0048] The punch 20 of Figure 3 comprises a body 22 and a head 24. The punch 20 is generally cylindrical, and defines a longitudinal axis 26. The punch further comprises a tip 28 having a compression surface 30. It will be seen that the compression surface is noncircular, such that it must be correctly aligned with a similar compression

surface on a cooperating punch to correctly form a tablet.

[0049] The punch, and in particular the punch body 22, comprises a plurality of cavities 32. Each cavity 32 comprises a generally cylindrical bore which extends part way into the body 22. The cavities are located at a predetermined angular location about the longitudinal axis 26 of the body, and are aligned with one another. In particular, each cavity defines a central axis extending longitudinally into the bore. The central axes of the plurality of cavities lie on a line 27 which is parallel to the longitudinal axis 26 of the body 22. Similar cavities may be located at another angular position as well, if desired.

[0050] Each cavity 32 comprises a key feature 34, one of which is shown removed from the punch in Figure 3a. Each key feature has a root portion 35 which is shaped to fit tightly inside the volume defined by a respective cavity so it can be held inside that cavity only by friction. In this example the root portion of each key feature is substantially the same shape and volume as the cavity 32 in which it is to be received. Each key feature also includes a protruding portion which extends from the root portion. When the key feature is held in the cavity the protruding portion extends radially outwardly from the body of the punch, so as to mark the predetermined angular position about the axis 26. In this example, each key feature 34 comprises a generally cylindrical pin, which is dimensioned such that the diameter of the key feature is substantially identical to the diameter of the cavity in which it is held.

[0051] The punch is shown in Figure 3 in an operating condition, in which the key features are held tightly within the cavities in the punch, such that they cannot easily be removed from the cavities.

[0052] The key features are manufactured separately from the punch body. To assemble the punch, the root portions of the respective key features must be inserted into the cavities in the punch body. As stated above, the cavities each define a volume, and each root portion is shaped to fit closely inside a respective volume, so as to be held inside the cavity only by friction. Thus to assemble the punch each key feature is aligned with a respective cavity so that the outline of the cross-section of the key feature fits within the cross-section of the cavity. The root portion of the key feature is then pushed inside the cavity. Because the key features are shaped to fit within a circular cross section, (and in this example define a circular cross-section) it is possible for them to be inserted into the cavity in any angular orientation, simplifying the process of alignment.

[0053] Another method of assembling the punch involves using a shrink fitting process. In such a process it is necessary to cause the punch to adopt an installation condition in which the key features can be inserted into the cavities. In particular, it is necessary to cause a change in the size and/or shape of the key features with respect to the cavities in the punch, so that the key features can be inserted into the cavities.

[0054] One way of doing this is to form the punch body (or at least the part of the punch body including the cavities) and/or key features from one or more materials which change dimension in dependence on external controllable factors, such as temperature. Where the punch body and/or key features are formed of such a material, increasing the difference between the relative temperatures of those components causes a relative dimensional change, which allows the punch to be assembled.

[0055] In this example, the key features 34 are formed of a metal, and in particular stainless steel, which shrinks when the temperature is lowered, and expands when the temperature is raised. In the installation condition the key features are caused to have a temperature which is different to, and in particular lower than, the temperature of the punch body.

[0056] When the temperature differential between the punch body and the key features is increased in this way, the key features shrink with respect to the punch body, allowing the root portions of the key features to be inserted into the cavities in the punch body.

[0057] However, when the temperature differential between the punch body and the key features is reduced, so as to cause the punch to adopt the operating condition, the key features will return to their original 'normal operation' size, creating a tight interference fit between each key feature and a respective cavity wall. Thus the key features are held tightly inside the cavities without the need for bolts, and leaving substantially no gaps between the cavity walls and the key features.

[0058] The alternative method of assembling the punch 20 is further described in Figure 4.

[0059] At step 201, a plurality of cavities are formed in a punch body. The cavities may be formed by any suitable means, for example by machining the cavities into the body.

[0060] At step 202, a plurality of key features are provided. The key features may be formed by any suitable means, for example by extruding a wire, and cutting the wire into sections. The key features are formed such that, at a normal operating (for example approximately 20°C) temperature, the cross-section of a key feature is substantially identical to the cross-section of the respective cavity into which that key feature is intended to fit.

[0061] At step 203, the temperature of the key features is reduced with respect to the temperature of the punch body. In particular, the temperature is reduced to cause the key features to shrink, such that the largest dimension of the cross-section of a key feature is smaller than its equivalent dimension at normal operating temperature.

[0062] This means that the largest dimension of the cross-section of the key feature is now smaller than the largest dimension of the cross-section of the cavity into which that key feature is intended to fit. This allows the key feature to be inserted into the cavity, at step 204.

[0063] Once each key feature has been inserted into a respective cavity, the temperature of the key features is caused or allowed to increase, at step 205, until the

temperature of the key feature is substantially the same as the temperature of the punch body. As the temperature of the key features increases, the key features expand. Once the normal operating temperature is reached, the key features fit tightly into the cavity, such that they cannot easily be removed.

[0064] Various modifications may be made without departing from the scope of the invention.

[0065] In the example shown the key features are substantially circular in cross-section. This can be advantageous, because a body with a circular cross-section can be inserted into a cylindrical cavity in any angular orientation. A key feature of the same cross-sectional shape as the cavity into which it is to fit maximises the surface area in contact with the cavity walls, so maximising friction. A cylindrical body also expands and contracts radially in a substantially linear manner, making such a key feature particularly conducive to the shrink fitting process. However, it will be appreciated that the key features and their respective cavities might have different cross-sections if required, for example square, triangular, oval or irregular.

[0066] It will be appreciated that a different number of key features might be provided to the number shown. Where only one key feature is provided, it is desirable that the key feature is noncircular, and in particular is elongate, in order to inhibit the punch from twisting out of axial alignment. As discussed above however, key features having a circular cross-section, or which are shaped to fit into a circular cavity can simplify the assembly process. Therefore, it can be advantageous to use a plurality of aligned key features as shown, for example two, three or four, rather than a single elongate key feature.

[0067] It will be further appreciated that the use of a plurality of key features may be advantageous even if the friction fitting method described above is not used to assemble the punch. That is because a plurality of key features having regular cross-sections, and in particular circular cross-sections, are in general easier to manufacture and assemble than an elongate key feature of the type shown in Figure 2. Such a punch may be formed by other methods of boltless fixing, for example gluing, rather than the friction or shrink fitting methods described.

[0068] It has been explained that a change in relative size is required between the key features and the cavities of the punch in order to assemble the punch 20 using a shrink fit. Causing a relative temperature change, as discussed above, is only one way of achieving this change in relative size.

[0069] It will be appreciated that steps 201 and 202 described in Figure 4 are optional in that one or more key features and a punch having suitable cavities might be provided to a user for carrying out the method of steps 203 to 205. The user need not necessarily manufacture the punch with cavities and key features himself.

[0070] Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be un-

derstood that the applicant claims protection in respect of any patentable feature or combination of features here-
inbefore referred to and/or shown in the drawings wheth-
er or not particular emphasis has been placed thereon.

Claims

1. A punch for a tablet press, the punch comprising a body portion defining a longitudinal axis, wherein the punch comprises a key feature at a predetermined angular location with respect to the longitudinal axis, and wherein the key feature is fixed to the punch using a screw-less fixing.
2. A punch according to claim 1, in which the key feature comprises a root portion which is held in a cavity of the punch by a friction fit, which friction fit may comprise a shrink fit.
3. A punch according to claims 1 or 2, in which the punch comprises a compression surface, the punch may comprise a plurality of key features at the predetermined angular location, with the key features arranged to maintain the compression surface in a predefined angular orientation with respect to the longitudinal axis when the punch is in use, and the compression surface may be provided at an end of the punch body.
4. A punch according to claim 3, in which the key features are located at the same angular position about the longitudinal axis, such that the key features are aligned, and the punch may comprise three key features.
5. A punch according to claims 3 or 4 when dependent on claim 2, in which at least one, and preferably each, key feature comprises a root portion which is shaped to be received in a respective cavity of the punch, and in particular a cavity of the body of the punch, and the root portion may be held inside the respective cavity by friction, without the use of a screw fixing, and the punch and the key features may have an operating condition, in which the root portions of the key features are received in the respective cavities, and an installation condition in which the root portions of the key features are insertable into the respective cavities, and the root portion of a key feature may be shaped to fit closely inside a volume defined by the cavity, and is substantially identical in shape and volume to the cavity in which it is held, such that it can be pushed into the cavity under pressure in the installation condition but not easily removed in the operating condition.
6. A punch according to claim 5, in which in the operating condition, both the punch and the key features are at substantially the same operating temperature, in which in the installation condition, the punch may be at a different temperature to the key features, and in which in the installation condition, the key features may be at a temperature which is lower than the operating temperature, such that the root portion is held inside the cavity by a shrink fit.
7. A punch according to any of claims 3 to 6, in which the key features are comprised of metal, may be of stainless steel, may comprise a substantially circular cross-section, and may be substantially cylindrical.
8. A punch for a tablet press, the punch comprising a body portion defining a longitudinal axis, wherein the punch is provided with a plurality of key features at a predetermined angular location with respect to the longitudinal axis, and at least one, and preferably each, key feature may comprise a root portion which is shaped to be received in a respective cavity of the punch, and in particular a cavity of the body of the punch, and the root portion may be held inside the respective cavity by friction, without the use of a screw fixing.
9. A punch according to claim 8, in which the punch comprises any of the features described in claims 1 to 7.
10. A tablet press comprising a punch according to any of claims 1 to 9, and the tablet press may comprise a plurality of such punches.
11. A method of manufacturing a punch for a tablet press, the method comprising fixing a key feature to a punch using a screw-less fixing.
12. A method according to claim 11, in which the fixing step comprises inserting a root portion of a key feature into a cavity defined in a punch body, wherein the cavity defines a volume, and the root portion of the key feature is shaped to fit closely inside that volume, so as to be held inside the cavity only by friction, and the method may further comprise the steps of: changing the cross-sectional dimension of at least one of the cavity and the key feature such that the key feature is insertable (i.e. can be inserted) into the cavity prior to the inserting step; and changing the cross-sectional dimension of at least one of the cavity and the key feature following the inserting step such that an interference fit is created between the key feature and a wall of the cavity.
13. A method according to claim 12, in which the first changing step comprises shrinking the key feature so as to reduce the size of the cross-sectional dimension of the key feature with respect to its size in the operating condition, in which the step of shrinking

may comprise changing the relative temperatures of the key feature and the punch so as to increase the temperature differential; and may comprise reducing the temperature of the key feature, in which the second changing step may comprise expanding the key feature so as to increase the size of the cross-sectional dimension of the key feature with respect its size in the inserting step, and in which the step of expanding may comprise changing the relative temperatures of the key feature and the punch so as to reduce the temperature differential, and may comprise, increasing the temperature of the key feature.

14. A method according to any of claims 11 to 13, in which the method comprises the step of forming one or more cavities in the punch body, and each cavity may define a shape, which may be a cylinder.
15. A method according to any of claims 11 to 14, in which the method comprises the step of forming a key feature for the cavity, the key feature having a root portion which is substantially the same shape as the cavity, the method may be repeated, so as to manufacture a punch comprising a plurality of key features, and the method may further comprise the step of assembling a plurality of such punches in a tablet press.

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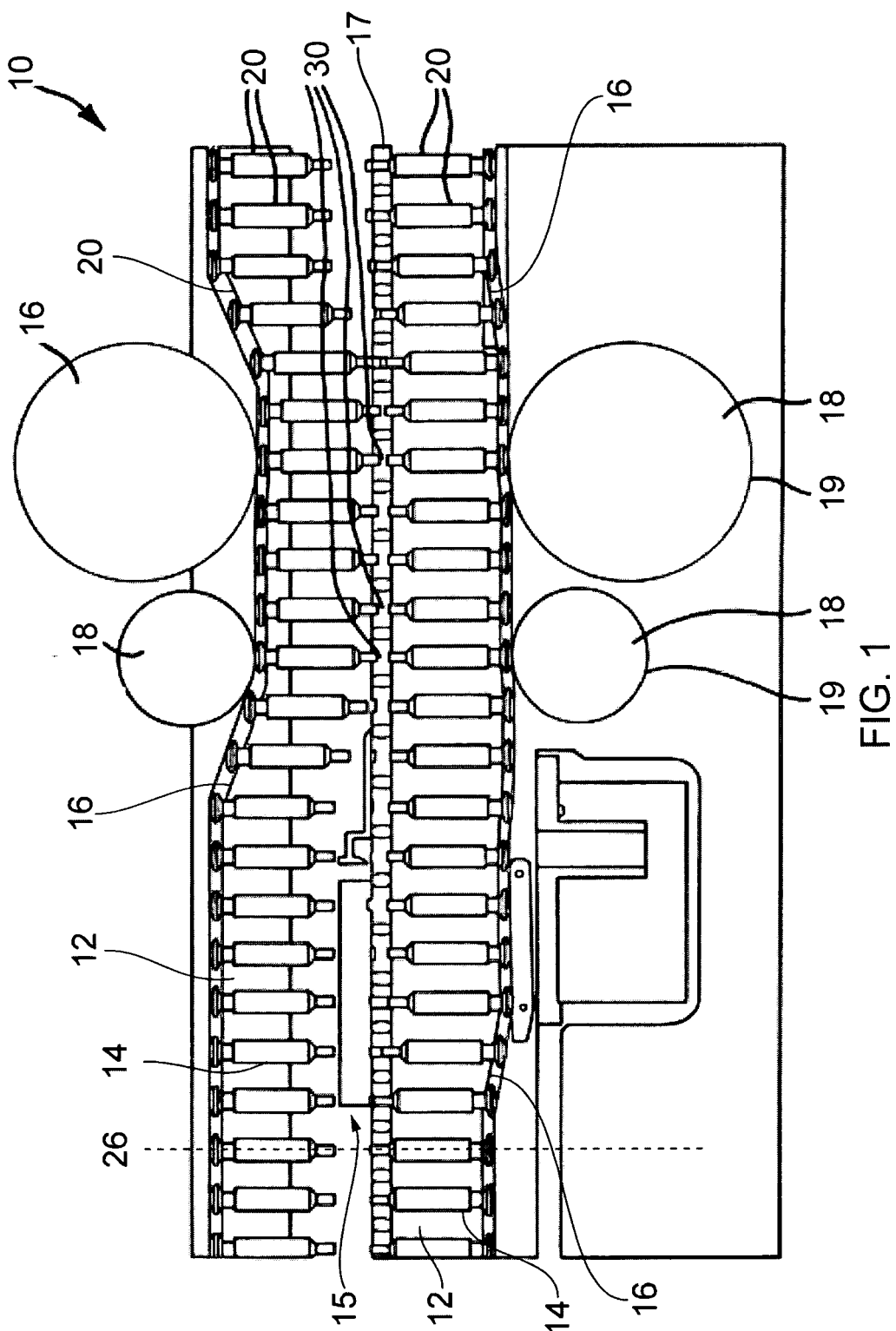
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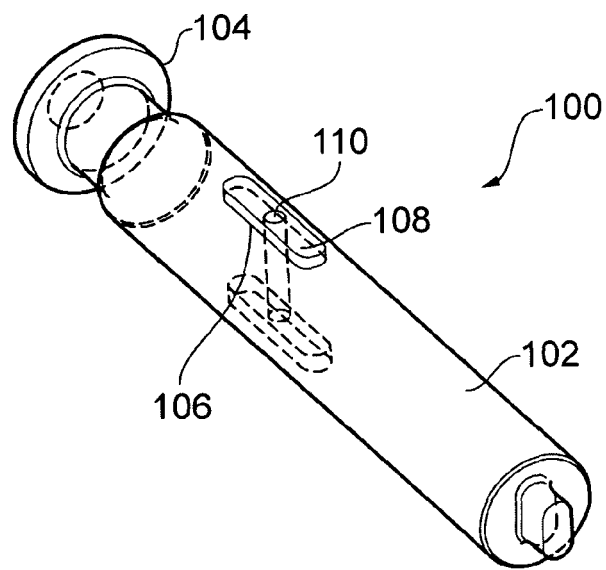


FIG. 2 (Prior Art)

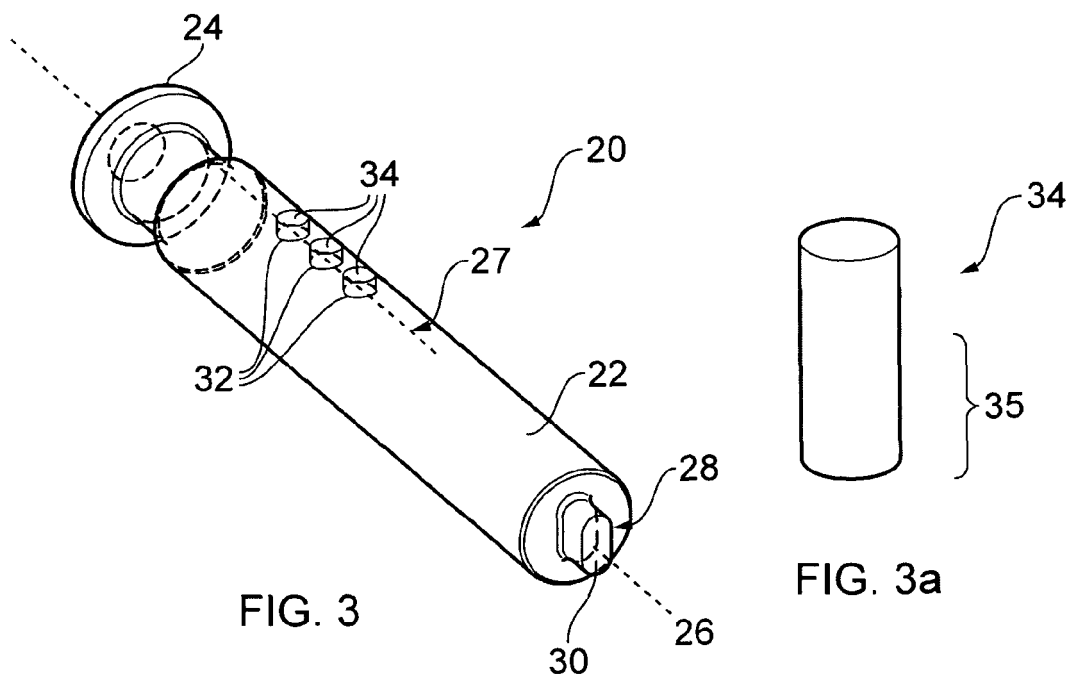


FIG. 3

FIG. 3a

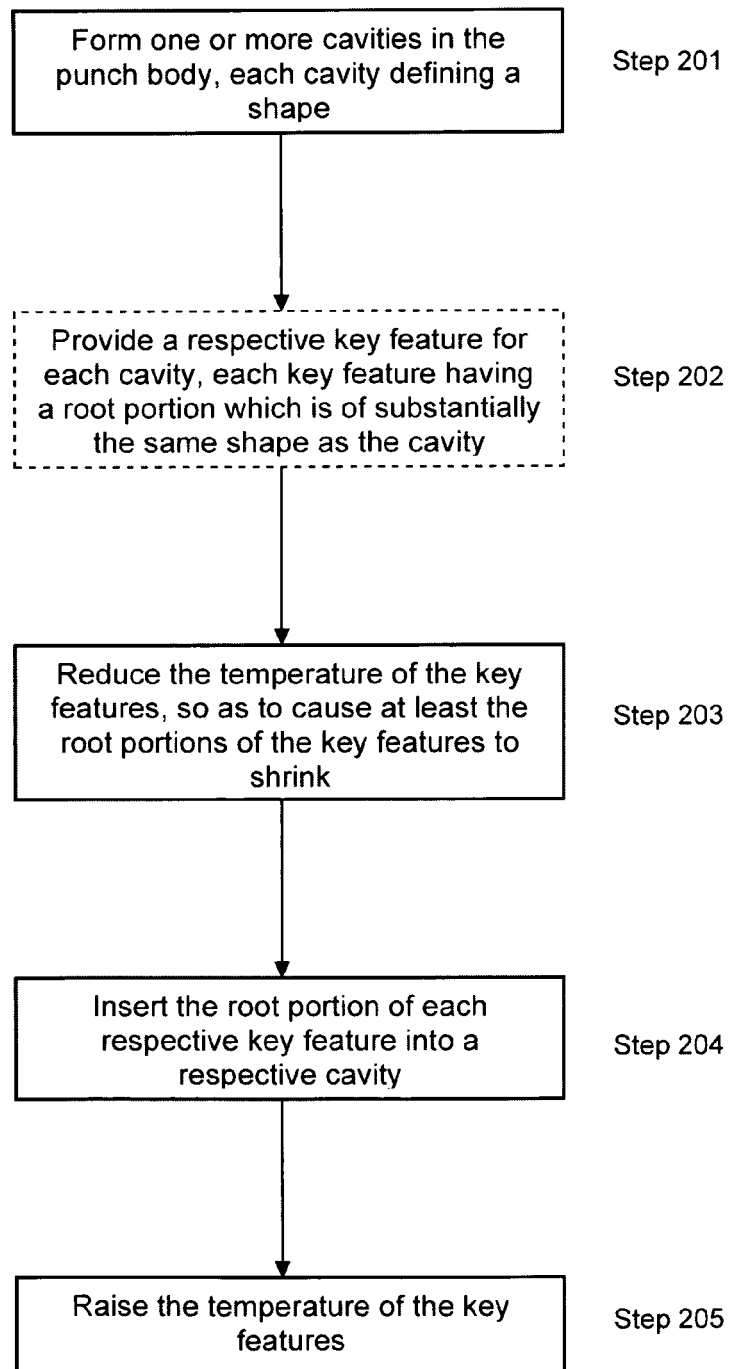


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 11 25 0934

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 May 2012	Examiner Labre, Arnaud
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 25 0934

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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