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## (54) Method and apparatus for producing ceramic products

(57) The present invention relates to a device for shaping ceramic bricks and a method for the same. The device includes a delivering apparatus for dispensing material to a conveyor belt. Moreover, the device further comprises a pressing machine including an upper punch, a lower punch and a base. The belt is positioned between the upper punch and the lower punch of the pressing machine. Moreover, the device further includes a sliding die frame positionable between said upper punch and said lower punch. The die frame is fabricated from a rigid material and is susceptible to being retracted together with the punches. The device for shaping ceramic bricks and he method of the same according to the present invention is capable of addressing a problem of providing various desired brick thicknesses which is not addressed by corresponding convention shaping devices. Simultaneously, the method of shaping ceramic bricks according to the present invention is also capable of providing various methods of decorating ceramic bricks.

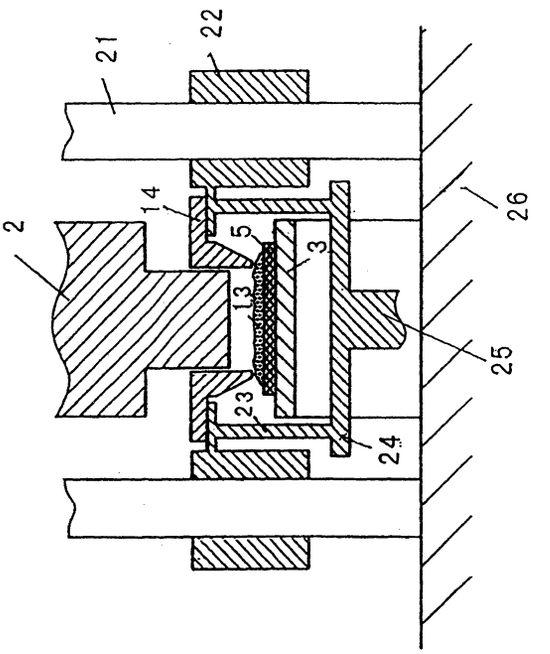


Fig. 7

EP 1 433 580 A2

## Description

### Field of the invention

**[0001]** The present invention relates to methods of shaping ceramic bricks; in particular, but not exclusively, the invention relates to a method of shaping bricks to various desired thicknesses. Moreover, the invention also relates to devices for shaping ceramic bricks.

### Background to the invention

**[0002]** As shown in Figure 1, ceramic bricks are usually formed by delivering material in a lattice frame and then by subsequently pressing the material. Equipment suitable for forming ceramic bricks comprises a lattice frame 6, for example as illustrated in Figure 2, an upper punch 2, a lower punch 3 and a fixed modular frame 11. A plurality of mutually orthogonal lattice bars 10 are fixed in the lattice frame 6.

**[0003]** In operation, the lattice frame 6 is filled with ceramic dry-mash, namely ceramic powder, by means of a hopper 7, and the lattice frame 6 with its ceramic powder are subsequently moved to a location over the lower punch 3 of a press. Next, the lower punch 3 is moved down and a die cavity 4 is thereby filled with ceramic material. Thereafter, the lattice frame 6 is retracted simultaneously with the surface of the dry-mash in the die cavity 4 being dubbed, namely flattened. Next, the upper punch 2 of the press is moved down and presses the dry-mash to generate a stock, namely a blank, whereafter the punch 2 subsequently rises in an upward movement. Subsequently, the lower punch 3 lifts the stock out in an upward movement. Next, the lattice frame 6 moves in a direction of the press again, accordingly pushing the pressed stock out of the press. Meanwhile, the lower punch 3 drops for charging the die cavity 4, and consequently repeating the cycle of operation.

**[0004]** By adjusting height of decline of the lower punch 3, it is possible to control the quantity of dry-mash charged; namely, it is possible to control stock thickness during production and hence thickness of a ceramic brick generated from the stock after suitable thermal processing. The equipment is capable of shaping a ceramic brick of partial thickness, namely in a range of 6 to 25 mm thick. However, the stock is susceptible to being easily destroyed when pushed out of the stock by the lattice frame for thin ceramic bricks having a thickness in a range of 3 to 6 mm.

**[0005]** A company Italy System Company recently undertook to provide shaping equipment for shaping ceramic bricks. Such equipment in shown in Figures 3 and 4, wherein the equipment principally comprises a cyclically revolving planar conveyor belt 5, an upper punch 2 and a lower punch 3 of a press 16, and a flexible contouring device 19 attached to the upper punch 2.

**[0006]** In operation, the revolving conveyor belt 5 bears a ceramic dry-mash 13 and moves it to a position between the upper punch 2 and the lower punch 3. The upper punch 2 and the lower punch 3 apply pressure to the dry-mash 13 and the flexible contouring device 19, and the conveyor belt 5 and the dry-mash 13 are pressed to form the stocks. Next, movement of the conveyor belt 5 removes the stocks from the press 16; meanwhile, the subsequent dry-mash 13 is removed from a position between the upper punch 2 and the lower punch 3, thereby completing a cycle of operation of the equipment.

**[0007]** When the press 16 operates, in order to avoid leakage of the dry-mash 13, the flexible contouring device 19 is attached to the surface of the upper punch 2 and bears pressure on the dry-mash 13. On account of the flexible contouring device 19 being an elastic item, it is only fitted when producing ceramic bricks have a thickness in a range of 3 to 5 mm. However, for ceramic bricks having a thickness greater than 8 mm, during shaping thereof, lateral thrust increases such that frictional force between the flexible contouring device 19 and the punches 2, 3 is not able to resist associated lateral thrust of the dry-mash 13, with a corresponding distortion or fall-off the brick shape; thus, it is not then possible to maintain the shape of the stock with a result that uniformity and quality of the bricks cannot be ensured.

### Summary of the invention

**[0008]** Therefore, an object of the present invention is to provide a method of and a device for shaping ceramic bricks with varying thickness, for example in a range of 3 to 25 mm thick, and thereby addressing aforementioned problems arising in the prior art.

**[0009]** In order the address said object of the invention, according to a first aspect of the present invention, there is provided a device for shaping ceramic bricks, the device comprising:

(a) a pressing machine including an upper punch, a lower punch and a base;
(b) a material delivering apparatus for delivering material to a conveyor belt, said belt being positioned between the upper punch and the lower punch of the pressing machine for delivering the material thereto,
characterized in that the device further comprises:

(c) a sliding die frame for receiving the material, the frame being positionable between said upper punch and said lower punch of the pressing machine, said die frame being fabricated from a rigid material and susceptible to being actuated axially with respect to directions of movement of said punches in operation during formation of said bricks within the device, the die frame co-operating with the punches for determining thickness of said bricks.

**[0010]** The sliding die frame, also known as a gliding die frame, is preferably fabricated from a rigid material.

**[0011]** Preferably, a pin and a groove are included in at least two relative sides of the sliding die frame and at least one of the punches respectively, such that the sliding die frame is coupled to said punch, said positioning pin being presented to the lower punch so that the height of ceramic bricks produced in the device is adjustable.

**[0012]** Preferably, a guiding pillar is mounted onto the pressing machine. The sliding die frame, namely gliding die frame, is coupled to a sliding bush, for example a jacket; said sliding bush is further coupled to a lift-out attachment, the lift-out attachment being operable to push the sliding die frame so that the frame moves axially along a direction of up/down actuation of the upper punch.

**[0013]** The device for shaping ceramic bricks of the present invention is suitable for manufacture of ceramic products of normally various desired thicknesses, for example in a range of 3 to 25 mm thick. A blank body is removed from the pressing machine by ejecting the body supported by a revolving conveyor belt, the blank body not being susceptible to damage when its thickness is more than 6 mm. On account of utilizing a rigid frame for the sliding die frame, which is susceptible to being perpendicularly slip-fitted to the punches, it is possible to obtain intensive use of the die frame on which lateral thrust of the ceramic powder acts whilst simultaneously ensuring precise relative positions of the punches and the die frame. When the die frame is retracted to its upper position, such retraction is of benefit to ensure unhindered motion of the conveyor belt, the ceramic powder and the blank.

**[0014]** The device of the present invention is relative simple in form. A cross-section of the aforesaid sliding die frame is designed to be of trapezoidal form including an upright plane. When the die frame is moved down in operation, excess ceramic powder is removed and required ceramic powder is restrained by the upright plane. Excess ceramic powder is pushed outwardly by said trapezoidal form. The device of the present invention is susceptible during operation to form shaped blanks whose sides are mutually normal and thereby circumventing a need for further cutting, thereby reducing an amount of cutting conventionally required.

**[0015]** In order to address the object of the present invention, according to a second aspect of the present invention, there is provided a method of shaping ceramic bricks, the method including the steps of:

(a) delivering a ceramic powder from a material delivery apparatus to a conveyor belt;
(b) transporting said ceramic powder by way of the conveyor belt to a position between an upper punch and a lower punch of a pressing machine;
(c) positioning a sliding die frame between the upper punch and the lower punch, the die frame being fabricated from a substantially rigid material, and the die frame being susceptible to being moved over the conveyor belt for accommodating the ceramic powder therein;
(d) moving the sliding frame accommodating the ceramic powder relative to the upper punch and/or the lower punch such that actuation of at least one of the punches is operable to compress the accommodated ceramic powder for shaping said powder to form a corresponding blank body;
(e) upwardly retracting the sliding die frame relative to the blank body;
(f) separating said blank body from the upper punch; and
(g) removing by way of the conveyor belt said blank body from the position between the upper punch and the lower punch.

The method of shaping ceramic bricks of the present invention is distinguished from contemporary methods of shaping ceramic bricks known in the prior art, such contemporary methods not being capable of sufficiently varying the thickness of blanks produced for manufacturing ceramic bricks. Moreover, the method of the present invention is of advantage in that it is capable of providing a fast operating cycle, enhanced versatility and straightforward operation, higher efficiency and uniform predictable quality.

**[0016]** It will be appreciated that features of the invention are susceptible to being combined in any combination without departing from the scope of the invention as defined by the appended claims.

**Description of the diagrams**

**[0017]** Embodiments of the invention will now be described, by way of example only, wherein:

Figure 1 is an illustration of a prior-art press-shaping device for delivering material by way of a lattice frame for manufacturing ceramic bricks;

Figure 2 is an illustration the lattice frame of the device of Figure 1;

Figure 3 is an illustration of a press-shaping device for producing ceramic bricks according to the present invention, the device utilizing a conveyor belt for delivering material;

Figure 4 is a cross-sectional diagram of the press-shaping device of Figure 3;

Figure 5 is a cross-sectional diagram of a press for a device for shaping ceramic bricks according to one embodiment of the present invention;

Figure 6 is a cross-sectional diagram illustrating a gliding die frame according to the present invention;

Figure 7 is a cross-sectional diagram illustrating other embodiments according to the present invention;

Figure 8 is a magnified illustration of a part of the device of Figure 5; and

Figure 9 is an illustration of another embodiment of the present invention;

wherein the following numerals will be employed to identify features in the aforementioned Figures 1 to 9 as provided in Table 1:

Table 1:

| | | |
|---|---|---|
| 1: frame | 2: upper punch | 3: lower punch |
| 4: die cavity | 5: conveyor belt | 6: lattice frame |
| 7: hopper | 8: dry-mash pipe | 9: bunker |
| 10: lattice bar | 11: fixing die frame | 12: die frame platform |
| 13: dry mash | 14: sliding die frame | 15: blank |
| 16: press | 17: ornamental equipment | 18: elastic edging |
| 19: elastic contouring device | 20: positioning pin | 21: guide pillar |
| 22: sliding sleeve | 23: upright pushing rod | 24: plane push rod |
| 25: roof bar | 26: base | 27: groove |
| 28: pin | 29: spring | 30: hydraulic device |

**Description of embodiments of the invention**

**[0018]** Referring to the accompanying drawings, a preferred embodiment of the present invention will now be described in detail. Features and the nature of the present invention will thereby be comprehended more clearly.

**[0019]** Referring to Figure 4, there is shown a cross-sectional diagram of a pressing machine of a device for shaping ceramic bricks according to one embodiment of the present invention. The device includes known delivering devices and ornamental equipment for applying ornamentation to ceramic bricks. The ornamentation equipment is preferably cloth or dry powder printing equipment or similar. The device comprises a sliding die frame 14, for example as illustrated in Figures 5 and 6, fitted on an outside surface of an upper punch 2, the frame 14 being operable to glide axially along a side surface of the upper punch 2. The upper punch 2 is fabricated from a rigid material, for example cast iron, so that it is capable of packing powder tightly in the die frame 14. The die frame 14 is connected to the upper punch 2 by a pin 28, for example as also shown in Figure 8. A first end of the pin 28 is preferable attached to an inside region of the die frame 14, and a second end of the pin 28 is positioned in a groove 27 of the upper punch 2 and can optionally also be abutted tightly by a spring 29 to the upper punch 2. Moreover, the groove 27 is preferably also incorporated in the sliding die frame 14, with the pin 28 coupled to the upper punch 2; alternatively, the sliding die frame 14 is directly connected to the upper punch 2, for example by way of a plastics material pin.

**[0020]** As illustrated in Figure 5, there is shown a cross-sectional view of the sliding die frame 14 which is optionally of trapezoidal cross-sectional form, namely each inside surface of the die frame 14 is parallel to each side of the upper punch 2, so that outside and inside surfaces of the die frame 14 form an included angle as illustrated.

**[0021]** A positioning pin 20 is included below the die frame 14 and is also included over the lower punch 3 by way

of a bracket (not shown). Moreover, the height of the positioning pin 20 is adjustable, thereby a varying desired thickness for a blank body produced can be controlled by adjusting the positioning pin 20. A plastics material edging 18 is positioned along edges of the conveyor belt 5 and is capable of preventing powder from escaping during the pressing process.

**[0022]** In operation, when powder is delivered to a position between the upper punch 2 and the lower punch 3 by way of the conveyor belt 5, the upper punch 2 and the die frame 14 which is actuated by the upper punch 2 via the pin 28 are together moved downwards.

**[0023]** Next, after the die frame 14 contacts with the position pin 20, the die frame 14 stops moving and contacts with the powder 13; the powder 13 is tightly restrained within the die frame 14 on account of the groove 27; the groove 27 results in the upper punch 2 moving downwards, thereby pressing the powder 13 to form a blank 15, for example as shown in Figure 3.

**[0024]** After the powder is formed into the blank 15, the upper punch 2 is retracted upwardly when a bottom region of the groove 27 contacts with the pin 20. Moreover, the upper punch 2 and the die frame 14 are actuated upwardly together by virtue of movement of the upper punch 2. Furthermore, the pressed shaped blanks for producing ceramic bricks are removed from a press 16 by way of the conveyor belt 5 simultaneously with new material being transported to a position between the upper punch 2 and the lower punch 3.

**[0025]** The function of the positioning pin 20 is to couple tightly the die frame to the conveyor belt 5 so as to provide an air-tight seal whilst not penetrating into the conveyor belt 5 and hence has a benefit of protecting the conveyor belt 5. An elastic edge is included on the conveyor belt 5 for further preventing the powder 13 from moving laterally, thereby improving quality of edges of the blanks for producing ceramic bricks.

**[0026]** Similarly, the present invention is also applicable to a press machine whose upper punch 2 is stationary and whose lower punch 3 is actuated, such that the die frame 14 is actively connected to the lower punch 2. Thus, upwardly directed pressure provided by the lower punch 3 is operable to compress the powder 13 into corresponding blanks 15 suitable for processing to produce ceramic bricks.

**[0027]** Referring to Figures 6 and 7, another embodiment of a device for shaping ceramic bricks according to the present invention is illustrated, the device comprising the upper punch 2, the lower punch 3, a roof bar 25, a base 26 and the die frame 14. A sliding sleeve 22 is arranged to slide in operation along a guide pillar 21. Moreover, the die frame 14 is coupled to the sliding sleeve 22, for example by way of a screw joint or other manner as known. The conveyor belt 5 is movable between the upper punch 2 and the lower punch 3.

**[0028]** The guide pillar 21 is mounted onto the base 26, such that actuation directions of the upper punch 2 and the lower punch 3 remain mutually parallel in operation. A groove is provided along a bottom region of the lower punch 3, such that the roof bar 25 and its associated plane push rod 24 form the groove. Moreover, the roof bar 25 is connected via the plane push rod 24 and an upright pushing rod 23 to the sliding sleeve 22. In operation, the roof bar 25 is arranged to push the plane push rod 24, the upright pushing rod 23, the sliding sleeve 22 and the die frame 14 so that these integrally make a vertical up/down movement in operation. The roof bar 25 is alternatively susceptible to being actuated in an up/down movement by way of a cam or other mechanical driving configuration.

**[0029]** In operation, dry-mash powder 13 is transported to a position between the upper punch 2 and the lower punch 3 by way of the conveyor belt 5. The sliding frame 14 actuated by the roof bar 25 is then moved down to a position over the conveyor belt 5, thereby enclosing the powder 13. Next, the upper punch 2 is pressed down to press the powder 13 into shaped blanks. Thereafter, the upper punch 2 is retracted upwardly, and the sliding die frame 14 actuated by the roof bar 25 is retracted upwardly. Next, the shaped blanks for producing ceramic bricks are removed along the conveyor belt 5, simultaneously with new powder being delivered to a position between the upper punch 2 and the lower punch 3, thereby completing one cycle of operation of the device.

**[0030]** In the aforementioned embodiment, the roof bar 25 actuating the die frame 14 in an upward/downward motion is only one particular example. It will be appreciated that actuation of the die frame 14 relative to the punches 2, 3 can be realized using other types of ejection device. Optionally, the ejection device is mountable outside the press, thereby avoiding a need to provide a groove in the lower punch 3.

**[0031]** As illustrated in Figure 9, another embodiment of the present invention is shown, wherein at least one hydraulic device 30 is coupled to the sliding sleeve 22. Moreover, the sliding sleeve 22 is connected via a screw thread to the die frame 14, Thus, the sliding sleeve 22 actuated by the hydraulic device 30 is susceptible to being moved axially relative to the upper punch 2 and the lower punch 3 and results in ceramic powder being tightly compressed in the die frame 14.

**[0032]** According to the method of shaping ceramic bricks of the present invention, an embodiment of the method can be elucidated with reference to the aforementioned device for shaping ceramic bricks. The method comprises the following steps of:

(a) delivering the ceramic powder 13 to the conveyor belt 5 of the device;
(b) transporting the ceramic powder 13 along the conveyor belt 5 to a position between the upper punch 2 and

lower punch 3 of the press;
(c) positioning the die frame 14 between the upper punch 2 and the lower punch 3;
(d) retracting the die frame 14 actuated by the roof bar 25 and the sliding sleeve 22 to a position over the conveyor belt 5;
(e) enclosing the powder 13 in the die frame 14, the die frame 14 being fabricated from a rigid material:
(f) moving the upper punch 2 axially downwards relative to the die frame 14 and thereby applying a pressing force to the powder 13 in the die frame 14;
(g) after the powder 13 is pressed into the form of blank bodies, upwardly retracting the upper punch 2;
(h) actuating the die frame 14 by way of the roof bar 25 and the sliding sleeve 22 so as to retract it upwardly and away from the conveyor belt 5; and
(i) removing the blank bodies via the conveyor belt 5 from a position between the upper punch 2 and the lower punch 3, whilst simultaneously delivering new powder material to a position between the upper punch 2 and the lower punch 3.

**[0033]** It will be appreciated that, besides embodiments of the invention described in the foregoing, several modifications and variations of the above embodiments may be implemented without departing from spirit and scope of the present invention. Accordingly, all such modifications and variations are intended to be included within the scope of the appended claims.

## Claims

**1.** A device for shaping ceramic bricks (15), the device comprising:

(a) a pressing machine (16) including an upper punch (2), a lower punch (3) and a base (26) ;
(b) a material delivering apparatus (7) for delivering material to a conveyor belt (5), said belt (5) being positioned between the upper punch (2) and the lower punch (3) of the pressing machine (16) for delivering the material thereto,
**characterized in that** the device further comprises:
(c) a sliding die frame (14) for receiving the material, the frame (14) being positionable between said upper punch (2) and said lower punch (3) of the pressing machine (16), said die frame (14) being fabricated from a rigid material and susceptible to being actuated axially with respect to directions of movement of said punches (2, 3) in operation during formation of said bricks (15) within the device, the die frame (14) co-operating with the punches (2, 3) for determining thickness of said bricks (15).

**2.** A device according to Claim 1, further including a positioning pin (20) and a groove (27) independently positionable with respect to the sliding frame (14) and at least two mutually opposing surfaces of the punches (2, 3), the sliding frame (14) being actively coupled to one of the punches (2, 3), the device further including a bracket whose height is adjustable with respect to the lower punch (3) with the positioning pin (20) mounted on the bracket, wherein said positioning pin (20), said bracket and said groove (27) are operable to co-operate to limit mutual actuation of the punches (2, 3) during formation of the bricks within the device to control their thickness.

**3.** A device according to Claim 1, wherein the sliding die frame (14) is coupled to an ejecting apparatus, the sliding frame (14) being arranged in operation to be pushed by the ejecting apparatus when moved axially along said direction of movement of said punches (2, 3).

**4.** A device according to Claim 3, wherein said ejecting apparatus comprises a guide pillar (21) on the base (26) of the pressing machine (16), a sliding sleeve (22) slidably engaged to the pillar (21), the sleeve being connected to the die frame (14) as an integral assembly, the sleeve (22) being coupled to a roof bar, wherein the sleeve (22) and the sliding frame (14) are susceptible to being actuated by the roof bar (25) to move them relative to at least one of the punches (2,3).

**5.** A device according to Claim 3, wherein the ejecting apparatus includes a guide pillar mounted on the base (26) of the pressing machine, the sliding sleeve being slidably mounted onto the guide pillar, the sleeve being connected with the die frame as an integral assembly, the sleeve being additionally coupled to at least one hydraulic actuating apparatus, the sleeve and the sliding frame arranged to be actuated by the hydraulic apparatus for moving them relative to at least one of the punches (2, 3).

6. A device according to Claim 4 or 5, wherein the sliding sleeve (22) is coupled to the sliding die frame (14) by way of a screw thread to form an integral assembly.

7. A device according to any one of Claims 1 to 5, wherein the sliding die frame (14) comprises peripheral members whose cross-section is of trapezoidal form, said peripheral members comprising inside surfaces disposed parallel to a direction of motion of the punches (2, 3) in operation, and also comprising outside surfaces disposed at an included angle relative to the inside surfaces.

8. A device according to any one of Claims 1 to 5, wherein the conveyor belt (5) comprises a peripheral edge thereto having an elastic edge strip.

9. A method of shaping ceramic bricks, the method including the steps of:

(a) delivering a ceramic powder from a material delivery apparatus (7, 17) to a conveyor belt (5);
(b) transporting said ceramic powder by way of the conveyor belt (5) to a position between an upper punch (2) and a lower punch (3) of a pressing machine (16);
(c) positioning a sliding die frame (14) between the upper punch (2) and the lower punch (3), the die frame (14) being fabricated from a substantially rigid material, and the die frame (14) being susceptible to being moved over the conveyor belt (5) for accommodating the ceramic powder therein;
(d) moving the sliding frame (14) accommodating the ceramic powder relative to the upper punch (2) and/or the lower punch (3) such that actuation of at least one of the punches (2,3) is operable to compress the accommodated ceramic powder for shaping said powder to form a corresponding blank body (15);
(e) upwardly retracting the sliding die frame (14) relative to the blank body (15);
(f) separating said blank body (15) from the upper punch (2); and
(g) removing by way of the conveyor belt (5) said blank body (15) from the position between the upper punch (2) and the lower punch (3).

10. A method according to Claim 9, wherein the blank body (15) is retracted from the position between the upper punch (2) and the lower punch (3) by way of the conveyor belt (5), substantially simultaneously as subsequent ceramic powder is transported to the position between the upper punch (2) and the lower punch (3).

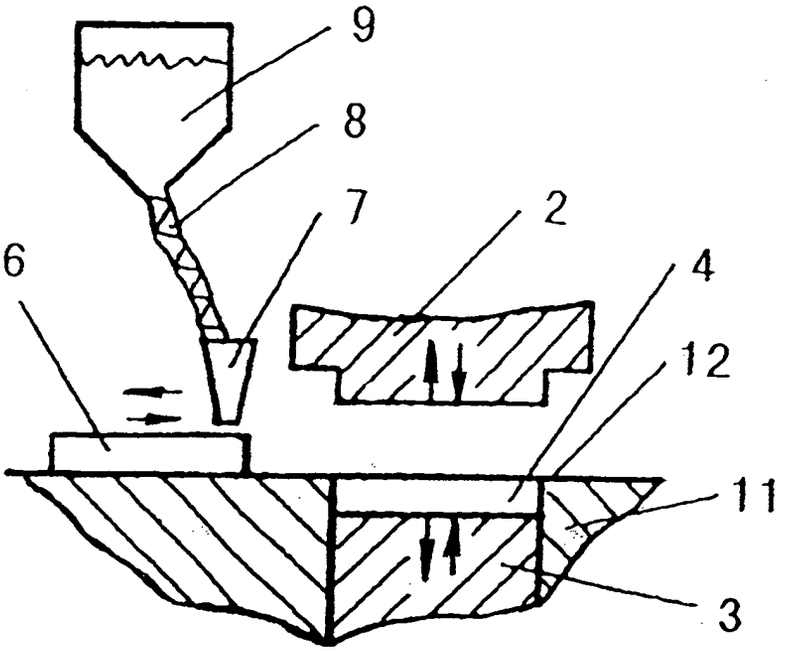


Fig. 1

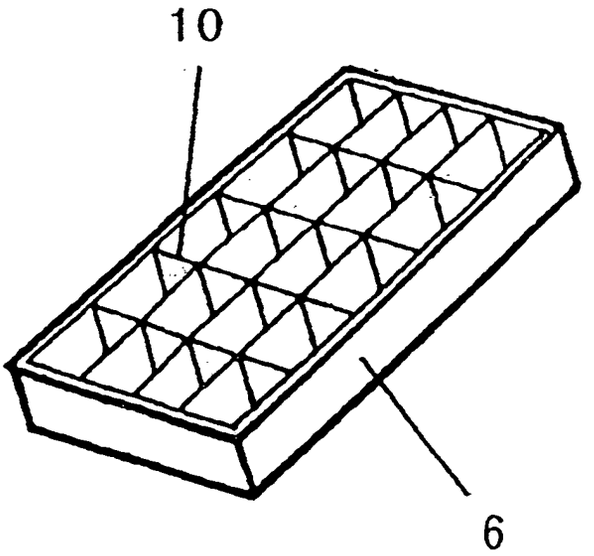


Fig. 2

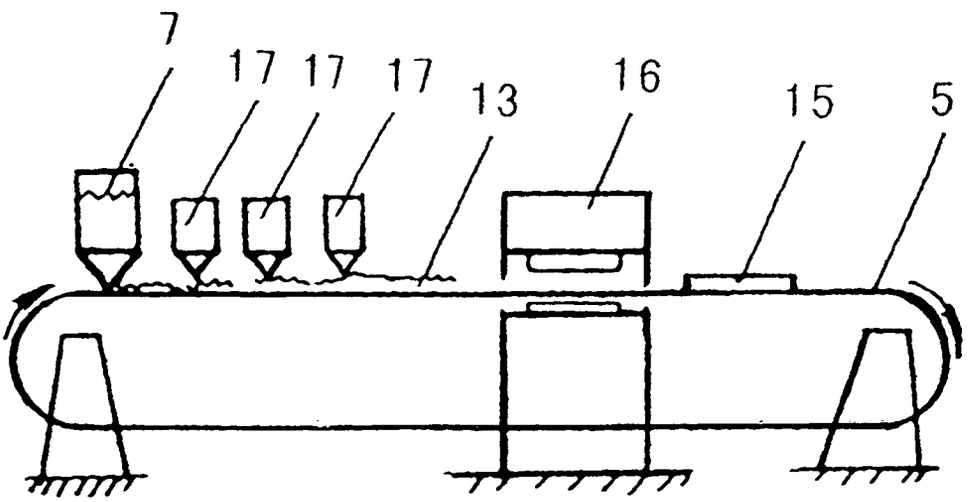


Fig. 3

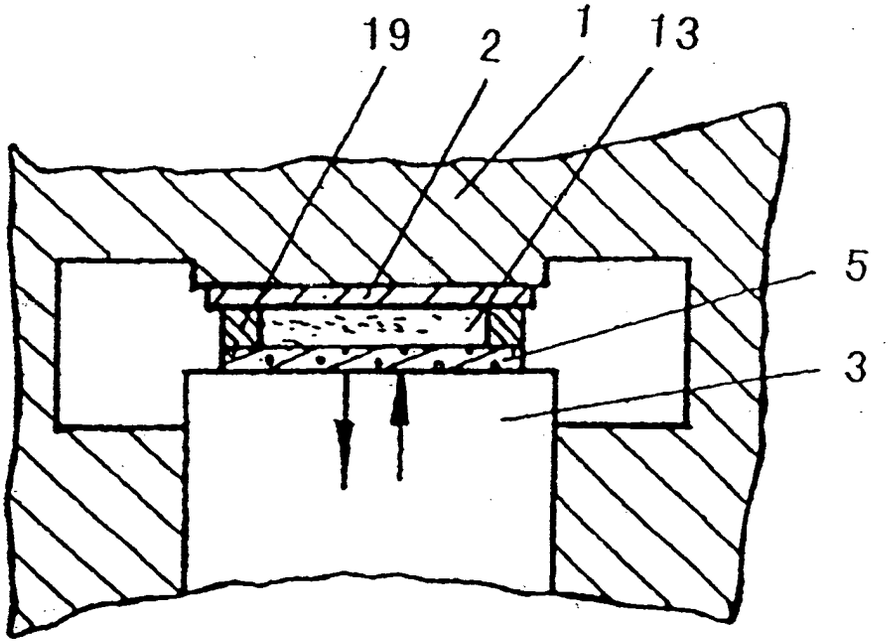


Fig. 4

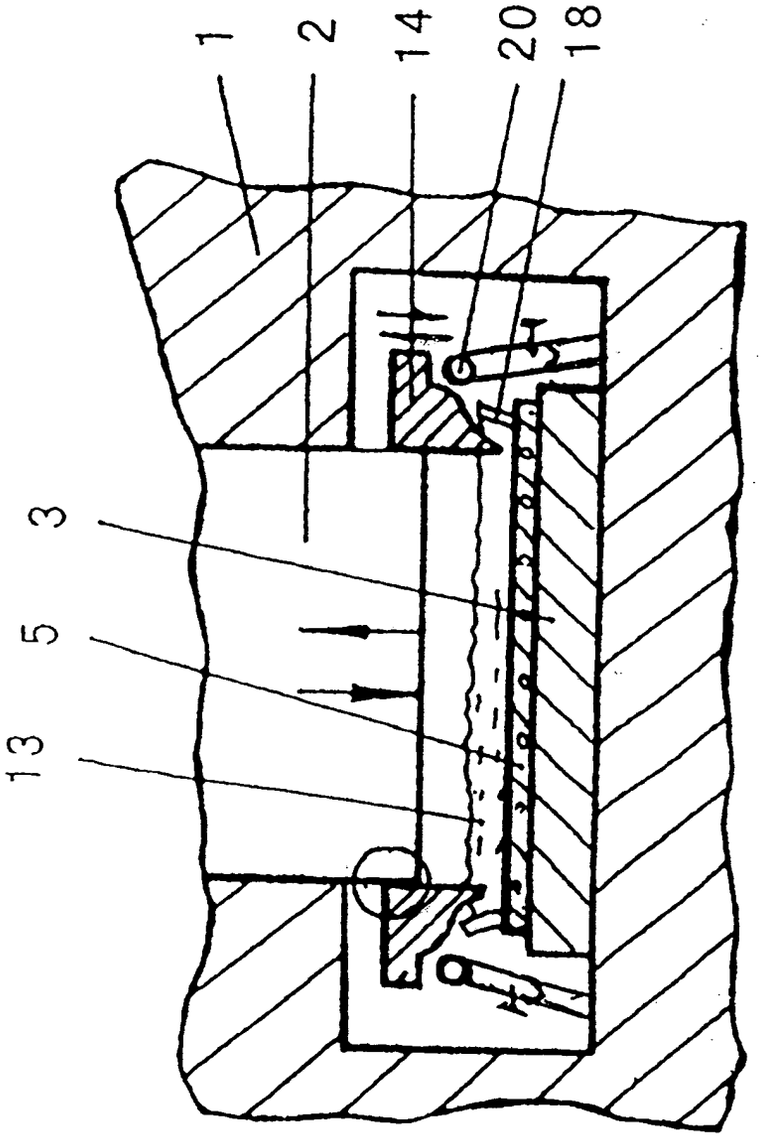


Fig. 5

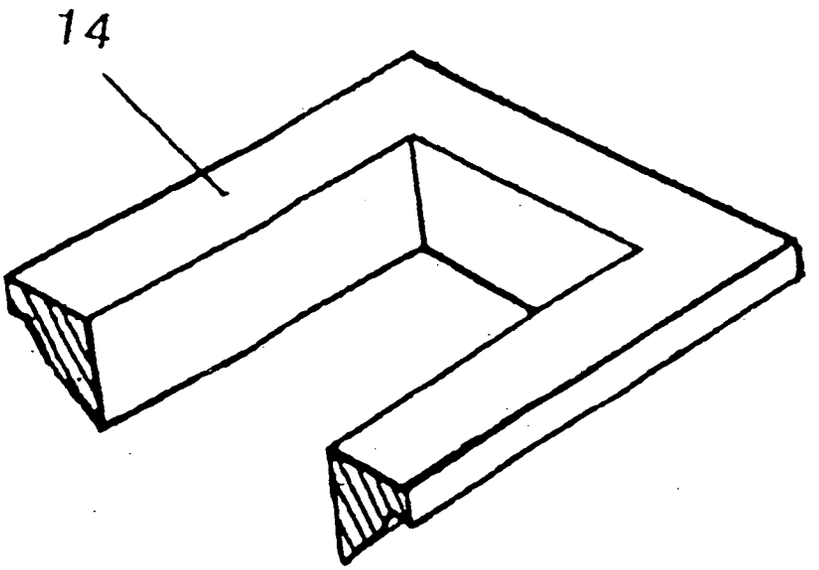


Fig. 6

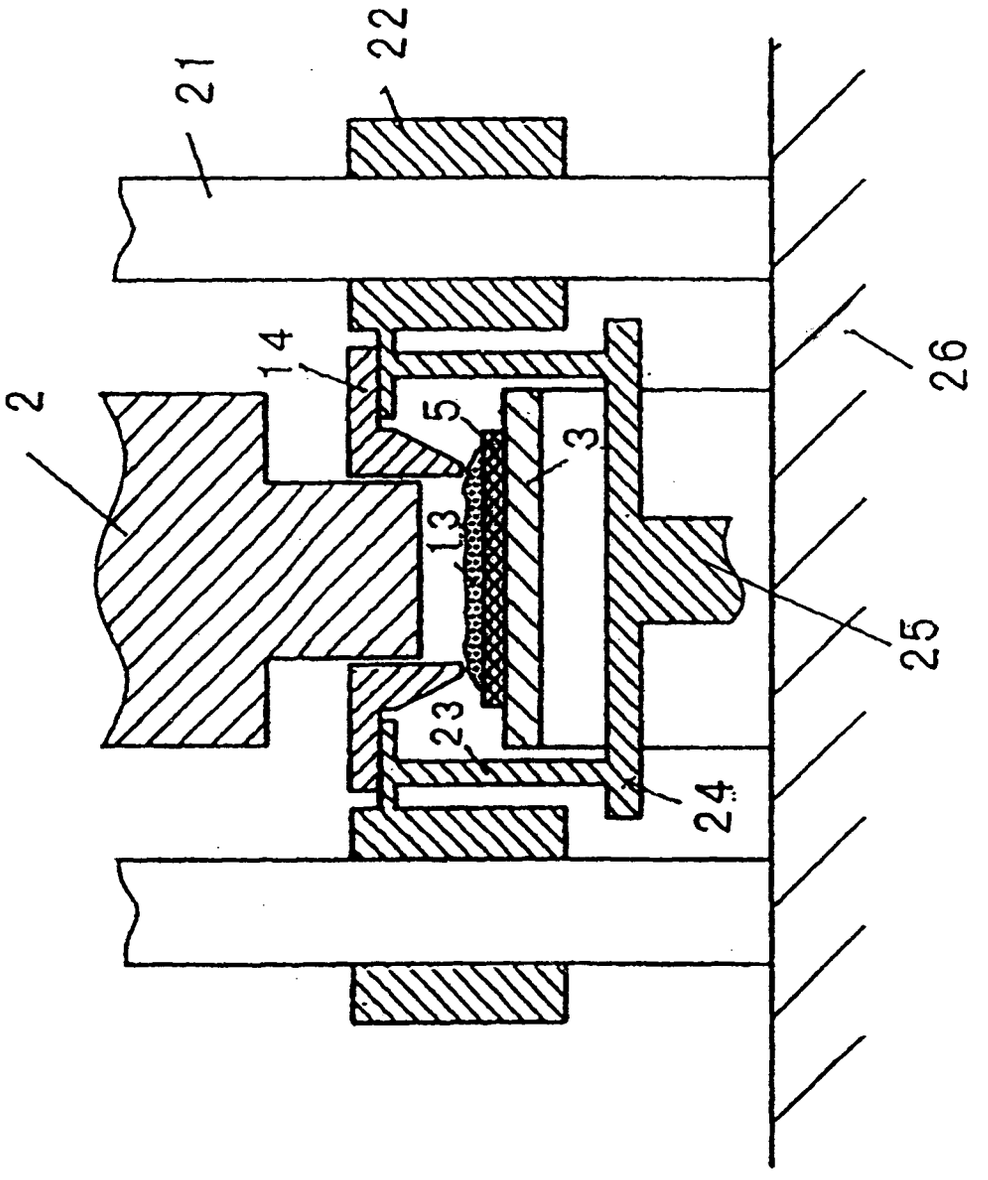


Fig. 7

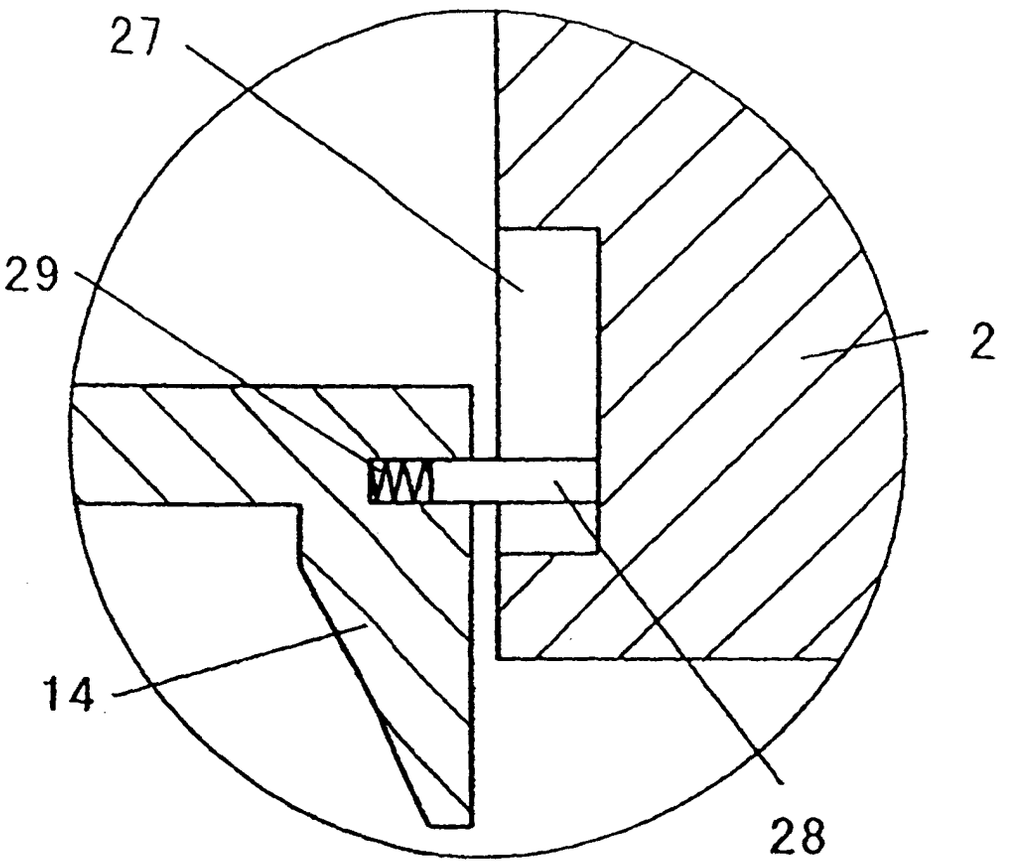


Fig. 8

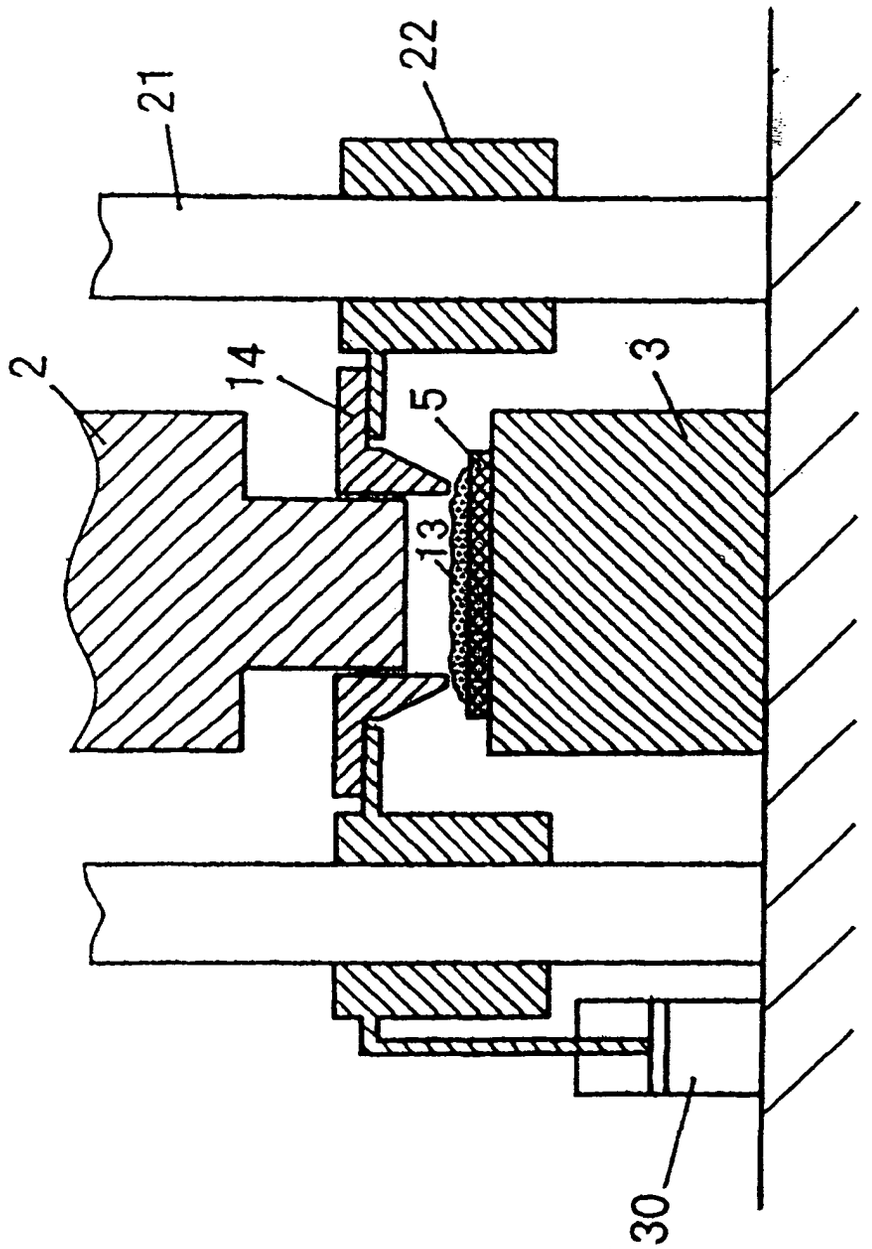


Fig. 9