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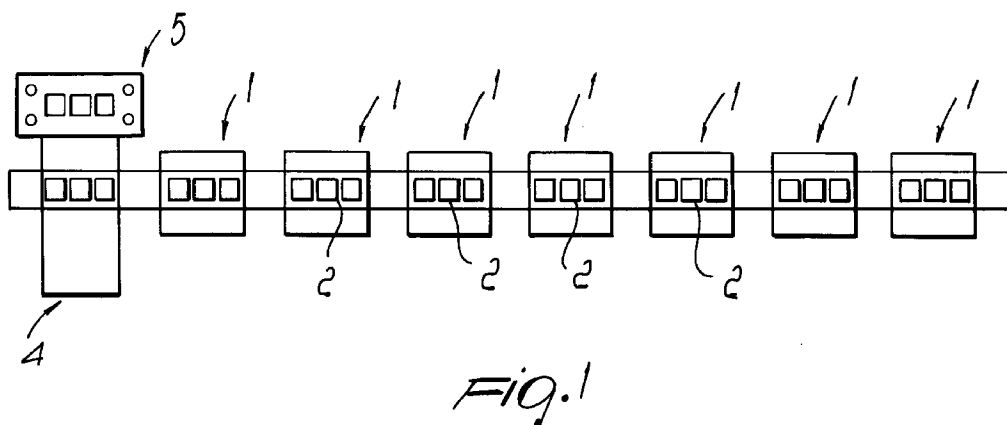
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(54) **Machine for forming and pressing powders, particularly for producing ceramic tiles, and method for producing ceramic tiles**

(57) A machine for forming and pressing powders, particularly for producing ceramic tiles, comprising: at least one unit (1) for organizing a charge of loose powders inside a tray (2) which forms at least one charge accommodation chamber which substantially matches a corresponding cavity of a pressing mold; at least one

unit (4) for transferring the charge into the cavity of the pressing mold without mutual movements among the components of the charge; and at least one press (5) for compacting the loose powders and obtaining the pressed product.



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Description

The present invention relates to a machine for forming and pressing powders, particularly for producing ceramic tiles, and to the method for producing ceramic tiles.

In the production of ceramic tiles formed by pressing there is conventionally a particular technological step, known as loose powder loading, which has the purpose of transferring the powders that constitute the mix from an external region, generally a hopper arranged above the press, to a region inside the press and more specifically inside the cavity or cavities of a mold. The cavity is delimited in a downward region by the lower punches and is delimited to the sides by the plates of the containment rim into which the upper punches, rigidly coupled to the moving part of the press, are made to descend in order to compact the loose powders and obtain the pressed product.

In current solutions, the powder loading operation significantly affects the production rate, the correct geometry of the finished part and the aesthetic appearance of the finished part, especially in the case of single-pressed or porcelainized-gres products, which are meant to undergo no further surface treatment for glazing and/or decoration but may undergo an optional dressing before or after baking.

In particular, it has been observed that the typical duration of a loading step in a modern hydraulic press for average sizes constitutes approximately 50% of the total duration of the entire pressing cycle; by way of example, mention can be made of the fact that the loading period can vary between 1.5 and 3 seconds on a complete cycle of 4-5 seconds, for a production of 15-12 beats per minute.

In the above-mentioned very short time it is necessary to transfer the loose charge into the mold and deposit it correctly to avoid forming holes or discontinuities or density differences which would inevitably lead to intolerable size defects in the finished part.

In the short loading times and in the very limited space available it is also necessary to perform aesthetic trimming by means of superimposed and well-separated layers of powders of different colors and kinds, of veins or streaks of different colors, discrete spots in different colors arranged in a pattern, and of the insertion of layers of granular or glassy material or flakes.

According to the method currently in use, loading is performed with several types of machine working in coordination with the press, so as to coordinate the sequence of operations.

The most conventional solution of loading machines provides for a structure which is rigidly coupled to the press and has a carriage which can slide on linear guides along a straight path and with an alternating motion which is accelerated or controlled by means of an axis control system.

The carriage supports a system of transverse grids

which slides on a wearproof material, and the space delimited by the grids is occupied by the loose material, when the carriage is retracted outside the press. The carriage constitutes a grid filling valve; in other cases, there are provided suitable rotary valves which fill the grids or complex systems of valves and pipes so as to produce a loading action which is differentiated according to the colors or materials or different particle sizes in its various regions.

Once loading has been completed, the carriage advances and the grids pour the loose powder into the cavity of the mold but inevitably produce in said charge of loose powder some stirring, separation by particle size, and color streaks caused by the advancement of the loose powder in the step that occurs outside the press and by the subsequent fall into the mold.

These effects, which are not always adequately controllable, are sometimes conveniently enhanced in order to obtain aesthetic effects such as streaks, veins and marbleizations, but are generally in conflict with the possibility of achieving precise patterns or backgrounds.

A second type of machine produces the movement of the carriage with linear actuators driven by servomotors, forming a feedback axis, and allows, also by using light alloys and composite materials in the construction of the moving part, to achieve variable accelerations and therefore a greater control over dynamic effects during the transfer of the loose powder charge. The movement can also be achieved by means of hydraulic motors provided with a gear which engages racks, but in this case too it is not possible to obtain precise patterns on the tile owing to the above-mentioned limitations.

A third type of machine provides so-called "double loading": in this solution, a linear carriage supports a second carriage and sometimes a system of screens of the screen-printing type or, more simply, interchangeable grids which are perforated in a pattern; with this machine it is possible to apply, over the loose powder that has already been deposited in the mold, a layer of uniform material or provide patterns which are significantly outlined but are limited in the number of their colors/materials.

The second loading, which necessarily occurs sequentially after the first one, considerably increases the total loading time, also because of the longer stroke of the carriage, and therefore the production of the press is practically halved.

A second carriage, mounted opposite to the first carriage on the other side of the press, also provides double loading, but the time loss is even higher.

A new type of machine includes, above the grids, a conveyor belt which by means of an axial control system provides, during the return stroke, a relative movement of the upper arm which is close to zero, allowing to deposit a second layer of materials on a first layer deposited earlier by the grids; a pattern which is formed by the powders on the belt is transferred into the cavity but undergoes the negative action, in terms of precision,

of the fall, however slight, from the belt into the mold.

Other machines place on the carriage only a conveyor belt, whose motion can be coordinated with the motion of the carriage and which deposits inside the mold, during the return stroke, the loose powder layer, optionally constituted by a plurality of materials organized in some manner, but it still entails a fall of the materials, which as in the previous case cannot form precise patterns.

All the above-described machines also have accessories which expel the parts pressed in the previous cycle, clean the mold, load the grids and/or the belt and/or the second hopper, optionally skim the deposited loose powder, scrapers, containment strips, hoppers for collecting the wasted material, and so forth.

The common characteristic of all the machines of the prior art is that the organization of the loose charge ends inside the mold arranged in the press, thus having limited time and space to perform the operation.

The aim of the present invention is to solve the above problems, by providing a machine for forming and pressing powders, particularly for producing ceramic tiles, which allows to considerably increase production cycles while providing tiles having clearly defined and preset patterns.

Within the scope of this aim, a particular object of the present invention is to provide a machine and a corresponding method which allow to perform all the loading operations directly outside the press and to transfer, without modifications, the preformed part into the press, without therefore being dependent, in the production cycle, on the time required for correct formation of the charge.

Another object of the present invention is to provide a method which allows to obtain ceramic tiles with patterns having clear outlines while being able to use a fully automated and fast production cycle.

Another object of the present invention is to provide a machine which by virtue of its particular constructive characteristics is capable of giving the greatest assurances of reliability and safety in use.

This aim, these objects and others which will become apparent hereinafter are achieved by a machine for forming and pressing powders, particularly for producing ceramic tiles, according to the present invention, characterized in that it comprises: at least one unit for organizing a charge of loose powders inside a tray which forms at least one charge accommodation chamber which substantially matches a corresponding cavity in a pressing mold; at least one unit for transferring said charge into the cavity of a pressing mold without mutual movements among the components of said charge; and at least one press for compacting said loose powders and obtaining the pressed product.

Further characteristics and advantages of the present invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of a machine for forming and pressing

powders, particularly for producing ceramic tiles, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic view of the machine according to the present invention;

figure 2 is a partially cutout elevation view of a tray;

figure 3 is a partially sectional plan view of a possible configuration of a tray;

figure 4 is a schematic sectional view of a tray;

figures 5 to 9 are schematic sequential views of the steps for overturning the tray, transferring the tray above the bed of the press, depositing the charge on the bed of the press, and moving away the tray;

figure 10 is a schematic view of a different embodiment of a tray with a moving bottom;

figures 11 to 13 are sequential views of the step for positioning the tray on the bed of the press, removing the bottom and moving away the tray.

With reference to the above figures, the machine for forming and pressing powders, particularly for producing ceramic tiles according to the present invention, comprises a plurality of filling stations 1 at which there are provided trays 2 which form one or more cavities inside them for organizing a charge of loose material.

In the various filling stations, whose number can vary, it is possible to perform full or partial loadings of the loose material, obtaining the arrangement deemed ideal.

The trays are then transferred to a loading station, generally designated by the reference numeral 4, which sends the trays to a press 5, where the charge is transferred into the mold of the press without mutual movements among the components of the charge.

In greater detail, the trays shown in figures 2 to 9 are used; said trays have a perimetric frame 10 provided by means of a tubular structure which forms a cavity 11 delimited, in a downward region, by a porous partition 12 which is constituted for example by a perforated metal plate 13 with a containment mesh 14 which lies above a suction chamber 15, in which spacing portions 16 are provided to allow to support the plate-like element in a perfectly level arrangement.

The cavity 11 has the same shape as the mold of the press, so that the charge that is entirely organized inside the tray can be transferred into the mold without being altered.

In greater detail, the porous partition is constituted by a stainless steel mesh 13 with openings measuring 180 to 250 microns and is fixed to, and tensioned on, the perforated metal plate by gluing or spot or intermittent welding or by means of screws.

The mold is laterally provided with plates 18 which can slide vertically or are fixed, are coated with non-stick and/or wearproof materials and delimit, together with the porous bottom partition, the space meant for the loose material charge.

This structure, which is particularly light, advantageously but not exclusively uses light alloys, composite materials, alloy steels, sealing materials, elastomers, polymers, non-stick and wearproof coatings and magnetic locking of the lateral plates.

The trays arranged in the various filling stations 1 follow a preloading path which arranges them sequentially in one or more filling stations arranged sequentially transversely or longitudinally or vertically or in a circular pattern proximate to the press; in each station, the upper cavity of the trays is filled entirely or partially, for example but not exclusively with the aid of screen-printing screens, perforated grids or templates that act as stencils, removable and fixed dividing elements, use of electrostatic systems, robotized tools provided or not with vision and image-recognition systems, microdosage units, vibrating units, air jets, suction nozzles or suckers, rods or mixers, or any other operation deemed suitable.

Once the preloading of the tray has been performed, with a time requirement that is fully independent of the press cycle, said tray is transferred into the charge transfer region 4 and is then conveyed to the press 5.

When the tray is transferred beneath the press, the charge is precompacted by applying vacuum. The charge is mainly composed of paraspherical granules having different particle sizes and therefore the filling of the tray leaves the charge highly permeable to air owing to the empty spaces that remain between the spherical granules.

When vacuum is applied, a violent flow of air occurs through the interstices, so that the finer granules are entrained towards the porous partition but ultimately clog the smaller interstices; the final result is that the charge is resettled according to particle size, becomes denser and is precompacted.

The resulting precompaction reduces the ability of the granules to flow and facilitates precise transfer into the mold.

Once charge precompaction has been performed, the tray is overturned, as shown schematically in figure 5, and is then arranged above the mold 20 of the press 5, which has a lower punch 21 which is moved down gradually, so that the precompacted charge is transferred onto the lower punch of the press without undergoing any displacement or alteration of its components, so that the integrity of the formed pattern is maintained.

When the charge has been fully transferred onto the mold, which has the same shape as the chamber in which said charge has been formed, the tray is moved away to perform another cycle.

The essential element is the fact that the loose charge has been permanently organized, preformed and precompacted outside the mold of the press, so that the time required does not affect the production cycles of the machine.

As shown in figures 10 to 13, it is possible to pro-

vide an alternative embodiment of the tray, designated by the reference numeral 30, which has a movable bottom 31 constituted by a thin plate of stainless steel which can be extracted from the guides 32 formed on the lateral plates 33; because of the limited thickness of the bottom plate, the fall of the charge is very short and its unsettling is likewise limited or negligible.

In practice, in this case too it is possible to transfer the charge without any modification to the arrangement of said charge, which has been organized fully outside the press and inserted in the mold of the press only to perform pressing instead of additional forming operations.

The method used is therefore highly innovative with respect to the prior art, since the use of trays and filling stations allows to multiply the time and space available to load the mold without affecting the speed of the press.

Accordingly, even very complex charges obtained in subsequent steps in the trays are then transferred intact and quickly into the cavity of the mold, with optimum results.

The time required for the entire cycle, which includes loading the tray, precompacting the charge, the stroke for inserting the tray beneath the press and expelling the intact charge into the mold cavity, is significantly similar to the entire carriage cycle of an average conventional machine and can vary between 1.5 and 2.5 seconds.

The active pressing cycle lasts approximately 3 seconds, during which the preloading region moves each tray by one step and replaces the empty tray with a full tray on the loading area, thus providing a cycle which lasts approximately 5 seconds with 12 beats per minute, as in conventional cycles.

From the above description it is thus evident that the invention achieves the intended aim and objects and in particular the fact is stressed that by providing the entire organization of the loose charge outside the press it is possible to have a long time available to prepare the charge, with the additional advantage of transferring said charge without any alteration beneath the mold of the press, thus obtaining products which have precise and perfectly repeatable patterns although using a fully automatic cycle.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may also be replaced with other technically equivalent elements.

In practice, the materials employed, as well as the contingent shapes and dimensions, may be any according to requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the inter-

pretation of each element identified by way of example by such reference signs.

Claims

1. A machine for forming and pressing powders, particularly for producing ceramic tiles, characterized in that it comprises: at least one unit (1) for organizing a charge of loose powders inside a tray (2, 30) which forms at least one charge accommodation chamber (11) which substantially matches a corresponding cavity in a pressing mold (20); at least one unit (4) for transferring said charge into said cavity of a pressing mold (20) without mutual movements among the components of said charge; and at least one press (5) for compacting said loose powders and obtaining the pressed product. 5 10
2. A machine according to claim 1, characterized in that said unit for organizing a charge of loose powders comprises a plurality of filling stations (1) for performing operations for the full or partial loading of the loose powder into said trays (2, 30), means for transferring said trays being further provided. 15 20
3. A machine according to the preceding claims, characterized in that said loading station (4) has means for precompacting said charge of loose powders. 25
4. A machine according to one or more of the preceding claims, characterized in that said loading station (4) comprises means for connecting said trays (2, 30) to a source of vacuum in order to precompact said charge of loose powders. 30 35
5. A machine according to one or more of the preceding claims, characterized in that it comprises means for overturning said trays (2, 30) with said precompacted charge of loose powders at the cavity of said mold. 40
6. A tray for containing a charge of loose powders, characterized in that it comprises a frame (10) which forms a cavity (11) which is delimited, in a downward region, by a porous bottom (12) below which a suction chamber (15) is provided. 45
7. A tray according to one or more of the preceding claims, characterized in that said porous bottom is obtained by means of a perforated metal plate (13) above which a containment mesh (14) is provided. 50
8. A tray according to one or more of the preceding claims, characterized in that said mesh (14) has openings measuring 180 to 250 microns. 55
9. A tray according to one or more of the preceding claims, characterized in that it comprises spacers (16) which support said perforated metal plate (13) and are provided in said suction chamber (15).
10. A tray according to one or more of the preceding claims, characterized in that it comprises a frame (33) which forms a cavity (11) for accommodating the charge of loose powders, said cavity (11) having a movable bottom (31) formed by a thin metal plate which can be extracted while said tray (30) is arranged at the mold (20) of the press (5).
11. A method for manufacturing ceramic tiles, characterized in that it consists in: filling with loose powders organized in any way, outside the region affected by the pressing press (5), a cavity (11) whose shape is substantially equal to the shape of the cavity of the pressing mold (20) provided in said press (5); transferring said charge from said tray (2, 30) to said mold (20) without mutual movements of the components of said charge.
12. A method according to claim 11, characterized in that the loose charge provided in said tray (2, 30) is subjected to precompaction.
13. A method according to one or more of the preceding claims, characterized in that said precompaction is performed outside the press (5) by drawing air through the mass that constitutes said charge of loose powders.
14. A method according to one or more of the preceding claims, characterized in that it entails overturning the charge of precompacted loose powders so as to position said powders at the lower punch (21) of the forming and pressing press (5).

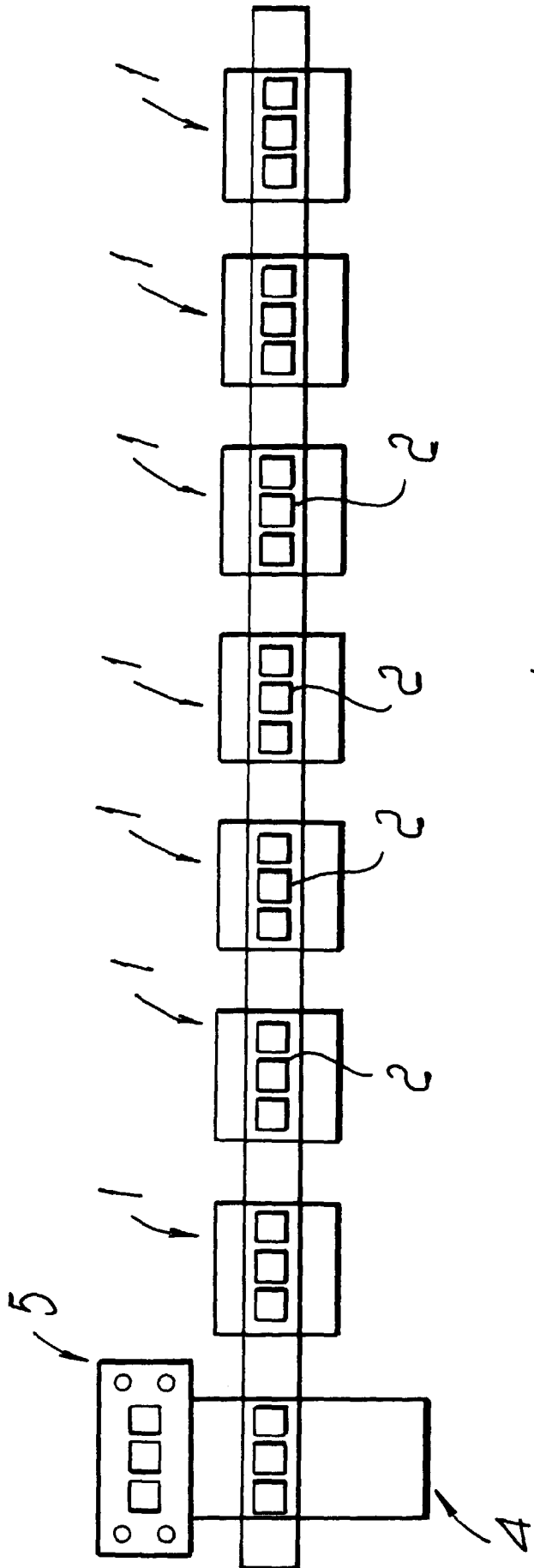
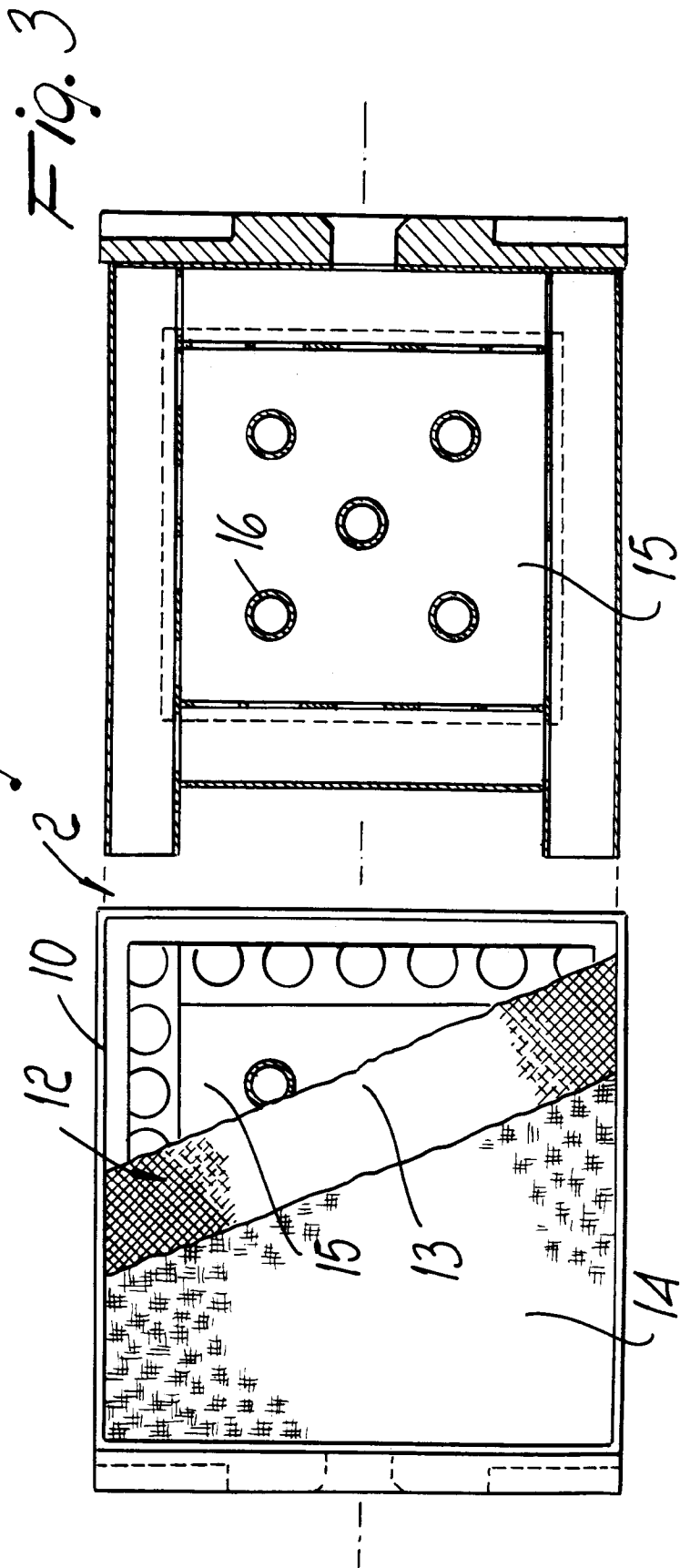
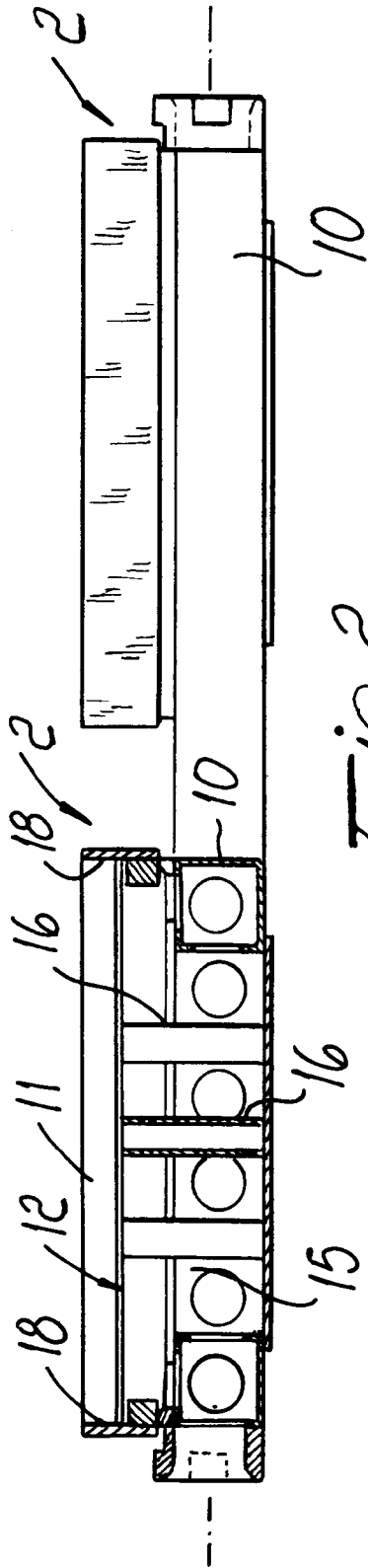
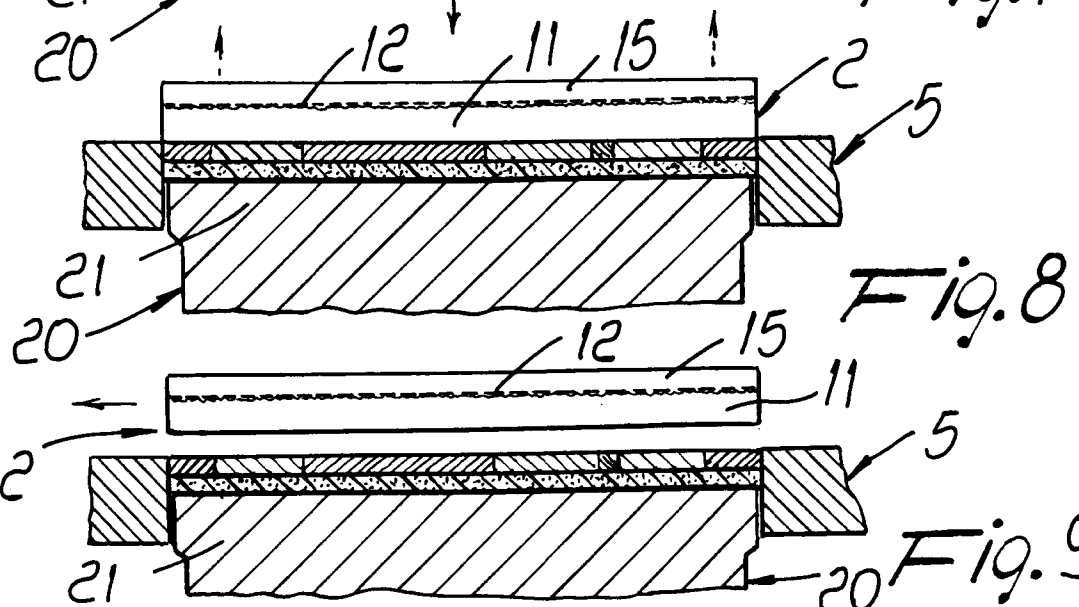
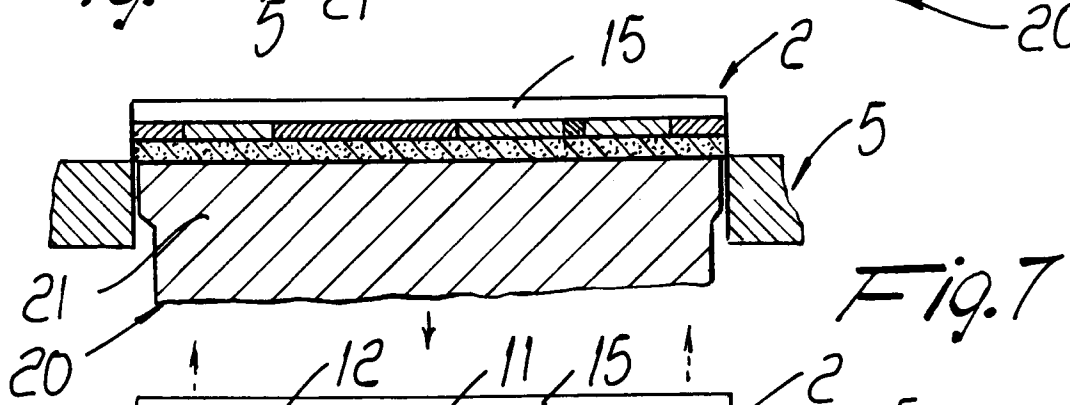
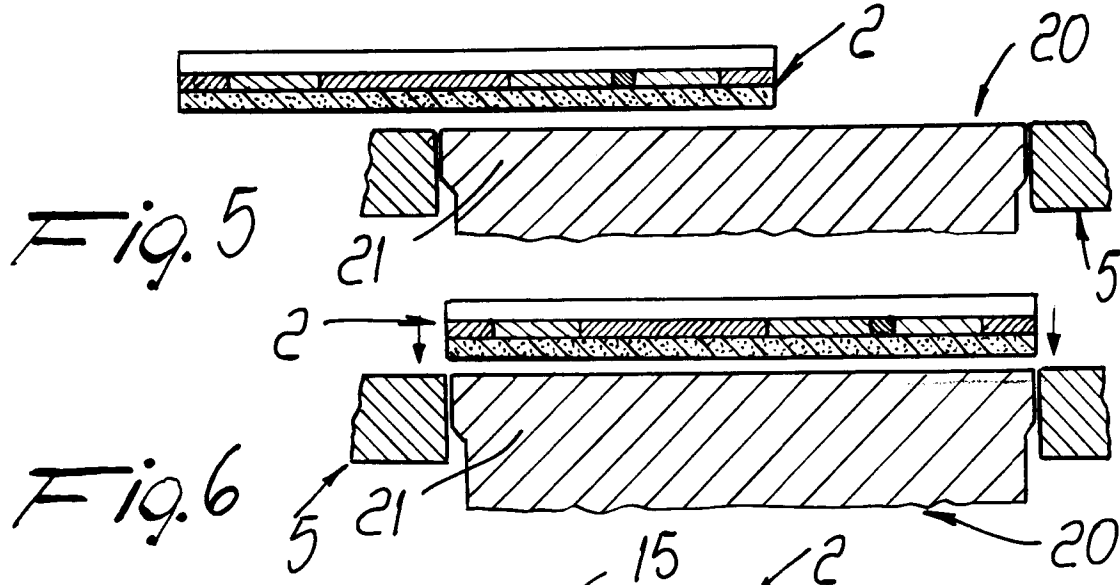
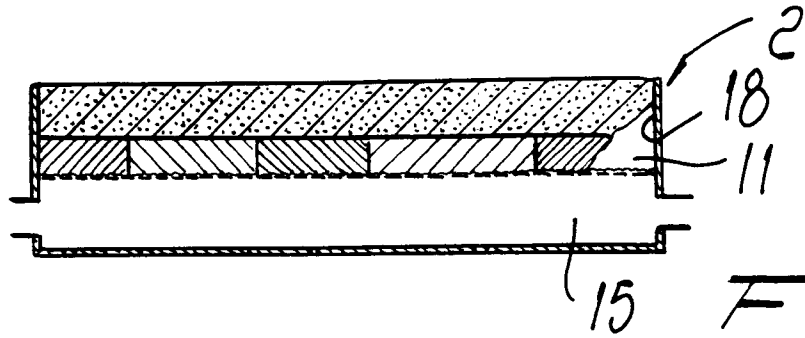
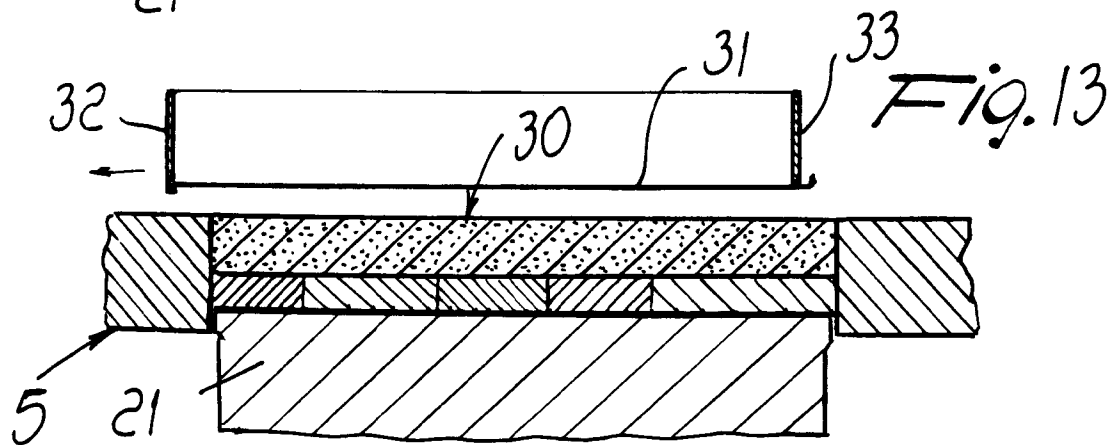
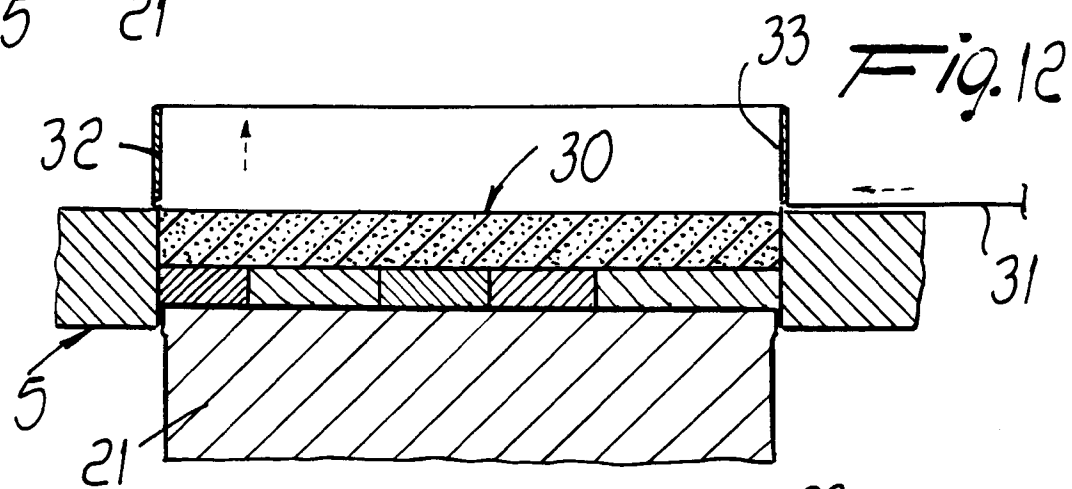
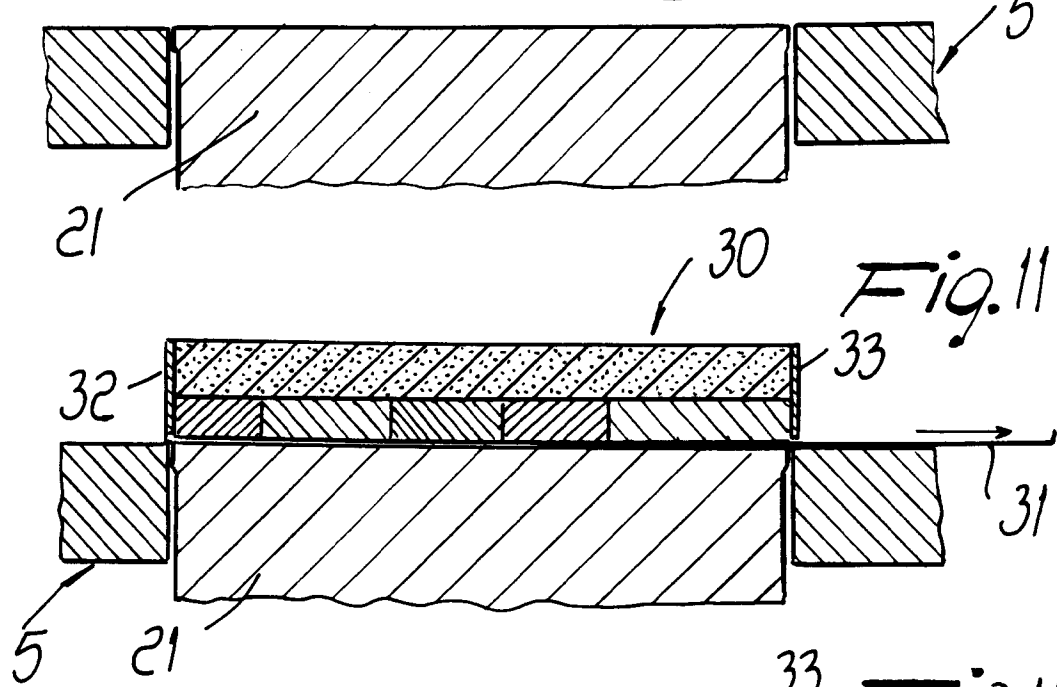
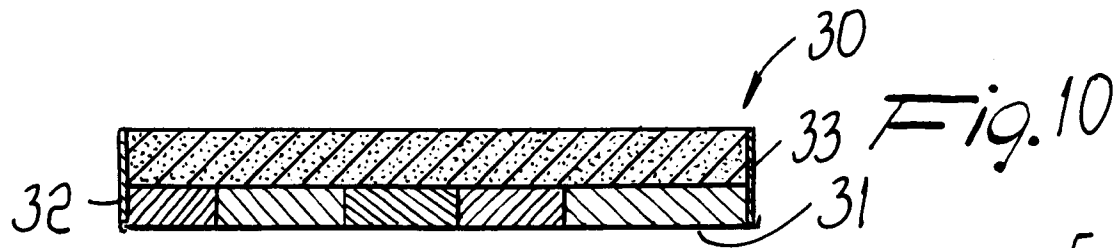


Fig. 1









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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 2127

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR 2 444 543 A (LONGINOTTI SPA) * the whole document *	1-4, 11-13	B28B13/02
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A	DE 39 41 346 A (MURATA MANUFACTURING CO) * column 2, line 67 - column 3, line 5 * * column 3, line 34 - column 3, line 46 * * figures 1,2B *	1,11	
A	WO 96 15888 A (CAMORANI CARLO ANTONIO ;ALGERI MARIS (IT)) * page 11, line 28 - page 12, line 16 * * page 13, line 12 - page 15, line 17 * * figures 1,9,28-30 *	1,11,12	
A	EP 0 693 352 A (L B ENGINEERING S R L) * the whole document *		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	EP 0 444 730 A (LB OFFICINE MECCANICHE SPA) * the whole document *		B28B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 14 May 1998	Examiner Gourier, P
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			

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