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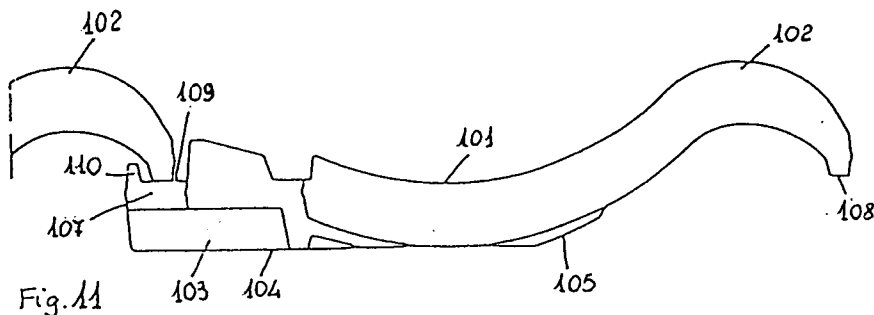
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(54) **A method for firing roof tiles in roller hearth kilns and a pressed roof tile for carrying out the method.**

(57) The invention relates to a method for firing tiles in roller-hearth kilns, and a tile for carrying out the method. The method is specially indicated for firing pressed tiles having complex shapes. According to the invention, the tiles (1) are suitable for transporting directly on a roller plane (2) in a special arrangement according to which, among other things, the tiles (1) can be coupled consecutively one to the next. A roof tile made by pressing with a ceramic material includes a central zone (101) and an over-

lapping bend (102). For firing in a roller hearth kiln, there are provided on a bottom side of the tile at least two reinforcing running ribs (103) for resting the tile on the rollers of the roller hearth kiln, and on an upper side of the tile in the area of a longitudinal edge of the tile opposite to the overlapping bend (102) a laying plane (107) for the external inferior edge (108) of the overlapping bend (102) of an adjacent like tile.



The invention relates to a method for firing rooftiles in roller hearth kilns, and rooftiles made by pressing with a ceramic material, including a central zone and an overlapping bend, particularly for carrying out the method.

Specifically but not exclusively, the invention is useful in firing rooftiles of the type known as Portuguese tiles or pantiles, or the like.

Pantiles comprise plain tiles with a straight central zone and a bent zone for overlapping an adjacent tile, or plain hollow tiles with a slight S-shape, or Roman tiles with a straight central zone and a large-radius bent overlapping zone.

All of the tiles are characterised by complex shapes, and they are not singly provided with flat surfaces permitting of simple and sure resting on roller type continuous conveyors.

To carry out firing of such tile types, the prior art teaches various solutions. For example, one commonly adopted solution is that of tunnel kilns using traditional cars loaded with the piled material, or using special auxiliary firing means constituted by supports made in U-shaped crates made in refractory material, each predisposed to receive a certain number of tiles, normally stacked vertically. The supports can be piled one on the other to form several tile layers.

Other realisations envisage tunnel kilns of the single layer type in which only one layer of tiles is formed on the cars, which tiles are arranged lying vertical and kept in that position by special support elements made in refractory material provided on the car.

For tiles of a particularly complex shape, tunnel kilns are envisaged but with the use of cars whereon the tiles are piled, lying horizontally, by means of special supports which can be jointed one on top of the other to form a pile. In this case, each tile rests on and is supported by its own refractory support, the presence of which guarantees, during firing, a perfect maintenance of the shape of the tile and thus a successful end product.

All the prior art solutions for firing tiles, however, require the housing of tiles in piles on cars in the tunnel kiln, with or without the use of refractory supports through which it is possible to perform the loading of the tiles on the cars. Independently of the complication that this can lead to, for example, in terms of loading and unloading machines, it is certain that the necessary presence of the supports on the one hand raises considerably the cost of the plant and on the other hand is an expression of a technique that is totally linked to the firing technology wherein the material is moved on cars, which is certainly not the most modern technology, nor the most efficient desirable. Kilns of this type have, among other things, rather long firing cycles, even of up to 24 hours.

All of this has very negative effect on the production costs of the tiles.

In the floor- and wall-tile industry roller hearth kilns are used, which are also functionally suitable for smooth surface-covering tiles. Roller hearth kilns of this type are both smaller and provide a considerably shorter firing time.

A principal aim of the present invention, as it is characterised in the claims that follow, is to obviate the drawbacks and limits of the prior art realisations, through a method permitting of firing in particular complex-shape tiles in roller-hearth kilns without the need to use special auxiliary supports for firing the tiles.

In particular the object of the invention is attained by a roof tile made by pressing with a ceramic material, including a central zone and an overlapping bend, which is characterised in that on a bottom side of the tile at least two reinforcing running ribs are provided for resting the tile on the rollers of a roller hearth kiln, and on an upper side of the tile and in the area of a longitudinal edge of the tile. On an opposite side of the overlapping bend there is provided a laying plane for an external inferior edge of the overlapping bend of an identical contiguous tile.

Pressed roof tiles formed in this way may be continuously fed through the roller hearth kiln without the use of any special auxiliary supports such that the tiles are securely supported by the running ribs on the rollers of the roller hearth kiln and by the inferior edge of the overlapping bend resting on the laying plane of the preceding tile. It is important that in the supporting area of the inferior edge of overlapping bend no overload of material occurs.

The running ribs preferably extend in transversal direction of the tile, but may also extend in longitudinal directions. In the latter case, additional support rollers for supporting the overlapping bend at the inferior edge thereof may be provided in the roller hearth kiln, preferably only in a softening zone thereof.

Further features and developments of the invention are apparent from claims 8 to 16.

The length of the laying planes of the running ribs being greater than the axial distance between two rollers ensures a secure support of the running ribs on at least two rollers at any time.

The presence of locking ribs projecting from the laying plane ensures a secure locking of the tiles in the roller hearth kiln.

Further characteristics and advantages of the present invention will better emerge from the detailed description that follows, of a preferred but non-exclusive embodiment here illustrated in the form of a non-limiting example in the accompanying drawings, in which:

- figure 1 shows a partial schematic plan view from above of a plant made according to the invention;
- figure 2 shows, in enlarged scale, a detail of one of the tiles represented in figure 1;
- figure 3 shows a frontal view of figure 2;
- figure 4 shows a schematic lateral view from the left of figure 2;
- figures 5 and 6 show in enlarged scale, two details of figure 1 relative to two different embodiments of the invention;
- figure 7 shows, in small scale, a schematic section made according to line VII-VII of figure 11;
- figure 8 shows a view from above of a second embodiment of the invention;
- figure 9 shows a view from below of the plain hollow tile of figure 8;
- figure 10 shows a section view of the plain hollow tile of figure 8, along line X-X of figure 8;
- figure 11 shows a lateral view of a plain hollow tile according to the invention inside the roller hearth kiln, including part of the overlapping bend of the successive hollow plain tile inserted;
- figure 12 shows a view of a section of a Roman tile according to the invention inside the roller hearth kiln, including part of the overlapping bend and with the successive Roman tile inserted;
- figure 13 shows a view of a section of a plain barrel tile according to the invention inside the roller hearth kiln, including part of the overlapping bend of the successive plain barrel tile inserted;
- figure 14 shows a view of a section of another hollow plain tile according to the invention, including part of the overlapping bend of the successive hollow plain tile inserted.

In the accompanying figures, 1 denotes a tile of the type known as a Portuguese tile or Roman tile, characterised in that it has a quite complex geometrical shape. It belongs to tile typologies that can be schematically defined, from the geometrical point of view, as being constituted by a curved part, similar to a cover, connected with a flatter part. The curved part has an edge for coupling and superposing it on the corresponding flat zone, which can joint with another, contiguous tile.

The tile 1 soffit, apart from having the usual hooking projections 10, jointing crossribs 11 and various joints and notches, all of which have the function of guaranteeing good connection between the tiles and ease of laying, also has ribs 12 (three in the embodiment shown) arranged exclusively with the aim of identifying an ideal flat laying surface for the tiles 1. In particular, the ribs 12 are arranged trans-

versally and exhibit a length such as to ensure a continuous lay on the rollers 3 of a roller plane 2 of a roller hearth kiln 4 for firing ceramic products. To ensure a good lay, the length of the ribs 12 should be as a rule at least twice the length of the interaxis between two rollers 3. Naturally the transversal arrangement of the ribs 12 is in accordance with the arrangement of the tiles 1 on the rollers 3, that is, the direction of the tiles 1 themselves with respect to the advancement direction of the entire roller plane 2 formed by the rollers 3.

The ribs 12 provide a flat surface for laying the tiles 1 on the rollers 3 thanks to the presence of which the projecting functional elements, such as the hooking projections 10, the various profiles and the various jointing crossribs 11, are situated on the same plane or above the laying plane configured by the ribs 12. The arrangement of the ribs 12 permits thus of laying a part of the soffit of the tile 1 on a roller plane 3, so as to permit the unproblematic movement of the tile 1 itself along the roller plane 2. The ribs 12 extend over a large part of the soffit of the tile 1 with the exclusion of the curved zone of the tile 1 at which zone there is a lateral overlapping edge 13. The said lateral overlapping edge 13 is predisposed to insert and couple, during its laying, in the special joint seating 14 made in proximity to the corresponding opposite lateral edge of the lateral overlapping edge 13 of an identical and contiguous tile 1.

The possibility of laying a tile 1 on a roller plane 2 to transfer it along the plane itself is obtained, according to the invention, by arranging the tile 1 on the plane with the ribs 12 arranged perpendicularly to the axes of the rollers 3 (and thus parallel to the advancement direction). With such an orientation, the ribs 12 rest continuously on the roller plane 2, which means they can be unproblematically transported.

The tiles 1 can be arranged on the roller plane 2 simply in line one behind the other, or in a sort of chain fashion.

According to one arrangement mode, the tiles 1, laid with their relative ribs 12 on the rollers 3, are consecutively coupled one to the next in such a way that the lateral overlapping edge 13 of a single tile 1 is inserted into the joint seating 14 of the immediately following tile 1. This arrangement, represented in figure 6, reproduces the configuration which will be used when the tiles are actually laid on a roof.

The coupling of the tiles 1 to form a chain can be easily realised according to the embodiment shown in figure 5, by means of the use of projecting elements 15 in the form of a shelf from the lateral edge of each single tile 1 opposite to the lateral overlapping edge 13. The elements 15, for example two in number, exhibit two prongs at their ends

which describe joint seatings 16 for coupling with the lateral overlapping edges 13.

The presence of the projecting elements 15 made on the piece does not prejudice the functionality of the tile 1 and allows an ordered line of tiles 1 to be created, in which the lateral overlapping edge 13 of a tile 1 can rest couplingly on the elements 15 of the following tile 1 without interfering with the zones of the functional elements of the tile 1 itself, that is, without being and remaining directly coupled and inserted, during the firing phase, in the joint seating 14 which is destined to receive the lateral overlapping edge 13 when laid. The arrangement realises, thanks to the presence of the ribs 12 and the possibility of the lateral overlapping edges' 13 stable resting of the single tiles 1 arranged in a line and coupled one consecutively to the other on any roller conveyor, and thus, in particular, on the roller planes usually used in roller hearth kilns for firing ceramic materials. The stability of the arrangement adopted is such that the tiles 1 maintain, during the firing process, together with a correct orientation with respect to the rollers, also all the characteristics of shape and function that are indispensable for their correct functioning when laid.

The advantages obtainable by the use of the invention are evident, with respect to firing systems in the prior art.

In figures 8 to 10 a preferred example of a pressed roof tile according to the invention is shown.

The tile comprises a central zone 101 and by an overlapping bend 102. On the bottom side there are three running ribs 103 arranged transversally with respect to the longitudinal direction of the tile, with horizontal laying planes 104 for resting on the rollers of a roller hearth kiln. The length of the laying planes 104 of the ribs 103, at least on the side of the head and the foot of the tile, is greater than double the axial distance between two rollers of the roller hearth kiln. The running ribs 103 further comprise by inclined surfaces 105 for easy insertion on the rollers of the roller hearth kiln.

On the superior side of the tile, in the area of the longitudinal edge 106 of the tile, on the opposite side from the overlapping bend 102, a laying surface 107 is envisaged for the external inferior edge 108 of the overlapping bend 109 of a similar tile. The laying surface 107 is provided with two projections 109 on the opposite side from the overlapping bend 102, which projections 109 are formed on the longitudinal edge 106 of the tile opposite to the overlapping bend 102. Each of the projections 109 further exhibits a locking rib 110 projecting from the laying plane 107, which guarantees a perfect blocking of two tiles when the laying surface 107 and the inferior edge of the overlapping bend 108 of an adjacent tile is ar-

ranged on the laying plane 107.

The running ribs 103 on the side of the head and on the side of the foot of the tile with a relative laying surface are continued on the inferior side of the projections 109 up to the external edges of the projections. Further, these two ribs 103 are arranged in such a way as not to interfere with either the roof beams or the covering.

In the case of pressed and glazed tiles, both the inferior edge of the overlapping bend 108 and the laying surface 107 are kept free of glaze, so that the pieces cannot become glued together during firing.

Figure 11 shows a hollow plain tile according to the invention, as described with respect to figures from 8 to 10, with a view of the foot of one tile with the overlapping bend of the successive tile at the moment of the passage through the kiln.

Figure 12 shows a section of a Roman tile according to the invention, with the overlapping bend 102 of the adjacent Roman tile laying on it during the passage through the roller hearth kiln. The Roman tile is distinct from the hollow plain tile described in figures from 8 to 11 because it does not exhibit projections 109, but rather is provided with an according laying surface 111 for the inferior edge of the overlapping bend 102 adjacent to a lateral upper rib 112. All of the other characteristics correspond to those described for figures from 8 to 11.

Figure 13 shows a plain barrel tile according to the invention in a similar view to the Roman tile of figure 12. No projections 109 are envisaged here, and the laying surface 111 of the inferior projection of the overlapping bend 108 is formed by the bottom of the external lateral groove.

Finally, figure 14 shows a hollow plain tile according to the invention, shown like the Roman tile of figure 12 and the plain barrel tile of figure 13. This hollow plain tile also has no projections 109. The laying surface 111 for the inferior edge 108 of the overlapping bend 102 is structured as the bottom of an external lateral groove situated lower, adjacent to the lateral upper rib 112.

For the first pressed tile of a line of tiles passing through a kiln an additional laying surface can be provided for the external projection 108 of its overlapping bend 102, on a separate shaped ceramic piece (not illustrated).

Both the laying surface 107 and the laying surface 111 of the inferior projection of the overlapping bend 108 are structured and arranged in such a way as not to lead, during firing in a roller hearth kiln, to an overload of the material.

Another possible alternative is to arrange the ribs 103 longitudinally with respect to the tile and to equip the roller hearth kiln with additional support rollers for the inferior edge 108 of the overlapping

bend 102 at least in the softening zone of the roller hearth kiln.

Claims

1. A method for firing tiles in roller-hearth kilns, characterised in that the tiles (1) are predisposed directly on a roller plane (2) of a roller-hearth kiln (4); each of the tiles (1) being provided, at at least one part of a soffit, with auxiliary rest means to identify an ideal rest plane thanks to which plane various projecting elements, such as hooking projections (10), joint ribs (11) and the like, are situated not below the laying plane; the said means being geometrically configured in such a way that the said rest plane identified is continuous at least according to a pre-established direction.
2. A method as in claim 1, characterised in that the said rest means comprise on one part of the soffit of each said tile (1) at least two ribs (12) identifying an ideal rest plane and being arranged parallel to an advancement direction of the tile (1) resting on the roller plane (2).
3. A method as in claim 2, characterised in that a length of the ribs (12) is equal to at least double a length of an interaxis between two contiguous rollers (3) of the roller plane (2).
4. A method as in claim 3, characterised in that the tiles (1) are arranged on the roller plane (2) resting on it by means of the ribs (12) and constrained one to another to form a chain through a reciprocal coupling between opposite lateral edges of the tiles (1).
5. A method as in claim 4, characterised in that the coupling between the opposite lateral edges of the tiles (1) is obtained by resting one overlapping edge (13) of a tile (1) on at least one projecting element in a shelf (15) shape, specially made at the opposite lateral edge to the lateral overlapping edge (13) of an identical tile (1) located contiguously to the first.
6. A method as in claim 4, characterised in that the coupling between the said opposite lateral edges of the tiles (1) is made by resting the overlapping edge (13) of one tile (1) in a joint seating (14) which, in an identical tile (1) situated contiguously, is made in proximity to an opposite lateral edge to the edge (13) to permit of coupling the tiles (1) during a laying operation.
7. A roof tile for carrying out the method of the preceding claims, made by pressing with a ceramic mixture characterised in that:
 - on a bottom side of the tile (1) at least two reinforcing ribs (103) are provided for resting the tile (1) on the rollers of a roller-hearth kiln, and
 - on an upper side of the tile (1), and in the area of a longitudinal edge (106) of the overlapping bend (102), there is provided a laying plane (107, 111) for an external inferior projection (108) of the overlapping bend (102) of an identical contiguous tile (1).
8. A pressed roof tile according to claim 7, characterised in that the length of the laying planes (104) of at least two ribs (103) is greater than an axial distance between two rollers of the roller-hearth kiln.
9. A pressed roof tile as in claim 7 or 8, characterised in that three or more running ribs (103) are provided.
10. A pressed roof tile according to any one of the claims from 7 to 9, characterised in that the running ribs (103) are arranged in such a way as not to hit against beams on a roof, nor disturb a roof covering.
11. A pressed roof tile according to any one of the claims from 7 to 10, characterised in that the laying plane (107) for the inferior edge (108) of the overlapping bend (102) is formed on two projections (109) on the longitudinal edge (106) of a tile (106) on an opposite side from the overlapping bend (102).
12. A pressed roof tile according to claim 11 or 12, characterised in that the projections (109) exhibit a locking rib (110) projecting from the laying plane (104).
13. A pressed roof tile according to claim 11 or 12, characterised in that the running ribs (103) are continued on a bottom side of the projections (109).
14. A pressed roof tile according to one of claims from 7 to 10, characterised in that the laying plane (111) for the inferior edge (108) of the overlapping bend (102) is formed directly adjacent to a lateral upper rib (112).
15. A pressed glazed roof tile according to any one of claims 7 to 14, characterised in that the inferior edge (108) of the overlapping bend

(102) and the laying plane (107, 111) therefor are kept free of glaze.

16. A pressed roof tile according to any one of the claims from 7 to 15, characterized in that an additional laying surface of the external inferior edge (108) of the overlapping bend (102) is provided on a separate shaped ceramic piece. 5
17. A pressed roof tile according to any ne of claims 7 to 16, characterized in that the running ribs (103) extend in transversal direction of the tile. 10
18. A pressed roof tile according to any one of claims 7 to 16, characterised in that the running ribs (103) extend in longitudinal direction of the tile. 15
19. A pressed roof tile according to claim 18, characterised in that the inferior edge (108) of the overlapping bend (102) is formed for resting on additional support rollers of the roller hearth kiln. 20
20. A pressed roof tile according to claim 19, characterised in that the inferior edge (108) of the overlapping bend (102) is formed for resting on additional support rollers of the roller hearth kiln only in a softening zone thereof. 25 30

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FIG 5

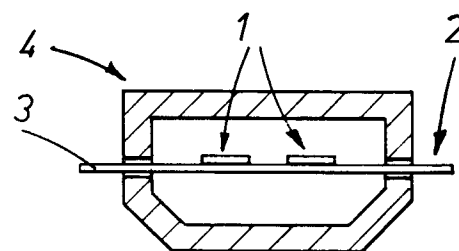
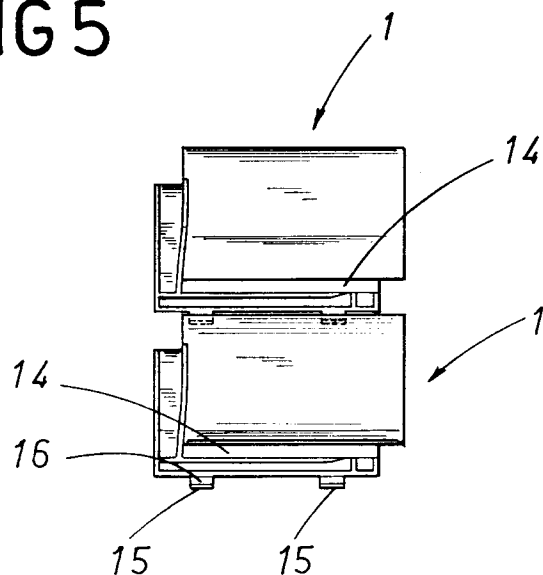


FIG 7

FIG 1

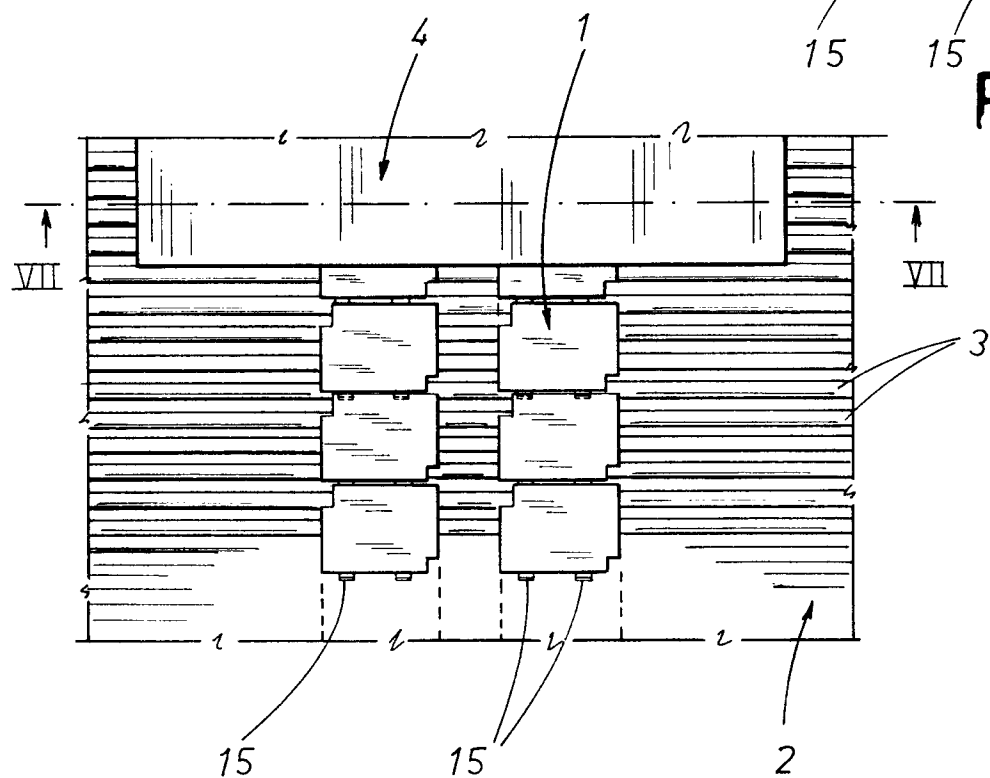


FIG 6

FIG 3

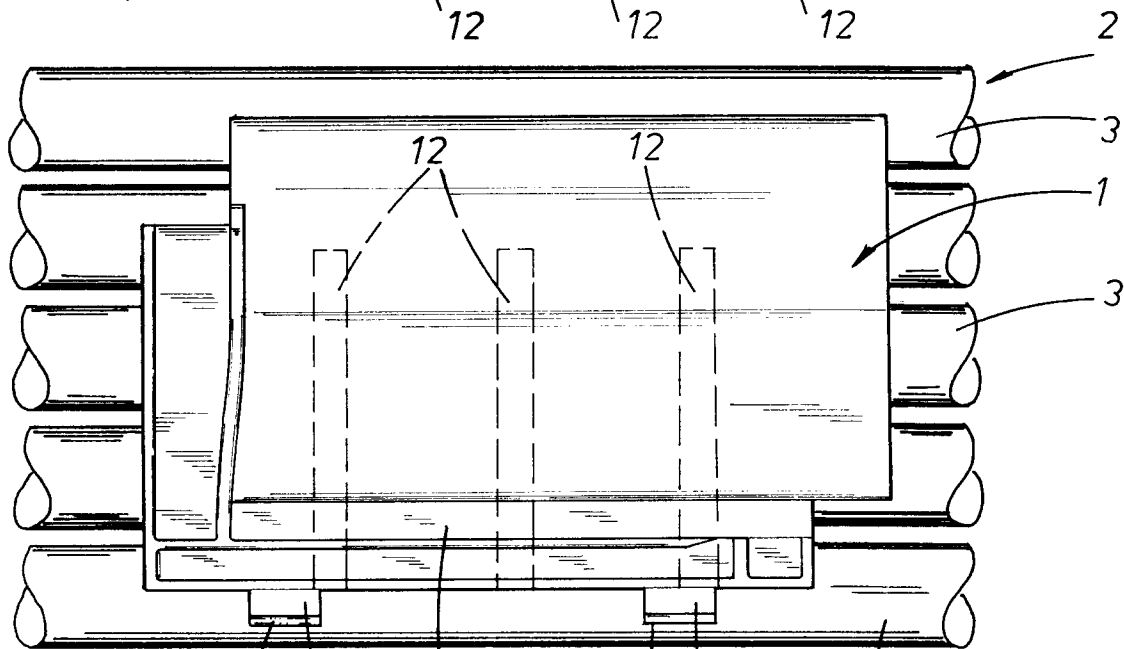
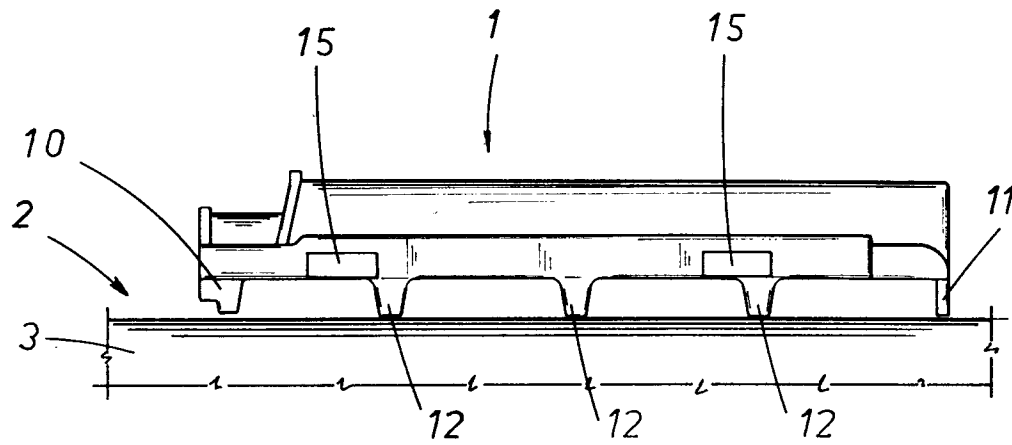


FIG 2

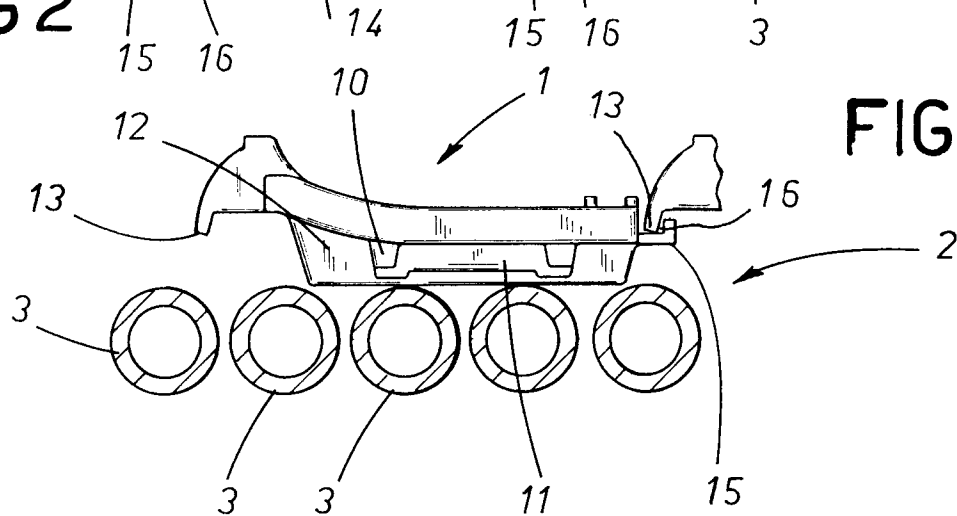


FIG 4

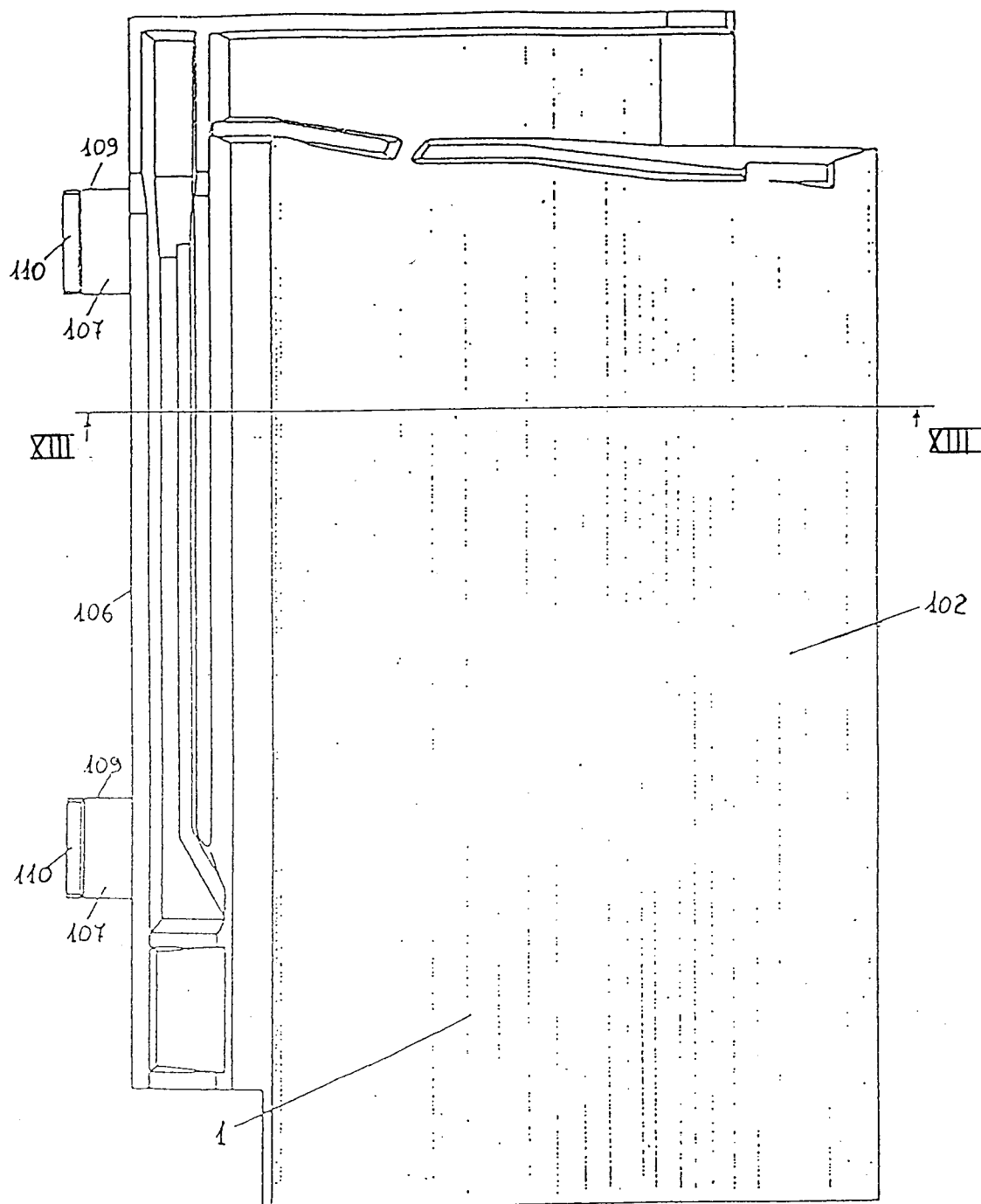


Fig. 8

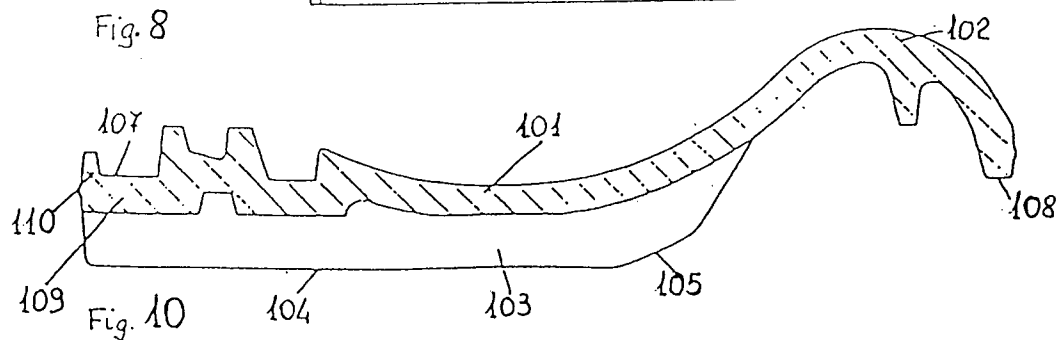


Fig. 10

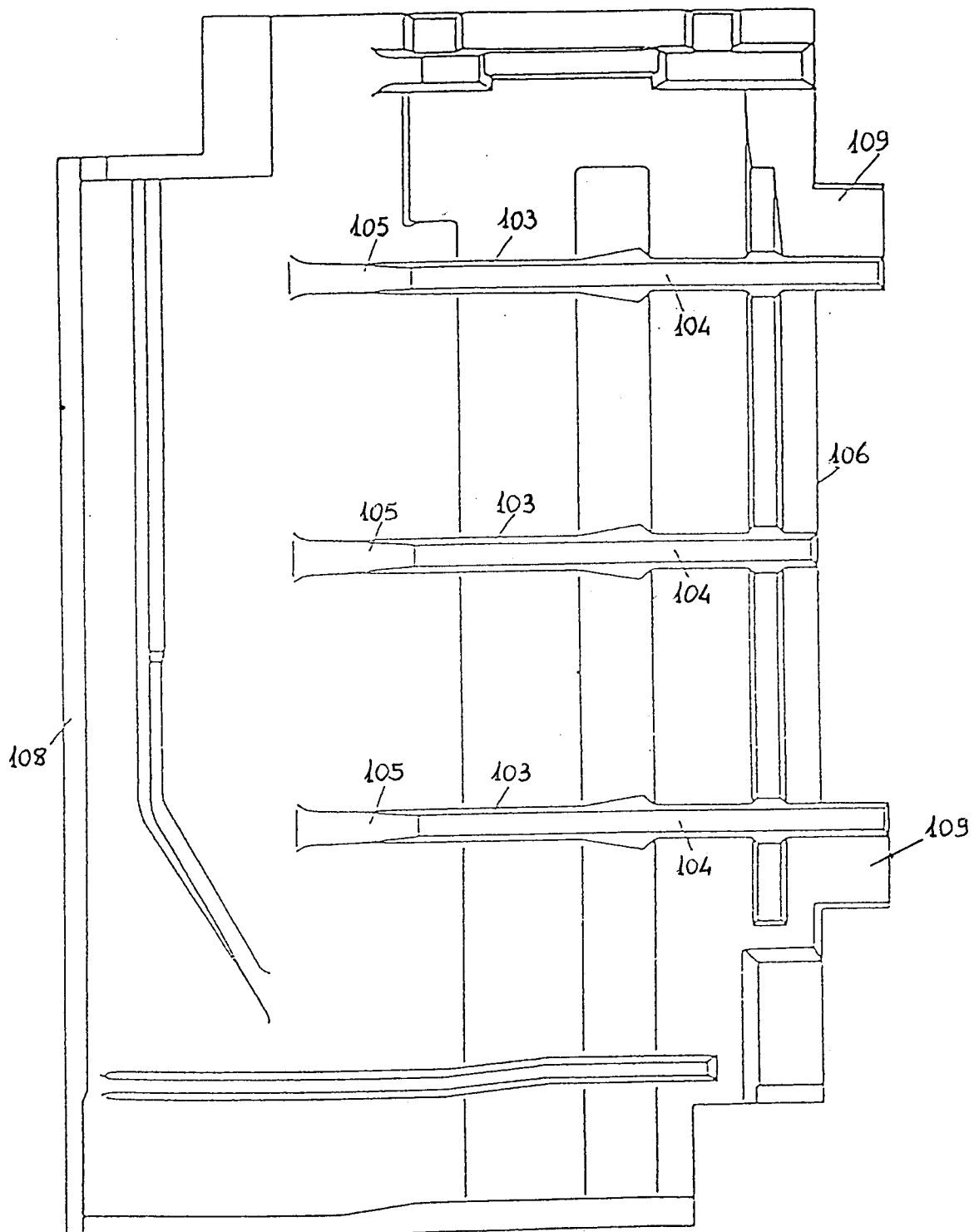
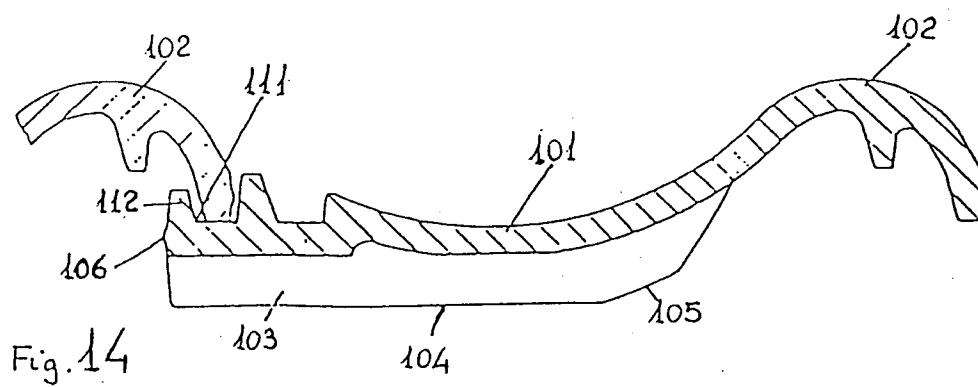
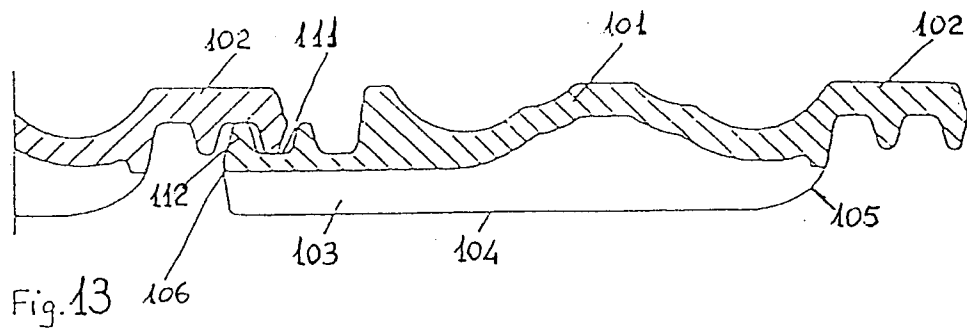
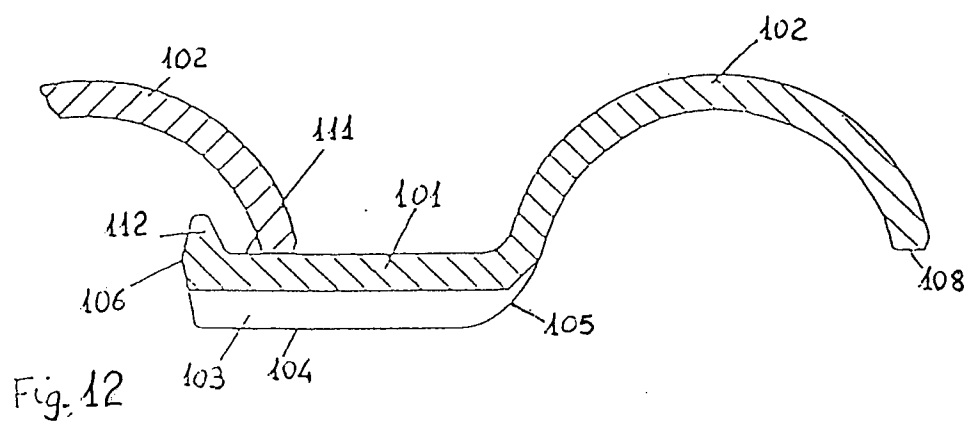
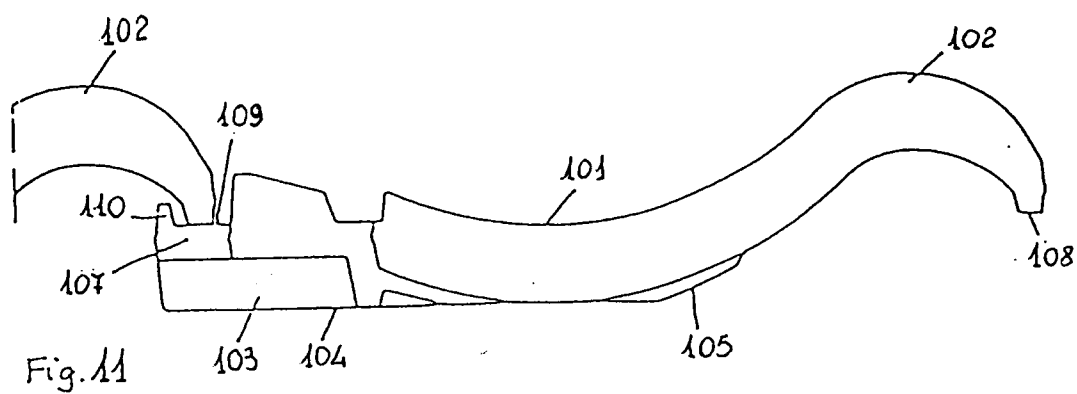


Fig. 9





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 93 83 0372

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.5)
X,P	DE-U-92 12 961 (TEICHGRÄBER GMBH) * the whole document * ---	1-18	F27D5/00 F27B9/24 E04D1/04 B28B11/00
X,P	EP-A-0 519 212 (CERIC ANLAGENBAU GMBH) * the whole document * ---	1-3, 7-10, 13, 18	
X,P	DE-A-42 00 012 (ERLUS BAUSTOFFWERKE AG) * the whole document * ---	1-3, 7-10, 13, 17	
X A	GB-A-2 018 962 (WELKO INDUSTRIALE S.P.A.) * the whole document * ---	1-3 7-9, 15, 17, 18	
A	DE-C-66 526 (H. BOLZE & CO.) * the whole document * ---	1, 4-7, 11, 12, 14	
A	US-A-2 762 618 (J. A. JOHNSON) * the whole document * ---	1, 4, 7	
A	FR-A-347 501 (SOCIETE GENTIL , BOUBDET ET CIE) * the whole document * ---	1, 7, 15	
A,D	US-A-3 830 625 (J. A. CABLE) * the whole document * -----	1, 4, 7	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 6 December 1993	Examiner Gourier, P
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