METHOD OF MAKING FIRING SETTERS FOR TILES AND OTHER CERAMIC ARTICLES

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ABSTRACT

A method of forming cell-shaped assemblies of firing setters for individually and spacably supporting a plurality of tiles and other ceramic ware during the firing of the glaze in a firing kiln which involves providing upright wall components made of refractory material with laterally extending projections for supporting the tiles, further providing transverse or horizontal components, also formed of ceramic material, with complimentary configurations for interengaging transverse components in a co-planar manner and interlinking the top and bottom ends of the upright components with the edge portions of the transverse components for affording an essentially loose interfitting engagement of the components to provide an assembly made of a plurality of superimposed and side-by-side located cells.

6 Claims, 10 Drawing Figures
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BACKGROUND

This invention concerns in general the firing technique for tiles, pottery, earthenware and the like, and more particularly the method of making and using means (usually called "firing setters") in the terminology belonging to the art) for supporting a plurality of pieces and articles during their stay in and movement across a firing kiln.

Many types of firing setters or supporting means have been heretofore proposed and made use of. In general, such firing setters comprise essentially vertical components, that form the walls or wall portions by which the inner space of any individual firing setter is defined, being such walls formed on one or both sides thereof, with pluralities of rows of vertically spaced projections which in combination with the projections formed at the same levels on the opposite wall or wall portion, form supporting points for the single tiles or other article to be fired. For simplicity sake, said components will be hereinafter called "walls".

The top edges and/or the bottom edges of such walls are connected with one another by crosswise extending components, whereby to form on the whole, a self-supporting and sufficiently rigid structure. In the conventional technique, rigid structures are utilized, wherein each firing setter consists of a one-piece component, made of a suitable refractory material, and comprising two opposite walls, and at least one crosswise extending horizontal wall, by which the bottom or top of the space enclosed between said walls is defined. According to other constructions, for dodging the difficulties involved in the molding and firing of complicated and heavy pieces of refractory material, the firing setters are made-up by the combination of different, separately produced components, designed to form the walls and the bottoms or covers, and that afterwards are rigidly connected with one another by means of a suitable cement grout to obtain a rigid and self-supporting assembly. The rigidity of the connection between the different components is sometimes enhanced by groove and tongue joints, wherein the interfitted portions are often frustoconically shaped, or even frusto-pyramidally shaped.

Such rigidity of the assembly of each firing setter, which is presently considered as critical to ensure the stability of same firing setters and of their contents, is however, a source of other drawbacks. As is already well known, the ceramic structures having a complicate shape and rather large sizes —no matter whether made as a one-piece structure or by the combination of single components— cannot be produced with close dimensional tolerances. Moreover, the same structures, owing to the inherent nature of their application, are subjected to heavy and repeated thermal shocks, leading to uneven deformation and to heavy internal stresses in their sections, with consequent failure or breakage thereof.

The above ill-effects become rather serious when, to increase the through-put of kilns or firing chambers —that usually consist of tunnels traversed by trolleys running on tracks— such trolleys are loaded with a large number of firing setters arranged in many rows and columns, placed side-by-side and superposed. Each deformation, already existing or successively caused by thermal shocks, of underlying firing setters, will obviously result in deviations and going out-of-alignment of superposed and adjacent rows and columns. The above shiftings often occur in opposite directions, which results in heavy localized stresses, with consequent failures. The mutual bearing of superposed firing setters becomes irregular and incomplete. Such ill-effects are made even worse when the firing setters are shaped in such a manner as to be adapted to be theoretically enmeshed with one another. Then, all possible relative motions of the same firing setters, caused by thermal expansion and contraction, the use of piping and loading devices is made practically impossible by the rigidity of structure. In fact, the unavoidable tolerances and variations in the positioning and levelling do not allow the use of structurally rigid loading devices, nor does the possibility exists of a compensation or equalization of said variations.

Therefore, it is an object of this invention to provide a method for the making of firing setters, and more particularly of assemblies of firing setters, comprising shaping a plurality of upright and transverse components for interengagement and interlinking the components together for affording a number, increasable at will, of cell-like spaces for the placing of tiles or other ceramic articles to be fired, the assemblies being free from the abovementioned and further drawbacks and also, in general, free from limitations to which the heretofore known supporting means are subjected.

Another object of this invention is to provide a method for the making of firing setters, and in particular of assemblies of firing setters, that comprises the prefabricating standardized components, having relatively small size, low weight and simple geometric configuration. In particular, and according to a preferred embodiment of the invention, every two types of components are prefabricated and utilized in the number as required for obtaining firing setter assemblies having overall sizes and volumes which can be increased at will —obviously within the practical limits as defined by the inner cross section of firing kilns.

A further object of the invention is to provide a method for making assemblies of firing setters, as previously stated, by assembling a plurality of interengaging components which form together a wholly self-supporting structure, without the necessity of having the same components rigidly or otherwise permanently connected with one another. Such advantageous feature allows to replace individually the only component or components accidently damaged or broken, and to change, reduce or increase the sizes of firing setting assemblies according to different requirements and operating conditions.

Consequently, the invention concerns also the firing setters and firing setter assemblies that can be obtained according to the above method, as well as the components that embody the means or articles of manufacture to be utilized for the making of said firing setter assemblies.

SUMMARY

According to the invention, it has been found and made use of the principle of forming a composite structure by gathering, superimposing and mutually connecting by interfitting a plurality of standardized components, by which the vertical walls, and respectively the bottom and the top of each firing setter are formed, being said interfitting brought about in such a manner as to allow a limited and controlled freedom of relative motion of the interfitted components, in an amount sufficient to allow the structure thus formed to take-up the dimensional changes of single components, due either to manufacturing allowances, and above all to thermal expansion, being moreover the adjoining components shaped in such a manner as to prevent, with an ample margin of safety, that said relative motions can be absorbed in amounts, without prejudice of the static stability of firing setter assembly, as well as to the resistance thereof, under the action of variable loads and of dynamic stresses resulting from the regular operation of the firing plant.

According to an important feature of the invention the top and bottom edges of components utilized as uprights or vertical walls of firing setters are formed with lateral projections forming essentially horizontal and bearing planes, having a width sufficient to ensure said stability, as well as with projections extending upwardly and respectively downwardly in respect of said planes, and forming the tongues of joints with the bottom and top components of single firing setters, as well as the means for the crosswise connection between the uprights or walls.

According to an advantageous feature of the invention, said top and bottom projections of uprights are located in different positions across the geometric vertical area of component, and the transverse components are formed with bores or
through recesses, positioned in such a manner as to indifferently accommodate either the top and bottom projections of vertical walls. Moreover, the opposite sides of said transverse components are shaped, limitedly to their portions designed to rest on the vertical walls, in such a manner as to provide complementary geometric configurations, whereby two oppositely directed transverse components can be fitted simultaneously and co-planarily on each vertical wall, to form both the top of underlying firing setters and at the same time the bottom of overlying firing setters.

The above and further features and advantages will be made apparent from the following detailed description of a preferred, but not exclusive embodiment of the invention, as shown by way of a non-restrictive example in the attached drawings.

**DRAWINGS**

FIG. 1 is a fragmentary, axonometric view of a firing setter assembly according to the invention.

FIG. 2 is an exploded view of part of components of above assembly.

FIG. 3 is a side view, on a reduced scale, of a wall forming element, having its middle section broken away.

FIG. 4 is a front view of same element.

FIG. 5 is a plan view of a transverse component, by which the vertical walls are connected, and the top and bottom of underlying and overlying firing setters respectively are formed.

FIGS. 6 and 7 are plan views of either ends of components shown in FIGS. 3 and 4, as viewed in the directions indicated by arrows VI and respectively VII in FIG. 3.

FIG. 8 is a fragmentary sectional view of a characteristic portion of the assembly, taken on the broken vertical plane VIII—VIII in FIG. 9.

FIG. 9 is a section of same portion taken on the horizontal plane IX—IX in FIG. 8, and

FIG. 10 shows the same components of FIGS. 8 and 9 in their positions preparatory for the making-up of the assembly.

**PREFERRED EMBODIMENT**

The method according to the invention consists essentially and as shown in FIGS. 1 and 2, in providing and assembling a plurality of two different components, i.e., of components M designed to form the uprights or vertical walls of assembly and including the supports for the tiles, pottery or other ceramic articles to be fired, and of components P designed to be placed horizontally to form at different levels the wall connections, said plurality being sufficient for making-up an assembly having the required sizes and capacity.

Formed on at least one, and preferably on both major faces of said wall components M are a row of vertically and uniformly spaced, rib-like projections, that serve as supports for the articles to be fired. Larger and substantially flat heads are formed at the top and bottom ends of wall components M, said heads being formed in turn with projections acting as tongues for engagement with the adjoining horizontal components P. Said projections are differently positioned in both heads, in order that they cannot coincide when two vertical wall components are coplanarly superposed.

The horizontal components P comprise ends formed with a plurality of said transverse components, as shown in more detail in FIG. 2, whereby two coplanar elements P can get engaged with each other, while resting together onto the upper head of an underlying upright M; on the continuous plane surface thus formed, the bottom head of an overlying similar upright component M can be engaged.

The two opposite complementary portions of said component P are formed with a plurality of ribs, positioned in register with all projections present in both top and bottom heads of uprights M.

Thus, as shown in FIG. 1, rows of horizontal, coplanar components P, mutually engaged with each other, can be interposed at each level as defined by the height of uprights M, thereby ensuring the reciprocal interlinking of all components of the assembly.

According to an important feature of the invention said projections and said bores are dimensioned in such a manner as to ensure their mutual engagement with a large margin of allowance. The interlinkage obtained by said mutual engagement is practically designed to ensure only a firm connection in the horizontal direction.

The top and bottom flat heads of uprights represent turn surfaces which are sufficiently large to ensure the stability of assembly, which is also enhanced by the action of gravity, that is of load weighing upon said surfaces, owing to the component's own weight, and prevalently by the weight of ceramic material loaded into the firing setters, as formed by the assembling of said components (see the example shown in FIG. 1).

As it can be better appreciated from the embodiment of the invention shown as a not restrictive example in FIGS. 3 to 10 inclusive, the top head 10 and the bottom head 11 (such terms are utilized in this specification for the matter of convenience only, since said heads might be laid in a reversed position, provided that such arrangement is maintained at least across a whole column of components M), are formed by expanded portions or shoes, showing an end flat surface of suitable width. Projecting from the upper head 10 are a plurality of tappets, and in particular a central tappet 12 and symmetrically located side tappets 13, which latter are suitably spaced from the head end. The bottom head 11, similarly widened and flattened, is formed with a different plurality of tappets, and in particular with inner side tappets 14 and with outer side tappets 15, the position of tappets 12 and 13 being such as to be, in a vertical projection, intermediate to that of tappets 14 and 15, as it can be clearly noticed from a comparison of FIGS. 6 and 7. The height of projection of said tappets is not greater than the thickness of components P.

The horizontal components P show in turn a geometrically complex configuration, and preferably are suitably lightened by perforations. Their opposite ends, designed to be placed on top, and respectively below of a pair of adjacent uprights M, by which the opposite walls of each single firing setter of the whole assembly are formed, have a geometrically complementary contour. Preferably, as shown in FIG. 5, one of their ends is formed with a narrow projecting portion 16, while the essentially fork-shaped opposite end consists of two spaced side portions 17, between which a space 18 is left, wherein the projection 16 of a similar adjoining coplanar component can be accommodated with a sufficient clearance, as shown in FIG. 9.

Formed in said portions 16 and 17 are through bores, wherein the tappets 12 and 14 and respectively 13 and 15 can be engaged. Such tappets are those of top end and bottom end of uprights M. The arrangement is clearly shown in FIG. 9.

Otherwise stated, by placing a component P upon two parallel, suitably spaced uprights M, the tappets 12 and 13 jutting out from the top of said components M, will engage a part only of the bores as formed in the superposed component P, wherein are therefore left further bores available for the engagement of tappets 14 and 15, present on the bottom head of a superimposed uprights M, thus allowing to have a second pair of uprights M placed upon the horizontal component P, that is laid on the top of first pair of uprights M.

Moreover, also as shown in more detail in FIGS. 8, 9, and 10, the top tappets 12, 13 and the bottom tappets 14, 15 of uprights M are engaged in part with the narrow central portion 16 and in part with the spaced side portions 17 of both overlying and underlying horizontal components P.

A twofold effect of interlinkage is thereby obtained, since the uprights M are linked with each other by the horizontal components P, while the overlying and underlying mutually engaged components P are in turn connected with each other by the same uprights M.

It has been surprisingly ascertained that an interlinkage of the abovedescribed or equivalent type, allows to obtain a structure having vertical and transversal dimensions (i.e.
horizontal dimensions in a direction orthogonal to the orientation of major plane of components M) large at will, obviously within the limits of practical useability in firing kilns.

In fact, such structure is not wholly rigid. A given deformability, particularly in a transverse direction, of the assembly is permitted by the allowances left in the engagement of upright tappets with the bores of horizontal components. However, such deformability is restricted to small angular values, insufficient to be prejudicial to the proper static stability of the whole assembly, by the width of bearing surfaces of heads 10 and 11, as formed on either ends of uprights M.

On the other hand, the interlinked components which theoretically ought to lie only in a space lattice formed by parallel and orthogonal, or better stated horizontal and vertical planes, may form with each other angles which are slightly different from the plane and right angles theoretically formed between coplanar components and intersecting and interlinked components. Such intentional, though restricted freedom of relative motion has proved to be far more than sufficient for taking-up even the heaviest dimensional changes and irregularities in the relative space positions, due to thermal deformations, even if strongly uneven, as well as the unavoidable production allowances.

In addition, the afore specified deformability allows to take-up even higher dynamic stresses, like those that are exerted in the course of loading and unloading operations of ceramic articles, while the trolleys are running on their tracks across the kiln, as well as during the even abrupt starting and braking. In fact, the large mass formed by a loaded firing setter assembly, obtained as specified above, is not compelled to follow instantaneously the strong irregularities in the trolley motion, whereby the powerful negative and positive accelerations which would be caused in the case of abrupt startings and brakings, are damped, because the large mass of load can materially displace itself, thus preventing the instantaneousness of dynamic effects, and largely reducing the value of acceleration in the above stated cases. However, since the above specified procedures and means for carrying the invention into practice have been described and shown as a not restrictive example only, it is to be understood that many changes and modifications may be made both in said procedures and in said means, to better conform with the local production and operating requirements, without departing from the spirit and scope of the invention.

I claim:

1. A method of forming firing setters and assemblies of firing setters used for supporting tiles and other ceramic articles while they are being fired, comprising the steps of providing upright components of refractory material with laterally extending projections for supporting the tiles and other ceramic materials, providing transverse components of refractory material with geometrically complementary contours for interfitting the ends of the transverse components in a co-planar manner, arranging the upright components and transverse components orthogonally and interlinking the upper and lower ends of each upright member with the adjacent ends of a pair of transverse components and interfitting the ends of the pair of transverse components in a co-planar end-to-end manner and providing a limited and controlled degree of relative movement between the interlinked upright and transverse components.

2. A method, as set forth in claim 1, comprising the steps of disposing the upright components vertically and the transverse components horizontally and arranging the transverse components so that they extend through and beyond the vertical plane containing the upright components.

3. A method, as set forth in claim 1, comprising the steps of providing the upright components with laterally expanded top and bottom ends for forming bearing surfaces for the transverse components located at the top and bottom ends thereof, and affording static and dynamic stability to the firing setter assemblies within the limits of formability provided by the limited and controlled degree of relative movement between the interlinked upright and transverse components.

4. A method, as set forth in claim 1, characterized by the further step of forming spaced projections on the top and bottom ends of the upright components, forming bores in the transverse components arranged to receive the projections on the upright components, and interlinking the top and bottom ends of the upright components into the bores in the transverse components.

5. A method, as set forth in claim 4, characterized therein by the further steps of forming each of the ends of the transverse components so that one end has a tongue and the other a groove and the tongue of one transverse component fits into the groove in the other one while the transverse components are disposed in a co-planar end-to-end relationship.

6. A method, as set forth in claim 5, characterized therein by the further step of providing the bores in the portion of each transverse component forming a tongue and in the portions defining the grooves therebetween for receiving the projections from the top and bottom ends of the upright components.

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