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(54) **TUNNEL KILN FOR FIRING CERAMIC ITEMS**

TUNNELOFEN ZUM BRENNEN VON KERAMISCHEN ARTIKELN

FOUR TUNNEL DESTINÉ À LA CUISSON D'ARTICLES CÉRAMIQUES

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EP 2 017 558 B1

Description

[0001] The invention belongs to the technical field related to the burning of the natural materials and their products and can be used in construction materials manufacturing (in particular, bricks).

[0002] The tunnel oven containing the channel divided into item drying, burning and cooling zones and ventilation system is known (patent RU 2187771, 2002). The hot gases are taken from the working channel, mixed with atmospheric air pumped in by forcing ventilator and fed to the oven's working channel in the drying zone. These operations provide the rational oven's working and item processing mode. However, the roof is heated much in the burning area. The heat comes to the over-roof space and thus is not used, i.e. resulting in the non-rational heat consumption in the burning zone, and, besides, the significant local roof's overheat can lead to the roof's deflection and destroying.

[0003] The tunnel oven with main and additional roofs with inter-roof space over the working channel is also applied (patent RU 2091688, 1997). The gaseous combustion products together with the gases extracted from the burnt items in the burning zone are led to the inter-roof space where they are neutralized and removed through the holes in the heat zone's walls.

[0004] Another one tunnel oven for the ceramic items burning (prototype) containing the working channel with preheating, burning and cooling zones limited by side walls, principal and additional roofs with inter-roof space. The inter-roof space is divided into sections. The oven is also supplied by ventilation system in the form of the forcing ventilator with the pipeline taking the hot gases from the inter-roof space and feeding pipeline (patent GB 1281504, 1972). The gases are taken from the inter-roof space section located over the cooling zone and from the inter-roof space section located before the burning zone and led to the working channel's preheating zone.

[0005] In some cases the appliance, which provides rather quick item's cooling by atmospheric air, are used. The big temperature and humidity difference between the hot items and atmospheric air can lead to the burnt items' cracking.

[0006] According to the invention, the tunnel kiln for the ceramic items firing includes the working channel with ceramic item preheating, firing and cooling zones. The working channel is defined by side walls, main arch roof and additional arch roof with inter-arch space. The main and additional arch roofs are implemented in the form of the overlaps. The inter-arch space is a space between the arch roofs. The tunnel kiln's gas distribution (ventilation) system contains, at least, the intake pipeline, ventilator and feeding pipeline, and the intake pipeline connects the ventilator with working channel's cooling zone and/or the space between the firing zone and working channel's cooling zone.

[0007] The technical result of the requested invention is in the stabilization of the finished products qualitative

parameters providing the most rational processing's temperature mode, as well as in fuel consumption decrease at the expense of the heat from the inter-arch space. Another one technical result is a gas consumption's increase in the inter-roof space thus preventing the excessive roof's overheat and contributes to its longevity's increase.

[0008] The pipes act as channels for the gas movement - gas guides (gas ducts). The pipes can have a rectangular, square or oval profile. The intake pipeline can be equipped with outer-air inlet appliance, e.g. in the form of the manifold with a door. The intake pipeline is connected with kiln's inter-arch space over the working channel's firing zone. The intake pipeline can be also connected with kiln's inter-arch space over the working channel's heat zone or cooling zone.

[0009] The feeding pipeline usually contains the collector-distributor with several manifolds having the direct output to the working channel's cooling zone.

[0010] The inter-arch space is made in the form of one cavity without any continuous partitions or with partitions bearing holes.

[0011] The tunnel kiln is included in the ceramic item manufacturing equipment. The ceramic item manufacturing equipment contains the drying oven and ceramic items firing kiln. To increase the gas (air) consumption through the inter-arch space the inter-arch space is connected with drying oven by pipeline (air duct or gas guide) and ventilator.

[0012] The drawing shows the tunnel kiln for the ceramic item firing in its longitudinal section.

[0013] Position 1 indicates the working channel's preheating zone, position 2 - firing zone, position 3 - cooling zone. There is an inter-arch space 6 between the main arch roof 4 and additional arch roof 5. The gas distribution (ventilation) system includes the intake pipeline 7, ventilator 8, feeding pipeline 9 and collector-distributor 10 with manifolds 11; the intake pipeline 7 connects the kiln's inter-arch space 6 over firing zone 2 with ventilator 8, and manifolds 11 of the collector-distributor 10 have an output directly to the cooling zone 3 near the working channel's firing zone 2. Position 13 indicates the burners located in the firing zone 2. The ventilation system can include several ventilators 8 with the corresponding amount of the connecting pipelines. Yet, the kiln can be supplied by exhaust ventilation to waste some part of the gases into the atmosphere and pipelines to feed the hot gases to the ceramic item's preheating zone 1 (such constructive elements are not shown on the drawing because they don't pertain to the invention).

[0014] The proposed tunnel kiln works as follows.

[0015] The burning trolleys filled with dried ceramic items move along the kiln's working channel. The trolleys move from the right to the left on the drawing, smoke gases - in the opposite direction. The ceramic items put to the thermal processing pass through the preheating, firing and cooling zones indicated by figures 1, 2 and 3 respectively. First, the items are heated in preheating

zone 1 at the expense of the heat coming from the firing zone 2 as a fuel combustion's result, then the firing at maximal temperatures (zone 2) takes place and afterwards the items gradually cool in cooling zone 3.

[0016] During their firing in the tunnel kiln the items (in particular, bricks) undergo the rising temperature's influence (from 80°C to 750°C) in the preheating zone; influence of temperature 750°C - 1100°C (in the firing zone); influence of the lowering temperature from 1100°C down to 50°C - in the cooling zone. The firing has been held for 40-55 hours.

[0017] The air forced at the kiln's end passes through the cooling zone 3, heats and comes to the firing zone where it takes part in the fuel combustion process, which fuel has come to firing zone 2. The heated air can be also withdrawn for the formed items drying in the drying ovens. The smoke gases resulted from the fuel combustion are directed to the preheating zone 1 where they are used for the final water's removal, heating and item's preparation for firing.

[0018] The heat generated from the fuel combustion is spent not only for the items burning, but also for the heating of the oven's fencing constructions (so called heat losses), including the suspended roof's heating. At the end of preheating zone 1, burning zone 2 and at the beginning of cooling zone 3 rather high temperatures are created influencing the strength parameters of the supporting metallic constructions of the principal and additional roofs. The heat from the working channel reaches the inter-roof space at the expense of the heat transfer through the main arch roof.

[0019] The hot air from the inter-arch space 6 is removed through the intake pipeline 7 by ventilator 8 and led via feeding pipeline 9 to working channel's cooling zone 3 or space between the firing zone 2 and working channel's cooling zone 3. The temperature of the gases removed from the inter-arch space 6 is 250-300°C, which is apparently lower than the temperature of the items leaving the firing zone, but it significantly exceeds the atmospheric air's temperature (which is also led to the fired items' cooling). The optimal cooling-down mode of the items can be attained at the expense of the items' cooling by air having a relatively high temperature (comparing with the atmospheric air) and gradual decrease of the cooling air's temperature combined with trolleys' movement along the cooling zone to the working channel's output. Under these conditions the item spoilage rate (caused by sharp temperature changes at cooling and uneven cooling of the different parts of the items) essentially decreases due to the atmospheric air blow-off only (comparing with cooling process).

[0020] When the temperature of the gases fed to the cooling zone 3 becomes too high, it can be lowered to the required level by mixing the hot gases with atmospheric air. For that purpose there is an atmospheric air inlet's manifold 12 on the intake pipeline 7. To regulate the taken air's quality, the consumption regulator (door) can be installed on the intake pipeline.

[0021] The gas distribution system provides the gas feeding from the inter-arch space to the working channel with consumption rate 0.01-10m³/c. The system is constructed to provide the gas consumption regulation.

[0022] Thus the stabilization of the qualitative parameters of the ceramic items is facilitated. Yet, the most rational temperature mode of the ceramic item's processing can be guaranteed, the fuel consumption at the expense of the heat from the inter-arch space can be lessened. The feeding of the heated air from the inter-arch space to the working channel shall compensate the heat losses arising after the kiln doors have been opened.

15 Claims

1. A tunnel kiln for the firing of ceramic items containing a working channel with preheating (1), firing (2), and cooling zones (3), defined by side walls, a main arch roof (4) and an additional arch roof (5) with an inter-arch space (6) and a gas distribution system equipped, at least, with an intake pipeline (7), a ventilator (8) and a feeding pipeline (9), **characterised in that** the intake pipeline (7) connects the kiln's inter-arch space (6) with the ventilator (8) over the working channel's firing zone (2), and the feeding pipeline (9) connects the ventilator (8) with the working channel's cooling zone (3) and/or a space between the firing zone (2) and the working channel's cooling zone (3).
2. The tunnel kiln of claim 1, wherein an atmospheric air inlet appliance (12) is installed on the intake pipeline (7).
3. The tunnel kiln of claim 2, wherein the atmospheric air inlet appliance (12) is in the form of a manifold with a door.
4. The tunnel kiln of claim 1, wherein a collector-distributor (10) with a manifold (11) is assembled in the feeding pipeline (9).

45 Patentansprüche

1. Tunnelofen zum Brennen von keramischen Gegenständen, der einen Arbeitskanal mit Vorheiz- (1), Brenn- (2) und Abkühlzonen (3) enthält, der definiert ist von Seitenwänden, einem gewölbten Hauptdach (4) und einem zusätzlichen gewölbten Dach (6) mit einem Zwischenwölbungsraum (6), und einem Gasverteilungssystem, das wenigstens ausgerüstet ist mit einer Ansaug-Rohrleitung (7), einem Ventilator (8) und einer Zuführungs-Rohrleitung (9), **dadurch gekennzeichnet, dass** die Ansaug-Rohrleitung (7) den Zwischenwölbungsraum (6) mit dem Ventilator (8) über der Brennzone (2) des Arbeitskanals ver-

bindet, und die Zuführungs-Rohrleitung (9) den Ventilator (8) mit der Kühlzone (3) des Arbeitskanals und/oder einem Raum zwischen der Brennzzone (2) und der Kühlzone (3) des Arbeitskanals verbindet.

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2. Tunnelofen nach Anspruch 1, wobei eine Einrichtung (12) für den Einlass von atmosphärischer Luft an der Ansaug-Rohrleitung (7) installiert ist.
3. Tunnelofen nach Anspruch 2, wobei die Einrichtung (12) für den Einlass der atmosphärischen Luft in Form einer Rohrverzweigung mit einer Klappe ausgeführt ist. 10
4. Tunnelofen nach Anspruch 1, wobei ein Sammler-Verteiler (10) mit einer Rohrverzweigung (11) in die Zuführleitung (9) eingebaut ist. 15

Revendications

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1. Four-tunnel destiné à la cuisson d'articles céramiques, contenant un canal de travail avec une zone de préchauffage (1), une zone de cuisson (2), et une zone de refroidissement (3), défini par des parois latérales, un toit principal en voûte (4) et un toit additionnel en voûte (5) avec un espace inter-voûtes (6) et un système de distribution de gaz équipé au moins avec une tubulure d'aspiration (7), un ventilateur (8) et une tubulure d'alimentation (9),
caractérisé en ce que la tubulure d'aspiration (7) relie l'espace intervoûtes (6) du four au ventilateur (8) via la zone de cuisson (2) du canal de travail, et la tubulure d'alimentation (9) relie le ventilateur (8) à la zone de refroidissement (3) du canal de travail et/ou à un espace entre la zone de cuisson (2) et la zone de refroidissement (3) du canal de travail. 25 30 35
2. Four-tunnel selon la revendication 1, dans lequel un appareillage d'entrée d'air atmosphérique (12) est installé sur la tubulure d'aspiration (7). 40
3. Four-tunnel selon la revendication 2, dans lequel l'appareillage d'entrée d'air atmosphérique (12) est sous la forme d'un collecteur avec un clapet. 45
4. Four-tunnel selon la revendication 1, dans lequel un collecteur-distributeur (10) avec une ramification tubulaire (11) est assemblé dans la tubulure d'alimentation (9). 50

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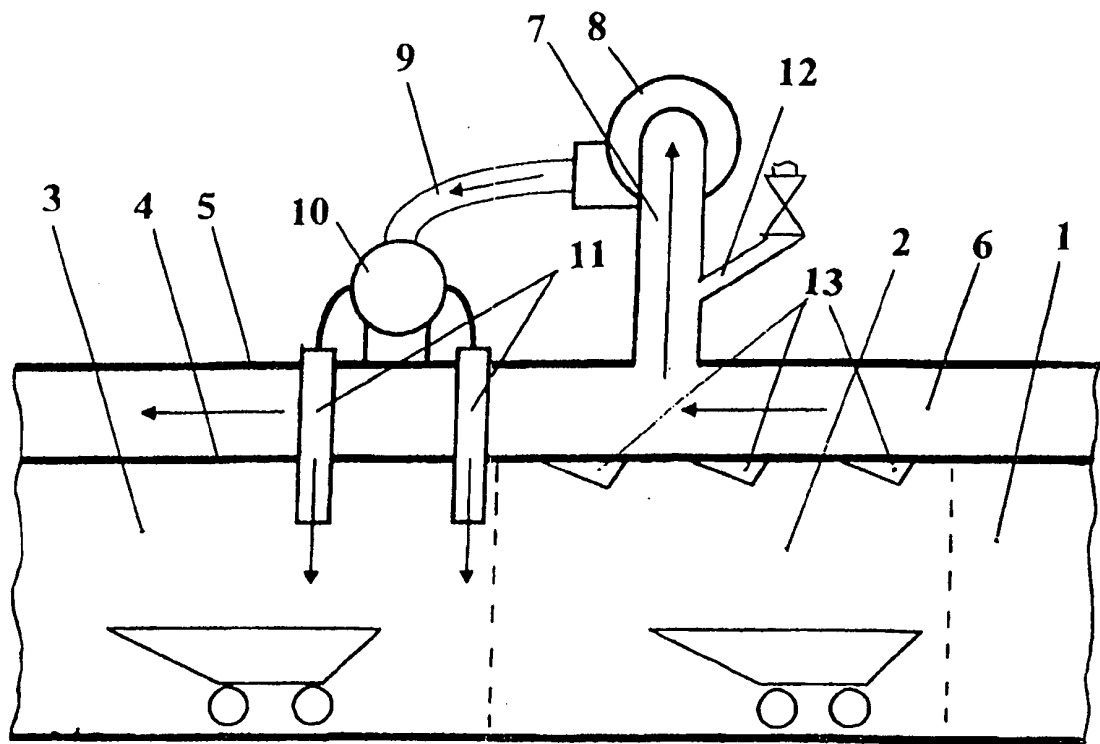


FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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