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

(57) The invention relates to engineering for firing natural materials and items made thereof and can be used for producing building ceramic units, in particular bricks. The inventive tunnel kiln for firing ceramic items comprises a working channel provided with ceramic item pre-heating, firing and cooling areas. Said working channel is defined by sidewalls, a main arch roof and an additional arch roof. The gas-distributing (ventilation) system of the tunnel kiln comprises at least one intake pipeline, a ventilator and a feeding pipeline, wherein the intake pipeline connects the inter-arch space of the kiln to

the ventilator and the feeding pipeline connects the ventilator to the working channel cooling area and/or to a space between the firing area and said working channel cooling area. Said invention makes it possible to stabilise the quality characteristics of final products, to ensure more rational temperature operating conditions and to reduce the fuel consumption by using the inter-arch space heat. In addition, the supply of hot gas from said inter-arch space to the working channel makes it possible to compensate losses of heat taking place when the doors of the kiln are open.

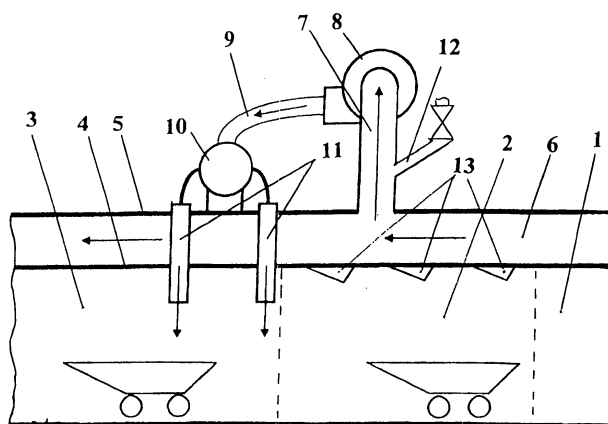


FIG. 1

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. In more admissible constructive variant 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.

Claims

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

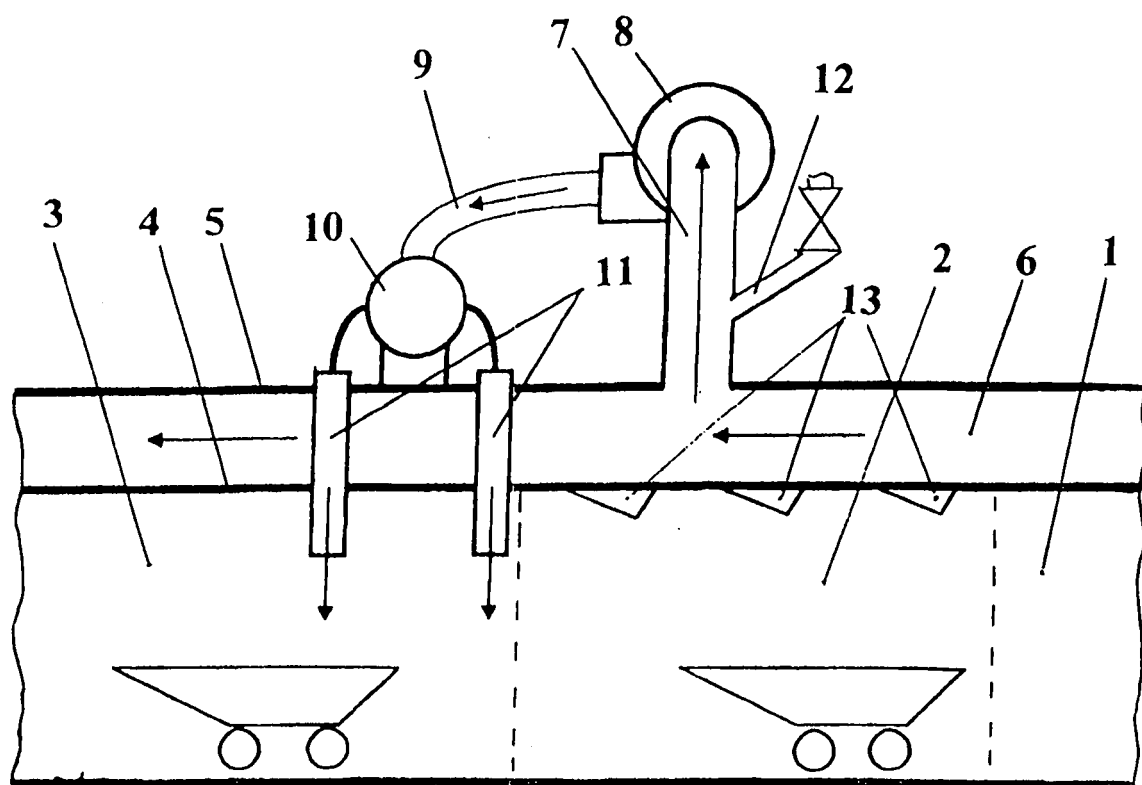


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 2007/000217

A. CLASSIFICATION OF SUBJECT MATTER		
F27B 9/00 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
F27B 9/00, 9/02, 9/04, 9/06, 9/08, 9/10, 9/12, 9/30		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
RUPAT, RUPAT_OLD, RUABRU, PatFT, PAJ, Esp@cencl, EPATIS, USPTO DB		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1281504 A (S.C.E.I. SOCIETA COSTRUZIONI ELETTROTERMICHE INDUSTRIALI) 12.07-1972	1-5
A	RU 2091688 C1 (ST. PETERBURSKII GOSUDARSTVENNI INSTITUT NAUCHNO-ISSLEDOVATELSKIKH PROEKTNIKH RABOT OGNEUPORNOI PROMZSHLENNOSTI) 27.09.1997	1-5
A	US 4568279 A (SOCIETE DES ELECTRODES ET REFRACTAIRES SAVOIE) 04.02.1986	1-5
A	US 4573909 A (GRANCO-CLARK, INC) 04.03, 1986	1-5
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
15 August 2007 (15.08.2007)		27 September 2007 (27.09.2007)
Name and mailing address of the ISA/		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- RU 2002 [0002]
- RU 2091688 [0003]
- RU 1997 [0003]
- GB 1281504 A [0004]
- GB 1972 A [0004]