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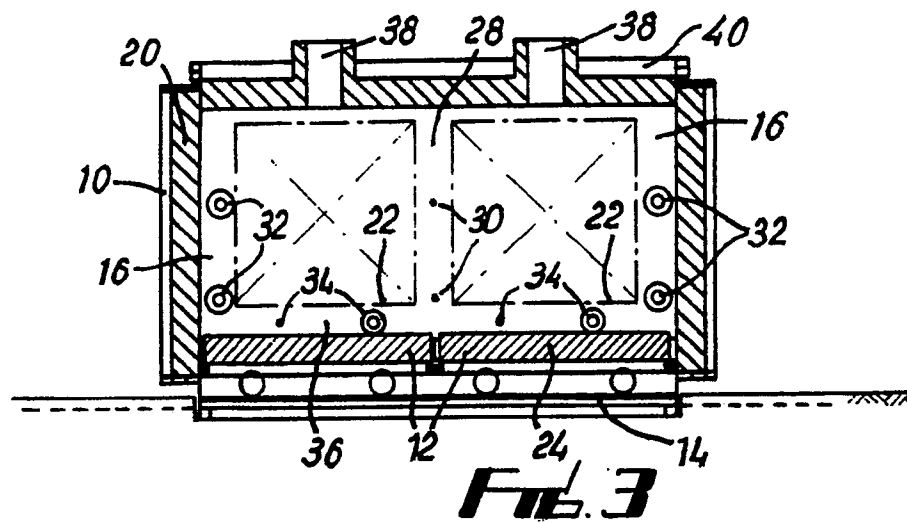
(71) Applicant: **BRITISH CERAMIC SERVICE
COMPANY LIMITED**
Rowhurst Industrial Estate, Chesterton
Newcastle-under-Lyme, Staffordshire ST5
6BH (GB)

(72) Inventor: **Rowley, Arthur John, British
Ceramic Service C.L.**
Rowhurst Industrial Estate, Chesterton
Newcastle-under-Lyme, Staffordshire, ST5
(GB)

(74) Representative: **Campbell, Iain Angus et al**
Swindell & Pearson 48 Friar Gate
Derby DE1 1GY (GB)

(54) Improvements of temperature distribution for kilns.

(57) A kiln (Fig. 3) for firing ware on a ware supporting arrangement such as a kiln car (12) accommodated within the kiln includes a multiplicity of firing means, a first group (30,32) of which are longitudinally spaced apart by a distance greater than the length of the ware supporting arrangement, and a second group (34) of which are mounted below the lowest level at which ware is supported within the kiln. This firing arrangement provides a high heat input and good heat distribution throughout the kiln to promote the rapid and even firing of the ware.



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IMPROVEMENTS IN OR RELATING TO KILNS

The present invention concerns improvements in or relating to kilns, especially but not exclusively kilns for firing ceramic articles, for example sanitary ware. The invention is not restricted to kilns of this type.

The ware for firing is generally supported within the kiln either on a fixed firing hearth or on one or more kiln cars which may be supplied to and removed from the kiln on suitable rails. The term "ware supporting arrangement" used hereinafter is to be understood to refer to a fixed hearth or a kiln car or any other suitable support.

Advances in the design of kilns have led to increased firing efficiency as a result of improved temperature distribution throughout the kiln. Such improved temperature distribution can lead to faster firing so that under given conditions the kiln can fire more articles than previously. Faster firing calls for a higher input of heat but in the past simply increasing heat input resulted in damage to the ware, either during the firing cycle or during the cooling cycle following firing.

Improved temperature distribution, in certain instances, has been achieved by the provision of a large number of relatively small output burners throughout the kiln. In one past example these burners have been arranged on the kiln floor and adapted to fire through passages formed in the base of the kiln car. Combustion air for the burners has been taken from the ambient air in the kiln and as a result of this it has been necessary to provide considerable air gaps in the kiln wall, normally by spacing the base of the kiln wall from the floor to provide a continuous gap. With such arrangements it is relatively difficult to control the products of combustion from the burners especially the oxygen content which is important to successful firing.

According to the present invention there is provided a kiln intended to fire ware on at least one ware supporting arrangement accommodated within the kiln, including a multiplicity of firing means mounted on the kiln wall, characterised in that firing means constituting a first group are longitudinally spaced apart by a distance greater than the length of the or each ware supporting arrangement, and firing means constituting a second group are mounted below the lowest level at which ware is supported within the kiln.

The firing means of the first group are preferably arranged in positions along the kiln wall which correspond during use of the kiln to the positions of respective spaces adjacent to the ends of the or each ware supporting arrangement, between the ends of the or each outermost, ware supporting arrangement and the ends of the kiln for example. Alternatively, or in addition, where each ware supporting arrangement comprises one of a plurality of kiln cars, the positions of the firing means of the first group may correspond

to the positions of spaces between successive adjacent kiln cars.

The firing means of the first group are preferably arranged in a mutually staggered relationship on opposite walls of the kiln.

Preferably a kiln adapted to accommodate two cars has firing means, of said first group, directed from one wall of the kiln into the space between the two kiln cars and from the other wall of the kiln into the respective spaces between the outermost ends of the kiln cars and the ends of the kiln.

Further preferably the firing means of said second group are arranged in mutually staggered relationship on opposite walls of the kiln.

Preferably the firing means of the first group are longitudinally spaced with respect to the firing means of the second group. Preferably the firing means of the first group comprises pairs of vertically spaced burner assemblies.

Preferably when the kiln doors are closed the kiln interior is sealed. Further preferably combustion air for the firing means is fed to the burners at elevated pressure from a source of compressed air arranged externally of the kiln and is precisely controllable.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which :

Fig.1 shows a sectional end elevation of a kiln on the line AA of Fig.2 ;

Fig.2 shows a sectional plan of a kiln ; and

Fig.3 shows a sectional elevation of a kiln.

The overall construction of the kiln shown in the drawings is in accordance with present kiln construction techniques and will not be described in great detail here as it does not form part of the present invention.

The kiln is of substantially rectangular cross-section in plan, in end elevation and in side elevation and has entry and exit doors 10 at its opposite ends. The walls of the kiln extend continuously from the floor to the roof so that when the kiln doors are closed the kiln interior is effectively sealed off from its surroundings. The kiln is adapted to accommodate two kiln cars 12 in an end-to-end relationship, the cars 12 being supplied to the kiln and removed therefrom on rails 14, the kiln cars 12 are constructed so that when they occupy their firing position within the kiln a first space 16 is defined between the outermost ends of the stacks of ware 18 on the respective cars and insulation 20 on the inner face of the kiln doors 10. Additionally a bat 22 on which the lowermost layer of the stack 18 of ware to be fired is supported is spaced above the upper surface of the kiln car chassis 24 by any appropriate means, for example, pillars (not shown).

Gas or oil burners are provided on each of the

insulated longer walls 26 of the kiln. Each burner is provided with a separate fuel supply and controllable supply of compressed combustion air. On a first wall 26(a) there is provided a pair of vertically spaced first burners 30 with one burner being arranged directly above the other, this first pair being located such that the products of combustion therefrom debouch into the kiln and into the space 28 between the respective stacks of ware on the kiln car. Two pairs of second burners 32 are arranged on the opposite wall 26(b) of the kiln with one burner of each pair vertically above the other and debouching into the respective spaces 16 between the outer ends of the stacks 18 of ware on the cars 12 and the kiln doors 10. Each facing side wall 26 of the kiln carries further burners 34 located at a level below the level of the lower most burner of the first and second burners 30,32 described above. The third burners 34 on one wall 26(b) are staggered with respect to the third burners 34 on the opposite wall 26(a) and debouch into the space 36 between the top of the kiln car chassis 24 and the lowermost bat 22 supporting the stack 18 of ware.

The chemical composition of the gas in the interior of the sealed kiln can be precisely controlled by controlling the air to fuel mixer at the burners, principally by controlling the supply of compressed air to each burner. This control can be especially precise thereby enabling close control of the chemical composition of the products of combustion within the kiln, and especially the oxygen content thereof.

Exhaust means in the form of two vents 38, normally connected to a source of reduced pressure, are provided in the insulated roof 40 of the kiln.

It should be realized therefore that the present invention provides a high heat input which is well distributed throughout the kiln at locations which do not cause heat from the burners to impinge directly on the ware being fired. The position of the burners throughout the kiln, in conjunction with the exhaust from the kiln roof, assures an adequate heat distribution throughout the kiln and consequently the relatively rapid firing of ware without any detrimental effect on the ware due to over or under heating. The precise fuel/air mixture control also means that the chemical composition and particularly the oxygen content of the kiln atmosphere can be precisely controlled.

When the firing cycle is completed cooling of the ware, prior to removal of the kiln cars, can be achieved in a controlled manner by supplying controlled amounts of cooling air through the burners, the cooled air, as a result of position in which it is introduced into the kiln and the location of the exhaust means on the roof of the kiln, passing over all of the ware in a manner readily and accurately controllable by the kiln operator.

Various modifications can be made without departing from the scope of the invention, for example the number and location of the burners can be altered

provided that their location conforms to the general locations discussed above.

The kiln can be adapted to accommodate a single kiln car or three or more kiln cars or fixed hearth. The overall construction of the kiln, for example the location of its doors etc., may be altered according to the particular needs to be met.

In a modified kiln each wall is provided with directly opposed burners. The burners are in turn controlled by an external control arrangement which ensures that when one burner is firing the opposed burner is extinguished thereby giving the effect of the staggered arrangement of burners described above but the opportunity to alter the firing characteristics from side to side of the kiln.

Claims

1. A kiln intended to fire ware on at least one ware supporting arrangement accommodated within the kiln, including a multiplicity of firing means mounted on the kiln wall, characterised in that firing means constituting a first group are longitudinally spaced apart by a distance greater than the length of the or each ware supporting arrangement, and firing means constituting a second group are mounted below the lowest level at which ware is supported within the kiln.
2. A kiln according to claim 1, characterised in that the firing means of the first group are arranged in positions along the kiln wall which correspond during use of the kiln to the positions of respective spaces adjacent to the ends of the or each ware supporting arrangement.
3. A kiln according to claim 1, characterised in that the firing means of the first group are arranged in positions along the kiln wall which correspond during use to the positions of respective spaces between the ends of the or each outermost, ware supporting arrangement and the ends of the kiln.
4. A kiln according to claim 1 or claim 3 when each ware supporting arrangement comprises one of a plurality of kiln cars, characterised in that the positions of the firing means of the first group correspond to the positions of spaces between successive adjacent kiln cars.
5. A kiln according to any of the preceding claims, characterised in that the firing means of the first and second groups are arranged in a mutually staggered relationship on opposite walls of the kiln.
6. A kiln according to claim 1 when each ware sup-

porting arrangement comprises one of two kiln cars, characterised in that the firing means of said first group are directed from one wall of the kiln into the space between the two kiln cars and from the other wall of the kiln into the respective spaces between the outermost ends of the kiln cars and the ends of the kiln.

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7. A kiln according to any of the preceding claims wherein the firing means of the first group are longitudinally spaced with respect to the firing means of the second group.

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8. A kiln according to any of the preceding claims, characterised in that the firing means of the first group comprises pairs of vertically spaced burner assemblies.

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9. A kiln according to any of the preceding claims, characterised in that the kiln interior is sealed and the firing means are each supplied with combustion air the pressure and value of which is controllable.

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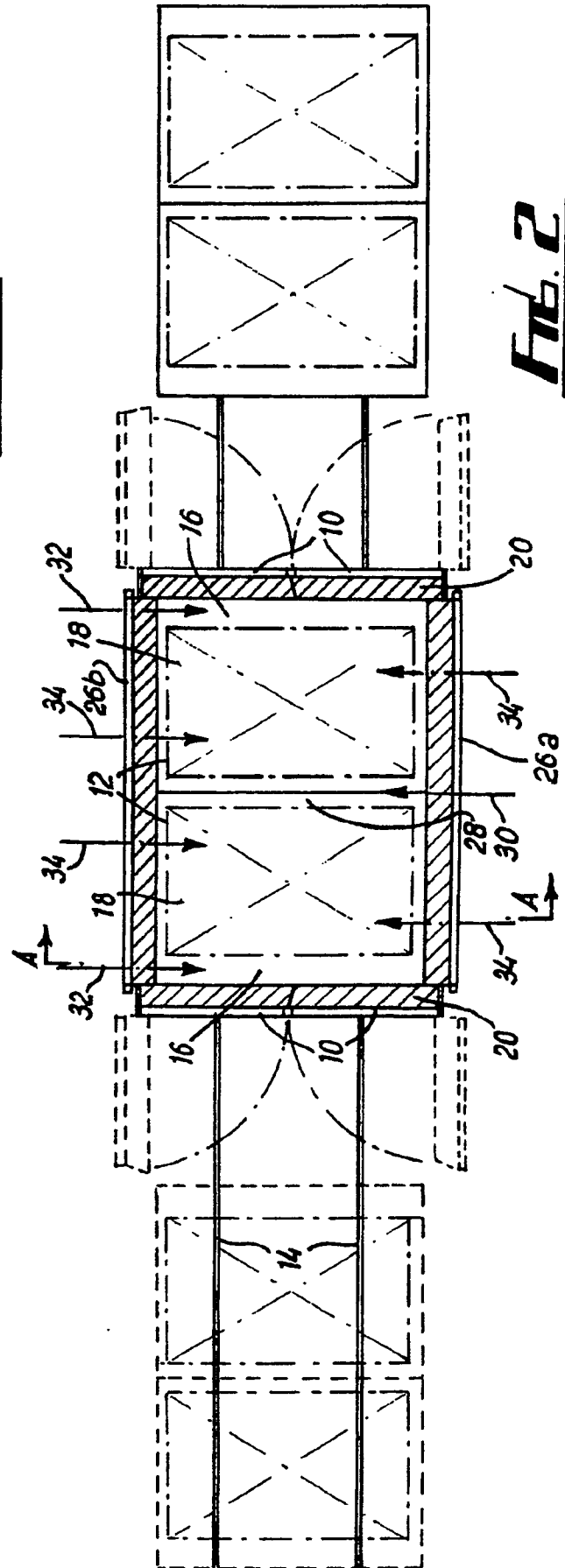
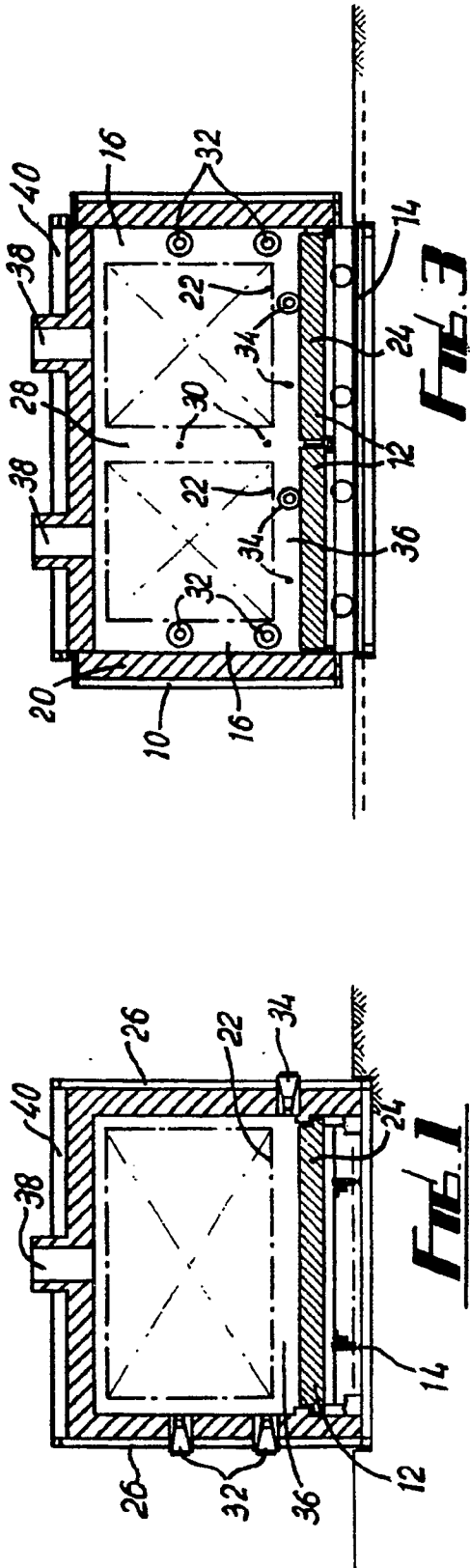


Fig. 2