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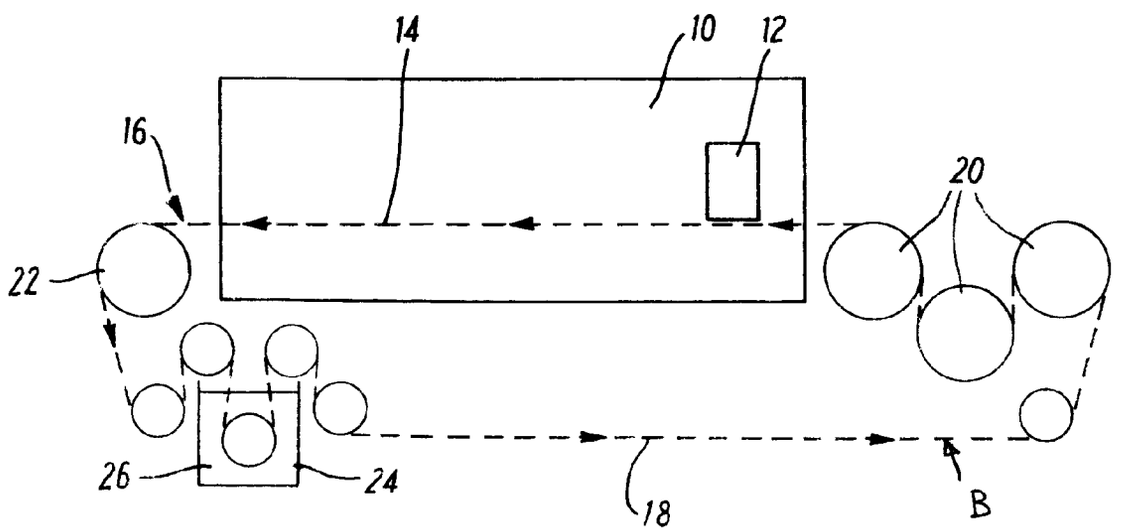
(71) Applicant : **BRITISH CERAMIC SERVICE COMPANY LIMITED**
**Rowhurst Industrial Estate, Chesterton**
**Newcastle-under-Lyme, Staffordshire ST5 6BH (GB)**

(72) Inventor : **Challinor, Graham, c/o British Ceramic Service Co., Ltd., Rowhurst Ind. Estate, Chesterton Newcastle, Staffordshire, ST5 6BH (GB)**

(74) Representative : **Swindell & Pearson**
**48 Friar Gate**
**Derby DE1 1GY (GB)**

## (54) Conveyor belts kiln.

(57) A conveyor kiln has a heated enclosure (10) through which there is guided an endless belt (16) for carrying ware to be heated in the kiln, the belt (16) being formed as a mesh of oxide dispersal strengthened alloy produced by mechanical oxidising and passing through means to apply aluminium or alumina thereto during operation of the kiln.

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The present invention concerns improvements in or relating to kilns, especially but not exclusively conveyor kilns.

There are many conveyor kilns in everyday use. These kilns comprise a conveyor belt normally in the form of a mesh woven from metal wire. Whereas these kilns perform adequately, they currently suffer from the major disadvantage that the maximum temperature at which they can operate is just over 1000°C.

The firing of many objects which could otherwise be fired in a conveyor kiln requires higher temperatures and it is an object of the present invention to obviate or mitigate this disadvantage.

According to the present invention there is provided a conveyor kiln having a heated enclosure and an endless conveyor assembly having a belt at least one run of which passes through the enclosure said belt being formed as a mesh or the like of an oxide dispersal strengthened alloy produced by mechanical alloying.

Preferably the mesh is formed from wires.

Preferably the alloy incorporates a protective aluminium oxide film suitably modified by YTTRIUM.

Preferably the alloy has a nominal composition by weight percentage of: iron 74%; chronium 20%; aluminium 4.5%; titanium 0.5%; yttrium oxide 0.5%.

Preferably the alloy is MA 956 supplied by Inco Alloys Limited.

Preferably the belt passes through means for depositing aluminium thereon, the aluminium forming an alumina coating on the wires forming the belt.

Alternatively the belt passes through means for depositing alumina thereon, the alumina supplementing the alumina coating of the wires forming the belt.

The aluminium or alumina may be applied to the belt by passing the belt through a bath of an aqueous aluminium solution. Alternatively aluminium may be sprayed onto the belt in an aqueous solution or aluminium in powder form may be electrostatically deposited thereon.

Preferably the means for applying aluminium or alumina to the belt are located at or near the point at which the belt exits from the heated enclosure.

Alternatively the means for applying aluminium or alumina to the belt are located at or near the point at which the belt enters the located enclosure.

Further according to the present invention there is provided a conveyor kiln having a heated enclosure and an endless conveyor assembly having a belt at least one run of which passes through the enclosure, said belt being formed as a mesh or the like of a metallic alloy including aluminium and having an alumina coating thereon, the kiln including means for applying aluminium or alumina to the wires of the belt during operation of the kiln.

Preferably said aluminium or alumina is applied by passing the conveyor through a bath containing aluminium or alumina in solution or suspension.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawing which shows diagrammatically a longitudinal cross-section through a conveyor kiln.

A conveyor kiln comprises a heated enclosure 10 in which articles 12, normally ceramic articles, to be treated are fired. The enclosure may be heated by any suitable means for example gas firing, oil firing, electrical heating elements, etc. none of which are shown in the drawing as they do not form part of the present invention. The upper run 14 of an endless conveyor belt 16 passes through the heated enclosure 10 the lower run 18 being guided below the heated enclosure 10. The endless conveyor includes an assembly of drive rollers 20 at one end and a return roller 22 at the other end. The belt of the conveyor is of mesh form and is manufactured from wire-like elements.

Temperature within the heated enclosure 10 in present kilns can be as high as 1050°C. This is the maximum temperature tolerable by presently employed alloys from which the wire making up the conveyor 16 is made. Above this temperature the wire either loses sufficient strength to reliably support articles to be fired placed thereon or alternatively, with certain alloys which have a higher strength at elevated temperatures, gives off, for example gases, which are known to contaminate the ceramic articles being fired. Consequently, for practical reasons, the maximum temperature achievable in the heated enclosure of current conveyor kilns is 1050°C.

It is desirable to increase this firing temperature while maintaining sufficient strength of the conveyor belt and ensuring that at the elevated temperatures the material of the belt does not emit contaminants which could prejudice the satisfactory firing of ware in the kiln.

The present invention recognises that a suitable alloy is an oxide dispersal strengthened alloy produced by mechanical alloying and including aluminium. An example of such an alloy has the following composition (% by weight)

Iron 74%
Chronium 20%
Aluminium 4.5%
Titanium 0.5%
Yttrium Oxide 0.5%

A suitable commercially available alloy is referred to by the reference MA 956 and is sold by Inco Alloys Limited.

The manufacture of this alloy is such that it has strength which enables it to be satisfactorily utilised in a conveyor kiln at temperatures up to 1450°C. Additionally at these operating temperatures the aluminium oxide (alumina) coating on the wires of the conveyor which is normally quicky abraded off is replaced by migration of aluminium from the alloy to the

surface of the wire where in the presence of oxygen in the heated enclosure it oxidises to alumina.

The alumina coating not only provides a satisfactory surface on the wire, that is, a surface which does not adversely affect the firing of ceramic ware, but also serves as a lubricant, reducing the frictional forces experienced on the belt as it passes around the conveyor assembly.

Whereas the alloy referred to above gives satisfactory results, there is a limit to the amount of aluminium which it can contain and which can migrate to the surface to enhance the alumina coating.

The present invention overcomes this problem by arranging to augment the aluminium particles available to form into an alumina coating by passing the belt 16, after it has exited from the heated enclosure 10 through a bath 24 containing an aqueous solution of aluminium 22. The belt 16, on passage through the bath 24 readily picking up aluminium particles as it is at this point at a relatively high temperature, having recently exited from the heated enclosure. The heat contained within the belt during its return to the heated enclosure 10 through the drive rollers 20 and/or subsequent heat applied to the belt during its further passage through the heated enclosure converts the aluminium particles into alumina coating thereby considerably extending the life of the belt and effectively eliminating the problem which would have been experienced as a result of aluminium defficiency in the alloy of the belt had the belt not been passed through the bath 24 of aqueous aluminium solution.

The bath 24 may be provided with an aqueous alumina solution instead of the aluminium solution.

In a first modification of the invention the aluminium/alumina bath 24 is replaced by a spray which sprays a metered quantity of aqueous solution containing aluminium/alumina particles onto the belt. The spraying may be achieved by a plasma spraying process. In a further modification aluminium/alumina particles can be applied to the belt in the form of a dried powder, for example by electrostatic deposition means.

In a further modification the kiln assembly can be modified by reversing the positions of the drive 20 and return means 22, that is the drive means 20 can be located at the exit from the heated enclosure 10. In a further modification, which may assist in the formation of the alumina coating, the return run 18 of the conveyor can be directed to pass through the heated enclosure 10.

In a still further modification the aluminium/alumina bath can be replaced by a bath containing combinations of aluminium and alumina carrying between 0 and 100% of each constituent.

In another modification the aluminium/alumina bath or spraying station can be located at or near the entry to the enclosure as illustrated at B in the drawing.

Various other alloys can be used for the material making up the belt, for example nickel/chrome/aluminiums having a suitable strength above 1050°C and an oxidation resistant surface coating primarily comprising alumina.

## Claims

1. A conveyor kiln having a heated enclosure and an endless conveyor assembly having a belt at least one run of which passes through the enclosure characterised in this said belt (16) is formed as a mesh or the like of an oxide dispersal strengthened alloy produced by mechanical alloying.

2. A conveyor kiln as claimed in claim 1, characterised in that the mesh is formed from wires.

3. A conveyor kiln as claimed in claim 1 or claim 2, characterised in that the alloy incorporates a protective aluminium oxide film suitably modified by YTTRIUM.

4. A conveyor kiln as claimed in any one of claims 1 to 3, chatacterised in that the alloy has a nominal composition by weight percentage of: iron 74%; chronium 20%; aluminium 4.5%; titanium 0.5%; yttrium oxide 0.5%.

5. A conveyor kiln as claimed in claim 4, characterised in that the alloy is MA 956 supplied by Inco Alloys Limited.

6. A conveyor kiln as claimed in any one of the preceding claims, characterised in that the belt (16) passes through means (24) for depositing aluminium thereon, the aluminium forming an alumina coating on the wires forming the belt.

7. A conveyor kiln as claimed in any one of claims 1 to 5, characterised in that the belt (16) passes through means (24) for depositing alumina thereon, the alumina supplementing the alumina coating of the wires forming the belt.

8. A conveyor kiln as claimed in any one of claims 1 to 5, characterised in that an aqueous aluminium/alumina solution is contained in a bath (24), through which the belt (16) is guided.

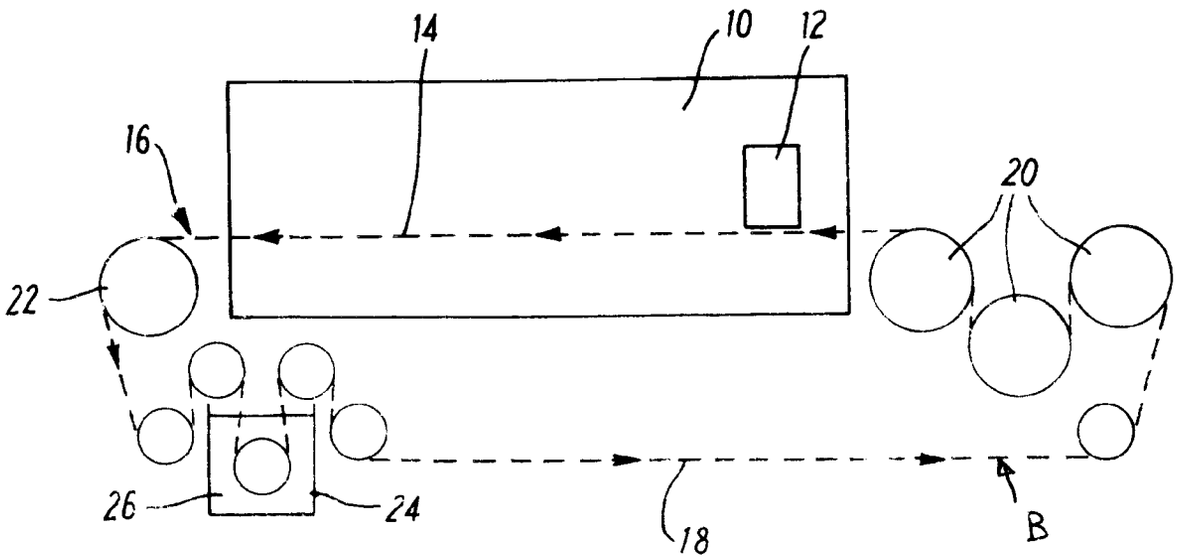
9. A conveyor kiln as claimed in any one of claims 1 to 5, characterised in that spray means for example plasma spray means directed on the belt (16) deposit an aqueous solution of aluminium/alumina on the belt.

10. A conveyor kiln as claimed in any one of claims 1

to 5, characterised in that electrostatic deposition means deposit aluminium/alumina powder on the belt (16).

**11.** A conveyor kiln as claimed in any one of claims 6 to 10, characterised in that the means (24) for applying aluminium or alumina to the belt are located at or near the point at which the belt exits from or enters the heated enclosure (10).

**12.** A conveyor kiln having a heated enclosure and an endless conveyor assembly having a belt at least one run of which passes through the enclosure, characterised in that said belt (16) is formed as a mesh or the like of a metallic alloy including aluminium and has an alumina coating thereon, the kiln including means (24) for applying aluminium or alumina to the wires of the belt during operation of the kiln.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# EUROPEAN SEARCH REPORT

Application Number
EP 93 30 2162

## 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) |
|---|---|---|---|
| Y | EP-A-0 441 574 (DAIDO TOKUSHUKO KK)<br>* claims 6,7; figures *<br>--- | 1 | F27B9/24<br>F27D1/16<br>C22C32/00 |
| Y | Section Ch,<br>Derwent Publications Ltd., London, GB;<br>Class M23, AN 85162092<br>& JP-A-60 092 071 (TOSHIBA) 23 May 1985<br>* abstract *<br>* line 7 - line 9 *<br>--- | 1<br><br><br><br><br>2-4,12 | |
| A | EP-A-0 256 555 (INCO ALLOYS)<br>* claims 1-11; figures *<br>----- | 1 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F27B
F27D
C22C

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 26 JULY 1993 | COULOMB J.C. |

CATEGORY OF CITED DOCUMENTS

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