Title: POLISHING SYSTEM FOR CERAMIC PRODUCTS

Abstract: A machine for surface working flat ceramic products comprises an operating head comprising tool means (10) suitable for working an external surface of said products (6), cooling conduit means (38, 40, 41, 42, 44, 46) arranged for cooling an interface region between said tool means (10) and said surface; the cooling conduit means (38, 40, 41, 42, 44, 46) is suitable for conveying a gaseous fluid, or a liquid, or a liquid dispersed in a gaseous phase.
Polishing system for ceramic products

The invention relates to a system for polishing flat ceramic products, such as tiles or slabs made of porcelain stoneware.

Prior art comprises machine tools which are fed with tiles already fired in kiln, for treating said tiles on their surface by means of abrasive or cutting tools, through which the tiles are subjected to polishing or satinizing on the face that will be visible after tile laying.

The above mentioned polishing or satinizing machine tools are provided with cooling means for cooling the interface region between tool and tile, said cooling means consisting of jets of lubricant-coolant liquid, in particular water, which completely floods the surface of tiles to be worked. The liquid jets can be manually positioned quite roughly and exaggerated water flows are therefore required, to be sure that the working surface is properly sprayed.

This implies a drawback consisting in a high production of sludge, containing particles of ceramic material removed from tiles suspended in the cooling liquid.

Therefore, expensive and bulky systems for purifying such sludge are needed, said systems comprising many sludge settling tanks and requiring long sludge treatment times and preparation of appropriate stonework.

Brushing machines are further known, to which tiles are led before conveying said tiles to the firing kiln, said brushing machines being able to superficially clean the tiles, thus improving visible surface appearance of tiles without carrying out on them any planarity smoothing as polishing machining does.

These brushing machines dry work on tiles, and have
therefore to work with a very low feed rate, which implies low productivity.
An object of the invention is to improve the known systems for surface treating flat ceramic products. A further object is to carry out on ceramic products high quality polishing or satinizing mechanical workings, preventing sludge to be produced, said sludge implying high disposal times and costs. A still further object is to increase the productivity of crushing machines for flat ceramic products.
In a first aspect of the invention, a machine is provided for surface working flat ceramic products, comprising an operating head comprising tool means suitable for working an external surface of said products, and cooling means arranged for cooling the interface region between said tool means and said surface, characterized in that, said cooling means comprises conduit means obtained in said operating head for conveying fluid cooling means to said interface region. Through the conduit means, substantially gaseous fluid cooling means can be fed, comprising pressurised air. Alternatively, the conduit means can be used for feeding fluid cooling means comprising a lubricant-coolant liquid.
Still more, the conduit means can convey towards the interface region fluid cooling means comprising a liquid phase suspended in a gaseous phase, in form for example of little water drops, contributing to improve the tool working condition.
Fluid cooling means are chosen depending on the selected type of tool and therefore on the type of machining that has to be carried out on products.
In a second aspect of the invention, a method is provided for surface working flat ceramic products, comprising
interacting with tool means with an external surface of said products, cooling an interface region between said tool means and said surface, characterized in that, said cooling comprises conveying towards said interface cooling means comprising a gaseous phase.

In a third aspect of the invention, a method is provided for surface working flat ceramic products, comprising interacting with tool means with an external surface of said products, cooling an interface region between said tool means and said surface, characterized in that, said cooling comprises conveying towards said interface cooling means comprising a liquid phase dispersed in a gaseous phase.

In a fourth aspect of the present invention, a method is provided for surface working flat ceramic products, comprising interacting with tool means with an external surface of said products, cooling an interface region between said tool means and said surface through liquid cooling means, characterized in that, said cooling comprises conveying said cooling means through conduit means of an operating head supporting said tool means, said cooling means being caused to be discharged through said tool means.

Owing to the invention, it is possible to carry out high quality workings on ceramic products since it is possible to convey the fluid cooling means to the working region of tools, remarkably improving their efficiency.

Furthermore, it is possible - by using gaseous cooling means - to reduce greatly sludge production, with significant cost saving.

The invention can be better understood and carried out with the aid of the enclosed drawings, which illustrate some exemplifying and not restrictive embodiment forms thereof, wherein:
Figure 1 is a lateral elevation view of a machine according to the invention;
Figure 2 is a vertical enlarged section of an operating head of the machine of Figure 1;
Figure 3 is a section like Figure 2, but in a further version.

As shown in Figure 1, a machine tool 1 comprises a base frame 2 and a pair of sides 3 at whose ends winding rollers 4 are supported on which a conveyer belt 5 is wound, said conveyer belt 5 defining an advancing plane of tiles 6 to be worked. The machine 1 further comprises a central column 7 to which an operating head 8 is fixed, said operating head 8 being actuated by a motorized group 9 suitable for rotating a set of peripheral tools 10 of the head 1. The motorized group 9 is also suitable for vertically moving the head 1 between a stand-by raised position, wherein the tools 10 do not interact with the tiles 6, and an operating lowered position wherein the tools 10 are in operating contact with the tiles 6.

With reference to Figure 2, a head 10 comprises a central spindle shaft 12 which is coupled, through an upper flange 14, with an electric motor 16 and is rotatably supported, through central bearings 18 and 19, to a central sleeve 20 fixed to a cover 22 of the head 10. The cover 22 is kept stationary with respect to rotation around a longitudinal shaft of the head 10 by screws 23 which connect the cover 22 to an anti-rotation bell 24 fixed to a portion of the frame of column 7.

At its end opposite to the flange 14, the central spindle shaft 12 is fixed to a sleeve 26 through keys 25; the sleeve 26 extends externally with a rotating plate 28 at whose periphery a plurality of peripheral sleeves 30 is fixed through screws 29.

Each peripheral sleeve 30 is rotatably coupled, through
bears 31 and 32, with a secondary spindle shaft 33 to which the respective tool 10 is fixed, at the external lower end, and a gear 34 is also fixed, in a region near the internal upper end. The set of gears 34 is rollingly engaged with the external teeth of a crown wheel 36 firmly coupled with the central sleeve 20 and then stationary with respect to rotation around the axis of the central spindle shaft 12.

Thus, the peripheral spindle shafts 33 - and consequently also the tools 10 - are rotatably actuated about the axis of the central spindle shaft 12 through the plate 28 and are also rotatably actuated about their respective longitudinal axes, parallel to the axis of the central spindle shaft 12, by the gears 34.

The central spindle shaft 12 is internally provided with an axial hole 38 communicating, through transverse holes 40, with conduits 42 flowing into a rotating joint 44 supported at the end of each secondary spindle shaft 33 and communicating through a central hole 41, with which each joint 44 is provided, with a longitudinal hole 46 passing through each secondary spindle shaft 33 along its full length. Therefore, each longitudinal hole 46 flows into the central mounting portion 48 of each tool 10, where it is mounted on the respective secondary spindle shaft 33.

Thus, a cooling fluid which is introduced under pressure through the axial hole 38 passes through the conduit 42 and the joint 44 until it is discharged, through the various longitudinal conduit 46, into the working region of each tool 10 on the product to be polished, or satinized.

In the version of Figure 2, the cover 22, instead of being fixed to a stationary frame portion, is rotated about the axis of the main spindle shaft 12 through
actuating means 50, roughly comprising a pinion 52 and a driven gear 54 fixed to the cover 22 by screws 56. It is thus possible to adjust as preferred the ratio between the rotation speed of tools 10 about the axes of the secondary spindle shafts 33 and the rotation speed of the tools 10 about the axis of the main spindle shaft 12. Obviously, the base frame 2 is provided with suction means - not shown - for sucking up particles of ceramic material removed from the product 6 and relative cooling fluid.
CLAIMS

1. Machine for surface working flat ceramic products (6), comprising an operating head (8) comprising tool means (10) suitable for working an external surface of said products (6), and cooling means (38, 40, 41, 42, 44, 46) arranged for cooling an interface region between said tool means (10) and said surface, characterized in that, said cooling means comprises conduit means (38, 40, 41, 42, 44, 46) obtained in said operating head (8) for conveying fluid cooling means to said interface region.

2. Machine according to claim 1, wherein said conduit means (38, 40) extends into central spindle means (12) of said head (8).

3. Machine according to claim 1, or 2, wherein said conduit means (46) extends into peripheral spindle means (33) of said head.

4. Machine according to claims 2 and 3, wherein said conduit means (42) extends between said central spindle means (12) and said peripheral spindle means (33).

5. Machine according to claim 4, wherein said conduit means further comprises rotating joint means (44) arranged between said central spindle means (12) and said peripheral spindle means (33).

6. Machine according to any of claims 3 to 5, when claim 3 is appended to claim 2, wherein rotating plate means (26, 28) are fixed to said central spindle means (12), said rotating plate means (26, 28) rotatably actuating said peripheral spindle means (33) about a longitudinal axis of said central spindle means (12).

7. Machine according to claim 6, wherein said peripheral spindle means (33) is provided with reaction means (34, 36) which forces said peripheral spindle means (33) to rotate about a longitudinal axis thereof.

8. Machine according to claim 7, wherein said reaction
means comprises crown wheel means (36) fixed to a portion (33) of a case (22) of said operating head (8), said crown wheel means (36) meshing gear means (34) fixed to said peripheral spindle means (33) and rollingly engaged on said crown wheel means (36).

9. Machine according to claim 8, wherein said case means (22) is fixed to anti-rotation means (24).

10. Machine according to claim 8, wherein said case means (22) is rotatably actuated about a longitudinal axis of said central spindle means (12) through actuating means (50).

11. Machine according to any of the preceding claims, wherein said conduit means (38, 40, 41, 42, 44, 46) is suitable for conveying substantially gaseous cooling fluid means comprising pressurised air.

12. Machine according to any of the preceding claims, wherein said conduit means (38, 40, 41, 42, 44, 46) is suitable for conveying cooling fluid means comprising a lubricant-coolant liquid.

13. Machine according to any of the preceding claims, wherein said conduit means (38, 40, 41, 42, 44, 46) is suitable for conveying fluid cooling means comprising a liquid phase suspended in a gaseous phase.

14. Method for surface working ceramic flat products (6), comprising interacting with tool means (10) with an external surface of said products (6), cooling an interface region between said tool means (10) and said surface, characterized in that, said cooling comprises conveying towards said interface region cooling means comprising a gaseous phase.

15. Method for surface working ceramic flat products (6), comprising interacting with tool means (10) with an external surface of said products, cooling an interface region between said tool means (10) and said surface,
characterized in that, said cooling comprises conveying towards said interface region cooling means comprising a liquid phase dispersed in a gaseous phase.

16. Method according to any of claims 14, or 15, wherein said conveying comprises introducing said cooling means into conduit means (38, 40, 41, 42, 44, 46) of an operating head (8) supporting said tool means (10), said cooling means being caused to be discharged through said tool means (10) in said interface region.

17. Method for surface working ceramic flat products (6), comprising interacting with tool means (10) with an external surface of said products, cooling an interface region between said tool means (10) and said surface through liquid cooling means, characterized in that, said cooling comprises conveying said cooling means into conduit means (38, 40, 41, 42, 44, 46) of an operating head (8) supporting said tool means (10), said cooling means being caused to be discharged through said tool means (10).
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B24B7/22 B24B55/02 B24B41/047 B24B27/00

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B24B B24D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched:

Electronic database consulted during the international search (name of database and where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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