The scope of the present invention is that to carry out all operations, necessary to the execution of the surface finishing of sanitary-ware and ceramic products, without the use of hand labour and in total absence of dust in the area surrounding the machine, eliminating therefore, the problem of silicosis in the finishing department. The invention has the characteristics to carry out all finishing operations automatically according to the sequences of prearranged operation, manually memorized in function of the forms of the pieces to be finished. Such sequences are repeatable in automatic in a closed environment to the inside of which is created a flow of aspirated air which is directed (after correct filtration) directly outside of the working area.
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Automatic surface finisher and finishing process
for sanitary-ware and ceramic products

Description

Technical field
The invention refers to the finishing process for sanitary ware and products of ceramic industry.

Background art
The surface finishing operations of the sanitary ware and product, made in the ceramic industry are currently carried out manually for the major part of the products.

In such environments a high dispersion of silicic dust is present, which causes damage to the health and consequently attributes professional illness (silicosis) to personnel.

Manual surface finishing operations further provoke, a slowing-down in the industry production cycle, which has, by now, automatized or semi-automatized all other phases which constitute such productive cycle.

The scope of the present invention is to carry out all operations, necessary for the performance of the surface finishing of the ceramic sanitary-ware, without the use of manual labour and in total absence of enviromental dust surrounding the machine, so eliminating the problem of silicosis in the surface finishing department.
The invention as described as follows, has the characteristics to carry out all surface finishing operations automatically, according to the pre-arranged operation sequences, manually stored in function with the pieces to be surface finished.

Such sequences are repeatable in automatic in a closed environment, of which internally a flow of aspirated air is created and sent (after oportunual filtration) directly to the outside of the working area. The invention as described can be therefore used in the ceramic industry substituting the usual manual surface finishing operations, with the scope of making better working conditions for personnel, consenting, furthermore, increase in production of the industry.

Disclosure of invention

Is formed, therefore, specific object of the present invention a machine for the automatic realisation of the necessary operations for the surface finishing of sanitary-ware and ceramic products, consisting in:

- a manipulator (or mechanical arm with electronic position control) able to move in the space surrounding the piece to be surface finished, in such a manner to reach, with the correct tools, all points which are subject to surface finishing;

- an environment (tunnel), closed on all sides, of which internally is situated the manipulator and of which inside the piece is surface finished;

- two openable gates in correspondence to the
extremes of the tunnel to consents the entrance and the exit of the piece;
- a guide rail system or a revolving support system for the entrance movement, the positioning for the surface finishing in the tunnel and the exit of the pieces;
- a device shaped in such a manner to consent the taking and releasing of the available tools for the finishing;
- an aspiration system applicated to the tunnel, which consents the aspiration of dust deriving from the finishing operations, extracting them and removing them from the piece under working, before the exit from the tunnel;

According to the invention, the manipulator can be cartesian type, in the case that the piece to be finished in positioned internally of the tunnel and remaining still while the manipulator moves in its surrounding space, or the manipulator can be antropomorphic type, in the case that the piece is positioned, internally of the tunnel, on a revolving table in such manner to consent the manipulator to reach all points subject to finishing.

In accordance with the invention such manipulator is preferred to be made with a first bridge structure on which are carried out the three ortogonal, horizontal an vertical (X,Y,Z) movements of the arm, with a second structure made in such a manner to rotate around the vertical axis and a third structure named "pulse"
made in the way to be able to rotate around any horizontal axis in the working space of the manipulator.

85 In accordance to the invention, the relative movements of the elements are made by means of position controlled electric motors and may be however carried out with any other form of position controlled actuator.

90 At the end of the "pulse", interchangeable tools are applied, in function of the type of sanitary-ware to be finished.

Such tools will be actioned by means of a variable speed electric motor, with the eventual interposition of a reducer, and will be realized by means of different shaped sponges and pads, all simmetric as regards to the rotation axis.

According to the invention, the gates which allow the entrance and exit of the piece, are preferreably vertical slip type with belts or chains actioned by a motor reducer.

The scope of the invention is also that to supply a procedure for the automatic finishing of sanitary-ware and ceramic products, consisting of phases:

105 - entrance, positioning, processing and exit of piece, completely run automatically by the machine;

- shaving of irregularity from the piece surface by mean of abrasive action of sponges and open celled pads made in Scotch Brite type or Abralon type material,

110 obtaining a regular surface, yet still ruled;
- surface smoothing by abrasive action of fine granulometry pads and by eventually amalgamating action of humid sponges;
- aspiration of dust deriving from the finishing operations.

According to the present invention, the procedure, compared to the manual one, has the advantage of complete personnel absence during the realization phases of the finishing process. This characteristic together with the fact that the finishing operations are completed in a closed environment with the aspiration of the dust powder, therefore allows the elimination of the professional illness problem, typical of this processing.

Brief description of drawing

The present invention is now described according to its preferred realization form with particular reference to the figures of the accompanying drawings in which:

- fig. 1 is an axonometric assembly schematic design of the machine in accordance with the invention;
- fig. 2 is an axonometric assembly schematic design of the manipulator in accordance with the invention;
- fig. 3 is a lateral assembly schematic design of the machine;
- fig. 4 describes schematically some types of tools used by the machine according to the invention;
- fig. 5 is a detailed view of the rapid clutch device.
for the tools with the relative function;

- Fig. 6 is a schematic view of the tool deposit with the relative taking and releasing operations. Such figures describe, by way of examples, non-restrictive, how the previously described scopes may be obtained.

Best mode for carrying out the invention

The example of realization is constituted by a frame or basement on which are mounted two parallel horizontal guides (direction X), which consent the movement along them of a structure (3) with orthogonal axis to them. On such structure (3), two other horizontal guides are positioned (4) orthogonal to the previous (direction Y) on which is carried out the movement of a plate (5). On the above mentioned plate (5) two couple of slides are positioned (6) of which internally run two vertical guides (7) (direction Z) coupled with a structure (8).

Such structure (8), therefore, results moving in the space by means of the composition of the three orthogonal motions obtained with the above described elements.

On such structure (8) an arm is present (9) made in such manner to rotate around the vertical axis (rotation Rz) at the end of which is positioned a pulse (10) in the conditions to be able to rotate around an axis (Ry) which is orthogonal to the vertical one of the rotation Rz.
At the end of the pulse an interchangeable tool is positioned (11) placed in rotation by a motor positioned into the inside of the pulse.

An adequate rapid engaging pneumatic clutch device (37,38) assembled coaxially to the motor axis (12), allows the automatic change of the under working tool in function of the operation to be carried out.

The five movements described are made by means of position controlled electric motors with reducer interposition.

The actuators of the three translations (X,Y,Z,) (13,14,15) and of the pulse rotation (16) act on tangent screws (17,18,19,20) coupled to bearing volutes.

The rotation actuator (21) Rz, works directly on the vertical arm (9).

In this way the manipulator is in condition to adequately position the tools in the working space so to carry out all necessary finishing operations for different pieces.

The sanitary-ware and ceramic products are positioned on trolleys (22) which by means of a rail (23) are transferred to the internal of the tunnel until they reach a pre-arranged position and finished by the manipulator.

Such trolleys are carried over to the rail by means of a couple of chains (24) which are engaged to them.

The motorization of such chains comes by mean of a
motor reducer (25).

At the entrance and exit of the tunnel two automatic vertical slip gates are present to allow the entrance and exit of pieces.

At the inside of the finishing tunnel is a deposit (27) for the different tools made in such manner to allow the manipulator a rapid substitution during the finishing phases.

According to the invention, such tools are made by means of different shaped sponges or pads, all symmetric as regards to the rotation axis.

Some of them (28), are coated in padded material, Scotch Brite type, and have the function to shave the irregularity on the surface of the pieces, others (29) have a surface contact made by sponge, and carry out the function to smooth the surface of the piece by eventual means of water, others (39) are made using abrasive pads, Abralon type or Scotch Brite type, allowing to obtain the shaving and the smoothing of the piece surface, without water, varying the distance and the speed of the tool with refer to the piece surface. A typical characteristic of this type of tool is to match to the surface in finishing thanks to the centrifugal action exercised on the pads by means of the high revolution speed of the tool.

The entire working space of the manipulator is closed by means of panels (30,31,32,33,34,35) some of which are transparent to allow the view of the manipulator and of the relative actions in the inside of the
tunnel.
The upper part of the tunnel is conformed as an aspiration hood (36) and allows to convey towards the outside the dust deriving from the finishing.
To allow to the aspiration system to withdraw and evacuate the mix with powder air from the tunnel, are positioned, on the lateral panels, scale gates able to automatically open when necessary to allow air input.
According to the invention, the machine is run and controlled by means of a control console, which allows to actuate the work cycle according to the previous operations manually set out and memorized.
During the phases of manual planning of the cycles and of the trajectory that have to be carried out automatically by the manipulator, are furthermore programmed the more adapt tools and their rotation speed in function of the forms and of the pieces to be finished.
With this described machine an automatic process is actuated, which, substantially foresees the phases of:
- ENTRANCE OF THE PIECE TO BE FINISHED (and consequently exit of the piece previously finished):
  during this phase the entrance of the piece, positioned on the trolley (22), in the is realized, in the tunnel, by means of carrying it over on the rails (23) by means of the chains (24) put in movement by the motor reducer (25).
  During this phase the gates are opened (26) to
allow the entrance of the trolley, and are re-closed at the moment in which the piece reaches the finishing position;

- SHAVING OF THE IRREGULARITY OF THE PIECE SURFACE:
during this phase the manipulator withdraws from the deposit the requested tool in function of the form and of the positions of pieces to be finished, it puts it in rotation and runs the zone which are interested to the operation. At the end of this phase the piece should result not to have anymore irregularity on the surface, but only superficial rules;

- SURFACE SMOOTHING OF THE PIECE:
This phase begins at the end of the previous and consists in the smoothing of all visible and/or paintable surface of the piece. Such smoothing is carried out by withdrawing from the tools deposit those more adapt, already programmed in the manual planning phase of the cycles.
At the end of this phase the piece results to be finished and is ready to exit from the tunnel;

- EXIT OF FINISHED PIECE (and consequent entrance of the successive piece to be finished):
During this phase the exit of the piece, positioned on the trolley (22), is realised by means of carrying it over to the rail (23) by means of chains (24) put in movement by the motor reducer (25).

During this phase, the gates are opened to allow
the exit of the trolley which are re-closed at the moment when the successive piece to be finished, results to have reached the finishing position.

An aspiration system is in function during the whole cycle, described as above, and allows to withdraw the dust and to send it outside in an opportune filter which separates in from the air.

The present invention has been described with specific reference to some preferred mode forms, but variations and/or modifications may be brought from the experts in this branch without going out of the relative protection field.
Claims

1. Automatic surface finisher for sanitary-ware and ceramic products consisting of:
   - a manipulator (or mechanical arm with position electronic control) able to move in the space surrounding the piece to be finished, so to reach with the correct tools, all the points subject to finishing;
   - an environment (tunnel), closed on all sides, on the inside of which is situated the manipulator and inside of which the piece is finished;
   - two openable gates in correspondence to the extremes of the tunnel to allow the entrance and the exit of the pieces;
   - a rail an a series of trolleys realized so to allow the entrance, the positioning for the finishing in the tunnel and the exit of the piece;
   - a device realized so to consent the storage and the change of the tools available for the finishing;
   - a device realized so to consent the taking and the releasing of the tools available for the finishing;
   - an aspiration system applied to the tunnel, which allows to remove the dust, deriving from the finishing operations, from the piece and evacuate them before the exit of the piece from the tunnel;
   - a series of interchangeable tools configured and motor actioned so to shave and smooth the surface of the pieces to be finished;

2. Machine as claimed in Claim 1, characterized by the fact that the manipulator is cartesian type and the
support of the piece is fixed in the working space;

3. Machine as claimed in Claim 1, characterized by the fact that the manipulator is anthropomorphic type and the support of the piece is revolving around its vertical axis in the working space;

4. Machine as claimed in Claim 1, independently from the type of manipulator and type of support of the piece to be finished;

5. Machine as claimed in one of the previous Claims, characterized by the fact that the finishing operations carried out by the manipulator come in closed enviroment with aspiration of air and dust deriving from the finishing;

6. Machine as claimed in one of the previous Claims, characterized by the fact that the closed enviroment in which the finishing operations are made, is provided with automatically actuated gates for the entrance and/or the exit of the pieces;

7. Machine as claimed in the previous Claims, characterized by the fact that the entrance and the exit of the pieces are realized by means of trolleys carried over on a rail and moved by a belt or chain transmission, or by means of supports which are mounted on a revolving wheel.

8. Machine as claimed in one of the previous Claims, characterized by the fact that the rapid clutch device for tools is pneumatic type;

9. Machine as claimed in one of the previous Claims,
characterized by the fact that the rapid clutch device for tools is mechanical or electromechanical type;  
10. Machine as claimed in one of the previous Claims, characterized by the fact that the tools are realized with a cylindric or conical support (symmetrical regards to the rotation axis) in soft sponge material eventually coated with other sponge material or pads made in Scotch Brite or Abralon type material;  
11. Machine as claimed in one of the previous Claims, characterized by the fact that the taking and realizing device for tools has input and output direction orthogonal to the rotation axis of the tool;  
12. Machine as claimed in one of the previous Claims, characterized by the fact to foresee a device for the electronic control of the cycle automation;  
13. Process for the automatic finishing of sanitaryware and ceramic products, in closed enviroment with the aspiration of the dust characterized by the fact to include the phases of:  
   - entrance of the piece to be finished in the closed enviroment (and consequent exit of the piece already previously finished) with positioning inside of it, by means of a carrying over of a trolley (on which is placed the piece) on rails by means of chains put in movement by a motor reducer;  
   - shaving of the irregularity of the piece surface, realized by the manipulator withdrawing from the tools storage those more adapt in function of the forms and the positions of the piece to be finished, and running
the interested zones of the piece with the tool in rotation;
- smoothing of all visible and/or paintable surfaces of
the piece carried out by the manipulator withdrawing
from the tools storage those more adapt in function of
the forms and the position of the piece to be finished,
and running the interested zone of the piece with the
tool in rotation;
- exit of finished piece from the closed finishing
environ (and following entrance of the successive
piece to be finished) by means of the carrying over of
the piece (on a trolley) moved by chains put in
motion by a motor reducer;
14. Process as claimed in Claim 13, characterized by
fact that such phases are made in a closed environ-
ment with aspiration of dust;
15. Process as claimed in Claim 13, characterized by
the fact that the change of the tools between and
during the shaving and smoothing phases comes by
automatic manner;
16. Automatic surface finisher for sanitary-ware and
ceramic products in closed environ with aspiration
of the dust as claimed in every one of the Claims from
1 to 12, and process for automatic finishing of
sanitary-ware and ceramic products as claimed in every
one of the Claims from 13 to 15, as substantially
illustrated and described.
INTERNATIONAL SEARCH REPORT

According to International Patent Classification (IPC) or to both national classification and IPC

Minimum documentation searched (classification system followed by classification symbols)

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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  'X' document member of the same patent family

Date of the actual completion of the international search: 23 October 1996

Date of mailing of the international search report: 08.11.96

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Fax (+31-70) 340-3016

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Eschbach, D

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