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(54) Compaction control system by means of isostatic moulds

(57) Control system of the compaction of the powder in a ceramic mould by means of a punch of isostatic type comprising an air space within which a quantity of oil is situated which is sufficient to support the elastic pressing membrane, in which said air space, at every compaction cycle, is placed in communication with a tank (6) and a pump (7) of feeding by means of a volumetric metering device (5) which sends the desired quantity of oil to the

air space of the mould, said metering device being associated with detection and reading means (56) of the oil quantity sent to the mould air space, and being associated with valve means (81, 82, 83) of delivering, blocking and discharging the oil to the, in the, and from the mould air space, to ensure the presence in said air space of a prearranged oil volume for every step of the compaction cycle.

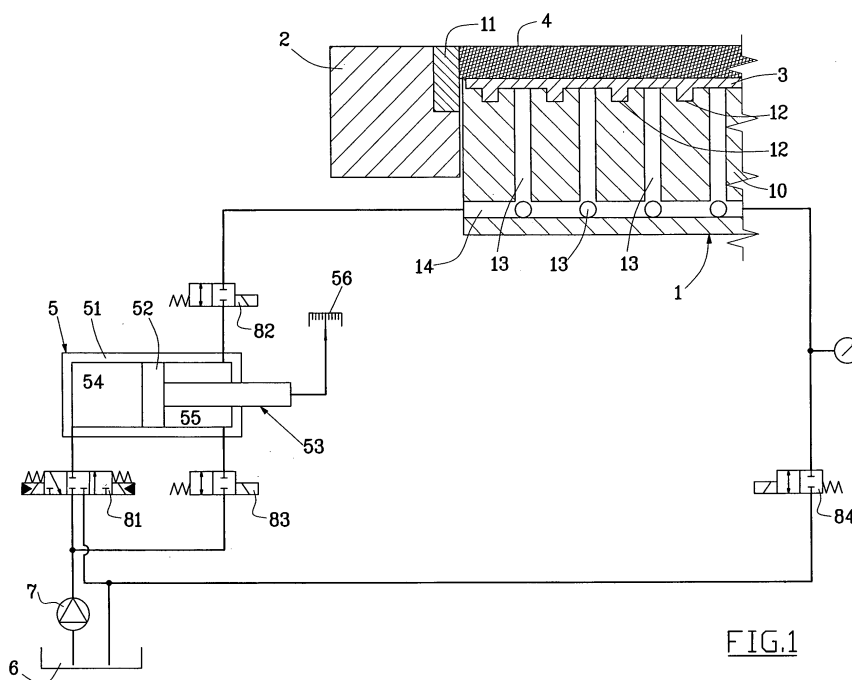


FIG.1

Description

[0001] The present invention refers to the isostatic moulds whose use is well-known for the pressing of forming powders of ceramic tiles.

[0002] In order to ensure the homogeneous compaction of the powder, necessary so to avoid size variations of the finished product, one of the punches of the normal ceramic mould comprises a metallic base in which an air space is defined. This air space is closed by a deformable membrane intended to come into contact with the powder and filled by means of a liquid, generally oil.

[0003] The air space may comprise a grid which defines a series of intercommunicating cells, to whose upper edge the membrane is fixed.

[0004] The filling of the air space by means of oil occurs by adjusting the pressure inside the punch, causing an elastic deformation of the membrane which remains in contact with the top of the grid, to which it is fixed.

[0005] Variations of the isostatic mould are known in which the membrane is supported at the metallic base and bound to the same only at distributed zones, so to define adjacent and communicating areas in which the membrane is simply supported at the metallic base.

[0006] The feeding of oil under pressure between the membrane and its support level causes the deformation of the membrane with a series of adjacent and intercommunicating swellings, intended to counter the pressing pressure in an isostatic manner.

[0007] Both of the known forms of isostatic mould are characterised in that they contain a quantity of oil which remains constant for the entire duration of the moulding, except for possible leakages or losses.

[0008] The known isostatic moulds often foresee that the isostatic punch equipped with membrane is the lower punch of the mould, which defines the base of the mould cavity wherein the powder to be pressed is received.

[0009] The widespread use of the isostatic moulds has highlighted a series of drawbacks which occur in the pressing cycle of the powders, which produces the raw tile that is then fired.

[0010] The more evident drawbacks arise from the fact the quantity of oil contained in the mould air space remains constant during the cycle.

[0011] The oil, in fact, modifies its own chemical-physical characteristics following aging, and may become aggressive over time with regards to the membrane: taking into account the very high stress to which it is subjected, which may reach hundreds of Kg per square cm, this phenomenon considerably shortens the life of the mould.

[0012] It is impossible, moreover, to avoid small leakages and losses of oil during the lifetime of the mould, leakages and losses which modify the behaviour of the punch by favouring for example the so-called transparency phenomena, due to which the design of the mould grid or rear grid of the tile, which generally coincide with each other, is visible on the side in view of the tile itself. Moreover, in every case, both coinciding with the loading

of the powder and unloading of the powders of the mould, the swellings of the membrane are at the origin of damaging phenomenon.

[0013] During the loading of the powders, these induce an irregular distribution of the powder itself with possible differences of compaction between the zones of the membrane deformed by the oil and those bound to the iron base.

[0014] During the extraction of the tile from the cavity in which it formed, the elastic action of the punch may cause defects or breaking of the tile itself.

[0015] During the ejection of the tile, the swellings of the membrane project beyond the upper face of the mould matrix, and are rubbed by the exiting tile, with premature localised wear and deterioration.

[0016] The object of the present invention is to eliminate the abovementioned drawbacks in the scope of a simple and economical solution.

[0017] This object is attained by a pressing system of the powders which makes use of an isostatic mould, thus as is defined in the independent claim.

[0018] The pressing system according to the finding foresees the use of an isostatic mould of substantially known type, associated with means of feeding and control of the oil contained in the same.

[0019] Said means of feeding and control comprise a volumetric metering device adapted, at every pressing cycle, to insert a precise and desired volume of oil in the punch, means adapted to discharge all of the oil contained in the punch at every pressing cycle and finally means to send towards an oil tank contained inside the pad, with the modes defined here below.

[0020] At the start of punch use, the operator decides the metered quantity of oil which must be present in the pad. At the start of the pressing cycle, the quantity of oil contained in the punch is equal to zero, or is in any case such to not deform the elastic membrane.

[0021] This situation remains during the loading step of the powder, and during the light pressure which corresponds to the deaeration step of the powder.

[0022] At the end of these steps, or partially during the same, the desired volume of oil is inserted into the mould, so that it is in normal operating configuration at the time it receives the impact of the compaction, and distributes the compaction pressure in isostatic manner.

[0023] When compaction is completed, the previously inserted oil is taken away from the mould, which is once again in the starting condition.

[0024] The merits and structural and functional characteristics of the finding will be made evident from the detailed description which follows, illustrated in the figures of the attached drawing tables and given as not limiting example.

[0025] Fig. 1 schematically illustrates an isostatic punch according to the finding with related hydraulic diagram.

[0026] As seen in the figure, the punch 1 is inserted in a mould of which one sees only the matrix 2; the known

anti-wear plates 11 are peripherally fixed to this matrix, flush to the upper edge. The punch comprises a metallic body 10.

[0027] The upper surface of the body 10 has a network of grooves 12, and a corresponding network of conduits 13 whose vertical segments lead to the centre of the areas defined by the grooves.

[0028] The conduits 13 lead to a single collector 14 which leads laterally outside the body 10.

[0029] The areas defined by the grooves 12 are covered by an anti-stick substance before they are cast and the elastic membrane 3 vulcanised or polymerised in situ; the elastic membrane thus results adherent to the metallic body only at the grooves and along the periphery.

[0030] The powder 4 to be compressed is supported on the membrane 3. When oil is inserted through the conduits 13, it is distributed in the areas between the grooves, swelling the overlying membrane which thus endows the punch with the isostatic property.

[0031] The volumetric metering device 5 is represented in the figure, schematised as a cylinder 51, wherein a sealed piston 52 slides, dividing the inside of the cylinder into two chambers 54 and 55.

[0032] The stem 53 is associated with a detection and measurement device 56 of the piston translations, which define the volume of oil fed by the metering device.

[0033] The chamber 54 of the cylinder is connected to an oil tank 6 by means of the pump 7 and the valve 81.

[0034] The chamber 55 of the metering device is connected to the collector 14 with the interposition of a valve 82, and to the tube which connects the pump 7 and the valve 81 with the interposition of the valve 83.

[0035] The collector 14 is directly connected to the tank 6 with the interposition of a two-way valve 84.

[0036] The operation of the device is as follows.

[0037] The system configuration illustrated in the figure corresponds to the raised position of the upper cross member of the press, not illustrated.

[0038] The operator decides beforehand the volume of the oil which he wishes to insert in the punch based on the pad's geometry, appropriately reading the device 56 which is a position transducer, and making sure that the tubing and the chambers 54 and 55 of the metering device are full of oil.

[0039] This completed, the valves 81, 82, 83 and 84 together with the device 56 are connected to the mould's control system, for example a PLC, which regulates the following operations in relation with the cycle step of the press.

[0040] During the descent of the cross member, and up until a press cycle step which may be set by the operator, usually the deaeration step, the system configuration does not change.

[0041] Once the aforesaid step is completed, the control system causes nearly simultaneously:

the starting of the pump 7, the movement (to the left in the figure) of the valve 81 slide and the movement

(to the right in the figure) of the valve slide 82.

[0042] Consequently, the pump feeds oil under pressure into the chamber 54 of the metering device and the piston moves, transferring the oil contained in the chamber 55 of the metering device to the inside of the mould.

[0043] As soon as the device 56 signals that the desired volume of oil has been transferred under the membrane 3, which occurs before the pressing necessary to ensure the final compaction of the tile, the valve 81 slide is repositioned in the centre, the valve 82 slide repositioned to the left.

[0044] In such a manner, the punch is insulated from the metering device and acts like a normal isostatic punch in the subsequent pressing steps.

[0045] During the last pressing, when the tile has already been compacted, a certain thrust is maintained on the tile, and the valve 82 slide is repositioned to the right as is the valve 81 slide. The thrust acting on the tile compresses the membrane 3 which in turn pushes the oil present in the pad. In this manner, the oil may exit the punch towards the chamber 55 of the metering device, which since the valve 81 slide is moved to the right, is connected to the tank 6; hence the piston 52 moves to the left, returning to its initial position.

[0046] The control system waits for the punch to be completely discharged by means of the position transducer 56, then the valve 82 slide is repositioned to the left, the valve 81 slide is repositioned in the centre and the press cycle continues normally.

[0047] Whenever it is desired to change the oil inside the pad, the following cycle is carried out:

the valve 82 slide is moved to the right like the slide of valve 84, the valve 81 slide is moved to the left so that it connects the chamber 54 with the pump line, while the punch and the chamber 55 of the metering device are placed in connection with the tank 6 so that the piston 52 moves to the right and the oil present in the punch is sent to the tank. When the piston reaches a defined position detected by the transducer 56, the valve 82 slide moves to the left, the valve 84 slide moves to the left, the valve 83 slide moves to the left and finally the valve 81 slide moves to the right so that the chamber 55 is placed in communication with the pump while the chamber 54 is placed in communication with the tank, and therefore the piston 53 moves to the left until it reaches a position detected by the transducer 56.

Finally, the valve 83 slide moves to the left, the valve 84 slide moves to the left and the valve 81 slide returns to central position.

Claims

1. Control system of the compaction of the powder in

a ceramic mould by means of a punch of isostatic type comprising an air space within which a quantity of oil is situated which is sufficient to support the elastic pressing membrane, **characterised in that** said air space, at every compaction cycle, is placed in communication with a tank (6) and a pump (7) of feeding by means of a volumetric metering device (5) which sends the desired quantity of oil to the air space of the mould, said metering device being associated with detection and reading means (56) of the oil quantity sent to the mould air space, and being associated with valve means (81, 82, 83) of delivering, blocking and discharging the oil to the, in the, and from the mould air space, to ensure the presence in said air space of a prearranged oil volume for every step of the compaction cycle.

2. System according to claim 1 **characterised in that** the air space of the mould is placed in direct communication by means of a valve (84) with the oil tank (6) without passing through the metering device (5).
3. System according to claim 1 **characterised in that** the metering device (5) is composed of a cylinder divided into two parts (54, 55) by a piston (52), of which one (54) is connected to the pump (7) through a three-way valve (81), while the other (55) is connected to the mould air space by means of a two-way valve (82), and to delivery conduit of the pump (7) by means of a two-way valve (83).
4. System according to claim 3 **characterised in that** the piston (52) comprises a stem associated with a position transducer (56).

