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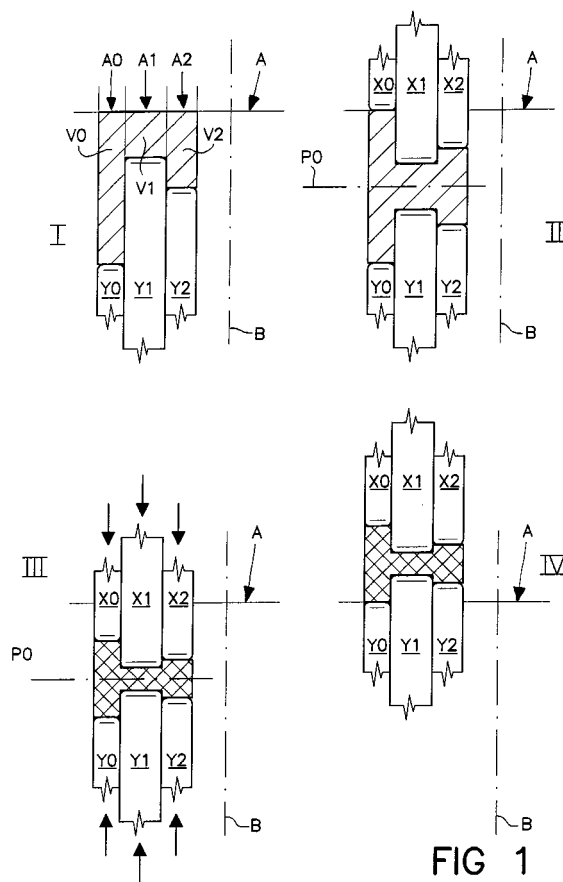
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(54) **Method and press for uniform pressing and compaction of parts**

(57) A method for uniform pressing and compaction of parts, comprising a first step (I), in which the powders to be pressed are loaded into the mold, with the lower male plugs (Y0,Y1,Y2) arranged in a preset position with respect to the upper surface (A) of the central female mold part, so as to form containment volumes (V0,V1,V2) for the powder to be pressed in each region of the part; a second step (II), in which the upper male plugs (X) are made to descend at a substantially low pressure until they make contact with the powder deposited in the female mold part and then each individual region of the lower male plugs descends synchronously with the upper male plugs in order to arrange the centerline planes of each individual region on a same plane, which will be the horizontal plane of symmetry of the finished part; a third step (III), in which the pressure increases gradually and the male plugs of the pairs of male plugs of each region move symmetrically toward each other with respect to the horizontal plane of symmetry of the part until final compaction occurs.



Description

[0001] The present invention relates to a method and a press for uniform pressing and compaction of parts.

[0002] Presses that have a central female mold part and a set of upper male plugs and a set of lower male plugs that are movable with respect to the central female mold part are known in the particular field of the compaction, by pressing at high pressure, of powdered materials (for example metallic and nonmetallic powders, ceramic powders, technical ceramic powders such as atomized ceramic powders used to produce technical articles, refractory powders, powders with graphite and/or carbon).

[0003] Depending on the various thicknesses that the part to be compacted may have, the surface of the female mold part is divided into a corresponding plurality of regions arranged in a mosaic pattern: each region of the female mold part is matched by an upper region and a lower region that are connected to a respective male plug of the upper set and of the lower set.

[0004] Currently, the powders to be pressed are loaded into the mold while the lower male plugs are arranged substantially in an intermediate position of their stroke; the upper surface of the central female mold part is placed so as to determine the volumes required to contain the powder to be pressed; then the upper male plugs are made to descend, substantially at low pressure, until contact with the powder deposited in the female mold part occurs; then each individual region of the lower male plugs descends simultaneously with the upper male plugs in order to arrange the centerline planes of each individual region on a same plane; at this point the pressure is increased gradually and in each region the male plugs move at different speeds along different vertical strokes and the horizontal plane of symmetry of the part moves with respect to the position that it had before pressing.

[0005] Often the cylinder with which one of the male plugs is associated is actuated until it performs a preset stroke and the other male plugs have movements that are correlated to this stroke limit.

[0006] The movements of the various regions at different speeds can produce, inside the part, an abnormal internal density of the part that can compromise its mechanical characteristics.

[0007] The aim of the present invention is to obviate the above-cited drawbacks and meet the mentioned requirements by providing a method and a press for uniform pressing and compaction of parts that avoid the onset of tensions and internal densities of the part that are distributed asymmetrically or unevenly.

[0008] Within this aim, an object of the present invention is to provide a structure that is simple, relatively easy to provide in practice, safe in use, effective in operation, and has a relatively low cost.

[0009] This aim and this and other objects that will become better apparent hereinafter are achieved by the

present method for uniform pressing and compaction of parts, characterized in that the method comprises a first step, in which the powders to be pressed are loaded into the mold, with the lower male plugs arranged in a preset position with respect to the upper surface of the central female mold part, so as to form the containment volumes for the powder to be pressed in each region of the part; a second step, in which the upper male plugs are made to descend at a substantially low pressure until they make contact with the powder deposited in the female mold part and then each individual region of the lower male plugs descends synchronously with the upper male plugs in order to arrange the centerline planes of each individual region on a same plane, which will be the horizontal plane of symmetry of the finished part; a third step, in which the pressure increases gradually and the male plugs of the pairs of male plugs of each region move symmetrically toward each other with respect to the horizontal plane of symmetry of the part until final compaction occurs.

[0010] The press for performing the method according to the invention is characterized in that said male plugs are associated with the moving elements of respective fluid-actuated cylinders.

[0011] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment of a method and a press for uniform pressing and compaction of parts according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic view of the four steps of the method for uniform pressing and compaction of parts according to the invention;

Figure 2 is a schematic sectional side view of a press for performing the method according to the invention.

[0012] With reference to the figures, the reference numeral 1 generally designates a press according to the invention.

[0013] The press 1 comprises a female mold part 2, which in the illustrated case is divided into three regions having areas A0, A1, A2; each area A has a corresponding upper male plug X0, X1, X2 and a lower male plug Y0, Y1, Y2.

[0014] The method for uniform compaction and pressing of parts according to the invention occurs according to the following steps:

-- a first step (I), in which the powders to be pressed are loaded into the mold while the lower male plugs Y0, Y1, Y2 are moved downward with respect to the upper surface A of the female mold part in a preset position, so as to form the volumes V0, V1, V2 for containing the powder to be pressed in each region of the part; the dot-and-dash line B indicates the

vertical axis of the part.

- a second step (II), in which the upper male plugs X are made to descend, substantially at low pressure, until they make contact with the powder deposited in the female mold part and then each individual region 0, 1, 2 of the lower male plugs descends synchronously with the upper male plugs in order to arrange the centerline planes of each individual region on a same plane P0, which will be the horizontal plane of symmetry of the finished part;
- a third step (III), in which the pressure increases gradually and the male plugs of the male plug pairs of each region X0,Y0 - X1,Y1 - X2,Y2 move symmetrically toward each other (the male plugs X move downward and the male plugs Y move upward) with respect to the horizontal plane of symmetry P0 of the part until final compaction occurs;
- a fourth step (IV), in which the compacted part is expelled.

[0015] The operation of the invention is intuitive: in each region, the movements of the upper male plugs and lower male plugs are symmetrical and do not generate abnormal internal tensions.

[0016] The compacted part can be expelled by keeping the female mold part motionless and making the male plugs Y0, Y1, Y2 rise simultaneously in order to expel the part from the female mold part; as an alternative, the compacted part can be expelled by making the female mold part descend and keeping the male plugs Y0, Y1, Y2 motionless.

[0017] The press related to the method according to the invention comprises a footing and a head, which are fixed and between which it is possible to fix, also by means of four lower columns 3 and four upper columns 4, a central female mold part supporting block 5; the cylinder of a large press, advantageously of the fluid-actuated type, is fixed to the head; the bottom 6 of the piston of said large press is shown in the figure.

[0018] An upper cross-member 7 is fixed below the piston 6 and rigidly supports the main upper male plug X0; the upper columns 4 have upper ends that are rigidly coupled to the lower surface of the cross-member 7; an upper intermediate cylinder 8 and an upper central cylinder 9 of the double-acting type are rigidly coupled to the upper cross-member, and the intermediate upper male plug 10 (X1) and the central upper male plug 11 (X2) are respectively associated with the moving elements 8a and 9a of said cylinders.

[0019] The actuation of the piston 6 is suitable to lift or lower simultaneously the three upper male plugs X0, X1, X2 for the rapid loading of the powders into the female mold part (by using, for example, a loading tray that can move horizontally on the upper surface of the female mold part).

[0020] A lower cross-member 12 is rigidly coupled to the lower footing of the press and in turn has a central body 13 rigidly coupled thereto; the lower columns 3

have lower ends that are rigidly coupled to the upper surface of the cross-member 12; the lower double-acting outer cylinder 14 is rigidly coupled to the lower cross-member 12, and a lower outer male plug 15 (Y0) is associated with the moving element 14a of said cylinder; the lower intermediate cylinder 16 and the lower central cylinder 17, of the double-acting type, are rigidly coupled to the central body 13, and a lower intermediate male plug 18 (Y1) and a lower central male plug 19 (Y2) are respectively associated with the moving elements 16a and 17a of said cylinders.

[0021] The reference numeral 20 designates a central pin for the central female mold part 21, which usually forms a central axial hole of the part.

[0022] The cylinders 8, 9, 14, 16 and 17 and the press of the piston 6 are advantageously of the double-acting type, but they might also be provided as single-acting elements.

[0023] In order to allow easier and faster operations for changing the part to be compacted, the pistons and the corresponding moving elements can be mutually joined into sets or subsets that can be mutually interlocked and allow interventions aimed at replacing one or more male plugs without acting on the others.

[0024] It has thus been shown that the invention achieves the proposed aim and objects.

[0025] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

[0026] All the details may further be replaced with other technically equivalent ones.

[0027] In practice, the materials used, as well as the shapes and the dimensions, may be any according to requirements without thereby abandoning the scope of the protection of the appended claims.

[0028] The disclosures in Italian Patent Application No. BO2001A000563 from which this application claims priority are incorporated herein by reference.

[0029] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for uniform pressing and compaction of parts, **characterized in that** the method comprises a first step, in which powders to be pressed are loaded into a mold, with lower male plugs arranged in a preset position with respect to the upper surface of a central female mold part, so as to form containment volumes for the powder to be pressed in each region of the part; a second step, in which upper male plugs are made to descend at a substantially

low pressure until they make contact with the powder deposited in the female mold part and then each individual region of the lower male plugs descends synchronously with the upper male plugs in order to arrange centerline planes of each individual region on a same plane, which will be the horizontal plane of symmetry of the finished part; a third step, in which the pressure increases gradually and the male plugs of the pairs of male plugs of each region move symmetrically toward each other with respect to the horizontal plane of symmetry of the part until final compaction occurs.

2. A press for performing the method according to claim 1, **characterized in that** said male plugs are associated with the moving elements of respective fluid-actuated cylinders.
3. The press according to claim 2, **characterized in that** said fluid-actuated cylinders are of the double-acting type.
4. The press according to claim 2, **characterized in that** the cylinders of said lower pistons are rigidly coupled to a lower cross-member or to a lower central body that are suitable to be rigidly coupled to the supporting structure of the press.
5. The press according to claim 2, **characterized in that** the main upper male plug is associated with a movable upper cross-member that is rigidly coupled to the moving element of a double-acting main cylinder that is fixed to the supporting structure of the press, and **in that** the other upper male plugs are associated with the moving elements of double-acting cylinders that are fixed to said upper movable cross-member, the actuation of said main cylinder being suitable to lift all the upper male plugs in order to load the powder to be pressed in the female mold part.

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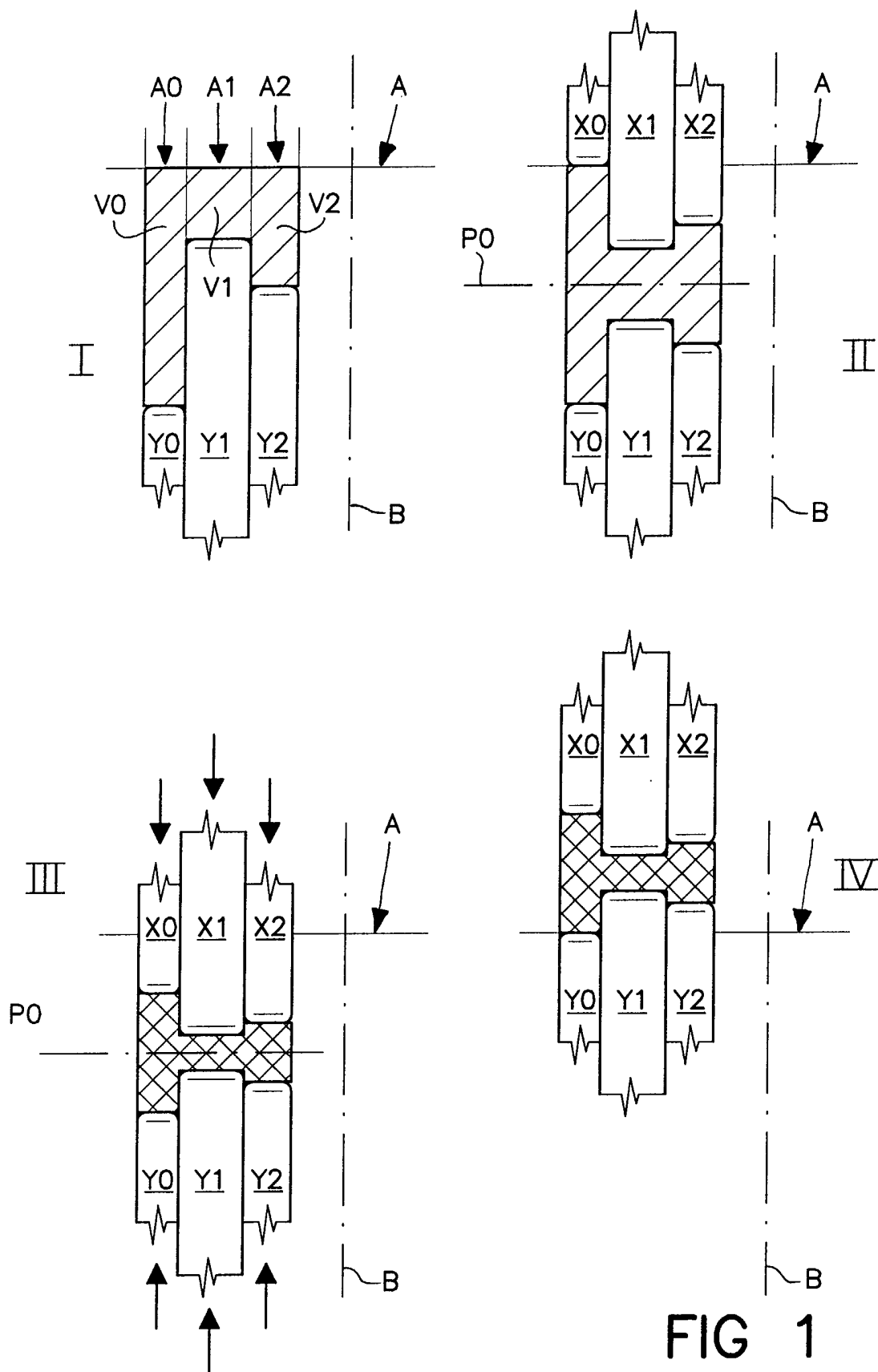


FIG 1

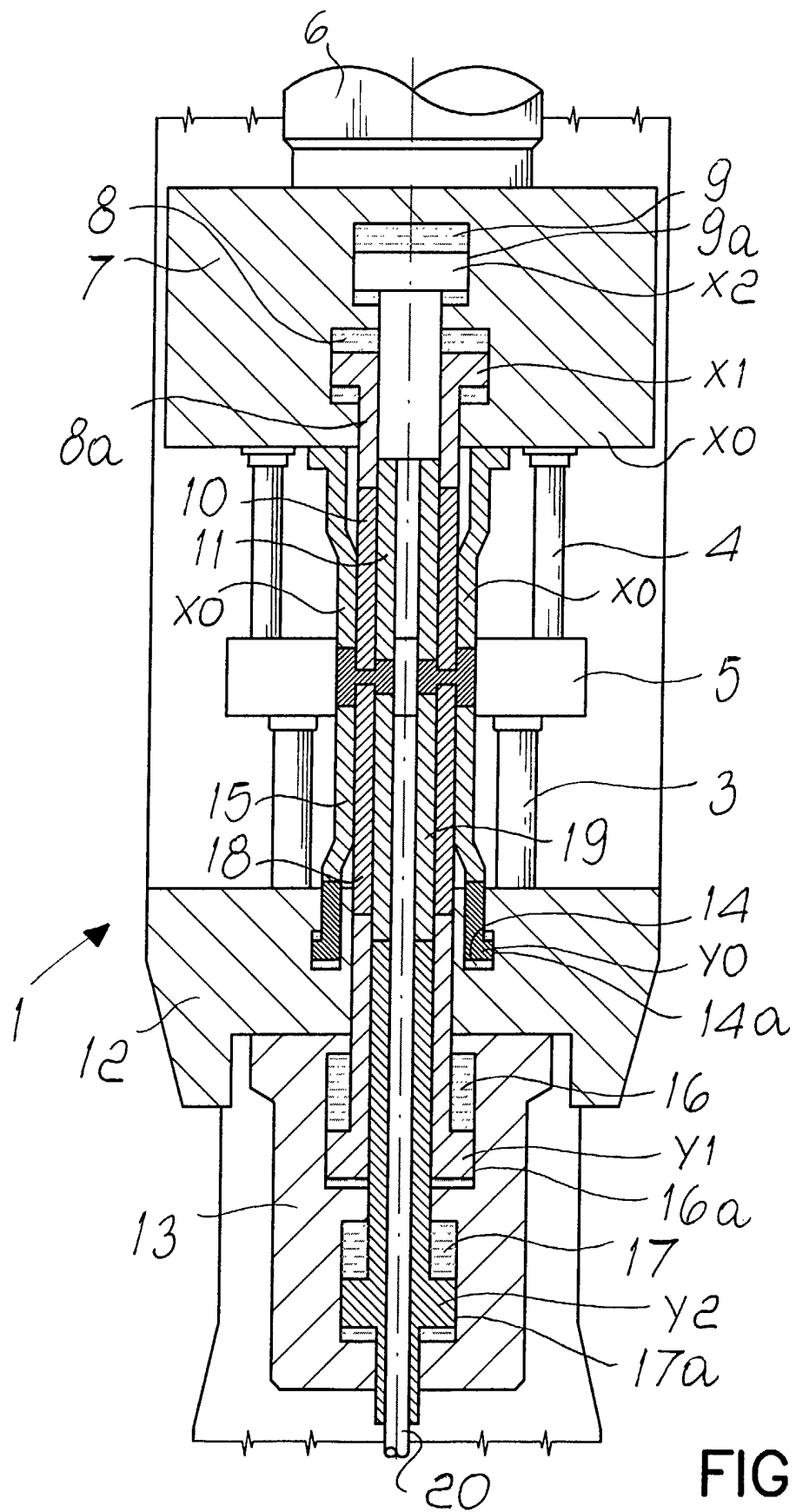


FIG 2