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(54) **Method and mould for cold compacting powders to be sintered**

(57) The invention is a method for the cold agglomeration of mixtures of metallic and non-metallic powders (P) on to the outer perimetral edge (B) of a core (A), comprising the following operations: positioning the core (A) inside a mould (1) between a pair of core-pressing means (7, 7') opposite each other; distributing the powder mixture (P) on to the outer perimetral edge (B) of the core (A); agglomerating the powders (P) together and on the edge (B) of the core through pow-

der-pressing means (21, 22, 23, 24); shifting the core-pressing means, the powder-pressing means and the core with respect to the plane on which the core is arranged; moving the powder-pressing means away from the powders (P) agglomerated on the edge (B) of the core (A); moving at least one of the core-pressing means (7, 7') away from the core; extracting the core (A) from the mould.

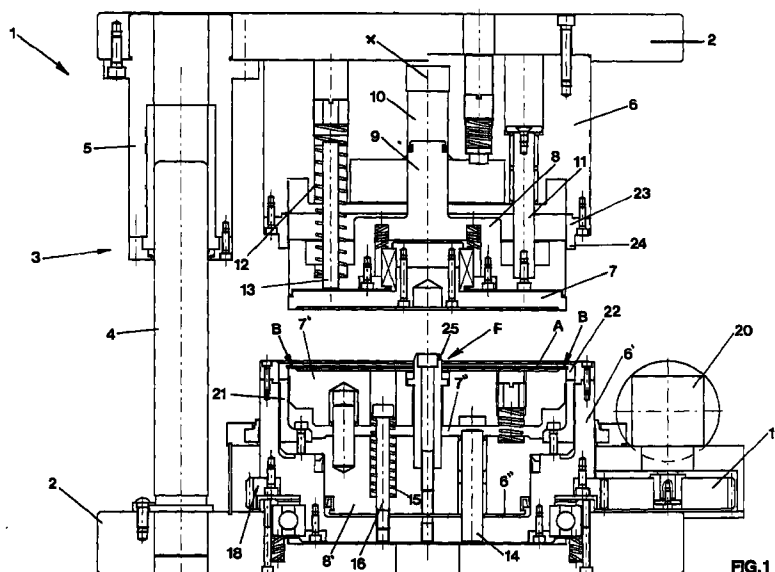


FIG.1

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Description

[0001] The invention concerns a method for the cold agglomeration of powders to be sintered and a mould suitable for implementing said method.

[0002] In particular, the method and the mould subject of the invention concern the agglomeration of abrasive powders on the edge of a disc-shaped metal core before the sintering process.

[0003] It is known that the sintering process consists in the cold compression of mixtures of very fine metallic and non-metallic powders into moulds with predefined shape and in their sintering inside furnaces at high temperatures; the non-metallic powders may contain even diamond powder.

[0004] The compression of the powders at high temperature is more properly called sintering and it is carried out at temperatures that usually correspond to 2/3 of the melting point of the most refractory material present in the powders, while the cold compression of the powders inside the moulds is called agglomeration.

[0005] Various types of mechanical components that are used for different purposes in various industrial sectors are produced through sintering processes.

[0006] In particular, sintering is used for the construction of abrasive discs that are obtained by sintering a mixture of metallic and non-metallic powders - the latter may even contain diamond powder - on the peripheral edge of a disc-shaped metal core.

[0007] According to the known manufacturing techniques, in the processing phases the metal core must first of all be positioned in a mould and the powders to be sintered must be distributed circumferentially on the perimetral edge of the core and contained in an annular chamber properly obtained in the mould.

[0008] After being uniformly distributed, the powders are cold-agglomerated by positioning the mould under a press provided with an apposite, properly shaped pressing element that compresses them and makes them adhere to the core.

[0009] The mould, complete with the pressing element, is then introduced in a furnace, brought to the sintering temperature and left in the furnace for a pre-established time.

[0010] Successively the mould is extracted from the furnace and positioned under a press, so that the annular edge, which by then stably adheres to the core, is subjected to a further hot-pressing action before cooling down.

[0011] Once it has cooled down, the mould is opened and the metal core is extracted together with the sintered annular edge stably fixed on to it.

[0012] The abrasive disc has thus been obtained.

[0013] However, the production method described above has some drawbacks.

[0014] A first drawback is represented by the fact that this method requires repeated handling of the cores and moulds, and therefore considerable labour and rather

long execution times.

[0015] A further drawback is constituted by the fact that the manufacturer must have a high number of moulds, since one mould contains only one core for the whole sintering cycle, from the distribution and agglomeration of the powders to the extraction of the sintered item.

[0016] The aim of the present invention is to eliminate all the drawbacks described above.

[0017] In particular, one of the aims of the invention is the implementation of a method for the cold agglomeration of powders to be sintered that makes it possible to reduce the manual operations necessary to move the pieces and the moulds.

[0018] Another aim of the invention is that the method subject of the invention should make it possible to use a single mould for the agglomeration of the powders on more than one core.

[0019] A further aim of the invention is the implementation of a method that for the agglomeration of the powders requires the use of a single mould, in fixed position and operating only at cold temperatures.

[0020] The goals described above have been achieved through the implementation of a method for the cold agglomeration of mixtures of metallic and non-metallic powders on to the outer perimetral edge of a support core, said method being characterized in that it comprises the following operations:

- positioning said support core inside a mould on a plane included between first core-pressing means and second core-pressing means that are opposite each other;
- locking said core between said core-pressing means;
- distributing said powder mixture on to the outer perimetral edge of said core;
- agglomerating said powders together and on said peripheral edge through compression with powder-pressing means;
- extracting said core from said mould.

[0021] The extraction of the core includes the following operations:

- shifting said core-pressing means and said powder-pressing means together with said core included between them with respect to the plane on which the core is arranged;
- moving said powder-pressing means away from said agglomerated powders;
- moving at least one of said core-pressing means away from said core;
- extracting said core from said mould.

[0022] According to a favourite application of the invention, the mould is manufactured in such a way as to house disc-shaped cores made of metal plate.

[0023] Advantageously, the method subject of the invention and the mould suitable for implementing it ensure high productivity in comparison with the known methods and moulds.

[0024] Furthermore, the use of a single mould for the agglomeration of the powders on the edges of all the cores that are subsequently sintered makes it possible to reduce the necessary equipment and to maintain a high quality standard for all the abrasive discs that are manufactured.

[0025] Another advantage is represented by the fact that the method subject of the invention and the relevant mould can obviously be employed to obtain the agglomeration of powders on the edges of any core, independently of its shape.

[0026] The aims and advantages described above will be highlighted in greater detail in the description of one among many possible applications of the invention in question, illustrated in the attached drawings, wherein:

- Figures from 1 to 6 show the mould suitable for implementing the method subject of the invention, represented in longitudinal section and in different processing phases.

[0027] With reference to the figures mentioned above, the method subject of the invention can be implemented by means of a mould, which is also subject of the invention, is indicated as a whole by 1 and, as shown in the enclosed figures, comprises an upper plate 2 and a lower plate 2'; said plates are spaced and opposite each other, can be coupled to the reciprocally movable elements of a press not represented in the figure, and are joined through guide means, indicated as a whole by 3, suitable for keeping them parallel to each other during their reciprocal shifting. Said guide means 3 comprise at least one column 4 fixed to the lower plate 2' and slidably coupled to a sleeve 5 fixed to the upper plate 2.

[0028] The upper plate 2 is also provided with an upper body 6 that supports first core-pressing means constituted by an upper core-pressing means 7 and analogously the lower plate 2' is provided with a lower body 6' that supports second core-pressing means constituted by a lower core-pressing means 7'.

[0029] The core A is positioned between the lower core-pressing means 7' and the upper core-pressing means 7 and abrasive powder P is agglomerated on the peripheral edge B of the core according to the procedure described below.

[0030] An upper intermediate body 8 is interposed between the upper body 6 and the upper core-pressing means 7, housed in the upper body 6 and fixed to the upper core-pressing means 7. A piston 9 belonging to the upper intermediate body 8 is inserted into an upper chamber 10 obtained in the upper body 6, within which the piston can slide in the direction defined by the longitudinal axis X of the mould, the upper intermediate body 8 being guided by pins 11.

[0031] Helical springs 12 cooperating with respective spring guides 13 make the movement of the piston 9 and of the relevant core-pressing means 7 elastic.

[0032] A lower intermediate body 8' is interposed between the lower body 6' and the lower core-pressing means 7'; together with the lower core-pressing means 7' it defines a first lower chamber 7'' and with the lower body 6' it defines a second lower chamber 6''.

[0033] The lower core-pressing means 7' slides axially with respect to the lower body 6' and is guided by one or more pins 14 passing through the lower intermediate body 8' and having one end fixed to the lower plate 2'. Helical springs 15 coupled to respective spring guides 16 make the movement of the core-pressing means 7' elastic with respect to the lower intermediate body 8' and the movement of both of them elastic with respect to the lower body 6'.

[0034] The lower body 6' is fixed to the lower plate 2' by means of a bearing 17 with the vertical axis positioned so that the lower body 6', together with the lower intermediate body 8' and with the lower core-pressing means 7', can rotate on the vertical axis X of the mould. For this purpose, a fifth wheel 18 is provided outside the lower body 6' and engages with a pinion 19 coupled to an actuator 20, preferably constituted by a fluid-operated motor, for example an air motor.

[0035] An annular body 21 is positioned between the lower core-pressing means 7' and the lower body 6' and is fixed to the lower intermediate body 8', thus defining - between the lower core-pressing means 7' and the lower body 6' - an annular chamber 22 that contains the powder P to be agglomerated.

[0036] A powder-pressing ring 23 is fixed to the upper body 6, in correspondence with its outer perimetral edge, said ring 23 being provided with an annular protrusion 24 whose profile is conjugated to the concave part defined by the annular chamber 22 and is therefore suitable for fitting inside it.

[0037] Operatively, the powder agglomeration cycle begins when the mould is positioned open as indicated in Figure 1. The core A is positioned inside the mould, resting on the lower core-pressing means 7' and centered with respect to the longitudinal axis X of the mould by means of a central reference pin 25 that fits into a corresponding central hole F made in the core A.

[0038] The vertical, downward shifting according to the direction 8 indicated in Figure 2 generated by the movement of the upper plane of the press results in the shifting - in the same direction - of the upper plate 2 fixed to it, until the upper core-pressing means 7 is compressed against the core A.

[0039] After the clamping of the core-pressing means the motor 20, through the kinematic chain constituted by the pinion 19 and the fifth wheel 18, sets the lower body 6' of the mould rotating on the axis X, together with the lower intermediate body 8', the lower core-pressing means 7' and the core A positioned on it. At the same time, an appropriate powder-distributing device, not rep-

resented in the figure, introduces the powder P to be sintered into the annular chamber 22, as shown in Figure 2. This powder is a mixture of metallic and non-metallic powders and the latter may even contain diamond powder.

[0040] The further lowering of the upper plate of the mould results, as shown in Figure 3, in the compression of the powder P on the edge B of the core A and inside the annular chamber 22, due to the action of the powder-pressing ring 23, whose protruding edge 24 gets into the chamber itself and thus compresses the powder present inside it. During this movement, the piston 9 is housed inside the chamber 10 due to the elastic yield of the helical spring. 12.

[0041] During the compression of the powder P the lower core-pressing means 7' lowers and strikes against the lower intermediate body 8' due to the disappearance of the first lower chamber 7". The lower intermediate body 8', therefore, constitutes the opposing element that reacts to the thrust of the press and contributes to the generation of the compressive action on the powder P in correspondence with the edge B of the core A.

[0042] After the powder compression phase, a pressurized fluid, preferably air, is introduced in the lower chamber 6", as shown in Figure 4, and causes the lifting of the lower intermediate body 8' in the direction V together with the core-pressing means 7 and 7', the upper intermediate body 8 and the core A included between them. The core is then lifted and positioned at the distance D from the upper edge of the lower body 6'.

[0043] The upper plane of the press keeps moving upwards in the direction V, lifting first of all the powder-pressing ring 23, as shown in Figure 5, and then the upper core-pressing means 7, as shown in Figure 6, with respect to the core A, thus creating the clearance L that makes it possible to extract the core with the powder agglomerated on its edge B.

[0044] If the compressed air present inside the second lower chamber 6" is bled, the lower intermediate body 8' and the lower core-pressing means 7' lower down and return to the position shown in Figure 1, in which the mould is ready for a new agglomeration cycle.

[0045] According to the above description, the method subject of the invention and the mould suitable for implementing said method achieve all the fixed goals.

[0046] Upon implementation changes may be necessary that are to be regarded as completely protected by the present patent, provided that they are based on the same innovative concept illustrated in the above description, in the enclosed figures and in the following claims.

Claims

1. Method for the cold agglomeration of mixtures of metallic and non-metallic powders (P) on to the outer perimetral edge (B) of a support core (A), **characterized in that** it comprises the following

operations:

- positioning said support core (A) inside a mould (1) between first core-pressing means (7) and second core-pressing means (7') opposite each other;
- locking said core (A) between said core-pressing means (7, 7');
- distributing said powder mixture (P) on to the outer peripheral edge (B) of said core (A);
- agglomerating said powders (P) together and on said peripheral edge (B) through compression with powder-pressing means (21, 22, 23, 24);
- extracting said core (A) from said mould.

2. Method according to claim 1, **characterized in that** the extraction of said core (A) from said mould comprises the following operations:

- shifting said core-pressing means (7, 7') and said powder-pressing means together with said core (A), included between them, with respect to the plane on which the core is arranged;
- moving said powder-pressing means away from said agglomerated powders (P);
- moving at least one of said core-pressing means (7, 7') away from said core (A);
- extracting said core (A) from said mould.

3. Mould (1) suitable for implementing the method according to claim 1), **characterized in that** it comprises an upper plate (2) and a lower plate (2') spaced and opposite each other, coupled to the reciprocally movable elements of a press and cooperating with each other through guide means (3) suitable for keeping them parallel to each other during their reciprocal shifting, **and in that** each one of said plates (2, 2') is coupled to core-pressing means (7, 7') suitable for reciprocally locking a disc-shaped core (A) and powder-pressing means (21, 22, 23, 24) suitable for agglomerating a mixture of metallic and non-metallic powders (P) on the outer perimetral edge of said disc-shaped core (A) through compression.

4. Mould (1) according to claim 3, **characterized in that** said powders (P) contain also diamond powder.

5. Mould (1) according to claim 3, **characterized in that** said upper plate (2) is connected to an upper body (6) supporting an upper core-pressing means (7) and said lower plate (2') is connected to a lower body (6') supporting a lower core-pressing means (7'), wherein each one of said plates (2, 2') can be coupled to one of the movable planes of a press.

6. Mould (1) according to claim 5, **characterized in that** said upper core-pressing means (7) is slidingly coupled to said upper body (6) through the interposition of an upper intermediate body (8), to one side of which said upper core-pressing means (7) is fixed, while the opposite side is provided with a piston (9) fitting into a chamber (10) obtained in said upper body (6). 5
7. Mould (1) according to claim 6, **characterized in that** said piston (9) is elastically sliding in said chamber (10), said upper intermediate body (8) being connected to said upper body (6) through the interposition of one or more helical springs (12) provided with respective spring guides (13). 10 15
8. Mould (1) according to claim 5, **characterized in that** said lower core-pressing means (7') is slidingly coupled to said lower body (6') through the interposition of a lower intermediate body (8') provided with sliding pins (14) passing through said lower intermediate body (8') and fixed to said lower body (6'). 20
9. Mould (1) according to claim 8, **characterized in that** an helical spring (15) and a spring guide (16) cooperate between said lower core-pressing means (7'), said lower intermediate body (8') and said lower body (6'), in such a way as to make said lower core-pressing means (7') elastic with respect to said lower intermediate body (8') and both said lower core-pressing means (7') and said lower intermediate body (8') elastic with respect to said lower body (6'). 25 30 35
10. Mould (1) according to claim 9, **characterized in that** said powder-pressing means comprise a powder-pressing ring (23) coaxially fixed outside said upper body (6) and an annular chamber (22) defined in correspondence with said lower body (6') and opposite said powder-pressing ring (23). 40
11. Mould (1) according to claim 10, **characterized in that** said annular chamber (22) is delimited by an annular body (21) included between a lower body (6') fixed to said lower plate (2') and a lower core-pressing means (7') supported by said lower body (6'). 45
12. Mould (1) according to claim 10, **characterized in that** said powder-pressing ring (23) is provided with an annular protrusion (24) whose profile is conjugated to the concave part of said annular chamber (22) in which it is fitted. 50 55
13. Mould (1) according to claim 5, **characterized in that** said lower body (6') is coupled to said lower plate (2') through the interposition of an axial rolling bearing (17).
14. Mould (1) according to claim 13, **characterized in that** said lower body (6') is externally provided with a fifth wheel (18) coaxial to the lower body (6') and engaging with a pinion (19) fixed to a motor (20).
15. Mould (1) according to claim 14, **characterized in that** said motor (20) is a pneumatic motor.

