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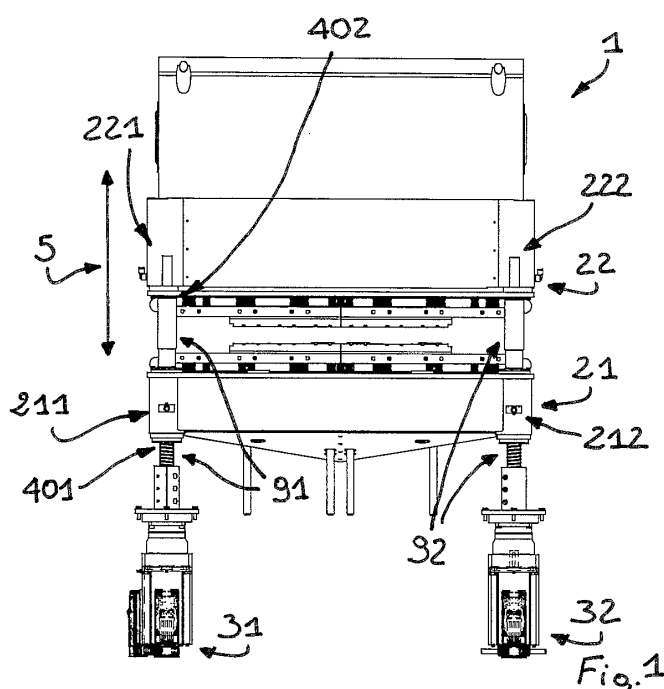
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(54) **COMPRESSION PRESS**

(57) A compression press comprising:
-a first support (21) suitable for supporting a first half-mould;
-a second support (22) suitable for supporting a second half-mould, said second support (22) being opposite the first support (21); the first and the second support (21, 22) being capable of being brought towards and/or away from each other;

-at least a first, a second and a third electric motor (31, 32, 33) that control the movement of the first and the second support (21, 22) towards and away from each other.

the first, the second and the third electric motor (31, 32, 33) act in a first, a second and a third zone (211, 212, 213) of the first support (21), respectively.



Description

[0001] The object of the present invention is a compression press and a forming method that employs the press.

[0002] There are compression presses known in the prior art that comprise a fluid-dynamic piston that moves a first forming plate that supports a first half-mould. The piston makes it possible to move the first plate towards or away from a second plate, which:

- is opposite the first plate;
- supports a matching mould that interacts with the first half-mould for forming a product.

[0003] There can possibly be a plurality of fluid-dynamic pistons connected to the same pump that sends a pressurized incompressible fluid into all the pistons simultaneously.

[0004] There can be drawbacks with a design solution such as this, in the case in which the first plate encounters, in different zones thereof, marked variability in compression resistance. For example, this variability could become evident in the case in which, owing to the shape of the product to be obtained by moulding, the mass to be compressed is distributed unevenly on the mould. In fact, in this case, problems concerning planarity between the first and the second plate could be created and this would translate into an absence of precision in the press. Moreover, if this absence of planarity is significant, it could also lead to the risk of damaging the guides for the first plate's course of travel.

[0005] In this context, the technical task underlying the present invention is to offer a compression press and a forming method that make it possible to improve the quality of the product obtained by pressing.

[0006] The defined technical task and the specified aims are substantially achieved by a compression press and a method for forming an object, comprising the technical characteristics set forth in one or more of the appended claims.

[0007] Further characteristics and advantages of the present invention will become more apparent from the approximate and thus non-limiting description of a preferred, but not exclusive, embodiment of a compression press and a forming method, as illustrated in the accompanying drawings, of which:

- Figures 1 and 2 represent a front view and a side view of a press according to the present invention, in a first configuration;
- Figures 3 and 4 represent a front view and a side view of a press according to the present invention, in a second configuration.

[0008] In the accompanying figures, a compression press is indicated by the reference number 1. The press 1 comprises:

- a first support 21 suitable for supporting a first half-mould;
- a second support 22 suitable for supporting a second half-mould.

[0009] The first and the second half-mould cooperate for moulding the product.

[0010] The first and the second half-mould can be removably constrained to the first and the second support 21, 22, respectively. They are replaceable according to the product one wishes to obtain. Therefore, the first and second half-mould are not part of the press claimed, but they are additional elements to be added according to the specific form of the product one wishes to obtain. Typically, but not necessarily, the pressing process is a hot-pressing process.

[0011] The second support 22 is opposite the first support 21. They face each other.

[0012] Typically, but not necessarily, the first and the second support 21, 22 are found one above the other. In particular, the first support 21 is found above the second support 22. The first and the second support 21, 22 are capable of being brought towards and/or away from each other. Typically, they can be brought towards and/or away from each other along a first direction 5. Preferably, this first direction 5 is vertical. In particular, the first support 21 can move in translational motion with respect to the second support 22.

[0013] The press 1 comprises at least a first, a second and a third electric motor 31, 32, 33 that control the movement of the first and the second support 21, 22 towards and/or away from each other. The first, the second and the third electric motor 31, 32, 33 act in a first, a second and a third zone 211, 212, 213 of the first support 21, respectively. As explained more fully below, one or more additional electric motors for activating the first support 21 may also be present. The presence of at least three electric motors that can independently control the planarity of three points on the first support 21 is important. In fact, at least three points are needed to identify a plane in space and for this plane to remain substantially parallel to itself (within very limited tolerances) during movement.

[0014] Advantageously, the first, the second and the third motor 31, 32, 33 are brushless motors (it is also possible that only one of these motors is brushless). They afford greater control of the power and improved precision of the positioning of the first and the second support 21, 22 (so as to obtain maximum planarity of the first and the second support 21, 22).

[0015] The first, the second and the third motor 31, 32, 33 can be activated independently of each other. In this regard, the press 1 comprises a control device that controls the operation of at least the first, the second and the third electric motor 31, 32, 33. The first, the second and the third motor 31, 32, 33 also act upon a first, a second and a third zone 221, 222, 223 of the second support 22, respectively (by means of the interposition of additional components). In the preferred solution, the first motor 31

acts upon the first zone 211 of the first support 21 and upon the first zone 221 of the second support 22. The second motor 32 acts upon the second zone 212 of the first support 21 and upon the second zone 222 of the second support 22. In the preferred solution, the third motor 33 upon the third zone 213 of the first support 21 and upon the third zone 223 of the second support 22. as illustrated by way of example in the attached figures, the first support 21 is substantially quadrilateral (at least in a plan view). Moreover, the second support 22 is also substantially quadrilateral. The first and/or the second support 21, 22 consist of a plate (they are therefore predominantly planar in extension). The first and the second support 21, 22 are parallel to each other.

[0016] The first support 21 comprises a bed in which the first half-mould can be positioned. Likewise, the second support 22 comprises a bed to which said second half-mould is applied. The bed of the first support 21 conveniently extends horizontally. This is repeatable for the second support 22.

[0017] The press 1 advantageously comprises a fourth electric motor, preferably a brushless motor. This fourth motor can also be activated independently of the first, the second and the third motor 31, 32, 33.

[0018] Preferably, the first, the second, the third and the fourth electric motor carry out their action for approaching and/or distancing movement in proximity to corresponding corners of the quadrilateral plate of the first support 21 and of the quadrilateral plate of the second support 22 or in proximity to points located along the perimeter of the first and the second support 21, 22. More specifically, they carry out their action in proximity to the vertices of the bed of the first and the second support 21, 22 or along the perimeter of the bed of the first and the second support 21, 22.

[0019] The press 1 comprises at least a first element 91 extending between the first and the second support 21, 22.

[0020] The element 91 comprises:

- a first section 401 that meshes with the first support 21 by means of a first thread; the handedness of the first thread is such that a first direction of rotation of the first element 91 determines a movement of the first zone 211 of the first support 21 towards the first zone 221 of the second support 22;
- a second section 402 that meshes with the second support 22 by means of a second thread; the handedness of the second thread is such that the first direction of rotation of the first element 91 determines a movement of the first zone 221 of the second support 22 towards the first zone 211 of the first support 21. More specifically, the first direction of rotation of the first element results in the lifting of the first support 21 and the lowering of the second support 22.

[0021] The first element 91 is activated by the first electric motor 31.

[0022] The first element 91 extends between and connects the first and the second support 21, 22. The first element 91 enables the transmission of motion from the first electric motor 31 to the first and the second support 21, 22. In combination with the first and the second support 21, 22, the first element 91 also enables conversion of rotational motion generated by the first electric motor 31 into substantially translational movement of the first and/or second support 21, 22.

[0023] The press 1 typically also comprises a second and a third element 92, 93 that extend between the first and the second support 21, 22 and that are activated by the second and the third motor 32, 33, respectively. The press 1 advantageously also comprises a fourth element that is activated by the fourth electric motor. The second element 92 (this can also be repeated for the third element 93 and possibly for the fourth element) comprises two threaded sections that mesh with the first and the second support 21, 22 and have an opposite handedness with respect to the first and the second support 21, 22 (in other words, rotation of the second element 92 in one case determines movement of the first support 21 towards the second support and movement of the second support 22 towards the first support 21 and in the other case, movement of the first and the second support 21, 22 away from each other).

[0024] Advantageously, the second element 92 comprises:

- a threaded section that meshes with the first support 21 and has a handedness opposite that of the first section 401 of the first element 91;
- a threaded section that meshes with the second support 22 and has a handedness opposite that of the second section 402 of the second element 92.

[0025] This contributes to the generation of the stresses that are at least partially balanced reducing the structural strain that the press 1 has to undergo.

[0026] Advantageously, in the case in which a first, a second, a third and a fourth element are present and activated by the first, the second, the third and the fourth electric motor, respectively, the approaching movement of the first and the second support 21, 22 implies that the first and the third element 91, 93 turn in one direction of rotation and that the second and the fourth element turn in an opposite direction of rotation.

[0027] Advantageously, following the perimeter of the plan view of the first support 21, the first, the second, the third and the fourth element extend in succession.

[0028] The first element 91 is a shaft connected to the first motor 31; moreover, it passes through the first support 21 in said first zone 211 of the first support 21 and is engaged in the first zone 221 of the second support 22.

[0029] Likewise, the second element 92 is a shaft connected to the second motor 32; it passes through the first support 21 in said second zone 212 of the first support 21 and is engaged in the second zone 222 of the second

support 22. However, the third element 93 is a shaft connected to the third motor 33; it passes through the first support 21 in said third zone 213 of the first support 21 and is engaged in the third zone 223 of the second support 22.

[0030] The first, and the second and the third motor 31, 32, 33 are coaxial with the first, the second and the third element 91, 92, 93, respectively.

[0031] The first, the second and the third element 91, 92, 93 are predominantly longitudinal in extension. In particular, this predominantly longitudinal extension is vertically oriented.

[0032] In this case, the first, the second and the third element 91, 92, 93 define a first, a second and a third column 41, 42, 43, which:

- connect the first and the second support 21, 22;
- are activated by the first, the second and the third motor 31, 32, 33, respectively;
- transmit motion from the first, the second and the third motor 31, 32, 33 to both the first support 21 and the second support 22;
- function as guides for the first and/or the second support 21, 22 during a course of travel of the first and the second support 21, 22 towards and/or away from each other.

[0033] Advantageously, there is at least a fourth column 44 (coinciding with the fourth element indicated hereinabove) activated by the fourth electric motor and for which the remaining characteristics described previously for the first, the second and the third column 41, 42 and 43 also hold.

[0034] An object of the present invention is also a method for forming an object by means of a compression press. Advantageously, this method is implemented by a press having one or more of the characteristics described hereinabove.

[0035] The method comprises the step of moving a first and a second support 21, 22 towards each other, said supports 21, 22 being designed to support respective half-moulds.

[0036] The step of moving the first and the second support 21, 22 towards each other comprises the step of activating at least three electric motors 31, 32, 33 (which are advantageously brushless motors) acting at least upon three distinct zones of the first support 21 and that bring said three zones 211, 212, 213 of the first support 21 towards three corresponding zones 221, 222, 223 of the second support 22.

[0037] The step of moving the first and the second support 21, 22 towards each other provides that said at least three electric motors 31, 32, 33 act also at least upon said three distinct zones of the second support 22, determining a movement of the first support 21 towards the second support 22 and a movement of the second support 22 towards the first support 21.

[0038] Said at least three electric motors comprise at

least a first, a second and a third motor 31, 32, 33. Advantageously, at least a fourth motor, preferably a brushless motor, is present.

[0039] The step of moving the first and the second support 21, 22 towards each other comprises the step of measuring the movement of the first and the second support 21, 22 towards each other, as brought about by the first, the second and the third motor 41, 42, 43. This step advantageously takes place by means of respective encoders associated at least with the first, the second and the third electric motor 31, 32, 33. Advantageously, an encoder is present and associated with (preferably incorporated in) each electric motor (which are advantageously brushless motors), enabling the movement of the first and the second support 21, 22 towards and/or away from each other.

[0040] If the approaching movement brought about by the first electric motor 31 is greater than a predetermined threshold with respect to the approaching movement brought about by the second or the third motor 32, 33, the first motor 31 reverses its direction of rotation so as to correct at least partially a deviation between the approaching movement brought about by the first motor and the approaching movement brought about by the second or the third motor (therefore, there is a slight distancing movement of part of the first and the second support 21, 22). The maximum allowable deviation (the pre-established threshold mentioned above) is very limited. Preferably, the maximum allowable deviation is set at a value of less than one tenth of a millimetre; advantageously, it is set at a value of less than 3 hundredths of a millimetre.

[0041] For example, this deviation could be caused by greater resistance encountered by the first motor 31, this greater resistance being attributable to greater resistance of the material in the zone in which the first element 91 is acting. The greater resistance of the material is typically caused by the shape of the first and the second half-moulds that can lead to a greater concentration of material closer to the zone of action of the first element 91, rather than the zone of action of the second or the third element 92, 93.

[0042] The step of moving the first and the second support 21, 22 towards each other after having corrected said deviation, comprises activating at least the first, the second and the third motor 31, 32, 33 again, so that the first, the second and the third motor 31, 32, 33 perform a joint action of bringing the first and the second support 21, 22 towards each other. If a deviation greater than a pre-established value is found once again between the approaching movement brought about by one of the electric motors and the approaching movement brought about by one of the remaining electric motors, the electric motor responsible for said excess of approaching movement reverses its direction of rotation so as to correct said deviation (which is then brought back below said pre-established value). The step of moving the first and the second support 21, 22 towards each other is thus

repeated iteratively; advantageously the maximum allowable deviation remains unchanged for all the iterative cycles.

[0043] The pressing process for pressing a body present in the half-moulds is preferably a hot-pressing process. The longer time at temperature of the material to be pressed facilitates its softening and therefore in the case in which a greater deviation from the predetermined threshold is detected, the material may be softer and thus more mouldable in the subsequent iteration.

[0044] The step of moving a first and a second support 21, 22 towards each other continues until a predetermined target point is reached (see Figures 3 and 4, in which the press is closed, whereas Figures 1 and 2 show the press 1 in the open state). The method subsequently comprises an adjustment, in which only part of said at least three motors 31, 32, 33 are activated for the purpose of changing the relative inclination of the first and the second support 21, 22. In particular, the first and the second support 21, 22 are inclined with respect to the horizontal (in any case, the inclination is imperceptible). This enables final adjustment of the pressing operation. In particular, this operation makes it possible to execute a more substantial thrust at a zone in which the mould has a more "open" shape, while making it possible to push less where the mould is more "closed".

[0045] The invention thus conceived makes it possible to achieve multiple advantages.

[0046] First of all, it provides for maximum planarity to be maintained between the first and the second support of the half-moulds. This makes it possible to optimize machining accuracy, a requisite for a high quality product.

[0047] Furthermore, the planarity also makes it possible to minimize possible mechanical problems that could arise in the case in which the first and the second support were to slide along their own guide means with an excessive deviation from the planarity.

[0048] The invention thus conceived is susceptible to numerous modifications and variants, all of which falling within the scope of the inventive concept characterizing the invention. Moreover, all details may be replaced with other technically equivalent elements. All the materials used, as well as the dimensions, may in practice be of any type, according to needs.

Claims

1. A compression press comprising:

- a first support (21) suitable for supporting a first half-mould;
- a second support (22) suitable for supporting a second half-mould, said second support (22) being opposite the first support (21); the first and the second support (21, 22) being capable of being brought towards and/or away from each other;

- at least a first, a second and a third electric motor (31, 32, 33) that control the movement of the first and the second support (21, 22) towards and away from each other; said first, said second and said third electric motor (31, 32, 33) acting in a first, a second and a third zone (211, 212, 213) of the first support (21), respectively.

2. The press according to claim 1, **characterized in that** the first, the second and the third motor (31, 32, 33) also act upon a first, a second and a third zone (221, 222, 223) of the second support (22), respectively.

3. The press according to claim 1 or 2, **characterized in that**:

- said first support (21) consists of a substantially quadrilateral plate;
- said second support (22) consists of a substantially quadrilateral plate; said press (1) comprising a fourth electric motor; the first, the second, the third and the fourth electric motor carrying out their action for approaching and/or distancing movement in proximity to corresponding corners of the quadrilateral plate of the first support (21) and of the quadrilateral plate of the second support (22).

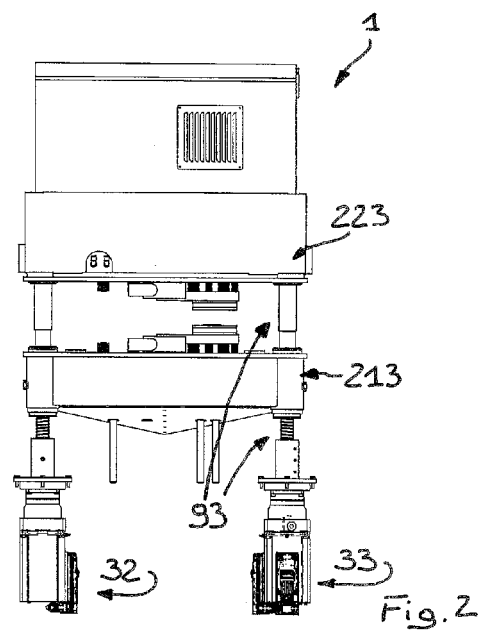
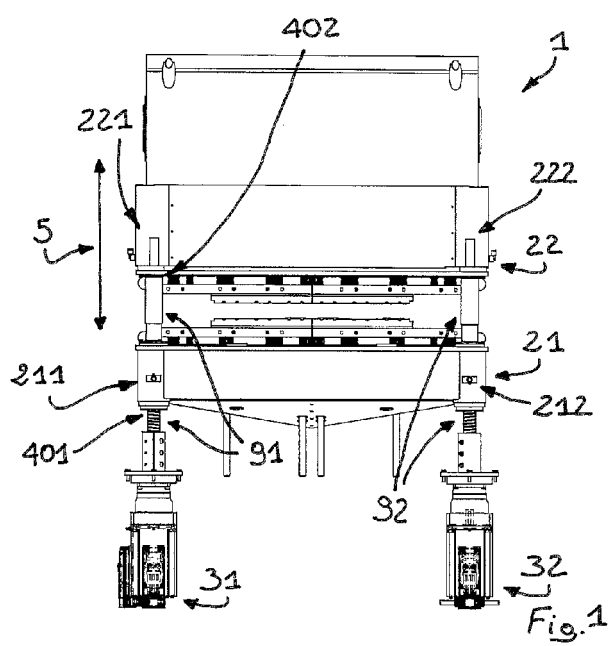
4. The press according to any one of the preceding claims, **characterized in that** it comprises at least a first element (91) extending between the first and the second support (21, 22) and comprising:

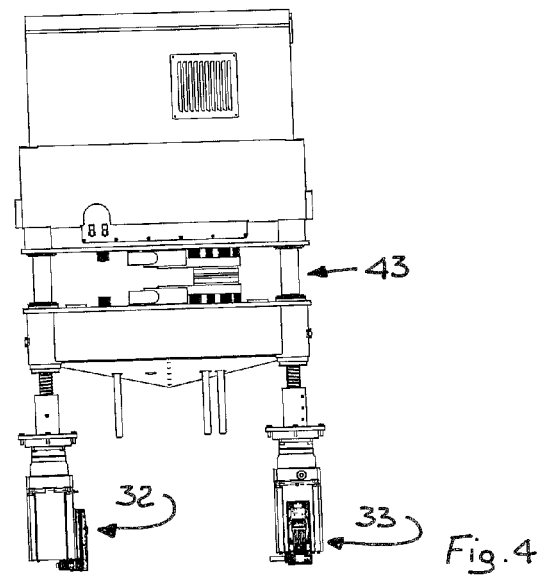
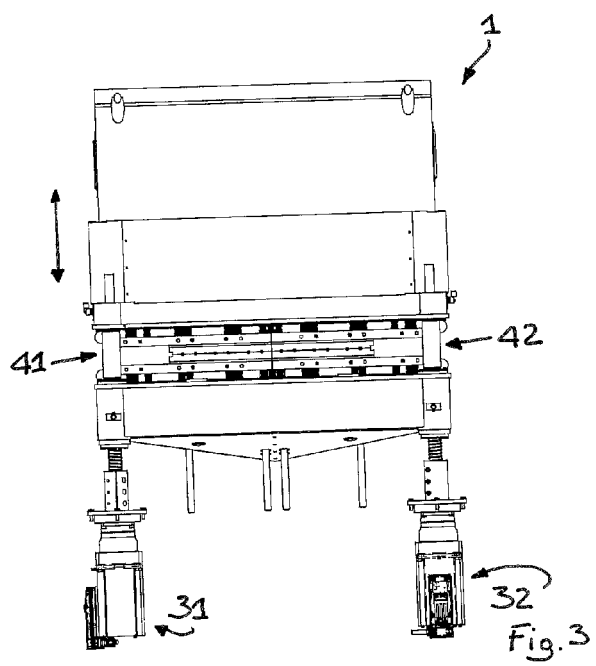
- a first section (401) that meshes with the first support (21) by means of a first thread; the handedness of the first thread being such that a first direction of rotation of the first element (91) determines a movement of the first support (21) towards the second support (22);
- a second section (402) that meshes with the second support (22) by means of a second thread; the handedness of the second thread being such that the first direction of rotation of the first element (91) determines a movement of the second support (22) towards the first support (21).

5. The press according to any one of the preceding claims, **characterized in that** it comprises at least a first, a second and a third column (41, 42, 43), which:

- connect the first and the second support (21, 22);
- are activated by the first, the second and the third motor (31, 32, 33), respectively;
- transmit motion from the first, the second and

- the third motor (31, 32, 33) to both the first support (21) and the second support (22);
- function as guides for the first and/or second support (21, 22) during a course of travel of the first and the second support (21, 22) towards and/or away from each other. 5
6. The press according to any one of the preceding claims, **characterized in that** the first, the second and the third electric motor (31, 32, 33) are brushless. 10
7. A method for forming an object by means of a compression press, comprising the step of moving a first and a second support (21, 22) towards each other, said supports (21, 22) being designed to support respective half-moulds. 15
said step of moving the first and second support (21, 22) towards each other comprising the step of activating at least three electric motors (31, 32, 33) acting at least upon three distinct zones of the first support (21) and that bring said three zones (211, 212, 213) of the first support (21) towards corresponding zones (221, 222, 223) of the second support (22), said at least three electric motors comprising at least a first, a second and a third electric motor (31, 32, 33). 20 25
8. The method according to claim 7, **characterized in that** the step of moving the first and second support (21, 22) towards each other comprises the step of measuring the mutual movement of said three zones (211, 212, 213) of the first support (21) towards the corresponding zones (221, 222, 223) of the second support (22); 30
if the approaching movement brought about by the first electric motor (31) is greater than a predetermined threshold with respect to the approaching movement brought about by the second motor (32), the first motor (31) reverses its direction of rotation so as to correct at least partially a deviation between the approaching movement brought about by the first motor (31) and the approaching movement brought about by the second motor (32). 35 40
9. The method according to claim 8, **characterized in that** the step of moving the first and second support (21, 22) towards each other after having corrected at least partially said deviation comprises activating at least the first, the second and the third motor (31, 32, 33) again so that the first, the second and the third motor (31, 32, 33) perform a joint action of bringing the first and the second support (21, 22) towards each other. 45 50
10. The method according to claim 7 or 8 or 9, **characterized in that** the pressing process for pressing a body present in the half-moulds is a hot-pressing process. 55
11. The method according to any one of claims 7 to 10, **characterized in that** the step of moving a first and a second support (21, 22) towards each other continues until a predetermined target point is reached in terms of the approaching movement; the method subsequently comprises an adjustment, wherein only part of said at least three motors (31, 32, 33) are activated for the purpose of changing the relative inclination of the first and the second support (21, 22).
12. The method according to any one of claims 7 to 11, **characterized in that** the first, the second and the third electric motor (31, 32, 33) are brushless.







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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82