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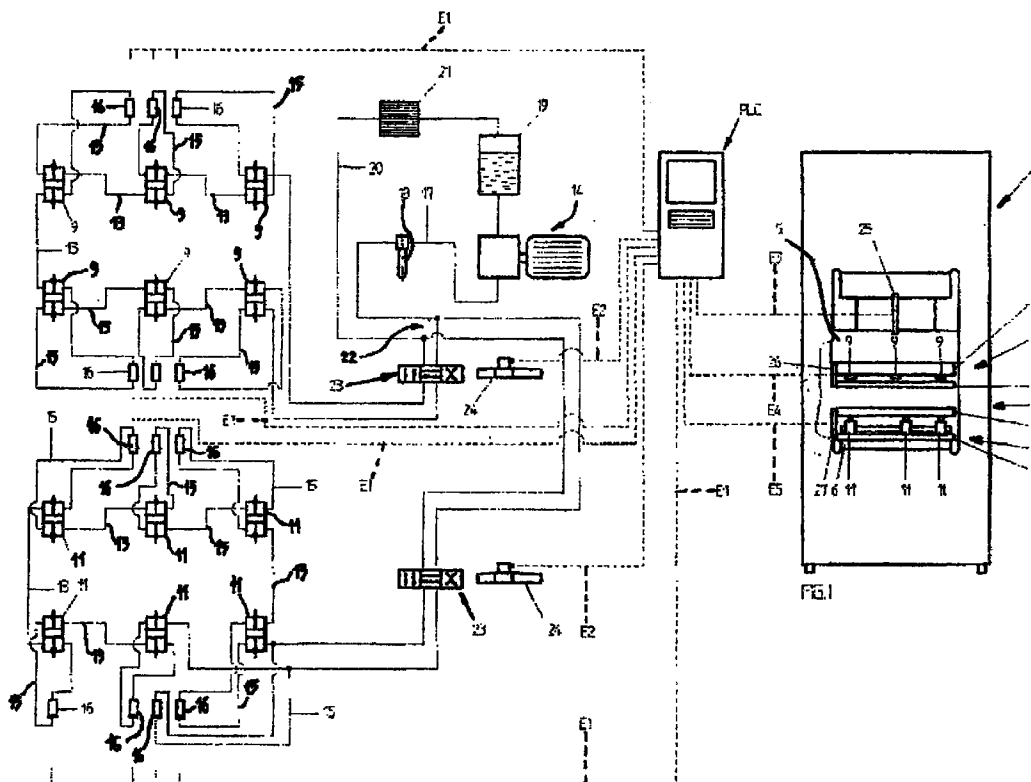
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(54) Die for pressing powder material

(57) A die for pressing powder material, particularly for ceramic tiles, comprises an upper die part (3) and a lower die part (2) which may be interconnected through hydraulic means (9, 11; 9, 11a) with operating fluid to a cross member (5) and to a base (6) of a press (1), respectively; the die parts (2, 3) of the die being approachable to, and movable away from, each other by

means of the movements of said cross member and of said hydraulic means (9, 11; 9, 11a) with operating fluid, which comprises a plurality of double-acting jacks (9, 11; 9, 11a) connected in series with each other; the displacements of the die parts are controlled and checked by dedicated programmable electronic means (PLC).



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Description

[0001] The invention concerns a die for pressing powder material, particularly for moulding ceramic tiles.

[0002] In the known dies for pressing ceramic dry tiles, an upper die body and a lower die body are provided, that may be reciprocally approached in order to compress powders which have been previously distributed in a cavity of matrix drawn in the lower die body. These known dies show a deficiency lying in the difficulty of keeping the upper die body and the lower die body parallel to each other, when one and/or the other of the two die bodies is moved from an opening position, in which a previously pressed tile may be removed from the cavity and further powder may be distributed in the cavity for a subsequent pressing, to a closing position in which the pressing actually takes place. This difficulty generates problems of functionality of the die and imperfections in the pressed tiles.

[0003] It is an object of the present invention to improve the existing dies, particularly to make possible to keep a condition of parallelism between the lower and upper die bodies in any operative condition.

[0004] According to the present invention, a die is provided comprising an upper die part and a lower die part which may be connected, through hydraulic means with operating fluid, to a cross member and to a base of a press, respectively; the parts of the die may be approached to and moved away from each other by means of the movements of said cross member and of said hydraulic means with operating fluid, characterised in that, said hydraulic means with operating fluid comprises a plurality of double-acting jacks, connected in series with each other through circuit means capable of allowing said fluid to pass from a chamber of a jack to a chamber of another jack connected thereto.

[0005] All that in order to cause the same displacements of the various jacks in all the zones of the die on which the jacks act.

[0006] In an advantageous embodiment, the jacks have the same surface of cross section and stems passing through the respective chambers in which the fluid is contained.

[0007] That allows all the jacks to apply substantially the same loads to the parts of the die.

[0008] In a further embodiment, the jacks have surfaces of cross section decreasing progressively departing from pump means of said fluid, the sections of the jacks being so dimensioned that it is guaranteed, in any event, that all the respective stems perform the same stroke.

[0009] Particularly, three pairs of jacks, arranged in the end zones and in an intermediate zone of each part of the die, may be provided, in order to make possible an optimum distribution of the loads and limit the deformations during working, as much as possible.

[0010] In a variation, the circuit means comprises by-pass conduit means interconnecting the chambers of a

same jack passing through on-off valve means.

[0011] That makes possible to make, after each pressing operation - or after a convenient number of pressing operations -, a scavenging of the chambers of each of each jack, in order to guarantee that, in the subsequent pressing operation, all the chambers are equally filled by the operating fluid. In fact, if that would not happen, it would be impossible to guarantee that the displacement of the operating fluid from a given chamber of a given jack to a further chamber of a further jack, connected to that given chamber involves, in the further jack, the same displacement that has been imparted to that given jack.

[0012] The scavenging of the chambers of the several jacks, in addition, makes possible to equalise the temperatures (particularly by lowering them) and, as a consequence, to equalise the viscosity of the operating fluid in order to obtain better performances of the die.

[0013] It is furthermore advantageous if the operating fluid is checked in the circuit means using suitable programmable electronic checking and control means (PLC).

[0014] Advantageously, the electronic checking and control means is incorporated in the die in order to avoid interference with the functionality of the press.

[0015] That makes possible to control as better as possible the working variables concerning the displacements of the jacks. Particularly, it is possible to change the thickness of the soft layer of powders that are to be pressed (and, as a consequence, to change the thickness of the pressed manufactured article) simply by setting suitable program controls of the PLC without modifying mechanic parts of the die, as conventional dies require..

[0016] The invention will be better understood and put into effect with reference to the enclosed drawings, that illustrate, as a non-limiting example, some embodiments, in which:

Figure 1 is an overall schematic view illustrating a press in which a die for pressing ceramic tiles is installed, a hydraulic circuit controlling the displacements of the die and interacting with a respective check and control circuit;

Figure 2 is a side schematic view, partially cut-away, of a mirror die for pressing ceramic tiles showing an upper part of the die facing a lower part of the die;

Figure 3 is a sectioned and enlarged detail of a hydraulic jack inserted in an upper part of the die;

Figure 4 is an enlarged detail comprising an axial section of a jack of a lower part of the die, in a suitable position for defining a loading space for the powders;

Figure 5 is a section like that of Figure 4, but concerning a position of the jack that defines a space having a smaller depth than the space shown in Figure 4;

Figure 6 is the axial section of two jacks provided with through stems passing and interconnected by a branch of hydraulic circuit, schematically depicted;

Figure 7 is a section like that of Figure 6, but concerning an embodiment exhibiting jacks provided with stems passing only through one of the two chambers of each jack;

Figure 8 is a greatly enlarged and sectioned detail of a coupling zone between edge portions of the parts of the die during pressing.

[0017] In a press 1 for moulding ceramic tiles a mould 2 is installed which is divided in an upper mould portion 3, fixed to a cross member 5 of the press 1, and a lower mould portion 4 fixed to a bed 6 of the press 1.

[0018] As shown in Figure 1, the upper portion 3 comprises an upper die body 7 connected, by means of upper jacks 9, to an upper plate 8 fixed to the cross member 5. The lower part 4 comprises a lower die body 10 connected, by means of jacks 11, to a lower plate 12 fixed to the bed 6.

[0019] In order to detect the position of the cross member 5, a first position transducer 25, for instance a linear encoder, is interposed between the cross member and a stationary part of the press 1. In order to detect the position of the upper die 7 in relation to the upper plate 8, a second position transducer 26 is interposed therebetween. In order to detect the position of the lower die 10 in relation to the lower plate 12, a third position transducer 27 is provided therebetween.

[0020] As shown in the left part of Figure 1, the upper jacks 9 are connected in series with each other through conduits 13 connecting a delivery chamber of an upstream jack 9, that is the jack closest to a volumetric pumping station 14, with a suction chamber of a downstream jack 9. The same applies to the lower hydraulic jacks 11, that are interconnected by circuit branches, therefore identified by the same reference number.

[0021] Each jack 9, or 11, exhibits a by-pass circuit branch 15, provided with a on-off valve 16.

[0022] The pumping station 14 is connected to a delivery circuit branch 17 provided with an oil filter 18, and sucks from a reservoir 19, which receives an exhaust circuit branch 20 provided with a heat exchanger 21, if any. The branches of the delivery circuit 17 and exhaust circuit 20 are apportioned, in correspondence of branch points 22, between the upper part 2 of the mould and lower part 4 of the the mould, and the apportioned branches intercept respective proportional valves 23, operated by electromagnetic actuators 24. Signals E1 relevant to the control of the on-off valves 16, signals E2 relevant to the control of the electromagnetic actuator 24, signals E3, E4 and E5 relevant to the transducers 25, 26 and 27 respectively, are associated with electronic control means PLC.

[0023] As shown in Figure 2, the upper die body 7 is provided with through openings 28, that allow the upper

die body 7 to slide axially in relation to upper punch bodies 29, fixed to the upper plate 8 in such a way as to protrude toward the lower part 4 of the mould, so that an active pressing surface 30 is turned toward underlying powders, that are to be pressed.

[0024] An intermediate plate 31 is interposed between the lower plate 12 and the lower die 10 to which lower punch bodies 32 are, said bodies, together with respective through openings 34 of the lower die 10 in which they are internally slidable, define spaces 33 capable of containing the powders that are to be pressed.

[0025] The intermediate plate 31 is connected to the upper ends of vertical extractors, not shown, being part of the press 1, that lift the lower punch bodies 34 up to the upper plane of the lower die 10 to allow the pressed tiles to be removed from the spaces 33. A bellow 35 is interposed between the outer edge of the intermediate plate 31 and the corresponding outer edge of the base plate 12.

[0026] Conduits 38 are obtained on the peripheral part of the base plate 12 for the circulation of the oil. Figure 3 illustrates how each upper hydraulic jack 9 is inserted in a hole 37 of the upper plate 8 and is kept tight therein by a flange 38 provided at one end of a jacket body 39 containing the operating fluid F. The operating fluid F, generally oil, fills opposite chambers C1 and C2 separated by a double-acting piston 40 associate with a respective stem 41 protruding from opposite sides of the jacket body 39.

[0027] Figures 4 and 5 show that the lower jacks 11 are comprised of an jacket body 42 arranged on the outside of the base plate 12, but having recesses 43 for receive receiving the stems 41 associated with the respective pistons 40 and protruding from end flanges 44. In addition, if figures 4 and 5 are compared with each other, it is clear how it is possible to modify in a very simple way the depth S1 of the space 33 in order to obtain a different depth S2 related to a different tile thickness, by modifying the programming of the PLC, which acts modifying the position of the lower die 10, detected by the third linear transducer 27. All that without intervention on mechanic parts.

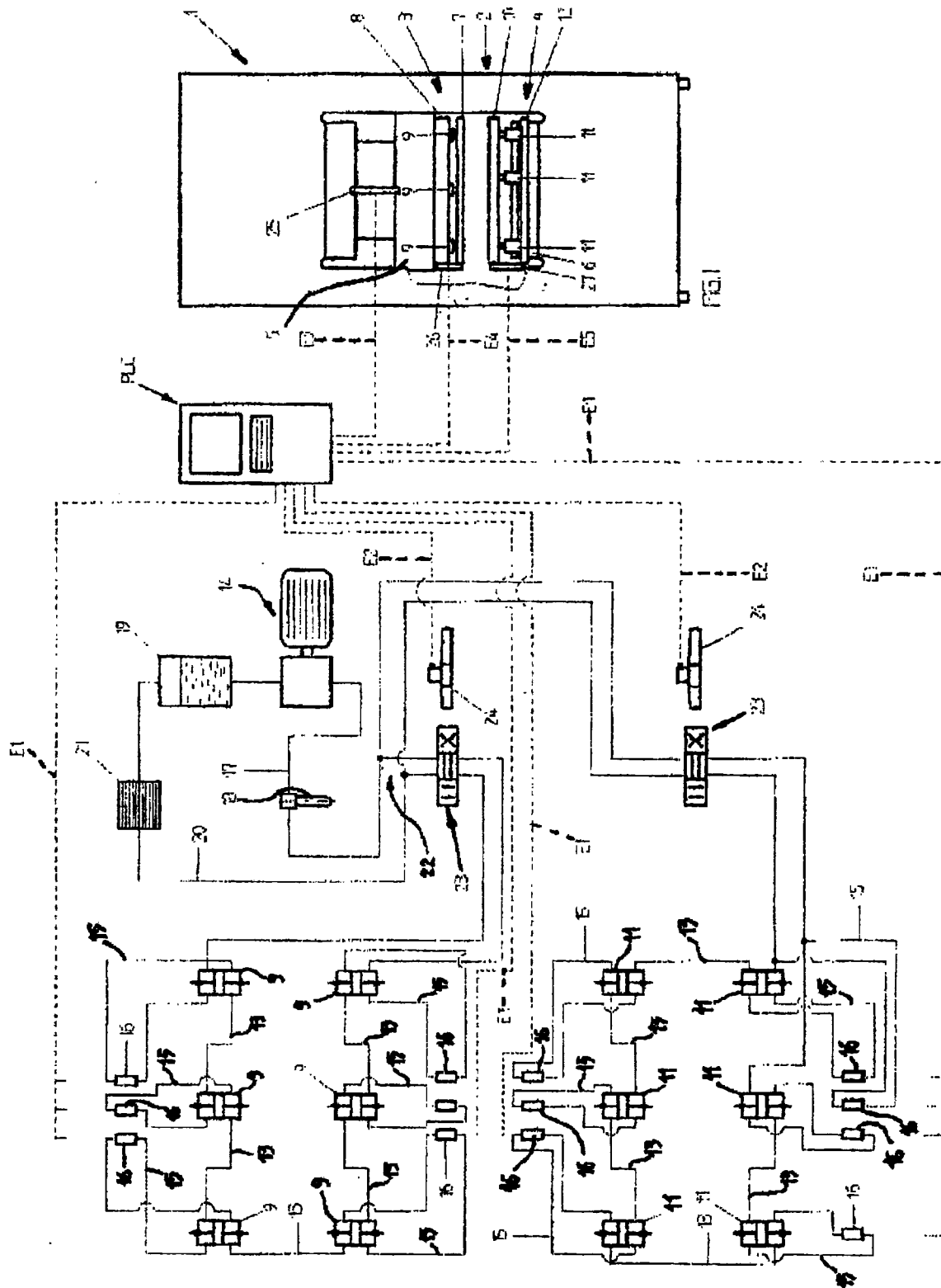
[0028] Referring now to Figure 7, there is shown that jacks 11a may be provided in which respective cylinder stems 41a, each of which is coupled with a respective piston 40, protrude only from a chamber C2 through a flange 44, while the other chamber C1a is free from any part of stem and is closed by a cover 45. In this situation, when oil is fed to a jack 11a associated to the lower part, and the same applies to the upper part of the mould, the jack connected to it downstream receives a sufficient amount of oil to cause its own stem 41a to perform the same stroke as the stem 41a of the upstream jack, only if the cross section of the downstream jack is adequately dimensioned.

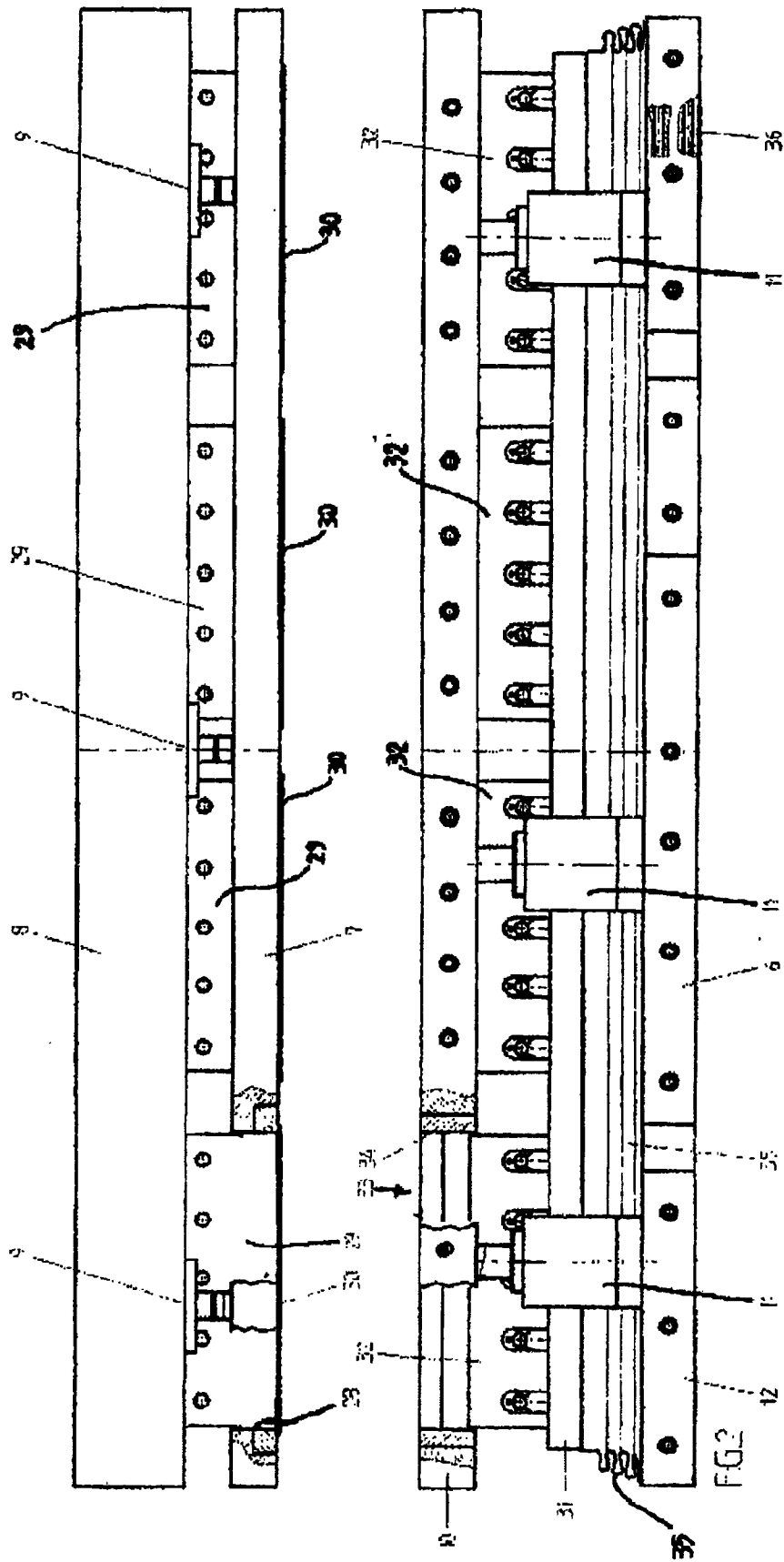
[0029] Particularly, each jack has a cross section smaller than the cross section of a jack placed immediately upstream.

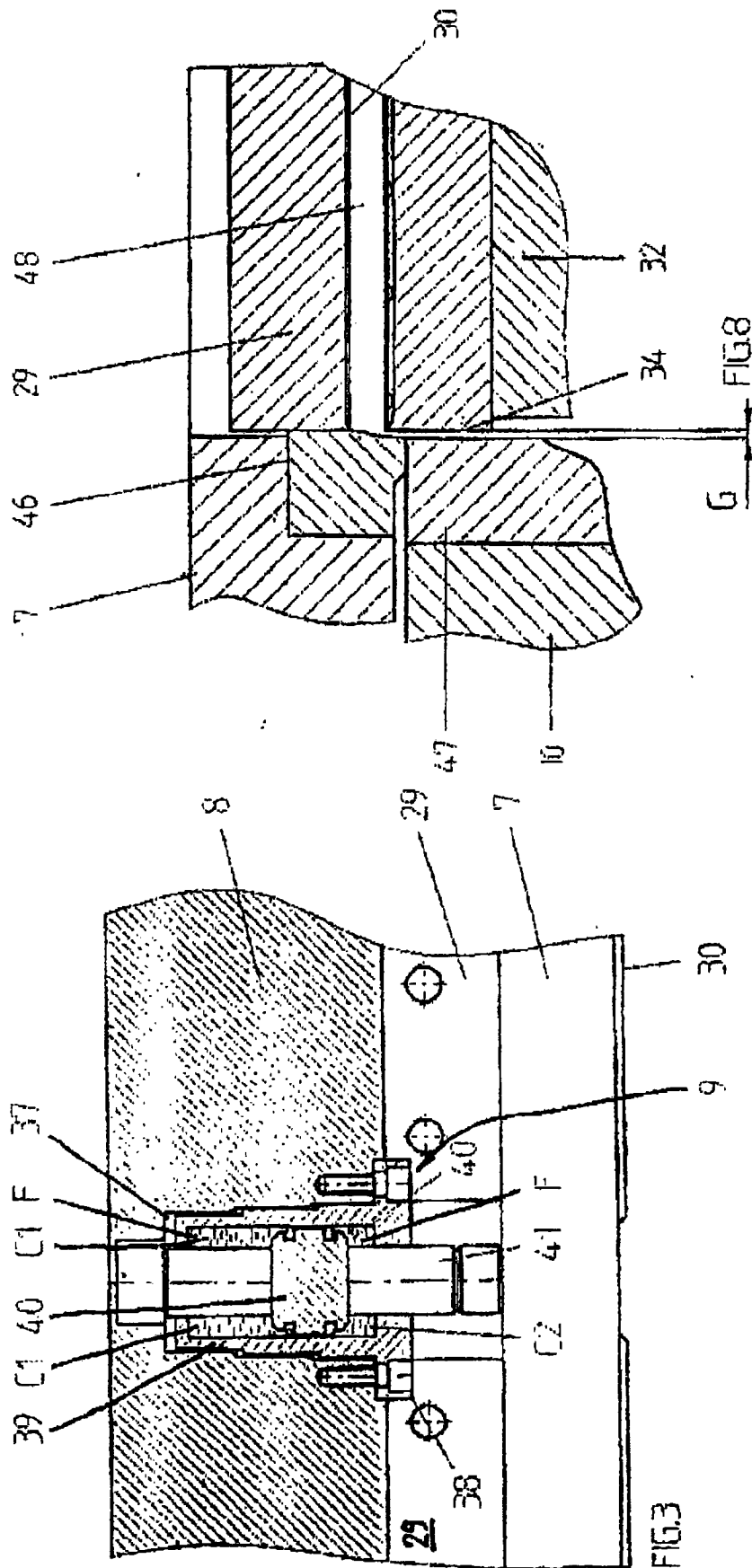
[0030] Figure 8 shows how the peripheral clearance G between an inner surface of an upper gib 46 and the respective punch body 34 may be modified by modifying the position of the upper die 7 (in which upper gibs 46 are accommodated which define an upper space 48 comprising the active pressing surface) using the upper jacks 9. This allows the stroke for de-aerating the powders during pressing to be modified, without being necessary to substitute or modify mechanical parts of the mould.

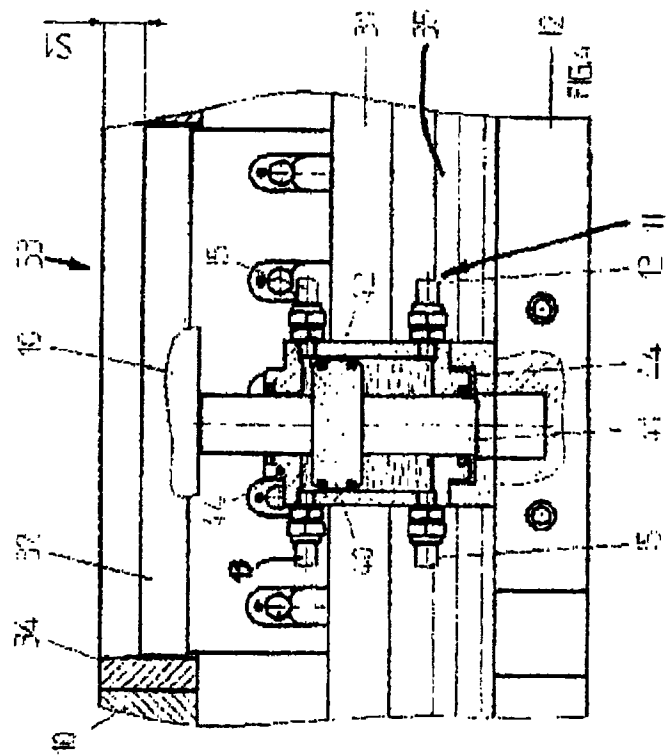
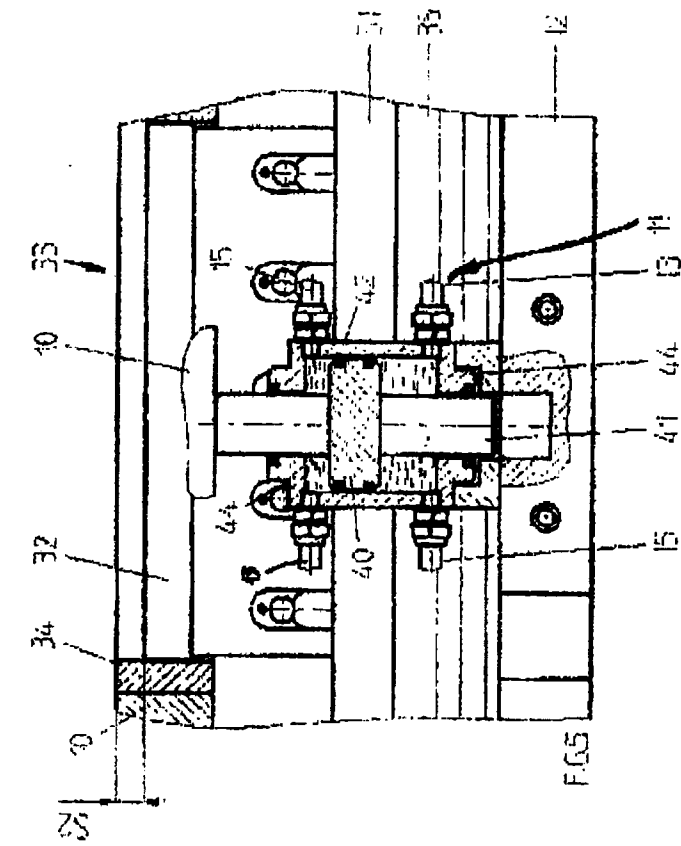
Claims

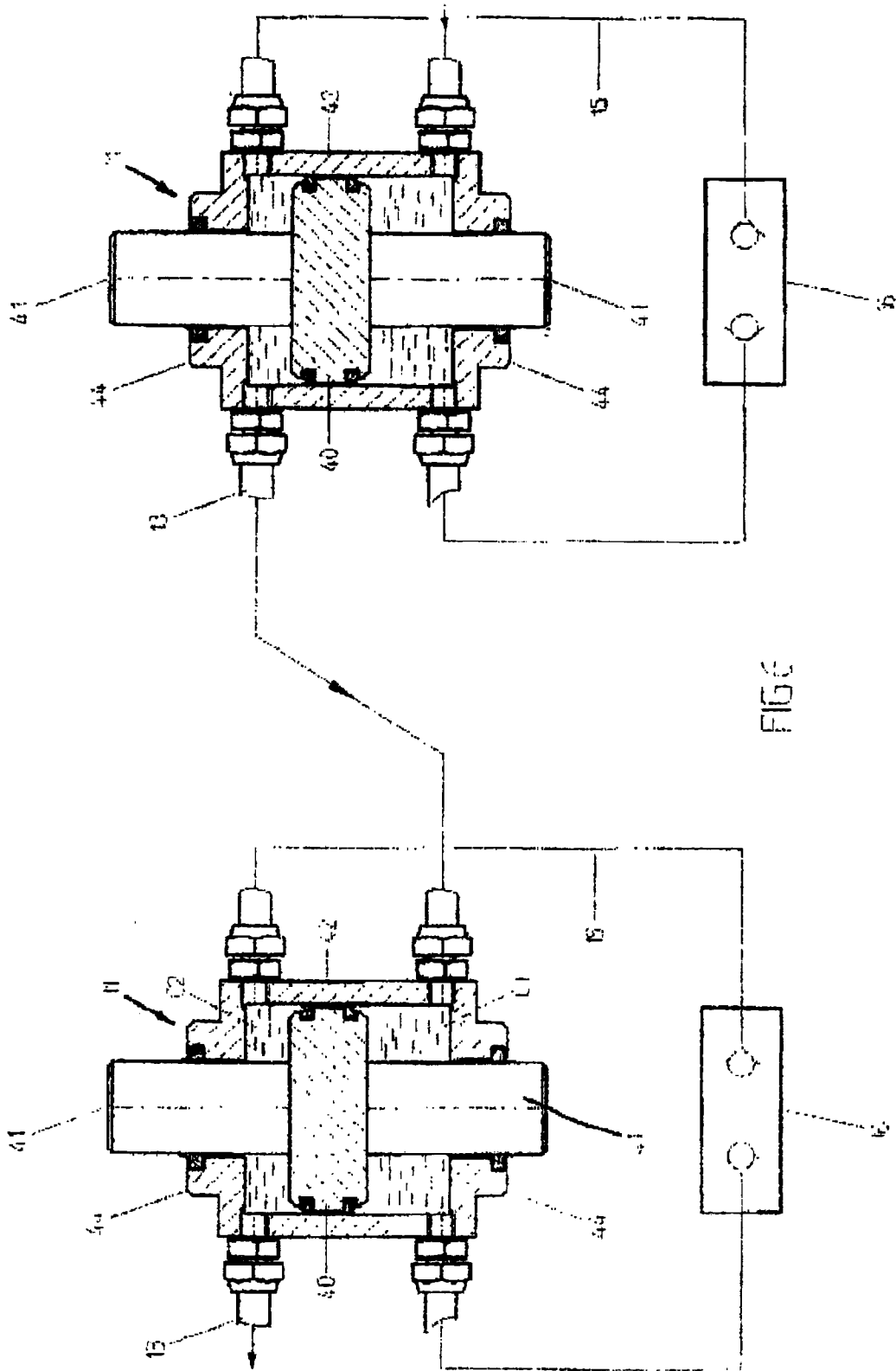
1. A die for pressing powder material, particularly for moulding ceramic tiles, comprising an upper die part (3) and a lower die part (2) which may be connected, through hydraulic means with operating fluid, to a cross member (5) and to a base (6) of a press (1), respectively; the die parts (2, 3) being approachable to, and movable away from, each other by means of the movements of said cross member and of said hydraulic means (9, 11; 9, 11A) with operating fluid, characterised in that, said hydraulic means with operating fluid comprises a plurality of double-acting jacks (9, 11; 9, 11a) connected in series with each other through circuit means (13) capable of allowing said fluid to pass from a chamber (C1, C2; C1a, C2) of a jack to a chamber of another jack connected thereto.
2. A die according to claim 1, wherein said jacks (9, 11) have the same surface of cross section and stems (41) passing through the respective chambers (C1, C2) in which said fluid is contained.
3. A die according to claim 1, wherein said the jacks (9, 11a) have respective stems (41a) passing only through a respective chamber (C2) of each jack (11a) and said jacks (11a) have surfaces of cross section decreasing progressively departing from pump means (14) of said fluid, the sections of the jacks (11, 11a) being so dimensioned that it is guaranteed, in any event, that all the respective stems (41, 41a) perform the same stroke.
4. A die according to one of preceding claims, wherein at least pair of jacks (9, 11; 9, 11a) are arranged in the end zones and in an intermediate zone of each of said die parts (2, 3).
5. A die according to one of preceding claims, wherein said conduit further comprises by-pass circuit means (15) which interconnects the chambers (C1, C2; C1a, C2) of a same jack (9, 11; 9, 11a) passing through on-off valve means (16).
6. A die according to one of preceding claims, wherein said circuit means further comprises pump means (14) for said fluid, connected to delivery branches (17) and exhaust branches (20) which are connected to proportional valve means (23) controlling the flow of said fluid to and from said die parts (2, 3).
7. A die according to one of preceding claims, wherein said operating fluid is controlled in said circuit means through appropriate programmable electronic control means (PLC).
8. A die according to claim 7, wherein said electronic control means (PLC) is completely dedicated to the mould (1), so that it can not interfere with the functionality of the press.
9. A die according to one of claims 6 or 7, wherein said electronic control means (PLC) interact with first sensor means (25), to detect the position of said cross member (5), with second sensor means (26), to detect the position of an upper die (7), and with third sensor means (27), to detect the position of a lower die (27).
10. A die according to one of preceding claims, wherein said jacks (9, 11; 9, 11a) are interposed between a plate (6; 8) and a die body (10; 7).
11. A die according to claim 9, wherein said jacks (9) are obtained in seats (37) of said plate (8).
12. A die according to one of preceding claims, wherein said circuit means comprises conduits (36) obtained in peripheral parts of the body of said plate (6).

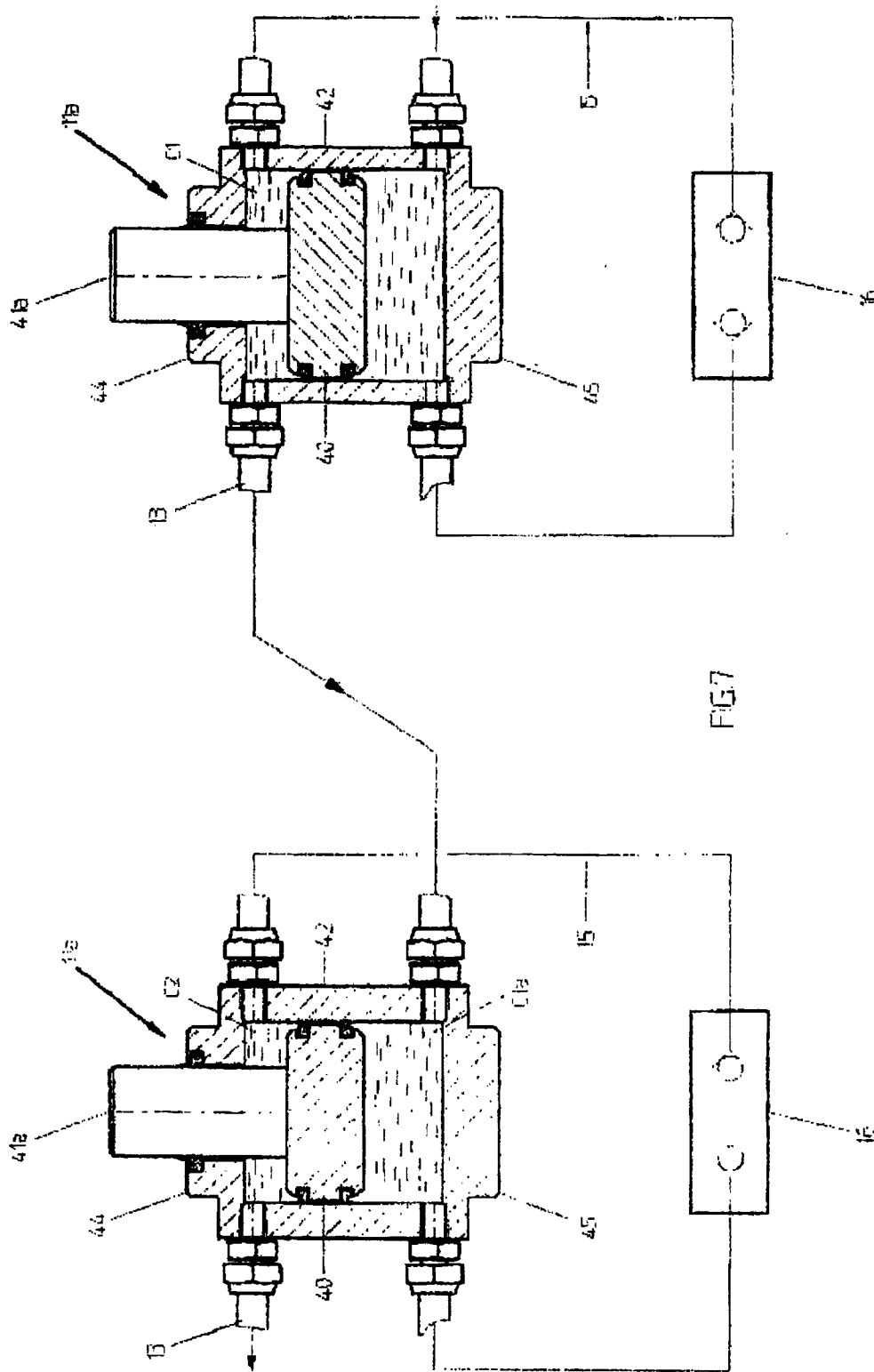














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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 0522

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 98 12 0522

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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