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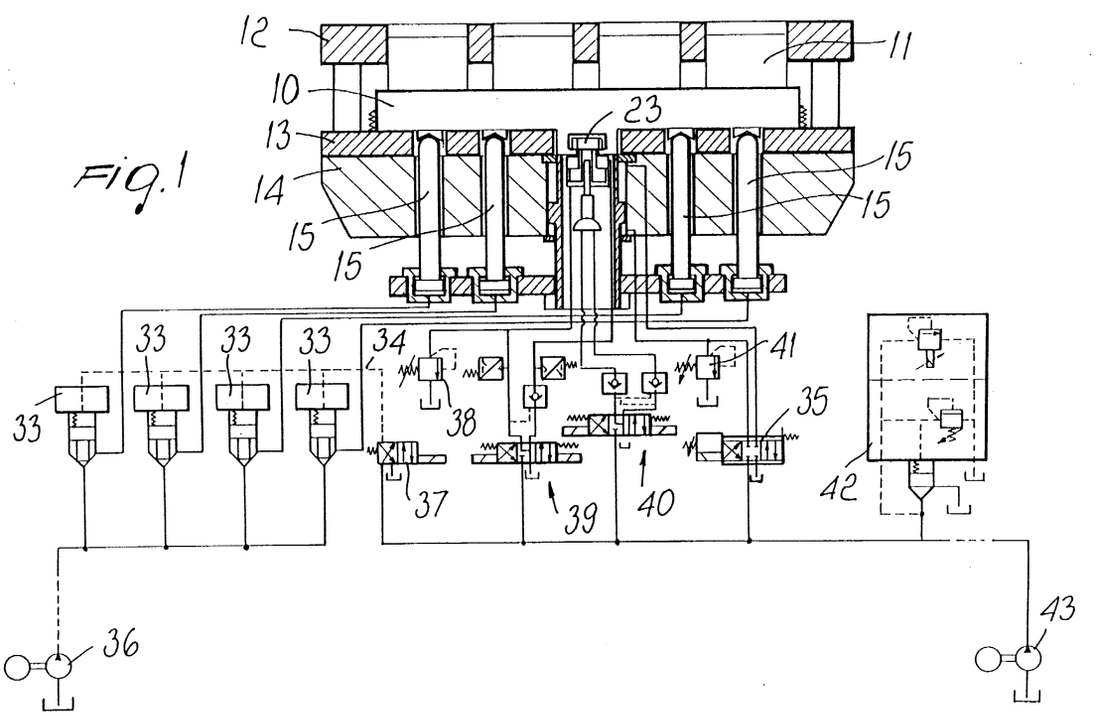
(54) Device for pressing a material in granular or powder form, and method that use the device

(57) The present invention relates to a method for the dry pressing of a material in granular or powder form, to a device suitable to be used to perform pressing. The device includes: a bed plate (14); a movable body (10) for supporting a mold; a plurality of vertical rods (15) which engage the movable body from below; a supporting member (17)for supporting the rods; and a movement member (19,20) for vertically moving the supporting member. The method includes feeding liquid at low pressure to cylinder and piston assemblies (28, 29) which support the rods, closing a flow control means in order to prevent the escape of the liquid, and actuating a movement member in order to lift the movable body (10).

Fig. 1



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Description

[0001] The present invention relates to a method for the dry-pressing of a material in granular or powder form, and to a device suitable to be used to perform pressing.

[0002] More particularly, a pressing apparatus suitable to perform the process includes: a generally annular main structure for containing a pressing force; a loading means for loading the material into a lower mold; a leveling means for leveling an upper surface of the material loaded into a lower mold; a vertical movement member for lifting or lowering a bottom of the lower mold. The loading means and the leveling means are preferably formed by a single body, generally known as truck or tray, which includes a grid which can slide for loading and a front end which performs leveling during backward motion.

[0003] More particularly, the present invention relates to an extraction device which includes a vertical movement member which is arranged so as to vary a depth of a lower mold, and therefore also lift a molded part, up to the level of the upper edge of the lower mold, so that the molded parts can be extracted from the mold and moved to the level of a substantially horizontal surface which is also known as mold template plane. The truck can move along the template plane between a position in which it lies below a hopper for feeding the material to be pressed and a position in which it lies above the mold to be filled. During the advancement of the truck, the finished part is furthermore unloaded by making it slide on the template plane.

[0004] The bottom of the lower mold is supported by a movable body which is arranged above a bed plate, known as strike plate. The movable body can be raised vertically by virtue of a vertical movement member, so as to directly raise or lower the bottom of the mold for loading and for extraction.

[0005] During pressing, the lower face of the movable body rests on the strike plate, which is fixed to the bed plate in order to discharge the pressing force onto the latter.

[0006] After unloading the finished part, during the loading of the material to be pressed, the movable body does not descend until it rests on the strike plate but arranges itself at a specific height which determines the volume of the mold that can be loaded with material and then leveled at the top. Then the movable body descends until it rest on the bed plate, which directly bears all the force of the pressing action; the upper mold part then descends and pressing occurs. The height at which the movable body stops for loading thus determines the vertical thickness of the finished part.

[0007] The upper mold is supported by a movable ram which is actuated, for example, by a hydraulic piston which is capable of providing the thrust for pressing.

[0008] Even more particularly, the pressing apparatus is suitable for the dry pressing of ceramic materials, so as to obtain for example tiles, plates, dishes and bricks of the refractory type, to be subsequently fired in kilns operating continuously at high temperature. These kilns, generally of the type with rollers, require a rather long time in order to start and reach the steady state and therefore cannot be shut down easily whenever an interruption in production occurs, typically when it is necessary to vary the size of the molds and/or the type of production. In this case it is in fact necessary to test and adapt the molds and/or the type of loading and/or the extent of the descent of the molds during loading, et cetera, with high precision in order to reduce the chances of rejects once production resumes. These tests can take as long as a couple of days. It is in fact necessary to check in practice the results of the loading of the material to be pressed, of the molding and of the unloading of the pressed material. These three aspects influence each other and depend to a large extent both on the type of production and on the size of the molds. In practice, it is very complicated to adjust and optimize the many variables of the process.

[0009] As regards the pressing apparatus that can be used in the context according to the present invention, it is known for example from patent application PCT 89/11969 in the name of the same Applicant.

[0010] The above is, in summary, the main field of industrial utilization of the invention but does not constitute a limitation of the scope of the invention, since the method, the device and the apparatus according to the invention, in particular as described and claimed, may be advantageously used in any other equivalent field, as claimed in the accompanying claims.

[0011] The above described characteristics, according to the field of the present invention, are known for example from European patent no. 547305, European patent no. 0753397 and from European patent no. 0753396, in the name of the same Applicant. The device described in these European patents uses a flow divider which feeds the same flow to a plurality of separate pistons and cylinders. In this manner, the movable body that supports the lower mold is moved so as to keep it parallel to itself. This type of device, while allowing a substantial technical improvement with respect to previous solutions, subjects the movable body, during movement, to two contrasting thrusts: a lateral upward thrust, due to the pistons fed by the flow divider, and an opposite central downward thrust generated by the vertical movement member. This entails the need to oversize the movable body in order to be able to withstand these contrasting thrusts. Furthermore, the flow divider requires periodic maintenance, such as for example gasket replacement, because the environment is highly aggressive owing to the presence of powder and therefore it may also be necessary to renew the chromium plating of the cylinders.

[0012] US 3524220 discloses a die for compacting powder that can be used to mold only very small objects and is completely unsuitable for the field of the present

invention. In fact it does not provide any means to guarantee planarity of the upper and lower surfaced of the molded article. This may not be a problem for very small articles, but is a very serious problem for molding tiles.

[0013] The aim of the present invention is therefore to overcome the above drawbacks with a device according to claim 1.

[0014] The invention furthermore relates to a method for the dry pressing of a material in granular or powder form according to claim 11.

[0015] The invention will become apparent with reference to the following detailed description of an embodiment of the invention, with particular reference to the accompanying drawings, given by way of non-limitative example and wherein:

Figure 1 is a schematic view of the device according to the invention;
Figure 2 is a partially sectional front view of a detail of the device of Figure 1;
Figure 3 is a plan view of the detail of Figure 2;
Figure 4 is an enlarged-scale sectional view of a detail of the device of Figure 2;
Figure 5 is a plan view of the device of Figure 4.

[0016] With reference to Figures 1 to 5, a movable body 10 supports the plungers 11 of the lower mold which, together with the template 12, form the mold. The movable body 10 rests above the strike plate 13, which rests above the bed plate 14, whose dimensions are adequate to withstand the pressing forces.

[0017] Multiple vertical rods 15 engage from below the movable body 10, passing through the openings 16 formed in the strike plate 13. The rods 15 are supported by the supporting member 17, which is actuated by the actuation member 18, which allows the vertical movement of the supporting member 17 of the rods 15 and therefore of the movable body 10.

[0018] With particular reference to Figure 3, the four lateral cylinders/pistons 28, 29 are arranged at the corners of a rectangle, while the first central cylinder/piston 19, 20 is arranged in the center of the rectangle.

[0019] The movement member 18 is accommodated inside the bed plate 14. In particular, the movement member 18 includes a cylinder 19 which is rigidly coupled to the bed plate 14 and a central piston 20 of the double-acting type which is rigidly coupled to the movement member 17. In particular, the piston 20 is fixed to the plate 17 that forms the supporting member by means of the flange 21. This embodiment is preferred, but the arrangement can also be reversed.

[0020] The central piston 20 centrally supports the movable body 10 during the vertical movement of the movable body 10. This support is provided by virtue of the resting of the piston 20 against the abutment 21, which contains a seat 22 for inserting a bracket 23 which is suitable for the engagement and disengagement of the movable body 10. The bracket 23 engages the complementary seat 22, which is arranged on the movable body 10, so that the rotation of the bracket 23 can produce engagement and disengagement. The means for engaging the movable body 10 furthermore includes the piston 24, which can move vertically, so as to raise the bracket 23 on engagement, and then lower the bracket 23 so as to draw the movable body 10 against the top 25 of the piston 20. In practice, therefore, the bracket 23 and the piston 24 allow to rigidly couple the movable body 10 to the piston 20, so as to maintain coupling during all the pressing operations and during all the movements of the movable body 10 for loading the molds and extracting the finished part. The rotation of the bracket 23 in order to disengage it from the seat 22 is performed only when it is necessary to change the molds, releasing the movable body 10 and therefore also the strike plate 13.

[0021] The movement of the central cylinder/piston 19, 20 is provided by means of the liquid delivered by means of a proportional valve 35, which is regulated according to a signal which is emitted by a position sensor arranged so as to be able to detect the depth of the lower mold.

[0022] Each one of the rods 15 engages the movable body 10 by means of a simple contact articulation 27, preferably of the ball type, so as to maintain the possibility of oscillations between the plane of the movable body 10 and the axis of each rod 15.

[0023] Remotely control adjust means 28, 29 are provided to adjust the vertical position each one of said rods 15. Particularly a rod 15 is supported by the supporting member 17 by means of the adjust means 28, 29. Preferably the adjust means 28, 29 comprise a cylinder 28 and piston 29 assembly which has a far shorter stroke than central piston 19, 20. While the stroke 31 of the central piston 20 is meant to lift the movable body 10, the stroke 30 of the cylinder and piston assembly 28, 29 is simply meant to allow each rod 15 to rest perfectly against the articulation 27 supported by the movable body 10. This compensates for any production defects or tolerances or deformations that can occur during production or appear later on, during the operation of the movable parts and of the couplings, due to wear. Each cylinder and piston assembly 28, 29 is provided with a flow control means which is suitable to prevent the escape of liquid. The flow control means is formed by the logic devices 33, which are driven so as to close by the line 34, so that each logic device 33 can feed a single cylinder and piston chamber 28 and 29.

[0024] Safety valves 38 and 41, a control 39 of the vertical movement of the bracket 23 and a control 40 of the rotary motion of the bracket 23 are furthermore provided. The valve 42 is a pressure limiting valve which is set so as to avoid exceeding the maximum pressure set in the high-pressure circuit. The low-pressure pump 36 supplies the auxiliary circuit, while the high-pressure pump 43 feeds the main circuit which also provides pressing.

[0025] According to the present invention, it is therefore possible to simplify and improve the operating conditions of the vertical movement means that vary the depth of the lower mold, furthermore allowing automatic engagement/disengagement of the vertical movement member with respect to the lower mold, so as to able to rapidly replace the mold with manual or automatic operations.

[0026] According to another advantage of the present invention, it is possible to simplify the actuation of the vertical movement means 18, fully eliminating the flow divider used according to the known art. The vertical movement of the vertical movement member is in fact provided by a central piston 20 which is rigidly coupled to the lower plate 17. In this manner, the lateral cylinder and piston assemblies 28, 29, which have a short stroke (limited to a few millimeters) are moved vertically, together with the rods 15, maintaining a constant orientation of the movable body 10 and its full support, without requiring a flow divider.

[0027] With respect to the known art described in European patent no. 0547305, in which the movable body for supporting the bottom of the lower mold is pushed vertically only by the four lateral cylinder and piston assemblies, according to the present invention the movable body 10 for supporting the bottom of the lower mold 11 is pushed vertically by the four lateral cylinder and piston assemblies 28, 29 and by the central cylinder and piston assembly 19, 20, thus preventing the central flexing of the movable body 10, which is generated, due to the resistance to upward vertical movement of the movable body, without the presence of an upward central thrust.

[0028] With the present invention, the four lateral cylinder and piston assemblies make the rods 15 rest on the movable body 10, thus producing only the thrust for upward vertical movement during the extraction of the molded part. The movable body 10 can move vertically downward by means of the central piston 20 by virtue of which the movable body 10 is rigidly fixed.

[0029] The simple contact coupling with the movable body is always ensured by virtue of the short stroke of the four lateral cylinder and piston assemblies 28, 29; by means of this stroke it is in fact possible to recover any small geometry errors/elastic yielding of the movable body 10 and eliminate any possible influence on the vertical direction of the thrust provided by the four lateral cylinder and piston assemblies 28, 29 and therefore provide them with optimum operating conditions, i.e., without the movable body 10 applying thereto mechanical torques which, by elastically deforming the four lateral cylinder and piston assemblies 28, 29, can reduce the life of the guides and of the gaskets of the lateral cylinder and piston assemblies 28 and 29 and can introduce consequent resistances to vertical movement. The stroke required by each one of the four lateral cylinder and piston assemblies 28, 29 in order to achieve simple contact without thrusting against the movable body is achieved by feeding liquid, with a maximum attainable pressure of no more than 10 bar, by means of the fixed-displacement pump 36, which is driven by a constant-speed electric motor.

[0030] The liquid dispensed by the pump 36, by passing through a cartridge-type logic device 33 for each one of the four lateral cylinder and piston assemblies, reaches the lower chamber 30 of the lateral cylinder and piston assemblies 28 and 29 and pushes the pistons and therefore the rods 15 so as to rest against the movable body 10. In order to prevent the escape of liquid from the lower chambers 30 during mold extraction, provided by means of the central cylinder and piston assembly 19, 20 and by virtue of the movement of the central cylinder and piston assembly 19 and 20 transmitted to the four lateral cylinder and piston assemblies 28, 29 by virtue of the lower plate 17, the cartridges of the four logic devices 33 are kept closed by virtue of the intervention of a suitable electric valve 37 which, when actuated, allows to feed liquid from the main circuit with a maximum pressure of 150 bar to the upper part of the cartridges of the four logic devices 33. The invention furthermore allows automatic engagement/release of the vertical movement means 18 with respect to the lower mold and in particular with respect to the movable body 10. More specifically, the engagement means 22 and 23 allows, on command, to rigidly engage or release the movable body 10 that supports the bottom of the lower mold with respect to the central piston 20.

[0031] Once the mold has been disengaged from the piston 20, it is possible for example to lift the mold, after interposing suitable shims between the lower movable body 10 and the template 12 of the mold, by virtue of the vertical movement of the rods 15 actuated by the central piston 20, which in turn provides a further fifth central thrust point. At this point it is possible to interpose, between the bed plate 14 and the strike plate 13, a means for supporting the mold 11 and to retract downward the vertical movement means 20, thus allowing the horizontal movement of the mold 11 from the inside of the press in an outward direction.

Claims

1. A device for pressing a material in granular or powder form, which comprises: a bed plate (14)fixed to the frame of the device; a movable body (10), which is arranged above said bed plate in order to support a lower mold (11); a plurality of vertical rods (15) which engage said movable body from below; a supporting member (17) for supporting said multiple vertical rods; a movement member (19, 20) for vertically moving said supporting member and therefore simultaneously moving said plurality of vertical rods and said movable body; remotely control adjust means (28, 29) to adjust the vertical position of at least one of said rods with respect to said sup-

porting member.

2. The device according to claim 1, wherein said movement member (19, 20) is accommodated inside said bed plate (14).

3. The device according to at least one of the preceding claims, wherein said movement member comprises a cylinder(19) which is preferably rigidly coupled to said bed plate (14) and a central piston (20), preferably of the double-acting type, which is preferably rigidly coupled to said supporting member (17).

4. The device according to claim 3, wherein said central piston (20) centrally supports said movable body (10) during the vertical movement of said movable body.

5. The device according to claim 3 or 4, wherein said piston (20)supports an engagement means (21, 22) which is suitable to engage and disengage said movable body (10).

6. The device according to claim 5, wherein said engagement means comprises an additional piston (24) which can move vertical and a rotating bracket (23) which is suitable to engage and disengage a complementary seat formed in said movable body.

7. The device according to at least one of the preceding claims, wherein each one of said rods (15)engages said movable body (10) by means of a preferably spherical articulation.

8. The device according to at least one of the preceding claims, wherein each one of said rods (15) is supported by said supporting member by means of said adjust means (28, 29).

9. The device according to claim 8 in which said adjust means comprise a cylinder (28) and piston (29) assembly which has a far shorter stroke than said central piston (20).

10. The device according to claim 9, wherein each one of said cylinder and piston assemblies (28, 29) is provided with a flow control means (33)which allows to prevent the escape of liquid, said flow control means being preferably formed by a dedicated logic valve device.

11. A method for the dry pressing of a material in granular or powder form with a device of the type that comprises: a bed plate fixed on the structure of the device; a movable body for supporting a lower mold which is arranged above said bed plate; a plurality of vertical rods which engage said movable body from below; a supporting member for supporting said plurality of vertical rods; a movement member for vertically moving said supporting member and therefore simultaneously moving said plurality of vertical rods and said movable body; a cylinder and piston assembly, for supporting each one of said rods; a flow control means, suitable to prevent the escape of liquid from cylinder and piston assembly; said method comprising: the supply of liquid at low pressure to said cylinder and piston assemblies, so that said rods engage said movable body; the closure of said flow control means in order to prevent the escape of said liquid; and the actuation of said movement member in order to lift said movable body.

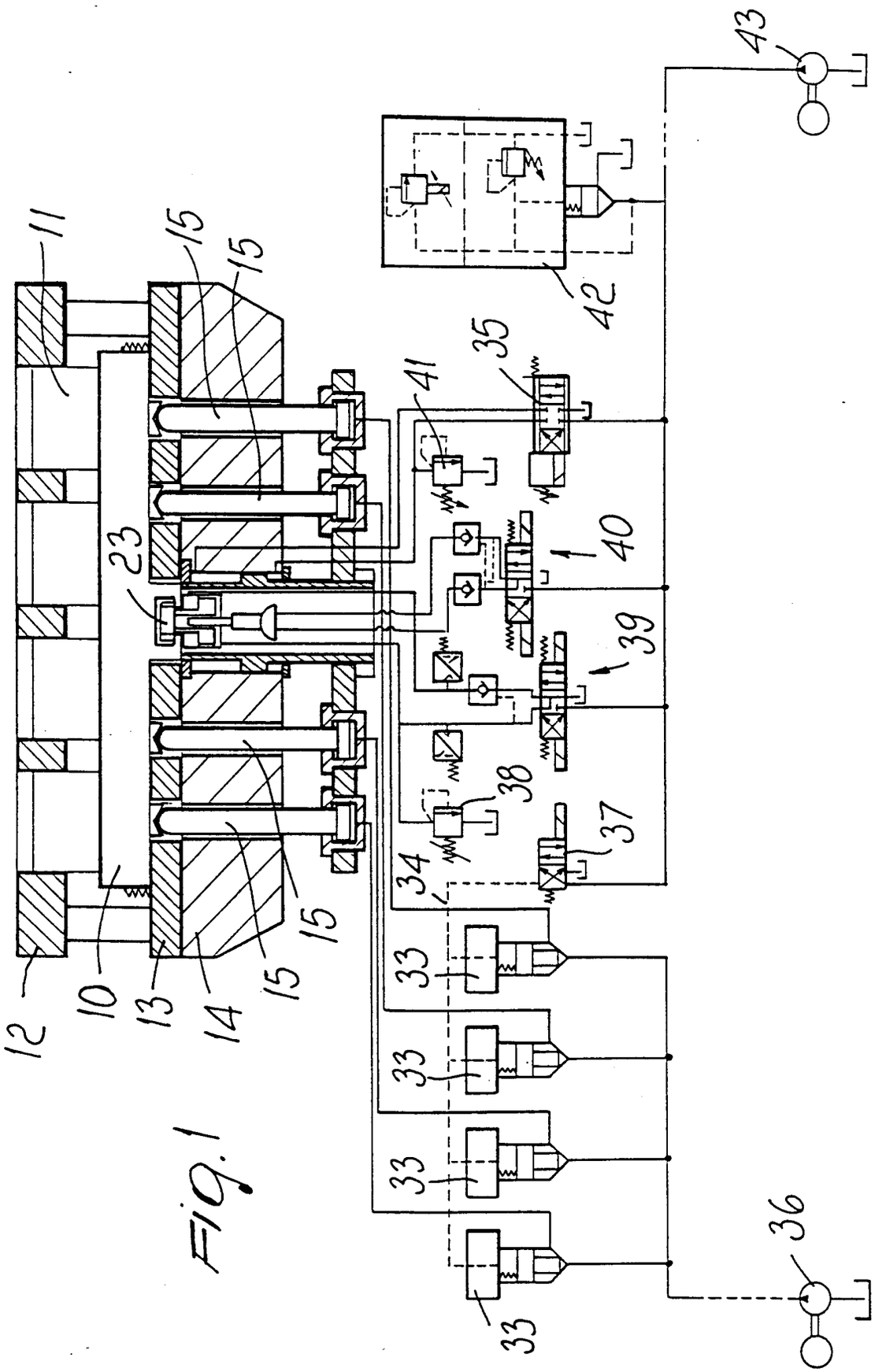

Fig. 1

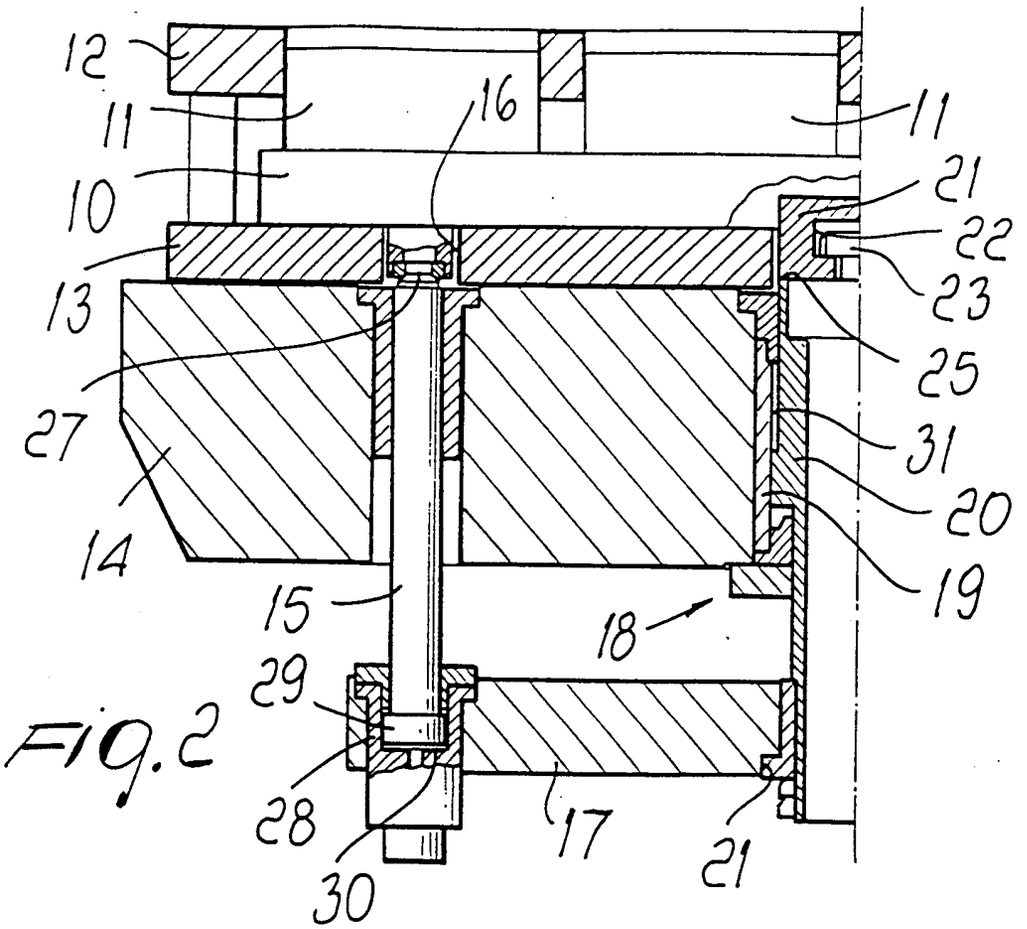
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FIG. 2

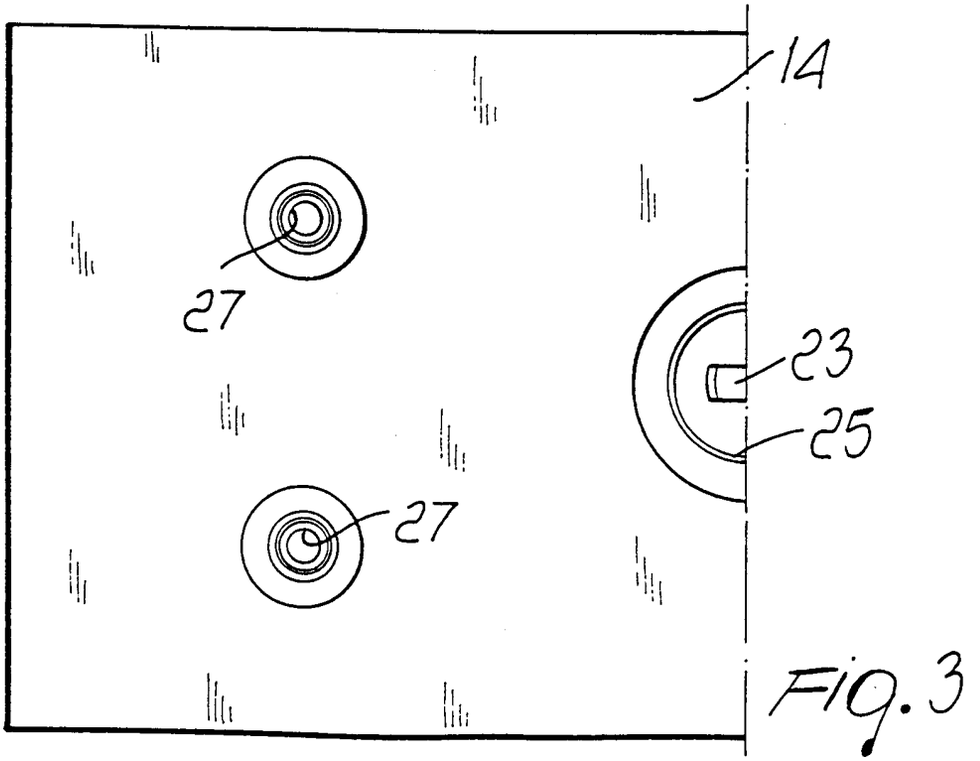
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FIG. 3

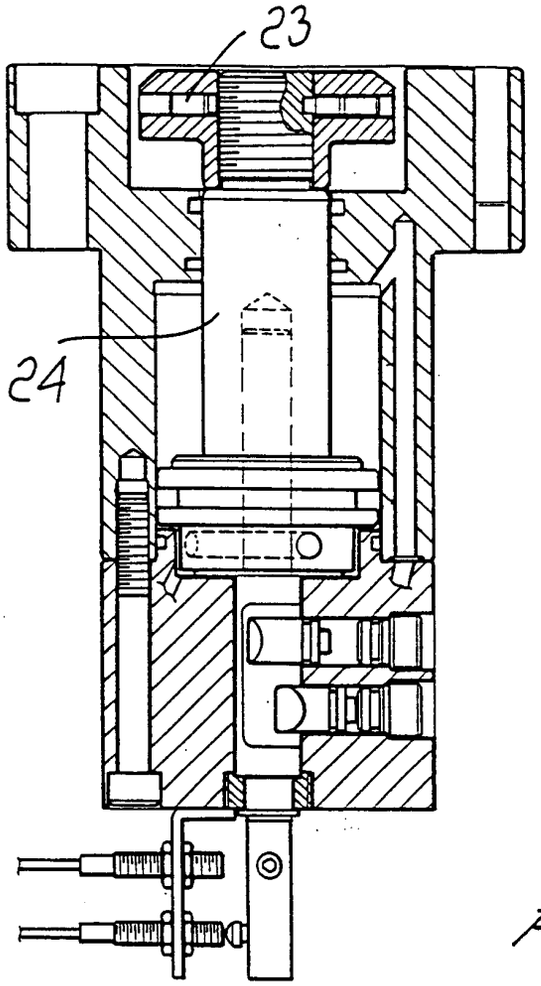

Fig. 4

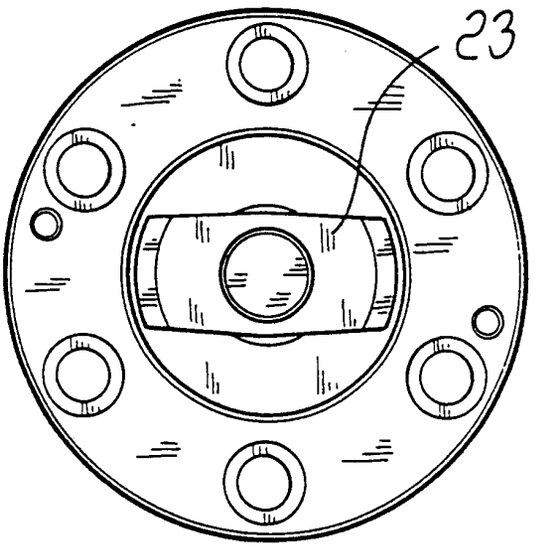

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 12 3943

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	20 February 2001	Belibel, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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