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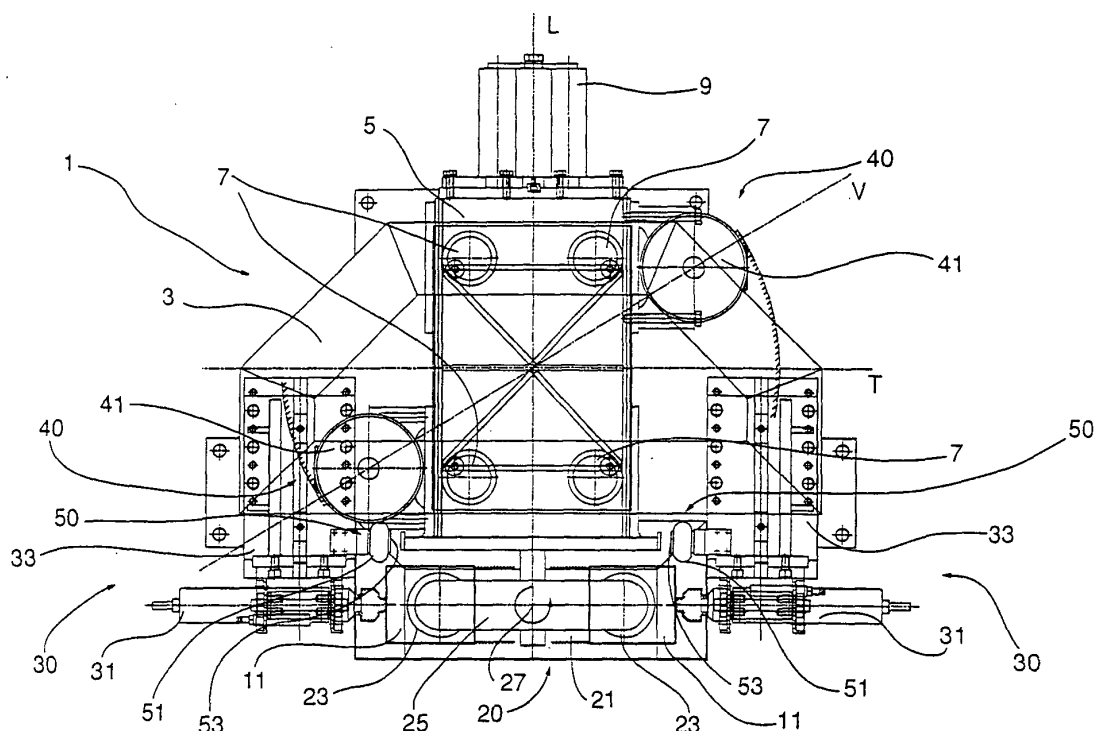
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(54) **A device for removing cores from foundry castings**

(57) The device (1) according to the invention allows to remove the cores from the foundry castings (11) by means of a hammering process and successive vibration. The particular arrangement of the vibrators (41), characterised by the fact that the plane (V) specified by the symmetry axes of said vibrators (41) forms with the median planes (L, T) of the chassis (5), to which the

foundry casting (11) is fixed, angles ( $\alpha$ ,  $\beta$ ) not null and different from  $90^\circ$ , guarantees that the vibratory movement is effectively transmitted to the foundry castings (11). The device (1) is further characterised by the presence of an additional blocking system (50) allowing to block the vibratory movement of the foundry casting (11) when this movement protracts after that the vibrators (41) have stopped.



**Fig. 1**

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## Description

**[0001]** The present invention refers to a device for removing cores from foundry castings.

**[0002]** As it is known, the hollow parts of a foundry casting are usually obtained having recourse to some cores made of sand. Said cores have a shape complementary to the shape of the cavity to be obtained and the molten metal is cast around said cores.

**[0003]** Once the foundry casting has cooled, it is necessary to separate it from the cores, and the more complex the shape of the foundry casting is, the harder is the removal of the sand.

**[0004]** According to the prior art, the cores are removed by blocking the foundry casting on a support and subjecting it to a hammering process and to a successive vibration process. By striking the foundry casting with a system constituted by hammers, the separation of the sand from the metal and a partial crushing of the core are obtained. The separation of the core fragments from the casting is completed by subjecting the casting itself to a vibratory movement so that the sand can be removed by force of gravity.

**[0005]** Said technique has been already widely developed in the past and various devices exist carrying out the removal of the cores by means of hammering and vibration processes.

**[0006]** In particular, the European patent EP 0,652,063 describes a device constituted by:

- a rigid chassis on which the foundry casting is blocked, said chassis being anchored to a fixed support by means of a plurality of elastically deformable joints;
- a system for blocking the foundry casting, said system making the casting itself totally integral with said chassis;
- a hammering system constituted by a plurality of pneumatic hammers arranged sideways to said chassis and on a plane perpendicular to it;
- a vibration system constituted by two vibrators arranged at the sides of said chassis, the symmetry axes of said chassis being perpendicular to the plane of the chassis itself.

**[0007]** The foundry casting is fixed to the rigid chassis thanks to the blocking system. Said blocking system is generally formed by a fixed element and by a mobile element gripping the foundry casting against the fixed element.

**[0008]** Once the casting has been blocked, it is subjected to the action of one or more pneumatic hammers striking the surface of said casting in order to lead to the separation of the core from the casting and to a partial crushing of the core.

**[0009]** The hammering phase is followed by the vibration phase. One or more vibrators are operated for transmitting a vibratory movement to the rigid chassis to

which the casting is fixed. The vibration of the chassis is permitted thanks to the fact that the joints connecting the chassis to the fixed support are elastically deformable. The vibratory movement allows to remove the core from the casting and to let escape the sand by gravity.

**[0010]** The above mentioned technique has been widely developed in the past. However, the today's required performance is very high and the mass tolerance of sand present in the casting at the end of the process is very rigid (some grams, also for complex foundry castings and of considerable size). Not all currently used devices are able to answer to these needs.

**[0011]** The main problems connected with the described process are bound to the vibration phase.

**[0012]** According to the prior art, the vibration of the foundry casting can be realised through the action of one or more vibrators integral with the support on which the casting is fixed and able to lead to a vibratory movement in said support. Usually, it is not made use of a single vibrator but of two vibrators or of a multiple of two. The vibratory movement of said devices can not turn into an effective vibration of the casting, as the different vibrators can interfere between them, so that their contributions dampen the vibratory movement of the foundry casting instead of increasing it.

**[0013]** A first object of the present invention is that of realising a device in which the vibration system is able to lead to an effective vibratory movement of the foundry casting in order to guarantee a high performance.

**[0014]** A further problem connected with the vibration phase is represented by the risk that the vibration of the foundry casting protracts too long after the end of the sand removal process, thereby preventing the operator to free immediately the casting from the support to which it is fixed and leading in this way to delays in the production line.

**[0015]** A second object of the present invention is that of realising a device able to overcome this drawback, so as to minimise the dead times of the process.

**[0016]** The above and other objects of the invention are obtained by means of a device for removing the cores in sand from the foundry castings as defined in the hereby attached claims.

**[0017]** The invention differentiates itself from the device described in the patent EP 0,652,063 and from other known devices, as it proposes a different arrangement of the elements of the vibration system.

**[0018]** In many known devices, the symmetry axes of the vibrators lie on one of the symmetry planes of the device section that is intended to vibrate. In other known devices, the plane specified by the symmetry axes of the vibrators is parallel to one of said symmetry planes.

**[0019]** On the contrary, the device according to the invention has recourse to two vibrators so arranged that the plane specified by the symmetry axes of said vibrators passes through the geometric centre of the above mentioned chassis and is inclined with respect to the symmetry planes of said chassis of an angle not null and

different from 90°.

**[0020]** This expedient makes it possible that the vibration of the two vibrators is effectively transmitted to the chassis and, as a consequence, to the foundry casting integral with said chassis. Therefore, when removing the core from the casting, a high performance of the device is assured.

**[0021]** In the known devices, the vibration is generally produced by vibrators of mechanical type incorporating a rod-crank system.

**[0022]** Advantageously, the device according to the invention has recourse to some electric motovibrators and this expedient allows to considerably reduce the dimensions of the device.

**[0023]** Besides, the device according to the invention is characterised by the presence of an additional blocking system integral with the support fixed to the ground.

**[0024]** In case the chassis, and the foundry casting with it, continues to vibrate also after that the core removal process has ended, the additional blocking system can intervene for blocking the vibratory movement and for allowing the operator to free immediately the foundry casting and for proceeding with the treatment of the successive casting.

**[0025]** In this way, it is possible to optimise the process time and to increase the number of castings treated in a given time interval.

**[0026]** An example of realisation of the present invention will be better described with reference to the hereby attached drawings, wherein:

- Figure 1 represents a plan view of the device according to a preferred embodiment of the invention;
- Figure 2 is a front view of the device shown in Figure 1;
- Figure 3 is a plan view of the device according to a variant of realisation of the invention;
- Figure 4 is a front view of the device shown in Figure 3.

**[0027]** With reference to the Figures 1 and 2, it is shown a device, indicated on the whole with the reference number 1, according to a first embodiment of the invention.

**[0028]** A rigid chassis 5, having a rectangular section, is mounted on a fixed base 3 bolted to the ground. The chassis 5 is connected with the fixed base 3 by means of four elastically deformable joints 7. In the shown embodiment, the joints 7 are made of an elastically deformable plastic material.

**[0029]** The device further incorporates a system 20 for blocking the foundry castings 11, a system 30 for hammering the castings 11, a system 40 for vibrating the castings 11 and, finally, a system 50 for rapidly blocking the castings 11 at the end of the core removal process.

**[0030]** The blocking system 20, mounted at an end of the chassis 5, can grip two foundry castings 11 at the

same time by acting vertically down from above. The blocking system 20 comprises a fixed part or base 21, and a mobile part or plates 24, said parts being mounted at the ends of a rotary arm 25 and being operated by two pneumatic actuators 23 arranged between the arm 25 and the plates 24. The arm 25 can rotate around the shaft 27 of 90° in order to spread apart the plates 24 and to allow the loading of the foundry castings 11 on the base 21. Once the foundry castings 11 have been loaded, the arm 25 is made to rotate so that the plates 24 are aligned with the base 21. The pneumatic actuators 23 are then expanded for bringing the plates 24 in engagement with the castings 11, so as to press them firmly against the base 21, one of the actuators being on the right and the other one on the left of the rotary shaft 27.

**[0031]** Advantageously, the pneumatic actuators 23 can be inflated and deflated by introducing air or sucking it back. Said actuators 23 can be connected, according to the needs, at the inlet or at the outlet of a compressed air pump, not shown in the Figure. When the foundry castings 11 must be blocked, the actuators 23 are connected to the pump outlet and then are inflated: in this way, the actuators can push the plates 24 on the castings 11 for keeping them pressed against the base 21. When, after that the sand has been removed, the foundry castings 11 must be released, the actuators 23 are deflated by acting on a by-pass valve connecting them to the pump inlet. In this way, the air present in the actuator chamber is rapidly sucked back, thereby allowing to free the castings 11.

**[0032]** A counterweight 9, compensating the weight of the foundry castings 11 and maintaining the chassis 5 in balance, is present at the opposite end of the chassis 5 with respect to the blocking system 20.

**[0033]** The presence of said counterweight 9 is peculiar to the described embodiment. In other embodiments, it will be possible for instance to insert, instead of the counterweight 9, a second blocking system, symmetric with respect to the blocking system 20, so that it is possible to proceed simultaneously with the core removal from four foundry castings, instead of removing the core from two castings only.

**[0034]** The hammering system 30 is constituted by four pneumatic hammers 31, two on the right side and two on the left side with respect to the blocking system 20. The hammers 31 are oriented towards the foundry castings 11 and are mounted on supports 33 in order to be aligned on a plane perpendicular to the plane of the chassis 5. Being the supports 33 fixed to the base 3, which is in turn fixed to the ground, and being said supports 33 independent from the chassis 5, the hammers 31 will not be subjected to vibrations during the vibration phase.

**[0035]** The vibration device 40 is constituted by two vibrators 41, arranged at two opposed sides of the chassis 5, that, when operated, lead to a vibratory movement in said chassis 5.

[0036] In the described embodiment, use is made of two electric monovibrators for reducing the dimensions of the device, compared to the traditional devices using mechanisms of the rod-crank type.

[0037] It should be noted that, given the geometry of the chassis 5, it is possible to define a longitudinal symmetry plane L and a transversal median plane T, that can be considered a symmetry plane provided that the counterweight 9 is considered equivalent to the blocking system 20.

[0038] If the plane specified by the two vertical symmetry axes of the two motovibrators 41 is indicated with V, it is clear that the plane V passes through the centre of the chassis 5 and forms with the symmetry planes L and T an angle  $\alpha$  and an angle  $\beta$  respectively, both not null and different from  $90^\circ$ , preferably approximately  $45^\circ$ .

[0039] This angular position, peculiar to the device according to the invention, ensures an effective transmission of the vibratory movement from the two motovibrators 41 to the chassis 5. In this way, high performance in removing the sand from the foundry castings 11 is guaranteed.

[0040] Another characteristic of the device is the presence of an additional blocking system 50. Said system is constituted by two pneumatic actuators 51, the operation of which is similar to that of the pneumatic actuators 23 and on which some plates 53 are mounted. The actuators 51 are mounted on the fixed support 3 and are not integral with the chassis 5. As a consequence, they are not subjected to vibrations during the vibration phase of the foundry castings 11.

[0041] In case the vibration of the chassis 5 protracts beyond the end of the core removal process or, in any case, for blocking the vibrations in a more rapid way, it is possible to let the blocking system 50 intervene: the actuators 51 push the plates 53 against the foundry castings 11 and stop the vibratory movement of said castings.

[0042] It is also possible to insert a timer, connected with the motovibrators 41, that automatically activates the actuators 51 after a predetermined time interval starting when the motovibrators 41 have stopped.

[0043] The Figures 3 and 4 show a second embodiment of the invention differentiating itself from the embodiment that has been described until now for the blocking system that will be indicated in this embodiment with the reference 20'.

[0044] In the embodiment of the Figures 3 and 4 (from which the additional blocking system 50 has been left out for sake of simplicity), the blocking system 20' is arranged for blocking the foundry castings 11 sideways instead of blocking them in their upper part. The plates 24a, 24b, operated by the pneumatic actuators 23a, 23b, constitute the mobile part of the blocking system 20'. The pneumatic actuators 23a, 23b operate according to the same mechanism of the pneumatic actuators 23 of the above described embodiment. Concerning the

fixed part of the blocking system 20', the wall 13 of the chassis 5 presents some slots 15: in said slots 15 are fixed some matching elements against which the actuators 23a, 23b push the foundry castings 11 to be treated. Said matching elements may be chosen and positioned every time according to the needs, in order to adapt them to the shape of the castings 11 from which the core must be removed.

[0045] Since the blocking occurs sideways, it is necessary to use a pair of plates 24a for the upper part of the castings 11 and a pair of plates 24b for their lower part for assuring an effective blocking.

[0046] Also thanks to the possibility of using different matching elements according to the foundry castings that must be treated, the lateral blocking may turn out to be more versatile and more adapted to castings of very different shape between them with respect to the vertical blocking.

## Claims

1. Device (1) for removing the cores from the foundry castings (11), said device comprising:

- a rigid chassis (5) anchored to a fixed support (3) by means of a plurality of elastically deformable joints (7);
- a blocking system (20) for fixing the foundry casting (11) to the rigid chassis (5);
- a system (30) for hammering the foundry casting (11);
- a vibration system (40) leading to a vibratory movement in the chassis (5) to which the foundry casting (11) is fixed, **characterised by** the fact that the vibration system (40) comprises two vibrators (41) so arranged that the plane (V) specified by the symmetry axes of said vibrators (41) forms with the median planes (L, T) of the chassis (5), to which the foundry casting (11) is fixed, angles ( $\alpha$ ,  $\beta$ ) not null and different from  $90^\circ$ .

2. Device (1) according to claim 1, wherein the plane (V) specified by the symmetry axes of said vibrators (41) passes through the centre of the chassis (5).

3. Device (1) according to claim 1 or 2, wherein said angles ( $\alpha$ ,  $\beta$ ) are preferably of approximately  $45^\circ$ .

4. Device (1) according to claim 1 or 2 or 3, **characterised by** the fact that said chassis (5) has a substantially rectangular shape and comprises a counterweight (9) mounted at the opposite end with respect to the blocking system (20).

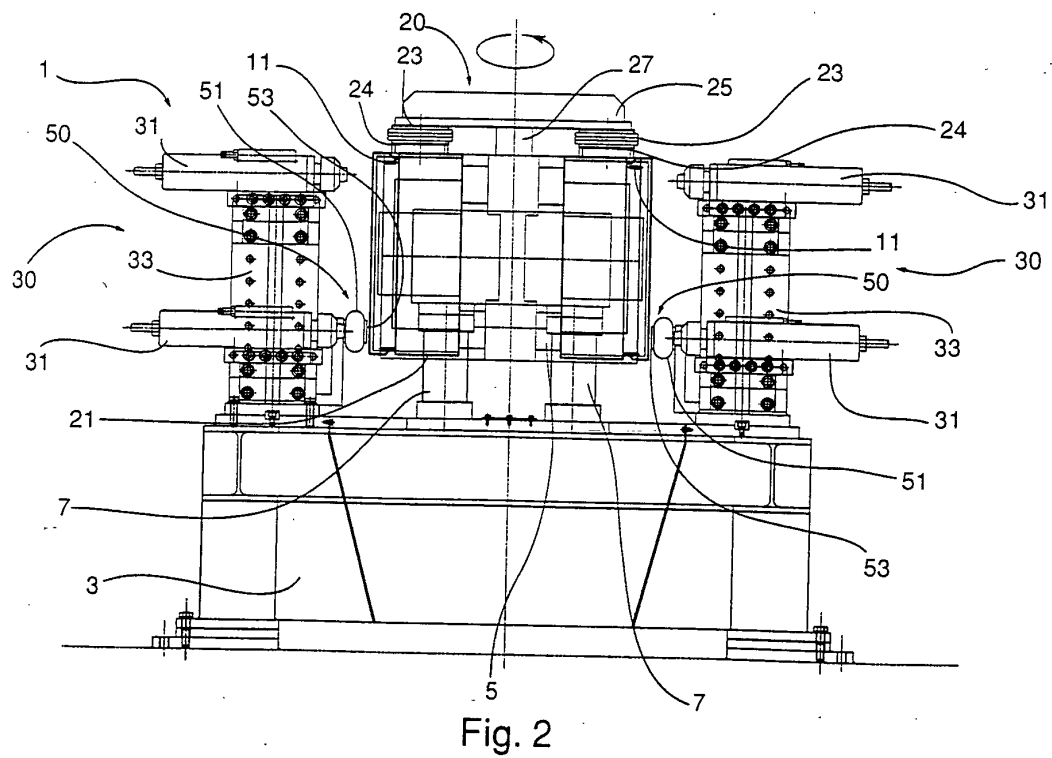
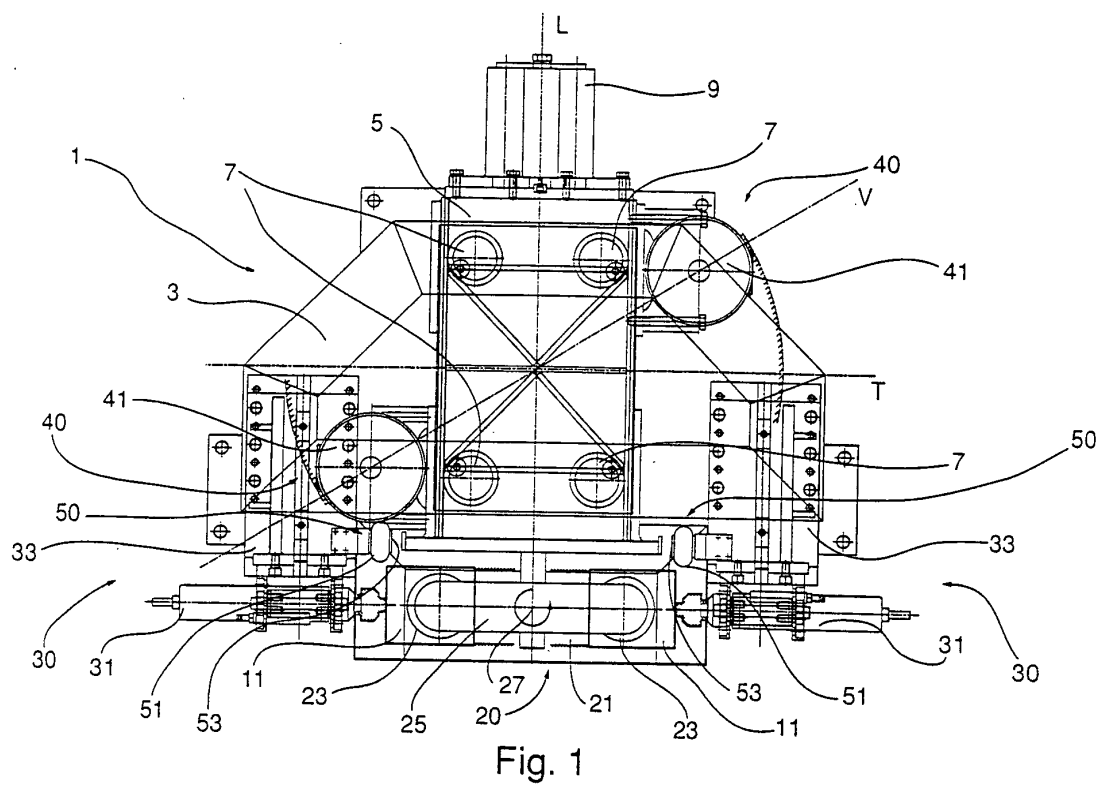
5. Device (1) according to claim 1 or 2 or 3, **characterised by** the fact that the blocking system (20) is

constituted by a fixed element and by a mobile element pushing the foundry casting (11) against the fixed element.

6. Device (1) according to claim 5, **characterised by** the fact that the mobile element of the blocking system (20) is constituted by one or more actuators (23) each of said actuators operating a plate (24). 5
7. Device (1) according to claim 6, **characterised by** the fact that the plates (24) are arranged above the foundry castings (11) and, thanks to the actuators (23), can block said castings (11) pushing them vertically down from above against a horizontal fixed element (21) of the blocking system (20). 10 15
8. Device (1) according to claim 6, **characterised by** the fact that the actuators (23) are mounted on an arm (25) that can rotate around a shaft (27) for making the operations of load and unload of the foundry castings (11) easier. 20
9. Device (1) according to claim 6, **characterised by** the fact that said plates (24a, 24b) are arranged sideways to the foundry castings (11) and, thanks to the actuators (23a, 23b), can block said castings by pushing them sideways against a vertical fixed element. 25
10. Device (1) according to claim 9, **characterised by** the fact that said vertical fixed element is constituted by at least a matching element fixed to a vertical wall (13) of the rigid chassis (5), being it possible to move or replace said matching element every time according to the shape of the foundry casting (11) to be held. 30 35
11. Device (1) according to claim 1 or 2 or 3, **characterised by** the fact that the vibrators (41) constituting the vibration system (40) are electric motovibrators. 40
12. Device (1), according to claim 1 or 2 or 3, **characterised by** the fact of further comprising an additional blocking system (50) allowing to block the vibratory movement of the foundry casting (11), when said movement protracts after that the vibrators (41) have been stopped. 45
13. Device (1) according to claim 12, **characterised by** the fact that said additional blocking system (50) is constituted by at least a pneumatic actuator (51) for each foundry casting (11) fixed on the chassis (5) and by a plate (53) that is pushed, if need be, by said at least an actuator (51) against the corresponding foundry casting (11). 50 55
14. Device (1) according to claim 12, **characterised by**

the fact that the additional blocking system (50) is driven by a timer connected with the vibration system (40), said timer letting said blocking system (50) go into action after a predetermined time interval starting from when the vibrators (41) have stopped.

15. Device (1) according to claim 6 or 13, **characterised by** the fact that said actuators (23, 51) are pneumatic actuators.
16. Device (1) according to claim 14, **characterised by** the fact that said actuators (23, 51) can be inflated and deflated by putting them into communication with the inlet and the outlet of a same air compressed pump respectively.



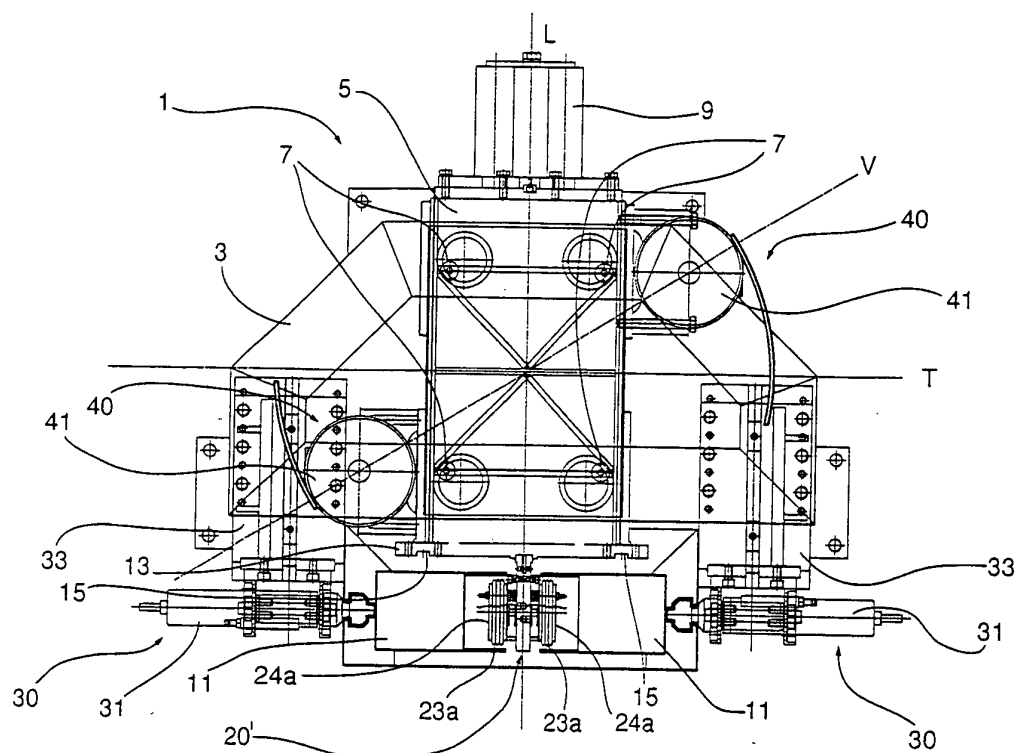


Fig. 3

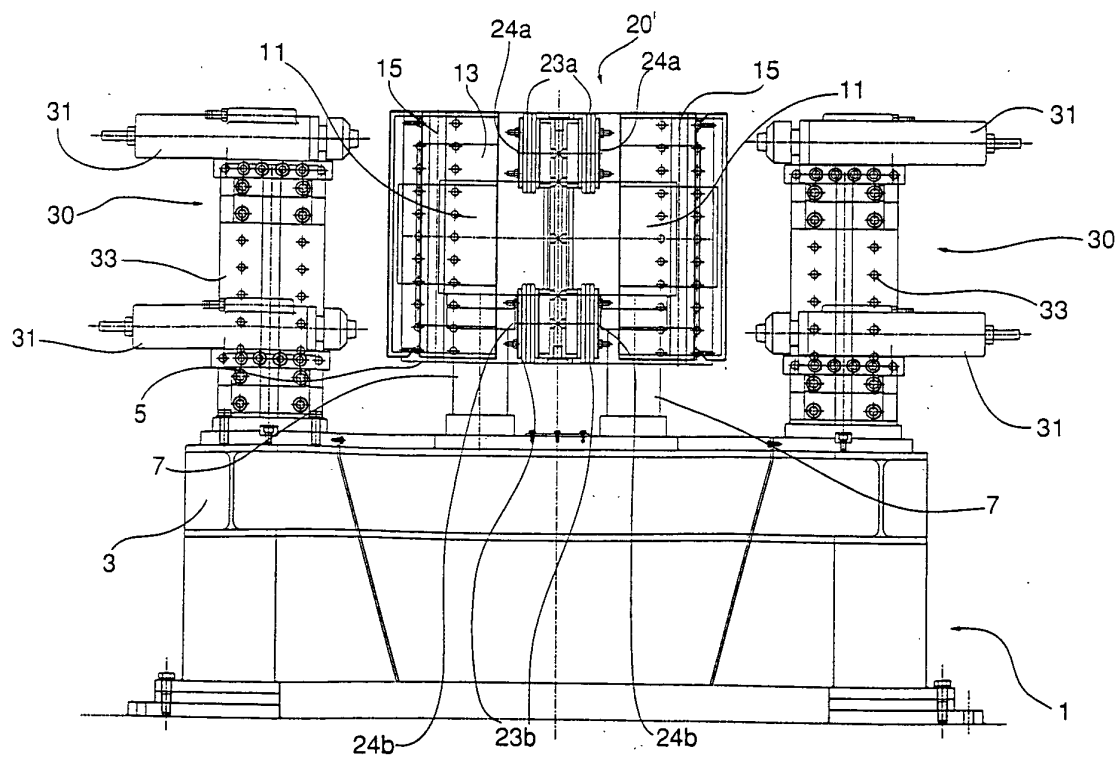


Fig. 4