A post-withdrawing device for at least one post (7a, 7b, 7c, 7d) of a molding machine (1) having a fixed clamping plate (2) with a first casting-mold half (3) arranged thereon and a movable clamping plate (4) with a second casting-mold half (5) arranged thereon. The movable clamping plate can be moved on posts detachably fastened in the fixed clamping plate. The post-withdrawing device is characterized in that the post-withdrawing device has the following units: a fastening device (10a, 10b, 10c, 10d) arranged on the movable clamping plate, for detachably connecting to a post and a further fastening device (15a, 15b) for detachably connecting to a post, which is arranged on a bar (11a, 11b), which is located on the side of the movable clamping plate facing away from the fixed clamping plate. A molding machine and method for extracting a post from such a molding machine are also disclosed.
TIE BAR WITHDRAWING DEVICE

[0001] This application is a National Stage completion of PCT/EP2014/052448 filed Feb. 7, 2014, which claims priority from European patent application serial no. 13164162.3 filed Apr. 17, 2013.

FIELD OF THE INVENTION

[0002] The present invention relates to a tie bar withdrawing device, in particular for a die casting machine, and to a method for withdrawing tie bars, in particular from a die casting machine.

BACKGROUND OF THE INVENTION

[0003] Die casting machines are used for the production of metal cast parts, for example engine blocks. For example, WO 2008/131571 A1 describes a horizontal two-plate die casting machine. This two-plate die casting machine comprises a movable die plate (BAP) and a fixed die plate (FAP) on each of which a casting-mold half is arranged. By moving the movable die plate, the die casting mold can be opened and closed. In the closed position, the two die plates are pressed firmly together such that the two casting-mold halves form a closed mold. A metal melt is introduced under pressure into the closed mold and is cooled, solidifying. The solidified cast part can be removed once the mold has been opened (by moving the movable die plate). In the machine according to WO 2008/131571 A1, the movable die plate is moved via tie bars, preferably 4 tie bars.

[0004] In order to change the casting mold, it is sometimes necessary to withdraw one or more tie bars from the space between the movable die plate and the fixed die plate, so as to allow sufficient access to the casting molds or to allow casting molds to be removed or introduced.

[0005] WO 2008/131571 A1 proposes drawing the tie bars out of the space between the movable and fixed die plates with the aid of a tie bar withdrawing cylinder located on the movable die plate. During the withdrawal of the tie bar, in the closed state of the mold, the coupling connection of the tie bar to the fixed die plate is released, while it remains coupled to the movable die plate. By opening the mold, the tie bar is withdrawn via the movement of the movable die plate out of the fixed die plate, in order to fully withdraw the tie bar, the coupling connection thereof to the movable die plate is subsequently released, such that the tie bar is moved away from the movable die plate by an extension movement of the tie bar withdrawing cylinder coupled to the tie bars.

[0006] This solution has the drawback that, in the case of large die casting machines, the comparatively long tie bars are not supported well in the withdrawn state and tend to droop.

[0007] U.S. Pat. No. 7,604,037 B2 shows an analogous tie bar withdrawing unit; however, the tie bar withdrawing cylinder is not arranged on the movable die plate but on a frame behind the movable die plate. Tie bar drawing takes place entirely with the aid of the tie bar withdrawing cylinder. In this solution, the above-described drawbacks are amplified, since long tie bar withdrawing cylinders and long tie bars have to be used. As a further consequence, the space requirement for tie bar drawing increases.

[0008] In U.S. Pat. No. 7,824,167 B2, tie bar drawing is carried out simply by the movement of the movable die plate into the opening position. The movable die plate is moved with the aid of a complicated electric drive. Moreover, only a limited space between the fixed and movable die plates is accessible after tie bar drawing, since the tie bars are not drawn fully out of the space between the movable and fixed die plates.

[0009] JP-2007-331332 A describes a tie bar withdrawing mechanism for a two-plate die casting machine, in which the tie bar is not withdrawn in the opening direction of the movable die plate but in the opposite direction. In the withdrawn state, the tie bar is then located on that side of the fixed die plate that is remote from the movable die plate.

[0010] It is known, in the case of horizontal three-plate die casting machines, to use the fixedly installed rear plate for tie bar withdrawal. U.S. Pat. No. 4,285,384 describes a tie bar withdrawing mechanism in which one or more tie bars are withdrawn such that they are fixedly coupled to the movable die plate during the movement of the movable die plate into an opening position. Subsequently, the tie bar is fixedly coupled to the rear plate in the position thus reached, and decoupled from the movable die plate. The movable die plate is moved back into the closing position. Then, the tie bar is coupled to the movable die plate again and is decoupled from the rear plate, and the entire operation is repeated until the tie bar has been fully withdrawn. This mechanism is limited to three-plate die casting machines, since no rear plate which could be used for tie bar drawing is present in two-plate die casting machines.

SUMMARY OF THE INVENTION

[0011] It was the object of the present invention to provide a tie bar withdrawing device which overcomes the above-described drawbacks of the prior art.

[0012] According to the present invention, this object is achieved by a tie bar withdrawing device for at least one tie bar of a casting machine, in particular of a die casting machine, having a fixed die plate with a first casting-mold half arranged thereon and having a movable die plate with a second casting-mold half arranged thereon, wherein the movable die plate can be moved on tie bars that are fastened releasably in the fixed die plate, preferably four tie bars that are fastened releasably at the corners of the fixed die plate, characterized in that the tie bar withdrawing device has the following units:

[0013] a fastening device arranged on the movable die plate for releasable connection to a tie bar,

[0014] a further fastening device for releasable connection to a tie bar, said further fastening device being arranged on a rack which, is located on that side of the movable die plate that is remote from the fixed die plate.

[0015] According to the present invention, a casting machine is understood to be a machine for producing molded parts, in which material is brought into the desired shape in a given hollow mold. According to the invention, the casting machine is preferably a die casting machine. However, the present invention can also be used in other casting machines such as injection-molding machines.

[0016] According to the present invention, the term “arranged” should be understood as meaning that the corresponding component, for example a fastening device, is connected directly or indirectly to another component, for example the movable die plate.

[0017] The tie bar withdrawing device of the present invention does not have a tie bar withdrawing cylinder arranged on the movable die plate, as is shown for example in WO 2008/131571 A1. As a result, the weight of the movable die plate is considerably reduced; the casting machine can be opened and closed more dynamically.
The tie bar withdrawing device of the present invention is distinguished by the fact that a rack is arranged on that side of the movable die plate that is remote from the fixed die plate, the tie bar being guided into said rack during withdrawal. The rack has a fastening device for releasable connection to a tie bar, by way of which the tie bar can be fixed to the rack. The rack on the one hand complies with an essential objective in the tie bar withdrawing mechanism, of the present invention, as is explained below. On the other hand, the rack has a supporting function. The withdrawn tie bars are supported in the racks, with the result that the load on the clamping cylinders is reduced and drooping of the tie bars is reduced.

Compared with the solution described in U.S. Pat. No. 7,604,037 B2, shorter tie bars can be used in the present invention, with the result that the overall machine length is shortened, and the space requirement is reduced.

In the present invention, tie bar drawing takes place by a movement of the movable die plate, wherein, during this movement, the tie bar to be drawn is connected fixedly to the movable die plate via a fastening device. The tie bar is or is away from the region between the fixed and movable die plates until it has been introduced into the rack arranged behind the movable die plate. Subsequently, the tie bar is fixed to the rack via a fastening device and is released from the movable die plate. The movable die plate can be moved back in the closing direction and, after completing its movement, can be connected fixedly to the tie bar again via the fastening device. The fixing of the tie bar to the rack is released, and, as a result of the movable die plate being moved again in the direction of the rack, the tie bar is drawn to a further extent out of the region between the fixed and movable die plates. This method, which is denoted pilgrimage step method according to the invention, should be carried out often enough until the tie bar has been drawn to a predetermined extent out of the region between the fixed and movable die plates.

In a conventional die casting machine, the method according to the invention should usually be carried out two to three times, preferably three times, in succession in order to achieve sufficient tie bar withdrawal.

In a conventional die casting machine, the movable die plate is guided, over 4 tie bars which are arranged releasably at the corners of the fixed die plate and are guided through openings in the corners of the movable die plate. In order to achieve sufficient access to the region between the fixed and movable die plates, preferably at least two upper tie bars should be withdrawn. A preferred embodiment of the present invention relates to a casting machine and a method comprising the withdrawal of the two upper tie bars of the machine.

Casting machines and in particular die casting machines are well known and do not need to be described in detail here. An essential component of these machines is two casting-mold halves which together define the outer contours of the molded part to be produced. In each case one casting-mold half is located on a fixed die plate and on a movable die plate. By moving the movable die plate into the closing position, the two casting-mold halves are pressed firmly together and thus form a hollow mold.

According to the invention, the closing position is understood to be the maximum position of the movable die plate which the movable die plate can take up when moving in the direction of the fixed die plate before its further movement is prevented by the fixed die plate. According to the invention, the closing direction is understood to be a movement of the movable die plate in the direction of the fixed die plate.

Material for producing the desired molded body can be introduced into the hollow mold formed. In the die casting method, this material is molten metals or molten metal alloys which are pressed, under pressure through a casting duct into the mold with the aid of a casting cylinder. In order to avoid opening of the mold under these demanding conditions, the movable die plate is kept in its closing position with the aid of a closing cylinder and by clamping cylinders fastened to the tie bars. Once the material in the mold has solidified, the mold is opened by moving the movable die plate in the opening direction, and the finished molded part can be removed.

According to the invention, the opening direction is understood to mean a movement of the movable die plate in a direction away from the fixed die plate. According to the invention, the opening position is understood to be the maximum position of the movable die plate which the movable die plate can take up on account of its structure when it moves in a direction away from the fixed die plate.

The tie bars are releasably connected to the fixed die plate, as explained above. The requisite fastening device for releasable connection to a tie bar can be embodied in a known manner according to the invention by suitable connecting connections, as are described in the prior art. A two-part nut is mentioned by way of example, i.e. a nut having two separate halves which can be moved away from or toward the tie bar, for example by a hydraulic drive. In order to fix the tie bar in the fixed die plate, the two halves of the nut are pressed together, with the result that a form-fitting connection is formed within the nut formed in this way and the tie bar. Preferably, the fastening device for releasable connection to a tie bar is arranged at one corner of the fixed die plate on the side remote from the movable die plate. Particularly preferably, such a fastening device for releasable connection to a tie bar is arranged in each corner of the fixed die plate on the side remote from the movable die plate.

During normal casting operation of the casting machine according to the invention, the tie bars are connected fixedly to the fixed die plate by the above-described fastening device for releasable connection to a tie bar. It is only during the operation of tie bar drawing that this connection is released.

A further fastening device, described in detail below, for releasable connection to a tie bar is arranged, as a component of the tie bar withdrawing device according to the invention, on the movable die plate of the casting machine according to the invention, preferably at one corner on the side remote from the fixed die plate. Since, as explained above, the two upper tie bars for exchanging the mold are intended to be withdrawn from the region between the fixed and movable die plates in the case of a casting machine, such as a die casting machine, having four tie bars, such fastening devices for releasable connection to a tie bar are preferably arranged at least at the two upper corners of the movable die plate. However, it is of course possible to provide such fastening devices for releasable connection to a tie bar at all the corners of the movable die plate on the side remote from the fixed die plate, in order to make it possible to withdraw all the tie bars from the machine.

The fastening device, arranged on the movable die plate, for releasable connection to a tie bar of the tie bar withdrawing device can be realized in a manner known from
the prior art. Preference is given to a coupling by way of which optionally a form-fitting or force-fitting connection to the tie bar can be established.

[0031] Tie bars that are conventionally used in casting machines such as die casting machines have flutes in the section at which they come into contact with the movable die plate during normal casting operation of the machine. These flutes serve to establish a connection that is as firm as possible between the movable and tie bar. Enormous strains, under which the mold has to be kept reliably closed, occur, as described above, in particular during casting operation of a die casting machine. To this end, the fastening device arranged on the fastened die plate establishes a form-fitting coupling to the tie bar. Preferably, a two-part nut is used for this purpose, i.e. a nut having two separate halves which can be moved away from or toward the tie bar, for example by a hydraulic drive. The inner surfaces, which come into contact with the tie bar of the nut halves have flutes which can come into form-fitting contact in an interacting manner with the flutes on the tie bar surface. In other words, a form-fitting connection can be created in that an elevation between two flutes on the inner surface of the nut halves engages in a flute on the tie bar surface, and vice versa. In order to fix the tie bar in the movable die plate, the two halves of the nut are pressed together, with the result that the above-described form-fitting connection between the nut formed in this way and the tie bar is formed.

[0032] Of course, the form-fitting connection, between the tie bar and movable die plate can also be realized in some other known manner than by the above-described flutes. The above-described embodiment is preferred according to the invention, however.

[0033] During normal casting operation of the casting machine according to the invention, the movable die plate is moved on the tie bars in that the above-described form-fitting coupling is released, with the result that the movable die plate can be moved in the closing direction or opening direction with the aid of a conventional drive. In order to fix the movable die plate in a desired position, the above-described form-fitting coupling to the tie bar is established.

[0034] During tie bar withdrawing operation, described in detail below, of the casting machine according to the invention, first of all the above-described form-fitting connection between the tie bar and the movable die plate is established, the coupling of the tie bars to the fixed die plate is released and the movable die plate is moved out of the closing position in the opening direction. In a further step, as explained below, the tie bar is fixed in the rack of the tie bar withdrawing device, the coupling between the movable die plate and the tie bar is released and the movable die plate is moved back in the closing direction. In order to withdraw the tie bar further out of the region between the fixed and movable die plates, coupling takes place again between the movable die plate and the tie bar. However, in this method step, a form-fitting coupling between the movable die plate and the tie bar can no longer be realized as a rule, since the surface section, having flutes, of the tie bar is already located at a position away from the movable die plate. Therefore, in this method step, a force-fitting connection is preferably realized between the movable die plate and the tie bar in that the halves of the nut are pressed firmly with high application of force against a non-fluted surface section of the tie bar. This coupling is not as firm as the above-described form-fitting coupling, but is sufficient for the purpose of tie bar drawing.

[0035] An essential component of the tie bar withdrawing device according to the invention is a rack, which is arranged on that side of the movable die plate that is remote from the fixed die plate. The rack has a fastening device for releasable connection to a tie bar, which is arranged on the rack such that a tie bar to be drawn can be introduced into this fastening device during the withdrawing operation. Preferably, the fastening device for releasable connection to a tie bar is arranged at the head end of a rack of corresponding length. According to the invention, the rack can have any suitable configuration with which the functions described below are achieved. Preferably, the rack is a bar or a framework of a plurality of bars made of metal or a metal compound or alloy, for example steel. The rack is preferably anchored firmly to the ground, for example by way of a screw connection.

[0036] The rack is arranged at such a distance from the movable die plate that, during tie bar drawing, a tie bar decoupled from the fixed die plate can be introduced into the fastening device arranged on the rack by moving the movable die plate from the closing position in the opening direction. The rack thus has to be positioned in such a way with respect to the movable die plate that the tie bar to be drawn is introduced into the fastening device arranged on the rack while the movable die plate is in a position between the closing position and opening position. Particularly preferably, the rack is positioned such that the tie bar to be drawn is introduced into the fastening device arranged on the rack when the movable die plate is in the opening position. As a result, the movement of the movable die plate is used optimally for the operation of tie bar drawing.

[0037] The fastening device, arranged on the rack, for releasable connection to a tie bar is preferably configured such that it has a clamping cylinder that acts on the tie bar from above and a supporting cylinder that acts on the tie bar from below. The cylinders are preferably actuated hydraulically. By way of the clamping cylinder and supporting cylinder, fastening parts such as nut halves with a shape complementary to the tie bar surface can be pressed firmly against the tie bar surface. In order to couple the tie bar fixedly to the rack, the fastening parts are pressed firmly against the tie bar surface by simultaneous actuation of the clamping cylinder and supporting cylinder. However, it is also possible for the rack only to exert, a supporting function on the tie bar. In this case, only the supporting cylinder is actuated, and the fastening part connected to the supporting cylinder is pressed against the tie bar from below. The clamping cylinder is not actuated; a fixed coupling is not realized in this embodiment.

[0038] In the case, preferred according to the invention, of drawing the two upper tie bars of a casting machine having four tie bars which are fastened releasably at the corners of the fixed die plate, the casting machine according to the invention comprises two such racks, wherein in each case one rack is assigned to one of the upper tie bars. In many cases, however, it is sufficient to draw only one of the upper tie bars.

[0039] According to a preferred embodiment of the present invention, the two lower tie bars of the casting machine according to the invention, in particular die casting machine, are connected together via a crossbar. Such an embodiment is described for example in WO 2008/131571 A1 and in WO 2007/121134 A1. The advantage of this embodiment is that, as described in the prior art cited above, a closing cylinder can be fastened to the crossbar, the other end of said closing cylinder being connected to the rear side of the movable die
plate. As a result, the force to be applied during the closing of the mold can be distributed advantageously to the tie bars.

[0040] In this embodiment, it is possible to arrange the rack or the racks of the tie bar withdrawing device on this crossbar. The rack or the racks then have a correspondingly reduced length since they do not have to be guided down to the ground. The rack or the racks can be connected to the crossbar in a known manner.

[0041] In order to achieve greater stability of the machine, it is preferred in this embodiment for the crossbar to be supported on the ground by way of at least one supporting element, preferably two supporting elements. These can be two simple metal bars which are fixedly connected to the crossbar and the ground.

[0042] With the present invention, tie bars of a casting machine such as a die-casting machine can be withdrawn in an advantageous manner from the region between the fixed and movable die plates. The present invention thus also relates to a method for withdrawing at least one tie bar from a casting machine, in particular a die-casting machine, wherein the casting machine comprises a fixed die plate with a first casting-mold half arranged thereon and a movable die plate with a second casting-mold half arranged thereon, and the movable die plate is guided on tie bars that are fastened releasably in the fixed die plate, preferably 4 tie bars that are releasably fastened in the corners of the fixed die plate, comprising the steps of:

[0043] a) releasing the releasable fastener of the tie bar in the fixed die plate in a machine position in which the movable die plate is in the closing position,

[0044] b) fixing the tie bar to the movable die plate by closing the fastening device arranged on the movable die plate,

[0045] c) moving the movable die plate in the opening direction to a position in which the tie bar has been introduced into a further fastening device for releasable connection to a tie bar, said further fastening device being arranged on a rack which is located on that side of the movable die plate that is remote from the fixed die plate,

[0046] d) fixing the tie bar to the rack by closing the fastening device arranged on the rack,

[0047] e) opening the fastening device arranged on the movable die plate,

[0048] f) moving the movable die plate in the closing direction,

[0049] g) optionally repeating steps b) to e) until the tie bar has been withdrawn to a predetermined degree from the region between the fixed and movable die plates.

[0050] As already described above, it is necessary in conventional casting machines such as die-casting machines to repeat steps b) to e) a further once or twice, preferably twice, in step g), in order to withdraw the tie bar completely from the region between the fixed and movable die plates.

[0051] As described above, it is preferred to withdraw the two upper tie bars of a conventional casting machine such as a die-casting machine having four tie bars arranged in the corners of the fixed die plate, in order to achieve sufficient accessibility to the mold. Therefore, the above method is preferably carried out according to the invention such that the two upper tie bars of a casting machine are withdrawn simultaneously. However, it is in many cases sufficient to draw only one of the upper tie bars.

[0052] In order to optimally use the movement of the movable die plate for the operation of tie bar drawing, it is advantageous, as described above, for the movable die plate to be moved between its maximum positions during the above-described method. Therefore, it is preferred that, in step c), the movable die plate is moved into the opening position. It is furthermore preferred that, in step f), the movable die plate is moved into the closing position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0053] The present invention is explained in more detail in the following text by way of non-limiting embodiments and drawings, in which:

[0054] FIG. 1 shows a schematic illustration of a die-casting machine according to the invention

[0055] FIG. 2a shows a schematic illustration of the releasable fastening device, arranged on the fixed die plate, in the closing position

[0056] FIG. 2b shows a schematic illustration of the releasable fastening device, arranged on the fixed die plate, in the opening position

[0057] FIG. 3a shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a form-fitting manner

[0058] FIG. 3b shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a form-fitting manner

[0059] FIG. 3c shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a force-fitting manner

[0060] FIG. 4a shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a force-fitting manner

[0061] FIG. 4b shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a force-fitting manner

[0062] FIG. 4c shows a schematic illustration of the releasable fastening device, arranged on the movable die plate, in a position coupled in a force-fitting manner

[0063] FIG. 5a-f show a sequence diagram of the method according to the invention for tie bar withdrawal

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0064] FIG. 1 shows a schematic illustration of a die-casting machine 1 according to the invention. The die-casting machine has a fixed die plate 2 with a first casting-mold half 3 arranged thereon and a movable die plate 4 with a second casting-mold half 5 arranged thereon. Fastening devices 6 for releasable connection to a tie bar are arranged on the fixed die plate 2 at the two upper corners on the side remote from the movable die plate 4. The releasable fastening devices 6 are explained in more detail below in FIGS. 2a and 2b.

[0065] The die-casting machine 1 has four tie bars 7a-7d. The two upper tie bars 7a and 7b are fixed in the fastening devices 6 on the fixed die plate 2. The two lower tie bars 7c and 7d are fixed in conventional fastening devices 6 on the fixed die plate 2 in the embodiment according to FIG. 1. It is of course conceivable to also provide fastening devices 6 for the lower tie bars 7c and 7d.

[0066] The movable die plate 4 is guided via the tie bars 7a-7d. The movement of the movable die plate 4 is carried out
with the aid of a drive 14, such as a hydraulic cylinder, which is located in the lower region of the movable die plate 4.

[0067] Clamping cylinders 9a-9d for the tie bars 7a-7d are provided on that side of the movable die plate 4 that is remote from the fixed die plate 2. The requisite fastening devices 10a-10d of the tie bar withdrawing device according to the invention are provided behind the clamping cylinders 9a-9d on that side of the movable die plate 4 that is remote from the fixed die plate 2. The requisite fastening devices 10a-10d are explained in more detail below in FIG. 3a-3c.

[0068] Racks 11a and 11b are arranged on that side of the movable die plate 4 that is remote from the fixed die plate 2. In this embodiment according to FIG. 1, the racks 11a and 11b are attached to a crossbar 12 which connects the two lower tie bars 7c and 7d together. The crossbar 12 is supported on the ground by two supporting elements 13a and 13b, or fixed by screw-connection for example.

[0069] A closing cylinder 14 is furthermore arranged centrally on the crossbar 12, between the lower tie bars 7c and 7d.

[0070] Fastening devices 15a and 15b for releasable connection to a tie bar are located on the racks 11a and 11b. The fastening devices 15a and 15b for releasable connection to a tie bar are explained in more detail below in FIG. 4a-4c.

[0071] In the embodiment according to FIG. 1, the tie bars 7a, 7b are releasably connected to the fixed die plate 2. The requisite fastening devices 6 for releasable connection to a tie bar are realized, in the embodiment according to FIG. 1, by suitable coupling connections which are described in more detail in FIGS. 2a and 2b.

[0072] The releasable fastening device 6 according to FIG. 2a and 2b is a two-part nut 16 which has two separate halves 16a, 16b that can be moved away from or toward the tie bar 7a, 7b, for example by a hydraulic drive. In order to fix the tie bar 7a, 7b in the fixed die plate 2, the two halves 16a, 16b of the nut 16 are pressed together, with the result that a form-fitting connection is formed between the nut 16 formed in this way and the tie bar 7a, 7b.

[0073] During normal casting operation of the casting machine according to the invention, the tie bars 7a, 7b are fixedly connected to the fixed die plate 2 by the above-described releasable fastening devices 6. It is only during the operation of the tie bar drawing that this connection is released.

[0074] The tie bars 7a, 7b, 7c, 7d are releasably connected to the movable die plate 4 in the embodiment according to FIG. 1. In the embodiment according to FIG. 1, the requisite fastening devices 10a-10d for releasable connection to a tie bar are realized by suitable coupling connections, which are described in more detail in FIG. 3a-c.

[0075] The fastening device 10a-10d, arranged on the movable die plate 4, of the tie bar withdrawing device for releasable connection to a tie bar is realized by nuts 17 according to FIG. 3a-c.

[0076] In the section in which they come into contact with the movable die plate 4 during normal casting operation of the machine 1, the tie bars 7a-7d used in the die casting machine 1 according to FIG. 1 have flutes. These flutes serve to establish a connection that is as firm as possible between the movable die plate 4 and the tie bar 7a-7d. To this end, a form-fitting coupling to the tie bar 7a-7d is established, by the fastening device 10a-10d arranged on the fastened die plate 4, as shown by way of example in FIG. 3a. For the upper tie bar 7a. For this purpose, use is made of a two-part nut 17, i.e. a nut having two separate halves 17a, 17b which can be moved away from or toward the tie bar 7a-7d, for example by a hydraulic drive. The inner surfaces of the nut halves 17a, 17b that come into contact with the tie bar 7a-7d have flutes which can come into form-fitting contact in an interacting manner with the flutes on the tie bar surface. In other words, a form-fitting connection can be created in that, an elevation between two flutes on the inner surface of the nut halves 17a, 17b engages in a flute on the tie bar surface, and vice versa. In order to fix the tie bar 7a-7d in the movable die plate, the two halves 17a, 17b of the nut 17 are pressed together, with the result that the above-described form-fitting connection between the nut formed in this way and the tie bar is formed.

[0077] During normal casting operation of the die casting machine 1, the movable die plate 4 is moved on the tie bars 7a-7d in that the above-described form-fitting coupling is released, as shown in FIG. 3b, by moving the halves 17a, 17b of the nut 17 apart.

[0078] During tie bar withdrawing operation of the die casting machine 1, first of all all the form-fitting connection, shown above in FIG. 3a, between the tie bar 7a-7d and the movable die plate 4 is established, the coupling of the tie bars 7a-7d to the fixed die plate 2 is released and the movable die plate 4 is moved out of the closing position in the opening direction.

[0079] In a further step, the tie bar 7a-7d is fixed in the rack 11a, 11b of the tie bar withdrawing device, the coupling between the movable die plate 4 and the tie bar 7a-7d is released and the movable die plate 4 is moved back in the closing direction. In order to withdraw the tie bar 7a-7d further from the region between the fixed and movable die plates, coupling takes place again between the movable die plate 4 and the tie bar 7a-7d, however, in this method step, form-fitting coupling can no longer be realized as a rule between the movable die plate 4 and the tie bar 7a-7d, since the surface section, having flutes, of the tie bar 7a-7d is already in a position away from the movable die plate. Therefore, in this method step, a force-fitting connection, shown in FIG. 3c, between the movable die plate 4 and the tie bar 7a-7d is realized in that the halves 17a, 17b of the nut 17 are pressed firmly with high application of force against a non-fluted surface section of the tie bar 7a-7d. This coupling is not as firm as the above-described form-fitting coupling, but is sufficient for the purpose of tie bar drawing.

[0080] The die casting machine 1 according to FIG. 1 has, as an essential component of the tie bar withdrawing device according to the invention, two racks 11a, 11b which are arranged on that side of the movable die plate 4 that is remote from the fixed die plate 2. The racks 11a, 11b have a fastening device 15a, 15b for releasable connection to a tie bar which is arranged on the racks 11a, 11b such that a tie bar 7a, 7b to be drawn can be introduced into this fastening device 15a, 15b during the withdrawing operation. To this end, the fastening device 15a, 15b for releasable connection to a tie bar is arranged at the end of the rack 11a, 11b of corresponding length.

[0081] As shown by way of example for the fastening device 15a in FIG. 4a-4c, the fastening device 15a, 15b, arranged on the rack, for releasable connection to a tie bar is configured such that it has a clamping cylinder 18 that acts on the tie bar 7a, 7b from above and a supporting cylinder 20 that acts on the tie bar 7a, 7b from below. The cylinders 13, 20 are preferably actuated hydraulically. With the clamping cylinder 18 and supporting cylinder 20, fastening parts 19, 21 such as nut halves having a shape complementary to the tie bar surface can be pressed firmly against the tie bar surface. If, as
shown in FIG. 4a, the clamping cylinder 18 and the supporting cylinder 20 are not actuated, coupling to the tie bar 7a, 7b does not occur. The tie bar 7a, 7b can be moved freely out of and into the rack 11a, 11b. In order to couple the tie bar 7a, 7b fixedly to the rack 11a, 11b, the fastening parts 19, 21 are as shown in FIG. 4c, pressed firmly against the tie bar surface by actuating the clamping cylinder 18 and supporting cylinder 20. However, it is also possible for the rack to exert only a supporting function on the tie bar. In this case, as shown in FIG. 4b, only the supporting cylinder 20 is actuated, and the fastening part 21 connected to the supporting cylinder 20 is pressed against the tie bar 7a, 7b from below. The clamping cylinder 18 is not actuated; a fixed coupling is not realized in this embodiment.

[0082] FIG. 5a-5f schematically illustrate the sequence of the tie bar withdrawing method according to the invention using the embodiment according to FIG. 1. Only those components that are relevant for the method are described again with reference signs in FIG. 5a-5f. The remaining components of the die casting machine 1 are described in FIG. 1. FIG. 5a-5f illustrate by way of example the simultaneous drawing of the two upper tie bars 7a, 7b, wherein the tie bar 7a and the associated parts of the tie bar withdrawing device according to the invention are concealed and are thus not visible. It should be emphasized again that in many cases the drawing of only one of the two upper tie bars is sufficient.

[0083] In FIG. 5a, the movable die plate 4 is in the closing position. In this operating position, tor the purpose of tie bar drawing, the fastening devices 6 on the fixed die plate 2 are opened, as shown in FIG. 2b. The fastening devices 10a, 10b are coupled to the tie bars 7a, 7b in a form-fitting manner, as shown in FIG. 3a. The fastening devices 15a, 15b on the racks 11a, 11b are opened, as shown in FIG. 4a.

[0084] As shown in FIG. 5b, the movable plate are place 4 is now moved in the opening direction; as far as the opening position in the embodiment according to FIG. 5b. Since the tie bars 7a, 7b are not coupled to the fixed die plate 2, they are withdrawn from the fixed die plate 2, on account of the movement of the movable die plate 4 to which they are coupled, and introduced into the fastening devices 15a, 15b.

[0085] As shown in FIG. 5c, the fastening devices 15a, 15b are subsequently coupled to the tie bars 7a, 7b in a form-fitting manner by actuating the clamping cylinder 18 and supporting cylinder 20, as illustrated in FIG. 4c. The tie bars 7a, 7b are now fixed in the racks 11a, 11b. The fastening devices 10a, 10b are opened, as illustrated in FIG. 3b. The movable die plate 4 is now decoupled from the tie bars 7a, 7b and can be moved in the closing direction without moving the tie bars 7a, 7b in the process. In the embodiment according to FIG. 5e, the movable die plate 4 is no longer moved back fully into its closing position, since, when the above steps are repeated, the tie bars 7a, 7b now no longer have to be withdrawn into the opening position by the entire amount of the movement of the movable die plate 4.

[0088] Subsequently, the tie bar withdrawing method according to the invention is carried out a third time in this embodiment. The fastening devices 10a, 10b are now coupled to the tie bars 7a, 7b in a force-fitting manner, as illustrated in FIG. 3c. The fastening devices 15a, 15b on the racks 11a, 11b are opened, as shown in FIG. 4a. As shown in FIG. 5f, the movable die plate 4 is now moved in the opening direction, into its opening position according to FIG. 5f. In this case, the tie bars 7a, 7b are withdrawn by the corresponding amount of the movement of the movable die plate 4.

1. Tie bar withdrawing device for at least one tie bar of a casting machine, having a fixed die plate with a first casting-mould half arranged thereon and having a movable die plate with a second casting-mould half arranged thereon, wherein the movable die plate can be moved on tie bars that are fastened releasably in the fixed die plate wherein the tie bar withdrawing device has the following units: a fastening device arranged on the movable die plate for releasable connection to a tie bar, a further fastening device for releasable connection to a tie bar, said further fastening device being arranged on a rack which is located on that side of the movable die plate that is remote from the fixed die plate.

2. Tie bar withdrawing device according to claim 1, wherein the fastening device, for releasable connection to a tie bar, of the tie bar withdrawing device, said fastening device being arranged on the movable die plate, is a coupling by way of which optionally a form-fitting or force-fitting connection to the tie bar can be established.

3. Tie bar withdrawing device according to claim 1, wherein the further fastening device for releasable connection to a tie bar, said further fastening device being arranged on the rack, comprises a clamping cylinder that acts on the tie bar from above and a supporting cylinder that acts on the tie bar from below.

4. Casting machine having a fixed die plate with a first casting-mould half arranged thereon and having a movable die plate with a second casting-mould half arranged thereon, wherein the movable die plate can be moved on tie bars that are fastened releasably in the fixed die plate, wherein the casting machine comprises a tie bar withdrawing device according to one of claims 1 to 3.

5. Casting machine according to claim 4, wherein for two tie bars of the casting machine in each case one tie bar withdrawing device is provided.

6. Casting machine according to claim 4, wherein, for the rack or the racks of the tie bar withdrawing device is/are arranged on a crossbar which is fastened to the ends of the lower tie bars of the casting machine.

7. Casting machine according to claim 6, wherein the crossbar is fastened to one end of a closing cylinder, the other end of which is connected to the rear side of the movable die plate.
8. Casting machine according to claim 6, wherein the crossbar is supported on the ground by at least one supporting element.

9. Method for withdrawing at least one tie bar from a casting machine, wherein the casting machine comprises a fixed die plate with a first casting-mould half arranged thereon and a movable die plate with a second casting-mould half arranged thereon, and the movable die plate is guided on tie bars that are fastened releasably in the fixed die plate, comprising the steps of:
   a) releasing the releasable fastener of the tie bar in the fixed die plate in a machine position in which the movable die plate is in the closing position.
   b) fixing the tie bar to the movable die plate by closing the fastening device arranged on the movable die plate.
   c) moving the movable die plate in the opening direction to a position in which the tie bar has been introduced into a further fastening device for releasable connection to a tie bar, said further fastening device being arranged on a rack which is located on that side of the movable die plate that is remote from the fixed die plate.
   d) fixing the tie bar to the rack by closing the fastening device arranged on the rack.
   e) opening the fastening device arranged on the movable die plate.
   f) moving the movable die plate in the closing direction.
   g) optionally repeating steps b) to e) until the tie bar has been withdrawn to a predetermined degree from a region between the fixed and movable die plates.

10. Method according to claim 9, wherein steps b) to e) are repeated at least once in step g).

11. Method according to claim 9, wherein the two upper tie bars of a casting machine are withdrawn simultaneously or individually.

12. Method according to claim 9, wherein in step d), the tie bar is fixed to the rack by way of a clamping cylinder that acts on the tie bar from above and a supporting cylinder that acts on the tie bar from below.

13. Method according to claim 9, wherein, in step c), the movable die plate is moved into the opening position.

14. Method according to claim 9, wherein, in step f), the movable die plate is moved into the closing position.