(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 646 966 B1**

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
15.06.2022 Bulletin 2022/24

(21) Application number: **19206537.3**

(22) Date of filing: **31.10.2019**

(51) International Patent Classification (IPC):
B22D 17/10 *(2006.01)* ***B22D 17/20*** *(2006.01)*
B22D 17/30 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B22D 17/10; B22D 17/2015; B22D 17/203; B22D 17/2053; B22D 17/30

(54) **INJECTION UNIT FOR DIECASTING MACHINES AND METHOD**

VORRICHTUNG EINHEIT FÜR SPRITZGUSS UND VERFAHREN

DISPOSITIF D'INJECTION POUR MOULAGE PAR INJECTION ET PROCÉDÉ

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **31.10.2018 IT 201800009961**

(43) Date of publication of application:
06.05.2020 Bulletin 2020/19

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(56) References cited:
EP-A1- 1 046 444 **DE-A1- 10 062 436**
JP-A- H04 143 058

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Description

Technical field

[0001] The present invention relates to an injection unit for diecasting machines and a method for using the injection unit.

Technological background

[0002] In the field of diecasting machines or injection-moulding machines, it is known that the presence inside the process of any potentially dangerous atmospheres poses a significant risk condition for efficiently obtaining a desired product.

[0003] In particular, atmospheres containing oxygen and/or hydrogen and/or nitrogen may be considered in each case to be contaminating in accordance with the material used and therefore preferably avoidable to the greatest possible extent.

[0004] EP 1046444 A1 describes a horizontal chamber die casting process that comprises forming a stabilized and homogenized cylindrical melt volume for feeding additional compression of the solidifying cast product in the die. A horizontal chamber die casting process comprises applying a vacuum to the chamber and piston, accelerating the melt before entry into the die and subjecting the die to pressure before or when the melt reaches the ingate opening. Before acceleration, t melt is formed to a cylindrical shape which is retained until achievement of hydrodynamic stabilization, temperature equalization and uniform pressure distribution in the cylindrical material volume and which is fed into the solidifying metal after filling o the die to provide additional compression during solidification of the cast product.

[0005] JP H04143058 discloses a feeder head in which it is arranged a first plunger tip freely movably back and forth in a second injection sleeve reciprocating in the first injection sleeve and connecting a second plunger tip at the end part of the second injection sleeve in order to keep filling ratio of molten metal into a sleeve to 100% and to perfectly perform the function of the feeder head.

[0006] The document EP2407260 describes a metering device for melted material which is suitable for carrying out the transfer of the above-mentioned melt from a zone for receiving the material to a zone for releasing it. In particular, this device makes provision for being able to take a controlled quantity of melted material, to store it under atmosphere and to transfer it to an injection station of a diecasting machine.

[0007] It is important to note that this process of introducing the melted material into the diecasting injection unit is carried out by means of gravitational force, at the pressure of the inert gas which is present where applicable, and, optionally, as a result of the contribution of the movement of a piston. This technology appears to be directed mainly towards casting applications of aluminium.

[0008] One of the most critical phases of this type of technical solution is constituted by the injection of the melt inside the supply opening in which the risk of obtaining contaminations of oxygen and hydrogen is significantly increased, thereby compromising the quality of the final product. Therefore, it would be preferable to be able to improve the process described by means of a system which prevents there from being any phases of contamination of the material by maintaining an optimum value of the purity of the melt.

[0009] It would further be preferable to be able to define in a precise and reproducible manner the quantity to be collected in a supply chamber advantageously before injecting it inside the mould.

Statement of invention

[0010] An object of the present invention is to at least partially overcome one of the limitations set out in the prior art.

[0011] Within this object, an additional objective is to provide a system which is capable of controlling and reducing the impurities present in a melted or softened material during the moulding step for metal or plastics materials. The invention is defined in the independent claims 1 and 6.

[0012] Further advantages of the invention are defined in the dependent claims. According to the invention it is provided an injection unit for diecasting machines comprising a collection chamber of melted material, which is preferably of substantially cylindrical form and which has a longitudinal axis, a first piston and a second piston which are received inside the above-mentioned collection chamber and which can be moved along the longitudinal axis of the collection chamber.

[0013] Preferably, the first and second pistons are arranged in such a manner that the respective travel paths are aligned with the longitudinal axis so as to be able to move from an extended configuration, in which the distance between the first and second pistons is at a maximum and the melted material is drawn by reduced pressure inside the collection chamber, to a drawn-together configuration, in which the distance between the first and second pistons is at a minimum and the melted material is at least partially discharged from the collection chamber and compressed inside a mould which is connected fluid-dynamically downstream of the collection chamber. In this context, the longitudinal axis corresponds to the axis having the greatest extent of a structure (for example, if the chamber is of cylindrical form, then the longitudinal axis is the centre axis of the cylinder itself).

[0014] It is thereby possible to move a desired quantity of melted or softened material with great precision inside the collection chamber and to inject it inside a mould without the above-mentioned melted or softened material coming into contact with potentially contaminating atmospheres.

[0015] In this context, potentially contaminating atmospheres are, for example, rich atmospheres of oxygen and/or hydrogen or gas which are not contaminating but which contribute to lowering the density of the fluid, gases such as nitrogen, argon, etc. A conventional example which is normally widespread of a contaminating atmosphere is constituted by air. As a result of this technical solution, it is ensured that the melted material as inserted inside the collection chamber is injected into the mould having a quality/purity which is identical to or even greater than the initial one.

[0016] This possible increase of quality, that is to say, this reduction of the gases and the volatile impurities which are present in the melted or softened material, can be brought about by having a level of reduced pressure, that is to say, a pressure reduction or a pressure lower than ambient pressure, inside the collection chamber which precisely facilitates the further degasification of the melted or softened material and prevents additional gas molecules from being able to come into contact with the melted or softened material before and during the step of injection into the mould.

[0017] By way of non-limiting example, this reduced pressure is between 40 mbar and 70 mbar.

[0018] Preferably, the first and/or second piston comprise(s) a contact surface with the melted material, which surface is made of ceramic material.

[0019] This technical condition minimizes the heat exchange between the pistons and the melted or softened material, thereby optimizing the fluidity of the melted material and consequently the moulding step.

[0020] Preferably, the melted material is a metal or a metal/polymer composite or a polymer/polymer composite.

[0021] According to an embodiment, the melted material is an aluminium alloy. In this case, the gas which is particularly problematic during the moulding step is, naturally in addition to oxygen, hydrogen.

[0022] As a result of this technical solution, there can be carried out a process for processing the material, in particular a liquid material, which allows it to be kept clean and protected from oxidations, maintaining it at a reasonably low temperature, so as to prevent situations in which the metal has an avidity to absorb gas, with the system proposed here it is possible to achieve the objective of producing products of high compactness, with the exception of intercrystalline gases, that is to say, productions of structural pieces. It is possible for the liquid alloy under given conditions to develop a high avidity for hydrogen, therefore lacking intergranular gas formation during the step of moulding; this intercrystalline gas brings about a fall in the physical/mechanical properties, therefore products with poor performance levels with respect to those which are obtained by means of the special system to which the present invention relates, and which ensure along the die a controlled temperature and atmosphere.

[0023] Preferably, the collection chamber is connected fluid-dynamically upstream to a supply unit for melted or softened material, which is also at reduced pressure. As a result of this technical solution, it can be ensured that the melted material which is being introduced into the collection chamber is also of good quality/optimum quality, that is to say, it does not have any contaminating gases to the greatest possible extent.

[0024] According to an embodiment, the reduced pressure of the supply unit is substantially equal to the reduced pressure in the collection chamber.

[0025] By means of this technical solution, there is optimized the step of insertion of the melted material inside the collection chamber, preventing or minimizing turbulence which can be brought about as a result of a pressure difference or movements of material following partial pressure differences between the supply unit and the collection chamber. Furthermore, the fact of having the melted or softened material already in a reduced pressure condition ensures that it is under ideal conditions in terms of purity. Preferably, the injection unit comprises a first and a second pressure reduction system which are connected fluid-dynamically to the collection chamber.

[0026] This technical solution allows one or more predetermined portions of the collection chamber to be cleaned or evacuated with reduced pressure.

[0027] Preferably, the first and second pressure reduction systems are positioned near the mould so as to be able to selectively evacuate by means of pressure reduction portions of the chamber which can be defined by means of the movement of the second and/or first piston.

[0028] The operating methods of the present invention will be better appreciated from the method for injecting melted or softened material inside a mould described below which comprises

- providing an injection unit having at least one of the features previously described,
- positioning the first piston and the second piston in accordance with the extended configuration allowing the introduction under reduced pressure into the melted material into the collection chamber,
- moving the first piston towards the second piston, that is to say, towards the drawn-together configuration, thereby compressing the melted material between the first and second pistons,
- moving in translation the first piston and second piston towards the mould,
- positioning the second piston inside a second seat which is located inside the collection chamber so as to connect fluid-dynamically the collection chamber and the melted material to an inlet channel of the mould,
- moving the first piston towards the second piston so as to produce the drawn-together configuration and thereby to inject the melted material inside the mould.

[0029] According to an embodiment, the action of moving the first piston and the second piston in translation towards the mould is carried out simultaneously. This feature defines a preferred method of moving the first piston and second piston relative to each other, keeping the mutual spacing and therefore the pressure applied to the melted or softened material substantially constant.

[0030] Preferably, the method comprises

- producing a reduced pressure condition in a portion of the collection chamber between the second piston and the second seat of the second piston before allowing the introduction of the melted material into the collection chamber.

[0031] In this manner, the portion of the collection chamber is evacuated and cleaned before the passage of the melted or softened material so as to ensure a high level of purity thereof and to thereby minimize the presence of any impurities and contaminating gases.

[0032] According to an embodiment, the method comprises

- actuating a supply unit, which is connected fluid-dynamically upstream of the collection chamber, and inserting inside the melted material contained in the collection chamber a bar of a predetermined metal.

[0033] As a result of this technical solution, it is possible to optimize the desired composition of the melted material.

[0034] Purely by way of non-limiting example, a preferable technical solution provides for the melted metal to be aluminium and for the bar to be of nickel so as to increase the mechanical characteristics of the material used for the mould.

Brief description of the drawings

[0035] The features and advantages of the invention will be better appreciated from the detailed description of a number of preferred embodiments thereof, which are illustrated by way of non-limiting example with reference to the appended drawings, in which:

- Figure 1 is a schematic view of the injection unit which is operationally connected to a diecasting machine.

Preferred embodiment of the invention

[0036] In Figure 1, there is generally designated 1 an injection unit for diecasting machines 200, comprising

- a collection chamber 2 for melted material, for example, melted aluminium, which preferably has a substantially cylindrical form and a longitudinal axis X,
- a first piston 10 and a second piston 20 which are received inside the collection chamber 2 and which can be moved along the longitudinal axis X of the collection chamber 2,
- the first and second pistons 10, 20 being arranged in such a manner that the respective travel paths are aligned with the longitudinal axis X so as to be able to move from an extended configuration, in which the distance D between the first and second pistons 10, 20 is at a maximum and the melted material is drawn by reduced pressure inside the collection chamber 2, and a drawn-together configuration, in which the distance D between the first and second pistons 10, 20 is at a minimum and the melted material is discharged from the collection chamber 2 and compressed inside a mould 4 which is connected fluid-dynamically to the collection chamber 2.

[0037] Advantageously, the collection chamber 2 is connected to a third pressure reduction system (not shown in the Figures) which is capable of producing and maintaining inside the collection chamber 2 a pressure value between 40 mbar and 70 mbar and more preferably of approximately 50 mbar. Furthermore merely by way of example, this level of pressure reduction (or reduced pressure) is advantageously produced with a primary pump or a dry pump or a turbo pump, etc.

[0038] According to an embodiment, the supply unit 30 is also in a condition of reduced pressure and this condition is brought about and maintained by means of a fourth pressure reduction system which is connected thereto fluid-dynamically. The same considerations set out for the third pressure reduction system apply to the fourth pressure reduction system.

[0039] In other words, the supply unit 30 is similar to a metal container and performs a function of storage for a predetermined metal. Advantageously, the supply unit 30 is provided with local heating means (for example, electrical resistor systems, Peltier cells, etc.) which allow the accurate production and control of the temperature inside the container, thereby being thermally heated and provided with a level control system. Furthermore, as a result of the fact that the supply unit 30 is at reduced pressure, it is possible to prepare the metal with off-cycle timings. In this manner, it is thereby ensured that the productive die, which is programmed to control the metal advantageously under a reduced pressure system and at a temperature for which an extremely low absorption of hydrogen is produced with respect to the metal contained, also has the selective possibility of metering and/or storing the metal in the container 30 with different seconds in advance with respect to the cyclicality of the units which are currently present on the market.

[0040] Therefore, this technical solution allows greater precision of transfer of the metal with significant reductions of the cycle times, thereby producing a diecasting process which is more efficient with respect to the solutions present in the prior art.

[0041] In fact, by means of operating methods, such as filling at reduced pressure, maintaining temperature, possibility of corrective incorporation of the metallurgy analysis, this allows the production of conditions which are suitable for obtaining high-quality productions, in particular involving virtually an absence of intercrystalline or intergranular gas, high level of compactness of the final product, etc.

[0042] With reference to Figure 1, there is defined a second seat 25 for the second piston 20. This second seat 25 is produced inside the collection chamber 2 and, when the second piston 20 is withdrawn completely and positioned inside the second seat 25, an inlet channel 4a of the mould 4 which is connected fluid-dynamically to the chamber 2 is open.

[0043] Preferably, the inlet channel 4a comprises a fourth pressure reduction valve 4b which is suitable for closing the inlet channel 4a selectively.

[0044] It is thereby possible to produce, by means of the first and second pressure reduction systems 41, 42, pressure reduction cycles inside the inlet chamber 4a without the melted material necessarily being inserted inside the mould.

[0045] The Applicant has established that this division of the volumes to be processed in terms of pressure reduction allows the production of an effective pressure reduction value which is far better and more uniform than the one which can be obtained by means of the solutions which can be produced by means of the prior art, which provides for a single large volume, in which attempts are made to produce a pressure reduction. Advantageously, there is defined a first seat 15, in which the first piston 10 is positioned before carrying out the introduction of the melted or softened material inside the collection chamber 2.

[0046] With reference to Figure 1, the first position of the first piston in the first seat 15 is designated X1.

[0047] Still with reference to Figure 1, when the second piston 20 is positioned in the second seat 25, this third position is designated X3.

[0048] Preferably, there is defined an intermediate position X2 which is equal to approximately half of the total length of the collection chamber 2.

[0049] The distance D is defined as the distance between the first piston 10 and the second piston 20 inside the collection chamber 2.

[0050] Advantageously, the maximum distance between the first piston 10 and the second piston 20 is defined when the first piston 10 is in the first seat 15 and the second piston is in the second seat 25.

[0051] The first piston 10 and the second piston 20 are movable inside the collection chamber 2 independently.

[0052] The melted material is inserted inside the collection chamber 2 when the first and the second pistons 10, 20 are moved and positioned towards the configuration with a maximum distance D.

[0053] The first and/or second piston 10, 20 comprise(s) a contact surface with the melted material, which surface is made of ceramic material.

[0054] Preferably, the melted material is a metal and more preferably it is aluminium or the alloys thereof, copper or the alloys thereof.

[0055] It is advantageous, for example, in the case of use of aluminium as the melted or softened material, for the solution involved in the present invention to allow a reduction or even elimination of the undesirable formation of intergranular aluminium which is connected with the excess presence of hydrogen in the melt.

[0056] The collection chamber 2 is connected fluid-dynamically upstream of the supply unit 30 which is also under reduced pressure. Advantageously, this supply unit 30 comprises a first pressure reduction valve 30b which is fluid-dynamically interposed between the supply unit 30 and the collection chamber 2 and connected thereto.

[0057] It is thereby possible to selectively produce a desired pressure reduction value in the supply unit 30.

[0058] Preferably, the pressure reduction of the supply unit 30 is substantially equal to the pressure reduction in the collection chamber 2, advantageously between 40 and 70 mbar.

[0059] The injection unit 1 comprises a first and a second pressure reduction system 41, 42 which are connected fluid-dynamically to the collection chamber 2. These first and second pressure reduction systems 41, 42 preferably comprise respective second and third pressure reduction valves 41b, 42b. These second and third pressure reduction valves 41b, 42b selectively allow an increase in the pressure reduction therein.

[0060] The Applicant has established that, by means of this first, second and third valve 30b, 41b, 42b, it is possible to establish a desired pressure reduction level inside the collection chamber 2, preferably with pressure reduction values between 40 and 50 mbar.

[0061] It is important to note that this technical solution allows a significant reduction of the possibilities of contamination of the melted aluminium by hydrogen.

[0062] The Applicant has established that this technical advantage cannot be obtained with a generic pressure reduction system which is connected to a plurality but provides for being able to separate into compartments the various sectors of the injection unit 1 for the diecasting machine associated therewith.

[0063] Furthermore, the above-mentioned technical features are included in the injection unit 1 which is thereby adaptable and can be installed in different types of diecasting machines, in which it is simply necessary to replace the injection head.

[0064] Furthermore, in order to be able to effectively reduce the presence of hydrogen in the melted or softened aluminium, it is possible by means of the interaction of the first, second, third valves 30b, 41b, 42b and the collection chamber 2, to allow a delimitation in the collection chamber 2 of a desired volume of melted or softened aluminium which can be moved by means of the movement of the first and/or second piston 10, 20, further reducing possible residual pockets of gas and thereby improving the quality of the product which can be obtained.

[0065] Furthermore, this type of solution allows the possibility of removing in a very precise manner the melted or softened aluminium material and inserting into the collection chamber 2 and/or the mould the desired quantity which is processed under reduced pressure according to the desired method.

[0066] Preferably and with reference to Figure 1, the first and second pressure reduction systems 41, 42 are connected downstream with respect to the location at which the supply unit 30 is connected to the collection chamber 2. Advantageously, the first and second pressure reduction systems 41, 42 are connected fluid-dynamically to the collection chamber 2 in positions which are substantially downstream of the second piston 20 when it is moved approximately into the intermediate position X2.

[0067] According to an embodiment, there is installed in the cavity of the die 4 an additional cleaning system for cleaning and/or blowing and/or lubricating and/or producing the pressure reduction by means of an additional independent system which is connected to cleaning units and/or units for producing pressure reduction (for example, primary pumps, dry scrolls, etc.), respectively. Advantageously, this additional cleaning system comprises at least one valve which is interposed fluid-dynamically between the die 4 and the cleaning system so as to obtain and control a pressure reduction inside the die at values which are preferably between 40 mbar and 70 mbar.

[0068] Additional preferred specifications will be described below.

[0069] It is advantageous to note that high reduced pressure values are not obtained to the detriment of longer cycle times and with complex and costly installation solutions, but instead by using systems which are far less costly than those normally used and which are substantially simplified so as to be highly efficient, readily able to be maintained, available with a modest investment cost as a result of the performance levels of the separation system.

[0070] With the particular valves of the pressure reduction used, it is possible to produce metal piece (metal mould) supply channels and paths which are much more efficient and with greater efficiency with respect to the technique which is normally used now. With the valves, in addition to readily obtaining in the environments high pressure reduction values, it is possible to programme work cycles with long work times and consequently with advance actuation with respect to the step of injection: according to the prior art, the pressure reduction in the mould, except for extremely specialized and costly systems, is produced at the same time as the mould filling step, this means that, in addition to obtaining a pressure reduction of a mediocre level with very delicate installations, there are also problems resulting from mixtures between metal which is introduced and air in the rarefaction/discharge step. The separator which is combined with the valves proposed inaugurates a new production method: reduced energy consumption, high level of safety, simplicity, high quality, high repeatability of the process.

[0071] In other words, according to an embodiment the injection unit 1 for diecasting machines 200 comprising

- a collection chamber 2 for melted aluminium or the alloys thereof, melted copper or the alloys thereof,
- a first piston 10 and a second piston 20 which are received inside the collection chamber 2 and which can be moved along a longitudinal axis X of the collection chamber 2,
- the first and second pistons 10, 20 being arranged in such a manner that the respective travel paths are aligned with the longitudinal axis X of the collection chamber 2 so as to be able to move from an extended configuration E, in which the distance D between the first and second pistons 10, 20 is at a maximum and the melted material is drawn by reduced pressure inside the collection chamber 2, to a drawn-together configuration R, in which the distance D between the first and second pistons 10, 20 is at a minimum and the melted material is discharged from the collection chamber 2 and compressed inside a mould 4 which is connected fluid-dynamically to the collection chamber 2,

- a first and second pressure reduction system 41, 42 which are connected substantially upstream and downstream of the collection chamber 2 and the first and second pressure reduction systems 41, 42 being connected fluid-dynamically to the collection chamber 2 by means of a second and third valve 41b, 42b,
- the second and third valves 41b, 42b being adapted to selectively controlling the pressure reduction level of the collection chamber 2 which is between 40 mbar and 70 mbar inside the collection chamber 2.

[0072] According to an embodiment, the collection chamber 2 is connected fluid-dynamically upstream to a supply unit 30 which is also at reduced pressure, the supply unit 30 comprising a first pressure reduction valve 30b which is fluid-dynamically interposed between the supply unit 30 and the collection chamber 2 and which is connected thereto.

[0073] Preferably, the reduced pressure of the supply unit 30 is substantially equal to the reduced pressure in the collection chamber 2, that is to say, between 40 mbar and 70 mbar.

[0074] According to an embodiment, the mould 4 is connected fluid-dynamically to the collection chamber 2 by means of an inlet channel 4a, the inlet channel 4a comprising a fourth pressure reduction valve 4b which is adapted to selectively closing the inlet channel 4a in a fluid-tight manner.

[0075] The operating modes for using the present invention can be represented according to the steps involved in the method for injecting melted or softened material inside a mould which is described below.

[0076] According to an embodiment, this method comprises

- providing an injection unit 1 having at least one of the features described above,
- positioning the first piston 10 and the second piston 20 in accordance with the extended configuration E allowing the introduction under reduced pressure in the melted material into the collection chamber 2,
- moving the first piston 10 towards the second piston 20, that is to say, towards the drawn-together configuration R, thereby compressing the melted material between the first and second pistons 10, 20. It is advantageous to note that, as a result of this technical solution, it is possible to thereby obtain a precise evaluation of the metal volume which is present, allowing the injection process to be recalibrated precisely and preventing the dangerous vacuum shocks with respect to the injection head;
- moving in translation the first piston 10 and second piston 20 towards the mould 4,
- positioning the second piston 20 inside a second seat 25 which is located inside the collection chamber 20 so as to connect fluid-dynamically the collection chamber and the melted material to an inlet channel 4a of the mould 4,
- moving the first piston 10 towards the second piston 20 so as to produce the drawn-together configuration R and thereby to inject the melted material inside the mould 4.

[0077] Preferably, when the melted or softened material is injected inside the chamber, the first piston 10 is positioned substantially in the first seat 15 (corresponding to the first position X1) and the second piston is positioned in correspondence with the intermediate position X2. This arrangement can advantageously be considered to be the initial position of the respective first and second pistons 10, 20 during the step of injecting the melt into the collection chamber 2.

[0078] Then, advantageously, the first piston and the second piston 10, 20 move in translation coherently until the second piston 20 is introduced in the second seat 25.

[0079] At this point, the inlet channel 4a of the mould 4 is advantageously open and by means of translational movement of the first piston 10 in the direction of the second piston 20, it is possible to compress the melted or softened material inside the mould 4 at the desired speed.

[0080] In other words, according to an embodiment of the present method for injecting melted or softened material inside a mould 4, this method comprises:

a. providing an injection unit 1 at least partially having the technical features described above,
b. producing a reduced pressure in the collection chamber 2 between 40 and 70 mbar,
c. positioning the first piston 10 and the second piston 20 in accordance with the extended configuration E allowing the introduction under reduced pressure from the supply unit 30 of the melted material, preferably aluminium or the alloys thereof or copper or the alloys thereof, into the collection chamber 2,
d. moving the first piston 10 towards the second piston 20, that is to say, towards the drawn-together configuration, thereby compressing the melted material between the first and second pistons 10, 20,
e. moving the first piston 10 and second piston 20 in translation towards the mould 4,
f. positioning the second piston 20 inside a second seat 25 which is located inside the collection chamber 20,
g. reversibly moving the first piston 10 towards or away from the second piston 20 so as to move towards or away from the drawn-together configuration, selectively closing at least the third or fourth pressure reduction valve 42b, 4b which is connected to the mould, thereby increasing the pressure reduction level in a range preferably between 40 mbar and 70 mbar,
h. obtaining the desired pressure reduction level, positioning the second piston 20 inside the second seat 25,
i. moving the first piston 10 away from the second piston 20 so as to reach the extended configuration,
j. opening the fourth valve 4b so as to connect fluid-dynamically the collection chamber 2 and the melted material to the inlet channel 4a of the mould 4 and selectively closing at least the first, second, third valves,
k. mutually moving together the first piston 10 and the second piston 20 and thereby injecting the melted material inside the mould 4.

[0081] According to an embodiment of the present method, the action of moving the first piston 10 and the second piston 20 in translation towards the mould 4 is carried out simultaneously.

[0082] Preferably, the above-mentioned method comprising

- producing a reduced pressure condition in a portion of the collection chamber 2 between the second piston 20 and the second seat 25 of the second piston 20 before allowing the introduction of the melted material into the collection chamber 2.

[0083] Advantageously, with this solution the separation of the work sequences allows long application times for the pressure reduction system and therefore the production of pressure reduction values which are highly efficient without increasing the cycle times and without using the known sophisticated and costly equipment items which are normally used in the known prior art.

[0084] In other words, according to an embodiment of the present method, it comprises

- producing a reduced pressure condition in a portion of the collection chamber 2 between the second piston 20 and the second seat 25 of the second piston 20, preferably closing the fourth valve 4b and opening the third valve 42b, before allowing the introduction of the melted material into the collection chamber 2.

[0085] According to an embodiment, this method comprises

- actuating a supply unit 30, which is connected fluid-dynamically upstream of the collection chamber 2 and preferably inserting, where necessary, inside the melted material contained in the collection chamber 2 a bar of a predetermined material, preferably a metal.

[0086] According to an embodiment, there is inserted inside the melt, for example, a bar of nickel (or other metal/alloy) which is stored in a separate portion 32 of the supply unit 30 so as to be able to vary the composition and therefore the resistance characteristics of the melted material. Advantageously, this melted metal is aluminium and insertion in an alloy of nickel involves the increase of the mechanical characteristics thereof. Alternatively, a melt of aluminium alloys or copper or the alloys thereof is used.

[0087] According to an embodiment of the present method, polymer material and/or polymer composite can also be used.

Claims

1. An injection unit (1) for diecasting machines (200) comprising

- a collection chamber (2) for melted aluminium or the alloys thereof, copper or the alloys thereof,
- a first piston (10) and a second piston (20) which are received inside the collection chamber (2) and which can be moved along a longitudinal axis (X) of the collection chamber (2),
- the first and second pistons (10, 20) being arranged in such a manner that the respective travel paths are aligned with the longitudinal axis (X) of the collection chamber (2) so as to be able to move from an extended configuration (E), in which the distance (D) between the first and second pistons (10, 20) is at a maximum and the melted material is drawn by reduced pressure inside the collection chamber (2), to a drawn-together configuration (R), in which the distance (D) between the first and second pistons (10, 20) is at a minimum and the melted material is discharged from the collection chamber (2) and compressed inside a mould (4) which is connected fluid-dynamically to the collection chamber (2),

characterized in that

- a first and a second pressure reduction system (41, 42) which are connected substantially upstream and downstream of the collection chamber (2) and the first and second pressure reduction systems (41, 42) being fluid-dynamically connected to the collection chamber (2) by means of a second and third valve (41b, 42b),
- the second and third valves (41b, 42b) being adapted to selectively controlling the pressure reduction level of the collection chamber (2) which is between 40 mbar and 70 mbar inside the collection chamber (2).

2. An injection unit (1) according to any one of the preceding claims, wherein the collection chamber (2) is connected fluid-dynamically upstream to a supply unit (30) which is also at reduced pressure, the supply unit (30) comprising a first pressure reduction valve (30b) which is fluid-dynamically interposed between the supply unit (30) and the collection chamber (2) and connected thereto.

3. An injection unit (1) according to the preceding claim, wherein the reduced pressure of the supply unit (30) is substantially equal to the reduced pressure in the collection chamber (2), that is to say, between 40 mbar and 70 mbar.

4. An injection unit (1) according to any one of the preceding claims, wherein the mould (4) is connected fluid-dynamically to the collection chamber (2) by means of an inlet channel (4a), the inlet channel (4a) comprising a fourth pressure reduction valve (4b) which is adapted to selectively closing the inlet channel (4a) in a fluid-tight manner.

5. An injection unit (1) according to any one of the preceding claims, wherein the first and/or second piston(s) (10, 20) comprise(s) a contact surface with the melted material, which surface is made of ceramic material.

6. A method for injecting melted or softened material inside a mould (4), comprising

a. providing an injection unit (1) according to either claim 4 or claim 5,
b. producing a pressure reduction in the collection chamber (2) between approximately 40 and 70 mbar,
c. positioning the first piston (10) and the second piston (20) in accordance with the extended configuration (E) allowing the introduction under reduced pressure from the supply unit (30) of the melted material, preferably aluminium or the al-

loys thereof or copper or the alloys thereof, into the collection chamber (2),

d. moving the first piston (10) towards the second piston (20), that is to say, towards the drawn-together configuration, thereby compressing the melted material between the first and second pistons (10, 20),

e. moving in translation the first piston (10) and second piston (20) towards the mould (4),

f. positioning the second piston (20) inside a second seat (25) which is located inside the collection chamber (20),

g. reversibly moving the first piston (10) towards or away from the second piston (20) so as to move towards or away from the drawn-together configuration, selectively closing at least the third or fourth pressure reduction valve (42b, 4b) which is connected to the mould, thereby increasing the pressure reduction level in a range preferably between 40 mbar and 70 mbar,

h. obtained the desired pressure reduction level, positioning the second piston (20) inside the second seat (25),

i. moving the first piston (10) away from the second piston (20) so as to reach the extended configuration,

j. opening the fourth valve (4b) so as to connect fluid-dynamically the collection chamber (2) and the melted material to the inlet channel (4a) of the mould (4) and selectively closing at least the first, second, third valves,

k. mutually moving together the first piston (10) and the second piston (20) and thereby injecting the melted material inside the mould (4).

7. A method according to the preceding claim, wherein the translational movement of the first piston (10) and the second piston (20) towards the mould (4) is carried out simultaneously.

8. A method according to either claim 6 or claim 7, comprising

- producing a reduced pressure condition in a portion of the collection chamber (2) comprised between the second piston (20) and the second seat (25) of the second piston (20), preferably closing the fourth valve (4b) and opening the third valve (42b), before allowing the introduction of the melted material into the collection chamber (2).

9. A method according to any one of claims 6 to 8, comprising

- actuating a supply unit (30), which is connected fluid-dynamically upstream of the collection chamber (2) and inserting inside the melted material contained in the collection chamber (2) a bar of a predetermined material, preferably a metal, even more preferably aluminium or the alloys thereof or copper or the alloys thereof.

Patentansprüche

1. Einspritzeinheit (1) für Druckgießmaschinen (200), umfassend

- eine Sammelkammer (2) für geschmolzenes Aluminium oder die Legierungen davon, Kupfer oder die Legierungen davon,
- einen ersten Kolben (10) und einen zweiten Kolben (20), die innerhalb der Sammelkammer (2) aufgenommen sind und die entlang einer Längsachse (X) der Sammelkammer (2) bewegbar sind,
- wobei der erste und der zweite Kolben (10, 20) eingerichtet sind, sodass die jeweiligen Bewegungspfade mit der Längsachse (X) der Sammelkammer (2) ausgerichtet sind, um sich von einer ausgefahrenen Konfiguration (E), in der der Abstand (D) zwischen dem ersten und dem zweiten Kolben (10, 20) maximal ist und das geschmolzene Material durch reduzierten Druck innerhalb der Sammelkammer (2) gezogen wird, zu einer zusammengezogenen Konfiguration (R) bewegen zu können, in der der Abstand (D) zwischen dem ersten und dem zweiten Kolben (10, 20) minimal ist und das geschmolzene Material von der Sammelkammer (2) abgelassen und innerhalb einer Form (4) komprimiert wird, die fluiddynamisch mit der Sammelkammer (2) verbunden ist,

dadurch gekennzeichnet, dass

- ein erstes und ein zweites Druckreduktionssystem (41, 42), die im Wesentlichen stromaufwärts und stromabwärts der Sammelkammer (2) verbunden sind, und das erste und das zweite Druckreduktionssystem (41, 42) mittels eines zweiten und eines dritten Ventils (41b, 42b) fluiddynamisch mit der Sammelkammer (2) verbunden sind,
- wobei das zweite und das dritte Ventil (41b, 42b) eingerichtet sind, das Druckreduktionsniveau der Sammelkammer (2) selektiv zu steuern, das zwischen 40 mbar und 70 mbar innerhalb der Sammelkammer (2) angeordnet ist.

2. Einspritzeinheit (1) nach einem der vorhergehenden Ansprüche, wobei die Sammelkammer (2) fluiddynamisch mit einer Zuführeinheit (30) verbunden ist, die ebenfalls unter reduziertem Druck steht, und die Zuführeinheit (30) ein erstes Druckreduktionsventil (30b) aufweist, das fluiddynamisch zwischen der Zuführeinheit (30) und der Sammelkammer (2) angeordnet und mit dieser verbunden ist.

3. Einspritzeinheit (1) nach dem vorhergehenden Anspruch, wobei der reduzierte Druck der Zuführeinheit (30) im Wesentlichen gleich dem reduzierten Druck in der Sammelkammer (2) ist, d.h. zwischen 40 mbar und 70 mbar.

4. Einspritzeinheit (1) nach einem der vorhergehenden Ansprüche, wobei die Form (4) mittels eines Einlasskanals (4a) fluiddynamisch mit der Sammelkammer (2) verbunden ist, wobei der Einlasskanal (4a) ein viertes Druckreduktionsventil (4b) aufweist, das eingerichtet ist, den Einlasskanal (4a) selektiv fluiddichterweise zu schließen.

5. Einspritzeinheit (1) nach einem der vorhergehenden Ansprüche, wobei der erste und/oder zweite Kolben (10, 20) eine Kontaktoberfläche mit dem geschmolzenen Material aufweist, die aus keramischem Material gefertigt ist.

6. Verfahren zum Einspritzen von geschmolzenem oder erweichtem Material innerhalb einer Form (4), umfassend

a. Bereitstellen einer Einspritzeinheit (1) nach Anspruch 4 oder Anspruch 5,
b. Erzeugen einer Druckreduktion in der Sammelkammer (2) zwischen etwa 40 und 70 mbar,
c. Positionieren des ersten Kolbens (10) und des zweiten Kolbens (20) nach der ausgefahrenen Konfiguration (E), die das Einführen des geschmolzenen Materials, vorzugsweise Aluminium oder Legierungen davon oder Kupfer oder Legierungen davon, in die Sammelkammer (2) unter reduziertem Druck von der Zuführeinheit (30) ermöglicht,
d. Verschieben des ersten Kolbens (10) zu dem zweiten Kolben (20), d.h. zu der zusammengezogenen Konfiguration, sodass das geschmolzene Material zwischen dem ersten und zweiten Kolben (10, 20) komprimiert wird,
e. Bewegen des ersten Kolbens (10) und des zweiten Kolbens (20) zu der Form (4) durch Verschieben,
f. Positionieren des zweiten Kolbens (20) innerhalb eines zweiten Sitzes (25), der innerhalb der Sammelkammer (20) angeordnet ist,
g. reversibles Bewegen des ersten Kolbens (10) zu dem zweiten Kolben (20) hin oder von ihm weg, um sich zu der zusammengezogenen Konfiguration hin oder von ihr weg zu bewegen, sodass zumindest das dritte oder vierte Druckreduktionsventil (42b, 4b), das mit der Form verbunden ist, selektiv geschlossen wird, sodass das Druckreduktionsniveau in einem Bereich vorzugsweise zwischen 40 mbar und 70 mbar erhöht wird,
h. Erreichen des gewünschten Druckreduktionsniveaus, Positionieren des zweiten Kolbens (20) innerhalb des zweiten Sitzes (25),
i. Bewegen des ersten Kolbens (10) weg vom zweiten Kolben (20), um die ausgefahrene Konfiguration zu erreichen,
j. Öffnen des vierten Ventils (4b), um die Sammelkammer (2) und das geschmolzene Material fluiddynamisch mit dem Einlasskanal (4a) der Form (4) zu verbinden, und selektives Schließen zumindest des ersten, zweiten und dritten Ventils,
k. gegenseitiges Bewegen des ersten Kolbens (10) und des zweiten Kolbens (20) zusammen und somit Einspritzen des geschmolzenen Materials innerhalb der Form (4).

7. Verfahren nach dem vorhergehenden Anspruch, wobei die Verschiebebewegung des ersten Kolbens (10) und des zweiten Kolbens (20) zu der Form (4) simultan durchgeführt wird.

8. Verfahren nach Anspruch 6 oder 7, umfassend

- Erzeugen eines Zustands reduzierten Drucks in einem Abschnitt der Sammelkammer (2), der zwischen dem zweiten Kolben (20) und dem zweiten Sitz (25) des zweiten Kolbens (20) vorhanden ist, vorzugsweise Schließen des vierten Ventils (4b) und Öffnen des dritten Ventils (42b), bevor das Einführen des geschmolzenen Materials in die Sammelkammer (2) ermöglicht wird.

9. Verfahren nach einem der Ansprüche 6 bis 8, umfassend

- Betätigen einer Zuführeinheit (30), die fluiddynamisch stromaufwärts der Sammelkammer (2) verbunden ist, und Einführen einer Stange aus einem vorbestimmten Material, vorzugsweise einem Metall, noch bevorzugter Aluminium oder den Legierungen davon oder Kupfer oder den Legierungen davon, innerhalb des in der Sammelkammer (2) aufgenommenen, geschmolzenen Materials.

Revendications

1. Unité d'injection (1) pour machines de coulée sous pression (200) comprenant

- une chambre de collecte (2) pour l'aluminium fondu ou ses alliages, le cuivre ou ses alliages ,
- un premier piston (10) et un second piston (20) qui sont reçus à l'intérieur de la chambre de collecte (2) et qui peuvent être déplacés le long

d'un axe longitudinal (X) de la chambre de collecte (2),

- les premier et second pistons (10, 20) étant agencés d'une manière telle que les trajets de déplacement respectifs sont alignés avec l'axe longitudinal (X) de la chambre de collecte (2) pour être capables de se déplacer d'une configuration déployée (E), dans laquelle la distance (D) entre les premier et second pistons (10, 20) à un maximum et la matière fondue est aspirée par pression réduite à l'intérieur de la chambre de collecte (2), à une configuration resserrée (R), dans laquelle la distance (D) entre les premier et second pistons (10, 20) est à un minimum et la matière fondue est évacuée de la chambre de collecte (2) et comprimée à l'intérieur d'un moule (4) qui est relié par dynamique des fluides à la chambre de collecte (2),

caractérisée en ce que

- un premier et un second système de réduction de pression (41, 42) qui sont reliés sensiblement en amont et en aval de la chambre de collecte (2) et les premier et second systèmes de réduction de pression (41, 42) étant reliés par dynamique des fluides à la chambre de collecte (2) au moyen d'une seconde et troisième vanne (41b, 42b),

- les seconde et troisième vannes (41b, 42b) étant adaptées pour commander sélectivement le niveau de réduction de pression de la chambre de collecte (2) qui est entre 40 mbar et 70 mbar à l'intérieur de la chambre de collecte (2).

2. Unité d'injection (1) selon l'une quelconque des revendications précédentes, dans laquelle la chambre de collecte (2) est reliée par dynamique des fluides en amont à une unité d'alimentation (30) qui est aussi sous pression réduite, l'unité d'alimentation (30) comprenant une première vanne de réduction de pression (30b) qui est intercalée par dynamique des fluides entre l'unité d'alimentation (30) et la chambre de collecte (2) et reliée à celles-ci.

3. Unité d'injection (1) selon la revendication précédente, dans laquelle la pression réduite de l'unité d'alimentation (30) est sensiblement égale à la pression réduite dans la chambre de collecte (2), c'est-à-dire entre 40 mbar et 70 mbar.

4. Unité d'injection (1) selon l'une quelconque des revendications précédentes, dans laquelle le moule (4) est relié par dynamique des fluides à la chambre de collecte (2) au moyen d'un canal d'entrée (4a), le canal d'entrée (4a) comprenant une quatrième vanne de réduction de pression (4b) qui est adaptée pour fermer sélectivement le canal d'entrée (4a) de manière étanche aux fluides.

5. Unité d'injection (1) selon l'une quelconque des revendications précédentes, dans laquelle le ou les premier(s) et/ou second(s) piston(s) (10, 20) comprend(nt) une surface de contact avec la matière fondue, laquelle surface est faite de matière céramique.

6. Procédé pour injecter une matière fondue ou ramollie à l'intérieur d'un moule (4), comprenant

a. la fourniture d'une unité d'injection (1) selon la revendication 4 ou la revendication 5,
b. la production d'une réduction de pression dans la chambre de collecte (2) entre approximativement 40 et 70 mbar,
c. le positionnement du premier piston (10) et du second piston (20) selon la configuration déployée (E) permettant l'introduction sous pression réduite à partir de l'unité d'alimentation (30) de la matière fondue, de préférence de l'aluminium ou ses alliages ou du cuivre ou ses alliages, dans la chambre de collecte (2),
d. le déplacement du premier piston (10) en direction du second piston (20), c'est-à-dire vers la configuration resserrée, comprimant ainsi la matière fondue entre les premier et second pistons (10, 20),
e. le déplacement en translation du premier piston (10) et du second piston (20) en direction du moule (4),
f. le positionnement du second piston (20) à l'intérieur d'un second siège (25) qui est situé à l'intérieur de la chambre de collecte (20),
g. le déplacement du premier piston (10) en direction de ou à distance du second piston (20) de manière réversible pour se déplacer en direction de ou à distance de la configuration resserrée, la fermeture sélectivement d'au moins la troisième ou quatrième vanne de réduction de pression (42b, 4b) qui est reliée au moule, augmentant ainsi le niveau de réduction de pression dans une plage de préférence entre 40 mbar et 70 mbar,
h. obtenu le niveau de réduction de pression souhaité, le positionnement du second piston (20) à l'intérieur du second siège (25),
i. le déplacement du premier piston (10) à distance du second piston (20) pour atteindre la configuration déployée,
j. l'ouverture de la quatrième vanne (4b) de manière à relier par dynamique des fluides la chambre de collecte (2) et la matière fondue au canal d'entrée (4a) du moule (4) et la fermeture sélectivement d'au moins les première, seconde, troisième vannes,
k. le déplacement mutuellement ensemble du premier piston (10) et du second piston (20) et ainsi l'injection de la matière fondue à l'intérieur du moule (4).

7. Procédé selon la revendication précédente, dans lequel le mouvement de translation du premier piston (10) et du second piston (20) en direction du moule (4) est effectué simultanément.

8. Procédé selon la revendication 6 ou la revendication 7, comprenant

- la production d'un état de pression réduite dans une partie de la chambre de collecte (2) comprise entre le second piston (20) et le second siège (25) du second piston (20), de préférence la fermeture de la quatrième vanne (4b) et l'ouverture de la troisième vanne (42b), avant de permettre l'introduction de la matière fondue dans la chambre de collecte (2).

9. Procédé selon l'une quelconque des revendications 6 à 8, comprenant

- l'actionnement d'une unité d'alimentation (30), qui est reliée par dynamique des fluides en amont de la chambre de collecte (2) et l'insertion à l'intérieur de la matière fondue contenue dans la chambre de collecte (2) d'un barreau d'une matière prédéterminée, de préférence un métal, de préférence encore l'aluminium ou ses alliages ou le cuivre ou ses alliages.

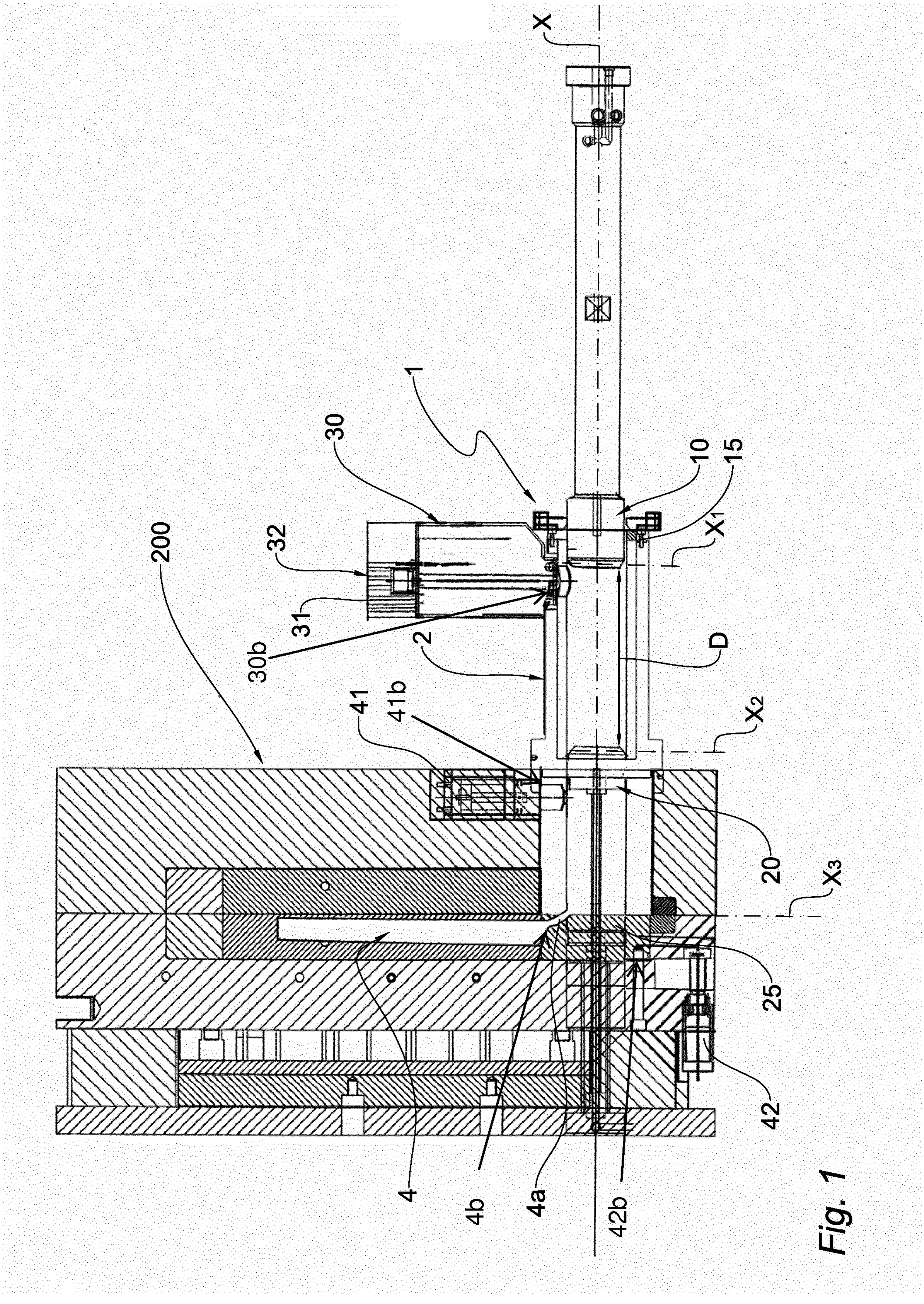

Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1046444 A1 **[0004]**
- JP H04143058 B **[0005]**
- EP 2407260 A **[0006]**