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(54) **CONTINUOUS CASTING FURNACE FOR THE MELTING OF NON-FERROUS METALS, IN PARTICULAR FOR JEWELRY**

(57) The present invention relates to a continuous casting furnace structure (10) for melting non-ferrous metals, in particular for jewellery making, comprising a supporting frame (11) on which there are arranged a melting and casting head (12), a pulling unit (13) for the extraction of a profile descending from said melting and casting head (12), and a cabinet (14), said cabinet (14) containing an electric generator unit (15), a hydraulic cooling unit (16), an inert gas circuit (17) and an electronic control unit.

In particular, the head (12) is removably mounted on a support shelf (31) of said supporting frame (11).

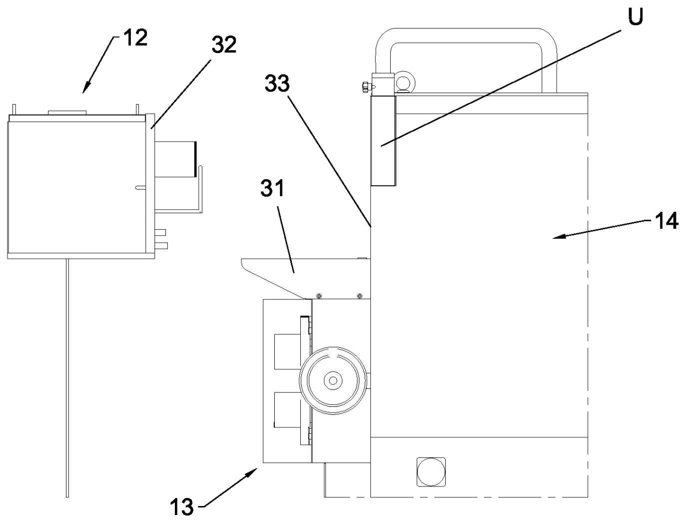

Fig. 4

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Description

Technical sector

[0001] The present invention relates to a continuous casting furnace structure for melting non-ferrous materials, particularly for jewellery making.

Background

[0002] The invention relates to the technical sector of melting alloys for jewellery with varying carat weight and various semi-finished profiles made using the method of "continuous casting."

[0003] Continuous casting furnaces generally produce semi-finished articles in the form of a wire, a bar, a sheet or a tube.

[0004] The invention is intended to prevent any contamination between the various metal alloys with different carat weights and compositions which are introduced into the continuous casting furnace.

[0005] It is nowadays known that the technique of continuous casting melting ensures a very high quality and ductility of the semi-finished alloys for the production of jewellery; generally, the manufacturers of furnaces, following a simple commercial practice, are organized to construct and sell a specific type or model of furnace for each type of profile which the buyer intends producing. The industrial process of metal working has, during the course of its history, undergone improvements as regards the methods used and the plants which have become increasingly more advanced and sophisticated; over the years the industrial processes for the production and machining of metallic materials have been developed so as to define highly dedicated techniques and technology for the specific compositions of the metal alloys which are to be made and formed. These techniques over the years have resulted in the development of melting furnaces which vary depending on the amount of metal to be melted, and in particular furnaces for processing daily batches and continuous-cycle furnaces are known.

[0006] These growth trends have been of fundamental importance in particular for the jewellery industry, where production has increased from a micro or small scale to large-scale artisanal production on a global and industrial level.

[0007] Nowadays induction furnaces have become increasingly more widespread compared to gas melting furnaces, still used in the poorer less industrialized countries, and electric resistance furnaces.

[0008] The induction furnace is used in particular in foundries where large-size castings are not required, as in the case of gold and gold alloy processing, and where large weights with very small volumes are present; owing to induction furnaces semi-finished articles, such as tubes, sheets and wires, with varying sizes and diameters depending on the user's requirements, are thus obtained and, in particular, the semi-finished articles obtained with continuous casting induction furnaces have very high ductility and quality characteristics compared to any other melting process previously performed manually using cast-iron clamps or ingot moulds. The first continuous casting induction furnaces introduced into the jewellery-making industry shortly before the 1980s opened up the market opportunities for the various furnace manufacturers first in Italy and then all over the world.

[0009] The continuous casting induction furnaces for melting non-ferrous metals which are known nowadays, although being increasingly more widespread and popular, have a number of drawbacks.

[0010] A first drawback is associated with that mentioned above regarding the unique intended use of a furnace model for a specific product.

[0011] Therefore, until now, if a company which produces profiles made of non-ferrous material wishes to produce both a wire, and a sheet, and a tube, or two tubes with different compositions or carat weights, this production company has to acquire three or four complete furnaces, with a consequent multiplication of the costs.

[0012] This problem is associated with the particular structure of the continuous casting induction furnace mainly present today on the market, which furnace structure generally comprises a supporting frame on which there are arranged a melting and casting head, a pulling unit for the extraction of the profile descending from the melting and casting head, and a cabinet containing an electric generator unit, a hydraulic cooling unit, an inert gas circuit and an electronic control unit; the melting and casting head comprising in turn:

- a box-like containment body, having an upper lid and a bottom;
- a crucible, usually made of graphite;
- a ceramic jacket surrounding the crucible;
- an airtight chamber defined between the crucible and the ceramic jacket and apt to fill with inert protection gas;
- a ceramic hatch for loading the metallic material to be melted, resting on the crucible by means of a sealing element, said ceramic hatch being configured to pass through the lid so as to be available for loading the granular metallic material to be melted;
- an inductor surrounding the ceramic jacket;
- a forming base, in the sector known as a "profile" or "die", having a shaped through-hole through which the molten metallic material descends towards the underlying pulling unit; this forming base is inserted in the lower part of the crucible and extends so as to cross the bottom of the ceramic jacket as far as a descent opening defined on the bottom of the box-like containment body;
- means for cooling the inductor;
- means for cooling the lower portion of the forming base;

- means for detecting the temperature of the crucible;
- means for detecting the temperature of the forming base.

[0013] The electric generator unit is configured to power the inductor and the pulling unit, where the pulling unit normally comprises an electric motor.

[0014] The hydraulic cooling unit is configured to supply the cooling means of the inductor and the means for cooling the lower portion of the forming base.

[0015] The inert gas circuit is configured to fill the airtight chamber and the crucible.

[0016] Nowadays, in order to change the intended use of a same melting and casting head from a first metal alloy to a second metal alloy, or from a first cross-sectional profile of the product to a second cross-sectional profile of the product, complex and delicate operations are required for disassembly of the crucible and the forming base.

[0017] The structural complexity of the melting and casting heads of the known type, as described above, therefore results, for example, in an operation for removal of a forming base which requires great expenditure, in terms of time, at least three hours, as well as labour, since it requires the intervention of an expert operator, with a consequent lack of productivity due to the machine downtime. In general, therefore, in the similar furnaces known nowadays, the head is fixed and the assembly consisting of a crucible and a specific die provide a specific profile, for example a wire with a circular cross-section, made using a specific metal alloy, and it is not possible to change quickly the die for the production of a wire with a round cross-section using a different die, for example for the production of a profile defining a rectangular sheet.

[0018] Since nowadays it is often necessary to change also the carat weight - or in in general the composition - of the alloy which is to be used for specific production needs, in order to satisfy increasingly numerous and demanding markets, manufacturers are substantially obliged to acquire several machines with a single head or machines with a fixed double head, in order to cover all the various production needs.

[0019] A second major drawback of the prior art is associated with the fact that, where a manufacturer does not have access to several machines, the need to replace the die and/or the crucible in order to change the carat weight during the same working day, results in the risk of breakage of the ceramic jacket since this jacket is sealed using a special ceramic silicone to the graphite parts which pass through it, namely the crucible and the die.

[0020] The mechanical separation of the crucible, die and ceramic jacket can therefore lead to damage of one or more of these parts, in particular in the frustoconical zone where the crucible and die are coupled together, and in the initial internal part of the die, where just a scratch or slight damage to the surface risks making the part unusable. Therefore, attempting to quickly replace one or more of the components, i.e. crucible, die and ceramic jacket, does not help avoid the risk of damage, which in turn leads to major costs, in particular as regards the possible irreparable damage to the die, which is a fundamental component of the continuous casting melting process.

Summary of the invention

[0021] The main task of the present invention is to therefore to provide a continuous casting furnace structure for melting non-ferrous materials, in particular for jewellery making, able to overcome the limitations and drawbacks of the prior art.

[0022] In connection with this task, an important object of the invention is to provide a continuous casting furnace structure which is able to allow rapid change-over of the intended end product, both in terms of the metal alloy used and in terms of the shape of the profile output from the melting head.

[0023] Another object of the invention is to provide a continuous casing furnace structure which is able to lengthen the life of the graphite parts.

[0024] Yet another object of the present invention is to provide a continuous casting furnace structure which has an efficiency and performance not inferior to those of similar furnaces of the known type.

[0025] The aforementioned task and objects are achieved by a continuous casting furnace structure for melting non-ferrous materials, in particular for jewellery making, according to claim 1.

[0026] Detailed characteristics of the furnace structure according to the invention are described in the dependent claims.

[0027] Further characteristic features and advantages will emerge more clearly from the description of a preferred, but non-exclusive, embodiment of the continuous casting furnace structure for melting non-ferrous materials according to the invention, with the aid of the drawings provided by way of a non-limiting example in the attached illustrations and listed below.

Brief description of the figures

[0028] Reference will be made to the figures of the attached drawings in which:

- Figure 1 shows a schematic perspective view of a furnace structure according to the invention;
- Figure 2 shows a side view of the furnace structure according to Figure 1;
- Figure 3 shows a schematic cross-sectioned view of a melting and casting head of the furnace structure according to the invention;
- Figure 4 shows a partially exploded side view of the furnace structure according to the invention;
- Figure 4A is a perspective view of Figure 4;
- Figure 5 is a rear perspective view of the melting and casting head of the furnace structure according

to the invention;

- Figure 6 shows a different rear perspective view of the melting and casting head according to Figure 5;
- Figure 7 shows a schematic view of the connections between the elements of the melting and casting head and the units inside the cabinet;
- Figures 8 to 13 each show a phase during a process for replacing a first melting and casting head with a second melting and casting head of the furnace structure according to the invention;
- Figure 14 shows a front view of a pulling unit of the furnace structure according to the invention in an operating condition;
- Figure 15 shows a front view of the pulling unit of Figure 14 in a non-operating condition;
- Figure 16 shows a schematic side view of the pulling unit of the furnace structure according to the invention;
- Figure 17 shows a rear perspective view of the pulling unit of the furnace structure according to the invention;
- Figure 18 shows a schematic front view of the pulling unit in an operating condition;
- Figure 19 shows the same view as Figure 18 in a non-operating condition; The thicknesses and curvatures shown in the figures mentioned above must be understood as being purely exemplary and are generally on a larger scale and not necessarily shown in proportion.

Detailed description of preferred embodiments

[0029] Below various embodiments and variants of the invention will be described with reference to the figures mentioned above.

[0030] Similar components are indicated in the various figures by the same reference number.

[0031] In the detailed description which follows, embodiments and variants in addition to those embodiments and variants already considered in the same description will be described only with regard to their differences from that already described.

[0032] Furthermore, the various embodiments and variants described below may be used in combination, where compatible.

[0033] With reference initially to Figure 1, the continuous casing furnace structure according to the invention is denoted overall by the number 10.

[0034] In the context of the present disclosure, the expression "furnace structure" is understood as being a furnace. In other words, the expression "furnace structure" is used as a synonym for furnace.

[0035] Said furnace structure 10 comprises a supporting frame 11 on which there are arranged a melting and casting head 12, a pulling unit 13 for the extraction of a profile descending from said melting and casting head 12, and a cabinet 14. The cabinet 14 contains an electric generator unit 15, a hydraulic cooling unit 16, an inert gas circuit 17 and comprises an electronic control unit U.

[0036] The electric generator unit 15, the hydraulic cooling unit 16 and the inert gas circuit 17 are schematically shown by means of broken-line rectangles in Figure 2 and are to be understood as being of the type known per se.

[0037] The electric generator unit 15, the hydraulic cooling unit 16, the inert gas circuit 17 and the electronic control unit U are to be understood as being positioned outside of the cabinet 14 or inside, or partly outside and partly inside.

[0038] The melting and casting head 12, schematically shown in Figure 3, comprises in turn:

- a box-like containment body 18, having an upper lid 19 and a bottom 20;
- a crucible 21, said crucible 21 being preferably, but not exclusively made of graphite or another technically equivalent material;
- a ceramic jacket 22 surrounding the crucible 21;
- an airtight chamber 23 defined between the crucible 21 and the ceramic jacket 22 and apt to fill with inert protection gas;
- a ceramic hatch 24 for loading the metallic material to be melted, resting on the crucible 21 by means of a sealing element 25, the ceramic hatch 24 being configured to pass through the upper lid 19 so as to be available for loading the metallic material to be melted;
- an inductor 26 surrounding the ceramic jacket 22;
- a forming base 27, in the sector also known as a "die", having a shaped through-hole 28 through which a melted metallic material descends towards the underlying pulling unit 13, the forming base 27 being inserted in the lower part of the crucible 21 and extending so as to cross the bottom 22a of the ceramic jacket 22 as far as a descent opening 29 defined on the bottom 20 of the box-like containment body 18;
- means for cooling the inductor 26;
- means for cooling a lower portion 27a of said forming base 27;
- means for detecting the temperature of the crucible 21;
- means for detecting the temperature of the forming base 27.

[0039] The electric generator unit 15 is configured to power the at least one inductor 26.

[0040] The forming base 27, also known as "die", is preferably made of graphite, but it is understood that it may also be made of another similar and technically equivalent material.

[0041] The hydraulic cooling unit 16 is configured to supply said cooling means of the inductor 26 and the means for cooling said lower portion 27a of the forming base 27.

[0042] The inert gas circuit 17 is configured to fill the airtight chamber 23 and the crucible 21.

[0043] The inert gas may be nitrogen or argon, or another similar or technically equivalent protective fluid.

[0044] The special feature of the present invention consists in the fact that the melting and casting head 12 is mounted removably on a support shelf 31 of said supporting frame 11. In this way, the melting and casting head 12 can be decoupled from the supporting frame 11 and it is therefore possible to replace the melting and casting head 12 with a different melting and casting head 12 depending on the type of alloy to be melted or the type of profile which is to be obtained.

[0045] In particular, the melting and casting head 12 has a rear panel 32, which is clearly visible in Figures 5 and 6, facing a correspondingly counter-shaped connection opening 33 defined on said cabinet 14.

[0046] The connection opening 33 allows an operator to access the rear panel 32 from the inside of the cabinet 14, once the cabinet 14 has been opened laterally. The rear panel 32 has:

- first reversible connection means 40 configured to electrically connect said inductor 26 with said electric generator unit 15;
- second reversible connection means 41 configured to hydraulically connect said cooling means of said inductor 26 with said hydraulic cooling unit 16;
- third reversible cooling means 42 configured to connect said means for cooling said lower portion 27a of said forming base 27 either with said hydraulic cooling unit 16 or with an auxiliary cooling unit;
- fourth reversible connection means 43 configured to connect said temperature detection means with said electronic control unit U;
- fifth reversible connection means 44 configured to connect said airtight chamber 23 and said crucible 21 with said inert gas circuit 17.

[0047] The airtight chamber 23 is sealed by means of sealing with ceramic silicone.

[0048] In accordance with that already known, a gripping bar 50 may be placed inside the shaped through-hole 28 in order to start the descent of the solidifying melted metal.

[0049] The first reversible connection means 40 comprise two electric power cables with terminals for connection to the generator unit 15.

[0050] The first reversible connection means 40 also comprise two signal cables 40a. The means for cooling the inductor 26 are included in the same inductor 26 which is tubular and inside which cooling water flows.

[0051] The second reversible connection means 41 may therefore be hydraulic connection elements of the known type.

[0052] The second reversible connection means 41 comprise two flexible hydraulic pipes.

[0053] The means for cooling the lower portion 27a of the forming base 27, or "die" comprise an annular bushing 51, schematically indicated in Figure 3, in turn surrounded by an annular tubular channel 52 for cooling water.

[0054] The third reversible connection means 42 comprise therefore flexible hydraulic pipes.

[0055] The temperature detection means comprise a first thermocouple 45 for detecting the temperature of the crucible 21 and a second thermocouple 46 for detecting the temperature of the forming base 27.

[0056] The fourth reversible connection means 43 therefore comprise respective electric cables and simple plug-in connectors.

[0057] The inert gas circuit 17 comprises an inert gas cylinder and a corresponding duct for delivery of the inert gas towards the melting and casting head 12.

[0058] The fifth reversible connection means therefore comprise at least one line of pipes configured to introduce the inert gas into the crucible 21 and the airtight chamber 23.

[0059] Advantageously, the first reversible connection means 40, the second reversible connection means 41, the third reversible connection means 42, the fourth reversible connection means 43 and the fifth reversible connection means 44 extend from said rear panel 32 and cross said connection opening 33 towards the inside of said cabinet 14.

[0060] Owing to this special furnace structure 10 it is possible to replace a melting and casting head 12 with another one by simply disconnecting the aforementioned reversible connection means, said operation being able to be performed by an operator in a rapid and intuitive manner.

[0061] Figures 8 to 13 schematically show in chronological order the main steps in a process for replacing a first melting and casting head 12A with a second melting and casting head 12B having a different forming base or having a new crucible suitable for the melting of an alloy different from that used in the crucible of the first melting and casting head 12A.

[0062] In this non-limiting example of embodiment of the invention, the support shelf 31 comprises two, substantially horizontal, parallel brackets on which a melting and casting head 12, 12A or 12B is transferred by means of frontal displacement or frontal sliding from a support carriage 60 towards the support shelf 31 or, vice versa, from the support shelf 31 towards the support carriage 60.

[0063] Figure 8 shows a first replacement step in which the support carriage 60 is moved towards the furnace structure 10 having, mounted thereon, a first melting and casting head 12A.

[0064] The support carriage 60 advantageously is substantially symmetrical and carries a second melting and casting head 12B.

[0065] Figure 9 schematically shows a positioning step in which a first support portion of the support carriage 60 is slid between the brackets of the support shelf 31 and the first melting and casting head 12A is disconnected from the cabinet 14 by means of opening of all the reversible connection means.

[0066] Figure 10 shows schematically a step involving the movement away of the support carriage 60 carrying both the first melting and casting head 12A and the second melting and casting head 12B intended to be connected to the cabinet 14 instead of the first melting and casting head 12A.

[0067] Figure 11 shows a step where the support carriage 60 is rotated so as to position the second casting and melting head 12B facing the cabinet 14, the second melting and casting head 12B being positioned on the support carriage 60 such that the rear panel 32 is directed outwards and therefore towards the connection opening 33 defined on the cabinet 14.

[0068] The connection opening 33 is defined opposite the support shelf 31 and above it.

[0069] Figure 12 schematically shows a step where the second melting and casting head 12B is transferred from the support carriage 60 onto the support shelf 31, with the consequent introduction of the reversible connection means inside the connection opening 33 and consequent step of performing the connections.

[0070] Figure 13 shows schematically a final step involving the movement away of the support carriage 60 carrying the first melting and casting head 12A which remains available for subsequent use.

[0071] Figures 14 to 19 show in greater detail the pulling unit 13.

[0072] The puling unit 13 is, in a known manner, positioned underneath the melting and casting head 12, 12A and 12B.

[0073] The pulling unit 13 comprises two pairs of shaped drive rollers, i.e. a first pair of upper shaped drive rollers 71 and 72 and a second pair of lower shaped drive rollers 73 and 74.

[0074] Each shaped drive roller 71, 72, 73, 74 is driven by a corresponding dedicated gearmotor 71a, 72a, 73a, 74a.

[0075] A first upper shaped roller 71 and a first lower shaped roller 73 are mounted on a first slide 75, while the second upper shaped roller 72 and the second lower shaped roller 74 are mounted on a second slide 76; the first slide 75 and second slide 76 are movable along a line perpendicular to the direction of output of a profile P formed by the melting and casting head 12.

[0076] For example, the movement line of the first slide 75 and second slide 76 is substantially horizontal, where the axis Y of descent of the profile P is substantially vertical.

[0077] The first slide 75 and the second slide 76 are slidable on respective horizontal guides 81 and 82 towards and away from each other. The horizontal guides 81 and 82 comprise for example two cylindrical bars, an upper bar and a lower bar, on which both the first slide 75 and the second slide 76 slide.

[0078] The two slides 75 and 76 are moved by symmetrical translation means configured cause a translation of the two slides 75 and 76, where the translation movements of the two slides 75 and 76 are:

- of the same amount, for example L1 and L2 in a first condition shown in Figure 8, and L3 and L4 in a second condition shown in Figure 9, with respect to a plane passing through an axis Y of descent of a formed profile P;
- such that these amounts L1,L2,L3,L4 are measured along a same translation axis X, where said translation axis X is transverse to the plane passing along the axis of descent Y;
- in the opposite direction or opposite sense.

[0079] At least one shaped drive roller of each slide is motorized, namely at least one shaped drive roller of the two shaped drive rollers 71 and 73 of the first slide 75 and at least one shaped drive roller of the two shaped drive rollers 72 and 74 of the second slide 76 are motorized.

[0080] Preferably and advantageously, each shaped drive roller 71, 72, 73, 74 is driven by a corresponding dedicated gearmotor 71a, 72a, 73a, 74a.

[0081] Each shaped drive roller 71, 72, 73, 74 is mounted on its corresponding first slide 75 or second slide 76 together with the corresponding dedicated gearmotor 71a, 72a, 73a, 74a.

[0082] The symmetrical translation means comprise for example:

- a driving bar 77 comprising a first threaded section 77a intended for the first slide 75 and a second threaded section 77b intended for the second slide 76;
- a first nut 78 integral with the first slide 75 and coupled to the first threaded section 77a;
- a second nut 79 integral with the second slide 76 and coupled to the second threaded section 77b.

[0083] The first threaded section 77a and the first nut 78 are configured to cause the displacement of the first slide 75 in a first direction along the translation axis X, and the second threaded section 77b and the second nut 79 are configured to cause the displacement of the second slide in the second direction opposite to the first direction along the same translation axis X.

[0084] For example, the symmetrical translation means comprise:

- a first threaded bar 77 where the first threaded section 77a and the second threaded section 77b are symmetrical with respect to the plane passing through the Y axis;
- a first nut 78 having a first counter-threading with a first orientation, said first nut 78 being located in the first slide 75;
- a second nut 79 having a second counter-threading with a second symmetrical opposite orientation with respect to the first orientation of the first nut 78.

[0085] The threaded driving bar 77 is operated for example by a manually operated handwheel 80.

[0086] Alternatively, the threaded driving bar 77 is operated by an electric precision motor.

[0087] The horizontal guides 81 and 82 and the threaded driving bar 77 are mounted inside a structural frame 85 which is in turn fixed to the supporting frame 11 of the furnace structure 10 according to the invention.

[0088] The structural frame 85 consists, for example but not exclusively, of a single-piece aluminium block.

[0089] The first slide 75 and the second slide 76 have a shape with opposite steps which favour their mutual centring when they move close together towards a working position, as shown by way of example in Figure 18.

[0090] Elastic thrust elements are mounted on the guides 81 and 82 and ensure the packing closure of the first slide 75 and the second slide 76; these elastic thrust elements are for example calibrated springs, not shown for simpler illustration. Such a pulling unit 13 is able to achieve an important advantage associated with the use of four motors, one for each of the drive rollers, since owing to the four motorized drive motors it is possible to obtain optimum control of the pulling force on the profile descending from the melting and casting head 12, preventing tearing and breakage of the same profile P. "Descending profile" is understood as meaning a profile output from the melting and casting head 12.

[0091] Furthermore, owing to the symmetrical translation means, rapid and precise symmetrical splaying of the driving rollers is obtained, with release of the final profile section descending from a first melting and casting head 12A, therefore allowing rapid removal of the melting and casting head 12 from the cabinet 14 as described above.

[0092] It can therefore be understood how with a furnace structure 10 according to the present invention the predefined task and objects may be achieved.

[0093] In particular, with the present invention a continuous casting furnace structure has been provided such that the small-size manufacturer may have only one induction generator, but has the possibility of using two or more different melting and casting heads 12, 12A, 12B, thus cutting costs in a very significant manner. Furthermore, with the invention a furnace structure has been provided such that the graphite parts, i.e. the crucible, die and ceramic parts, are able to reach the end of their working life, whereas previously they could be used only a few times a month depending on needs.

[0094] With the present invention it has been possible to provide a furnace structure which avoids the forced replacement of the aforementioned parts, eliminating the risks of damage and the long machine downtime required for changes in the intended final use.

[0095] In particular, a furnace structure 10 according to the invention has a preferred application in the sector of fine and costume jewellery, and in general in the sector of fashion accessories, which comprise the manufacture of semi-finished profiles to be extracted by continuous casting, such as round wires, square wires, semi-round wires, rectangular sheets, sheets with particular profiles, empty tubes of various sizes.

[0096] The invention thus devised may be subject to numerous modifications and variations, all of which fall within the scope of protection of the attached claims. Moreover, all the details may be replaced by other technically equivalent elements.

[0097] Where the operational characteristics and the techniques mentioned are followed by reference numbers or symbols, these reference numbers or symbols have been assigned with the sole purpose of facilitating understanding of the description and said claims and consequently they do not limit in any way the interpretation of each element which is identified, purely by way of example, by said reference numbers or symbols.

Claims

1. Continuous casting furnace structure (10) for melting non-ferrous metals, particularly for jewellery making, comprising a supporting frame (11), on which there are arranged a melting and casting head (12), a pulling unit (13) for the extraction of a profile descending from said melting and casting head (12), and a cabinet (14), said cabinet (14) containing an electric generator unit (15), a hydraulic cooling unit (16) and an inert gas circuit (17), and comprising an electronic control unit, said melting and casting head (12) comprising in turn:

    - a box-like containment body (18), having an upper lid (19) and a bottom (20),
    - a crucible (21),
    - a ceramic jacket (22) surrounding said crucible (21),
    - an airtight chamber (23) defined between the crucible (21) and the ceramic jacket (22) and apt to fill with inert protection gas,
    - a ceramic hatch (24) for loading the metallic material to be melted, resting on said crucible (21) by means of a sealing element (25), said ceramic hatch (24) being configured to pass through said upper lid (19) so as to be available for loading the metallic material to be melted,
    - an inductor (26) surrounding said ceramic jacket (22),
    - a forming base (27) having a shaped through-hole (28) through which a molten metallic material descends towards said underlying pulling unit (13); said forming base (27) being inserted in the lower part of the crucible (21) and extending so as to cross the bottom of said ceramic jacket (22) as far as a descent opening (29) defined on said bottom (20) of said box-like containment body (18),
    - means for cooling said inductor (26),
    - means for cooling a lower portion (27a) of said

forming base (27),
- means for detecting the temperature of said crucible (21),
- means for detecting the temperature of said forming base (27),

said electric generator unit (15) being configured to power at least said inductor (26),

said hydraulic cooling unit (16) being configured to supply said means for cooling the inductor and said means for cooling said lower portion (27a) of said forming base (27),
said inert gas circuit (17) being configured to fill said airtight chamber (23) and said crucible (21),
characterized in that
said melting and casting head (12) is removably mounted on a support shelf (31) of said supporting frame (11).

2. Furnace structure according to claim 1, **characterized in that** said melting and casting head (12) has a rear panel (32) facing a corresponding counter-shaped connection opening (33) defined on said cabinet (14).

3. Furnace structure according to the preceding claim, **characterized in that** said rear panel (32) has:

- first reversible connection means (40) configured to electrically connect said inductor (26) with said electric generator unit (15),
- second reversible connection means (41) configured to hydraulically connect said means for cooling said inductor (26) with said hydraulic cooling unit (16),
- third reversible connection means (42) configured to connect said means for cooling said lower portion (27a) of said forming base (27) either with said hydraulic cooling unit (16) or with an auxiliary hydraulic cooling unit,
- fourth reversible connection means (43) configured to connect said temperature detection means with said electronic control unit,
- fifth reversible connection means (44) configured to connect said airtight chamber (23) and said crucible (21) with said inert gas circuit.

4. Furnace structure according to the preceding claim, **characterized in that** said first reversible connection means (40) comprise two electric power cables with terminals for connection to the generator unit (15).

5. Furnace structure according to one or more of the preceding claims, **characterized in that** said first reversible connection means (40) also comprise two signal cables (40a).

6. Furnace structure according to one or more of the preceding claims, **characterized in that** said means for cooling the inductor (26) are included in the same inductor (26) which is tubular, and cooling water flows inside it, said second reversible connection means (41) comprising two flexible hydraulic pipes.

7. Furnace structure according to one or more of the preceding claims, **characterized in that** said means for cooling the lower portion (27a) of the forming base (27), or 'die', comprise an annular bushing (51), which in turn is surrounded by an annular tubular channel (52) for cooling water, said third reversible connection means (42) therefore comprising flexible hydraulic pipes.

8. Furnace structure according to one or more of the preceding claims, **characterized in that** said temperature detection means comprise a first thermocouple (45) for detecting the temperature of the crucible (21) and a second thermocouple (46) for detecting the temperature of the forming base (27), said fourth reversible connection means (43) therefore comprising corresponding electric cables and simple plug-in connectors.

9. Furnace structure according to one or more of the preceding claims, **characterized in that** said inert gas circuit (17) comprises an inert gas cylinder and a corresponding duct for delivering inert gas towards the melting and casting head (12), said fifth reversible connection means therefore comprising at least one line of pipes configured to introduce the inert gas into the crucible (21) and into the airtight chamber (23).

10. Furnace structure according to one or more of the preceding claims, **characterized in that** said first reversible connection means (40), second reversible connection means (41), third reversible connection means (42), fourth reversible connection means (43) and fifth reversible connection means (44) extend from said rear panel (32) and pass through said connection opening (33) towards the inside of said cabinet (14).

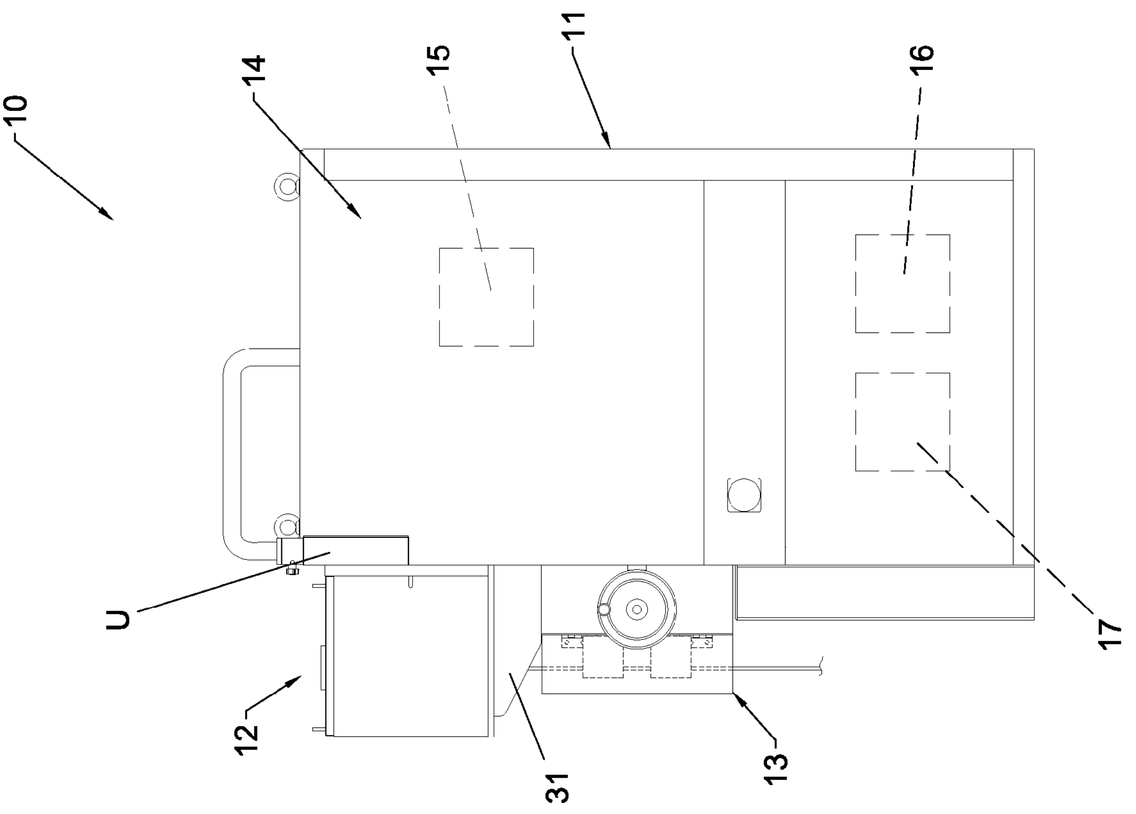

Fig. 2

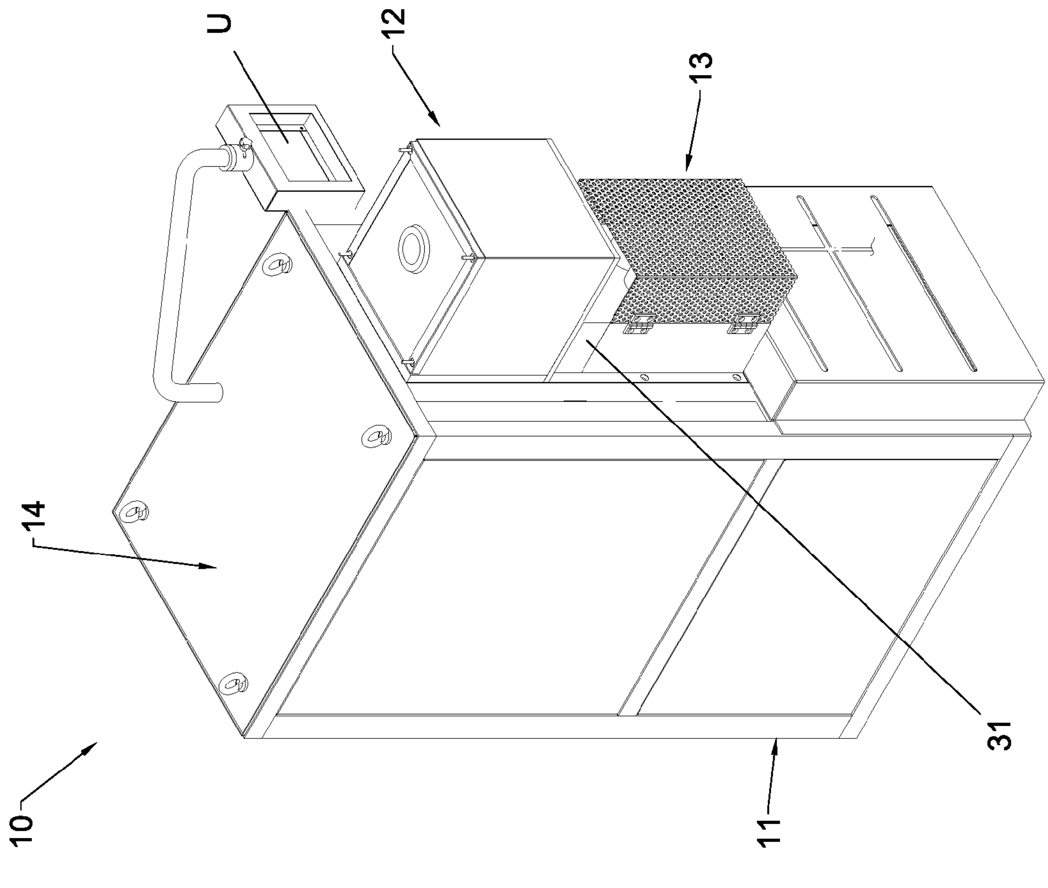

Fig. 1

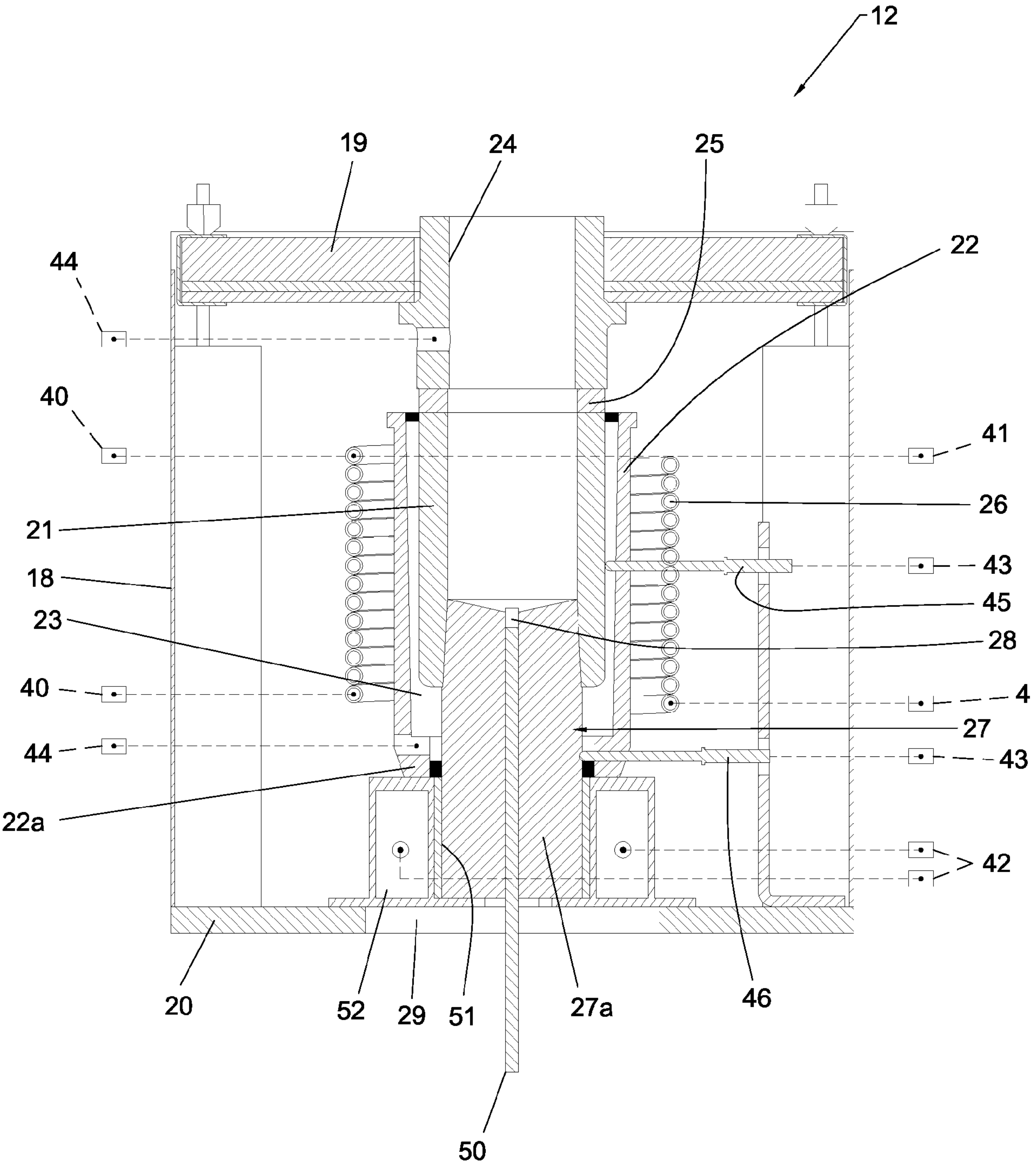
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Fig. 3

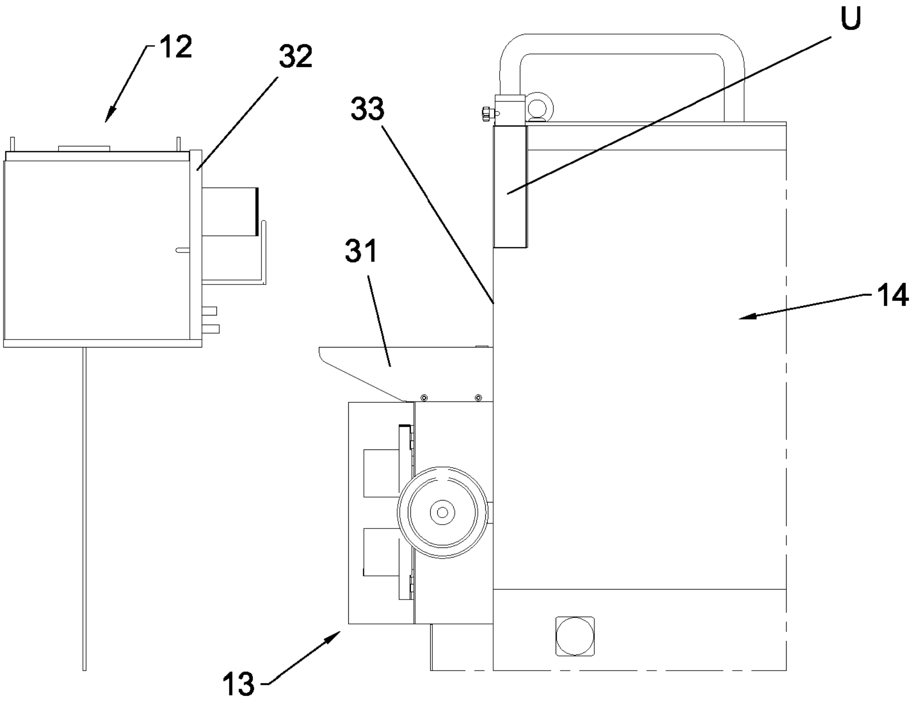

Fig. 4

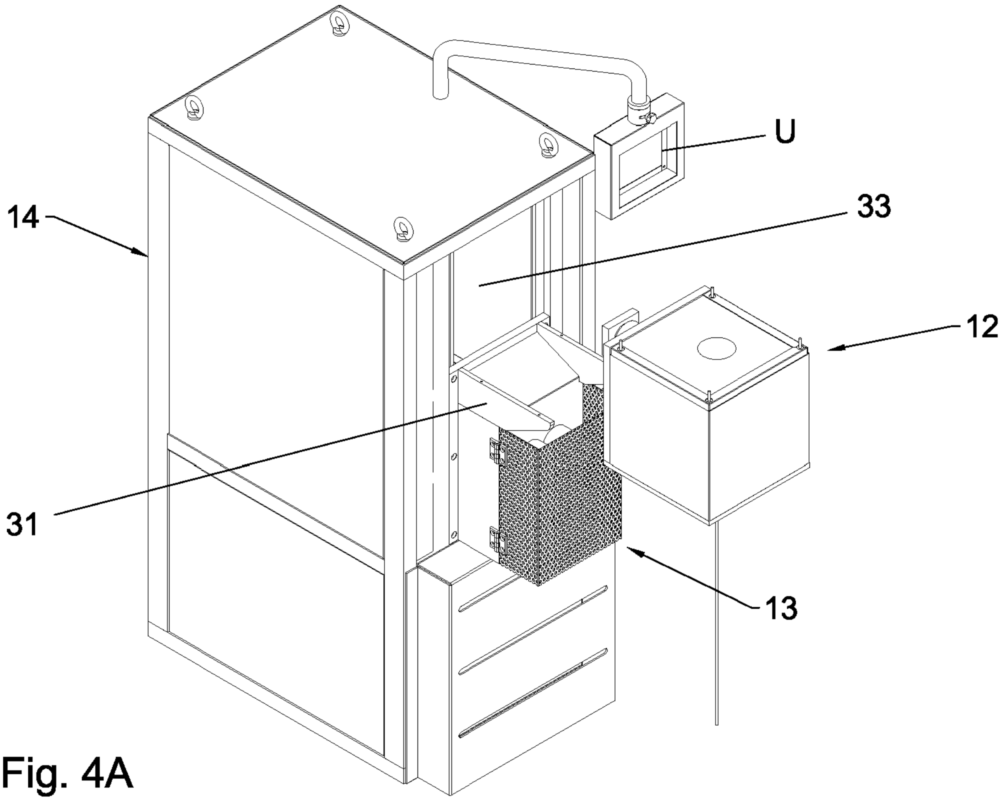

Fig. 4A

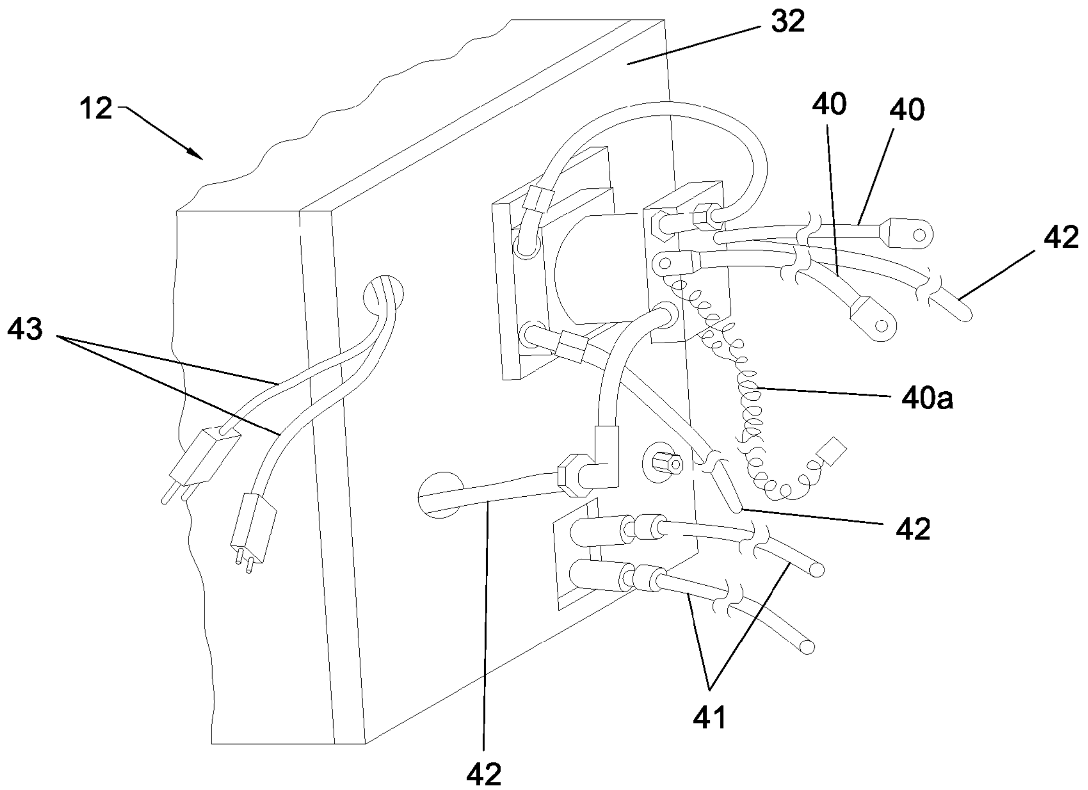

Fig.5

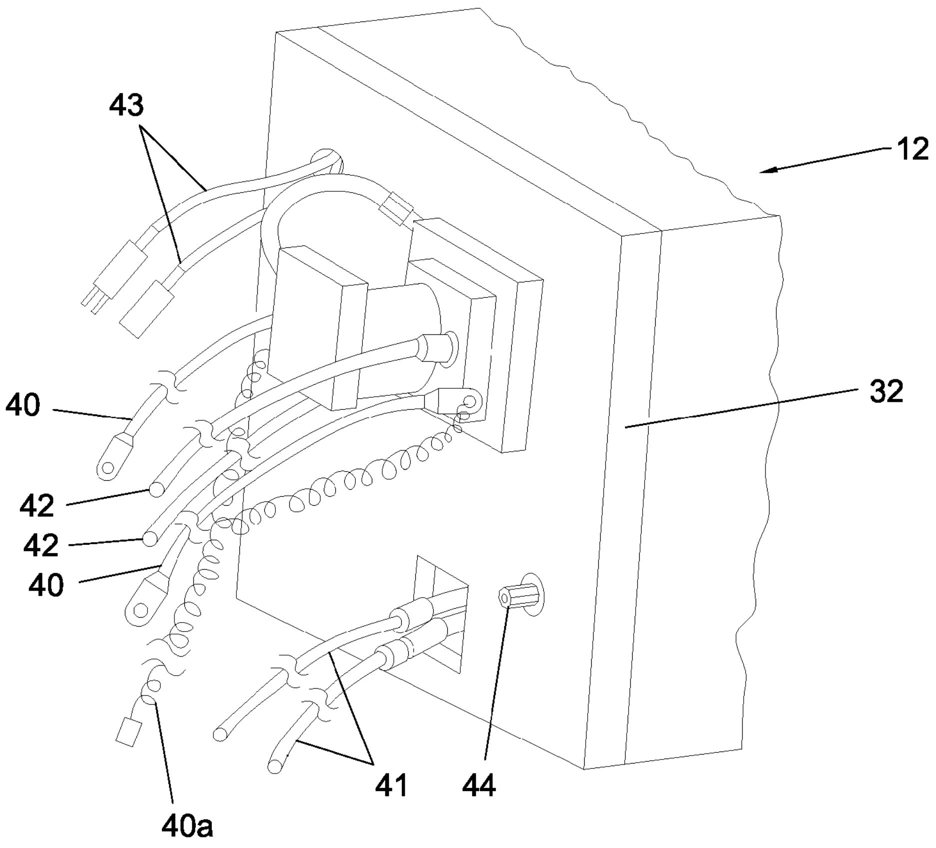

Fig.6

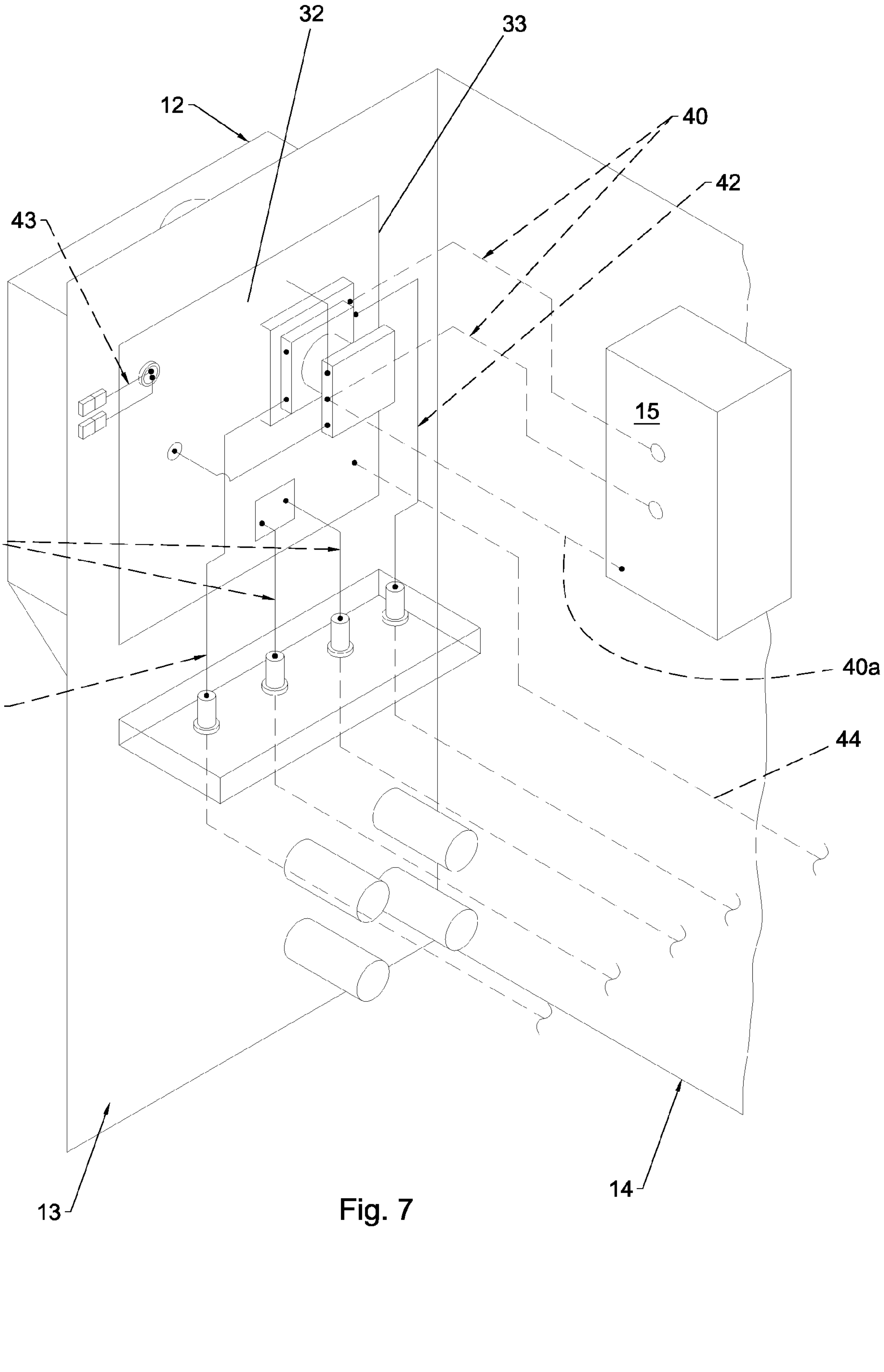

Fig. 7

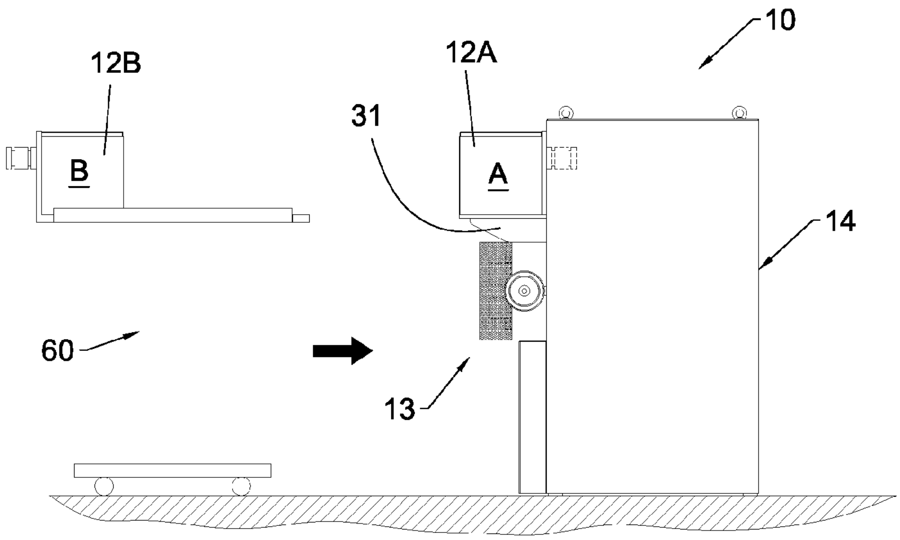

Fig. 8

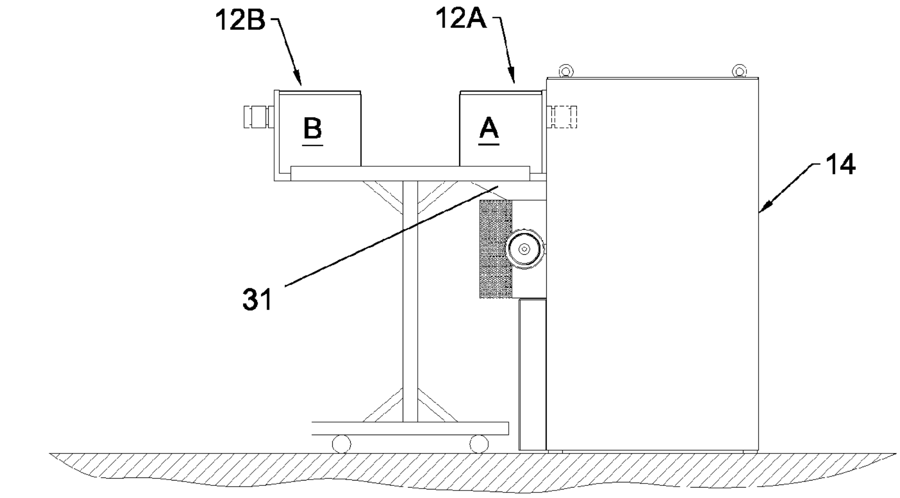

Fig. 9

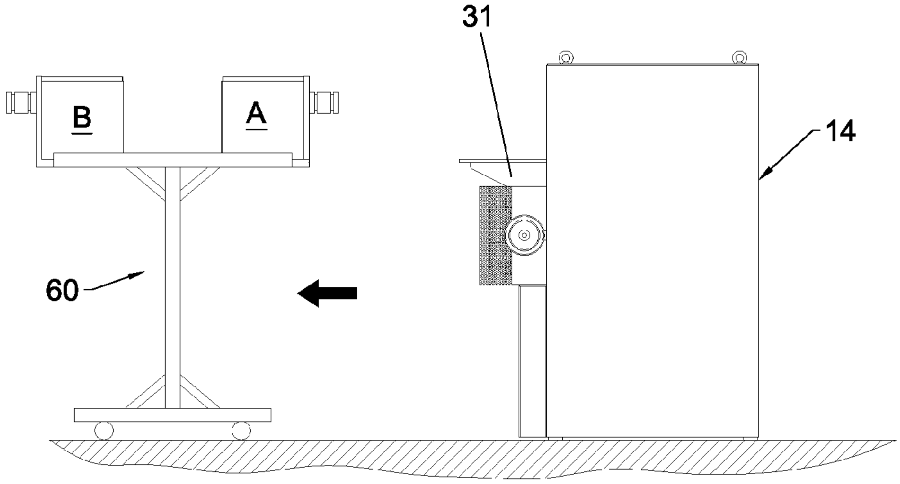

Fig. 10

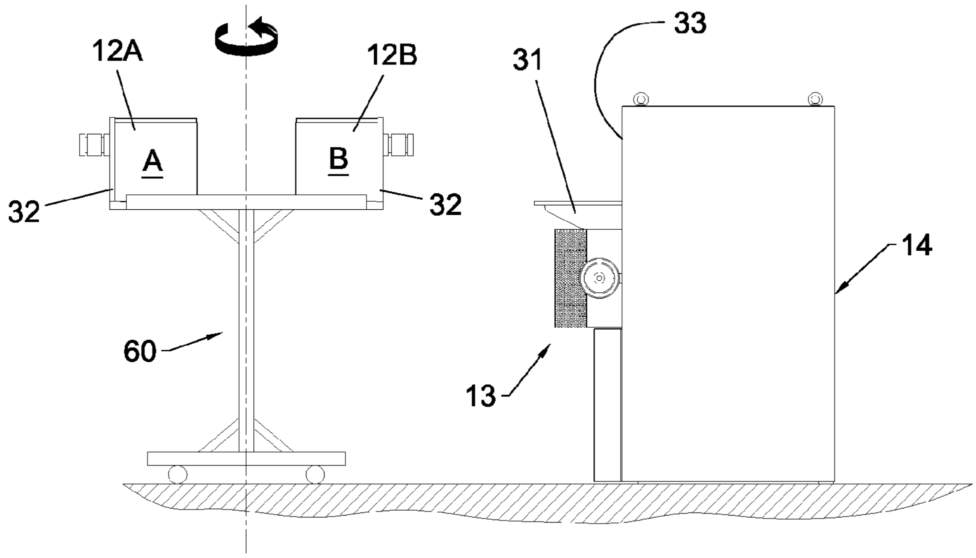

Fig. 11

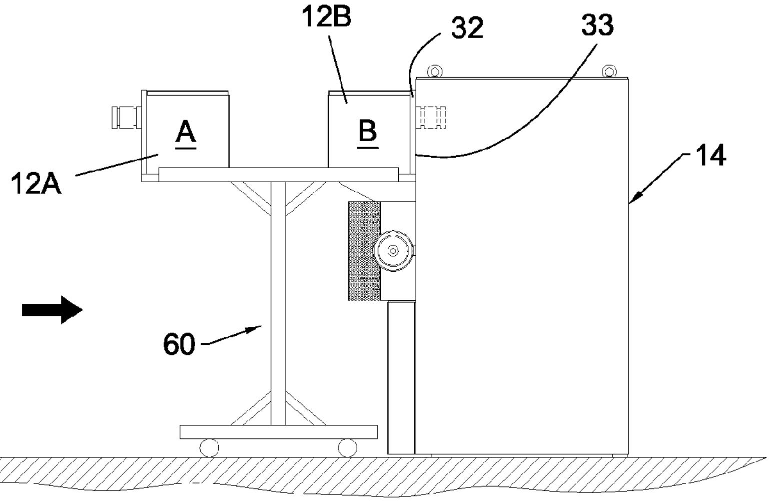

Fig. 12

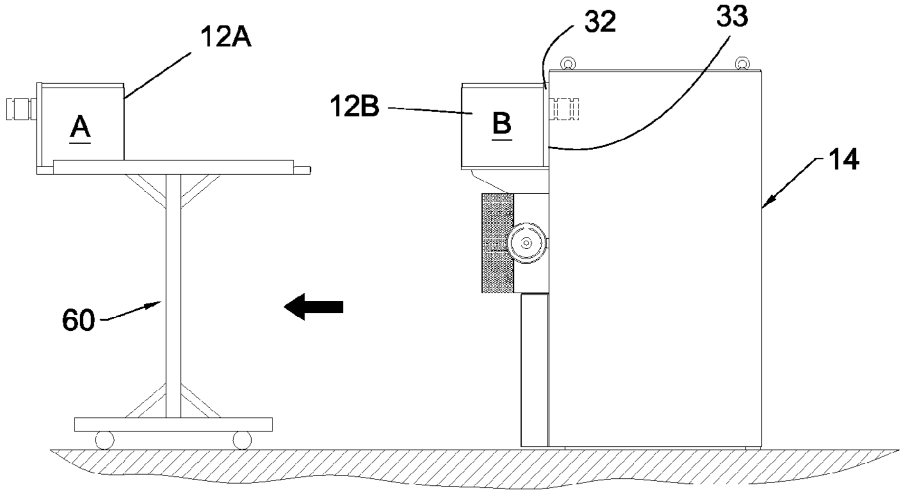

Fig. 13

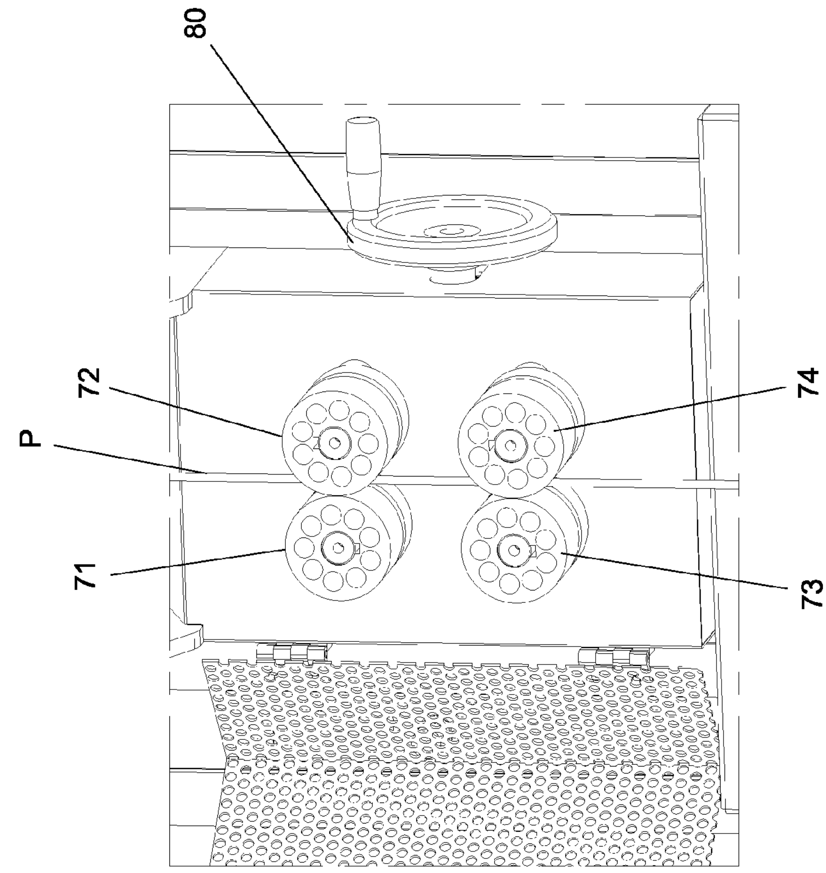

Fig. 15

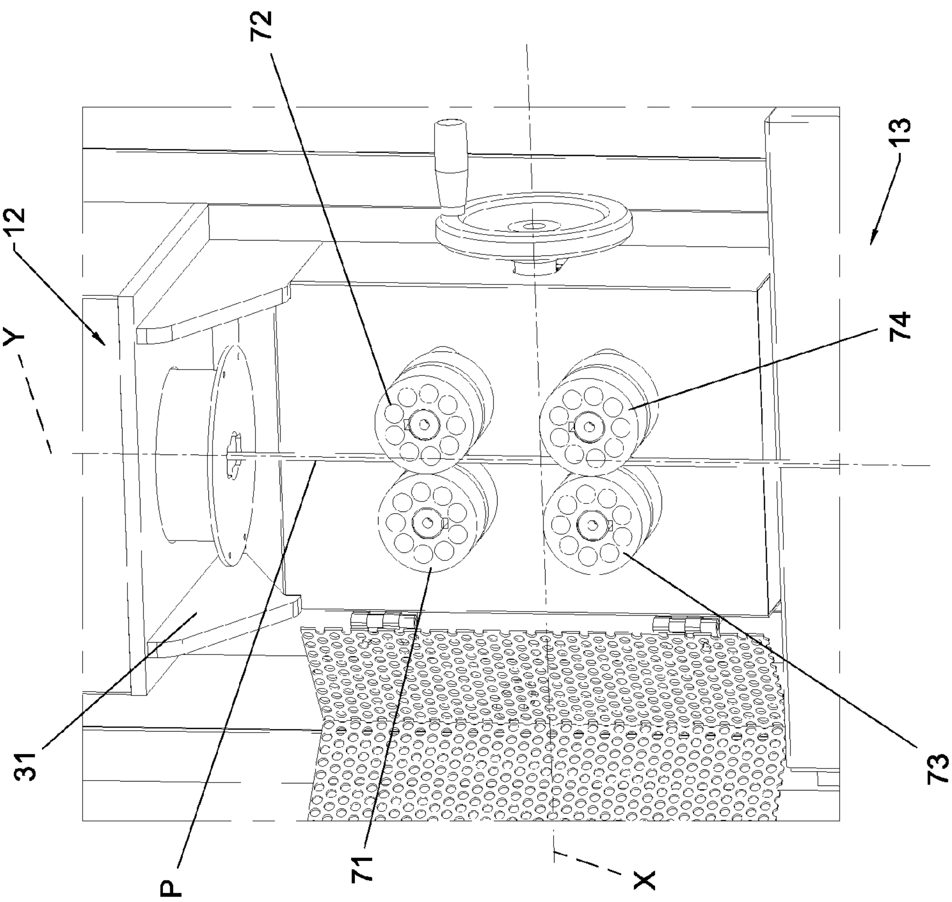

Fig. 14

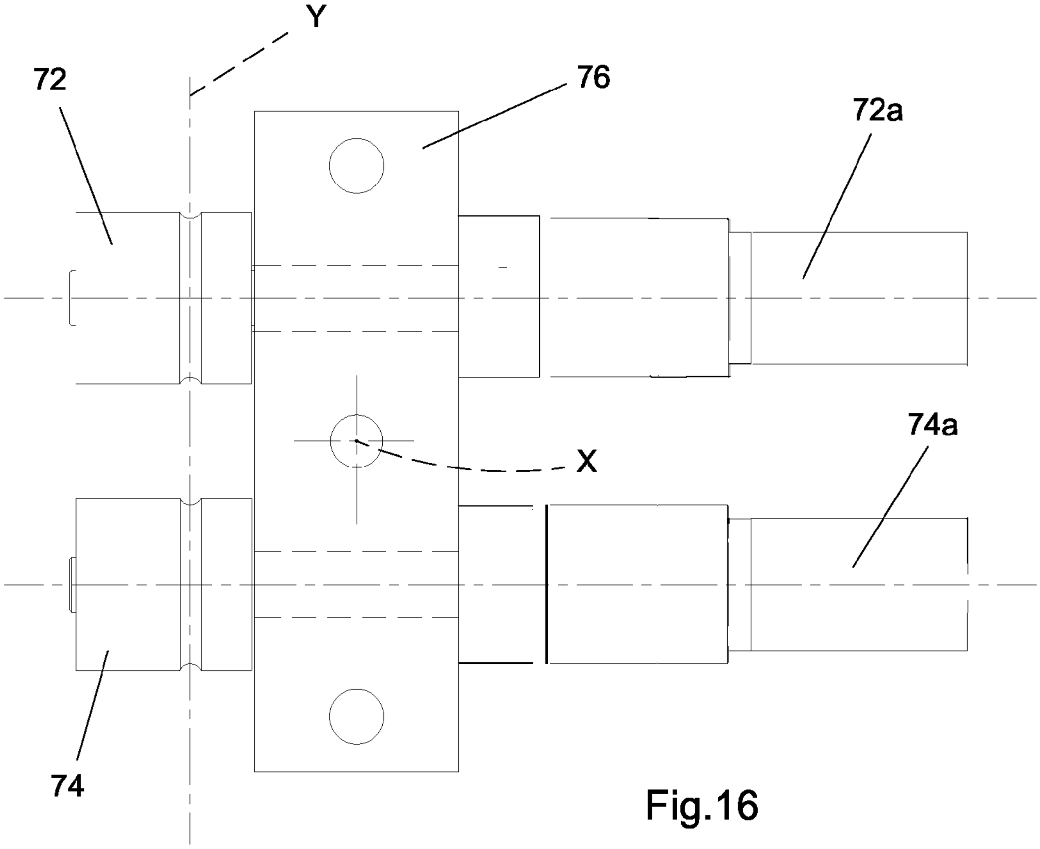

Fig.16

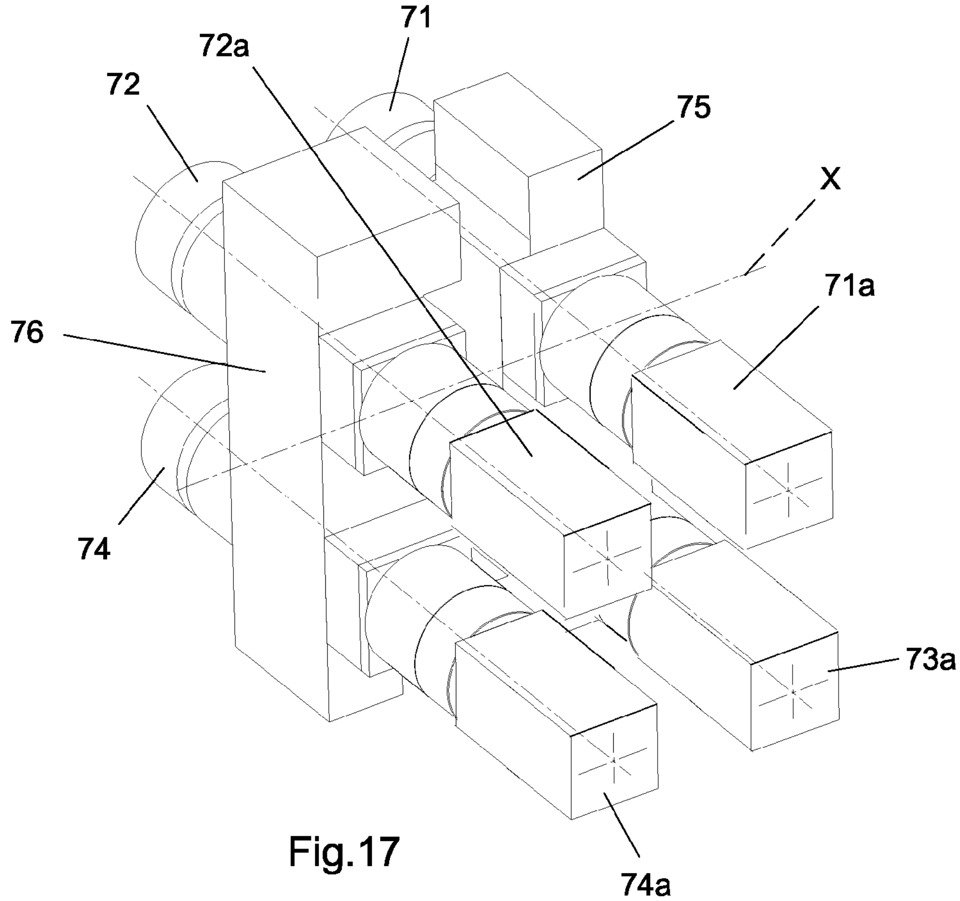

Fig.17

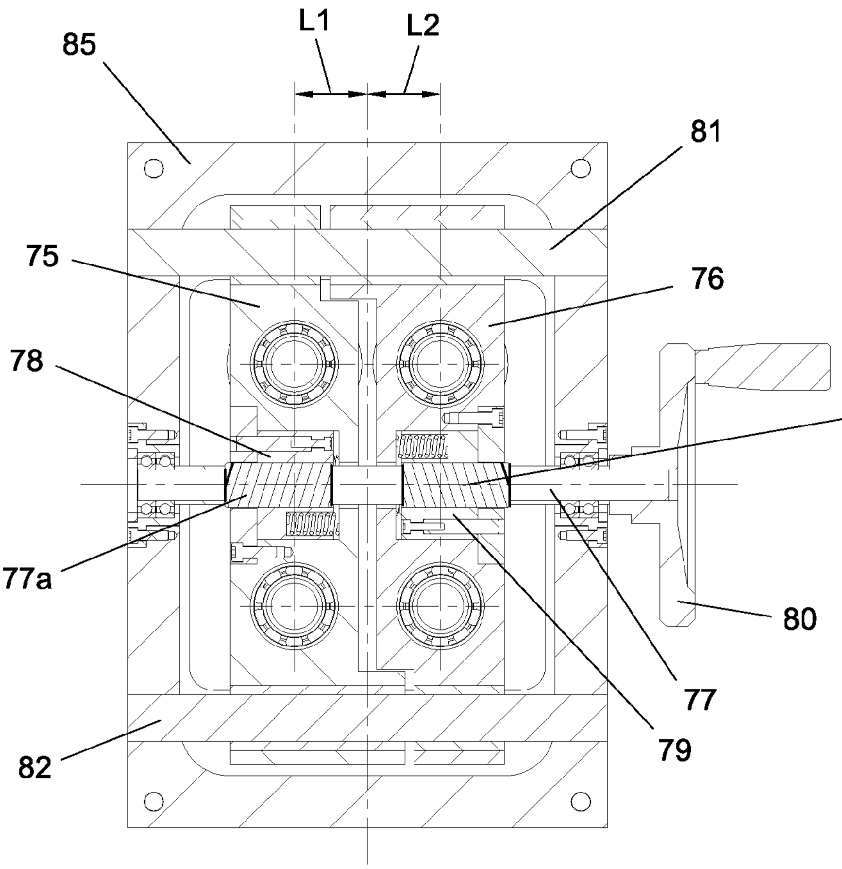

Fig. 18

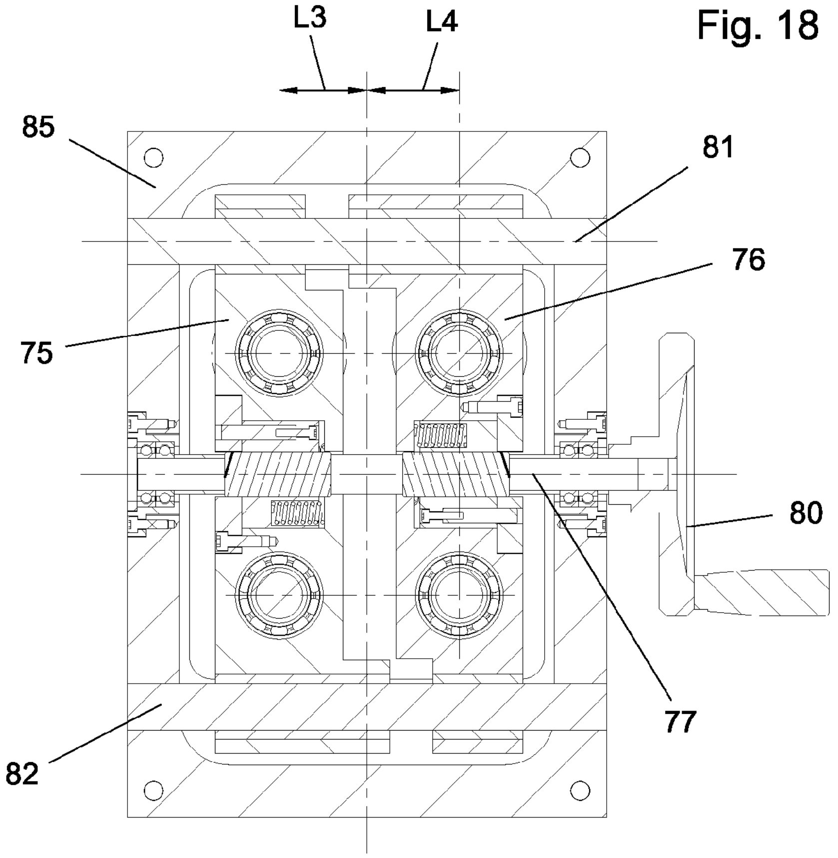

Fig.19