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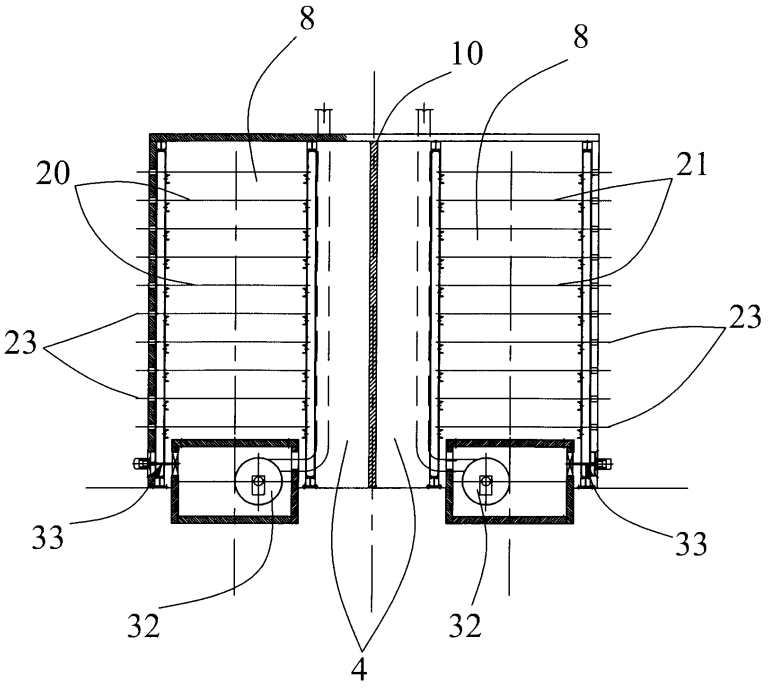
(54) Furnace for heat treatment of metallic draw pieces

(57) Furnace (1) for the heat treatment of metallic draw pieces (2) including a chamber (3), having an inlet (5) and an outlet (6), and thermally insulated from the outside, equipped with heating means (32), displacement means (20) for transporting the draw pieces (2) between the inlet (5) and the outlet (6) of the chamber (3), in turn moved thanks to actuation means (25), transfer means (30) of the draw pieces (2), operably associable at the inlet (5) and the outlet (6) of the chamber (3) for the introduction and the withdrawal of the draw pieces (2) from the displacement means (20), and control means for adjusting the functioning of the furnace (1) itself. The displacement means (20) are suitable for displacing the draw pieces (2) in a direction parallel to their longitudinal extension in the two directions. Furthermore, the displacement means (20) can be arranged on a plurality of height levels (23) for defining a plurality of displacement pathways (24) for the draw pieces (2) within the furnace (1).

FIG. 6



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Description

[0001] The aim of the present invention is a furnace for the heat treatment of extruded metallic draw pieces, or, more generally, metallic elements extended in a longitudinal direction. Such kind of furnace is particularly used for the ageing process of aluminium draw pieces, to which the following description is expressly referred to, without losing for this reason its generality.

[0002] The ageing process of an aluminium draw piece usually takes place downstream of the of extrusion, cooling, drawing and cutting steps.

[0003] It is well known that, such process makes use of a furnace in which the draw pieces are introduced in metallic shelves, called baskets, in which they are placed, which are stacked so as to substantially assume the dimension of the furnace itself. Specifically, the draw pieces are manually or automatically loaded in the baskets where they are spaced apart from each other by spacers which are preferably coated, for example with fabric, in order to avoid damages to the draw piece itself. Subsequently, such baskets are transported to the furnace inlet, introduced therein and withdrawn at the end of the residence time required for completing the heat treatment.

[0004] However, the furnaces above described show some drawbacks.

[0005] Firstly, they require a high employment of means, spaces, times and manpower for the loading, unloading and transport operations of the baskets, with a consequent increase of the costs, above all the warehouse management and the level of the production lead time. Secondly, during such operations, impacts, shakings and displacements of the draw pieces in the baskets frequently occur, which can give rise to more or less significant damages of the draw pieces themselves. Furthermore, because of the remarkable dimension and weight of the baskets, the introduction and extraction operations of the same from the furnace require a considerable time. Moreover, this involves a significant loss of heat which requires additional operations of furnace heating, in order to bring back the temperature at the working values, which negatively affect the process times, the costs, particularly those of energy consumption and the productive yields. The energy consumption is made even more considerable because of the heat uselessly absorbed, and therefore wasted, from the baskets themselves, as they are also made of metallic materials, generally iron. Furthermore, the high quantity of heat exiting from the furnace during the introduction and extraction steps of the baskets produces uncomfortable working conditions for the operators. Finally, because of the thermal losses and the laboriousness of the baskets displacement, the simultaneously treatment of draw pieces which need a different residence time in the furnace is difficult and technically disadvantageous, complicating the rationalization and the result of the productive process of the draw pieces.

[0006] Some of these drawbacks, such as the high waste of (human and not) resources, the high chance of damages to the draw pieces during the loading and unloading operations of the furnace, the significant loss of heat and the dangerousness of the working environment for the operators are partly resolved thanks to a second technology for the heat treatment of metallic draw pieces.

[0007] As it is known, such technology consists of an internally dynamic furnace in which the draw pieces are displaced by conveyor means from the inlet to the outlet of the furnace itself in a predetermined time and on multiple height levels. The transport of the draw pieces takes place perpendicularly with respect to their longitudinal extension, namely their length. In particular, the transport of the draw pieces is carried out with the back-step or square pitch technology.

[0008] However, also this second kind of furnace involves some drawbacks. As the displacement of the draw pieces within the furnace occurs transversally to their length, the furnaces must have a correspondingly remarkable width and, therefore, a very strong and heavy structure. The width of the furnace is further limited from external bonds, such as the dimension of the productive spaces and the capacity of the transport means. Accordingly, the furnace is only able to contain draw pieces having a length lower than about 8000 mm. Secondly, the use of a back-step or square pitch transport system involves that the movement takes place in a single direction and in a synchronous way for each height level. In this way, it is very difficult to correct positioning or setting errors of the parameters, if any, and to obtain an optimal filling of the furnace, with a consequent decrease of the productive yields. Furthermore, the heating plant is positioned within the upper surface of the furnace and is equipped with fans in order to make uniform the temperature of the chamber. This involves an increase at the energy consumption level, as the natural ascending convective movement of the hot air is not exploited. The known furnaces further have the drawback of not allowing the simultaneous treatment of draw pieces which require different temperatures, by negatively affecting the optimization of the productive process of the draw pieces.

[0009] In this situation, the technical task placed at the base of the present invention is to obviate to the drawbacks above mentioned.

[0010] Therefore, the aim of the invention is to provide a furnace for the heat treatment of metallic draw pieces which requires a reduced use of resources (operators, displacement means, warehouses, energy, etc.). Furthermore, the aim of the invention is to provide a furnace which offers high productive yields and, namely, allows to completely exploit the working capability, which allows to treat draw pieces having different requirements in terms of process times and temperatures and which has reduced losses of heat. A further aim of the invention is to provide such a furnace that the damage risks to the draw pieces during the loading, unloading and internal displacement operations are reduced. It is still an aim of the invention to provide a furnace which allows to ther-

mally treat draw pieces with a different and high length, compatibly with the plant engineering spaces and the bonds imposed by the displacement of the draw pieces themselves. Moreover, an aim of the invention is to provide a furnace which has a reduced impact on the working conditions of the operators. Finally, an aim of the invention is to provide a furnace which has a rational and compact structure, which is easy to carry out and with a limited cost.

[0011] These and other aims, which will better result during the following description, are attained, according to the present invention, by a furnace for the heat treatment of metallic draw pieces according to the appended claims.

[0012] Further features and advantages of the invention will result more evident from the description of a preferred but non exclusive embodiment of the furnace, which is more detailed below with the aid of the following figures:

- figure 1 shows a side view of a furnace chamber according to the invention, wherein the furnace is equipped with a single chamber;
- figure 1a shows an enlarged particular of the furnace of figure 1;
- figure 2 shows a section of the furnace of figure 1 taken according to the lines II-II;
- figure 3 shows a front view of the furnace of figure 1;
- figure 4 shows a side view of the chamber of a furnace according to the invention, wherein the furnace has two thermally insulated chambers;
- figure 5 shows a section of the furnace of figure 4 taken according to the lines V-V;
- figure 6 shows a front view of the furnace of figure 4;
- figure 7 shows a top view of the displacement means of a furnace according to the invention;
- figure 8 shows a front view of the transfer means of a furnace according to the invention;
- figure 8a shows a side view of the transfer means of figure 8;
- figure 8b shows a top view of the transfer means of figure 8.

[0013] Referring to the mentioned figures, a furnace for the heat treatment of metallic draw pieces and, particularly, a furnace for the ageing of aluminium draw pieces according to the invention is shown in the enclosed figures by numeral 1. The draw pieces are shown by numeral 2 in the figures and are represented in groups, more commonly called maps.

[0014] Such furnace 1 firstly includes a chamber 3, equipped with an inlet 5 and an outlet 6 for the introduction and the extraction of the draw pieces 2 and thermally insulated from the outside. In working conditions, such chamber 3 is heated by heating means 32 until it reaches an adequate temperature for the heat treatment process which one desires to carry out, which, in case of the aluminium ageing corresponds to about 200°.

[0015] According to the invention, the heating means 32, which are preferably burners, are arranged in the lower surface 7 of the chamber 3 or rather, generally, they are installed in the flooring, as it is shown in figures 3 and 6. In this way, the natural ascending convective movements of the hot air can be exploited with a saving at the energy consumption level. Furthermore, the heating means 32 can be advantageously equipped with blowing means 33 (figures 3 and 6) for uniformly dispensing the hot air within the chamber 3, so as to avoid any differences, also minimal, in the draw pieces 2 simultaneously treated.

[0016] A furnace 1 according to the invention can be defined as a dynamic furnace since it has displacement means 20 suitable for transporting the draw pieces 2 from its inlet 5 to its outlet 6 in a predetermined and specific time for each map of draw pieces 2, similar to that required for completing the ageing process.

[0017] The displacement means 20 are characterized in that they displace the draw pieces 2 in a direction parallel to their longitudinal extension, namely to their length.

[0018] Preferably, such displacement means 20 include rollers 21 placed between the inlet 5 and the outlet 6 of the chamber 3 of the furnace 1 and arranged such that they have main axes 22 parallel therebetween and perpendicular to the displacement direction of the draw pieces 2.

[0019] In turn, the displacement means 20 are made operative by actuation means 25 which generally include some electric motors 26.

[0020] In a preferred embodiment of the invention, a motor 26 for each group of rollers 21 is foreseen, such that each of these group of rollers 21 can be operated in an independent way relative to the others, with remarkable advantages (shown below) at the flexibility level of the heat treatment process carried out.

[0021] Alternatively, a distinct motor 26 for each roller 21 could be foreseen, in order to render the movement of each roller 21 independent from each other. However, this latter solution involves greater costs and greater execution difficulties.

[0022] Furthermore, the actuation means 25 allow to displace the rollers 21 in both directions, allowing the operator which controls the furnace 1 to correct possible errors in the setting of the functioning parameters or to improve the filling of the furnace 1, for example following to the withdrawal of some draw piece 2, through the control means. In fact, the displacement means 20 are reversibly mounted such that the motion direction of the draw pieces 2 can be inverted.

[0023] Alternatively to the rollers 21, the displacement means 20 can also include some conveyor belts (alternative not shown). In this case, it is very important to use some bored belts for ensuring a proper heat exchange between the draw pieces 2 and the chamber 3 during the residence of the draw pieces 2 themselves inside the furnace 1.

[0024] A furnace 1 according to the invention further

includes transfer means 30 for the draw pieces 2, operably connected with the inlet 5 of the chamber 3 of the furnace 1 for positioning the draw pieces 2 on the displacement means 20 and at the outlet 6 of the chamber 3 for collecting the draw pieces 2 from the displacement means 20 at the end of the heat treatment. In figure 8, the transfer means 30 placed at the furnace inlet are shown. Such means 30 are suitable for displacing the draw pieces according to an advancing direction 34 towards the furnace inlet, thanks to the displacement means 37 which, as it can be seen in figure 8b, preferably consist of rollers.

[0025] In particular, the draw pieces 2 are positioned on the displacement means 20 from the transfer means 30 such that the main longitudinal axes are substantially parallel therebetween and extending according to the longitudinal extension direction of the furnace 1 itself. This makes possible, when allowed by the dimensions of the available spaces and the capacity of the transfer means 30, to treat draw pieces 2 having a theoretical length up to 48 m and a practical length up to 24 m.

[0026] The parts of the displacement means 20 and the transfer means 30 which greatly come into contact with the draw pieces 2 having a high temperature are preferably coated with a thermally insulating material and structured so as to reduce the possibility of damage of the draw pieces 2 themselves during the displacement, for example with some fabric. In order to reduce the problem of the loss of heat, particularly significant during the loading and unloading steps of the draw pieces 2 on the displacement means 20, the inlet 5 and the outlet 6 of the chamber 3 can be advantageously equipped with closing means (not shown in the figures) suitable for thermally insulating the chamber 3 from the outside when the transfer means 30 have finished the loading or unloading operations. The closing means can include, for example, a door equipped with springs or an automatically operated gate.

[0027] A further important component of a furnace 1 for the heat treatment of metallic draw pieces 2 according to the invention are the control means (not shown) which are effectively operative on the heating means 32, the actuation means 25, the transfer means 30 and, advantageously, also the closing means, for example in case of an automatic gate.

[0028] Such control means manage the heat treatment process carried out in all its parts and include an electronic card equipped with a microprocessor and interface means for setting the operating parameters from the outside. In fact, it is possible to set, for example, the temperature at which the chamber 3 of the furnace 1 is to be brought and maintained by acting on the heating means 32, the residence time of the draw pieces 2 within the furnace 1 by controlling the speed of the displacement means 20 and dividing the loading and unloading operations of the draw pieces 2 from the displacement means 20, so as to ensure an always optimal filling of the furnace 1 and proper process lead times.

[0029] The displacement means 20 can be arranged on a single height level 23 but, in a preferred embodiment of the invention, they are arranged on at least two different height levels 23 for defining at least two displacement pathways 24 for the draw pieces 2 within the furnace 1 (figures 1, 2, 4 and 6).

[0030] Therefore, the transfer means 30 also include some lifts 31 for displacing the draw pieces 2 on the different height levels 23 wherein the displacement means 20 are positioned. As it can be seen in figure 8, in fact, the transfer means 30 are suitable for displacing the draw pieces, in addition to an advancing direction 34 also in an uphill direction 35 and a downhill direction 36.

[0031] Specifically, for example, the furnace 1 can be structured on a multiplicity of height levels 23 accessible from a first lift 31 for the loading of the draw pieces 2 and from a second lift 31 which provides for the extraction.

[0032] A peculiar characteristic of the displacement means 20 arranged on a plurality of height levels 23 is the moving freedom between the aforesaid levels 23. In this way, in the same furnace 1 it is possible to treat draw pieces 2 which require different residence times because, for example, of a different length or different section dimensions.

[0033] In an embodiment of the invention, the furnace 1 is characterized by a chamber 3 including at least two secondary chambers 4 thermally insulated therebetween and equipped with respective inlets 8 and outlets 9, heating means 32, displacement means 20 and actuation means 25, for thermally treating the draw pieces 2 at different temperatures, as it is shown by figures 4, 5 and 6. Preferably, it is the chamber 3 itself of the furnace 1 which results subdivided in two secondary chambers 4 through an insulating wall 10 (figures 5 and 6). The two chambers 4 are generally carried out such that they have the inlets 8 and the outlets 9 respectively flanked, in order to rationalize and simplify the introduction and extraction steps of the draw pieces 2 from the furnace 1 (figure 5).

[0034] In this case, the two chambers are separately managed by the control means, both at the temperature level and the residence times of the draw pieces 2 within the furnace 1.

[0035] Alternatively, the heat treatment of draw pieces which require different temperatures can be carried out by using two furnaces placed in proximity with a proper working space.

[0036] The functioning of a furnace 1 according to the invention is summarized in the lines below based on the description shown.

[0037] At the beginning, the operator sets the fundamental parameters which adjust the process, namely the temperature of the chamber 3 and the residence time in the furnace 1 of each kind of draw piece 2. The control means, through some temperature sensors placed within the chamber 3, detect the temperature of the chamber 3 and adjust the same. Therefore, the transfer means 30 withdraw the draw pieces 2 and transport them on the displacement means 20. Each kind of draw piece 2, char-

acterized for example by a particular length and the section dimensions, is arranged on the displacement means 20 placed at a particular height level 23 for following a displacement within the furnace 1 controlled by a particular timing. Depending on the parameters set by the operator, which can also undergo some corrections during the heat treatment, the control means operate the actuation means 25 in a controlled way until the draw pieces 2 have completed the treatment. At this point, the transfer means 30 withdraw the draw pieces 2 in order to direct them toward the following steps of their productive process and the control means provide, if necessary, to adjust the arrangement of the draw pieces 2 remained in the furnace 1, for improving the filling thereof and therefore the yield of the process itself.

[0038] Indeed, the materials used, as well as the dimensions, could be any one, depending on the requirements.

[0039] Furthermore, all the details are replaceable with other technically equivalent elements.

[0040] The invention attains important advantages.

[0041] Firstly, a furnace for the heat treatment of metallic draw pieces according to the invention remarkably reduces the problem of the loss of heat, thanks to the automation which has allowed to speed up especially the steps of loading, internal displacement and unloading of the draw pieces from the furnace, the use of closing means on the inlets and outlets from the chambers, the use of a structure on multiple height levels and the transport parallel to the longitudinal extension of the draw pieces themselves which allow to dimensionally reduce the inlet and outlet areas. This positively affects the costs, especially those of energy consumption, the times and, therefore, the productive yields. The reduction of the energy waste is also promoted by the positioning of the heating means in the lower surface of the chamber, so as to exploit the ascending convective movement which characterizes the hot air by nature, contrary to what happens in the furnaces of a known type wherein the heating means are arranged in the upper surface of the furnace.

[0042] Moreover, the high automation level which characterizes the invention with respect to the prior technologies and the pathways on the created multiple height levels allow to reduce the use of resources and spaces with benefits at the costs level, particularly those of manpower and warehouse, and to increase the productivity not only of the heat treatment process per se but also of the whole production process of the draw pieces.

[0043] The reduction of the loss of heat, the automation and the total management of the plant through the control means have also allowed the improvement of the working conditions of the operators and the reduction of the damage possibility of the draw pieces during the heat treatment.

[0044] A further advantage is that the displacement of the draw pieces parallelly to their longitudinal extension and their positioning in the furnace with the main axis lying parallelly to the longitudinal extension of the furnace have allowed to lighten the structure of the furnace itself, above all in the width, and to carry out the heat treatment step also upstream of the cutting step, since, compatibly with the spaces dimension and the capacity of the transfer means, the furnace can contain draw pieces having a theoretical length up to 48 mm.

[0045] Furthermore, the furnace shown is characterized by a high flexibility as it can simultaneously treat draw pieces having different requirements in the heat treatment, both at the level of residence times in the furnace and temperature, with important advantages on the optimization of the productive process, above all thanks to the remote management of the functioning of the furnace itself due to the control means. Finally, a single furnace of large dimensions with multiple chambers operating at different temperatures allows to greatly exploit the scale economy with respect to multiple furnaces with lower dimensions, by inducing some benefits, such as the reduction of the energy consumption, a lower loss of heat and a lower use of human resources.

Claims

1. Furnace (1) for the heat treatment of metallic draw pieces (2) including:

a chamber (3) having an inlet (5) and an outlet (6) and thermally insulated from the outside,
heating means (32) of said chamber (3),
displacement means (20) placed between said inlet (5) and said outlet (6) of said chamber (3) for displacing said metallic draw pieces (2),
actuation means (25) operably operative on said displacement means (20) for imparting the movement to said displacement means (20) and control means operably operative on said heating means (32) and said actuation means (25);

characterized in that
said displacement means (20) are suitable for displacing said draw pieces (2) in a direction parallel to the longitudinal extension of said draw pieces (2).

2. Furnace (1) according to the preceding claim, **characterized in that** said displacement means (20) include rollers (21) positioned between said inlet (5) and said outlet (6) of said chamber (3) with longitudinal main axes parallel therebetween and perpendicular to said displacement direction of said draw pieces (2) .

3. Furnace (1) according to any one of the preceding claims, **characterized in that** said actuation means (25) include electric motors (26).

4. Furnace (1) according to claim 3, when depending from claim 2, **characterized in that** each of said

rollers (21) is associated with an own electric motor (26) for being operable independently from the remaining rollers (21).

5. Furnace (1) according to claim 1, **characterized in that** said displacement means (20) include bored conveyor belts for allowing the heat exchange between said chamber (3) and said draw pieces (2) during the displacement of said draw pieces (2).

6. Furnace (1) according to any one of the preceding claims, **characterized in that** said displacement means (20) are reversible for allowing the reversal of the motion direction of the draw pieces (2) in the furnace (1).

7. Furnace (1) according to any one of the preceding claims, **characterized in that** said heating means (32) are positioned below a lower surface (7) of said chamber (3).

8. Furnace (1) according to any one of the preceding claims, **characterized in that** said heating means (32) are burners.

9. Furnace (1) according to any one of the preceding claims, **characterized in that** said heating means (32) are equipped with blowing means (33) for uniformly dispensing hot air within said chamber (3).

10. Furnace (1) according to any one of the preceding claims, **characterized in that** it further includes transfer means (30) of said draw pieces (2), connected with said control means, operably associable to said inlet (5) of said chamber (3) for positioning said draw pieces (2) on said displacement means (20) and said outlet (6) of said chamber (3) for taking said draw pieces (2) from said displacement means (20).

11. Furnace (1) according to claim 10, **characterized in that** it further includes means for closing said inlet (5) and said outlet (6) of said chamber (3) when said transfer means (30) are inoperative for reducing the loss of heat in said chamber (3).

12. Furnace (1) according to any one of the preceding claims, **characterized in that** said control means include an electronic card equipped with microprocessors and interface means for setting functioning parameters from the outside.

13. Furnace (1) according to any one of the preceding claims, **characterized in that** it includes displacement means (20) arranged on a height level (23) for defining a single displacement pathway (24) of said draw pieces (2) in said furnace (1).

14. Furnace (1) according to any one of the preceding claims, **characterized in that** it includes displacement means (20) arranged on at least two different height levels (23) for defining at least two displacement pathways (24) of said draw pieces (2) in said furnace (1).

15. Furnace (1) according to any one of the preceding claims, **characterized in that** it includes displacement means (20) arranged on a plurality of height levels (23) for defining a plurality of displacement pathways (24) of said draw pieces (2) in said furnace (1).

16. Furnace (1) according to claims 14 or 15, when depending from claim 10, **characterized in that** said transfer means (30) include lifts (31) suitable for displacing said draw pieces (2) in correspondence with said height levels (23) on which said displacement means (20) are arranged.

17. Furnace (1) according to any one of the preceding claims, **characterized in that** said chamber (3) includes at least two secondary chambers (4) thermally insulated therebetween and equipped with respective inlets (8) and outlets (9), heating means (32), displacement means (20) and actuation means (25) for thermally treating said draw pieces (2) at different temperatures.

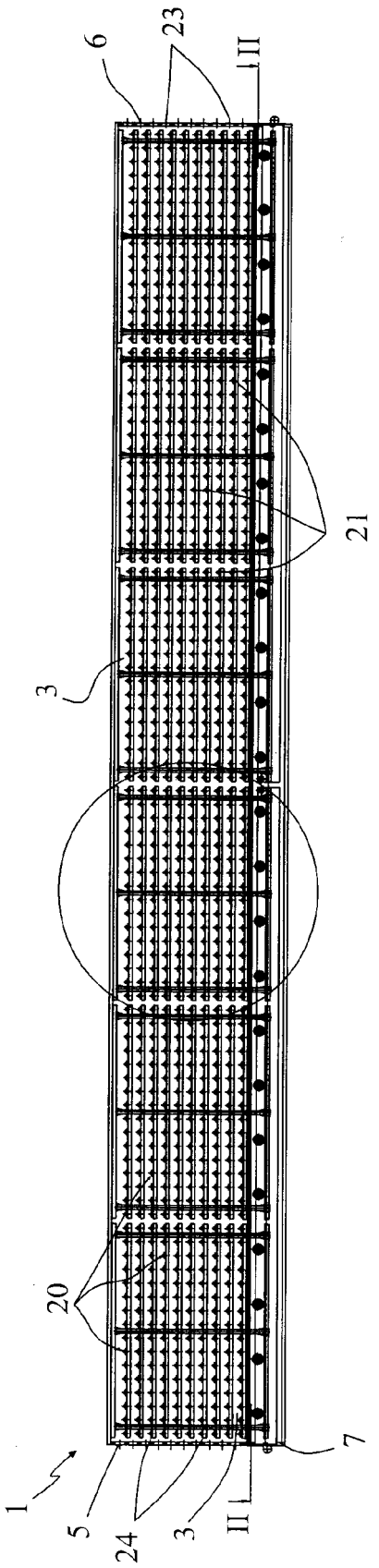
18. Furnace (1) according to claim 17, **characterized in that** said secondary chambers (4) are arranged such that they have said inlets (8) flanked and said outlets (9) flanked.

19. Furnace (1) according to claims 17 or 18, **characterized in that** said chamber (3) is subdivided in two secondary chambers (4) through an insulating wall (10) .

20. Furnace (1) according to any one of the preceding claims, **characterized in that** it is suitable for the ageing heat treatment of aluminium draw pieces (2).

21. Plant for the heat treatment of metallic draw pieces (2) **characterized in that** it includes a furnace (1) according to any one of the preceding claims.

FIG. 1



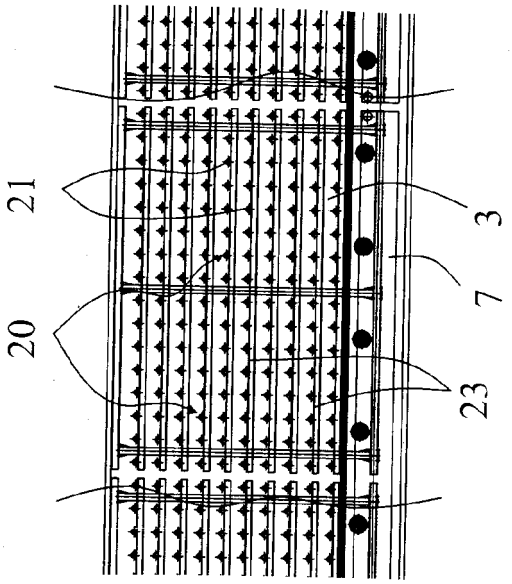


FIG. 1a

FIG. 2

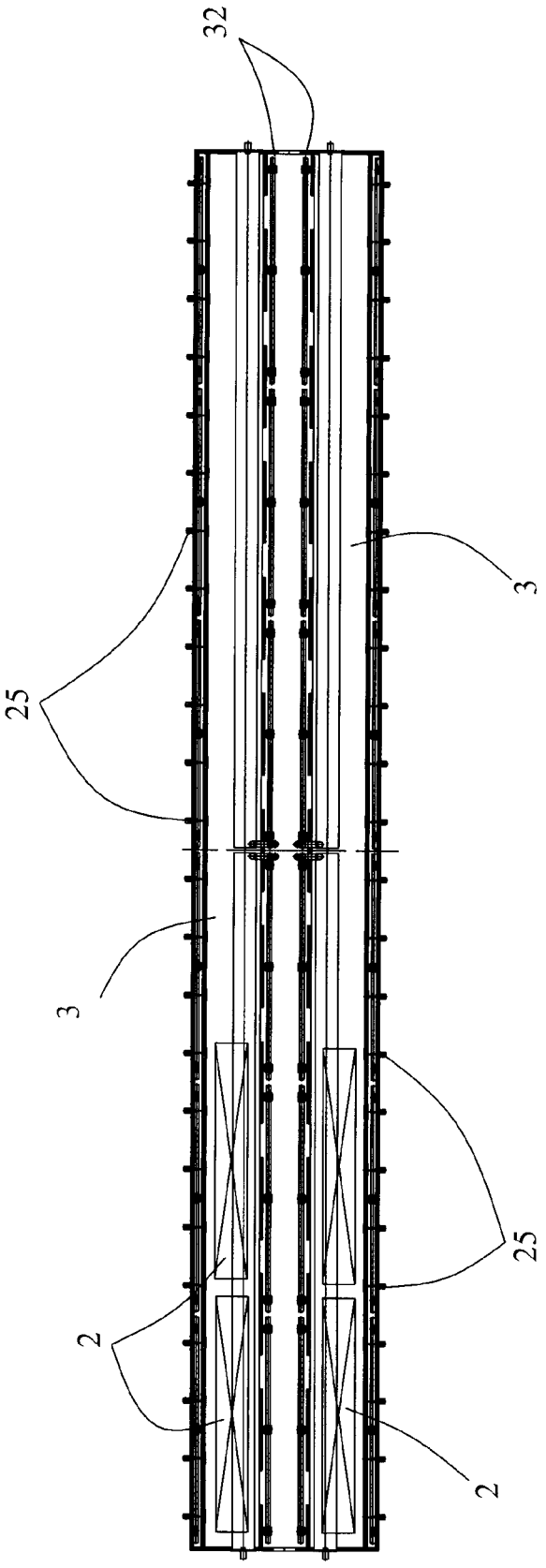


FIG. 3

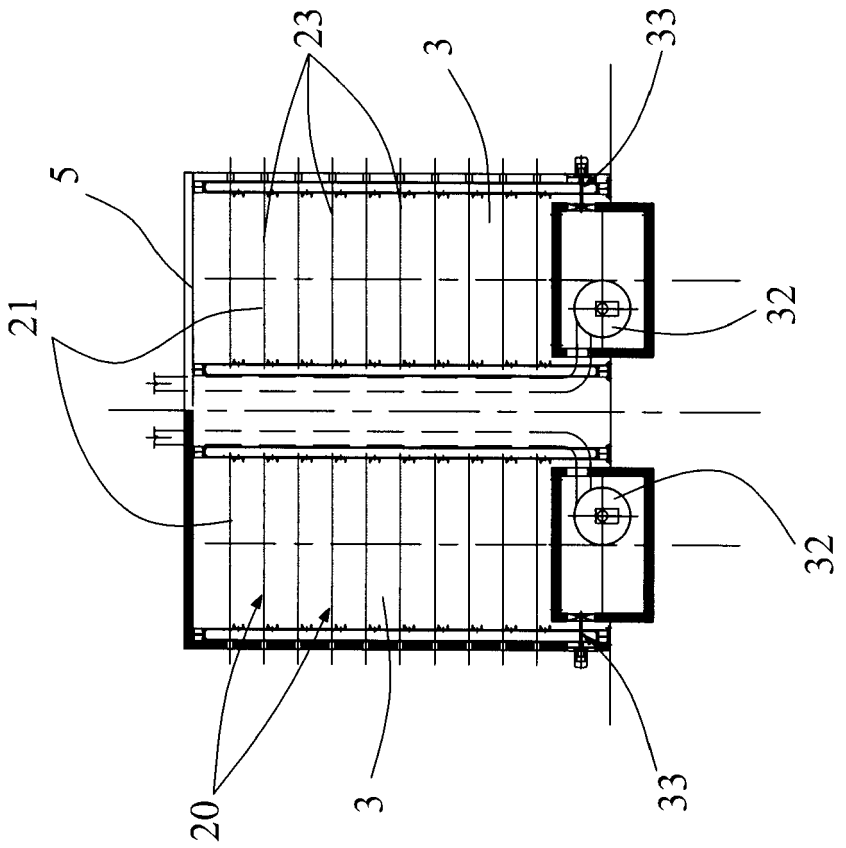


FIG. 4

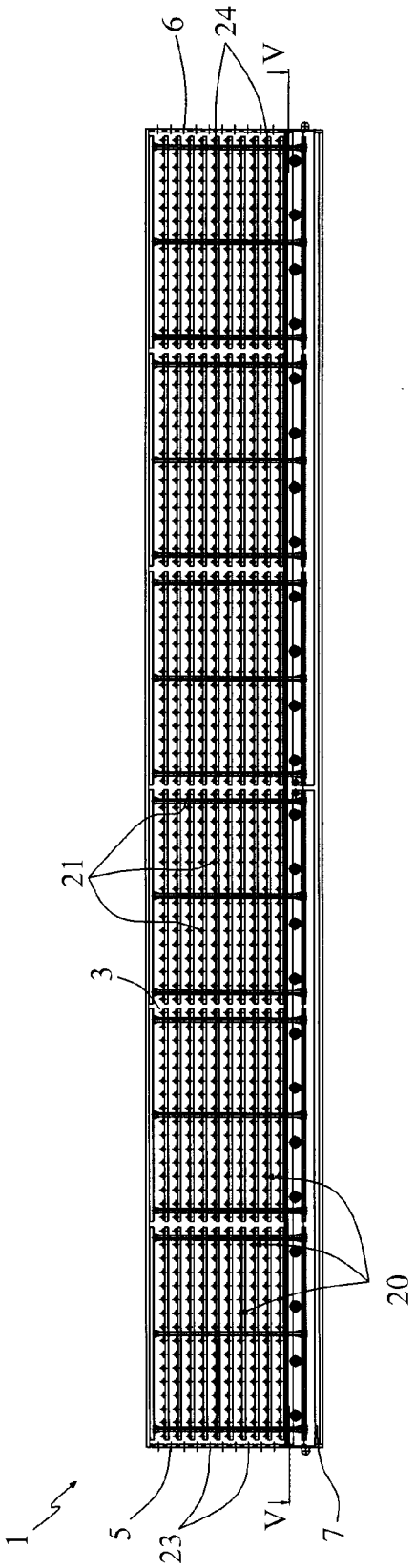


FIG. 5

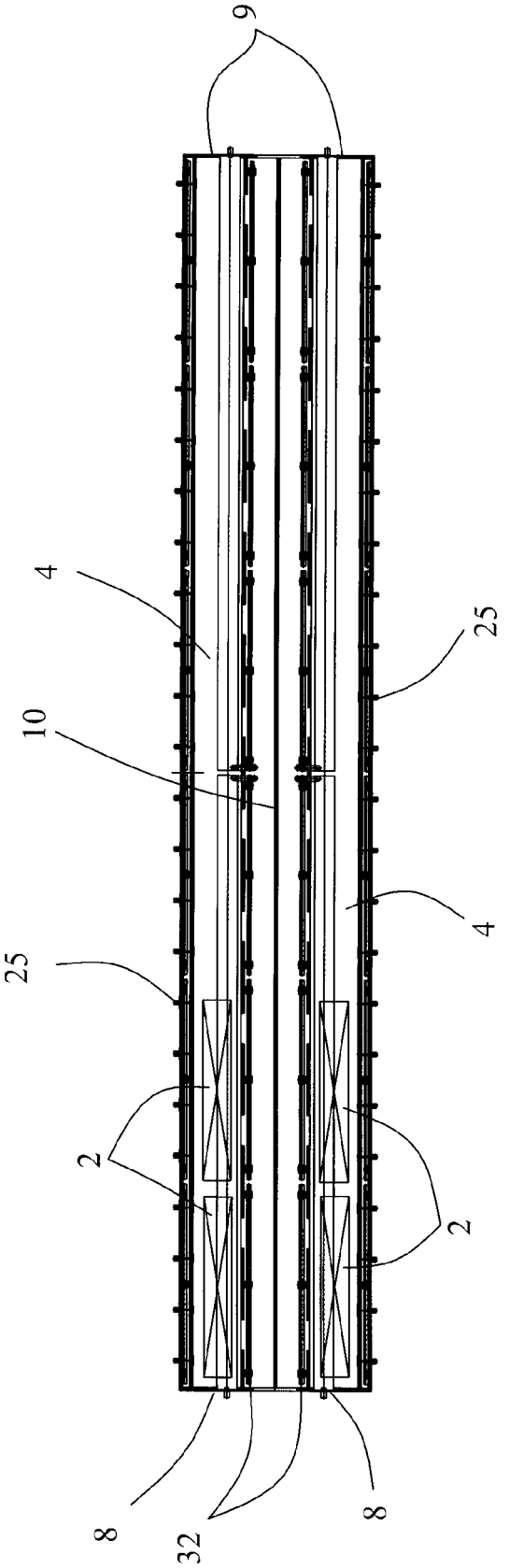


FIG. 6

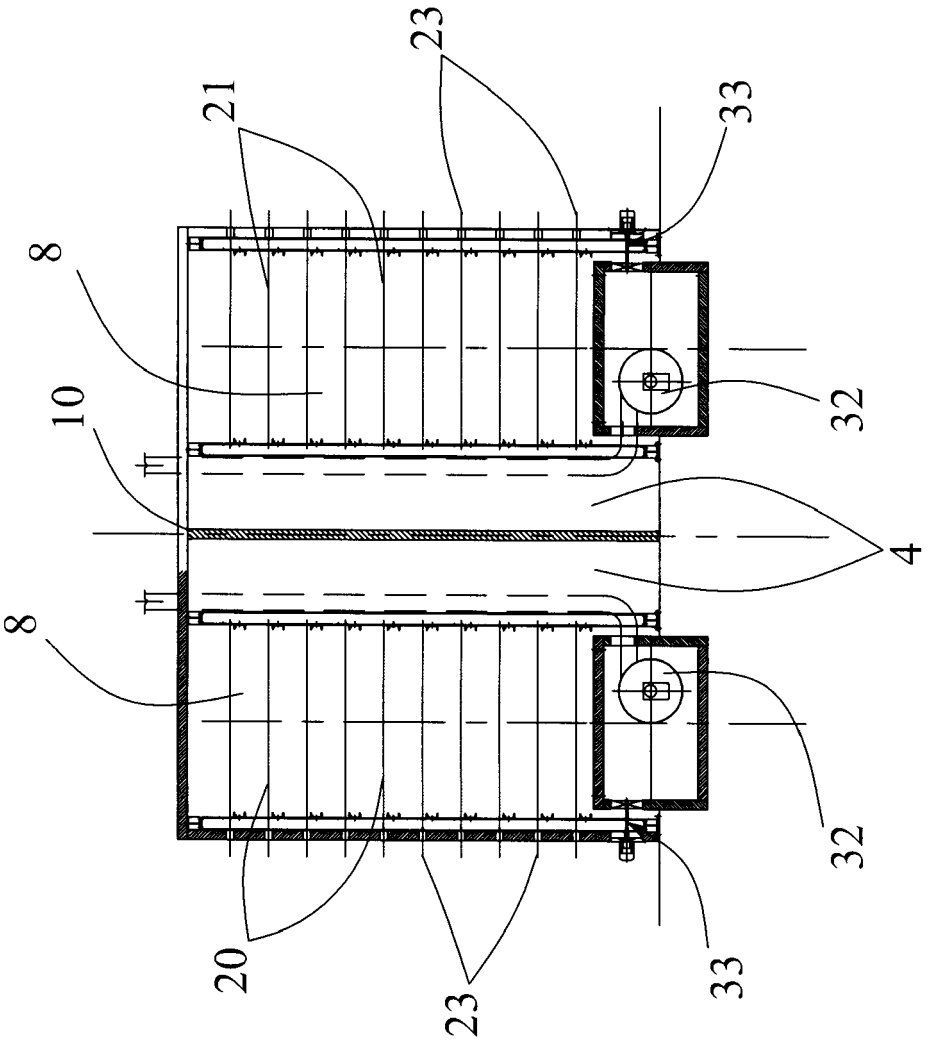


FIG. 7

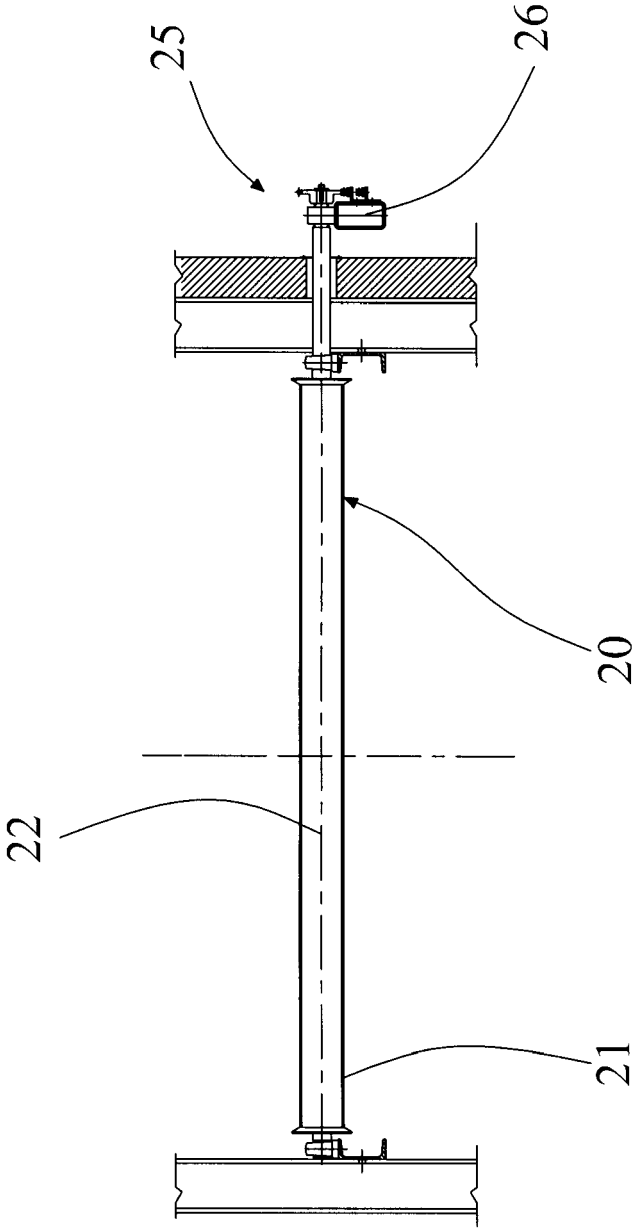


FIG. 8a

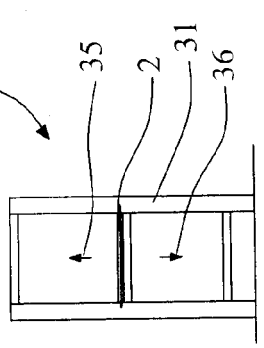
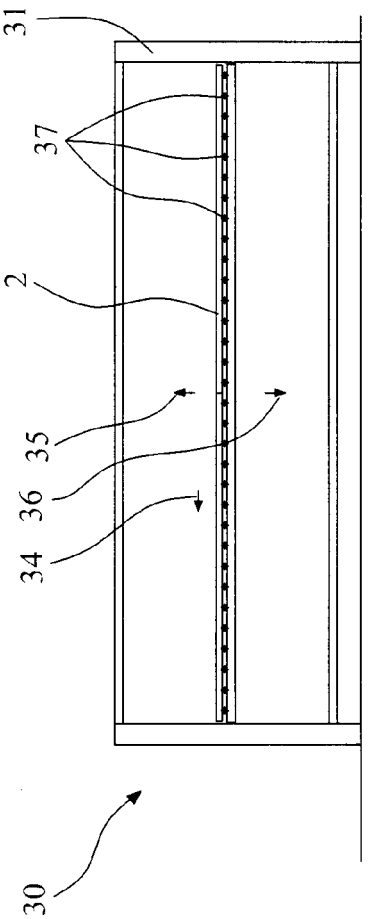


FIG. 8



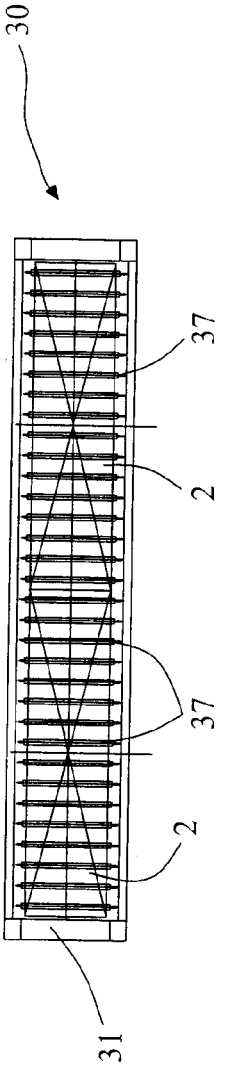


FIG. 8b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 1648

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 02/061154 A (O.M.S. S.N.C; SPIZZO, ADINO) 8 August 2002 (2002-08-08) * claims 1-7; figures 1-5 *	1-21	INV. F27B9/24 C21D9/00 C22F1/04
X	US 3 254 778 A (MARLAND JOSEPH A ET AL) 7 June 1966 (1966-06-07) * column 9, line 12 - column 10, line 55; claims 27-31; figures 6,14 *	1-21	
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