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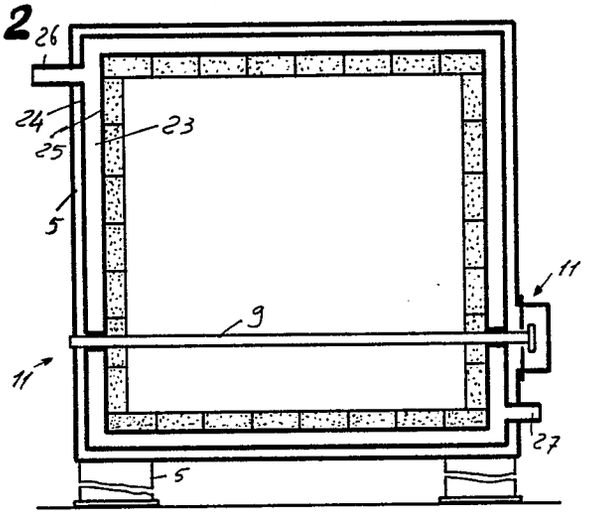
(54) Continuous furnace for sintering pressed metal powders.

(57) Continuous furnace for sintering pressed metal powders, constituted by a furnace traversed by a plurality of transverse, parallel, adjacent and continuously rotating rollers (9) made of refractory material which operate in an inert-gas atmosphere, and comprising gas sealing means (11) and burners arranged at the inlet and at the outlet of the furnace and adapted to eliminate by combustion any traces of oxidating gases.

FIG. 2



EP 0 332 926 A2

CONTINUOUS FURNACE FOR SINTERING PRESSED METAL POWDERS

The present invention relates to a continuous furnace for sintering pressed metal powders.

Many products are obtained by means of a sintering process which consists in molding metal powders with presses and molds and in subjecting the semi-worked items to a sintering process, i.e. to annealing at a temperature lower than the metal's melting temperature: in order to provide parts with valid mechanical characteristics, sintering must occur at controlled temperatures for controlled time periods and in an atmosphere of particular gases, usually ammonia or nitrogen, to avoid oxidation phenomena.

It may be sometimes convenient to precede the actual sintering with a preheating phase which purges the part of any binding or lubricating agents used in the preceding molding step.

It has been observed that mechanically more valid, and of a higher density, parts could be obtained by raising the furnace's temperature, but the industrial furnaces currently in use do not exceed operating temperatures of a little over one thousand degrees Centigrade.

In the continuous furnaces currently in use, a limit to the increase of the temperature is set by the parts feed system.

Currently manufactured belt furnaces in fact comprise a horizontally extending chamber made of refractory material in which a conveyor belt, forming a loop, is mounted; its lower return portion extends outside the furnace, and the parts rest on said belt either directly or on sort of trays.

The belt of the conveyor is made of stainless steel, in order to avoid oxidation phenomena, and naturally cannot operate at temperatures near its melting temperature; when working at 1030° C the belt is already subject to elongations which must be compensated by particular devices, and the elongations and contractions to which it is subject due to the temperature differences caused by its repeated entry and exit from the furnace make it deteriorate rapidly. Such belt furnaces furthermore have high heat losses indeed due to the continuous entry and exit of the belt elements into and out of the furnace.

Roller furnaces are known and used in the ceramics industry to achieve higher operating temperatures; in these furnaces, the parts are fed by means of a plurality of rollers made of refractory material, mounted and rotatably actuated about horizontal axes and arranged transversely to the direction of the furnace. However, such furnaces cannot be used for sintering metal powders since an inert-gas atmosphere cannot be provided in them.

The technical aim of the present invention is to obviate the above described disadvantages by providing a continuous furnace which can operate at high temperatures in an inert-gas atmosphere.

Within the scope of this technical aim, an object of the present invention is to achieve the above described aim with a simple structure which is relatively easy to execute in practice, safe in use and effective in operation as well as relatively modest in cost.

This aim and this object are achieved by a continuous furnace for sintering pressed metal powders, characterized in that it comprises: a horizontally extending furnace traversed by a plurality of transverse, parallel and mutually adjacent rollers, made of refractory material, which rotatably insert in supporting holes of the walls of the furnace, said rollers having, on one side, respective sprockets mounted on their ends, said sprockets meshing with a feed chain closed in a loop and rotatably actuated by a motor-reducer unit; ducts for introducing inert gases, such as ammonia and nitrogen, in slight overpressure in the central and end regions of the furnace; sealing means mounted at the roller-furnace wall couplings, said sealing means being adapted to prevent the escape of the inert gases; burners arranged at the inlet and outlet of the furnace and adapted to eliminate by combustion any traces of oxidating gases.

Further details will become apparent from the detailed description of a preferred but not exclusive embodiment of a furnace according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic lateral view of the furnace according to the invention;

figure 2 is a schematic transverse sectional view of the furnace in the region proximate to its outlet;

figure 3 is a detail view of the coupling of the feed rollers to the walls of the furnace.

With reference to said figures, the reference numeral 1 generally indicates the continuous furnace for sintering pressed metal powders according to the inventioin.

The furnace 1 comprises a central high-temperature region 2, a preheating region 3 and a cooling region 4.

The furnace 1 is constituted by a supporting structure made of mutually assembled frames 5 which support, in the heated region, a container made of metal plate 6 which contains a wall 7 of ceramic fiber wool and a further wall 8 of light refractory bricks.

The parts advance in the furnace by means of a plurality of transverse rotatable rollers 9 made of refractory material, arranged mutually parallel and adjacent; the rollers are mutually coupled by means of respective sprockets 10 keyed to one of the ends of the roller and actuated by a chain, closed in a loop, and by a motor-reducer assembly, not illustrated in the figure. The rollers are arranged mutually adjacent so as to produce no discontinuity which may affect the feeding of the parts; trays or containment supports of refractory material are used in any case for small-size parts.

The sprockets 10 extend outside the walls of the furnace, since they cannot withstand its high temperatures, and a seal is provided on the rollers by means of stuffing boxes 11 made of ceramic fiber wool 12 accommodated in metallic bushes 6a defined by the sheet metal 6; the wool is pressed against the bricks 8 on one side and by a series of containment plates 13 on the other side; said plates 13 are rigidly associated with the wall 6 by bolts 14 and are traversed by the rollers at holes 15.

Housings 17 are fixed on the plates 13 by means of bolts 16 and have seats for sealing gaskets 18 which act against the plates; small covers 20 are in turn coupled to the housings 17 by means of bolts 19 and allow rapid access to the rollers, to the sprockets and to the chain.

On the other side of the furnace the seal is obtained in a simplified manner, since the chain and the sprockets are not provided thereat.

The high-temperature portion 2 of the furnace can be advantageously heated, instead of with resistor or gas-fuelled burners, by silicon carbide resistors (commercially known by the name Globar), which substantially consist of cylindrical bars. To prevent them from being in contact with the internal environment, said resistors are conveniently inserted in ceramic tubes (made for example of alumina or mullite) arranged transversely to the furnace in its upper portion; this insulation of the resistors is deemed convenient in order to avoid the deposition thereon of metal vapors or oxides which may form during sintering.

An inert-gas atmosphere is created in the furnace by means of ducts 21 which feed ammonia and are arranged approximately halfway, at the inlet and at the outlet of the portions 2 and 4 of the furnace, and by means of the duct 22 which feeds nitrogen: the feed pressure of the inert gases is slightly higher than the atmospheric pressure to oppose the inflow of air.

The heating resistors are not provided in the last portion 4 of the furnace, where the parts are cooled, and an interspace 23 is defined between two slightly spaced walls 24 and 25 outside the bricks 8; said interspace is connected to inlets 26 and outlets 27 for cooling water.

Groups of burners, not illustrated in the figure, are furthermore mounted at the inlet of the portion 2 and at the outlet of the portion 4; said burners are adapted to burn atmospheric oxygen to prevent it from entering the furnace and causing oxidation phenomena during sintering.

The preheating furnace 3 is arranged ahead of the portion 2 of the furnace, and operates with free air circulation; said furnace 3 has a hood 28, an aspirator 29 and a fume-removal duct 30, and frees the parts from any residuals of lubricants or binding agents used in the previous pressing.

It should be noted that feeding the parts by using rollers of refractory material and silicon carbide resistors, allows operating temperatures to reach up to 1300°, and that very modest energy and operating consumptions are achieved as there are no feed elements which enter and exit the furnace, as occurs instead for belt advancement systems.

It should be furthermore noted that if the feed elements break down, replacements or repairs can be performed without shutting down the furnace, after removing the covers 20 or the housings 17.

The plane of advancement of the parts may advantageously rise slightly towards the centerline of the furnace.

It has thus been observed that the invention achieves the intended aim and object.

The invention thus conceived is susceptible to numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials employed, as well as the shapes and dimensions, may be any according to the requirements, without thereby abandoning the scope of the protection of the following claims.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Continuous furnace for sintering pressed metal powders, characterized in that it comprises: a horizontally extending furnace traversed by a plurality of transverse, parallel and mutually adjacent rollers (9), made of refractory material, which rotatably insert in supporting holes of the walls (7,8) of the furnace, said rollers having, on one

side, respective sprockets (10) mounted on their ends, said sprockets meshing with a feed chain closed in a loop and rotatably actuated by a motor-reducer unit; ducts (21,22) for introducing inert gases, such as ammonia and nitrogen, in slight overpressure in the central and end regions of the furnace; sealing means (11) mounted at the roller-furnace wall couplings, said sealing means being adapted to prevent the escape of the inert gases; burners arranged at the inlet and at the outlet of the furnace and adapted to eliminate by combustion any traces of oxidating gases.

2. Furnace according to claim 1, characterized in that said sealing means comprises stuffing-boxes (11) and in that ceramic fiber wool (12) is used as sealing material.

3. Furnace according to claim 2, characterized in that said stuffing boxes (11) can be accessed from the outside of the furnace by removing adapted covers (20).

4. Furnace according to claim 1, characterized in that a preheating furnace (3), having a forced gas suction system, is arranged ahead of the furnace and is aligned therewith.

5. Furnace according to claim 1, characterized in that a cooling region (4) is provided in the terminal portion of the furnace, the refractory materials which compose the furnace being externally provided, in said cooling region (4), with an interspace (23) to which cooling water is fed.

6. Furnace according to claim 1, characterized in that the furnace is heated by rod-like silicon carbide resistors inserted in ceramic tubes arranged in the upper portion of the furnace and adapted to insulate the rods from the environment of said furnace.

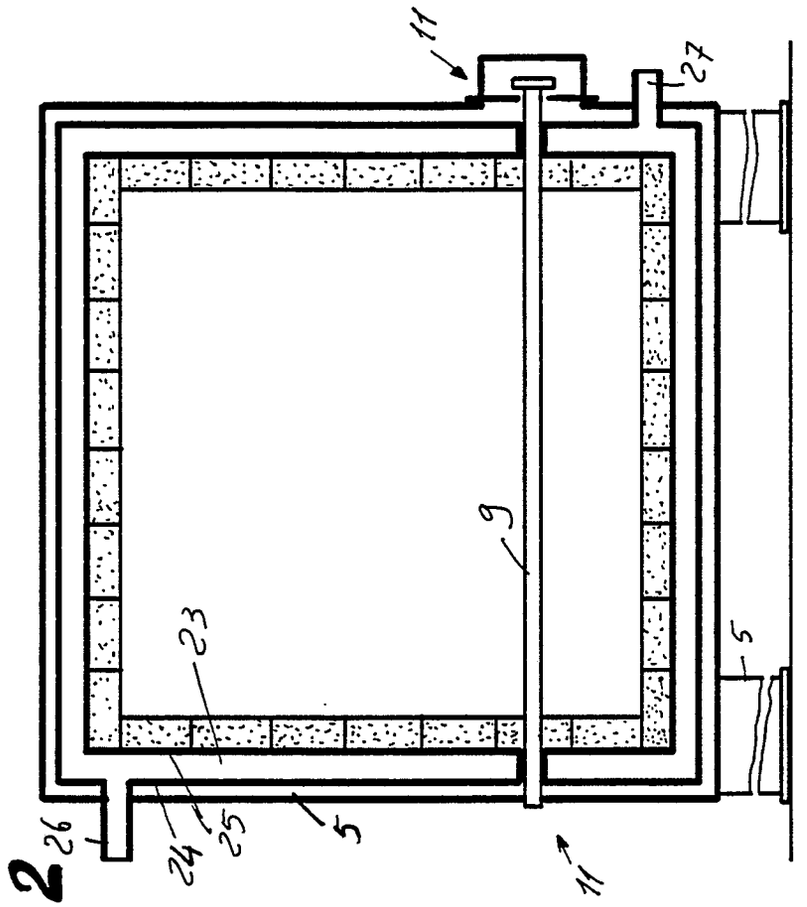


FIG. 2

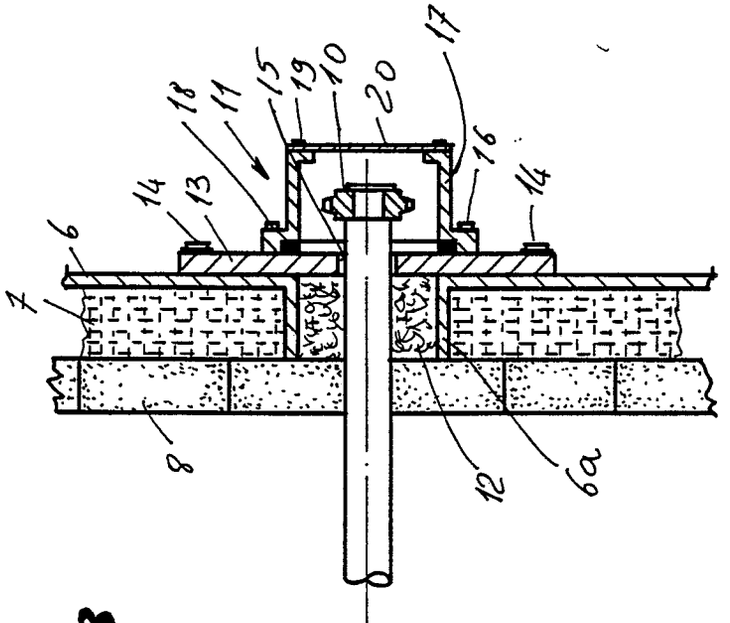


FIG. 3

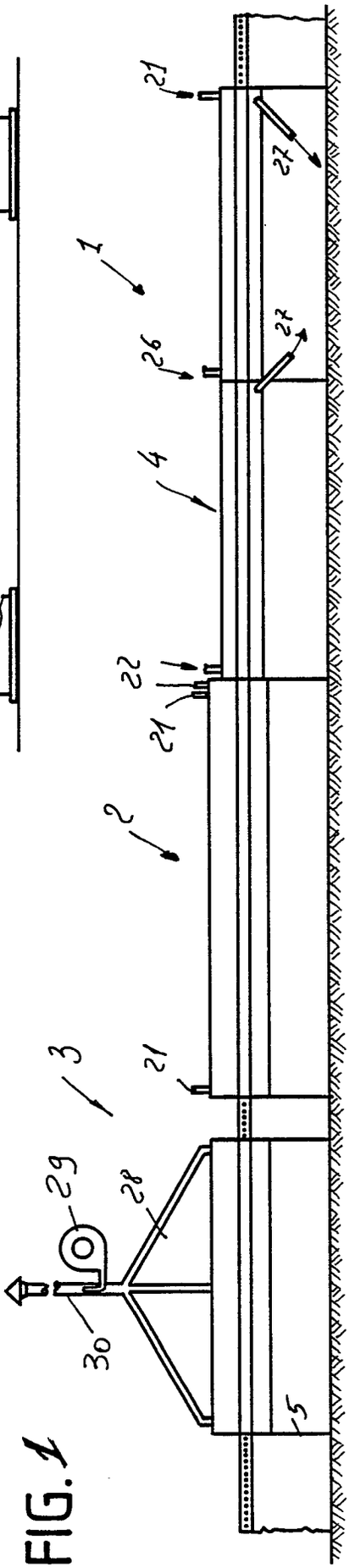


FIG. 1