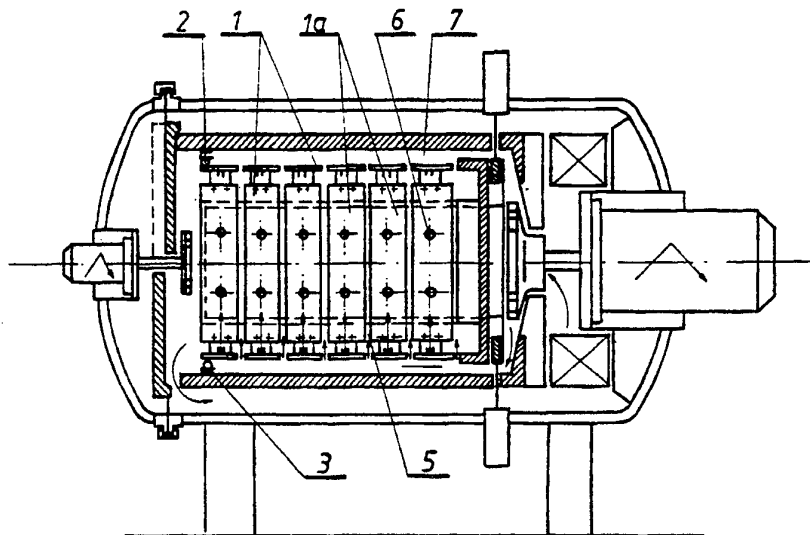




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<p>(21) International Application Number: PCT/PL93/00001 (22) International Filing Date: 4 March 1993 (04.03.93) (30) Priority Data: P.297439 14 January 1993 (14.01.93) PL (71) Applicant (for all designated States except US): SECO/WARWICK SPÓLKA Z O.O. (LTD) [PL/PL]; ul. Sobieskiego 8, PL-66-200 Świebodzin (PL). (72) Inventor; and (75) Inventor/Applicant (for US only): OLEJNIK, Józef [PL/PL]; Osiedle Zaków 61, PL-66-200 Świebodzin (PL).</p>		<p>(81) Designated States: CA, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report.</p>

(54) Title: VACUUM FURNACE FOR THERMAL TREATMENT



(57) Abstract

The object of the present invention is a vacuum furnace for thermal treatment, particularly for quenching of metal workpieces made of various grades of steel and alloys. According to the invention the furnace has on the perimeter of the heating chamber flat rectangular elements (1) made of a resistive heating material which secures dimensional and thermal stability. Except for the element situated at the back wall of the furnace, the elements (1) have on their edges a seal (2) of ceramic material, being at the time a current insulator. They are connected by links (4) of a material of good electric conductivity. Each element (1) is divided into segment (1a) of equal size so that a slot (5) is created, insulating each of them electrically. Apertures (6) are made in each segment to allow the flow of gas. The space between the internal wall of the heating chamber and the elements (1) mounted on it is the gas collector (7) from which the cooling gas is forced into the work space of the heating chamber through aperture (6) and slots (5). The furnace is equipped with an element being at the same time a heater and gas collector which makes it possible to increase the work space of the heating chamber without increasing the overall dimensions of the furnace.

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VACUUM FURNACE FOR THERMAL TREATMENT

The object of the present invention is a vacuum furnace for thermal treatment, particularly for quenching metal workpieces made of various grades of steel and alloys. It may be used for annealing and soldering.

5 In standard vacuum furnaces the objects under thermal treatment are placed in a thermally insulated heating chamber and heated by convection until they reach the temperature of 700° - 900° C; whereas in the case of the vacuum furnace - the austenitizing temperature. Next, the charge is cooled by a neutral cooling gas
10 which is circulated under pressure through the heating chamber.

In general, the process of heating cooling is performed by two independent structural elements of the furnace, namely: heating elements and gas collectors.

Application P 292 743 presented a solution where the collectors
15 were installed inside the heating chamber and placed evenly on the perimeter of the charge outline. As far as the heating elements are concerned, a well-known and classic solution was used.

The West German patent No. 3 736 502 presented a construction
20 of a furnace gas collectors were thin-walled tubular heating elements of the diameter of 60 - 120 mm, made of C-C composite materials. In this solution gas collectors were placed evenly round the charge .

The drawback of the most frequently employed solution is that
25 independent heating elements and gas collectors increase the overall dimensions of a furnace or limit the work space of the heating chamber. Such disadvantages were partially avoided in the

of the furnace without limiting the work space of the heating
35 chamber and obtaining an even temperature in the whole chamber as
well as fast and good cooling, a furnace was designed in which one
structural element functions as both the heating element and gas
collector.

In the present invention the vacuum furnace for thermal treat-
40 ment has got on the perimeter of the heating chamber flat rectangu-
lar elements made of a resistive heating material which secures di-
mensional and thermal stability at temperatures up to 1 400° C. The
edges of these elements, except for the one situated at the back wall
of the furnace, are sealed with a ceramic material. The seal is em-
45 bedded on a flexible bracket made of a heating material; preferably
in the form of a thin-walled channel-bar.

At the same time, the seal serves as a current insulator at the
spot where the element is fixed to the insulation wall of the fur-
nace.

50 The elements are also connected to each other by connecting links
made of materials of good electric conductivity in order to obtain
an electric circuit.

Each of the flat elements is divided into segments of equal size

- 3 -

so that a slot thus created between the segments would constitute
55 an electric insulation of each individual segment. The number of
segments depends on the scheme of connections employed for the
current supply to the heating chamber. It is advisable to assign
two segments to one phase. At the same time, the slots between the
segments constitute the collector's cooling slot nozzles. The space
60 between the internal wall of the heating chamber and the flat rec-
tangular multi-segment elements installed there constitutes the gas
collector. From the gas collector the gas is forced into the work
space of the heating chamber through apertures made in individual
segments and through the slot nozzles. The apertures are placed
65 evenly on the perimeter of the charge outline.

A furnace equipped with an element functioning both as a hea-
ter and a gas collector makes it possible to increase the work spa-
ce of the heating chamber without increasing the overall dimensions
of the furnace. A large area of the flat elements divided into seg-
70 ments allows us to obtain a very homogeneous thermal field.

The gas flowing through the nozzles in the segments and slots bet-
ween the segments cools the charge quickly and evenly.

The object of the present invention is shown in enclosed fi-
gures.

75 Fig.1 shows an end view,

Fig.2 - cross-sectional view of the furnace,

Fig.3 - detail of mounting to insulation wall together with the seal.

The furnace for thermal treatment has in the heating chamber
four flat rectangular elements 1 made of C-C composite materials.

80 The elements 1 have on their edges a seal 2 made of ceramic tubes

(except for the part situated at the back wall of the furnace).
At the same time, the seal 2 is a current insulator between the
element 1 and the outer furnace body at the spot where it is
fixed to the insulation wall. It is embedded on a flexible rac-
85 ket 3 in the form of a thin-walled channel-bar of C-C compo-
site. Elements 1 are connected with each other by electric con-
ductors 4 in order to produce an electric circuit.
Each of the elements 1 is divided into six equal segments 1a
which create slots 5 of the width of 2,5 mm constituting electric
90 insulation. At the same time, the slot 5 nozzle of the cooling gas
collector. In each of the segments 1a two apertures 6 are made
where the nozzles are mounted. The apertures 6 are so placed as
to create a uniform grid on the perimeter of the charge outline.
The space 7 of the width of 5 mm between the insulation wall of
95 the furnace and elements 1 fixed to it constitutes the gas col-
lector from which the cooling gas is forced to the charge space
through slots 5 and apertures 6.

CLAIMS

1. The vacuum furnace for thermal treatment, particularly for quenching, with an insulated cylindrical heating chamber equipped with heating elements and cooling gas collector, is characterized in that on the perimeter of the heating chamber it has flat rectangular elements (1) made of a resistive heating material whose edges, except for the element situated at the back wall of the furnace, have a seal (2) of ceramic material being at the same time a current insulation at the spot where the element (1) is fixed to the insulation wall of the furnace and which are connected with each other by connecting links (4) of a material of good electric conductivity; and each of the elements (1) is divided into segments (1a) of equal size so that a slot is created between them which constitutes an electric insulation of each segment (1a) and which functions at the same time as a cooling slot nozzle; the apertures (6) are made in each of the segments and the space created between the insulation wall of the furnace and the flat rectangular element (1) is a gas collector (7) from which the cooling gas is forced into the charge space through the apertures (6) and slots (5).
- 20 2. The vacuum furnace according to claim 1 is characterized in that the flat rectangular element (1) is divided into such a number of segments (1a) that each phase of current supply is assigned two segments.
3. The vacuum furnace according to claim 1 is characterized in

25 that the apertures (6) in the segments (1a) are placed evenly on the perimeter of the charge outline.

4. The vacuum furnace according to claim 1 is characterized in that seal (2) is embedded in a flexible bracket (3) made of a resistive heating material in the form of a thin-walled
30 channel-bar.

5. The vacuum furnace according to claim 1 is characterized in that the flat rectangular elements (1) maintain dimensional and thermal stability at the temperature of up to 1400° C.

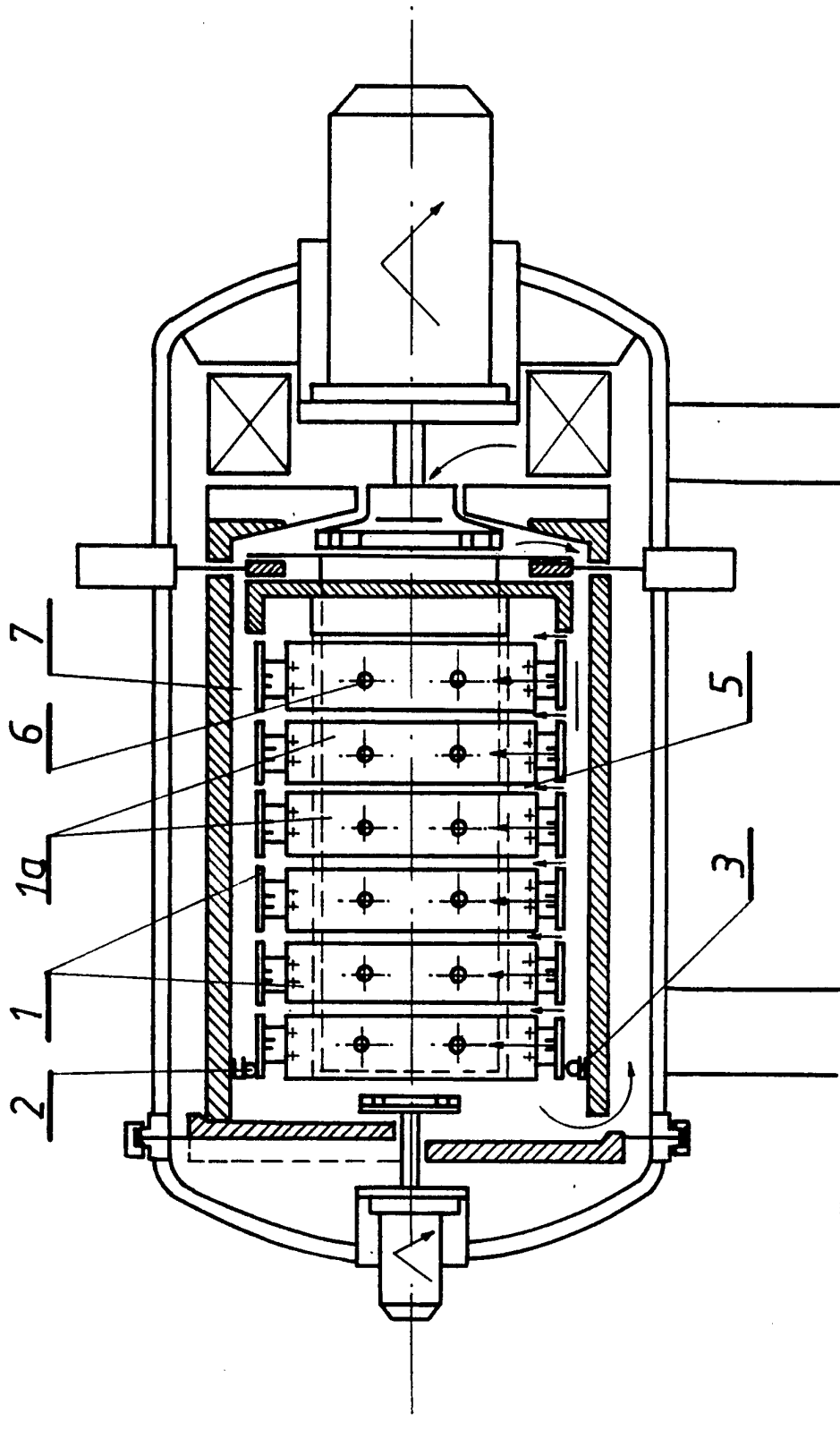


Fig. 1

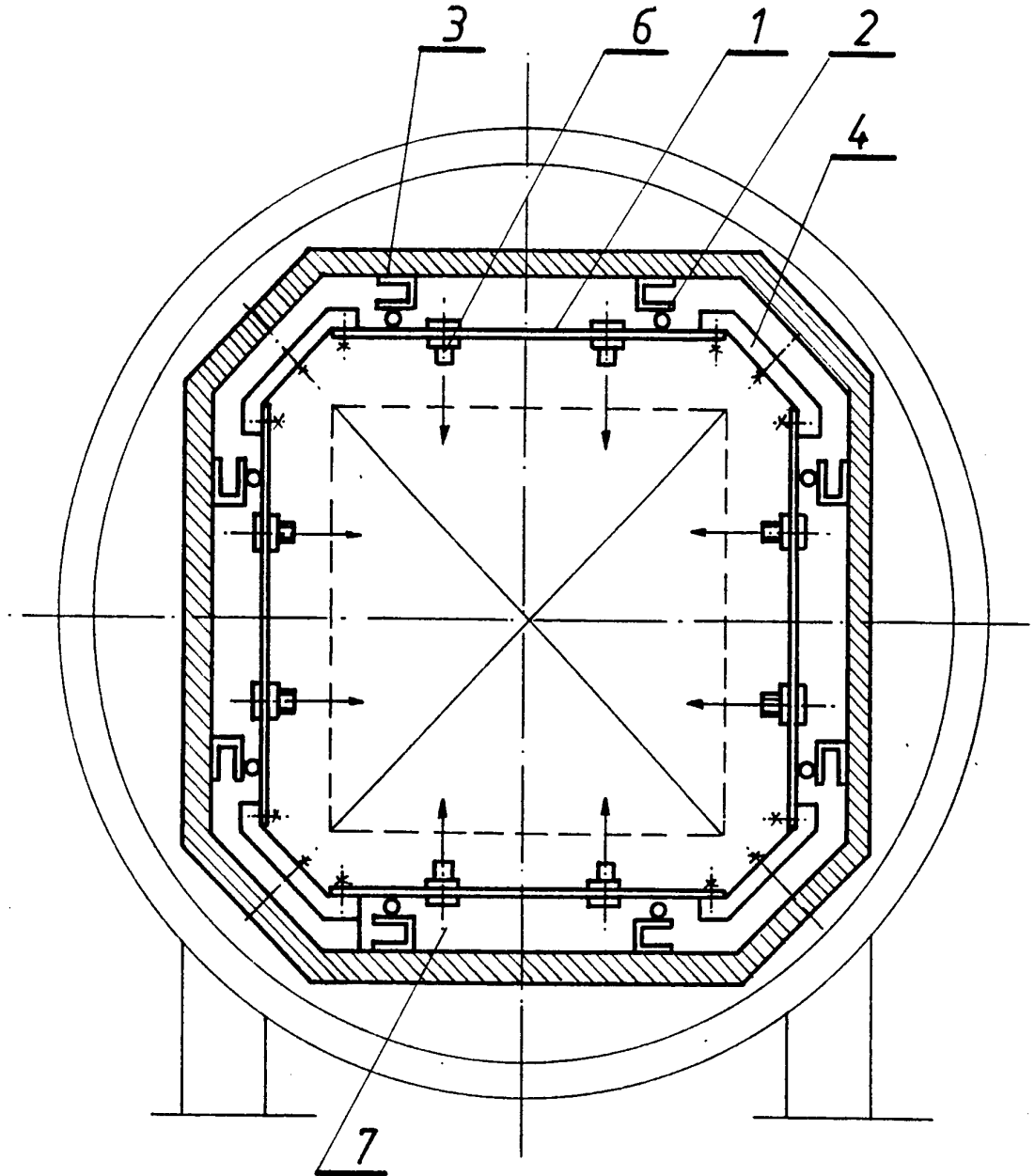


Fig. 2

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 F27B5/16; C21D1/773		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	F27B ; C21D ; F27D	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	EP,A,0 313 889 (DEGUSSA AG) 3 May 1989 & DE,A,3 736 502 cited in the application ---	
A	DE,A,4 113 458 (IVA INDUSTRIEÖFEN) 29 October 1992 ---	
A	US,A,4 799 881 (J.K.GRIER) 24 January 1989 -----	
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
13 OCTOBER 1993	25. 10. 93	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	COULOMB J.C.	

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

PL 9300001
SA 72127

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
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13/10/93

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		AU-A- 2440588	04-05-89
		DE-A- 3864008	05-09-91
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		US-A- 4869470	26-09-89

DE-A-4113458	29-10-92	None	

US-A-4799881	24-01-89	None	
