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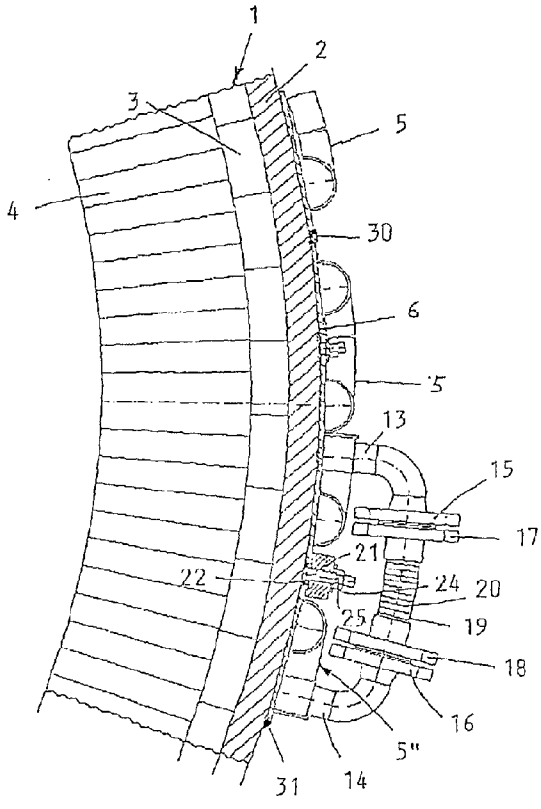
(54) Title: PROCESS CONTAINER WITH COOLING ELEMENTS

(54) Bezeichnung: PROZESSBEHÄLTER MIT KÜHLELEMENTEN



(57) **Abstract:** In order to cool a process container (1), several cooling elements (5,5',5") are fixed to the outer side of a metal container wall (2) by means of threaded bolts (21) that are welded to the container wall (2) in several places. The clamping pressure of the screw nuts (25) that are screwed on the threaded bolts (21) is sufficient to deform a relatively thin base plate (6) of the cooling elements (5,5',5") including their welded cooling channels (7) so that the cooling elements (5,5',5") are pressed against the outer side of the container wall (2). In order to achieve an additional improvement of heat transmission from the container wall (2) to the cooling elements (5,5',5"), a heat conductive paste preventing insulating air gaps is provided between the base plate (6) and the container wall (2).

(57) **Zusammenfassung:** Für die Kühlung eines Prozessbehälters (1) sind an der Aussenseite einer metallischen Behälterwand (2) mehrere Kühlelemente (5,5',5") mittels an der Behälterwand (2) an mehreren Stellen angeschweisster Gewindebolzen (21) befestigt. Der Spanndruck von auf die Gewindebolzen (21) aufgeschraubter Muttern (25) ist ausreichend, um eine verhältnismässsig dünne Basisplatte (6) der Kühlelemente (5,5',5") einschliesslich ihres aufgeschweissten Kühlkanals (7) zu verformen, so dass die Kühlelemente (5,5',5") sich an die Aussenseite der Behälterwand (2) anschmiegen. Für eine weitere Verbesserung der Wärmeübertragung von der Behälterwand (2) auf die Kühlelemente (5,5',5") ist zwischen deren Basisplatte (6) und der Behälterwand (2) eine Wärmeleitplaste vorgesehen, die isolierende Luftspalte verhindert.

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Erklärungen gemäß Regel 4.17:

— *Erfindererklärung (Regel 4.17 Ziffer iv) nur für US*

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Veröffentlicht:

— *mit internationalem Recherchenbericht*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eintreffen*

Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Process Container with Cooling Elements

The invention relates to a process container with cooling elements and with at least one refractory cladding layer applied on the inner side of a metallic container casing, whereby each cooling element consists of a base plate and at least one cooling channel connected to this in a heat-conducting manner, the ends of which in each case exhibit a connection arrangement for the connection to the cooling channel of an adjacent cooling element.

The refractory claddings of metallic containers must be resistant to the effects of molten melts and slags, and also have an insulating effect, so that the container casing remains cool enough and therefore sufficiently load-bearing. The wear on the claddings, which is often considerable, can be reduced by cooling.

Cooling elements for electric melting furnaces are known, which form a substantial static constituent part of the container wall structure, inasmuch as they represent relatively large, rigid plate elements and are in fixed connection with the fire-resistant cladding layer applied directly on their inner side. Examples of such cooling elements can be found in US 3,314,668, US 4,221,922, WO 02/27042, or WO 02/081757. The dimensions of such a cooling element amount, for example, according to the details in said US 4,221,922, to 1.71 m x 6.10 m, and the thickness of its base plate 16 mm.

The frequently used cooling technique for the container wall by means of external water sprinkling has the disadvantage of water losses and the depositing of limescale and impurities. The principle is also known of welding cooling pipes onto the container casing. As a result of this, however, cracks may occur in the container casing, through which the cooling water penetrates into the cladding layer.

Examples of the invention seek to provide a process container of the type described in the preamble which can be manufactured with relatively low effort and therefore economically and can also be refurbishment of an existing process container, and which, due to a reduction of the wear on its refractory cladding, will allow for a longer period of operation until the next repair of the cladding.

In accordance with the present invention, there is provided a process container with cooling elements and with at least one refractory cladding layer applied on the inner side of a metallic container casing, whereby each cooling element consists of a base plate and at least one cooling channel connected to this in a heat-conducting manner, the ends of which in each case exhibit a connection arrangement for the connection to the cooling channel of an adjacent cooling element, wherein the cooling elements are secured on the outside of the container casing by screw connections with threaded bolts, welded in each case on the outside of the container casing, so that, under the tension pressure of the screw connections, they nestle closely to this due to flexural deformation.

The metallic container casing of a metallurgical process container will in any event deviate from the theoretically ideal shape, e.g. cylindrical. The imperfections of the new component, not under load, are in most cases still quite small. However, if the container material is heated by the process heat, it expands. Because the casing temperature is not uniform due to the differing application and removal of heat, e.g. due to the inflow on one side due to air blast or the depositing of dust on individual areas, the degrees of expansion are different over the circumference. The casing will therefore necessarily deviate from the theoretical shape, e.g. cylindrical. Local bulging or indentations can be particularly large if limited damage to the refractory cladding has resulted in severe local overheating. While the imperfections incurred by manufacture are in the order of, for example, 1/1000 of the diameter of the casing, among containers of many years' operation shape deviations can be found in the range of 1/100 of the diameter. Other causes of such deformations of the casing of a process container can be: Weight loading due to the melts, load due to the displacement of the centre of gravity, e.g. when tipping the vessel to empty out the melts, and/or support forces which take effect on the casing from the inside due to the expansion of the refractory cladding.

In the final analysis, account is to be taken of the expansions and shape changes of a metallic furnace casing or shell during commissioning and when shutting down, which are incurred b the high operating temperature. The cooling device described on the basis of the embodiment is well-suited for adapting to such changes in shape, and in this context of withstanding the high surface temperatures of, for example, a melting furnace for the refining of lead.

The invention is described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 shows a radial section through an area of a container casing equipped with cooling elements in accordance with Fig. 1.

Fig. 2 shows a full plan view of a cooling element and a partial representation of two adjacent connected cooling elements of the same type, not completely represented.

The process container 1, by way of example cylindrical in shape, arranged standing or lying, has a container casing 2, shaped out of steel, which is protected against a highly-heated container content, e.g. a metal melt, by means of refractory cladding layers 3, 4. In order to increase the resistance of the cladding layers 3, 4 and the protection of the container casing 2 against overheating, a plurality of cooling elements 5, 5', 5", of the same design, are secured to the outside of the container casing 2.

Each cooling element 5, 5', 5", of which in each case, for example, twenty are arranged next to one another on a process container 1 with a diameter of, for example, 3 m, and a length of, for example, 25 m, in both the circumferential as well as the longitudinal direction, consists of a relatively thin and therefore flexible base plate 6, with a thickness of, for example, less than 5 mm, and preferably 3 or 4 mm, and at least one cooling channel 7, connected to this in a heat-conducting manner.

The cooling channel 7, with several runs, for example three, 8, 9, 10, and connecting 180° elbow bends, extends in a snaking or serpentine manner cambered along the outer side of the base plate 6 facing away from the container casing 2, over the largest possible part of its surface, in order to be in heat-conducting contact with this over a large surface area. It has, for example, the shell-form cross-section shape of a half-sectioned tube, which is welded to the base plate 6 along its sectional ends, so that the base plate 6 forms a part of the channel cross-section. It is also possible, however, for other cross-sectional shapes to be chosen, for which examples are cited by the previously mentioned US 4,221,922.

For the connection to the cooling channel 7 of an adjacent cooling element 5, 5', 5", the two ends 11, 12 of the cooling channel 7 in each case have a connection arrangement which consists of a cambered connection nozzle 13, 14, directed outwards away from the cooling element 5, 5', 5" or from the process container 1 respectively, with an end flange 15, 16, and a compensation pipe 19, exhibiting an end flange 17, 18 connecting the connection nozzles 13, 14 of adjacent cooling elements 5, 5', 5". This pipe has a bellows-type section 20, so that imprecisions in the arrangement between adjacent cooling elements 5, 5', 5" and thermal expansion in the container casing 2 can be compensated for.

A detachable securing of the cooling elements 5, 5', 5" is provided by a plurality of threaded bolts 21, welded to the outside of the container casing 2, which extend through a number of bolt holes 22 provided at appropriate positions in the base plate 6, and also along the edges 27, 28 of the base plate 6 in a gap space between adjacent cooling elements 5, 5', 5". A pressure element 23, pushed on them in each case, which is substantially wider than the bolt holes 22, and a disk spring 24, are tensioned by a lock nut 25, so that each base plate 6 is pressed with elastic preliminary tension at numerous points, according to the size of the pressure element 23, against the container casing 2, and due to flexural deformation nestles against the surface shape of the container casing 2. This deformability of the base plate 6 guarantees good adaptation to irregularities on the surface of the container casing 2, incurred for manufacturing reasons, and which also derive from the heating of the process container and its charge, with the result that an extensive heat-transferring contact is guaranteed between the cooling elements 5, 5', 5" and the container casing 2.

For further improvement of the heat transfer from the container casing 2 to the base plates 6 of the cooling elements 5, 5', 5", and therefore to the coolant fluid circulating in the cooling channels, provision is made in an example of the invention,
between the container wall 2 and the base plate 6 of the cooling elements 5, 5', 5", for a heat-conductive paste, by means of which air gaps can be avoided or filled out, which would be unavoidable despite the relatively good ability of the cooling elements 5, 5', 5" to nestle against the container wall 2. The plastic deformability of the heat-conductive paste guarantees adaptation to changes in the shape or size of the filled-out gap as a consequence of the relative deformation between the base plate 6 and the container wall

2, as referred to, which arises during the operation of the process container. The elastic pre-tension of the screw securing also contributes to this, which is achieved by the disk springs 24 referred to.

In order to fill out or introduce a heat-conductive paste, available on the market from a number of manufacturers, between the container casing 2 and the base plate 6 in each case, threaded holes 25 are provided at several points in the base plate 6, into which the nipples of a paste press can be connected.

The introduction of the heat-conductive paste behind the base plate 6 of the cooling elements 3, 3', 3" is carried out, for example, until it emerges at the edges of the base plate 6. Premature swelling out of heat-conductive paste at the edges of the base plate 6 can, however, also be prevented or restricted to selected points, by the base plate 6 being sealed along its edges. Suitable for this is, for example, a hardening heat-conductive paste 30, 31, which is applied externally along the edges of the base plate 6, and in this situation can also fill out the gap space 31 between adjacent cooling elements 5, 5', 5". The seal along the edges of the base plate 6 also allows for the use of a less tough heat-conductive paste, optimised in respect of its heat conducting properties, between the container casing 2 and the base plate 6 of the cooling elements 5, 5', 5".

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process container with cooling elements and with at least one refractory cladding layer applied on the inner side of a metallic container casing, whereby each cooling element consists of a base plate and at least one cooling channel connected to this in a heat-conducting manner, the ends of which in each case exhibit a connection arrangement for the connection to the cooling channel of an adjacent cooling element, wherein the cooling elements are secured on the outside of the container casing by screw connections with threaded bolts, welded in each case on the outside of the container casing, so that, under the tension pressure of the screw connections, they nestle closely to this due to flexural deformation.

2. Process container according to Claim 1, wherein the threaded bolts are provided for distributing both over the individual cooling element, extending through the bolt holes provided in the base plate, as well as along the edges of the base plate of the cooling elements.

3. Process container according to Claim 1 or 2, wherein the screw connections are spring elastic due to the disk springs pushed onto the threaded bolts.

4. Process container according to one of Claims 1 to 3, wherein a heat-conductive paste is provided for between the base plate of the cooling elements and the container casing.

5. Process container according to Claim 4, wherein several filling holes for the heat-conductive paste are provided over the base plate of each cooling element.

6. Process container according to one of Claims 1 to 5, wherein each cooling element exhibits a cooling channel extending in at least two runs in snake-like fashion over the base plate, said channel being formed from a hollow profile which in cross-section is open on one side, and which is welded along its edges to the base plate.

7. Process container according to one of Claims 1 to 6, wherein provision is made at the ends of the cooling channel for a connection nozzle directed outwards, whereby the connection nozzles of adjacent cooling elements are connected to one another by means of a compensation pipe which exhibits a bellows-type section.

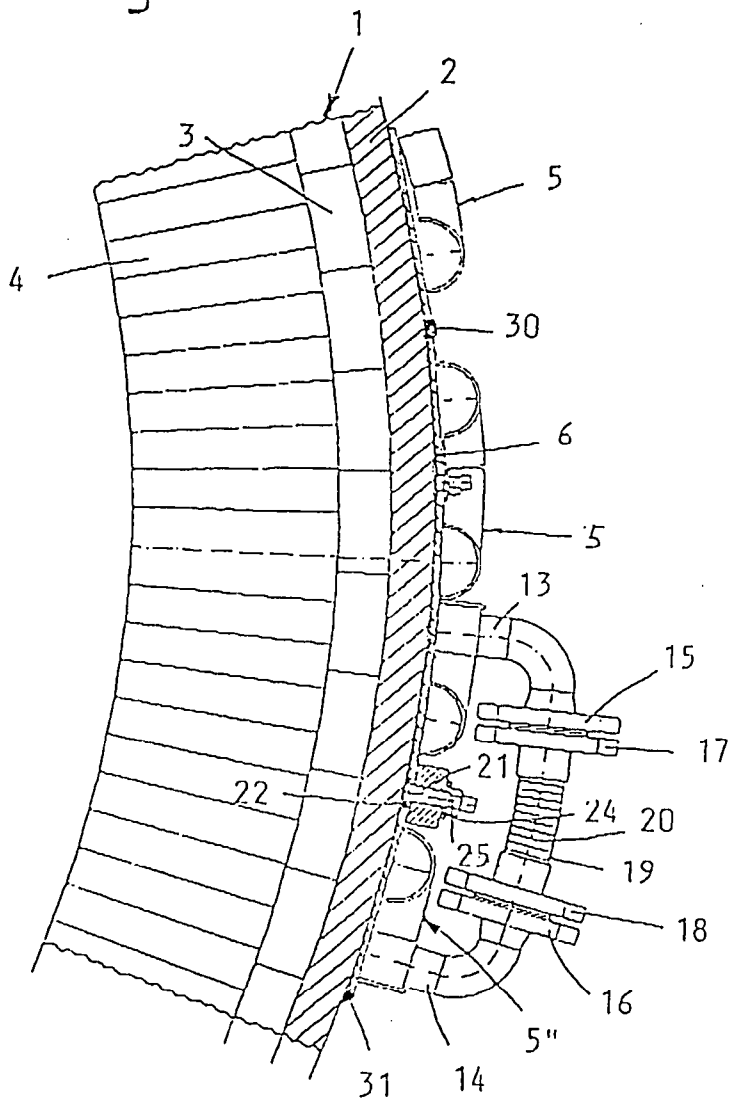
8. Process container according to one of Claims 1 to 7, wherein the base plate is less than 5 mm thick.

9. Process container according to one of Claims 1 to 8, wherein the base plate exhibits edge seals along its circumference, and a heat-conductive paste is provided between the base plate and the container casing.

10. Process container according to one of Claims 1 to 9, wherein the edge seals consist of a hardening heat-conductive paste.

11. A process container substantially as hereinbefore described with reference to the drawings and/or Examples.

Fig.1



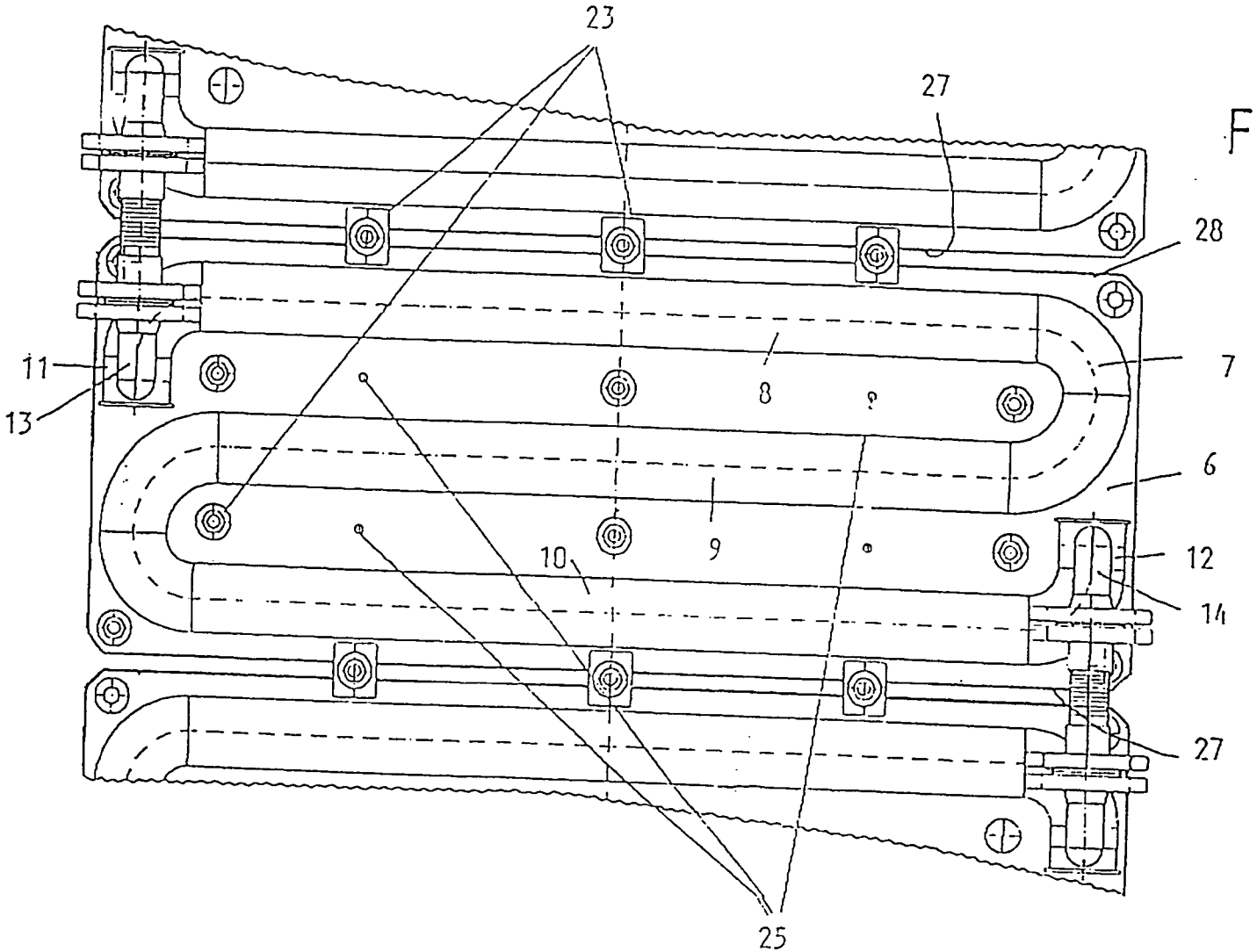


Fig.2