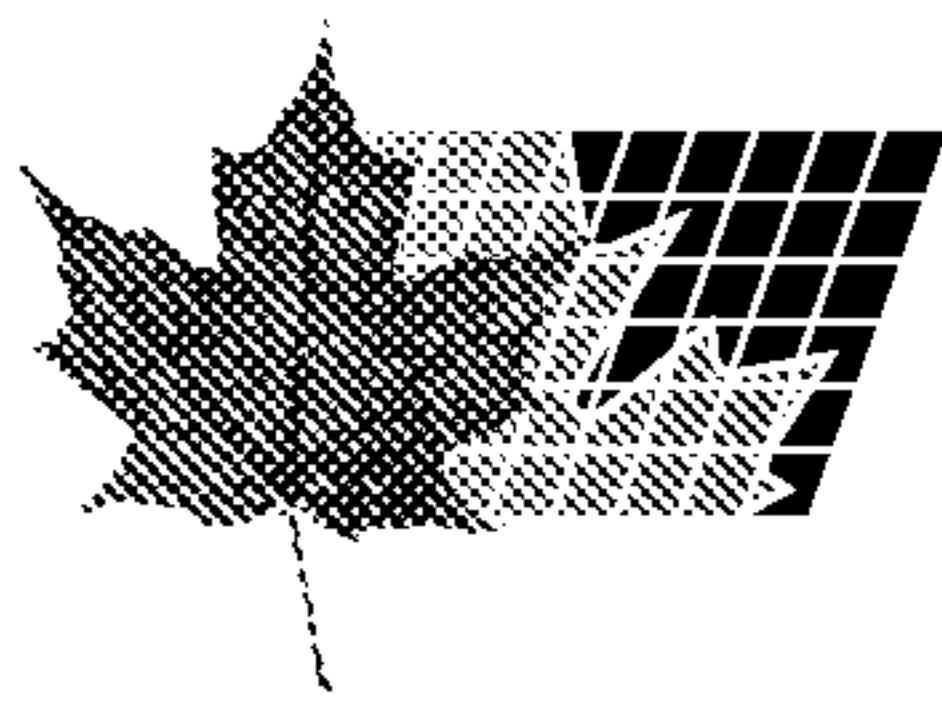




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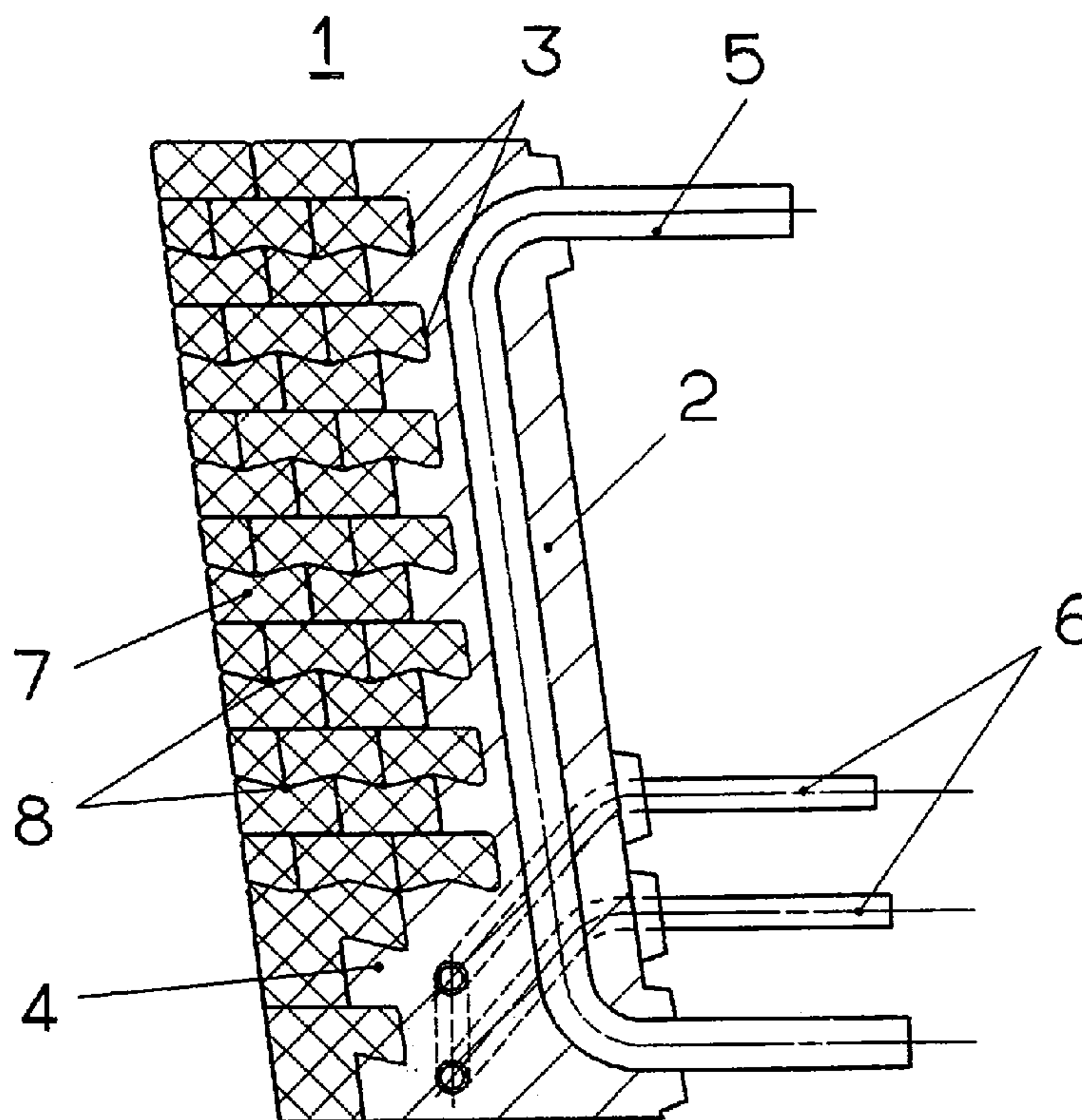
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(54) **ELEMENT REFROIDISSEUR POUR HAUT-FOURNEAU**

(54) **A COOLING ELEMENT FOR SHAFT FURNACES**



(57) A cooling element is disclosed for shaft furnace walls, comprising a metal plate (2) and coolant tubes (5). The lower edge of the plate (2) is formed as a supporting nose (4) for the refractory lining (7). The supporting nose possesses at least one additional cooling tube (6). The cooling element (1) according to the invention is assembled as a complete unit outside the furnace in a workshop. The refractory lining (7) consists of concentric annular sections of small bricks bonded or cemented together with the plate. The refractory bricks are provided with notches (8) at which the bricks are intended to break. If necessary, the layers of bricks in the lining (7) are provided with expansion joints (9). Bricks of different thermal conductivity may be used for the refractory lining (7).

ABSTRACT OF THE DISCLOSURE

A cooling element is disclosed for shaft furnace walls, comprising a metal plate (2) and coolant tubes (5). The lower
5 edge of the plate (2) is formed as a supporting nose (4) for the refractory lining (7). The supporting nose possesses at least one additional cooling tube (6). The cooling element (1) according to the invention is assembled as a complete unit outside the furnace in a workshop. The refractory lining
10 (7) consists of concentric annular sections of small bricks bonded or cemented together with the plate. The refractory bricks are provided with notches (8) at which the bricks are intended to break. If necessary, the layers of bricks in the lining (7) are provided with expansion joints (9). Bricks of
15 different thermal conductivity may be used for the refractory lining (7).

The invention relates to a cooling element, through which a coolant flows. The cooling element, which is intended for use in the walls of shaft furnaces and in particular blast furnaces, consists of plates made of cast iron or some
5 other metal and having internally arranged pipes containing a coolant. These pipes run parallel to the hot side and emerge on the cold side of the furnace wall. On the hot side, they are fitted with mainly horizontally oriented attachment points for the furnace lining.

10 Such cooling elements are customarily arranged between the steel outer shell of the furnace and the furnace lining and they are connected to the blast furnace cooling system. On the side facing the interior of the furnace, the cooling elements are provided with refractory material.

15 In a shaft furnace, the length of the furnace campaign depends to a large extent on the lifetime of the refractory lining. The lifetime of the lining can be extended not only by choosing materials with good refractory properties, but also by ensuring that it is well cooled.

20 The use of cooling elements through which a liquid coolant flows has proved to be a particularly effective method of cooling. In contrast to other methods, it achieves uniform cooling over the entire surface of the shaft furnace wall and thus also of the furnace lining.

25 Up until now, the method used to line a new furnace or to renew a worn lining was as follows: The cooling elements, i.e. the metal plates, were first mounted on the inner surface of the steel shell of the furnace, and then the refractory lining material was added, working from the bottom
30 upwards. To ensure the transfer of heat between the refractory lining and the cooling plates, the annular gap formed between the two was carefully grouted with mortar.

The wear rate of the refractory lining is determined

mainly by chemical, mechanical and thermal stresses. As the lining wear progresses, the thermal stresses on the cooling plates increase. Once the refractory lining has been completely eroded away, the cooling plates are exposed to the
5 maximum level of chemical and mechanical stresses.

It is an object of the invention to extend the furnace campaign by intensifying the cooling efficiency, and also to reduce the time required to install the cooling elements when lining a new furnace or replacing a worn lining.

10 In general terms, the invention provides a cooling element, through which a liquid flows, used in the walls of shaft furnaces, in particular blast furnaces, and comprising a plate made of cast iron or another metal having within the plate coolant tubes running parallel to the hot side and
15 emerging on the cold side, and the hot side of the plate is fitted with mainly horizontal-oriented recesses in which the lining engages. According to the invention, the lower edge of the hot side of the plate has the form of a nose which supports the refractory lining. The supporting nose is cooled
20 by at least one additional cooling tube. after the metal plate has been cast, but before it is installed in the wall of the shaft furnace, a refractory lining arranged in horizontal concentric rings is applied to the hot side of the plate and is bonded or cemented to the plate to form a one-
25 piece cooling element.

In another aspect, the invention provides a method of producing a cooling element having a cold side and a hot side, through which element a liquid flows, for use in the walls of shaft furnaces, in particular blast furnaces, which
30 element comprises a plate made of cast iron or another metal having within the plate coolant tubes running parallel to the hot side and emerging on the cold side, and the hot side of the plate is fitted with mainly horizontal-oriented recesses in which the lining engages, said method comprising the steps
35 of

- (a) providing a lower edge of the hot side of the plate with the form of a nose which supports the refractory lining;
- (b) the supporting nose being arranged to be cooled by at least one additional cooling tube, said element further comprising a refractory lining so disposed that, upon installation in the wall of a shaft furnace, the linings of the respective cooling elements are arranged in horizontal concentric rings;
- (c) said lining being applied to the hot side of the plate and bonded or cemented to the plate to form a one-piece cooling element after the metal plate has been cast, but before it is installed in the wall of a shaft furnace.

The invention provides the following advantageous features:

- Shorter installation or replacement times for shaft furnace linings, and thus lower production losses.
- Better connections between the refractory lining and the metal cooling plates guarantee improved heat removal and thus optimum cooling of the lining material, thereby also increasing the lifetime of the cooling elements themselves.
- The cast-on, cooled nose of each plate is arranged at the bottom, narrow side of the plate where it provides a solid support for the refractory bricks which make up the furnace lining.
- If a layer of refractory bricks breaks off or is lost after the furnace has been in operation for a long period of time, the cooled nose according to the invention as a rule limits the damage to one single cooling element so that the adjacent elements are not jointly affected.
- Notches provided as predetermined breaking points in the refractory bricks ensure that not all the refractory

lining in front of the plate is lost, but instead the wear process proceeds layer by layer and at a delayed rate.

- It is no longer necessary to install the refractory bricks by working inside the furnace itself. Instead, the lining work is carried out under favourable ergonomic conditions in a workshop; this method of work and the elimination of time pressure combine to promote the quality of the work performed.

10 It is a well-known fact that the expansion characteristics of the refractory lining differ from those of the cooling plates, therefore small-sized firebricks have been selected for the cooling element described in the invention. In this way, not only heat but also the mechanical stresses can be dissipated via the normal joints between the bricks. In case this is not adequate when certain qualities of refractory lining material are used, additional expansion joints can be provided in the refractory part of the cooling element.

20 Depending on the stress in the individual concentric, annular layers, bricks with different expansion characteristics and different degrees of resistance to mechanical erosion and chemical attack can be selected. For example, for the first layer adjacent to the plate a material with high thermal conductivity, such as SiC, may be used and for the layers further away from the plates a material with a lower thermal conductivity can be selected. It goes without saying, that the firebrick material should in general be as resistant as possible to abrasion and should be able to withstand chemical attack.

In certain areas of the shaft furnace, where the stresses are low, the refractory lining according to the invention can also be carried on shortened supporting noses. Such elements can be used, for example, in the upper shaft of

the furnace. On the other hand, it is also possible to dispense entirely with such supporting noses on the cooling element plates, for example, in the bosh of the furnace.

The subject of the invention is described in more detail below, on the basis of the embodiments depicted in the drawings.

Figs. 1 - 3 are longitudinal sections through a cooling element, and

Fig. 4 is detail of Figs. 1 - 3, seen from the cold side.

The overall cooling element 1 is made up of the metal plate 2 containing the tubes 5, 6, through which the coolant flows, and the refractory lining 7. The plate 2 is as a rule made of cast iron. The coolant tubes 5, 6 are customarily made of steel.

At its bottom edge, the plate 2 possesses a supporting nose 4 which projects towards the hot side of the furnace and serves to support the small firebricks which make up the refractory lining 7. On the side towards the interior of the furnace, the entire face of the cooling plate 2 is provided with attachment recesses 3 for the lining material.

Figs. 1 - 3 show one of the main cooling tubes 5 in longitudinal section, with an inlet and outlet connection. Furthermore, a cross section is shown through a cooling tube 6 which is used to cool the supporting nose 4. The latter tube is depicted on an enlarged scale in Fig. 4, together with the inlet and outlet connections, and it possesses the form of a recumbent figure eight, so that uniform cooling is achieved in the area of the supporting nose.

The other main cooling tubes, which are not visible in the drawings, are arranged parallel to the cooling tube which has been depicted. In the normal case, it is sufficient to

provide just one cooling tube 6 to cool the supporting nose 4. However, if necessary, further cooling tubes can also be provided.

The refractory lining 7 is made up of small firebricks 5 which, once the plate 2 has been cast, can be bonded or cemented together to form a one-piece cooling element 1.

This is one of the major advantages of the cooling element according to the invention compared with known types of cooling plates. The cooling elements according to the invention can, in fact, be manufactured as complete, ready-to-install units, i.e. including the refractory lining, in a workshop under favourable ergonomic conditions and without time pressure. Once the complete cooling elements have been installed in the furnace wall, only the horizontal and 15 vertical joints between the adjacent cooling elements need to be sealed with mortar. Each cooling element is designed in such a manner according to the invention that it is guaranteed to have a long service life in the shaft furnace, and the separately cooled nose fitted at the bottom edge of 20 the plate reliably supports the refractory lining of the cooling element.

The refractory bricks used in the lining 7 are provided with tongued-and-grooved connections in the circumferential direction. On one side they also possess notches 8 which act 25 as predetermined breaking points so that, as the lining wear progresses, only one annular layer at a time in the refractory lining and not the entire lining of a cooling element breaks away. These notches 8 at which the breaking is intended to occur may also be arranged on both sides of the 30 bricks.

The bricks in the lining 7 possess joints on all sides by means of which the mechanical and thermal stresses can be accommodated. In addition, horizontal expansion joints 9 as shown in Fig. 2 may also be provided in the refractory lining

material 7.

By means of different shading, Fig. 3 shows that refractory bricks of different quality may be used for lining the hot side of the cooling element 1. This permits better
5 adaptation to locally different temperatures, and locally different mechanical and chemical stresses. For example, for the surface of the cooling element facing the interior of the furnace one would select bricks of highly abrasion-resistant material but lower thermal conductivity than for the layer
10 close to the cooling plate, which should ideally be made up of firebricks having a high degree of thermal conductivity.

CLAIMS

1 1. A cooling element, through which a liquid flows, used in the walls of
2 a shaft furnace, in particular blast furnaces, and comprising a plate having a
3 hot side turned toward the interior of the furnace, the plate being made of cast
4 iron or another metal having within the plate coolant tubes running parallel to
5 the hot side and emerging on the cold side, and the hot side of the plate is
6 fitted with mainly horizontal-oriented recesses in which a refractory lining
7 engages, wherein the lower edge of the hot side of the plate has the form of
8 a nose which supports the refractory lining, the supporting nose being arranged
9 to be cooled by at least one additional cooling tube, said element further
10 comprising a refractory lining arranged in horizontal concentric rings, said lining
11 having been applied to the hot side of the plate and bonded or cemented to the
12 plate to form a one-piece cooling element after the metal plate has been cast,
13 but before it is installed in the wall of a shaft furnace.

1 2. A cooling element according to Claim 1, wherein the refractory lining
2 is made up of small firebricks which are designed with notches acting as
3 predetermined breaking points.

1 3. A cooling element according to Claim 1, wherein the firebricks of which
2 the refractory lining is made up are provided circumferentially with tongue-and-
3 groove joints.

1 4. A cooling element according to one of Claims 1, 2 or 3, wherein
2 firebricks of different quality are used in the various concentric rings of which
3 the refractory lining is made up.

1 5. A cooling element according to one of Claims 1, 2 or 3, wherein the
2 layers of brick in the refractory lining possess mainly horizontal expansion
3 joints.

1 6. A cooling element according to Claim 1, wherein inlet and outlet
2 connections of the main cooling tubes are situated close to the upper or lower
3 edges respectively of the plate, and the inlet and outlet connections of the

4 nose cooling tube are located in the area of the plate situated between the inlet
5 and outlet connections of the main cooling tubes.

1 7. A cooling element according to claim 4, wherein the layers of brick in
2 the refractory lining possess mainly horizontal expansion joints.

1 8. Method of producing a cooling element comprising a plate having a
2 cold side and a hot side, through which element a liquid flows, for use in walls
3 of shaft furnaces, in particular blast furnaces, which element comprises a plate
4 made of cast iron or another metal having within the plate coolant tubes
5 running parallel to the hot side and emerging on the cold side, and the hot side
6 of the plate is fitted with mainly horizontal-oriented recesses in which a
7 refractory lining engages, said method comprising the steps of:
8 (a) providing a lower edge of the hot side of the plate with the form of a
9 nose which supports the refractory lining;
10 (b) the supporting nose being arranged to be cooled by at least one
11 additional cooling tube, said refractory lining being so disposed that,
12 upon installation in the wall of a shaft furnace, the linings of the
13 respective cooling elements are arranged in horizontal concentric rings;
14 (c) said lining being applied to the hot side of the plate and bonded or
15 cemented to the plate to form a one-piece cooling element after the
16 metal plate has been cast, but before it is installed in the wall of a shaft
17 furnace.

FIG. 1

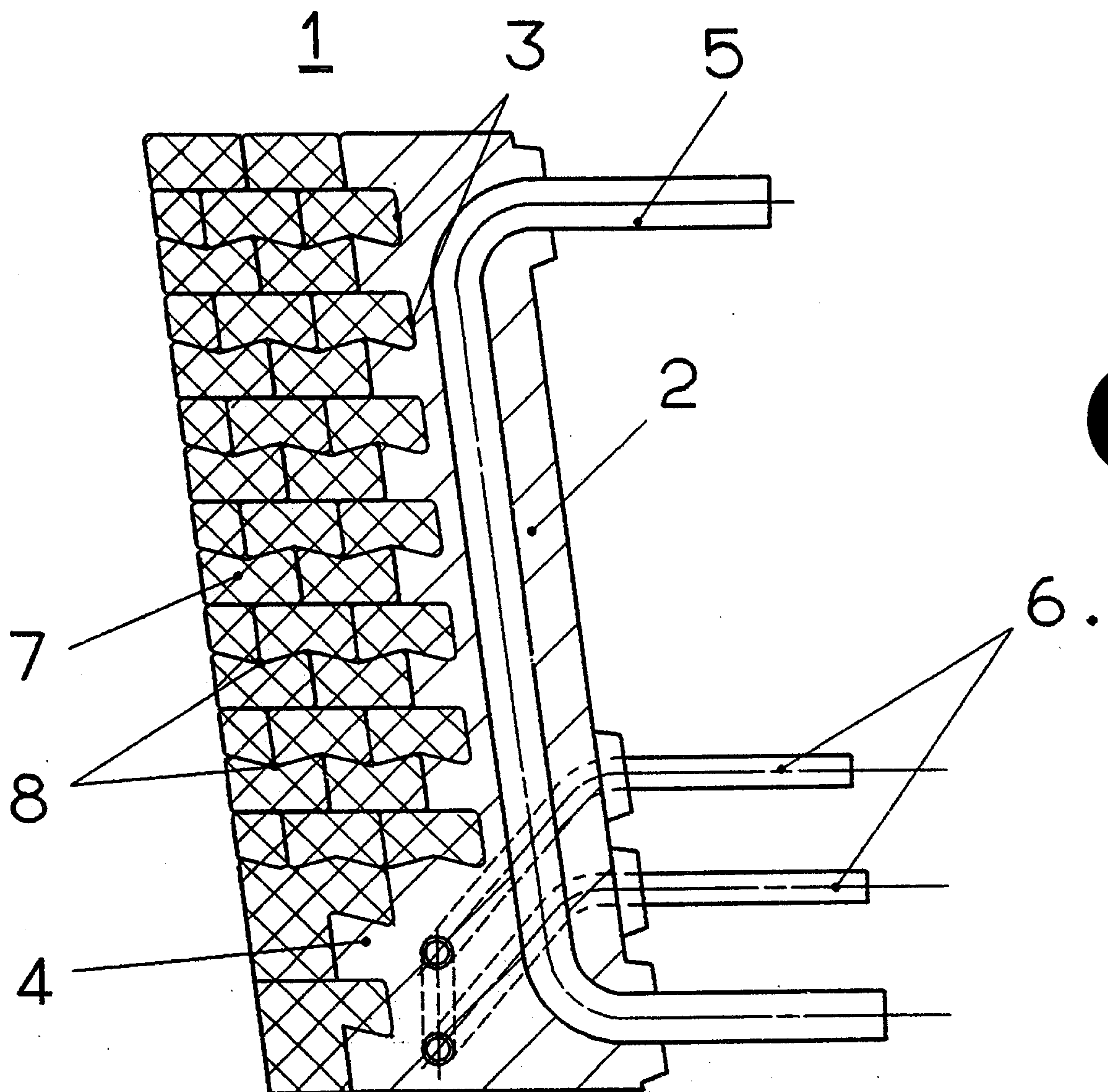


FIG. 2

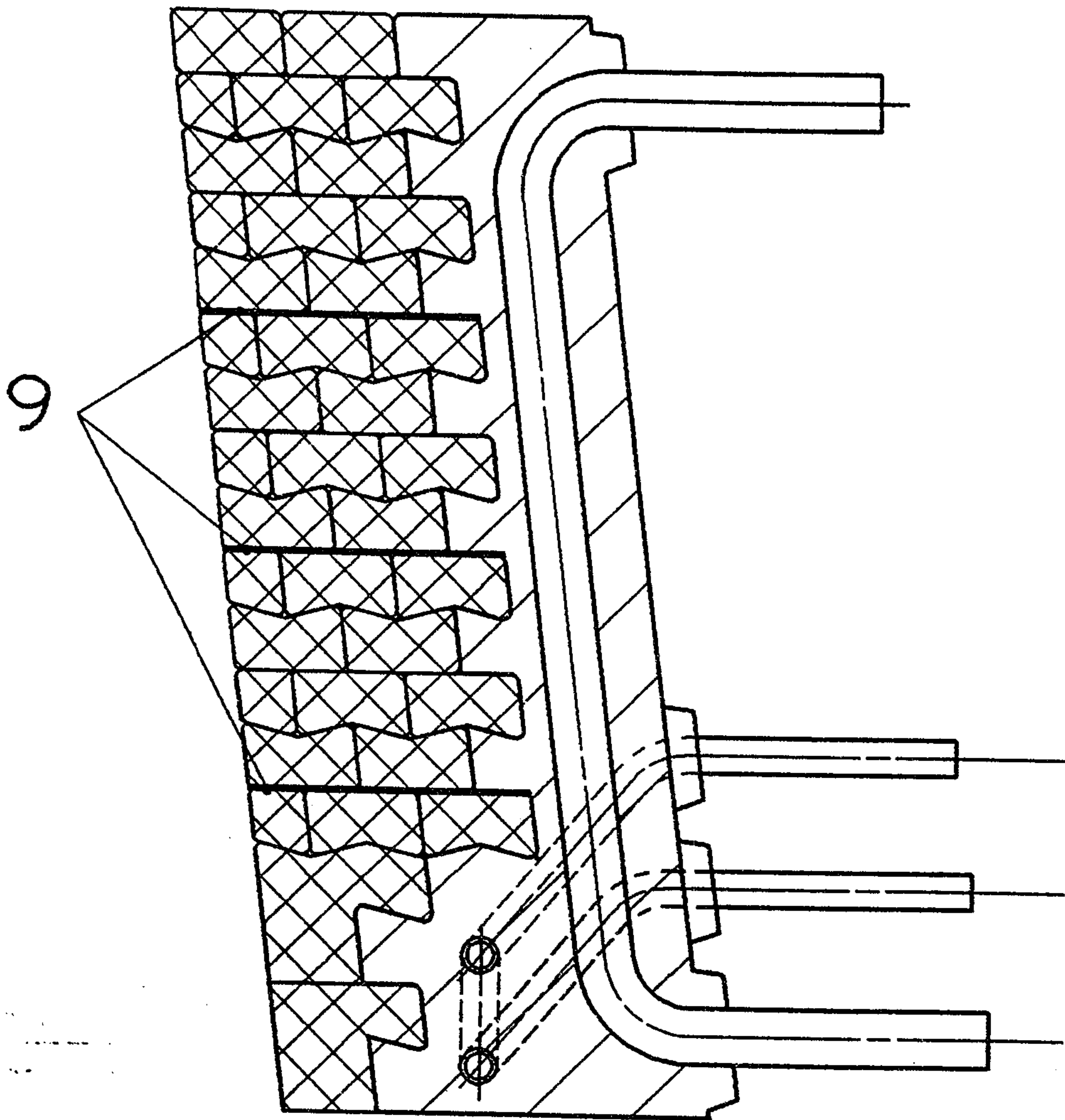


FIG. 3

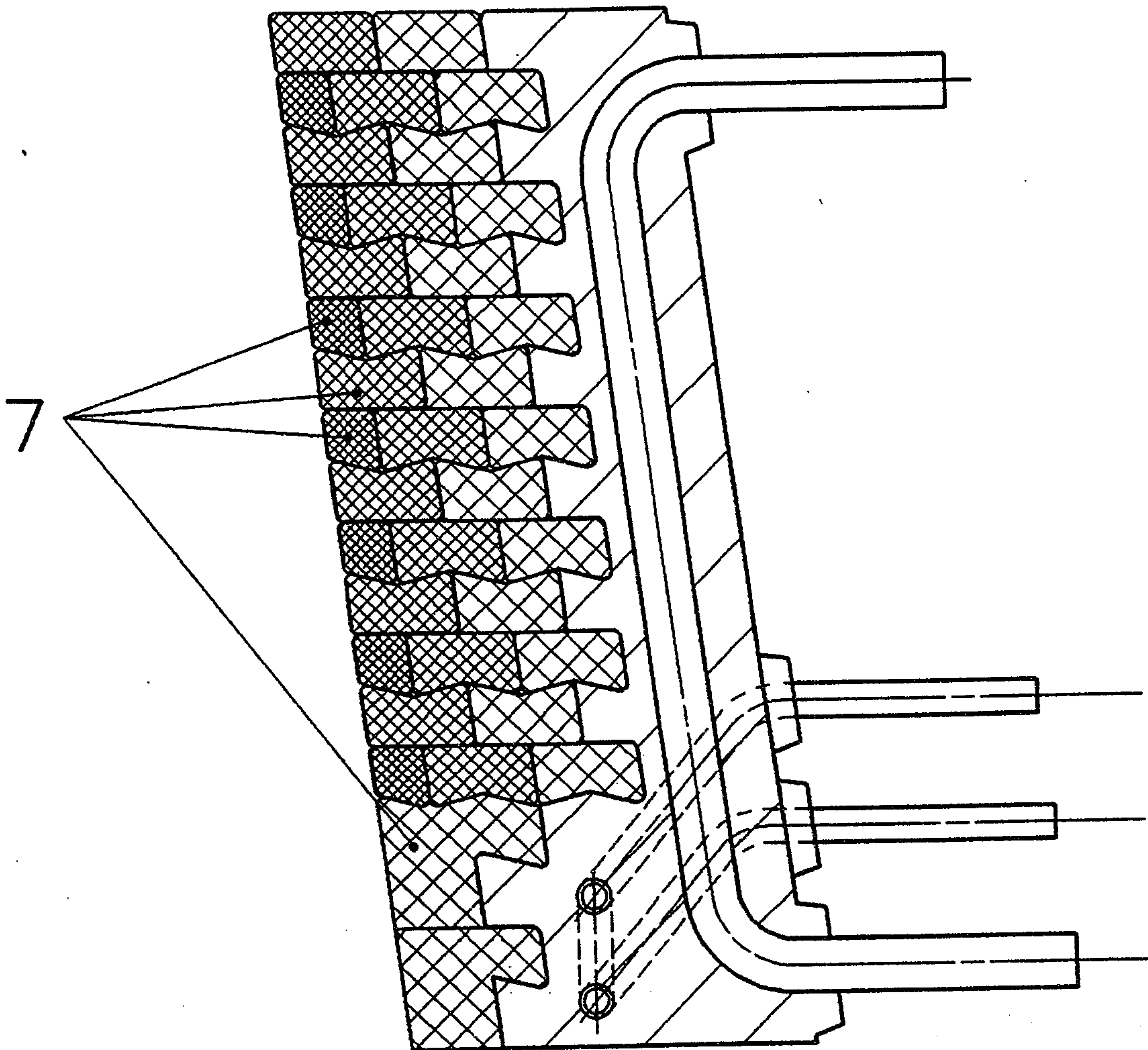


FIG. 4

