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Cooled panels for walls of electric furnaces

This invention relates to panels cooled by water or other suitable liquid for forming the walls of electric furnaces, wherein, as well known, smelting takes place by electric discharges.

An ideal panel, which may be part of a wall or may form the whole wall of an electric furnace should fulfill the following requirements:

(1) Provide minimal heat losses through the panel.

(2) Provide the greatest possible safety against any accidental exit of water or other fluid.

(3) Be of a big anough size, so that only a reduced number of outside connections has to be carried out for the supply and discharge of water or other fluids.

(4) Be of a suitable size and having thermal characteristics according to each site or zone of each furnace.

(5) Enable a long life of the panel in use.

(6) Allow the partial replacement of zones of the panel according to requirements and as desired.

Different types of panel are commercially available, but the solutions hitherto proposed only partly meet these conditions. Particularly, boxes or sectors are used as panels for electric furnaces having water circulating therein, but this fluid, though it has fixed paths, may, due to the provision of not circular sections, easily build up pockets of steam or dead water causing overheating of some zones of the boxes and accordingly a perforation thereof.

Also steel blocks are used as having a built-in inner coil. The water path is fixed therein, thus assuring a smooth flow, but the disadvantage arises that the panel smelting involves a complicated operation, the reduced size of the panel causing the increase of outside connections. A further disadvantage is that during use the considerable size of the panel causes cracks on the melted inner wall thereof. In this case, it is also required to provide panels for each specific requirement. Thus, different panels should be provided for each type of furnace and in a same furnace panels which are different as to characteristics and size according to the different use zones or sites.

The U.S.A. Patent 3.829.595 shows a furnace of single piece panel containing their tubes, even these being in a single piece. The tubes contained in these panels are connected to one another.

These traditional panels must have a reduced size for avoiding cracks when they are subjected to thermal expansion and for adapting themselves to the ideal profile of the furnace surface which is to be coated. Moreover the traditional panel must be manufactured also considering its constructive requirements.

These requirements are in contrast with the furnace requirements due to the fact that the panel in the nearest zone to the bath must disperse more heat than a panel in a zone further off from the same. The U.S.A. patent provides therefore a panel which is a compromise which satisfies only partially the local thermal requirements of the furnace. Further due to the relatively small size of the panel according to the U.S.A. patent a plurality of external connections of the tubes must be provided, which results difficult and expensive. Moreover according to the U.S.A. patent one must construct different panels for each size of the furnace.

Therefore the object of the present invention is to make panels

a) which are perfectly adapted to the local thermal requirements of each furnace providing an optimum heat-exchange and therefore resulting in a low energy consumption;

b) which have considerable size without presenting any breakages due to thermal expansion;

c) which have reduced manufacturing expenses, making use of a small series of elements adaptable to any furnace diameter, these elements thus being independent of the furnace diameter;

d) which have a long life;

e) which allow the replacement even of a single zone of the panel.

These objects have been obtained as specified in the claims.

Preferably, these elements comprise an outer body which is inserted over a special tube or by a tube portion which is incorporated in an outer body, said tubes serving for the passage or cooling water or other fluid.

A preferred solution also provides that the panel surface facing inwardly of the furnace is shaped so as to retain therein insulating material comprising slags produced by the furnace itself, or refractory material which is suitably before hand.

Preferably, the modular elements are assembled by welding to some of the elements comprising curves or bendings some tube lengths over which one or more elements provided with corresponding holes are inserted, then further curved elements are welded to the free ends of said tubes, thus providing a circuit or path for the cooling fluid. Such a formed panel can now be bent for adaptation to the diameter of the furnace to which it will be applied.

In case, portions of refractory material can be incorprated between the various modular elements.

The invention will now be more clearly explained with reference to an exemplary embodiment which has been shown in the figures of the accompanying drawings, in which:

Fig. 1 is a front view of a portion of two walls for an electric furnace according to the present invention;

Fig. 2 is a sectional view taken along line II—II of Fig. 1;

Fig. 3 is a sectional view taken along line III—III of Fig. 1;

Fig. 4 is a view taken along line IV—IV of Fig. 1; and

Fig. 5 is a developed view of a wall of a furnace lined up with panels according to the present invention.

Fig. 1 shows a portion of a wall of a furnace, in which a portion of a panel 1 is shown at right to line IV—IV, while a portion of a panel 18 adjacent to the first mentioned panel is shown at the left to line IV—IV.

In the zone underlying said two panels, there is a refractory base 12. In Fiugs. 2, 3 and 4 there is also shown the supporting structure comprising two vertical tie rods 13 passing into holes 19 suitably provided in each of the modular elements. Said tie rods 13 are then secured to the furnace housing 14.

Each panel comprises several modular elements, which will now be described one by one.

Element 2 (Figs. 1, 2 and 3) comprises a block containing two parallel holes shown at 2*a* respectively, in which tubes 16 are inserted during assembling. Elements 3 and 4 (Figs. 1 and 4) comprise blocks containing curved or bent tubes 3*t* and 4*t*, respectively. Element 6 is quite similar to element 2, but the distance or spacing between the parallel holes 6*a*, and hence between tubes 16 therein contained is larger than that between tubes 16 of said element 2. Element 5 comprises a semi-element having a single hole 5*a* and is for completion of the panel. Finally, element 15 is similar to element 5, but comprises a curved element 15a connected to tube 8 or 9, respectively serving for the return and delivery of the cooling fluid.

The assembling of the various elements, so that the latter will form a panel, may be effected by merely taking elements 3 or 4 comprising a curve or bending, preferably projecting out of the element, and welding on these tube ends some lengths of straight tube 16 of a suitable size, then inserting on such straight tubes the preselected elements, such as those of type 2, 6 or the like, finally welding to the end of these straight tubes other curved tubes 3a or 4a, and two elements 15, 15a with associated tube 8 and 9, thus forming a continuous circuit panel. Now the panel thus obtained will be curved for adaptation to the furnace diameter. In case, refractory bricks 7 are incorporated in the panel, bricks which are supported by the adjoining elements.

The gaps 10 and 11 in the vertical and horizontal joint zones, respectively, between two adjoining elements, are filled with refractory material or simply with slags produced by the furnace operation, thus rendering the structure sufficiently monolithic.

The side wall of the furnace shown in Fig. 5 comprises nine panels, of which six are for example of a length L1 of 1910 mm and a height H1 of 1200 mm, two are of a length L2 of 1680 mm and a height H2 of 950 mm, and finally one of a length L3 of 920 mm and a height H3 of 530 mm. The asembly of these panels may form the side walls of an electric furnace of about 50t, the circumference T of which is 16,014 mm. In the drawing of Fig. 5, reference numeral 26 denotes the tapping hole and 17 the casting or pouring level. Above this level, the side walls of the furnace first comprise a refractory 12 of a minimal height H4 of 550 mm, this height increasing in proximity of tapping hole 26 and of the gate for the admission of additive materials.

In Fig. 5 three panels have been shown along with the structural modular elements thereof, the water circuit having been shown by arrows and dashed lines indicating the path for the tubes in the elements. Generally, the elements are arranged so as to be offset in height, each row relative to the adjacent row, but this is not the only possible solution, as shown in one of the panels of Fig. 5.

The darkened zones in each of the panels are those in which refractory material 7 has been inserted.

From the foregoing description, it will be appreciated that panels can be provided of different characteristics along the height thereof, having for example lower zones with a larger cooling factor than that of the upper zones, as predicated. This can be done only because of the availability of small modular casting elements.

By this principle, the furnace cooling can be differentiately balanced: at the hot locations, a higher cooling is provided, while at those less liable to heat, cooling is smaller.

From Figs. 2 and 3, it will be also appreciated that the surface of each element is formed with cavities 2*b* and 6*b*, in which refractory material is inserted, and in any case against which the furnace slags will deposit, thus increasing the wall insulation and hence decreasing the heat exchange and increasing the panel life. These cavities may be of any shape and pattern as far as capable of retaining the insulating material.

The provision of refractory bricks along with cavities 2*b* and 6*b* carrying refractory material or slags allows a lower removal of calories from the cooling water and accordingly a lower energy consumption for steel smelting.

Claims

1. A panel forming a wall portion for electric furnaces, comprising a body in which a tube (16) for cooling is inserted, this latter extending from an inlet to an outlet, characterized in that the body consists of a plurality of separate

elements (2, 3, 4, 5, 6, 15) containing curved or rectilinear tube portions (16) in corresponding holes therein and connected with one another, thus forming a single means for the cooling flow.

2. A panel according to claim 1, characterized in that the inner surface of the elements (2, 6) has a cavity (2b, 6b) which can receive sprayed refractory material or furnace slags.

3. A panel according to claim 1 or 2 characterized in that there are at least two types of elements (2, 6; 4, 3) wherein the tubes can be inserted at different spacings, thus allowing different thermal exchange in a same panel.

4. A panel according to any of the preceding claims, characterized in that refractory material (7) is inserted between at least two elements.

5. A panel according to any of the preceding claims characterized in that at least a gap (10, 11) is left between the elements (2, 3, 4, 5, 6) of a panel.

6. A method for assembling a panel forming a wall portion for electric furnaces as claimed in claim 1, characterized by the following steps:

a) welding straight tube portions (16) to the ends of curved tubes contained in corresponding holes in separate elements (3, 4);

b) threading one or more elements (2, 6) provided with corresponding straight holes onto the straight tube portions (16);

c) welding to the ends of the straight tube portions (16) the ends of curved tubes contained in corresponding holes in further elements (3, 4) to form a single means for the cooling flow; and

d) curving the panel according to the diameter of each specific furnace.

Revendications

1. Panneau qui constitue une part de la paroi pour fours électriques; il comprend un corps où il y a un tuyau (16) de refroidissement, qui s'étend d'une entrée à une sortie. Le corps est constitué de plusieurs éléments séparés (2, 3, 4, 5, 6, 15), qui contiennent des parts de tubes (16) cintrées ou rectilignes, dans des trous correspondants exécutés dans les tubes mêmes et reliés l'un de l'autre de façon à former un engin unique pour l'écoulement refroidissant.

2. Panneau d'après la revendication 1, caractérisé par une cavité (2*b*, 6*b*) de la surface interne des éléments (2, 6) qui peut recevoir du matériel réfractaire giclé ou des laitiers de four.

3. Panneau d'après la revendication 1 ou 2, caractérisé par deux types d'éléments au moins (2, 6; 4, 3), où les tubes peuvent être insérés avec des espacements différents, de façon à permettre un échange thermique différencié dans le même panneau.

4. Panneau d'après n'importe quelle revendication précédente, caractérisé par l'insertion du matériel réfractaire (7) entre deux éléments au moins.

5. Panneau d'après n'importe quelle revendication précédente, caractérisé par un éspace (10, 11) inséré entre les éléments (2, 3, 4, 5, 6) d'un panneau.

6. Mode d'assemblage d'un panneau qui forme und part d'une paroi pour fours électriques, d'après la revendication 1, caractérisé par les phases suivantes:

a) soudure des parts droites du tuyau (16) aux extrémités des tubes cintrés, contenus dans des trous correspondants, qui forment des éléments séparés (3, 4);

b) filetage d'un ou de plusieurs éléments (2, 6), pourvus de trous droits correspondants, sur les parts droites du tuyau (16);

c) soudure à l'extrémité des parts droites du tuyau (16), des parties terminales des tubes cintrés pour former d'autres éléments (3, 4) qui constituent un engin unique pour l'écoulement de refroidissement et

d) ploiement du panneau selon le diamètre de chaque four spécifique.

Patentansprüche

1. Tafel, die einen Teil der Elektroofenwand bildet, mit einem Körper, in den ein Kühlungsrohr (16) eingesetzt ist, das sich von einem Eingang bis zu einem Ausgang erstreckt, dadurch gekennzeichnet, daß der Körper aus einer Mehrzahl getrennter Elemente (2, 3, 4, 5, 6, 15) besteht, die gebogene oder gerade Rohrteile (16) in entsprechenden Löchern enthalten, die in denselben gebohrt sind, und miteinander so verbunden sind, daß sie ein einziges Mittel für den Kühlungsstrom bilden.

2. Tafel nach Anspruch 1, dadurch gekennzeichnet, daß die Innenfläche der Elemente (2, 6) einen Hohlraum (2*b*, 6*b*) aufweist, der gespritztes feuersicheres Material oder Ofenschlakken aufnehmen kann.

3. Tafel nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß sie mindestens zwei Elementtypen (2, 6; 4, 3) aufweist, in die die Rohre mit verschiedenen Abständen eingesetzt werden können, so daß in einer selben Tafel ein differenzierter Wärmeaustausch möglich ist.

4. Tafel nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß zwischen mindestens zwei Elemente feuersicheres Material (7) eingesetzt ist.

5. Tafel nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß zwischen den Elementen (2, 3, 4, 5, 6) einer Tafel mindestens ein Zwischenraum (10, 11) vorhanden ist.

6. Verfahren zum Zusammenbau einer Tafel, die einen Teil einer Elektroofenwand bildet, wie im Anspruch 1 beansprucht, durch folgende Phasen gekennzeichnet:

a) Schweißung von geraden Rohrteilen (16) an den Enden von gebogenen Rohren, die in entsprechenden Löchern getrennter Elemente (3, 4) enthalten sind.

b) Gewindeschneiden eines oder mehrerer

Elemente (2, 6), die mit entsprechenden geraden Löchern auf den geraden Rohrteilen (16) versehen sind.

c) Schweißung an den Enden der geraden Rohrteile (16) der gebogenen Rohrendteile, die in entsprechenden Löchern weiterer Elemente (3, 4) enthalten sind, um ein einziges Mittel für den Kühlungsstrom zu bilden, und

d) Biegung der Tafel gemäß dem Durchmesser jedes bestimmten Ofens.

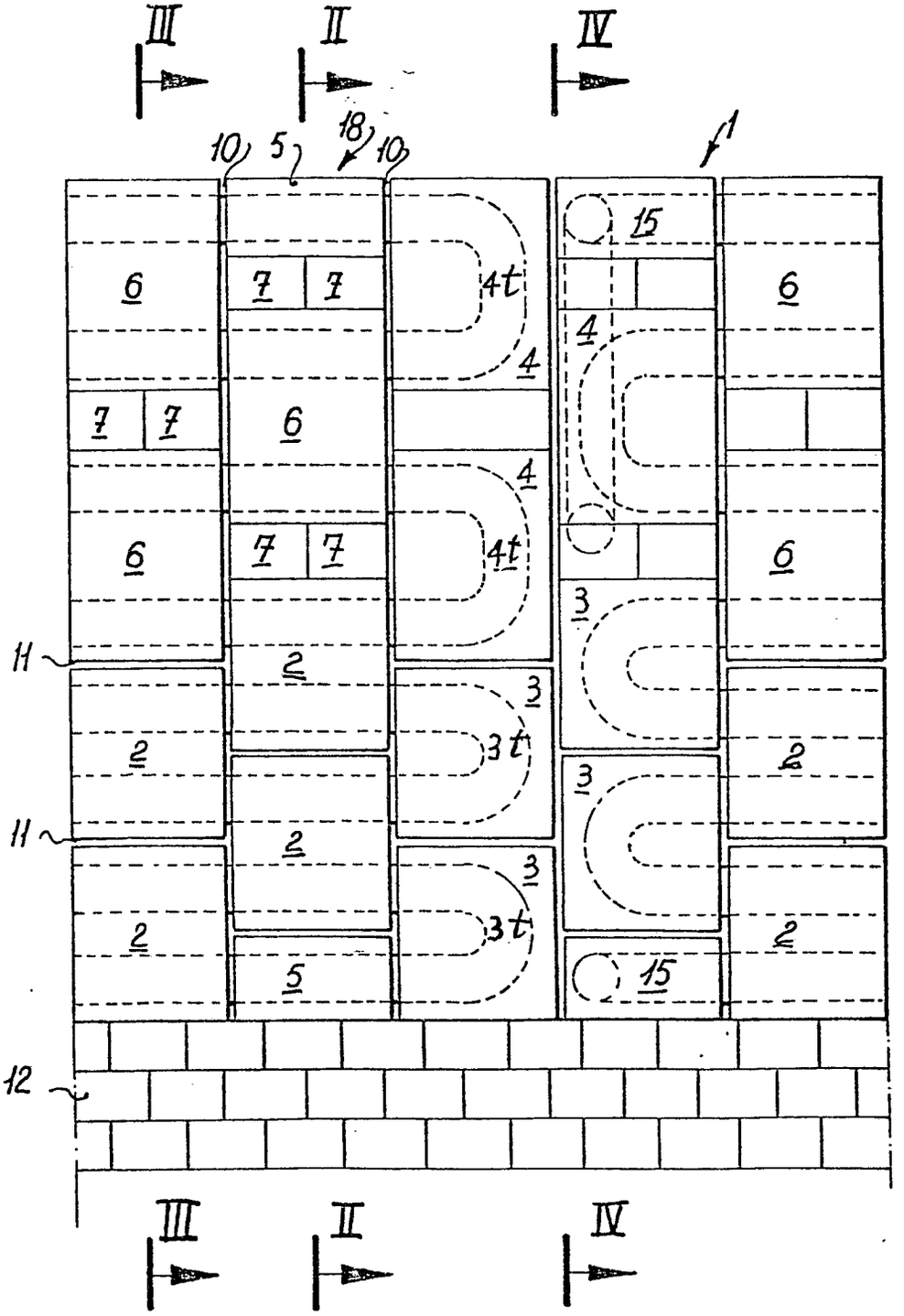

III
II
IV
10
5
18
10
1
15
6
7
7
4t
4
6
7
7
6
4
4t
6
7
7
6
3
11
2
3
3t
2
2
11
2
3
3t
2
3
2
5
15
12
III
II
IV

Fig. 1

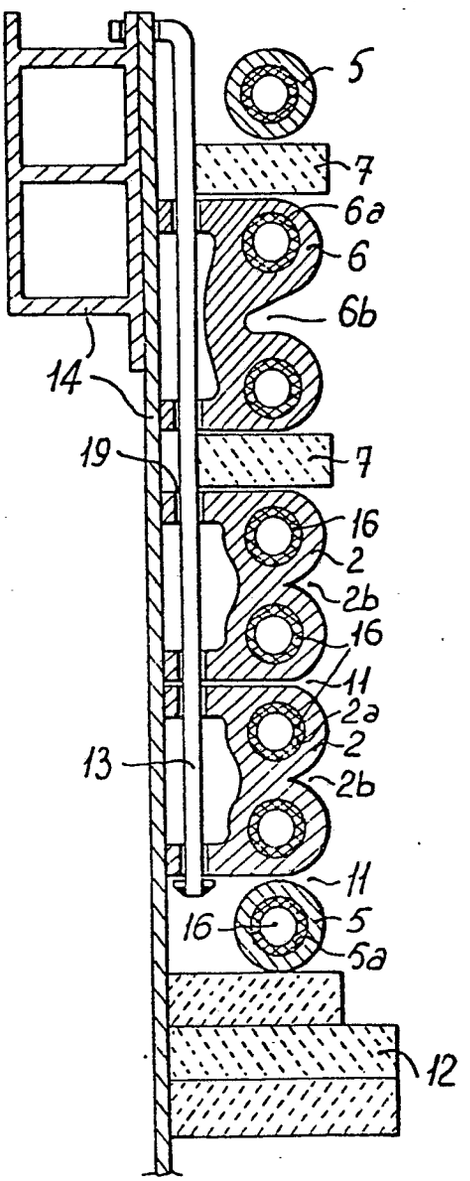

5
7
6a
6
6b
14
19
7
16
2
2b
16
11
2a
2
13
2b
11
16
5
5a
12

Fig. 2

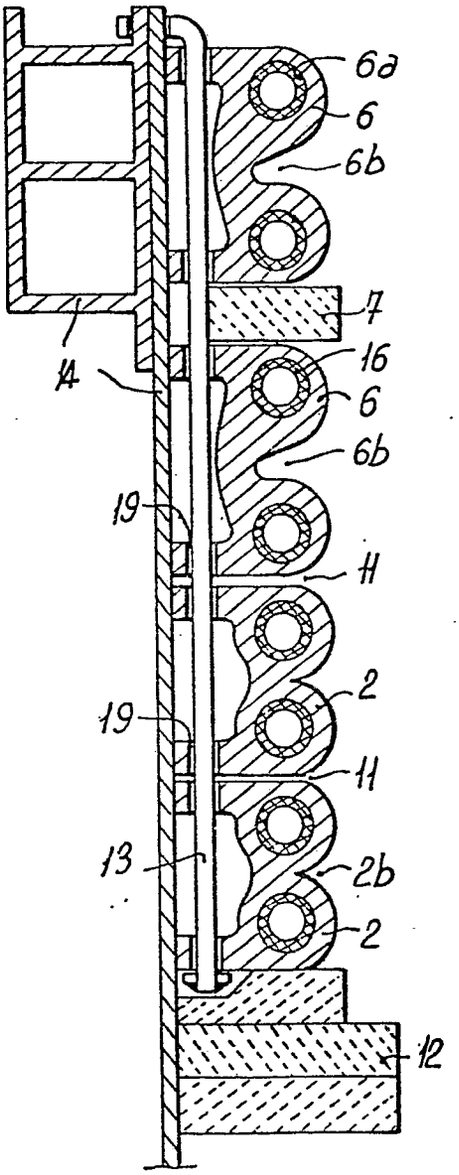
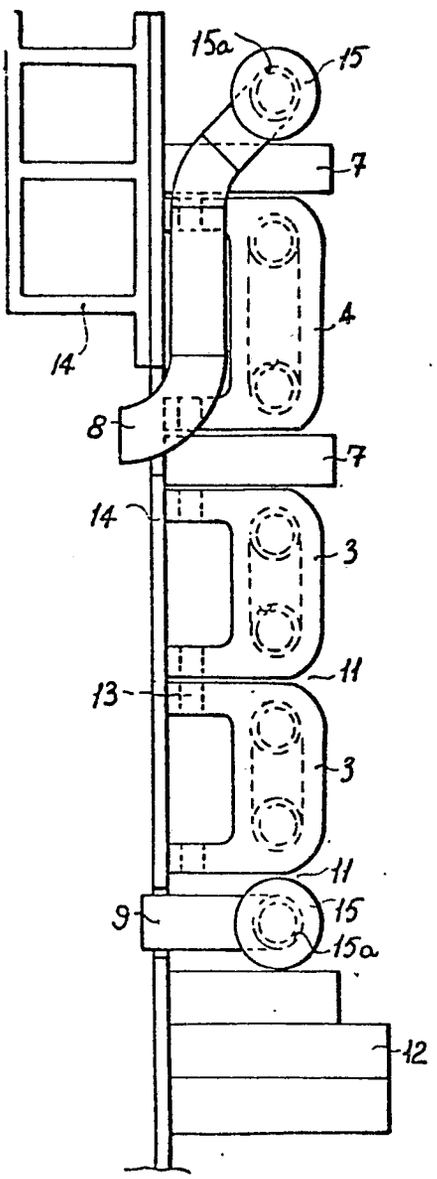

6a
6
6b
7
16
14
6
6b
19
11
2
19
11
13
2b
2
12

Fig. 3


15a
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4
14
8
7
14
3
11
13
3
11
9
15
15a
12

Fig. 4

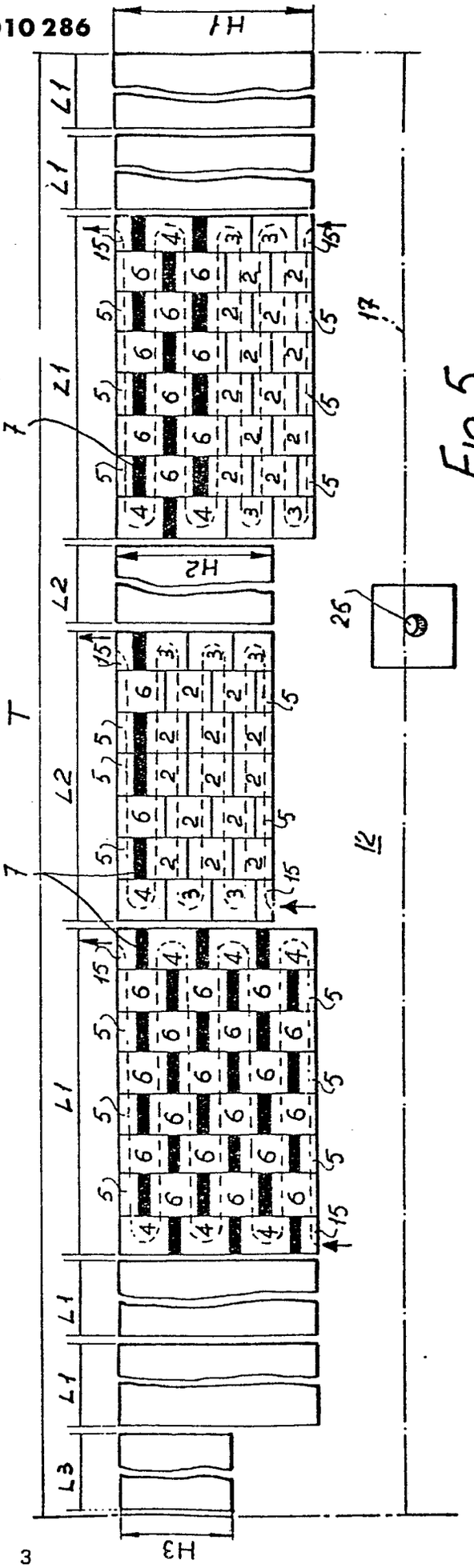
H1
L1
L1
7
L1
H2
L2
T
L2
7
L1
L1
L1
L3
H3
25
12
17

Fig. 5