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Description

The present invention relates to a heating furnace, particularly a furnace for heating a steel prior to the hot working of the steel. The present invention relates, more particularly, to a walking beam type heating furnace and a pusher type heating furnace for heating the steel prior to the hot working of the steel, preferably an electromagnetic steel.

As is well known, while slabs are being introduced in a walking beam type heating furnace, conveyed to the discharging direction of the furnace, and heated to a required temperature for hot working and metallurgical processing, the steel material is alternately placed on a group of stationary skid beams and a group of movable skid beams. The movable skid beams are moved in one cycle along the lifting, forward moving, lowering and returning paths, and thus forward the slabs in the walking beam type heating furnace. The movable skid beams being lifted receive the slabs on the stationary skid beams. When the movable skid beams are lowered, the slabs are placed back on the stationary skid beams. The movable skid beams and the stationary skid beams, which are immovable, are constructed by welding water-cooled metallic skids on water-cooled metallic tubes which extend in the longitudinal direction of the furnace, and by lining the entire outer circumference of the water-cooled metallic tubes with a refractory material layer. The water-cooled, metallic skids are spaced from each other by a predetermined gap. The water-cooled metallic tubes are supported by water-cooled posts, these posts being covered by a refractory material and protruding through the hearth of the walking beam type heating furnace. The water-cooled posts, which support the stationary skid beams, stand vertically on the hearth and are stationary with respect to the hearth, while the water-cooled posts, which support the movable skid beams, protrude through slots in the hearth and are connected to a driving device located below the hearth. The hearth portions through which the posts supporting the movable beams protrude are provided with a bank formed on the hearth around each of these posts, so as to prevent the influx of molten slag or scale into the slots (c.f. Japanese Published Utility Model Applications Nos. 47—2739 and 49—15).

If molten slag or scale flows into the slots, the lifting, lowering, forward moving and returning movements of the water-cooled posts become impossible. Since slabs of electromagnetic steel have a high silicon content and are heated to a high temperature, for example above 1250°C, slag or scale is dropped from the slabs of the electromagnetic steel. Consequently, the technique of formation of the bank mentioned above is advisable for heating the electromagnetic steel. However, in the conventional walking beam type heating furnaces there is the problem of accumulation of the molten slag or scale at the space between the banks, which problem is explained hereinafter in connection with the explanation of the water-cooled posts of the conventional walking beam type furnaces.

As is well known, the charging and discharging of slabs are performed by pushing the slabs from the charging side to the discharging side of the pusher type heating furnace. The heating zone of the furnace is provided with water cooled skid tubes to allow the slabs to be conveyed and suppprted. In the soaking zone of the pusher type heating furnace the slabs are pushed into contact with the refractory hearth, thereby allowing removal of so-called skid marks. The structure of the water-cooled metallic tubes, water-cooled posts and metallic skids of pusher type heating furnaces is the same as in the walking beam type heating furnaces. However, no gap is formed between the metallic skids in the pusher type heating furnace, because any gap acts as a resistance during the sliding movement of the steel sections, i.e. the steel slabs.

The number of the above mentioned water-cooled posts of the walking beam and the pusher type heating furnaces is desirably as small as possible for the following reasons: When the number of water-cooled posts is large, and further the heating temperature of the slabs is high, for example in the heating of electromagnetic steel, fuel consumption must be great enough to compensate for the heat withdrawal caused by the cooling water in the water-cooled posts. When the heat insulating function of all of the water-cooled posts is increased so as to avoid high fuel consumption, the installation cost becomes very great. In summary, from the point of view of heating energy, installation and maintainance costs, the number of water cooled posts should be as small as possible.

In the walking beam type heating furnaces, the following special problem arises. Each of the driven water-cooled posts of the walking beam type heating furnaces protrudes through the slot mentioned above, and a water-cooled sealing box is fitted below the slot so as to prevent influx of the air through the slot into the interior of the walking beam type heating furnaces. The withdrawal of heat by the water in the water-cooled sealing box is more serious than that by the cooling water of the water-cooled posts.

As is well known, the known water-cooled posts of the walking beam and pusher type heating furnaces are tubes which directly support the skid tubes. If the water-cooled posts are reduced to a certain number, the supporting force of the water-cooled posts is decreased correspondingly to the reduced number. It was believed in the art of slab heating furnaces that the force required for supporting the skid beams is provided by a certain number of the water-cooled posts, which number could not be reduced.

Furthermore, in the walking beam type heating furnaces the distance between a water-cooled post and an adjacent bank is small. This is because the number of the water-cooled posts is large, as explained above. Accumulation of molten slag or scale occurs at the space between the water-cooled post and the banks, with the result that the molten slag or scale overflows the banks into the slots. Accordingly, the walking beam type heating furnaces provided with the banks involve the problem of molten slag or scale accumulation, which should be eliminated.

In US—A—3 089 687 is described a walking beam furnace for moving work to be heated through the furnace. This furnace is so designed that the work supporting and moving members are periodically rotated so that they will be kept straight, and will wear evenly, thus prolonging their life and efficiency.

US—A—3 345 050 discloses continuous or pusher type furnaces, in which steel slabs, blooms, billets, ingots, or other forms of metal articles are heated to rolling, forging or other desired temperature. One row, or more, of such articles is supported on water-cooled skid rails extending between the charging end of the furnace and a refractory soaking or discharge hearth located adjacent to the opposite end of the furnace. In order to reduce the cooling effect of the skid rails on the engaged body portions of the metal articles, novel means are combined with the skid rails to arrest or diminish the thermal conductivity between such rails and the bodies of the articles supported thereby.

The object of the DE—C—563 976 is supporting pillars for cantlever pusher type heating furnace-skid tubes, characterized by a water-cooled post (a, i) supported on the furnace plate. The part of the post extending from the furnace bottom into the inner furnace is at its lower end surrounded by a loose, easily replaceable insulating material, e.g. sand, and at its upper part by a solid insulating substance, e.g. refractory stone which is supported by notches fixed at the post above the replaceable insulating material.

Finally, the invention described in DE—B—1 758 288 is related to a walking beam type heating furnace to perform heat treatment measures, especially on slabs and billets and similar with cooled stationary beams extending in the longitudinal direction of the furnace, and parallel to these cooled walking beams which are rigidly connected to a walking beam frame situated below the furnace bottom.

The known devices, however, do not yet completely satisfy the requirements, especially as to the necessary number of posts and the flow of the molten slag or scale.

It is an object of the present invention to reduce the number of water-cooled posts supporting water-cooled metallic skid tubes of skid beams of heating furnaces as compared to the prior art, the reduction of the number of posts being achieved by the provision of heads of such posts, the shape and structure of these posts being so skillfully designed that the reduction of the number of posts can be achieved even with skid beams having the same cross section as in the prior art.

It is another object of the present invention to ensure a smooth flow of the molten slag or scale on the hearth of a walking beam type heating furnace.

It is a further object of the present invention to effectively protect the post heads from great heat in walking beam pusher type heating furnaces, thereby allowing the post heads to stably support the skid tubes over a long period of time.

It is yet a further object of the present invention to facilitate maintenance of a walking beam type heating furnace and a pusher type heating furnace.

A heating furnace according to the present invention comprises skid tubes of water-cooled skid beams and water-cooled posts for supporting the water-cooled skid beams, and is characterized in that

a) a post head having a trough-shaped receiving portion for supporting the skid tube is stationarily located on each of said water-cooled posts at the upper portion thereof;

b) the post head has a length greater than the outer diameter of said water-cooled post provided with said post head;

c) the skid tubes are mounted on one of said trough-shaped receiving portions with a highly heat-conductive material in between;

d) a bracket is rigidly secured to the lower side of each of said skid tubes and extends in the longitudinal direction of said skid tubes, and said post head is connected to said bracket by means of a pin; and

e) the portion of said post head in which said water-cooled skid tube is secured has a small thickness and, further, a highly heat-insulating refractory material is mounted on said thin portion of the post head.

The present invention is hereinafter explained with regard to embodiments of the walking beam type heating furnace. However, it will be obvious to the persons skilled in the art to which the present invention pertains, that the skid beams and the watercooled posts explained in these embodiments can be used in the pusher type heating furnaces.

The post head is provided with a trough-shaped receiving portion for a skid tube of a water-cooled skid beam and has a length greater than the outer diameter of the water-cooled post.

The skid tubes of the water-cooled skid beams are metallic and cooling water flows through them. The skid tubes and the water cooled posts constitute continuous beams having a number of fulcrums. In these continuous beams, the bending moment (M_l) at each fulcrum is from 1.4 to 2 times the bending moment (m_l) at the center between every two fulcrums ($M_l = (1.4 \sim 2)m_l$). In addition, the cross section of the skid tubes is usually determined by the bending moment (M_l) at each fulcrum. The present invention involves the concept of supplementing the force for supporting each of the skid tubes in the proximity of the fulcrums by means of the strength of each post head. This concept leads to the determination of the cross section of the skid tubes based on the bending moment (m_l at the center between the fulcrums, not by the bending moment (M_l) at the fulcrums, with the result that the cross section of the skid tubes can be from 1/1.4 to 1/2 times that in the prior art. On the other hand, when the cross section of the skid tubes of the present invention is equal to that of the prior art, the moment (m_l), and hence the distance between the fulcrums according to the present invention, can be greater than in the prior art. Accordingly, it is possible to reduce the number of the water-cooled posts as compared to the prior art, because of the trough-shaped receiving portion of the post head according to the present invention. When the length (l) of the trough-shaped receiving portion is from 2 to 5 times the outer diameter (d) of the water-cooled posts, the number of posts can be reduced to one half or less the number of posts having an outer diameter (d) equal to the length (l). The skid tubes and the water-cooled posts are provided with a covering of a refractory material resistant to the molten slag or scale at the outer circumference thereof.

The skid tubes are mounted on one of the trough-shaped receiving portions with a highly heat-conductive material in between. The highly heat-conductive material may be compactly filled between the skid tubes and the trough-shaped receiving portions. The highly heat-conductive material is used in the present invention for the following reasons: In order to exert the cooling effect of the skid tubes on the post heads, and hence to protect the post heads by cooling, the skid tubes and the post heads are desirably in contact with each other. The heat conduction between the so contacted skid tubes and post heads would be high if a metallic contact were realized between them. However, it is in practice difficult to achieve a completely metallic contact between the skid tubes and the post heads due to the working accuracy of these tubes and post heads. Minute clearances are, therefore, locally formed between these tubes and post heads, and a heat-insulating layer is unavoidably formed due to gases in the clearances. In order to prevent the formation of the insulating layer, and hence to enhance the thermal conduction between the skid tubes and the post heads, the highly heat-conductive material is placed in between. The amount of the highly heat-conductive material compactly filled between the skid tubes and the trough-shaped receiving portions may be small. It is possible to effectively prevent a reduction of strength of the post heads because the cooling effect of the skid tubes satisfactorily extends to the post heads.

In the heating furnace of the present invention, a bracket is rigidly secured to the lower side of each of the skid tubes and extends in the longitudinal direction of the skid tubes, and the post head is connected to the bracket by means of a pin. The skid tubes can be readily exchanged by removing the pin from the bracket and the trough-shaped receiving portion and then withdrawing the skid tubes from the receiving portion.

The pin-securing portion of the post head has a small thickness and is in the form of a thin neck. A highly heat-insulating refractory layer which is covered by the refractory covering at the outermost part of the water-cooled posts is formed on the neck portion. The thin neck portion is liable to have such a structure that it is difficult to accomodate therein a water cooling system. The structure of the neck portion is, therefore, not highly resistant to heat. Since the neck portion is thin, the thickness of the heat-insulating refractory layer is large. The thick and highly heat-insulating refractory layer can effectively protect the neck portion from a high-temperature heat in a heating furnace.

In a preferred embodiment of the present invention the water-cooled posts are arranged in a zigzag pattern as seen in a plan view. In a walking beam type heating furnace the water-cooled posts, the posts of the stationary skid beams and the posts of the movable skid beams, which are surrounded by banks for preventing the influx of molten slag or scale, are alternately arranged in a zigzag pattern. In this embodiment no water-cooled posts are positioned between the banks of the walking beam type heating furnace, and the distance between a water-cooled post and an adjacent bank is large. Consequently, the flowability of the molten slag or scale is considerably increased over the flowability in conventional walking beam type heating furnaces.

The linear arrangement of the posts in conventional heating furnaces can also be adopted in the furnaces of the present invention. However, when the zigzag arrangement is used in the walking beam type heating furnace as described above, the advantage of a small number of posts as well as the advantage of considerable enhancement of the flowability of the molten slag or scale on the hearth are achieved.

Preferable embodiments of the present invention are hereinafter explained with reference to the drawings, wherein:

Fig. 1 illustrates an arrangement of skid beams in a walking beam type heating furnace;

Fig. 2 is a cross sectional view along line X—X in Fig. 1;

Fig. 3 is an elevational view of a skid beam and a water cooled post, where the outermost refractory covering has not yet been formed on the beam and post;

Fig. 4 is a cross sectional view along line A—A in Fig. 3, but with refractory layers formed on the skid beam and the water-cooled post;

Fig. 5 is a plan view illustrating an arrangement of the water-cooled posts of the stationary skid beams and banks, and;

Fig. 6 is a view similar to Fig. 5.

In a walking beam type heating furnace 1 illustrated in Figs. 1 and 2, the movable (driven) skid beams 2, 3, 4 and 5 and the stationary skid beams 6, 7, 8, 9 and 10 are arranged in parallel and alternately in the furnace 1, and run from a charging opening 11 to a discharging opening 12 of the furnace. Not shown axial flow burners are located on the furnace roof above the beams 2 through 10. Side burners 16 are located on the furnace side walls 13 and 14 below the beams 2 to 10 in such a manner that the axis 15 of the flame is horizontal. The side burners 16 are alternately positioned on the side wall 13 and the side wall 14. The axial flow burners and side burners are arranged in each of a preheating zone Za, a heating zone Zb and a soaking zone Zc.

In the walking beam furnace, particularly as used for such high temperature heating as in the heating of an electromagnetic steel, the hearth 18 is provided with extraction slots 21 for the molten slag or scale in both borders of the hearth along the side walls 13 and 14. In addition, the hearth 18 has gentle slopes which descend from the top at the center of the hearth to both borders along the side walls 13 and 14. The molten slag or scale, which falls down from the slab 17 to the hearth 18, is therefore caused to flow into the extraction slots 21. Slag or scale melting burners 23 located on the side walls enhance the flowability of the molten slag or scale on the hearth 18. The skid beams 2 to 10 are supported by water-cooled posts 19 and 24, which are described in detail below. A bank 30 is formed on the hearth 18 so that the inner wall of the bank 30 surrounds each of the slots 20 through which the water-cooled posts 19 for supporting the movable skid beams protrude. The banks 30 prevent the influx of the molten slag or scale into the slots 20. A beveled body 48 is rigidly secured to each of the water-cooled posts 19 and prevents the flow of the molten slag or scale along the posts 19 into the slots 20 and the dropping of the molten slag or scale directly into the slots 20.

In Figs. 3 and 4 the structure of the skid tubes and water-cooled posts is illustrated in detail. In Figs. 3 and 4, reference numeral 31 indicates a skid tube having a rectangular cross section and reference numeral 32 indicates a skid rail. A core tube 34 is accomodated in a water-cooled post 19 (24) to water-cool the post 19 (24). A metallic post head 35 is provided on the water-cooled post 19 (24) and supports the skid tubes 31. The post head 35 has a trough-shaped cross section and the length (l) of the trough-shaped post head is greater than the outer diameter (d) of the water-cooled posts 19 (24) which are made of metallic tubes. Accordingly, the supporting force of the skid tubes at a fulcrum portion is greater in the supporting system of $l > d$ than in the supporting system of $l = d$ and, therefore, the distance between the fulcrums is shorter in the former supporting system than in the latter supporting system. In an example of the length (l) of the trough-shaped post head, the length is 2.5 times the outer diameter (d), i.e. $l = 2.5$ d. In this example the number of water cooled posts is approximately one half of that in a walking beam type heating furnace where l is equal to d.

Quantitatively speaking with regard to a particular conventional walking beam type heating furnace, the number of stationary skid beams is five and each of the stationary skid beams is supported by sixteen water-cooled posts. The total number of the water-cooled posts for supporting the stationary skid beams is, therefore, eighty. On the other hand the number of movable skid beams is four and each of the movable skid beams is supported by sixteen water cooled posts which are driven so as to realize the movement of the movable skid beams. The total number of the driven water-cooled posts is, therefore, sixty-four.

According to the present invention, the number of water-cooled posts necessary for supporting one stationary skid beam of similar capacity to the particular furnace mentioned above is decreased from the sixteen mentioned above to nine. In addition, the number of water-cooled posts for supporting one movable skid beam is decreased from the sixteen mentioned above to eight. The total number of the water cooled posts is, therefore, decreased from 144 in the particular conventional walking beam type heating furnace mentioned above to 72 in the comparable furnace according to the present invention.

Returning to Figs. 3 and 4, a bracket 37 is fixed to the lower surface of the skid tube 31 along the longitudinal direction of the skid tube. A trough-shaped upper receiving portion 36 of the post head 35 is contiguous to a lower neck portion 40 thereof. The bracket 37 is secured to the post head by a pin connection through a positioning pin and a nut 38. Since the pin and nut are removable, the skid tubes 31 can be easily disassembled from the post head, if necessary.

A highly heat-conductive material 39, for example SiC, is filled between the skid tube 31 and the inner surface of the post head 35. The skid tube 31 is welded to the circumference of the trough-shaped receiving portion 36 by a weld 41.

A cooling effect extends from the skid tube 31 and water-cooled post 19 (24) to the post head 40. However, the cooling effect extended from the skid tube 31 and the water cooled post 19 (24) is least at the thin neck portion 40

Therefore, the thin neck portion 40 is subjected to external high temperature heat and is likely to lose its supporting function due to buckling. Consequently, a thick refractory layer 42, which is highly heat-insulating is formed on the neck portion 40. The refractory layer 42 may be ceramic fiber layers. Stainless sheets 43 are applied on the refractory layer 42.

Stud pins 45 shown in Fig. 4 are rigidly secured to the water cooled posts 19 (24) and the skid tube 31. A refractory layer 46 covers all of the members of the skid tubes and the water cooled posts, so as to protect these members from the molten slag or scale which is generated by the melting of scale from the material being heated. The material of the refractory layer 46 is selected from such groups of materials as ceramic refractories which are not eroded by the molten slag or scale.

As will be understood from the explanation with reference to Figs. 3 and 4, the water cooled posts according to the present invention greatly contribute to the operation of a walking beam type heating furnace and reduction of the heat withdrawal as compared with the prior art, because the load supporting system is realized by greatly increasing the distance between the fulcrums as compared with the prior art.

As seen in the plan view of Fig. 6, the banks 30 and the posts 24 of stationary skid beams are arranged in a zigzag pattern, while the conventional skid beam arrangement pattern is linear, as seen in Fig. 5. Referring to Fig. 6, there are no water-cooled posts between the adjacent banks 30 and, therefore, the free space in between, having a distance (L), is large as compared to the free space in the arrangement in Fig. 5. In addition, the free space between an adjacent post and bank, having a distance (L') is also large. As a result of this large free space, the flowability of molten slag or scale on the hearth is considerably enhanced and therefore the flow of molten slag or scale into the slots 20 due to the accumulation of molten slag or scale on the hearth is not likely to occur.

When the water-cooled posts of movable skid beams are extremely difficult to drive for the required conveying of steel sections due to the influx of molten slag or scale into the slots, the operation of the furnace must be interrupted so as to withdraw the molten slag or scale from the furnace. According to the present invention, particularly the embodiment illustrated in Fig. 6, the number of such interruptions of furnace operation is low. Consequently, compared to the prior art, in the present invention the heat loss due to interruption of the furnace operation is low and hence the degree by which the furnace is cooled is decreased. As a result, the amount of fuel necessary to heat the steel is less than in the prior art and, in addition, the maintenance costs involved in the withdrawal of the molten slag or scale from the furnace are low.

Claims

1. A heating furnace comprising skid tubes of water-cooled skid beams and water-cooled posts for supporting said water-cooled skid beams, characterized in that

a) a post head having a trough-shaped receiving portion for supporting the skid tube is stationarily located on each of said water-cooled posts at the upper portion thereof;

b) the post head has a length greater than the outer diameter of said water-cooled post provided with said post head;

c) the skid tubes are mounted on one of said trough-shaped receiving portions with a highly heat-conductive material in between;

d) a bracket is rigidly secured to the lower side of each of said skid tubes and extends in the longitudinal direction of said skid tubes, and said post head is connected to said bracket by means of a pin; and

e) the portion of said post head in which said water-cooled skid tube is secured has a small thickness and, further, a highly heat-insulating refractory material is mounted on said thin portion of the post head.

2. A heating furnace according to claim 1, wherein the length of said post head is from 2 to 5 times said outer diameter of said water-cooled post.

3. A heating furnace according to claim 1, wherein said water-cooled posts are arranged in a zigzag pattern as seen in plan view, said heating furnace is a walking beam type heating furnace comprising stationary and movable water-cooled skid beams, and each of said water-cooled posts for supporting said movable water-cooled skid tubes is surrounded by a bank, and these water-cooled posts and said water-cooled posts for supporting said stationary water-cooled skid tubes are alternately arranged in zigzag pattern.

4. A heating furnace according to claim 1 to 3, wherein said heating furnace is a pusher type heating furnace.

Revendications

1. Four de réchauffage comprenant des tubes de ripage de poutres de ripage refroidies à l'eau, et des colonnes refroidies à l'eau pour supporter ces poutres de ripage refroidies à l'eau, caractérisé en ce que:

a) une tête de colonne présentant une partie de réception en forme de gorge pour supporter le tube de ripage est agencée de manière fixe sur chacune des colonnes refroidies à l'eau, à leur partie supérieure;

b) le tête de colonne présente une longueur supérieure au diamètre externe de la colonne refroidie à l'eau, pourvue de cette tête de colonne;

c) les tubes de ripage sont montés sur l'une des parties de réception susdites en forme de gorge, avec interposition d'une matière très conductrice de la chaleur;

d) un support est relié de manière fixe au côté inférieur de chacun des tubes de ripage et s'étend suivant la direction longitudinale de ces tubes de ripage, la tête de colonne étant reliée au support grâce à une broche; et

e) la partie de la tête de colonne, dans laquelle le tube de ripage refroidi à l'eau est fixé, présente une faible épaisseur, et en outre une matière réfractaire très isolante du point de vue thermique est montée sur cette partie mince de la tête de colonne.

2. Four de réchauffage suivant la revendication 1, caractérisé en ce que la longueur de la tête de colonne est de 2 à 5 fois le diamètre externe de la colonne refroidie à l'eau.

3. Four de réchauffage suivant la revendication 1, caractérisé en ce que les colonnes refroidies à l'eau sont agencées suivant un dessin en zig-zag, lorsqu'on les regarde en plan, le four de réchauffage étant un four de réchauffage du type à balanciers comprenant des poutres de ripage refroidies à l'eau, fixes et mobiles, en ce que chacune de ces colonnes refroidies à l'eau, qui supportent les tubes de ripage mobiles refroidis à l'eau, est entourée par un talus, et en ce que ces colonnes refroidies à l'eau et les colonnes susdites refroidies à l'eau, destinées à supporter les tubes de ripage fixes, refroidis à l'eau, sont agencés de manière alternée suivant un dessin en zig-zag.

4. Four de réchauffage suivant l'une des revendications 1 à 3, caractérisé en ce que le four de réchauffage est un four de réchauffage du type poussant.

Patentansprüche

1. Ein Heizofen, der Gleitrohre von wassergekühlten Gleitbalken und wassergekühlte Stützpfeiler für die wassergekühlten Gleitbalken aufweist, dadurch gekennzeichnet, daß

a) sich auf jedem der wassergekühlten Pfeiler in ihrem oberen Bereich ortsfest ein Pfeilerkopf mit einem wannenförmigen Aufnahmebereich zum Stützen des Gleitrohres befindet;

b) der Pfeilerkopf eine größere Länge als der Außendurchmesser des wassergekühlten Pfeilers aufweist, der mit dem Pfeilerkopf ausgerüstet ist;

c) die Gleitrohre auf einem der wannenförmigen Aufnahmebereiche mit einer Zwischenschicht aus gut wärmeleitendem Material gelagert sind;

d) ein Arm fest mit der Unterseite aller Gleitrohre verbunden ist und sich in Längsrichtung der Gleitrohre erstreckt und daß der Pfeilerkopf mit dem genannten Arm mittels eines Dornes verbunden ist; und

e) der Bereich des Pfeilerkopfs, in dem das wassergekühlte Gleitrohr befestigt ist, eine geringe Dicke aufweist und daß außerdem ein stark wärmeisolierendes, feuerfestes Material auf dem genannten dünnen Bereich des Pfeilerkopfs angebracht ist.

2. Heizofen nach Anspruch 1, wobei der Pfeilerkopf zweibis fünfmal so lang wie der Außendurchmesser des wassergekühlten Pfeilers ist.

3. Heizofen nach Anspruch 1, wobei die wassergekühlten Pfeiler in der Aufsicht in einem zick-zack-Muster angeordnet sind, der Heizofen ein Hubbalkenofen ist, der ortsfeste und bewegliche wassergekühlte Gleitbalken umfaßt, alle wassergekühlten Stützpfeiler für die beweglichen wassergekühlten Gleitrohre von einem Damm umgeben sind und diese wassergekühlten Pfeiler und die wassergekühlten Stützpfeiler für die ortsfesten wassergekühlten Gleitrohre wechselweise im zick-zack-Muster angeordnet sind.

4. Heizofen nach Anspruch 1 bis 3, wobei der Heizofen ein Stoßofen ist.

Fig. I

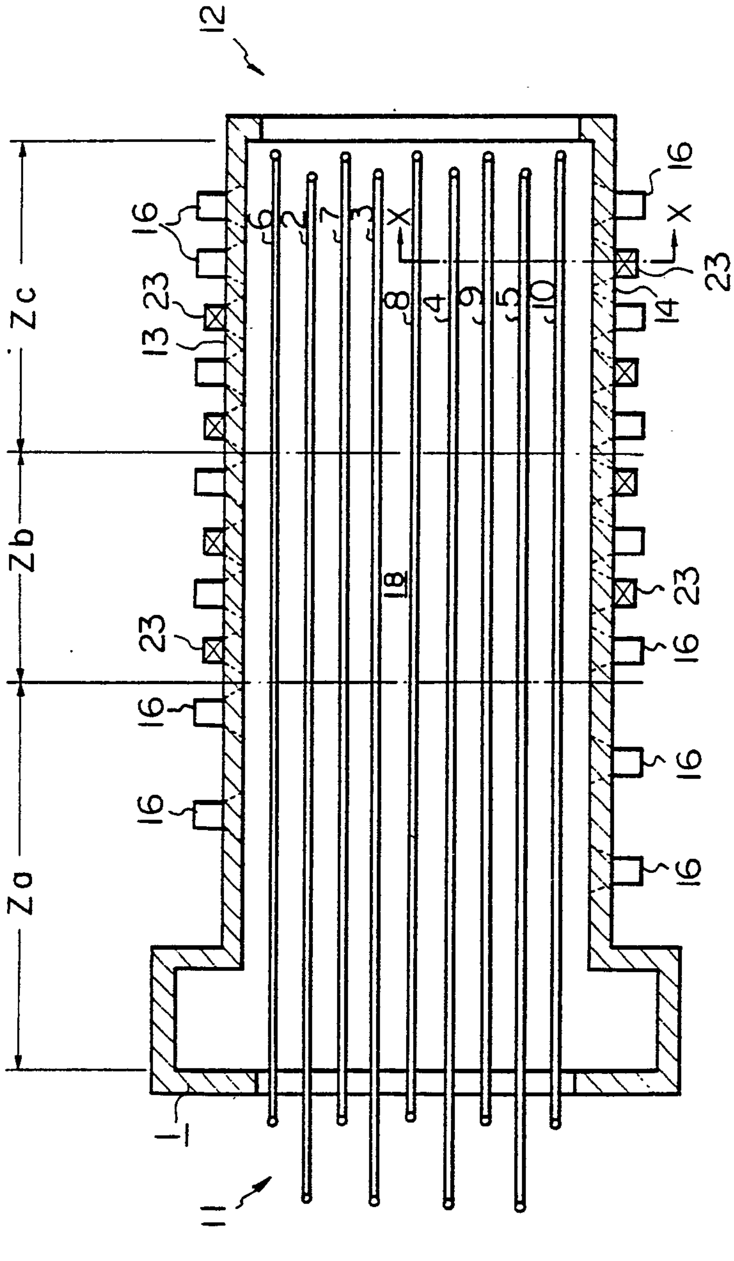

Fig. 2

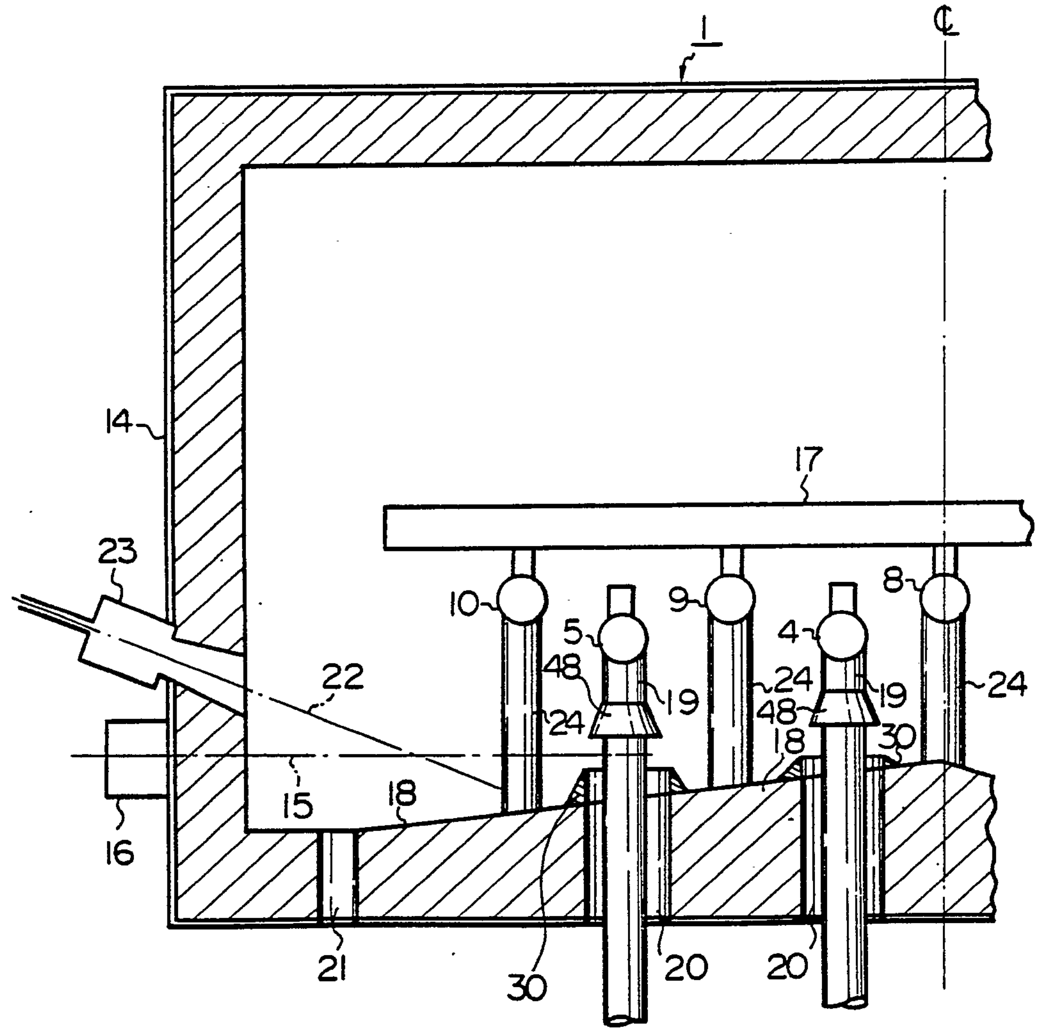

Fig. 3

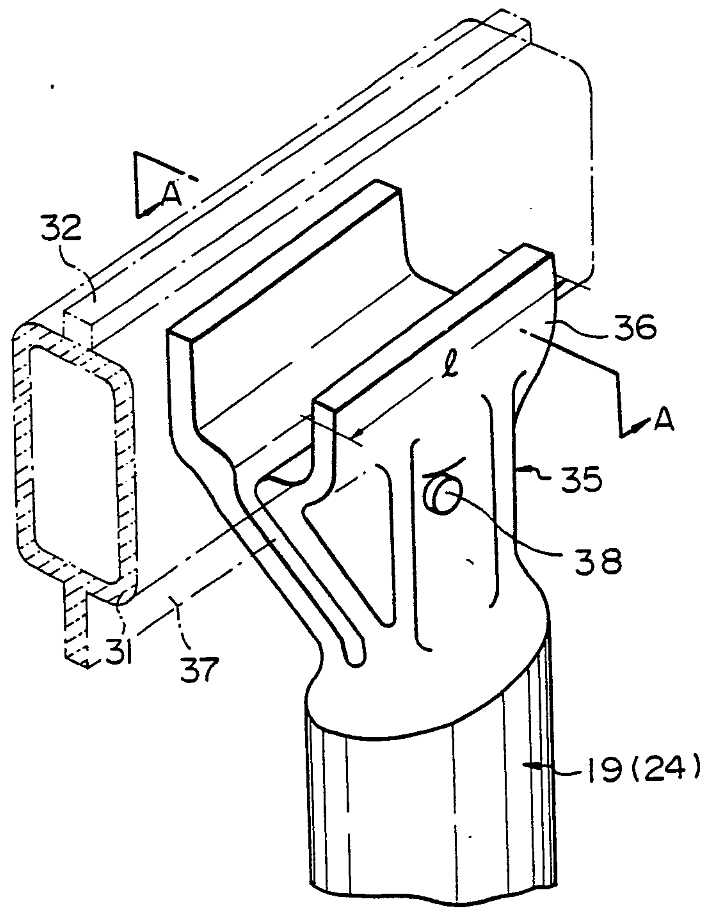

Fig. 4

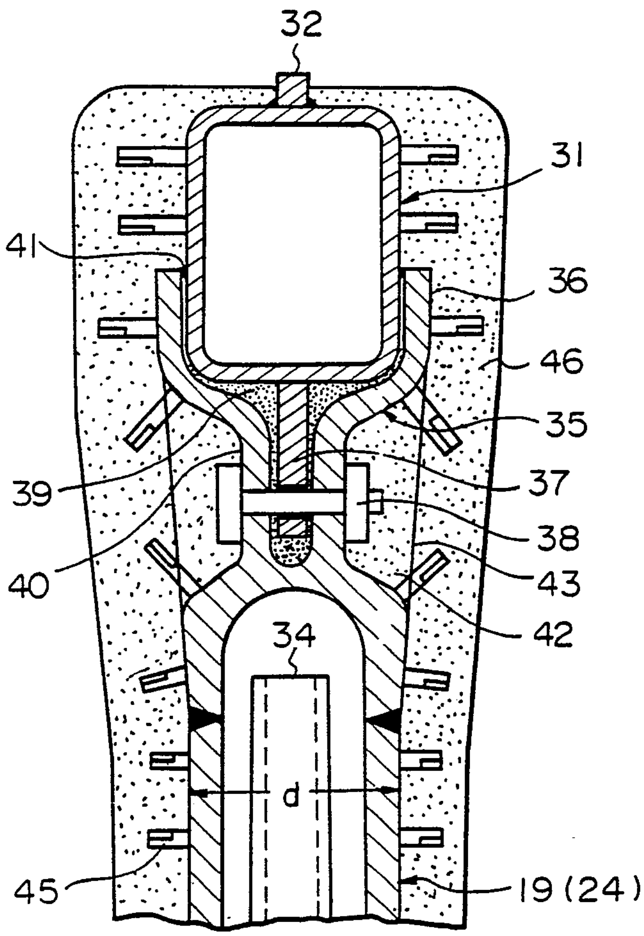

Fig. 5

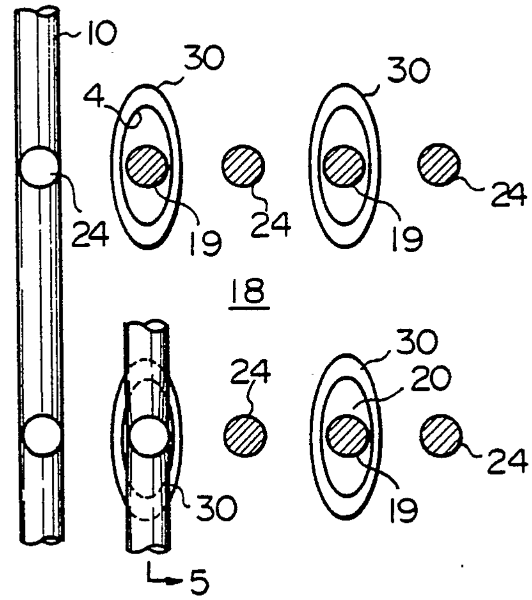

Fig. 6