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Suydam

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[54] **WALKING BEAM FURNACE**

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[52] **U.S. Cl.** **432/122,** 432/234, 432/235, 432/243, 432/75, 198/219

[51] **Int. Cl.** **F27d 3/12**

[58] **Field of Search** ..... 263/6 A, 6 B, 6 R; 198/219; 432/6, 9, 33, 34, 45, 122, 75, 234, 235, 243

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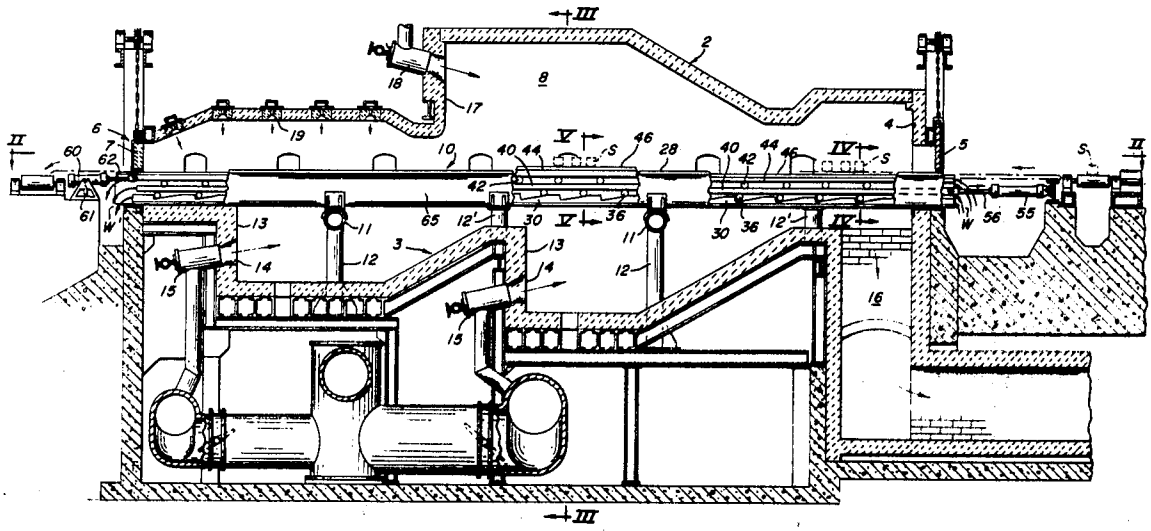
[57] **ABSTRACT**

The improvement in top and bottom-fired walking beam furnaces wherein the lower burners, like the top ones, fire opposite to the direction of travel of the work pieces from the charging to the discharge end of the furnace. This is accomplished by the use of a plurality of parallel walking beam assemblies, each of which has two spaced stationary water-cooled beam sections having a supporting rail along the top. The bottoms of these side pieces are rigidly integrated through a bottom water-cooled beam section. There is an idler beam section supported for longitudinal motion above the bottom beam section, longitudinal travel of which in one direction raises the idler section and in the opposite direction lowers it. There is a longitudinally-movable traversing beam section having a load-traversing rail at its top which is lifted above the support rails on the side beam members when the idler beam raises, but which is normally lower than the support rails. After the traversing beam is raised it is moved longitudinally toward the discharge end of the furnace and when it is lowered it is returned to its normal position. Combined tie rods and spacers at intervals along the assembly connect the upper portions of the side beam sections so that the girder is in effect a box section within which are the walking beam elements. Mechanism outside the furnace at one end moves the idler beam section and at the opposite end moves the traversing beam member, and each holds its beam against endwise travel when the other is moving.

18 Claims, 7 Drawing Figures



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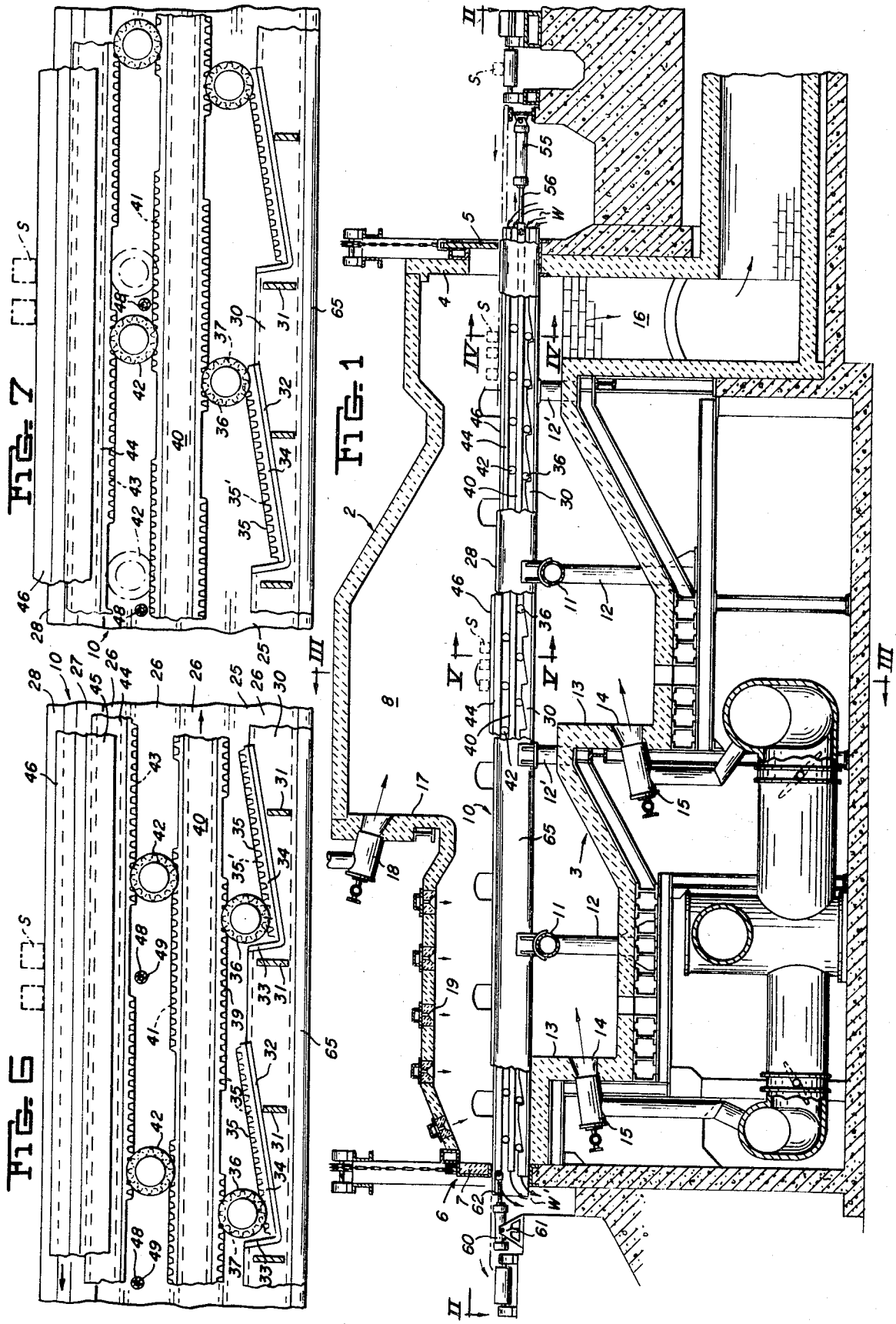

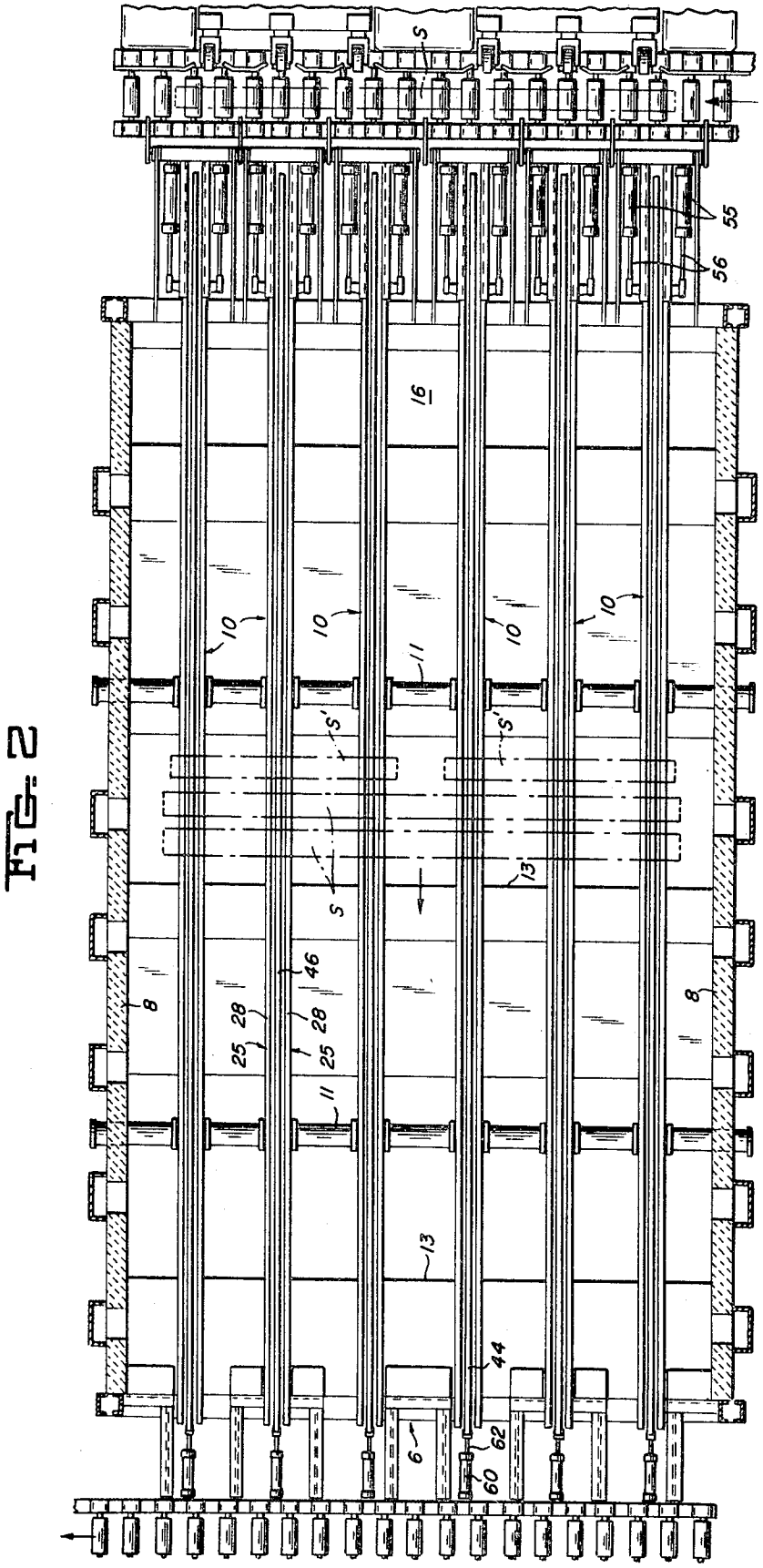

FIG. 2

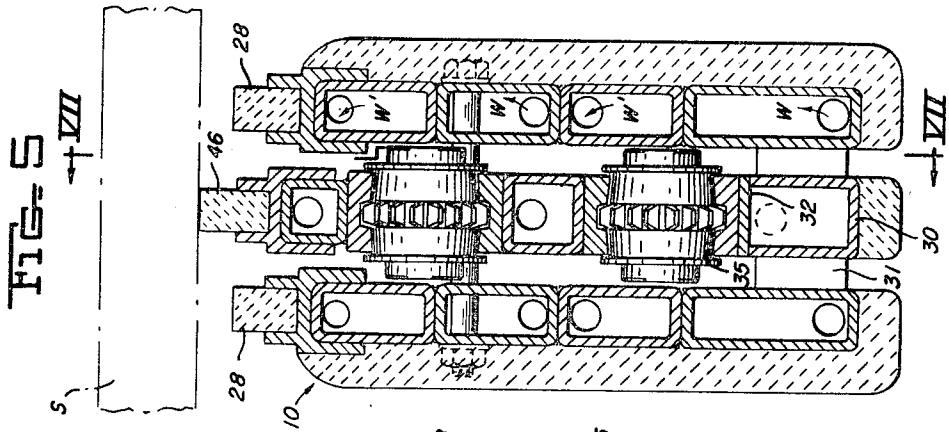

Fig. 5

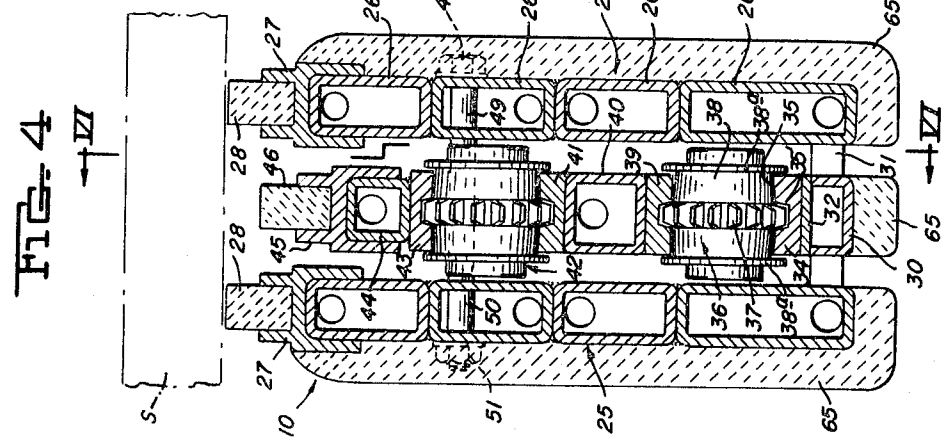

Fig. 4

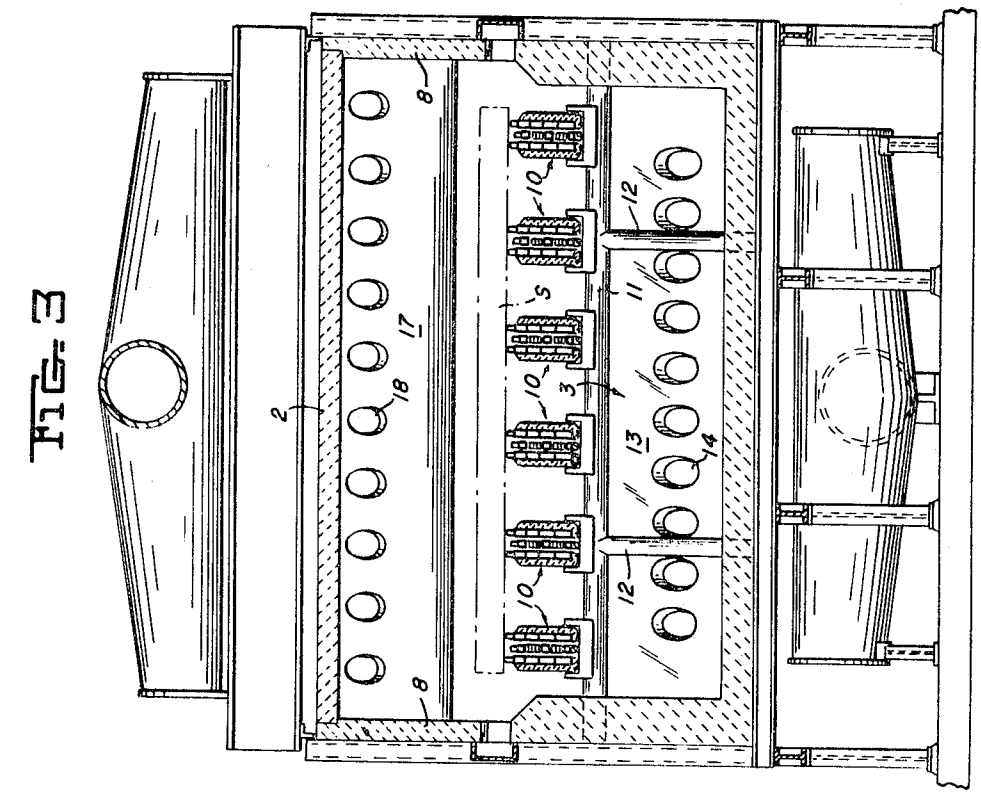

Fig. 3

WALKING BEAM FURNACE

This invention is for a walking beam assembly for use in a furnace for the heating of billets and slabs preparatory to hot rolling them into semi-finished or finished products.

BACKGROUND

Walking beam furnaces have been used for some time for heating billets or slabs for hot rolling, but until relatively recent times they have been top-fired furnaces where all of the burners for heating the slabs or billets were in the upper part of the furnace structure above the walking beam conveyor at the level of the hearth of the furnace.

The increasing demand for greater furnace output and the increased thickness of billets and slabs has required that provision be made for the simultaneous heating of the billets or slabs both from below and above the walking beam assembly or other support for moving the work pieces through the furnace. This has vastly complicated the consturciton of the furnace and very substantially added to the cost, because while the fixed supporting rails and the traversing rails are in the furnace above the hearth, the fIxed and movable supporting beams for these rails are below the hearth. Vertical posts pass upwardly through the hearth from the fixed beams to the supporting rails, and other posts, passing through slots in the hearth support and transmit the up and down and longitudinal movement or "walking" movement, to the traversing rails. Complicated seals are required to provide for hearth bottom sealing and for the removal of scale that falls through the slots in the hearth. Typical constructions are shown in a paper appearing in the Oct. 1970 issue of "Iron and Steel Engineer," pages 56—64 Gottfried Straus entitled "Design and Automation of a Top and Bottom Fired 210-ton per hr. Walking Beam Furnace" and in a paper by Yukinaga Kabahashi and Koji Fujikawa entitled "IHI Walking Beam Type Continuous Slab and Billet Preheating Furnace," pages 42–50 of Special Issue 70, June 1970 of the publication IHI Engineering Review.

Not only are such structures complicated and expensive, but because of the vast number of fixed and movable columns in the space above the hearth and below the supporting and traversing rails, the bottom burners must fire crossways instead of lengthwise of the furnace, although lengthwise firing gives a much more uniform heat distribution and is generally, if not exclusively, used for top firing where the space above the work pieces is unobstructed.

SUMMARY OF THE INVENTION

The present invention provides a top and bottom fired walking beam furnace where the fixed and traversing work supports are combined in a rigid girder-like assembly that generally extends from the entrance door of the furnace to the exit and which is supported at each end of the furnace. Intermediate the end supports, these girder-like walking beam assemblies may rest on simple water-cooled beams above the hearth and with supporting posts or jacks that do not interfere with the use of bottom burners that fire opposite the direction of travel of the work pieces, similarly to the top burners.

More specifically, each walking beam assembly comprises two spaced deep parallel side beam sections arranged for water-cooling, providing rigid side beams or truss sections. Between these two sections and spaced from each of them, but rigidly integrated ith them through struts, is an intermediate fixed beam section, which, for reasons hereinafter appearing, is referred to as the "ramp section." There is a second beam section called the "idler section" between the two side sections above the ramp section, and which is supported by the ramp section. It is movable longitudinally relative to the side beam members and ramp section, and means interposed between the ramp and idler sections is arranged to raise the idler beam vertically when said beam is moved in one direction, and when moved in the opposite direction from the high limit of travel it moves down to it lowermost position. There is a third traversing beam section above the idler section suported by means, as for example rollers, interposed between the traverse and idler sections so that it is movable longitudinally relative to the idler sections. This traversing beam section is lifted and lowered by the raising and lowering of the idler section. At its normal lowermost position, a work piece lifting rail along its top is below the rails at the top of the side beam sections, but at the upper limit of the idler beam travel the rail at the top of the traversing section is above the level of the work support rails of the side beam sections.

When the traversing beam is raised its rail lifts the work pieces in the furnace from the rails on the side support beams, and when so raised this beam is then moved longitudinally toward the discharge end of the furnace. Then when the traversing beam lowers it deposits the work pieces on the rails of the side beams at the new position to which they have been carried, and the traversing beam, being clear of the work pieces, returns to its starting position. Thus with two or more parallel assemblies of this kind working in unison the work pieces are moved step by step or "walked" through the furnace from one end to the other. Means is provided for reciprocating the idler beam section of each assembly longitudinally and other means is provided for reciprocating the traversing beam section of each assembly, each of the said means being operable to restrain the beam which it operates against longitudinal travel when the other is moving.

With the beam assemblies so constructed the bottom burners can be and are positioned to fire longitudinally of the beam assemblies, and slotted hearths, scale deflectors and water seals are eliminated. There is some conventional or preferred arrangement for placing work pieces on the walking beam assemblies of the furnace at the charging end and conventional or preferred means at the discharge end for extracting or unloading the heated work pieces, said loading and extracting means forming no part of this invention are provided.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more fully understood by reference to the accompanying drawings showing a preferred embodiment of my invention, in which:

FIG. 1 is a longitudinal section through a walking beam furnace embodying the invention;

FIG. 2 is a plan view of the interior furnace of FIG. 1 being essentially a horizontal section in the plane of line II—II of FIG. 1;

FIG. 3 is a transverse section through the furnace substantially in the plane of line III—III of FIG. 1;

FIG. 4 is a transverse section on a larger scale of one single beam system with its fixed and movable rails showing the movable or traverse rail in its lowermost position, the view being a transverse section in the same plane as FIG. 3;

FIG. 5 is a view similar to FIG. 4 showing the top porion of the assembly with the movable or traverse rail raised to its upper limit of travel;

FIG. 6 is a fragmentary longitudinal section in substantially the plane of line VI–VI of FIG. 4 showing in side elevation a portion of the "lifting-ramp" section of the assembly along with portions of the idler beams and traversing beam, with the traversing beam in its lowermost or normal position; and

FIG. 7 is a view similar to FIG. 6 with the traversing beam raised and the work pieces shifted to the left, at which point the traversing beam is about to be lowered.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIGS. 1 and 3, the numeral 2 designates generally the top or roof structure of a furnace and 3 designates generally the entire hearth area of the furnace. The front wall is designated 4, and 5 is the charging door or opening. The rear wall is designated 6 and has a discharge door at 7. The side walls of the furnace are marked 8. The work pieces to be heated, i.e., slabs or billets, enter the furnace through the charging door, being usually pushed on supporting skids to a selected position outside the charging end of the furnace, the door is a well-known or preferred manner by mechanism forming no part of this invention, and they progress in increments through the furnace in the direction of the arrow, each work piece being parallel with the preceding one, toward the discharge door.

In moving through the furnace the work pieces are supported by and moved through the furnace by two or more parallel beam assemblies designated 10 which are important components of this invention and which will be hereinafter described in detail, but as seen in FIG. 2 there are, in the structure here shown, six of these assemblies spaced from one another and from the side walls of the furnace, with three of them each side of the center line, but the number may vary, although for present mill practice six permit a good combination of long and half-length slabs to be simultaneously or successively moved through the furnace. In FIG. 2 for example S and S' are long and short slabs, respectively.

As best seen in FIGS. 1 and 3 the assemblies 10 preferably extend through the charging or front end of the furnace and are supported on a structure outside the furnace. At the discharge or rear end of the furnace these assemblies 10 also extend through the rear wall and are supported on a structure outside the rear wall.

As best seen in FIG. 1 the assemblies 10 are supported at the front end on a structure outside of the furnace and at the opposite end on a structure outside of the furnace. As best seen in FIGS. 1 and 3 there are intermediate transverse hollow beams 11 on which these assemblies are supported, the beams being hollow for water-cooling and having their ends supported in the side walls of the furnace and which are supported intermediate their ends by hollow vertical columns 12 which are also designed to be water-cooled. There are also jacks 12' to provide support. Water-cooling of structures of this kind is per se well known in the art and I have not shown in detail cooling water inlet and outlet connections. The columns 12 and jacks 12' are arranged in rows lengthwise of the furnace so that, from front to back each such post and intervening jack in a row is directly behind the one ahead, and as seen in FIG. 2 the space under the supporting beams 10 and above the hearth is relatively open and clear of any obstruction.

In the furnace shown in the drawings the bottom of the hearth structure has two offsets providing vertical wall porions 13 in each of which is a horizontal row of burner ports 14 with bottom burners 15 therein for directing flames upwardly and forwardly toward the charging door. The hearth is of course spaced above the floor of the entire furnace to provide space for the fuel and air ducts. The flames and hot combustion gases travel longitudinally forward under the assemblies 10 for discharge through a flue 16 at the front of the furnace.

As is usual in furnaces of this type, the top or roof structure of the furnace has an offset providing a vertical burner wall 17 with a horizontal row of burner ports for top firing burners 18 that project flames downwardly and forwardly opposite to the direction of travel of the work pieces through the furnace. Rearwardly of these burners 18 there are roof burners 19 in the roof over the soaking zone.

As previously indicated it is the structure of the beam assembly units 10 which makes possible the longitudinal firing of the bottom burners. Each beam assembly is a girder extending, as previously described, from one end of the furnace to the other. It has two parallel side sections designated generally as 25, each of which, as here shown, provide a number of longitudinally-extending passages 26 one above another. They comprise vertically-elongated generally rectangular sections and may be formed of four-sided tube sections 25 placed one upon another and welded together, or perhaps for heavier loads be formed of heavy metal plates with weldments to provide a similar beam section with spaced side walls and top and bottom walls and intermediate partitions. Water inlets and outlets may be formed in the end walls of the beam structures, so arranged that water enters and leaves at the same end, as indicaed at W but at the other end there are return loops W' so water leaving one passage reenters and flows in the opposite direction in the next. As here indicated there are four passages 26 in each side section, but there could be more or less, depending on the load that the beam assemblies must carry.

On the top of each side assembly there is a modified H section 27 in which is a rail 28 which may be of a high temperature refractory material and is sometimes referred to as a "rider tile." While the present indications are that a refractory rail will be preferable, part of its length may be comprised of a high temperature alloy, or the entire rail may be metal. The advantage of using tile or ceramic is that while the H-section 27 is water-cooled by its contact with the upper tube 26, the lower heat conductivity of the refractory will reduce or substantially reduce he "shadow" on the slabs or billets which are supported on the rails during the operation of the furnace. The term "shadow" of course refers to a restricted area of the work piece which does not receive full heat or from which excessive heat is removed by contact with a cooled support, and shadows are ob-

jectionable since they interfere with uniform rolling of the work piece.

In the space between the two outer side sections **25** there is an intermediate fixed four-sided hollow or tubular water-cooled fixed lower section **30.** Struts **31** welded to tube section **30** and the bottom tube sections **26** at relatively close intervals integrate the section **30** and the two side sections **25** at the bottom of the beam assembly and maintain them in parallel spaced relation. Typically the struts are spaced about two feet apart along the length of the beam assembly. The space at each side of the section **30** and the side beams allows gases to circulate and scale to drop down through the assembly.

By reference to FIG. **6** it will be seen that the top of tube **30** has a series of separated inclined ramps thereon. This is provided by cutting notches of the required shape in the top of the section **30** and then welding in the inclined ramp-forming plates **32** and vertical abutment plates **33.** Each ramp **32** as here shown has a track section **34** secured to the top thereof along the center of which is a toothed gear rack and there is a bearing or track surface **35** at each side of the rack, the rack being designated as **35'**.

There are a series of flanged lifting pinions **36,** one on each ramp, with a central gear portion **37,** roller portions **38** that ride on the track surfaces **35,** and peripheral flanges **38***a* which restrain the rollers against displacement in the axial direction. Resting on these rollers is a track section **39** similar to but confronting the section **34.** The section **39** is carried on and secured to the under surface of a longitudinally-extending four-sided hollow or tubular section **40** which I term the "idler section." The central gear portions of the pinion rollers **36** are engaged in the racks of the confronting track sections **34** and **39** while the roller portions bear on the track surfaces at each side of the respective racks. The arrangement is such that any vertical load is transmitted through the track surfaces and roller surfaces of the rollers and not through the gear teeth of the racks and pinions. It so happens that because of this, the pitch diameter of the gear teeth on the rollers coincides with the diameter of the roller portions on the rollers at each side of the gear teeth, and of course a corresponding relation exists between the gear teeth of the rack and the levels of the track surfaces at each side of the rack.

There is a second track section **41** extending along and fixed to the top of the idler beam section **40.** It is similar to rack sections **34** and **39** with a central rack and flat track strips at each side of the rack. There are flanged rollers **42** similar to the rollers or lifting pinions **36** at intervals along the section **40** and which may roll on this section. These rollers support a fourth track and rack section **43** fixed on and extending along the underside of a hollow rigid section **44,** which, like all the others, are water-cooled. This section has a modified H section **45** along the top thereof in which is a rail **46,** sections **45** and **46** being similar to sections **27** and **28** respectively at the top of the side beam assemblies **25,** with the rail **46** being ceramic or metal or a combination of both, depending on which may be best suited to a particular operation.

For purposes of simplifying nomenclature the intermediate fixed bottom beam member **30** is sometimes referred to as the "lifting ramp" or "ramp section," and the inclined track sections **34** are called the "lifting racks." The rollers **36** are the lifting gears or pinions, the section **40** with its track sections **39** and **41** is the idler beam. The upper gear rollers **42** are the transverse pinions or gears and the four-sided beam section **44** is the traverse beam. The rails **28** on the two side beams are the support rails and the rails **46** are the traverse rails. Tie bolts **48** with spacing sleeves **49** and **50** and nuts **51** at intervals along the length of the assembly are located at a level above the idler beam and below the traverse beam and are at a level where they do not restrict the up and down travel of these two beams and at spaced intervals where they are not contacted by the traversing pinions **42.**

At the charging end and outside of the furnace there are means, preferably fluid pressure cylinder and piston units, each having the cylinder **55** pivotally anchored to a fixed support outside the furnace and a piston rod **56** pivotally connected outside the furnace with one end of the idlerbeam, the pivots being arranged for a limited pivoting of these units in a vertical direction. Normaly the piston is fully extended in the arrangement shown. By applying fluid pressure, preferably hydraulic pressure to the left end of these cylinders, the piston rods move under tension to pull the idler bar toward the right, causing the lifting pinions to ride up the fixed lifting racks and raise the idler bar relative to the ramp section and the side beam assemblies **25.** This upward travel is communicated through traverse pinions **42** in the traverse beam **44.** All cylinders **55** are simultaneously operated, and the work pieces S and S' that normally are extending across and resting on the supporting rails **28** are lifted clear of said rails and supported on the traverse rails **46,** FIG. **5** showing the traverse rail of one assembly, being at the upper limit of its travel. With the traverse rails **46** elevated, pressure is held in the cylinders **55** to keep them elevated.

At the discharge end of each traverse beam outside the furnace there is a cylinder **60** pivoted to a fixed anchor at **61** with a piston rod **62** that is normally extended and which is pivotally outside the furnace with the traverse beam, the pivoting accommodating the up-and-down travel of this beam. When the idler beam is moving this cylinder restrains the traverse beam from moving so that the traverse pinions roll on the top of the idler beam and only the vertical travel of the idler beam is transmitted to the traverse beam. However when the traverse beam is elevated, as above described, fluid pressure is applied to the cylinders **60** to simultaneously move the elevated traverse beams toward the left a short distance, depending on the size or the pieces in the furnace, the traverse rollers rolling on the then fixed idler beam. With the pressure then held in the cylinders **60,** the cylinders **55** are pressurized to move their piston rods **56** to the left to correspondingly move the idler beams to the left, causing the lifting pinions to roll down the ramps to their lowermost position, thus lowering the traverse beams to deposit the work pieces back onto the support rails in the position to which they have been advanced. With the traverse beam at or near its normal level below the supporting rails, cylinder-piston units **60–62** are actuated in the reverse direction to return the traverse beams to their starting positions. It will be seen that when the lifting of the load is taking place, the idler bars and their piston rods **56** are under tension and when the traverse beams are carrying the load toward the discharge end, they and their piston rods **62** are under tension, but in lowering the load and

retracting the traverse rods free of the load, then only are the respective beams and piston rods operating in compression or thrust. Mechanically this is an ideal arrangement since at high temperatures pulling stresses are less likely to cause damage, such as bending, then pushing stresses. By providing each assembly with its individual power cylinders the size of the cylinders is smaller than where one operating cylinder is connected to all units, and a simple control may effect the simultaneous operation of the several cylinders.

It will thus be seen that the invention provides a walking beam furnace wherein there are a plurality of separate lengthwise-extending water-cooled girders, each comprising two spaced side beam assemblies of deep section from top to bottom integrated through the fixed intermediate lifting ramp secton **30** and the struts **31** and the tie bolts **48** with compression or spacer sleeves near their tops which provide a strong beam assembly of box-girder-like strength and capable of being effectively water-cooled. These side sections have the support rails at their tops. By moving the idler beam lengthwise, cooperating means effective between the idler beam and the lifting beams, such as the inclined ramp and lifting pinion arrangement, is effective to raise and lower the idler beam relative to the side beams and thereby raise the traverse beam and rail. By then moving the traverse rail longitudinally while it is raised, then lowering it by reversing the travel of the idler beam and finally restoring the traverse beam and rail to its starting position, a compact assembly is provided requiring little in the way of support between its ends. Hence a number of these assemblies arranged parallel with each other within the furnace, enable the area under the beam assemblies to be so free of supports that longitudinally-firing burners may be used below the work pieces as well as above, and complicated seals and scale disposal arrangements required in structures as heretofore provided become unnecessary. The exterior and bottoms of the side beams **25** as shown in FIG. **4** are preferably covered with insulating refractor **65** to reduce the rate of heat transfer through the outer walls of the beam assembly and thus reduce cooling water demands.

I claim:

1. A top and bottom-fired walking beam furnace having a hearth, a roof, and inlet and discharge ends wherein:

a. there are a plurality of spaced parallel walking beam assemblies spaced above the hearth and below the roof extending from one end to the other, each assembly comprising a unitary girder-like structure having

1. two parallel spaced water-cooled side beam sections of vertically-elongated generally rectangular section,
2. a traversing beam between the upper portions of the side beams movable longitudinally and vertically,
3. means rigidly connecting and integrating the lower portions of the side beam sections into a unitary structure,
4. reciprocable means between the side beams below the traversing beams and above the bottom of the girder for raising and lowering the traversing beam,
5. means outside the furnace at one end thereof for reciprocating said last-named means of several assemblies in unison,
6. means outside the furnace at one end thereof for reciprocating the traversing beams of the several assemblies in unison when the traversing beams are raised,

b. burners above said walking beam assemblies arranged to direct their flames toward the charging end of the furnace generally in the direction of the length of said girder-like units, and

c. burners below said walking beam assemblies also arranged to direct their flames toward the charging end of the furnace generally in the direction of the length of said girder-like units.

2. A top and bottom walking beam furnace as defined in claim **1** in which the traversing beam section and the reciprocable means below it have water-cooling passages therethrough.

3. A top and bottom walking beam furnace as defined in claim **1** in which there is at least one row of burners in close side-by-side relation in the roof extending crosswise of the length of the girders across the full width of the furnace and at least one row of burners in the hearth in close side-by-side relation extending across the full width of the furnace crosswise of the length of the girder.

4. A top and bottom-fired walking beam furnace as defined in claim **1** in which the said reciprocable means below the traversing beam for raising and lowering the traversing comprises an idler beam, the means for reciprocating the respective beams comprising a fluid pressure means for reciprocating the traversing beam and other fluid pressure means for reciprocating the idler beam, the said fluid pressure means for the idler beam being arranged to pull the idler beam when it is reciprocated to raise the traversing beam and push when it is lowering said beam and its means for reciprocating the traversing beam being arranged to pull said beam when it is raised and to push said beam when it is lowered.

5. A top and bottom-fired walking beam furnace as defined in claim **1** in which the girder-like structures are supported at each end outside the furnace structure adjacent the inlet and discharge openings and are supported in part above the hearth intermediate their ends on fixed water-cooled beams positioned above the hearth and extending traverse to the lengths of the girder-like structures.

6. A walking beam assembly for use in a top and bottom-fired furnace comprising a composite girder structure having:

a. two spaced parallel water-cooled side beam sections of vertically-elongated rectangular section each having a work-supporting means along the top edge,

b. a fixed lower beam section extending lengthwise between but spaced from the lower portions of the side beam sections, with means connecting and rigidly integrating all three sections,

c. a traversing beam section extending longitudinally between the upper portions of the side beam sections but spaced from each of them, the traversing beam having work-supporting means along the upper surface thereof,

d. means between the traversing beam and said fixed lower section for raising and lowering the travers-

ing beam between a normal low position where the work-supporting means on the top edge thereof is below the work-supporting means of the side beam sections to a raised position where its work-supporting means is above the work-supporting means of the side beam sections, and

e. means for effecting a work-traversing longitudinal movement of the traversing beam when it is raised and returning it to its original position when it is lowered.

7. A walking beam assembly as defined in claim **6** wherein the work-supporting means on the side beam sections and the traversing beam section are rails carried on and extending above the tops of the respective sections on which they are carried.

8. A walking beam assembly as defined in claim **7** wherein said rails, at least for a porion of their length, are of a ceramic material.

9. A walking beam assembly as defined in claim **7** in which the rails are received in the top of an H-section which is set astraddle and extends lengthwise of the tops of the respective beam sections on which rails are provided.

10. A walking beam assembly as defined in claim **6** wherein said means for raising and lowering the traversing beam section comprising an idler beam section extending longitudinally between the side beam sections below the traversing beam section and above the fixed lower beam section arranged to reciprocate relative to both the traversing beam section and the fixed lower beam section, and wherein there are means effective between the lower fixed beam section and the idler beam section arranged to raise the latter when it is moved in one direction and lower it from a raised position when moved in the opposite direction, and means effective between the idler beam section and the traversing beam section for supporting the traversing beam section on the idlerbeam section to raise and lower therewith but which is ineffective to transmit the reciprocable travel of either of said beam section to the other.

11. A walking beam assembly as defined in claim **10** wherein said means for raising and lowering said idler beam section when it is reciprocated relative to the fixed beam section comprises inclined ramps on one of said two sections at intervals therealong and a roller on each ramp between the two sections arranged to roll on said ramps to translate longitudinal motion of the idler beam section into vertical movement thereof.

12. The walking beam assembly as defined in claim **11** wherein the ramps are on the fixed lower section.

13. The walking beam assembly as defined in claim **11** wherein the surfaces of the ramp and of the idler beam section which engage said rollers have gear racks therealong and the rollers have gear teeth engaged in said racks.

14. The walking beam assemby defined in claim **1** wherein the top surface of the idler beam section and the lower surface of the traverse beam section have tracks therealong and there are rollers at intervals along the assembly between said two sections that roll on said tracks.

15. The walking beam assembly as defined in claim **14** in which said tracks include a gear rack and each roller has a gear thereon meshing with the gear racks on the said two beam sections.

16. The walking beam assembly defined in claim **15** in which the traverse beam section has a fluid pressure means for reciprocating it and the idler beam section has other fluid pressure means for reciprocating it, each of the said fluid pressure means being effective to restrain its respective beam sections against longitudinal movement when the other beam section is moving longitudinally.

17. A walking beam assembly for use in top and bottom-fired billet and slab-heating furnaces comprising:

a. a composite girder having two spaced parallel water-cooled side beams of the full height of the girder,

b. a lower intermediate beam section extending lengthwise between but spaced from the lower portions of said side beams but rigidly fixed to the side beams and integrating the structure through transverse struts at intervals therealong,

c. a reciprocable idler beam section between the side beams above said lower fixed intermediate beam section,

d. means between said idler beam section and the said lower intermediate fixed beam section arranged to raise said idler beam section when it is reciprocated in one direction and to lower it when it is moved in the other direction from a raised position,

e. a reciprocable traversing beam section extending longitudinally between the top portions of the two side beams,

f. means for transmitting only the raising and lowering motion of the idler beam to the traversing beam while the traversing beam is held against longitudinal travel of the idler beam,

g. means for selectively reciprocating the idler beam or restraining it against reciprocation,

h. means for selectively reciprocating the traversing beam or restraining it against reciprocation,

i. the side beams and the traversing beam section each having a work piece-supporting rail along the top edge thereof, the rail on the traversing rail being positioned to lift above the rails of the side beam when the traversing rail is fully raised but is below the rails of the side beams when the traversing beam is lowered,

j. the fixed lower inermediate beam, the idler beam and the traversing beam each being hollow for the circulation of cooling water therethrough.

18. A walking beam assembly as defined in claim **17** wherein there are means extending at intervals along the length of the girder at a level between the idler beam and the traverse beam connecting the upper portions of the two side beams and holding them in parallel spaced relation.

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