

March 19, 1929.

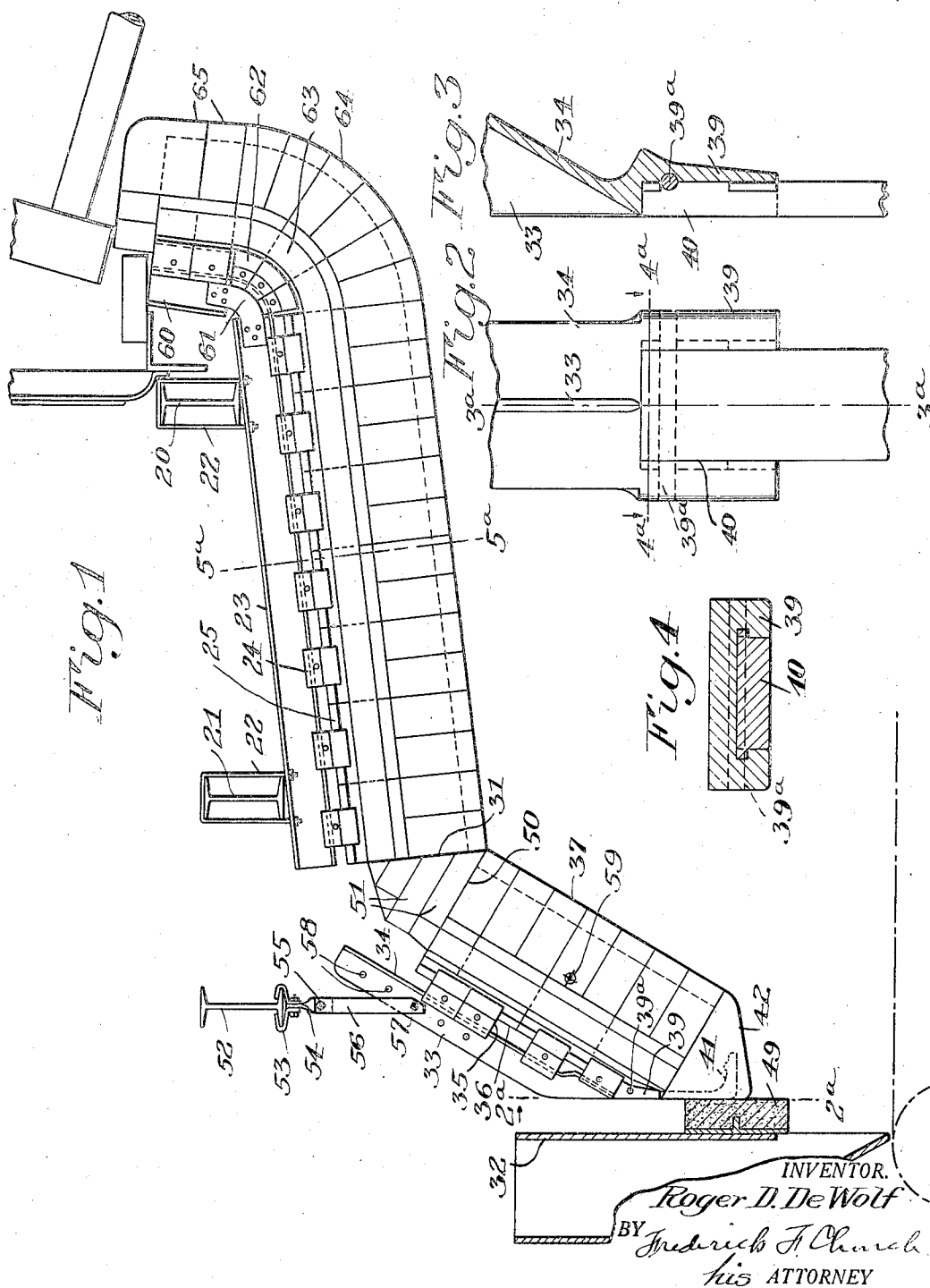
R. D. DE WOLF

1,705,965

FURNACE CONSTRUCTION

Filed Feb. 21, 1924

4 Sheets-Sheet 1



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Fig. 5

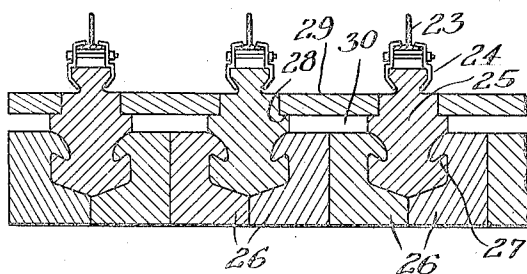


Fig. 6

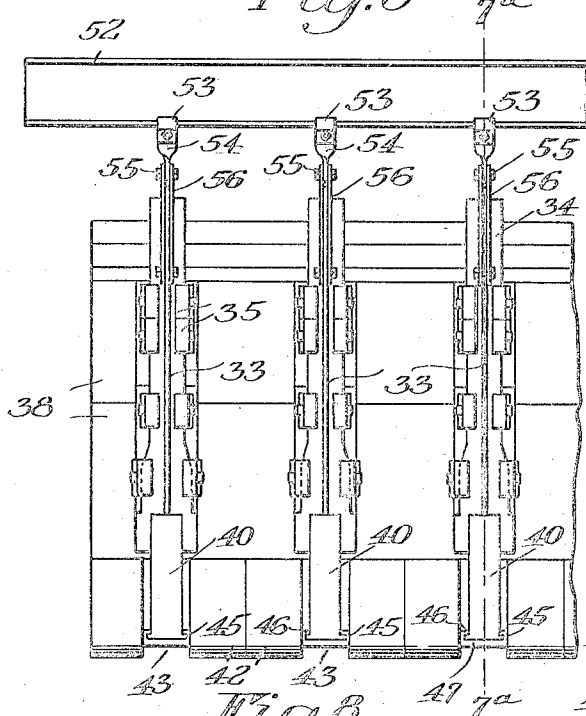


Fig. 8

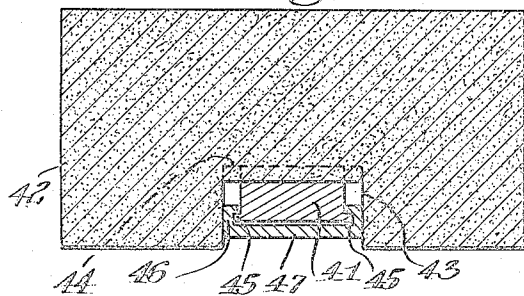
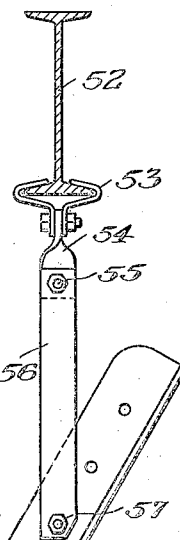
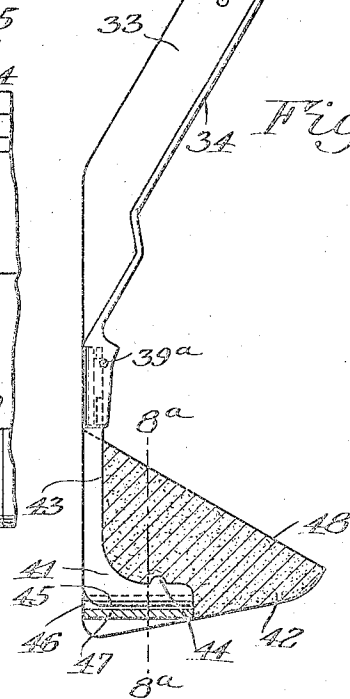


Fig. 7



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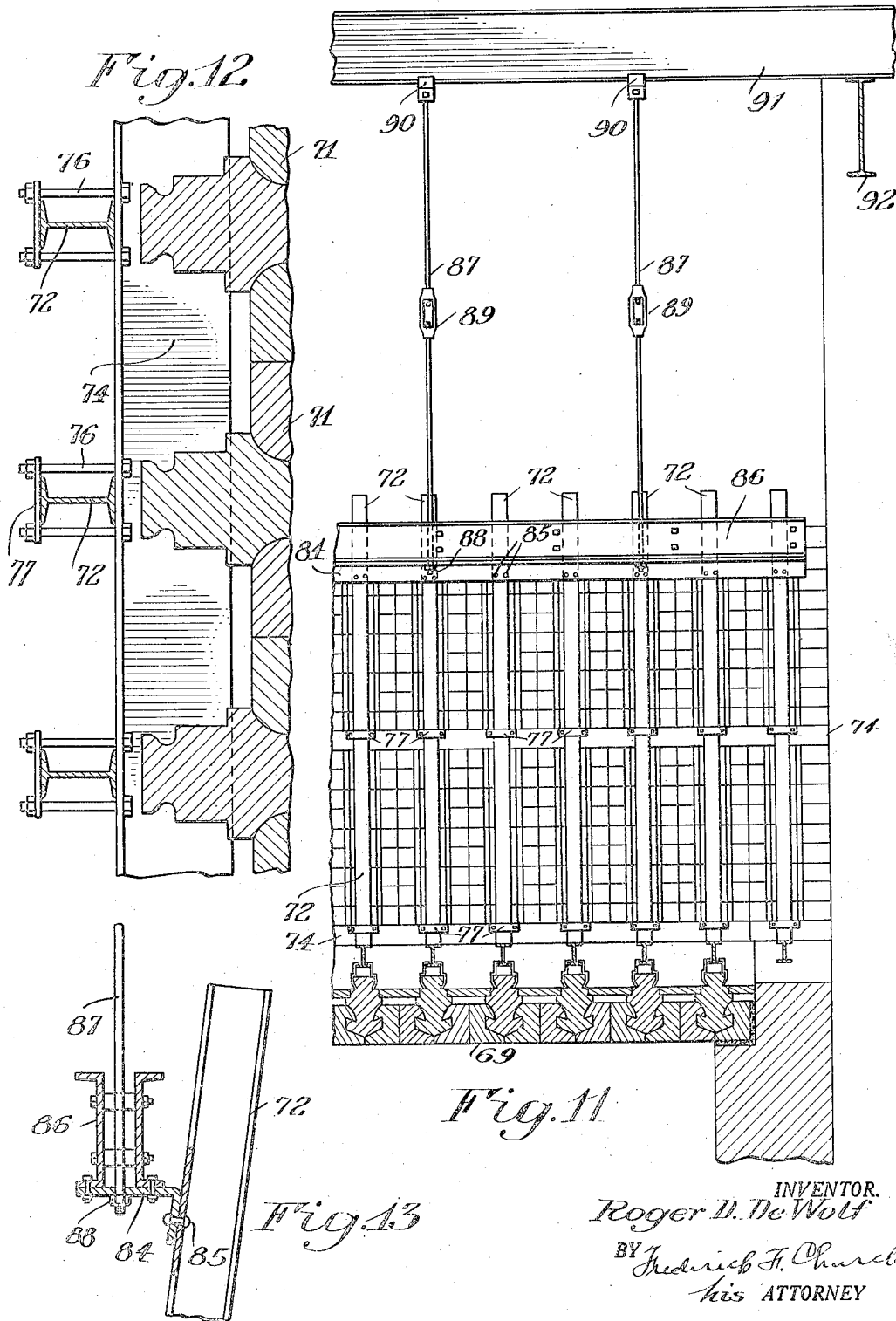
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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE.

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FURNACE CONSTRUCTION.

Application filed February 21, 1924. Serial No. 694,196.

This invention relates to furnaces and more particularly to the wall and arch construction thereof, one object of the invention being to provide a construction of this character comprising a portion arranged for movement relative to the contiguous portions to accommodate expanding and contracting movement of such portions under variations in temperature. Another object is the provision of such a furnace comprising an arch portion constructed and arranged for support by suspension means affording expansive movement of the portions under variations in temperature. A further object is the provision of a furnace having a separately constructed arch portion carried by suspension means movably connected therewith at one side of the center of gravity thereof and tending to effect a tilting action of the suspended portion for maintaining continuous contact with contiguous portions of the furnace during expansion and contraction under temperature changes.

To these and other ends the invention resides in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Fig. 1 is a side elevation partly in section of a furnace construction embodying the present invention;

Fig. 2 is an enlarged view of supporting members detached as seen substantially from the line 2^a—2^a in Fig. 1;

Fig. 3 is a sectional view on the line 3^a—3^a in Fig. 2;

Fig. 4 is a sectional view on the line 4^a—4^a in Fig. 2;

Fig. 5 is a sectional elevation on the line 5^a—5^a in Fig. 1;

Fig. 6 is an elevation of the movable arch portion as seen from the left in Fig. 1;

Fig. 7 is an enlarged sectional elevation on the line 7^a—7^a in Fig. 6;

Fig. 8 is an enlarged sectional elevation on the line 8^a—8^a in Fig. 7;

Fig. 9 is a sectional elevation of a modified embodiment of the invention;

Fig. 10 is a fragmentary enlargement of parts shown in Fig. 9;

Fig. 11 is an elevational view, partly in section, as seen from the line 11^a—11^a in Fig. 9;

Fig. 12 is an enlarged sectional view on the line 12^a—12^a in Fig. 9, and

Fig. 13 is an enlarged sectional detail view of suspension means shown in Fig. 9.

Similar reference numerals throughout the several views indicate the same parts.

The construction of furnace walls and arches presents among other difficulties, the problem of providing for the relative expanding and contracting movements of the different portions corresponding to the variations of temperature in operation, while at the same time maintaining close contact between the different portions to prevent the escape of the heated gases. It has been found that this problem is solved by a construction comprising a separately assembled portion supported and arranged in such a manner as to afford movement thereof relative to contiguous portions during expansion and contraction, and the movable portion is preferably so disposed as to effect a swinging, or pivotal tilting, or other movement thereof tending to maintain it in contact with the contiguous portion in all positions of the latter to maintain tight joints. This invention provides a practical construction of this nature applied in the present instance, by way of illustration, to the furnace arch which is particularly subjected to high temperatures tending to produce considerable expansion and contraction and furthermore requires close contact between its parts to confine the intensely hot gases which flow against it. The present embodiment of the invention thus comprises a movably supported arch portion preferably having the improved form of construction disclosed in my prior Letters Patent No. 1,462,267 granted July 17, 1923, for furnace arches.

Referring more particularly to the drawings, there is shown in Fig. 1 a furnace having a fixed main arch portion and a movably suspended ignition arch portion connecting the same with the front wall of the furnace. The fixed arch portion comprises a pair of transversely extending I beams 20 and 21 from which are suspended, as by means of straps 22, a series of beams 23 as shown also in Fig. 5. Suspended from each of the beams 23, as by means of clamps 24, is a series of hanger bricks 25 of the shape shown. A plurality of lining bricks 26 are carried by each series of hanger bricks by means of the interlocking flanges indicated at 27, Fig. 5, while

shoulders 28 of adjacent series of hanger bricks support partition bricks 29 which further close the brick portion of the arch and also provide channels 30 having an insulating function and serving also as conduits for a supply of air under pressure if so desired. This construction is shown and described in detail in my said Letters Patent so that further description thereof herein appears superfluous. This construction is practical and advantageous in various respects as pointed out in said Letters Patent, including the advantage that when any of the bricks require replacement in use, such bricks may be readily removed and replaced with a minimum amount of disturbance of adjoining bricks and of labor generally by releasing the clamps 24 of the hanger brick or bricks carrying the defective pieces and lowering the latter through the arch. The defective bricks are then replaced by new ones and the parts replaced in position and clamped to the I beam 23 as before.

The main arch portion constructed and supported in fixed relation as described above is preferably terminated at 31, Fig. 1, at some distance from the front wall of the furnace represented in the present instance by a mechanical stoker portion 32 of any known or suitable construction. This space is filled by a separately constructed ignition arch portion movably suspended in accordance with the present invention. The construction of this arch portion is similar in character to that described above and in said Letters Patent, in that it comprises a series of parallel beams 33 to the flanges 34 of which are secured clamps 35 carrying aligned series of hanger bricks 36. Facing or lining bricks 37 are supported by the latter as also the partition bricks 38, supplying a practical and durable construction having the adaptability to repair pointed out above.

The movable arch portion is arranged as shown in inclined relation, as common in ignition arch portions for reasons well understood in the art, and embodies the further feature of an advantageous abutment or foot portion on each beam 33 for additionally supporting the bricks and taking up the component of the weight thereof extending longitudinally of the beam. The latter is in the present instance of special construction having the main vertical web portion with a bottom flange 34 as shown and the lower end of the beam is preferably extended vertically downward and formed with the T shaped terminal socket portion 39, as shown in Figs. 2, 3 and 4. Removably fitting in this socket portion and removably secured as by means of a locking key or pin 39^a is the T shaped upper end 40 of a foot portion 41 extending horizontally inward as shown. Mounted on each such foot portion is a brick 42 formed with a channel 43 along its outer side and

bottom to receive the foot portion which latter preferably has a rib 44 engaging in a recess in the brick for retaining the latter in place. The bottom of the foot portion is preferably formed with side flanges 45 with which are slidably engaged the side flanges 46 of a shoe 47 which with the brick 42 protects the foot portion from the heat and may be replaced if burned. Should the foot portion also be injured in use, it may obviously be removed and replaced.

The brick 42 on the foot portion of each beam 33 has an inclined surface 48 forming an abutment supporting the series of bricks carried by the corresponding beam against movement longitudinally thereof and relieving these bricks and their clamps 35 from twisting stresses. Any of the bricks may obviously be replaced when necessary as described above without disturbing any considerable portion of the arch.

The forward end of the movable arch portion comprising the abutment bricks 48 is in sliding contact with the front wall of the furnace which at this portion is preferably fitted with a cooperating brick surface such for example as shown at 49, Fig. 1. On the upper and inner end 50 of the movable arch portion are placed, and cemented if desired, one or more bricks 51 in sliding contact with the forward end 31 of the fixed arch portion and thus filling up the angle between the two portions.

The movable arch portion is preferably supported by a form of suspension means affording a bodily swinging movement or an angular tilting movement about an axis thereof, or both, to accommodate expansion and contraction of the contiguous furnace portions under variations in temperature while so arranged as to maintain close contact between the portions to confine the heat. To this end there is preferably provided a transverse I beam 52 to the lower flange of which is secured clamps 53 of any suitable construction comprising depending straps 54 to which are pivotally secured, as by means of bolts 55, a series of aligned suspension links or straps 56. The latter are pivotally connected at their lower ends, as by means of bolts 57 with the webs of the respective beams 33, Fig. 6. The latter may be conveniently formed with a series of longitudinally spaced bolt holes 58 for adjusting the connection therewith of the suspension links. Preferably the axis of pivotal connection of the suspension means with the beams 33 is at one side of a vertical plane passing through the center of gravity of the suspended arch portion which may be represented for present purposes as at 59.

The flexible character of support afforded by the pivotal connection between clamps 53 and the links 56 provides for a bodily swinging movement of the ignition arch accommodating any simultaneous expansive move-

ment of the front wall and fixed arch portion in the same direction, as may occur under certain constructions and conditions of operation. The pivotal support of the ignition
 5 arch for angular tilting movement about an axis thereof passing through the bolts 57 connecting the same with the suspension links, affords in addition a tilting movement of the
 10 arch portion accommodating expansive movement of the furnace wall and fixed arch portion in opposite directions, or differential expansion in the same direction. Furthermore, by disposing the pivotal connection between the suspension links and arch portion
 15 at one side of the center of gravity, the arch portion tends automatically to tilt about such axis until it engages the fixed arch portion or the front wall portion, or both where as in the present instance the suspension linkage is of
 20 a flexible character. The ignition arch portion is by this construction not only rendered movable to accommodate expansion of the fixed wall and arch portions and thus relieve expansive stresses which might otherwise
 25 have destructive results, but is so supported that it tends at all times to follow the expansive and contractive movements of the fixed arch and wall portions and maintain in contact therewith to prevent the escape of the
 30 gases.

The fixed portion of the furnace arch embodies in the present instance, in addition to the construction described above, an improved inner end construction where it extends upwardly adjacent the boiler drum and
 35 tubes. Abutting the end of each supporting beam 23 is an upwardly disposed extension portion 60 connected with the adjacent end of the corresponding beam 23 as by means of
 40 an arcuate plate 61 riveted to the beam sections as shown. The upper flange and web of the extension portion 60 are cut away to clear beam 23, the lower flange being continued and curved to abut the lower flange of
 45 beam 23 and form a continuous upwardly curved extension thereof for receiving wedge shaped clamps 62 similar to the clamps 24. These clamps support wedge shaped hanger bricks 63 which in turn support lining bricks
 50 64, otherwise similar to bricks 25 and 26 respectively. Section 60 by the same means supports lining bricks 65 the end of which may be enlarged as shown to protect the end of the arch which thus embodies the same advantageous form of construction throughout
 55 both its straight and angular portions.

In Figs. 9 to 13 inclusive is shown a modified embodiment of the invention particularly adapted in this instance for the requirements of a furnace designed for the
 60 combustion of powdered fuel. In this construction, the furnace comprises a front wall 68 on which is seated in fixed relation the forward end of a fixed arch portion 69 constructed and suspended from transverse
 65

beams 70 as already described in connection with the fixed arch portion shown in Fig. 1. The fixed arch portion in this modification is spaced from the boiler drum or tubes as shown in Fig. 9 and this space is filled by a
 70 movably suspended arch portion indicated generally at 71.

The movable arch portion of this modification has the character of construction already described comprising spaced parallel beams
 75 72 to which the hanger and lining bricks are clamped as before by means of clamps 73. The arch portion in this case is inclined to a degree approaching the vertical and the longitudinal thrust of the weight of the bricks is
 80 taken by two angle bars 74, extending transversely adjacent the center and lower end of the arch portion and riveted thereto as at 75. These angle bars may be further secured to the beams 72 as by means of bolts 76 passed
 85 through the bars and to a plate 77 thus held against the other side of the beams 72. One leg of each bar extends inwardly as in the case of the foot portion 41 of the first modification and engages under the hanger bricks
 90 to form a supporting abutment for the latter. Any number of such foot portions or abutments may of course be employed for the purpose explained.

The lower end of the movably supported
 95 portion 71 has, in abutting relation with the inner end of the fixed arch portion 69 a suitably curved section similar to the inner end of the fixed arch of the first modification and preferably formed by curving the lower ends
 100 of the beams 72 about a suitable radius as at 78, Fig. 10. Wedge or sector shaped clamps 79, Fig. 9, are secured on the flange 80 of the curved section 78 and support a suitably wedge shaped series of hanger bricks 81 and
 105 facing bricks 82 of the character already described, providing a continuous curved facing between the two arched portions. The upper end of the suspended arch portion 71 is movably connected in any suitable manner
 110 with the boiler drums and other portions as by means of a suitable packing material 83 arranged to prevent the escape of the gases.

Arch portion 71 is movably suspended in the present instance by means comprising a
 115 transverse angle bar 84, Fig. 13, riveted to the flanges of each of the beams 72 as at 85. The bar 84 forms part of a beam 86 built up of spaced channels bolted together to provide a rigid member to which a series of aligned,
 120 flexible suspension links 87 are fixed. The latter are in the present instance in the form of rods passed between the channels of beam 86 and through bar 84 in which the rods are secured as by means of nuts 88. The sus-
 125 pension links or rods are provided with adjusting turn buckles 89 and their upper ends are attached to clamps 90 engaged with the flange of an I beam 91 suitably supported as
 130 by means of main beams 92 which carry the

boiler drums and tubing. The swinging and tilting movements of the suspended arch portion are afforded in this modification by the flexibility of the angle bar 84, or of the elongated suspension rods 87 or of both, the device described for attaching these rods to the arch portion being preferably located at one side of the center of gravity of the latter so that it tends to swing and tilt to maintain contact with the fixed arch portion 69 at one end and with the boiler drum at the other in the manner and with the advantages described for the previous modification.

The invention thus provides in combination with an improved form of arch construction, a practical and efficient combination of relatively fixed and movable portions and suspension means for the movable portions capable of various adaptations. During expansion and contraction of the different portions under variations in temperature, the movably supported portion tends to swing bodily, or to tilt pivotally about its axis of support, or to partake of both motions, but always maintains close contact with the contiguous portions to prevent escape of the hot gases.

I claim as my invention:

1. In a furnace, a separately constructed arch portion comprising beam means and a plurality of bricks having means connecting the latter with said beam means, said arch portion being arranged to abut and move relative to adjacent furnace portions on opposite sides thereof and being normally inclined with respect thereto, and supporting means having a connection with said arch portion at one side of the center of gravity of the latter independently of said brick connecting means tending to produce a tilting movement of said arch portion for maintaining the same in contact with abutting furnace portions during expansion of the parts under variations in temperature.

2. In a furnace, a separately constructed arch portion comprising beam means and a plurality of bricks having means connecting the latter with said beam means, said arch portion being arranged to abut and move relative to adjacent furnace portions and flexible supporting means having a connection with said arch portion independently of said brick connecting means adapted to normally afford a bodily swinging and also an angular tilting movement thereof for accommodating the expansive movement of the furnace portions produced by temperature changes and maintaining said arch portion in contact with said adjacent portions.

3. In a furnace, an arch portion comprising beam means and a plurality of bricks having means connecting the latter with said beam means, said arch portion being arranged to abut and move relative to adjacent furnace portions and being normally inclined

with respect to the latter, and flexible link means having a pivoted connection with said arch portion independently of the brick connecting means adapted to normally afford bodily swinging and also an angular tilting movement of the latter to accommodate expansive movement of the furnace portion under variations in temperature and maintain said arch portion in contact with said adjacent portions.

4. In a furnace, an arch portion comprising beam means and a plurality of bricks having means connecting the latter with said beam means, said arch portion being arranged to abut and move relative to adjacent furnace portions and being normally inclined with respect thereto, and a plurality of aligned flexible link means supporting said arch portion from above and having pivotal connections therewith independently of the brick connecting means and at one side of the center of gravity thereof affording a bodily swinging and also an angular tilting movement of the arch portion tending to maintain the same in contact with abutting furnace portions during expansion and contraction produced by temperature changes.

5. The combination with a furnace construction, of an arch portion comprising supporting beams inclined to the horizontal and a lining of heat resistant material therefor, supporting means above said arch portion and a series of suspension members carried by said supporting means and adjustably connected with said beams along an inclined axis of the latter disposed to effect a tilting movement thereof for maintaining the lining in contact with abutting furnace portions during the expansive movement produced by variations in temperature.

6. The combination with a furnace having a front wall and a fixed arch portion, of a movable arch portion comprising supporting beams inclined to the horizontal and a lining of heat resistant material suspended from the beams and also inclined to the horizontal and abutting said fixed portion at one side and disposed in sliding engagement with the inner face of said front wall at its opposite side, and supporting means having a connection with said movable arch portion independently of said lining material tending to effect movement of the arch portion for maintaining the same in contact with said fixed arch portion during expansive movement produced by temperature changes.

7. A furnace comprising a wall portion, a fixed arch portion, and a movable ignition arch comprising supporting beams inclined to the horizontal and a lining of heat resistant material therefor extending obliquely between said wall and fixed arch portions and supporting means connected with said movable arch at one side of the center of gravity thereof independently of said lining

material and tending to effect a tilting movement of said arch for maintaining the same in contact with said wall and fixed arch portions during expansion of said parts under variations in temperature.

8. The combination with a furnace of a movable arch portion comprising inclined supporting beams, transversely extending abutment means carried by said beams, bricks of heat resisting material secured to said beams and supported by said abutment means, and suspension means having a connection with said arch portion tending to produce a tilting movement thereof to accommodate expansion of the furnace parts under variations in temperature and maintain said movable arch portion in contact with adjacent furnace parts.

9. The combination with a furnace of an arch portion comprising a series of beams arranged at an inclination to the horizontal and provided with transversely extending abutment means, fire bricks secured to said beams and seated on said abutment means, and suspension means for said beams arranged to produce a tilting movement thereof adapted to maintain said arch portion in contact with abutting portions of the furnace.

10. The combination with a furnace of an arch portion comprising a series of beams arranged at an inclination to the horizontal and provided with transversely extending abutment means, hanger bricks secured to said beams, lining bricks carried by said hanger bricks, said hanger and lining bricks being held against movement longitudinally of said beams by said abutment means, and supporting means having a connection with said beams tending to produce a tilting movement thereof to accommodate expansion of said arch and abutting furnace portions produced by temperature variations and maintain said arch portion in contact with said abutting furnace portions.

11. The combination with a furnace of an arch portion comprising a series of beams arranged at an inclination to the horizontal, a transversely extending foot portion at the lower end of said beams, a protective shoe removably disposed on said foot portion, fire bricks carried by said beams and held against movement longitudinally thereof by said foot portion, and suspension means movably supporting said beams permitting the latter to swing under the expansive movement of said

arch and abutting furnace portions produced by variations in temperature.

12. The combination with a furnace construction comprising a wall portion and a fixed arch portion, of a movable arch portion comprising a series of beams extending obliquely from an end of said fixed arch portion to said wall portion, transversely extending abutment means at the lower ends of said beams and fire bricks carried by said beams and held against movement longitudinally thereof by said abutment means, and flexible suspension means pivotally connected with said beams at one side of the center of gravity thereof and tending to effect a tilting action of said movable arch portion for maintaining the same in contact with said fixed arch portion and wall during expansion and contraction of the furnace.

13. In a furnace, the combination with a front wall and an arch portion spaced therefrom, of supporting means, a separately constructed arch carried thereby comprising a series of beams arranged at an inclination to the horizontal between said wall and arch portion and provided with depending hangers in sliding engagement with the inner face of said wall and having laterally extending lugs, base blocks recessed to receive said hangers, a series of bricks superimposed upon said base blocks and connections between said bricks and said beams.

14. In a furnace, supporting means, a separately constructed arch carried thereby comprising a series of beams arranged at an inclination to the horizontal and having recessed portions at their lower ends vertically disposed, hangers depending from said beams having their upper ends secured within said recessed portions and provided at their lower ends with inwardly projecting feet, base blocks secured upon said feet, a series of bricks superimposed upon each of the blocks, and means connecting the bricks with said beams.

15. In a furnace, supporting means and an arch carried thereby, comprising a series of vertically disposed hangers having foot-like portions on their lower ends, base blocks superimposed upon said foot-like portions, detachable shoes forming guards for protecting said foot-like portions from the heat of the furnace and a series of bricks superimposed upon each base block.

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