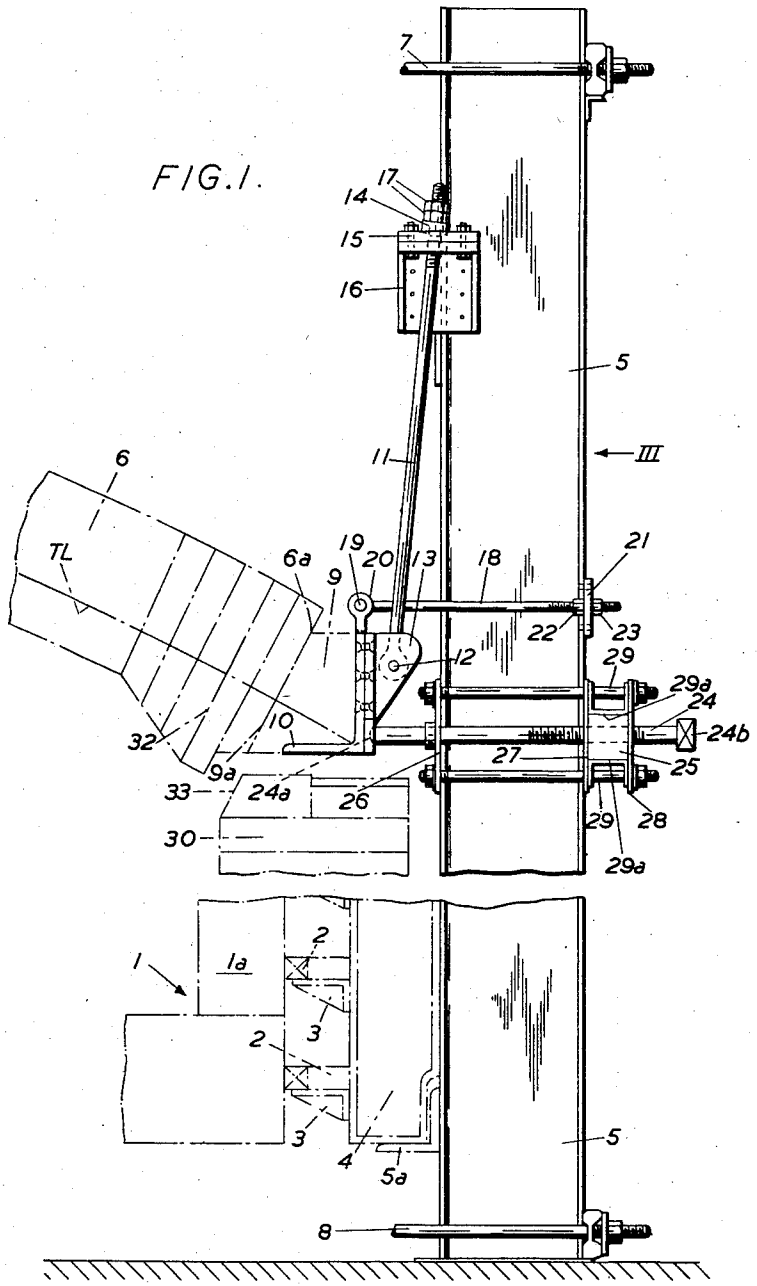
May 13, 1958 W. B. ROXBURGH 2,834,306

FURNACES

Filed Jan. 14, 1953 3 Sheets-Sheet 1

FIG. 1.



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FURNACES

Filed Jan. 14, 1953 3 Sheets-Sheet 2

FIG. 2.

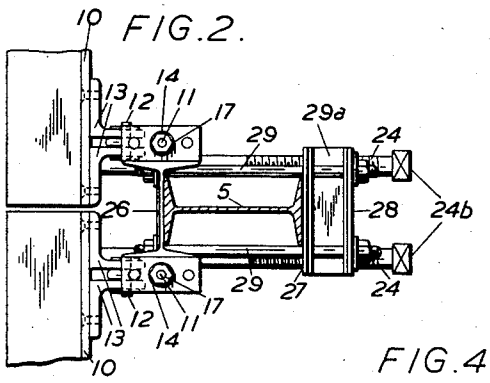


FIG. 3.

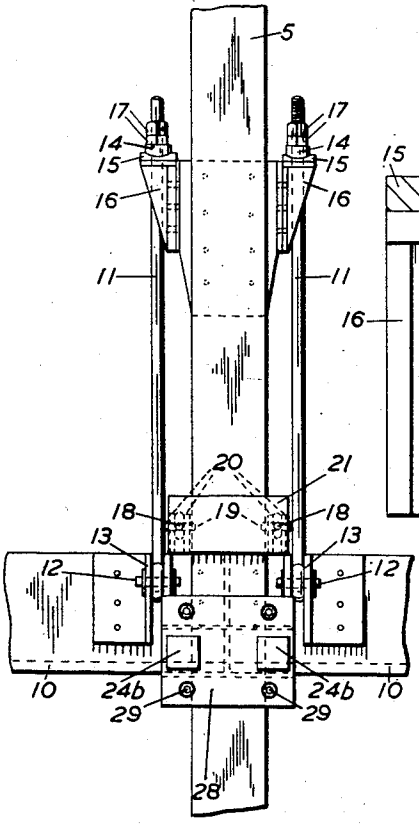
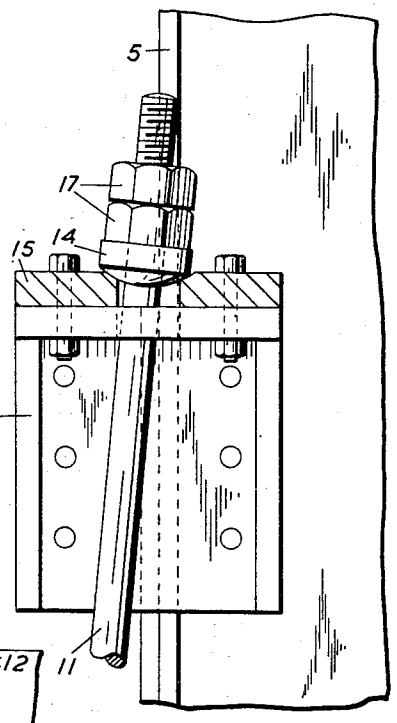


FIG. 4.



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Filed Jan. 14, 1953 3 Sheets-Sheet 3

FIG. 5.

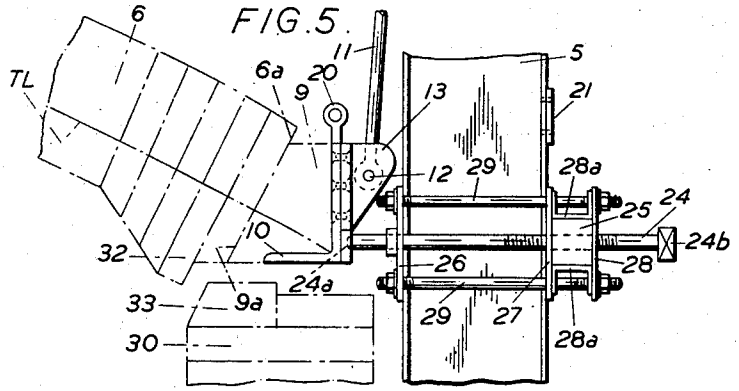


FIG. 6.

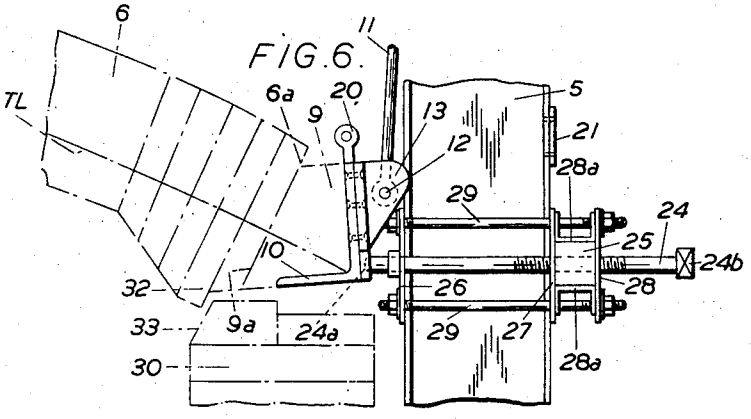
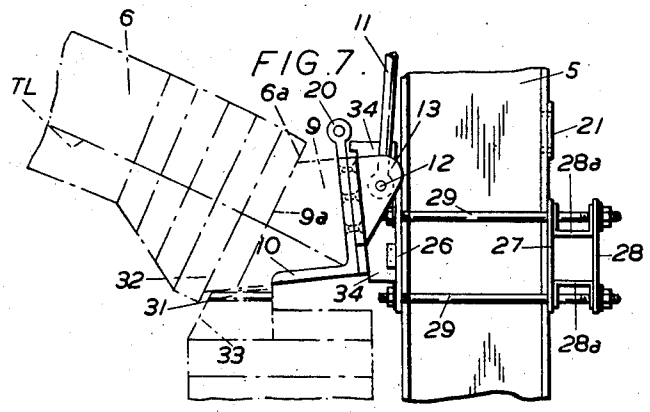


FIG. 7.



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FURNACES

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Application January 14, 1953, Serial No. 331,198

Claims priority, application Great Britain February 26, 1952

1 Claim. (Cl. 110—99)

This invention relates to furnaces, and in particular to glass-making furnaces, which comprise a floating arched roof rested on springers and covering a melting tank.

During heating or cooling of a furnace of the kind above described the roof bricks undergo changes according to the temperature they attain and as the inner face of the roof may attain a temperature of 1500° C. while the outer face may not reach more than about 300° C., the roof bricks become divided into zones having different characteristics of thermal expansion and contraction. Consequently, there is a tendency for the bricks to crack at some level in the thickness of the roof with the result that a piece of brick may drop out and fall into the tank.

Cracking or spalling of the roof bricks at some position in the thickness of the roof can also be caused by the crushing effect of too much mechanical resistance to expansion, or as the result of the thermal shock caused by sudden heating or cooling.

It is one object of the present invention to provide a method whereby lateral expansion and contraction of the floating arched roof can be accommodated in a manner such that the lateral movements of the roof resulting from such expansion or contraction do not entail movement of furnace elements such as elements a function of which is to support the weight of the roof and to resist the lateral thrust thereof.

A further object of the invention is so to utilise the said method that there is produced in the roof a thrust line which holds together the elements thereof at the inner roof face during expansion and contraction of the roof to reduce cracking of the face during expansion and contraction.

According to the present invention there is provided for a glass-making furnace structure comprising a floating arched roof rested on springers and covering a melting tank, a series of elements erected alongside of the roof and tank, a function of said elements being to support the weight of the roof, a roof supporting structure comprising springer supports in the form of angle brackets suspendable from said elements for tilting movement about axes extending lengthwise of the roof and for movement towards and away from said elements, axially adjustable rigid thrust-reaction members to engage the springer supports and act as fulcrums therefor, bearings to support the reaction members with their axes in a horizontal plane intersecting the abutting faces of the springers and the sides of the roof, means to connect the bearings to said elements for adjustment lengthwise thereof, thereby to permit selection of the positions of engagement of the thrust-reaction members with the springer supports, and means for effecting axial adjustment of the reaction members to restrict reaction thrust to said horizontal plane to produce in the roof a thrust along a line at a position such that the thrust holds together the elements thereof during differential lateral movements of the inner and outer roof faces due to expansion or contraction of the roof.

In order that the invention may be clearly understood one preferred embodiment thereof will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:

Fig. 1 is a broken elevation of one side of a glass-making furnace structure according to the invention, the parts being shown in the positions they occupy during construction of the floating arched roof,

Fig. 2 is a top plan of Figure 1, some parts being omitted for clarity,

Fig. 3 is a view of a part of Fig. 1, looking in the direction of the arrow III, Fig. 1,

Fig. 4 illustrates, to an enlarged scale, a part of the roof suspension means illustrated in Fig. 1,

Fig. 5 is a view of a part of Fig. 1 and shows the elements in intermediate positions occupied by them during heating-up of the furnace,

Fig. 6 is a view similar to that of Fig. 5 but shows the elements in the positions they occupy at the end of the heating-up process, and

Fig. 7 is a view similar to that of Fig. 6 but showing the elements during the normal operation of the furnace.

In the drawings, Figure 1, as stated above, illustrates one side only of a glass-making furnace, it being understood that the opposite side is of like construction, and in Figures 1, 5, 6, and 7, the brick-work of the furnace is indicated in chain line.

Referring to Fig. 1, the furnace comprises a melting tank **1** the side walls **1***a* of which are held in position by packing pieces **2** supported by brackets **3** carried by legs **4** secured by bolts (not shown) to elements **5**, shown in the example being herein described as buckstays, erected alongside the tank in the usual spaced relation, and a floating arched roof **6** covering the tank. The legs are additionally supported on brackets **5***a* secured to the buckstays. The buckstays are arranged in pairs, one on each of the opposite sides of the tank **1** and, as is customary, the buckstays of a pair are tied by tie members **7** and **8** extending over the roof **6** and under the tank **1** respectively.

The arched roof **6** of the funace is rested on springers **9** supported by angle bracket **10**. Each angle bracket **10** is slung by a pair of links **11** parallelly depending from the buckstays; accordingly the arched roof may be considered as a floating roof. Connection between each angle bracket **10** and the respective links is effected by co-axial pivot pins **12** which extend through the lower ends of the links **11** and through respective winged brackets **13** is riveted or otherwise suitably secured to each side of the angle bracket **10** and the axes of the pivot pins **12** extend lengthwise of the roof.

At its upper end each link **11** is connected by a swivel joint to a buckstay, a swivel joint being formed by a slidable collar **14** mounted on its link for movement axially thereof and having its under-surface shaped to be of convex formation to seat in a concave seating, see Fig. 4, formed in a pad plate **15** supported by a bracket **16** riveted or otherwise suitably secured to a buckstay. The effective length of each link **11** is determined by locking nuts **17** at the upper end thereof.

As already explained, Fig. 1 illustrates the positions of the various parts of the supporting structure during the construction of the roof. At this time it is necessary to provide means to prevent tilting of the angle brackets **10** and which such means comprises steadying rods **18** each connected at one end by a pin **19** to an eye-member **20** extending upwards from the respective sides of the angle brackets **10**. The opposite ends of the rods **18** are screw-threaded and pass through plates **21** suitably secured to the buckstays and the rods are maintained in adjusted position by nuts **22, 23**. When the roof has been prepared, and before the furnace is heated up, the steady rods **18** are removed so that the springers **9** and their supporting angle brackets **10** can hinge during expansion of the roof.

The approximate position of the thrust-line which, by experiment, has been found to hold together the elements of the roof at the inner roof face is indiacted in the drawings by the reference letters TL, which is disposed more than half the distance from the outside (upperside) to the inside (lowerside) of the roof and which passes approximately through the corner junctions of the sides of the angle brackets **10**.

During heating-up each of the angle brackets **10** is engaged by an axially adjustable rigid thrust reaction member carried as part of a unit which is vertically adjustable on the respective buckstays. In the construction illustrated each thrust member comprises a pair of square-headed screws **24** passing through bearing nuts **25** the vertical adjustment being such that the ends **24***a* of the members **24** form fulcrums for and engage the angle brackets **10** at about the corner junctions of the sides thereof to produce in the roof a thrust along the thrust-line TL. The thrust reaction members **24** and nuts **25** are supported in predetermined position in relation to the buckstays by clamping plates 26, 27, 28 which are held in position by four bolts **29** passing through them to each side of a buckstay and the position at which the angle brackets **10** are engaged by the thrust reaction members **24** can be adjusted by loosening the bolts **29** and sliding the plates **26, 27, 28** together with the member **24** and nut **25** lengthwise by the buckstay. The plates **27, 28** are retained in spaced relation by inverted channel irons **29***a*, Figs. 1 and 2, which also prevent rotation of the nuts **25**.

When heating-up is commenced, after removal of the steady rods **18**, the arched roof **6** gradually expands laterally and this is accommodated by progressively screwing back the thrust reaction members **24** by the application of a spanner or other suitable tool to the heads **24***b* thereof, so that the angle brackets **10** are permitted to move towards the buckstays and away from a vertical plane in which the longitudinal centre line of the roof is located about the swivel joints **14, 15** and to tilt relative to said vertical plane about the ends **24***a* of the thrust reaction members **24**. Fig. 5 illustrates an intermediate stage in heating-up and from this figure it wil be observed that although the position of the thrust reaction member **24** has been adjusted the degree of tilting is very slight although the angle brackets **10** have, through the swivel joints, moved towards the buckstays and therefore away from said vertical plane. Towards the end of the heating up process, however, the tilting of the angle brackets **10** about the ends **24***a* of the thrust reaction member **24** is more marked and the positions of the thrust reaction members **24** and angle brackets **10** are somewhat as shown in Fig. 6. As the furnace remains operative for a considerable time the gap between the underside of the end blocks of the roof and the top of the superstructure **30** of the tank is, after completion of expansion, substantially closed by refractory packing **31**, Fig. 7, to prevent "sting-out" flame distorting the angle bracket **10**. The end portions of the roof **6** and superstructure **30** are also suitably shaped, as indicated at **32, 33**, for the purpose of shielding the gap through which flames tend to escape.

After heating up is completed the links **11** may be let down a little by adjustment of the nuts **17** thereon. This action would assist the packing **31** to seal the gap between the roof and the superstructure **30**. Further, wedges **34**, Fig. 7, may be inserted between the angle brackets **10** and the buckstays to permit the thrust reaction members **24** and their nuts **25** to be removed, greased and stored until required for use during the cooling down process which precedes the next cold servicing operations to the furnace as otherwise these parts are liable to become corroded and inoperable owning to the high temperature at the positions in which they are used on the furnace.

When the furnace is to be cooled down, the thrust reaction members **24** are replaced to engage the angle brackets **10**, the wedges **34** are removed, and the link **11** readjusted if necessary. During cooling-down the thrust reaction members are progressively screwed inwards as the angle brackets **10** are tilted about the ends **24***a* thereof, the links **11** moving about their swivel joints **14, 15**, towards their pristine positions.

From the foregoing it will be understood that by supporting an arched roof for a furnace in the manner herein described so that interfacial engagement of the sides of the roof with the springers is maintained and the supporting angle brackets **10** are tiltable while engaging the roof springers during expansion or contraction of the roof, that is during differential lateral movements of the inner and outer roof faces, the reaction thrust is restricted to a horizontal plane which intersects the plane of the interfaces 6*a*, 9*a* of the sides of the roof and produces a thrust along a line which is disposed more than half the distance from the outside to the inside of the roof, so that the thrust holds together the elements of the roof at the inner roof face and by so doing the effects resulting from cracking of the roof bricks are minimized and the roof is maintained in good condition.

I claim:

In a furnace having buckstays and an arched roof resting on springers at the sides of the roof along the length thereof and supported solely at the sides to permit movement of the roof as a unit upon expansion and contraction thereof, the combination to permit the roof to accommodate itself to thermal changes during the stages when the temperature of the furnace is substantially increasing or decreasing, comprising links on the sides of the roof extending downward therefrom for carrying the downward pressure of the roof, and pivotally supported at their upper ends by the buckstays for swinging movements towards and away from the adjoining buckstays, a springer supporting angle bracket at each longitudinal side of the roof, said angle brackets being pivotally supported from the lower ends of said links for angular movement about axes extending lengthwise of the roof arch, rigid thrust reaction members engaging the angle brackets at about the corner junctions of the sides thereof to produce in the roof a thrust along a line disposed more than half the distance from the outside to the inside of the roof, thereby to hold together the elements of the roof at its inner face, said links, angle brackets and thrust reaction members constituting the sole means of support of the roof during said stages, whereby as said roof is expanded or contracted by changes in temperature, the link swing about their upper supports towards or away from the adjoining buckstays and at the same time, the sides of said roof under control of said angle brackets swing angularly about the thrust reaction members as fixed fulcrums, and means rigidly but adjustably supporting said thrust reaction members on said buckstays for adjustment along straight lines in their respective directions of thrust in relation to said buckstays to vary lateral thrust transmitted from said thrust reaction members to the buckstays and to the roof during said stages and to compensate thereby for thermal expansion or contraction of the roof.

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