ABSTRACT OF THE DISCLOSURE

This invention relates to the construction of furnace roofs of the type, for example, used with electric furnaces, open hearth furnaces, fluidized reactors, which roofs require contour-controlling, hold-down structure. This contour-controlling structure is comprised of an outer layer of refractory brick which is in abutment with an inner downwardly converging layer of refractory brick at a central area and at the ends to provide a void space between the layers. The upper layer prevents the lower layer from moving upward.

Furnace roofs as heretofore known, have generally been arched but have sometimes been flat. Arched roofs are usually installed in one of two ways. Either the individual blocks are held by hangers that support the blocks from a fixed supporting structure of the furnace, or else the blocks support each other according to the arch principle. That is, the side surfaces of adjacent blocks press against each other in such a way as to retain the blocks in the configuration of an arch. Flat roofs, which are not readily adaptable to the arch principle, have heretofore been supported by hangers.

In either type of roof, the refractory brick of which the roof is made are subjected to relatively high temperatures during the operation of the furnace. When subjected to such temperatures over a period of time, the brick undergo a typical change known as expansion. During expansion, the physical dimensions of the brick increase or grow. Such expansion is taking place, the thickness of the roof arch gradually diminishes because of erosion, spalling and melting of the underside of the roof which is exposed to the combined influences of heat and gases in the interior of the furnace. Simultaneous expansion or growth of the roof brick and decrease in the thickness of the roof arch cause the roof to deviate from its original design contour and fail prematurely.

In order to minimize the detrimental effects of the expansion characteristics of roof brick, a hold-down system has been utilized. Typically, one consists of a plurality of short steel beams disposed horizontally on the top of the arched roof in spaced parallel relation across the roof. The steel beams were braced against the furnace roof with rigid steel posts which were interposed between the beams and the overhead beams of the furnace frame work. The bottoms of the posts were bolted to the hold-down beam while the upper ends thereof were rigidly attached to the overhead frame work beam by welding. Thus, after assembly, the steel posts provided a rigid connection between the hold-down beams and the furnace steel frame work. The above construction, while satisfactory, required a great deal of hardware and cannot be employed with many removable electric furnace roofs.

It is an object of the present invention to provide an improved furnace arch roof construction which will permit a limited amount of expansion and growth of the refractory roof arch and at the same time apply a restraining force to the thermal expansion of the roof arch. In the drawings, only two of the numerous embodiments in which the invention may appear are illustrated, selecting the forms shown from the standpoint of convenience and illustration, satisfactory operations and clear demonstration of the principles involved.

FIGURE 1 is a fragmentary perspective view of a sprung arch of the invention applied to the dome of a furnace.

FIGURE 2 is a fragmentary perspective of a sprung arch of the invention applied to the roof of an open hearth furnace, for example.

In accordance with the present invention, there is provided a sprung arch for a furnace or the like. The arch consists of an inner layer of refractory brick and an outer layer of refractory brick. The layers contain a central area at which the brick in the outer layer are in contiguous contact with the brick in the inner layer. The remainder of the inner layer converges downward, away from the outer layer to provide a void space between layers surrounding the central area. The converging inner layer has substantially the same terminus as the outer layer. The termini of both layers are connected by a column of refractory brick preferably; although other connecting means may be employed.

The outer layer is suitably of a refractory brick which has the most desirable structural characteristics under the particular service conditions, especially the elevated temperatures. It should be of a refractory brick which is strong and rigid under the conditions.

The inner layer is made of a refractory brick which is best suited to function under the prevailing conditions on the inside of a furnace, for example, best able to withstand the inner temperature, or to resist the thermal shock of heating and cooling, or to function under the conditions of erosion or corrosion which prevail in the particular furnace, or any combination of these.

Referring to the drawings, FIG. 1 shows a sprung arch according to the invention which in this case takes the form of a dome and suitably may be used as the dome of an electric metallurgical furnace or a blast furnace stove or the internal or external domes of a fluidized reactor.

The roof includes annular skew backs supporting a sprung arch which extends inwardly and may have ports or openings at suitable points if desired. Generally, the openings for electric furnace roofs are located in the central area to accommodate the furnace electrodes. The ports for an internal dome of a fluidized reactor may be many.

The sprung arch comprises an inner layer of refractory brick and an outer layer of refractory brick. The inner layer of brick is supported directly by the skew backs. The brick in the central area of the inner layer are longer than the brick in the remainder of the layer for reasons that will be explained subsequently.

The outer layer of refractory brick is disposed above the inner layer and is in contiguous abutment therewith at the central area. The outer layer is not as downwardly convergent as the inner layer providing a void space around the central area. By employing longer brick in the central area of the inner layer, and aligning the remainder of the brick in that layer so that a smooth continuous surface is defined along the interior thereof, the void space is provided without too great a difference in convergence of the layers. The ends of each layer are connected by a column of refractory brick which is disposed on the upper surface of the skew backs. The terminus of the brick in the outer layer rests atop the refractory column.

The void space between the outer and inner layers of brick preferably is filled with a loose granular refractory material. The purpose of this is to absorb part of the upper growth or expansion of the inner layer while still maintaining restriction of movement thereof. Thus, the
outer layer provides contour control for the inner layer.

In FIG. 2, a portion of an arched roof for an open hearth furnace is generally indicated at 30. The cross-
sectional configuration of the roof is similar to that of FIG. 1. Here, of course, the arch is not spherical or dome-
shaped but is semi-cylindrical. The inner layer 32 of brick
rest upon skew backs 34, which rest upon a front wall
36, and similarly, on the back wall (not shown) of the
furnace. The outer layer is connected to the inner layer
with a column 38 of refractory brick as in FIG. 1.

The present invention can be practiced with a wide
variety of refractory brick compositions for the inner and
outer layers. The combinations may be numerous depend-
ing on service conditions such as temperature, thermal
shock, gas exposure, corrosion and erosion. For example,
the brick in the outer layer may be silica or semi-silica
brick. These are extremely strong and rigid and act as a
good structural support for the strong arch.

A very good refractory brick for the inner layer in
many installations is sillimanite, which has the capability
of resisting high temperature and is more resistant to
thermal shock. Sillimanite, however, tends to soften at
operating temperatures so that it would not be depend-
able structurally in any installation if the entire arch were
constructed thereof. Other suitable brick for the inner
layer, which might not be suitable for a complete sprung
arch under many working conditions, are muillite, high
alumina, chrome magnesite and magnesite chrome.

While the present invention has been described with
regard to certain embodiments and examples, it should
be understood that it may be applied to other embodi-
ments without departing from the spirit and scope of
the invention.

Having thus described the invention in detail and with
sufficient particularity as to enable those skilled in the
art to practice it, what is desired to have protected by
Letters Patent is set forth in the following claims.

References Cited

UNITED STATES PATENTS

464,562 12/1891 Guastavino 52—89
1,655,680 1/1928 Goodwillie 52—89
1,686,761 10/1928 Norton 110—99
3,171,370 3/1965 Fay 52—89

FRANK L. ABBOTT, Primary Examiner.
J. L. RIDGILL, Jr., Assistant Examiner.

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