

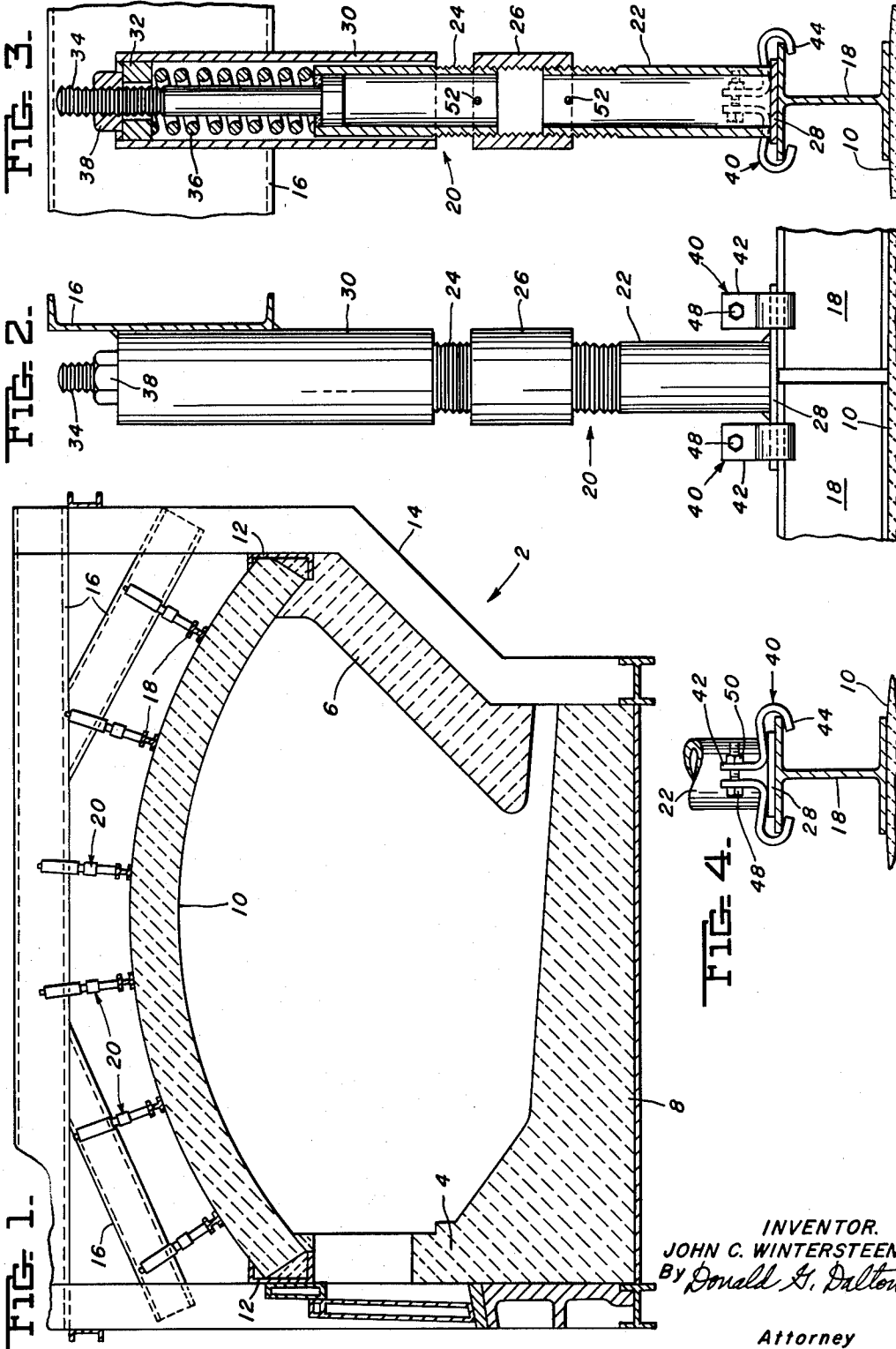
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ROOF-JACK FOR A METALLURGICAL FURNACE

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ROOF-JACK FOR A METALLURGICAL FURNACE

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The present invention relates generally to metallurgical furnace equipment and more particularly to an improved roof-jack especially suitable for use with an open hearth furnace.

A modern open hearth furnace is usually constructed with an arched refractory brick roof which is supported by the walls of the furnace. A steel framework of slabs, plates and structural shapes rigidly tied together by transversely extending overhead beams supports the furnace bottom and walls.

The refractory bricks of which the roof is made are subjected to relatively high temperatures during operation of the furnace and when subjected to such temperatures over a period of time the bricks undergo a physical change which is known in the art as "growth." During "growth" the physical dimensions of the brick increase or grow. At the same time such "growth" 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 "growth" of the roof brick and decrease of 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 "growth" characteristic of roof brick, a hold-down system is utilized. Prior to my invention a typical hold-down system usually included a plurality of short steel beams which were disposed horizontally on the top of the arched roof in spaced parallel relation extending along the length of the roof. The steel beams were braced against the furnace roof arch by rigid steel posts which were interposed between the beams and the overhead beams of the furnace framework. The bottoms of the posts were bolted to the hold-down beams while the upper ends thereof were rigidly attached to the overhead framework beams by welding. Thus, after assembly, the steel posts provided a rigid connection between the hold-down beams and the furnace steel framework.

The present practice of building or rebuilding the roof of an open hearth furnace involves laying the roof arch on a form which is supported from below and which is removed when the roof arch is completed. After the roof arch has been completed, the hold-down beams are laid on the top side of the arch in predetermined locations. Then the hold-down posts are bolted to the hold-down beams and welded to the furnace steel framework.

The hold-down beams and posts and their attachment to the furnace steel framework as arranged prior to my invention constituted a rigid hold-down system. Due to the rigidity of this hold-down system, the forces generated by thermal expansion of the roof arch during operation of the furnace and the "growth" of the refractory brick making up the roof arch were transmitted into the furnace steel framework and caused deflection or bending of the components of the furnace steel framework. This deflection or bending of the furnace framework tended to lessen

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support of the furnace refractory materials and consequently resulted in accelerated furnace failure.

The stability and strength of an arched open hearth furnace roof is also influenced by the load or weight supported by the roof as well as the contour of the arch. Since the roof arch hold-down system of the prior art was rigid there was no adjustment possible to compensate for the decreasing thickness of and dead load carried by the roof arch which occurred as a result of erosion, spalling, and melting.

After a furnace equipped with the prior art hold-down system had been in operation for a period of time and the roof arch materials had deteriorated to the extent that rebuilding or replacement of the furnace roof was necessary, it was found that the upper furnace steel framework, to which the hold-down posts were welded, although still satisfactory for further service, was often bent and warped so that the alignment and lengths of the original hold-down posts did not agree perfectly with the locations and lengths of posts required when the roof arch and hold-down beams were replaced in the original locations after the roof was rebuilt. When this occurred it was necessary to chip the posts from the supporting steel framework and re-weld them to suit the replacement arch and the positions of the hold-down beams thereon. This required extending the down-time of the furnace and increased rebuilding costs.

It is, accordingly, the primary object of my invention to provide an improved roof-jack for a metallurgical furnace having a refractory roof arch which when installed between the hold-down beams and the upper steel framework of the furnace will permit a limited amount of expansion and "growth" of the refractory roof arch and at the same time apply an adjustable and predetermined restraining force to thermal expansion of the roof arch.

Another object of my invention is to provide an improved furnace roof-jack of the character described which is capable of automatically applying a gradually increasing resistance to the "growth" of the refractory roof arch so that the loss of thickness of the arch and consequent loss of dead weight bearing on the arch will be compensated for automatically.

It is a further object of my invention to provide an improved furnace roof-jack of the character described which can be fastened to the hold-down beams in a manner which will permit easy adjustment along the beam due to misalignment or other reasons.

These and other objects will become more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a cross sectional view of an open hearth furnace having the roof-jacks of my invention installed thereon;

FIGURE 2 is an enlarged elevational view of the roof-jack of the invention;

FIGURE 3 is a vertical sectional view of the roof-jack of the invention; and

FIGURE 4 is a partial elevational view turned 90° from FIGURE 2.

Referring more particularly to the drawings, reference numeral 2 designates, generally, an open hearth furnace having a refractory front wall 4, back wall 6, bottom 8, and an arched refractory roof 10 supported by skewbacks 12 in the front and back wall. The refractory walls and bottom of the furnace are supported by a steel frame-

work 14 which includes an upper portion consisting of beams 16 extending transversely above the roof 10. A series of hold-down beams 18 are disposed in spaced parallel relation on the arched roof 10 extending lengthwise thereof. At least one roof-jack of the invention, indicated generally by reference numeral 20, is interposed between each hold-down beam and the upper portion of the framework 14.1

As best shown in FIGURE 3, the roof-jack 20 of the invention includes an extensible post portion made up of lower and upper hollow cylinders 22 and 24, respectively, disposed in vertical alignment. The adjacent ends of the cylinders 22 and 24 are externally threaded and are adjustably joined by means of a coupling 26. A plate 28 is welded or otherwise rigidly secured across the bottom end of lower cylinder 22.

A sleeve 30 is telescoped on the upper end of cylinder 24 and is provided with an internal collar 32 welded or otherwise securely fastened in its upper end. A bolt 34 is disposed with its head welded in the upper end of the cylinder 24 and its shaft extending upwardly through the sleeve 30 and projecting outwardly thereof. A helical compression spring 36 is circumferentially disposed around the shaft of bolt 34 in the sleeve 30 with one end thereof bearing against the upper end of cylinder 24 and its other end bearing against the collar 32. The projecting end of the shaft of the bolt 34 is threaded and has a nut 38 adjustably threaded thereon bearing against the collar 32. The spring 36 and sleeve 30 thus constitute a spring cushion which may be adjusted to the desired degree of tension to resiliently maintain the sleeve in telescoping relation with the extensible post formed by the cylinders 22 and 24 and the coupling 26.

A predetermined initial compression is created in the jack 20 by adjusting the position of the nut 38 while upper cylinder 24 is restrained from turning. Length adjustment of the extensible post portion is achieved by rotating cylinder 22 or cylinder 24, or both cylinders, while coupling 26 is restrained from turning.

Two pairs of clips 40 are used to attach the base 28 of the jack to one of the hold-down beams 18, as shown in FIGURES 2, 3 and 4. Each of the clips 40 is formed with an upright portion 42 and a hook portion 44 which engages the upper flange of the hold-down beam and the base plate 28, as best shown in FIGURE 4. The upright portions 42 of each pair of clips 40 are provided with aligned holes for accommodating a bolt 48 which is secured by a nut 50 and serves to lock the clips 40 in engagement with the plate 28 and the flanges of the hold-down beam 18.

Before installation, the jack 20 of the invention is assembled by threading the cylinders 22 and 24 into opposite ends of the coupling 26. The sleeve 30 containing the helical spring 36 is telescoped over the free end of the upper cylinder 24 so that the spring surrounds the shaft of the bolt 34, which was previously affixed in the upper end of the cylinder 24 as described above. The end of the bolt shaft passes through the collar 32 which is welded on the inside of the sleeve 30. The nut 38 is then threaded on the projecting end of the shaft of the bolt 34 to maintain the sleeve on the cylinder 24. The sleeve 30 is then welded adjacent its upper end to the web of one of the beams 16 in the upper part of the framework 14. Then, while the coupling 26 is held under restraint the lower cylinder 22 is threaded outwardly of the coupling until the plate 28 on the bottom of the cylinder rests on the upper surface of one of the hold-down beams 18. If desired, a hole 52 may be provided through the body of each of the cylinders 22 and 24 adjacent the adjoining ends thereof. The holes 52 in each cylinder are located at a distance away from the end of the cylinder which is equal to the minimum threaded engagement desired with the coupling 26 so that disengagement of the cylinders and coupling can be easily avoided.

After the bottom of the cylinder 22 is placed on the

hold-down beam, clips 40 are affixed to the plate 28 on opposite sides of the cylinder in engagement with the flange of the hold-down beam so as to secure the jack to the hold-down beam. After the jack has thus been secured to the hold-down beam, the nut 38 is adjusted to compress the spring 36 sufficiently so that the jack is under compression between the upper framework 14 and the hold-down beam.

Each of the jacks can be individually adjusted to meet various conditions of arch size, expected thermal expansion of the roof arch, and the "growth" characteristics of the refractory brick making up the roof arch. Then, as the roof arch thickness decreases and as the refractory roof material "grows," the increasing deflection of the helical spring 36 in each of the jacks will automatically compensate for the loss in dead weight of the arch material, thereby helping the roof arch to maintain its strength. The cylinders 22 and 24 and their threaded engagement with the coupling permits minute length adjustment of each jack. The ease with which the lower cylinder 22 can be removed from the jack and the easily removable clip arrangement connecting the jack to the hold-down beam facilitates the replacement of hold-down beams when it is necessary to rebuild the furnace roof. The use of the removable clips 40 to secure the base of the jack to the hold-down beam also permits some variation in the positioning of the jack along the length of the hold-down beam.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. The combination with an arched furnace roof and an overhead structural framework extending transversely thereabove, of a plurality of jacks connected to said framework and bearing downwardly on said roof, each jack comprising an extensible post and a pre-loaded spring cushion aligned with the post, each of said jacks being disposed in substantially upright position between said overhead framework and said roof whereby said pre-loaded spring cushions exert force pressing down on said roof from said overhead framework.

2. The combination defined by claim 1 characterized by each of said extensible posts comprising a pair of elongated hollow cylinders disposed in longitudinal alignment with their adjacent ends adjustably threaded into opposite ends of a coupling whereby said cylinders can be moved axially toward and away from each other.

3. The combination defined by claim 1 characterized by said cushion including a sleeve telescoped on said extensible post and projecting coaxial therewith, and spring means in said sleeve resiliently maintaining said sleeve in telescoping relation with said post.

4. In an open hearth furnace having an arched roof, a plurality of spaced beams extending along said roof, and a structural framework extending transversely above said roof, the improvement therewith of a plurality of roof jacks connected to said framework and bearing against said beams, each of said roof jacks comprising a pair of upper and lower elongated hollow cylinders disposed in longitudinal alignment between one of said beams and said framework with their adjacent ends adjustably threaded into opposite ends of a coupling whereby said cylinders can be moved axially toward and away from each other, a sleeve telescoped on the free end of the upper cylinder and projecting coaxial therewith, a shaft having a threaded end disposed concentrically in said sleeve with its threaded end projecting outwardly of said sleeve and its other end anchored in the upper end of the upper cylinder, an internal collar rigidly disposed in the upper end of said sleeve surrounding said shaft, a helical compression spring circumferentially disposed around said shaft in said sleeve with one end bearing against the upper end of the upper cylinder and its other

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end bearing against said collar, a nut adjustably threaded on the projecting end of said shaft and bearing against said collar to thereby resiliently maintain said sleeve in telescoping relation with the upper cylinder, said sleeve being rigidly fastened to said framework adjacent its upper end, and means removably connecting the lower cylinder to said one of said beams.

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