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BASIC OXYGEN STEELMAKING VESSELS

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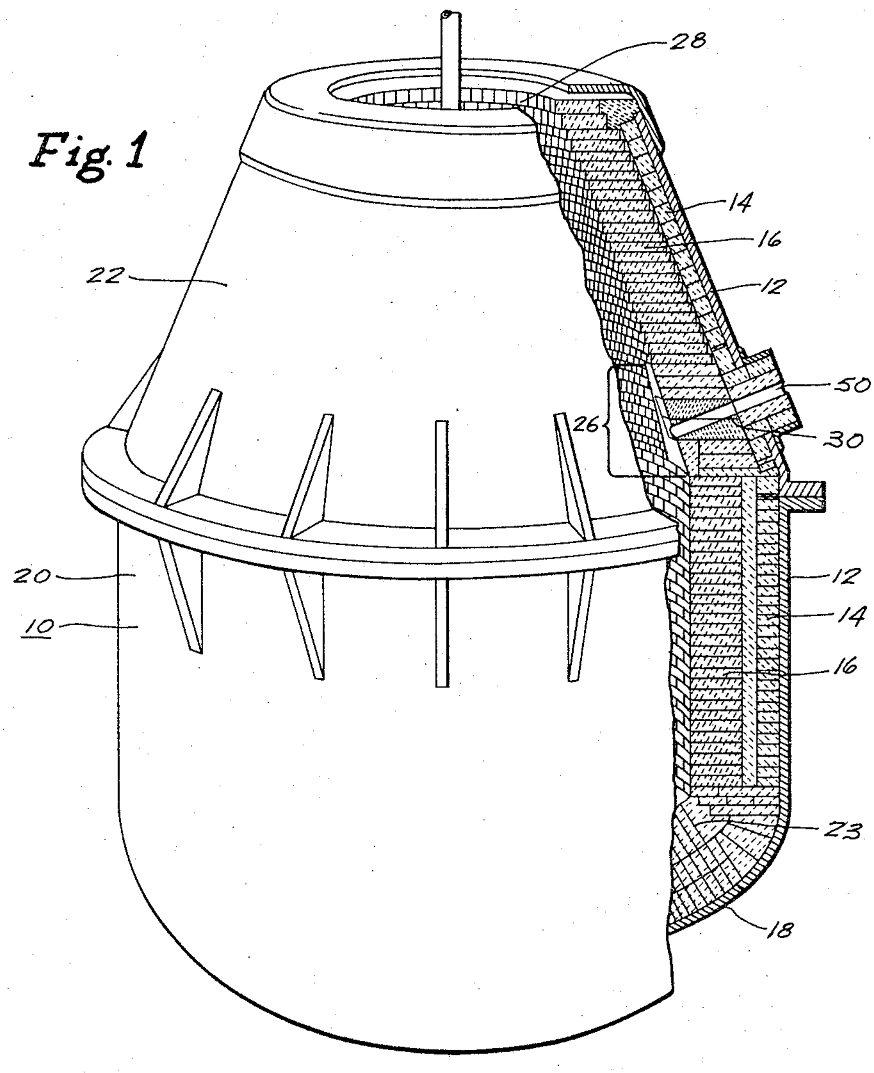
Fig. 1



INVENTOR
ALFRED E. FINN
BY William C. Healm
ATTORNEY

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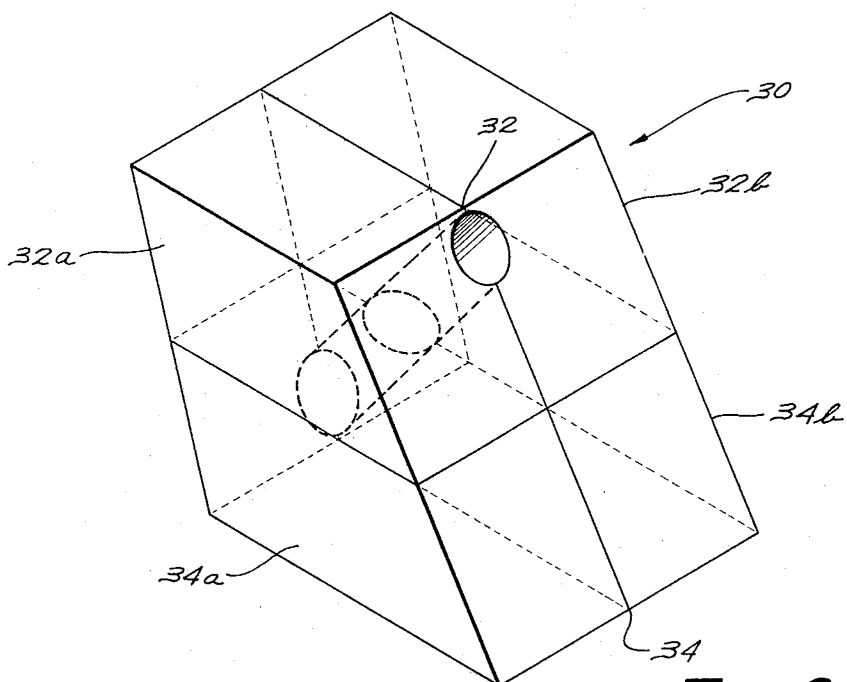

Fig. 2

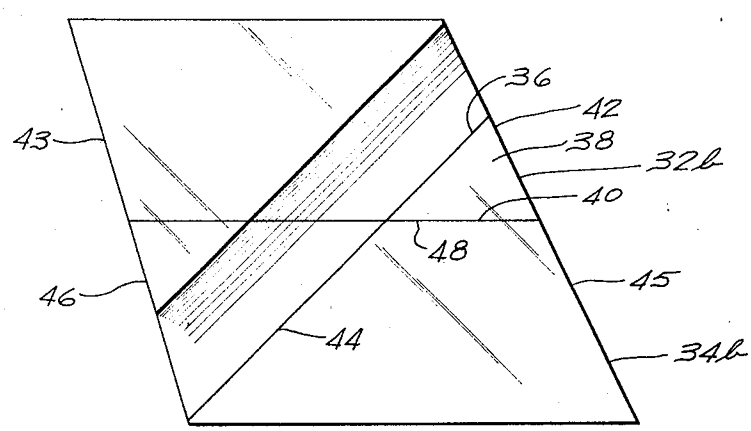

Fig. 3

INVENTOR.
ALFRED E. FINN
BY William C. Nealon
ATTORNEY

United States Patent Office

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BASIC OXYGEN STEELMAKING VESSELS

Alfred E. Finn, Pittsburgh, Pa., assignor to Harbison-Walker Refractories Company, Pittsburgh, Pa., a corporation of Pennsylvania

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The present invention relates to basic oxygen steelmaking vessels and more particularly, to prefabricated, highly refractory tapholes for such vessels.

It has been standard practice in the steel industry to form basic oxygen furnace tapholes from dead burned magnesite refractories having a high MgO content, since magnesite is one of the best basic refractories known for contact with molten metal in basic steelmaking furnaces, and for resisting the high temperatures and chemical attack which occur in the operation of such furnaces.

Heretofore, basic oxygen furnace tapholes have been formed in a variety of ways. One such mode of installation was by ramming successive layers of magnesite grain about a steel pipe passing through the taphole opening in the furnace shell and opening into the furnace chamber until the taphole area was completely filled with the refractory. However, owing to the structure and location of the tapholes, it was found difficult to ram all of the interstices or crevices in the taphole area and to obtain high densities thereby. The same difficulties were encountered in completely vibration casting the taphole area. There will be noted subsequently from the drawings that the taphole area, if located in the cone section of the furnace, as in the basic oxygen furnace, is not an ideal place to endeavor a vibration cast taphole. Another objection to the above method is that vibration casting mixes typically contain between 7 and 8% of water, and the water must be removed during burnin. This requires higher temperatures and a relatively long burn-in schedule which extends the down-time of the vessel. It is important that the refractory employed for the taphole and the technique used to install it be compatible with the burn-in schedule of the refractory lining of the basic oxygen furnace since it comprises the bulk of the furnace.

Accordingly, there has been a long existing need in the art for reducing the time required to install a basic oxygen furnace taphole; for eliminating the lack of uniformity inherent in rammed and vibration cast tapholes; and for significantly reducing the maintenance and repair costs and furnace down-time involved for delays in taphole area repairs in the operation of the basic oxygen furnaces.

Therefore, it is an object of the present invention to provide a novel, integral, uniform, dense, highly refractory taphole in a basic oxygen furnace which substantially reduces the time heretofore required for installing or replacing basic oxygen furnace tapholes.

Another object of the invention is to provide a prefabricated, highly refractory taphole in a basic oxygen furnace which is compatible with the burnin schedule of the refractory lining in the remainder of the furnace.

Other objects of the invention will be apparent hereinafter.

In the drawings:

FIG. 1 is a perspective view, partly broken away, of a basic oxygen furnace, particularly showing the taphole side of the furnace;

FIG. 2 is a perspective view of a prefabricated taphole for use in basic oxygen furnaces, according to the present invention; and,

FIG. 3 is an elevation view of shapes used in fabricating tapholes.

In accordance with the present invention, there is provided a prefabricated taphole assembly in the cone section zone of basic oxygen converter vessels of the type having a generally circular barrel zone and a downwardly opening truncated cone section zone. The assembly is composed of a plurality of mated pairs of refractory brick shapes. The individual brick and each pair have generally face, side, and end surfaces. Each brick contains a groove in a face surface thereof which intersects at least two of the other surfaces. Each pair of brick defines a portion of an inclined taphole. The pairs are arranged one over the other to provide a continuous inclined taphole extending through the brick assembly.

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Referring to FIG. 1, there is shown a basic oxygen furnace **10** consisting of an outer metal shell **12**, a shell protective brick lining **14** in contact with the inside surface of the shell and a brick working lining **16**. The vessel is constructed of three major zones, the bottom zone **18**, the barrel zone **20**, and the cone section **22**. The bottom zone is dish shaped and of upwardly opening concave configuration. The brick **23** in the bottom zone terminate at the barrel zone **20** with their face surfaces inclined from the bottom upwardly to the cone section zone. The working lining brick **14** in both the barrel and the cone section zones are disposed so that their face surfaces are in the horizontal plane. The cone section zone, having a taphole area **26**, extends upwardly and terminates in the form of a mouth **28** at the top of the vessel. The cone section zone is of downwardly opening truncated cross-sectional configuration.

Disposed in the taphole area of the vessel is a taphole assembly **30** according to the present invention (best shown in FIG. 2). The taphole assembly **30** is composed of two mated pairs **32** and **34** of refractory brick shapes. The individual brick in each pair contain generally face, side and end surfaces.

Referring to FIG. 3, there is shown the righthand sided brick **32*b*** and **34*b*** of the taphole assembly shown in FIG. 2. The brick **32*b*** contains a groove **36** in the face surface **38** thereof. The groove intersects the end surface **40** and the side surface **42**. The brick **34*b*** contains a groove **44** that intersects the end surface **46** and the side surface **48**. The angle of the groove formed through both brick is dependent on the inclination of the taphole opening. Thus, if the angle of the groove with respect to the horizontal were of greater value than that shown, the grooves could intersect three surfaces of each of the brick **32*b*** and **34*b***. The end surfaces **42, 43, 45** and **46**, are unidirectionally inclined to the side surfaces of the respective brick **32*b*** and **34*b*** to conform in contour to the truncated cone section zone. Each of the brick could be of a true parallelogram cross-sectional configuration depending upon the bias of the cone section zone.

The other brick **32*a*** and **34*a*** of each mated pair **32** and **34** are of similar configuration. Actually, when placed together as shown in FIG. 2 the pairs of brick are "mirror images" of each other, so that each pair of brick define a portion of the inclined taphole. The pairs **32** and **34** are arranged one over the other to provide a continuous inclined taphole extending through the taphole assembly.

While FIG. 2 shows that there are two pair of refractory brick stacked one on top of the other, other pairs could conceivably be stacked on top of the pairs shown, if the inclination of the taphole is somewhat greater than that shown in FIG. **1**.

In practice, the taphole assembly of the present invention can be placed in the basic oxygen vessel shown in FIG. 1, readily and with a minimum of labor. Each of the mating faces of the refractory brick **32*a*, 32*b*, 34*a***, and **34*b*** may be dipped in a mortar slurry, if desired, before assembly thereof. After the brick in the barrel zone are stacked up to the cone section zone and the taphole opening, the taphole assembly is merely laid and mortared to the terminal brick in the barrel zone or separated with a minimum amount of rammed fill so that the continuous inclined taphole is in alignment with the taphole opening **50** through the furnace shell. Then the cone section zone, in the taphole area, is laid in the normal manner.

As shown in FIG. 1, the inclined end surfaces of the brick are contiguous with the shell protective lining. The remainder of the taphole opening may be readily fabricated by inserting a pipe in alignment with the prefabricated inclined taphole and then filling around the pipe with a monolithic refractory material from exterior the furnace.

Further, the taphole opening in the mated pairs **32** may be provided with a female socket which extends from the cold face thereof. The extending socket is secured to one end of the pipe to insure continuous alignment and connection therewith.

The individual brick of the taphole assembly could be composed of highly refractory, dead burned magnesite processed to high densities as are the remainder of the brick lining the vessel; so that the burnin schedule of the taphole would be similar to the burnin schedule of the remainder of the lining and the problems heretofore encountered with differently fabricated tapholes would not occur. However, it is not intended that the taphole construction of present invention be limited to magnesite shapes. Other basic refractories conventionally used in the basic oxygen furnace are suitable.

While the invention has been described with reference to basic oxygen steelmaking vessels, it should not be limited thereto, as the prefabricated taphole assembly of the type shown could be utilized with other vessels requiring an inclined taphole.

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.

I claim:

1. In metallurgical vessels of the type having an outer metal shell, a refractory lining in contact with the interior of the shell and an inclined taphole opening passing through the metal shell, the improvement comprising a prefabricated taphole assembly opening into said taphole opening composed of a plurality of mated pairs of refrac-

tory brick having generally face, side and end surfaces, each brick in each of said pairs containing a groove in a face surface thereof, said groove extending entirely across the face surface in which it is formed and intersecting an adjacent side and end surface which side and end surface intersect to form a common edge, both brick in each pair being arranged so that the respective groove containing face surfaces are in contiguous contact with each other with said respective groove containing faces cooperating to define an open ended passage which forms a portion of an inclined taphole, a said pair of brick being arranged with its side surfaces in contiguous contact with an adjacent pair along a vertical axis of the vessel with respective open ended passages aligned to provide an open ended continuous inclined taphole, with respect to said vertical axis, extending through the brick assembly.

2. The vessel of claim **1** in which the taphole assembly consists of two pairs of refractory brick shapes.

3. The vessel of claim **1** in which the end surfaces of the individual brick in the taphole assembly are unidirectionally inclined to the side surfaces thereof.

4. The vessels of claim **1** in which each of the brick shapes is a parallelogram in cross-section but having sloped ends and in which each brick shape of each mated pair is a mirror image of the other.

5. The vessel of claim **1** in which the metallurgical vessel is a basic oxygen converter of the type having a generally circular open topped barrel zone and a downwardly opening truncated cone section zone superposed thereover and said taphole assembly opens into the cone section zone.

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JOHN F. CAMPBELL, *Primary Examiner.*

J. M. ROMANCHIK, *Assistant Examiner.*