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METALLURGICAL FURNACE

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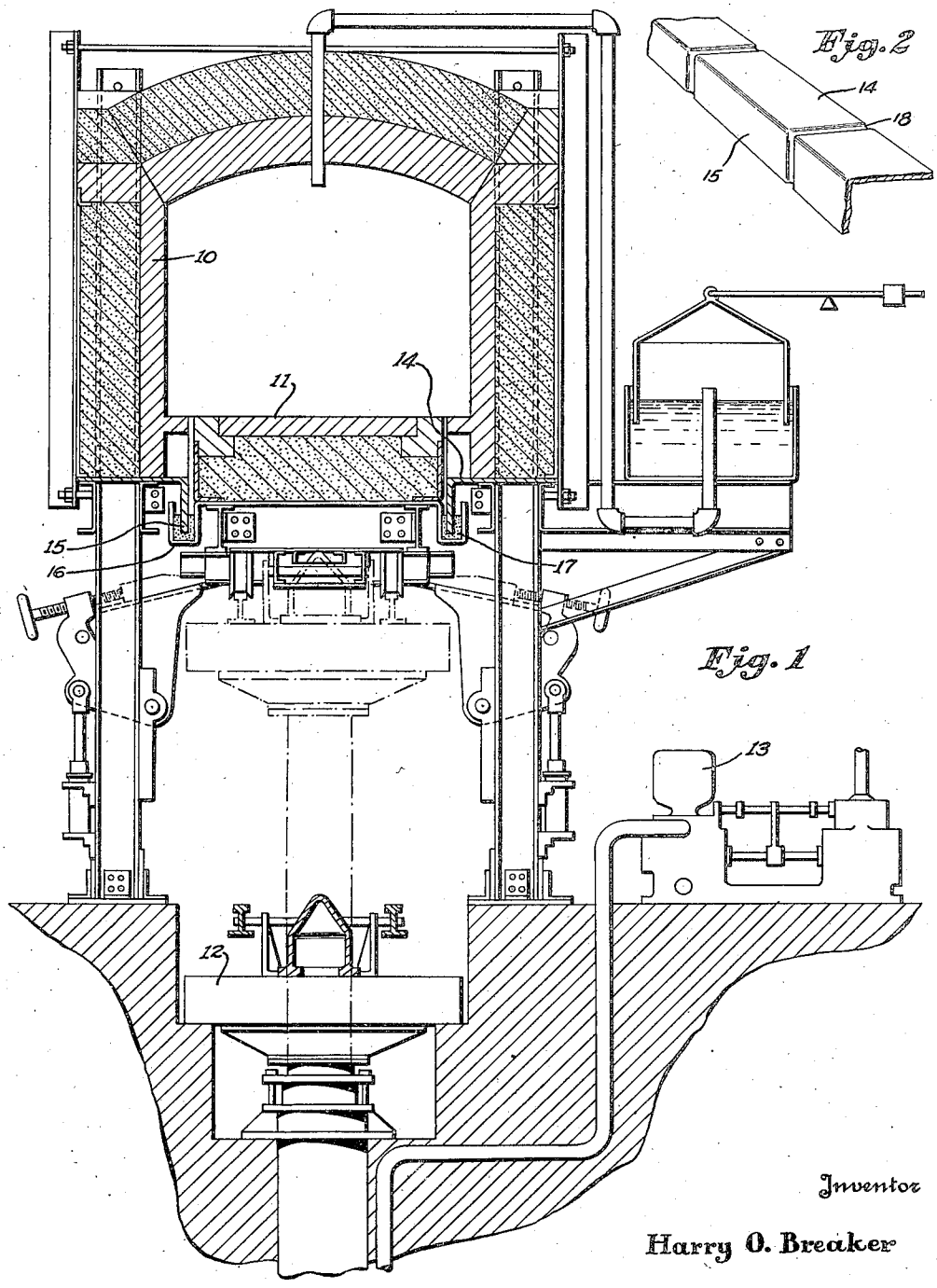


Fig. 1

Fig. 2

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METALLURGICAL FURNACE

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4 Claims. (Cl. 263—28)

This invention relates to metallurgical furnaces and it has particular reference to the provision of means for providing an air or gas tight removable joint for such devices.

In my prior patents, Nos. 1,636,041 and 1,694,964, I have disclosed furnace constructions in which an electrically heated furnace is provided with a vertically movable bottom wall to permit of the insertion and withdrawal of the charge. The fixed body of the furnace is formed with a straight knife-edge angle member adapted to fit in a cupped or channel member secured to the movable bottom, which cup or channel is filled with sand, the two members thereby providing a seal or joint preventing undue leakage of air or gas into or out of the furnace.

In the application of this apparatus to certain metallurgical operations, such as the heat treatment of white cast iron, it has recently been discovered that the seal or joint set forth in the stated patents permitted small amounts of gas to leak out of the furnace, or air to leak in. While these leakages were numerically of low value, they were, in some instances, sufficient to interfere with the desired constancy of operation in the process for which the furnace was immediately intended. Part of this leakage has been attributed to the character of the loose material in the channel member, and part to the characteristics of more rigid portions of the furnace. It has been discovered, for example, that sand is somewhat permeable to air or carbon monoxide, and that the straight knife-edged members would warp when subjected to the temperatures employed. These two factors conjointly resulted in the stated leakage through the sand seal.

The present invention contemplates means for overcoming this leakage. I have discovered that other materials may be used in place of sand, which are much less pervious to gas filtration, and I have also discovered that distortion of the straight knife-edged member may be compensated for, and so am enabled to overcome the effects of high temperature operation.

More particularly, I compensate for distortions at high temperatures by forming the knife-edged member with transverse spaced corrugations, and I utilize powdered iron oxide or equivalent substance as the material in the channel member.

In the drawing:

Fig. 1 is a vertical cross-sectional view of a typical furnace construction; and

Fig. 2 is a fragmentary perspective view of the knife-edged member.

The furnace of Fig. 1 is similar in construction and principle to that shown in my stated prior patents. The main body of the furnace 10 comprises a five-sided box, with a removable bottom 11, which is elevated or dropped by means of a hydraulic operated piston head 12, operated by means of a suitable pump 13. Disposed around the bottom edges of the furnace 10 is an angle member 14 formed with a downwardly depending flange 15, which is adapted, (when the furnace bottom is elevated), to enter into the cup formed by the channel member 16, secured to the removable bottom 11. It may here be assumed that the furnace is formed in such fashion as to provide sealed joints, except for the space between the flange 15 and the cup 16. To seal this space, the cup 16 is filled with finely divided material into which the knife 15 penetrates, as indicated by the numeral 17.

I have found that, when the furnace is operated at high temperatures, there is a tendency for a straight knife edge fitting into the cup 16 to warp or become distorted, thereby opening up cracks in and through the powdered sealing material and permitting gas leakage. I have found that this warping may be overcome by corrugating the angle member 14, as illustrated in Fig. 2. As here shown, the angle 14 is transversely corrugated at a number of places along its length, with the result that, as the angle and knife edge expand or contract under the changes of temperature, the motion is practically all longitudinal, and the distortion of the knife edge 15, to a point permitting of gas leakage, is practically eliminated.

For the sealing material 17, I have found that the following attributes are desirable. The material should be inert; unaffected to a practical extent by the temperature employed; should be of relatively high specific gravity, (five or greater); should be non-adsorbent; should be of an amorphous character rather than markedly crystalline; should, in the powdered condition, pack readily; and it should be adherent in nature. With respect to sand, or finely divided silica, I find that a certain amount of gas leakage may obtain, which is possibly due to the crystalline nature of the material. The material is also low in its adhering properties.

I have further made the rather surprising discovery that finely divided iron oxide or red oxide of iron, and other metallic oxides, satisfy the desired criteria, and are quite impervious to gases. To indicate the relative values of sand and iron oxide, I may refer to the following tests.

The time was measured for 100 c. c. of gas to filter through the seal, and it was found that only two minutes were required with a sand seal, with no gas and air pressure differential, but that eight and a half minutes were required when iron oxide was used and a pressure differential of four inches of water was created within the furnace. That is to say, iron oxide has over four times the resistance of sand to gas filtration. Fifty c. c. of sand were allowed to run through a funnel having a one-eighth of an inch orifice, and it was found that the time was twenty-one seconds. Iron ore would not pass through at all, as it caked in the tube, and this effect was observed even when a funnel having a one-half inch orifice was used. Manganese oxide behaves in similar fashion, packing in the funnel, and offering a filtration resistance of six and one-half minutes. Cobalt oxide also is highly resistant. These powdered ores pack and adhere satisfactorily when employed in particle sizes between forty and eighty mesh. The expression "particle sizes between forty and eighty mesh" will be understood to refer to the common methods of screening powdered materials. That is to say, powdered material having particles of varying size, all of which passes a forty mesh screen, is deemed forty mesh material, and if all the material will pass an eighty mesh screen, the powdered substance may be specified as eighty mesh. It will be understood, however, that such materials include a large percentage of particles which are much smaller than the average screen openings, but the nature of the pulverizing process is such as to give a product which is suited for commercial work if all the material will pass through such screens.

I find that magnesium oxide is too light for practical work, while zinc oxide has low adherence and also adsorbs large amounts of gas, having a filtration resistance of less than three minutes.

It is not known why iron oxide and like metallic oxides show these properties, as it would be presupposed that the ore would react with carbon monoxide in the furnace gases. I do not find, however, that such reaction takes place, or, if it does, the extent of the reaction is so small as to be negligible. It may be that the furnace gases enter into a reaction with the outer layers of powdered particles, but, due to the poor adsorption, the progress of the reaction is checked. Whatever may be the ultimate scientific explanation, the facts are as noted.

In employing these improvements in a furnace wherein white cast iron was being malleabilized, I have found that the gas or air leakage is so slight as to cause no interference with the control of the heat treatment. This has made possible the application of the apparatus to certain processes, in which gas control, constancy, and pressure operation play an important part, and has also enhanced the efficiency of the furnace in operations with various other kinds of work. It will, of course, be understood that the improvements herein set forth may be adapted to furnaces other than that specifically referred to, and that the specific reference to iron oxide in the following claims is to be taken as a generic expression and to include all proper equivalents, such as manganese oxide, cobalt oxide, and like metallic oxides which, in finely divided form, are effective in applying the principles herein set forth.

I claim:—

1. The method of preventing the interchange of furnace gases with the atmosphere which comprises positioning a layer of iron oxide of average particle size less than forty and eighty mesh between said gases and the atmosphere.

2. A furnace having a fixed portion including side, top and end walls, a movable bottom wall, channel members and knife members secured to the side, end, to bottom walls and adapted to engage each other in telescopic relationship when the furnace is closed, and powdered iron oxide in said channel members and forming a seal between the channel members and the knife members.

3. A furnace seal comprising relatively movable channel members and knife members adapted to be disposed within the channel members and spaced from the walls thereof when the seal is established, wherein iron oxide is positioned in said channel members to cover the edge of said knife member, and said knife member is transversely corrugated.

4. The method of preventing the interchange of furnace gases with the atmosphere which comprises positioning a layer of powdered iron oxide between said gases and the atmosphere, said iron oxide being pulverized to such extent that substantially all of the particles will pass screens of sizes between forty and eighty mesh.

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