Jan. 20, 1942. J. WALLERIUS 2,270,484

SELF-SEALING DOOR FOR FURNACES

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Fig. 1

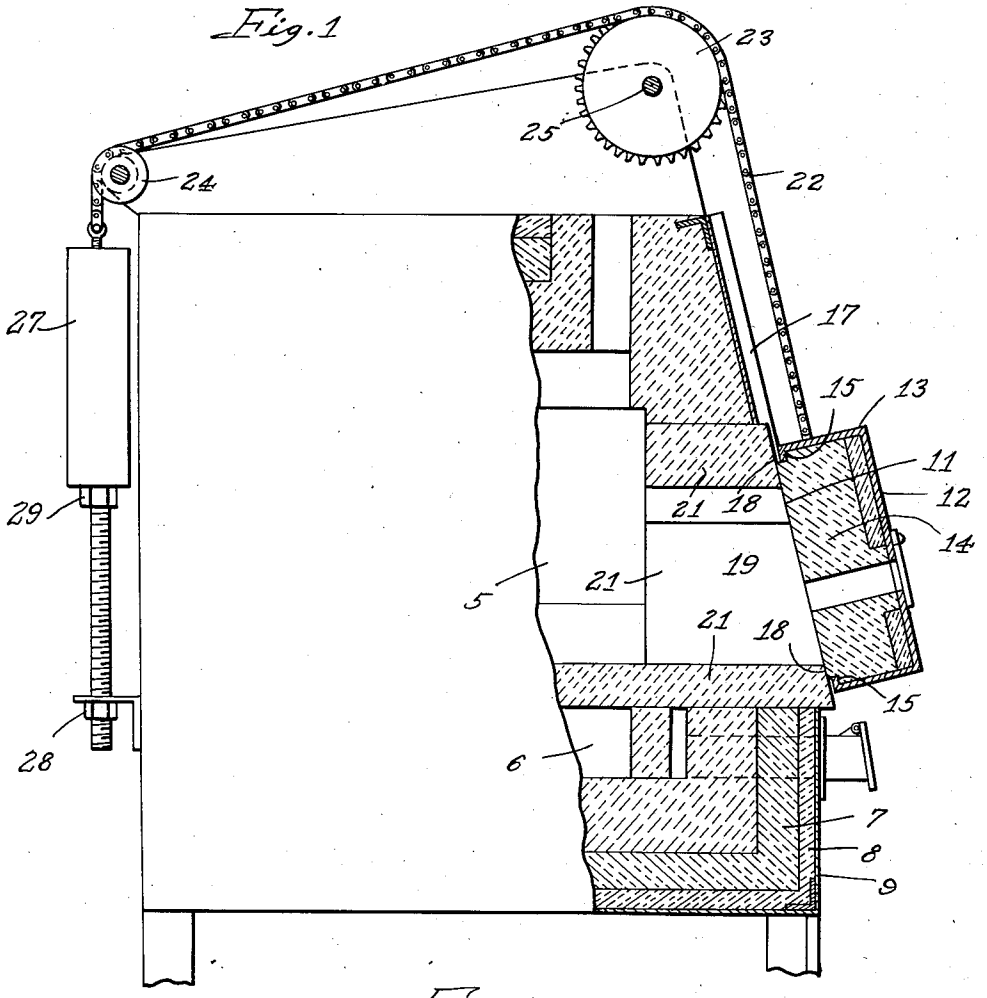
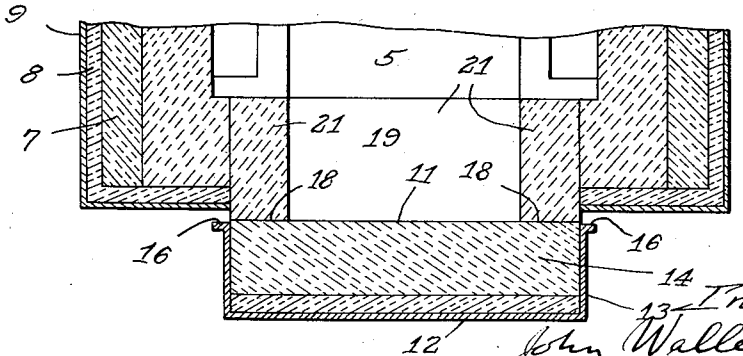


Fig. 3



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Fig. 2

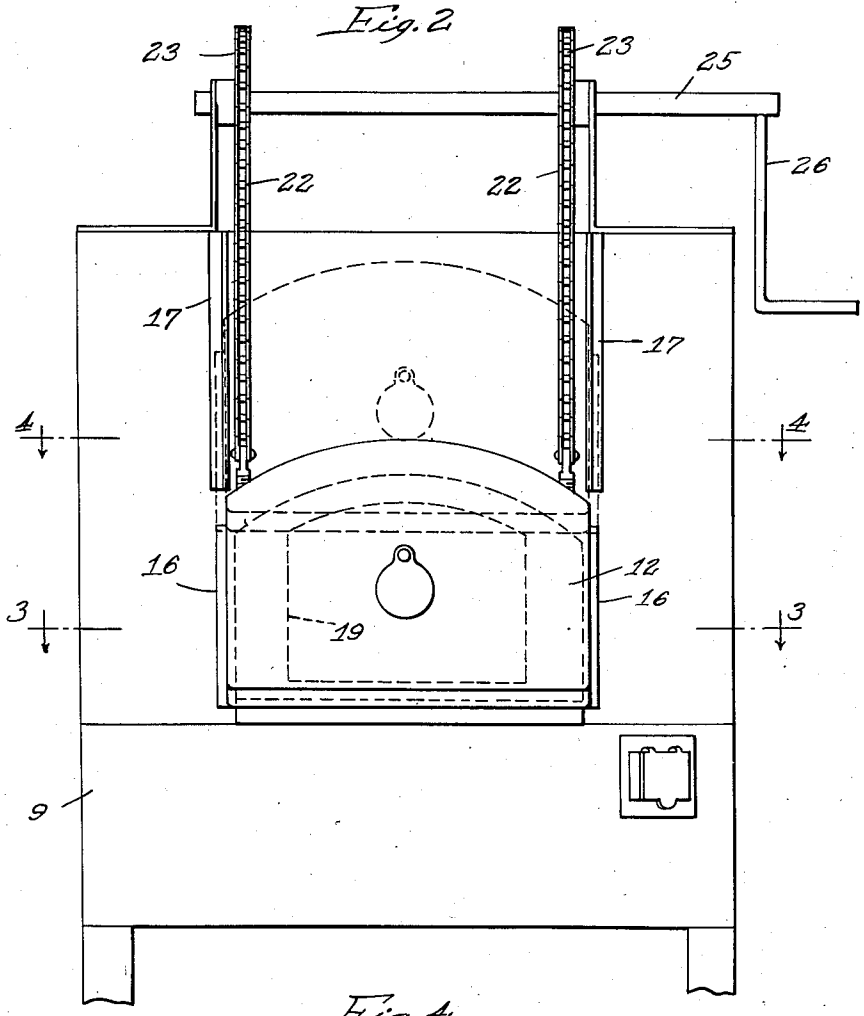
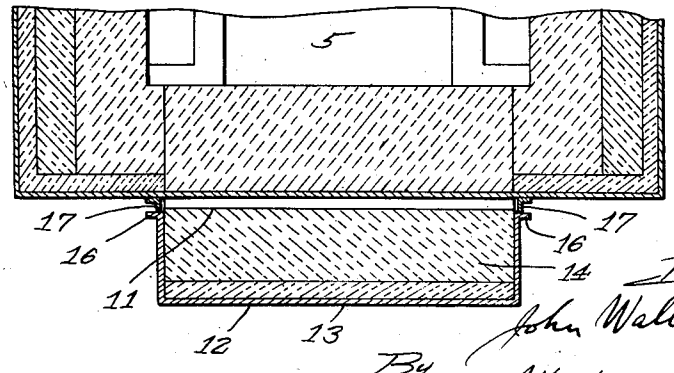


Fig. 4



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UNITED STATES PATENT OFFICE

2,270,484

SELF-SEALING DOOR FOR FURNACES

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Application February 19, 1940, Serial No. 319,676

1 Claim. (Cl. 110—173)

This invention relates to furnaces of the type adapted for hardening, annealing, normalizing, and drawing or tempering operations, and has more particular reference to the problem of maintaining a predetermined atmosphere inside the heating chamber.

For example, in the use of muffle type furnaces as well as furnaces for high speed steel hardening, brazing, annealing and carburizing operations, it is important to maintain a predetermined atmosphere inside the heating chamber or oven having certain percentages of carbon dioxide, carbon monoxide, hydrogen and nitrogen. Every effort is made to prevent oxidation of the metal and obviously any infiltration of air is inimical to satisfactory operation. Now, in order to maintain the desired percentage relations between these gases, not only when the furnace is new, but during a normal operating period or until the furnace lining has to be replaced, it is essential to prevent infiltration of air into the heating chamber. Various means and instrumentalities have been provided toward this end. Usually special efforts are directed toward sealing the door opening and in new furnaces of conventional design the door opening can be sealed more or less efficiently by the use of cams or other mechanical devices, but after operations over a comparatively short period at high heats the expansion and contraction of the brickwork and the metal parts seriously affects the structure and makes it impossible to maintain a tight seal.

A principal object of my invention is to provide a door structure for furnaces of the type described which will be inherently self-sealing and which will maintain a good seal over a comparatively long period of use. I have also aimed to provide a structure for this purpose without the use of cams, mechanical devices or extraneous means. To this end my invention contemplates constructing both the face of the oven opening and the complemental face of the door, of refractory material such for example as firebrick, so that there is intimate contact between the two faces of such character as to maintain a most effective seal. I have further aimed to arrange the sealing surfaces in a plane inclined upwardly and backwardly with the result that the door normally gravitates to a sealing position and its weight is a function in maintaining a good seal. I have also aimed to slide the door back and forth on its refractory sealing surface so that it actually has a wearing-in effect which further serves to maintain the desired self-sealing result.

Another object is to provide a furnace structure of the character described which will be economical to manufacture and will satisfactorily serve the purposes intended.

Other objects and tentative advantages will be appreciated by those skilled in the art as the invention becomes better understood by reference to the following description when considered in connection with the accompanying drawings, in which

Figure 1 is a side elevation partly in vertical section of a semi-muffle type furnace embodying my invention;

Fig. 2 is a front elevation of the furnace;

Fig. 3 is a section substantially on the line 3—3 of Fig. 2; and

Fig. 4 is a section on line 4—4 at a higher elevation on Fig. 2 with the door in a raised position.

As stated, my invention is adapted for application to furnaces of the type in which it is desired to maintain a predetermined atmospheric condition in the heating chamber and particularly for the prevention of oxidation of the work pieces, whether the operations be hardening, annealing, normalizing, tempering, or the like. A good example of my invention is, therefore, in its application to furnaces of the muffle type and I have here shown in the drawings what is known as a semi-muffle furnace adapted to be fired by either gas or oil. The heating chamber 5 is formed by walls of suitable refractory material such as firebrick. In this instance the combustion chamber is at 6 and the heated gases pass into the chamber 5 through suitable passages such as vertical passages 6' located at the sides of the chamber 5, as shown in Fig. 3. The fuel burners are not shown for the reason that they form no part of the present invention and any suitable means may be provided for this purpose, as is well known in the art. The remainder of the furnace structure except the door structure and its mounting may be conventional according to the particular purpose of the furnace or the kind of work to be performed. In the furnace here shown the heating and combustion chambers are suitably encased in insulation firebrick 7, a sheet of asbestos 8 and an outside protective sheet 9 of metal, the metal structure being suitably tied together usually by riveting or welding.

According to my invention the inner face 11 of the door 12 is composed of refractory material accurately finished to provide a sealing surface in a plane. In this instance the door comprises a cast iron casing 13 which forms a housing structure for the refractory material. In actual practice in a furnace of the type here shown the refractory material 14 is firebrick, but is should be understood that other refractory materials may be used. As an illustration of the type of refractory materials, fire clay, silica, bauxite, chrome and magnesia, granular bonded materials usually termed fire clay brick, silica brick, etc., are suitable. Here, the metal casing 13 has an inturned flange 15 along the inner edge of its top and bottom walls, as shown in Fig. 1, to retain the firebrick in position and outwardly

turned flanges 16 along the inner edge of its upright side walls which serve as guides or shoes adapted to ride on complemental guide rails or tracks 17 fixed to the front of the furnace casing above the oven opening. It will be observed in Figs. 1 and 3 that the sealing face 11 of the door projects inwardly beyond the flanges 15 and 16 so that only this surface is utilized for sealing. It will also be observed that the face 18 immediately surrounding or contiguous to the oven opening 19 is composed of refractory material which may be similar to the door face 11. In this instance the face 18 is composed of firebrick which makes up the walls 21 defining the bottom, sides and top of the opening 19 to the heating chamber 5. This face 18 is also finished to provide a flat sealing surface complemental to the surface 11. In order to insure a most effective seal the door surface 11 is actually ground in against the furnace face 18 at the time of manufacture of the furnace. It will be manifest, however, that in actual operation as the door is repeatedly slid back and forth in the plane of the surfaces 11 and 18 it will, by reason of the physical characteristics of these surfaces, actually "wear-in" and thereby inherently maintain an air-tight seal.

Another feature of my invention is in the location of the surfaces 11—18 in a plane inclined upwardly and rearwardly from a vertical plane at the front of the furnace and arranging the guide rails 17 in substantially the same inclined plane. The door is now suspended so that it is free to seat under its own weight against the face 18 so that gravitation of the door is a further function in maintaining the desired seal. In this instance the door is suspended by means of chains 22 which are trained over sprocket wheels 23 and 24 at the top of the furnace. The sprocket wheels 23 are fixed to a shaft 25 which may be rotated by suitable means, either manually or by power, to raise and lower the door, in this instance the hand crank 26 being used. A counter-weight 27 is fixed to the opposite end of each sprocket chain for the purpose of counter-balancing the weight of the door. Suitable stop nuts 28 and 29 are provided for limiting the lower and upper positions respectively. By reason of this construction the heavy door may be easily raised and lowered. It will be observed that in raising and lowering the door its surface 11 slides on the surface 18, preferably at all times. Partial weight of the door as a result of the inclined mounting is, therefore, carried against the sealing surfaces in the sealing position and to a lesser degree at all elevated positions. In the upper positions the weight of the door is partially carried by the rail 17 and in these upper positions there is clearance between the face 11 of the door and the face of the furnace except where there is contact with the upper portion of the face 11.

It will be apparent from the foregoing that the structure provides an effective seal which will prevent infiltration of air into the heating chamber and that as an inherent result of this construction the seal will be effectively maintained over a long period in proportion to the useful life of the firebrick or other refractory material used for the facing. Furthermore, the structure is advantageous in all furnaces where it is desired to prevent the escape of gases or protective atmospheres. This applies particularly to furnaces used for bright annealing of fabricated steel products, copper brazing of metal parts, hydrogen brazing of jeweler's alloys and noble metals, and clean and bright hardening of low, medium and high carbon steel products. In many cases the protective atmosphere is costly to produce and must be generated outside the furnace. Some of these atmospheres are highly inflammable, even explosive in some concentrations, and some contain carbon monoxide and are injurious to health. With my invention the contacting refractory granular sealing surfaces have a wearing-in effect incidental to all of the door movements, thus serving to maintain a very effective seal. This self-sealing function is maintained at all positions of the door. The door structure prevents escape of the above mentioned gases and protective atmospheres by reason of the continuous seal and the pocket effect of the door even when it is in partially open positions sufficient for loading or access to the furnace chamber. In many cases where protective atmospheres are used only a limited door opening is needed for ordinary requirements and my invention permits of these door opening movements without appreciable escape or loss of such atmospheres. A further advantage is that this structure requires no attention on the part of the operator either to effect the seal or to maintain it. It should also be manifest that my invention in its broader aspect is not confined to the use of flat surfaces for the faces 17 and 18 since these might be complemental curved surfaces, also that the door might be moved on its sealing surface horizontally instead of vertically. The construction shown, however, is preferred because of the definite advantages inherent in this design.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and the appended claim, in which I claim:

A self-sealing door structure for a furnace of the character described, comprising a wall of refractory material formed with an opening to the chamber of the furnace, the face of said wall around said opening being finished to provide a sealing surface in a flat plane inclined upwardly and backwardly with respect to a vertical plane at the front of said opening, a door for said opening having a face of refractory material finished to provide a flat sealing surface complemental to and seating against said inclined refractory sealing surface entirely around said opening, and operable means supporting the door so that it is free to gravitate to maintain its said refractory sealing surface seated in sealing contact with said refractory sealing surface of the wall entirely around said opening, said means being operable to slide the door on the wall in opening and closing movements in said inclined plane with said refractory sealing surfaces continuously in contact in response to gravitation of the door and with said sealing surfaces constituting the sole sealing contact between the door and the wall in all said positions of the door, the sliding action of the refractory granular sealing surface of the door against the corresponding surface of the wall having a wearing-in effect serving to continuously maintain said sealing contact at all said positions of the door.

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