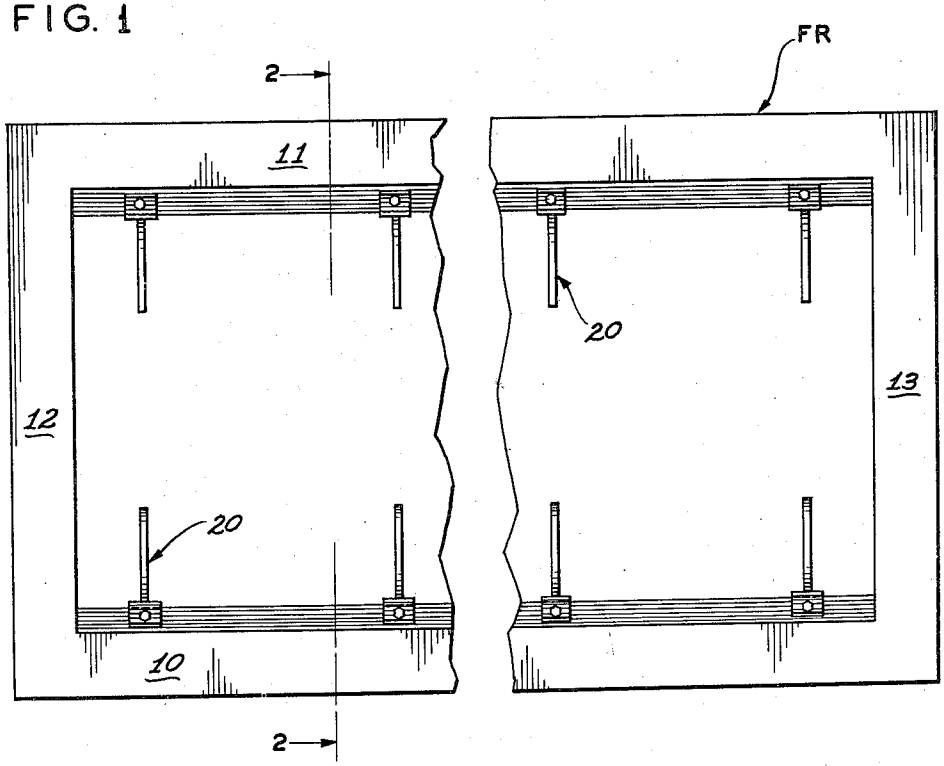
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DIVIDER PLATES FOR FURNACES

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FIG. 1



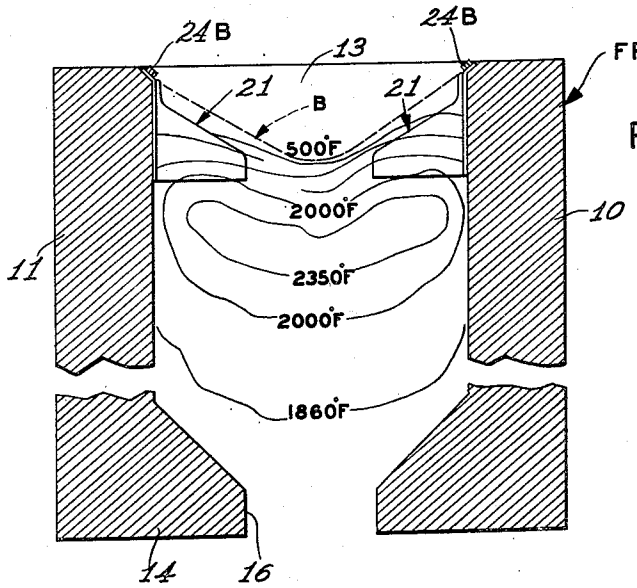


FIG. 2

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FIG. 3

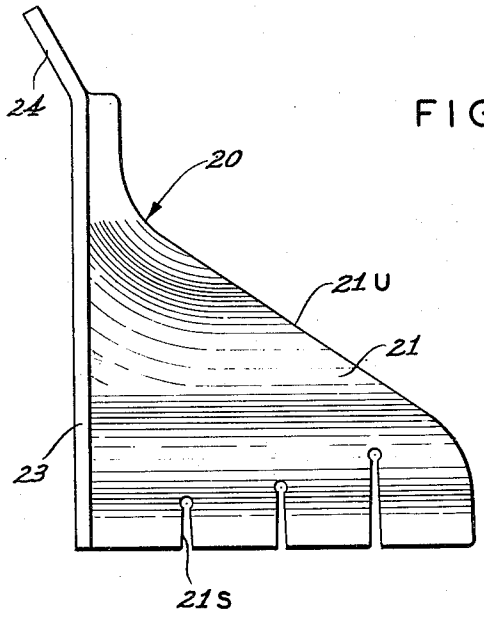


FIG. 4

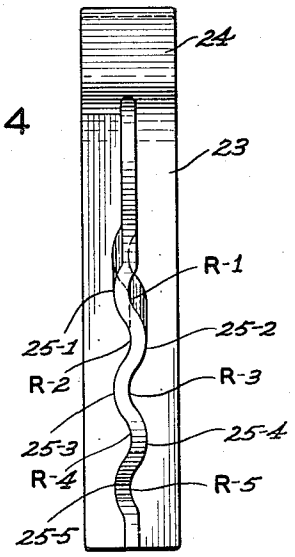


FIG. 5

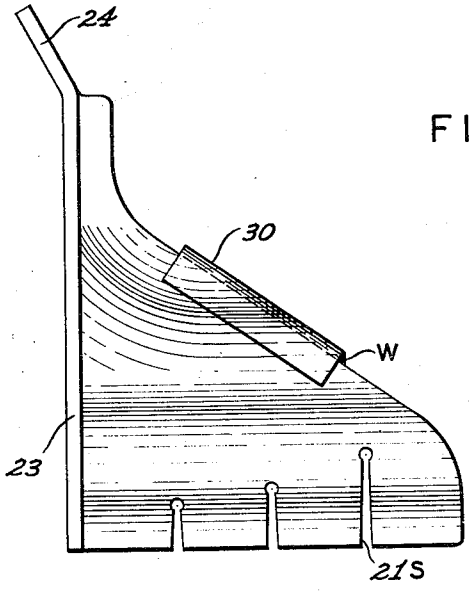
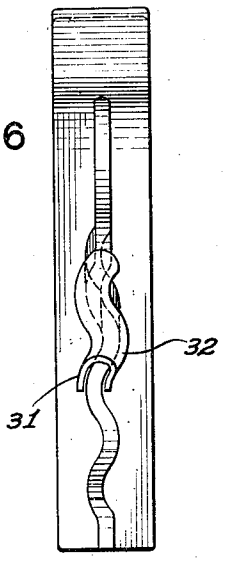


FIG. 6



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2,824,730

DIVIDER PLATES FOR FURNACES

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Application October 12, 1955, Serial No. 539,970

12 Claims. (Cl. 266—25)

This invention relates to divider plates for furnaces used to dry or sinter ore material or other metal-containing material such as pellets of iron ore or the like.

In drying or sintering metal-containing material such as iron ore pellets or the like, such is often performed in a furnace in which hot air is introduced into the furnace through tuyeres at the bottom thereof. The material to be heat treated is introduced at the top of the furnace, gradually progressing downward through the furnace, and the blast of hot air travels upwardly to produce the desired drying or sintering effect.

It is advantageous for the hot air used for heat treatment to travel freely up through the bed of the material in the furnace, but it has been found in furnaces of the foregoing kind that there is a tendency for the material to pack and form a hard crust at the top of the bed where most of the burning occurs, the resultant crust preventing the free passage of the heated air therethrough. To remedy this, it was proposed to increase the force of the hot air, but it was found that such merely resulted in a sudden rupture of the crust with a consequent loss of heat.

One of the primary objects of the present invention is to enable the top of a furnace of the foregoing kind to be equipped with divider plates on opposite sides of the furnace that tend to prevent packing of the material at the top of the furnace where most of the burning occurs and to thereby inhibit the formation of an air-tight crust. Thus, the present invention induces continuous collapsing of the material undergoing introduction into the furnace, breaking up the material as it progresses downwardly. Ancillary to this, a further object is to form the divider plates so as to effectively absorb the thermal stresses created as the result of the extreme operating temperatures within the furnace.

Because of the high thermal differential that occurs across the face of a divider plate in a furnace of the foregoing kind, it is important too that these plates be of minimum thickness in order to lessen the tendency of the plates to crack. At the same time, a divider plate of high strength is required, and a further object of the present invention is to enable these characteristics to be achieved by composing the plates of high heat-resistant alloy and corrugating the divider plate generally parallel to the isotherms of the furnace.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawing which, by way of illustration, shows preferred embodiments of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

Fig. 1 is a diagrammatic top plan view of a furnace in which the present invention may be embodied;

Fig. 2 is a sectional view taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a side elevation of a divider plate constructed in accordance with the present invention;

Fig. 4 is an end elevation of the plate shown in Fig. 3;

Fig. 5 is a side elevation similar to Fig. 3 with the upper edge of the divider plate baffled or shrouded; and

Fig. 6 is an end elevation of the modification shown in Fig. 5.

In Figs. 1 and 2 there is shown diagrammatically a furnace FR of the kind with which the present invention is concerned. The furnace FR is constructed of refractory brick and includes vertical side walls **10** and **11**, vertical end walls **12** and **13**, and a bottom wall **14**. The bottom wall **14** is provided with an opening **16** of the usual kind through which a blast of hot air is introduced into the furnace from tuyeres to produce the heat in the furnace cavity.

The material that is to be exposed to the heat is introduced at the top of the furnace, and under the present invention the side walls **10** and **11** at the upper portions thereof are provided with a plurality of inwardly directed divider plates **20** which maintain the top of the bed of the material undergoing heat treatment in a continuous collapsed, that is, loose condition so that tendency for the material to coalesce or fuse into a cake or crust is prevented. Such assures a free, uniform flow of hot air upwardly through the furnace and breaks up the material in the furnace so that the material is uniformly heat treated.

The divider plates **20** in the present instance are produced as castings, and because of the high temperatures encountered these castings consist of a heat-resistant alloy. I have found that a highly alloyed steel containing 24 percent chromium, 12 percent nickel, 0.30 percent carbon, and the remainder essentially iron gives highly satisfactory performance. This alloy is extremely strong and ductile, consistent with the mechanical and thermal stress conditions encountered in a furnace as FR. Chromium may vary from 20 to 40 percent; nickel from 10 to 20 percent; carbon from 0.20 to 0.40 percent; remainder iron.

Each divider plate **20** as thus cast includes a flange of relatively narrow width, Fig. 4, and a vertical web **23** at the rear edge of the flange. As shown in Fig. 2, the upper side edges of the furnace FR are bevelled. The plates **20** are adapted to be secured to these bevelled faces of the furnace FR, and to this end the upper portions of the webs **23** are provided with rearwardly inclined ears **24** which constitute extensions of the webs **23**.

The ears **24** are adapted to be drilled to receive fastening bolts **24B**, Fig. 2, which serve to anchor the plates **20** securely in place with the flanges **21** thereof extending inwardly of the side walls of the furnace, that is, in a normal relation compared to the side walls of the furnace.

The thermal stresses to which the plates **20** are subjected are rather severe, especially when it is considered that the heat at the lower edge of the flanges **21** may be as high as 2,000° F. under certain operating conditions, and under these same conditions the temperature at the top of the material bed just above the upper edge of the flanges **21** is at 500° F. as indicated by the isothermals in Fig. 2. It will therefore be seen that the temperature differential between the upper and lower edges of the flanges **21** is quite large, and such severe temperature conditions have resulted in short life of furnace divider plates as heretofore constructed.

Under the present invention the flanges of the divider plates are reversely corrugated, that is, the flanges **21** are sinusoidally shaped or contoured in a top to bottom direction thereby affording a series of parallel rounded ribs

25–1, 25–2, 25–3, 25–4, and 25–5, and a like or complementary series of rounded recesses or grooves R–1, R–2, R–3, R–4 and R–5, Fig. 4, that extend forwardly from the rear edges of the flanges 21, alternating on opposite sides of the flanges 21. Thus, as shown in Figs. 4 and 5, a rib is a consequent of a groove, and conversely on opposite sides of the flanges 21.

Additionally, the upper edge 21U of each flange 21 is sloped downwardly so as to be generally parallel to the downwardly sloping sides of the top of the material bed B as indicated by the dotted line in Fig. 2. Such sloping of the upper edges of the flanges 21 maintains the top of the bed relatively uniform, and it has been found that this results in optimum furnace operation.

The serpentine ribs 25–1 through 25–5 are in effect parallel to the isothermal lines within the furnace as shown in Fig. 2, and therefore, differential expansion of the plates occurs freely without danger of cracking or rupture due to a sharp change in temperature between the bottom and the top of the flange 21. Thus, said isothermal lines are of progressively increasing order proceeding from the lower to the upper edge of the flange of the divider plate, so that stated in other words the aforesaid ribs and grooves are generally parallel one to the other in the area between the opposed upper and lower edges of the flange of the divider plate and extend generally normal to the rear edge portion of the flange corresponding to the web 23 and also, of course, normal to the plane of the web 23.

It has been found that under some conditions it is advantageous to reinforce the sloped upper edge 21U of the divider plate 20, and as shown in Figs. 5 and 6 this is accomplished by a shroud or cap 30 that is generally U-shaped in section so as to afford opposite walls 31 and 32 that embrace the corresponding sides of the upper edge portion 21U of the flange 21. Thus, as shown in Fig. 6, the cap 30 is complemental to the ribs and grooves provided on either side of the flange 21 so as to neatly fit thereon. The cap 30 may be held in place by a weld W as shown in Fig. 5. In this way the flange 21 is effectively reinforced at the upper edge 21U thereof where the thermal stresses are most severe, and where there are sudden changes as when the bed level B drops. Preferably, the cap or baffle 30 is of the same alloy as the divider 20. A like cap may be advantageously attached to the lower edge of the flange 21.

Preferably, to account for longitudinal expansion that may occur between the cold end of the flange 21, that is, the end corresponding to web 23, and the hot or inner end, spaced-apart slits 21S are formed at the lower end of the flange 21, and these extend upwardly toward the medial portion of the flange.

It will be seen from the foregoing that in accordance with the present invention there is afforded a divider plate for a material handling furnace which assures that the material being fed to the furnace is broken up, thereby preventing the formation of a sinter crust or the like at the top of the bed, and such divider plates are cast to include a relatively narrow flange portion consistent with the desirability of a thin divider plate to reduce the possibilities of thermal cracking or rupture. However, the divider plate is nevertheless of high strength, thermally and mechanically, due to the alloy nature thereof and the ribs and grooves therein that impart mechanical strength thereto and which enable thermal contraction and expansion to occur between the upper and lower edges thereof consistent with the rather extreme temperature differential between these remote edges.

Hence, while I have illustrated and described the preferred embodiments of my invention, it is to be understood that these are capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of

such changes and alterations as fall within the purview of the following claims.

I claim:

1. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a substantially vertically straight rear edge portion and a relatively narrow elongated flange extending forwardly thereof which flange when operatively oriented in such a furnace will project inwardly generally in normal relation to a side wall of the furnace, said flange having an upper edge so arranged that at least a portion thereof is sloped downwardly toward the lower edge of said flange, and said flange having alternate ribs and grooves on opposite faces thereof that are extended substantially parallel one with the other and in a direction generally normal to the direction of said rear edge portion and of which at least some extend to said sloped edge.

2. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a relatively narrow elongated flange which when operatively oriented in such a furnace will project inwardly in normal relation to a side wall of the furnace, said divider plate including a substantially vertically straight web representing the rear thereof and which lies in a plane normal to the plane of said flange so as to be engageable with a wall of said furnace, the upper and lower edges of said flange being so related that at least a portion of the upper edge is sloped downwardly in a direction proceeding from said web toward the lower edge of said flange, and said flange being provided with alternate ribs, and grooves on opposite faces thereof that are extended substantially parallel one with the other and generally normal to the plane of said web and of which at least some extend to said sloped edge, and means on said plate engageable with a part of said furnace to support the plate with said web engaged with a side wall of the furnace.

3. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a substantially vertically straight rear edge portion and a relatively narrow elongated flange which when operatively oriented in such a furnace will project inwardly in normal relation to a side wall of the furnace, the upper and lower edges of said flange being so related that at least a portion of the upper edge is sloped downwardly in a direction proceeding from said rear edge portion toward the lower edge of said flange, and said flange being off-set laterally at an area between the upper and lower edges thereof to provide a rib on one side thereof and an aligned groove on the opposite side and which extend substantially parallel to one another and in a direction generally normal to the direction of said rear edge portion, said flange consisting primarily of heat-resistant alloy steel containing substantially 20 to 40 percent chromium, 10 to 20 percent nickel, carbon from 0.20 to 0.40 percent, remainder substantially all iron.

4. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a substantially vertically straight rear edge portion and a relatively narrow elongated flange which flange when operatively oriented in such a furnace will project inwardly in normal relation to a side wall of the furnace, opposite upper and lower edges of said flange being so related that at least a portion of said upper edge is sloped downwardly in a direction proceeding from said rear edge portion toward said lower edge, and said flange being provided with at least a serpentine rib and groove on opposite sides thereof between such opposite edges and which extend substantially parallel

to one another and in a direction generally normal to the direction of said rear edge portion.

5. A divider plate according to claim 4 wherein said rib and groove extend to said sloped edge.

6. A divider plate according to claim 5 wherein a separable heat-resistant cap is mounted on said sloped edge and is complemental to the portions of the rib and groove coextensive therewith.

7. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including at the rear thereof a substantially vertically straight web engageable with a wall of said furnace, said divider plate including a relatively narrow elongated flange substantially solely of heat-resistant alloy steel and disposed in a plane normal to the plane of said web and which when operatively oriented in such a furnace will project inwardly in normal relation to a side wall of the furnace, said flange having opposite upper and lower edges so arranged that at least a portion of said upper edge is sloped downwardly in a direction proceeding from said web toward the lower edge of said flange, and said flange being provided with at least an elongated rib and groove in substantially parallel alignment on opposite sides thereof between such opposite edges and which extend in a direction generally normal to said web.

8. A divider plate for a furnace of the kind described and adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a substantially vertically straight rear edge portion and a relatively narrow elongated flange which flange when operatively oriented in such a furnace will project inwardly in normal relation to a side wall of the furnace into the bed of the charge, at least a portion of the upper edge of said flange between the upper and lower edges thereof being provided on opposite faces thereof with an elongated rib and groove arranged to extend in a direction generally normal to the direction of said rear edge portion, and the upper edge of said flange at least in part being sloped downwardly in a direction proceeding from said rear edge portion to the lower edge of said flange.

9. A divider plate according to claim 8 wherein said flange is of heat-resistant alloy steel.

10. In a furnace of the kind described having a vertical side wall, a divider plate secured to the side wall of the furnace adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat

treatment therein and including a substantially vertically straight rear edge portion aligned vertically with said side wall and a relatively narrow elongated flange extending forwardly from said edge portion, said flange being operatively oriented in said furnace so as to project inwardly in normal relation to said side wall of the furnace, at least a portion of the upper edge of said flange between the upper and lower edges thereof being off-set laterally to provide on opposite faces thereof an elongated rib and groove each aligned in a direction generally normal to the direction of said rear edge portion and the vertical plane of said furnace side wall, and the upper edge of said flange at least in part being sloped downwardly in a direction proceeding from said rear edge portion to the lower edge of said flange.

11. In a furnace of the kind described having a vertical side wall, a divider plate secured to the side wall of the furnace adapted to maintain in a loose, unpacked condition charges fed to the furnace to undergo heat treatment therein and including a substantially vertically straight rear edge portion aligned vertically with said side wall and a relatively narrow elongated flange forwardly of said rear edge portion and operatively oriented in said furnace so as to project inwardly in normal relation to said side wall, at least a portion of said flange in the area between the upper and lower edges thereof being corrugated to provide elongated ribs and grooves substantially parallel to one another and extended in a direction generally normal to the direction of said rear edge portion, and said upper edge of said flange being sloped downwardly in a direction proceeding from said rear edge portion toward the lower edge of said flange.

12. A divider plate according to claim 11 wherein said flange is of heat-resistant alloy steel.

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