Jan. 29, 1957 R. STEINITZ 2,779,579

CONVEYOR FOR HIGH TEMPERATURE FURNACES

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FIG. 2.

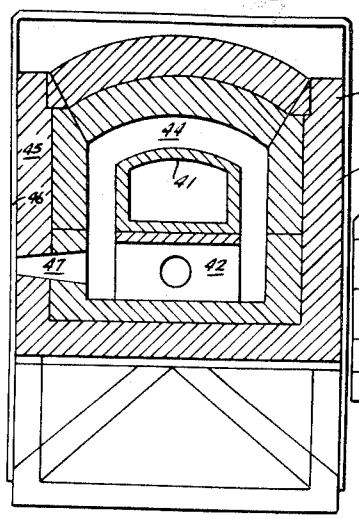


FIG. 1.

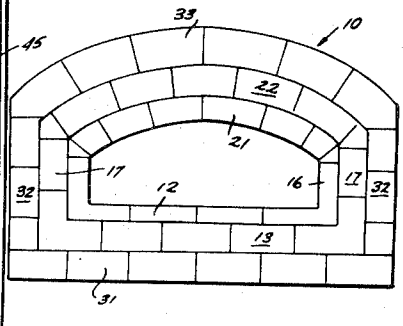
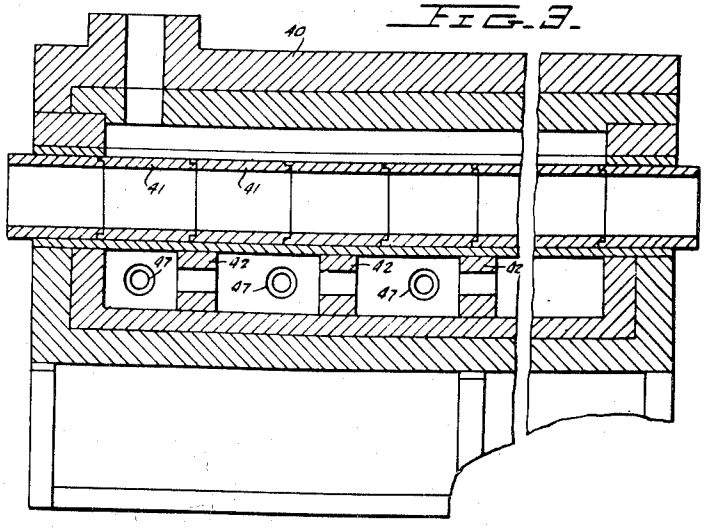


FIG. 3.



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FIG. 4

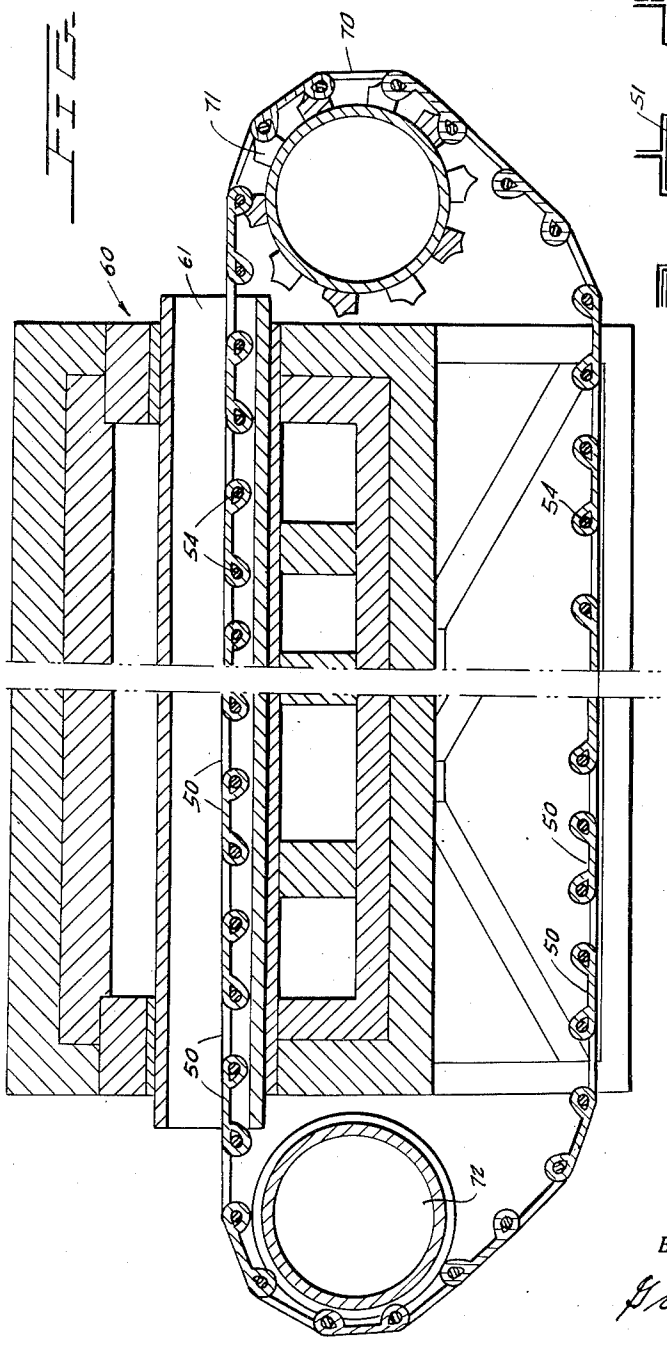


FIG. 6

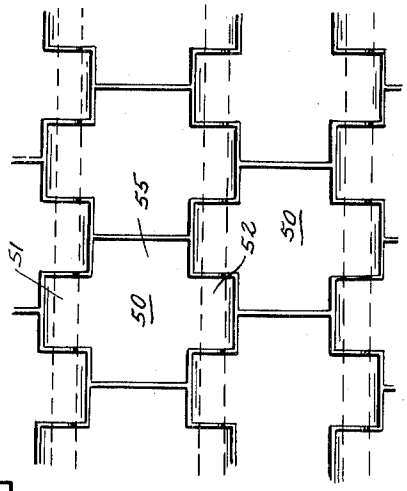
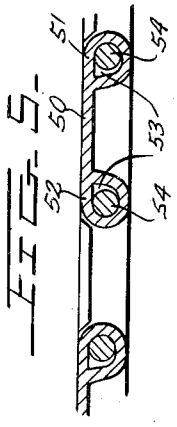


FIG. 5



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2,779,579

CONVEYOR FOR HIGH TEMPERATURE FURNACES

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Application July 26, 1954, Serial No. 445,788

2 Claims. (Cl. 263—8)

The invention relates to high temperature furnaces and processes for making the same.

In high temperature furnaces, for use in treating metals at high temperatures, or for firing porcelain and similar applications, it is of great importance to provide an inner furnace lining of high heat conductivity so as to assure that all parts of the interior heated furnace space are maintained at a substantially uniform temperature. In the past, it has been found that to achieve such uniform high furnace temperature, it is best to use as the interior furnace lining, or at least for the furnace hearth, bricks of silicon carbide because of its high heat conductivity. However, bricks of silicon carbide have serious limitations and disadvantages. They burn in oxidizing atmospheres at 1350° C. and sublime at 1600° C. even in a neutral atmosphere or in vacuum. In addition, they produce in the furnace a carburizing atmosphere which is in many applications, harmful to the object that is being heated.

Among the objects of the invention is a high temperature furnace having an interior furnace lining, or at least a part of the interior furnace lining formed of furnace brick of high heat conductivity capable of assuring a uniform distribution of heat, which brick at the same time does not burn in oxidizing atmospheres or form a reducing or carburizing atmosphere at the high internal furnace temperature.

Among other objects of the invention is a high temperature furnace having as interior furnace lining a high temperature brick of high heat conductivity, which brick is stable in oxidizing atmospheres up to 1700° C. and which brick does not melt below 2000° C. and does not decompose or sublime below its melting temperature.

Among other objects of the invention is to provide an improved conveyor belt for high temperature furnaces.

This invention is based on the discovery that high temperature furnaces can be heated to much higher temperatures than possible in the past and maintained at uniform temperatures by making the interior furnace lining at least in part of bricks consisting of molybdenum disilicide.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawing in which:

Figure 1 is a partially diagrammatic cross-sectional view of constructional features of a high temperature furnace exemplifying the invention.

Fig. 2 is a cross-sectional view of a muffle furnace made according to the invention.

Fig. 3 is a longitudinal cross-sectional view of the furnace of Fig. 2.

Fig. 4 is a longitudinal cross-sectional view of a continuous furnace provided with a conveyor belt made according to the invention.

Fig. 5 is an enlarged cross-sectional view of one of the units of the conveyor belt of Fig. 4.

Fig. 6 is a top plan view of the conveyor belt.

As explained above, in constructing high temperature furnaces, it has been found in the past necessary to use bricks of silicon carbide either for the entire inner lining layer of the furnace or at least for the hearth of the furnace in order to assure that all parts of the heated interior furnace space are maintained at and are brought quickly to a substantially uniform temperature. It was also long known that the use of silicon carbide bricks as interior furnace lining of high temperature furnaces has certain disadvantages compared to furnaces having an interior lining of common firebricks. Among the disadvantages of silicon carbide bricks is the fact that silicon carbide burns in an oxidizing atmosphere at about 1350° C. and thus limits the maximum temperature to which such furnace may be heated. In addition, silicon carbide sublimes even in a neutral atmosphere or in vacuum and accordingly, a furnace having such brick lining could not be heated to 1600° C. even if vacuum or a neutral atmosphere is maintained in the interior furnace space. Furthermore, the presence of silicon carbide bricks in the interior of the heated furnace results in the production of carburizing or reducing furnace atmospheres which in many cases impair the characteristics of the objects heated or treated in the furnace. By way of example, in heating ceramic ware in a high temperature furnace having an interior of silicon carbide bricks, specks of graphite are deposited on the ceramic ware thereby impairing its quality. For this reason, high temperature furnaces have an interior lining with only the hearth plate formed of silicon carbide bricks with the major area of the inner furnace lining consisting of the conventional firebricks.

According to the invention, the difficulties encountered with the use of silicon carbide bricks as the inner lining for high temperature furnaces are eliminated by making such high temperature furnaces with an inner lining of bricks consisting predominantly or in their entirety essentially of molybdenum disilicide $MoSi_2$ or chromium disilicide $CrSi_2$.

Such bricks of the invention are very effective because of their high heat conductivity, resistance to oxidation, resistance to temperatures of up to 2000° C., and high heat shock resistance. Furnaces made of such bricks may be heated for long periods of time to temperatures as high as 1800° C.

In particular, the heat conductivity of a molybdenum disilicide $MoSi_2$ brick is about .075 cal./cm./C. °/sec. If desired, this high heat conductivity of such bricks can be reduced by making them porous or hollow without decreasing the heat or oxidation resistance of the brick.

There will now be described by way of exemplification in connection with the figures of the drawing, several forms of structural features of high temperature furnaces exemplifying the principles of the invention. The furnace **10** of Fig. 1 has a floor comprising an inner layer of bricks **12** and an outer layer of bricks **13**, two opposite side walls comprising similarly an inner layer of bricks **16** and an outer layer of bricks **17** and a top wall comprised similarly of an inner layer of bricks **21** and an outer lay of bricks **22**. The additional outer bricks **31, 32, 33** of the furnace which surround its two inner brick layers **12, 13, 16, 17, 21, 22** are formed of conventional firebricks consisting essentially of clay or the like. The bricks **12, 16** and **21** which form the inner layer of the furnace are all of molybdenum disilicide $MoSi_2$ or chromium disilicide $CrSi_2$ or a 50/50 combination of $MoSi_2$ and $CrSi_2$.

Good results are obtained by making the inner lining of the high temperature furnace out of a layer of dense molybdenum disilicide bricks and making the next outer layer of the furnace of molybdenum disilicide bricks

having high porosity so as to reduce their heat conductivity and reduce the loss of heat from the furnace while contributing to the high heat conductivity of the inner layer formation of the furnace. Instead of making the outer layer of the furnace lining of porous $MoSi_2$ bricks, it may be made out of hollow $MoSi_2$ bricks.

Instead of using as inner furnace lining, bricks consisting entirely of $MoSi_2$, it is of advantage to make these bricks of a combination of $MoSi_2$ and $CrSi_2$ in 50/50% proportions (by weight). By making the bricks of $MoSi_2$ and $CrSi_2$ in 50/50% proportions, there are obtained bricks of the superior oxidation resistance because in such proportions, the two disilicides go into solid solution.

In assembling a top wall of the furnace with a double layer **21**, **22** of bricks, it might be desirable to assemble each pair of the two similarly shaped bricks which are to form the inner and outer layers of the top wall before cementing the bricks into the wall. If desired, only the floor portion of the furnace may be lined with the disilicide bricks. Aluminum oxide bricks, for example, are low cost, highly effective refractory bricks with low conductivity and are well adapted to be employed with the bricks of the invention.

The heating structures of the furnace are not shown since they are not a part of the present invention. Since the furnace is resistance to high temperatures and oxidizing conditions it does not make any difference what means is employed to heat the furnace. For example, it may be heated electrically by resistance heater or by fuel gas.

Figs. 2 and 3 show a muffle type furnace which is adapted to be heated by gas. In this furnace **40**, the muffle parts **41** are made of the $MoSi_2$, $CrSi_2$ or mixtures thereof. The muffle is supported on a plurality of firebricks **42** in a spaced position from walls **43** so as to form a chamber **44** between muffle **41** and walls **43**. Walls **43** are supported on the outside by brick walls **45**. Metal braces **46** surround the outside wall **45**. Openings **47** are provided for firing the furnace.

A very satisfactory way of making the muffle parts **41**, etc., is by extrusion. A finely powdered mixture of 50% molybdenum disilicide and 50% chromium disilicide are mixed with water and a binder such as carboxymethyl cellulose or water soluble methyl cellulose to form a coherent paste, which is then extruded to the form desired. From ½ to 4% of the binder is satisfactory. After extrusion the parts are sintered at 1600° C. to 1900° C. to burn off the binder and cement the particles together.

Figs. 4, 5 and 6 show a continuous type furnace equipped with a conveyor belt made up of units of the molybdenum disilicide or chromium disilicide. According to this modification the said disilicides are formed into units **50** such as shown in Fig. 5 having end portions **51**, **52** containing loopholes **53** through which connecting rods **54** are adapted to be passed. The end portions **51**, **52** as shown in Fig. 6 are narrower than central portion **55** thus enabling the units to be interfitted and united by

connecting rods **54**. The belt is pulled through the muffle tube **61** of furnace **60** by means of spurred roller **70** containing the spurs **71** adapted to fit under the ends **51** or **52** of units **50**. Roller **72** at the entrance end of the furnace need not contain such spurs **71**.

A very satisfactory way of making the links or units **50** is to press such links in the form of plates, as solid pieces without the holes **53** therein, presinter the pressed plates at about 1000°–1200° C., drill the holes **53** in the presintered plates and finally sintering at a temperature of about 1500° C. to 1700° C.

It is also possible, of course, to press the links **50** initially with the holes **53** therein. The rod **54** may be made of molybdenum disilicide also and this rod may be formed by extruding a molybdenum silicide powder mixed with a temporary binder, and then sintering.

The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific features or details shown and described in connection with the exemplifications thereof.

I claim:

1. In a high temperature furnace having an interior furnace space, a belt-like endless conveyor structure having a plurality of link members with each link member movably joined to a preceding and succeeding link member and consisting essentially of a solid solution of molybdenum disilicide and chromium disilicide, said link members being arranged to be moved along a predetermined path facing the interior of said furnace space for carrying objects to be heated in said furnace space.

2. A conveyor structure for a high temperature furnace as claimed in claim 1 wherein said link members consist essentially of a solid solution of molybdenum disilicide and chromium disilicide with each of said two disilicides constituting about 50% of the total disilicide content.

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