June 15, 1926. 1,588,473

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METHOD OF MAKING CARBORUNDUM STRUCTURES

Filed Oct. 10, 1925

Fig. 1.

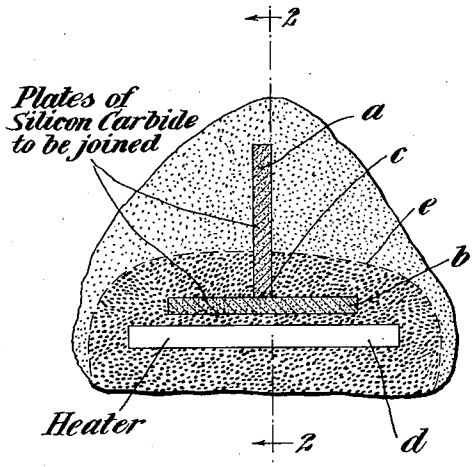


Fig. 2.

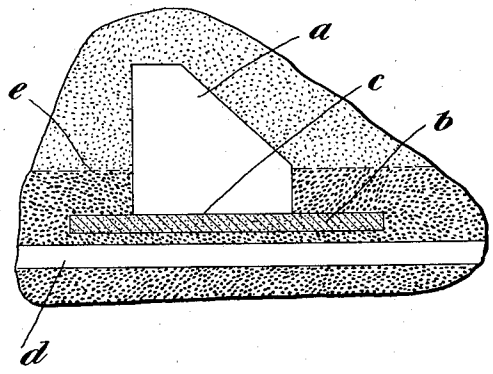


Fig. 3.

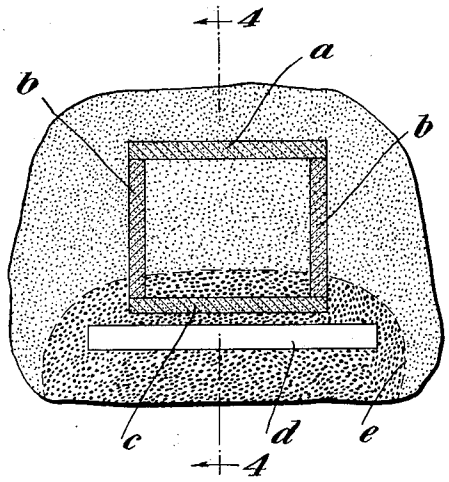
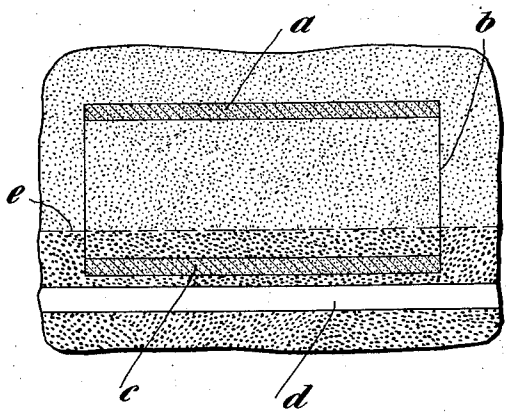


Fig. 4.



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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING CARBORUNDUM STRUCTURES.

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This invention relates to a method of making carborundum structures.

While my invention may be embodied in a variety of forms, in its preferred embodiment it is applied to the manufacture of monolithic carborundum linings for the interior of furnaces such as the lining of the combustion or heating chamber of a reverberatory furnace. Such linings serve to conduct heat to the muffle and at the same time prevent escape of any gas from the heating chamber to the muffle chamber. A lining of this character which is free from joints or cracks is, of course, desirable. When, however, attempts have been made to make such a lining without joints or cracks by making up large pieces of recrystallized silicon carbide, the product is warped and there is ununiformity in the context and size of the crystal. In accordance with my invention, I am able to form a monolithic lining of any form or size desired, without any of the disadvantages referred to.

I have discovered that if two pieces of silicon carbide made up for the purpose of recrystallizing, or if two pieces of recrystallized silicon carbide ware, be placed adjacent and in close contact with each other in a furnace such as a recrystallizing furnace, preferably in such a manner that the surface of contact is at right angles to the flow of heat in the furnace, and if a small amount of loose silicon carbide mix be placed between the two pieces, then upon heating the material to the recrystallizing temperature these two pieces will be found to be joined together, apparently by a growth of crystal from one piece to the other. In this manner large and complicated sections may be built up.

While a carborundum mix such as coke, sawdust and sand may be used between the surfaces which it is desired to join, this is not absolutely essential as fine carborundum grains will act in a similar manner, and in fact if two pieces of carborundum ware recrystallized, or to be recrystallized, be placed in the furnace in close proximity without any bonding material whatever, a union may be effected. I, however, preferably use some bonding material. To effect the union I find that it is preferable to have a certain amount of carbon present and the atmosphere in which the pieces are heated should be non-oxidizing. The temperature to which they are heated should be approximately 1800° C. or over. While I have mentioned a recrystallizing furnace as the furnace in which the heating is effected, it is obvious that furnaces of other kinds may be employed.

In heating green ware for the purpose of recrystallizing the same, it is customary to embed the ware in carborundum mix. When large structures of more or less complicated form are made by joining portions of the structure in the manner above described, it is preferable to recrystallize the various parts of the structure before joining the parts together, because this avoids the necessity of embedding the entire structure in mix. When the recrystallized parts are joined, I may then embed merely the joint in the mix.

In the accompanying drawing, which illustrates one way in which my invention may be carried out, Fig. 1 is a diagrammatic sectional view of a portion of the interior of a recrystallizing furnace, showing a heater and two plates of carborundum in position to be joined to one another.

Fig. 2 is a diagrammatic transverse section taken on the line 2—2 of Fig. 1 and

Figs. 3 and 4 are views similar respectively to Figs. 1 and 2, but showing four carborundum plates in position to be joined to form a muffle open at the ends.

The recrystallizing furnace contains a heating element *d* surrounded by carborundum mixture which is composed of coke, sand and sawdust in the proper proportions and the articles to be recrystallized are placed in the proximity of the heating element *d* so that when the furnace has been run the crystalline form of carborundum will surround the article to be recrystallized as shown by the dotted line *e*. If now, as in the case of Figs. 1 and 2, the plates *a* and *b* are to be joined together at the joint *c*, the plate *b* is placed horizontally well within the zone whose boundary is the line *e* inside which crystalline carborundum will be formed. The plate *a* is then placed upon the plate *b* with perhaps some small amount of carborundum mix without the sawdust placed between the two plates. The object of this mixture, which preferably should be finely ground, is to accentuate the crystal growth between the two plates. The whole may then be covered with carborundum mix-

ture as in the ordinary way of running a carborundum furace, and the furnace run for its correct length of time and energy input and when the plates *b* and *a* are removed it will be found that they have joined together due to crystalline growth between the two plates at the joint *c*.

These plates such as *a* and *b* may be either placed in the furnace in the green form, that is to say finely crushed carborundum crystals bonded together with some temporary bond such as glue, in which case only the plate *b* and the part of plate *a* inside the crystalline zone whose boundary is *e* would be recrystallized. The plate outside the boundary *e* would be still in an unrecrystallized condition, that is to say the crystals in the plate at this point would still retain the original size of the crystal particles as used in molding the green plate and would not be bonded together.

The plates *a* and *b* might also be first recrystallized separately or the plate *a* might be recrystallized and the plate *b* might be a green plate. This would depend entirely upon the size, shape and convenience of handling the plates *a* and *b*.

In the form shown in Figs. 3 and 4 the procedure would be similar to the one already described in connection with Figs. 1 and 2. The plates *a* and *bb* would be first joined and then the hollow trough would be turned upside down and the plate *c* would be joined to the side plates *bb* of the finished muffle.

The shape as shown in Figs. 1 and 2 would be an extremely difficult shape to produce by the simple molding and recrystallizing process and the shape 3 would be almost impossible to produce if the muffle were at all large. In the drawing I have illustrated but two of the many shapes which may be produced by means of my improved method.

I claim:

1. The method of uniting two pieces of silicon carbide which comprises heating them in contact with one another to a temperature of approximately 1800° C. or over, in a non-oxidizing atmosphere.

2. The method of uniting two pieces of recrystallized silicon carbide which comprises heating them in contact with one another to a temperature of approximately 1800° C. or over in a non-oxidizing atmosphere in the presence of carbon.

3. The method of uniting and recrystallizing two pieces of molded unrecrystallized silicon carbide which comprises heating them in contact with one another to a temperature of approximately 1800° C. or over, in a non-oxidizing atmosphere.

4. The method of uniting and recrystallizing two pieces of molded unrecrystallized silicon carbide which comprises heating them in contact with one another to a temperature of approximately 1800° C. or over in a non-oxidizing atmosphere in the presence of carbon.

5. The method of uniting two pieces of silicon carbide which consists of placing said pieces in substantial contact with one another with finely divided carborundum between their contacting faces, and heating the pieces while so positioned to approximately 1800° C. or over.

6. The method of uniting two pieces of silicon carbide which consists of placing said pieces in substantial contact with one another with carborundum mix between their contacting faces, and heating the pieces while so positioned to approximately 1800° C. or over.

7. The method of uniting two pieces of silicon carbide which consists of placing said pieces in substantial contact with one another with carbonaceous material between their contacting faces, and heating the pieces while so positioned to approximately 1800° C. or over.

8. The method of uniting two pieces of silicon carbide which consists in placing said pieces in substantial contact with one another with carbonaceous material between their contacting surfaces, and raising the temperature of said surfaces to approximately 1800° C. or over by a flow of heat in a direction substantially at right angles to said surfaces.

9. The method of uniting two pieces of silicon carbide which consists in placing said pieces in substantial contact with one another with carborundum material between their contacting surfaces, and raising the temperature of said surfaces to approximately 1800° C. or over by a flow of heat in a direction substantially at right angles to said surfaces.

10. The method of uniting and recrystallizing two pieces of molded unrecrystallized silicon carbide which consists in placing said pieces in substantial contact with one another with carbonaceous material between their contacting surfaces and raising the temperature of said pieces to approximately 1800° C. or over by a flow of heat in a direction substantially at right angles to said contacting surfaces.

11. The method of uniting two pieces of carborundum which consists in mounting them in a furnace in contact with one another and embedding the portions of said pieces adjacent their contacting surfaces in carborundum mix, and heating said mix until the same is converted into crystalline carborundum.

12. The method of uniting and recrystallizing two pieces of unrecrystallized carborundum which consists in mounting said pieces in a furnace in contact with one another, embedding the pieces in carborundum

mix and heating the furnace until the mix is converted into crystalline carborundum.

13. The method of forming a structure by uniting several pieces of carborundum which consists in placing a plurality of said pieces in contact in a furnace and embedding the portions of said pieces adjacent their contacting surfaces in carborundum mix, heating the mix until it is converted into crystallized carborundum and the pieces are thus united, placing another of the pieces of carborundum in contact with the structure so formed and uniting said other piece thereto by embedding and heating as above set forth.

JAMES KELLEHER.