P. R. HERSHMAN.

METHOD OF PRODUCING HEAT RESISTING BODIES.

APPLICATION FILED OCT. 12, 1914.

1,135,182. Patented Apr. 13, 1915.

Fig 1.

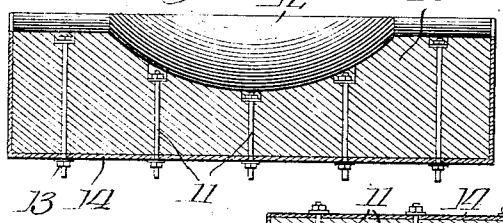


Fig 2.

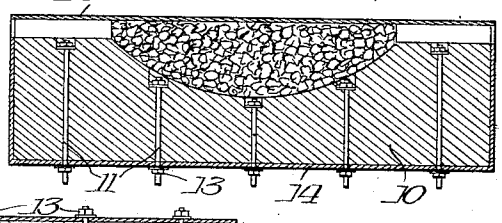


Fig 3.

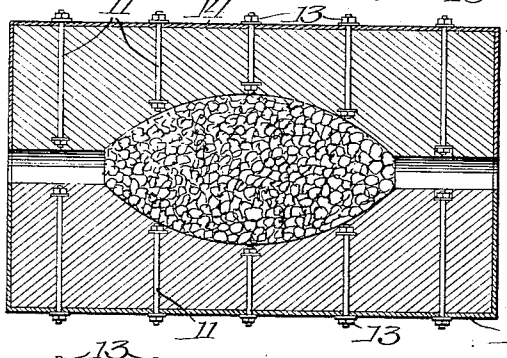


Fig 4.

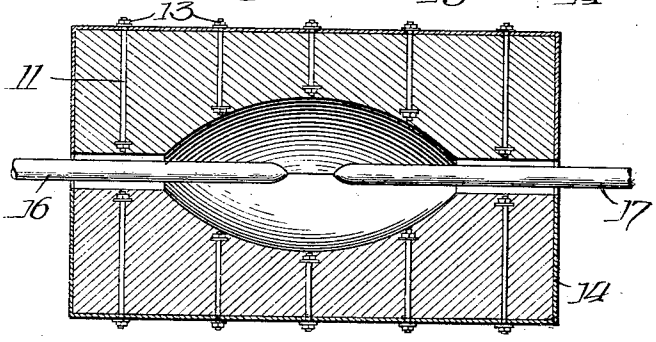
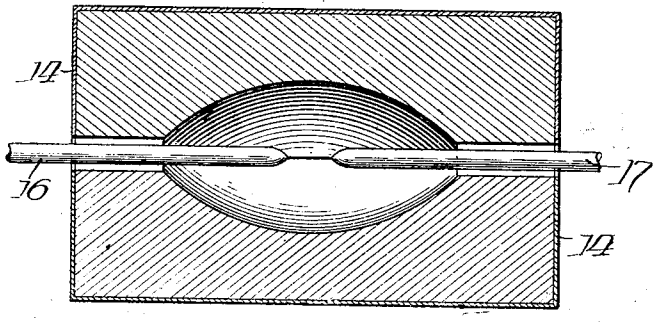


Fig 5.



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UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING HEAT-RESISTING BODIES.

1,135,182. Specification of Letters Patent. Patented Apr. 13, 1915.

Application filed October 12, 1914. Serial No. 866,291.

To all whom it may concern:

Be it known that I, PAUL RALPH HERSHMAN, a subject of Austria-Hungary, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of Producing Heat-Resisting Bodies, of which the following is a specification.

One of the main and principal objects of the present invention is the production of bodies of heat-resisting material, preferably solid, massive bodies, capable of employment as furnace linings and in other relations where heat-resisting materials are necessary, and able to withstand the highest temperatures obtainable in electric or similar furnaces without being injured, cracked or caused to chip off by the heat at the high temperatures employed.

Another salient feature and purpose of the invention resides in the manufacture of such bodies or furnace linings of this character from aluminum waste products, or other suitable materials easily and cheaply procurable, whereby their production may be effected economically.

In order that those skilled in this art may have a full and complete understanding of the invention, I have illustrated in the accompanying drawing, forming a part of this specification, the various steps employed in carrying out the improved process, and in this drawing, Figure 1 illustrates the molding of the plastic mass into suitable shape in one of the furnace parts or halves; Fig. 2 shows the initial heating of the mass at a relatively low temperature; Fig. 3 illustrates the two parts of the furnace lining assembled and subjected to further heating at a low temperature; Fig. 4 shows the further heating of the two parts of the lining at a higher temperature by the electric arc in the presence of a gas incapable of combining with carbon at the temperature employed; and Fig. 5 illustrates the completed parts of the furnace lining. In all of these figures of the drawing the furnace is illustrated in section.

This improved and novel method consists, in its preferred form, in mixing a heated body of relatively cheap, aluminum particles, such as the commercial by-products, filings, grindings, shavings, &c., which may, however, incidentally contain a certain amount of copper, iron, and silicon, with a sufficient quantity of heated, melted, heavy tar, to form a thick, plastic mass. This body of aluminum particles is initially or preliminarily heated, so that when mixed with the melted tar it will have no chilling action on the latter, the result being a more uniform plastic mass. The finer or smaller the aluminum particles are, the better, but in ordinary practice particles approximating 1/32 inch, 1/64 inch, or less, in diameter, are suitable for the purpose.

The tar is used both as a binder for the aluminum particles and also to cause the formation of carbids. Tar is employed in the preferred way of carrying out the process because it is relatively cheap, and the percentage used depends somewhat upon the sizes of the aluminum particles. An average amount of the tar used would be approximately 25% to 50% of the weight of the aluminum, which mixture results in a semi-paste. Various other carbonaceous materials might be used in place of the tar, such, for example, as glue, sugar, molasses, and the like. If desired, approximately one to two per cent. of magnesium dust, based on the weight of the aluminum used, may be added by first intimately mixing it with the aluminum particles, the function of the magnesium dust being to render the lining harder; but it is to be understood that it is not necessarily an essential ingredient of the mixture. This mass is molded into shape preferably by using each of the two furnace halves as molds, and in conjunction with suitably shaped cores to provide the necessary cavities in the finished lining, and the mass is reinforced and maintained in position by means of small aluminum wires, rods or bolts, embedded in the mass and suitably fastened to the mold or furnace casing. These aluminum wires or rods act to hold the mass of material in better shape while drying and hardening, and are burned or consumed as the temperature is raised in carrying out the process. That is to say, they are employed merely as temporary supports or reinforcements. The process can be carried out without using such wires or rods, if necessary, and, instead of aluminum wires or rods, magnesium or similar wires may be employed. These wires are ordinarily held in vertical position by suitable fastening means, such as screw threads or nuts, and they may be from one thirty-sec-

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ond to a quarter of an inch in diameter, and about one or two feet in length, but it is to be understood that their dimensions may be varied within wide limits.

In shaping or molding the mass in each of the furnace halves, it is tamped, compacted or condensed as solidly as possible while still hot. Each mass or body, with the embedded rods, is dried in the air for approximately half a day, and is preferably subjected to the action of a relatively low temperature by means of a charcoal fire placed in the cavity from which the core has been removed, the charcoal being covered over sufficiently to exclude an excess of air. After the two blocks have become sufficiently hardened by this action of the heat, the two parts of the furnace are assembled, so that the two masses of the material are in juxtaposition, with the usual cavity between them, the rods or wires assisting in holding the lining parts in place. A charcoal fire is then built in this cavity, which subjects the blocks of material to a moderate temperature of approximately 800° centigrade for about one or two days. Then the charcoal fire is removed and the lining is electrically heated, by the electric arc or otherwise, to form one thousand to two thousand degrees centigrade in a current of gas incapable of combining with the carbon at the temperature employed, such for instance as carbon monoxid, hydrogen, &c. During the application of this higher temperature, the aluminum supporting or reinforcing rods are consumed and disappear, and the aluminum particles combine or react with the carbonaceous matter, producing a furnace lining with remarkable heat-resisting qualities, experience showing that such linings will resist or stand temperatures above 2000° centigrade without injury.

In the drawing, I have illustrated, in Fig. 1, one of the furnace halves used as a mold and containing the mixture 10, which has embedded therein its reinforcing and supporting aluminum rods, pins or bolts 11, 11. This mass of material is brought to proper shape by the use of a wooden core 12. As is clearly illustrated, the reinforcing rods are fastened by means of nuts 13 to the shell 14 of the furnace. It should be understood that each half of the furnace is supplied with such a mass of the plastic mixture. After this mass has been properly condensed and compacted, and brought to the desired shape in each half of the furnace (only one of which halves is illustrated in Fig. 1), the core is removed and the mass allowed to dry in the air for any suitable length of time. Its cavity is then supplied with a charcoal fire, over which a cover 15 is placed, and the mass of material is thus heated at a moderate temperature for about half a day. This part of the process is illustrated in Fig. 2. Then the two parts of the lining are sufficiently hard so that the two parts of the furnace may be assembled in their usual relation, with the two blocks of material one above the other and their cavities registering, as shown in Fig. 3, the masses of material being held in place by the rods. Then a charcoal fire is built in this cavity, and the blocks of material are subjected to a temperature of approximately 800° centigrade for one or two days, as is shown in Fig. 3. Then the charcoal fire is removed and the electric terminals 16 and 17 inserted, as shown in Fig. 4, after which the two parts of the lining are subjected to the heat of an electric arc between these terminals, which raises the temperature to approximately 1000 to 2000° centigrade, and at the same time a current of a gas incapable of combining with the carbon at the temperature employed passes through the furnace. A gas suitable for this purpose may be carbon monoxid, hydrogen, &c. At this high temperature the aluminum rods or bolts disappear by reason of their consumption, and the lining parts harden and become refractory and heat-resisting to such a degree that they will withstand excessively high temperatures. The finished lining is illustrated in Fig. 5.

While I have herein set forth in detail the ingredients employed, the percentages used and the temperatures suitable for the purpose, it is to be understood that these may be modified materially without departing from the substance of the invention, and that materials other than aluminum may be used as the main ingredient of the mixture.

The scope of the invention is defined by the appended claims, and I do not wish therefore to be limited by the above description except as such claims require.

I claim:

1. The method consisting of mixing with carbonaceous material a body of particles capable of reacting with carbon, and heating such mixture at a sufficient temperature and for a sufficient length of time to effect such reaction without liquefaction, producing a solid mass of heat resisting material suitable for use as a furnace lining, substantially as described.

2. The method consisting of forming a plastic mass by mixing a carbonaceous binder with a body of particles capable of reacting with carbon, and heating such mass to effect the reaction without liquefaction, producing a solid body of heat resisting material suitable for use as a furnace lining, substantially as described.

3. The method of producing a solid mass of heat-resisting material which consists in mixing a body of aluminum particles with carbonaceous material, and heating the mix-

ture to effect the reaction between the ingredients, substantially as described.

4. The method of producing a solid body of heat-resisting material which consists in forming a plastic mass by mixing a body of aluminum particles with a carbonaceous binder, and heating the mass at a sufficient temperature and for a sufficient length of time to effect the reaction between the ingredients, substantially as described.

5. The method consisting of forming a plastic mass by mixing with a carbonaceous binder a body of particles capable of reacting with carbon, and heating the mass first at a moderate temperature and then at a higher temperature to effect the reaction between the ingredients without liquefaction, producing a solid mass of heat resisting material suitable for use as a furnace lining, substantially as described.

6. The method consisting of forming a plastic mass by mixing with a carbonaceous binder a body of particles capable of reacting with carbon, heating the mass at a moderate temperature and then at a higher temperature without liquefaction in the presence of a gas incapable of combining with carbon at the higher temperature employed, producing a solid mass of heat resisting material suitable for use as a furnace lining, substantially as described.

7. The method consisting of forming a plastic mass by mixing a body of aluminum particles with a carbonaceous binder, heating the mass first at a moderate temperature and then at a higher temperature without liquefaction in the presence of a gas incapable of combining with carbon at the higher temperature employed, producing a heat resisting material suitable for use as a furnace lining, substantially as described.

8. The method consisting of forming a plastic mass by mixing with a heated carbonaceous binder a heated body of particles capable of reacting with carbon, heating such mass first at a moderate temperature and then at a higher temperature without liquefaction of the ingredients, producing a solid mass of heat resisting material suitable for use as a furnace lining, substantially as described.

9. The method of producing a solid mass of heat-resisting material consisting in forming a plastic mass by mixing a heated body of aluminum particles with a heated carbonaceous binder, heating the mass first at a moderate temperature, and then at a higher temperature in the presence of a gas incapable of combining with carbon at the temperatures employed, substantially as described.

10. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, and heating the mass to effect the reaction between the ingredients, substantially as described.

11. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, heating the mass at a moderate temperature, and then at a higher temperature to effect the reaction between the ingredients, substantially as described.

12. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, heating the mass at a moderate temperature, and then at a higher temperature in the presence of a gas incapable of combining with carbon at the temperatures employed, substantially as described.

13. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, heating the mass at a moderate temperature, and then heating the mass *in situ* as a furnace lining at a higher temperature, substantially as described.

14. The method of producing a solid mass of heat-resisting material which consists in forming a plastic mass by mixing with a carbonaceous binder a body of particles capable of reacting with carbon, heating such mass at a moderate temperature by means of a charcoal fire, and subsequently heating the mass at a higher temperature *in situ* as a furnace lining, substantially as described.

15. The method of producing a body of heat-resisting material consisting in mixing with carbonaceous material a body of particles capable of reacting with carbon, embedding reinforcing means in such mixture, and heating such mixture at a sufficient temperature and for a sufficient length of time to effect the reaction between the ingredients and cause the consumption of the reinforcing means, substantially as described.

16. The method of producing a solid mass of heat-resisting material which consists in forming a plastic mass by mixing with a carbonaceous binder a body of particles capable of reacting with carbon and embedding reinforcing means in the mixture, and heating such mass at a sufficient temperature and for a sufficient length of time to effect the reaction between the ingredients and cause the consumption of the reinforcing means, substantially as described.

17. The method of producing a solid mass of heat-resisting material which consists in mixing a body of aluminum particles with a carbonaceous binder to form a plastic mass and embedding reinforcing means in such mass, and heating the mass at a sufficient

temperature and for a sufficient length of time to effect the reaction between the ingredients and cause the consumption of the reinforcing means, substantially as described.

18. The method of producing a solid mass of heat-resisting material which consists in mixing a body of aluminum particles with a carbonaceous binder to form a plastic mass, embedding aluminum reinforcing rods in such mass, and heating the mass at a sufficient temperature and for a sufficient length of time to effect the reaction between the ingredients and cause the consumption of the reinforcing rods, substantially as described.

19. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, embedding reinforcing aluminum rods in said mass, heating the mass at a moderate temperature, and then at a higher temperature in the presence of a gas incapable of combining with carbon at the temperatures employed, whereby to effect the reaction between the ingredients and cause the consumption of the reinforcing rods, substantially as described.

20. The method of producing a solid mass of heat-resisting material consisting in mixing a heated body of aluminum particles with melted tar to form a plastic mass, embedding aluminum reinforcing rods in said mass, heating the mass at a moderate temperature, and then heating the mass *in situ* as a furnace lining at a higher temperature in the presence of a gas incapable of combining with carbon at the temperatures employed, whereby to effect the reaction between the ingredients and cause the consumption of the reinforcing rods, substantially as described.

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Witnesses:

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C. F. HAGEDORN.