

UNITED STATES PATENT OFFICE

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METHOD OF MAKING CAST BASALT ARTICLES

No Drawing.

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The present invention relates to the manufacture of articles by fusing and casting volcanic rock and relates particularly to the devitrification of the cast material which without special heat treatment would assume a vitreous state.

U. S. Letters Patent No. 1,108,007, dated August 18, 1914, and issued to Francois Ribbe deals generally with a process for the manufacture of articles from certain volcanic rocks, such as basalt. In the said patent the process described consists in melting basalt, casting objects from the molten mass, and heat treating the cast objects in a specified manner to devitrify the basalt. While it is recognized that it is of primary importance to completely devitrify the basalt after the articles have been cast since it is in the devitrified state that they possess the greatest strength and best insulating qualities, yet the procedure outlined in the said Ribbe patent does not yield the same product nor uniform products in every case.

The present invention aims to improve the devitrifying process by controlling devitrification exactly and producing cast devitrified basalt articles without failure. I have discovered that in order to do this special controlling cycles are necessary, depending upon the nature of the atmosphere used in melting the basalt. In other words, while Ribbe makes no mention of the type of atmosphere used in his process for the melting operation or the fact that when a given atmosphere for the melting operation is used, a particular heat treatment must be followed in the recrystallization or devitrifying operation, I have discovered that it is essential to know and to control the atmosphere used in the melting operation and to follow a definite subsequent heat treatment or cycle, depending on the type of atmosphere used in the melting operation, to insure complete devitrification and uniform products.

In order that my invention may be more fully understood by those skilled in the art to which it pertains, I will describe the same more fully and point out its scope in the appended claims.

The articles of basalt may be made by using

either a reducing atmosphere or an oxidizing atmosphere in the operations. I shall first describe the process employed when a reducing atmosphere is used.

A suitable charge of basalt is first melted in a furnace which may be of the open-hearth type and capable of being tilted. For creating a reducing atmosphere ordinary illuminating gas admixed with air may be used. An amount of air is used such that the flue gas analyzes (Orsat analysis) approximately $\frac{1}{4}$ to $\frac{1}{2}$ per cent CO content. It is not necessary to use illuminating gas but any fuel which will give the proper reducing conditions may be used; for example, instead of using illuminating gas admixed with the proper amount of air, fuel oil may be burned using insufficient air for complete combustion and proportions such that the proper reducing atmosphere is produced.

The melt is cast in suitable molds of the desired shape. For this purpose cast iron molds have been found satisfactory, but it is to be understood that molds of other suitable materials may also be used in casting the fused basalt. The castings while still highly heated and perhaps unsolidified in the interior are placed in saggars, which are containers formed of any suitable material which will withstand corrosion, and larger in size than the castings therein, and containing a mixture of sand and graphite. The function of the sagger is to support the cast basalt articles and keep them in shape during the subsequent operations. Instead of sand in the mixture, other inert materials such as zirconium silicate, for example, may be used, and in place of graphite any form of carbon may be used, but graphite is preferred. The carbon functions to accelerate the devitrification and aids in the production of a highly finished or lustrous surface.

The saggars are immediately loaded in the furnace, the furnace temperature being about 725° C. which temperature may vary somewhat depending on the size of the articles to be treated and the speed of loading. The articles are kept at the furnace temperature until they have reached an equilibrium temperature which is a temperature probably

somewhat higher than that of the furnace but at which all the articles are uniformly of this same temperature throughout their mass. Under ordinary conditions of operation the time will be about one hour. The articles are now reheated to approximately 900° C. and kept there approximately one hour. They are then cooled to room temperature, the cooling being permitted to take place either within or without the furnace and may be as rapid as is possible without cracking taking place.

If an oxidizing atmosphere is employed in the melting furnace then the procedure is varied and is as follows:

The charge of basalt is first melted as in the prior procedure but using an oxidizing atmosphere in the furnace. In order to obtain this oxidizing atmosphere any suitable means may be employed. For example, ordinary illuminating gas mixed with the correct amount of air so as to give about 1/4-1/2% oxygen analysis in the flue gas (Orsat analysis) is a convenient means. The melt is cast into suitable shapes and placed in saggars, in accordance with this method outlined above, the saggars are loaded in a furnace at about 900° C. In this case care should be taken to load as quickly as possible and to avoid chilling. The temperature is kept at 900° C. for about one hour after the last article has been loaded into the furnace. The articles finally are cooled to room temperature, observing the same precautions as outlined above.

The last method outlined is not as precise in its character as the former method but has the advantage that less additional heat is necessary in the devitrification treatment. However, the product obtained by the former method is more uniform in character than that obtained by the latter method and has a thinner vitreous skin on its surface. Each method produces without failure completely devitrified articles and the products of each has its field of usefulness.

One outstanding feature of the present invention is that the control outlined may, with certain variations, be used to obtain vitreous cast basalt articles if desired, and at will. For example, it is only necessary to apply the heat treatment of the last method outlined above to the cast melt obtained by the first method outlined above in order to get a vitreous product instead of a devitrified product. Similarly, if the heat treatment employed in connection with material melted in a reducing atmosphere to get a devitrified product is applied to the cast melt obtained by the last method outlined above, a vitreous product results in every case. It will thus be seen that the control described is absolutely essential to the successful production in every case of completely devitrified basalt articles and that a definite heat treatment is neces-

sary in every case and is fixed according to the type of atmosphere employed in the melting furnace. It will also be observed that any departure from the control described yields different products.

It is also a characteristic of my invention that basalt which has previously been treated in a reducing atmosphere and has been cooled to a point substantially below 700° C., or even to room temperature, may be readily devitrified by raising the temperature to 900° C. for a sufficient length of time to allow the crystals to form uniformly throughout the mass, and then cooling to room temperature.

Material melted in a reducing atmosphere and subjected to the chilling action of 725° C. and reheating to 900° C. in the manner pointed out previously, always recrystallizes from the outside to the center presenting, however, an exceedingly thin surface of vitreous material which forms the finish of the article. Material melted under reducing atmosphere but subjected directly to the 900° C. treatment without chilling, as pointed out previously, will be nearly all glass-like, that is vitreous in character, except for a small amount of haphazard crystallization dispersed throughout the entire mass.

Material melted under oxidizing conditions and subjected to 725° C. chilling action then to the 900° C. temperature, as previously pointed out, will be practically glassy throughout the entire mass, that is, vitreous in character. Material melting under oxidizing conditions but subjected directly to 900° C. without chilling action as heretofore pointed out, shows uniform crystallization, the growth starting from the center and extending to the outside. At the surface a vitreous skin, extending in some instances to a fraction of an inch into the interior, is present.

It will be obvious that the time factor for processing the material treated by the methods hereinabove enumerated will vary with the size and number of the pieces under treatment.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method which comprises melting basalt in a controlled reducing atmosphere, casting the melt so obtained into articles of desired shape and subsequently completely devitrifying said cast articles by a definite heat treatment.

2. The method of devitrifying cast basalt by reheating to about 900° C. prior to cooling to room temperature, which is characterized by controlling the reducing conditions of the atmosphere in which the basalt is melted prior to casting, and carrying the cast articles to the reheating temperature through an intermediate stage of heating.

3. The method of devitrifying cast basalt by reheating to about 900° C. prior to cool-

ing to room temperature, which is characterized by controlling the reducing conditions of the atmosphere in which the basalt is melted prior to casting, and carrying the
5 cast articles to the reheating temperature through an intermediate stage of heating to about 725° C.

4. The method which comprises melting basalt in a controlled reducing atmosphere,
10 casting the melt so obtained into articles of desired shape, devitrifying said cast articles by maintaining them at a temperature approximately 725° C., then reheating to about 900° C. and finally cooling to room temperature.
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5. The method which comprises melting basalt in a controlled reducing atmosphere, said reducing atmosphere being such that the flue gas therefrom analyzes by the Orsat analysis
20 a CO content of about $\frac{1}{4}$ to $\frac{1}{2}\%$, casting the melt so obtained into articles of desired shape, maintaining the cast articles at a temperature of about 725° C. until they are all uniformly of this temperature, reheating
25 to about 900° C., and cooling said articles to room temperature.

6. The method of producing electrical insulators from basalt which comprises melting a definite charge of basalt in a controlled
30 reducing atmosphere, casting the melt so obtained into insulators of desired shape, placing said insulators into saggars containing a charge of sand and graphite therein, maintaining said saggars at a temperature of
35 about 725° C. until all the insulators therein are uniformly of this temperature, reheating to about 900° C. and maintaining said insulators at this temperature about one hour, and cooling said insulators to room temperature.
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7. The method which comprises melting basalt in a controlled reducing atmosphere, casting the melt so obtained into articles of
45 desired shape, cooling the articles so cast to approximately room temperature, placing said articles into saggars containing a charge of sand and graphite therein, raising the temperature of the articles in the saggars to about 900° C., maintaining said articles at
50 this temperature for about one hour and cooling said articles to room temperature.

In witness whereof, I have hereunto set my hand this twelfth day of June, 1930.

HAROLD L. WATSON.

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