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MANUFACTURE OF INDUSTRIAL OBJECTS FROM VOLCANIC OR OTHER FUSIBLE ROCK.

1,108,007.

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No Drawing.

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To all whom it may concern:

Be it known that I, FRANÇOIS RIBBE, a citizen of the Republic of France, residing at 26 Avenue de la Gare, Mauriac, Cantal, in the Republic of France, have invented certain new and useful Improvements in the Manufacture of Industrial Objects from Volcanic or other Fusible Rock, of which the following is a specification.

10 This invention relates to an improved process for the manufacture of industrial and other objects from volcanic or other fusible rock.

The improved process is distinguished from previous processes for the manufacture of articles from volcanic rocks or other minerals by melting and molding said rocks or mineral, the distinction being due to the fact that the rocks or minerals are, after fusion and molding, but before their temperature falls below 500° C., placed in a reheating furnace, heated to about 800° C. and remain in this temperature from half an hour to an hour and a half according to the size of the object, and are then cooled very gradually. The prolonged action of the high temperature has the effect of devitrifying the substances cast, by which they acquire advantageous qualities, principally great strength and toughness. However, this action is only effective if the substances to be operated upon have high melting points and are otherwise suitable, for example basalt, lava, trachyte, etc.; but with too easily fusible substances like scoria, slag, etc., the present process does not give good results from the point of view of resistance of the products.

Basalt is typical of the volcanic rocks and will be given in the following description as an example of the substances treated. This rock, which melts between 880° and 1300° C. according to the variety thereof, is melted in any suitable furnace capable of producing the requisite temperature. it can then be brought to a spongy state similar to pumice stone by one of the three methods hereinafter given by way of examples, or it can be molded or fashioned by a fourth method without being brought to a spongy state.

First method.

The substance in a semi-fluid state is placed in a heated receptacle of preferably tall shape and of which the bottom is provided with numerous and very fine tuyers

through which a gas at a high temperature and at a convenient pressure is introduced. Part of the gas escapes but part remains in the mass in the form of bubbles which puff up the mass. Casting is done when the increase in volume of the mass is judged sufficient.

Instead of perforating the bottom of the receptacle, quartz or other pipes can be used which do not fuse at the temperatures employed and which can be in the form of very fine tuyers by which the gas is introduced into the mass as above described.

The basalt can be run in a state of fusion into a tall receptacle maintained at a suitable temperature and provided along all its height with pipes similar to those above described and arranged in quincunx in horizontal rows and through which the gas is introduced into the mass. The mass flows past the tubes and escapes at the bottom, of the receptacle gathering fresh bubbles in its passage. The bubbles drawn by the flow of the mass can in this method only slightly burst on the surface.

Second method.

To the mass in fusion coming from the furnace is added from about $\frac{1}{2}$ to 5% of a pulverized substance capable at the given temperature of producing numerous gaseous molecules of steam or other gas in the mass or which can decompose without explosion in producing a gas. Among suitable substances are basalt itself (which should be slightly heated) carbonate of lime, bicarbonate of soda, gypsum, sawdust, carbon, graphite, etc.; the substance added is mixed quickly and as evenly as possible with the mass. The action of the pulverized basalt, like that of the other pulverized inert bodies, is a result of the disengagement of the air stored up between the particles of the pulverized matter. It should not be stirred very long so as not to facilitate the escape of the bubbles. The gas given off by the mixture of graphite and carbon with melted basalt is the result of the reducing action of the carbon on the oxid of iron contained in the basalt, the oxid of iron being reduced by the carbon and the carbonic acid given off according to the well known reaction.

The gaseous bubbles are for the most part retained in the basaltic bath and produce a porous state which varies according to the spaces left and the more or less perfect man-

ner in which the mixing has been effected. Sawdust produces large bubbles; bicarbonate of soda gives smaller bubbles.

The operation can be made in any heated receptacle suitable for receiving basalt in fusion and if necessary it can be done in the mold itself. The following method is more simple: The basalt is melted either in a crucible of commercial plumbago, or in a furnace lined with plates or bricks of plumbago of the same composition. Directly the mass has become pasty the reaction commences. Certain elements of basalt combine with the carbon of the graphite and produce a gas, numerous bubbles of which are very regularly disengaged producing the porous condition of the substance. Casting is effected directly the mass reaches the volume desired. By this process objects are obtained, the density of which is notably less than that of water.

Carbon and coke only imperfectly replace graphite in the above described method.

Casting.—For the casting operation cast iron, steel, earth, earthenware, iron plate or other molds can be used. With the exception of those of iron plate, the molds should be heated to about 600° C. They are best made of several pieces to facilitate removal of the cast.

Fourth method.

Instead of being made of porous basalt certain articles can be made of solid basalt, lightened by one or more spaces. These spaces can be formed when casting by using suitable cores. Certain hollow objects could even be blown, similar to glass. Further certain objects requiring great resistant qualities can be obtained by casting in solid basalt without spaces.

Annealing.—The formed objects should be placed in a reheating furnace otherwise their exterior parts rapidly cool and become vitreous; the core only would be devitrified and take the properties of the rock. If the object were very rapidly cooled it would break spontaneously. The objects are placed in the reheating furnace either immediately after they are set in the mold or immediately after the consistency of the material is sufficient if they should be removed from the molds before baking; in all cases the articles are placed in the reheating furnace before their temperature falls below about 500° C. If solid vitreous basalt articles are required the temperature is allowed to rapidly fall to about 600° C. the remainder of the cooling process being slow and gradual. The temperature of the reheating furnace for objects to be completely devitrified is maintained at about 800° C. Below about 700° C. devitrification would not be produced; above 900° the object would take a some-

what unpleasant red color. The time necessary for the devitrification of objects varies with the temperature of the reheating furnace, the temperature of the objects placed in the furnace, the thickness and nature of the walls of the molds, etc. A period of two hours is more than sufficient for massive objects placed in the oven after removal from the mold. Porous objects contain for an equal volume less heat by reason of their lesser density and become more deeply vitrified during the casting operation. They have also to be reheated for a longer time. The devitrification being finished the objects are cooled gradually and slowly as in glass making. It is advisable to take care that the parts of each object are exposed to temperatures as near as possible equal at a given moment, this being particularly true of objects of large size.

All the objects are covered with a glaze varying in color according to the reheating temperature, particularly from the manner in which they have been first attacked by this temperature. Bronze, bluish and violet colors are the most ordinary.

The described treatment of basalt is applicable to other rocks of volcanic origin, to the lavas of Auvergne in particular. Certain modern igneous rocks obsidians for example, disengage suddenly at the melting temperature, a great quantity of gas sometimes giving rise to a veritable explosion. Mixed with other rocks in a small proportion it gives to the entire mass a very marked porous state. Several of these substances can be used for forming a single object, some forming the core and others the outer surface, the said core being either a porous or full mass.

Non-fusible and various objects capable of supporting high temperatures can be given a covering of cast basalt, this covering can be total or partial and can be thick or reduced to a simple layer, but it is necessary that the coefficients of expansion of the two bodies are approximately the same. Sand, silicious gravels, carborundum and other substances can be incorporated with basalt in the manufacture of certain objects for example paving stone.

Basalt initially vitrified and then devitrified by reheating has much greater resistance to wear and is of greater hardness than basalt devitrified in the first instance, so that in the first case basalt can be used for the manufacture of grindstones, either pure or with the addition of carborundum, for example. Colorants or decolorants as used in the manufacture of glass can be added to the fused mass to modify the colors; in some cases the objects made can be coated with artificial enamel. Further in the process where gaseous insufflation is used a gas,

can be selected, which would chemically act on the natural colorants of the different rocks so as to modify the general color.

The property which melted basalt has of adhering to iron when the latter is brought to a temperature of about 1000° C. can be utilized for making objects of armored basalt.

The elasticity of the substance, especially when porous, allows it to expand or contract with the metal without ceasing to adhere thereto.

The new products hereinbefore described are both light and very resistant, unalterable and impenetrable by damp, are bad conductors of sound, heat and electricity, are not attacked by acids, are molded as easily as plaster and are harder than marble. They are suitable for many applications. For instance they can be made into simple molded or carved building stones, guttering, flagstones, tables, tiles, grindstones, pulleys, connecting plates, basins, bricks, cornices, various pipes, insulators, columns, vases, many objects of art, knobs, door handles, curbstones, vessels, railway sleepers and various other objects too numerous to mention.

Claims:

1. The method hereinbefore described for the manufacture of objects made of molten stone which consists in melting basalt, in casting the objects from the melted mass thus formed, in placing such objects, before their temperatures has fallen below 500° centigrade, in a reheating oven at a temperature of about 800° centigrade, in maintaining the said objects at the last named temperature until such objects are completely devitrified and in cooling the said objects very slowly.

2. The method hereinbefore described for the manufacture of objects made of molten stone which consists in melting basalt, in subjecting the mass thus melted to the action of a body capable of producing bubbles, in casting the objects from the said mass thus

rendered porous, in placing the objects thus melted, before their temperature has fallen below 500° centigrade, in a reheating oven at a temperature of about 800° centigrade, in maintaining the said objects at the last named temperature until such objects are completely devitrified and in cooling the said objects very slowly.

3. The hereinbefore described method for the manufacture of objects made of molten stone which consists in melting basalt, in subjecting the mass of molten basalt to the contact of carbon for the purpose of giving off gases therein which renders such mass porous, in casting the objects from the said mass thus rendered porous, in placing the objects thus cast, before their temperature has fallen below 500° centigrade, in a reheating oven at a temperature of about 800° centigrade, in maintaining the said objects at the last named temperature until such objects are completely devitrified and in cooling the said objects very slowly.

4. The hereinbefore described method for the manufacture of objects made of molten stone which consists in melting basalt on a hearth of carbonaceous material for the purpose of giving off gases therein which renders such mass porous, in casting objects from the mass thus rendered porous, in placing the objects thus cast, before their temperature has fallen below 500° centigrade in a reheating oven at a temperature of about 800° centigrade, in maintaining the said objects at the last named temperature until such objects are completely devitrified and in cooling the said objects very slowly.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

FRANÇOIS RIBBE.

Witnesses:

DEAN B. MASON,
MAURICE ROUX.