

# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN THE MANUFACTURE OF ARTIFICIAL STONE.

Specification forming part of Letters Patent No. 88,545, dated April 6, 1869.

*To all whom it may concern:*

Be it known that I, F. COIGNET, of the city of Paris, in the Department of La Seine and Empire of France, have invented certain Improvements in the Manufacture of Artificial Stones; and I do hereby declare that the following is a full and exact description thereof, which will enable others skilled in the art to make and perform the same without further experiments and invention.

The nature of this invention consists in a special mode of manipulation, whereby, by the use of hydraulic lime, of sand, and, in some cases, the addition of a small quantity of hydraulic cement, artificial stones much harder than any artificial stones ever made from similar materials can be uniformly manufactured, my new artificial stones resisting perfectly the effects of frost, of currents of water, the infiltration of sea-water, the action of alkaline and neutral salts, and the friction of wheels.

After repeated experiments I have found that, in order to obtain uniformly good artificial stone with sand, hydraulic lime, and hydraulic cement, it was necessary, first, to regulate in a systematic manner the amount of water employed in the manufacture thereof; second, to obtain with a minimum quantity of water the lime or cement in a state of plastic or viscous paste; third, to have each grain of sand entirely lubricated and coated over with a thin stratum of this viscous paste; and, fourth, to bring each and every grain of sand in close proximity with one another in a more thorough and effectual manner than is possible in any of the present known modes of manufacture of artificial stones.

To obtain these results I proceed as follows:

*Preparation of the Lime.*—The lime I prefer to employ is the kind known as hydraulic lime, as so denominated in "Totten on Mortars," 1838, page 2.

I have found it impossible to obtain a lime-paste of the proper quality for my purpose by the ordinary methods used in making mortars, for, if we take air-slaked lime and add to it the necessary amount of water (about fifty per cent. in bulk) to obtain a paste, it would

contain too much water for my purpose. If, on the contrary, we reduce the quantity of water by using quicklime and moist sand, or slaked lime and moist or dry sand, we obtain, instead of a paste, a moist powder of lime, which remained, in the subsequent treatment, in the interstices of the stone in an inert manner, and is totally unfit for the purpose.

To prepare the lime I take of air-slaked lime one hundred, by measure, and of water from thirty to forty, by measure. This I introduce into a suitable mill, acting by compression and friction, and subject the mixture to a thorough trituration until the result is a paste which is perfectly plastic, viscous, sticky, and quite characteristic.

*Preparation of the Sand.*—Although any and every sand can be employed in the manufacture of artificial stones, yet, when it is desired to obtain special results and a maximum of hardness, it is necessary to employ none but selected or washed sand. The sand should be deprived of moisture, and for that purpose may be dried by the action of the sun or the application of artificial heat. When it becomes desirable to apply this artificial heat my plan is to place the sand in suitable chambers, and to drive through it a current of heated air; but any mode of drying the sand which can accomplish the results desired may be employed instead.

*Trituration.*—The lime-paste and sand, being mixed in the desired proportions, (see further,) are introduced into a powerful mill, into which the mixture is trituated in an energetic manner, and until, without the introduction of a further quantity of water, the paste will present the desired degree of homogeneity and plasticity. When, for special purposes, it is desirable to introduce in the mixture a certain quantity of hydraulic cement, this has to be done during the process of trituration, and the desired quantity of water, regulated by the quantity and nature of the cement employed, has to be introduced at or about the same time, so that, after proper trituration, the whole material will present the appearance of a short paste or pasty pow-



der, which is quite characteristic of my process of manipulation.

The following proportions I generally employ for divers purposes, according to circumstances and quality of materials:

Articles.	Proportions.					
	6	4	5	4	4	5
Sand, by bulk .....	6	4	5	4	4	5
Hydraulic lime, by bulk .....	1	1	1	1	1	1
Hydraulic cement, by bulk .....	0	0	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	1

It may sometimes happen that too much water has been introduced into the preparation of the paste by some cause or another. In that case I use a proportionate quantity of pozzolana or of trass, or of any burnt clay properly prepared; but I regard all such addition as detrimental to the quality of the stone, and only use it in emergencies.

By employing none but white materials a stone closely imitating white marble may be made; while by the introduction in the paste of any coloring matters, oxides, carbonates, &c., or fragments of natural stones, any shade, variegations, or texture may be produced.

In some cases it may be found more convenient to measure the different materials, to introduce them all at once in the mill, and to subject the whole to an energetic trituration, and, when it is desirable to obtain the maximum of hardness, to return the paste a second and even a third time to the mill; but in all cases the mass must be brought to the state of pasty powder or short paste, which I designate as artificial-stone paste.

*Agglomeration.*—The artificial-stone paste or pasty powder, described above, in order to become stone has to be agglomerated in molds; or, in other words, the grains of sand have to be brought in as near proximity one to the other as possible. This I hold is impossible by any of the present modes of manufacturing artificial stones, for any pressure you may apply to one, both, or every side of a block of artificial-stone paste will only agglomerate the parts close, or relatively close, to the spot where the said pressure is exerted, leaving the middle of the block porous, spongy, and open. This, which is true of small blocks, as bricks, becomes still more apparent in large blocks and in monolithic structures.

To obviate this difficulty the following is the mode of agglomerating the artificial-stone paste which I employ: We will suppose that it is desired to obtain a block of stone of two feet long, one foot wide, and one foot thick. I procure a mold the proper interior dimensions. This mold should be capable of sustaining heavy pressure, and of being taken apart at pleasure.

In this mold I introduce a certain quantity of artificial-stone paste, and, with a rake, I

spread it to about one inch of thickness, more or less, according to the kind of work and character of the materials employed. Now, with a pounder or flat-end tool, heavy and hard, and by the application of repeated and systematic action on this stratum of material, I reduce its thickness to nearly one-half its height or thickness. When this stratum is perfectly packed in the mold a new portion of material is introduced and packed in the same manner, so that, by continuing to pour in the mold new portions of stone-paste, and agglomerating said portions with the former stratums, the whole mass has been packed and compressed in a most efficient manner, and when the stone has acquired the desired thickness in the mold the said mold can be opened and the stone extracted.

In the case of masonry the molds may be made of a number of pieces of the proper shape to confine the work, and be raised as the work progresses, so as to allow of the day's work to unite intimately with the work of the previous evening, whereby an endless stone may be obtained. I do not deem it necessary to describe more at length this mode of establishing molds, as they are well understood in the construction of what are known as gravel structures or concrete constructions, where a mortar, mixed with broken stones or gravel, is dumped into the molds arranged to determine the thickness of the walls.

My invention, or the art of making endless stone by the agglomeration of sand, then consists, in systematically regulating the amount of water employed; in obtaining, by repeated or prolonged trituration, a viscous, plastic, pulverulent paste or short pasty powder, and in agglomerating the same in molds by the systematic action of a pounder, or repeated blows of a hard and heavy tool exerting its pounding effect upon successive stratums of materials.

The difference of the result obtained by my mode of manipulation is manifest when it is established that, with the same proportions of lime, sand, and cement I employ, any of the stones produced by other processes, after one year of exposure to the air, will hardly resist the crushing-weight of ten or twelve kilograms to the square centimeter, while my specimens of stones, under the same circumstances, have resisted the enormous crushing-weight of two hundred, three hundred, four hundred, and upward of five hundred kilograms to the square centimeter, as shown by the report of M. Michelot, (Ingénieur en chef des ponts et chaussées,) in his experiments made at the Conservatoire des Arts et Métiers, of France, to establish the bearing-strength of my agglomerated artificial stones. This extraordinary result is due to the fact that, in my system of manipulation, the lime employed is converted into a marble-like or limestone-like carbonate, while in the other



specimens of mortars or artificial stones it is present as a chalk-like carbonate, having no cohesive strength.

What I claim and desire to secure by Letters Patent, is—

1. The herein-described plastic, pulverulent, artificial-stone paste, composed of sand, hydraulic lime, and—in some cases—hydraulic cement, prepared substantially in the manner and for the purpose set forth.

2. In the manufacture of artificial stones or monolithic masonry, the herein-described mode of bringing the molecules of the mass in close proximity one to the other, and obtaining a hard stone by means and with the

use of a heavy and hard pounder exerting its action in a systematic manner upon successive layers of artificial-stone paste, of the character and under the circumstances substantially as herein set forth.

3. As a new article of manufacture, the stones or monolithic masonry, when made from the substances herein set forth, treated substantially in the manner specified.

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