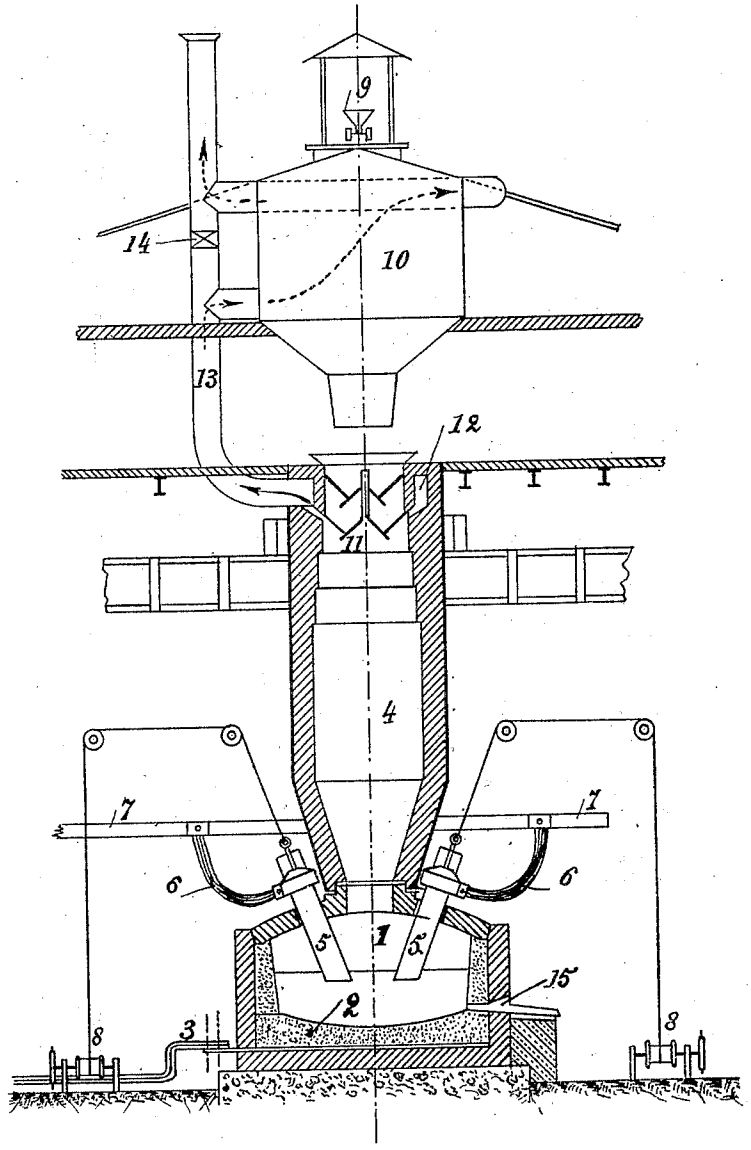
M. L. BOILLOT AND J. DAUDIGNAC.

PROCESS FOR THE MANUFACTURE OF CEMENTS AND SIMILAR PRODUCTS.

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MAURICE LUCIEN BOILLOT AND JEAN DAUDIGNAC, OF MOUTIERS, FRANCE.

PROCESS FOR THE MANUFACTURE OF CEMENTS AND SIMILAR PRODUCTS.

1,332,422. Specification of Letters Patent. Patented Mar. 2, 1920.

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To all whom it may concern:

Be it known that we, MAURICE LUCIEN BOILLOT and JEAN DAUDIGNAC, residing at Moutiers, France, have invented new and useful Processes for the Manufacture of Cements and Similar Products, of which the following is a specification.

This invention relates to the manufacture, in an electric furnace, of cements and similar so-called hydraulic products, by an integral fusion of the whole of the constituent elements of the said products, to whatever combination they belong.

It is universally admitted and recognized in the present manufacture that the temperature in the interior of the burning kiln must not reach such a degree that the materials introduced into the same should fuse, and in all kilns hitherto used, even in the most modern ones, regulation of the said temperature is exceedingly difficult, and it is necessary to stop the operation at the beginning of vitrification of the materials used. This results in the serious drawback that, after each taking out of the kiln, there is obtained a large quantity of unburnt material owing to inequalities of temperature in the various zones of the kiln. Moreover, there is a risk of the vitrified materials adhering to the walls of the kiln, as the latter cannot provide the temperature required to keep the melted materials in a liquid state, or enable a complete homogeneity of the product to be insured.

The electric furnace already commonly used in electro-chemistry and electro-metallurgy, is remarkable by the flexibility of its working; it makes it possible to obtain any temperature, from a few hundreds of degrees to that of the volatilization of coal, with the possibility of modifying its working at any moment or bringing it to the most suitable temperature for the manufacture in question.

In the process according to this invention, the constituent materials of the cement are first ground, then thoroughly mixed together without a previous treatment, and introduced into the electric furnace where they are completely melted. Owing to the considerable temperature obtained, the materials completely react on each other in order to form calcic silicates and aluminates, and transmit by radiation and conductivity part of their heat to the adjoining elements which melt. Moreover, the molten mass is kept constantly in motion by the action of the arc produced under the foot of the electrodes, and by the descent of the comparatively cool mixture into the molten mass. This results therefore in an energetic mixing insuring perfect homogeneity of the finished product which can thus be made, according to the mixture employed and to the products to be manufactured, pasty liquid or extra fluid by superheating.

The accompanying drawing given merely by way of example, shows an electric furnace in vertical section.

At its lower base is arranged the hearth 1 made of refractory materials and provided at the sides with a lining resisting the destructive action of the molten products. The hearth plate 2 of the furnace is constituted by a conducting pisé (rammed earth) resting on a current-supplying plate connected to the conductor bar 3. The arch of the hearth 1 is connected to the shaft 4 of the furnace and leaves a passage for four electrodes 5 connected by cables 6 to the other conductor bars 7. The number of electrodes varies according to the intensity of working to be obtained, the nature of the current, the method of connection and the shape of the hearth. The electrodes 5 are operated by means of winches 8.

The materials brought on a truck 9, are discharged into a receiver 10 where they are dried by the passage of the hot gases escaping through the throat 11, flues 12 and the funnel 13. A valve 14 makes it possible to regulate the passage of the hot gases. The materials drop from the receiver 10 into the throat 11, then into the shaft 4 of the furnace where they are gradually heated as they descend, by the action of the heat of the furnace and of the gases of the melting hearth, and the reactions between the various elements take place.

The molten final product after the operation has been properly carried out, is suddenly cooled by water or by air, and cast at regular intervals through the orifice 15 into movable molds.

According to circumstances and to the object to be attained, the furnace can more-

over vary in its constructional details, it could be fed by a continuous current or by an alternating current.

By means of this process, and with the use of an electric furnace, it is possible to obtain hydraulic lime and any desired artificial cements, quick-setting, half-slow, slow-setting, puzzolan, synthetic, with any indexes of "hydraulicity."

In the same way, it is possible to obtain any desired hydraulic products, of any composition, according to the mixtures to be treated and to the reactions in the furnace, and of colors varying from white to blackish gray, by the addition or suppression of reducing agent in the mixture.

This process by fusion in an electric furnace does not affect the quickness of setting of the cements, as it is possible to obtain, with suitable mixtures, quick-setting molten products that is to say quick-setting molten artificial cements.

It is also possible to obtain hydraulic products of variable density by the addition or subtraction of metal oxids, chiefly ferruginous, and any silicates of lime, aluminates of lime and silico-aluminates of lime, and therefore to imitate any natural or artificial cement.

The hydraulic products cast are of two classes:

1. Those which after the cooling disintegrate in the air and are converted into impalpable powder which does not leave any residue on screen No. 80. These products can therefore be packed at once without any additional treatment; the products removed from the electric furnace are perfectly burnt, as they are molten, and have a great resistance to tension and to compression and are also highly suitable for grinding.

2. The products remaining compact during slow or sudden cooling, which are treated subsequently like clinkers of cement kilns.

The difference found between the products of these two classes is due to proportions of silica, alumina and lime used in the mixtures, and to the time of fusion.

The quality of a hydraulic product, and therefore its commercial value, depend not only on careful manufacture, but also on the chemical constancy of the layers in the quarry used, and on the necessity of treating comparatively fusible materials at the temperature of cement kilns (1250 to 1400 degrees).

Hydraulic qualities are imparted to clays or clayey limestones generally used, by the addition of limestone or lime.

The electric furnace in which very few substances resist fusion, makes it possible to use materials which are too refractory for ordinary kilns, and generally speaking, any raw materials the elements of which can enter into the composition of hydraulic products or be simultaneously eliminated at the high temperature which it develops.

Among the raw materials treated by this process, can be used:

1. Any primitive rocks: gneiss, mica-schists, chlorite-schists and horn blende schists.

2. Eruptive and volcanic rocks; granite, quartz, porphyry, trachyte, basalt, lava, etc., and products of decomposition, sandstone slate, puzzolan, sand, comprising moreover any silico-aluminate of the feldspar class, zeoliths, micas, chlorites, schists, clays.

3. Silicates of lime, iron, groups of "augite" hornblende and "olivine."

4. Natural silicates of alumina such as andalousite, staurolithe.

5. Natural aluminates and bauxite.

6. Pure, magnesium-containing or clay-limestones and any calcium compounds such as sulfates, phosphates, tungstates, chlorids, fluorids.

7. Combinations of iron, manganese, titanium, tungsten, chromium existing in the state of impurity in the materials hereinbefore specified, or by addition to the mixtures used.

8. Slags of blast furnaces, acid or basic steel furnaces and electric furnaces with ferro-alloys.

These materials are used in accordance with their analytical composition, with connection of one or another of the constituents, and by addition or subtraction of one or more elements in order to arrive at the desired composition of the final product. The question of fusibility plays a part therefore only in the economical use of the electric energy required for the reaction, and the quantity of coal to be used depends on the quantity of oxids which have to be reduced. It is therefore always very small, with rare exceptions.

By generalizing its application, the cement industry would cease to depend on special deposits or quarries, but only on cheap electrical energy produced by waterfalls. Water power resources are however very considerable throughout the whole world, and their position is generally that of the deposits of all the materials to be used. Building of cement mills utilizing this process is therefore independent of the quarry to be worked, but depends only on the place where installation of hydraulic force will be the cheapest and where the transport of finished products is easy.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:

1. The process of manufacturing cement and the like, consisting in grinding and mixing the constituent material, melting the same in an electric furnace, keeping the

molten mass in motion by the action of the electric arc until the same is discharged from the furnace.

2. The process of manufacturing cement and the like, consisting in grinding and mixing the constituent material, melting the same in an electric furnace, utilizing the heat of the furnace to heat the materials while chargng the furnace therewith, and keeping the molten mass in motion by the action of the electric arc until the same is discharged from the furnace.

In testimony whereof we affix our signatures in presence of two witnesses.

MAURICE LUCIEN BOILLOT.
JEAN DAUDIGNAC.

Witnesses:
CHAS. P. PRESSLY,
J. LEBSEUR.