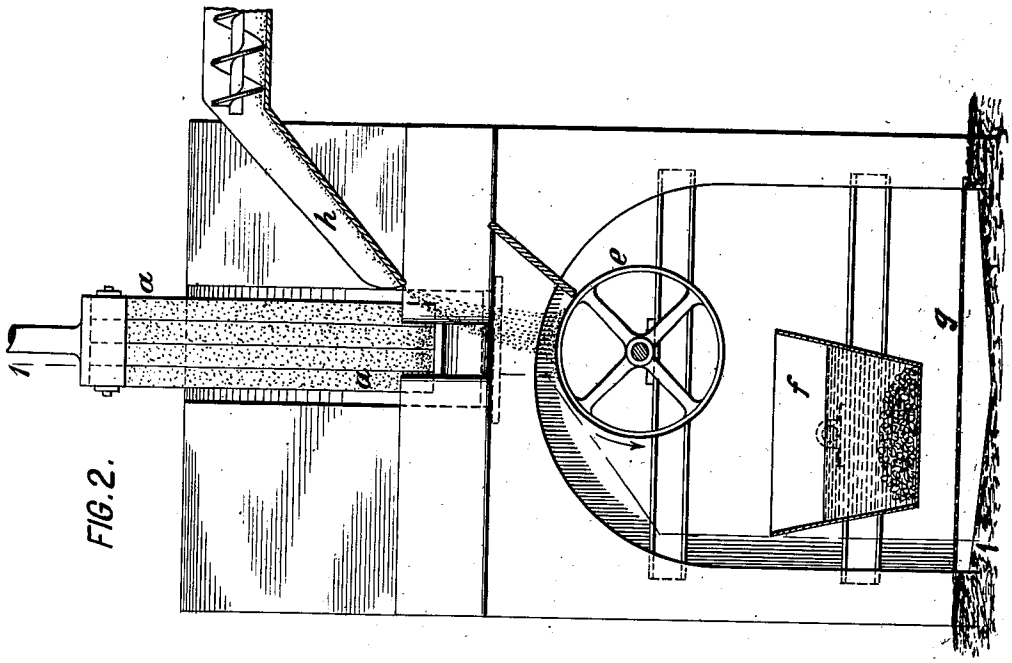
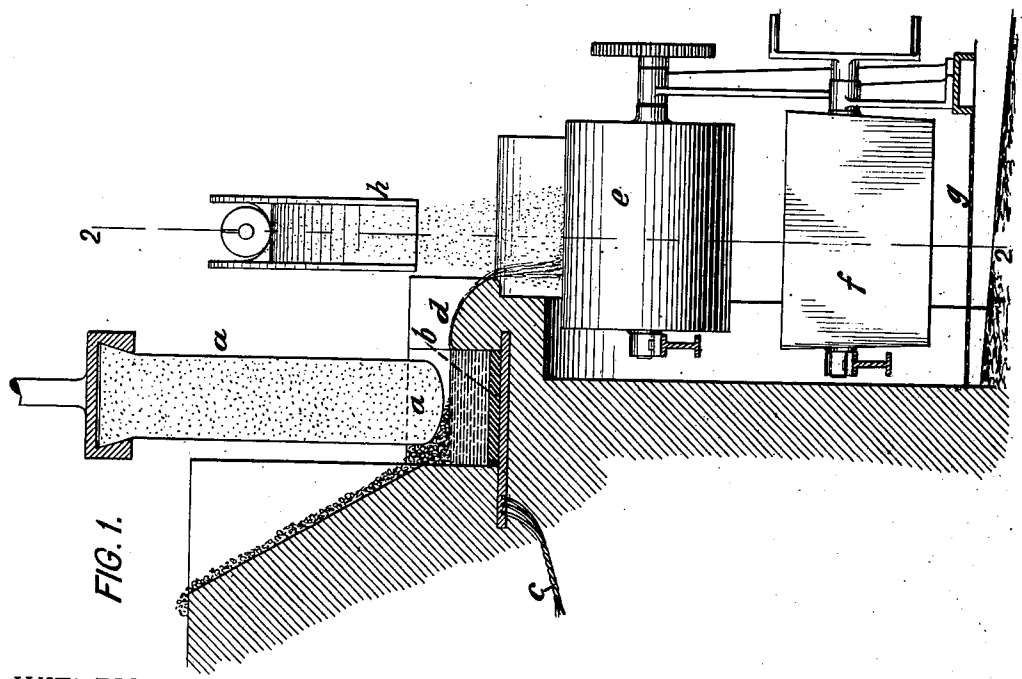
(No Model.)

G. DE CHALMOT.

TREATMENT OF PHOSPHATES.

No. 588,266. Patented Aug. 17, 1897.





WITNESSES:

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TREATMENT OF PHOSPHATES.

SPECIFICATION forming part of Letters Patent No. 588,266, dated August 17, 1897.

Application filed December 20, 1895. Serial No. 572,733. (No specimens.)

To all whom it may concern:

Be it known that I, GUILLAUME DE CHALMOT, a subject of the Queen of the Netherlands, (having declared my intention of becoming a citizen of the United States,) residing in Leaksville, in the county of Rockingham and State of North Carolina, have invented certain new and useful Improvements in the Treatment of Phosphates, of which the following is a specification.

This invention relates to an improved treatment of phosphates, and especially natural phosphates or phosphate-rocks, the purpose of which is to render the phosphoric acid contained in them more soluble and available as plant-food.

I have discovered that if natural phosphates are molten in an electric furnace the phosphoric acid contained in them becomes more soluble. I have also found that the phosphate should not remain in the furnace after it is fused, but should be removed as quickly as possible, as otherwise the amount of available phosphoric acid decreases by a part of the phosphoric acid becoming reduced or volatilized. I have also found that if the molten phosphate is run into and mixed with sand this treatment renders the phosphoric acid still more soluble.

I have practiced my invention with a red phosphate-rock containing twenty-three per cent. of phosphoric acid, but almost worthless for fertilizing purposes, since only 1.39 per cent. of the phosphoric acid is soluble in Wagner's citrate solution. After treatment according to my invention, even without mixing with sand, the resulting phosphate contains 29.50 per cent. phosphoric acid, of which 9.5 per cent. is soluble in the citrate solution.

In practicing my invention I employ an electric furnace comprising a hollow hearth having a bottom of carbon or other conducting material connected with one electrode and a pencil or pencils of carbon arranged above the hearth and connected with the opposite electrode or terminal of a suitable dynamo or (in case of alternating currents) with the opposite terminals of a transformer. The phosphate-rock, broken into lumps of suitable size, is placed in the furnace, and an arc is started by which the phosphate is fused and accumulates in a pool on the hearth, more phosphate-rock being added until after a time the molten phosphate stands high enough in the furnace to run over the wall of the hearth on one side. Fresh rock is fed into the furnace as fast as it becomes molten, and consequently the molten phosphate continues to run over and flow out immediately. By this means the reduction of the phosphoric acid is almost wholly prevented. Only that portion of the molten phosphate which is at the bottom of the pool becomes reduced, and this portion remains in the furnace. The molten phosphate which overflows from the furnace is caused to fall immediately onto sand, and more sand is sprinkled over it. The partial reaction which thus occurs increases the proportion of soluble phosphoric acid. The phosphate while very hot is then dumped into water, which causes it to crack in all directions, so that it can easily be crushed. After cooling, the phosphate has only to be finely crushed or reduced to a fine powder to be immediately available as a fertilizer.

The accompanying drawings illustrate the construction of furnace and accessory apparatus suitable for practicing my invention.

Figure 1 is a vertical section, and Fig. 2 is a vertical transverse section cut on the line 2 2 in Fig. 1.

Let *a* designate the carbon pencil or electrode of the furnace, which is built up usually of slabs of carbon carried by a suitable head or holder and adjustable vertically, and *b* the hearth or crucible or cavity of the furnace, which has a bottom layer of carbon superposed, preferably, upon a plate of iron connected by copper cables *c* to one terminal of the dynamo or transformer, while the holder for the carbon pencil is connected to the opposite terminal. The furnace is constructed with a wall *d* on one side somewhat lower than the other walls and arranged to slope outwardly to facilitate the overflowing of the molten phosphate. The phosphate which flows over this wall falls onto a slowly-revolving iron cylinder *e*, mounted beneath the furnace and rotated by any suitable means. Above this cylinder is arranged a hopper or chute *h*, from which sand is discharged upon the cylinder, falling sufficiently to one side, as shown in Fig. 2, to strike the cylinder before the phosphate can fall upon it, in order to cover its surface with a layer of sand and prevent as far as possible direct contact of

the hot phosphate with the iron of the cylinder. Some of the sand, however, falls upon the phosphate, so that the latter is thus brought thoroughly into contact with the sand both above and below. The cylinder is protected by the sand from the heat of the phosphate, and being hollow it is able to rapidly cool on all sides by radiation, or it may be cooled by a current of water, as by playing a hose upon it or running water into it. Beneath the cylinder is arranged a water-tank *f*, into which as the cylinder slowly revolves the phosphate is caused to drop. As the phosphate-rock falls into the water it cracks in all directions, so that it can afterward easily be reduced to a fine power. When most of the water in the tank has evaporated, the tank, which is mounted on trunnions, is turned over, so as to dump out the phosphate, which falls on a sieve or grating *g*. The phosphate remains on the grating and the water flows off.

The wall *d* of the furnace is made best of phosphate-rock and can at any time be easily replaced. The bottom of the furnace-hearth remains always covered with liquid phosphate which cannot run off. This is of great practical advantage, because the phosphate becomes reduced where it touches the carbon bottom, and calcium phosphide is formed, which is not a plant-food, but, on the contrary, is somewhat poisonous. By making the bottom of the furnace of molten phosphate the reduction of the phosphate that runs over is greatly diminished.

I have employed by preference an alternating electric current whereby electrolytic action is avoided, but my invention may nevertheless be practiced with a continuous current.

The action of my process in increasing the solubility of the phosphoric acid may be due partly to the formation of silico-phosphate of lime according to the equation

$$Ca_3P_2O_8+SiO_2+2CaCO_3=5CaO,P_2O_5,SiO_2+2CO_2.$$

In these reactions Fe or Al may replace Ca. In this equation both SiO_2 and $CaCO_3$ are supposed to preëxist in the phosphate, which is generally the case. The rock which I have used contained 3.22 per cent. of SiO_2; or it is possible that a part of the iron oxid and alumina is disunited from the phosphoric acid by the high heat; or it is possible and even likely that other reactions are involved the nature of which is as yet not known. The fact that phosphate containing only as little silica as 3.22 per cent. can be made soluble by my process points in this direction.

I do not claim in this application the electric fusing of a mixture of phosphate-rock and sand or silica, as I have made another invention involving that process, which is made the subject of a separate application for patent, filed December 21, 1895, Serial No. 572,842.

I am aware that phosphates have been heated with carbon in an electric furnace to drive off and reduce the phosphoric acid to produce phosphorus, but this is a different process from my invention. I employ no reducing agent and aim not to drive off the phosphoric acid and not to reduce it, nor do I employ any fluxing materials which would promote the liberation of phosphoric acid, but, on the contrary, avoid their use. In fact the opposite expedient of adding lime, which would prevent loss of phosphoric acid, would be within the practical application of my invention. I resort, therefore, to the simple fusion of the phosphate at a high temperature without the addition of either a reducing agent or a flux, and by this process produce the new result of so altering the character of the phosphate as to greatly increase its proportion of soluble and available phosphoric acid.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. The treatment of natural phosphate-rock containing silica, alumina, or iron oxid by simple fusion in an electric furnace, whereby the proportion of soluble phosphoric acid is increased, and immediately removing the molten phosphate from the furnace, whereby its reduction is prevented.

2. The treatment of natural phosphate-rock containing silica, alumina, or iron oxid, by fusion in an electric furnace, whereby the proportion of soluble phosphoric acid is increased, removing the molten phosphate from the furnace, and bringing it into contact with silica, whereby the phosphoric acid is rendered still more soluble.

3. The treatment of natural phosphate-rock containing silica, alumina, or iron oxid, by simple fusion in an electric furnace, without the addition of a reducing agent, and causing the molten phosphate to overflow at the top, whereby the reduction of the phosphate which is thus discharged is prevented, the reduced phosphate which is confined to the bottom of the molten mass being retained in the furnace.

4. The treatment of phosphate by fusing it in an electric furnace, and causing the molten phosphate to overflow from the top of the furnace, dropping it onto silica, and sprinkling silica over it.

5. The treatment of phosphate by fusing it in an electric furnace, removing the molten phosphate from the furnace and bringing it into contact with silica, and then while still hot dropping it into water.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

G. DE CHALMOT.

Witnesses:
J. M. HOPPER,
S. P. JARRETT.