

I. HECHENBLEIKNER.  
 METHOD OF TREATING GASES.  
 APPLICATION FILED DEC. 29, 1917.

Patented Apr. 1, 1919.

1,299,337.

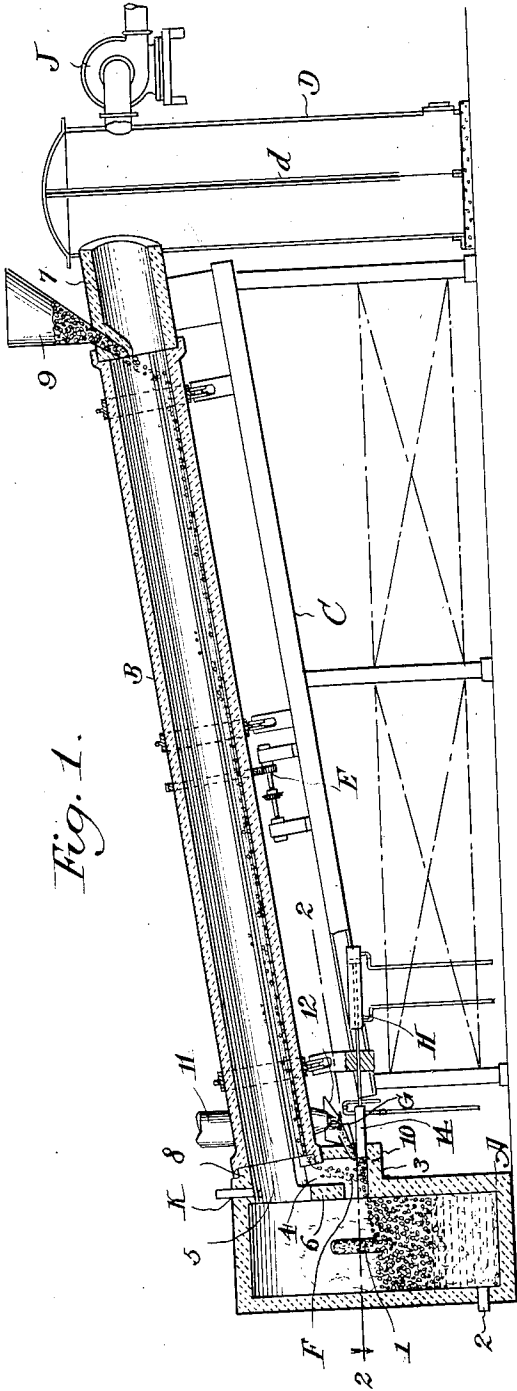


Fig. 1.

Fig. 4.

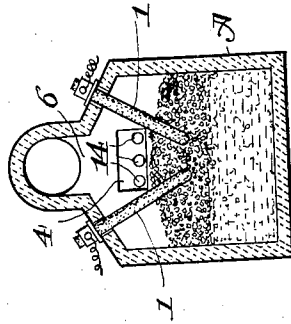


Fig. 3.

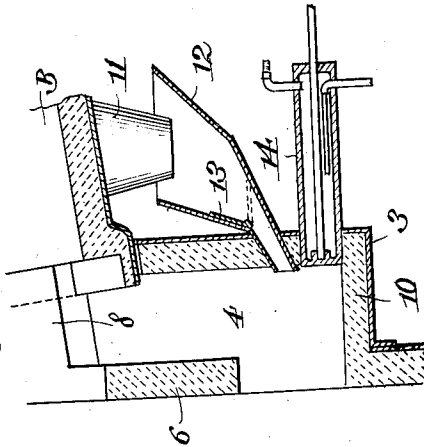
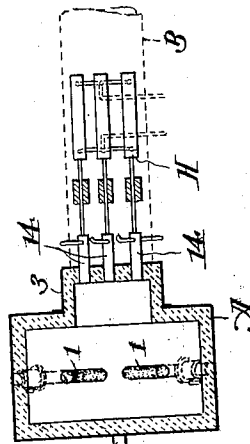


Fig. 2.



Inventor,  
*Ingenuin Hechenbleikner*  
 By his Attorneys  
*Meyers, Cushman & Rea*

# UNITED STATES PATENT OFFICE.

INGENUIN HECHENBLEIKNER, OF CHARLOTTE, NORTH CAROLINA, ASSIGNOR TO SOUTHERN ELECTRO-CHEMICAL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

## METHOD OF TREATING GASES.

1,299,337.

Specification of Letters Patent.

Patented Apr. 1, 1919.

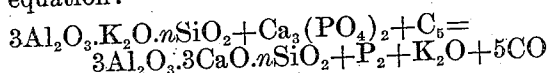
Application filed December 29, 1917. Serial No. 209,577.

To all whom it may concern:

Be it known that I, INGENUIN HECHENBLEIKNER, a citizen of the United States, residing at Charlotte, in the county of Mecklenburg and State of North Carolina, have invented new and useful Improvements in Methods of Treating Gases, of which the following is a specification.

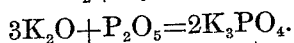
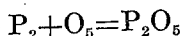
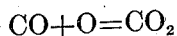
This invention relates to the treatment of ores or minerals containing potash or phosphorus, the method being particularly useful in the preparation of fertilizing material. In the patent to Max M. Haff, dated February 20, 1912, No. 1,018,186, is set forth a process for obtaining phosphate of potash, and in which process feldspar (orthoclase) as the source of potash and calcium sulfate as the source of phosphorus are heated in an electric furnace.

As contradistinguished from the process set forth in said patent I subject a mixture or charge of feldspar, calcium phosphate and the carbonaceous material, such as coke, to the action of an electric furnace so that the reaction is represented by the following equation:



wherein  $n$  is any figure.

After the oxidation of the phosphorus gases with air or oxygen the reaction is



Therefore, it is essential to insure the presence of a large amount of carbonaceous material to produce the desired results.

In the practice of my method I also employ an electric furnace, but use in connection therewith a rotary kiln arrangement into which I feed a mixture composed of feldspar and calcium phosphate, and with the rotation of the kiln this mixture is fed downward into the furnace, and at its point of entry the furnace is supplied with, or has added thereto a body of carbonaceous material such as coke. The air necessary for the oxidation is preferably admitted at or near the lower or discharge end of the rotary kiln. The size and length of the rotary kiln which I use in the practice of

my method is dependent upon the character and amount of the mixture employed, and the use of such kiln is exceedingly important in several respects in the successful conduct of my method. First, the heated gases issuing from the electric furnace travel up through this rotary kiln and preheat the mixture or mass of phosphate rock and feldspar moving down the kiln to the furnace, and at the same time by introducing the carbonaceous material at the point of entry of the mixture into the furnace I obviate the objection of preheating and preliminarily or partially consuming the carbonaceous material which would occur were it fed into the rotary kiln along with the phosphate and potash materials. Second, another important advantage of the use of such a rotary kiln in connection with my method is that it serves to purify the gases escaping from the furnace. It is well known that in the treatment of a mixture of phosphate rock and silicious material, or silicious material containing potash, the materials used contain certain impurities which have a decided influence on the commercial operation of the process. For instance, in such mixtures calcium fluorid is sometimes present in quantities as high as 10%, and in the action of the electric furnace and under subsequent re-oxidation, gases or vapors are formed which contain not only phosphorus pentoxid, potassium oxid and carbon dioxid, but also certain impurities, such as silicon fluorid, silicon dioxid and the like, in addition to some mechanical dust. I have found that by passing these gases and vapors through a properly constructed and proportioned rotary kiln some of the constituents of the gases and vapors, especially those constituting impurities, such as  $SiO_2$  and  $SiF_4$  will be removed or eliminated from the outgoing gases by being absorbed, through chemical reaction, by the incoming charge in the kiln and fed back into the furnace from which products may be removed with the slag. In the practice of the method it is necessary that the gases or vapors while in the rotary kiln be subjected to a temperature sufficiently high to prevent the condensation of the potassium phosphate or the phosphoric acid, yet low enough to allow of the before mentioned elimination of the impurities, such as the

SiO<sub>2</sub> and SiF<sub>4</sub>. Thus the length and diameter of the kiln should be proportioned to the amount of charge for the furnace operation. It is also desirable to regulate the pressure of the gases in the kiln in such manner as to prevent the condensation of the phosphoric acid and potash vapors, as a relatively large pressure will result in the condensation of these latter. Therefore, after leaving the rotary kiln the gases are treated in a scrubbing system such for instance as is shown in my earlier Patent No. 1,112,211, or in an electric precipitator system for the recovery of the phosphoric acid and the potash, the proper pressure being maintained on the rotary kiln with the aid of an exhaust fan located beyond the latter, thus enabling the gases to be drawn through the system by suction. In the accompanying drawing I have shown one apparatus by means of which my method may be practised.

In the said drawings;

Figure 1 is a view partly in vertical longitudinal section and partly in elevation of an apparatus for practising my method.

Fig. 2 is a horizontal sectional view taken through the electric furnace on the line 2—2 of Fig. 1 and looking in the direction of the arrow.

Fig. 3 is an enlarged vertical sectional view of a portion of the apparatus where the rotary kiln discharges the charge to the electric furnace.

Fig. 4 is a transverse vertical sectional view taken through the electric furnace and showing the even distribution of the charge therein.

Referring now to the accompanying drawings in detail, the letter A indicates the electric furnace provided with the usual carbon electrodes 1 and the tap hole 2 for the slag. This furnace is made practically air-tight, as is desired in an apparatus of this type for reasons now understood in the art, and adjacent its upper end is formed with an extension 3 having a passage 4 through which the charge of material passes on its way to the furnace, and a gas exit passage 5 leading from the furnace to the rotary kiln B, these two passages 4 and 5 being separated by a partition wall 6. The rotary kiln B is mounted on a suitable supporting frame C, this kiln being supported at one end upon a pipe section 7 connected with a dust collector D, the opposite end of the kiln being supported upon the collar or neck 8 forming part of the wall of the gas exit passage 5. As will be seen by reference to Fig. 1, the rotary kiln is inclined upward from the electric furnace to the dust collector and is intended to be revolved by means of any suitable mechanism, such as is conventionally shown at E in said Fig. 1, the ends of the kiln finding bearings on the pipe

section 7 and the neck 8, as just described. The pipe section 7 connecting the kiln with the dust collector D is provided with a suitable hopper 9 into which is dumped certain ingredients of the mixture to be fed into the electric furnace, such as the phosphate rock and the feldspar. Under the rotation of the kiln this material is fed slowly down the latter, traveling through a path of such a length as to be preheated by gases flowing up through the kiln. At the discharge end of the rotary kiln this material shown at F drops onto the floor 10 of the feed passage 4, and is there mixed with coke or other carbonaceous material indicated at G, such coke being fed down through the spout 11, and into the hopper 12 which discharges into the passage 4, as will be clearly understood by reference to Fig. 3. This hopper is provided with a hinged controlling gate 13 for the obvious purpose of controlling the supply of coke allowed to enter the electric furnace.

The now complete charge consisting of the feldspar, phosphate rock and coke is mixed in the feed passage 4 and fed into the furnace by means of the reciprocating water-cooled plungers 14 of the stoking mechanism, which is indicated as an entirety by the letter H. There are several advantages incident to this manner of feeding the complete charge into the furnace. In prior apparatus of this general type where the coke is fed into the kiln with the rock and sand mixture such coke in its passage through the kiln becomes heated and partially consumed so that its efficiency as a reducing agent is greatly impaired by the time it enters the furnace. Furthermore, with the usual type of apparatus where the mixture was simply fed into the furnace by gravity, it usually formed a pile or bank at one side of the furnace instead of being evenly distributed over the entire combustion zone of the latter. This was due to the fact that no adequate means has been provided for spreading or leveling the charge in the electric furnace, and obviously it is impossible to do this by hand stoking owing to the enormously high temperature of the furnace as well as the closed nature of the latter. By the arrangement of feed passage and stoking mechanism as herein shown I am enabled to feed fresh coke mixed with the preheated rock and silicious material evenly and uniformly to the furnace so that the bed in the furnace will be substantially level with reference to the electrodes and thereby give the best possible results of combustion and production of gases.

Under the heat of the electric furnace, the gases or vapors hereinbefore mentioned are generated and passing out through the exit passage 5 enter the rotary kiln B, passing up the same and preheating the mixture flowing down the latter. As before indi-

cated the rotary kiln is of such length and diameter that the impurities in the gases or vapors such as the silica and silicon fluorid are condensed will be removed or eliminated from the outgoing gases by chemical absorption by the incoming charge and under the rotation of the kiln are carried back to the furnace and drawn off with the slag. Of course the length of the kiln will depend to a considerable degree upon the amount and character of the charge, in some instances a kiln of the length of 60 feet being admirably adapted for an ordinary charge. Phosphorus and potash vapors and gases, however, require a lower temperature for condensation, and under the action of the suction fan J are drawn through the kiln and pipe section 7 to the dust collector D where any fine mechanical dust which may have been drawn through is trapped or caught, as the gases must pass down around the usual partition *d* in the dust collecting chamber. After the phosphorus and potash gases pass through the dust collector they are conducted to the usual scrubbing system or to an electric precipitator where they are condensed and concentrated, as is well understood in this art.

As the gases leave the electric furnace and just before they enter the rotary kiln they are subjected to oxidization through air or oxygen admitted through an air inlet K which preferably communicates with the upper portion of the passage 5, the air being drawn in at this point under the velocity of the gases passing out of the electric furnace to the rotary kiln.

While I have herein shown and described one apparatus for carrying my invention into effect, I wish it to be understood that such method is not limited to practice with this particular apparatus, but other modification and variation may be made in such respect without departing from the spirit of the invention or exceeding the scope of the appended claims.

What I claim is:

1. The herein described method which comprises subjecting a mixture of phosphate rock, a silicious mineral containing potash and a carbonaceous substance to the heat of an electric furnace to volatilize the same, then oxidizing the resultant gases, and then removing or eliminating certain impurities

of the gases, such as  $\text{SiO}_2$  and  $\text{SiF}_4$ , while maintaining the potash and phosphate substances in gaseous form.

2. The herein described method which comprises subjecting a mixture of calcium phosphate, feldspar and coke to the action of an electric furnace to volatilize the same, then oxidizing the resultant gases after they leave the furnace and then removing or eliminating certain constituent gases such as  $\text{SiO}_2$  and  $\text{SiF}_4$  while maintaining the potash constituents in gaseous form.

3. The herein described method which comprises mixing phosphate rock and feldspar and passing the same along a relatively long path to an electric furnace, the said mixture being preheated in its passage to the furnace, mixing coke with the preheated mixture of phosphate rock and feldspar at the point of entrance of the latter to the furnace, subjecting the charge to the heat of the furnace to volatilize the same, then oxidizing the resultant gases, and then removing or eliminating certain impurities of the gases while maintaining the potash and phosphate substances in gaseous form.

4. The herein described method which comprises heating a mixture of phosphate rock, a silicious mineral and a carbonaceous substance in an electric furnace to volatilize the same, then oxidizing the resultant gases, then passing the gases through a rotary kiln and in contact with an incoming charge of the mixture to remove certain constituents from the gases and which constituents are returned to the furnace with the incoming charge.

5. The herein described method which comprises heating a mixture of phosphate rock, a silicious mineral containing potash and a carbonaceous substance in an electric furnace to volatilize the same, oxidizing the resultant gases, then passing said gases through a rotary kiln and maintaining the gases at such a temperature as to remove or eliminate certain impurities such as  $\text{SiO}_2$  and  $\text{SiF}_4$ , while maintaining the potash and phosphate substances in gaseous form, freeing the gases from the dust, and then subsequently condensing the potash and phosphate gases.

In testimony whereof I have hereunto set my hand.

INGENUIN HECHENBLEIKNER.