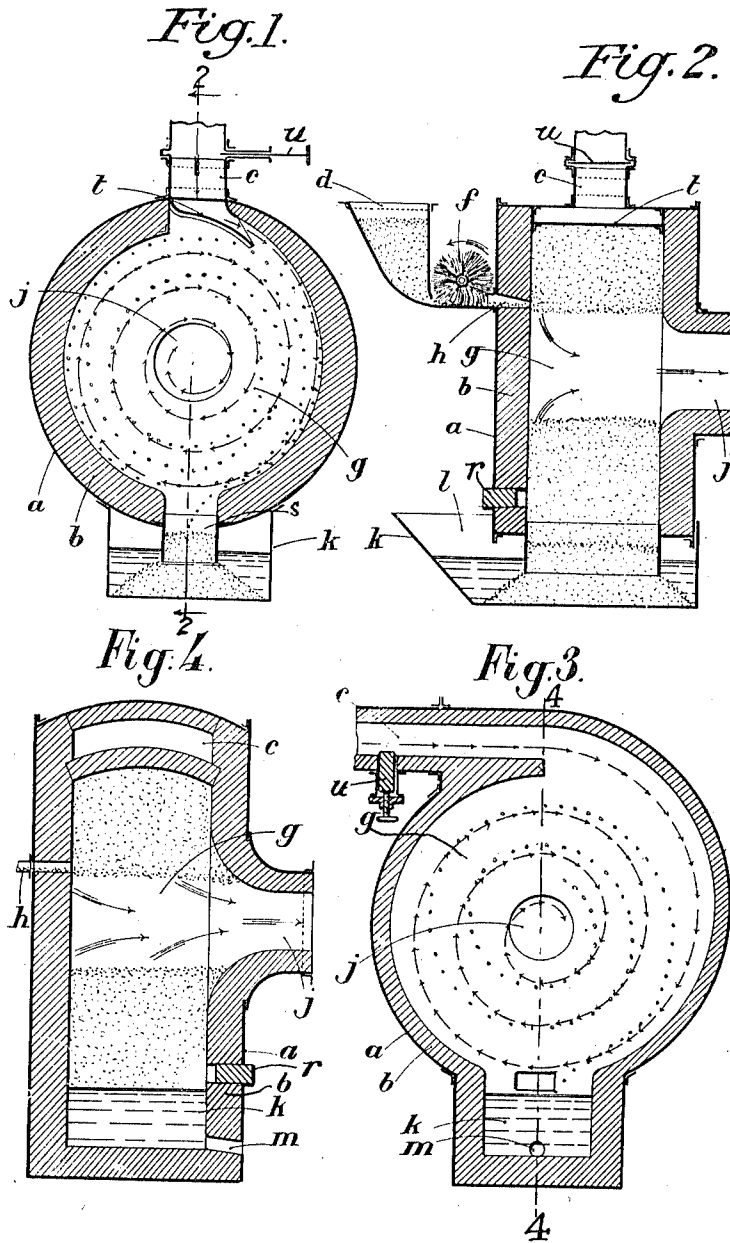


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METHOD OF TREATING PULVERULENT SUBSTANCES.
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Patented May 13, 1913



Witnesses.

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METHOD OF TREATING PULVERULENT SUBSTANCES.

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To all whom it may concern:

Be it known that I, EMILE GOBBE, subject of the King of Belgium, residing at Jumet, in Belgium, have invented certain new and useful Improvements in Methods of Treating Pulverulent Substances, of which the following is a specification.

This invention relates to an improved process for treating pulverulent substances, whether such treating consists in gasifying, burning, oxidizing, baking, fusing or similar operations.

The treatment as hereinafter described can be performed in numerous kinds of apparatus adapted for such purposes, but to make the description of the process clear, an apparatus has been illustrated in the accompanying drawings, which is especially adapted for carrying out the improved process.

In these drawings, Figure 1 is a vertical section of an apparatus designed to burn, gasify, oxidize, bake, etc., substances which remain pulverulent during and after their treatment without becoming fused. Fig. 2 is a vertical section taken on line 2—2 of Fig. 1. Fig. 3 is a vertical section of an apparatus adapted to treat fusible substances. Fig. 4 is a vertical section taken on the line 4—4 of Fig. 3.

The apparatus disclosed in Figs. 1 and 2 consists of a plate-iron receptacle *a* having a cylindrical form closed by two vertical walls plane or arched. This casing is furnished interiorly with a refractory lining *b*. At the upper part of Fig. 1 and of Fig. 2 is shown a conduit *c* by which a draft is created under pressure tangentially to the curved interior surface of the apparatus. A damper *u* controls the conduit *c* and regulates the amount of the draft admitted therethrough. A hopper *d* holds in reserve a certain quantity of pulverulent substances and a rotary metallic brush *f* projects these substances into the working space *g* through a small opening *h* arranged a little above the opening *j* by which the fumes exhaust and which is located at the center of the apparatus. A metallic reservoir *k* with or without a liquid seal receives the baked substances which are extracted mechanically or by a scoop through the opening *l*. Let us suppose that it is desired simply to burn a combustible pulverulent substance in this apparatus in order to cause it to operate as a furnace for powdered coal. In order to

set it in action first the working space *g* must be heated by burning therein wood, petrol, gas or other combustible which may be introduced through an opening which is normally sealed by the closure *r*. The fuel so introduced may be ignited through the opening *s* (Fig. 1) or *m* (Fig. 4). After the working space *g* has attained the proper temperature powdered coal is shot in by starting the metallic brush *f* and by supplying at the same time a draft by the conduit *c*. Owing to the oblique surface *t* the draft enters tangentially at the curved interior surface of the working space and describes in the apparatus a spiral which is drawn gradually toward the central exit where the exhaust *j* of the flames or fumes is located, as is indicated by the arrows. The powdered coal is lighted immediately on entering into the apparatus where it whirls with the draft which draws it; but the centrifugal force causes the solid matters to gradually approach the periphery of the cylinder, following the spiral indicated by the dots. The coal ashes are stopped in their centrifugal movement and roll then against the circular wall from whence they fall continuously into the ashpit *k*, without adhering to the walls, since these are relatively cool as a result of being constantly swept by the cool air which the ashes have to traverse, the latter being thus also cooled before coming into contact with the walls.

By regulating in a convenient manner the proportion of air and powdered coal a perfect and smoke-consuming combustion could be obtained since the combustion is effected in a rational and methodical manner. In fact, the combustible enters thoroughly into the bed of air which whirls with it; it at first drops as soon as it arrives at the periphery of the central exit of the apparatus; it is rapidly heated in the flame and when it has attained its maximum temperature it meets with air increasingly rich in oxygen, in which it immediately burns without any particle being able to escape combustion. Further, as the coal dust whirls with the flame the combustible and the flame are for a long time in intimate contact, which insures their perfect and complete combination without it being necessary to reduce the combustible to an impalpable condition as is necessary in the case of burners now in use in which already coal dust is employed, and in which the combus-

tion is spontaneous but unmethodical. In fact in the process heretofore known the cold air and the powdered coal enter together into the apparatus in the form of a horizontal jet which is intended to burn spontaneously, but the small grains escape combustion since there is hardly any oxygen at the extremity of the flame and the contact between the combustible and the flame is of too short duration. Further, with the old process the coal ashes which result from the combustion are drawn with the flame; while my apparatus retains them by centrifugal force and only allows a flame properly so called to exhaust by the central conduit *j* at an intense temperature capable of heating directly any kind of furnaces or different objects which may be placed in this flame, or even of bringing to incandescence Auer mantles thus producing illumination with a solid combustible costing much less than gas or electricity.

The same apparatus can serve for producing air-gas without the necessity for any modification. For this purpose it is sufficient to introduce into the apparatus proportionately more coal dust and less air in such a manner that the carbonic acid which is formed especially at the periphery of the apparatus where the air arrives rich in oxygen, is transformed into oxid of carbon by contact with the red carbon which it encounters in its passage before issuing through the central opening *j* drawing with it the hydrocarburets resulting from the spontaneous distillation of the coal after its entry into the apparatus. If the proportion of air and coal dust is properly regulated a perfect gas will be obtained without any manual operation since the charging of the coal and the removal of the ashes can be effected mechanically. Further this very simple gasogene will be less expensive in construction and less cumbersome and will have nevertheless the great advantage of being able to transform into gas large quantities of pulverulent combustible by reason of the spontaneity of the combustion due to the large contact surface of the combustible and the flame and to their intimate and orderly admixture. This apparatus thus advantageously acts as a substitute for all gasogenes, Siemens and others, which are very expensive in construction and require manual operation which is troublesome and difficult.

The same apparatus might also be employed without modifying it for baking lime, cement, or other non-fusible pulverulent substances. For this purpose it is sufficient to mix the combustible and the substance to be baked in proper proportions and to introduce the pulverulent mixture in the hopper *d*. After the mixture enters into the working chamber *g* it whirls with the

gases and the combustible burns spontaneously in the very middle of the substance, the baking of which is effected also spontaneously and in an orderly manner such that this after having passed through the cool air is stopped by the circular walls and falls into the ash pit *k* from which in this case the water is left out in order to enable the baked substances to be extracted in the dry condition either by means of a scoop or by a mechanical carrier or extractor of any kind. In this case again the substances are baked in a rational and orderly manner which is at the same time economical and extremely rapid since the substances are treated in the pulverulent condition and are baked in the very middle of the flame, that is to say, at the spot where the heat is generated to be immediately absorbed, that is by the substances which are also heated methodically at the same time cooling the hot gases before their exit from the apparatus through the central opening *j*. Further, the baked products also give up their heat to the cool air which circulates at the periphery of the apparatus, before falling cooled into the ash pit. This very simple apparatus involving but a slight expense and trouble, will with advantage replace lime furnaces and above all large rotary furnaces for cement which are at present heated with powdered coal but by an irrational and uneconomical method as I have explained above.

Figs. 3 and 4 represent in longitudinal section and in transverse section the same apparatus constructed in such a manner that it can be fed with hot air or with combustible gas in order to enable pulverized substances of a fusible nature to be treated therein. In this apparatus the same letters indicate the same parts as in Figs. 1 and 2. The metallic brush which projects the powdered substances into the apparatus is not shown since I do not attach any importance to the process which will be employed therewith, seeing that all processes already known may be employed especially the direct projection of the powdered substances after their exit from the pulverizer or their projection by an air jet which it would be advisable in the present case to replace by gas which could be taken from the exhaust exit *j* of the apparatus in order to be returned by the aid of a blower through the opening *h* together with the powdered substance drawn therewith, since if air should be introduced at this point a part of the gas which issues through the central opening *j* would be there burned uselessly. The opening *c*, by which the draft is introduced, is furnished interiorly with a refractory lining, in order that a superheated draft or flame, or a mixture of air and combustible gas may be supplied. The ashpit *k* is also

of refractory material since it has to receive melted substances which from time to time will be poured away through the tap-hole *m*.

Let us suppose that it is desired to employ this apparatus for manufacturing cast iron, for example, with the same substances as those employed in the blast furnaces but treating them in the pulverulent condition. A jet of powder will be shot through the openings *h*, including a mixture properly proportioned of ore, carbonate of calcium, and coal, then a draft, preferably hot, will be blown in through the conduit *c*. The pulverulent mixture will whirl with the gas which will be heated at first in the central zone, then will enter into the reducing zone, where the ore will be reduced by contact with the oxid of carbon, and where the carbonate of calcium will be transformed into lime (although it might not be advantageous to supply lime already baked, which is easily pulverized, as appears to be indicated in this case). In proportion as the substance approaches the periphery of the apparatus, it will become fused, and the mixture of cast iron and slag will be projected by centrifugal force against the circular walls, whence it will drop into the lower reservoir *z*. The air, while drawing the pulverulent substances into its whirl, will go in the contrary direction as it approaches the center, at the same time burning the carbon, first into carbonic acid, then into oxid of carbon, in order to escape, under this latter form, through the central opening *j* with the gases which proceed from the spontaneous distillation of the pit-coal.

This apparatus which is very simple, and of small dimensions, thus works in the same manner as a blast furnace but with this great difference that it treats the substances in the pulverulent condition, which present very considerable surfaces of re-action and thus produce spontaneously the combustion of the coal and the fusion of the substances which explains its considerable output in spite of its small dimensions. Further, it will no longer be necessary to give a high pressure to the forced draft since this will meet with but a low resistance in the apparatus, the air in its circular movement carrying the pulverulent substances in the same direction. Finally this apparatus can be fed with coal dust instead of coke in large pieces that is to say with a combustible much less expensive, it will give nevertheless a gas richer in calorific capacity, since it will include the gases of distillation and will consequently serve for heating metallurgical furnaces. It is evident that if any

other ores whatsoever should be introduced into this apparatus they will be treated with the same facility. It could even be fed with a mixture of very fine sand, lime, sodium or other fluxes finely pulverized, in order to melt glass under very economical conditions. In this latter case however it will always be preferable to replace coal dust by a mixture of air and gas which might be introduced through the conduit *c*, since glass is injured by contact with solid coal which tints it or makes it cloudy. Glass is also injured by contact with the ashes.

I claim:

1. The method of treating pulverulent substances which consists in forming a rotating hollow cylindrical mass of the same by admitting the substance at substantially the central part of said mass and mechanically distributing the same substantially over the entire width thereof, admitting a tangential draft at the periphery of said mass and over substantially the entire width thereof, igniting the incoming substance, collecting the resultant products at the periphery of the rotating mass and discharging the gases at the central part thereof whereby a melting zone is formed at the periphery of the rotating mass, a heating zone at the central part thereof, and a reduction zone intermediate the said melting and heating zones.

2. The method of treating pulverulent substances which consists in forming a rotating hollow cylindrical mass of the same by admitting the substance at substantially the central part of said mass and mechanically distributing the same substantially over the entire width thereof, igniting the incoming substance, admitting a tangential draft at the periphery of said mass and over substantially the entire width thereof and discharging the same at the central part of the rotating mass, said draft traveling in an opposite direction to the particles of the pulverulent substance which are thrown outwardly by centrifugal force, whereby a melting zone is formed at the periphery of the rotating mass, a heating zone at the central part thereof, and a reduction zone intermediate the said melting and heating zones.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

EMILE GOBBE.

Witnesses:

G. ROOSEVELT PHELANS,
EMILE VAN WAMECH.