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METHOD OF PRODUCING NITROGEN AND CARBON DIOXID FROM GASEOUS PRODUCTS OF COMBUSTION.

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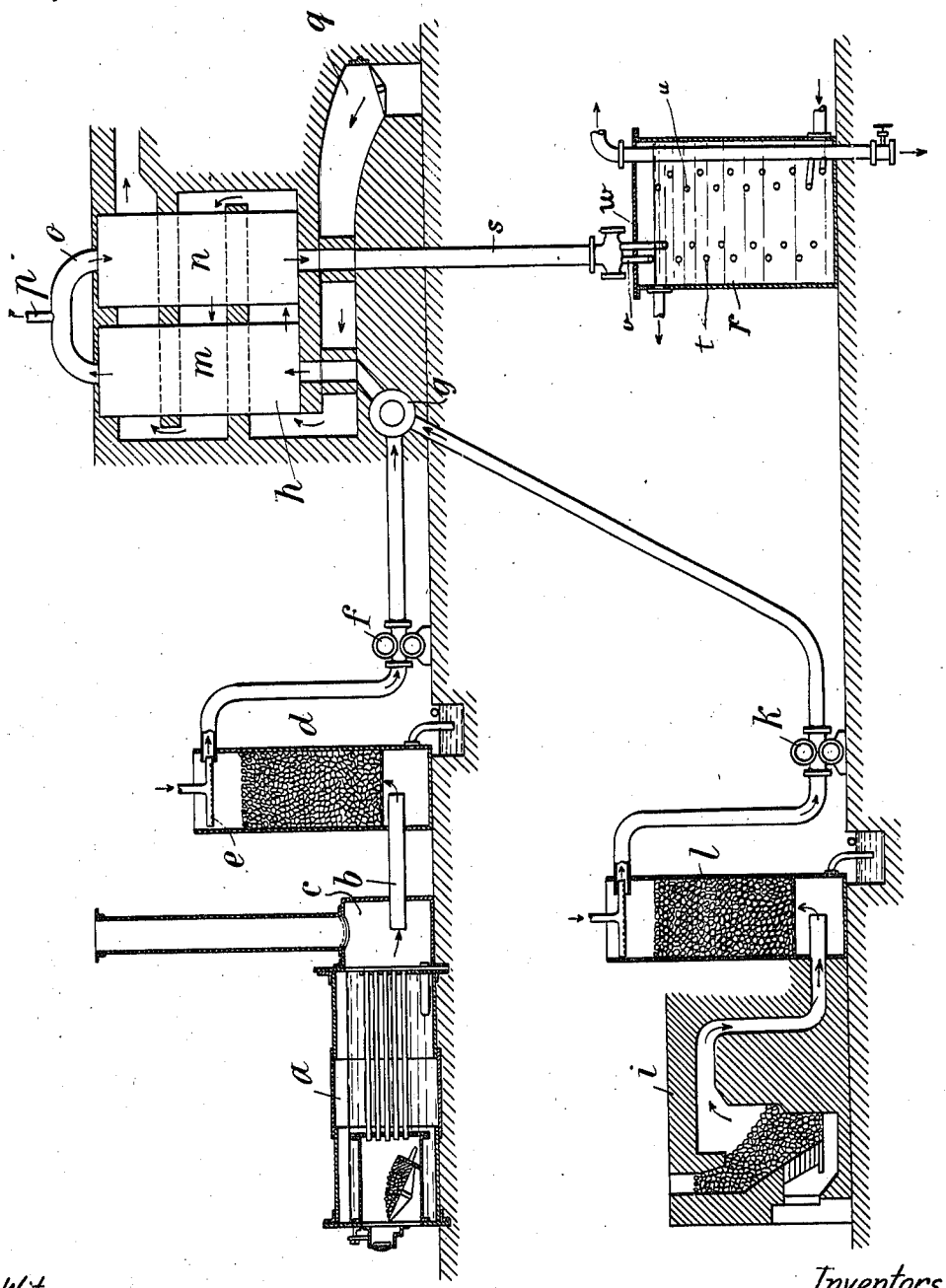

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METHOD OF PRODUCING NITROGEN AND CARBON DIOXID FROM GASEOUS PRODUCTS OF COMBUSTION.

984,605. Specification of Letters Patent. **Patented Feb. 21, 1911.**

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To all whom it may concern:

Be it known that we, MAX REICHEL and HEINRICH BRAUN, citizens of the German Empire, and residents of Berlin, in the Kingdom of Prussia, Germany, have invented certain new and useful Improvements in Methods of Producing Nitrogen and Carbonic Acid from Gaseous Products of Combustion, of which the following is a specification.

Our invention relates to improvements in a method of producing nitrogen and carbonic acid from gaseous products of combustion. Heretofore pure mixtures of nitrogen and carbonic acid have been produced by conducting said gaseous products over heated oxids of metals which can readily be reduced, and the metals of which are readily oxidized, such gases as consist of carbon monoxid, carbonic acid, hydrocarbons, hydrogen and nitrogen coming into question. In the method referred to, the metal formed by the oxidation of the combustible parts of the gases is regenerated in a separate process by means of air which is conducted over the said metal, whereby the metal is again transformed into its oxid. Simultaneously, pure nitrogen is obtained from the air, the oxygen of which is bound to the metal. This method has heretofore been modified by performing the said successive steps of the process, to wit the oxidation of the combustible parts of the gases, and the regeneration of the oxid of the metal, in the same apparatus, for which purpose the combustible parts of the gases were oxidized by varying the amount of air supplied to the fuel from which the said gases are generated. By throttling the admission of the secondary air to a greater or less degree, the process can be made to successively have a reducing or oxidizing character, so that oxidation and reduction are successively performed in the same apparatus. Obviously, the process must be performed in such a way, that the metal is never completely transformed into its oxid, because otherwise the oxygen contained within the gaseous products of combustion during the oxidation period would not come in contact with the metal necessary for binding the same. On the other hand, care must be taken, that during the reduction period the oxid is not completely transformed into its metal, because otherwise reducing gases would escape from the apparatus. In practice, this method has proved objectionable, because by decreasing the air supply, for example to the fire box of a steam boiler, the heating effect of the gases can not be completely utilized. Therefore, for the purpose of completely utilizing the heating effect of the fuel, the combustion must be independent of the process which is carried out in the oxidizing apparatus.

Now, the object of our improvements is to provide a method in which the heating effect of the gases can be completely utilized, independently of the requirements of the oxidizing or reducing process. For this purpose, the gases are burned as completely as possible in the steam generator or other apparatus, and after their discharge from said generator they are mixed with a suitable amount of reducing gas, or reducing gases, which amounts corresponds to the amount of oxygen contained in the gaseous products of combustion and the mixture of said gases and the reducing gas is conducted over a metal and an oxid of metal. In this way the combustion within the steam generator is entirely independent of the requirements of the process which is carried out in the oxidizing apparatus.

For the purpose of explaining the invention more in detail an apparatus suitable for carrying out the improved method has been shown in the accompanying drawing in which a side view of said apparatus is illustrated.

As shown in the drawing, *a* indicates a steam boiler of ordinary construction. Through a pipe *b*, the smoke box *c* of the latter is connected with the lower end of a washer *d* which is filled with lime stone, and which at its upper end is provided with a suitable water supply *e*. At its upper end the washer is connected with a fan or blower *f* or the like which is adapted to withdraw the gaseous products of combustion from the smoke chamber *c* and through the washer *d*, and to supply the same to a mixing apparatus *g* and from the latter to the oxidizer *h*.

The mixing apparatus *g* has a supply of a gas which has a reducing action, and which will hereafter be termed the reducing current. The said reducing gas may for exam-

ple be water gas, generator gas, Dowson gas, petroleum, etc., which contains combustible gases such as hydrogen, carbon monoxid and hydrocarbons. In the example shown, the reducing gas is supplied from a generator *i*, and is forced, by a blower *k*, through a washer *l* and to the mixing apparatus *g*, where it is mixed with the gases taken from the smoke box *c* of steam boiler *a*.

As shown, the oxidizing apparatus consists of two retorts *m* and *n* connected with each other at their upper ends by a pipe *o*. From the latter a discharge pipe *p* is branched off through which the oxidizing or reducing process may be observed, as will be explained hereafter. At its bottom the chamber *n* is connected by a pipe *s* with a suitable condenser *r* for separating the water from the mixture of carbonic acid and nitrogen. This condenser comprises essentially a pair of concentric cooling coils *t*, *u* which by a pair of small pipes *v*, *w* communicate with pipe *s*. The retorts *m* and *n* can be heated at the beginning of the process, for which purpose they are disposed within the flues of a fire box *q*. They are initially filled either with copper, copper oxid, or a mixture of both.

In carrying out the process, the gaseous products of combustion containing a certain proportion of oxygen are supplied from the smoke box *c* of the boiler *a* to the mixing apparatus *g* where they are mixed with a suitable amount of generator gas supplied from the generator *i*. Within the retorts *m* and *n* the copper combines with the excess of oxygen contained within the mixture, and it is thereby transformed into copper oxid. On the other hand the copper oxid oxidizes the combustible parts of the mixture into water and carbonic acid, the copper oxid being transformed into copper. Finally a mixture is discharged from the oxidizing apparatus which contains exclusively nitrogen, carbonic acid, and water in the form of steam.

At the beginning of the process the retorts *m* and *n* must be preheated. However, after starting the process, the said heating may be stopped, because the heat developed in the retorts is sufficient to carry the process out. The most effective temperature of the retorts is from 500 to 600 degrees centigrade.

The gaseous mixture discharged from the retort *n* consists of nitrogen, carbonic acid, and water in the form of steam. The latter is removed from the mixture in condenser *r*, whereupon the carbonic acid and the nitrogen are separated by known methods.

A suitable method for separating the said gases consists in passing the said mixture through absorbing chambers which are filled with coke, and through which a solution of potash flows in a direction opposite to that of the gaseous mixture. Thereby the carbonic acid is dissolved, while the nitrogen flows on. By the carbonic acid the carbonate of potassium is transformed into the bicarbonate, which is conveyed to a boiler where it is again transformed into the carbonate, the carbonic acid being set free. The regenerated solution of potash is again supplied to the absorbing chambers.

We claim.

1. The herein described method of producing nitrogen and carbonic acid from ordinary products of combustion, which consists in mixing therewith a gas having a reducing action, passing the mixture thus produced in contact with hot metal and metal oxid, and separating the water, the carbonic acid and the nitrogen.

2. The herein described method of producing nitrogen and carbonic acid from ordinary products of combustion, which consists in mixing therewith a gas having a reducing action, passing the mixture thus produced in contact with hot copper and copper oxid, and separating the water, the carbonic acid and the nitrogen.

In testimony whereof we affix our signatures.

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