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APPARATUS FOR OBTAINING NITROGEN FROM THE ATMOSPHERE.

APPLICATION FILED FEB. 10, 1912.

1,078,423. Patented Nov. 11, 1913.

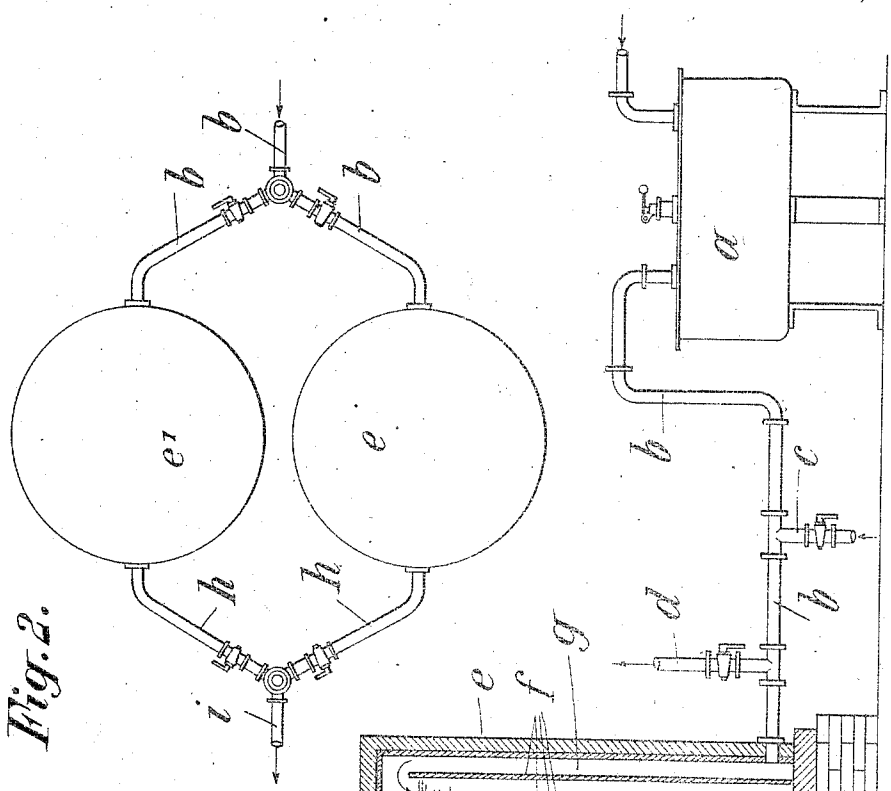


Fig. 2.

Fig. 1.

Witnesses:
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UNITED STATES PATENT OFFICE.

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APPARATUS FOR OBTAINING NITROGEN FROM THE ATMOSPHERE.

1,078,423. Specification of Letters Patent. Patented Nov. 11, 1913.

Application filed February 10, 1912. Serial No. 676,845.

To all whom it may concern:

Be it known that we, OTTO FRANK and OSKAR FINCKE, subjects of the German Emperor, and residents of Berlin, Germany, have invented certain new and useful Improvements in Apparatus for Obtaining Nitrogen from the Atmosphere, of which the following is a specification.

This invention relates to a process for manufacturing a fertilizing agent with the aid of the nitrogen of the air which process is characterized in that the nitrogen of the air, after the previous combustion of the oxygen, is introduced into a heated mixture of one or more bases with one or more metals and is fixed as nitrid.

It has been found that, when nitrogen is caused to act upon bases and metals and when only one base and one metal is employed, the absorption of the nitrogen takes place only in a reduced quantity or not at all, the reason being probably because in such cases the contact mass melts with extraordinary ease, while, when one or more bases and metals are employed mixed together, a very energetic absorption takes place and the contact mass does not melt but remains in the state of powder. As readily seen it is essential to render possible and accelerate the formation of nitrid by making use of a mixture of bases and metals because in this manner the melting of the contact mass is prevented. Mixtures which are suitable for this purpose are silicon and lime, or silicon and barium, or silicon, iron and lime, or iron, magnesite, silicon and lime, or silicon and magnesite and so on. A particularly strong absorption of the nitrogen is obtained with a mixture of a part in weight of iron, 5 parts in weight of freshly calcined dolomitic lime and one fourth of a part in weight of amorphous silicon or one fourth of a part in weight of amorphous boron or sodium.

Example of execution I.—6 parts in weight of lime and 10 parts in weight of silicon are heated up to 700 degrees centigrade and the nitrogen is caused to act upon the mixture while the temperature is raised at the same time up to 1050 degrees. One obtains thus:

$$Ca_6Si_{10}+14N=2CaSi_2N_3+2Ca_2Si_3N_4.$$

Example of execution II.—3 parts in weight of silicon are mixed with 2 parts in weight of iron and 8 parts in weight of lime, this mixture is then also heated first to 700 degrees centigrade and then the nitrogen is caused to act upon the mixture while the temperature is raised to 1000 degrees centigrade. One obtains thus:

$$2Fe_2Si_3+4Ca_2+16N=2Ca_2FeN_4+2Ca_2Si_3FeN_4.$$

As readily seen the nitrids of the calcosilicon or of the iron and the silicon are obtained. These are powder like materials which are not hygroscopic, do not produce dust, have no poisonous effect on men or on plants and which yield the nitrogen quite gradually to the soil of the fields and consequently unite in themselves all the properties of a useful fertilizer.

For carrying out the process described above use is preferably made of a plant such as shown in the drawing in which:

Figure 1 shows a longitudinal section; Fig. 2 a top plan view of a part of the plant.

In this plant the atmospheric air compressed in a boiler or tank *a* is first conveyed to an apparatus *e* which is hermetically closed and filled with thin copper spirals or copper wires and which is heated to a temperature of 800–900 degrees centigrade. In this apparatus the oxygen burns forming oxid of copper which remains on the pieces of copper while the nitrogen is set free. This apparatus *e* is followed by the furnace *h* which receives the mixture of bases and metals. This furnace is heated to a temperature of 1000–1050 degrees centigrade and then the nitrogen is introduced.

The cock *c* allows of the introduction of steam into the air while the latter flows from the boiler *a* through the pipe *b* to the apparatus *e* in order to accelerate the decomposition in the apparatus *e* and render it easier.

Mounted in the apparatus *e* are baffle plates or partitions *f* made of copper and arranged in such a manner, that the air is compelled to follow the longest possible route in order to remove the oxygen therefrom in a thorough manner. The inner walls of the apparatus *e* are lined with copper sheets and the intervals between the partition walls *f* are filled with copper, either with small pieces of copper or—in order to obtain the largest possible surface of copper—with copper wire gauze which is rolled up in rolls. Instead of heating the appara-

tus from the outside, one may advantageously make the copper incandescent by sending an electric current through it.

The apparatus *e* is preferably made in pairs so that always one of the apparatuses can be cut out for the purpose of reducing the oxid of copper formed which reduction is carried out by introducing water gas or methylic alcohol at *d*, while the other apparatus is working.

The pipe *h i* leads from the apparatus *e* to the furnace *k* which contains the mixture of bases and metals. The gases evolved in the furnace *k* can be collected by means of suitable devices such as those well known appliances employed in working blast furnaces. After the nitrogen has been absorbed, the mass is removed from the furnace *k* and is ready for use.

Having now fully described our said invention, what we claim and desire to secure by Letters Patent, is:

1. An apparatus for obtaining nitrogen from the atmosphere, comprising a compressed air receptacle, an air tight receptacle, lined with copper, copper baffle plates mounted in the air tight receptacle, a body of copper supported in the receptacle, a pipe communicating with the boiler and the receptacle, a valve in the pipe, a steam inlet pipe communicating with the aforesaid pipe, a valve in the steam pipe, a furnace, a pipe communicating with the furnace and the receptacle and a valve in the latter pipe.

2. An apparatus for obtaining nitrogen from the atmosphere comprising a compressed air receptacle, a pair of air tight receptacles, each receptacle having a plurality of copper baffle plates mounted therein, a body of copper supported in each receptacle, a pipe communication leading from the boiler, branch pipes extending from said latter pipe and communicating with the pair of receptacles, a valve in each branch, a steam inlet pipe communicating with the pipe leading from the boiler, a valve in said steam pipe, a furnace, a pipe leading from the furnace, branch pipes leading from the latter pipe and communicating with the receptacles, and a valve in each of the latter branch pipes.

In testimony whereof we have hereunto set our hands in presence of two witnesses.

OTTO FRANK.
OSKAR FINCKE.

Witnesses:
HENRY HASPER,
WOLDEMAR HAUPT.