No. 607,943. Patented July 26, 1898.

H. MEHNER.

METHOD OF PRODUCING AMMONIA.

(Application filed Mar. 11, 1897.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

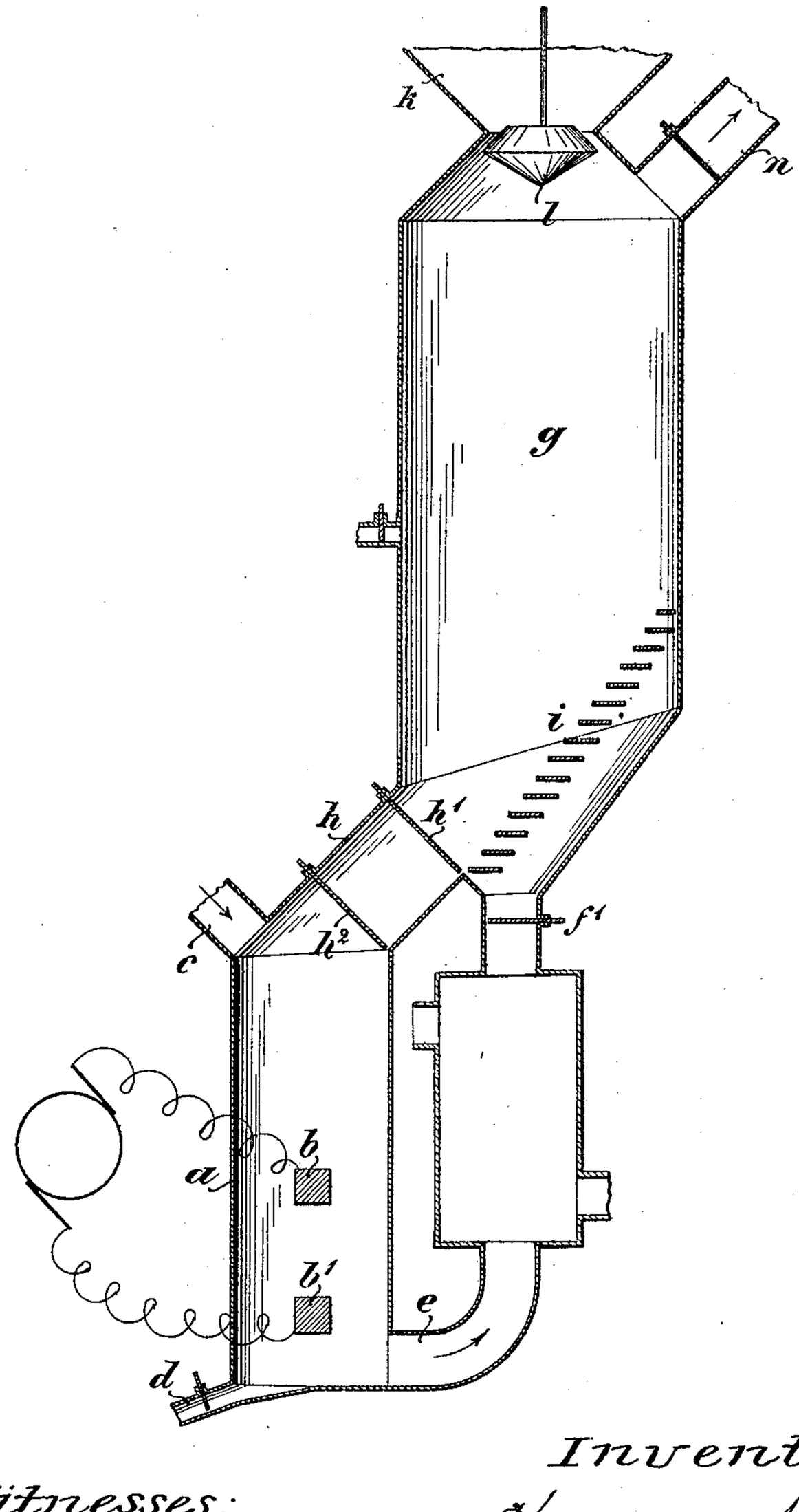

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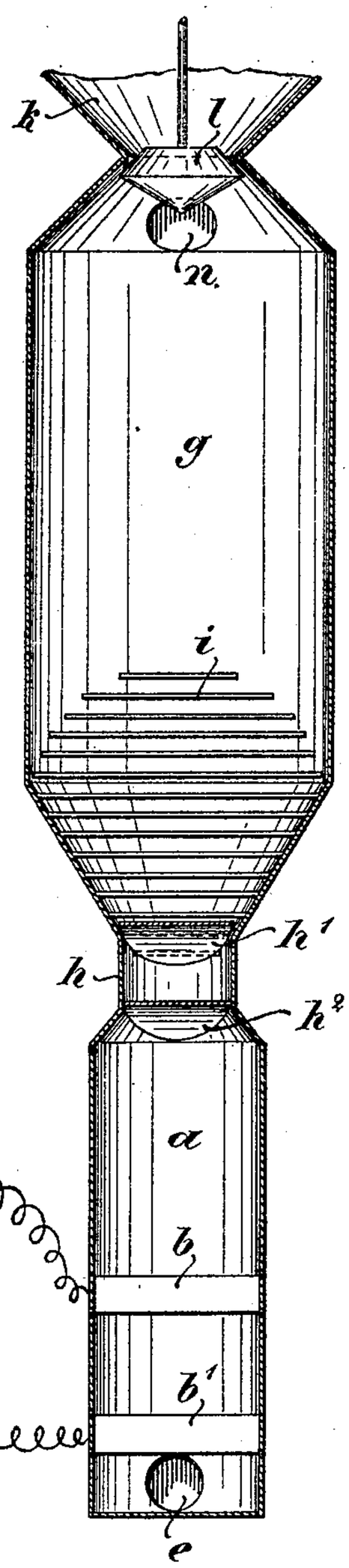
Fig. 2.



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UNITED STATES PATENT OFFICE.

HERMANN MEHNER, OF BERLIN, GERMANY.

METHOD OF PRODUCING AMMONIA.

SPECIFICATION forming part of Letters Patent No. 607,943, dated July 26, 1898.

Application filed March 11, 1897. Serial No. 627,057. (No specimens.) Patented in Luxemburg February 2, 1897, No. 2,746.

To all whom it may concern:

Be it known that I, HERMANN MEHNER, doctor of philosophy, chemist, of the city of Berlin, in the Kingdom Prussia, German Empire, have invented a new and useful Improved Method of Producing Ammonia, (for which I have obtained a patent in Luxemburg, dated February 2, 1897, No. 2,746;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the well-known production of ammonia from the nitrogen of the air by bringing together atmospheric air and an incandescent mixture of coal and an alkaline or earth-alkaline salt, preferably a carbonate, whereby alkaline cyanid or earth-alkaline cyanid is formed, which by treatment with water-vapor or steam is decomposed for developing ammonia with re-formation of alkaline carbonate or earth-alkaline carbonate.

When carried out in the customary manner, this method has certain defects. Thus owing to the necessity for mixing the residue from the steaming with fresh coal considerable time and work is spent. Moreover, the decomposition of the cyanid within the reaction apparatus has also attendant defects. If, however, the cyanid were removed from the reaction apparatus in order to pass it into a special decomposing apparatus, the simple manufacture of ammonia would present all the inconveniences and dangers of the manufacture of cyanid. To obviate these and other inconveniences is the object of the aforesaid invention, which consists in modifying the method in such a manner that the cyanid is obtained in the form of vapors. These vapors are conducted for the purpose of condensation over or through coal. The mixture thus consisting of condensed cyanid and coal is treated with steam, thereby obtaining as a residue a mixture of coal and alkaline or earth-alkaline carbonate, which constitutes the product started from in a following operation. In this manner the special mixing operation is dispensed with and the decomposition of the cyanid is rendered practicable outside the reaction-chamber without any need for removing it from the apparatus.

In the first part of the improved method I avail myself of the well-known use of the electric furnace for producing cyanid from an alkali or an earth alkali or their carbonates—coal and nitrogen—employing an electric shaft-furnace provided with the electrodes in its lower part and conducting the air from above to its charge, which consists in a mixture of coal or coke and alkalies or earth alkalies or their carbonates, and sinks gradually downward as the reaction proceeds.

According to this invention the cyanid vapors formed, together with the gaseous products, are allowed to escape behind the zone of the electrodes—that is to say, within or directly below the zone of greatest heat—through an air-tight passage into a receiver which is filled with coal or coke and secured against the access of air. In this receiver the cyanid vapors are allowed to condense in their passage through the coal or coke. When the formation of cyanid ceases and the last cyanid vapors have been condensed, steam is conducted into the receiver or condenser, which is for this purpose provided with a steam-inlet at a suitable point, and the cyanid is decomposed into ammonia and alkaline or earth-alkaline carbonate. The former escapes, together with the other gaseous products, through a discharge-pipe provided for this purpose to the purifying and absorption apparatus, while the latter remains behind mixed with coal (coke) and serves as a fresh charge for the reaction-furnace. It is preferred to arrange the receiver above the furnace, so that the charge obtained as described as residue in the condenser can be allowed to fall by its own weight into the furnace on opening a slide or door.

Besides the advantage of obviating the inconveniences hereinbefore referred to the described method further possesses the special advantage of a very considerable saving of heat. The raw materials used for the formation of ammonia are very cheap, the heat, which is here for the most part introduced as electrical energy, alone is expensive, and the amount of energy necessary to produce the high temperature of the carbon is very great. As the very hot products of the reaction are caused to pass over the coal or coke contained in the receiver, a considerable portion of the heat they carry with them is left behind in

that part of the said coal or coke first met with by them, and which thus can be heated nearly up to the temperature of the reaction before entering the furnace. For this reason it is preferred to conduct the operation in the receiver in such a manner that in charging the furnace from the receiver at the point where the admission of the hot gases and vapors into the latter takes place there will always remain behind a quantity of the mixture of coal (coke) and regenerated alkaline or earth-alkaline carbonate as obtained in the development of ammonia, so that the hot current of gas and vapors must first pass through part of said mixture before the cyanid vapors are allowed to condense, so that condensation takes place only in the remoter layers of the charge in the receiver. This may easily be obtained by imparting to that portion of the receiver which communicates with the furnace such an initial temperature as prevents condensation and protecting it against cooling by radiation. The portion of the mixture thus preliminarily heated is then passed into the reaction-furnace in order to charge the same. The layers following it take its place, and a fresh quantity of coal (coke) is filled in at the top of the receiver. It is also advisable to preliminarily heat the air to be conducted into the reaction-furnace, for which purpose use may also be made of the heat of the gases and vapors passing from the reaction-furnace by conducting them prior to their passage into the receiver through an air-heating apparatus of any known construction.

On the annexed sheet of drawing is shown a diagram of an apparatus for carrying out the improved process.

a is the electrical shaft-furnace, with the electrodes *b b'* in its lower part. At the top the furnace is provided with an inlet *c* for the air, and in its lower part, just below the zone of the electrodes *b b'*, with an outlet *e* for the cyanid vapors and gases produced. A conduit *f*, which may be provided with a shutting-off device *f'*, connects said outlet *e* with the bottom of the receiver *g*. As seen, the latter is placed above the furnace *a*. On the other side the bottom of the receiver communicates with the upper part of the furnace through an inclined channel *h*, provided with double slides *h' h²* and serving for conveying the mixture of alkali carbonate and coal obtained in the receiver into the furnace, above the electrodes of the latter. In the receiver there is arranged a step-grate *i*, so as to extend over the mouth of the conduit *f*. Thus the said grate, on the one hand, serves for distributing the cyanid vapors and gases through the charge of the receiver and, on the other hand, constitutes an incline leading the receiver charge into the channel *h* when the slide *h'* is opened. On the top of the receiver is arranged a cup and cone charger *k l* for filling in the coal, (coke.) *m* is the steam-inlet of the receiver, and *n* the outlet for the ammonia, &c. Next to the bottom of the furnace is a tap-hole *d* for removing the slag.

What I claim is—

1. The herein-described process for producing ammonia which consists in exposing a mixture of coal and alkali or alkaline earth-metal carbonate to the heat of an electric furnace while air is caused to pass through the same, allowing the cyanid vapors produced to escape into a receiver, causing them to condense therein upon coal, decomposing the condensed cyanid into ammonia and alkali carbonate by admitting steam into the condenser, and returning the residual mixture of alkali carbonate and coal into the furnace, substantially as and for the purpose stated.

2. The described process for producing ammonia which consists in exposing a mixture of coal and alkali or alkaline earth-metal carbonate to the heat of an electric furnace while air is caused to pass through the same, allowing the cyanid vapors to escape at the zone of the electrodes into a receiver, causing them to condense therein upon coal, decomposing the condensed cyanid into ammonia and alkali or alkaline earth-metal carbonate by admitting steam into the condenser, and returning the resulting mixture of carbonate and coal into the furnace, substantially as and for the purpose stated.

3. The improvement in the production of ammonia consisting in passing air in contact with a heated mixture of coal and alkali or alkaline earth-metal carbonate to produce cyanid vapors, condensing the vapors in contact with coal outside of the furnace, steaming the thus-obtained mixture to decompose the cyanid, and using the thus-alkalinized coal for contact with a fresh body of air for a repetition of the process, substantially as described.

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

HERMANN MEHNER.

Witnesses:
HENRY HASPER,
W. HAUPT.