

# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN PROCESSES OF MANUFACTURING AMMONIA.

Specification forming part of Letters Patent No. **161,137**, dated March 23, 1875; application filed March 10, 1875.

*To all whom it may concern:*

Be it known that I, FARNHAM MAXWELL-LYTE, of Paris, France, have invented Production of Ammonia by the Synthesis of its Elements; and I do hereby declare that the following is a full, clear, and exact description of the same.

My invention relates to an improved process for the manufacture of ammonia; and it consists in combining a triad or pentad element with a readily-oxidizable element, so as to form an alloy of the two, which shall be of a spongy character to present increased surface.

This said alloy is subjected to a moderate degree of heat in a closed chamber, and a mixture of nitrogen and hydrogen (or a hydrogen compound) is then passed over the alloy, which produces, under the influences of heat and chemical affinity, a combination of nitrogen and hydrogen to form ammonia.

I produce, first of all, a combination or alloy of one of the more easily oxidizable metals (say, for instance, potassium, sodium, one of the alkalino-earthly metals, or even zinc) with one of the triad elements, as, for instance, antimony, bismuth, arsenic, phosphorus, or tin, it being understood that the combination or alloy in question should be of such chemical or physical constitution as to be able to decompose water or watery vapor at a moderate temperature, not exceeding that of low or incipient redness. An alloy of antimony and sodium or potassium, for instance, which decomposes water at ordinary temperatures, and rapidly at the boiling heat, is of this nature.

Such an alloy may, for convenience, be produced by calcining oxide of antimony, or the powder or a suitable salt of that metal, with carbonate of soda or potassa, and enough charcoal or organic matter to effect the reduction, or with any proper reducing material. If the carbon or organic matter be in sufficient excess, it retains the reduced metals in an amorphous and porous state, fit to be rapidly acted on in the subsequent treatment.

I now place this reduced alloy or combination in a proper receptacle, and expose it to the action of a mixture of aqueous vapor and

nitrogen, when the sodium or potassium of the alloy, uniting with the oxygen of the water, produces hydrogen, which, in its nascent state, combines with the nitrogen present, and produces ammonia.

Arsenide of sodium, phosphide of sodium, bismuthide of sodium, tin, and sodium produce similar results with nitrogen and aqueous vapor—not all, however, to the same extent.

The process being accelerated by heat, it is advisable to maintain the material at a temperature of from 212° to 750° Fahrenheit during the passage of the nitrogen and aqueous vapor. The sodium may be here replaced by the other alkaline metals, alkalino-earthly metals, or by zinc, or by a mixture of them.

The reaction here employed may be represented by the following general formula, where M represents the triad or pentad element, and R the oxidizable metal; N, nitrogen; H, hydrogen, and O oxygen:  $2(MR_3) + 2N + 3(H_2O) = M_2 + 6(RO) + 2(NH_3)$ .

The presence of the triad or pentad element is essential to the process, but the presence of hydrogen in the nascent form is also essential.

I may add that, in order to regenerate the metallic alloy or combination, and to reproduce the ammonia-producing compound, it is sufficient to expose the same to a red heat under the action of a reducing agent—gaseous, liquid, solid, inorganic, or organic; for instance, if enough carbon still remains in the compound, simple heating to redness will regenerate it.

It is evident that in this reaction it may also be presumed that there is formation of a hydrogen compound of the triad or pentad, which is subsequently decomposed in contact with the nitrogen present, as, for instance, the compound of triad antimony with hydrogen. The reaction in this case would not be represented as above, and would be thus for the case of antimony:  $SbH_3 + N = NH_3 + Sb$ , or, generally,  $MH_3 + N = M + NH_3$ ; but in this case it is none the less certain that we have, equally as before, the presence of nascent hydrogen with nitrogen, and the simultaneous presence of a triad, which combination of substances

forms the basis of the present patent, the presence of aqueous vapor being merely an accessory requisite for production of nascent hydrogen in certain cases.

I claim—

The herein-described process of producing ammonia by the combination of nitrogen with

nascent hydrogen liberated in the presence of a triad or pentad element, substantially as described.

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Witnesses:

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