(No Model.)

H. ALBERT.

PROCESS OF MANUFACTURING PHOSPHATES OF ALKALIES.

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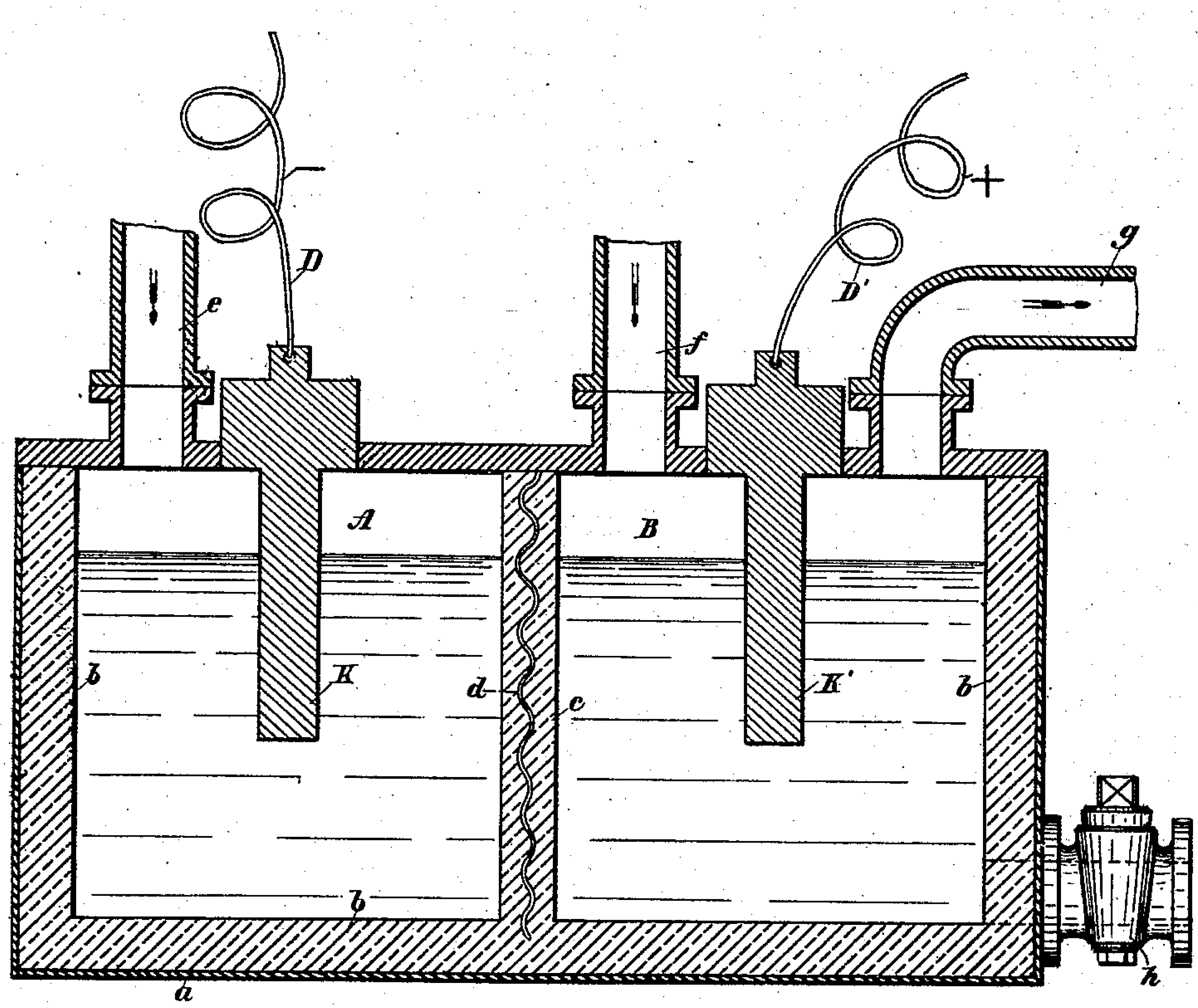

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UNITED STATES PATENT OFFICE.

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PROCESS OF MANUFACTURING PHOSPHATES OF ALKALIES.

SPECIFICATION forming part of Letters Patent No. 572,512, dated December 8, 1896.

Application filed January 28, 1896. Serial No. 577,149. (No specimens.)

To all whom it may concern:

Be it known that I, HEINRICH ALBERT, of Biebrich-on-the-Rhine, Germany, have invented an Improved Process for the Manufacture of Phosphates of Alkalies, of which the following is a specification.

This invention relates to a process for the manufacture of phosphates of alkalies; and it consists in the process of producing caustic alkalies by electrolysis of phosphoric acid and such soluble salts of the alkalies as by ordinary chemical reactions do not undergo double decomposition in the presence of phosphoric acid. The phosphates of alkalies hereby formed by electrolysis are decomposed, forming caustic alkalies, while phosphoric acid, recombined as salt of lime, &c., is recovered.

The process hitherto used for the manufacture of phosphates of the alkalies was never a satisfactory one for the reason that the phosphoric acid obtained from crude phosphate and sulfuric acid was neutralized with alkaline carbonates, whereby the carbonic acid was lost. Even the later methods for producing the corresponding salts directly from the crude phosphate did not yield a profit on account of the unsatisfactory results. I have succeeded in producing the phosphates of the alkalies in a pure state in an economical manner by the action of the electrical current on phosphoric acid and the corresponding salts of the alkalies, such as the nitrates, sulfates, and chlorids, &c., of the alkalies. The reactions occurring, in case nitrate of soda is used, are explained by the following equations:

1. $NaNO_3+H_3PO_4=HNO_3+NaH_2PO_4$.
2. $2NaNO_3+H_3PO_4=2HNO_3+Na_2HPO_4$.
3. $3NaNO_3+H_3PO_4=3HNO_3+Na_3PO_4$.

If solutions of phosphoric acid and of the salts of the alkalies, like nitrates, sulfates, and chlorids, &c., of whatsoever concentration, are submitted, while separated by a proper diaphragm, for instance, a diaphragm of porous clay work, to the action of the electrical current, either at ordinary or an elevated temperature, separation of the respective acids takes place, and nitric acid, sulfuric acid, or chlorin is set free at the anode. In order to obtain the volatile substances like nitric acid, chlorin, &c., it is only necessary to heat the solutions. Inasmuch as hereby, as well as by the effect of the electrolytic process, the volume of the solution in contact with the anode is quickly reduced, a continual addition of fresh salt solution is needed. On the cathode the corresponding phosphate salt is formed, as, for instance, the mono, di, or tri basic phosphate of potash, soda, &c. The formation of these respective salts depends on the quantity of salts used on the anode. The process may be interrupted at the proper time for the purpose of obtaining either the mono or the di or tri basic salt. If the solution of phosphoric acid is sufficiently strong, the salts formed are deposited in solid state on the cathode and may be dipped out; otherwise the cathode solution has to be concentrated.

The phosphates obtained electrolytically in this manner may also be applied directly to the manufacture of caustic alkalies, for instance, with caustic lime. Salts, as Chili saltpeter and chlorid of sodium, and so on, which do not undergo double decomposition are, in the presence of phosphoric acid, converted by electrolysis into products which can be directly split up, whereby the phosphoric acid returns to the manufacturing process or may be otherwise employed. It must be remembered that in this process the cost of the splitting-up operation performed on the salts is completely covered by the recovery of the phosphoric acid and that the yield of caustic alkali is theoretically proportional to the amount of the salt used, as, for instance, nitrate of soda.

My process possesses the following advantages: First, the process is a continuous one; second, in place of the expensive carbonates of alkalies hitherto used, as, for instance, soda, such cheap salts as Chili saltpeter, &c., are employed; third, valuable substances like nitric acid, sulfuric acid, &c., are obtained as by-products; fourth, the concentration of the solution by evaporation may be completely omitted; fifth, the alkaline phosphate thus cheaply produced may be directly converted into caustic alkali by treatment, as, for in-

stance, with quicklime, while the phosphoric acid in the shape of phosphate of lime returns to the manufacture or is otherwise employed.

An apparatus for carrying out my process is shown in the accompanying drawing.

In the drawing, *a* is a wrought-iron vessel which is coated with cement or similar material *b*. This vessel is divided by a diaphragm *d* of porous clay or similar substance covered by a coating *c* of cement or similar material. The phosphorous solution (phosphoric acid) is contained in the compartment A and a chlorid-of-sodium solution in the compartment B, the phosphorous solution (phosphoric acid) being brought in through the pipe *e* and the salt solution through the pipe *f*. Electrodes K K′ dip into these solutions and receive electric current by means of the wires D D′, respectively. The anode is preferably made of carbon and the cathode of lead or a metal not attacked by phosphoric acid. The chlorin which is liberated by the process of decomposition escapes through the pipe *g*. A cock *h* is provided for draining off the liquid when desired.

What I claim is—

1. The herein-described process of manufacturing phosphates of the alkalies which consists in forming a bath of phosphoric acid and a bath of one or more of the soluble salts of the alkali metals, associating the said two baths together in an electrical circuit, the said baths being separated by a porous diaphragm and thereupon electrolyzing the said combined baths by passing a current of electricity therethrough, whereby a mono, di or tri basic phosphate of the alkali employed is produced at the cathode.

2. The herein-described process for the manufacture of caustic alkalies which consists in forming a bath of phosphoric acid and a bath of one or more of the soluble salts of the alkali metals, associating the said two baths together in an electrical circuit, the said baths being separated by a porous diaphragm and thereupon electrolyzing the said combined baths by passing a current of electricity therethrough, whereby a mono, di or tri basic phosphate of the alkali employed is produced at the cathode, and treating the phosphate of the alkali produced with lime, substantially as described.

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Witnesses:
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