No. 883,531. PATENTED MAR. 31, 1908.

# H. FOERSTERLING & H. PHILIPP.

## PROCESS OF GENERATING HYDROGEN.

APPLICATION FILED APR. 16, 1907.

Fig. 1.

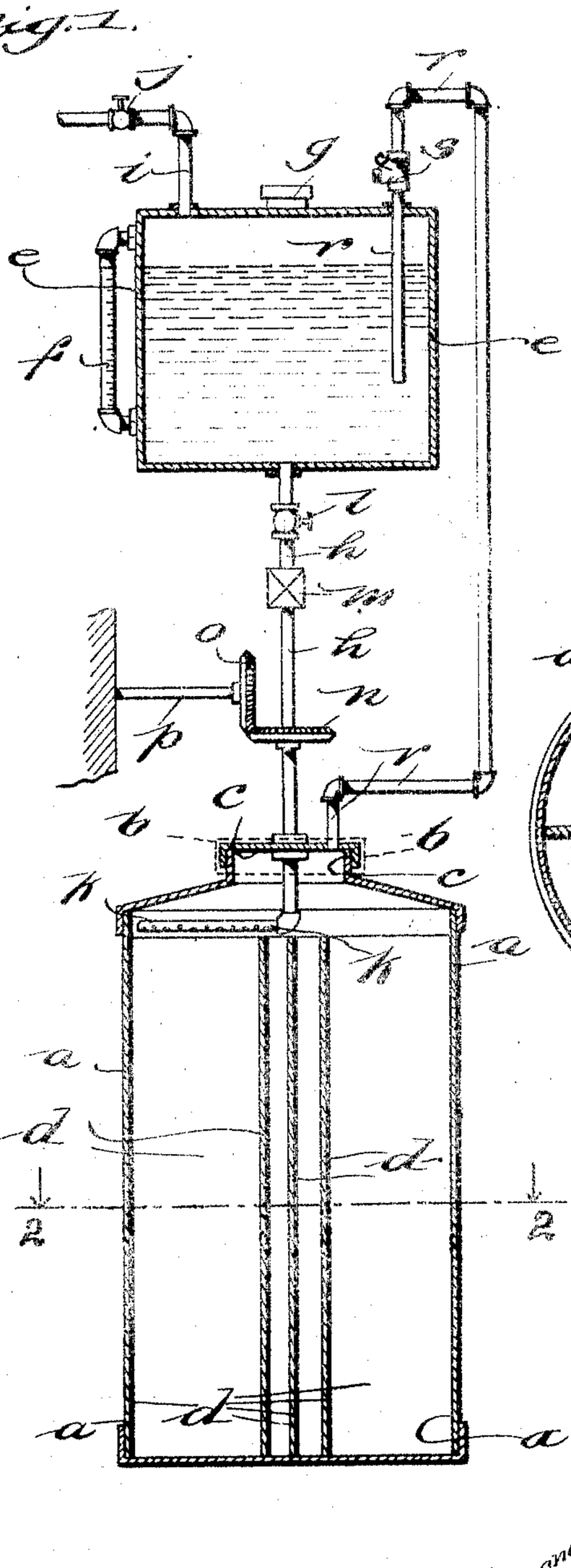
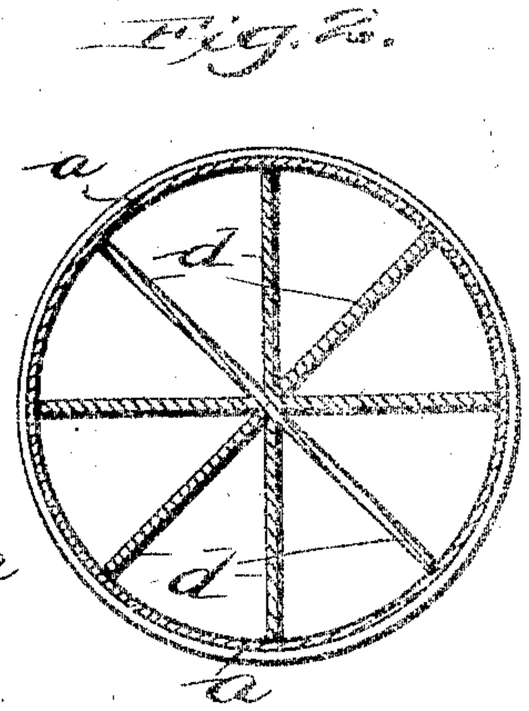



Fig. 2.

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# UNITED STATES PATENT OFFICE.

HANS FOERSTERLING AND HERBERT PHILIPP, OF PERTH AMBOY, NEW JERSEY, ASSIGNORS TO THE ROESSLER & HASSLACHER CHEMICAL CO., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## PROCESS OF GENERATING HYDROGEN.

No. 883,531. Specification of Letters Patent. Patented March 31, 1908.

Application filed April 16, 1907. Serial No. 368,474.

*To all whom it may concern:*

Be it known that we, HANS FOERSTERLING, a subject of the German Emperor, and HERBERT PHILIPP, a subject of the King of England, respectively, residing at Perth Amboy, in the county of Middlesex and State of New Jersey, have invented a certain new and useful Process of Generating Hydrogen, of which the following is a specification.

Our invention relates to a new process of generating hydrogen from alkali metals and its principal objects are to provide means whereby hydrogen may be quickly and cheaply generated and wherein the substances used and the means for practicing the process may be readily transportable and movable. Such process has long been desired especially for ballooning purposes wherein the advantages set forth are obvious.

It is well known that hydrogen can be obtained by the reaction of water on alkali metals, but on account of the violent reaction which takes place when water reacts with the alkali metal as such process has heretofore been practiced, this reaction has not been made use of in a commercial manner. The hydrogen produced at the present time is mostly generated from water by electrolysis, or from a metal in reaction with an acid, as for instance zinc and sulfuric acid, or from calcium hydrid and water.

The electrolysis requires an electrolytic plant, which is not easily movable. The method of obtaining hydrogen from a metal and an acid, as for instance zinc and sulfuric acid, has the disadvantage of being a slow one and besides the acid is not easily transported. The hydrogen generated from calcium hydrid is very expensive on account of the costly raw material. Besides, the calcium hydrate formed by the reaction of water is a bulky material.

Knowing the explosive reaction between alkali metal and hydrogen, we prepared at first different alloys containing an alkali metal and another metal. The alloys of lead and sodium especially offered a means of generating hydrogen quickly. The greater the proportion of alkali metal in the alloy the quicker hydrogen is generated. An alloy containing 40% of sodium and 60% of lead generates 2.6 cubic feet of hydrogen per pound of alloy. But such alloys have the disadvantage that a dead weight has to be carried which is unavailable for the generation of hydrogen, and this feature is objectionable for ballooning purposes. We tried next to react alkali metal with a strong solution of caustic. Here the generation of hydrogen can be regulated provided the caustic solution can be cooled, but the cooling of the caustic solution makes this method also undesirable. We then discovered an extremely simple method whereby water and alkali metal can be used. We put a piece of sodium in a closed vessel and let water run into the vessel at the same rate that the hydrogen was generated. In other words, we never worked with a surplus of water, so that no solution was formed. After the reaction we opened the vessel and found a cake of solid caustic. The advantage this method has will be readily understood. Only one material, the alkali metal, need be carried along, water being almost universally present. Furthermore a large yield of hydrogen is obtained, one pound of sodium, for example, generating over eight cubic feet of hydrogen.

We shall describe, in connection with the accompanying drawings, a very simple illustrative apparatus of one way of practicing our process.

In the drawings Figure 1 is an elevation, partially in section of said apparatus and Fig. 2 is a cross-sectional view of the container portion of Fig. 1 along the line 2—2.

Similar letters indicate similar parts throughout the several views.

*a* represents a drum or container for the alkali metal and is preferably that in which the alkali metal is shipped from the factory, the container cover, indicated at *b* by dotted lines, being removed and replaced by another cover *c* adapted to make air tight closure with the container and equipped as hereinafter described. The drum or container *a* is preferably provided with vertically arranged partitions *d* separating the contents of the container so that a reaction in one division of the container will not affect the alkali metal in any other division.

*e* represents a tank of any convenient shape, suitably supported above the container *a*, and provided with a gage *f*, an inlet port *g* for filling the tank with water and adapted to be made air tight, an outlet pipe *h* connecting the tank and the container and an outlet pipe *i* controlled by a valve *j* for the purpose hereinafter set forth.

Outlet pipe *h* is adapted to be passed

through a suitable stuffing box in cover *c* and is provided at its lower end with a sprinkler section *k*.

*l* is a valve controlling pipe *h*; *m* is a stuffing box within which the lower part of pipe *h* is adapted to turn and *n* is a gear in mesh with gear *o* on shaft *p*, actuated by any suitable means (not shown) and adapted to give a rotary movement to the lower part of pipe *h* carrying sprinkler *k* over each division of the container at any predetermined rate of speed.

*r* is a pipe passing through cover *c* and connecting container *a* and tank *e* into which latter the pipe projects so that its outlet shall be below the surface of the water in the tank. *s* is a check valve to prevent the water from flowing back from the tank when the water is under pressure.

The operation is as follows: The container *a* being filled with sodium metal and tank *e* being filled nearly to its capacity with water, and valve *j* opened, valve *l* is opened very slightly. Pipe *h* is then slowly rotated by the means disclosed causing sprinkler *k* to travel slowly over the various divisions of container *a*, thereby allowing the small quantity of water coming in contact with the sodium metal in any one division to complete its reaction before a further quantity of water comes into contact therewith. In this manner a steady and quick generation of hydrogen is effected. The hydrogen passes through pipe *r* into tank *e* where it is washed and cooled by being passed through the water in the tank and then passes out to any suitable receptacle through pipe *i*. During the first part of the operation the water supply should be slow so as to permit the air to be driven out the apparatus, but as soon as this has been accomplished the amount of water supplied is regulated according to the size of the container always provided that not more water is supplied than sufficient to cause a reaction with the alkali metal in proportion to the generation of hydrogen and to form substantially no solution. The water in tank *e* is to be replenished from time to time as may be seen necessary from the reading of the gage.

It is obvious that other means than those illustrated may be utilized in practicing our process without departing from the spirit of our invention.

What we claim and desire to secure by Letters Patent of the United States is:—

1. A process of generating hydrogen from sodium consisting in reacting the sodium with water in a finely divided state at such a rate that substantially no solution is formed.

2. A process of generating hydrogen from sodium consisting in serially reacting relatively small masses of sodium separated from each other in the same container, with water at such a rate that substantially no solution is formed, the reactions being such that the supply of hydrogen is continuous.

In testimony whereof we have hereunto signed our names in the presence of two subscribing witnesses.

HANS FOERSTERLING.
HERBERT PHILIPP.

Witnesses:
L. M. ROSSI,
FRITZ HOYLER.