(No Model.) 2 Sheets—Sheet 1.

W. & T. HAWKINS.

HYDROGEN GENERATING APPARATUS.

No. 533,643. Patented Feb. 5, 1895.

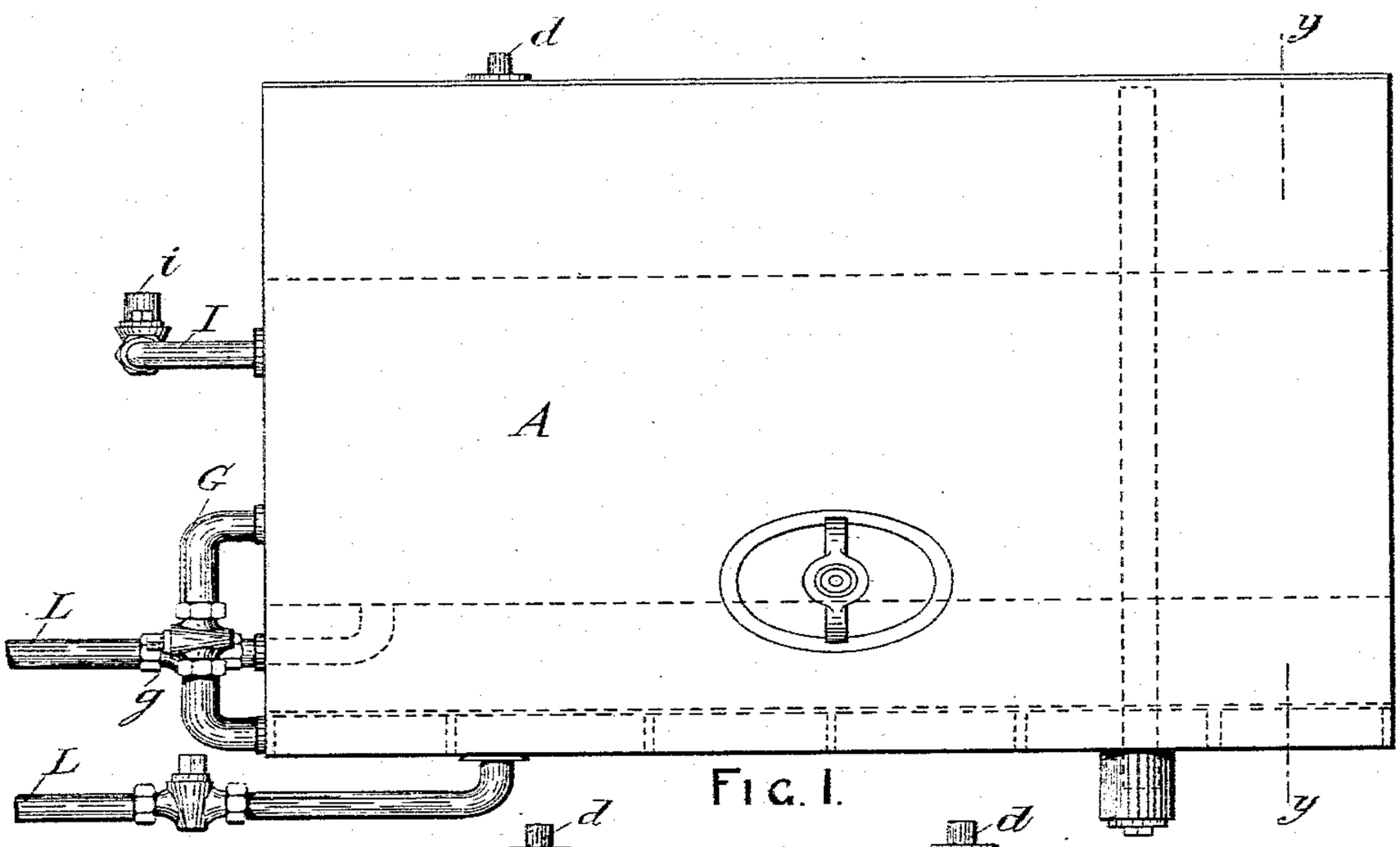

FIG. 1.

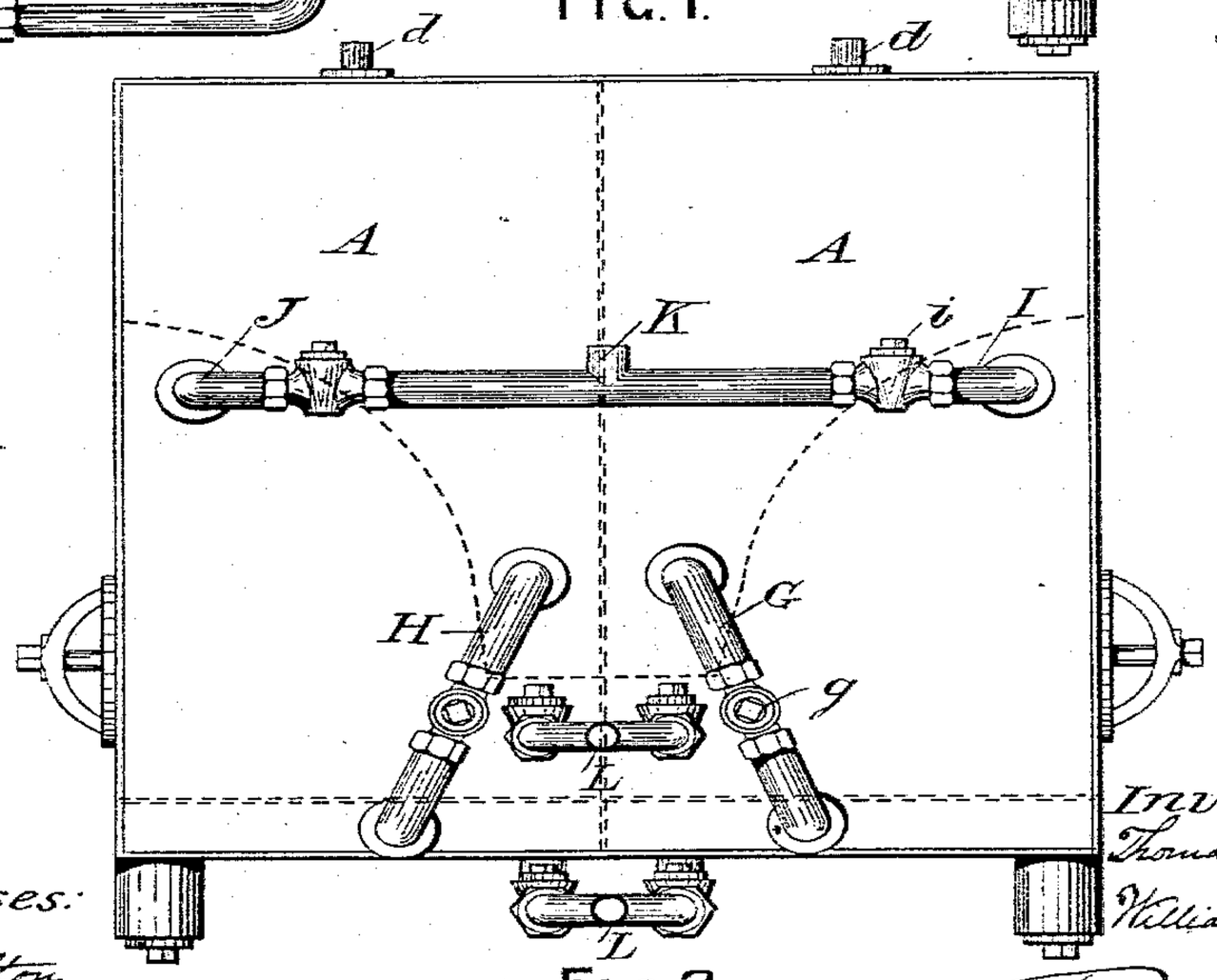

FIG. 2.

Witnesses:
E. B. Bolton
M. B. Barker.

Inventors:
Thomas Hawkins
William Hawkins
By Richards & Leo
their Attorneys.

(No Model.) 2 Sheets—Sheet 2.

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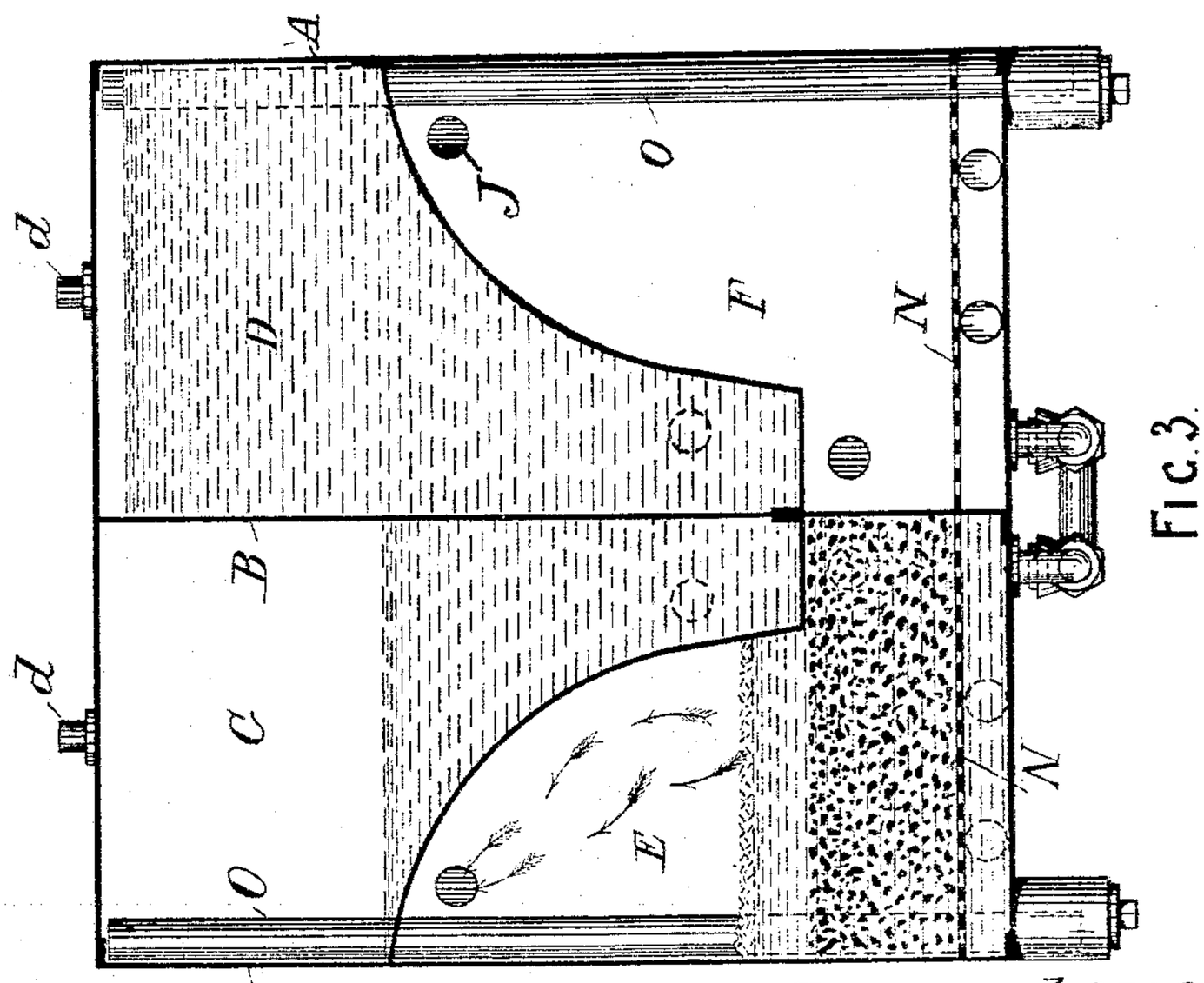

FIG. 3.

Witnesses:
C. B. Bolton
M. B. Barker.

Inventors:
Thomas Hawkins
William Hawkins
By Richards & Co.
their Attorneys.

UNITED STATES PATENT OFFICE.

WILLIAM HAWKINS AND THOMAS HAWKINS, OF PORTSMOUTH, ENGLAND.

HYDROGEN-GENERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 533,643, dated February 5, 1895.

Application filed September 21, 1893. Serial No. 486,149. (No model.) Patented in England July 21, 1892, No. 13,379.

To all whom it may concern:

Be it known that we, WILLIAM HAWKINS and THOMAS HAWKINS, subjects of the Queen of England, residing at 38 Queen's Road, Buckland, Portsmouth, England, have invented certain new and useful Improvements in Generators to be Used in the Production of Hydrogen Gas, of which the following is a specification.

British Patent No. 13,379, dated July 21, 1892, has been granted for this invention.

The object of our invention is to devise certain improvements in generators to be used in the production of hydrogen gas and more particularly to that class of apparatus adapted to be employed in the evolution of the said gas by the action of diluted sulphuric or muriatic acid upon metals such as zinc or iron, and our invention consists in the details and combination of parts hereinafter described and set forth.

Referring to the accompanying drawings, wherein like letters indicate corresponding parts thoughout the several views, Figure 1 is a side elevation of a generator constructed in accordance with our said invention. Fig. 2 is a front elevation of the same. Fig. 3 is a transverse section taken on the line *y y* in Fig. 1.

Our improved generator consists of a vessel A, of copper (which we find will resist the action of the acid sufficiently for our purpose) or of iron lined with lead or any suitable acid resisting material preferably rectangular in shape, the said vessel A being divided by a vertical partition or diaphragm B, the said vessel being further divided into upper and lower compartments C, D, E and F respectively upon each side of the said diaphragm B. The upper compartments C, D are intended for use, as receptacles or tanks for acidulated water, the lower compartments E, F forming the generating chambers in which are placed the metal or metals employed.

A pipe G leads from the acid tank C to the generating chamber E for the passage of the acidulated water and H is a similar pipe communicating with the acid tank D and generating chamber F. A pipe I leads from the upper portion of the generating chamber E for the passage of the gas while a similar pipe J provides for the passage of the gas from the chamber F, the said pipes I and J being connected to a common or main pipe from which it is delivered to the apparatus in which it is collected or used. Suitable pipes L are also provided in the lower portion of each compartment for drawing off the liquid when required.

A perforated shelf N is placed in the lower part of each of the generating chambers for supporting the metals which are placed therein. The vessel is also provided with suitable manholes for the insertion and the removal of the metal. There are also provided upon the upper face of the vessel one or more apertures for the charging of the acid tanks.

The method of using the apparatus is as follows:—The lower or generating chambers E, F are charged with a suitable quantity of metal, the said metal being placed upon the perforated shelves N within the said chambers. The upper chambers C, D forming the acid tanks are charged with a suitable volume of acidulated water as before mentioned. The apparatus is then ready for use. When it is required to produce the gas the acidulated water in the acid tank C, is allowed to flow through the pipe G leading to the generating chamber E by opening a valve or cock *g* in the said acid pipe. The gas evolved by the contact of the acidulated water and the metal within the generating chamber, will pass out of the said chamber through the pipe I before referred to, the said pipe being also controlled by means of a suitable valve *i*. Should the gas be produced in a greater volume within either of the generating chambers than can escape through the gas outlet pipes leading therefrom, the acidulated water in contact with the metal within the chamber will by the pressure of the gas be driven back through the pipes G and the pipes O into the acid tank. The pipes O remain permanently open and are mainly intended for the purpose of forming additional and adequate relieving channels in the event of a sudden evolution of a large volume of gas in the generating chambers for the relief of which the pipes G would not be sufficient. In practice it is found impossible to drive back the whole of the acidulated water from the metal in the acid chamber to the generating chamber in consequence of a certain portion of the acid-

ulated water adhering to the numerous interstices of the metal thus continuing the evolution of gas in small quantity and it is not till the metal is perfectly dry that the evolution of gas absolutely ceases. Said pipes O serve the purpose of permitting the unimpeded escape of the excess gas from the generating chambers to the upper part of the acid chambers and thence to the atmosphere by means of vents *d* without the necessity of said gas having to pass through the acidulated water in the acid chambers and thence to the atmosphere which it must do if forced through the supply pipe G; and in the event of valves *g* being closed, said pipes O will act as relief pipes should the pressure in the generators become excessive.

When the production of the gas in the generating chamber E becomes slow, the valve *i* in the gas pipe I is closed which causes the acidulated water to be driven off the metal in the said generating chamber in the manner described. At the same time the production of gas may be continued in the other generating chamber F, in a similar manner to that already described, and thus, by working the generating chambers alternately a continuous supply of gas may be maintained.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

The combination in a hydrogen generating apparatus of acid chambers C D in communication at will, respectively with generating chambers E F by means of pipes G H and valves said acid chambers and generating chambers being also respectively situated in the upper and lower portions of a vessel A having in its upper portion vents *d*, open to the atmosphere, and pipes O communicating between the lower portion of said generating chambers and the upper portion of said acid chambers, all for the purposes and substantially in the manner hereinbefore described.

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

WILLIAM HAWKINS.
THOMAS HAWKINS.

Witnesses:
W. WILSON HORN,
ARTHUR CARRICK.