May 1, 1923. 1,453,435

C. H. BUETTNER

METHOD AND APPARATUS FOR NITROGEN FIXATION

Filed Nov. 17., 1921 3 Sheets-Sheet 1

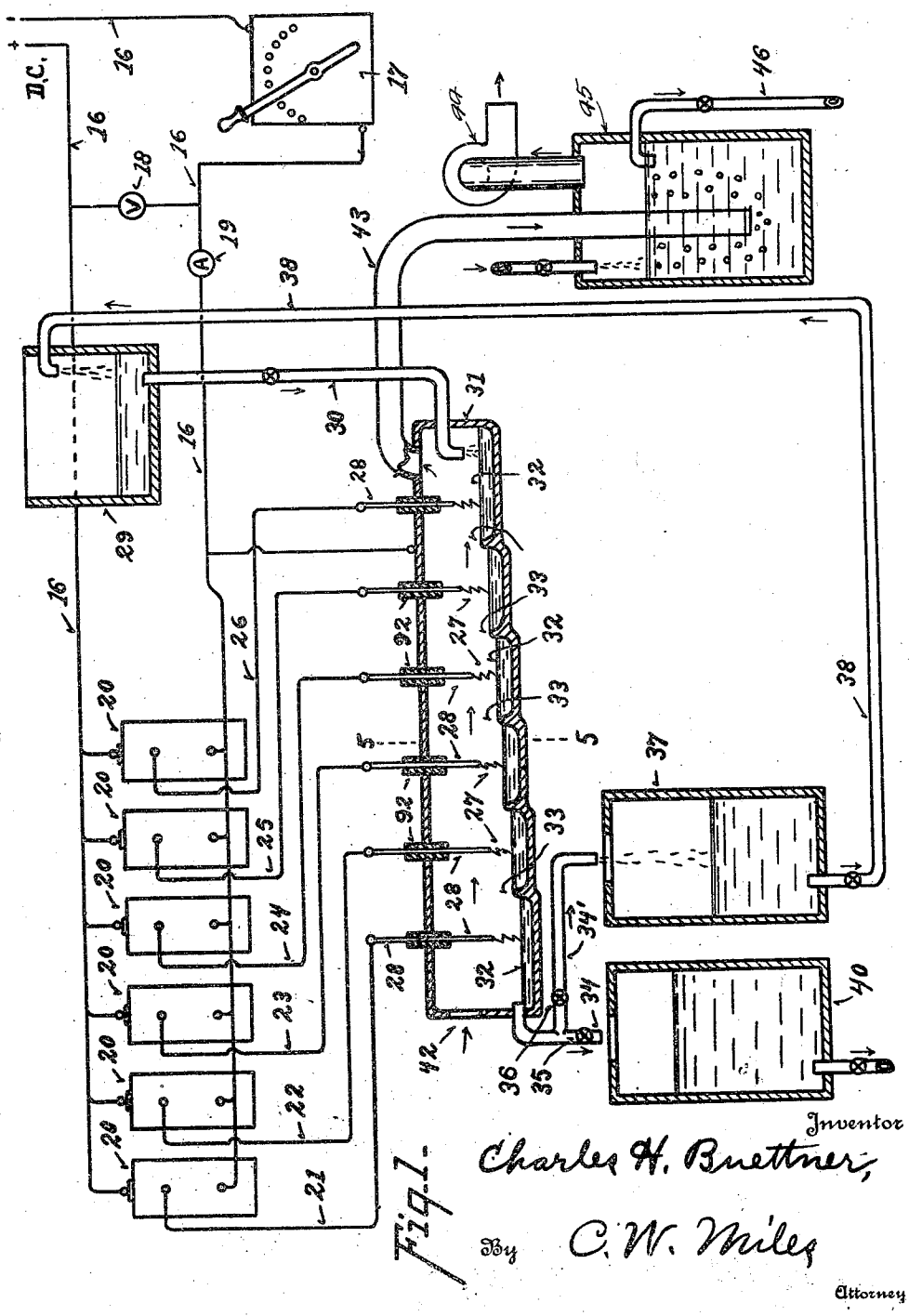


Fig. 1.

Inventor

Charles H. Buettner,

By C. W. Miles

Attorney

May 1, 1923. 1,453,435

C. H. BUETTNER

METHOD AND APPARATUS FOR NITROGEN FIXATION

Filed Nov. 17, 1921 3 Sheets-Sheet 2

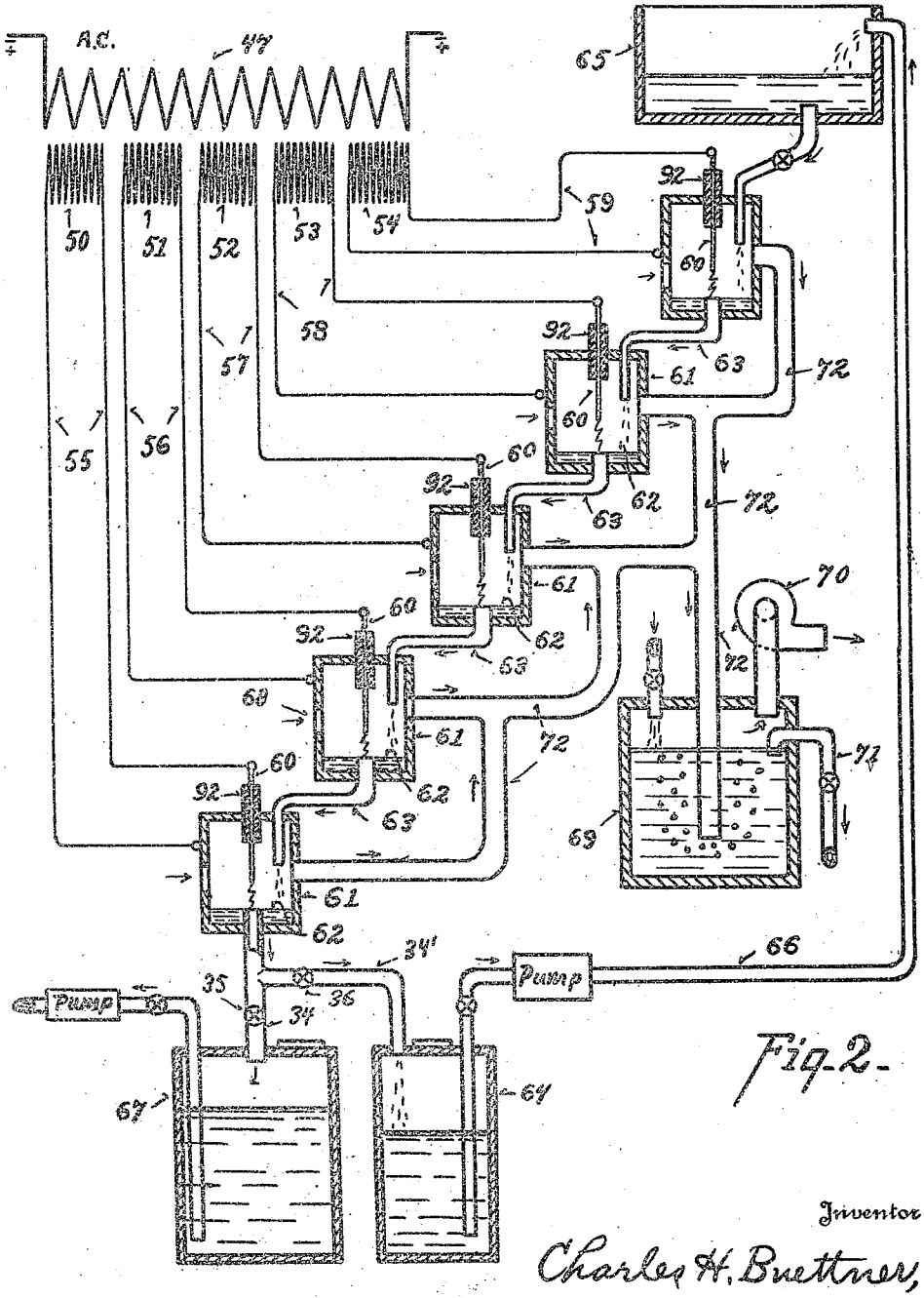


Fig. 2.

Inventor
Charles H. Buettner,
By C. W. Miley,
Attorney

May 1, 1923. 1,453,435

C. H. BUETTNER

METHOD AND APPARATUS FOR NITROGEN FIXATION

Filed Nov. 17, 1921 3 Sheets-Sheet 3

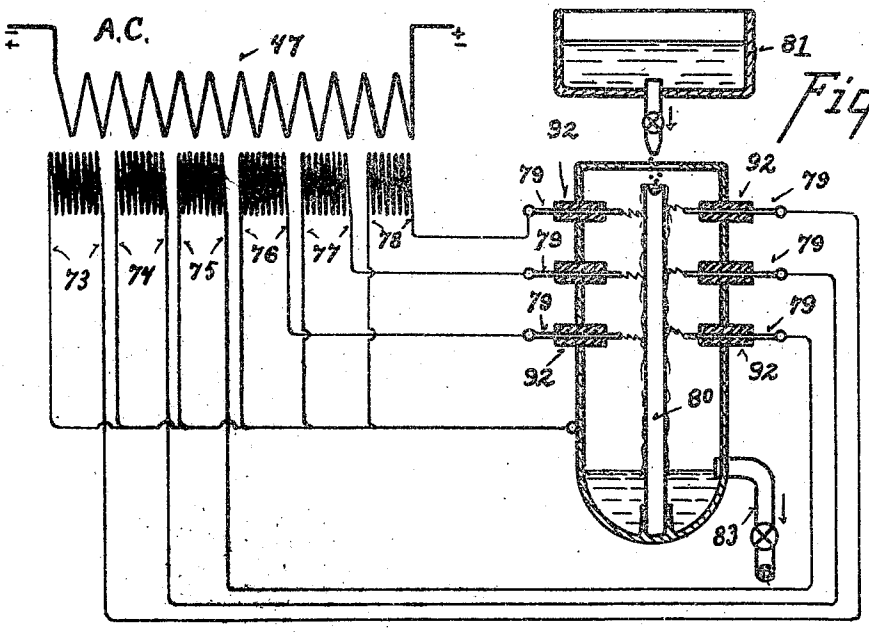


Fig. 3.

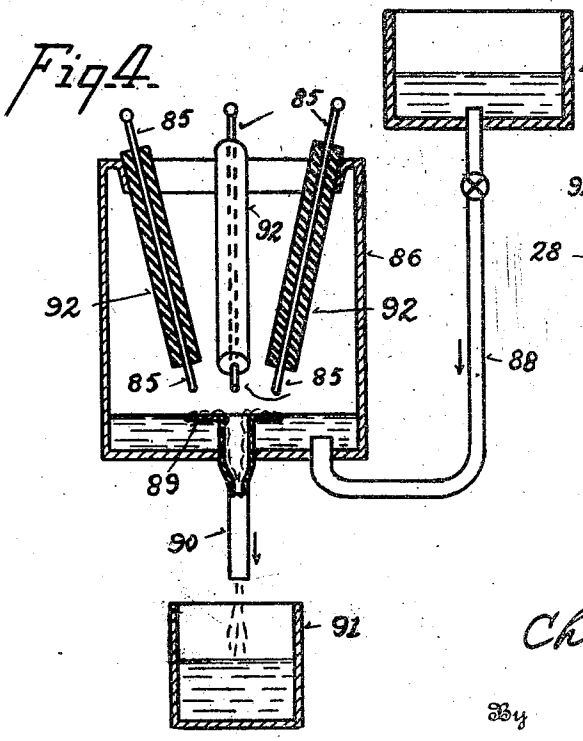


Fig. 4.

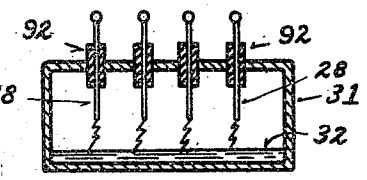


Fig. 5.

Inventor

Charles H. Buettner.

By C. W. Miles.

Attorney

Patented May 1, 1923. 1,453,435

UNITED STATES PATENT OFFICE.

CHARLES H. BUETTNER, OF CINCINNATI, OHIO.

METHOD AND APPARATUS FOR NITROGEN FIXATION.

Application filed November 17, 1921. Serial No. 515,844.

To all whom it may concern:

Be it known that I, CHARLES H. BUETTNER, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Methods and Apparatus for Nitrogen Fixation, of which the following is a specification.

My invention relates to improvements in method and apparatus to synthetically produce nitric acid and other nitrogen compounds. One of its objects is to provide simple and reliable method and apparatus by means of which nitric acid and alkaline nitrates as for instance calcium or potassium nitrate, may be economically produced directly from the air or by employing air and water at the place where the nitrates are required to be applied to the soil for agricultural purposes, as for instance by employing wind or wave power or similar widely available and inexpensive source of electrical power. Another object is to provide an improved method of electrical distribution over an extended liquid surface. Another object is to provide improved apparatus to effect a reliable electrical distribution over an extended liquid surface. Another object is to provide improved method and means to quickly reduce the temperature of the gases and to chemically fix the nitric and nitrous or nitrogen compounds formed before they have an opportunity to disintegrate or revert to their original condition. My invention also comprises certain method steps and order of procedure, and certain details of improvements in apparatus, all of which will be fully set forth in the description of the accompanying drawings in which:

Fig. 1, is a diagrammatic view illustrating my improved apparatus for carrying out my improved method.

Fig. 2, is a diagrammatic view illustrating a modification of Fig. 1.

Fig. 3, is a diagrammatic view illustrating another modification.

Fig. 4, is a sectional detail illustrating another modification.

Fig. 5, is a sectional detail taken on line 5—5 of Fig. 1.

The accompanying drawings illustrate the preferred embodiments of my invention in Fig. 1 of which 16 represents a direct current circuit, 17 a rheostat to regulate the direct current, 18 a voltmeter and 19 an ammeter in said direct current. 20, represent a series of electrical transformers of the spark coil type in which an interrupted direct current is supplied to a low tension primary coil to induce an alternating current of relatively high potential in a secondary coil. I am thus enabled to provide a plurality of independent high potential alternating circuits 21, 22, 23, 24, 25, and 26 which circuits are respectively provided with spark gaps 27 across which the current is designed to leap in rapid relatively hot sparks through the ordinary atmosphere or other mixture of oxygen and nitrogen. A series of metallic terminals 28, preferably of a metal which is not readily corroded, are provided above the spark gaps, while a body or stream of water or preferably alkaline water forms the lower spark terminals.

The current of water is allowed to flow from a vat or storage reservoir 29 slowly through a valve controlled conduit 30 to a container 31 in which are preferably provided a series of pools 32 and cascades 33 leading from one pool to another. From the last pool 32 the water charged with nitric acid nitrous acid or alkaline nitrates and alkaline nitrites overflows through a forked conduit 34 and 34′ provided with valves 35 and 36 by means of which the overflow liquid may be directed to a reservoir 37 from which it may be pumped through conduit 38 back to the reservoir 29 to be again passed through the container 31 to increase the percentage of nitrates or nitrites therein.

When the strength or percentage of nitrates is sufficient, the liquid is discharged into the reservoir 40 instead of to the reservoir 37. From the reservoir 40 the liquid may be used directly for fertilizer purposes, or may be drawn off to be treated to concentrate the nitrates or to otherwise make use thereof.

I also preferably provide for a more or less active circulation of air through the container from the port 42 to the conduit 43. A blower 44 is preferably employed to create a circulation of air and to draw the air charged with nitrates and nitrites from the interior of the container 31 through the conduit 43 to below the surface of a body of alkaline liquid in the container 45 where the nitrates and nitrites are absorbed from the air current into the liquid of container 45 and the strong liquid thereof conducted

BEST AVAILABLE COPY

away through the overflow conduit 46 for concentration or use.

In the modification Fig. 2, 47 represents the primary coil of an alternating current transformer and 50, 51, 52, 53, and 54 represent independent secondary coils to produce a series of independent circuits of alternating current of relatively high potential 55, 56, 57, 58, and 59 which high tension circuits are connected up to the respective metallic terminals 60 and to the containers 61 containing the liquid pools 62. The respective containers 62 are connected in an overflow or cascade series by means of the overflow conduits 63 which conduct the liquid successively from one to another of the containers and finally discharge the strong liquor into either reservoir 64 from which it may be pumped back to the supply reservoir 65, through the conduit 66 or to reservoir 67 from which the strong liquor is conducted away to be made use of. The terminals 60 are preferably set over the overflow ports so as to cause the sparks to strike the liquid as it is in the act of or about to flow down the conduits 63. A series of air ports 68 and air conduits 72 provide for currents of air through the several containers to the reservoir 69 where the nitrates and nitrites carried in the air are absorbed into the liquid of reservoir 69, and the air passed through the blower 70 and wasted. The strong liquor from reservoir 69 is conducted away through conduit 71 to be made use of.

In the modification Fig. 3, the transformer is substantially as shown and described for Fig. 2, and provides a plurality of independent secondary circuits 73, 74, 75, 76, 77 and 78 provided each with a metallic terminal 79, and with a terminal 80, common to all of said secondary circuits, preferably composed of metal or carbon. Water or alkaline solution from the supply reservoir 81 drips or flows to the rounded or cupped upper end of the terminal 80 and flows downwardly over the exterior thereof in a thin film where it is exposed to the atmosphere and to the sparks which leap through the atmosphere from the several terminals 79 to the terminal 80. The strong liquor overflows from the lower portion of the container 82 through a conduit 83.

In the modification Fig. 4 independent secondary circuits of high potential as shown and described for Fig. 1, and 2, are applied to the several terminals 85 arranged within a container 86 which forms the opposite terminal and is common to all of the secondary circuits. The alkaline liquid is supplied from supply reservoir 87 through conduit 88 to container 86 from which it overflows in a thin film across the plate or flange 89 and flows down the overflow conduit 90 to a strong liquor storage reservoir 91. The sparks pass from terminals 85 to the liquid on the face of plate 89. In the several figures 92 represents insulating material to insulate the metallic terminals and support them in position. The intimate relations of the sparks and the liquid tend to absorb the product before a reversion or decomposition of the product can take place. Also the liquid tends to exert a rapid cooling effect in the immediate neighborhood of each spark and also a strong tendency to absorb and fix the product. If desired nitrogen and oxygen mixed in proportions other than those commonly found in the atmosphere may be employed.

The method and apparatus herein illustrated and described are capable of considerable modification without departing from the spirit of my invention.

What I claim is:

1. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to an electrical discharge between a plurality of electrical terminals each in an independent electrical circuit and a body of water, and absorbing the fixation products into said body of water.

2. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to the action of a plurality of electrical discharges each in an independent electrical circuit and passed between a body of water and a plurality of electrical terminals adjacent thereto.

3. The method of nitrogen fixation which comprises subjecting atmospheric air to the action of a plurality of electrical discharges each in an independent electrical circuit and passed through said air between a body of water and a plurality of electrical terminals adjacent thereto.

4. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to an electrical spark discharge between a plurality of electrical terminals each in an independent electrical circuit and a body of alkaline water, and absorbing the fixation products into said body of water.

5. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to the action of a plurality of electrical spark discharges each in an independent electrical circuit and passed between a body of alkaline water and a plurality of electrical terminals adjacent thereto.

6. The method of nitrogen fixation which comprises subjecting atmospheric air to the action of a plurality of electrical spark discharges each in an independent electrical circuit and passed through said air between a body of alkaline water and a plurality of electrical terminals adjacent thereto.

7. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen simultaneously in the presence of a

body of water to the action of a plurality of independent electrical circuits of high potential to pass a plurality of electrical discharges through said mixed nitrogen and oxygen between said body of water and a plurality of independent electrical terminals.

8. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen simultaneously in the presence of a body of alkaline water to the action of a plurality of independent electrical circuits of high potential to pass a plurality of electrical discharges through said mixed nitrogen and oxygen between said body of water and a plurality of independent electrical terminals.

9. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to the action of a plurality of electrical sparks each in an independent electrical circuit and passed between a body of water and a plurality of electrical terminals adjacent thereto, and causing a circulation of mixed nitrogen and oxygen gas across the face of said body of water to remove a portion of the fixation products for the subsequent recovery thereof.

10. The method of nitrogen fixation which comprises subjecting atmospheric air to the action of a plurality of electrical discharges each in an independent electrical circuit and passing between a body of water and a plurality of electrical terminals adjacent thereto, causing a circulation of atmospheric air across the face of said body of water to remove a portion of the fixation products and subsequently treating the air so removed from the face of said body of water to recover the fixation products therefrom.

11. The method of nitrogen fixation which comprises subjecting atmospheric air to the action of a plurality of electrical discharges each in an independent electrical circuit and passing through said air between electrical terminals in pairs, circulating and removing said air from between said electrical terminals and treating the air so removed to recover the fixation products therefrom.

12. An apparatus for nitrogen fixation comprising a body of water constituting an electrical terminal common to a plurality of electrical circuits, a plurality of independent electrical circuits of relatively high potential each having an electrical terminal adjacent to said body of water to enable a plurality of electrical discharges to be passed through a mixture of nitrogen and oxygen and between said body of water and said respective circuit terminals.

13. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to the action of a plurality of electrical discharges each in an independent electrical circuit and passed between a body of alkaline water and a plurality of electrical terminals adjacent thereto, and causing a circulation of mixed nitrogen and oxygen gas across the face of said body of water to remove a portion of the fixation products for the subsequent recovery thereof.

14. The method of nitrogen fixation which comprises subjecting mixed nitrogen and oxygen to the action of a plurality of electrical discharges each in an independent electrical circuit and passed between a body of flowing water and a plurality of electrical terminals adjacent thereto.

15. An apparatus for nitrogen fixation comprising a body of water in motion to carry away the fixation products and constituting an electrical terminal common to a plurality of electrical circuits, a plurality of independent electrical circuits of relatively high potential each having an electrical terminal adjacent to said body of water to enable a plurality of electrical discharges to be passed through a mixture of nitrogen and oxygen and between said body of water and said respective circuit terminals.

In testimony whereof I have affixed my signature.

CHARLES H. BUETTNER.