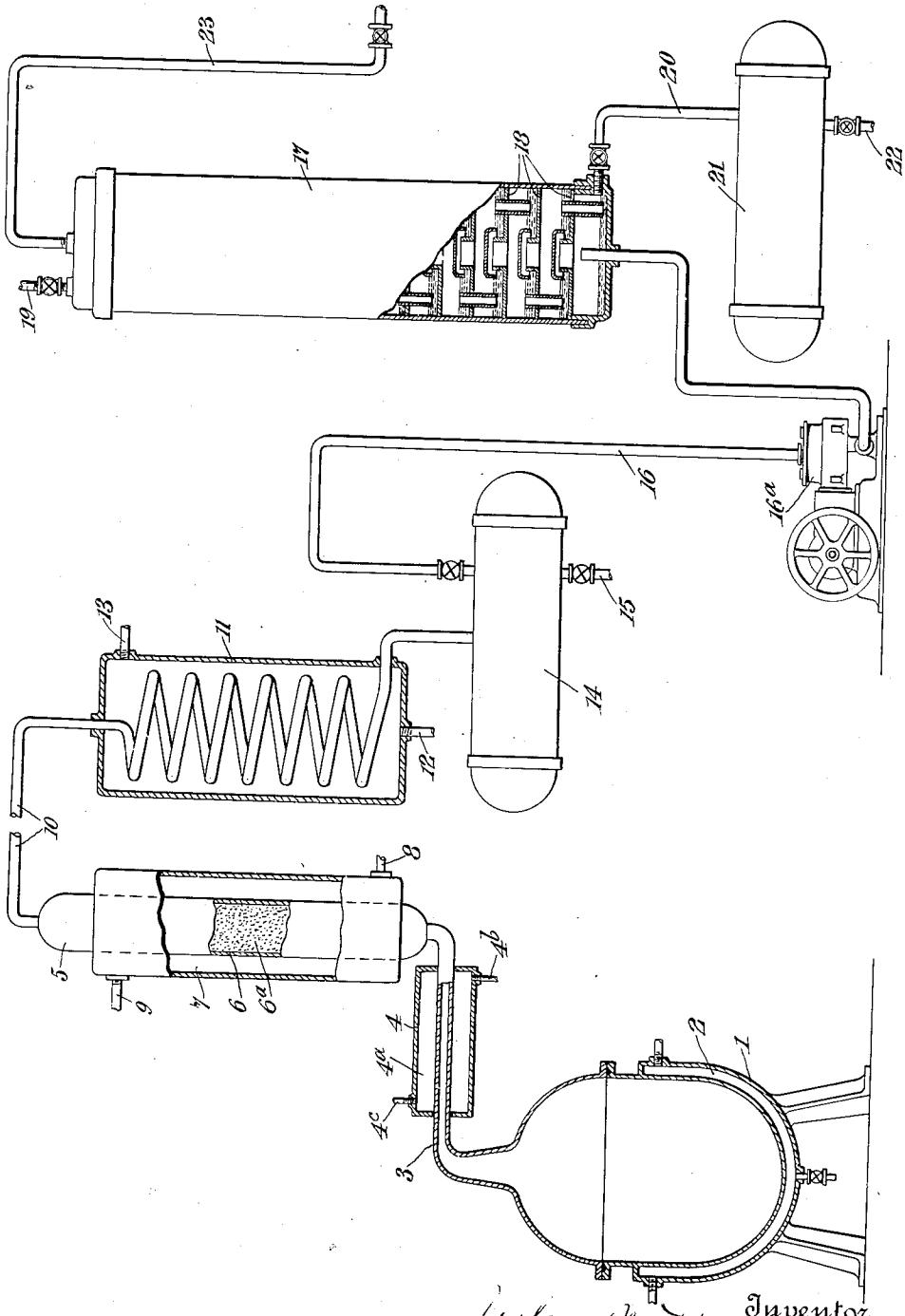
A. A. BACKHAUS AND F. B. ARENTZ.

METHOD OF MAKING ALDEHYDES AND SEPARATING THE SAME FROM THE OTHER PRODUCTS FORMED.

APPLICATION FILED JUNE 15, 1918.

1,400,205. Patented Dec. 13, 1921.



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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING ALDEHYDES AND SEPARATING THE SAME FROM THE OTHER PRODUCTS FORMED.

1,400,205. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed June 15, 1918. Serial No. 240,225.

To all whom it may concern:

Be it known that we, ARTHUR A. BACKHAUS, of Baltimore, in the State of Maryland, and FRED B. ARENTZ, of Curtis Bay, in the county of Anne Arundel, and in the State of Maryland, have invented a certain new and useful Improvement in Methods of Making Aldehydes and Separating the Same from the other Products Formed, and do hereby declare that the following is a full, clear, and exact description thereof.

Our invention relates particularly to a process of producing aldehydes, but it has reference particularly to the production of acetaldehyde.

The object of our invention is to provide a process by means of which aldehydes, and particularly acetaldehyde, may be readily formed from the corresponding alcohol.

A further object is to carry out said process by means of a catalyzer.

The object of our invention is especially to recover the aldehyde and separate it from the other products of the process in an advantageous manner.

Further objects of our invention including the production of acetic acid will appear from the detailed description thereof contained hereinafter.

While our invention is capable of embodiment in many different forms, for the purpose of illustration we shall describe only one form of our process hereinafter, and while said process is capable of being carried out with many different types of apparatus, for the purpose of illustration we have shown only one type of apparatus for use in connection therewith in the accompanying drawing, in which—

The figure is a diagrammatic representation, partly in section, of an apparatus which may be used in carrying out our invention.

In the drawing, we have shown an alcohol still 1, adapted to be heated by means of a steam jacket 2, having a vapor outlet pipe 3, which passes through a preheater 4, adapted to be heated in any suitable way, as for example by an oil jacket 4^a, having inlet and outlet pipes 4^b and 4^c. The tube 3 is connected to a catalyzer 5, which is comprised of a copper tube 6, carrying a quantity of granular porous material 6^a, such for example as pumice stone, unglazed porcelain, charcoal or terra cotta, carrying throughout the same particles of a finely divided catalyzer metal such for example as copper, nickel, chromium or iron, which may be deposited therein by any suitable means, but preferably in such a manner as to involve the reduction of an oxid of the metal by a current of hydrogen, as for example in accordance with the process of making catalyzers set forth in application, Serial Number 240221, filed June 15, 1918, by Arthur A. Backhaus.

Said catalyzer 5 is provided with any suitable heating means, but may, for example, be provided for this purpose with a heating jacket 7, having inlet and outlet pipes 8 and 9, respectively, for supplying a current of highly heated oil thereto. A tube 10 leads from the upper portion of the catalyzer 5 to a condenser 11, which is provided with the usual inlet and outlet pipes for cooling water 12 and 13, and which is adapted to condense the alcohol from the vapors which pass out of the catalyzer 5. The condensed alcohol is caught in a cylindrical receiver 14 and may be drawn off by valved pipe 15, while the uncondensed gases, comprising acetaldehyde and hydrogen, pass out by a pipe 16, which may, if desired, contain a compressor 16^a, and thence to a scrubbing tower or column 17. The vapors in the tower 17 pass through a series of liquid sealed pans 18, constructed in the same manner in which scrubbing towers or columns are ordinarily made, in which pans a current of absorbing liquid is caused to flow in the opposite direction from an inlet pipe 19 located at the top of the tower. The absorbing liquid may be water or alcohol, but said liquid is preferably comprised of acetic acid, the most preferred form of which for this purpose is glacial acetic acid, in which the aldehyde formed is very soluble. In this way an acetic acid containing 50% of acetaldehyde may be obtained and will flow out of the tower 17 by means of an outlet pipe 20, and thence into a receiver 21, from which it may be drawn off by an outlet pipe 22. The hydrogen passes out of the tower 17 by means of a pipe 23, and may be collected in any suitable manner.

In carrying out our process, a quantity of

an alcohol, such for example as ethyl alcohol, is introduced into the still 1, and is distilled therein by means of the heat applied by the steam jacket 2. The alcohol vapors are conveyed away by the pipe 3 to the preheater 4, where the vapors are heated to a temperature of between 250° and 350° C., but preferably of approximately 300° C., before they enter the catalyzer 5, the temperature at which it is desired to act upon the alcohol vapors with the catalyzer. The alcohol vapors, therefore, enter the catalyzer 5 at the required temperature, so that the formation of acetaldehyde immediately begins as soon as the vapors reach the finely divided metal carried upon the granular particles within the catalyzer tube 6. The oil jacket 7 maintains the vapors in the tube 6 at from 250° to 350° C., but preferably about 300° C., throughout the entire length of said tube, and a large percentage of the alcohol vapors is thus decomposed to form acetaldehyde and hydrogen.

The vapors passing out of the catalyzer by means of the tube 10 are conducted through the condenser 11, maintained at a temperature of 20–30° C., where any alcohol vapors present are condensed, and are collected in the receiver 14, from which the alcohol may be drawn off by means of the pipe 15. The acetaldehyde and the hydrogen pass out of the receiver 14, and are conducted to the scrubbing tower or column 17, where the ascending vapors of acetaldehyde and hydrogen are subjected to a counter current of an absorbing liquid, such as water, alcohol or acetic acid, preferably glacial acetic acid, by passing through the series of liquid sealed pans 18 therein, until substantially all of the acetaldehyde has become absorbed in the acetic acid and forms a solution, which passes out of the tower 17 by means of the pipe 20, and which comprises approximately one part of glacial acetic acid and one part of acetaldehyde.

The hydrogen passes away from the top of the tower 17 by means of the pipe 23, from which the hydrogen may be collected in any suitable manner.

In this process it is preferable to use acetic acid as the absorbing medium, particularly when the acetaldehyde recovered is to be changed into acetic acid, as for example by the action of a current of air under pressure of 50–75 lbs. and at an elevated temperature of 45–65° C.

While we have described our invention above in detail, we wish it to be understood that many changes may be made therein without departing from the spirit of our invention.

We claim:

1. The process which comprises passing vapors of alcohol over a catalytic agent, thus forming acetaldehyde, then separating the resulting aldehyde and hydrogen by passing the vapors through a scrubbing tower containing acetic acid and forming acetic acid from the aldehyde dissolved in the acetic acid by subjecting the solution to heated air under pressure.

2. The process which comprises passing vapors of alcohol over a catalytic agent, thus forming acetaldehyde, then separating the resulting aldehyde and hydrogen by passing the vapors through a scrubbing tower containing glacial acetic acid and forming acetic acid from the aldehyde dissolved in the acetic acid by subjecting the solution to heated air under pressure.

3. The process which comprises passing vapors of alcohol over a catalytic agent, thus forming acetaldehyde, then separating the resulting aldehyde and hydrogen by passing the vapors through a scrubbing tower containing acetic acid, the vapors and liquid being passed through the tower on the counter-current principle and forming acetic acid from the aldehyde dissolved in the acetic acid by subjecting the solution to heated air under pressure.

4. The process which comprises passing vapors of alcohol over a catalytic agent, thus forming acetaldehyde, then separating the resulting aldehyde and hydrogen by passing the vapors through a scrubbing tower containing glacial acetic acid, the vapors and liquid being passed through the tower on the counter-current principle and forming acetic acid from the aldehyde dissolved in the acetic acid by subjecting the solution to heated air under pressure.

5. The process of preparing an acid from an alcohol by way of aldehyde which comprises (1) a thermo-catalytic decomposition of the alcohol with liberation of hydrogen, (2) a direct absorption of the simultaneously produced aldehyde in the corresponding acid, and (3) an oxidation of the aldehyde while in admixture with said acid, to increase the acid content of the mixture.

6. The process of preparing acetic acid from alcohol by way of acetaldehyde which comprises (1) a thermo-catalytic decomposition of the alcohol with liberation of hydrogen, (2) a direct absorption of the simultaneously produced acetaldehyde in acetic acid, and (3) an oxidation of the acetaldehyde while in solution of the acetic acid.

In testimony that we claim the foregoing we have hereunto set our hands.

ARTHUR A. BACKHAUS.
FRED B. ARENTZ.

Witnesses:
JOHN P. GISCHEL,
ARTHUR WRIGHT.