March 4, 1930. J. F. WAIT 1,749,455

PROCESS OF DEHYDRATING MATERIALS

Filed Dec. 31, 1924

Fig. 1.

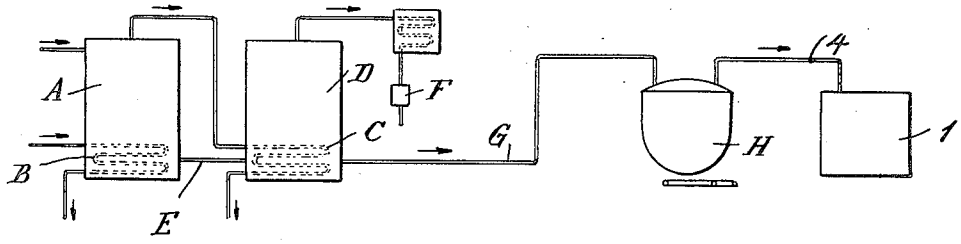
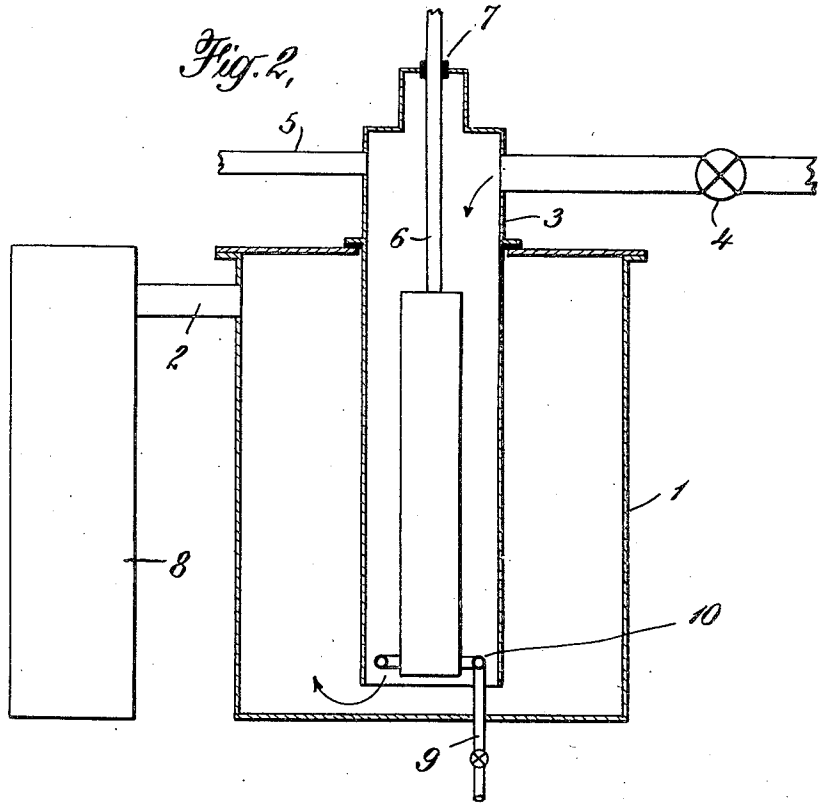


Fig. 2.



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Patented Mar. 4, 1930 1,749,455

UNITED STATES PATENT OFFICE

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PROCESS OF DEHYDRATING MATERIALS

Application filed December 31, 1924. Serial No. 759,047.

This invention relates to a process for removing volatile or vaporizable products from a material or a mixture of different solid materials. It relates more particularly to a process by which the heating effect of an electrical current is employed for removing volatile products when such products are of small relative volume. In cases where there is a large amount of the volatile or vaporizable products to be removed, it will generally be preferable to remove a large portion thereof by ordinary drying or dehydrating processes and to complete the removal by the electrical heating means.

In prior processes of dehydrating materials, such as caustic alkali, for example, it has been found that difficulties and troubles often arise especially when the product has been partially dehydrated or when it is has become considerably concentrated due to the corrosive effect of the concentrated material. It is especially true where it is necessary to have excessively high temperatures to complete the dehydration step.

By the present invention the materials to be dried or dehydrated may first be treated in an ordinary dehydrator of a single or double step type that may be steam heated or fire heated to a sufficient degree to remove the major portion of the moisture after which the remainder of the operation is completed to dry or dehydrate the material to the desired extent by utilizing the heating effect of an electrical current. The electrical current method is especially desirable because of the readiness with which the amount of heat input can be controlled and the facility with which the heat input can be immediately cut off. This portion of the process is also advantageous when the product that is to be dehydrated is to be lateral electrolyzed because incipient electrolysis may be initiated during the dehydration step.

By following this invention it is possible to utilize steam heat for removing moisture while it is present and capable of being removed within the temperature limits of ordinary commercial steam supply sources thus effecting this portion of the moisture removal with economic advantage. After the steam heat has been utilized to remove as much moisture as is practically advantageous, fire heat may be employed to remove another portion of the moisture, after which the electrical means can be used for finishing the dehydrating step. In some cases either the steam heat or the fire heat or both may be eliminated and the electrical heat utilized throughout the entire process for removal of moisture. In many cases it will also be found advantageous to employ a vacuum to aid in removing the moisture or in permitting the moisture to be removed at lower temperatures. A similar advantageous result may also be obtained by passing a suitable gas through the mass while the drying or dehydration is taking place.

In the accompanying drawings, an arrangement of apparatus is illustrated by which the process can be carried out. In the drawings,

Fig. 1 shows diagrammatically the arrangement of apparatus; and

Fig. 2 shows more of the details of the electric dehydrator.

Reference character 1 (Fig. 2) indicates a closed tank or receptacle which may, for example, be of cylindrical shape. This tank is provided with an overflow 2. A concentric cylinder 3 whose lower end is open extends into the tank 1. The cylinder 3 has a valved inlet 4 for the supply of material to be dehydrated and an outlet 5 which leads to a receiver and vacuum producing means not shown. An electrode 6 extends through an insulated opening 7 into the cylinder 3. The electrode 6 is connected to one side of a source of electric current and the cylinder 3 which operates as the other electrode is connected to the other side of the source of current. Either alternating or direct current may be used, alternating current being preferable where it is desired not to electrolyze the material that is to be dried and direct current may be used in cases where electrolysis is not objectionable or where it might aid. The outlet 2 may lead to a receiver 8 which may, if desired, be maintained under a vacuum. A gas supply pipe 9 leading from a source not shown may lead to a distributor 10 that

is located near the bottom of the cylinder 3 between said cylinder and the electrode 6 by which gases from the pipe 9 may be bubbled through the mass as it is being dried or dehydrated by means of an electric current.

In Fig. 1 is shown diagrammatically the apparatus by which the entire dehydration may be effected. Reference character A indicates an evaporator that is heated by means of the steam coil B, the vapors therefrom serving to heat the coil C in evaporator D. The partially concentrated material flows from evaporator A into evaporator D through the pipe E where it is further concentrated under vacuum that is maintained by the vacuum pump F. The concentrated material then flows from the evaporator D through the pipe G into the fire heated dehydrator H where additional concentration takes place after which the material is fed into the electrical dehydrator 1 where the final concentration is caused to take place. In this particular arrangement of apparatus it will be seen that the vapors passing off from the material to be dehydrated are removed from the coil C, from the condenser and vacuum producing means F and from the vented dehydrator H and also the final dehydrator 1 as already explained. The dehydrator H may be heated by a gas flame or other direct fire, or it may be externally heated by an indirect method such as hot gases or externally applied electric heating. In the specification and claims the expression "direct fire" is intended to mean a heating means which produces temperatures approximately equivalent to those obtained by application of a direct flame to the vessel. It will be understood that either one or all of the evaporators A, D and dehydrator H may be eliminated in case the materials have small enough moisture therein to make the removal thereof economical in the dehydrator 1.

As a specific illustration of material that may be treated by this invention may be mentioned a solution of a mixture of sodium and potassium hydroxide. A dilute solution may be concentrated in a two-stage steam heated evaporator, the second stage of which operates under vacuum. The caustic containing liquid is concentrated to a strength of about 50% in this equipment. The partially concentrated solution is then fed into oil fired dehydrators, likewise operating under vacuum, and wherein the concentration is increased to above 90%. The partially dehydrated caustic then contains less than 10% of water. This is charged through the feed line 4 and passes through the zone between the electrodes 3 and 6 wherein it is subjected to the heating effect of the electric current. The heat generated causes vapors to form which rise to the top of the chamber 3 wherefrom they are removed through the outlet 5. The region 3 and the outlet 5 are preferably maintained under a vacuum to give an absolute pressure of less than 12 pounds. Provision must be made to balance the imposed vacuum so as to maintain a flow of caustic between the electrodes. This may be done by imposing the same vacuum conditions upon the receiver 8. The dehydrated caustic flows through the bottom of the chamber 3 upward through the tank 1 and through the outlet 2 to the receiver. The direction of flow of the solution may be changed, if desired, so as to have the vapors evolved by the heating effect of the electric current while the mixture is passing upwardly, corresponding changes as to feed and vacuum being made to permit this direction of flow to be maintained. The desired degree of dehydration is obtained by controlling the rate of flow of the caustic mixture and the current flow.

The process may likewise be applied to the removal of volatile substances such as alcohol, ether, and benzol, which may be mixed with less volatile or solid material and which can be caused to flow through the passages.

I claim:

1. In the process of dehydrating caustic alkali, the steps which comprise passing said alkali containing water and in a molten condition between electrodes while causing sufficient current to flow between said electrodes to eliminate water.

2. In a process of dehydrating a mixture of caustic soda and caustic potash, the steps which comprise passing said mixture containing water and in a molten condition between electrodes while causing sufficient current to flow between said electrodes to evaporate water, and removing the vapors.

3. In the process of dehydrating molten caustic alkali, the steps which comprise passing said alkali containing less than 10 per cent of water between electrodes while causing sufficient current to flow between said electrodes to evaporate water, and removing the vapors while maintaining a vacuum.

4. In the process of dehydrating caustic alkali the steps which comprise the evaporation of water from the said caustic alkali by means of steam heat, further evaporating water by means of application of direct heat from a flame and subsequently dehydrating the caustic by passing it in molten condition between electrodes while causing sufficient current to flow between said electrodes to evaporate moisture, and removing the vapors.

5. In the process of dehydrating caustic alkali, the steps which comprise heating the mixture containing caustic alkali in an evaporator to remove moisture therefrom and to produce a caustic liquor of at least 45% concentration, further concentrating said caustic containing liquids in a direct fire heated dehydrator to a concentration of at

least 90% and passing said partially dehydrated caustic in molten condition between electrodes while causing sufficient current to flow between said electrodes to evaporate moisture, and removing the vapors.

6. In the process of dehydrating molten caustic alkali, the steps which comprise passing said alkali containing water between electrodes while causing sufficient direct current to flow between said electrodes to eliminate water by electrolysis.

7. In the process of dehydrating molten alkaline materials, the steps which comprise passing said material containing moisture between electrodes while causing sufficient current to flow between said electrodes to evaporate moisture and removing the vapors by passing a current of inert gas through said material during the evaporation.

8. In the process of dehydrating molten alkaline materials, the steps which comprise heating said materials by means of steam, causing partial concentration thereof, heating the partially concentrated materials by means of the employment of direct fire and passing the concentrated material between electrodes while causing sufficient current to flow between said electrodes to evaporate moisture, and removing the vapors.

9. In the process of dehydrating molten alkaline materials containing an electrolyte, the steps which comprise passing said materials containing moisture between electrodes while causing sufficient direct current to flow between said electrodes to eliminate said moisture by electrolysis.

In testimony whereof I affix my signature.

JUSTIN F. WAIT.

CERTIFICATE OF CORRECTION.

Patent No. 1,749,455. **Granted March 4, 1930, to**

JUSTIN F. WAIT.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 41, for the word "lateral" read "later"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of April, A. D. 1930.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)