

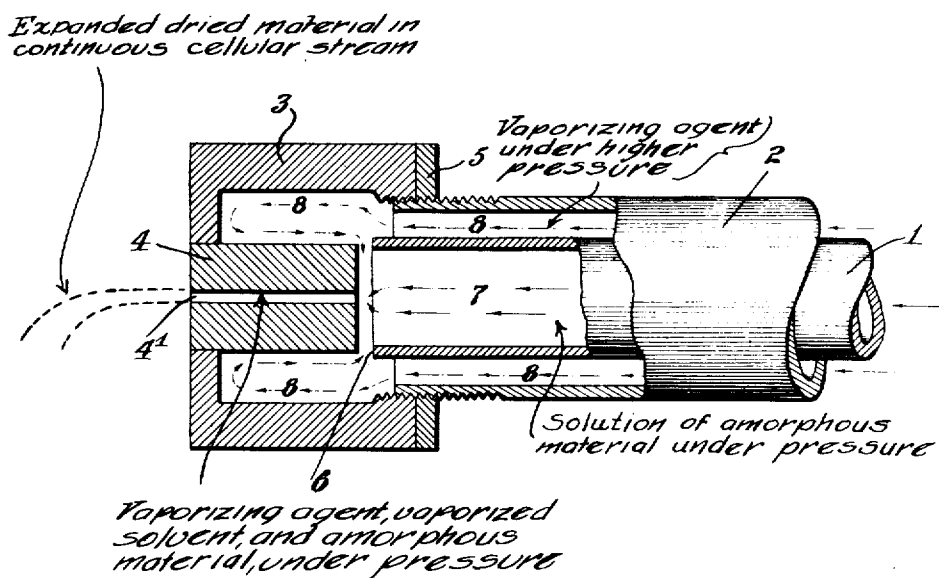
June 12, 1928.

1,673,685

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METHOD OF AND APPARATUS FOR TREATING SOLUTIONS AND PRODUCTS

Filed June 15, 1927



BY

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METHOD OF AND APPARATUS FOR TREATING SOLUTIONS AND PRODUCTS.

Application filed June 15, 1927. Serial No. 199,112.

This invention relates to a method of and apparatus for treating solutions of material and to the product, and is more particularly concerned with the recovery of plastic, gummy or amorphous materials from their solutions.

Difficulty is had in the recovery of certain plastic, amorphous or gummy materials from solution, since owing to the character of the materials, the solvent cannot be readily and completely eliminated. In certain cases the driving off of the solvent can be assisted to some extent by steam distillation, but even then it is difficult to entirely remove the solvent and in many cases the product is then also contaminated by a certain amount of moisture from the steam. Moreover, in the arts, it is frequently desirable to obtain materials of the character specified in a powdered or finely divided form, and owing to their physical characteristics, this cannot be readily done if they are first recovered from solution in compact and undivided form.

An object of our invention is to provide a process by which a plastic, amorphous or gummy material may be recovered from a solution thereof with complete or nearly complete elimination of the solvent. Another object is to provide a process by which the solvent can be removed with the aid of steam without contamination of the product by moisture. Still another object is to provide a method for recovering a plastic, amorphous or gummy material from a solution thereof in a friable expanded cellular mass which can be easily crushed when the material is desired in a powdered or finely divided condition. Further objects are to provide an apparatus for carrying out the method and to provide a product of the character above specified.

The invention broadly comprises intimately mixing a vaporized agent under pressure with the solution to be dried, and suddenly releasing the pressure. It further comprises intimately mixing a heated gaseous drying agent under pressure with a solution of the material to be dried under pressure, extending the mixture into attenuated form while maintaining the pressure and heat, and suddenly releasing the pres-

sure. The invention further comprises the product of the method and an apparatus for carrying out the method.

For a detailed disclosure of the nature and objects of the invention, reference is had to the accompanying specification and drawing, in which latter:

The figure illustrates one form of an apparatus for carrying out the method.

Referring to the drawing, the numeral 1 represents a pipe for the solution of the plastic or other material, 2 is a pipe or jacket surrounding the pipe 1 for supplying the heating and vaporizing agent, and 3 is a screw cap adapted to be threaded on to the jacket 2. The screw cap 3 has rigidly connected thereto a nozzle member 4 located opposite the passage 1 and provided with a discharge passage or bore 4'. A lock nut 5 threaded on the jacket 2 engages the cap 3 and holds it in a predetermined position whereby the base of the nozzle member 4 can be seated against the forward end of the passage 1 or can be spaced apart therefrom at a predetermined distance. It is obvious that this spacing can be varied by moving pipe 1 instead of nozzle member 4. The adjoining ends of pipe 1 and nozzle 4 are preferably ground, so that an accurate control of the vaporizing agent may be had at this point.

The path of the solution is indicated at 7 and the path of the vaporizing medium at 8.

In operation the vaporizing medium is introduced into the jacket 2 and run through it until the passage 1 has become heated. Thereupon the solution to be dried is introduced into the passage 1 under a lesser pressure than that applied to the vaporizing medium. With the nozzle member 4 spaced apart from the forward end 6 of the passage 1, the vaporizing medium follows the general course indicated at 8, and comes in contact with and mingles with the stream of solution whose direction of travel is indicated at 7. The mixture of the vaporizing agent and heated solution is ejected or extruded through the passage 4' of the nozzle. The mixture as it reaches the mouth of the passage 4' issues in the form of a rod or stick filled with small bubbles of the

vaporizing medium which sometimes explode with a snap. The solvent in the plastic solution is vaporized during the travel of the mixture through the passage 4'. The rod or stick builds up continuously and may be recovered in lengths or pieces as desired substantially dry and free from solvent and in a form which is readily pulverizable due to its spongy texture and which is in a convenient form for further manufacturing operations.

To illustrate the practice of the invention a 60% solution of a polymerized styrol in ethyl benzol or other organic solvent may be employed as the solution of the plastic. Steam under pressure may be employed as the vaporizing medium. The steam is started through the jacket 2 at say 115 lbs. pressure, and after a brief period to insure the proper heating of the passage 1 and the nozzle 4, the flow of styrol solution is started through the passage 1, and the styrol solution is placed under a pressure of 70-80 lbs. in any desired manner. The styrol solution is thus preheated during its travel through the passage 1 and, at the time it reaches the end 6 of the passage 1 has acquired substantially the temperature necessary to vaporize the solvent. The steam swirls around in the cap 3 and seeks egress through the opening between the base of the nozzle 4 and the end 6 of the passage 1. Here it comes in contact with the solution, and mingles therewith and the mixture then issues through the passage 4' by virtue of the positive pressure on the steam. During the travel through the passage 4' in the nozzle, the ethyl benzol or other solvent is substantially completely vaporized, but is entrapped in the styrol in bubbles, along with the steam. As soon as the mixture issues from the mouth of the passage, and the pressure is thus suddenly and entirely released, the bubbles expand, and both ethyl benzol and steam escape from the issuing polymerized styrol. The polymerized styrol builds up continuously at the end of the passage, and assumes the form of a rod or stick of sufficient strength and tenacity to support its own weight over some little distance of travel as a result of which it can be broken off and collected in stick or rod form. These sticks, being filled with pores and passages due to the sudden escape of solvent and steam, can be readily reduced to a powder by simple grinding. In the manufacture of certain types of articles the crudely broken sticks may be molded directly without first grinding them to a powder.

While the operation of the method has been illustrated with a solution of polymerized styrol, the invention may be applied to the treatment of other polymerized plastics or in general to any solutions of ma-

terials which when dried have sufficient cohesion between the particles thereof to form a continuous stick or rod. The invention appears to be more suitable to solutions of materials in organic solvents which can be removed by steam distillation.

The steam may be more or less superheated prior to the introduction into the jacket in which case there will be a lesser opportunity for condensation of water in the stick of plastic with consequent production of material containing less moisture and which may be made bone dry if desired. Further, the higher the superheat on the steam the more shredded or sponge-like is the rod of polymerized styrol. From 50-150° F. is sufficient superheat for most purposes. It is desirable to have the passage 4' in the nozzle of sufficient length so that the solvent will be substantially completely vaporized, but not so long that the plastic will be completely dried within the passage as this tends to reduce the rate of discharge. For treating styrol solutions a passage length of 1½ in. and a diameter of about .20 in. will give very satisfactory results. In the above specific embodiment the pressures are capable of variation. For the vaporizing medium the available heat must be sufficient to insure vaporization of the solvent. The pressure on the styrol or other solution will be dependent of course upon the viscosity of the solution. However, it is necessary that the steam or vaporizing agent be under higher pressure than the styrol or plastic solution, in order that the latter is not forced into the steam jacket.

It is of course understood that variations in nozzle construction and temperatures can also be made without departing from the spirit of the invention. The process may be run in connection with solvent recovery apparatus in order that there may not be a loss of solvent.

Having thus described our invention what we claim and desire to protect by Letters Patent is:

1. A process for removing solvent from solutions of solid materials which comprises intimately mixing a gaseous drying agent under pressure with a solution of the material to be dried, and suddenly releasing the pressure from the mixture.

2. A process for removing solvent from solutions of solid materials which comprises intimately mixing a heated gaseous drying agent under pressure with a heated solution of the material to be dried, extending the mixture into an attenuated form, and suddenly releasing the pressure.

3. A process for removing solvent from solutions of solid materials which comprises intimately mixing a heated gaseous drying agent under pressure with a heated solution of the material to be dried, extending

the mixture into attenuated form while continuing the heating and pressure and suddenly releasing the pressure.

4. A process for removing solvent from solutions of solid materials which comprises preheating said solution, mixing therewith a vaporizing medium under pressure, vaporizing the solvent in the mixture while still under pressure, and suddenly releasing the pressure on the mixture.

5. A process for converting solutions of polymerized plastics into solid form which comprises preheating a solution of a plastic, mixing a vaporizing medium therewith, distilling off the solvent while projecting the mixture through a constricted passage and suddenly releasing all pressure at the end of the passage, whereupon entrapped solvent vapor and vaporizing medium are released from the dried plastic, and recovering the plastic in the form of a sponge-like body.

6. A process for recovering solid polymerized styrol from solutions thereof which comprises preheating a solution of polymerized styrol, intermingling superheated steam therewith, distilling off the solvent while projecting the mixture under pressure through a constricted passage, and suddenly releasing all pressure at the end of the passage, allowing entrapped solvent vapor and steam to pass out of the dried styrol, and recovering the dried polymerized styrol in the form of a sponge-like body.

7. As a new product, a reticular mass of a substantially solvent- and -moisture- free polymerized styrol.

8. As a new product, an easily crushed cellular mass of a dried polymerized styrol.

9. As a new product, an expanded cellular and friable mass of a tough, amorphous styrol polymer.

10. An apparatus for removing solvent from solutions of solid materials comprising an inner supply pipe for the solution to be dried, an outer surrounding supply pipe for a heated gaseous drying agent, a head having a constricted discharge passage adjacent and aligned with the end of the said first pipe, and means whereby the drying agent may be inwardly and radially admitted to the solution prior to the entrance of the latter into the discharge passage.

11. An apparatus for removing solvent from solutions of solid materials comprising an inner supply pipe for the solution to be dried, an outer surrounding supply pipe for a heated gaseous drying agent, a longitudinally adjustable cap mounted on said second pipe, and a nozzle member carried by said cap in alignment with said first pipe.

12. An apparatus for removing solvent from solutions of solid materials comprising an outer supply pipe for a vaporizing medium, a cap mounted on the end of said pipe and having an inwardly extending nozzle member, an inner pipe for the solution to be dried disposed in alignment with said nozzle member, and means whereby the inner pipe and nozzle member may be relatively adjusted.

Signed at New York, New York, this 8th day of June, 1927.

WILLIAM S. JOHNSTON.

Signed at New York, New York, this 8th day of June, 1927.

ALEXIS W. KEEN.

CERTIFICATE OF CORRECTION.

Patent No. 1,673,685.

Granted June 12, 1928, to

WILLIAM S. JOHNSTON ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, line 44, for the word "vaporized" read "vaporizing"; 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 14th day of August, A. D. 1928.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.

the mixture into attenuated form while continuing the heating and pressure and suddenly releasing the pressure.

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