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G. H. BENJAMIN

METHOD OF AND APPARATUS FOR DEHYDRATING FLUID BODIES

Filed Nov. 9, 1918

FIG. 1.

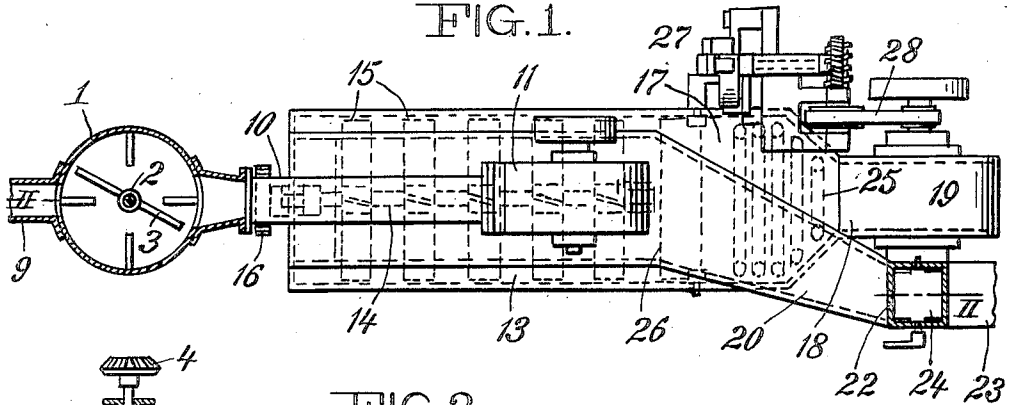


FIG. 2.

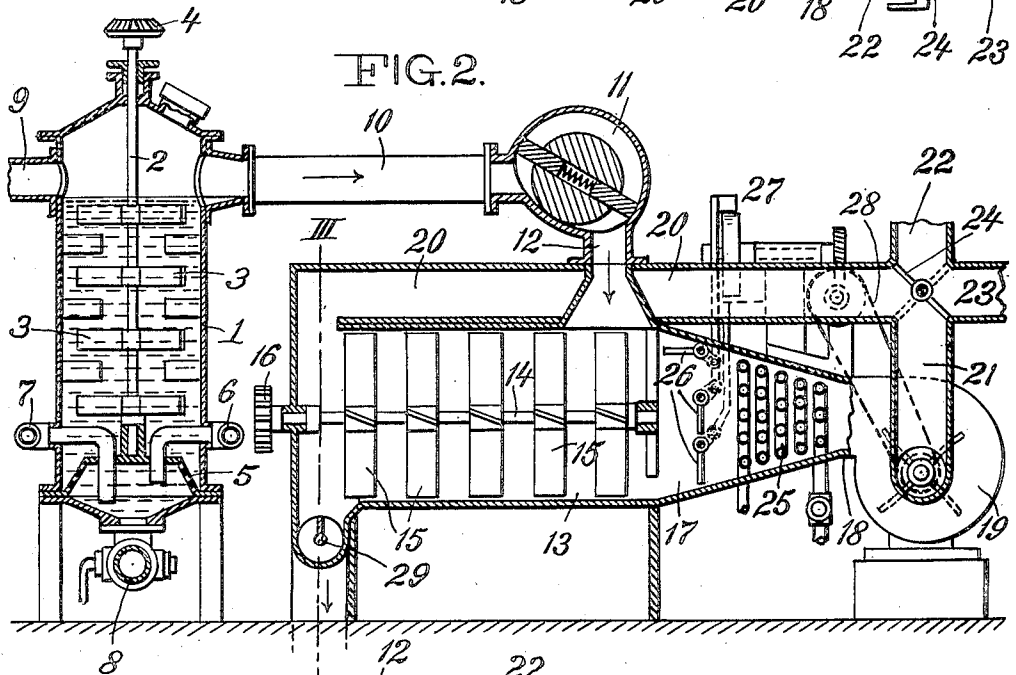
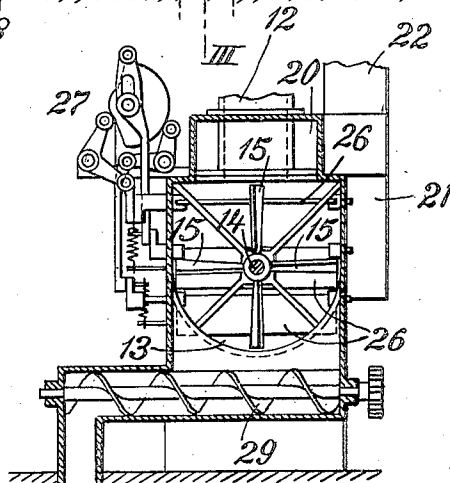


FIG. 3.



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METHOD OF AND APPARATUS FOR DEHYDRATING FLUID BODIES.

Application filed November 9, 1918. Serial No. 261,759.

To all whom it may concern:

Be it known that I, GEORGE HILLARD BENJAMIN, a citizen of the United States, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Dehydrating Fluid Bodies, of which the following is a specification.

My invention consists in a method of and apparatus for dehydrating fluid bodies.

The method, broadly stated, consists in subjecting the body to be dehydrated, to the action of a mechanical force by reason of which the body is beaten into a foam, and then subjecting the foam to the action of a mechanical force which will agitate or create motion in the foam and simultaneously to the action of absorptive air currents by reason of which the permanently fluid elements of the body acted on, as found in the foam, will be separated and the solid elements precipitated as a dry body.

The apparatus which I find best adapted to carry my invention into effect, consists of a vessel in which the body to be dehydrated is subjected to the application of a mechanical force applied through rapidly revolving beater arms, alone or in connection with an introduced body of air or gas; means for conveying the foam as produced, from the vessel in which it is produced to a dehydrating chamber; means in the dehydrating chamber for exerting a mechanical force through the action of beater arms; a pump through which absorptive air may be conveyed to the dehydrating chamber; means for heating the introduced air so as to increase its absorptive capacity; means for mechanically altering the horizontal level of the air through the dehydrating chamber; means for conveying the air, after it passes through the dehydrating chamber, back to the pump to be re-circulated or alternately discharged into the atmosphere, with a valve for determining and altering the circulation of the air as desired; and means for discharging the dried material from the dehydrating apparatus.

My improved method is especially applicable to treating that class of bodies in which a solid is associated with water or similar fluid, such for instance, as milk,

eggs, blood, vegetable and animal extracts, solutions etc.

The accompanying drawings will serve to illustrate such an apparatus as may be employed to carry my method into effect. I wish it understood, however, that I do not limit myself to the details of construction of the apparatus as shown, as other apparatus may be used to accomplish the same results.

Referring to the drawings, Fig. 1 is a plan view and partial horizontal section.

Fig. 2 is a vertical longitudinal section on the line II—II of Fig. 1, and

Fig. 3 is a vertical transverse section taken on the line III—III of Fig. 2.

In the drawings, 1 indicates a vessel in which is mounted a shaft 2. Located on this shaft, within the vessel, are a series of vanes or paddles 3. Upon the upper end of the shaft 2 is a gear 4 through which motion may be imparted to the shaft 2 and vanes or paddles 3. Located in the bottom of the vessel is a perforated screen 5. Situated at the right hand side of the vessel and adapted to discharge below the screen, is a pipe 6, through which the fluid material to be dehydrated may be introduced. Located on the left hand side of the vessel, at a point below the discharge of the pipe 6, is a pipe 7 through which an absorptive air or gas under pressure, may be introduced. The purpose of the arrangement of screen and pipes 6 and 7, is to bring about an intimate mixture of the body to be dehydrated with the introduced air or gas before the mixed body is brought into the zone of action of the revolving vanes or paddles; also to prevent coagulated masses from passing up into the cavity of the vessel. Connecting with the bottom of the vessel is a discharge pipe 8. Connected to the top of the vessel is a pipe 9, by which an absorptive air or a gas under pressure may be blown into the top of the vessel 1. Situated opposite the pipe 9, is a pipe 10 connected to the inlet of a pump 11, through which the foam as formed in the vessel 1 may be delivered to the pipe 10, either by pressure of air or a gas introduced through the pipe 9, or suction action of the pump 11. Connected to the outlet of the pump 11 is a delivery pipe 12, which communicates with the upper part of a dehydrating chamber 13. Arranged in this

chamber is a shaft 14, and on this shaft is mounted a series of vanes or paddles 15. On the left hand end of the shaft, outside of the dehydrating chamber, is a gear 16, through which motion may be imparted to the shaft 14 and vanes or paddles 15. Connected to the right hand end of the dehydrating chamber 13, is an air trunk 17, which air trunk is connected to the delivery orifice 18 of a pump 19.

The left hand end of the dehydrating chamber 13 is connected to an air trunk 20, which air trunk is connected to an air trunk 21, which is connected to the inlet of pump 19 and to an outlet pipe 22. 23 indicates an air pipe connected with the external air. Situated between the air ducts 20, 21, 22 and 23, is a butterfly valve 24, which, in the position shown in full lines, connects the air trunk 20 to the air trunk 21 leading to the inlet of the pump, and when in the position shown in dotted lines, connects the air trunk 20 to the outlet pipe 22. Situated in the air trunk 17 is a steam coil 25, connected with any suitable source of steam, and situated to the left of the steam coil 25 are a series of dampers 26, adapted to be actuated by means of a cam device 27, shown in Fig. 3. The cam device 27 is driven by a belt 28, from the shaft which drives the pump 19. The connection of the cam device is such that the valves 26 will alternately be placed in the open and closed position, thereby controlling the horizontal level through the dehydrating chamber, of the air delivered from the pump 19. 29 is a worm located at the left hand end of the bottom of the dehydrating chamber and adapted to discharge the dry material from the dehydrating chamber. I do not limit myself in any wise to the mechanical means described for converting the originally introduced body into a foam, or to the means described for agitating or creating motion in the body of foam within the dehydrating apparatus, as manifestly, many means other than that shown may be used.

I do not give any extended description of the dehydrating apparatus or its several parts, including the valves 24, as the same has been made the subject of a prior Patent No. 1,284,218 which was granted to me Nov. 11 1918.

The operation of the device used in carrying out my improved method, is as follows:

The material to be acted upon is introduced through the pipe 6 and fills the vessel 1, approximately to the level of the pipes 9 and 10. The shaft 2 carrying the vanes or paddles 3, is then set in motion and revolved very rapidly. The rapidity of motion will depend upon the material treated. Anywhere from 1000 to 1500 revolutions a minute will serve to convert any material into a foam. The foaming of some mate-

rials will be facilitated by introducing air or gas through the pipe 7—preferably a warm air or a warm gas. The gas may be a gas which will or will not coact chemically with the material under treatment. In practice I have found that N or CO₂ gas is useful; however, I have used other gases which have chemical reactions, such for instance as a P gas or NH₃ gas, which tend to break down the combinations between the fluid constituents and the solid constituents of cereain bodies.

The body to be dehydrated, alone or in connection with air or a gas, may be introduced into the vessel in sufficient quantity to fill the vessel, after which the flow may be stopped; or preferably, a constant flow of one or both of the bodies maintained, which will be in proportion to the foam removed, so that the level of the fluid in the vessel 1 will be approximately constant. Further, in using a gas which will chemically combine with the material to be dehydrated, means may be provided for regulating the temperature of the body in the vessel 1. Thus the temperature of the body may be increased to facilitate chemical action, or it may be decreased to prevent chemical action. I have not shown, in the drawings, any apparatus for heating the material in the vessel 1, as such apparatus is well known and will at once suggest itself to any one familiar with the use of such apparatus.

As an example of how a CO₂ gas may be employed, it will be assumed that the body introduced to be dehydrated, is a sugar solution carrying calcium hydrate. When this solution is introduced into the vessel and a CO₂ gas likewise introduced, the CO₂ gas will combine with the lime to form a lime carbonate, which, when beaten into a foam and passed through the dehydrating apparatus, will be delivered from the dehydrating apparatus in a dry state for subsequent treatment for the recovery of the sugar. Examples of the use of the other gases mentioned might be given, but it is believed this is unnecessary, as they will readily suggest themselves to those skilled in the chemical art.

As the foam is produced by the beating action, it accumulates in the upper part of the vessel 1, from which it may be blown into the pipe 10 by introducing air or gas under pressure through the pipe 9, or the foam may be drawn into the pipe 9 through the action of the pump 11 and delivered by the pump 11 into the cavity of the dehydrating chamber 13. The foam as it enters the dehydrating chamber, is subjected to the action of the vanes or paddles 15, which are rapidly rotated by power applied to the shaft 14 from an external source. The rapidity of dehydration will depend somewhat upon the rapidity of

action of the shaft, and vanes or paddles. In practice I find 200 to 400 revolutions a minute will suffice. The beating of the foam brings about an intimate mixture between the introduced air and foam, and facilitates the extraction of moisture from the foam by the introduced air currents. As the foam is introduced into the dehydrating chamber, it is mingled with absorptive air transmitted from the pump 19, the air being warmed in passing over the steam coils 25 and delivered into the dehydrating chamber, delivery of the air being in successive horizontal zones as the valves 26 are actuated.

As fluid is extracted from the foam under treatment in the dehydrating chamber 13, the solid matters in the dry state fall and are discharged from the apparatus by means of the worm 29. The air containing the extracted moisture passes to the air trunk 20 and thence, with the valve 24 in the position shown, back to the pump 19 to be again circulated. When the moisture in the air reaches a predetermined amount, the valve 24 is shifted, at which time the moisture charged air passes out through the outlet pipe 22 and fresh air is introduced through the inlet pipe 23. By means of a thermostatic valve (not shown) the valve 24 can be arranged to operate when the moisture content of the air reaches a predetermined amount.

I have described the use, in a dehydrating apparatus of dehydrated air as a means for absorbing the fluid portion of the body treated. Manifestly I may substitute for the dehydrated air, any dehydrating gaseous body which will absorb fluid.

Having thus described my invention, I claim:

1. The method of dehydrating fluid bodies described, which consist in first subjecting the body to a force to convert it into a foam, then the foam and a heated water absorptive medium to the action of a force to agitate and commingle these bodies in contact, to effect absorption of the separable moisture, contained in the foam, and precipitation of the solid portion of the foam.

2. The method of dehydrating fluid bodies described, which consist in first subjecting the body to a force and a gaseous body, to convert it into a foam, then the foam and a heated water absorptive medium to a force to agitate and commingle the foam and the heated water absorptive medium, for the purpose of absorbing the separable moisture contained in the foam, and permit the precipitation of the solid portion of the foam.

3. The method of dehydrating fluid bodies described, which consists in first introducing into the body to be dehydrated, a gaseous medium, then subjecting the body and the gaseous medium to a force to convert it into a foam, then the foam and a heated water

absorptive medium, to a force to agitate and commingle these bodies in contact, to separate the fluid portion of the foam from the non-fluid portion of the foam.

4. A step in the dehydrating method described, which consists in subjecting the body to be dehydrated, when in the form of a foam, to the simultaneous action of a heated water absorptive medium, and a force, by reason of which the foam and the absorptive medium are brought into intimate relation by agitation and stirring.

5. A step in the dehydrating method described, which consists in subjecting the body to be dehydrated when in the form of foam, to the simultaneous action of a heated water absorptive medium and a force, which will effect agitation and mixing of the foam and the heated water absorptive medium, whereby the liquid and solid constituents of the foam will be separated.

6. In an apparatus for dehydrating fluids, the combination of means for converting the body to be dehydrated into a foam, means for introducing into contact with the foam, a heated water absorptive medium, and means adapted to bring about agitation and mixing of the foam and the water absorptive medium, to thereby separate the liquid from the solid constituents of the foam.

7. In an apparatus for dehydrating fluid bodies, the combination of a vessel, means for introducing the body to be dehydrated into the vessel, means for subjecting the body while in the vessel to the action of a force which will convert the body into a foam; a dehydrating apparatus, means for conveying the foam from the vessel in which it is produced into the dehydrating apparatus, means in the dehydrating apparatus for agitating and creating motion in the foam in such apparatus; means for transmitting a water absorptive medium through the foam in the dehydrating apparatus whereby the fluid and solid constituents of the foam are separated, together with means for removing the separated solid material from the dehydrator apparatus.

8. In an apparatus for dehydrating fluid bodies, the combination of a dehydrating vessel, means for introducing the body to be dehydrated into the vessel, in the form of a foam, means for introducing into said vessel and foam, a heated water absorptive medium, and means within the vessel for agitating the foam and heated water absorptive material, whereby they are commingled, means for re-circulating through the dehydrating vessel, the heated water absorptive medium, together with means for supplying heat to the absorptive medium, as its liquid contents are increased.

9. In an apparatus of the class described, the combination of a vessel, means in said vessel for converting a body introduced into

said vessel from a liquid to a foam; a second vessel, means interposed between the two vessels for drawing the foam from one vessel and introducing it into the other, means
5 in said second named vessel for agitating and producing movement in the foam introduced, means for circulating a heated water absorbing vapor through the foam in said second named vessel, together with means
10 whereby at intervals a partially saturated vapor, may be delivered into the atmosphere and fresh vapor introduced into the circulating vapor, and means by reason of which any solid materials derived from the originally introduced foam may be withdrawn 15 from the apparatus.

10. The method of drying fluid bodies described, which consists in first converting the body into a foam, then creating motion of the particles of the foam, as regards each 20 other, then subjecting them while in motion to the action of an absorptive vapor, whereby the fluid and solid constituents of the fluid body acted on are separated.

In testimony whereof I affix my signature.
GEORGE HILLARD BENJAMIN.