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METHOD OF COOLING AND DRYING MATERIALS

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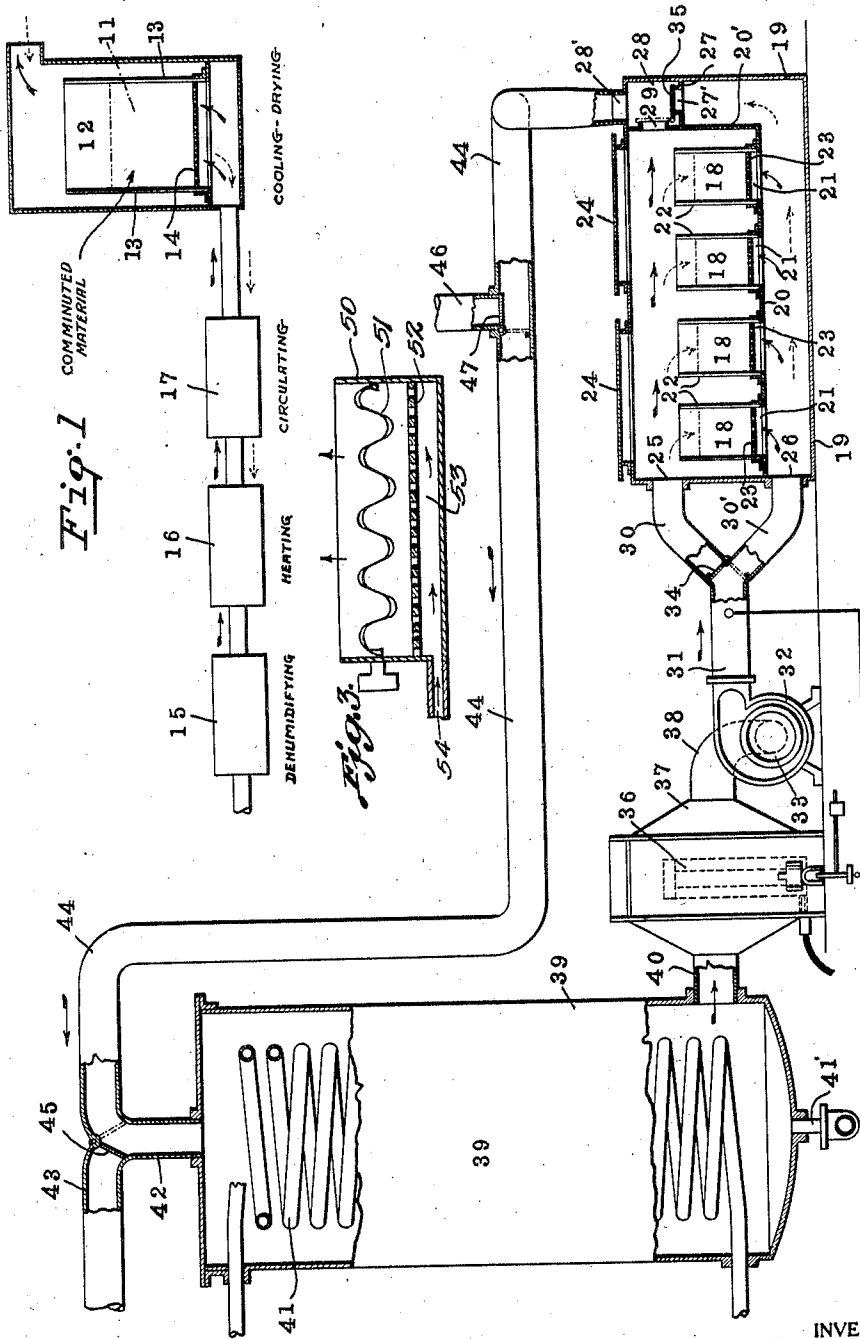


Fig. 2

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METHOD OF COOLING AND DRYING MATERIALS.

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This invention relates to methods of cooling and drying materials and more particularly to methods adapted for use in the handling and drying of materials such as yeast which tend to deteriorate at high temperatures.

An object of the invention is to provide an improved method of cooling and drying materials wherein the effects obtained are properly controlled and coordinated, and which is both efficient and economical.

Another object is to provide a method of cooling and drying a mass of moist particles in a manner such that there are produced substantially uniform effects throughout the mass.

A further object is to provide a method of preparing dried yeast whereby any substantial deterioration in the yeast during the drying process is avoided.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others thereof, which will be exemplified in the method hereinafter disclosed, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 illustrates diagrammatically the steps of a method embodying the features of the invention;

Fig. 2 illustrates one type of apparatus whereby the invention may be practiced; and

Fig. 3 illustrates diagrammatically a yeast-mixing machine adapted for use in the practice of the invention.

In the usual prior methods of drying comminuted materials, a thin layer of the material is spread on one or more shallow trays or receptacles and a current of air or other gaseous drying medium is passed through the space adjacent thereto. These methods are unsatisfactory, however, both from the standpoint of economy of operation and of uniformity and quality of product obtained.

They are uneconomical because the drying apparatus must necessarily occupy a large amount of space and also because the efficiency is low, in that only a small portion of the drying medium actually comes in contact with the surface of the particles to be dried, so as to be effective to absorb moisture therefrom, and the amount of drying medium which must be passed through the space is therefore greatly out of proportion to the amount of moisture absorbed from the material.

It is, moreover, substantially impossible to obtain uniform results by these prior methods both because the amount of drying medium actually coming in contact with the various particles of the material will tend to vary from time to time and because it contacts with the material only at the surface and hence tends to absorb a greater or less amount of moisture in accordance with the area of exposed surface and the amount to which the upper particles have been dried, and therefore uniform drying throughout the mass of moist particles cannot generally be obtained unless the mass of the material be constantly stirred by mechanical means. These methods are particularly unsatisfactory in cases where it is desirable to cool the material or to maintain it at a low temperature during the drying; since, if a heated gas is used, the heat of the gas will be dissipated only to a small extent by the evaporation of the moisture contained in particles of the material, after which the material will absorb heat from the gas, and since, if cool air is employed, the drying operation will be very long drawn out.

In the practice of the present invention these disadvantages are overcome by bringing a suitable gaseous drying medium into intimate contact with the individual particles of a mass of comminuted material so as to utilize the drying properties of the gas to the maximum extent consistent with economy in operation. To this end a relatively thick mass of moist particles, such as the particles of a comminuted material, is confined in a partially enclosed space and a gaseous medium possessing the proper characteristics to exert an efficient and properly coordinated drying and cooling of the mass is passed through this space at a speed at which it effects the desired results.

In the diagrammatic exemplification of the method illustrated in Fig. 1, a mass of loosely packed moist particles 11 is placed in a receptacle 12 having an unbroken side wall 13, a foraminated bottom wall 14, and an open top. The depth or thickness of the mass of particles 11 is preferably such that the gas passed therethrough will come into contact with a large number of particles successively. The gaseous drying medium employed may have its moisture content reduced to any desired extent at 15, and its moisture absorbing powers increased by heating at 16, and the necessary movement in either direction at 15 will may be imparted thereto at 17, this movement being preferably sufficiently slow that the gas becomes saturated with moisture before it is passed entirely through the thick mass of particles 11.

Because of the large amount of evaporation taking place throughout the mass of moist particles, a comparatively large proportion of the heat contained therein and also of the heat of the entering gas will be dissipated in the evaporation of moisture and the particles will thus be simultaneously dried and cooled. In fact, since the cooling effect obtained by this method is very great as compared to the drying, the method may be employed to cool moist materials even though no substantial drying is desired, the operation in this case being carried on only a sufficient length of time to bring the material to the desired low temperature. Such treatment has been found to be particularly advantageous in the cooling of pressed yeast which has become more or less heated due to the high pressures used in pressing off the yeast from the residuary wort. When on the other hand it is primarily desired to dry a mass of moist particles, the operation may be carried on throughout such a period as is necessary to remove the desired quantity of moisture from the particles, and the particles during the greater part of this operation will be maintained at a low temperature, so that the present method is well adapted for use in the drying of materials which tend to deteriorate at relatively high temperatures.

In order to obtain a uniform drying action throughout the entire mass of particles, it is, moreover, desirable to reverse the direction of flow of the gas through the receptacle from time to time as the drying operation proceeds, so that the comparatively dry gas which first comes in contact with the particles will be effective upon different portions of the mass successively. For example, the gas may be passed through the openings 14 in the bottom of the receptacle 12 and thence out of the top (as shown by the heavy arrows), during certain portions of the drying operation, and during other portions thereof it may be passed into the top of the receptacle

and thence out through the openings in the bottom (as shown by the dotted arrows).

The present method contemplates the use of means for controlling the initial moisture and temperature and the rate of flow of the gaseous medium, and in order that a maximum efficiency may be obtained, it is sometimes desirable that certain of these factors be varied as the operation proceeds. For example, the temperature of the entering gas may be increased toward the end of the operation when the material will, as in the case of yeast, be less sensitive to heat, or the speed of the entering gas may be reduced as the thickness of the layer of moist particles decreases with the absorption of moisture therefrom. Since the amount of moisture absorbed in bringing a given amount of gas to its saturation point at a given temperature may be readily computed when the humidity of the entering gas and the relative temperatures of the entering and leaving gas are known, the amount of moisture remaining in the material at any given time may be ascertained and the drying operation stopped at such time as the material has been dried to the desired extent. Moreover, when the gas is saturated before leaving the material the temperature of the gas which is passed through the material and the temperature of the material itself will be approximately the same, so that the temperature of the material may be readily ascertained merely by taking the temperature of the escaping gas.

Inasmuch as a material which contains a large amount of moisture will shrink to a considerable extent upon being dried, the thickness (or depth) of the mass of comminuted material in the container will often decrease to such an extent during the drying process that the gas will pass therethrough before it has approached its saturation point. As a consequence in the practice of the present invention, in drying materials it is sometimes desirable to employ a plurality of receptacles and to combine the contents of two or more receptacles and a single receptacle at some stage of the drying process.

Structural details of apparatus adapted to carry out the present method in cooling and drying materials are disclosed in the copending application, Serial No. 33,913, filed June 1, 1925, but for purposes of clarification one type of such apparatus particularly adapted for drying purposes has been shown in Fig. 2. In this exemplification the apparatus includes a plurality of receptacles 18 removably disposed within a casing 19 and resting upon a ledge 20 which extends entirely across the casing and for a considerable portion of the length thereof and is provided with a plurality of openings 21 with which the bottom of the receptacles are adapted to register. The receptacles each comprise a cy-

lindrical side wall 22 and a foraminated bottom wall 23, and are open at their upper ends. In order that the receptacles 18 may readily be removed from and replaced in the casing 5 19 there are provided in the top of the casing a plurality of removable lids 24. At one end the casing is also provided with openings 25 and 26, positioned respectively above and below a supporting ledge 20, and at its inner 10 end the supporting ledge is connected to a vertical partition 20' which extends upwardly to the top wall of the casing 19. The ledge 20 and the partition 20' form, with the adjacent bottom and end walls of the casing 19, 15 a gas passage connected at one end with the openings 26 and which, at the other end, is partially obstructed by a partition 27 in which there is an opening 27' opening into a chamber 28. Adjacent the chamber 28 the 20 partition 20' is also provided with an opening 29 which opens into said chamber. A pair of conduits 30 and 30' respectively lead from the openings 25 and 26 to a gas conduit 31, which extends to the housing 32 of a blower 25 33. At the juncture of the pipe 30 and 30' there is provided a valve 34 whereby one or the other of these pipes may be closed while allowing the gas to flow through the other thereof. There is also provided in connection with the openings 27' and 29 a valve 35 30 whereby these openings may be closed alternately. By the manipulation of valves 34 and 35, therefore, a current of gas from the blower 33 may be directed into the casing 35 either above or below the ledge 20 and directed thence through the material in the containers to the other side of the ledge and out through one of the openings 27' or 29, as indicated in one case by the heavy arrows and 40 in the other by the dotted arrows. The heating means in the present instance comprises a heating element 36 disposed within a casing 37 which is connected to the blower housing by means of a conduit 38, and the air 45 dryer or dehumidifier consists of a casing 39 connected with the heater casing 37 by means of a conduit 40 and containing one or more coiled pipes 41 which may be filled with cold brine or other cooling medium.

50 The casing 39 is provided at the bottom with a drain pipe 41' and at the top with a gas conduit 42, which is in turn provided with a connection 43 communicating with the air. Inasmuch, however, as the gas escaping into the outlet chamber 28 is ordinarily 55 cooler and consequently, as a general rule, of a lower humidity than the outer air, it is often desirable to conduct this gas to the dehumidifier so that a continuous circulation 60 may be had from the dehumidifier to the casing 19, through the receptacles 18, and back to the dehumidifier. To this end the pipe 42 is connected with the chamber 28 through the opening 28' by means of a pipe 44, and there 65 is provided at the junction of the pipes 42,

43 and 44, a valve 45 whereby either the pipe 43 or the pipe 44 may be shut off from the pipe 42, and the pipe 44 is provided with an outlet 46 controlled by a valve 47.

The provision of a plurality of receptacles, 70 such as shown at 18, through which a current of gas may be passed simultaneously, enables the method to be employed to produce successive batches of dried material at comparatively short intervals. In this case each of 75 the receptacles will contain material at a different stage of dryness and be emptied and refilled with moist material immediately upon the material contained therein becoming dry. The arrangement exemplified also permits the 80 contents of two or more receptacles to be incorporated in a single receptacle when the volume of the material in each receptacle has been reduced to such an extent that the 85 gaseous medium passing therethrough is not properly saturated.

It will, moreover, be apparent that because of the amount of cooling undergone by the gas in absorbing sufficient moisture to be 90 brought to its saturation point, the temperature of the moisture-laden gas will, as a general rule, be lower than the room temperature and consequently the temperature of the drying 95 apparatus. By means of the present method, therefore, condensation of moisture upon the inner surfaces of this apparatus is effectually prevented.

The method described is well adapted for employment in the handling of yeast, both 100 because of the efficiency and economy obtained thereby and because of the tendency of moist yeast to deteriorate at relatively high temperatures. In the manufacture of compressed yeast the cream yeast obtained from 105 the wort by separation is ordinarily compressed so as to squeeze out a portion of the moisture therefrom, and during this compression considerable heat is generated, which heat tends to cause deterioration of the mass 110 of yeast. Therefore, by aerating the compressed yeast for a brief time, as, for example, during the mixing stage, it can be readily cooled to the desired temperature. Moreover, a certain amount of deterioration will 115 occur at ordinary temperatures, and this will be greatly accelerated if any of the heat of the drying gas is absorbed by the yeast. Thus the advantages of drying yeast by a process wherein the yeast is cooled at the same time 120 that it is dried will be readily apparent.

In the use of the present method, either a gas or mixture of gases, which is substantially 125 inert to the material to be treated, may be used as a cooling and drying medium, and in the treatment of yeast, for example, carbon dioxide, hydrogen, nitrogen, oxygen, or air have been found to be satisfactory, the latter gas being particularly suitable because of its inertness and ready availability. As is 130 pointed out above, the material to be treated

should be first subdivided into small particles. These may vary in size from approximately 2 or 3 millimeters to perhaps 1 or 2 centimeters, and in the use of the apparatus above referred to, it may be placed on the foraminate bottoms of the treating chambers in a thickness of from 4 to 12 inches. Also, obviously, in the cooling of compressed yeast by the present method it would only be necessary to provide the mixer with suitable injection openings connected to an air supply such as above described.

An example of such a mixer is shown in Patent No. 1,417,065 to C. W. Hottmann, and there is illustrated in Fig. 3 one manner in which such a machine may be arranged for operation in accordance with the invention. In this exemplification a container 50 is provided with a mixing element 51 and the container is formed with a foraminate base 52 and an open top. Adjacent the base of the container is a chamber 53 from which extends a passageway 54, through which a suitable gaseous medium may be introduced.

Further data exemplifying the manner in which the method contemplated by the present invention may be applied to the drying and cooling of yeast follows:

One hundred pounds of compressed yeast having a moisture content of about 70% is comminuted and placed in one or more receptacles through which a current of air may be passed, the receptacles being of such size that the layer of yeast therein will be preferably about 8 inches thick. The temperature in the dehumidifier is so controlled that the air which leaves the same will contain about 1 to 2 grains of moisture per cubic foot, as, for example, about 1.25 grains. The air is then heated to about 60° F. so as greatly to increase its power of absorption of moisture and is then passed through comminuted yeast at a rate of approximately 200 cubic feet per minute, or 2 cubic feet per minute per pound of yeast. At this rate of speed, the air will have become saturated with moisture before leaving the layer of yeast. The evaporation of the moisture by the air lowers the temperature of the air and simultaneously lowers the temperature of the yeast to about 43° F., at which temperature there will be no substantial tendency for the yeast to deteriorate. This method, when continued for about 18 hours, will remove about 65 pounds of moisture from the yeast, thus producing a yeast containing only about 10% to 13% of moisture, which yeast is sufficiently dry for ordinary purposes.

Since certain changes may be made in carrying out the above method without departing from the scope of the invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the follow-

ing claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which as a matter of language might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of cooling and drying yeast, which comprises confining in a given space a relatively thick mass of particles of moist yeast and passing a warm gaseous drying medium uniformly therethrough at a rate of speed sufficiently slow so that the heat absorbed from the yeast by evaporation will more than offset the heat imparted to the yeast by the gas.

2. The method of cooling pressed yeast, the temperature of which has been raised during the pressing operation, with consequent tendency of the yeast to deteriorate, which comprises confining a relatively thick mass of the yeast in a given space and injecting a gaseous drying medium therethrough in such manner that the gaseous medium will absorb moisture from substantially each particle of the yeast so as to prevent any substantial amount of the yeast from remaining at a deteriorating temperature.

3. The method of cooling pressed yeast, which comprises injecting a gaseous drying medium therethrough during the mixing operation, whereby the heat acquired by the yeast during the pressing operation and the heat evolved during the mixing operation will be dissipated by the absorption of moisture from the yeast by the gaseous medium.

4. The method of drying yeast, which comprises confining a comminuted mass of moist yeast in a given space and passing a gaseous drying medium uniformly through the mass at such a slow rate of speed and under such conditions that sufficient evaporation of moisture from the yeast will occur to maintain the temperature of the yeast low enough to prevent any substantial deterioration thereof.

5. The method of cooling and drying yeast, which comprises confining a relatively thick mass of moist yeast particles in a given space and passing a warm dry gas through said mass, the ratio of the speed of the gas and the thickness and moisture content of the mass of yeast being such that the gas will be substantially saturated with moisture on leaving the mass.

6. The method of drying materials subject to deterioration at relatively high temperatures, which comprises confining a relatively thick mass of moist particles of said material in a given space and passing a warm gaseous drying medium through said mass at a rate of speed sufficiently slow so that the temperature of the particles will be brought to and maintained at a temperature beneath that at which the material deteriorates.

7. The method of cooling and drying yeast, which comprises passing a current of air, 10
which comprises passing a gaseous drying
medium having a temperature of over 45° F.,
and containing less than approximately two
5 grains of moisture per cubic foot through a thick
comminuted mass of moist yeast at a rate of
approximately two cubic feet per minute per 15
pound of yeast.
8. The method of cooling and drying yeast,

In testimony whereof I affix my signature.

ELMER B. BROWN.