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C. W. VOLNEY.

ART OF TREATING MATERIALS.

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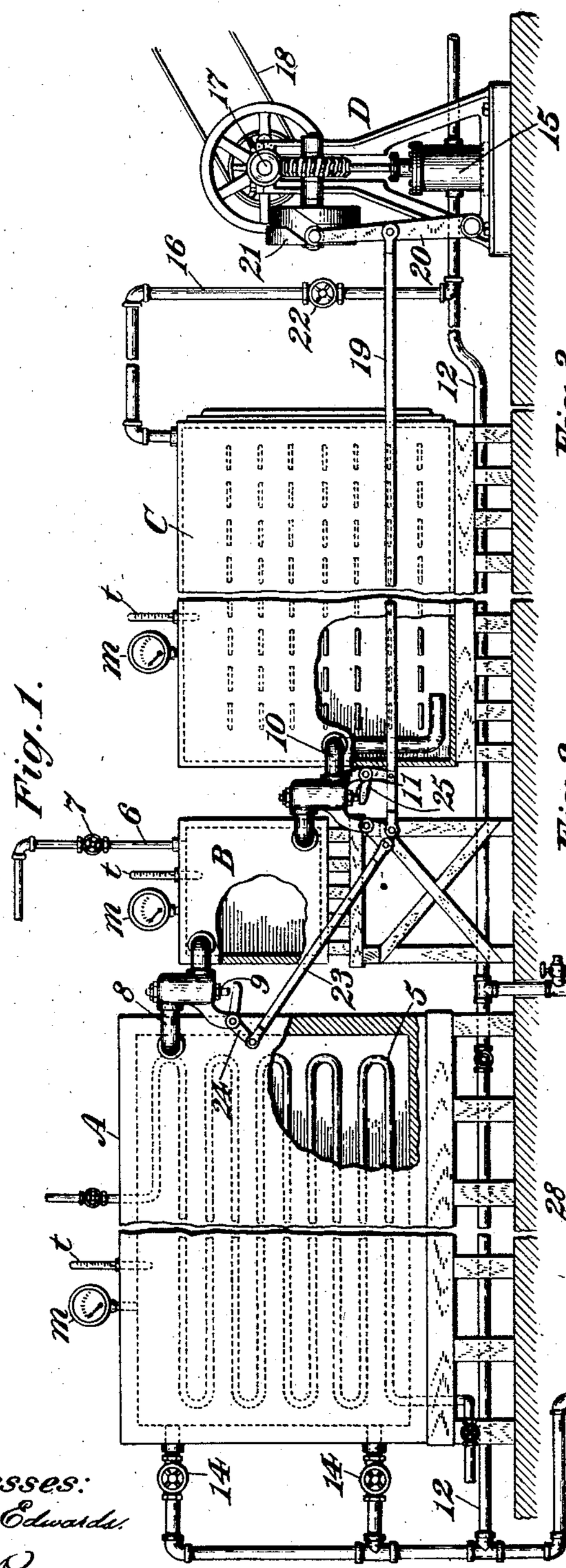

Fig. 1.

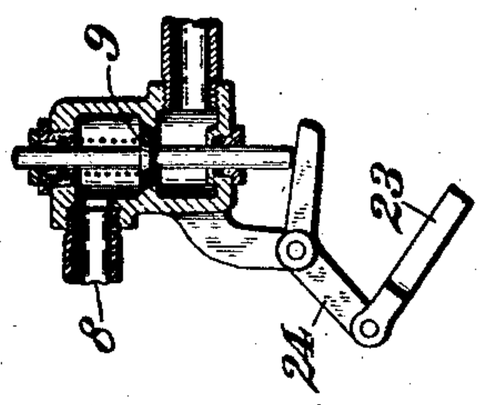

Fig. 3.

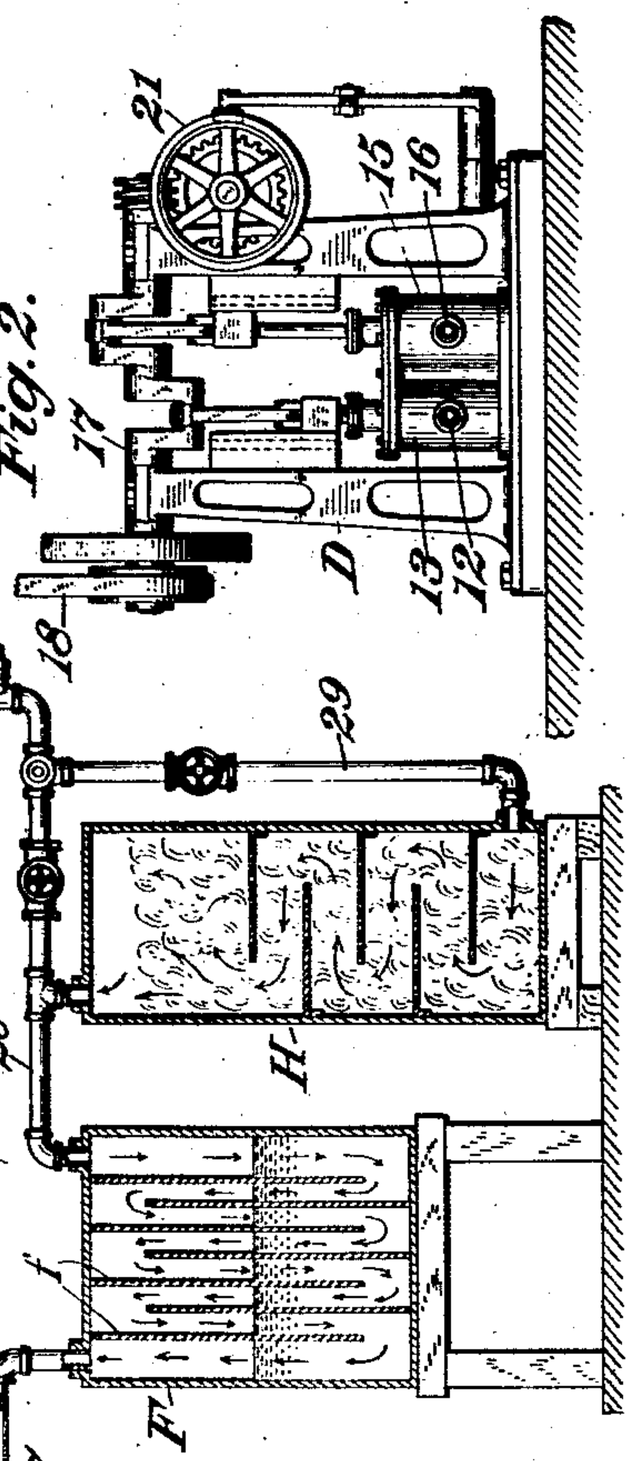

Fig. 2.

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UNITED STATES PATENT OFFICE.

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ART OF TREATING MATERIALS.

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To all whom it may concern:

Be it known that I, CARL WALTER VOLNEY, a citizen of the United States, residing in Keyport, in the county of Monmouth and State of New Jersey, have invented certain new and useful Improvements in the Art of Treating Materials, of which the following is a specification.

This invention relates to a process or method of treating material of various kinds for the purpose of removing other material in the form of liquid or vapor, contained in the interior of the particles or the mass of the material.

The object of the invention is to provide an improved method or process for this purpose, whereby the material will be dried in a much shorter time than heretofore, and to a much higher degree.

A further object of the invention is to provide such a process or method in which is prevented any injurious action on the substance to be dried, by the medium used for the drying or evaporation, and at a time to prevent any dangerous treatment of the material when in the nature of easily decomposible or explosive substances, or such as are sensitive to heat, vibration, friction, concussion, etc., that might produce an overheating or an explosion of the material.

In the accompanying drawing illustrating a form of apparatus that may be used for carrying out this invention; Figure 1 is a side elevation, certain parts being shown in section. Fig. 2 is an end view; and Fig. 3 shows one of the valves and its operating means.

The process broadly stated consists in placing the substance to be treated in a closed vessel and admitting any suitable gaseous medium thereto, preferably air, which has been previously treated to remove all aqueous vapor and other undesirable elements therefrom. It is further desirable to subject the air or other gas to treatment by antiseptic and sterilizing agents. The air or other medium, introduced into the closed vessel, has its pressure caused to fluctuate at certain periods, and between certain predetermined pressures.

In practice I have found that atmospheric pressure is a sufficient maximum for explosive substances which pressure is periodically reduced. I have also found that the temperature inside the vessel should be maintained at between 35 and 40 degrees C., to give the best results. And also that the variation of pressure in the vessel for use with explosive substances should not exceed about 75 to 80 mm. or about 3 inches of vacuum; which temperatures and pressures can be varied for use with non-explosive material.

In the process of this invention it is necessary to take into account the circumstances that while a reduction of pressure, that is, the creation of some vacuum, tends to increase the power of the air to absorb the fluid, this normal increase is accompanied under ordinary conditions, with a substantially corresponding reduction of temperature, caused by the expansion of the air itself. In this invention I provide a remedy for this opposing action of one phenomenon to defeat the normal effect of the other. Now, the exhaustion of the chamber expands the air and reduces its temperature. The temperature of the air, however, since it corresponds to a normal expansion of the air, accounts for and creates the absorptive power of the air to take up the fluid. The reduction of temperature therefore which inevitably accompanies the expansion of the air by such exhaustion of the chamber substantially balances and counteracts the increased absorptive power which would otherwise be given to the air by the expansion. I overcome this by providing an apparatus whereby the requisite measured and timed expansion and compression of the air in the drying chamber will be effected, and at the same time whereby the air so admitted to the drying chamber will be preheated by an amount to offset the degree of cold which would otherwise be produced as the direct result of the expansion. This preheating of the air therefore becomes a feature of some importance, and possibly of essential importance, in making the alternating higher and lower pressures in the drying chamber effective for the purpose of treating materials which cannot, by reason of their chemical nature, be safely subjected during the drying process to any large or considerable variation in temperature. At the same time, in connection with this peculiar mode of treating the material, the admission of fresh, properly heated air or gas to the drying chamber, and the subsequent exhaustion of the same therefrom, is timed to occur relatively slowly, sufficient in practice to prevent the material in the drying chamber from being subjected to vibration, while at

the same time, preventing the material from being simultaneously subjected to both vibration and cold.

By preheating the air to the predetermined, regulated point where it properly corresponds with the amount of cold which will immediately be produced through the expansion of the same air by its admission into the partially exhausted drying chamber, the power of the air to absorb fluid is maintained to substantially the full amount which would be due to the increased heat of the air under normal pressures,—that is, the temperature it has in the heating chamber, to under atmospheric pressure, for instance. Through this mode of operating the apparatus, whereby to carry out the drying process under the uniform and controlled condition set forth, it becomes practicable to maintain the drying chamber at the desired and constant degree of temperature, while increasing the absorptive power of the air, and at the same time effecting the dislodgment of the small and widely disseminated volumes of solvent which may remain in the interior portions of the masses to be dried, and which are therefore practically impossible of rapid removal by methods heretofore employed.

As each reduction of pressure, or production of vacuum, results in the expansion of the air or other medium, there is also a decrease of temperature caused thereby; and as such decrease or lowering of temperature takes place at every admission, into the vacuum space, producing ultimately a freezing temperature in the vacuum chamber, this will utterly frustrate the purposes of the present invention. All the present process for drying explosive substances for vacuum have been failures as they have not taken into due consideration these circumstances. The present practice includes the application of more or less heat; but the heat is applied to the outside of the masses or grains of powder, and if the interior of the grains is of a higher temperature, an unduly prolonged exposure to heat, or to a dangerously high temperature has to be employed. To overcome these difficulties the present method or process includes means for admitting to the vacuum chamber, a certain predetermined volume of the air or other medium, whose temperature is sufficiently elevated to counteract the reduction of temperature caused by the expansion of such volume when admitted to the vacuum chamber.

In the drawings a closed vessel or tank C is provided with suitable shelves on which the material to be dried is placed, a second closed tank A is provided with a heating coil 5 through which coil a heating medium of any desired kind is passed. Between the tanks A and C is located a small tank B of a certain predetermined capacity relative to the tank C. Each of these tanks is provided with a monometer *m*, for determining the pressure and a thermometer *t*, to indicate the temperature therein, the small tank B is provided with an outlet pipe 6 at its top that may be controlled by a valve 7. The tank A is connected with the tank B at their upper parts by a pipe 8 containing a valve 9, that controls the admission from the tank A into the tank B. A pipe 10 connects the lower part of B with the tank C at its lower part which pipe is controlled by valve 11.

Air or other gaseous medium is admitted into the tank A in any suitable manner, either under atmospheric pressure or under a greater pressure if desired. The pipe 12 may be connected with a pump apparatus D if desired to admit air under pressure. The pump D has a cylinder 13 operating to force air through the pipe 12 in the tank A. The pipe 12 has its admission into tank A controlled by valve 14 to vary the pressure. The pump D has a second cylinder 15 connecting with tank C at its top by pipe 16. The pistons may be continuously driven from a crank shaft 17 operated by a belt 18 from any suitable source of power. The valves 9 and 11 are suitably operated whereby when the valve 11 is closed the valve 9 is opened, permitting the dried heated air from the vessel A to enter the tank B. Then the valve 9 is closed, and the valve 11 is opened. The pump having produced a certain degree of vacuum in the tank C, the air in tank B, under atmospheric or other pressure, will at once expand and pass into the tank C until equilibrium is restored between the two tanks. Thereupon the valve 11 is closed and then the valve 9 again opened, permitting air to pass from tank A into tank B, which will restore the pressure in the tank B. Suitable means may be provided to automatically operate these valves in the described sequences from the operation of the pump device D. The connecting rod 19 is pivoted at one end to a lever 20 whose extremity engages the walls of a cam member 21 rotated from the pump member D. A crank 22 is pivoted to the connecting rod 19 and also pivoted to a connecting rod 23; which latter is pivoted to a lever 24 that engages the valve 9. A bent lever 25 is pivoted to the rod 19 and serves to operate the valve 11. When the lever 20 is shifted in one direction, the valve 11 will be first closed and upon further movement in the same direction, the valve 9 will open. Obviously the movement of the lever and rod 19 in the opposite direction will first close the valve 9 and then open the valve 11.

Suitable means are provided for drying the air or other medium to remove its aqueous vapor before passing into the tank A. A vessel F is provided having alternately

depending and upstanding partitions *f* therein, which vessel is connected with the pipe 12 by a pipe 27. This vessel contains a hygroscopic material, such as calcium chlorid or other suitable material. The air admitted to the tank F by pipe 28 will pass alternately up and down between the partitions and through the fluid therein, and thus be deprived of its moisture and thoroughly dried before entering the tank A. For the use in drying explosive substance such treatment will be practically sufficient, but with the drying of other substances such as fruit or vegetable materials, it is also advisable to purify and sterilize the air, or other medium. This can be effected in a vesel H containing raw cotton or other substance that has the effect of removing bacteria and germs from air or other gas. The air may enter tank H through pipe 29 and then pass through pipe 28 in the vessel H.

When it is desired to cut out the vessel H, a valve 30 in the pipe 29 is closed, and a valve 31 in the pipe 28 is opened. But when valve 31 is closed and valve 30 open the air or other gas will be drawn through the vessel H and sterilized.

For explosive substances it is desirable to keep the temperature of the material treated below 43 degrees C., and the measuring tank B being preferably about 1/20 of the volume of the vacuum chamber C, may be treated to about 75 degrees C.; whereby on entering the chamber A and expanding, under a difference of pressure of about 75 to 80 mm. the temperature in the tank C is maintained at a safe degree.

It is seen that it is essentially necessary to have the volume of the entering air of a predetermined size, and to impart to it a predetermined temperature, and provide for the periods of admission; which latter I have found should be about six to eight per minute to give the best results.

In general, the relative applications of the entering volumes in the described manner admits of changes in volumes, (temperatures and pressures) greater volume of entering air, higher temperature, greater differences in the resulting pressures of the vacuum will produce quicker results, the material will dry faster. But for the treatment of explosive matters, however, the means of avoiding all moving of explosives, drying it completely without friction or shock of any kind are offered in the herein before described invention; and the entering of the absorbing medium into the porous interior of the explosive material, its removal, periodically, with diffused moisture or vaporous solvents as well as to maintain an even and uniform temperature in the grains or masses of the explosives, the absence of friction and shock, insures complete safety and protection from decomposition by higher temperatures; which is one of the dangerous consequences of applying outside heat.

Having thus described my invention, I claim:

1. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been treated with hygroscopic material; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of said gas treated as aforesaid, and exhausting it from the said vessel.

2. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been treated with hygroscopic materials, and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of gas treated as aforesaid, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent.

3. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been treated with hygroscopic material; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

4. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the powder in a closed vessel and introducing into the vessel a heated gas that has been treated with hygroscopic materials; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

5. In the art of finishing powder containing cellulose nitrates, the process of removing from the powder in pressed form the volatile matter in the nature of solvents such as alcohol and ether, consisting in placing the powder in a closed vessel and introducing into the vessel heated air or other gas that has

been treated with hygroscopic materials; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

6. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been sterilized and treated with antiseptic and germ destroying and hygroscopic material; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of said gas treated as aforesaid, and exhausting it from the said vessel.

7. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been sterilized and treated with antiseptic and germ destroying and hygroscopic materials, and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of gas treated as aforesaid, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent.

8. The herein described process or method of drying or removing volatile substances from various materials, consisting in placing the material in a closed vessel and introducing into the vessel a heated gas that has been sterilized and treated with antiseptic and germ destroying and hygroscopic material; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

9. The herein described process or method of drying or removing volatile substances from powder consisting in placing the powder in a closed vessel and introducing into the vessel a heated gas that has been sterilized and treated with antiseptic and germ destroying and hygroscopic materials; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

10. In the art of finishing powder containing cellulose nitrates and kindred substances the process of removing from the powder in pressed form the volatile matter in the nature of solvents such as alcohol and ether, consisting in placing the powder in a closed vessel and introducing into the vessel heated air or other gas that has been sterilized and treated with antiseptic and germ destroying and hygroscopic materials; and exhausting a portion of such charged gas from the closed tank to reduce the pressure therein, and alternately repeating the introduction of fresh quantities of such gas, and exhausting it from the said vessel, the pressure in the closed vessel being thereby caused to fluctuate about ten per cent, the temperature in the closed vessel being maintained at from 35 to 40 degrees centigrade.

11. In the art of drying dangerous, easily decomposed or explosive material or removing therefrom moisture and volatile matter or finishing gunpowder with nitro-cellulose or similar matter as a constituent part, the process of removing from such material moisture, alcohol, ether or other volatile matter consisting in subjecting such matter to a vacuum of about 250 mm., and admitting periodically a predetermined volume of dried air under atmospheric pressure of a temperature of 75 degrees C. so that the temperature of the vacuum remains at 40 to 43 degrees C. and the differentiation of vacuum in the drying chamber being maximum at about 25 to 30 mm.

12. A process or method of drying or removing volatile substances from material in grains or masses, consisting in placing the material in a vacuum chamber, producing therein a suitable vacuum and admitting periodically, under atmospheric pressure a certain predetermined volume of purified, sterilized air or gas of suitable temperature; periodically reproducing the former vacuum and then again admitting another said volume of the purified, sterilized and heated air, under atmospheric pressure, and thus repeating the evacuations and admissions until the moisture or volatile matter is removed.

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