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I. WARNER
METHOD OF HYDRATING DOLOMITIC OR OTHER
RELATIVELY SLOW-SLAKING LIMES
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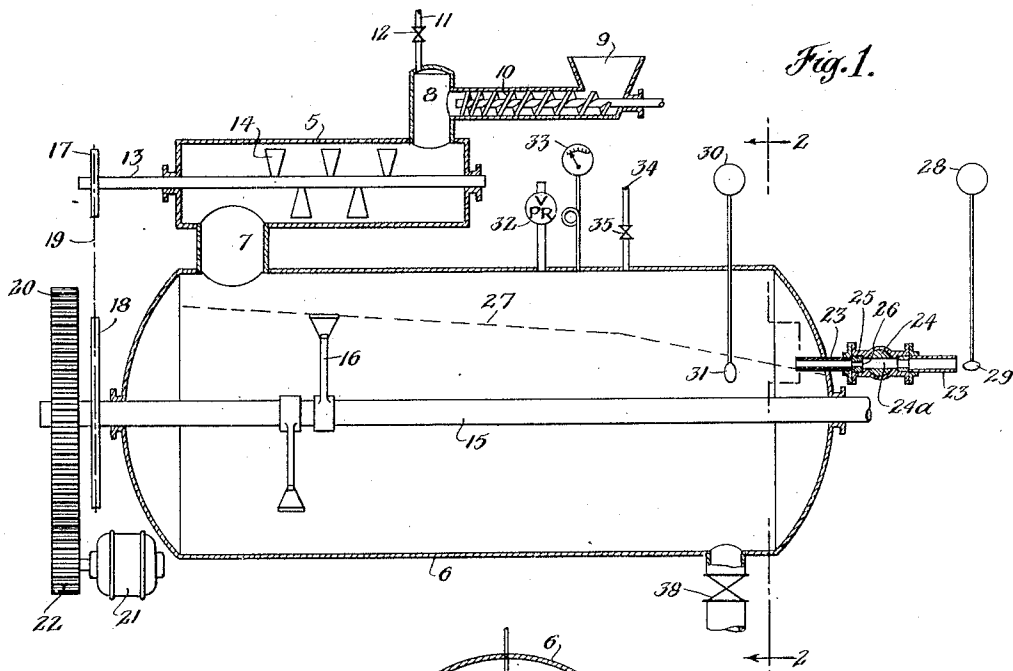


Fig. 1.

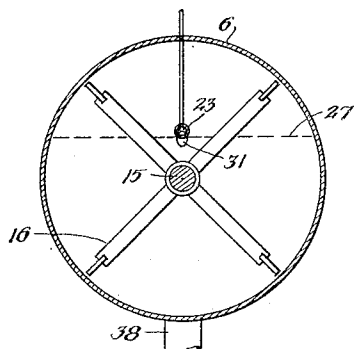


Fig. 2.

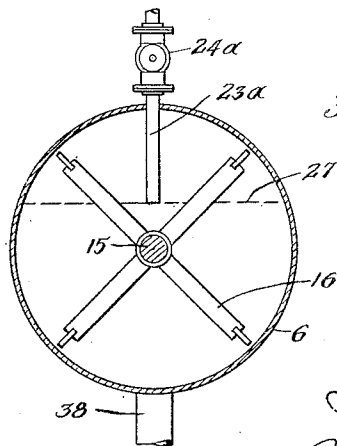


Fig. 3.

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METHOD OF HYDRATING DOLOMITIC OR
OTHER RELATIVELY SLOW-SLAKING
LIMES

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20 Claims. (Cl. 23—188)

This invention relates to the art of hydrating lime and is particularly concerned with the provision of an improved process and apparatus for hydrating relatively slow-slaking material, such as dolomitic lime, which contains a high percentage of magnesia (MgO). Others of these relatively slow-slaking materials are limes high in acidic constituents, such as silica, iron, alumina, etc.

Generally stated, the principal objects of the invention are to improve the plasticity, the sand-carrying capacity, and the water retentivity of the finished product, to insure the rapid hydration to any desired extent of whatever MgO may be present in the quicklime as well as the substantially complete hydration of the CaO , to convert unsound constituents into beneficial forms, and to provide a continuously operable process for effecting the hydration.

It has heretofore been known that the hydration of relatively slow-slaking limes and particularly dolomitic limes under pressures above atmospheric will serve to break down and hydrate lime compounds of silica, iron and alumina, which arise from incipient fusion between the lime and the impurities in the stone at the time of calcination, and will also serve to hydrate the MgO fraction which, under normal atmospheric methods of hydration, ordinarily does not hydrate at all or only to a very limited extent or at a very low rate. Insofar as I am aware, however, no process has heretofore been developed for successfully or economically performing such pressure hydration as a continuously operable process. My invention, therefore, is specifically concerned with the provision of a continuously operable pressure process.

My invention also contemplates the provision of a method by means of which the finished product may be substantially continuously ejected from the pressure vessel by means of and along with autogenously generated steam as well as the provision of a safe method of pressure hydration, i. e., one in which all danger of explosion is avoided.

A further object is to provide a method which makes available for hydration some materials which might not otherwise be usable, such, for example, as overburned lime or lime high in acidic constituents. The invention makes possible the development to a high degree of the desired characteristics as to plasticity, sand-carrying capacity, water retentivity, etc. in a shorter space of time and with materials, which ordi-

narily, would not easily yield a product of the desired quality.

Still another object is to provide a novel apparatus for use in the production of hydrated lime from relatively slow-slaking materials.

How the foregoing objects, together with such other objects as are incident to my invention, or which may appear hereinafter, are attained, will now be described in connection with the accompanying drawing, which illustrates preferred embodiments of the improved apparatus which I have developed for the manufacture of my improved product, wherein—

Figure 1 is a vertical longitudinal section through the equipment;

Figure 2 is a transverse vertical section taken approximately as indicated by the line 2—2 of Figure 1; and

Figure 3 is a fragmentary section similar to that of Figure 2 but illustrating a modified arrangement for ejecting the product.

In carrying out my invention I provide a pressure vessel having a preliminary mixing chamber or pug mill 5 and a secondary or main hydrating and seasoning chamber 6, both of which are preferably cylindrical in form, as shown, and constructed to withstand the desired pressures. The pug mill is small in relation to the seasoning chamber 6 and is arranged above the latter with a large discharge opening 7 at one end in direct communication with the upper portion of one end of the chamber 6, so that the pressure in the two chambers is maintained substantially uniform throughout.

At the upper portion of the opposite end of the pug mill I provide a relatively small entrance chamber or vestibule 8, also subject to the pressure existing within the equipment, into which the quicklime is delivered by means of the hopper 9 and variable pitch screw 10, the pitch of the screw being less at the discharge end than at the entrance end, in order to force the material into the vestibule 8 against the pressure existing therein without the necessity of opening the equipment, which opening, of course, would release steam and tend to lower the pressure. Such variable pitch screws are well known to those familiar with the art and form no part of my invention. Instead of a variable pitch screw, an air lock system might be employed, but this is not illustrated because it may assume any one of a number of different forms.

The water is introduced under pressure through the pipe 11 and valve 12. A shaft 13 extends longitudinally through the center of the pug mill 5

upon which are mounted suitable mixing vanes 14, the device being proportioned and arranged so that the mixing is thorough and complete before it is discharged through the passage 7 which leads to the upper portion of one end of the seasoning chamber 6 as already described. The time for effecting mixture in the pug mill is not vital but is generally accomplished in a relatively short period compared to the time in transit through the seasoning chamber, say about one minute or even less as against an hour or more.

The chamber 6 is also provided with a longitudinally extending shaft 15 carrying suitable agitator arms or vanes 16. Shafts 13 and 15 may be interconnected by means of the sprockets 17 and 18 and the drive chain 19. At the end the shaft 15 carries a driving gear 20 which is driven by a motor 21 through a driving pinion 22. The driving connections are so arranged as to impart high speed to the pug mill shaft 13 and a relatively slow speed to the shaft 15 in the seasoning chamber. This makes it possible to pass the freshly mixed material very quickly through the pug mill and very slowly through the seasoning chamber. The vanes 14 and 16 are given a slight cut so as to aid in advancing the material through the apparatus.

At the end opposite to the opening 7 the seasoning chamber 6 is provided with a vent pipe 23 in which is located a suitable valve 24. In the embodiment of Figures 1 and 2 this vent pipe is horizontally disposed, as shown, and is located at the interface between the mass of material in process and the steam space thereabove in accordance with the principles of operation to be discussed more fully hereinafter.

Immediately adjacent the valve 24 and on the pressure side thereof I provide a readily renewable wear-resistant bushing 25 having a fixed orifice 26, so located with reference to the passage 24a through the valve 24 as to pass the outgoing stream of mixed lime and steam in such a way as to avoid substantially all contact with the interior of the valve. The reason for this is that the stream of finished material passing out through the vent 23 is highly abrasive in nature and would tend to injure the valve and require its replacement at frequent intervals. By providing a readily renewable orifice member as described, the wear can be concentrated upon this part so as to avoid the necessity of expensive and troublesome valve replacements.

At the outlet side of the valve 24 there is provided a thermometer 28, the bulb 29 of which is located directly in the path of flow of the material which discharges from the vent 23 as and for the purpose which will appear more fully hereinafter.

Another thermometer 30 has its bulb 31 located just beneath the surface of the material at a point closely adjacent to the inlet end of the vent pipe 23.

At the top, the chamber 6 may, if desired, be provided with a pressure relief safety valve 32. A pressure gauge 33 is also provided so that the pressure within the vessel is always known. A steam vent 34, manually controlled by valve 35, is also provided at the top of the vessel as shown. The valve controlled bottom discharge opening 38 is provided simply for convenience in cleaning out the cylinder and is not intended to be used as a means for discharging the finished material.

I will now fully describe my improved method of operation. The valve 24 is closed and the motor 21 is started in order to turn the shafts 13 and 15 with their agitator arms 14 and 16.

Properly proportioned amounts of quicklime and water are then separately introduced by means of the conveyor 10 and the pipe 11, the quicklime having been reduced in size for handling and introduction into the processing vessel. The quantity of water should be sufficient to supply that which is needed to satisfy the chemical reaction incident to the desired hydration as well as that which will be converted into steam by the heat of the exothermic reaction. A portion of the water which ultimately appears as steam temporarily remains in the vessel in the liquid phase because of the fact that the process operates at a pressure above atmospheric pressure. This water subsequently becomes steam on venting to the atmosphere, which action tends to cool the product and while present as water in the vessel 6, it serves to avoid burning of the lime by preventing the temperature of the charge from rising above the temperature which corresponds to the existing steam pressure. In addition there should be enough water to yield at least a trace of free moisture in the finally discharged material. The character of the lime, of course, will determine the amount of water which will be necessary in accordance with the foregoing instructions, but as a general rule for dolomitic limes having a MgO content of approximately 40%, of which at least 85% is to be hydrated, the weight of the water will approximate 70% of the weight of the quicklime. This 70% is approximately twice that amount of water theoretically necessary to complete the chemical reaction incident to that degree of hydration which corresponds to 85% magnesia hydration.

In a few moments after the materials are introduced, the slaking reaction will begin in the pug mill 5 and/or in the main vessel 6. The heat of the exothermic reaction results in the evolution of steam which immediately tends to build up a pressure within the processing equipment, all valves being closed to begin with and the shafts 13 and 15 being adequately packed for this purpose.

The operating pressure so developed may vary, of course, over a considerable extent depending very largely upon the character of the lime. Certain principles, however, having a bearing upon the most successful manner of carrying out my improved process should be borne in mind, and these will be developed more fully below. However, I have found it desirable to operate at a pressure of from 10 to 50 pounds, and in practice at the present time highly satisfactory results are being obtained with a pressure in the neighborhood of 27 pounds gauge. This range of pressure is particularly suitable for dolomitic limes wherein the MgO content approximates 40%.

At this point I should like to bring out the fact that in starting up the process the pressure vessel, of course, is empty. In practice, therefore, a deficient amount of water may be used initially so as to develop the heat and pressure as quickly as possible. In about five minutes after the start, the pressure will begin to develop and in a few minutes more, will arrive at the preferred operating pressure of 27 pounds gauge, whereupon the manually controlled valve 35 at the top may be opened so as to release steam and hold the pressure substantially constant. Instead of the manually controlled vent, an automatic safety valve could be employed if desired, although for

close regulation I have found it best to rely upon the manual control of the operator.

By the time that the pressure has arrived at the desired point, i. e., 27 pounds gauge or even slightly before such time, the operator will have adjusted his water addition to the full quantity desired which, as stated, is usually about 70% of the quicklime by weight. Very soon there is such a large quantity of steam being generated that the lime vent cock 24 may safely be opened, and I prefer to open this cock before the mass of the charge has risen to the level of the outlet or vent pipe 23 so that when the cock 24 is first opened steam alone will be ejected through the orifice 26. When the vent cock 24 is opened, in order to maintain the desired operating pressure within the chamber 6, it is necessary to greatly reduce the amount of steam that is controllably vented from the top of the vessel through the pipe 34. As the process proceeds, the lime charge comes up to the level of the vent 23, whereupon the hydrated product begins to go out with the steam so that the amount of steam that can pass out through the orifice 26 is greatly reduced, under which conditions it is necessary to allow more of the steam to pass out through the controllable release at the top.

From all of the foregoing it will be seen that the size of the discharge orifice for the venting of the finished material is quite critical for any given set of conditions. In the first place, it must not be so large as to make it impossible to maintain the desired operating pressure and, in the second place, it must not be so small as to result in clogging of the vent pipe and stoppage of the process. As a practical guide I have found that the upper limit on the size of the vent should not be greater preferably than would be capable of passing approximately 80% of the steam generated by the process if steam alone were being vented. The lower limit as to the size of the vent is preferably such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate. If the vent is made smaller than this it is difficult, if not impossible, for the steam to impart the necessary velocity to the hydrated product to keep the vent clear.

As a guide to the practical operation of my improved process, I should like to present the following example and calculations.

In the first place, at the preferred pressures, it takes approximately one hour to hydrate a dolomitic lime of 40% magnesia content to the desired degree. This involves, of course, the complete hydration of the CaO fraction which, as is well known, hydrates with relatively great rapidity, especially under pressure. The magnesia content is generally not completely hydrated and the degree of hydration may vary over a considerable extent, but is preferably between 80% and 90%. For the sake of the following examples, it will be assumed that the magnesia is to be 80% hydrated and that the time in process is approximately one hour.

It will further be assumed that it is desired to produce approximately 200 pounds of finished hydrate per minute. The equipment will then be designed to handle the necessary materials for this purpose.

For the sake of convenience in calculation, it will further be assumed that it is desired to operate at a pressure of 20 pounds gauge. Under these assumptions the following table will indicate the proper diameter of orifice 26 which it

will be necessary to employ for various weights of steam discharged with the hydrated material. The table also indicates the approximate velocity in feet per second of the discharging stream of mixed steam and lime, as well as the amount of steam which would pass through the orifice if steam alone were being vented.

Per 200 lbs./min. of hydrated lime—20 lbs. per square inch pressure

	Pounds of steam per 200# of lime	Velocity, ft./sec.	Diameter of orifice	Amount of free steam passing orifice
1	2	220	Inches	21
2	5	345	1.08	32
3	10	480	1.35	45
4	20	665	1.60	66
5	30	790	1.93	84

NOTE.—The diameter of the orifice is predicated upon an orifice efficiency of 67%; that is, the area must be 150% of the theoretical. This is due to the well known formation of vortices when a pressure fluid passes thru an orifice.

In connection with the foregoing table it should be understood that the amount of autogenously generated steam available for maintaining the pressure and for discharging the finished product is roughly 50 pounds per minute. It should also be kept in mind in interpreting the table that steam alone, even at the comparatively low pressure of 20 pounds gauge, will go out through an orifice with great velocity, theoretically calculated at 2200 feet per second. If hydrated lime is passing out with the steam this velocity, of course, is greatly reduced, as shown by the table, because the lime is inert and must be energized by the steam.

Still further in connection with interpreting the foregoing table, it must be borne in mind that the vent is located at the interface between the steam space and the material in process just at the point to give a volume in the vessel which provides the charge with the correct time to secure the desired degree of hydration. At this point the material is in a highly fluffy, almost fluid, state, the voids of which are completely filled with steam at the operating pressure. In this condition the mass flows somewhat like water and may be readily ejected through a small orifice with the aid of a comparatively small amount of free steam.

The process, of course, is being operated at a prescribed rate, with the quantities of incoming quicklime and water held at a substantially constant level. The quantity of material to be discharged, therefore, is substantially constant, so it will be obvious that if the size of the discharge orifice 26 is changed the quantity of steam which passes out with the lime will also vary, while the quantity of lime remains approximately the same.

With an orifice diameter of 1.08 square inches, therefore, as shown by the table, approximately 2 pounds of steam by weight will pass outwardly for every 200 pounds of hydrated lime which is ejected and the velocity of this combined stream of steam and lime is shown to be approximately 220 feet per second. Under this condition the amount of steam which would pass the orifice if steam alone were being ejected would be 21 pounds per minute or something less than half of the available 50 pounds per minute. Operation at this point I have found to be hardly practicable and the table includes an orifice of this size simply to illustrate the point.

The next larger size orifice given in the table is 1.35 square inches, in line 2 of the table, which orifice will pass 5 pounds of steam at a combined velocity of 345 feet per second.

The next size orifice, namely, 1.60 square inches, if steam alone is being vented, would pass 45 pounds of steam per minute, which is so close to the 50 pounds available as to be relatively unsatisfactory from a practical standpoint, because it leaves too small a margin for satisfactory control of the process. Obviously, the two larger orifices in the fourth and fifth lines of the table are quite out of the question for the conditions specified since more free steam may be passed than the process is capable of generating. In actual practice, I have found that an orifice of roughly 1.5 square inches, which lies somewhere between the second and third lines of the table, gives exceedingly satisfactory results, and I prefer to employ an orifice of this size because, as a matter of convenience and accuracy in operation, it is important to have a balance of steam that can be controllably vented through the upper pipe 34.

Other points of advantage are also obtained by keeping the orifice as small as possible. For example, the lime and the steam must be vented to a separator or collector chamber where the lime can be dropped out and the steam vented without its load of lime dust. Obviously, the less the amount of steam going out with the lime the easier it is to accomplish this separation and with smaller equipment. Furthermore, the velocity through the orifice is reduced when the orifice is made smaller, which saves wear and tear on the equipment and finally, as above indicated, the smaller the orifice the greater the quantity of steam available for controllable release at another point, which is important for satisfactory operating control.

The figure of 50 pounds of steam per minute produced exothermically under the conditions assumed is based upon use of a well insulated processing vessel with a good active lime. But without thorough insulation, and especially if the lime is not highly active, this quantity of steam may not be available, so that some external heat may have to be applied or the process operated on a different basis calculated to a lesser volume of steam. The important point is to be sure that the finished material is being vented before any substantial cooling can take place, for if there is loss of heat through the walls of the vessel, condensation is liable to form on the inside of the vessel and dampen the product to a degree which interferes with successful venting in the manner described. For these reasons I prefer to operate the process so that venting occurs while there is some unreacted magnesia (MgO) and residual water remaining. In this way some hydration and heat generation are still taking place in the material that is being ejected. This will effectively prevent re-condensation on the hydrate as it nears the end of the processing vessel.

It will be seen from the foregoing that the process is peculiarly applicable to dolomitic lime because of the manner in which magnesia hydrates. Calcium limes hydrate extremely rapidly, especially under pressure, but magnesium limes are much slower to hydrate. It is this time element which makes possible the control and manner of venting which are characteristic of my improved process.

In designing the equipment and operating my process, I wish to call attention to the following matters which have a marked bearing upon the success with which the invention may be employed. The equipment must be so proportioned in relation to the desired volume of production and the entrance to the vent 23 must be so located in relation to the passage 7 that there will be no danger of the development of what is termed "solid pressure" at the point where the passage 7 discharges into the vessel 6. The material in process gradually assumes a level indicated roughly by the dash line 27, there being a gradual slope in the surface of the material which is probably sharper at the discharge end but which may build up all the way back to the inlet 7 as shown. The inlet to the vent 23 must not be so high as to cause the material in the vessel 6 to completely close the passage 7, as this will tend to develop the "solid pressure" referred to above, which pressure might very well rupture the equipment.

Furthermore, in the pug mill or premixer 5, in order to obtain best results with my improved process, there should be at least a partial and preferably a substantial hydration of the CaO fraction of the quicklime. It is difficult to determine the exact extent to which the CaO should be hydrated in the pug mill since this will vary with the nature of the lime. However, enough hydration should take place to reduce the free water in the mix to a point where the remaining water will not easily segregate from the partially hydrated mass when it is discharged from the premixer into the main hydrator because, if much segregation of free water takes place, then the slurry entering the main hydrator through the passage 7 is liable to lose a portion of its water to the older parts of the charge which already have sufficient water, thus causing a loss of homogeneity which cannot be fully reestablished by the mild agitation in the main hydrator. There is no upper limit to the degree of hydration of the CaO fraction which may take place in the premixer, but as a practical matter in good plant operation it is better to avoid too high a degree of hydration in the pug mill because this will cause the premixer to labor. One skilled in the art can readily determine this by designing a premixer so that it has a capacity sufficient to give more hydration of the CaO fraction than would be necessary to avoid the troublesome water segregation just mentioned, after which he can readily modify the adjustment so as to reduce the elapsed time during which the charge remains in the premixer and thereby reduce the degree of hydration of the CaO fraction to any desired amount which will give proper functioning of the equipment without laboring.

My improved process is essentially a relatively low pressure process. To attempt to operate at too great a pressure necessitates the use of such a small vent opening in order to retain sufficient of the autogenously generated steam to develop the requisite pressure, as to result in difficulty with clogging of the vent pipe. Furthermore, the higher the pressure the more water is held in the mass as water. As a practical matter, all the pressure that is necessary is such as to develop whatever temperature may be required to satisfactorily hydrate the magnesia content of the lime to the desired degree in a reasonably short space of time, say approximately one hour. Aside from this desideratum the lower limit on

pressure is to be determined by the minimum pressure of steam necessary to give the proper velocity to the combined outflowing mass of lime and steam. From experience, I might say that I have found a pressure range of from 10 pounds to 50 pounds gauge represents the most satisfactory range.

It is desired to point out that operating rates other than 200 pounds per minute are quite possible, and the necessary sizes, proportions, pressures, etc. can readily be determined for any special rate which may be desired just so long as the principles herein set forth are observed.

The thermometers 28—29 and 30—31 offer a very simple and relatively inexpensive means of determining whether or not there is some moisture present in the material before and after ejection. Thermometer 30—31 will record a temperature corresponding to that of the pressure of steam being employed, and if this thermometer rises above such temperature, it is an indication of the loss of all free moisture with impaired quality of product resulting therefrom. In other words, the material must never be allowed to go on what is known as the dry side, and this thermometer will be a ready means of determining this fact. Thermometer 28—29 is under atmospheric pressure and receives the blast of the mixed steam and lime being ejected through the vent 23. It will show a temperature of 212° F. unless the lime after venting has lost all of its free moisture, whereupon the temperature will tend to rise above 212° F. It must not be overlooked that the process of venting the material from the pressure within the vessel to atmospheric pressure results in a loss of moisture, and if insufficient moisture is present in the material just prior to venting the temperature may rise above 212° F. at the moment of discharge. In view of this fact thermometer 28—29 may show a rise above the correct reading of 212° F. while thermometer 30—31 inside the vessel is still showing a correct reading. The readings on the two thermometers considered together, however, constitute a simple and relatively inexpensive way of checking for the presence of some free moisture, although they do not give any positive indication quantitatively.

My improved process is continuously operable and results in a product which is of generally better physical characteristics than products produced by other methods of hydration. It has a higher degree of plasticity as well as greater sand-carrying capacity and water retentivity than other hydrates with which I am familiar. Furthermore, the plasticity can be obtained in subsequent finishing operations much more easily and quickly than has heretofore been possible and, in some instances, can be attained where otherwise it would not be attainable at all. Furthermore, the MgO fraction can be substantially hydrated and, in fact, almost completely hydrated if desired in order to meet specifications to this effect.

In Figure 3 the vent pipe 23a is arranged vertically instead of horizontally and the lower end projects downwardly in the vessel 6 to the interface between the steam and mass of the material to be discharged. Otherwise the structure of this figure is the same as that of Figures 1 and 2.

This application is a continuation-in-part of my prior applications, Serial Nos. 345,036, filed July 12, 1940, and 364,344, filed November 5, 1940.

I claim:

1. In the pressure hydration of slow slaking limes such as dolomitic lime, the method which includes discharging the processed material from a pressure vessel by means of and along with autogenously generated steam through a continuously open vent at a rate which will maintain the pressure above atmospheric pressure.

2. The method of hydrating the relatively slow slaking limes which comprises feeding the quicklime and the water into a processing vessel in which the autogenously generated steam will raise the pressure above atmospheric pressure, and utilizing steam so generated to discharge the product through a continuously open vent while material is still reacting at the point of discharge, the rate of discharge being such as will maintain the pressure above atmospheric pressure.

3. The method of hydrating the relatively slow slaking limes which comprises feeding the quicklime and the water into a processing vessel in which the autogenously generated steam will raise the pressure above atmospheric pressure, utilizing autogenously generated steam to discharge the product through a continuously open vent at a rate which will utilize less steam than is being generated by the process, and maintaining the pressure at a predetermined substantially constant value by controllably venting steam alone through a second vent.

4. The method of hydrating the relatively slow slaking limes which comprises feeding quicklime and water into a pressure vessel, holding autogenously generated steam in the vessel so that the pressure rises above atmospheric, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, and discharging the hydrated product through a suitable vent by means of and along with autogenously generated steam at a rate which maintains the vessel under pressure and while material is still reacting at the point of discharge.

5. The method of hydrating dolomitic lime which comprises mixing it with water in a pressure vessel, holding autogenously generated steam in the vessel so that the pressure rises above atmospheric, the quantity of water being sufficient so that some of it will appear in liquid phase under the existing pressure, and discharging the hydrated product through a suitable vent by means of and along with autogenously generated steam at a rate which maintains the vessel under pressure and while some of the magnesia content of the material is still reacting at the point of discharge.

6. The method of hydrating the relatively slow slaking limes which comprises feeding quicklime and water substantially continuously into a processing vessel in which the autogenously generated steam will raise the pressure above atmospheric pressure, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, and discharging the processed material by means of and along with autogenously generated steam through a continuously open vent at a rate which will maintain the pressure above atmospheric pressure.

7. The method of hydrating the relatively slow slaking limes which comprises feeding quicklime and water substantially continuously into a processing vessel in which the autogenously generated steam will raise the pressure above atmos-

pheric pressure, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, continuously discharging the processed material by means of and along with autogenously generated steam through a vent at a rate which will utilize less steam than is being generated by the process, and maintaining the pressure at a predetermined substantially constant value by controllably venting steam alone through a second vent.

8. The method of claim 4 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate.

9. The method of claim 6 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate.

10. The method of claim 7 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate.

11. The method of claim 2 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate nor greater than approximately 80% of the steam which is being generated by the process.

12. The method of claim 6 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate nor greater than approximately 80% of the steam which is being generated by the process.

13. The method of claim 7 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate nor greater than approximately 80% of the steam which is being generated by the process.

14. The continuously operable method of hydrating dolomitic limes which comprises feeding quicklime and an excess of water into a pressure vessel, holding autogenously generated steam in the vessel so that the pressure rises to between approximately 10 and 50 lbs. gage, and discharging the hydrated product through a suitable vent by means of and along with autogenously generated steam at a rate which maintains the vessel under pressure within said range and while some of the magnesia content of the material is still reacting at the point of discharge, the quantity of water being sufficient to effect hydration, to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, for some to appear in liquid phase under the pressure existing in the vessel and to leave at least a trace of free moisture in the finally discharged and cooled material.

15. The method of claim 14 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate.

16. The method of claim 14 wherein the rate of discharge is such as will pass a weight of steam which is not less than approximately 2% of the weight of the ejected hydrate nor greater than approximately 80% of the steam which is being generated by the process.

17. The continuously operable method of producing a dry hydrate of lime from dolomitic quicklimes which comprises continuously introducing quicklime and water into a pressure ves-

sel; holding autogenously generated steam in the vessel so that the pressure rises to between approximately 10 and 50 lbs. gauge; discharging the hydrated product through a suitable vent by means of and along with autogenously generated steam while some of the magnesia content of the material is still reacting at the point of discharge; and controllably venting steam alone through a second vent as required to maintain the pressure as desired; the quantity of water being sufficient to effect hydration, to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, for some to appear in liquid phase under the pressure existing in the vessel and to leave at least a trace of free moisture in the discharged material when cooled.

18. The method of hydrating the relatively slow slaking limes which comprises substantially continuously feeding the quicklime and the water into a processing vessel of a size such as will provide a steam space above the body of material in process, holding autogenously generated steam in the vessel so that the pressure rises above atmospheric, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, and discharging the hydrated product by means of and along with autogenously generated steam through a continuously open vent located approximately at the interface between the steam space and the material in process, said discharge being at a rate which will maintain the pressure above atmospheric pressure.

19. The method of hydrating the relatively slow slaking limes which comprises substantially continuously feeding the quicklime and the water into a processing vessel of a size such as will provide a steam space above the body of material in process, holding autogenously generated steam in the vessel so that the pressure rises above atmosphere, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, discharging the hydrated product by means of and along with autogenously generated steam through a continuously open vent located approximately at the interface between the steam space and the material in process, and maintaining the pressure substantially constant by controllably venting steam alone through a second vent.

20. The method of hydrating dolomitic lime which comprises feeding quicklime and water into a pressure vessel having a premixing chamber and a main hydrating chamber, the materials being introduced into said mixing chamber, holding autogenously generated steam in the vessel so that the pressure rises above atmospheric, the quantity of water being sufficient to effect hydration and to provide for all the steam which can be autogenously generated by the heat of the slaking reaction, rapidly mixing the lime and the water and effecting substantial hydration of the CaO in said mixing chamber, discharging the mixture from said mixing chamber into said main hydrating chamber, passing the mixture relatively slowly through said main chamber, and discharging the hydrated product through a suitable vent by means of and along with autogenously generated steam at a rate which maintains the vessel under pressure and while material is still reacting at the point of discharge.

IRVING WARNER.