A. S. DWIGHT AND R. L. LLOYD.

METHOD OF PRODUCING LIME.

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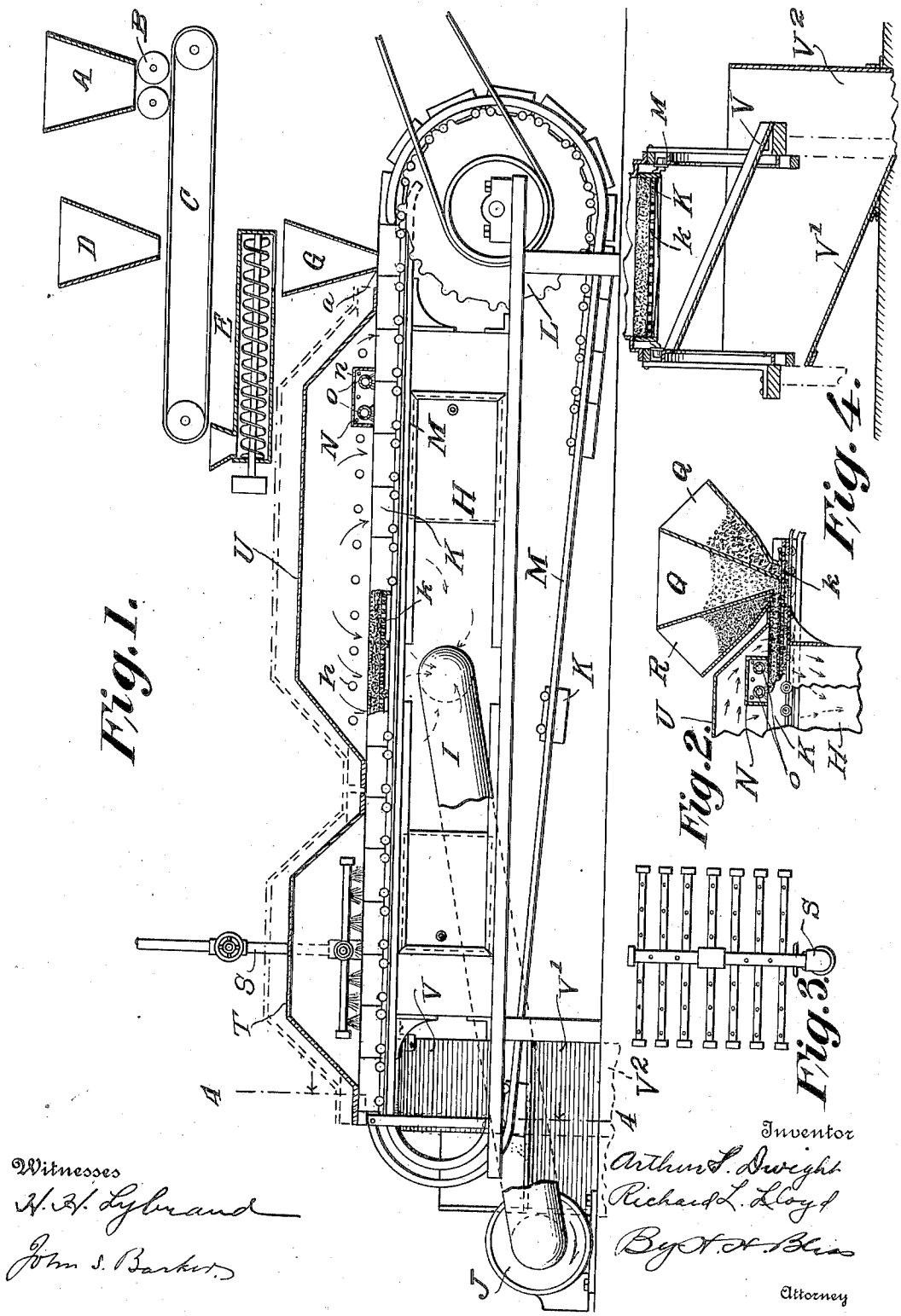


Fig. 1.

Fig. 4.

Fig. 2.

Fig. 3.

Witnesses

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METHOD OF PRODUCING LIME.

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To all whom it may concern:

Be it known that we, ARTHUR S. DWIGHT and RICHARD L. LLOYD, citizens of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Methods of Producing Lime, of which the following is a specification, reference being had therein to the accompanying drawing.

Our invention relates to the art of making lime, and has for its object to treat limestone in a novel manner as will be hereinafter pointed out.

The invention has for its object to treat limestone which is initially, or at the time that it is burned to convert it into lime, in a finely divided condition, thus making available for use much of the fine material from the quarries which is now rejected as being too fine for economical treatment, and also rendering available for the manufacture of lime certain types of limestone which occur in nature in a finely divided state, such as the oolitic limestone.

The product of our process is novel and of superior quality, as will be pointed out.

When limestone is burned in the ordinary kiln a greater or less proportion of the material taken from the quarry, depending in amount upon the character of the rock, has to be discarded and go to the dump, because material below a certain degree of fineness will so clog the kiln and interfere with the draft as to preclude its being utilized. This discarded limestone may be entirely suitable for the production of lime, except for the size of the particles of which it is composed, and therefore represents an element of waste.

In the kiln treatment for producing lime where, as above intimated, it is necessary to employ pieces of limestone rock of considerable size, the resulting product is not ideally perfect, because the particles of rock, especially the larger pieces, are not uniformly burned or calcined throughout, the interior portions thereof being often practically chemically unaffected and left as calcium carbonate, while the exterior portions of the mass are changed to lime, or calcium oxid.

Further, the product of the ordinary lime kiln is not, even if completely converted into calcium oxid, in ideal physical condition for subsequent treatment, such as its conversion into calcium hydrate, since the particles thereof vary largely in size, and most of them are too large for perfect and rapid conversion into the hydrate; and the product of the kiln is not, immediately upon formation, in position for subsequent treatment, but requires to be removed from the kiln and transported and rearranged.

The process which we have invented and shall describe not only enables a much larger proportion of the product of the quarry to be treated than by methods heretofore in vogue as well as the utilization of material available in large quantities, but by present processes not suited to the production of lime, but also results in a superior product, being one of practically uniform condition throughout, of a size, as to its particles, well adapting it for subsequent treatment, and delivered in condition to be immediately treated, to hydrate it for instance, without necessitating its disturbance from the position it occupied during the calcining process.

The process can be carried out in any of numerous mechanisms, and we have illustrated, in the accompanying drawing, one suitable for that purpose, though we do not wish to be understood as thereby restricting our invention in its useful applications and adaptations to a mechanism of the particular kind illustrated.

Referring to the drawings—

Figure 1 is a side elevation of an apparatus by means of which the present invention may be carried into effect.

Fig. 2 is a vertical sectional view of a modified form of the feeding hopper and the adjacent parts of the mechanism.

Fig. 3 is a bottom plan view of the water distributing devices.

Fig. 4 is a vertical transverse section on the dotted line 4—4 of Fig. 1.

Referring to such drawings, A indicates a hopper or receptacle in which may be placed the rock or other raw material from which the lime is to be produced. This hopper delivers to a crusher B of any suitable and approved type and construction from which the finely broken material passes to a belt or conveyer C. D indicates another hopper or receptacle in which is placed crushed carbonaceous material, such as coal

or coke, and which, as shown, may also be arranged to deliver to the conveyer C. This conveyer delivers the raw lime-forming material and pulverized fuel to a mixer E where they are thoroughly commingled. From the mixer the material discharges into a hopper or receptacle G, and this in turn delivers to the mechanism where the calcining and burning operations take place. It will be understood that the several elements of the apparatus thus far referred to are provided with means for regulating their operations so that the proportions of lime material and pulverized fuel may be regulated to a nicety to suit the working conditions met with, and so that the material delivered to the apparatus where the burning and calcining takes place can be regulated. It will also be evident that these elements of the apparatus may be more or less widely separated one from the other without in any way affecting the essential principles of our invention, and that the crusher or rock-reducing element of the apparatus, indicated in a general way at B, may be entirely omitted if the nature of the rock being treated does not require its use.

Referring to the mechanism where the burning and calcining of the material takes place, H designates an air box connected by a trunk I with a suction fan J, or other air-moving device. The upper end of the air box is open, and across this moves a series of pallets or individual material-carrying elements K, which are caused to slowly move by suitable mechanism, characterized by the wheels L. The pallets K are each provided with a perforated bottom *k* upon which the material from the hopper G is delivered. The pallets are preferably open-ended so that when in train, as illustrated, they together constitute an elongated continuous trough having a perforated bottom and closed sides, but open at the top. The pallets are directed in their course by tracks and guide pieces M so that they are caused to take an endless path as is apparent from an inspection of the drawings.

N indicates a hood arranged above the pallets and preferably directly over that end of the air box H which is nearest to the feed hopper G. Within this hood is an igniter for setting fire to the carbonaceous material forming the combustible element of the charge delivered to the pallets from the hopper G. This igniter may be of any suitable character. It is represented as consisting of a pair of gas pipes O, perforated, or provided with burner tips, and arranged to project a rather broad flame upon the exposed surface of the material carried by the pallets. The hood is perforated at *n* to admit air to support the combustion of the gas delivered from the pipes O, and to permit the igniting operation to be observed.

The pallets, by the power mechanism, designated generally by the wheels L, are passed one after another beneath the hopper G where they are filled, and are moved, preferably in train, across the open end of the air box H. During such movement they pass beneath the hood N, and the material they carry is subjected to the action of the igniting devices O, which set fire to the upper or exposed surface of the stratum of material being treated. From the moment that any particular portion of the charge is ignited, and until that portion passes beyond the limits of the air box H, it is subjected to the currents of air caused to pass through the material by the fan J. These currents of air preferably pass in a downward direction through the material, as indicated by the arrows in the drawings, and operate to hold the particles thereof quiescent.

The movements of the parts of the apparatus are preferably so timed that the combustion in any particular portion or body of the material is maintained so long as that portion or body is over the air box H; and during such time the zone of ignition passes from the upper or first ignited surface entirely through the mass of material to the lower surface resting upon the grate *k*. The amount of fuel, relative to the amount of lime-forming material, the force of the air currents produced by the fan J, and the speed of the mechanism, are so proportioned and regulated that the combustion of the fuel constituent of the mass is of such intensity as will cause a complete and uniform calcining of the mass of lime-forming material from surface to surface, at about the time the product passes beyond the air box H.

The product of the process described is lime in a finely divided state of exceedingly uniform consistency throughout. Such lime in this physical condition is desirable for many purposes, and especially in the manufacture of hydrated lime.

When hydrated lime is to be produced the tracks upon which the pallets move in a horizontal direction are continued considerably beyond the air box H, and arrangements are made for treating the lime with water or steam to hydrate it while still supported by the pallets. Such an arrangement of apparatus is illustrated, and S designates a piping system through which water, either as liquid or in the form of steam, may be delivered to the lime. That portion of the support and carrier for the material where hydration takes place may be covered by a removable hood T. The portion of the carrier where the calcining operation takes place may also be covered by a hood, U, if found desirable.

After the final treatment of the material,

whether it be the burning and calcining, or a subsequent hydrating, the finished material is delivered from the pallets as they turn at the end of the apparatus and pass onto the lower section of the track or guideway M. The material delivered from the pallets falls upon a chute V′ whence it may be directed into any suitable receptacles or conveyances.

As shown in the drawings, this chute V′ is so situated as to receive the principal part of the contents of each pallet, the latter being inverted as it travels around a sharp turn at the end of the mechanism, this turn giving it a sudden tilting action and then inverting it and jarring it to insure the thorough detachment from the grate of the adjacent particles. But as there is the possibility that some of the particles of the treated material will escape from the train of pallets at the point where they successively begin to descend, I prefer to employ a supplemental chute as at V which lies under the pallets just before they begin their downward movement. These chutes may be arranged to both empty into a common chute or receptacle as at V^2 from which they can be delivered to a car or other desired receptacle.

In order to insure against incomplete calcining of the material at the surfaces, where the heat from the internal combustion within the mass being treated is less intense than throughout the interior of the mass, we prefer to deliver from a hopper Q upon the grates *k* of the pallets a thin layer of already burned lime, or a mixture of such lime and pulverized fuel, upon which is deposited the charge from the main hopper G. This thin bottom layer operates to prevent the heat being too rapidly carried away from the lower surface of the body of material being treated.

The upper surface of the material delivered from the hopper G may be covered with a thin layer of pulverized fuel, or such fuel mixed with already burned lime, this being supplied from hopper R. By means of these two additional or protective layers of material we effectively guard against incomplete calcining of the mass at its opposite surfaces.

What we claim is:

1. The herein described method of producing lime, which consists in thoroughly and intimately commingling finely reduced fuel material with carbonate of lime in a native finely divided condition, depositing this mixture in a thin layer upon a layer of lime and covering the said layer of mixed material with a third layer containing fuel without the admixture therewith of limestone, setting fire to the said covering layer and passing air through the entire body of material to cause combustion of the fuel component thereof.

2. The herein described method of producing hydrated lime which consists in thoroughly and intimately commingling finely reduced fuel material with carbonate of lime in a native finely divided condition and depositing this in a thin layer, setting fire to and burning the fuel component of the said mixture deposited in a layer as stated to convert the limestone into lime, and thereafter subjecting the lime while still maintained in a thin layer, to the action of water to hydrate it.

3. The herein described method of producing hydrated lime, which consists in thoroughly and intimately commingling finely reduced carbonaceous material with carbonate of lime in a native finely divided condition, depositing this mixture in a thin layer, moving the said layer of material along substantially horizontal lines, setting fire to the fuel component of the mixture and burning it to convert the limestone into lime during one portion of the movement of the said layer of material, and subjecting the layer of material tnrough another portion of its movements and after it has been converted into lime to the action of water to cause the lime to become hydrated.

4. The herein described method of producing hydrated lime which consists in arranging carbonate of lime in a native finely divided condition in a thin layer upon a pervious support, subjecting such layer to the simultaneous action of air currents passing through it and heat to convert the limestone into lime, and then without removing the lime from its support subjecting it to the action of water to hydrate it.

5. The herein described method of producing lime which consists in thoroughly and intimately commingling carbonate of lime in a native finely divided condition with fuel material, depositing this mixture in a thin layer, igniting the fuel component of the mixture at one surface of the layer, and passing air through the layer from the ignited surface to cause combustion of the said fuel material to take place progressively throughout the mass to reduce the carbonate to anhydrous lime.

In testimony whereof we affix our signatures, in presence of two witnesses.

ARTHUR S. DWIGHT.
RICHARD LEWIS LLOYD.

Witnesses:
JOHN KNOX,
WILLIAM J. HOLLEN.