(No Model.)

W. & H. G. BUTLER.

METHOD OF BURNING CLAY TO MAKE BALLAST, &c.

No. 491,764. Patented Feb. 14, 1893.

Fig. 1.

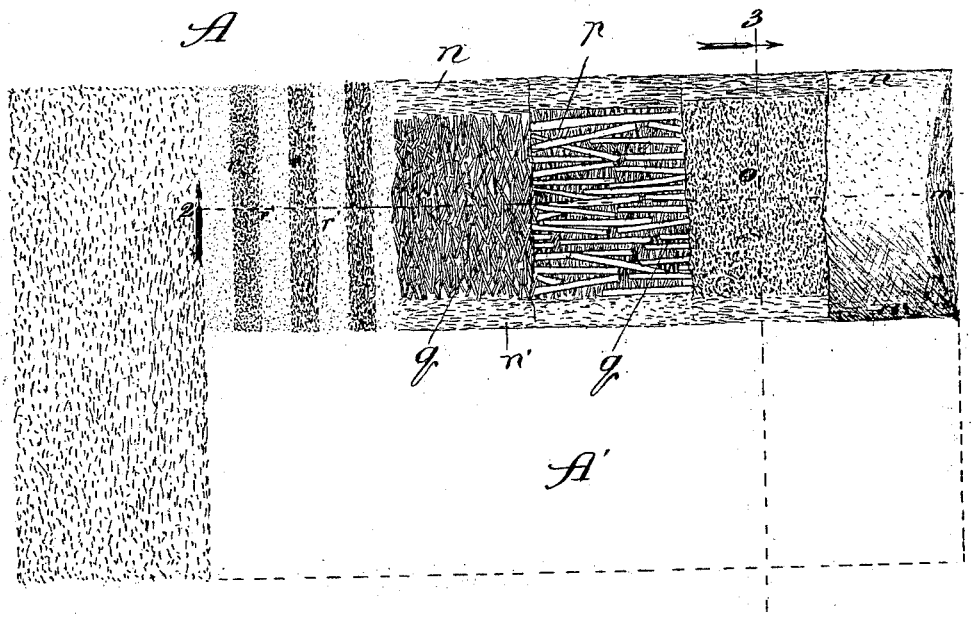


Fig. 2.

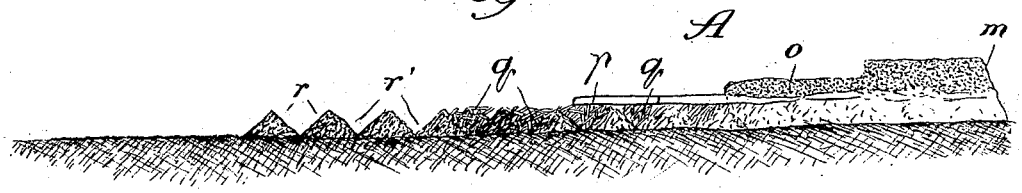
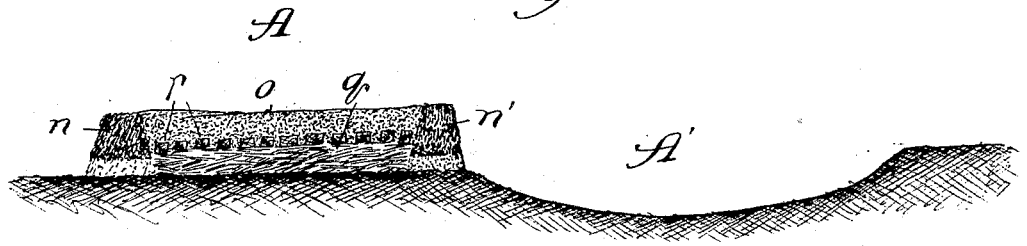


Fig. 3.



Witnesses:
Chas. E. Gaylord.
Clifford N. White.

Inventors
{William Butler.
{Henry G. Butler.
By Dyrenforth & Dyrenforth
Attys

UNITED STATES PATENT OFFICE.

WILLIAM BUTLER AND HENRY G. BUTLER, OF KENOSHA, WISCONSIN.

METHOD OF BURNING CLAY TO MAKE BALLAST, &c.

SPECIFICATION forming part of Letters Patent No. 491,764, dated February 14, 1893.

Application filed August 25, 1892. Serial No. 444,044. (No specimens.)

To all whom it may concern:

Be it known that we, WILLIAM BUTLER and HENRY G. BUTLER, both of Kenosha, in the county of Kenosha and State of Wisconsin, have invented a new and useful Improvement in Methods of Burning Clay to Make Ballast, &c., of which the following is a specification.

Our invention relates to an improved procedure in burning clay to manufacture the igneous product used as ballast for railroads, as paving material for streets, and the like.

The object of our invention is, generally stated, to improve upon previous methods of burning clay, whether practiced according to the earlier method of burning in kilns or according to the more modern method of burning in the open air (that is in a pile or "fire" exposed throughout its entire surface to the open air) by facilitating and cheapening the procedure and obtaining better results.

Our present procedure involves, essentially, the practice of the clay-burning operation in a kiln, in the sense of a structure inclosing the "fire" or pile of material to be burned to produce ballast, the outside walls of which, however, are of such close structure as to preclude, even if they be composed, as they may be and preferably are, of green earthy material, such draft through them as would tend to convert the material into ballast; but our improvement is distinguished from the old method of burning in a kiln by the leading characteristic of erecting the kiln-walls as the building of the pile of material to be burned, or "fire" proceeds, and, as we prefer to practice the invention, in building a number of the kilns, one abreast of the other, thereby utilizing a wall of each preceding kiln to form, as it were, a party-wall for the next added one, whereby for each kiln after the first, but one inclosing wall for the "fire" has to be built and the material of all the walls for the several kilns abreast, except the two front or outer ones, may be burned to make ballast.

Following is a detailed description of our method of procedure in burning clay, explained with reference to the accompanying drawings, in which

Figure 1 is a broken plan view, in the nature of a diagram, of a kiln resulting from the procedure, and Figs. 2 and 3 are sections taken respectively at the lines 2 and 3 on Fig. 1 and viewed as indicated by arrows.

The first step after selecting suitable clay-ground is to cover a width thereof sufficient to form a base for the kiln with coal, coal-slack or analogous fuel, the covering of fuel being extended laterally beyond the side or sides of the base from which the clay to be piled on the base, and burned, is to be dug, whether by machinery or by hand. The clay-supply for the burning may be piled on the "fire" in the kiln A from both sides of the base, though we intend generally to take it from only one side; and the description hereinafter contained refers only to the last named practice. From the side of the base, strewn with coal, we dig clay, taking care to mix as intimately as practicable in the digging, the strewn coal and clay together; to promote the burning of this upper dirt, which is liable to be of poor quality, or is usually too fine for use in subsequent layers piled on the fire; and with the clay and coal mixture thus first dug we form inverted substantially V-shaped and contiguous or closely placed ridges *r*, extending across the prepared base of the kiln, and the substance of which, owing to the coal in it, will be burned and form good ballast. The ridges *r* form between them trenches *r'* affording combustion-promoting chambers or draft-flues, as they are hereinafter termed. In these cross-flues and lengthwise thereof kindling *q* is then laid and coal added, this kindling-fuel supply thus extending, preferably, across the entire base of the kiln, which may be of any desired width and length, though a few hundred feet is the maximum length of the kiln according to our practice, for a reason that will hereinafter appear. To continue building the fire, we pile kindling *p* in the direction of extending lengthwise of the kiln and thus across the ridges *r* and flues *r'*, and upon this layer of kindling we spread coal to the desired thickness or in suitable quantity. The bed thus prepared for kindling is next covered with a layer of clay *o* dug from the ground and having mixed with it a sufficient amount of coal to insure rapid and thorough transmission of fire through the

clay. The clay should be moist, and where it is not naturally so, we sprinkle it with water for a purpose hereinafter explained. The fire is then ready all but walling it in to inclose it in a kiln, which may be done in either, or any two, or in all of three ways, namely, first by plastering it over the four sides or the sides and ends with soft or tempered clay; second, by building its side walls n, n' and end-walls m with sod or lumps of clay and filling the crevices with fine earth; or by banking with fine earth, the latter being preferred for the ends, since the fineness of the earth causes it to pack sufficiently to prevent draft at the ends of the kiln. The material for the inclosing walls of the kiln might, for our purpose, as well, were it not for the expense, be brick or stone, which may be used repeatedly for different burnings. The kiln thus built has reached its initial stage wherein it is ready to have the burning proceed within it, which is started by lighting the kindling q at both open or exposed ends of the flues r', the operation of kindling being performed, by preference, simultaneously at the opposite ends of all the flues, or sufficiently so to produce equal, or practically equal, starting of the fire and excite, at once, accordingly equal draft toward the longitudinal center of the kiln. All the fuel in the combustion chambers r soon ignites and transmits fire to the superimposed fuel, generating heat that acts upon the clay and vaporizes and drives out the moisture. When the first layer of clay has been thus sufficiently dried, a layer of coal and then a second layer of clay mixed with coal and moistened, as previously described (the moistening being preferably performed by sprinkling the clay while in the shovel or digging implement) are applied, and the kiln walls n, n' and m, are continued to the top of the new layer. The further development of the kiln proceeds in like manner, thus by applying to the previously dried clay base successive layers of coal and clay or moist clay and coal mixed, and then building up the kiln-walls; and care should always be observed to have the upper layer of clay, previous to adding material upon it, sufficiently dried to prevent it from "damping," "sweating down" or compacting and to have a sufficient quantity of coal in the interposed layers and mixed with the clay, which should be adequately moist. When the kiln has reached a height too great to permit the increment of coal and clay to be hoisted conveniently and cheaply, we proceed to start another kiln A' (indicated by dotted lines on Fig. 1) begun and continued like, and preferably located abreast of the first, of which, however, we may utilize the adjacent wall n' as the inner wall of the second kiln, and thereby burn the material of that wall into ballast, besides saving the labor of erecting one wall for the second kiln. Any number of kilns may be added in like manner, the base of each being prepared in the excavation formed by digging clay for the preceding kiln, thereby increasing the depth of successive kilns which improves the quality of the ballast.

By moistening the clay previous to applying it, or employing naturally wet clay, as described, the advantage is attained of producing adhesion of the smaller particles to the large lumps, thereby rendering the mass in the layer porous to an extent that permits quite free passage of air and heat through it, and enabling us to burn well in the kiln clay that would be otherwise unmanageable, and furthermore, enabling us to deposit the clay immediately after digging it, thus without previous separation of the finer matter from the lumps, as would otherwise be more or less necessary in kiln burning.

A further advantage afforded by the moist condition of the clay is that the moisture tends to condense throughout the clay the free carbon rising through it from the fuel below and to fix it, whereby it is saved from passing off as noxious smoke and gas and being wasted, and the thoroughness of its combustion is enhanced. Moreover the heat in the kiln is sufficient to decompose the elements of the water and generate therefrom with the carbon a gas, rich in hydrogen, and therefore having a high degree of heating power.

As additional advantages derived from mixing coal with each layer of clay to be deposited on the fire may be mentioned those of thereby lessening the quantity of coal required for the interposed coal-layers and the obstruction to the passage through the mass of the products of combustion, by rendering the mass the more porous, whereby the heat may come into the more intimate and uniform contact with all the particles of the clay and afford the production of the better quality of ballast with the least quantity of fuel. We prefer to pile on the fire but one layer at a time of the clay (which may be from a few inches to several feet thick, according to the lumpiness of the clay and its tendency to disintegrate readily under the influence of the heat), since thereby sufficient of the vapor from the water may pass off readily and leave the kiln dry. Obviously the fuel in the base of the kiln is exhausted first, and the clay of the ridges r and that in the primary layers is the first of the finished product to cool. The inclosing sides of the kiln, being thoroughly made up, prevent the escape of gases and the loss of heat and exclude the admission of air except by way of the base-flues, whereby the draft is forced from the base through the top of the kiln, thus the most effectively in forcing the heat from the finished or burned out layers up through the green layers.

According to our method of burning the clay the material need not be disturbed from the time it is piled on till it is finished and cooled, by dragging and raking from time to time, so necessary in the open-air burning but which opens the fire to the detriment thereof and of the product, by the consequent rapid

cooling, shrinking and disintegration of the mass; and by the comparatively even distribution of fuel and layers of clay for which our improvement provides, an even quality of ballast is produced, a result impossible to attain by open-air burnings wherein the work is of necessity very uneven and irregular. The outer inclosing walls of the kiln, whether it be a single walled-in pile or two or more of the piles abreast, as described, are, as such, essentially incapable of being converted into ballast by the burning operation, being packed too closely, if formed of green earthy substance, to permit sufficient draft through them; and, of course, if the outer walls are formed of brick or stone, they are not changed in character by the burning. Whichever the material employed to form the inclosing walls, it has to be stripped, at least from one side of the burned or finished pile previous to taking away the ballast, to permit access to the latter. This stripping step characterizes our process as a strictly kiln-burning proceeding, or proceeding in which the outer walls are, in the proper sense, inclosing walls for the fire, as distinguished from layers of the material burned to produce ballast according to the open-air burning method hereinbefore referred to.

In the foregoing description, we have, for the sake of clearness, enumerated and minutely specified all the steps we observe in the practice of our method and which we believe to be important to be observed to attain the best results by our invention. All these, however, are not necessary to attain desirable results, and our invention is not to be understood as being limited thereto.

What we claim as new and desire to secure by Letters Patent is—

1. In kiln-burning clay to produce ballast and the like, the method of constructing the kiln, which consists in building the walls to inclose the mass of the material to be burned by applying to the sides thereof a close covering of green earthy material, or analogous covering, and continuing building the said walls as the increment and burning of the said mass proceeds, substantially as described.

2. The method of kiln-burning clay to produce ballast and the like, which consists in forming a bed with flues, building the "fire" on said flues, inclosing the "fire" between close walls, kindling the "fire" and from time to time adding thereto the material to be burned, continuing the close-wall inclosing structure as the increment and burning of the "fire" proceed, substantially as described.

3. The method of kiln-burning clay to produce ballast and the like, which consists in forming a bed with ridges *r* of mixed clay and coal and forming transverse flues, building the "fire" on said flues, inclosing the "fire" in a kiln by applying close walls to the sides thereof forming the kiln-walls, kindling the "fire" and continuing the burning thereof and its increment and the kiln-wall construction to a desired height, and similarly forming a kiln and burning abreast of the said first-named kiln, utilizing the adjacent wall of the latter for the inner wall of the new kiln, substantially as described.

4. The method of kiln-burning clay to produce ballast and the like, which consists in forming a bed with transverse flues, applying kindling material on the flues and covering it with alternate layers of coal and clay and burning the pile, mixing the clay, before applying it, with coal and wetting it, and inclosing the "fire" thus formed between walls by applying green earthy material to the surface of the "fire" from time to time as the height thereof increases, substantially as described.

5. The method of kiln-burning clay to produce ballast and the like, which consists in forming a bed by applying thereto coal, forming transverse flues on said bed with mixed clay and coal, filling the said flues with kindling and piling kindling across the flues, piling on the kindling alternate layers of coal and clay and burning, mixing the clay, before applying it, with coal and wetting it, and inclosing the "fire" thus formed between walls by applying green earthy material to the sides of the "fire" from time to time as the height thereof increases, substantially as described.

WILLIAM BUTLER.
HENRY G. BUTLER.

In presence of—
J. W. DYRENFORTH,
L. J. DYRENFORTH.