L. N. McCARTER.

DRYING AND HEATING APPARATUS FOR STONE.

APPLICATION FILED JUNE 10, 1901.

900,032. **Patented Sept. 29, 1908.**

Fig: 1.

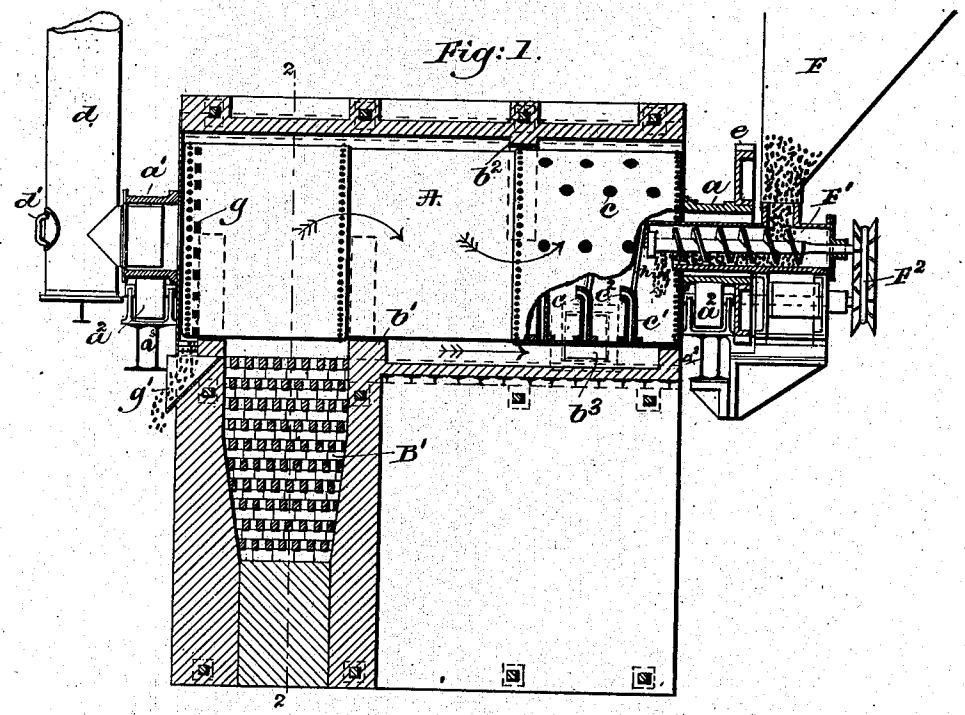
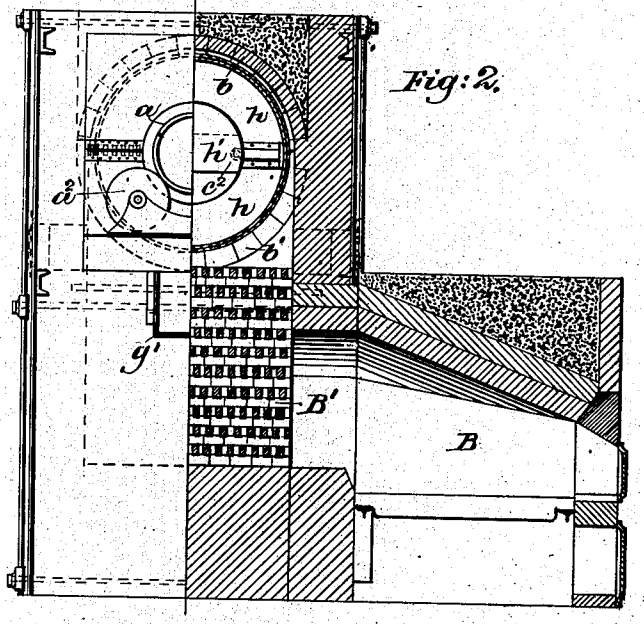


Fig: 2.



Witnesses:
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UNITED STATES PATENT OFFICE.

LOUIS N. McCARTER, OF NORRISTOWN, PENNSYLVANIA, ASSIGNOR TO THE INTERNATIONAL PAVEMENT COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF CONNECTICUT.

DRYING AND HEATING APPARATUS FOR STONE.

No. 900,032. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed June 10, 1901. Serial No. 63,864.

To all whom it may concern:

Be it known that I, LOUIS N. McCARTER, a citizen of the United States, residing at Norristown, in the county of Montgomery and State of Pennsylvania, have invented an Improvement in Drying and Heating Apparatus for Stone, &c., of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention has for its object to provide an improved apparatus for drying and heating stone and the like for any purpose in the arts for which dried or heated stone,—in whatever form,—or other materials may be desired.

My invention is particularly useful in connection with drying and heating apparatus employed in the manufacture of artificial asphaltum tiles and paving blocks wherein the ground and partly pulverized stone which is incorporated with the asphaltum cement or compound is mixed with the latter while both are in a heated condition.

My apparatus is of the general type illustrated by U. S. patent to A. G. Smith, No. 245,980, dated August 23rd, 1881. In the apparatus of the said Smith patent a rotating cylindrical drier is employed into which the material to be heated is conveyed, the said material being delivered into the said drier at one end thereof and caused to travel through the drier for its entire length and discharged at the opposite end thereof. In the ordinary arrangement of this apparatus, this drier revolves about a horizontal axis and an annular helix or spiral applied to the inner wall of the drier acts to feed the material from one to the opposite end thereof. A combustion chamber is located under or adjacent the delivery end of the drier, the barrel of the drier being perforated to permit the products of combustion to pass through to the interior of the drier, thence to the delivery end of the drier and to the stack. An objection to this arrangement is that the products of combustion from the furnace tend to enter the cylinder through the perforations immediately adjacent the combustion chamber, passing thence directly to the stack and without reaching the opposite end of the drier, so that substantially the entire heating effect is located at or near one end of the cylinder.

The object of my invention is to improve this class of apparatus in such a way as to enforce a more effective travel of the products of combustion for the more thorough and uniform heating and drying of the contents of the drier. The various features of my invention, whereby this result is accomplished, will appear more clearly from a description of one form of apparatus illustrating my invention and which is shown in the annexed drawings, wherein,—

Figure 1, in vertical longitudinal section, partial elevation, shows an apparatus made in accordance with my invention; and, Fig. 2, a vertical half section and end elevation thereof, the section being taken on the dotted line, 2—2.

In the particular embodiment of my invention used as an illustration herein and shown in the drawings, A indicates the drier shown as cylindrical in form and horizontally arranged, said drier being provided at its ends with large tubular trunnions, a, a', that rest in suitable, preferably roller, bearings, a^2, mounted upon suitable supports, shown as girders, a^3.

The furnace combustion chamber, B, as here shown, is arranged adjacent one end of the cylinder, A, but is formed at one side of the preferably brick setting of the apparatus. The combustion chamber has its outlet in or through a mass of "checkered" brick work, B′, immediately beneath the delivery end of the drier cylinder and through which the products of combustion are required to pass before circulating around the said cylinder, as will be described. By this construction, sufficient heat is obtained without direct contact of the hottest products of combustion with the metal of the cylinder to burn the same, as is likely to happen unless great care is used, in constructions wherein the combustion chamber occupies the place of the "checkered" brick work directly under one end of the cylinder. The brick setting of the apparatus is constructed to inclose the cylinder, A, as effectually as possible, it having an arch, b, extending over the said cylinder, and the said setting is constructed to cause the products of combustion arising or issuing from the combustion chamber to pur-

sue a more or less tortuous path from the end of the cylinder adjacent to the combustion chamber to the opposite end of said cylinder, thereby to increase the heating effect.

In the present embodiment of my invention sufficient space is left between the exterior of the cylinder, A, and the inclosing walls of the setting to provide for free circulation of the products of combustion, and immediately in front of the combustion chamber, B, the setting is constructed to produce an inverted arch, b', that approaches closely to the exterior of the drier cylinder and extends upward at each side of the latter to about its horizontal diameter, thus causing the products of combustion rising from the combustion chamber to flow upward about and over the top of this inverted arch, contacting with at least one-half the full diameter of the cylinder before passing along the cylinder. Between the inverted arch, b', and the opposite end of the cylinder, I have arranged a second arch b^2, depending from the top, b, of the setting and extending downward to inclose approximately one half of the full diameter of the cylinder to cause the products of combustion, after passing over the inverted arch, b', to be diverted downward towards the bottom half of the said cylinder in order to clear the said arch, b^2. The products of combustion are thus caused to pursue a tortuous path that may be increased or decreased at will by adding to or reducing the number of arches, b', b^2, employed and the extent to which they encompass the cylindrical exterior of the drier cylinder. The drier cylinder, A, at its end beyond the arch, b^2, is provided with perforations, c, and these perforations, within the cylinder, open into radial pipes, c', standing inward from the inner wall of the cylinder. These pipes, at their inner ends, nearest the axis of the cylinder, preferably have their ends, c^2, curved or directed at an angle, say at right angles, towards the delivery end of the cylinder.

The products of combustion circulating around the outside of the cylinder, pass inward through the openings, c, and pipes, c', to the interior of the cylinder, to contact with and dry the contents of said cylinder.

The overturned or barred ends of the radial pipes, c', prevent any of the contents of the cylinder, during rotation of the latter, from falling out through said pipes, yet the free passage of the products of combustion therethrough is not interfered with. The products of combustion that enter the inlet end of the cylinder through the openings, c, and radial pipes, c', return again through the cylinder to the end of said cylinder that lies immediately over or adjacent the combustion chamber, passing thence outward through the hollow trunnion, a', into the stack, d.

The entire shell is preferably made up of plates welded together, so that there are no joints to expand or rivets to burn off, or, where this method is too costly, the end of the drier cylinder, A, that is above and exposed to the action of the hottest products of combustion direct from the combustion chamber may be formed of a single plate completely encircling the said cylinder, thereby to avoid destructive expansion and contraction that would result from the use of a number of plates and the resultant joints or seams between the same.

The drier cylinder, A, is rotated continuously while in use by suitable means. I have here shown a gear wheel, e, applied to the trunnion, a, and which may be driven from an intermeshing spur wheel not shown.

The material to be dried and heated,—which may be ground and partly pulverized stone,—is deposited in the hopper, F, from which it is discharged in suitable manner, as by the feed screw, F', into the interior of the adjacent end of the drier cylinder, A, said material during rotation of the cylinder being caused to travel lengthwise of the cylinder to the opposite or delivery end thereof over the combustion chamber, where it escapes through circumferential openings, g, into a suitable receiving hopper, g', from which it may be taken or conducted to the desired point.

While any suitable means may be employed for causing travel of the material from one to the other end of the drier through rotation of the latter, I prefer to employ an annular helix or spiral encircling the interior of the drier and projecting from the wall thereof sufficiently to control whatever amount of material may properly be deposited in the drier and yet leave a sufficient conduit through the middle of the drier for the passage therethrough of the products of combustion on their way to the stack. In the drawing, this spiral feed or conveyer is shown at h, it being formed by bolting metal plates to the shell of the drier and between the radial pipes, c', where such pipes exist, so as preferably to form a substantially continuous helix or spiral throughout the length of the drier. The material entering the cylinder immediately gravitates to the bottom thereof, and is maintained constantly agitated by the rotation of the cylinder that causes the material to be more or less lifted and then to drop back again upon the bottom, the spiral, h, moving it constantly towards the opposite end of the cylinder.

It will be observed that the highest heat applied exteriorly to the drier is at and adjacent the delivery end of the latter, and that the highest heat applied internally to the drier is at or adjacent the inlet end of the drier. Thus the material entering the drier is first brought into direct contact with the partially cooled products of combustion that

enter the drier through the pipes, c', near the inlet end of the drier, and these products of combustion take up a large percentage of the moisture that may be incorporated with the stone or material to be dried, and pass off with the same to the stack. As the material moves toward the delivery end of the drier, and the internal heating effect becomes less, the external heating effect becomes greatly increased, the result being that the highest heating effect is really obtained exteriorly and at the delivery end of the drier, just prior to the escape of the material therefrom into the hopper, g', from which it is removed for use. The result of this arrangement is a much more uniform, thorough and efficient heating and drying of the material within the drier than is possible with an apparatus arranged as in the Smith patent, where the most effective and hottest products of combustion are permitted to pass directly into and through the drier to the stack, where they are required to take up a large part of the moisture and are correspondingly reduced in capacity for drying. In my improved apparatus the most of the moisture is absorbed by the less effective and cooler products of combustion which are sufficient for this purpose, leaving the hottest products of combustion to act upon the material in its nearly dried or heated state to obtain the final necessary degree of heating or drying.

Where there is room to build the combustion chamber at one side of the brick setting, as shown in the drawings, and the checkered work, B′, is employed, the products of combustion first heat this checkered work to incandescence and subsequent passage of the products of combustion through this incandescent checkered work superheats said products and mellows the same, so that no possible damage to the adjacent plate of the cylinder can result. Where this is not possible, however, the combustion chamber, as stated, may occupy the place where the checkered work is shown in the drawings.

The hand-hole, d', in the stack, furnishes access to the interior of the stack as well as of the trunnion, a', and one or more side openings, b^3, permit access to the heating chamber surrounding the rotating drier, and also admit of necessary control of the temperature by furnishing means for admitting such exterior air as may be necessary to avoid overheating in the apparatus.

To further restrict the flow of products of combustion through the drier, I have applied within the latter the alternately arranged or staggered baffle plates, h', that are secured to the inner edges of the spiral, h, the overlapping edges of which cause the products of combustion to pursue within the drier also a tortuous path that compels them to dip downward or pass upward into contact with the material upon the bottom of the drier or the shell of the drier itself.

The feed device, F′, is shown as driven from one of the rollers of the drier trunnion through the medium of a belt, F^2, passing about expanding cone pulleys of usual and well-known construction, whereby the relative speed of rotation of the feed device and its driving roller may be varied at will to produce any desired rate of feed of the material into the drier.

While the apparatus here disclosed and shown has been found in practice to produce excellent results, yet my invention is not necessarily limited to this or any particular structure of apparatus, as the same obviously may be varied without departing from the spirit and scope of my invention.

Having described my invention, what I claim is,—

1. In a drying apparatus a revolving drier, means to cause travel of the material to be dried from the inlet end of said drier to the delivery end thereof, an exterior combustion chamber adjacent the delivery end of said drier, and means to cause the products of combustion therefrom to flow exteriorly of said drier towards the inlet end thereof and admission openings for said products of combustion located only near the inlet end of said drier.

2. In a drying apparatus a revolving drier, means to cause travel of the material to be dried from the inlet end of said drier to the delivery end thereof, an exterior combustion chamber adjacent the delivery end of said drier, and means to cause the products of combustion therefrom to flow exteriorly of said drier and by a tortuous path towards the inlet end thereof and to return within the said drier.

3. In a drying apparatus a revolving drier containing a spiral feed device, a combustion chamber adjacent the delivery end of said drier, and means to cause the products of combustion therefrom to flow exteriorly towards the opposite inlet end thereof and to return within said drier.

4. In an apparatus of the class described a revolving drier containing a spiral feed device, an inclosing setting for said drier containing a combustion chamber and means to cause the products of combustion therefrom to flow exteriorly of said drier toward the opposite inlet end thereof and to return within the said drier, and alternately arranged arches and inverted arches to cause said products of combustion to pursue exteriorly a tortuous path in traversing the length of said drier.

5. An apparatus of the class described containing a revolving drier, constructed to receive the material to be heated at one portion, and deliver said material at the opposite portion, and means to produce a tortuous

conduit for the products of combustion through the interior of said drier in the same direction as that of the travel of the material to be heated.

6. An apparatus of the class described containing a revolving drier with a spiral feed device, and baffle plates staggered within the said drier to cause tortuous passage of products of combustion therethrough.

7. In a drying apparatus, a revolving drier constructed to receive the material to be heated at one portion and to deliver said material at the opposite portion, heating means therefor and means arranged to conduct the products of combustion exteriorly of said drier from outlet to inlet end and directly into said drier through the side walls thereof adjacent said inlet end only, whereby all of said products will traverse the length of the drier in contact with said material.

8. In a drying apparatus a revolving drier means for causing the continuous passage therethrough of the material to be dried, an inclosing setting for said drier, and a combustion chamber arranged outside of said setting, with means to conduct the products of combustion within said setting and along the outside of said cylinder, returning through the interior thereof.

9. A revolving drier of the class described, inlet tubes to admit the products of combustion from the exterior to the interior of the drier, confined to the feed inlet end thereof and means closing the ends of said tubes against the entrance of falling materials within the drier yet permitting free exit of the products of combustion from said tubes to the interior of said drier.

10. In a drying apparatus of the class specified, radial inlet tubes to admit the products of combustion from the exterior to the interior of the drier, confined to the feed inlet end thereof the ends of said tubes being directed at an angle to thereby close the ends of said tubes against falling materials within the drier yet permit free escape of products of combustion therethrough to the interior of said drier.

11. In an apparatus of the class specified, a revolving drier cylinder having radial inlet passages for the products of combustion confined to the portion adjacent the feed inlet end thereof.

12. In a drying apparatus, a revolving drier constructed to receive the material to be heated at one portion and deliver said material at the opposite portion, a combustion chamber therefor and means including deflecting arches to conduct the products of combustion in a tortuous path exteriorly of said cylinder from outlet to inlet end thereof and interiorly from inlet to outlet end thereof.

13. In an apparatus of the class specified a revolving drier cylinder having radial inlet passages for the products of combustion confined to the portion adjacent the feed inlet end thereof, and means to prevent the passage of the material to be heated into said inlet passages.

14. A drying apparatus comprising a revolving drier, a combustion chamber arranged adjacent one end and at one side thereof, "checkered" work between the combustion chamber and the drier to prevent direct contact of the flame with the drier and means to conduct the products of combustion along the length of said drier exteriorly thereof, and back through the interior thereof, to dry the contents.

15. A drying apparatus comprising a revolving drier, means for causing the continuous passage therethrough of the material to be dried, an inclosing setting for said drier, a combustion chamber arranged outside of said setting, "checkered" work interposed between said combustion chamber and said drier and means to conduct the products of combustion within said setting and along the outside of said cylinder, returning through the interior thereof.

16. A drying apparatus comprising a revolving drier, means for causing the passage therethrough of the material to be dried, an inclosing setting for said drier, a combustion chamber arranged outside of said setting, "checkered" work interposed between said combustion chamber and said drier and means to conduct the products of combustion within said setting, along the outside of said cylinder and into the interior of the latter.

17. A drying apparatus comprising a revolving cylinder, means to cause travel of the material to be dried from the inlet portion of said drier to the delivery portion thereof, an exterior combustion chamber adjacent the delivery portion of said drier and at one side thereof, and means to cause the products of combustion therefrom to flow exteriorly of said drier and by a tortuous path towards the inlet portion thereof and to return within the said drier.

18. A drying apparatus comprising a revolving drier, means to cause travel of the material to be dried from the inlet portion of said drier to the delivery portion thereof, an exterior combustion chamber adjacent the delivery portion of said drier and at one side thereof, "checkered" work interposed between said combustion chamber and said drier and means to cause the products of combustion therefrom to flow exteriorly of said drier and by a tortuous path towards the inlet portion thereof and to return within the said drier.

19. A drying apparatus comprising a revolving drier, means to cause travel of the material to be dried from the inlet portion of said drier to the delivery portion thereof,

an exterior combustion chamber adjacent the delivery portion of said drier and at one side thereof, means to cause the products of combustion therefrom to flow exteriorly of said drier towards the inlet portion thereof and admission openings for said products of combustion only near the inlet portion of said drier.

20. A drying apparatus comprising a revolving drier, means to cause travel of the material to be dried from the inlet portion of said drier to the delivery portion thereof, an exterior combustion chamber adjacent the delivery portion of said drier and at one side thereof, "checkered" work interposed between said combustion chamber and the drier, means to cause the products of combustion therefrom to flow exteriorly of said drier towards the inlet portion thereof and admission openings for said products of combustion only near the inlet portion of said drier.

21. A drying apparatus comprising a revolving drier containing a spiral feed device, a combustion chamber adjacent the delivery portion of said drier and at one side thereof, and means to cause the products of combustion therefrom to flow exteriorly towards the opposite inlet portion thereof and to return within said drier.

22. A drying apparatus comprising a revolving drier containing a spiral feed device, a combustion chamber adjacent the delivery portion of said drier and at one side thereof, "checkered" work interposed between the combustion chamber and the drier, and means to cause the products of combustion therefrom to flow exteriorly towards the opposite inlet portion thereof and to return within said drier.

23. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and to deliver said material at its opposite portion, heating means therefor arranged at one side of the drier and means arranged to conduct the products of combustion exteriorly of said drier from outlet to inlet and directly into said drier through the side walls thereof adjacent said inlet only, whereby all of said products will traverse the length of the drier in contact with said material.

24. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and to deliver said material at its opposite portion, heating means therefor arranged at one side thereof and having "checkered" work arranged in coöperative relation with the drier and means arranged to conduct the products of combustion exteriorly of said drier from outlet to inlet and directly into said drier through the side walls thereof adjacent said inlet only, whereby all of said products will traverse the length of the drier in contact with said material.

25. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and to deliver said material at its opposite portion, heating means therefor arranged at one side thereof and means arranged to conduct the products of combustion exteriorly of said drier from outlet to inlet and directly into said drier through the walls thereof adjacent the inlet whereby all of said products will traverse the length of the drier in contact with said material.

26. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and deliver said material at its opposite portion, heating means therefor arranged at one side of the drier and means to produce a tortuous conduit for the products of combustion through the interior of said drier in the same direction as that of the travel of the material to be heated.

27. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and deliver said material at its opposite portion, heating means therefor arranged at one side of the drier, "checkered" work interposed between the heating means and the said drier and means to produce a tortuous conduit for the products of combustion through the interior of said drier in the same direction as that of the travel of the material to be heated.

28. A drying apparatus comprising a revolving drier constructed to receive the material to be heated at one portion and to deliver said material at its opposite portion, heating means therefor, means arranged to conduct the products of combustion exteriorly of said drier from outlet to inlet and directly into said drier through the walls thereof adjacent the inlet, and means to provide a tortuous passage of the products of combustion exteriorly of said drier.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

LOUIS N. McCARTER.

Witnesses:
W. B. BEYER,
JOHN WAGNER.