United States Patent [19]

Allred

[11] **3,763,011**

[45] **Oct. 2, 1973**

[54] **ROTARY HEARTH CALCINER HAVING STATIONARY SOAKING PIT**

[75] Inventor: **Victor D. Allred,** Littleton, Colo.

[73] Assignee: **Marathon Oil Company,** Findlay, Ohio

[22] Filed: **Apr. 28, 1971**

[21] Appl. No.: **138,054**

[52] **U.S. Cl.** **202/100,** 202/103, 202/135, 202/136, 201/33, 201/37, 432/138, 432/139, 202/218

[51] **Int. Cl.** **C10b 7/00**

[58] **Field of Search** 263/7, 26, 36, 39; 202/100, 103, 135, 136, 104, 99, 108; 432/139, 138, 128

[56] **References Cited**

UNITED STATES PATENTS

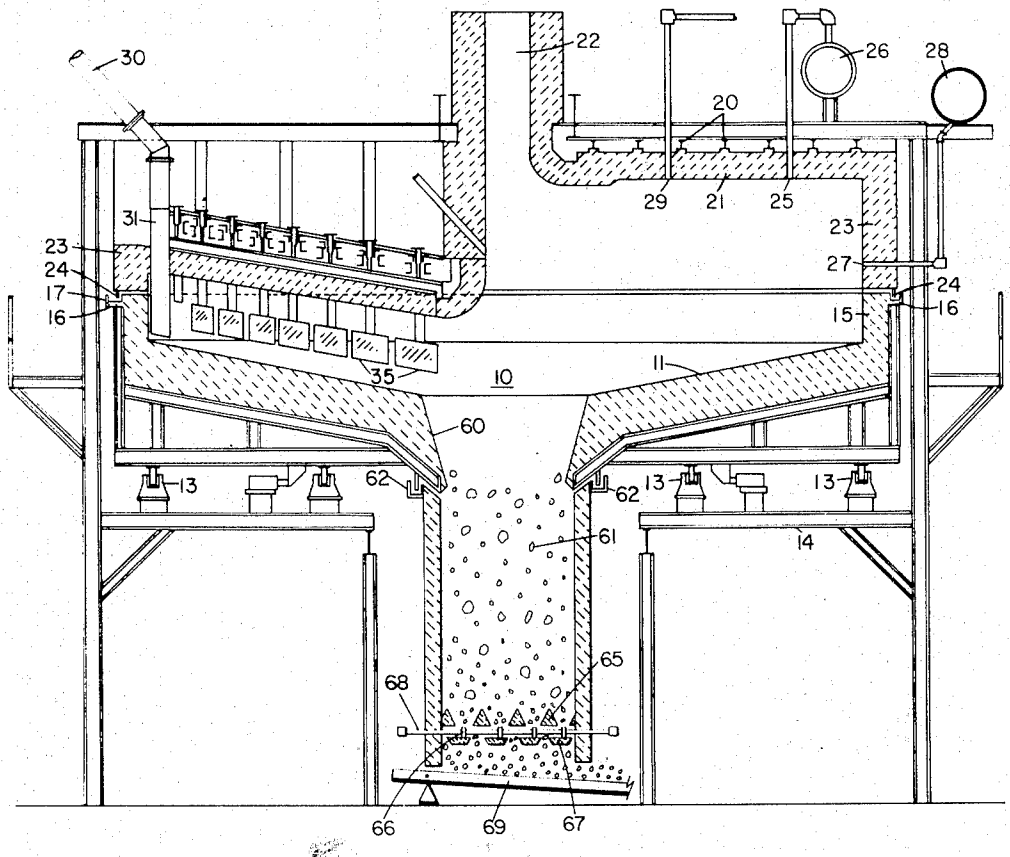
1,989,662	2/1935	Bernhard et al.	263/36 X
2,471,882	5/1949	Martin	263/26
1,385,480	7/1921	Turtle	263/7
3,401,922	9/1968	Jones	263/26
3,448,012	6/1969	Allred	263/26 X

Primary Examiner—Norman Yudkoff
Assistant Examiner—David Edwards
Attorney—Joseph C. Herring, Richard C. Willson, Jr. and Jack L. Hummel

[57] **ABSTRACT**

The soaking pit of a rotary hearth furnace is isolated from the hearth by a circulate water seal so that the hearth can rotate while the soaking pit remains stationary. The soaking pit can have a conventional slide gate or other discharge device.

3 Claims, 2 Drawing Figures

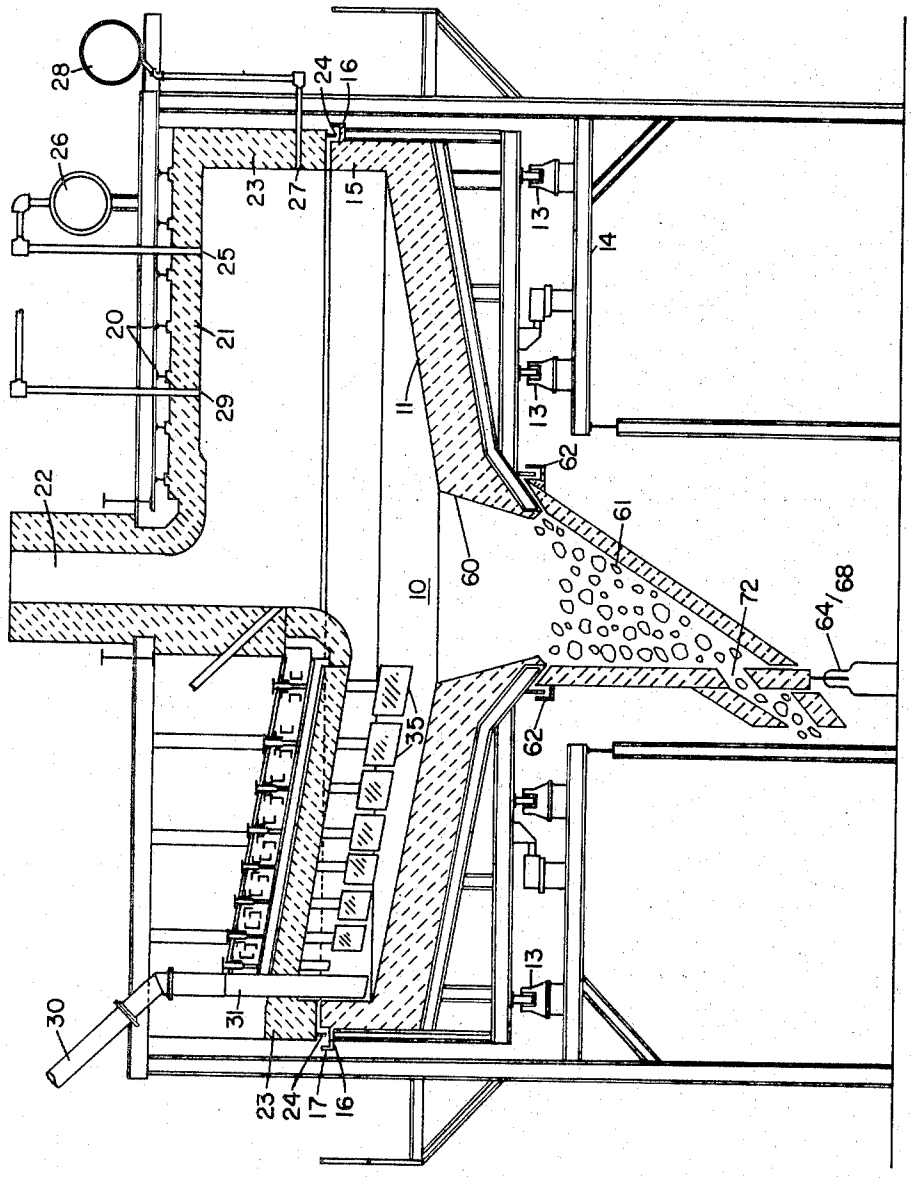


PATENTED OCT 2 1973

3,763,011

SHEET 1 OF 2

Fig. 1



INVENTOR
VICTOR D. ALLRED

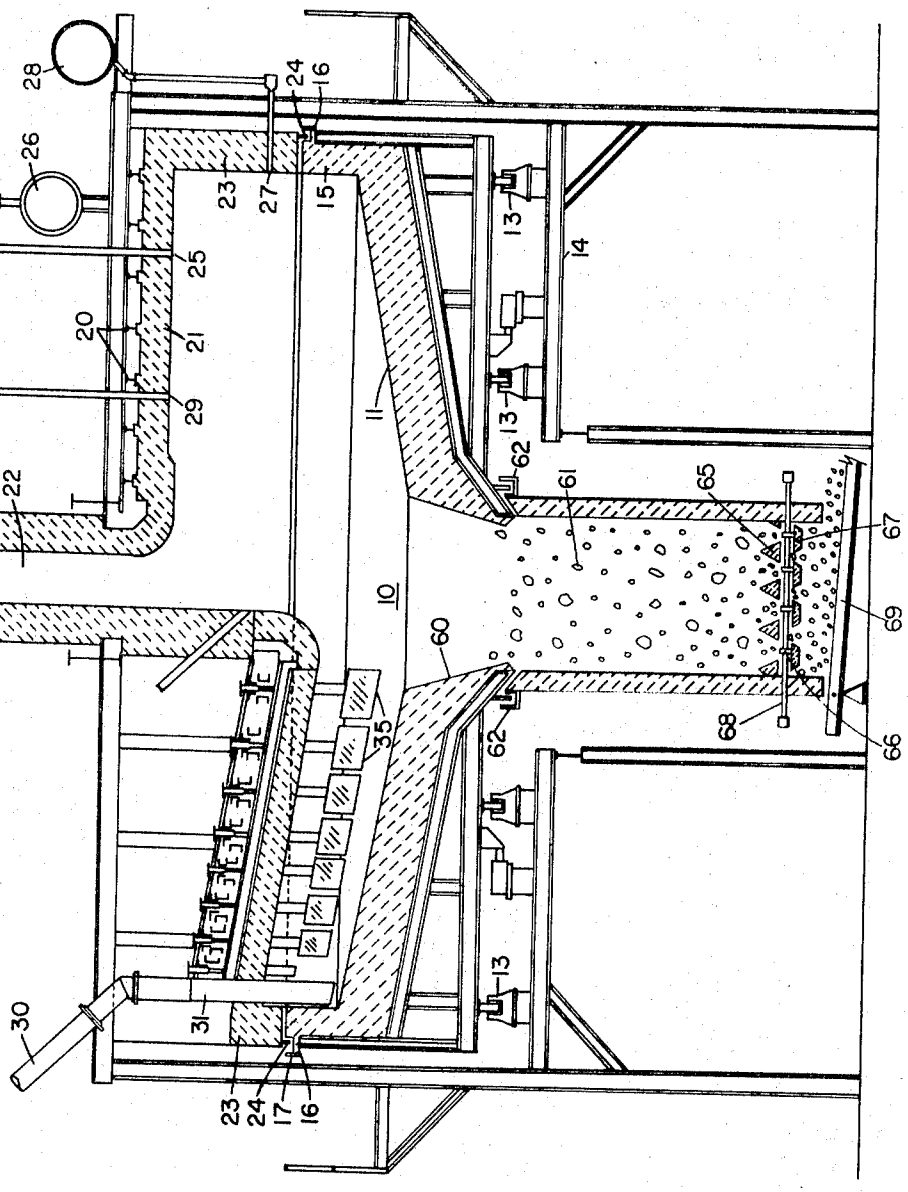
WITNESS

Mary Elizabeth Stumpe

BY Richard C. Wilson Jr.

ATTORNEY

Fig. 2



INVENTOR
VICTOR D. ALLRED

WITNESS
Mary Elizabeth Stamp

BY
Richard C. Gilbreath Jr.
ATTORNEY

ROTARY HEARTH CALCINER HAVING STATIONARY SOAKING PIT

CROSS REFERENCES TO RELATED APPLICATIONS

The following copending patent applications relate to the general field of the present invention: Ser. No. 89,320, filed Nov. 13, 1970; Ser. No. 887,449, filed Dec. 22, 1969 now U.S. Pat. No. 3,594,287 Ser. No. 866,790, filed Oct. 6, 1969 now U.S. Pat. No. 3,652,426; Ser. No. 888,698, filed Dec. 29, 1969; and Ser. No. 887,540, filed Dec. 22, 1969 now U.S. Pat. No. 3,612,497.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the calcining of solid materials generally classified in subclasses 201-33 201-34, 202-102, 202-103, 202-117, 202-120, 202-136, 202-218, 202-239, 110-13, 110-24, 110-36, and 110-171.

2. Description of the Prior Art

U.S. Pat. Nos. 3,470,068, 3,475,286, both to J. L. Kemmerer, Jr. et al. and 3,448,012 to V. Dean Allred each relate to rotary hearth furnaces utilizing rotating soaking pits. A search in the U.S. Patent Office disclosed no patent teaching a furnace having the combination of a hearth rotating relative to a stationary soaking pit.

SUMMARY OF THE INVENTION

General Statement of the Invention

The present invention is adaptable to each of the prior patents mentioned above which concern rotary hearth furnaces. Most of these patents teach the use of a soaking pit concentric with the rotary hearth and depending downward from the hearth to form a conduit for conveying the calcined coke from the hearth to a rotary discharge table. The rotary discharge table and/or other conveying apparatus delivers the hot calcined coke to a cooler in most instances.

According to the present invention, the rotating soaking pit is eliminated and is replaced with a stationary soaking pit so that the rotary seal which separates the stationary from the rotating portions of the furnace is located in close proximity to the material outlet at or near the center of the rotating hearth. The soaking pit, being stationary, can be adapted to a wide variety of discharge devices which control the duration of the detention in the soaking pit of the material being calcined. Elimination of the rotation of the soaking pit permits more sophisticated instrumentation, e.g., level control devices to be more easily installed and the detention time can therefore be more closely controlled.

Control of detention time within the soaking pit is important to provide a uniform product quality. For example, in calcining petroleum coke, the grain density which is an important quality characteristic of the finished product, varies closely with the maximum temperature the coke has attained during calcining. In moving coke from the feed chute located near the periphery of the rotary hearth (as described in the aforementioned rotary hearth patents), across the hearth to the material outlet, the bed of coke is exposed to a high amount of radiant heat. However, the retention time on the hearth may not be sufficient to cause a larger coke particle to come to a uniform temperature throughout.

Detention in the soaking pit provides necessary time interval for the completion of the heat transfer which brings the entire coke particle to a uniform or nearly uniform temperature. Thus the grain density within each individual particle is made uniform throughout that particle. Further, the grain density is made relatively uniform for each particle, whether larger or smaller than average size.

As an additional advantage, the present invention permits the elimination of the rotary discharge table previously employed with rotating hearth furnaces. This eliminates a portion of the capital investment previously required. Importantly, it also eliminates the dust which becomes airborne by convection over the rotary discharge table, and the need for the close contact with air which the coke suffered during its retention on the rotary discharge table which generally served as the adapting link between the rotating soaking pit and the stationary materials handling apparatus or cooler. This contact with air previously caused loss of substantial quantities of fixed carbon values through the formation of carbon oxides due to contact between the air and the hot coke.

Utility of the Invention

The present invention is useful for thermal soaking of a wide variety of calcined solid materials exiting from the hearth of a rotary hearth furnace. These include coke, e.g., delayed petroleum coke, fluid petroleum coke, coal, coke, e.g., from bituminous or anthracite coal, limestone, calcined garbage residues, or any other solid material which it is desirable to calcine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a section view of the rotary hearth furnace showing the stationary soaking pit of the present invention.

FIG. 2 is a section view of a rotary hearth furnace showing another type of stationary soaking pit according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Starting Materials: The starting materials for the present invention can be the materials listed under "Utility of the Invention."

Examples: FIG. 1 illustrates a furnace having a rotary hearth **10** with inner hearth surface **11** sloping from the outer periphery downwardly to a bevelled surface **60** which conveys the coke into a concentric stationary soaking pit **61** located below the surface of the hearth. The rotary hearth **10** is supported on suitable rollers **13** and furnace frame **14** and is driven by a motor and drive in conventional manner for rotary hearth furnaces. A curb **15** extends vertically above the hearth's surface **11** at its outer periphery and carries a trough **16** with sand or water **17**. A second sand seal **62** serves to connect the stationary soaking pit **61** with the rotating hearth **11**. In each of these sand or water seals, a flange attached to the upper member, extends downwardly into sand which is confined in a trough attached to the lower member. Other conventional sealing means may be substituted.

Roof beams **20** support a refractory roof **21** having a central stack or flue **22**. The roof **21** has a depending wall **23** carrying flange **24** which extends into the sand **17** and trough **16** forming the rotary sand seal between

the hearth **10** and the roof **21.** The roof **21** is provided with airports **25** and receives air from duct **26** mounted on the furnace frame **14.** Conventional gas burners **29** are provided to heat the furnace in cases where oxidation of volatile matter driven off from the material being calcined does not provide sufficient heat, and during start-up operations. A feed chute **30** passes through the roof **21** and has a vertically adjustable delivery end **31** to deliver a selected thickness of feed onto the hearth. A radially extending N-shaped rabble pit, shown at the left side of the cross-sectional view of FIG. **1,** is formed in the roof from the stack **22** to the roof wall **23.** The bottom of the pit is provided with slots (not shown) adapted to slidably receive rabbles **35** which may be solid or hollow plate-like structures and which may be water or air cooled. The rabbles are positioned to dispose of solid material on the hearth **11** into a series of windrows and furrows which radiate spirally from the feed chute **31** toward the outlet point **60.** Material is thus gradually conveyed across the hearth from the feed chute **31** to the outlet, progressing inwardly one windrow per revolution of the rotary hearth **11.**

FIG. **1** shows the following: depending from beneath the bevelled surface **60** of the discharge outlet on the rotary hearth **11** is a stationary soaking pit **61** which is connected to the rotary hearth by means of a sand seal **62.** This soaking pit has an outlet **72** having a controlled discharge device **64** which controls the discharge of the coke from the soaking pit into a conventional cooler or vibratory conveyor of suitable construction to withstand the high temperature of the coke from the soaking pit.

In operation, coke is moved from feed chute **31** across the hearth **11** by the action of rabbles **35.** The innermost rabble plows the coke from the surface of hearth **11** onto the beveled surface **60** which conveys it into chamber **61.** The action of discharge mechanism **64–68** causes the chamber to be full of coke up to a preset level. Volatile gases emitted from the coke in the soaking pit are burned within the furnace chamber and all of the products of combustion exit from the furnace through flue **22.**

FIG. **2** shows a similar rotary hearth in which all elements designated by numbers below **60** are identical with the corresponding numbered elements in FIG. **1.** The hearth outlet has a sloping surface **60** and a sand seal **62** from which depends a soaking pit **64.** A grate **65** is installed above an offset grate **67** and an intermediate grate **66** is in wiping contact with grate **67.** Shaft **68** is reciprocated by the action of a motor operating against an opposed spring, neither of which is shown. The wiping action of grate **66** moves coke through grate **67** at a rate which can be controlled by varying the rate of reciprocation of shaft **68.** The vibratory conveyor **69** operates conventionally.

Modifications of the Invention

It should be understood that the invention is capable of a variety of modifications and variations which will be made apparent to those skilled in the art by a reading of the specification and which are to be included within the spirit of the claims appended hereto. For example, the shape of the soaking pit, while preferably round, can be circular or of other horizontal cross sectional shape; the detention means which detains the solid material for sufficient time to permit equalizing of temperatures can be merely a constriction at the bottom of the soaking pit chamber **61** or a sliding gate, a rotary valve, a screw discharge, grates, etc.

What is claimed is:

1. An apparatus for heating coke which apparatus comprises a heating chamber having an upper portion, means for injecting air into said upper portion, means for injecting air into said upper portion of said heating chamber to contact volatile gases emitted from said coke to cause burned said gases to be in contact with said air to emit heat and a rotary hearth in a lower portion of said chamber, a material outlet centrally located on said hearth, means for delivering material to the hearth at a point near the periphery of the hearth to form a bed of material on the hearth, rabble means for moving said material across said rotary hearth to the material outlet, the improvement comprising:

a. rotary seal means encircling said material outlet,

b. a substantially vertical chamber depending from said vertical seal means and communicating with with said material outlet, said chamber being substantially non-rotating,

c. detention means extending substantially over the entire bottom of said vertical chamber, for detaining said coke in contact with said heat for controlled length of time with inner base below a portion of said vertical chamber, wherein said detention means comprises a first series of substantially horizontal spaced elements which extend across said chamber, a second series of spaced elements in a plane parallel to and spaced above said first elements, said second elements overlying the spaces between said first elements a third series of spaced elements substantially parallel to said first set of spaced elements, and located between said first and said second element and being in substantially wiping contact with said first set of spaced elements and means for causing said third elements to alternately wipe across said first elements and then move to a position above the spaces between said first and said second elements, then wipe across said first elements in the reverse direction, and to repeat the described motions.

2. Apparatus according to claim **1** wherein the hearth rotates, wherein the means for moving material across said hearth to the material outlet comprises a spaced series of rabbles, each of which progressively deflects the coke into a windrow nearer to the center of rotation of said hearth, and wherein said material outlet is located substantially at the center of said hearth.

3. Apparatus according to claim **1** wherein the hearth rotates, wherein the means for moving material across said hearth to the material outlet comprises a spaced series of rabbles, each of which progressively deflects the coke into a windrow nearer to the center of rotation of said hearth, and wherein said material outlet is located substantially at the center of said hearth.

* * * * *