United States Patent [19]

Allred

[11] **3,763,013**

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

[54] **NON CONCENTRIC DISCHARGE TABLE FOR ROTARY HEARTH CALCINER**

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

[22] Filed: **Nov. 13, 1970**

[21] Appl. No.: **89,321**

[52] **U.S. Cl.** **202/103**, 202/100, 202/230, 202/262, 263/26, 214/35

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

[58] **Field of Search** ..... 202/102, 103, 104, 202/227, 230, 252, 253, 262, 263, 100, 99; 263/26, 29, 44; 201/39, 34; 214/17 D, 17 C, 35 R, 37, 18 V

[56] **References Cited**

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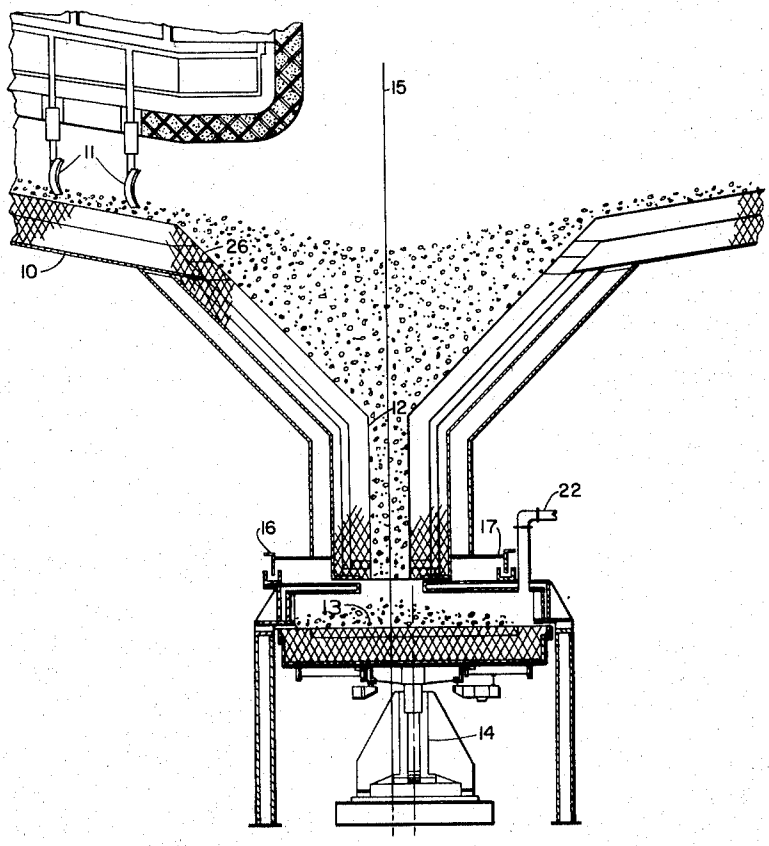
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[57] **ABSTRACT**

The center of the discharge table normally used with rotary hearth calciners is moved away from the center line of the rotary hearth so that the coke moves out from under the soaking pit, giving greater access and ease of installation for rabbles which plow the coke to the edge of the discharge table.

6 Claims, 5 Drawing Figures



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SHEET 1 OF 3

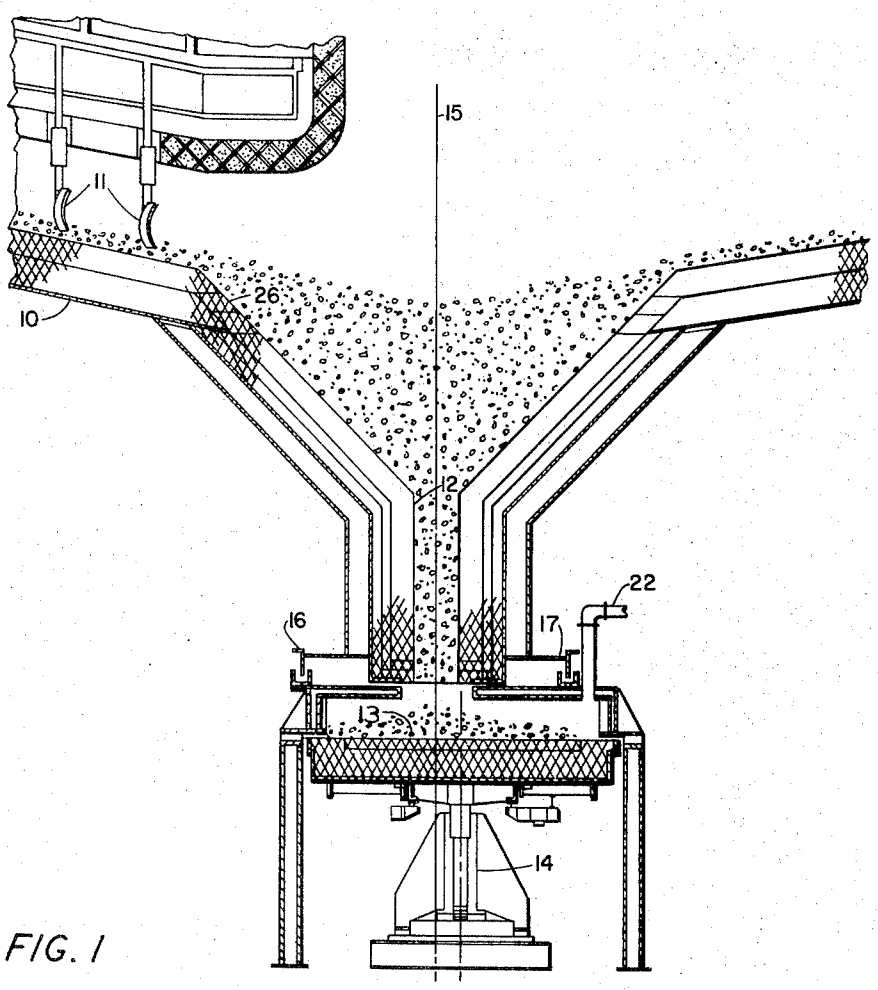


FIG. 1

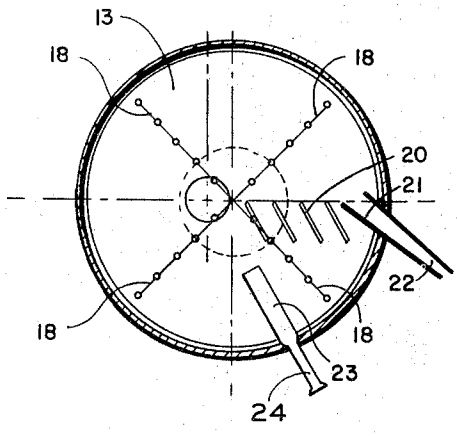


FIG. 2

WITNESS

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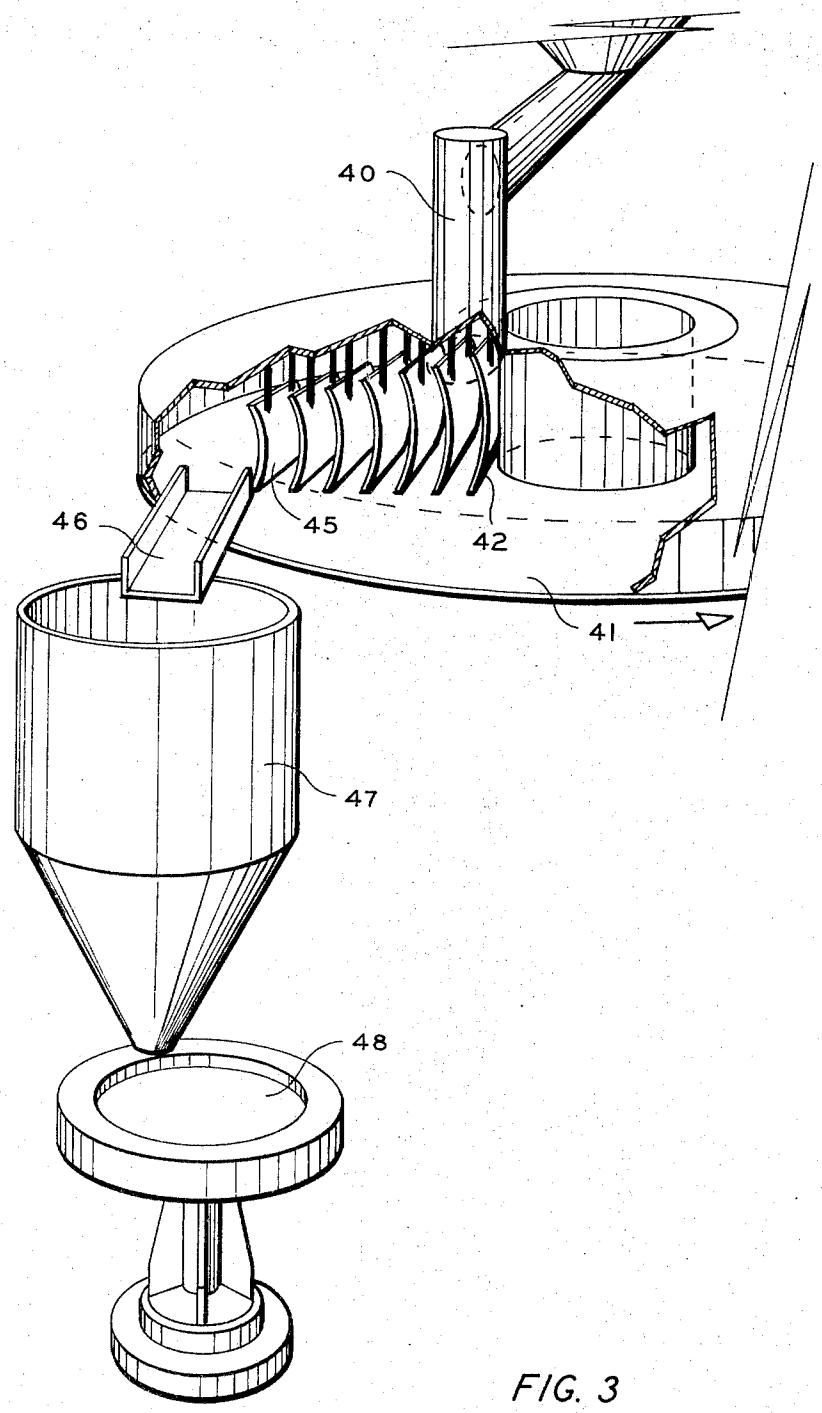


FIG. 3

WITNESS

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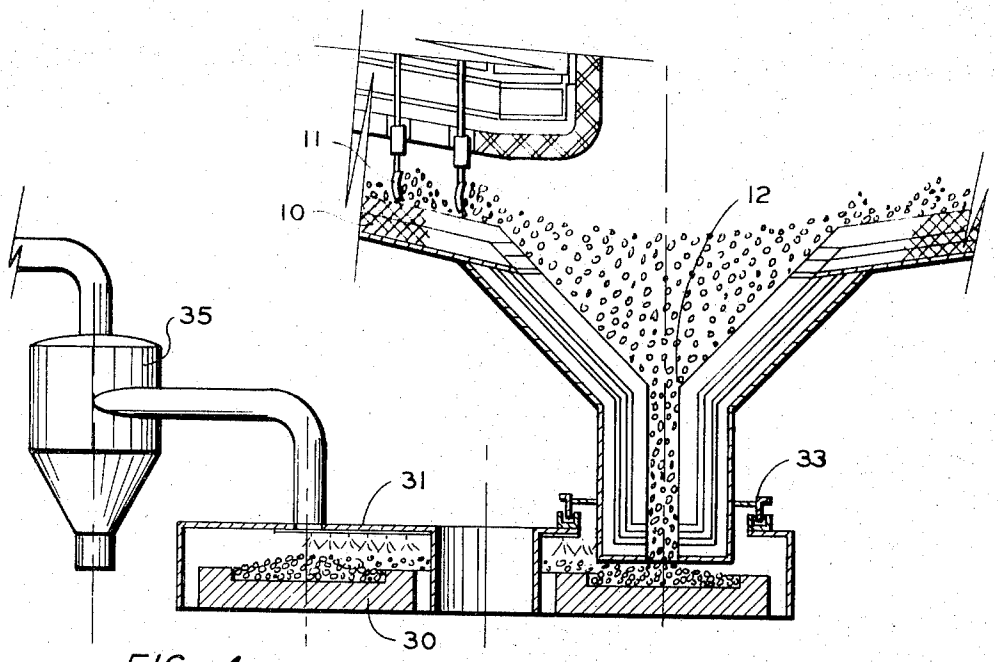


FIG. 4

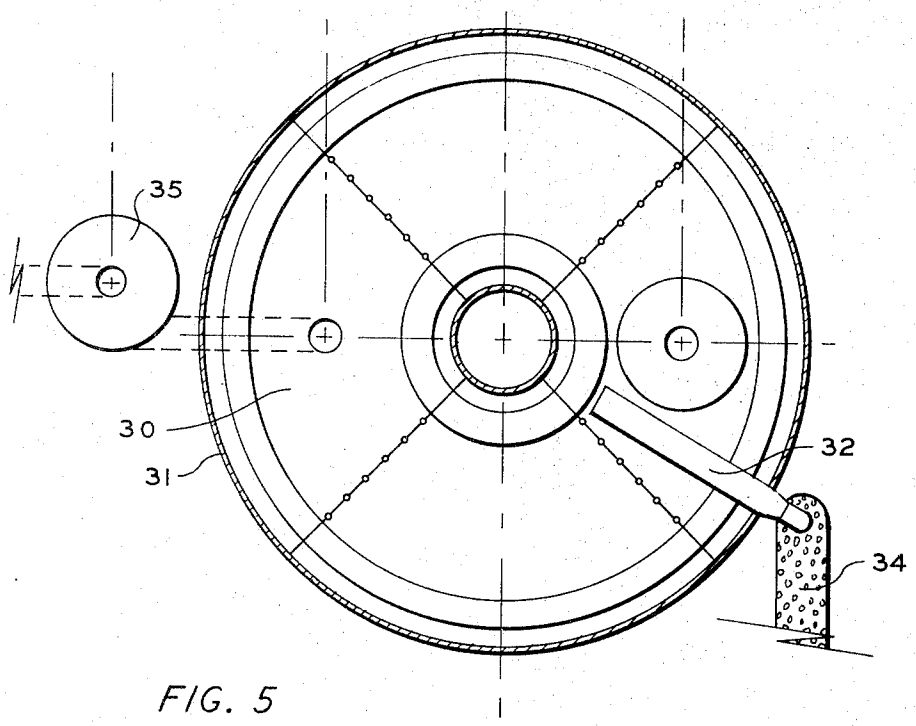


FIG. 5

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NON CONCENTRIC DISCHARGE TABLE FOR ROTARY HEARTH CALCINER

CROSS REFERENCES TO RELATED APPLICATIONS

A variety of pending and issued patent applications have taught rotary hearth furnaces. These include U.S. Pat. No. 3,448,012; U.S. Pat. No. 3,470,078, and U.S. Pat. No. 3,475,286 and U.S. Pat. applications Ser. No. 866,790 filed Oct. 6, 1969, now U.S. Pat. No. 3,652,426, Ser. No. 888,698 filed December 29, 1969, Ser. No. 887,450 filed Dec. 22, 1969, now U.S. Pat. No. 3,612,497, Ser. No. 887,449 filed Dec. 22, 1969, now U.S. Pat. No. 3,594,287.

A number of these patents teach the use of concentric discharge tables onto which calcined coke or other material falls from the rotary hearth of the furnace. Such discharge tables are centered under the center outlet of the rotary hearth and plow means sweep the material from the center to the outer edge of the rotary discharge table. However, in all cases, the rotary discharge tables taught have been concentric with the rotary hearth and have therefore not obtained the advantages of the present invention.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to thermolytic distillation processes, generally classified in Class 201, subclasses 33–34 of the United States Patent Office.

2. Description of the Prior Art

A variety of prior art patents have taught discharge tables rotating beneath the soaking pit of a rotary hearth furnace, but in each instance the discharge table has been located so as to rotate about the same axis as the rotary hearth. Therefore, none of the prior art has apparently taught the non-concentric relationship between rotary hearth and discharge table and the attendant advantages as enjoyed by the present invention. Patents showing concentric rotary hearth and discharge table installations include U.S. Pat. No. 3,470,068 and U.S. Pat. No. 3,475,286 to J.L.Kemmerer, et al. and also U.S. Pat. No. 3,448,012 to the inventor of the present invention.

SUMMARY

General Statement of the Invention

The invention is used in rotary hearth furnaces which have a delivery point at which materials delivered onto the rotary hearth and an outlet point at which material leaves the hearth, and are generally provided with means for moving material across the hearth from the delivery point to the outlet point, e.g., plows or rabbles. According to the present invention, the discharge table is located so as to rotate about a different vertical axis from the axis of rotation of the rotary hearth. That is, the discharge table is non-concentric with the rotary hearth. By shifting the axis of the discharge table away from that of the rotary hearth, in rotary hearth installations having center discharges (soaking-pits), the center portion of the discharge table can be removed from the center of the soaking pit of the rotary hearth. The soaking pit discharge then becomes a true feed chute to the discharge table in similar manner to that which the rotary hearth is fed. Installation of the rabbles to move the calcined coke across the discharge table is thus greatly simplified. This invention has its greatest utility when using the discharge table as a coke cooler.

The discharge table can be utilized as a cooler, either by the natural convection of air moving across the unradiated coke lying on this portion of the discharge table, or by supplying fluids, e.g., water spray or air circulating across the bed of cooling coke on the discharge table or using a perforate discharge table with fluids moving through the bed of cooling coke.

Utility of the Invention

The present invention is useful for the production of calcined coke which is used principally for the manufacture of electrodes for aluminum production and other electro-chemical processes. The invention has the advantages that the coke is caused to move out from under the soaking pit in conventional rotary hearth furnaces having center soaking pit-type outlets. Rabbles may then be readily installed to move the coke across the discharge table to a point where the coke falls from the edge of the table. Such rabbles provide greater ease of access and installation than those which are located on discharge tables concentric and directly beneath the soaking pit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a rotary hearth having a discharge table located non-concentrically with the hearth. For ease of illustration the rabbles are omitted from the discharge table assembly of FIG. 1.

FIG. 2 is a schematic plan view of the discharge table shown in FIG. 1 showing schematically the rabbles, water spray, and steam manifold all suspended above the discharge table.

FIG. 3 is a schematic view showing the non-concentric discharge table of the present invention in use in conjunction with a rotary hearth having a discharge at the periphery rather than at the center. Such a rotary hearth is described more fully in U.S. Pat. application Ser. No. 887,450 filed Dec. 22, 1969 by the inventor of the present invention.

FIG. 4 is a schematic diagram showing the use of a shielded annular discharge table having cooling sprays and a single blade means for removing cooled material from the discharge table after approximately a single revolution.

FIG. 5 is a schematic plan view of the apparatus of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Apparatus

Referring to FIG, 1, the rotary hearth is constructed and operates just as described in U.S. Pat. No. 3,475,286 with raw coke being placed on the hearth **10** and being moved across by the action of a series of rabbles, two of which are shown as **11**, until it falls into a soaking pit **12**. Coke from the soaking pit **12** falls onto the upper surface of discharge table **13** which rotates about an axis **14** which is offset from axis **15** of the rotary hearth furnace. A water seal **16** seals a shroud **17** in gas-tight contact with the outside of the soaking pit.

Referring to FIG. 2 (the plan view of the discharge table shown in FIG. 1), water sprays **18** consisting of pipes having downward directed nozzles spaced at intervals along their length, are suspended horizontally above the table extending in approximately radial di-

rections. A series of rabbles **20** which are water cooled in the manner described in the aforementioned U.S. Pat. No. 3,475,286 distribute the calcined coke on the surface of the discharge table **13** into a series of spiral furrows, moving the coke progressively outward until it is discharged by contacting blade **21** of discharge chute **22.** A steam manifold **23** is connected to a blower (not shown) and to a dust collector (also not shown). The manifold is composed of a channel closed at one end with the open portion facing downward. A flow of air through the open end of the channel **24** causes steam rising from the coke to be pulled into the blower and dust collector arrangement, recovering some coke fines and reducing release of water vapor in the vicinity of the discharge table.

Operation

Referring to FIG. **1,** coke, deposited at the outer edge of the rotary hearth is plowed from one furrow to the next, gradually moving from the deposit point toward the two rabbles **11** shown in FIG. **1.** The first of these contacts the coke, forming a furrow lying substantially between the two plows shown in FIG. **1.** After an additional revolution the innermost plow strikes the coke causing it to slide down the slightly slanting surface of the soaking pit inlet **26,** through the soaking pit proper, **12** onto the upper surface **13** of the discharge table.

The coke is formed into a furrow by the innermost of the discharge table plows **20.** After one revolution the coke is transferred to the next outer furrow by the action of the plow which is second from the center of the discharge table. During the next revolution the coke is subjected to water sprays which cool primarily the exposed surface of the coke. The coke then encounters the third plow from the center which, like all of the plows, turns the coke bed over, exposing a new surface. This new surface is then cooled by contact with the water sprays during the next revolution. The next outer discharge table plow exposes still another surface which is cooled by water sprays and this process continues until the coke is discharged from the table by the action of plow **21** which transfers the coke into discharge chute **22** which delivers it to additional cooling facilities, e.g., water cooled rotating shelves or air-cooled open vibrating tables or chutes. Alternatively, the coke can be transferred directly to conveyors which deliver it to a storage location provided that the temperature of the coke leaving the discharge table has been reduced sufficiently to permit the coke to be stored without further cooling.

The steam generated by contact of the coke with water fills shroud **17** and is withdrawn through steam manifold **23** which leads to dust collection apparatus and the suction of a blower (both not shown), mentioned above.

It will be noted that the coke has at no time suffered any violent agitation which would cause breakage of the relatively friable coke particles, increasing the percentage of the coke which is in the form of generally undesirable fine particles. This gentle treatment of the coke by the process of the present invention is in sharp contrast to the vibrating conveyors and tumbling type drum coolers which are frequently utilized to move coke from the calciner and to cool it. Since the soaking pit will generally be operated approximately full of coke, there will be no severe drip from the hearth surface to the discharge table. Instead, the coke detained in the soaking pit will gradually move downward as coke is removed from the bottom of the soaking pit by the action of the rotating discharge table.

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. Some of these modifications are mentioned below.

The material being heat treated can be petroleum coke, including both delayed and fluid petroleum coke, coal, pellets or briquets containing bituminous coking coal or other carbonaceous materials together with a binder, limestone, dolomite, cement rock, carbonates from which the corresponding metal oxides are to be reclaimed, sulfates or chlorides for decomposition, oil shale for recovery of oil, and many other materials to be subjected to heat treatment.

The temperature in the rotary hearth is not narrowly critical, but in calcining petroleum cokes will generally be in the range of from about 1,500° to 3,000°F., more preferably 1,800° to 2,700°F., and most preferably **2200** to 2,500°F., as measured at the bed of calcining material. Temperatures for calcining coal will be in the range of from 1,000 to 2,500, more preferably 1,200 to 2200, and most preferably 1,800° to 2,100°F., with most coals. Temperatures for calcining other materials will be selected in accordance with the well-known techniques for such calcining.

The fluids used to cool the material on the discharge table will generally be water or air, but may be nitrogen or other non-reactive gases or steam or any other fluid capable of removing heat from the material on the discharge table without entering into undesirable chemical reactions with the material. The quantity of cooling fluids to be utilized will, of course, vary with the temperature and heat capacity of the material being deposited on the surface of the discharge table and the degree of cooling required.

FIG. **3** shows a discharge table of the general type shown in FIGS. **1** and **2,** but used in conjunction with a peripheral-discharge rotary hearth furnace of the type described in copending U.S. Pat. application Ser. No. 887,450 filed Dec. 29, 1969. The feed enters through a conventional feed chute **40** (shown schematically) near the center of the rotating hearth **41** and is arranged in furrows which are gradually moved from the center toward the periphery of the rotary hearth by means of rabbles **42** through **45.** Rabble **45** dislodges the calcined coke from the hearth **41** and sends it through a feed chute **46** into a small soaking pit **47.** This soaking pit operates essentially full of coke and permits the various sizes of coke particles to come to a uniform temperature prior to cooling. This final temperature reached by the coke is especially important in maintaining high quality such as low coefficient of thermal expansion, a property particularly desired in cokes to be used for electrodes. The discharge table **48** is equipped with rabbles, water sprays, a shroud and steam manifold (all not shown) of the type shown in FIGS. **1–3.**

The configuration of the discharge table may be varied. For example, as shown in FIG. **4,** the table **30** and the shroud **31** are annular with a single blade **32** (shown in FIG. **5**) removing the coke from the table

after one revolution of the table. The "tunnel" or "doughnut" configuration is particularly useful for moving the calcined coke in a horizontal manner out from under the hearth. It also generally allows a greater area for cooling the coke since the size will not be limited by the supporting members (not shown) for the rotary hearth. Conventional dust collecting apparatus **35** can be connected to the shroud to withdraw steam and recover fine particles of carbon. The water seal **33**, soaking pit **12**, rotary hearth **10**, and rabbles **11** and the other components of the rotary hearth furnace can be as shown in FIGS. **1** and **2**. Operation is, in general, similar to that described above in connection with FIGS. **1** and **2**. A vibratory conveyor **34** can serve to remove the material from the cooler discharge.

What is claimed is:

1. In a rotary hearth furnace having a delivery point at which material is delivered to said rotating hearth and a central outlet point at which material leaves said rotating hearth and means for moving material across said hearth from said delivery point to said outlet point, the improvement comprising a discharge table located to receive material as it leaves said rotating hearth at said outlet point, said discharge table itself comprising a table rotating about a fixed axis and having a deposit point for receiving material from said rotary hearth and an outlet point for discharging material from said discharge table and means for moving materials from said deposit piont to said outlet point on said discharge table, said fixed axis of said discharge table being offset away from the axis of said rotating rotary hearth, wherein the delivery point is located substantially on the periphery of said rotary hearth and wherein the outlet point is located substantially at the center of said rotary hearth, and wherein at least one plow depends above said discharge table and wherein the material is moved across said discharge table from said delivery point to said outlet point by means of said at least one plow moving relative to said discharge table.

2. Apparatus according to claim **1** wherein the delivery point is located substantially on the periphery of said rotary hearth and wherein the outlet point is located substantially at the center of said rotary hearth.

3. Apparatus according to claim **1** wherein the delivery point is located substantially at the center of said discharge table and wherein the outlet point is located substantially at the periphery of said discharge table.

4. Apparatus according to claim **2** wherein the delivery point is located substantially at the center of said discharge table and wherein the outlet point is located substantially at the periphery of said discharge table.

5. In a rotary hearth furnace of claim **1**, the further improvement comprising cooling means located above said discharge table for distributing fluids downward onto said materials on said discharge table.

6. Apparatus according to claim **6** wherein water sprays are provided above said discharge table for cooling material on said discharge table by directing water downward to contact said material on said discharge table.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,763,013 Dated 10/2/73

Inventor(s) VICTOR D. ALLRED

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 3, line 66:	Delete "drip" and insert therefor --drop--.
Claim 6, line 26:	Delete "according to Claim 6" and insert --according to Claim 5--.

Signed and Sealed this

Sixth **Day of** *September 1977*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks