United States Patent [19]

Brewer

[11] **3,794,250**

[45] **Feb. 26, 1974**

[54] **PROCESS AND SYSTEM FOR RECOVERING CARBON**

[75] Inventor: **John C. Brewer**, Salt Lake City, Utah

[73] Assignee: **Garbalizer Corporation of America**, Salt Lake City, Utah

[22] Filed: **Feb. 23, 1973**

[21] Appl. No.: **335,009**

[52] **U.S. Cl.** **241/21**, 241/24

[51] **Int. Cl.** **B02c 21/00**

[58] **Field of Search** 241/20, 21, 24

[56] **References Cited**

UNITED STATES PATENTS

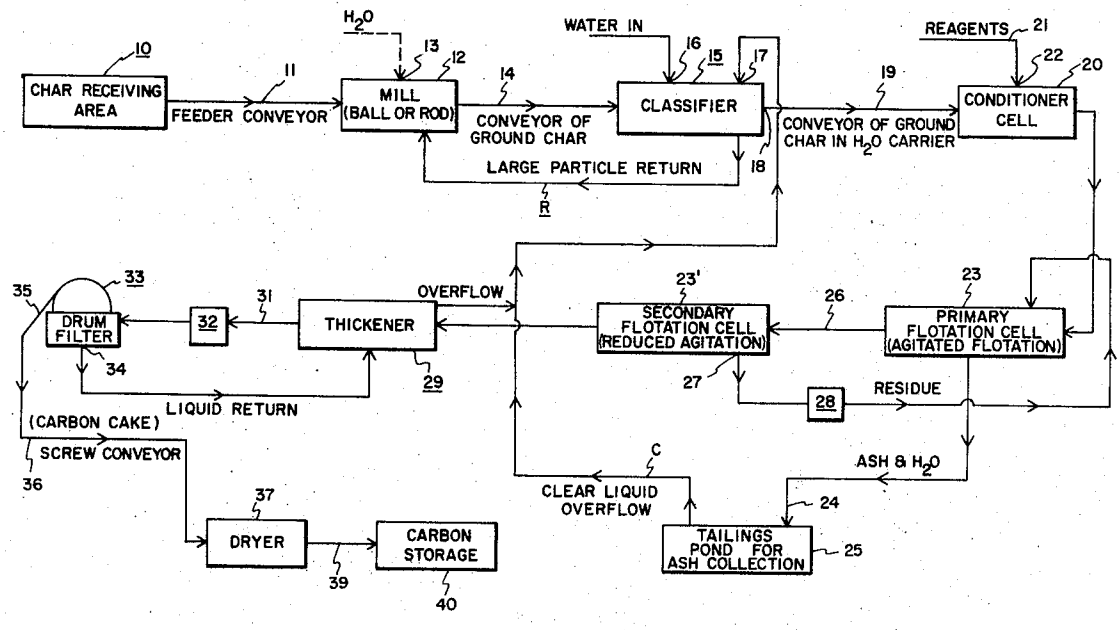
2,903,374	9/1959	Ramse et al.	241/21
3,602,437	8/1971	Driscoll	241/21

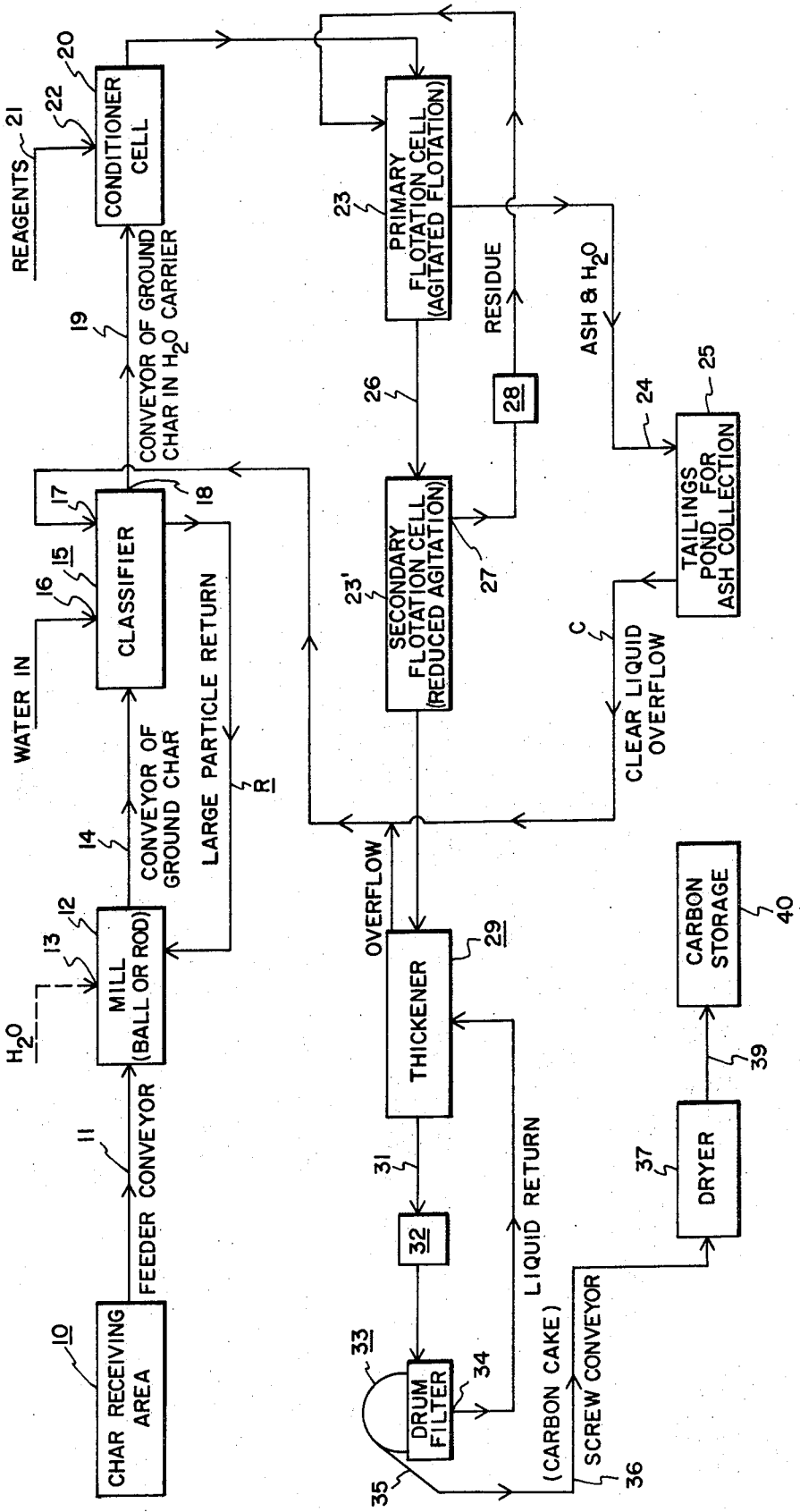
Primary Examiner—Granville Y. Custer, Jr.

[57] **ABSTRACT**

A process and system for the reduction (by milling), separation and recovery of carbon contained in char, coke and other residues resulting from distillation or destructive distillation of carbon-containing materials. The process or system includes ball or rod mill means for pulverizing incoming carbonaceous materials such as char, routing the output of the mill to a classifier so as to provide for a large particle return, conveying the output of the classifier to a flotation system wherein appropriate reagents are added to effect froth recovery, and finally, thickening the result of the material and otherwise processing it so that a carbon cake may be derived, dried, and deposited for carbon storage. Resultant carbon is thus produced in essentially a pure form, rivaling that derived through current mining processes.

14 Claims, 1 Drawing Figure




CHAR RECEIVING AREA
10
FEEDER CONVEYOR
11
MILL (BALL OR ROD)
12
13
H2O
CONVEYOR OF GROUND CHAR
14
CLASSIFIER
15
16
WATER IN
17
18
LARGE PARTICLE RETURN
R
CONVEYOR OF GROUND CHAR IN H2O CARRIER
19
CONDITIONER CELL
20
22
REAGENTS
21
PRIMARY FLOTATION CELL (AGITATED FLOTATION)
23
RESIDUE
28
ASH & H2O
24
TAILINGS POND FOR ASH COLLECTION
25
26
SECONDARY FLOTATION CELL (REDUCED AGITATION)
23'
27
C
CLEAR LIQUID OVERFLOW
OVERFLOW
THICKENER
29
31
32
LIQUID RETURN
DRUM FILTER
33
34
35
(CARBON CAKE)
SCREW CONVEYOR
36
DRYER
37
39
CARBON STORAGE
40

PROCESS AND SYSTEM FOR RECOVERING CARBON

The present invention relates to the production of carbon and, more particularly, to a process and system capable of receiving carbonaceous residue such as char or coke and processing these residues to separate clays, ash and other foreign matter out from the desired carbon recovery.

Inherent in the system is one or a series of flotation cells, by which foreign material is caused to settle or drop out as residue, whereas carbon particles are recovered by the froth in the flotation system and which froth is subsequently processed as through thickener and filter means so that an essentially pure carbon cake is dried, later pulverized if desired, and stored.

In the invention a mill means, in the nature of a rod or ball mill, is used to pulverize incoming char or coke, so that a majority of the output of the mill will be fine powder, or at least of the order of a maximum of 1/16th inch particle size or less. Any large chunks of incoming char or coke which are not pulverized in the mill are routed back for subsequent processing in the mill through a classifier system.

Means is provided for recirculating water as from a tailings pond and at thickener stages to the classifier stage, the outcome of which is fed into the flotation sub-system.

Accordingly, a principal object of the invention is to provide a process for treating char, coke and other residues such that essentially pure carbon may be derived therefrom.

A further object of the invention is to provide a complete, pulverizing and flotation system for pulverizing incoming material and to derive flecks or particles through a frothing system, the output of the latter being treated to provide a carbon cake that can be stored.

A further object of the invention is to treat the surfaces of carbon and ash particles as to aid in a separation thereof in the flotation sub-system of the invention.

Another object is to provide a method of treating residues derived from distillation or destructive distillation wherein carbon content may be derived through other than electrical means.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the sole FIGURE in which:

The sole FIGURE is a schematic block diagram of the the method and system contemplated by the present invention.

In FIG. 1 the char receiving area **10** may be any designated area, bin, hopper or other structure suitable for collecting materials to be processed. These materials will comprise carbon-including materials, and specifically will comprise materials such as char, coke and other residues as results from distillation or destructive distillation of carbon-containing materials or mixtures.

The subject materials received at char-receiving area or structure **10** will be conveyed by feeder conveyor **11** such as an endless conveyor or screw conveyor. Mill **12** will comprise a tumbler type mill such as a ball mill or rod mill. There may be provided a water inlet **13** such that the materials introduced to the mill **12** will be ground in aqueous environment. Milling should continue until a majority of materials milled by unit **12** will pass a 1/16th inch screen mesh. In other words, a majority of the material will comprise fines of particulate form in majority of which will not exceed 1/16th inch in cross sectional diameter or dimension.

Conveyor **14** may be of the endless, conduit, or screw-conveyor type, designed to feed material into a conventional classifier **15.** Here at the latter may include a water inlet at **16** as well as return water at **17,** hereinafter described. The classifier unit **15** of the sole FIGURE may comprise any one of a number of types of classifiers such as the Krebs cyclone-pump unit or another unit used in the industry and going under the name (Dorr-Oliver) "Dorrclone" by way of example. To the output **18** or classifier **15** is coupled conveyor **19,** suitably designed to convey ground char in an aqueous medium to conditioner cell **20.** The latter may comprise a flotation tank, a mixing chamber, or simply a vessel into which reagents as at **21** may be introduced as in inlet **22** to mix with the ground char as carried by the aqueous medium at **19.** The suitable reagents that can be used are well known in the copper-concentrate flotation art and will include kerosene, sodium silicate, and a conventional MIBC alcohol frother. Thus, a ground char in the H_2O conveyor and the aqueous carrier and with the addition reagents enters into the primary flotation cell **23.**

Flotation machines are used in non-analagous art such as the recovery of copper from low grade ore. A flotation cell or machine is simply a vessel having a special agitation device that mechanically maintains suspension of particulate solids in an aqueous medium while simultaneously producing a dispersion of small air bubbles to which particles having hydrophobic surfaces become attached. The latter rise to the surface for availability as a froth-concentrate. During this operation the flotation cell simply settles out ash and clays, which can be carried as by conveyor means **24** to a tailings pond **25.** Accordingly, a primary flotation cell **23** may comprise a conventional flotation cell as is used presently in the copper industry; the same consists simply of a vessel having some type of movable stirrer or other suitable means for maintaining a general suspension of particulates within the cell during the flotation process. The frother of the flotation unit produced by the reagents hereinabove described simply provides for the generation of air bubbles to which the small particles of carbon can adhere so that the latter may arise to the surface of the cell.

The latter is drawn off as an output at **26** and is fed to a secondary cell **23'**, similar to the first but having an agitation unit of reduced movement. This can be accomplished simply by reducing the speed of the stirrer, propeller, paddle or other agitation means. The purpose for the reduced agitation of course it to obtain additional separation of the desired carbon particles from ash, clays and silt, for example such that the latter may be removed at outlet **27.** To outlet **27** is coupled a pump **28** which pumps the material back into the flotation cell for further processing in a re-cycle type of operation.

The final end product of the secondary flotation cell **28** is fed to a thickener unit **29.** "Thickeners" or "thickener machines," as they are called in the indus-

try, are manufactured currently by the Envirotech Corporation, the Denver Equipment Company, and so forth. The output **31** of thickener **29** is fed through a diaphragm pump **32** which forces a carbon concentrate material through a drum filter **33.** The latter is provided with a re-cycling circuit **34,** and fresh liquid carrier such as water may be returned from the drum filter and fed to the thickener with the ash being piped to a tailings pond for re-use or disposal. Overflow water from the tailings pond may be piped back through conduit C to the classifier where the water phase may be re-used. It is noted by the liquid-return will supply clear liquid overflow from both the tailings pond at **25** and also from thickener **29.**

The refinement of flotation recovery is effected at the secondary flotation cell, wherein the end product is thickened at thickener **29** and, by means of drum filter **33** and dryer **37,** will become suitable for carbon storage. Carbon will have purity properties similar to that of mined carbon. Accordingly, the present invention provides a method of producing carbon from char, coke and other residues in a new and entirely unique manner. The process is suitable for inputs of charcoal and other residues resulting from distillation or destruction distillation of carbon-containing materials.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects, and within the true spirit and scope of the invention.

I claim:

1. A system for recovering carbon from feed stock comprising char, coke or other residues containing carbonaceous materials, including, in combination: milling means for receiving such feed stock and physically reducing the same to particulates, flotation cells means coupled to said milling means for froth-separating out carbon particles from said particulates in the production of a carbon-froth output; and means coupled to said flotation cell means for reducing the water content of said froth output to produce a carbonaceous mass.

2. The system of claim **1** wherein said milling means comprise a tumbler mill of one of a class of mills, said class comprising rod mills and ball mills.

3. The combination of claim **1** wherein said system includes a classifier interposed between said milling means and said flotation cell means, and means for routing particles of a size greater than 1/16 inch diameter back to said milling means for further physical reduction.

4. The system of claim **1** wherein said flotation cell means comprises a primary flotation cell coupled to and followed by a secondary, quieter flotation cell, and means intercoupled between said flotation cells for conducting residue from said secondary flotation cell back to said primary flotation cell, and residue outlet means coupled to the bottom of said primary flotation cell to an external tailings pond.

5. The combination of claim **1** wherein said water reducing means comprises a thickener coupled to said flotation cell means, a drum filter, pump means interposed between said drum filter and said thickener for conducting the output of the latter to the former, and dryer means coupled to said drum filter for receiving the output of the latter and drying the same, to produce a storable carbonaceous end product.

6. The combination of claim **1** wherein a conditioner, reagent-receiving cell is interposed between said milling means and said flotation cell means.

7. The combination of claim **3** wherein a conditioner, reagent-receiving cell is interposed between said classifier and said flotation cell means.

8. The combination of claim **4** wherein said water reducing means includes a thickener coupled to said secondary flotation cell, said system including a classifier interposed between said milling means and said primary flotation cell, and means for conducting water overflow from said external tailings pond and also from said thickener to said classifier.

9. A method of producing essentially pure carbon from carbonaceous residues such as coke and char, including the steps of: providing a carbonaceous residue input feed stock;

milling said feed stock to particulates a majority of which is less than one-sixteenth inch diameter size;

subjecting said particulates to froth-flotation to produce a carbon-froth output;

thickening said output; and then

drying said output to produce a storable carbon cake.

10. The method of claim **9** wherein there is included the additional step of:

conducting residues derived from said froth-flotation step to a tailings pond, and

conducting clear liquid from said tailings pond for reuse in the practicing of said method.

11. The method of claim **9** wherein said froth-flotation step comprises:

subjecting said particulates, first, to a coarse froth flotation step and then, second, a quieter flotation step, and

conducting the residue output from said quieter flotation step back to said coarse flotation step.

12. The method of claim **9** wherein said milling step comprises milling said feed stock in an aqueous environment.

13. The method of claim **9** wherein, after said milling step, there is included the additional step of classifying the output derived from said milling step to feed oversized particles back to said milling step for further physical reduction.

14. The method of claim **13** wherein there is included the additional step of supplying a water input to said classifier step.

* * * * *