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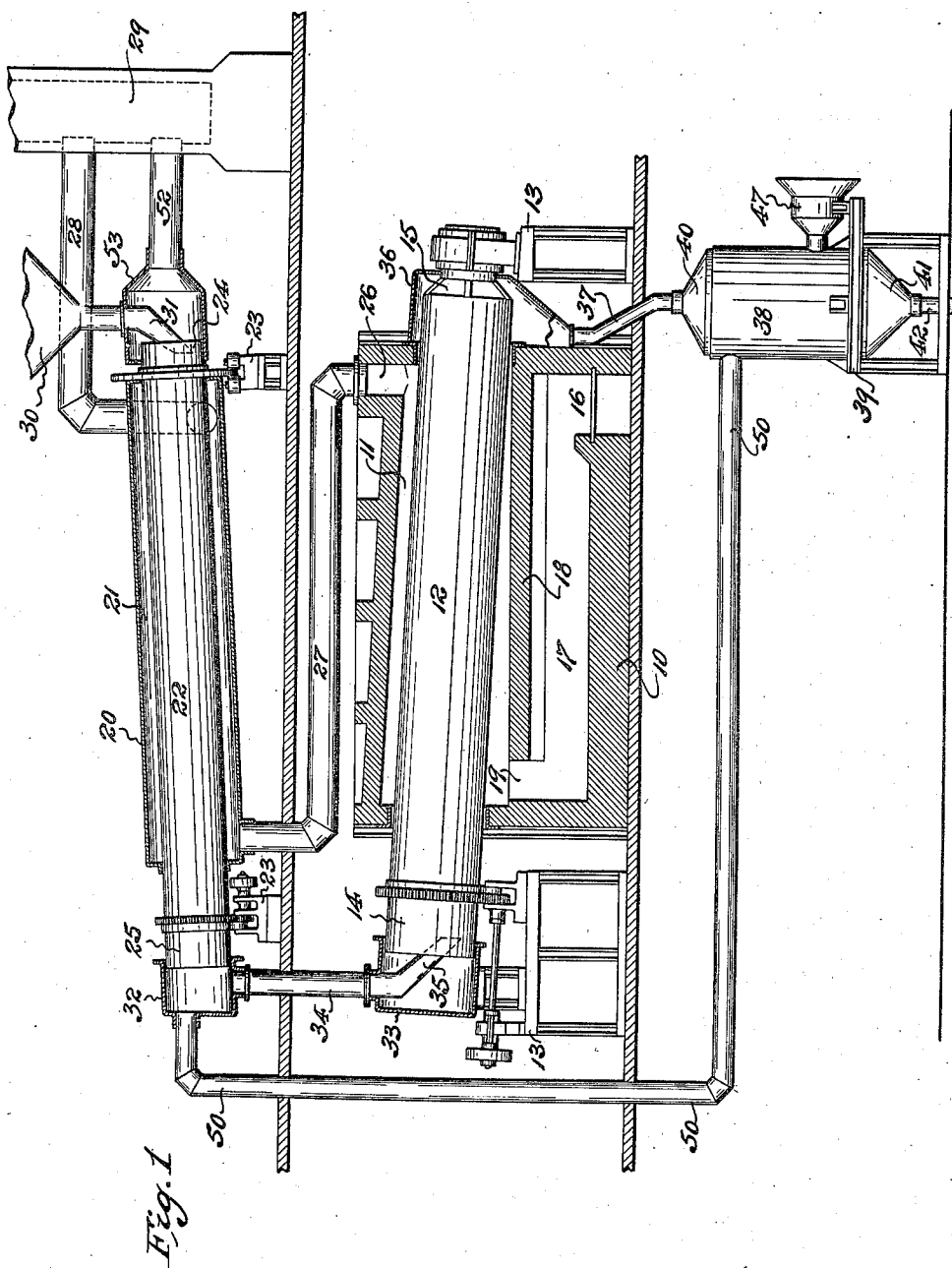
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2,400,935

CHAR REVIVIFICATION APPARATUS

Filed May 23, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

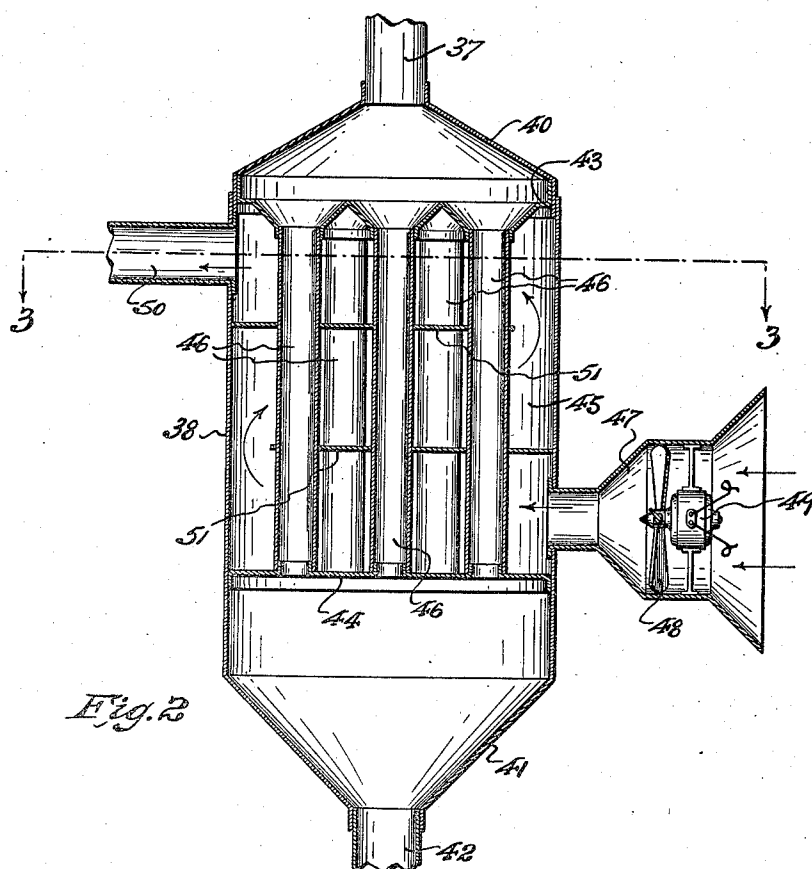


Fig. 2

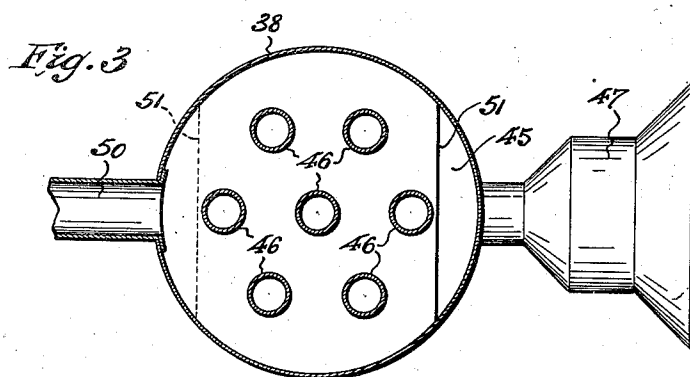


Fig. 3

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CHAR REVIVIFICATION APPARATUS

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4 Claims. (Cl. 202—131)

This invention relates, generally, to an improved apparatus for revivifying or decarbonizing filtrate material such as char or bone-black.

As is well understood by those skilled in the art, a filtrate material such as char, which has been used in filtration operations, may be revivified and freed from excess carbon content by baking the same in a kiln or retort heated to a cherry red heat, whereby the impurities collected in the pores of the char particles are burnt or distilled off, so that the filtering value of the char is brought back to its initial efficiency. In carrying out such revivification process, the moist used char is first passed through a drier, preferably of the rotary type, to substantially free the same from moisture, whereupon it is delivered to and passed through a kiln, such as a furnace heated rotary kiln, to burn or distil off the impurities; the thus treated char, while still in a highly heated condition (having a temperature of approximately 800° F.), is then discharged from the kiln and passed through cooling apparatus, whereby it is cooled by transfer of heat therefrom (usually down to a temperature of approximately 200° F.).

Having the above described practice in view, it is an object of this invention to provide means for reclaiming the heat removed from the revivified char passing through the cooler for reuse in the revivification processes, whereby to expedite and increase the efficiency of such processes; and, to this end, means is provided for transferring the heat removed from the char to an air stream, and thereupon delivering thus preheated air to the drier, preferably in counterflow relation to the moist char passing through the latter on its way to the kiln, whereby not only to expedite the char drying step, but also to somewhat raise the temperature of the char preliminary to delivery thereof into the kiln, so that the kiln efficiency or capacity or both is enhanced.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which:

Fig. 1 is an elevational view in part section of interconnected drier, kiln and cooler means of char revivification apparatus according to this invention; Fig. 2 is a vertical longitudinal sectional view of the char cooler and heat reclamation means of the apparatus, said view being drawn on an enlarged scale; and Fig. 3 is a horizontal sectional view, taken on line 3—3 in Fig. 2.

Similar characters of reference are employed

in the above described views, to indicate corresponding parts.

Referring to the drawings, the reference character 10 indicates a kiln heating furnace, usually built of brick. The upper interior portion of said furnace provides a main rotary kiln drum chamber 11, through which extends the kiln drum 12. Said kiln drum usually comprises a hollow cylindrical steel shell, the external ends of which are suitably supported upon cradle frames 13 for rotation about its longitudinal axis, and so as to incline downwardly from its receiving end 14 toward its discharge end 15. As well known to the art, any suitable power transmission means may be provided for rotating the kiln drum 12.

The lower interior portion of the furnace 10 is constructed to provide a fire-box 16 from which extends a combustion chamber 17. The fire-box and combustion chamber is separated from the kiln drum chamber 11 by a transverse arch 18, which is provided, at the end opposite the fire-box, with a port 19 affording communication between said combustion chamber and said kiln drum chamber.

Located above the aforesaid furnace heated kiln is a drier housing 20, the interior of which provides a drier drum chamber 21 through which extends a drier drum 22. Said drier drum also comprises a hollow cylindrical steel shell, the external ends of which are suitably supported upon cradle frames 23 for rotation about its longitudinal axis, and so as to incline downwardly from its receiving end 24 toward its discharge end 25. As also well known to the art, any suitable transmission means may be provided for rotating said drier drum 22.

The kiln drum chamber 11 is provided with an outlet port 26 which is connected by piping 27 in communication with the interior of the drier drum chamber 21, preferably at a point adjacent to one end of the latter. The opposite end of said drier drum chamber 21 is connected by piping 28 in communication with a flue or stack 29.

Wet char from a storage means or hopper 30 is delivered into the receiving end 24 of the drier drum 22 by a delivery chute means 31 which leads from said storage means or hopper.

The discharge end 25 of the drier drum 22 is closed by a suitable hood 32, and in like manner the receiving end of the kiln drum 12 is closed by a similar hood 33. Char dried in the drier drum 22 is discharged therefrom into the hood 32, to be thence delivered through a drop pipe 34 which enters the hood 33 of the kiln drum 12. Said drop pipe 34 terminates in a delivery chute

means 35 which discharges the dried char into the receiving end 14 of the kiln drum 12, for passage therethrough.

The discharge end of said kiln drum 12 is closed by a suitable hood 36. Revivified char is discharged from the discharge end 15 of said kiln drum into said hood 36, to be thence delivered through a drop pipe 37 to a char cooler means, which is located below said discharge end of the kiln drum.

The char cooler means, in an illustrative form thereof as shown, comprises a suitably shaped casing 38 mounted on a supporting framework 39. The upper end of said casing 38 is closed by a top end wall 40, through which the drop pipe 37 enters to communicate with the casing interior. The bottom end of said casing 38 is provided with a funnel-like bottom end wall 41 from which leads the cooler discharge pipe 42, which serves to convey away the cooled revivified char to suitable storage means (not shown).

Affixed across the upper interior of said casing 38, so as to be suitably spaced below the closed top end thereof, is a suitably shaped top partition wall 43. In like manner, affixed across the lower interior of said casing 38, so as to be suitably spaced above the closed bottom end thereof, is a bottom partition wall 44. Said partition walls define an intermediate cooler chamber 45 through which a cooling fluid may circulate.

Extending between said top and bottom partition walls 43 and 44, so as to communicate with the casing interior above and below said partition walls, are a series of perpendicular and relatively laterally spaced, endwise open cooler tubes 46, which extend through the cooler chamber 45 so as to be surrounded by the cooling fluid circulated therethrough.

According to this invention, the cooling fluid employed is, preferably, relatively cold air. Connected in communication with the lower portion of said cooler chamber 45 is an outwardly open air intake means 47 of suitable shape. Within and across the air intake means is arranged a blower for inducing forced flow of cool air into and through the cooler chamber 45. Said blower comprises a power driven fan 48, preferably driven by an electric motor 49. Leading outwardly from the upper portion of said cooler chamber 45 is a hot air conduit 50, through which air, to which heat has been transferred from the hot char, is discharged from the cooler chamber 45.

In order to compel the cool air delivered into the cooler chamber to circulate therethrough in heat transfer contact with all portions of the cooler tubes 46, the interior of said cooler chamber 45 is subdivided by a plurality of staggered transverse baffle plates 51.

The air, to which heat has been transferred from the hot char, in the cooling of the latter as it passes downwardly through the cooler tubes 46, is discharged into the conduit 50. This conduit 50 is extended to communicate with the interior of the drier drum 22, preferably so as to enter the discharge end of the latter for flow therethrough counter to the direction of movement of and in direct contact with char passing therethrough for drying. To this end, the delivery end of said conduit 50 is arranged to communicate with the interior of the hood 32 by which the discharge end of said drier drum 22 is enclosed. The hot air, after passing through the drier drum 22 is conducted to and vented through the flue or stack 28, and, to this end, an

air discharge conduit 52 leads from the hood 32, which encloses the receiving end of the drier drum 22, to said flue or stack 28.

In the operation of apparatus for char revivification, after the moisture content of the char to be treated has been substantially driven off therefrom by its passage through the drier, the char is delivered into and caused to flow through the highly heated kiln, so that the content of excess and inactive carbon, which it accumulated during its previous use as a filtrate material, together with other impurities, are burnt or distilled off, thereby revivifying the char for reuse as a filtrate material.

In passing through the kiln, the temperature of the char is raised to approximately 800° F., at which temperature it is discharged to the cooler. The function of the cooler is to reduce the temperature of the char to approximately 200° F., before it is deposited in storage. This means that approximately 600° F. of heat is transferred to the cooling medium circulated through the cooler, and, so far as the char revivification process is concerned, has heretofore become waste heat. By the method and apparatus of this invention, this waste heat is reclaimed and applied to useful work in the char revivification process per se. This is accomplished by transferring heat from the char passing through the cooler to a fluid capable of serving as a vehicle therefor, as well as one which can be brought into direct contact with the char being processed. For such purpose, a gaseous fluid such as air provides a satisfactory medium. Accordingly, air is introduced into and caused to flow in intimate contact with the cooler tubes through which the hot char passes, whereby heat is transferred from the char to said air, with resultant desired cooling of the former. The resulting hot air is thereupon conducted to the char drier, and caused to flow therethrough in direct contact with the char passing therethrough on its way to the kiln, preferably in counterflow relation thereto. The hot air thus brought into contact with the moist char combines with the external heat applied to the drier by hot gases of combustion from the kiln furnace, which are delivered into and caused to flow through the drier housing, to effect more rapid and efficient drying of the char. The hot air stream also more efficiently vents the vapors from the drying char by carrying the same to the flue or stack 28 for escape therethrough. Not only is the char, in this manner, more rapidly dried, but also the temperature thereof is raised so that it becomes more quickly responsive to the revivifying effects of the kiln heat, when delivered and passed through the kiln. As a consequence of this, speed of flow of the char through both the drier and the kiln may be stepped up, and the efficiency or capacity or both of the kiln is substantially increased. It has been calculated that the capacity of the drier-kiln apparatus is, by use of the heat reclaimed at the cooler, increased from ten to twenty per cent.

It will be understood that many changes could be made in the construction and arrangement of the apparatus without departing from the scope of this invention as defined in the following claims. It is therefore intended that all matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In apparatus for the purposes described, a

rotary kiln drum and a rotary drier drum relatively mounted so that the discharge end of the latter is adjacent to the receiving end of the former, char conducting means between the discharge end of said drier drum and the receiving end of said kiln drum, a cooler having char passage means, means for delivering hot char discharged from said kiln drum into said cooler for movement through its char passage means, means for flowing a gaseous cooling medium through said cooler in contact with the char passage means thereof, whereby to transfer heat from said hot char to said medium, and means for conducting the heated medium from said cooler and delivering the same into said drier drum for movement through the latter in contact with the tumbling char passing therethrough.

2. In apparatus for the purposes described, a rotary kiln drum and a rotary drier drum relatively mounted so that the discharge end of the latter is adjacent to the receiving end of the former, char conducting means between the discharge end of said drier drum and the receiving end of said kiln drum, a cooler having char passage means, means for delivering hot char discharged from said kiln drum into said cooler for movement through its char passage means, means for flowing a gaseous cooling medium through said cooler in contact with the char passage means thereof, whereby to transfer heat from said hot char to said medium, and means for conducting the heated medium from said cooler and delivering the same into the discharge end of said drier drum for movement therethrough in counterflowing direct contact with the tumbling char passing therethrough, a flue, and means for conducting said medium from the receiving end of said drier drum to said flue for discharge therefrom.

3. In apparatus for the purposes described, a rotary kiln drum and a rotary drier drum relatively mounted so that the discharge end of the latter is adjacent to the receiving end of the former, char conducting means between the discharge end of said drier drum and the receiving end of said kiln drum, means to heat said kiln

drum, means to apply heat externally to said drier drum, a cooler, means for delivering hot char discharged from said kiln drum into said cooler, said cooler comprising a casing interiorly subdivided to provide a char receiving chamber, a char discharge chamber and an intermediate cooling chamber, a plurality of spaced char passage tubes extending through said cooling chamber from said receiving chamber to said discharge chamber, means for inducting relatively cool air into said cooling chamber to contact said char passage tubes, whereby to transfer heat from the hot char traversing said tubes to said air, and means leading from said cooling chamber for conducting heated air therefrom and delivering the same into said drier drum for direct contact with the tumbling char passing therethrough.

4. In apparatus for the purposes described, a rotary kiln drum and a rotary drier drum relatively mounted so that the discharge end of the latter is adjacent to the receiving end of the former, char conducting means between the discharge end of said drier drum and the receiving end of said kiln drum, means to heat said kiln drum, means to apply heat externally to said drier drum, a cooler, means for delivering hot char discharged from said kiln drum into said cooler, said cooler comprising a casing interiorly subdivided to provide a char receiving chamber, a char discharge chamber and an intermediate cooling chamber, a plurality of spaced char passage tubes extending through said cooling chamber from said receiving chamber to said discharge chamber, means for inducting relatively cool air into said cooling chamber to contact said char passage tubes, whereby to transfer heat from the hot char traversing said tubes to said air, and means leading from said cooling chamber for conducting heated air therefrom and delivering the same into the discharge end of said drier drum for movement therethrough in counterflowing direct contact with the tumbling char passing therethrough, a flue, and means for conducting said air from the receiving end of said drier drum to said flue for discharge therefrom.

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