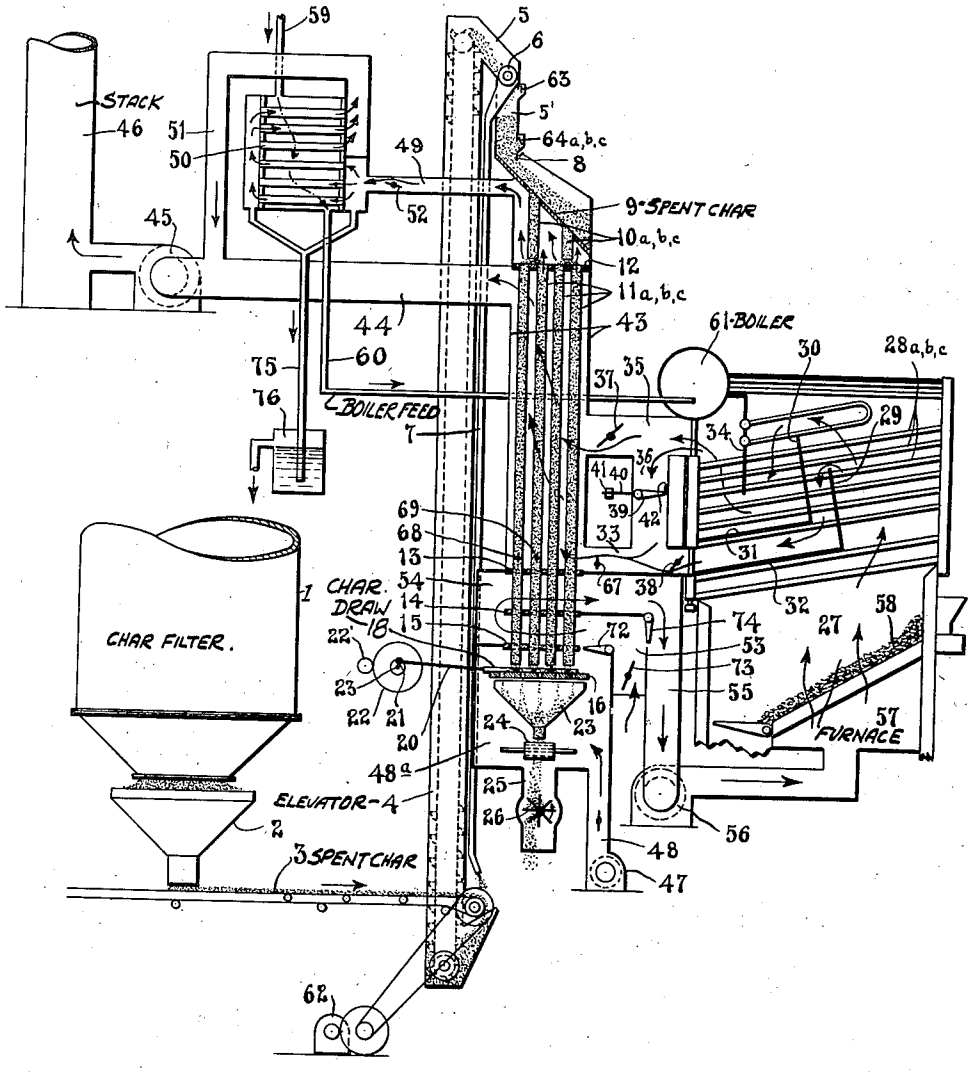
Dec. 22, 1936. N. R. ANDREWS 2,064,813

APPARATUS FOR UTILIZING FURNACE GASES IN THE RECLAIMING OF BONE BLACK AND LIKE MATERIALS

Original Filed April 24, 1933 4 Sheets-Sheet 1

Fig. 1



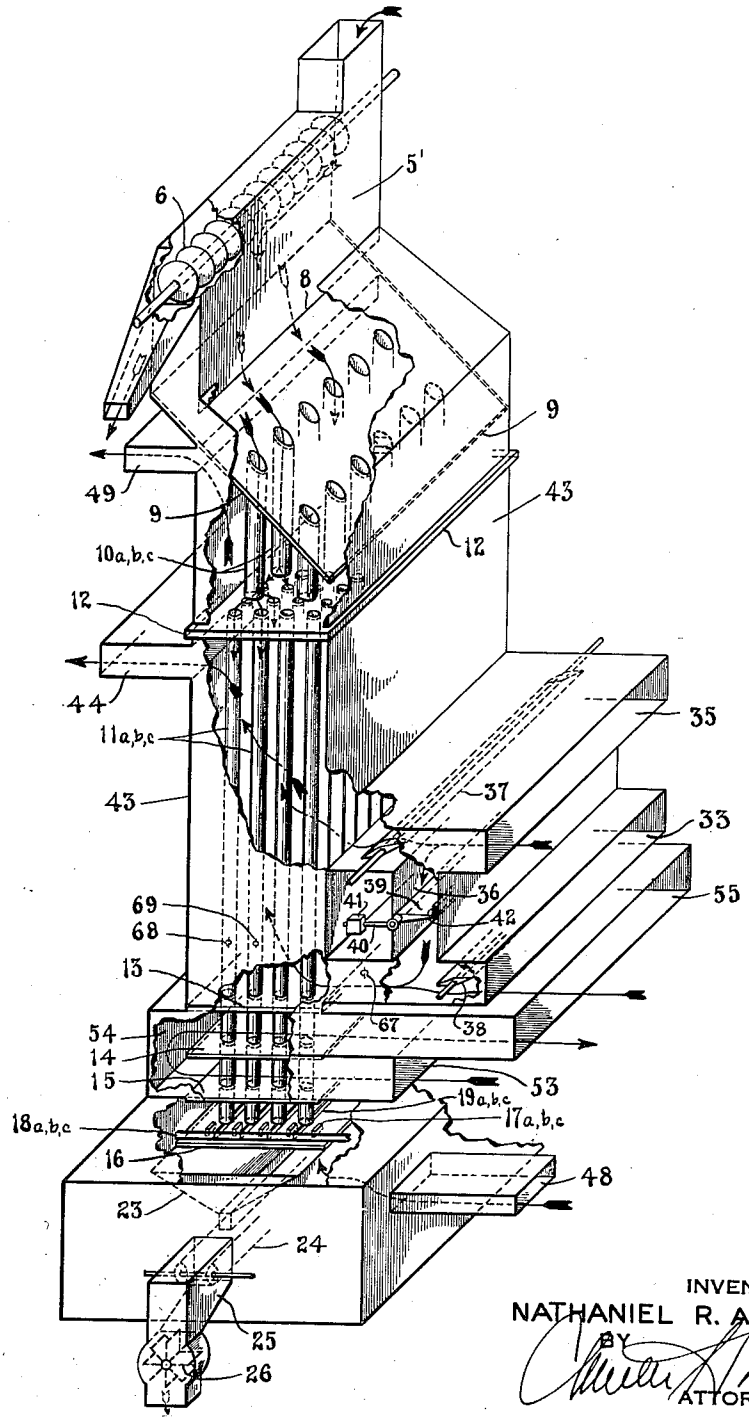
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APPARATUS FOR UTILIZING FURNACE GASES IN THE RECLAIMING OF BONE BLACK AND LIKE MATERIALS

Original Filed April 24, 1933 4 Sheets-Sheet 2

Fig. 2



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APPARATUS FOR UTILIZING FURNACE GASES IN THE RECLAIMING OF BONE BLACK AND LIKE MATERIALS

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Fig. 3

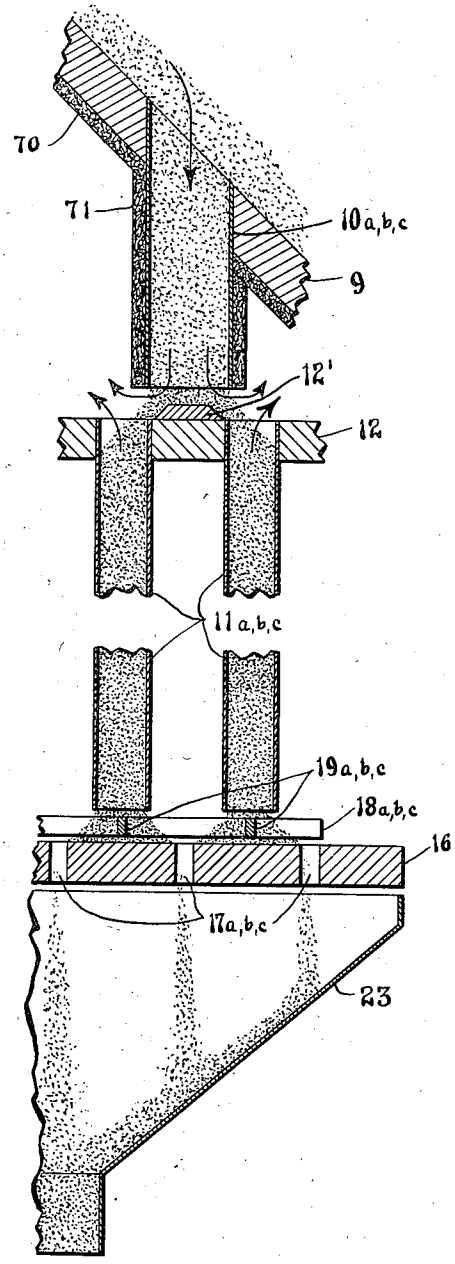


Fig. 4

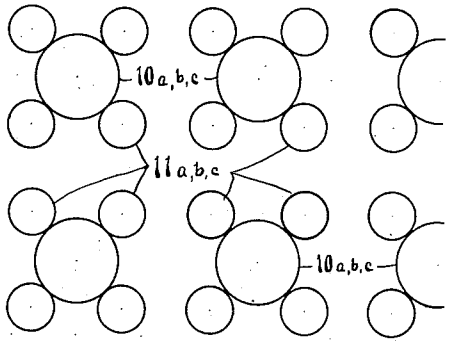
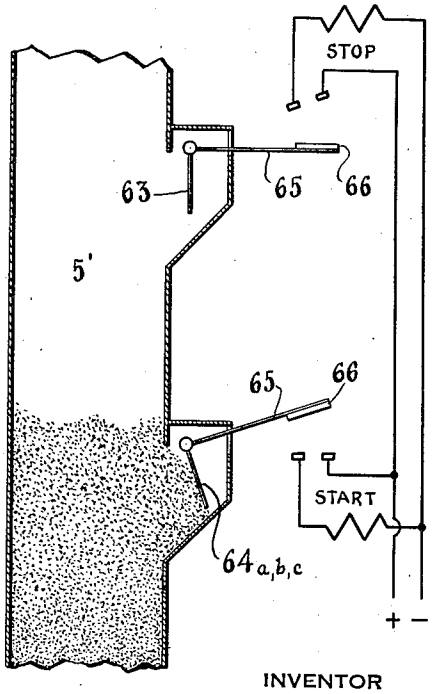


Fig. 5



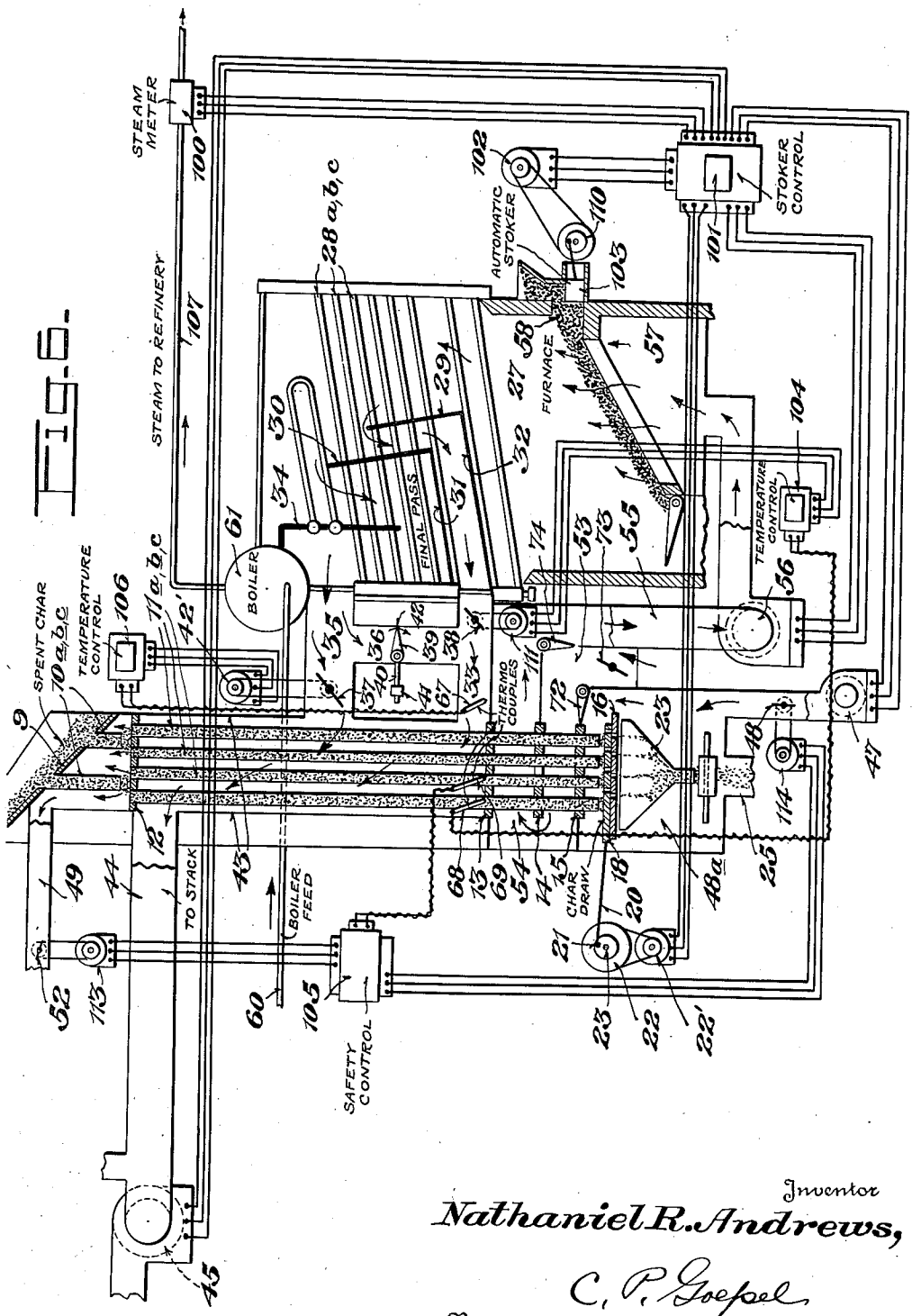
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Original Filed April 24, 1933 4 Sheets-Sheet 4

Fig. 6.



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Patented Dec. 22, 1936

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UNITED STATES PATENT OFFICE

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APPARATUS FOR UTILIZING FURNACE GASES IN THE RECLAIMING OF BONE BLACK AND LIKE MATERIALS

Nathaniel R. Andrews, Yonkers, N. Y.

Original application April 24, 1933, Serial No. 667,723. Divided and this application April 24, 1933, Serial No. 667,722

8 Claims. (Cl. 202—114)

This invention relates to new and improved apparatus for reclaiming or reconditioning bone-black or animal charcoal, commonly known in the sugar refining and allied arts as "char".

The present application is a division of my co-pending application, Serial No. 667,723, filed April 24, 1933, now Patent No. 1,971,895. My acknowledged patent is drawn to a process of reclaiming bone black from spent char while the present application is drawn to one type of apparatus which can be employed in the process of the said patent.

One of the objects of the invention is to provide new and improved apparatus such that the revivifying or reconditioning of the char is accomplished more economically than it has been possible to process the char in apparatus as hitherto constructed.

Another object of the invention is to provide new and improved apparatus for processing char whereby gases from the boiler furnace of a sugar refining plant may be most economically and efficiently utilized in the reconditioning or revivifying of the char.

Another object of the invention is to provide new and improved apparatus wherein the vapors and products of combustion driven off or distilled off from the char during the process of reconditioning the latter may be effectively utilized in preheating the boiler water.

Another object of the invention is to provide new and improved apparatus whereby air utilized in cooling the reconditioned or revivified char and thus heated by the heat given off in cooling the char may be utilized in the furnace of the boiler.

Another object of the invention is to provide new and improved apparatus of the above character wherein the danger of destroying or injuring the char structure during the revivifying or reconditioning process is entirely eliminated.

Another object of the invention is to provide apparatus of the above character wherein boiler furnace gases of a sugar refinery are utilized in the processing of the char such that the rate of processing will be proportional to the rate of fuel burning in the furnace of the boiler and therefore also proportional to the rate of processing of the sugar.

Another object of the invention is to provide new and improved apparatus of the above character wherein boiler furnace gases are utilized in the reconditioning of char such that lower temperatured furnace gases may be mixed with higher temperatured furnace gases so that the resultant mixture will be at the maximum temperture required for processing char.

Another object of the invention is to provide new and improved apparatus of the above character wherein a blanketing or extinguisher action is provided for the char in process in the event that the temperature thereof rises to such a point that the char structure might be injured or destroyed.

Another object of the invention is to provide in apparatus of the class described, means whereby the rate of processing the char by the heat of the boiler furnace gas is such that said rate of processing or the amount of char processed is determined by the rate of fuel burned in the boiler furnace, or is proportional to the steam demand upon the boiler and therefore to the rate of processing of the sugar.

More particularly, my new and improved apparatus for reconditioning or reclaiming char contemplates the use of the boiler furnace gases of a sugar refinery in such a way that the heat produced by burning off or distilling off the impurities or foreign matter in the char being processed is utilized for preheating the boiler water, the air used for cooling the processed char and thus heated is used in the combustion chamber of the boiler furnace so that the apparatus becomes, in effect, an economizer for the boiler "breathing" with the boiler, so that the heat reclaimed from the furnace gases and also the heat produced by combustion of the impurities or foreign matter in the char is proportional to the rate of fuel burning in the boiler furnace.

It is, of course, well known that the steam generated in a sugar refinery is employed almost exclusively in the processing of the sugar; for example, in the evaporating pans, etc. Any steam used for heating of the building or for other non-sugar uses is usually exhaust steam from one or more of the sugar processing operations. It is therefore clear that, if the char processing is controlled in such manner as to be proportional to the steam demand or to the fuel consumed in the boiler room of a refinery, it is also substantially proportional to the rate of sugar processing, which in turn is proportional to the demand for the char employed during the processing. I have found that a control based in this manner is convenient, effective, inexpensive and labor saving.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements

and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings wherein I have illustrated a preferred form of embodiment of my invention, some parts of the apparatus being illustrated schematically,

Figure 1 is a view partly in elevation and partly in section illustrating my improved apparatus,

Figure 2 is a perspective view of the char processing part of the apparatus showing portions of the flues which lead to and from the boiler furnace,

Figure 3 is a vertical sectional view of a part of the reconditioning apparatus showing a detail of construction,

Figure 4 is a horizontal sectional view showing schematically the disposition of the char feed tubes relative to the char processing tubes,

Figure 5 is a vertical sectional view, partly schematic, showing the means employed for automatically discharging char to be processed into the apparatus, while

Figure 6 is a diagrammatic showing of the control features of my invention.

Referring now to the drawings wherein similar reference characters refer to similar parts throughout the several views of the drawings, the reference numeral **1** denotes the char filter having a hopper tube which is adapted to discharge the char to be processed upon a belt conveyor **3**, said belt conveyor discharging the char into the boot of the bucket elevator **4**. This bucket elevator discharges the char into the upper end of a feed hopper **5**, having a chute 5^1.

The reference numeral **6** denotes a screw conveyor which forms its own trough in the char and distributes the latter evenly in the feed hopper chute 5^1, any excess of char spilling into the chute through the pipe **7**, which delivers it into the boot of the bucket elevator **4**. The elevator **4** and the screw conveyor **6** are adapted to be driven constantly by any suitable means (not shown).

The reference numeral **8** denotes a feed plate at the lower end of the chute 5^1 of the hopper **5**. This feed plate **8**, which may be adjustable, is adapted to regulate the amount of char being delivered from the chute 5^1, onto an inclined tube sheet **9**.

The reference numerals **10***a. b. c.* designate what may be termed char feed tubes, said tubes having their upper ends expanded or otherwise fixed into apertures formed in the inclined tube sheet **9**. The char flows downwardly through the feed tubes **10***a. b. c.* into the process tubes **11***a. b. c.*, which process tubes have their upper ends expanded into or otherwise fixed in the tube sheet **12**. The process tubes **11***a. b. c.* extend downwardly through a tube sheet **13**, a baffle plate **14**, and the tube sheet **15**.

The process tubes **11***a. b. c.* are preferably expanded into or otherwise snugly fitted in apertures provided in the tube sheets **13** and **15**, and the baffle plate **14**.

It will be noted by reference to Figures 3 and 4 of the drawings that the feed tubes **10***a. b. c.* are of larger diameter than the diameter of the process tubes **11***a. b. c.* and are out of vertical alignment therewith, in the present instance the structure being such that a single feed tube will serve four of the process tubes. The tube sheet **12** is provided with a plurality of frustro-conical members 12^1 positioned thereon directly underneath each of the feed tubes as illustrated in Figure 3 of the drawings. The purpose of these members 12^1 is to direct the char to be reconditioned into the various process tubes as indicated in Figure 3 of the drawings.

The feed tubes as well as the process tubes, it will be noted, are disposed vertically and in parallel relation, the char falling by gravity through both sets of tubes.

The reference numeral **16** denotes what may be termed the "char draw" consisting of a stationary plate having slots or holes **17***a. b. c.* provided thereon, and movable bars **18***a. b. c.*, only one of which is shown herein, raised upon the stationary plate **16**. These bars **18***a. b. c.* have fixed thereon and at right angles thereto the bars **19***a. b. c.*

The movable bars **18***a. b. c.* are given a reciprocal motion by means of the "char draw" drive consisting of the connecting rod **20**, connected to said movable bars and actuated by a crank pin **21**, provided upon a disk **22**, revolving about the center **23**, said disk being driven by any suitable means, such as a stoker mechanism, forming part of an automatic combustion control mechanism shown schematically at **22'**.

It will be seen that (Figure 1) the reciprocating motion given the bars **18***a. b. c.* and consequently to the bars **19***a. b. c.*, the char is pushed from side to side, causing it to flow intermittently through the slots **17***a. b. c.* provided in the stationary plate **16**.

These slots **17***a. b. c.* in the plate **16** are so located with respect to the bars **19***a. b. c.* that when the latter are centrally disposed under the lower ends of the process tubes, **11***a. b. c.*, the angle of repose of the char is such that the reconditioned char cannot flow through the slots or holes **17***a. b. c.*

It will, therefore, be seen that the rate at which the char is allowed to escape from the process tubes **11***a. b. c.* or is drawn therefrom, is controlled by the rate of reciprocation of the bars **19***a. b. c.*, operated as above described, from the disk **22**. In other words, the speed of rotation of the disk **22** determines the amount of discharge of the char from the process tubes through the apertures of the plate **16**.

The char after passing through the "char draw" falls into the hopper **23**, from which it flows onto the conveyor belt **24**, which in turn discharges it into the hopper **25**, whence it passes through trap **26**, out of the apparatus.

It will be obvious that while I refer to feed tubes as **10***a. b. c.*, and similarly to the other cooperating parts of the apparatus, there is provided a large bank of these tubes and their corresponding cooperating parts depending upon the capacity of the apparatus employed to carry out the process. The reference letters "*a. b. c.*" mean that any desired number of the instrumentalities referred to by the prefix number may be provided.

Figure 2 of the drawings shows the manner in which these feed tubes and their cooperating instrumentality may be banked within the enclosing casing **43**.

The reference numeral **27** denotes the furnace, the gases of combustion from which pass up vertically through the "nest" of boiler tubes **28***a. b. c.*, and may pass out of the furnace over the top of the baffle **29**, between the baffles **29** and **30**, between the baffles **31** and **32**, and out of the boiler gas passages into the flue **33**, or said gases of combustion may pass over the top of the baffle

30, under the lower edge of the baffle 34, and then out of the boiler into the flue 35, or only a portion of the combustion gases may pass out of the boiler simultaneously at each of the above described routes.

The flue 36 connects the flues 33 and 35, and a damper 37 is provided in the flue 35, a damper 38 in the flue 33, and a check damper 39, provided with an arm or lever 40 and a weight 41, closing against stop 42, is provided in the flue 36. Damper 39 is so counterbalanced that in free air or free gases it just closes against stop 42, but is free to swing downwardly thus connecting, under certain conditions, flues 33 and 35.

The gases flow from flues 33 and 35 into the enclosure or heating chamber formed by the tube sheets 12 and 13, and the casing 43, passing upwardly around the process tubes 11*a*. *b*. *c*., and into the flue 44, thence through exhaust fan 45, and up the chimney or stack 46, to the atmosphere.

As already stated, the char comes from the char filters containing from fifteen (15) to twenty (20) percent of moisture. This moisture, of course, must be driven from the char before the latter can be heated to such a temperature as will permit the burning or distillation of the solid impurities of the char.

It is also an important object of my invention to conserve as much of the heat energy of the boiler furnace gases as it is possible to do. This is accomplished by utilizing as fully as possible the furnace gases at their normal exit temperature level, using only enough of the higher temperature furnace gases as is necessary properly to process the char. The char, of course, falls by gravity through the process tubes 11*a*. *b*. *c*., in accordance with the operation of the char draw.

I therefore provide the flue 35 so that furnace gases at their normal exit temperature level may be conducted directly into the upper part of the heating chamber formed by the casing and the tube sheets 12 and 13. These gases conducted through the flue 35 are sufficiently high in temperature to drive out all or the major part of the moisture and the more volatile constituents of the char before the latter has reached the higher temperature zone of the heating chamber to which the higher temperature gases are conducted by the flue 33.

The gases at their normal exit temperature level, are, therefore, discharged from the final pass into the heating chamber at a location considerably above the point where the higher temperature gases enter said chamber.

Only enough of the furnace gases at their normal exit temperature level passes through the flue 36 and past the check damper 39 as is necessary to temper or cool the higher temperatured furnace gases so that the resultant mixture of the higher and lower temperature gases will be of a temperature sufficiently high to cause such combustion of the foreign matter in the char at the point where these higher temperatured gases enter as is necessary properly to process the same after the moisture or a large part thereof, has been driven from the char by the lower temperature gases entering the heating chamber through the flue 35.

Free air is drawn into the blower 47, and forced through the flue 48, into the closed pressure or discharge chamber 48ª, the top wall of which is formed by the tube sheet 15. Air passes into the process tubes 11*a*. *b*. *c*. through the spaces between the particles of char at the lower end of the process tubes 11*a*. *b*. *c*. This air is preheated to some extent by being passed in heat transfer relationship with the reconditioned char in hopper 23.

The products of combustion formed by burning off materials subtracted from the sugar solution by the char distillates, and the steam driven from the char pass out from the upper end of the process tubes 11*a*. *b*. *c*. into an enclosed vapor chamber, the top and bottom walls of which are formed by the tube sheets 9 and 12 respectively.

From this vapor chamber the steam and vapors from the process tubes 11*a*. *b*. *c*. mingle with some air which is drawn through the char in the feed tubes 10*a*. *b*. *c*., pass through the flue 49, into the surface condenser or heat exchanger 50, and thence into the flue 51, into flue 44, through the exhaust fan 45, being discharged into the atmosphere by the stack or chimney 46. A damper 52 is provided in the flue 49. Condensate from the condenser 50, flows out through the pipe 75, and is trapped from the apparatus by means of the trap 76.

Free air passes into the flue 53, through the spaces provided between the process tubes 11*a*. *b*. *c*. under the baffle plate 14, into the flue 54, and in reverse direction, directly over baffle 14, and the tube sheet 13, thence to flue 55, through the blower 56 into the air chamber 57, from whence it passes into the furnace 47 through the fuel bed 58. Thus the air utilized to cool the reconditioned char is preheated and discharged into the boiler furnace.

The boiler feed water entering through the pipe 59 flows through the surface condenser or heat exchanger 50, passes by way of pipe 60, into the boiler drum 61. Thus the heat generated by burning out the foreign matter present in the char is conserved by preheating the boiler water.

For purposes of this description of my improved apparatus, I assume that the boiler and the furnace are equipped with a combustion control, this term including an automatic stoker 103 which proportions the rate of fuel feed to the steam demands upon the boiler. Since automatic combustion control mechanisms are conventional I have illustrated the various elements in Fig. 6 diagrammatically. A steam meter 100 is shown, this meter being electrically connected to a stoker control unit 101. This unit in turn is connected electrically to the motor 102 which drives the automatic stoker 103 through the eccentric disc 110. The steam meter 100 measures the steam demand, i. e. steam flow and the automatic stoker 103 is driven by stoker control 101 at a speed proportional to this demand.

The stoker control 101 is shown electrically connected to motor 22', which drives the eccentric disc 23 at a speed proportional to the steam demand or to the speed of the stoker 103. The disc 23 reciprocates the char draw 18 and thus the feed of char past this point is automatically proportioned to the steam demand or the rate of the stoker 103. The blower 56 is likewise driven from the stoker control 101 in proportion to steam demand or rate of stoking by means of the electrical connections shown. This causes the air fed to the furnace to be proportioned to the rate of stoking.

The blower 47 is likewise driven from the stoker control by the electrical connections shown in Fig. 6. This blower therefore automatically produces a pressure within the pressure chamber 48ª and a flow of conditioning air through process tubes 11*a*. *b*. *c*. at a rate proportional to

steam demand or rate of stoking. Since the conditioning air cools the char this is also accomplished at a rate proportional to steam demand or rate of stoking. Exhauster 45 is likewise driven from stoker control 101 at a rate proportional to steam demand.

It is also assumed that the elevator 4, and the conveyor 6, are driven continuously at a constant rate.

The belt conveyor 3, by means of which the char to be processed is delivered into the boot of the elevator 4, is driven by the motor 62, as shown, which is controlled as to stopping and starting by the swinging targets 63 and 64*a. b. c.*, located in the feed hopper chute 5¹. Target 63 is located at the end of the feed hopper chute 5¹, furthest from the discharge of elevator 4. Targets 64*a. b. c.*, only one of which is shown, extend along the lower portion of the feed chute 5¹. These targets normally hang by gravity in vertical positions, but, as indicated, are pushed aside by the char in the hopper and its chute. Each target is provided with the lever 65, and the armatures 66, which make electrical connections at the positions shown, these energizing coils which throw motor control contactors, not shown, in or out, thereby stopping or starting the motor 62, which drives the conveyor 3.

The construction is such that any one of the targets 64*a. b. c.* may start the motor 62. That is to say, the strength of the starting coil energized by the targets 64*a. b. c.* is sufficient to overcome the strength of the stopping coil controlled by the target 63 so that the motor 62 will start when any of the targets 64*a. b. c.* are vertical regardless of the target 63.

From the foregoing, it will be seen that this automatically operated mechanism insures that a uniform supply or constant head of char to be processed will, at all times, be maintained upon the surface of the tube sheet 9.

A thermostatic control consisting in part of a thermocouple, the hot junction of which is inserted in the char in one of the process tubes 11*a. b. c.* at the point 68, operates damper 38 to admit gas from the high temperature zone in a quantity or volume sufficient, when tempered or cooled with gas from the low temperature zone of the boiler furnace, to raise and maintain the temperature of the char in process tubes 11*a. b. c.* to the desired degree. Thus, the thermocouple 68 is connected to temperature control 104 (Fig. 6) which in turn is electrically connected to motor 111 which operates to open damper 38 when the temperature at 68 has fallen below a given point.

A temperature control comprising a thermocouple having its hot junction inserted in flue 33 at 67 operates to adjust damper 37 in flue 35 so that sufficient gas will flow from flue 35 through flue 36, past counter-balanced check damper 39, into flue 33, to maintain the temperature of gas at the point 67 at a constant desired temperature. Since the temperature of these gases is held constant at the point 67, it is the volume rather than the temperature of these gases which is controlled in order to maintain the char at the point 68 at a constant temperature. Any increased flow of gases through damper 38 is followed by a correspondingly increased flow past the check 39.

As shown in Fig. 6, thermocouple 67 is connected to the temperature controller 106 which in turn is electrically connected to motor 112 which operates to close damper 37 when the temperature at 67 has risen above a certain point.

The check damper 39 prevents any flow of gas from flue 33 to flue 35.

The damper 52 in the flue 49 is operated thermostatically from the point 69, by means of a thermocouple having its hot junction inserted in the char in one of the process tubes 11*a. b. c.* in such a manner that if for any reason the char temperature in the process tubes rises above a certain fixed degree, the damper 52 will close and will not again open until the temperature of the char has fallen to the desired safe processing temperature.

Damper 48 is controlled in the same manner and if desired, may be mechanically connected to the damper 52. In Fig. 6 thermocouple 69 is shown connected to the safety control 105. This control, when the temperature at 69 has risen beyond a certain point automatically operates motors 113 and 114 to close dampers 52 and 48 respectively.

This provides for a blanketing or extinguisher action in the process tubes.

Inasmuch as the steam and vapors are unable to escape through flue 49, their easiest course of travel will be downwardly through the process tubes thereby blanketing or extinguishing such combustion in the process tubes in the event that the temperature of the char has risen above a fixed point.

To prevent condensation of the steam and vapors at the entrance of char to the process tubes 11*a. b. c.*, the feed tubes 10*a. b. c.*, the inclined tube sheet 9, and the sides of the vapor chamber directly underneath the tube sheet 9, are covered with heat insulating material. Moreover, the relative position of the feed tubes and the process tubes is made such that the char does not entirely fill the ends of the process tubes, as will be seen by reference to Figure 1 of the drawings. Also, since some air is allowed to enter the vapor chamber through the char in the feed tubes, very little of the incoming char is exposed to the steam rising from the process tubes.

It will, therefore, be seen that I have provided an apparatus for revivifying or reconditioning char well adapted to attain, among others, all the ends and objects above pointed out in a very simple manner.

By the zoning of the gases in the passages of the boiler furnace, thus providing a "bleeder" type furnace and delivering, that is to say, by using gases at one or more temperature levels, one of which may be the normal exit gas temperature and the other or others at successively higher temperature levels, I am able by mixing of the lower temperature gas with the gas of higher temperature to gain and maintain a desired temperature somewhere between the two or more temperatures without regard (within certain limits, of course) to the amount of gas required at the said desired temperature for processing.

It will also be seen that I am able to use the air employed in the cooling of the char in the combustion furnace of the boiler and I am also able to use the heat in the steam and vapors driven from the char in the processing tubes to heat the boiler feed water.

I am also able to control the combustion of the foreign matter in the char in such a way that a blanketing or extinguisher action is provided in case the temperature of the char being processed rises above a fixed point in the process

tubes, and am also able so to regulate the char feeding equipment whereby condensation, which would tend to bridge the char and thus prevent its free entry into the process tubes, is avoided.

Another advantage of my improved apparatus is that the char is treated in vertical, stationary tubes of comparatively small diameters in such a manner that the char entering each tube is dried, burned and cooled in said tube which is continuous from end to end, the char being exposed to such oxidizing agent, air or gas in the tube as is admitted at the lower end and moved upwardly through the tube this air supply being automatically proportioned to the amount of char being processed.

Another and most important end obtained by means of my improved apparatus is the manner of controlling the amount of char being processed, or the rate of flow of char into the process tubes as well as the amount of air admitted, from the rate of fuel burned in the boiler furnace so that the char processing apparatus "breathes" with the boiler or is proportional to the steam demand upon the boiler or to the fuel consumed whereby the heating of the feed water and the preheating of the air entering the boiler furnace makes this process a true fuel economizer complete in itself for the boiler.

There is a complete combination or cooperation between the boiler furnace and the char processing equipment. As stated previously the steam demand or rate of fuel consumed by the boiler of a refinery is roughly proportional to the rate of sugar processing and hence to the demand for char. As the sugar processing increases more steam is used in the evaporating pans etc., this produces (through the boiler combustion control mechanism) an automatic increase in the fuel consumed in the boiler; i. e. the automatic stoking mechanism speeds up. More air is required for the furnace and this is supplied automatically by the control attached to blower **56**. The control disk **22** operating the char draw automatically speeds up, delivering more reconditioned char. There is a demand for additional flue gases to heat up the process tubes more rapidly and this increase is produced automatically by the increased feed of fuel and air to the boiler furnace. There is also a demand for more conditioning air to pass upwardly through the processing tubes. This is supplied by the increased pressure produced in the char discharge chamber by the automatic speeding up of blower **47**. There is also an increased demand for the preheating of the boiler feed water and this is supplied by the additional vapors rising through the process tubes which deliver their heat to the boiler feed water in the feed heater **50**. Each element of the equipment therefore depends upon the operation of the remaining elements.

As has already been stated, certain parts of the apparatus are illustrated in the drawings schematically.

The construction of the parts or elements shown schematically is a matter of ordinary mechanical and electrical construction such as could be produced by a reasonably skilled mechanic or electrician. Some of the features of construction described and illustrated are well known in the art. For instance, the "char draw" is now in common use and is old except as to its application in the apparatus described.

I have also illustrated a common type of water tube boiler preferably equipped with an under feed stoker, and a system of baffling is provided designed to attain the ends sought in the present invention. In this apparatus, of course, any type of boiler and fuel burning equipment may be employed so long as the zoning and control of the gases of combustion and the adaption of the char reclaiming apparatus as a heat reclaiming system is associated with the boiler.

Although not illustrated in the drawings, it will be noted that such parts of the apparatus will be covered or lined with heat insulating material wherever possible so that loss of heat by radiation will be minimized.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language might be said to fall therebetween.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In apparatus for conditioning char and the like by heating, a vertically disposed, heated, char processing tube, a tube above said processing tube for feeding char into said processing tube, means for producing a positive pressure of air at the lower end of said processing tube, means for drawing air upwardly through said processing tube and downwardly through said feed tube and temperature responsive means for rendering said pressure producing and said air drawing means inoperative upon a dangerous temperature being reached within said processing tube.

2. In apparatus for reconditioning char and the like by heating, in combination, an elongated retort divided into sections for heating at different temperatures, a boiler and a furnace for heating the same, means for passing flue gases from said furnace in series through a plurality of passes in contact with said boiler, means for extracting flue gases from a point in the final pass and conducting it directly to one section of said retort, means for extracting flue gases from a point intermediate the final pass and the furnace, means for receiving and mixing the flue gases from said points and means for passing said mixture from the mixing means into contact with a second section of said retort heated to a higher temperature than said first section.

3. In apparatus for reconditioning char and the like by heating, in combination, a retort consisting of vertically disposed process tubes adapted to receive the char to be processed, a heating chamber for heating said tubes divided into sections for heating at different temperatures, a boiler and a furnace for heating the same, means for passing flue gases from said furnace in series through a plurality of passes in contact with said boiler, means for extracting flue gases from a point in the final pass and conducting it directly to one section of said heating chamber, means for extracting flue gases from a point intermediate said final pass and the furnace, means for receiving and mixing the flue gases from said points and means for passing said mixture from the

mixing means to a second section of said heating chamber situated below said first named section and heated to a higher temperature.

4. The apparatus of claim 2 wherein means are provided for maintaining the mixed flue gases at a constant temperature prior to passing them into contact with said second section of said retort.

5. The apparatus of claim 3 wherein means are provided for maintaining the mixed flue gases at a constant temperature prior to passing them to said second section of said heating chamber.

6. The apparatus of claim 2 in combination with temperature actuated means for controlling the rate of flow of said mixed flue gases in order to maintain the char in said second section of said retort at a constant reconditioning temperature.

7. The apparatus of claim 3 in combination with temperature actuated means for controlling the rate of flow of said mixed flue gases to said second section of said heating chamber in order to maintain the char heated in said section at a constant temperature.

8. In apparatus for reconditioning char and the like by heating, in combination, an elongated retort divided into two sections for heating the char at different temperatures and provided with a third section for cooling the hot reconditioned char received from said heated sections, a boiler and a furnace for heating the same, means for passing flue gases from said furnace in series through a plurality of passes in contact with said boiler, means for extracting flue gases from a point in the final pass and conducting it directly to one heating section of said retort, means for extracting flue gases from a point intermediate the final pass and the furnace and for passing it into contact with the second heating section of said retort, means for passing cooling air into contact with the third section of said retort and for feeding the so-heated air into said furnace to serve as air of combustion.

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