

Aug. 13, 1957

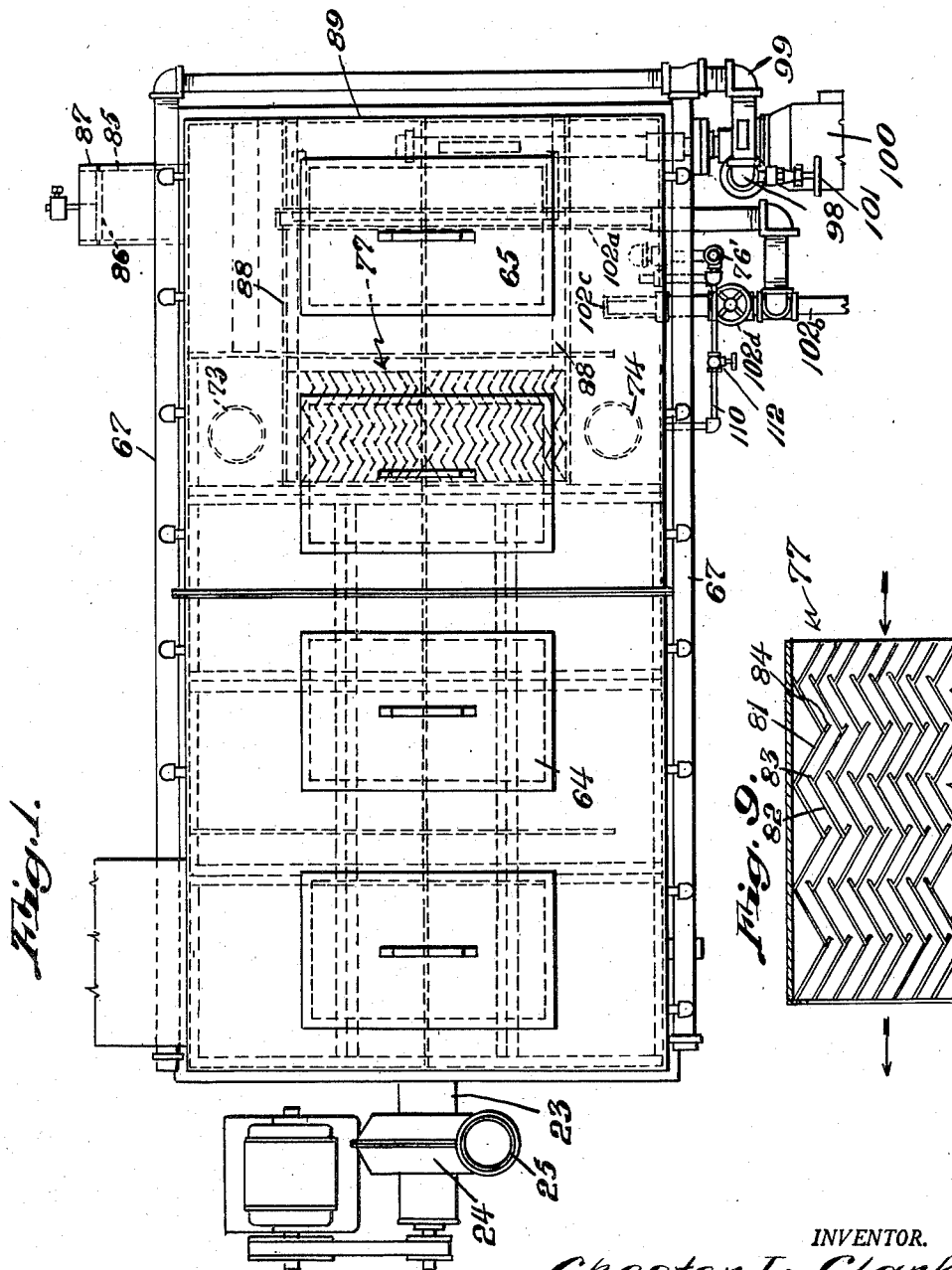
C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 1



INVENTOR.

Chester L. Clark

BY

Barlow & Barlow
ATTORNEYS.

Aug. 13, 1957

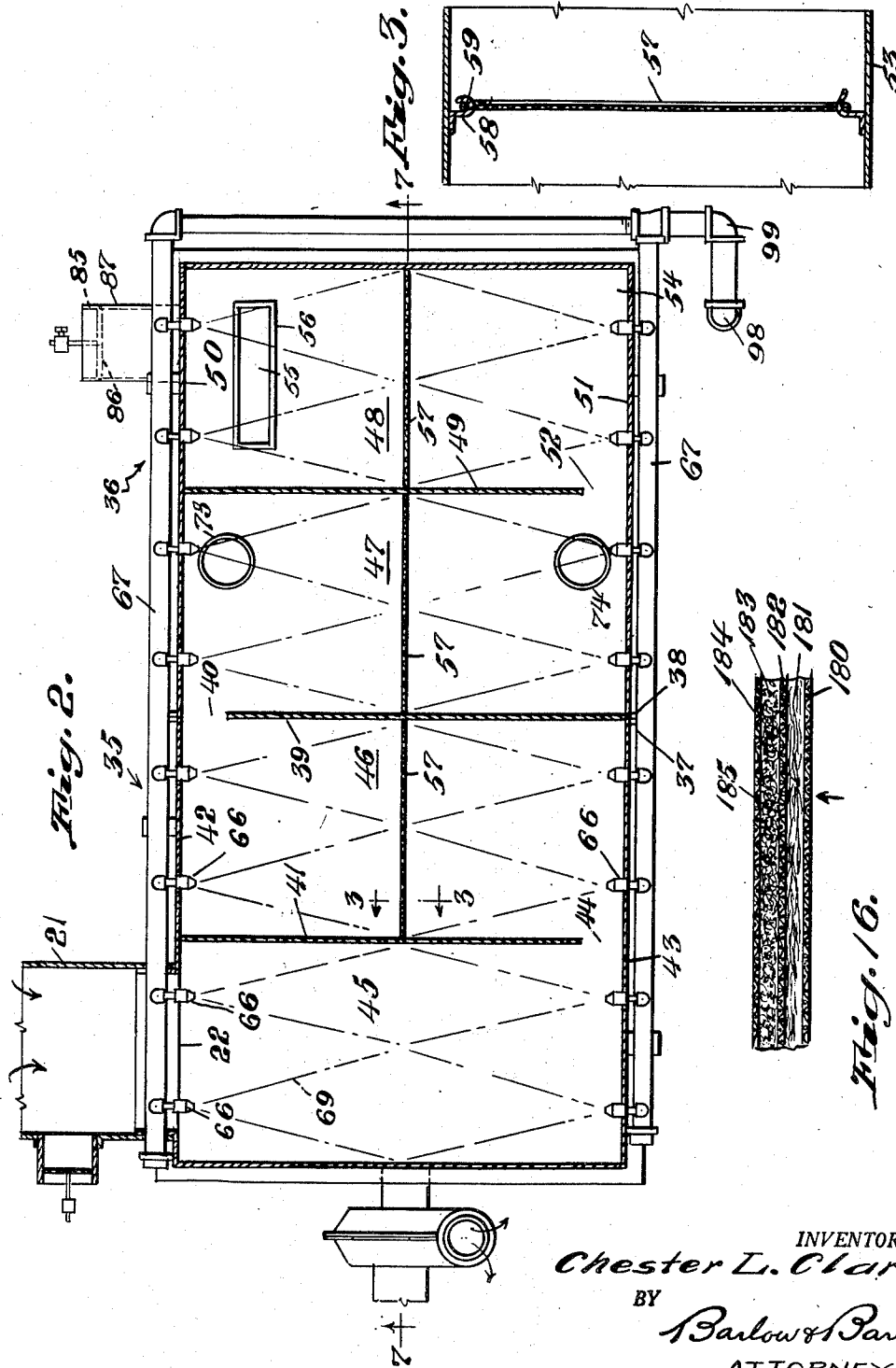
C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 2



Aug. 13, 1957

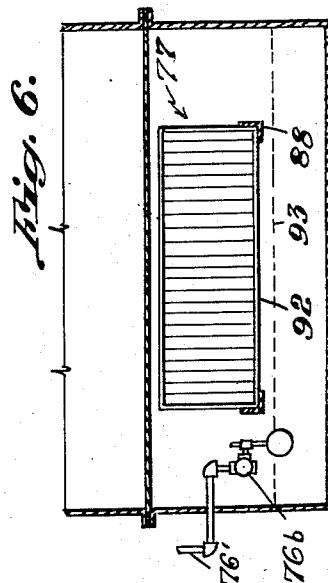
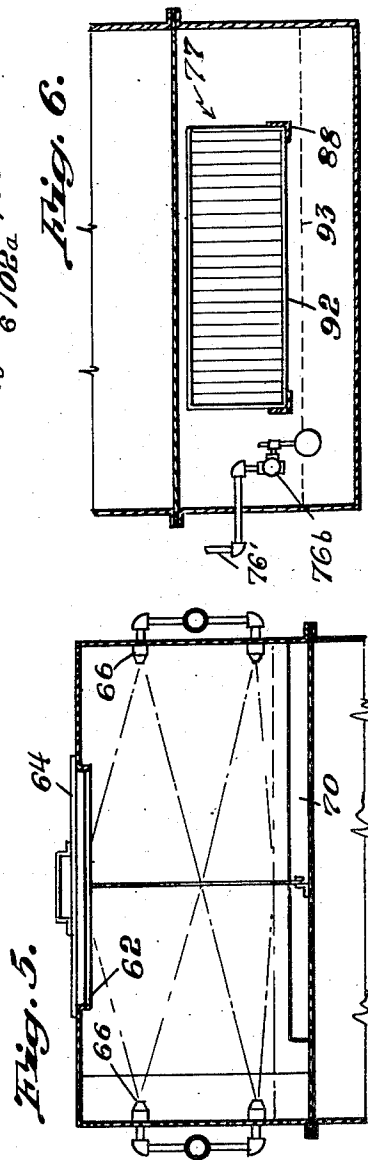
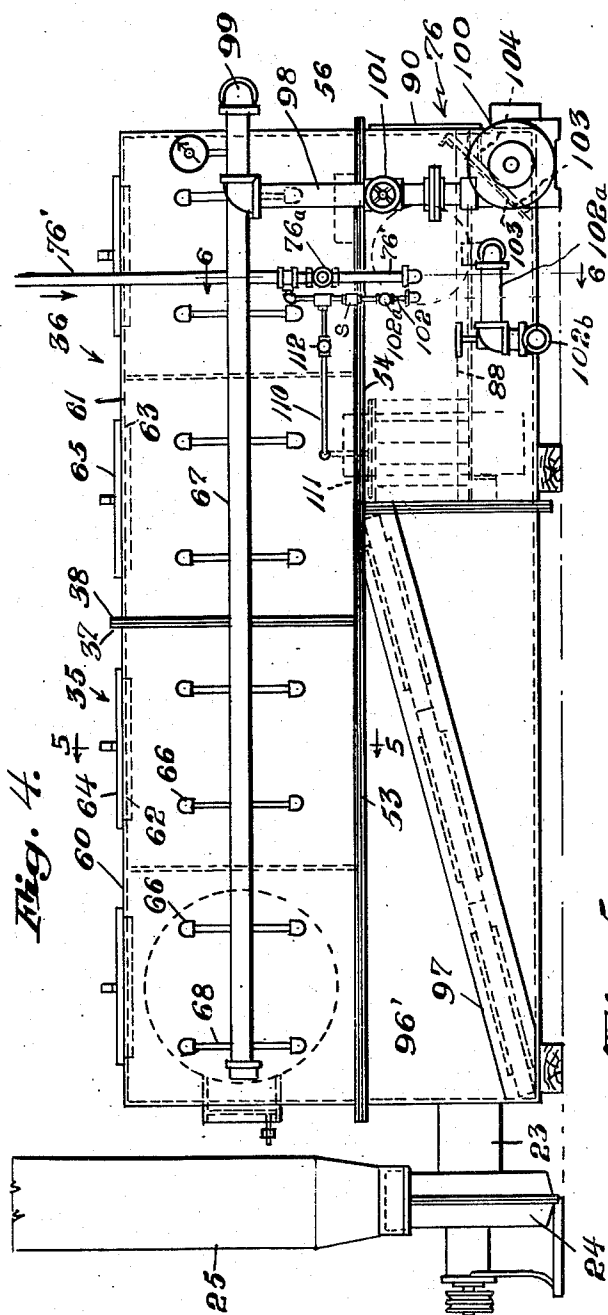
C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 3



Aug. 13, 1957

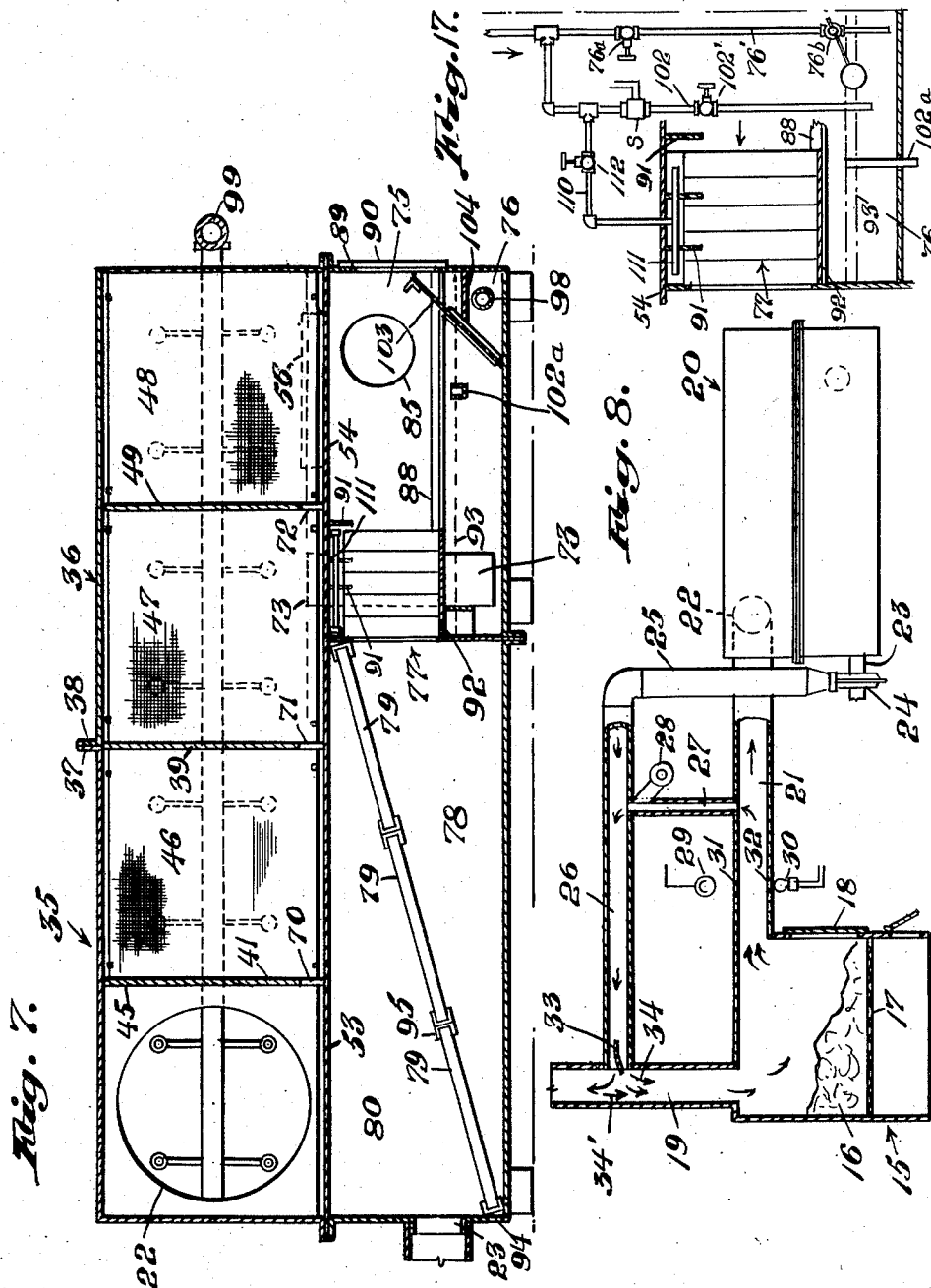
C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 4



INVENTOR.
Chester L. Clark
BY
Barlow & Barlow
ATTORNEYS.

Aug. 13, 1957

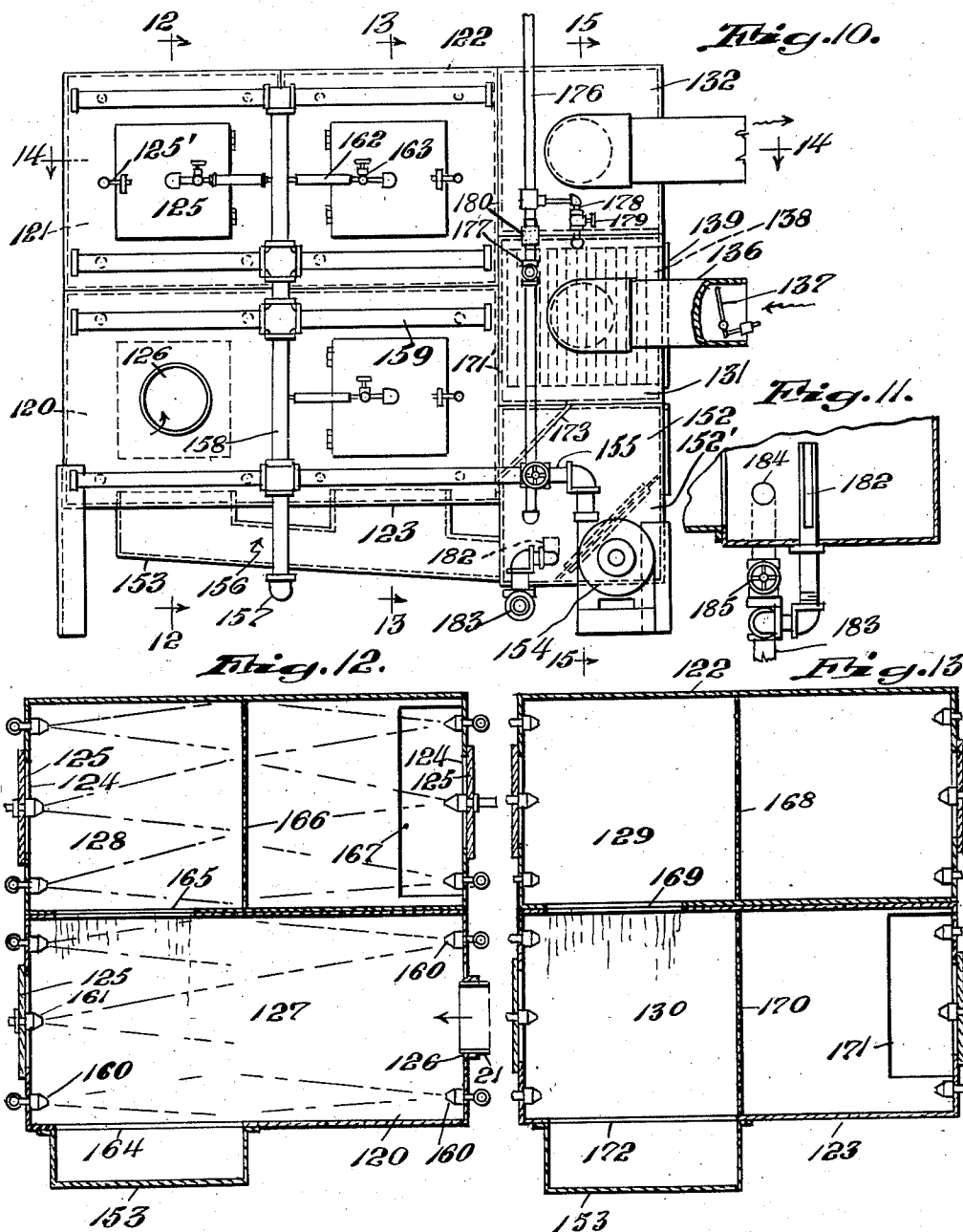
C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 5



INVENTOR.
Chester L. Clark
 BY *Barlow & Barlow*
 ATTORNEYS.

Aug. 13, 1957

C. L. CLARK

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Filed Dec. 24, 1953

6 Sheets-Sheet 6

Fig. 14.

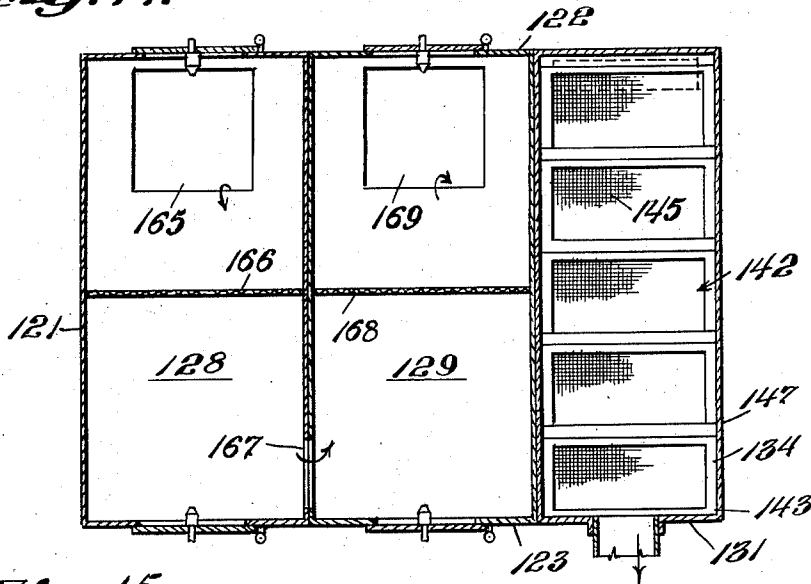
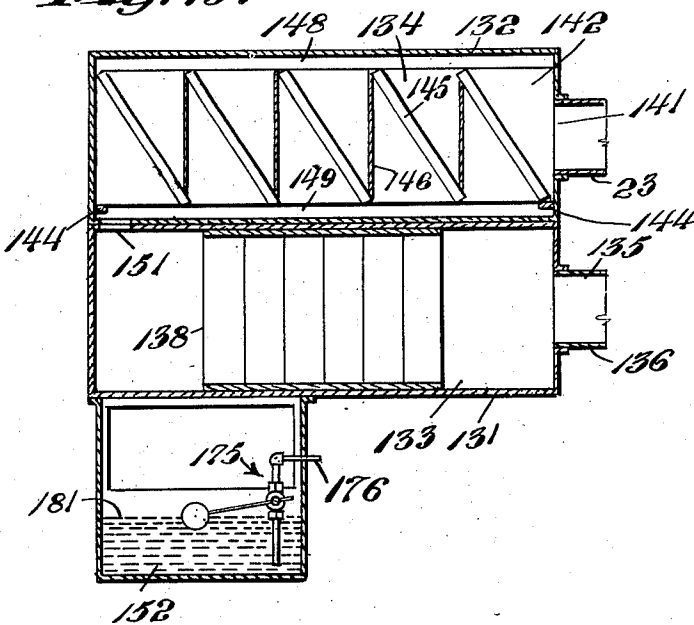


Fig. 15.



INVENTOR.
Chester L. Clark
BY *Barlow & Barlow*
ATTORNEYS.

1

2,802,543

APPARATUS FOR TREATING SMOKE AND GASES

Chester L. Clark, Providence, R. I.

Application December 24, 1953, Serial No. 400,238

12 Claims. (Cl. 183—5)

This invention relates to an apparatus and method of treating smoke and gases which are the products of combustion.

A problem is often presented in disposing of waste materials, especially in large cities or congested areas. In these locations apartment houses, markets, and the like have waste material in the form of vegetables, garbage, papers, and so forth, which it is desired to dispose of. A convenient way of disposing of this material is by burning the same. In burning this material, smoke and obnoxious gases are produced, and because of city ordinances, the producing of such smoke and obnoxious gases is prohibited.

One of the objects of this invention is to provide an apparatus and method of handling smoke and gases from the burning of such waste so that when they are emitted to the air, the smoke will be sufficiently cleaned of unburned matter and the gases will be free from obnoxious odors so as to be unobjectionable.

More specifically, an object of this invention is to so wash the gases as to remove a majority of the carbonaceous material and odors therefrom.

Another object of the invention is to wash the majority of the undesirable matter from the gases and then filter from the gases the remainder of any carbonaceous particles or odors.

Another object of the invention is to so wash the gases and so dry the washed gases that they may be filtered without clogging the filter.

Another object of the invention is to utilize water for washing the gases and to recirculate the water so that a minimum of water may be used for performing the desired object.

Another object of the invention is to pass the gases to be cleaned through a conduit which has a water film extending substantially completely across the cross section of the passage so that all gases which pass through the passage must pass through the water film.

Another object of the invention is to provide a stack or chimney open at all times for the dropping of refuse into the fire and a control of this stack so that the gases to be emitted will pass through the cleaning mechanism prior to passing up the stack even though the stack is open at all times for receiving waste material to be burned.

Another object of the invention is to provide a control so that the cleaning mechanism will operate only when the gases are sufficiently dense with carbonaceous or other foreign matter to require their cleaning.

Another object of the invention is to cool the gases just prior to the last step of filtering so that the carbonaceous material which may be cooled and collected on the filter will have capacity to adsorb other gases and serve as an increasing filter medium for the better operation of the filtering of the gases formed.

Another object of the invention is to utilize the washing water as a means for sealing the passages for the gases through the apparatus and providing a different path for the washing water.

2

Another object of the invention is to provide a series of unit cases which may be stacked in different relationships depending upon the space available and the connecting of these units one with the other through openings in the walls thereof.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a top plan view of the apparatus for treating the smoke or gases from burned refuse;

Figure 2 is a sectional view showing the top portion of the structure illustrated in Figure 1 removed and looking into the upper compartment of the apparatus and with dotted lines indicating the position of mechanism below this compartment omitted for the sake of clarity of the operation in the upper part of the unit;

Figure 3 is a sectional view substantially on line 3—3 of Figure 2;

Figure 4 is an elevation of the apparatus shown in Figure 1;

Figure 5 is a sectional view on substantially line 5—5 of Figure 4;

Figure 6 is a sectional view on substantially line 6—6 of Figure 4;

Figure 7 is a sectional view similar to Figure 4 substantially on line 7—7 of Figure 2 but showing the water film forming screens;

Figure 8 is a diagrammatic view illustrating the furnace smoke stack and the connections from the furnace through my apparatus and back to the smoke stack illustrating in a general way the system employed in this invention;

Figure 9 is a larger plan view of the eliminator plates;

Figure 10 is a side elevational view of a modified apparatus;

Figure 11 is a plan sectional view of a fragmentary portion of the water supply tank of the apparatus of Figure 10 showing draining conduits therefrom;

Figures 12, 13, 14 and 15 respectively are section views taken substantially along lines 12—12, 13—13, 14—14 and 15—15 respectively of Figure 10;

Figure 16 is a section view of a fragmental portion of a filter;

Figure 17 is a fragmental partial sectional view showing the water conduits.

The general layout of this invention is perhaps best understood by reference first to Figure 8. The furnace 15 is shown with the fire box 16 above the grate 17 which may be loaded through door 18 or be loaded by dropping refuse from the smoke stack 19 directly into the fire box. The apparatus which is primarily the subject of this invention is designated generally 20 and receives the smoke from the fire box through conduit 21 to its inlet opening 22, after which it passes through the apparatus 20, which will be described in greater detail hereinafter, and is exhausted through outlet 23 by pump or blower 24 to be driven through conduits 25 and 26 to the stack 19. A by-pass tube 27 extends between conduits 21 and 26 while a fan 28 serves to force gases through the conduit 27 from the conduit 21 to the conduit 26.

With a view of automatically controlling the operation of the apparatus 20 so that the same may be shut off when there is no fire in the furnace and to be placed in operation upon starting a fire in the furnace, the conduit 21 has opposite aligned openings 31 and 32 through the walls thereof at a location between the furnace and the by-pass conduit 27. A photo tube 29, which is in the electric circuit (not shown) of motor blower 24 and motor fan 28, is positioned opposite one of said openings, as for example opening 31, to receive light rays

projecting through said openings from an exciter lamp 30 which is positioned opposite the said opening 32. The photo tube may be shielded (not shown) in an obvious way to receive only light from lamp 30, which also may have a protecting shield (not shown). The photo-tube is arranged to control the said electric circuit such that when smoke or gas flowing past the said openings 31, 32 is sufficiently dense as to block the light of lamp 30 from falling on the photo tube, the electric circuit will be closed at the blower 24 and open at the fan 28. Assuming that no refuse is being burned in the furnace, the light rays of lamp 30 will fall on the photo tube and actuate the same to close the circuit at the fan 28 to set the same in operation and draw through the by-pass 27 and conduit 21, the motor blower 24 being at rest. Upon the furnace being charged with refuse and set to burning, sufficient of the smoke made will be drawn past openings 31, 32 to by-pass 27. Upon such smoke becoming sufficiently dense as to block the light from lamp 30 from falling on the photo tube, the same will be actuated to open the circuit at the fan 28 and close the circuit at the blower 24 to set the same in action to draw smoke through the apparatus from conduit 21 through inlet opening 22. When the refuse has been completely burned or the smoke flowing through conduit 21 becomes sufficiently clear so as to not require passing through the apparatus 20, the light of lamp 30 will fall on photo tube 29 to actuate the same in the other direction to open the circuit at the motor blower 24 and close the circuit at the fan 28 to return the apparatus 20 to the idle condition thereof.

When the blower 24 is in operation, the pressure of the out flow of gases in conduit 26 will be somewhat in excess of the normal updraft of smoke in stack 19 so as to cause but a portion of the gases to be directed upwardly while another portion is directed downwardly at one side of the baffle 33 as shown by arrow 34 and thus form a block to prevent the gases of combustion in the furnace from being normally pulled up the stack 19 but rather will cause them to circulate through the apparatus 20. Thus, the stack 19 is left open at all times for the dropping of refuse into the furnace such as down the chute of an apartment house as shown by arrow 34' although the gases will travel through the cleaning apparatus and thence up the stack after being cleaned.

The apparatus designated 20 consists essentially of a washing area for the gases, a drying area for the gases, and a filtering area for the gases. The washing area performs the function of removing about 75 percent of the solid matter contained in the gases passing through the inlet 22, such as the heavy particles of combustion. The drying area serves to remove the moisture or water vapor which has been picked up by the gases during washing so as to condition the gases for efficient filtration, it having been found that gases with considerable moisture in them serve to quickly clog a filter, making filter cleaning frequent. The drying therefore links the washing with the filtering so that the filtering may be performed in the efficient cleaning of the gases. The filtering serves to remove the carbonaceous material which still remains in the gases and to accumulate the carbonaceous material on the filter, and as this carbonaceous material is prepared for filtering, it is cooled so that the carbonaceous material, as it builds up on the filter, has a capacity for adsorbing other gases to be filtered and serves to increase the efficiency of the apparatus in the removal of other undesirable solids and gaseous material.

The washing area of the apparatus 20 consists of a pair of units 35 and 36 which are in the form of generally rectangular casings with open sides positioned side by side with their adjacent sides provided with flanges 37 and 38 secured together as shown in Figure 4. A division wall 39 (Fig. 2) is provided at the junction of said flanges and has an opening 40 so as to provide communication between these casings. Casing 35 also has a division wall or

baffle 41 extending from an end wall 42 to a point short of the opposite end wall 43 so as to provide a passage 44 between the two sections of the casing thus divided. The inlet opening 22 is in the end wall 42 at the location of the section 45 of the compartment so that the gases to be treated will enter from conduit 21 through the opening 22 and pass into section 45 thence out through opening 44 into section 46, out of section 46 through the opening 40 to section 47 and out thereof to pass into section 48 through opening 52 at the end of baffle 49 extending from wall 50 of the unit 36 short of the wall 51 to provide said opening 52 leading from section 47 to 48. The bottom wall of the casing 35 is continuous as at 53, Fig. 7, while the bottom wall 54 of the casing 36 has an opening 55 (see Figs. 2 and 7) in the section 48 thereof, there being a flange 56 (see Figure 7) about this opening to a height sufficient to prevent water which extends over the bottom walls of these casings from passing downwardly through this opening but permitting the gases to pass downwardly out of these casings.

The sections 46, 47, and 48 are each provided with a screen 57 which is shown in greater detail in Figure 3. This screen extends from wall to wall laterally of the length of the section and from the top thereof to a point adjacent the bottom close enough to be below the water level along the bottom wall of the section. Hooks 58 are secured to the top wall of the casing and engage rods 59 secured to the screen 57 to support the same in depending relation. These screens may be removed through the top wall 60 of the casing 35 and 61 of the casing 36 by means of openings 62 and 63 which are provided with covers 64 and 65 over them, the diagonal of these openings affording sufficient room for the removal of the screen therefrom for cleaning as may be desired. No screen is provided in the first section 45, as it is in this section that the large particles of solid matter are struck from the gases, and a screen might clog up too quickly if located in this first section.

The washing of the gases occurs in these four serially connected sections by means of four nozzles 66 at each end of each section. These nozzles receive water under pressure from a common conduit 67 which is branched at each insert as at 68. By mounting these nozzles in the opposite ends of each section (see Figure 2) the water spray designated in dotted lines 69 from the nozzles are directed toward each other in flaring streams so as to meet at substantially the center of the section and completely fill the cross section of each section so that all gases will pass through some water in moving through the section 45, and large solid particles which are struck with the stream will be dropped to the floor of the casing.

In the section 46 and subsequent sections, the screen 57 which is there located will receive the water from the nozzles at the opposite ends and form a film of water which will be broken by the gases as they pass through this film in passing through the sections. The water is continually flowing down the screens from its upper portion to its lower portion, which will continually wash the screen and remove any solid particles which may be caught on the screen, thus keeping the screen clean while the water film will serve to wash the gases as they pass through the film in moving through each section.

In order that the water which collects on the floor of each of the casings need not pass in the serpentine path of the gases, the partitions 39, 41, and 49 are spaced from the floor of the casings 53 and 54 as shown at 70, 71, and 72 (Fig. 7) and in order to provide a water level higher than the lower edges of these walls and above the space 70, 71, and 72, water drain-off conduits are located in section 47 at 73 and 74 (Fig. 2) and extend within the section to a greater height than the openings 70, 71, and 72 so that the water will be maintained in sealing relation with the lower part of these partitions and will overflow into the drain conduits to pass out of the section 47. It will, of

course, be understood that the flange 56 about the gas opening 55 is of a height greater than the height of the conduits 73, 74 and above the water level.

The gases pass from the washing operation through the conduit 55 into a chamber 75 (Figure 7) the lower portion of which forms a water tank 76 into which the overflow conduits 73 and 74 are submerged to return the spent waters to be cleaned and reused as will hereinafter appear. The gases pass from this chamber 75 through eliminator plates 77 (see Figure 9) into a chamber 78 on one side of filter 79 and thence through filter 79 to the area 80 on the other side of the filter and then out through outlet 23 to the pump or blower and thence to conduit 25 and to the stack. The blower 24 serves to draw the gases through the sinuous path of the washer through the eliminator plates and the filters and drive it back into the stack under pressure greater than normal stack pressure.

The eliminator plates 77 provide a series of sinuous paths through which the gases pass, the plates being of zig-zag formation as at 81 and 82 as shown in plan in Figure 9 with flanges 83 and 84 so that water vapor or moisture which may be in the gas being treated will be taken out of the gas and the gas dried as it passes through these plates. As the gases pass into chamber 75 they are intermixed with cold fresh air which is drawn through the opening 85 controlled by means of a damper 86 (Fig. 1) in the conduit 87 which is open to atmosphere. This fresh air serves to cool the gases passing into chamber 75 and serves to condense the water vapor into larger drops which assists in knocking out moisture from the gases as they pass through the eliminator plates and also assists in driving any gases out of any carbonaceous material which may have been absorbed therein while at high heat. This damper also serves to provide a more constant draft in the flue. These eliminator plates are provided as a multiple unit which may be slid along channels 88 (Fig. 6) to and from position by providing an opening in the end wall 89 (Fig. 1) of the lower portion of the casing which may be closed by door 90 (Fig. 4). The eliminator plates are spaced at their upper edges from the wall 54 (Figs. 7 and 17) and baffle plates 91 extend from this wall a distance beyond the upper edges of the plates as shown to prevent the free passage of gases around the upper edges of the plates. The lower end of the plates are closed by a wall 92, preventing the free passage of the gases around the lower edges of the eliminator plates, thus causing the gases to pass through the eliminator plates. Wall 92 is slightly inclined to discharge washing water into the tank.

The filters 79 (Figure 7) are shown in three sections or units, which together divide the compartment into areas 78 and 80, and each of these is supported by channel bars 94, 95. Each filter is removably inserted in position by being slid through the side wall 96 (see Figure 4) which is covered as at 97 after which the filters are in place. These filters each comprise a surface which will collect the carbonaceous material remaining in the gases after washing.

Each of the filters, a fragmentary portion of which is shown in sectional view Figure 16, comprises a supporting wire screen 180 of one half inch mesh. On this screen 180, I place a layer of loose fiber glass 181 in sheet form about one inch thick. A second or dividing wire screen 182 of one half inch mesh is placed on the layer of fiber glass and on this screen I place a second layer 183 about one inch thick of loose fiber glass which has been mixed with hydrated lime and lamp black. A second supporting wire screen of one half inch mesh 184 is placed in the second layer of filtering material so as to support the layers between the screen with the dividing screen 182 therebetween to maintain the layers separated and for convenience in building the filter. The screens 180 and 184 are supported on open frames (not shown) which are secured to each other and form filter units. The filter units thus formed are six foot square.

To form the one inch second layer 183, I take about

forty pounds of loose fiber glass which is obtained in a loose lumpy condition, two pounds of hydrated lime, and one pound of lamp black and machine mix these very thoroughly. The mixing of the loose fiber glass with the lime and lamp black reduces the fiber glass to a porous mass which serves to intercept the smaller particles of carbonaceous matter 185 which may have passed through the first layer 181. The lime tends to maintain the second layer in a rather dry condition to avoid matting. This filter collects the carbonaceous material 185 which has been cooled and thus has such gases as it originally contained driven from it. As the carbonaceous material collects, it provides a somewhat denser filter, and the carbonaceous material serves as a filter medium to additionally filter the gases as they pass therethrough. By reason of the gases being relatively dry by their passage through the eliminator, they do not clog the filter as otherwise would be the case if the collected particles were in a moist condition, which would enable them to pack solidly on the filter and block it up.

The make-up tank 76 (see Figures 4, 6, 7 and 17) is supplied with water through conduit 76' which is controlled by hand valve 76a and extends to a float valve 76b (Figs. 6 and 17) which maintains the water level at level 93 in the tank. Water from this tank is used for supplying the conduits 67 by being drawn from the tank by pump 100 shown in Figure 4 and passes through pipes 98 and 99 to the conduit 67 for the washing of the gases. A valve 101 manually controls the conduit 98. In order that the water that is withdrawn from the tank by the pump may be free of foreign matter, I have provided a screen 103 (see Figure 7) located diagonally across the area from which the water is withdrawn so that the contamination in the tank will not reach the outlet passage for the water from the tank. Further, this area of the tank from which the water is withdrawn is shielded by an imperforate plate 104 just below the surface of the water extending from the diagonal screen to the wall of the tank so that any discharge from the gases on to the surface of the water will be prevented from circulating by being picked up from the discharge from the tank. In order that sludge may be removed which floats on the water, I provide an overflow from the tank at all times to carry off the surface sludge. A by-pass conduit 102 (see Figs. 4 and 17) extends from the supply conduit 76' ahead of the valve 76a and is controlled by manually operable valve 102' to discharge into the tank a small amount to cause overflow into the conduit 102a to carry floating sludge with it to the sewer or drain 102b. This conduit is also connected at 102c (Fig. 1) to the lower part of the tank for draining the tank which is controlled by manual valve 102d.

In order to wash the eliminator plates at intervals, there is also tapped into this conduit 102 a conduit 110 which is controlled by manual valve 112 and which connects to a spray nozzle 111 located between wall 54 and over the upper edges of the eliminator plates so as to wash down these eliminator plates and clear them from any contaminant which might collect upon them. This water runs down to the bottom of these plates and thence back into the make-up tank. In order to automatically control the flow through the pipe 102, to the tank 76, a solenoid valve S is located below the juncture of the conduits 102 and 110 which is controlled by the electrical power for operating the entire apparatus so that this valve will close when the power is shut off and will shut off the water being supplied to the tank. Thus, this water will not be running when the apparatus is shut off. It may be desirable to utilize soda ash in the water to maintain it on the alkaline side and protect the metal parts of the apparatus from corrosion.

In Figures 10 to 15, inclusive, I have shown a modified apparatus in which a plurality of casings 120, 121, 122 and 123 are arranged in contact side by side and one above the other. These casings are generally similar to

each other of generally rectangular shape and with the exception of casing 120 are provided with an opening 124 at each end which is normally closed by a hinged door 125 to provide for inspection of different units when desired. These doors may be held closed in any manner, as for example by a latch and catch 125'. The casing 120 is similarly provided with an opening 124 at one end which is closed by a similar hinged door 125. The other end of the casing 120 has an inlet opening 126 which may be connected to the conduit 21 for admission of smoke and gases from the furnace 15. Thus, the casings form adjacent chambers 127, 128, 129 and 130 respectively, which inter-communicate with each other through matched openings through adjacent walls of said chambers as will hereinafter appear. The casings may be secured together in any appropriate manner (not shown).

At one side of the assembled stack of unit chambers, there is provided two additional casings 131 and 132 (Figure 15) which are superimposed one on the other and shown as being smaller in cross section than the casings 120, etc. These latter casings abut the adjacent walls of casing 122, 123 and form chambers 133 and 134 which intercommunicate with each other and with chamber 123 as will hereinafter appear.

The chamber 133 has an inlet opening 135 having a suitable conduit 136 leading to the atmosphere and may be automatically controlled by a weighted damper or like device 137 (see Figure 10). The outer side of chamber 133 has an opening through which an assembly of eliminator plate units 138 may be passed into the chamber. This unit has a wall 139 which, when the unit is in position within the chamber, forms a closure for the opening.

The chamber 134 has an outlet opening 141 which may be connected to the conduit 23 (Fig. 8) to the motor blower 24. In this chamber 134 there is positioned a filter unit 142 which is inserted within the chamber through an open side of the chamber as at 143 (Fig. 14) to rest upon support bars 144 (Fig. 15). The unit comprises individual filters 145 extending generally vertically and separated by walls 146 and mounted on a wall 147 (Fig. 14) which forms a closure for the said open side 143. The filters 145 extend on an upward slant and are spaced both from the top and bottom of the chamber wall and form passages 148 and 149. The passage 149 has direct communication with the effluent side of the eliminator unit as by means of a passage 151 through the adjacent top and bottom walls of chambers 133 and 134. Passage 148 has direct communication with the outlet 141.

The make-up tank 152 is in the present instance positioned beneath the casing 131 and abuts the bottom wall thereof and the adjacent wall portion of casing 123 (Figure 10). A drain conduit 153 leads from washing chambers 127 and 130 to said tank 152 for the return of spent water thereto. Water under pressure drawn from a screened portion 152' of the tank as by means of a motor-operated pump 154 is supplied through conduit 155 to spray headers 156 which are positioned at each end of the apparatus and connected to each other by a conduit 157. Each header 156 is similar and comprises a generally vertical pipe 158 from which there extends lateral conduits 159 on each side of said pipe 158. To these lateral conduits there are connected a plurality of spray nozzles 160 which are positioned within each of the said chambers 127—130 at a location closely adjacent the end walls thereof. There is also provided a similar nozzle 161 on the inner side of each door 125, and these are connected to the vertical portion 158 of the headers as by means of a flexible conduit 162, thereby to permit opening of each door 125 without any necessity of disconnecting such conduits 162. A manually operated valve 163 is provided in the conduit 162 to shut off the flow

through individual conduits 162 should it become desirable to open a door 125 during operation of the apparatus.

The operation of the apparatus shown in Figure 10 is similar to the operation of the apparatus shown in Figure 1. Smoke and gases from burning refuse in furnace 15 (Fig. 8) are drawn into the apparatus through inlet 126 by means of the force drafts through the apparatus caused by the operation of the motor blower 24. The smoke and gases hereinafter to be referred to generally as smoke flowing into chamber 127 (see Figure 12) will be washed by the spray of water from nozzles 160, 161 and large unburned matter which has been drawn from the furnace with the smoke will be knocked down to be carried by the flow of water draining from chamber 127 through opening 164 into conduit 153 and thence to tank 152. The smoke and gases now partially free of large matter will pass upwardly through openings 165 into chamber 128 to be washed by the spray of the nozzles within the chamber. The return flow of the spent water from chamber 128 will drain into chamber 127 through said opening 165 and form a continuous curtain of water about the edges of said opening which with the spray of the adjacent nozzles 160, 161 will form a liquid sheet through which the smoke in passing therethrough will be additionally washed in passing from chamber 127 to chamber 128. A screen 166 is also provided about midway of chamber 128, and the spray from the nozzles 160, 161 within said chamber 128 impinges upon this screen on each side thereof and causes a downwardly moving flow of a film of water on both sides of the screen through which the smoke must pass and be washed free of foreign matter contained therein. The smoke passes from chamber 128 through openings 167 at the distant end of the chamber into chamber 129 to be similarly washed and then passes through screen 168 of the chamber. The smoke is thence drawn into the lower chamber 130 through opening 169 to be additionally washed by the downflow of spent water draining from chamber 129 into chamber 130. The smoke having now been washed in chamber 130 in a similar manner, passes through screen 170 of this chamber 130 to pass out through opening 171 into chamber 133 through opening 171'. Spent water from chamber 130 will be returned to tank 152 through opening 172 connecting to conduit 153.

As previously described, the conduit 136 is open to atmosphere and controlled automatically to permit a predetermined volume of fresh air to be drawn into chamber 133 to admix with the now cleansed smoke to cool and remove a certain amount of moisture therefrom. The smoke now passes between the eliminator plates to further remove moisture therefrom. The moisture or water removed from the smoke will flow along the bottom of the chamber at the in-fluent side of the said eliminator plates to drain through slanted duct 173 ((see Figure 10) into chamber 123 and out through opening 172 as previously described. The smoke now practically free of water will pass from the effluent side of the eliminator plates and out of chamber 133 through opening 151 into passage 149 and thence pass through the filters 145 to passage 148 and out through outlet conduit 141. The filters and eliminator of the present modification are similar to those previously described and perform a like function.

The make-up tank has a float valve 175 in the fresh water supply line 176 thereto to control the water level in said tank which is in the form of a closed chamber having an opening provided with a door for access within the tank.

Water supply is through conduit 176 to the make-up tank which is controlled by valve 177. The eliminator plates are washed through the branch conduit 178 controlled by hand-operated valve 179, while a solenoid valve 180 below the juncture of the pipes 176 and 178

serves to shut off the supply of water to the tank when the apparatus is stopped.

The water level is maintained at 181 which is controlled by the overflow pipe 182 shown in plan in Figure 11 from which the drain is to the sewer through conduit 183. A drain for the entire tank is at 184 which is controlled by valve 185.

I claim:

1. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, means to direct water spray lengthwise of the passage, said tortuous passage being formed by a plurality of casings with the wall of one casing contiguous with the wall of another casing and with openings in each of said contacting walls registering with each other to provide a passage from one to the other, some of the casings being superimposed one on the other and the openings from one to the other providing a vertical path for the drainage of water in the form of a sheet to intercept the gases and wash the same, and a conduit beneath the lower casing with a drain from the lower casing into the conduit.

2. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, means to direct water spray lengthwise of the passage, said tortuous passage being formed by a plurality of casings with the wall of one casing contiguous with the wall of another casing and with openings in each of said contacting walls registering with each other to provide a passage from one to the other, some of the casings being superimposed one on the other and the openings from one to the other providing a vertical path for the drainage of water in the form of a sheet to intercept the gases and wash the same, and a conduit beneath the lower casing with a drain from the lower casing into the conduit aligned vertically with the path for the drain of water from the superimposed casings.

3. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, spray nozzles directed lengthwise of said passage, a water tank for the supply of water to said spray nozzles, means to return the used water to said tank, a discharge outlet from said tank, a screen separating the area about said discharge outlet from the remainder of said tank and a baffle plate below the water level extending parallel to the surface of the water in the tank from said screen to the wall of said tank in the screen separated area to shield the outlet from accumulating settlings from the air over the surface of the water in the tank.

4. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, spray nozzles directed lengthwise of said passage, a water tank, conduits from said tank to said spray nozzles, means to return the used water to said tank, a discharge outlet from said tank, an overflow conduit at the water surface for collecting surface contaminant on the water in the tank, and means independent of said nozzles operable during the draining of the overflow conduit to supply said tank with a predetermined quantity of water to cause overflow of water into said overflow conduit from said tank.

5. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, spray nozzles directed lengthwise of said passage, a water tank, conduits from said tank to said spray nozzles, means to return the used water to said tank, a discharge outlet from said tank, an overflow conduit at the water surface for collecting surface contaminant on the water of said tank, a float valve for maintaining the water level in said tank, and means independent of said nozzles operable during the draining of the overflow conduit to supply said tank with a prede-

termined quantity of water to cause overflow of water into said overflow conduit from said tank.

6. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, vertically disposed eliminator plates providing a zig-zag air passage positioned at the discharge end of said passage through which the gases pass to remove water therefrom, washing means directed against said eliminator plates to clean the same by vertical drainage therefrom, a water tank, means for directing the used water from said washing means into the tank, and manually controlled means for intermittently supplying at least some of the washing means from said tank.

7. In an apparatus for treating the smoke and gaseous products of combustion, a casing having a plurality of partition walls extending from one vertical side of the casing to adjacent the opposite vertical side thereof and alternating as to the side from which they extend providing a tortuous passage for the gases, each wall being spaced from the bottom of the casing, water spray in said passage to wash the gases, said water falling to the bottom of the passage and flowing in the space below the walls out of said passage without following said tortuous path for the gases said water being supplied in a volume to seal the space below the walls against air following the path of water flow.

8. In an apparatus as in claim 7 wherein means are provided to maintain the water level on the bottom of said casing above said space to prevent the passage of gases therethrough.

9. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, means for washing the gases in said passage, eliminator plates positioned at the discharge end of said passage for removing the wash water from said gases, means to filter the drier gases, and damper controlled means positioned at the discharge end of said passage to admit air and cool the gases just prior to their entering the eliminator plates.

10. In an apparatus for treating the smoke and gaseous products of combustion, means providing a tortuous passage for the gases, means for washing the gases in said passage, eliminator plates positioned at the discharge end of said passage through which the gases pass to remove water therefrom, and means positioned at the discharge end of said passage to admit cooler air into the gases just prior to entering the eliminator plates to condense water carried by the gases prior to the gases entering the eliminator plates.

11. In an apparatus for treating the smoke and gaseous products of combustion, an enclosure having lower side-by-side casings and upper side-by-side casings superimposed on said lower casings in line therewith and with the walls of each of said upper and lower casings at one end portion thereof having openings which register forming a passageway therethrough and with the adjacent side walls between the upper casings at the other end thereof having openings which register forming a passageway therethrough, said passageways providing a tortuous passage for the gases through said casings, means to direct water spray lengthwise of said casings, and an opening in the lower wall of the lower casing directly beneath the said passageways between the upper and lower casings for drainage of water from said casings.

12. In an apparatus as in claim 11 wherein each of said casings is a separate unit.

References Cited in the file of this patent

UNITED STATES PATENTS

516,674	Butterfield	Mar. 20, 1894
904,301	Black et al.	Nov. 17, 1908
1,010,068	Pavella	Nov. 28, 1911
1,023,260	Leuhrs et al.	Apr. 16, 1912

(Other references on following page)

11

UNITED STATES PATENTS

1,063,320	Bayer	June 3, 1913	
1,081,116	Holmes	Dec. 9, 1913	
1,169,919	Brassert	Feb. 1, 1916	
1,434,301	Liljegan	Oct. 31, 1922	5
1,523,560	Prescott	Jan. 20, 1925	
1,577,703	Fedeler	Mar. 23, 1926	
1,743,554	Larkin	Jan. 14, 1930	
1,793,620	Jacobus	Feb. 24, 1931	
1,824,713	Fisher et al.	Sept. 22, 1931	10

12

1,824,891	Hill	Sept. 29, 1931	
1,841,250	Merryweather	Jan. 12, 1932	
1,843,999	White	Feb. 9, 1932	
1,867,933	Wilton	July 19, 1932	
2,161,412	Gregg	June 6, 1939	
2,215,707	Malonovich-Manor et al.	Sept. 24, 1940	
2,337,983	Fisher	Dec. 28, 1943	
2,353,548	Dalton	July 11, 1944	
2,496,281	Fisher	Feb. 7, 1950	