

Sept. 24, 1940.

G. C. DERRY

2,215,807

ELECTROSTATIC GAS CLEANER

Filed June 2, 1939

2 Sheets-Sheet 1

Fig. 1.

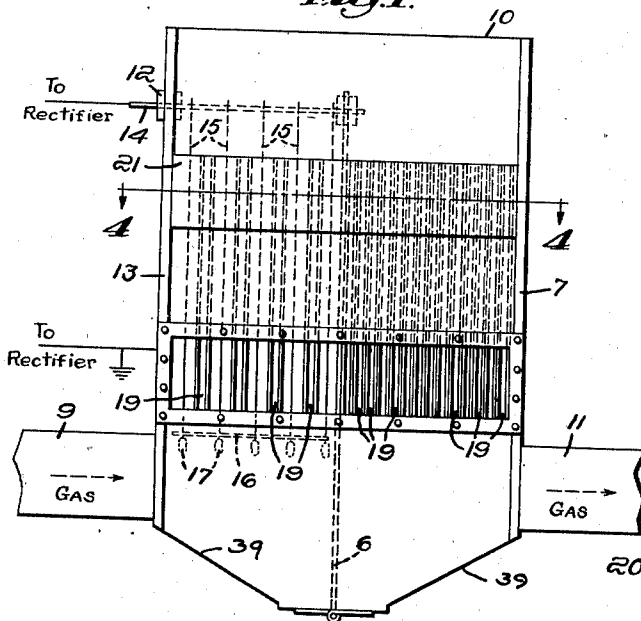


Fig. 2.

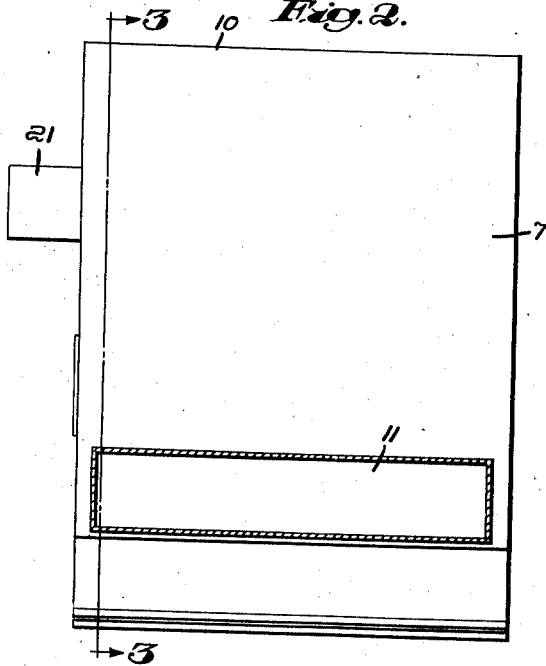
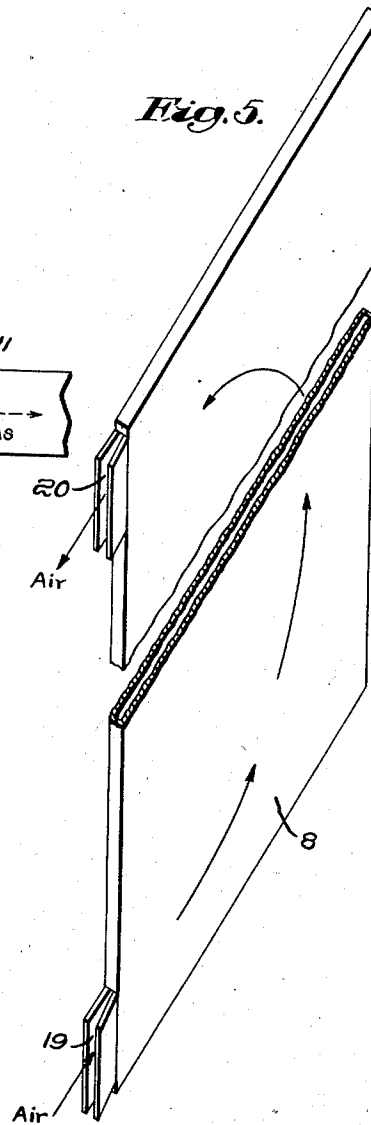


Fig. 5.



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Fig. 4.

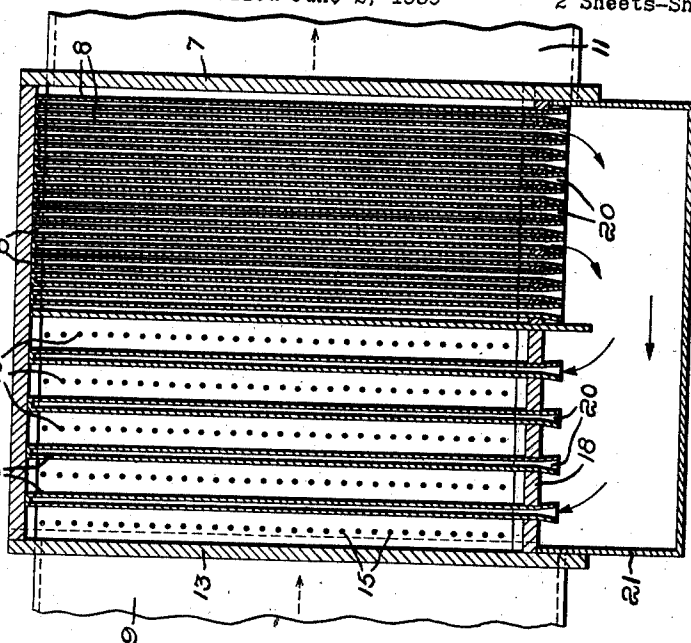
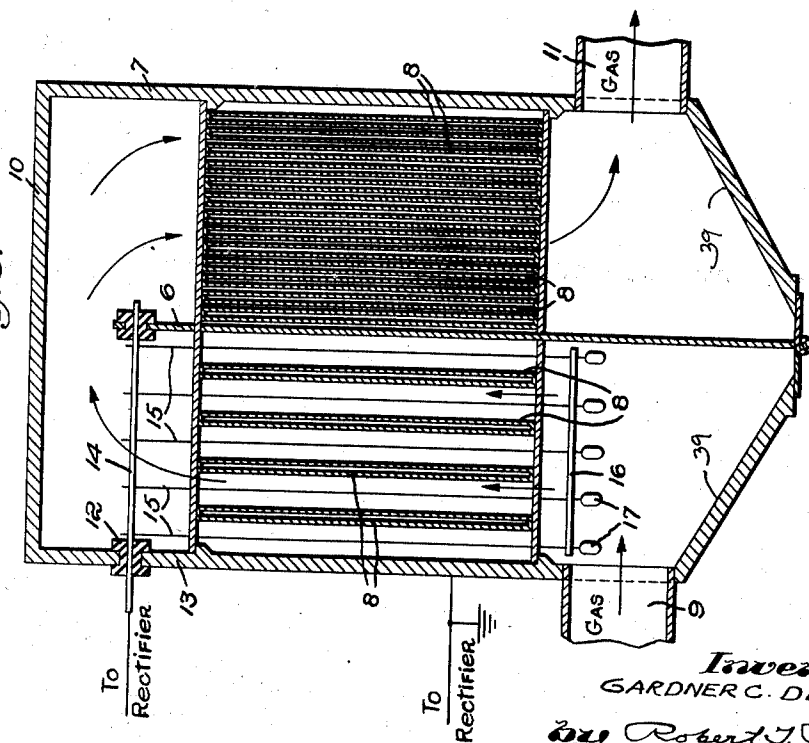


Fig. 3.



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UNITED STATES PATENT OFFICE

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ELECTROSTATIC GAS CLEANER

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Application June 2, 1939, Serial No. 277,041

5 Claims. (Cl. 183-7)

This invention relates to electrostatic gas cleaners and indirect heaters, and relates more particularly to combined air heaters and electrostatic gas cleaners.

5 Combined air heaters and electrostatic gas cleaners utilizing vertical tubes with centrally suspended wires as electrodes, the heated gas to be cleaned passing through the tubes and the air to be heated passing over the tubes have been proposed heretofore. An improved form of such a device is disclosed in my co-pending application, Serial No. 240,996, filed November 17, 1938.

15 The present invention provides an electrostatic gas cleaner and air heater dispensing with tubes and utilizing spaced pairs of plates, the heated gas to be cleaned moving vertically between the pairs of plates and the air to be heated moving between the plates of each pair. Electrode wires suspended vertically between the pairs of plates cooperate with the plates acting also as electrodes to precipitate solid particles from the gas stream into an underlying collector.

25 A feature of this invention resides in providing a two pass gas flow, the gas passing first between pairs of plates spaced relatively far apart arranged as an effective electrostatic precipitator and then between relatively closely spaced pairs of plates for efficient air heating.

30 An object of the invention is to combine in one relatively simple unit, an electrostatic precipitator and an indirect heat exchanger.

Other objects of the invention will be apparent from the following description and from the drawings.

35 The invention will now be described with reference to the drawings, of which:

Fig. 1 is a front view of an assembled unit embodying this invention;

40 Fig. 2 is a side view with a portion in section of the unit of Fig. 1;

Fig. 3 is a sectional view along the lines 3-3 of Fig. 2;

Fig. 4 is a sectional view along the lines 4-4 of Fig. 1, and

45 Fig. 5 is a projected view of one of the air heating chambers of Figs. 1-4.

Referring first to Fig. 3 of the drawings, the central vertical wall 6 divides the unit 7 into two passages for gas flow. To the left (facing the drawing) of the wall 6, the air chambers 8, the details of which are illustrated by Fig. 5, are supported vertically and are spaced relatively far apart. In a commercial embodiment for use with a steam power plant, for example, they may be spaced 6' apart.

To the right (facing the drawing) of the wall 6, similar chambers 8 are relatively closely spaced, for example, 1' apart.

The flue gases enter through the gas inlet 9, pass upwardly between the air chambers 8 to the left of the wall 6, are then deflected by the upper wall 10, to pass between the air chambers 8 to the right of the wall 6, and then pass out the gas outlet 11.

10 The high voltage insulators 12 are mounted in the walls 13 and support the metal electrode supporting rods 14 which extend horizontally above the air chambers 8. The negative electrode wires 15 are attached to the rods 14 and are suspended from same centrally down between those air chambers 8 arranged to the left of the wall 6. The horizontal beams 16 are attached to the lower ends of the wires 15 below the air chambers 8, and the weights 17 are suspended from the beams 16 for maintaining the wires under tension.

25 The rods 14 of which there are one for each of the rows of wires shown by Fig. 4, are connected in parallel and to the negative terminal of a suitable high voltage direct current supply which may be rectified alternating current. The metal walls 13 are connected to ground and to the positive terminal of the current supply source. The air chambers 8 are connected to the current supply source through the walls 13 and plates 18 (Fig. 4) and form positive electrodes.

30 The lower walls 19 converge to form a cinder hopper below the unit 7 for collecting the cinders or other solid particles precipitated from the gas.

35 As the flue gas passes upwardly between the air chambers 8 arranged to the left of the wall 6, it is ionized by the potential impressed between the wires 15 and the walls of the chambers 8. Ions are formed near the negative wires 15 and these ions travel towards the positively charged walls of the chambers 8, colliding with, negatively charging and carrying with them, cinders and other solid particles which are in their paths. The negatively charged cinders then strike and adhere to the chamber walls.

45 In steam power plants for which the unit illustrated was designed, the particles adhering to the walls are expected to agglomerate and form large particles which will usually fall from the walls into the lower hopper. If because of water vapor or other reasons, the particles adhere to the walls they may be easily dislodged by hand or mechanically operated rappers which vibrate the walls, and the wires 15.

Due to the relatively great spacing between

the walls of those air chambers 8 arranged to the left of the wall 6, which spacing is necessary for electrical reasons, all of the heat it is desired to extract from the flue gases cannot be extracted without providing more widely spaced air chambers 6 than are necessary for precipitating purposes. Accordingly, the right hand side of the unit contains relatively closely spaced air chambers 8, which receive the clean but still hot flue gas leaving the left hand side of the unit, and extract the desired quantity of heat from it.

The air chambers 8 as shown by Fig. 5, have walls which form a closed space except for the passages 19 and 20 which serve as inlets or outlets as will be described. With reference to Fig. 5, the lower passage 19 serves as an air inlet and the upper passage 20 serves as an air outlet. The air in its passage through the chamber 8 is heated through the heat imparted to the walls of the chamber by the heat flue gases passing in contact with their exterior as has previously been described.

As shown by Fig. 1, the air chambers 8 arranged to the right of the wall 6, receive air through the lower passages 19, this incoming and coldest air contacting the leaving and coldest gas leaving through the outlet 11. The air leaving the upper passages 20 of the chambers 8 to the right of the wall 6 passes into the duct 21 which confines the air leaving the passages 20 from the right hand group of chambers 8 and guides it into the upper passages 20 of the left hand chambers 8. The air then leaves the left hand chamber 8 through the lower passages 19. With this arrangement, the coldest air is in heat exchange with the coldest gas and as the air becomes heated, it is progressively in heat exchange with progressively hotter gas. Thus, the heated air leaving the lower passages 19 of the left hand chambers 8 is in heat exchange with the heated gases entering the unit.

The drawings are not intended to be to scale or to illustrate the number or arrangement of air heaters.

While one embodiment of the invention has been described for the purpose of illustration, it should be understood that other apparatus and arrangements of apparatus may be suggested by those skilled in the art without departing from the essence of the invention.

What is claimed is:

1. A combined gas cleaner and air heater comprising means including a plurality of spaced, parallel, vertical plates forming alternate gas and air passages, means for dividing said plates into two groups, a hopper below said groups, means forming a gas inlet passage into the gas passages of one of said groups between said hopper and the lower ends of said one of said groups, means for deflecting the gas leaving the upper ends of said gas passages of said one of said groups into the upper ends of the gas passages of the other of said groups, said plates of said groups being so spaced that the gas passages of said one group are substantially wider than the gas passages of said other group, electric wires extending vertically in said gas passages of said one group, means for connecting high potential electric energy to said plates and said wires, means for passing air to be heated into and out of said air passages, and means forming a gas outlet passage at the lower ends of said other of said groups and between same and said hopper.

2. A combined gas cleaner and air heater comprising a plurality of spaced, parallel, vertical

plates forming vertically extending air chambers therebetween, means forming horizontal air passages into said chambers adjacent the upper and lower ends thereof, said chambers having upper and lower walls for forming with said plates air spaces which are closed except for said passages, means for dividing said chambers into two groups, the chambers of one of said groups being spaced apart a distance substantially greater than the distance between the chambers of the other of said groups, electric wires extending vertically between said chambers of said one of said groups, means for connecting high potential electric energy to said plates and to said wires, means for passing heated gas in between said chambers of said one of said groups, means for guiding the gas leaving said one of said groups in between the chambers at said other of said groups, means forming a gas inlet passage for the gas leaving said other of said groups, and means forming a duct connecting one of said air passages of one of said groups with one of said air passages of said other of said groups.

3. A combined gas cleaner and air heater comprising a plurality of spaced, parallel, vertical plates forming vertically extending air chambers therebetween, means forming horizontal air passages into said chambers adjacent the upper and lower ends thereof, said chambers having upper and lower walls for forming with said plates air spaces which are closed except for said passages, means for dividing said chambers into two groups, the chambers of one of said groups being spaced apart a distance substantially greater than the distance between the chambers of the other of said groups, electric wires extending vertically between said chambers of said one of said groups, means for connecting high potential electric energy to said plates and to said wires, a hopper below said chambers, means for passing heated gas in between said chambers of said one of said groups and between the lower ends thereof and said hopper, means for guiding the gas leaving the upper ends of said one of said groups in between the chambers at the upper ends of said other of said groups, means forming a gas inlet passage for the gas leaving the lower ends of said other of said groups, and means forming a duct connecting one of said air passages of one of said groups with one of said air passages of said other of said groups.

4. A combined gas cleaner and air heater comprising a plurality of spaced, parallel, vertical plates forming vertically extending air chambers therebetween, means forming horizontal air passages into said chambers adjacent the upper and lower ends thereof, said chambers having upper and lower walls for forming with said plates air spaces which are closed except for said passages, means for dividing said chambers into two groups, the chambers of one of said groups being spaced apart a distance substantially greater than the distance between the chambers of the other of said groups, electric wires extending vertically between said chambers of said one of said groups, means for connecting high potential electric energy to said plates and to said wires, a hopper below said chambers, means for passing heated gas in between said chambers of said one of said groups and between the lower ends thereof and said hopper, means for guiding the gas leaving the upper ends of said one of said groups in between the chambers at the upper ends of said other of said groups, means forming a gas inlet passage for the gas leaving the lower ends of said

other of said groups, and means forming a duct connecting one of said air passages of one of said groups with the corresponding air passage of the other of said groups.

- 5 5. A combined gas cleaner and air heater comprising a plurality of spaced, parallel, vertical plates forming vertically extending air chambers therebetween, means forming horizontal air passages into said chambers adjacent the upper and
10 lower ends thereof, said chambers having upper and lower walls for forming with said plates air spaces which are closed except for said passages, means for dividing said chambers into two groups, the chambers of one of said groups being spaced
15 apart a distance substantially greater than the distance between the chambers of the other of said groups, electric wires extending vertically between said chambers of said one of said groups,

means for connecting high potential electric energy to said plates and to said wires, a hopper below said chambers, means for passing heated gas in between said chambers of said one of said groups and between the lower ends thereof and
5 said hopper, means for guiding the gas leaving the upper ends of said one of said groups in between the chambers at the upper ends of said other of said groups, means forming a gas inlet
10 passage for the gas leaving the lower ends of said other of said groups, means for passing air to be heated into the lower of said air passages of said other of said groups, a duct connecting the upper gas passages of said groups, and means for
15 passing the heated air out of the lower passage of said one of said groups.

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