J. McPHAIL.

GAS CLEANER.

APPLICATION FILED JUNE 2, 1915.

1,164,949.

Patented Dec. 21, 1915.

3 SHEETS—SHEET 1.

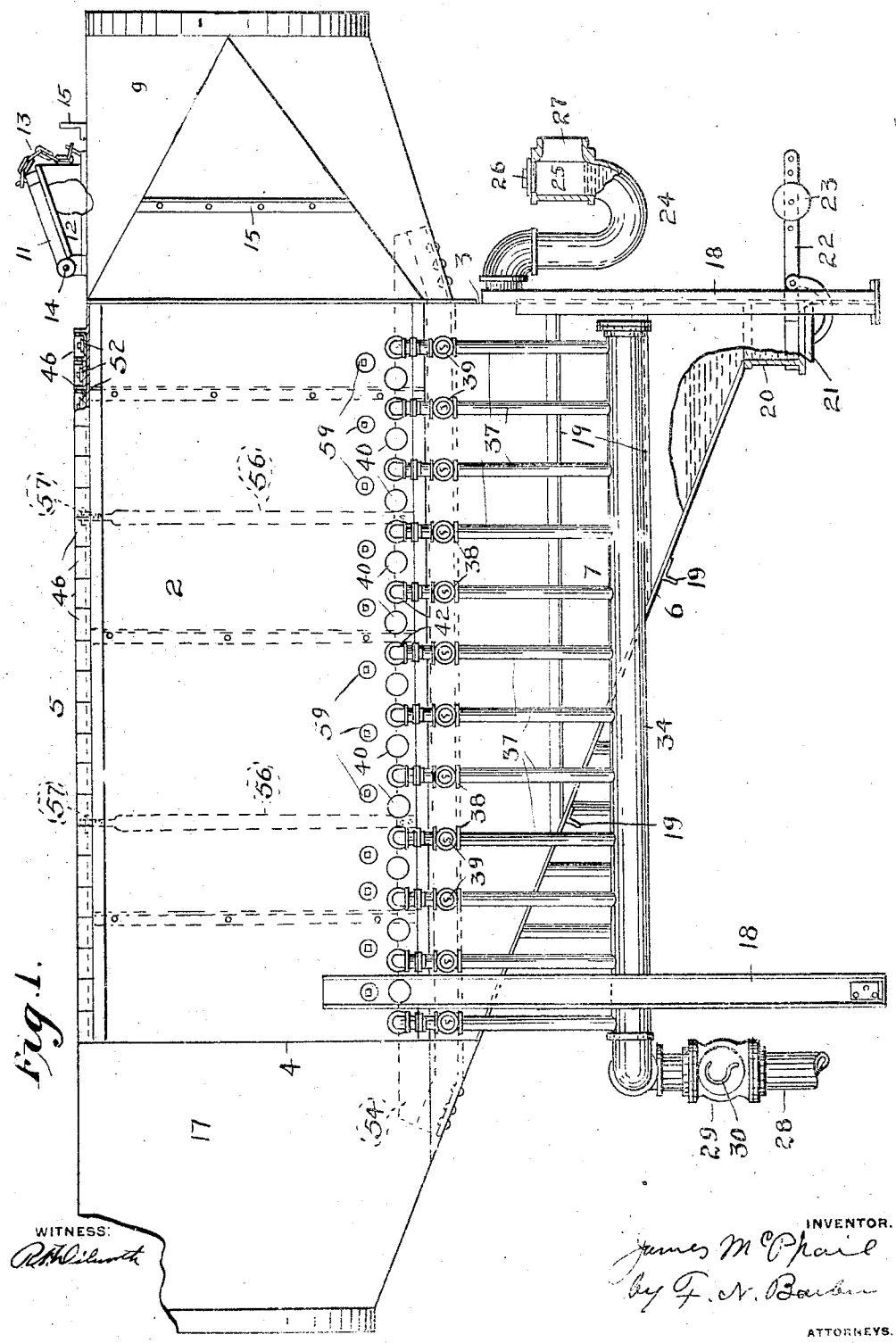


Fig. 1.

WITNESS:

INVENTOR.

James McPhail

by F. N. Barber

ATTORNEYS.

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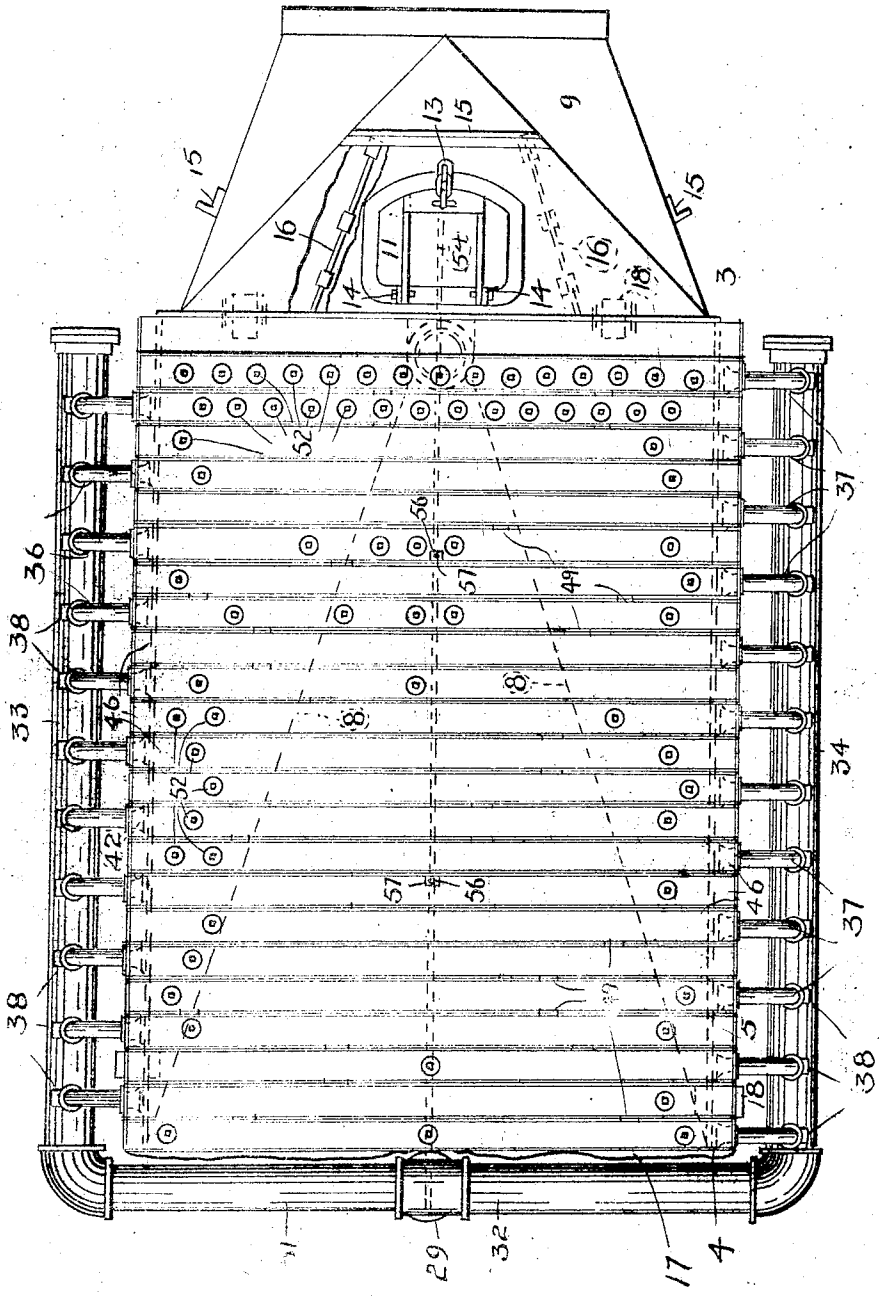


Fig. 2.

WITNESS:

INVENTOR.

James McPhail

Chas F. N. Barber

ATTORNEYS.

J. McPHAIL.

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3 SHEETS—SHEET 3.

Fig. 3.

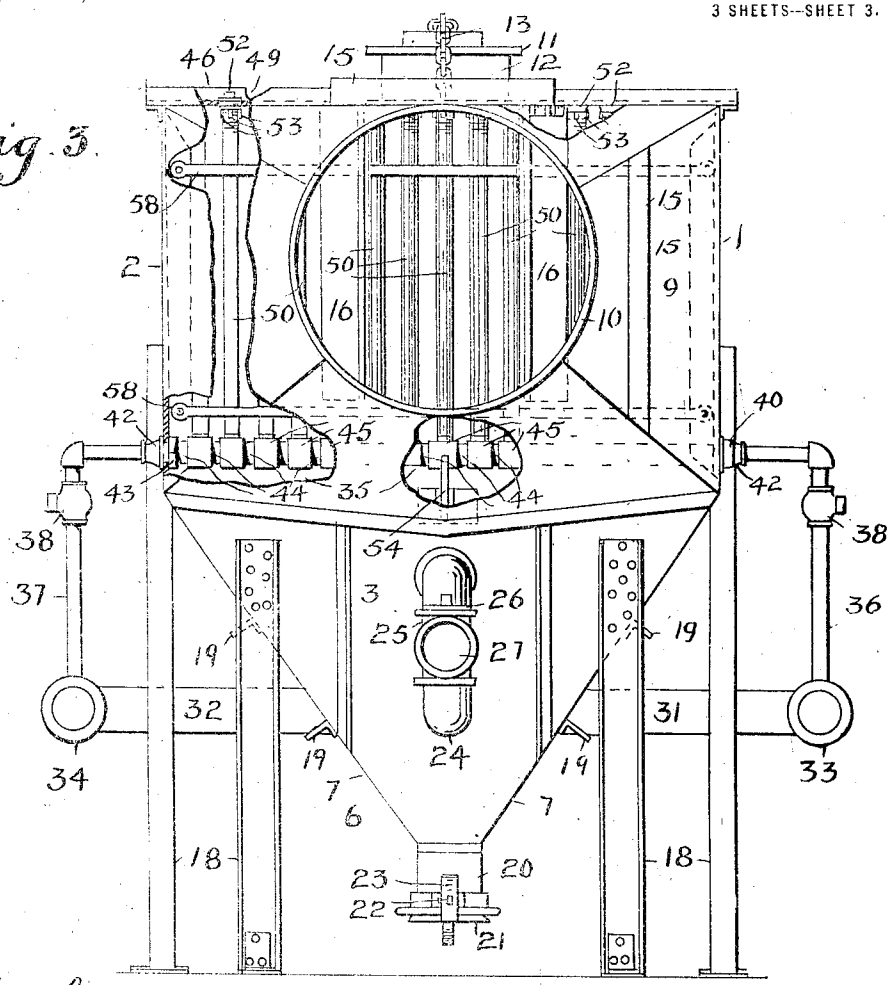


Fig. 4.

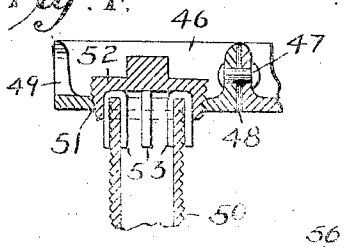
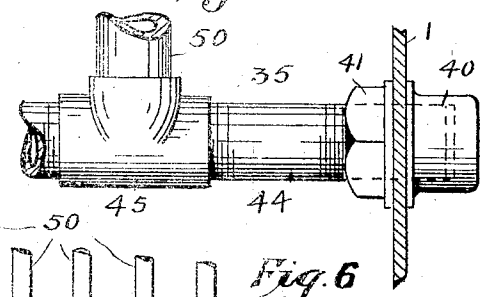


Fig. 5.



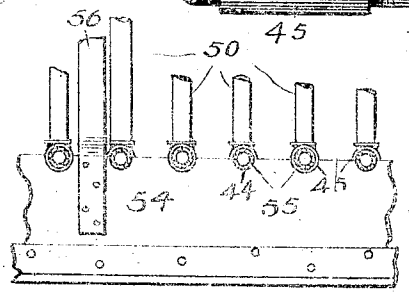


Fig. 6

WITNESS:

R. F. Ellsworth

INVENTOR.

James McPhail

by F. N. Barber

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JAMES McPHAIL, OF LOWELLVILLE, OHIO, ASSIGNOR OF ONE-HALF TO WILLIAM C. HOLZWORTH, OF LOWELLVILLE, OHIO.

GAS-CLEANER.

1,164,949. Specification of Letters Patent. Patented Dec. 21, 1915.

Application filed June 2, 1915. Serial No. 31,669.

To all whom it may concern:

Be it known that I, JAMES McPHAIL, a citizen of the United States, residing at Lowellville, in the county of Mahoning and State of Ohio, have invented new and useful Improvements in Gas-Cleaners, of which the following is a specification.

My invention relates to apparatus for cleaning gases.

The object of this invention is to provide an apparatus by which gases charged with impurities may be brought into intimate contact with numerous streams or sheets of water, preferably flowing downwardly on the exterior surfaces of vertical water tubes, whereby the solid ingredients, such as ore dust, coke dust, soot, and the like, and the soluble gaseous ingredients may be arrested by the water and deposited in a suitable place, whence the said ingredients may be discharged from time to time.

It is another object to provide suitable means for regulating and maintaining the flow of water along the said tubes and for preventing any interference with the said means by unauthorized persons.

Another object is to provide adequate means for preventing the intense heat of the gases, which may be, for example, such gases as are discharged through the downcomer of a blast furnace, from warping and twisting any of the parts of my said apparatus. I provide my apparatus against damage by severe explosions due to "slips" in the blast furnace.

Other objects will appear hereinafter.

Referring to the accompanying drawings, Figure 1 is a side elevation of a gas cleaner embodying the principles of my invention, portions being broken away. Fig. 2 is a plan view of Fig. 1. Fig. 3 is an end elevation of the same. Fig. 4 is a sectional detail showing the connection of a water tube with the top of the casing. Fig. 5 is a detail showing the manner of connecting the distributer tubes to the casing. Fig. 6 is a detail showing the means for supporting the said tubes.

On the drawings, I show a main metallic casing having the vertical sides 1 and 2, the ends 3 and 4, the horizontal top 5, and the bottom 6. The bottom 6 is formed of three inclined portions, two of these portions, marked 7, being downward converging extensions or continuations of the sides 1 and 2, and the remaining bottom portion extending downwardly and forwardly from the rear end 4 and having its edges forming tight joints (indicated by the dotted lines 8, Fig. 2) with the bottom edges of the said portions 7, which make tight joints with the downwardly tapering front 3.

The front of the casing upward from about the lines where the sides meet the bottom portions 7 comprises a forwardly tapering gas-distributing casing 9 having its rear edges made gas-tight with the sides 1 and 2, the front 3 and the top 5. The forward end of the casing 9 has the inlet opening 10 which may be connected to the outlet end of a downcomer pipe of a blast furnace or to any other desired source of gas which it is desired to clean. The explosion door 11 normally closes an opening communicating with the interior of the casing 9. I have shown this door resting on and closing the top of the box 12 secured to the top of the casing 9, the bottom of the box opening into the said casing. The door 11 is hinged at its rear edge and has its front edge provided with the chain 13 secured to the casing 9, the chain being of such length as to prevent the center of gravity of the door 11 from passing rearwardly of the hinges or pivots 14 by which the door is secured to the box 12. The casing is braced by suitable L-bars 15 secured thereto. To the top of the casing 9 I hinge the vertical distributer plates, or guides, 16, one at each side of the longitudinal center thereof so as to divide the interior of the casing into three passages. The plates 6 diverge rearwardly and swing freely on their hinges. The gases admitted to the main casing are discharged through the rearwardly-tapering casing 17 secured gas-tight to the sides 1 and 2, the top 5, and the bottom 6.

The structure so far described is supported on the columns 18, and the bottom is reinforced by the L-bars 19 secured thereto.

20 is a vertical conduit connected to the lowest part of the bottom 6 and the front 3. The lower end of the conduit is closed by the upwardly-seating valve 21 carried by the lever 22, which has the adjustable weight 23 for holding the valve against its seat at the lower end of the conduit 20 with a predetermined pressure.

24 is a U-shaped trap secured in the front 3 and having its free end comprising the T 25. The upper end of the T is provided with the plug 26, which prevents the entrance of dirt into the trap, but which may be removed to facilitate the cleaning out of the trap. The horizontal central opening 27 of the T constitutes the outlet of the trap.

28 is a pipe connected to a supply of water under pressure. In this pipe is the valve 29 controlled by a key of special shape, for example, by a key shaped to fit the special slot 30, in which the key must be inserted before the valve can be operated. The details of such a special valve are old and need not be further described.

The pipe 28 communicates with the two horizontal pipes 31 and 32 which lead the water right and left. These pipes are preferably in the rear of the end 4 of the main casing. The pipe 31 communicates with the horizontal distributing pipe 33 and the pipe 32 with the horizontal distributing pipe 34, the pipes 33 and 34 extending forwardly on opposite sides of the main casing, and practically to the forward end thereof. The forward ends of the pipes 33 and 34 are closed.

A number of horizontal pipes 35 are arranged side by side within the main casing. These pipes are arranged below the level of the opening 10 and may have their ends secured in the sides 1 and 2. Alternate one of the pipes 35 are connected to the pipe 33 by the respective pipes 36, and the remaining pipes 35 are connected to the pipe 34 by the pipes 37. The pipes 36 and 37 contain the special valves 38 which like the valve 29 require a special key for controlling them. I have on Fig. 1 shown the valves provided with the specially-shaped key slots 39. The ends of those pipes which are not connected to the pipes 36 and 37 are provided with the screw-caps 40 which screw up against the outer faces of the sides 1 and 2, nuts 41 being screwed up on the pipes against the inner faces of the said sides. The other ends of the pipes 35 are connected to the sides 1 and 2 by the pipes 36 and 37 by the reducing sections 42 and the nuts 43 in a similar manner, the section 42 engaging the outer faces of the said sides and the nuts 43 the inner faces thereof. The pipes 35 are each composed of the nipples 44 and T's 45 arranged alternately, the central openings of the T's all being up.

The top 5 of the main casing is composed of a series of channel bars 46 with their channels opening upwardly and their ends closed. There is one channel bar 46 directly over and parallel with each pipe 35. The adjacent channel bars are riveted together as shown at 47 on Fig. 4, a strip of packing 48 being placed between the adjacent flanges as shown on the same figure. The rivets and packing are omitted from the other views owing to the small scale used thereon. The channels are designed to contain water, notches 49 being cut through the flanges of adjacent channels in order that the water may have its water level equalized automatically. Water may be supplied to the channels by any suitable means to make up for the waste by evaporation.

Vertical pipes 50 are screwed into the central openings of the T's 45, the upper ends of the pipes being threaded externally and extending up into openings 51 in the bottoms of the channels 46. These openings are closed by screw plugs 52 having each a recess on its under side to receive the upper end of a pipe 50. The recess is somewhat larger than the pipe and a number of U-shaped spacers 53 are placed on the ends of the pipes so that the outer members of the spacers on each pipe fit between the pipe and the wall of the recess in the plug 52 in which the end of the pipe stands, the remaining member of each spacer extending downwardly along the inner wall of the pipe. It will be noted from Fig. 2 that the pipes 50 are staggered from front to rear, that is, the pipes in one transverse row stand opposite the spaces between the pipes in the next row.

54 is a metal support extending lengthwise of the apparatus and provided with the notches 55 in which the central portions of the pipes 35 rest to prevent their horizontal movement. Vertical hangers 56 have their lower ends connected to the support 54 and their upper ends extending through the top 5. The hangers are suspended from the top 5 by the nuts 57 screwed on the hangers and resting on the top 5.

The sides 1 and 2 are tied together by the eye-bars 58.

I provide a number of plugs 59 which when removed permit an inspection of the water tubes 50 for the purpose of ascertaining whether or not water is flowing down the said tubes. These plugs are located opposite the spaces between the transverse rows of tubes.

The inlet opening 10 is connected, for example, to the downcomer of a blast furnace. The outlet casing 17 may be connected, for example, to hot-blast stoves, or other apparatus for consuming the cleaned gases. Water flows from the supply pipe 28 through two branches. In one branch the water flows through the horizontal pipes 31 and 33, the vertical pipes 38, alternate pipes 35, and those vertical pipes 50 which are connected to the said pipes 38. Water in the other branch flows through the horizontal pipes 32 and 34, the vertical pipes 37, the remaining horizontal pipes 35, and the remaining vertical pipes 50. The gases enter the casing 9 and come into intimate contact with the

water flowing down the water tubes 50, whereby the ore dust, coke dust, soot, and other solid matter, and all soluble matter in the gases is wet and absorbed by the water which falls upon the bottom 6 and collects thereon to a predetermined level, at which the pressure of the water automatically opens the valve 21, allowing the accumulated water and refuse matter to escape. In case the dirt should accumulate so as to prevent the valve from opening the water would escape by way of the trap 24.

It is necessary for the best operation of my gas cleaner that the water flow over the pipes 50 for their entire length. By temporarily removing the plugs 59, one at a time and observing the pipes 50 through the openings from which the plugs have been removed, the valves 38 may be turned so as to allow the right quantity of water to enter the water tubes for keeping the water tubes covered with running water all the time the gas cleaner is in use. The rate of flow of water down the outside of the several cross rows of water tubes can be adjusted separately. The front rows of water tubes which are first met by the hot gases require that the valves 38 be opened further than the rows behind. The valves for the front rows will be the farthest open and the valves will be closed more and more toward the rear where the gases become more and more cooled.

In order to cause the water to adhere to the water tubes 50 and wet them entirely, I thread their upper ends whereby the water is given a motion around the tubes, but I do not limit myself to the distance downwardly they are threaded.

The distributing plates 16 divide the gases into different paths so that they will be sent to all parts of the casing. In case of an explosion in the blast furnace these plates will swing on their hinges so that the pressure in the casing will quickly become equalized. The door 11 will also open and relieve the pressure in a large degree.

I claim—

1. In a gas cleaning apparatus, a casing through which the gas passes, a plurality of vertical tubes in the casing and in the path of the gas, and means for supplying a constant flow of water up through the tubes and down the outer surfaces of the same.

2. In a gas cleaning apparatus, a casing through which the gas passes, a plurality of vertical tubes arranged in staggered transverse rows in the casing and in the path of the gas, and means for supplying a constant flow of water up through the tubes and down the outer surfaces of the same.

3. In a gas cleaning apparatus, a casing through which the gas passes, a plurality of vertical tubes in the casing and in the path of the gas, means for supplying a constant flow of water down the outer surfaces of the tubes, and means for causing the water to flow spirally around the tubes.

4. In a gas cleaning apparatus, a casing through which the gas passes, a plurality of vertical tubes in the casing and in the path of the gas, and means for supplying a constant flow of water down the outer surfaces of the tubes, the tubes being threaded on their exterior surface.

5. In a gas cleaning apparatus, a casing through which gas may pass, the top of the casing having openings therein, plugs secured in the openings and provided with recesses in their under sides, a plurality of vertical water tubes in the casing and in the path of the gas having their upper ends in the recesses and at least their upper portions threaded externally, and means for supplying water under pressure to the lower ends of the water tubes, the water tubes being spaced from the sides of the recesses.

6. In a gas cleaning apparatus, a casing through which gas may pass, the top of the casing having openings therein, plugs secured in the openings and provided with recesses in their under sides, a plurality of vertical water tubes in the casing and in the path of the gas having their upper ends in the recesses and at least their upper portions threaded externally, means for spacing the water tubes from the sides and ends of the recesses, and means for supplying water under pressure to the lower ends of the water tubes.

7. In a gas cleaning apparatus, a casing through which gas may pass, the top of the casing comprising a series of channel-bars closed at their ends, plugs secured in openings in the bottom of the channel-bars and provided with recesses in their under sides. a source of water supply and a plurality of vertical tubes in the casing and in the path of the gas, the upper ends of the tubes extending into the recesses but being spaced therefrom, whereby water may flow up the tubes, over their upper ends and down their exterior surfaces.

8. In a gas cleaning apparatus, a casing in which hot gases are cooled, the casing having its top composed of channel-bars arranged side by side with their ends closed, the channels being open upwardly and there being communicating openings through the flanges of adjacent channel-bars.

9. In a gas cleaning apparatus, a casing through which the gas passes, a series of horizontal tubes arranged side by side in the casing, a series of vertical tubes communicating with each horizontal tube, a source of water supply for the tubes, means for securing the ends of the horizontal tubes to the casing, and means for supporting the central portions of the horizontal tubes and preventing lateral movement of the said

portions, there being provision for water to flow from the interior of the vertical tubes downwardly over their exterior surfaces.

10. In a gas cleaning apparatus, a casing through which the gas passes, a series of horizontal tubes arranged side by side in the casing, a series of vertical tubes communicating with each horizontal tube, means for securing the ends of the horizontal tubes to the casing, and means for supporting the central portions of the horizontal tubes and preventing lateral movement of the said portions, and a source of water supply for the said tubes, the last named means comprising a metal plate secured to the casing transversely of the horizontal tubes and having recesses in which the horizontal tubes are seated.

11. In a gas cleaning apparatus, a casing through which the gas passes, a plurality of vertical tubes in the casing and in the path of the gas, from which tubes water therein may flow down the exterior surfaces thereof, openings in the casing permitting observation of the said tubes, a source of water supply for the tubes, and means for regulating the rate of flow of the water through the tubes.

12. In a gas cleaning apparatus, a casing through which the gas passes, means in the path of the gas for removing impurities therefrom, and means in front of the first means, for distributing the gas into streams directed toward different portions of the said removing means.

13. In a gas cleaning apparatus, a casing through which the gas passes, means in the path of the gas for removing impurities therefrom, deflectors in front of the said means and means permitting the deflectors to move laterally in case of violent increases of gas pressure for distributing the gas into streams directed toward different portions of the said removing means.

14. In a gas cleaning apparatus, a casing through which the gas passes, means in the path of the gas for removing impurities therefrom, and guide plates hinged at their upper edges in front of the said means, for distributing the gas into streams directed toward different portions of the said removing means.

15. In a gas cleaning apparatus, a casing through which the gas passes, means for supplying water for washing impurities from the gas as it passes through the casing, means for collecting the water and the impurities therein, and a valve operated by the head of water in the last named means for releasing the collected water and impurities automatically when the collected water reaches a predetermined level.

16. In a gas cleaning apparatus, a casing through which the gas passes, means for supplying water for washing impurities from the gas as it passes through the casing, means for collecting the water and the impurities therein, a valve operated by the head of water in the last named means for releasing the collected water and impurities automatically when the collected water reaches a predetermined level, and a trap for automatically discharging such water as may rise above a predetermined height above the said level.

Signed at Lowellville, Ohio, this 28th day of May, 1915.

JAMES McPHAIL.