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[54] **PROCESS AND APPARATUS FOR CLEANING FURNACE GASES**
12 Claims, 1 Drawing Fig.

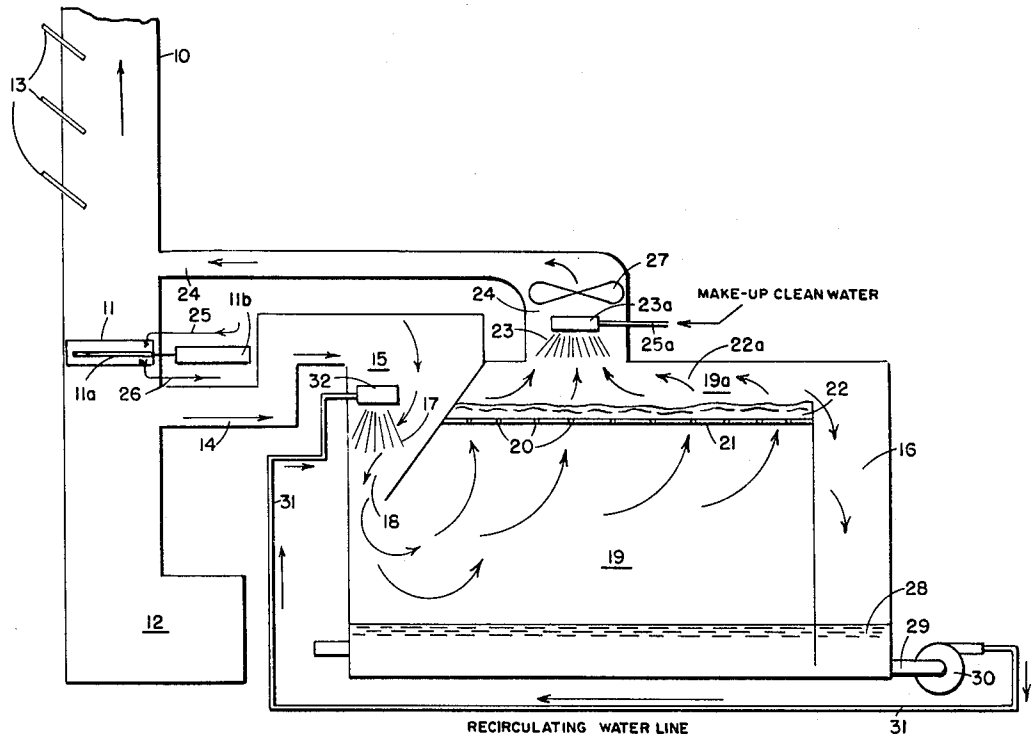
[52] **U.S. Cl.** **110/18,** 110/119
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[50] **Field of Search** 110/8, 8A, 18, 119; 261/17, 113, 116, 117

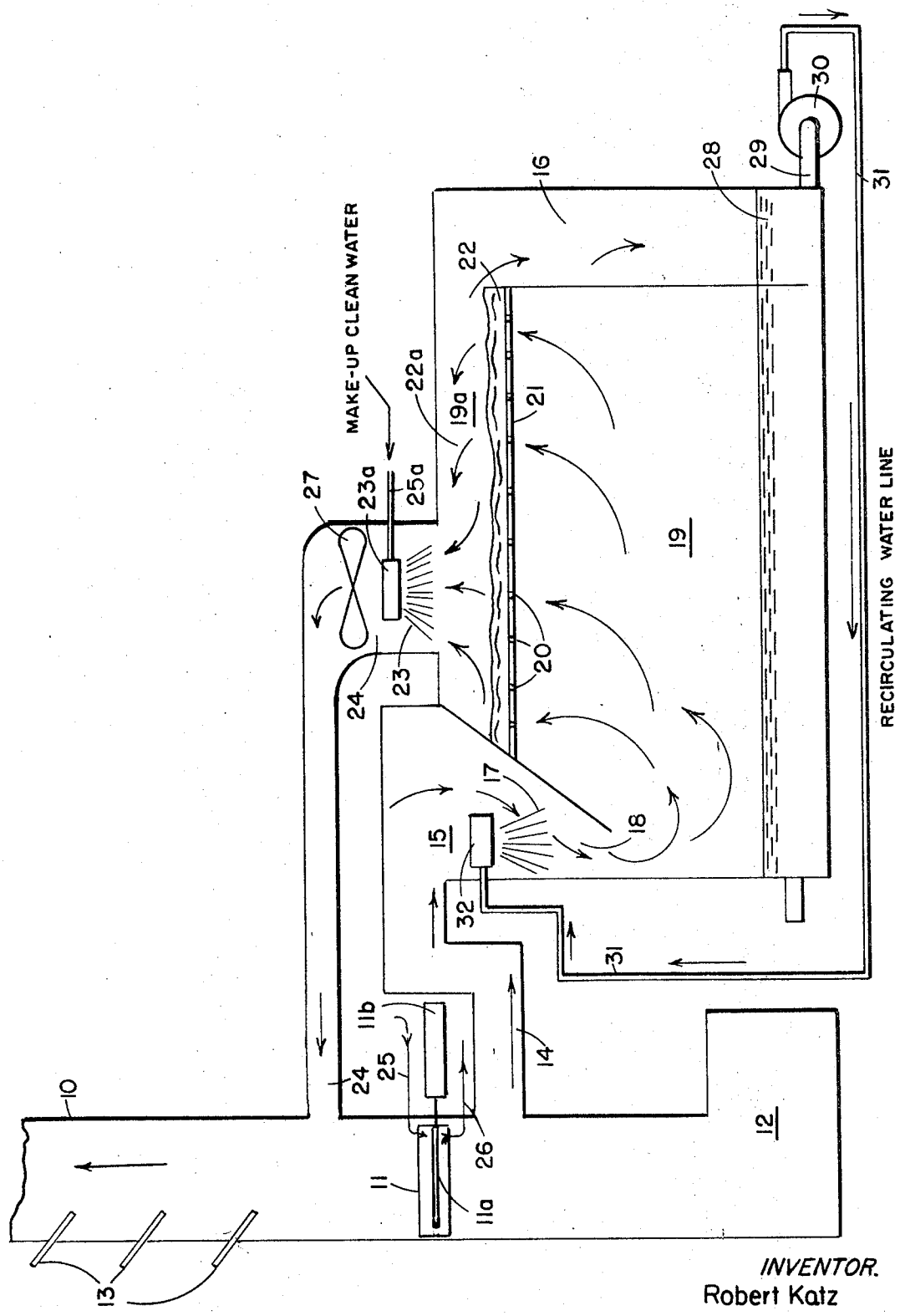
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ABSTRACT: Furnace flue gases, and particularly incinerator flue gases of apartment houses wherein the same chimney or stack, provided with a damper, serves for discharging the furnace combustion gases and for receiving garbage at the different levels, are withdrawn from the stack in advance of the damper and subjected to a plurality of stages of scrubbing with water of different degrees of purity, and then returned to the stack by means of a fan or blower at a point above the damper, the damper being cooled with fresh water to prevent ignition of garbage deposited thereon either during or between combustion cycles, such cooling water being employed in the last gas-scrubbing stage.





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PROCESS AND APPARATUS FOR CLEANING FURNACE GASES

The present invention relates to an improved process and apparatus for cleaning furnace flue gases and particularly incinerator flue gases of solid and gaseous pollutants.

In accordance with the present invention, the flue gases entering a chimney or smokestack in advance of the damper are bypassed into a scrubber system which removes the suspended particles and the cleaned gases are then returned to the chimney or smokestack at the discharge side of the damper.

As the invention is of particular value in the cleaning of the flue gases of apartment house incinerators, it will be further described in detail hereinbelow in connection with such use, but it will be readily apparent that the invention is applicable also to commercial installations for the removal of soot and other suspended particles and soluble gases from flue gases.

It is the general object of the invention to provide an improved process and apparatus for scrubbing and cleaning flue gases which can be incorporated in existing buildings or in buildings in process of construction.

It is also an object of the invention to provide an improved process and apparatus for the cleaning of incinerator and furnace flue gases with the aid of water in which the water is utilized economically and with a minimum expenditure thereof.

It is a further object of the invention to provide a process and apparatus for the cleaning of incinerator and furnace flue gases wherein the latter are subjected to repeated treatment with water, both re-used and fresh water, whereby a high degree of purification is attained.

It is a still further object of the invention to provide a cooled damper in a chimney or smokestack of apartment houses wherein the same stack is used for the furnace of the apartment house as well as for the disposal of garbage through chutes at the different floor levels, the damper serving to block off the stack so that combustion gases may be diverted from a point in advance of the damper to the scrubber section of the apparatus, the cleansed gases being returned to the stack at the other side of the damper; the damper being constructed so as to be capable of being cooled with water to guard against ignition of rubbish and garbage that may be discharged thereon and thereby prevent pollution of the gases which have been cleaned in the scrubber section of my improved apparatus and returned to the stack.

Another object of the invention is to provide an apparatus of the kind indicated wherein the cooling water for the damper is utilized as make-up water for the scrubber section.

Other objects and advantages of the invention will appear from the following detailed description thereof and the features of novelty will be set forth in the appended claims.

The accompanying drawing shows schematically a furnace and smokestack arrangement provided with my improved cooled damper and with connections for bypassing the furnace gases to the scrubber system and with a return connection for discharging the cleaned gases into the chimney or stack above the damper.

Referring to the drawing, the chimney or stack is shown at **10**, there being provided a damper **11** which, when closed, blocks the flow of furnace gases through the stack, the furnace being indicated diagrammatically at **12**. At the various floors of the apartment house there are provided garbage chutes, indicated diagrammatically at **13**, and when the furnace is not in operation, the damper **11** is open so that the garbage falls freely into the furnace before the furnace is fired again.

Combustion of the garbage occurs in the furnace **12** and the furnace gases are normally discharged through the stack **10**. The furnace gases are usually soot and smoke-laden, by reason of the fact that the garbage is generally moist and does not burn readily; and in addition, the gases have suspended therein more or less large particles of burnt paper, so that the discharged gases contribute to an important degree to the pollution of the city atmosphere.

In accordance with the present invention, the flue gases are

by-passed to a scrubber system (by closing damper **11**) wherein the suspended matter is substantially completely removed along with water-soluble noxious gases, such as the sulfur oxides, nitrogen oxides, and the like, and thereafter the gases are discharged in cleansed condition into the smokestack at a point above the damper **11**. To this end, the gases are withdrawn from the smokestack by the conduit **14** and flow into a scrubber apparatus having three sections comprising a venturi spray section, a tray section using either bubble caps, sieve trays or the like, and a "polishing" section using sprays of clean water which are collected and charged into the tray section.

It will be understood that when the scrubber section is in operation, the damper is in the closed or gas-blocking position.

The soot-laden gases are directed from the furnace section **12** and through the pipe **14** into the chamber **15** of the scrubber **16**. In the scrubber, the gases are first preliminarily washed by a water spray **17** as they pass through a venturi throat **18** and into the chamber **19**. The gases are still under suction as they enter the chamber **19**, but are at a relative super-pressure with respect to region **19*a***, which is under the maximum suction created by a fan or blower **27**. In the preferred form of the apparatus, the gases pass through a multitude of small openings **20** in a tray **21** which supports a layer or bed of water **22**, the difference in pressure between the spaces **19** and **19*a*** being sufficient to enable the gases to bubble through the layer of water **22**. As they pass through the water layer, they are further scrubbed of a large part of their solid matter and as they escape above the layer of water, as indicated by the arrows **22**, they pass into the discharge conduit **24** where they meet a spray of clean water **23** and receive a final cleansing.

From the conduit **24** they are discharged into the smokestack above the damper as indicated in the drawing.

As will be seen from the foregoing, the polluted gases are subjected to an initial cleaning at the throat **18**, then given a more thorough cleansing in the layer of water **22**, and finally by the spray **23**.

Upon discharge from the conduit **24**, they are substantially completely free of solid matter and also of the gases which are soluble in water.

As stated hereinbefore, the damper of the smokestack is water-cooled in order to prevent ignition of garbage or rubbish deposited thereon when tenants throw such material down the chutes while the damper is in closed position and still hot from the preceding combustion cycle, or while the damper is in closed position during operation of the incinerator furnace to enable the combustion gases temporarily to bypass the smokestack. This clean damper cooling water constitutes, in accordance with the invention, at least part of the spray **23**, and to such cooling water there may be added fresh make-up water which replaces water lost by evaporation and in the form of suspended droplets in the gases discharged at **24**.

The fresh water is charged into the damper through a pipe **25** and is compelled to travel the full length of the damper by a baffle **11*a*** or in any other suitable manner, and is discharged through a pipe **26** which is connected to the spray nozzle **23*a*** and forms part of the spray **23**. The damper is operated in known manner by an actuator **11*b*** of any suitable type.

The overflow from the tray **21** falls into a tank or sump **28** from which water is withdrawn by a pipe **29** and charged by the pump **30** into conduit **31** which feeds the water to the spray nozzle **32** at the venturi section of the scrubber. The overflow from the sump **28** carrying the lighter particles of soot is discharged through a pipe **33** and may be discharged as waste water, or, when the supply of water is limited, it may be directed into a settling tank, from which the at least partially clarified water can be fed to the nozzle **32** or onto the tray **21**. The sump **28** can be provided with a cleaning out valve **34** for discharging or flushing out soot deposited at the bottom of the sump.

It will be understood that the perforated tray **21** represents only one type of device for effecting a partial cleansing of the gases. The tray can be replaced by bubble caps or by a separate spray system.

I claim:

1. Process for cleaning furnace flue gases which are discharged through a smokestack provided with a damper, which comprises keeping the damper closed and by-passing the furnace flue gases into a scrubber system, scrubbing the gases in said system by separate bodies of water, and thereafter returning the cleaned gases to the smokestack of the furnace at a point above the damper.

2. Process according to claim **1**, wherein clean water is charged into the damper of the smokestack to cool the same and thereafter charging such water into the scrubber for the final scrubbing of the gases.

3. Process according to claim **1**, wherein the scrubbing of the gases includes the steps of increasing the speed of the flue gases and subjecting them to a first water spray, then causing the gases to bubble through a layer of water, and finally subjecting the gases to a spray of fresh water, directing said last-mentioned spray into a said layer, combining the overflow of said layer with the discharged water of said first spray, drawing off the soot-laden upper portion of the so-formed body of water, and utilizing the lower portion of such body of water to form the first spray.

4. In combination with a furnace and stack thereof provided with a damper, of means for scrubbing the furnace gases and returning them to the stack above the damper, comprising a conduit for withdrawing the gases from beneath the damper and a scrubber system into which the conduit discharges the soot-laden gases and comprising a water-spray section in which the gases are first subjected to a water spray, a second scrubbing section comprising means for subjecting the gases to the cleansing action of a further body of water, a further spray section, and means for charging clean water into the latter, and a fan for withdrawing the gases from the scrubber section and charging the same into the smokestack at a point above the damper.

5. Flue gas cleaning apparatus according to claim **4**, wherein the damper is hollow and is provided with an inlet and an outlet for cooling water, and a conduit for leading the discharged water into the scrubber.

6. Apparatus according to claim **5**, wherein the damper cooling water is brought into contact with the flue gases in the last cleaning step of the scrubber.

7. Apparatus according to claim **4**, wherein the cleaning water of the second scrubbing stage is collected and recirculated and discharged into the first scrubbing stage.

8. Apparatus according to claim **4**, wherein the second scrubbing stage comprises a perforated tray on which is disposed a layer of water, and a blower arranged to produce sufficiently low sub-atmospheric pressure to cause the flue gases to flow through the perforations of the tray and bubble through the layer of water.

9. Apparatus according to claim **8**, wherein the tray is arranged to receive the cleaning water discharging from a subsequent cleaning stage of the scrubber.

10. Apparatus according to claim **9**, including means for collecting the overflow from said tray, and means for pumping the water from said collecting means to the first cleaning stage of the scrubber.

11. The combination with the stack of an apartment house garbage incinerator provided with chutes at the different floors discharging into the stack, said stack having a damper therein, of a multistage scrubber unit, a conduit connected with the stack below the damper for discharging into the scrubber unit the flue gases issuing from the furnace of the incinerator, said scrubber including a final stage wherein the gases are brought into contact with clean water, a stage wherein they are brought into contact with water discharged by said last stage, and a conduit for returning the cleaned gases to the stack above the damper.

12. The combination according to claim **11**, wherever the damper is hollow, and including feed and discharge conduits for bringing the fresh water first into heat-exchange relation with the damper to cool it sufficiently to prevent ignition of garbage falling upon it.