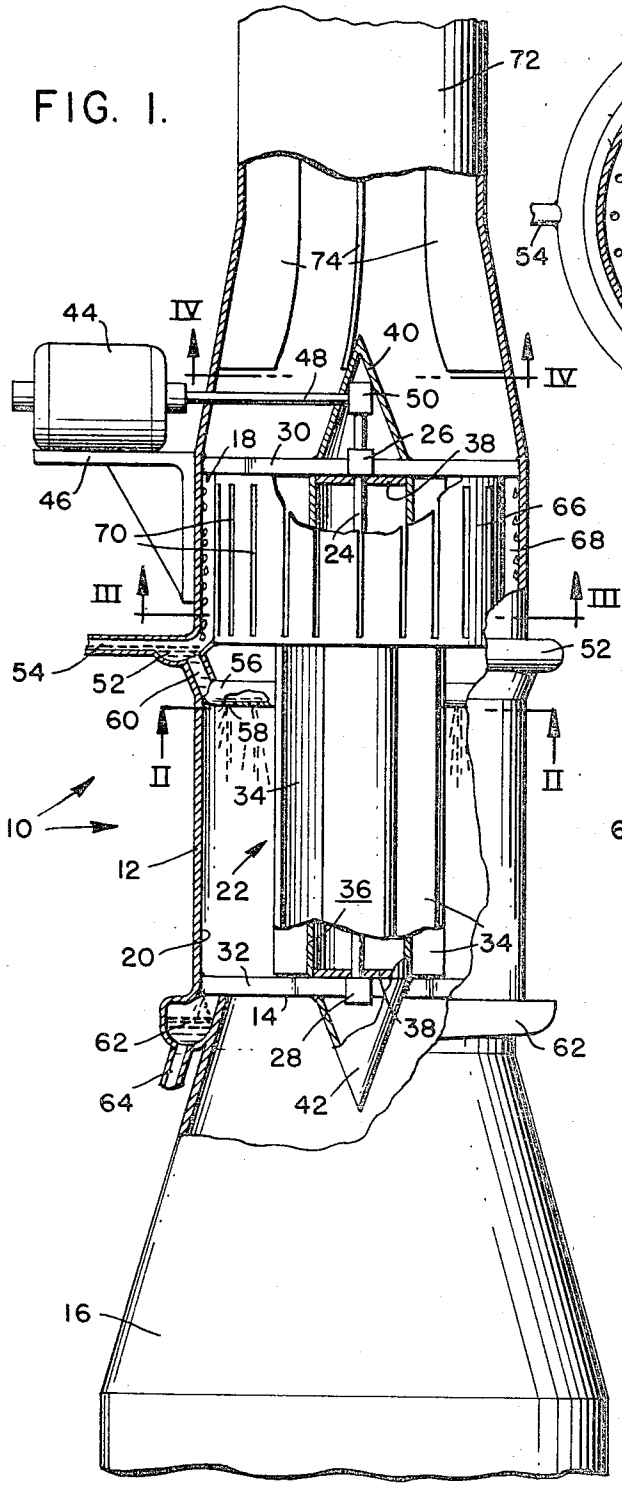
Oct. 22, 1968 LE ROY F. DEMING 3,406,500

SOOT ELIMINATOR

Filed Sept. 22. 1965

FIG. 1.



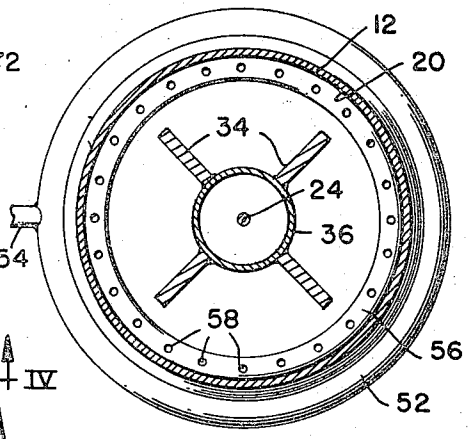


FIG. 2.

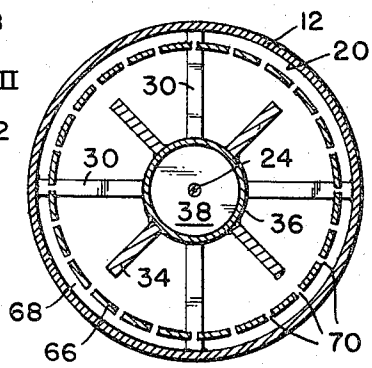


FIG. 3.

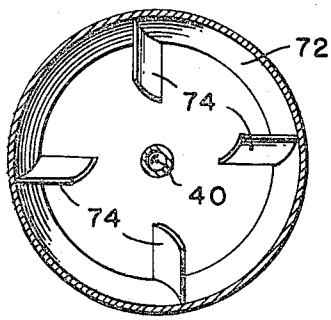


FIG. 4.

INVENTOR.
LE ROY F. DEMING
BY Erwin F. Johnston
ATTORNEY.

United States Patent Office 3,406,500 Patented Oct. 22, 1968

3,406,500

SOOT ELIMINATOR

Le Roy F. Deming, 1512 17th St. N., Arlington, Va. 22209

Filed Sept. 22, 1965, Ser. No. 489,438
4 Claims. (Cl. 55—241)

ABSTRACT OF THE DISCLOSURE

A soot eliminator which is adapted to remove soot particles which are heavier than the gases which entrain such particles. The eliminator utilizes an impeller which rotates in a smoke column within a hollow cylindrical collector. The impeller throws, by centrifugal force, the soot particles against the inner wall of the collector where a wall of water is provided to entrain the particles and carry them to a disposal area.

Air pollution is becoming an increasing problem in the various cities throughout the United States. Since a good portion of this pollution is caused by smoke emanating from boilers, incinerators, foundries, and so forth considerable research is still being undertaken to come up with new methods of preventing this smoke from being dissipated into the air. In some areas the pollution concentration becomes so great that it is considered dangerous and an alert is called to require all manufacturing plants to switch their heating means from coal or fuel oil to gas. Therefore, there is a need for an effective soot eliminator which can be easily adapted to a boiler outlet, incinerator, and so forth for removing the soot from the smoke stream emanating therefrom.

The present invention provides a compact simply constructed soot eliminator which will effectively remove the soot from a smoke stream. The present soot eliminator is adapted to be mounted within the normal stream of the smoke column and is self-cleaning so that costly maintenance is not required. The present soot eliminator may include a hollow cylindrical soot collector which has a bottom smoke receiving inlet and a top gas discharge outlet. Mounted within the hollow cylinder collector there may be an impeller means for centrifugally forcing the soot to the inner wall of the cylinder. Also mounted within the collector there may be a means for discharging wash water over the collector's inner wall so that the soot particles located thereat are washed downwardly. Mounted within the collector above the water discharging means there may be a means for trapping water particles and returning them to the water discharging means. In this manner water particles which remain in the upwardly flowing gases after the washing process will be recovered and returned to the water discharging means. An exit duct may be connected to the collector's top outlet for receiving the clean gas and a baffle means may be mounted within this duct for impeding any circular motion of this gas as it continues its upward flow.

An object of the present invention is to provide a soot eliminator which is capable of more efficiently removing soot particles from smoke emanating from a boiler outlet, incinerator and the like;

Another object is to provide a soot eliminator which employs a wash water technique and which is adapted to be connected to a smoke emanating device along the normal upward flow of said smoke;

A further object is to provide a soot eliminator which employs a wash water technique wherein water remaining in the cleaned gases is recoverable and returnable for the washing process;

Still another object is to provide a soot eliminator which forceably mixes soot particles with wash water and yet discharges the cleaned gases with a minimum of turbulence; and

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing wherein:

FIG. 1 is an elevational side view of the soot eliminator with portions cut away to show the details thereof;

FIG. 2 is a cross sectional view taken along plane II—II of FIG. 1;

FIG. 3 is a cross sectional view taken along plane III—III of FIG. 1; and

FIG. 4 is a cross sectional view taken along plane IV—IV of FIG. 1.

Referring now to the drawing wherein like reference numerals designate like or similar parts throughout the several views there is shown in FIG. 1 the soot eliminator **10** which includes a hollow cylindrical soot collector **12**. The soot collector **12** includes a bottom smoke receiving inlet **14**, which is capable of being connected to an outlet **16** of a boiler, incinerator or the like, and further includes a top gas discharge outlet **18** with a gas column extending between the inlet and outlet. Accordingly, as smoke exits the boiler outlet **16** it will pass upwardly through the soot collector **12**. Soot, for purposes of this application, shall include all solids and particulate material entrained in the gas or air stream, irrespective of the source, of which the specific gravity is greater than that of the gas entraining the material and which is therefore adaptable to removal by centrifugal force in a device such as is described herein.

Mounted within the collector **12** is a means for forcing the soot to the inner wall **20** of the collector **12**. This means may include an elongated multiple vane impeller **22** which is rotatably mounted within the collector **12** with its axis of rotation substantially aligned with the longitudinal axis of the collector **12**. The impeller shaft **24** may be journalled within top and bottom bearings **26** and **28** which are mounted within the collector **12** by top and bottom spiders **30** and **32** respectively, the spider **30** being transversely connected to the collector across its outlet **18** and the spider **32** being transversely connected to the collector across the inlet **14**.

The blades **34** of the impeller may be radially offset from the impeller shaft **24** by a large diameter tube **36** which is connected to the impeller shaft **24** by end plates **38**. The blades **34** may be mounted to the tube **36** by any suitable means such as welding. The tube **36** serves the purpose of filling the central space within the collector where the centrifugal force on the column of soot particles would be at a minimum. A cone **40** may be mounted on top of the large diameter tube **36** for protecting the bearing **26** from soot particles. A similar cone **42** may be mounted at the bottom of the tube **36** for protecting the bearing **28** and baffling the upwardly traveling smoke into the impeller area.

In order to drive the impeller **22** a variable speed motor **44** may be mounted on the exterior of the collector **12** by a welded bracket **46** with the motor shaft **48** extending transverse the collector and into the top cone **40**. A right angle gear box **50** may be connected at the upper interior end of the cone **40** by welding so as to receive the ends of the motor shaft **48** and the impeller shaft **24**. It is now readily apparent that when smoke travels upwardly within the collector **12** the impeller **22** can be rotated at a desired speed by the motor **44** to centrifugally force soot particles in the column of smoke to the inner wall **20** of the collector.

In order to capture the soot particles which have been centrifugally forced to the inner wall **20** of the collector a means may be mounted within the collector for discharging wash water over this inner wall. The wash water discharging means may include an annular wash water supply header **52** which is mounted integrally with the collector wall and intermediate the inlet and outlet **14** and **18**. Connected to the header **52** is a wash water supply conduit **54** which may be connected at an opposite end to a fresh water supply source (not shown). The wash water discharging means may further include an annular perforated tube **56** which is mounted adjacent to and circumferentially along the inner periphery of the inner wall **20** of the collector a short distance below the header **52**. The tube **56** may be provided with a series of downwardly facing perforations **58** which are adjacent the inner wall **20**, the tube **56** being connected to the header **52** by an annular conduit **60**. Accordingly, the wash water is supplied to the annular tube **56** after which the water exits through the many perforations **58** to provide a wall of water about the inner wall **20** around the outer periphery of the gas column of the collector **12**. The outwardly thrown soot particles are mixed with this wall of water and are carried downwardly within the collector to an annular scavenging trough **62**. The scavenging trough **62** may be integral with the wall of the collector **12** and may be mounted at its inlet end **14**. A drain pipe **64** may be connected to the scavenging trough **62** for draining the soot filled water to a sewer system, or to a filter where it can be cleaned and made available for recirculation.

Because of the turbulence of the upwardly rising gaseous products within the collector **12** there may be some water particles entrained in the gas above the annular tube **56**. It is desirable that these water particles be removed from the upwardly moving gas and returned to the wash water header **52**. In order to accomplish this a means has been mounted within the collector above the wash water tube **56** for trapping the water particles and returning them to the header **52**. The water trapping means may include an inner hollow cylinder **66** which is concentrically mounted in a spaced relationship within the collector **12** so as to provide an annular space **68** therebetween. Accordingly, the space **68** will provide a drain area for returning water to the header **52**. The bottom end of the hollow cylinder **66** may be integrally connected with the header **52** and a top end of the cylinder **66** may be connected to the spider **30** by welding. Intermediate the top and bottom ends of the cylinder **66** are vertically extending slots **70** which communicate the interior of the collector **12** with the annular space **68**. Accordingly, the upwardly rising water particles are centrifugally forced outwardly by the impeller **22** onto the inner surface of the cylinder **66** where the water particles will collect and run into the annular space **68** through the slots **70**. The water collected within the annular space **68** will then drain down the interior wall **20** of the collector into the header **52** whereupon it will be fed to the annular tube **56** for further washing purposes.

A slight amount of water may still be entrained within the circular moving gaseous products as they leave the outlet end **18** of the collector. It is desirable that as much of this water as possible be returned to the collector so that it can be forced through the slots **70** into the annular drain area **68**. As shown in FIG. 1 an exit duct **72** is connected to the upper outlet end **18** of the collector. This exit duct may be connected at an opposite end to a chimney which will dissipate the gases into the atmosphere. The water particles within the column of gases in the exit duct **72** may be returned to the collector **12** by a baffle means which is mounted within the exit duct for impeding the circular motion of the gases. The baffle means may include a series of baffles **74** which are mounted to the inner wall of the exit duct **72** and which extend inwardly with a slight curve opposite to the circular motion of the upwardly rising gases. These baffles **74** will slow the circular motion of the gases thereby causing entrained water particles to fall or drain into the collector **12** and within the cylinder **66** where they can be recovered for washing purposes.

The soot eliminator may be constructed mainly of sheet metal and metal parts. The various components may be connected together by any suitable means such as welding.

In the operation of the soot eliminator the upwardly rising smoke from the boiler outlet **16** is caused to undertake a high circumferential velocity within the collector **20** due to the action of the impeller **22**. The soot particles within the upwardly rising smoke column are forced outwardly onto the inner wall **20** of the collector where a wall of water captures and entrains these particles and washes them downwardly into the scavenging trough **62**. The water particles entrained within the upwardly rising cleaned gases are then recovered in the trough **62** after they are forced through the slots **70** by the action of the impeller **22**. Water which is still entrained in the gases leaving the outlet **18** is returned by the baffles **74** to the water recovering cylinder **66**.

It is now readily apparent that the present invention provides an easily constructed soot eliminator which will efficiently remove soot particles from a smoke column. The soot eliminator uses wash water techniques to provide a maximum cleaning of the gaseous products and yet the soot eliminator can be mounted to a smoke discharging apparatus along the normal upward movement of the smoke column.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A soot eliminator comprising:
a hollow cylindrical soot collector having a bottom smoke receiving inlet, a top gas discharge outlet, and a gas column therebetween;
rotatable impeller means mounted within said collector for centrifugally throwing soot particles from the gas column toward the inner wall of the collector;
means mounted within said collector substantially adjacent to and circumferentially along the inner periphery of the inner wall for discharging wash water over said inner wall around the outer periphery of the gas column so as to provide a peripheral wall of wash water about the gas column for receiving said soot particles;
motor means connected to the impeller means for rotating said impeller means;
means mounted within said collector above the water discharging means for trapping water particles and returning them to the water discharging means;
means for forcing said water particles to the water trapping means;
the means for forcing the soot to the inner wall and the means for forcing the water particles to the water trapping means is said rotatable impeller; and
said water trapping means including:
an inner hollow cylinder concentrically mounted in a spaced relationship within the collector;
the inner cylinder having longitudinal slots for receiving the water particles; and
the water discharging means opening into the space between the inner hollow cylinder and the collector opening for receiving water trapped in said space.

2. A soot eliminator comprising:
a hollow cylindrical soot collector having a bottom smoke receiving inlet, a top gas discharge outlet, and a gas column therebetween;
impeller means mounted within said collector for

centrifugally forcing soot particles from the gas column toward the inner wall of the collector;

said impeller means including:

a central hub which extends in axial alignment along the collector throughout substantially the full length of said wall of wash water; and

a plurality of vanes mounted on said hub and extending along the hub throughout substantially the full length of said wall of water;

means mounted within said collector substantially adjacent to and circumferentially along the inner periphery of the inner wall for discharging wash water over said inner wall around the outer periphery of the gas column so as to provide a peripheral wall of wash water about the gas column for receiving soot particles;

means mounted within said collector above the water discharging means for trapping water particles and returning them to the water discharging means;

an exit duct connected to the collector's top outlet for receiving the cleaned gas;

baffle means mounted within the exit duct for impeding any circular motion of said gas;

motor means connected to the impeller means for rotating said impeller means;

said water discharge means including:

an annular header mounted about the collector's inner wall;

said annular header being open on a top side for receiving the trapped water particles from the water trapping and returning means; and

an annular perforated tube also mounted about the collector's inner wall below the annular header and connected to the header for receiving wash water therefrom;

a wash water scavenging trough mounted about the collector's inner wall near the bottom inlet for receiving the soot filled wash water;

said water trapping means including:

an inner hollow cylinder concentrically mounted in a spaced relationship within the collector;

the inner cylinder having longitudinal slots for receiving the water particles; and

the space between the inner hollow cylinder and the collector opening into the water discharging means.

3. A soot eliminator as claimed in claim 2 wherein:

said impeller means extends into said inner hollow cylinder for centrifugally forcing the water particles through the slots of the inner hollow cylinder.

4. A soot eliminator as claimed in claim 3 including:

a wash water scavenging trough mounted about the collector's inner wall near the bottom inlet for receiving the soot filled wash water.

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HARRY B. THORNTON, *Primary Examiner.*

B. NOZICK, *Assistant Examiner.*