Sept. 4, 1956 B. O. BROMAN 2,761,652

DEVICE FOR CLEANING GAS-SWEPT HEATING SURFACES IN HEATING APPARATUS AND THE LIKE

Filed Dec. 18, 1953

4 Sheets-Sheet 1

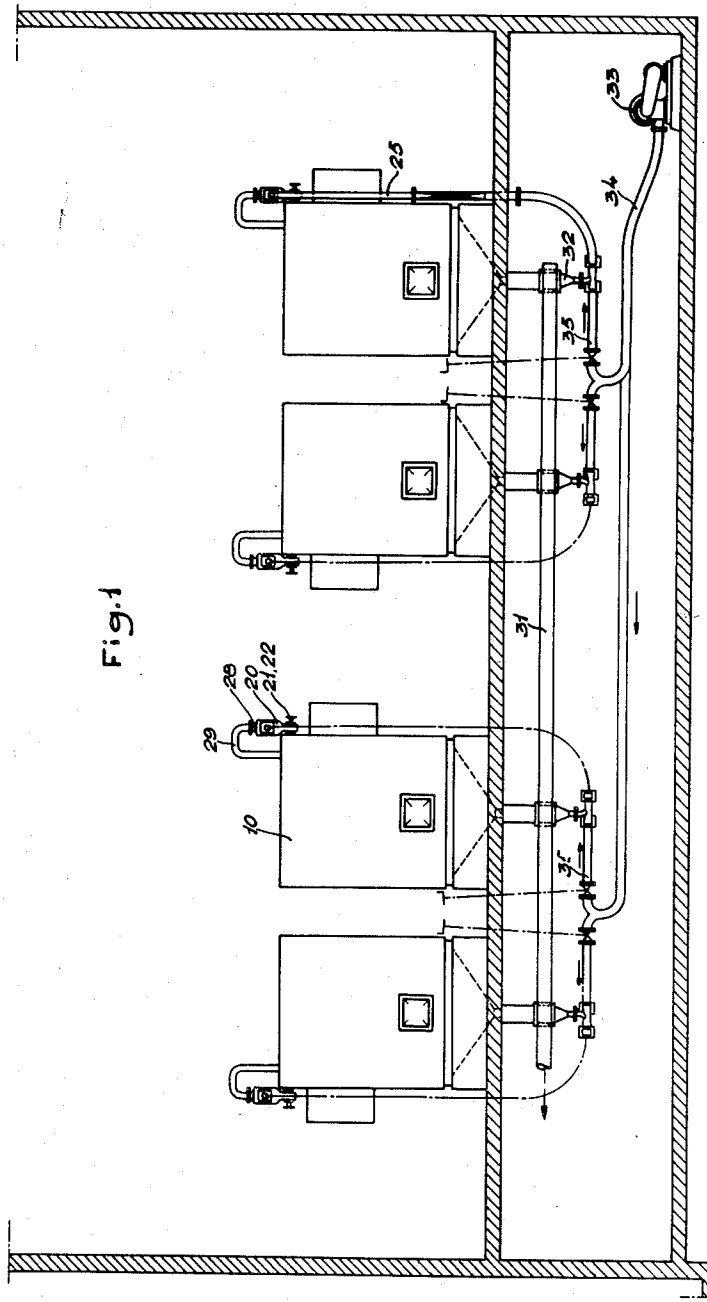


Fig. 1

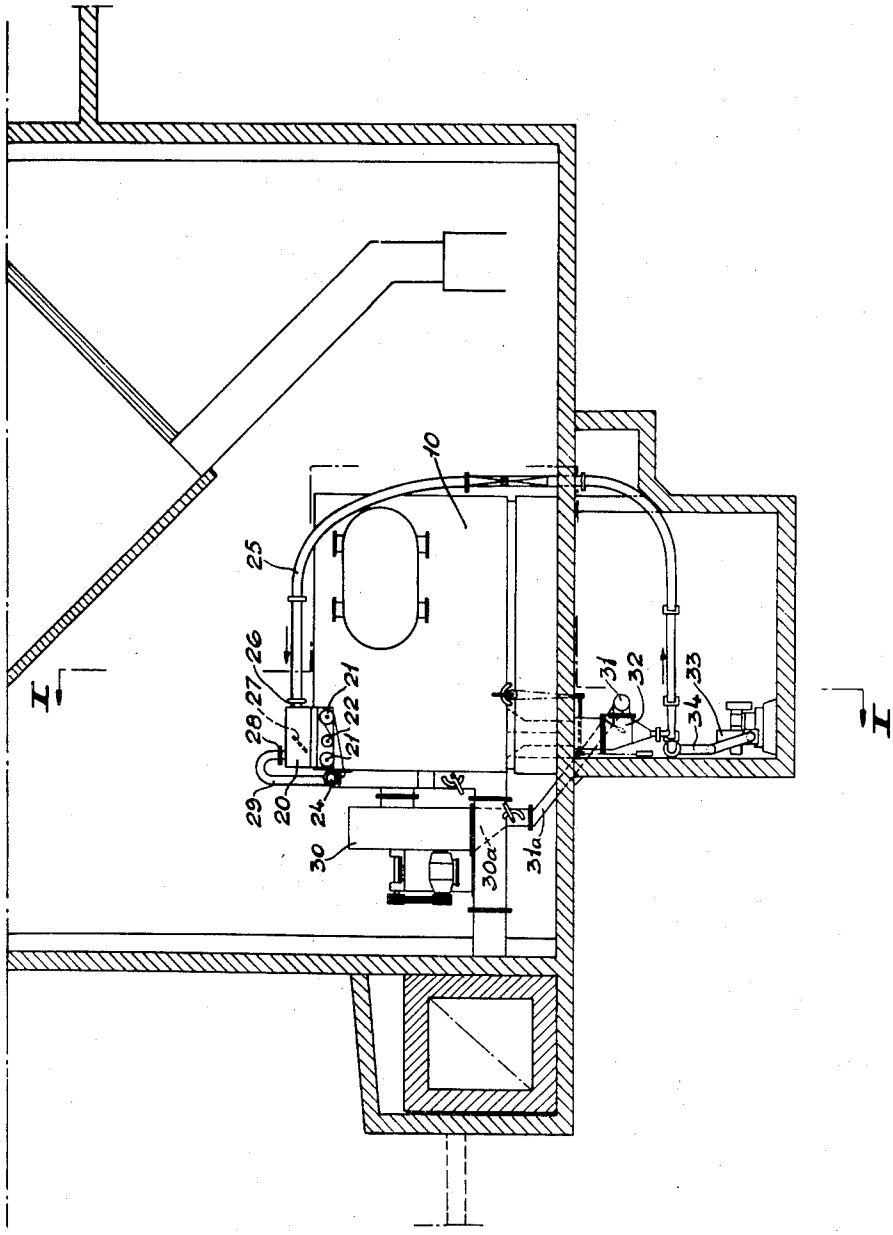
Inventor
B. O. Broman
By Glascock Downing Seibold
Attys.

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Filed Dec. 18, 1953 4 Sheets-Sheet 2

Fig. 2



Inventor
B. O. Broman
By Glascock Downing Seebold
Attys.

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Filed Dec. 18, 1953 4 Sheets-Sheet 3

Fig. 3

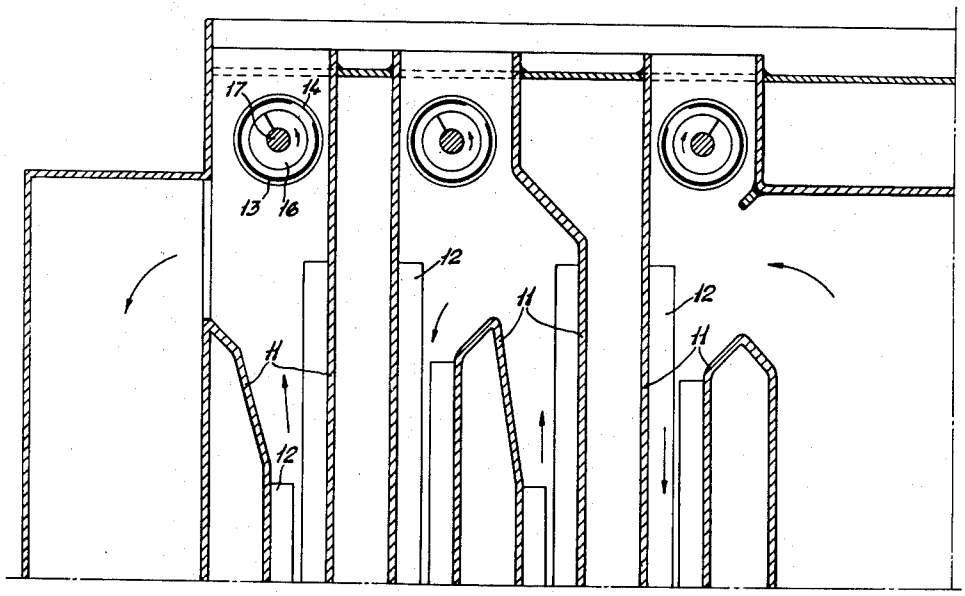
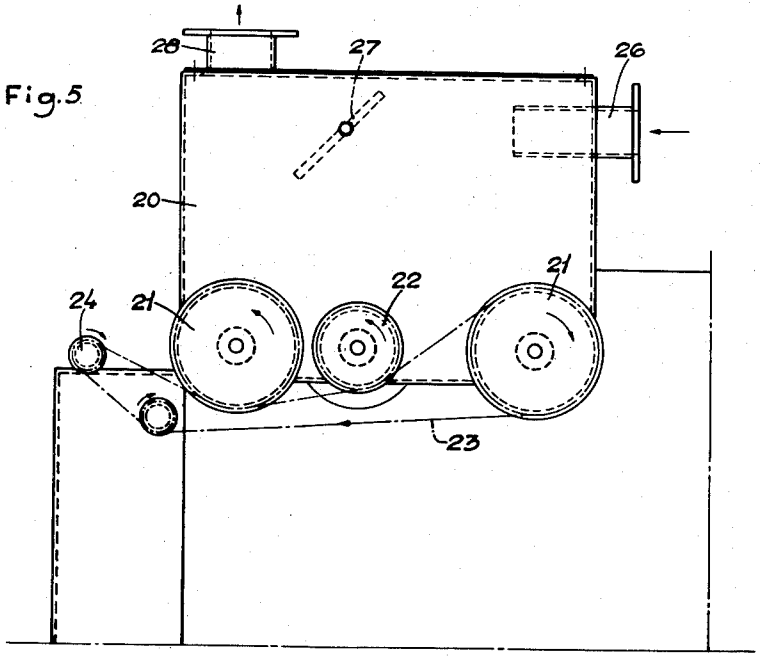


Fig. 5



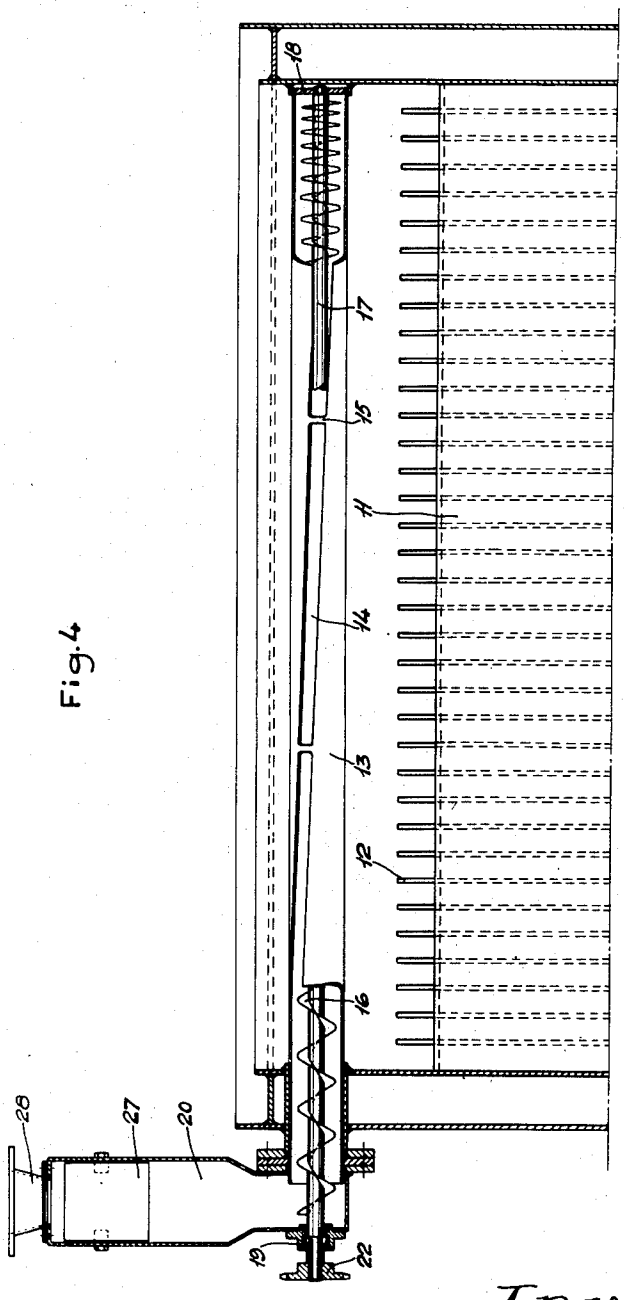
Inventor
B. O. Broman
By Glascock Downing Seebold
Attys.

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Filed Dec. 18, 1953 4 Sheets-Sheet 4

Fig. 4



Inventor
B. O. Broman
By Glenn Dorsey Tuttle
Attys.

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DEVICE FOR CLEANING GAS-SWEPT HEATING SURFACES IN HEATING APPARATUS AND THE LIKE

Bror Olof Broman, Stora Essingen, Sweden, assignor to Aktiebolaget A. Ekstroms Maskinaffar, Stockholm, Sweden

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Claims priority, application Sweden December 20, 1952

7 Claims. (Cl. 257—1)

By using the action of cleaning particles, preferably consisting of steel shot, which are caused to drop against gas-swept heating surfaces in heat exchanging apparatus and the like, very good results with regard to the cleaning action and the operating conditions for apparatus cleaned in that manner have been attained. Usually some mechanical device is provided for distributing the cleaning particles over the area to be treated, before the particles drop against the heating surfaces, and the particles as a rule are subsequently recovered and recycled. The area over which the cleaning particles are to be distributed as a rule has a width which does not very much differ from its length, and the distributor devices used for this purpose therefore are designed in such a manner that an even or desired distribution over said area is attained.

When the horizontal sectional area of the heating surfaces has a comparatively elongated and narrow shape it is not apt to distribute the cleaning particles evenly in all directions, and distributor devices giving such even distribution are not suitable. The cleaning particles should be distributed in such a manner that their action will be the most effective, and the present invention has for its object a method in cleaning gas-swept heating surfaces in preferably such heating boilers and the like in which the heating surfaces limit essentially vertical and shallow channels which in their turn may be subdivided into smaller compartments by vertically disposed supporting flanges which increase the heat transmission, and this method is characterised in that the cleaning particles which preferably consist of steel shot, are fed out so as to form screens with a distribution of the cleaning particles which is essentially adapted to the heating surfaces, by means of movable members which are disposed essentially along the whole length of said channels.

The invention also has for its object devices for operating the method. A such device is characterised in that above said channels and essentially parallelly to the latter distributing devices for the cleaning particles are disposed which comprise tubes, each surrounding a rotatably disposed feed screw which extends along the whole feeding length, said tubes having each an essentially longitudinally extending slot for the feeding out of the cleaning particles so as to form falling screens.

Further objects, features and advantages of the invention will be evident from the following description of an embodiment of the invention given by way of example, reference being had therein to the appended drawings.

In the drawings Fig. 1 is a front elevation partly in section along line I—I in Fig. 2 of a boiler plant comprising four heating boilers. Fig. 2 is a side elevation partly in section through the same plant. Fig. 3 shows a partial longitudinal section through the top of a heating boiler showing the disposition of the heating surfaces. Fig. 4 is a vertical cross section through the same portion of the boiler. Fig. 5 is a detail view of a hopper device disposed at the top of the boiler.

The plant illustrated in Figs. 1 and 2 is a heating plant

with great capacity equipped with four heating boilers 10. The heating surfaces 11 of the boilers (Fig. 3) extend essentially vertically, and the channels formed by the heating surfaces are comparatively narrow, but have an important height and width. On the heating surfaces 10 essentially vertical, heat transmitting and stiffening flanges 12 are provided, and the channels are subdivided into a plurality of smaller compartments by said flanges.

In Fig. 3 the flow directions of the flue gases between the heating surfaces are indicated by arrows. Above the heating surfaces distributing devices for the steel shot are provided to feed out the steel shot along the heating surfaces which are hit by the shot. The distributing devices comprise tubes 13 of heat resistant steel which are disposed transversally within the boiler and run parallel to the heating surfaces. One such tube is shown in greater detail in Fig. 4 which shows the tube rigidly connected by its ends to the side walls of the boiler. In the tube wall a helical slot 14 with a very great pitch is formed, and said slot extends from near the one side wall of the boiler close to the upper side of the tube and runs with a downward inclination to the proximity of the opposite side wall of the boiler. The slot 14 is not continuous, but is interrupted by spaced remaining portions 15 of the wall material for the purpose of giving the tube sufficient strength. The slot may run continuously, but in that case reinforcing pieces may be welded or otherwise secured to the tube to provide reinforcements.

Within each tube 13 a screw member 16 is coaxially disposed, and the shaft portion 17 of said screw member is journalled at one end in a plate 18 which shuts off one end of tube 13 and at the other end in a bearing 19 secured to a container 20 which is supported by the top portion of the opposite end of the boiler. The outer diameter of screw member 16 is smaller than the inside diameter of the tube 13 by such an amount that single cleaning particles cannot jam between the screw member and the tube wall. The open end of tube 13 opens into the bottom portion of the container 20, and if screw member 16 is rotated oppositely to the pitch direction of its thread steel shot held by container 20 will be fed along through the tube, and will drop through slot 14 in the tube wall so that a screen of dropping particles will hit against the heating surfaces 11 and will remove dust and coatings adhering thereto.

For the purpose of evenly distributing the steel shot along the whole length of slot 14 the pitch of screw member 16 is such that it decreases progressively from the intake end on. This disposition is explained by the fact that the screw member which has to feed particles to consecutive portions of tube 13 should have a conveying capacity which corresponds to the distances between the said consecutive portions and the intake end, so that the foremost portion of the screw member which has to convey the whole quantity of steel shot has the greatest pitch while the pitch of the subsequent portions should decrease accordingly.

It is, however, not sufficient that the screw member has a progressively decreasing pitch to attain an even distribution of the steel shot. If slot 14 should run parallel to the screw axis of the result would be in practice that a greater quantity of steel shot would be fed out through the portions of the slot which are closer to the intake end of the screw member than to the more distant portions, and that is the reason for disposing the slot essentially along a helical curve the pitch of which is opposite to that of the screw member and being so arranged that its position in the tube wall will be progressively lower in the feed direction. When the pitch of the screw is correctly chosen with respect to the in-

clination of the slot and the position of the latter in the tube wall a very satisfactory and even distribution of the steel shot along the whole length of the slot can be attained, and that fact has been proved in practice.

The pitch of the screw member need not decrease continuously, but can be uniform within different portions of the screw, with the respective portions being arranged with successively decrease pitches whereby the pitch of the screw generally decreases.

Fig. 3 illustrates the disposition of three tubes **13** with screw members **16**, **17** with regard to the heating surfaces **11**. The middle tube and its slot **14** are so arranged that both sides of adjacent heating surfaces may be acted upon by steel shot fed out from that single tube.

With regard to the elevated flue velocities in the boiler the cleaning should not be performed in full operation or continuously since the downward gas flow in certain channels may produce a blasting action which is to be avoided on account of the increased wear of the heating surfaces, while the upward gas flow in other channels may approach or exceed the dropping velocity of the cleaning particles, and in such case the cleaning action will fail partly or completely. The cleaning must therefore be performed during idling conditions or with the boiler cut out. The gas velocity should, however, be so elevated that the dust particles carried by the flue gases will be brought along by the latter.

The central or shaft portions **17** of screw members **16** are extended beyond their bearings **19** and carry each a chain wheel. The chain wheels **21** for the outer screws are of equal size while the middle one **22** is smaller. The chain wheels **21**, **22** are rotated by a chain **23** which is driven from a chain wheel **24** connected to a motor (not shown). Chain wheel **22** is smaller than chain wheels **21** since the screw **16** actuated by the former has to feed a greater quantity of steel shot than the other screws, the former screw feeding steel shot to twice the number of heating surface as either of the other screws.

The steel shot is fed to the container **20** through a conduit **25** connected to the bottom portion of the boiler. The steel shot having passed the heating surfaces and having cleaned the latter is collected at the bottom of the boiler and is conveyed through conduit **25** to an intake **26** the mouth of which faces an inclined baffle member **27** disposed within the container and arranged to deflect the steel shot against the bottom of the container. An air vent **28** in the top of the container conveys the air flow which is drawn off by the flue gas suction fan **30** of the boiler through a conduit **29**. Suction fan **30** separates dust contained in the flue gases to a pocket **30***a* disposed below the fan, and pocket **30***a* is connected to another conduit **31** through a conduit **31***a*. The collected dust is carried along by another suction fan (not shown). The steel shot and the heavier removed dust is conducted to a separating device **32** underneath the boiler, whereafter the steel shot is fed into conduit **25** by injecting while the dust mixed with the steel shot is drawn from the separating device through conduit **31**. The drawing off of soot and dust from the separating device **32** may be operated continuously which may be desirable as some soot and dust will be fed to the separating device even during normal operation of the boiler when cleaning does not take place.

In the embodiment having just been described the tubes **13** are horizontally disposed and slots **14** extend with a certain downward inclination in the feed direction. As an alternative the tubes themselves may be inclined and in that case the screw member might have a uniform pitch. The position of slot **14** in that case may be suitably modified.

If the arrangement of the heating surfaces should be such that an uneven distributing intensity along the length of the slot would be desirable, that may be attained within certain limits by modifying the pitch of the screw member **13** and the arrangement of slot **14**.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A distributing means for simultaneously introducing and spreading solid cleaning particles within a compartment of greater length than width and within which compartment are means providing heat exchange surfaces defining at least one vertically extending narrow channel comprising a stationary tube exending across the compartment axially of its length, parallel to the channel and above the surfaces, a rotatable feed screw of varying pitch within the tube, said tube being slotted substantially coextensive in length therewith and along one side only of the tube in a direction oblique to the axis of the tube to define at least one narrow discharge opening through which particles fed by the screw pass to fall in the form of a falling curtain of particles extending substantially throughout the length of the compartment.

2. A distributing means for simultaneously introducing and spreading solid cleaning particles within a compartment of greater length than width and within which compartment are means providing heat exchange surfaces defining at least one vertically extending narrow channel said distributing means comprising a stationary tube extending across the compartment axially of its length parallel to the channel and above the surfaces, a rotatable feed screw of varying pitch within the tube, said tube being slotted substantially coextensive in length therewith along one side only of the tube in a direction obliquely of the axis of the tube to define at least one narrow discharge opening through which particles fed by the screw pass to fall in the form of a falling curtain of particles extending substantially throughout the length of the compartment, means closing one end of the tube, said tube being open at its other end and means operably associated with the open end for introducing particles into the tube and the pitch of said screw decreasing in a direction away from the open end and toward the closed end of the tube.

3. A distributing means as claimed in claim 2 in which the tube is slotted along a helical curve and which curve is inclined downwardly from the open end to the closed end of the tube.

4. A distributing means as claimed in claim 2 in which the slot that extends along the tube is continuous.

5. A distributing means as claimed in claim 2 in which the tube is interruptedly slotted to provide plural closely spaced slots extending along the length of the tube, said slots being separated from one another by narrow portions of the tube and said feed screw being of continuously decreasing pitch in a direction away from the open end of the tube.

6. A distributing means as claimed in claim 1 in which the feed screw has axially spaced portions each having the same pitch with successive portions being of a decreased pitch.

7. In heat interchanging apparatus of the type including a casing having side walls and a top wall, the improvement comprising a plurality of compartments within the casing each having greater length than width, means providing heat exchange surfaces within each compartment and defining at least one vertically extending narrow channel in each compartment extending substantially coextensive in length therein, gas inlet and outlet means communicating with the compartments so that gas flowing therethrough can pass in heat exchange relationship with said surfaces, stationary tubes supported within the casing above the surfaces in each compartment and extending at least coextensive in length with the length of the channel in each compartment and parallel thereto, each tube having an end extending beyond the adjacent side wall of the casing, a hopper means supported exteriorly of the casing, the projecting end of each tube being open and disposed within the hopper means, the opposite end of each tube being closed, each tube being slotted

along the length thereof within the compartments with the slot being disposed essentially to one side of the vertical median plane of the tube and extending obliquely to the axis of the tube and inclined downwardly from the end of the tube adjacent to the hopper means to the closed end of the tube, a feed screw rotatably supported within each tube and including a shaft having a portion extending through the hopper means, drive means connected to the extending portion of each shaft, each said screw having a pitch decreasing progressively in a direction from the hopper to the closed end of the tube, said hopper including a top having an outlet therein, means for introducing a stream of solid cleaning particles within the hopper, any dust accompanying said particles being separated within the hopper and passing out the outlet, means for simultaneously driving all said drive means whereby rotation of the said feed screws forces particles

through the slot in each tube to fall by gravity in the form of a falling curtain of particles extending throughout each channel to clean the surfaces, and means for recovering the particles and introducing them into the means for feeding the same into the hopper to provide a continuous flow of particles.

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