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L. J. HERSH

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SEPARATOR

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Fig. 2.

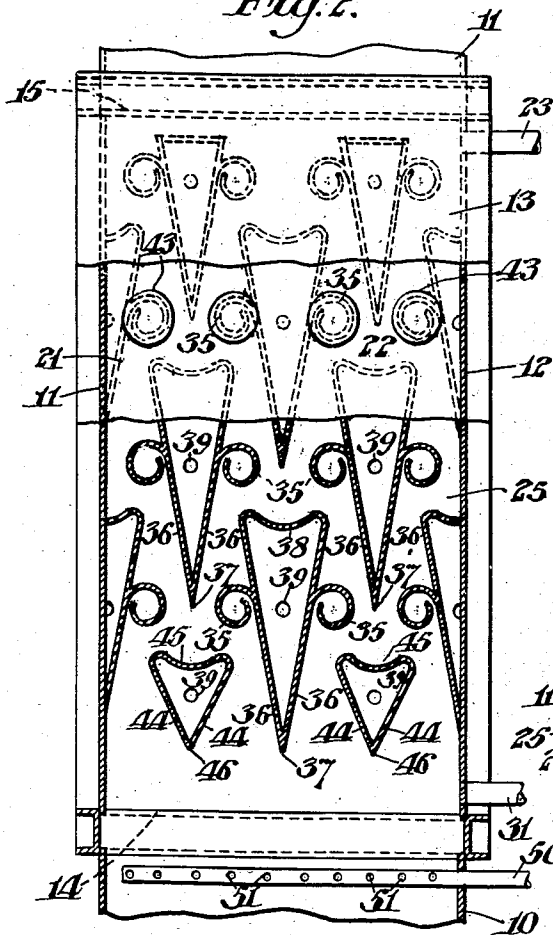


Fig. 1.

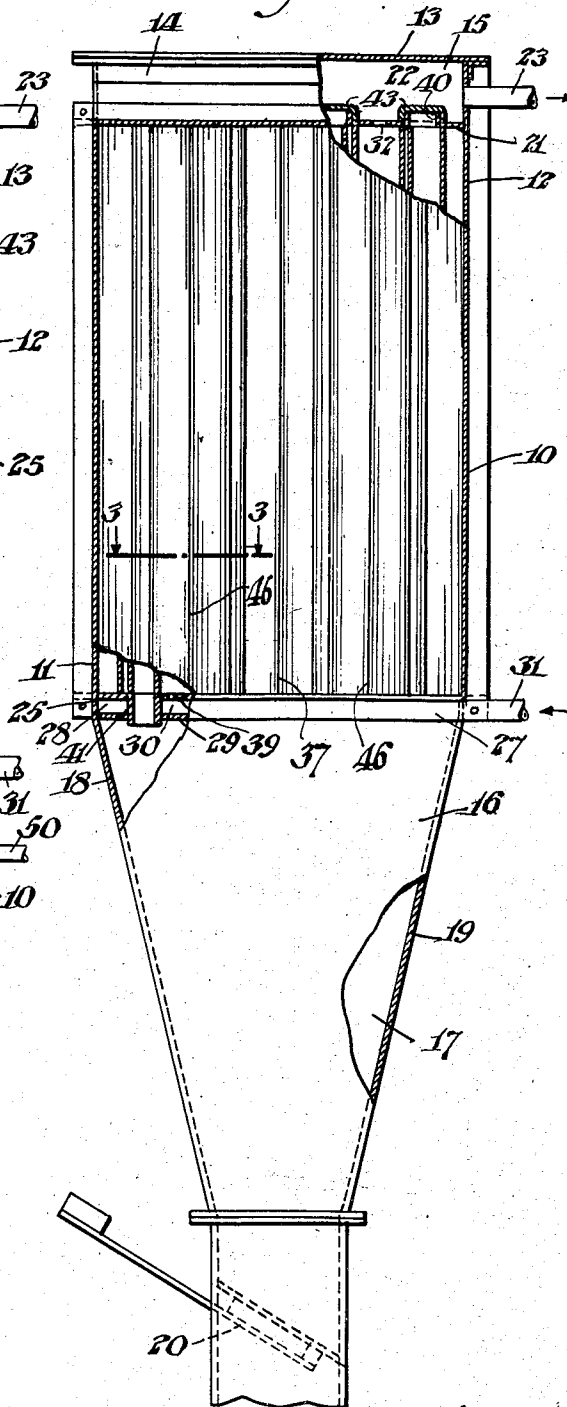
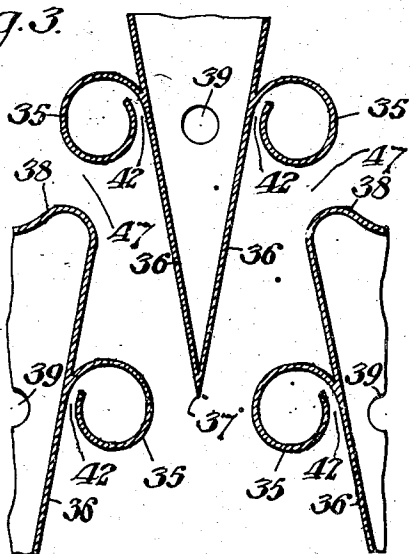


Fig. 3.



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6 Claims. (Cl. 183—23)

This invention relates to separators and more particularly to a separator for removing suspended solid particles of small sizes from a gaseous stream. The solid particles may be dust, ash, soot, or the like, and the gaseous stream may consist of the products of combustion from furnaces, an air stream or the like, or the gaseous stream exhausting from a kiln.

This invention relates further to a separator of the character aforesaid, having a wide range of adaptability whereby the same may be utilized for the dry collecting of solid particles, the dry collecting of solid particles with cooling, or the wet collecting of solid particles with or without cooling.

This invention is an improvement upon the separator shown and described in my prior application for Letters Patent, filed October 4, 1941, Serial No. 413,603, and contemplates particularly an improved character of path for handling the fluid stream within which the solid particles are carried in suspension and the separation of the solid particles in a more effective manner.

It is a further object of the present invention to provide a separator of greater effectiveness than has heretofore been available while keeping to a minimum the pressure drop through the separator.

It is a further object of the present invention to provide a separator capable of operating at higher temperature ranges than the separators heretofore available.

Other objects of the invention will be apparent from the annexed specification and claims.

The nature and characteristic features of the invention will be more readily understood from the following description, taken in connection with the accompanying drawing forming part thereof, in which:

Figure 1 is a front elevation view of a separator embodying the main features of the invention, parts being broken away to show the interior construction thereof;

Fig. 2 is a view of the separator shown in Fig. 1 partly in plan and partly in section at different horizontal levels showing the details of construction and;

Fig. 3 is a horizontal sectional view taken approximately on the plane indicated by the line 3—3 of Fig. 1, and on a larger scale, to illustrate the details of the separator elements and the path of flow of the gases and the separated solid particles.

It will, of course, be understood that the de-

scription and drawing herein are illustrative merely, and that various modifications and changes may be made in the structure disclosed without departing from the spirit of the invention.

Referring more particularly to the drawing, in which a preferred embodiment of the invention is illustrated, a separator is provided having a gas delivery duct 10 connected to the inlet side and a gas discharge duct 11 connected to the outlet side thereof. The separator includes vertical side walls, 11 and 12, a horizontal top wall 13 and upper front and rear walls 14 and 15 extending downwardly from the top wall 13. Inclined lower front and rear walls 16 and 17 and inclined side walls 18 and 19 are provided forming a collecting hopper. The lower end of the hopper is preferably provided with suitable gates 20 for controlling the discharge of the collected solid particles.

Adjacent to the top wall 13 and spaced downwardly therefrom an upper horizontal tube sheet 21 is provided. The tube sheet 21 is preferably connected at its edges to the vertical side walls 11 and 12 and to the front and rear walls 14 and 15 in fluid tight relationship. The top wall 13, the front wall 14, the rear wall 15, and the upper portions of the side walls 11 and 12 provide a closed upper fluid chamber 22 with which a fluid discharge pipe 23 is in communication.

A lower horizontal tube sheet 25 is also provided at the lower ends of the side walls 11 and 12. The lower tube sheet 25 is disposed parallel to the upper tube sheet 21. The lower tube sheet 25 is also preferably connected to the side walls 11 and 12 and to lower front and rear walls 27 and 28 in fluid tight relationship. A lowermost tube sheet 29 is also provided, spaced below the lower tube sheet 25 and is also preferably connected to the side walls 11 and 12 and to the lower front and rear walls 27 and 28 in fluid tight relationship. The lowermost tube sheet 29 serves as an upper closure wall for the hopper. The space between the tube sheet 25, the tube sheet 29, the side walls 11 and 12, the lower front and rear walls 27 and 28 constitutes a lower fluid chamber 30, and a fluid delivery pipe 31 is in communication therewith. In the space between the vertical side walls 11 and 12, the upper tube sheet 21 and the lower tube sheet 25 vertically disposed guiding and separating members are provided in the path of the gas flow. The separator members preferably include tube elements 35 in the form of scrolls and oppositely curved. The separator members of one row are

preferably staggered with respect to the separator members of the next succeeding row. Each pair of tube elements 35 in one row is tangentially connected to a pair of forwardly extending vertical guide plates 36 which terminate at an apex 37 at their front ends. The vertical plates 36 are connected at their rear ends preferably by portions 38 which are curved to provide a smooth path of gas flow. The interior spaces within the vertical guide plates 36 and the curved connecting plates 38 are preferably in communication respectively with the lower chamber 30 through openings 39 and the upper chamber 22 through openings 32. The tube elements 35 are preferably formed from suitable straight lengths of piping or tubing, such as boiler tubes or the like cut lengthwise. The tube elements 35 preferably have the upper end portions 40 which extend above the upper tube sheet 21 and the lower end portions 41 which extend between the lower tube sheet 25 and the lowermost tube sheet 29 and below the lowermost tube sheet 29, cylindrical and undeformed. The portions of the tube elements 35 which lie between the upper tube sheet 21 and the lower tube sheet 25 are bent into scroll shape. This is preferably accomplished by cutting or slitting the tubes longitudinally and bending the portions of the tube elements along the slit into a curve having the characteristics of an involute or spiral. The tube elements 35 are preferably secured respectively to the upper tube sheet 21 and to the lower tube sheet 25 in fluid tight relationship. The shaping of the scrolls and their tangential arrangement with respect to the guide plates 36 thus provides narrow converging openings 42 into the interior of each of the scroll portions.

The upper ends 40 of the tube elements 35 within the upper chamber 22 are preferably closed by caps 43 which prevent any flow of gas into the upper chamber 22, from the interiors of the scrolls 35 and prevent any flow of liquid from the chamber 22 into the interior of the scrolls 35. The caps 43 may be removed for cleaning.

The lower ends 41 of the tube elements 35 below the lowermost tube sheet 29 are in communication with the hopper for the delivery of separated solid material into the hopper.

At the front of the separator guide baffle plates 44 connected at their rear ends by curved plates 45, are provided for initially guiding the fluent stream entering the separator from the delivery duct 10 into the proper relationship with respect to the tubular elements 35. The interior spaces within the vertical plates 44 and the curved plates 45 are preferably in communication respectively with the lower chamber 30 through the openings 39 and the upper chamber 22 through the openings 32.

It will be seen that provision is made for dividing the gaseous stream at the respective apices 37 and directing the several streams towards the converging openings 42. The respective divided streams of gas then pass transversely or sidewise at 47 between the rear of the baffle plates 38 and the outside of the scroll tubes 35 for further treatment and for subsequent discharge into the discharge duct 11.

At the front of the separator, if desired, spray pipes 50 having a plurality of spray nozzles 51 may be provided for introducing liquid in finely divided or mist form for cooling the gaseous stream or for wet collecting of the solids from the gaseous stream.

The mode of operation of the separator of the present invention will now be pointed out.

The dust laden gaseous stream with its solid content of ash, cinders, cement or the like is delivered by the duct 10 to the separator with a pressure derived from a fan (not shown) connected to the delivery duct 10, from an induced draft fan (not shown) connected to the discharge duct 11, or in any other desired manner.

The dust laden gaseous stream upon entering the front of the separator is divided by the apices 37 and 46 of the plates 36 and of the plates 44 into a plurality of directed streams. These directed streams are guided by the walls 36 and the walls 44 towards the converging openings 42. The solid particles in the divided gaseous streams are impelled in a converging path and in a direction towards the converging openings 42. The solid particles in large proportion leave the gaseous stream by reason of the momentum imparted thereto, enter the converging openings 42 and pass into the interiors of the tube elements 35 of the first row. The gaseous streams then pass transversely between the outer surfaces of the scroll tubes 35 and the rear of the walls 36, are redivided by the next row of apices 37 of the plates 36 and are directed into converging paths, as before, for delivery of solid particles into the interiors of the next succeeding row of tubular elements. This redividing of the gaseous streams is repeated successively at each row of apices 37 and the separating of dust particles is effected at each row of converging openings 42.

The gaseous streams are prevented from entering the interior spaces of the tubular elements 35 because of the narrow character of the converging openings 42. The tops of the scrolls 35 are closed at the tops by the caps 43 and the hopper is likewise closed. The interior spaces of the scroll elements 35 function as dead gas spaces, substantially free from pressure changes. The interior spaces and the hopper have a pressure slightly above or slightly below that of the gaseous stream in the separator in accordance with the use of a forced or induced flow of the gaseous stream through the separator.

The solid particles delivered into the interiors of the tubes 35 have a spiral motion imparted thereto upon their introduction and fall by gravity downwardly in the tubular elements 35 and into the hopper. The solid particles, in falling, tend to adhere to and aid in the downward delivery of other solid particles and the generally downward spiral motion of the particles produces a scouring action in the interior spaces of the scroll tubes 35.

The solid particles are collected in the hopper and may be withdrawn from time to time as desired. The interior of the hopper because of its closed condition remains in a quiescent state and there is no return of the collected solid particles to the advancing gaseous stream.

The gas, freed of its content of solid particles passes out the rear side of the separator and into the gas discharge duct 11.

With certain types of dust or solid particles laden gas the temperature of the gas is beyond that which the walls are capable of withstanding without injury. To overcome this provision is made for circulating cooling fluid in the interior spaces. Cooling fluid, such as water is delivered through the pipe 31 to the lower chamber 30, passes through the openings 39 into the interior spaces and upwardly therein, and then through

the openings 32 into the upper chamber 22 for delivery through the discharge pipe 23.

For other types of gaseous stream and for cooling or moistening, or both, it is desirable to introduce a fluid in spray or mist form directly into the gaseous stream. For this purpose fluid is delivered through the pipes 50 and the spray nozzles 51 into the advancing gaseous stream and intermixes therewith. The solid particles are cooled or wetted, or both, prior to their delivery through the converging openings 42 into the interiors of the scroll tubes 33 and their subsequent discharge into the hopper.

It will thus be seen that the separator of the present invention has a wide range of adaptability and has greater capabilities of usefulness than most of the separators heretofore available.

I claim:

1. Apparatus for separating suspended solid particles from a gaseous stream which includes a chamber bounded at the top and bottom by spaced upper and lower tube sheets, a closed hopper below said lower tube sheet, vertical particle separator members in staggered rows extending between said tube sheets, each of said separator members comprising a pair of rearwardly flaring deflecting members meeting at their front ends and closed at their rear ends and oppositely arranged scroll elements outside said deflecting members on each side thereof and respectively connected tangentially to said deflecting members, said scroll elements being closed at the top and each having a dead gas space in the interior thereof with a vertical converging opening in communication with said interior, the lower portions of the interior dead gas spaces being in communication with said hopper for the delivery

of solid particles into said hopper, the forward faces of said deflecting members and the forward faces of said scroll elements providing surfaces for directing solid particles into said converging openings, the deflecting members and scroll elements in successive rows being disposed to provide gas paths converging toward said openings with transverse gas paths between outside portions of said scroll elements and rear portions of said deflecting members.

2. Apparatus according to claim 1, including rear extensions of said deflecting members aligned therewith to the rear of said scroll elements for directing the gaseous streams towards the openings in the scroll elements of the succeeding row.

3. Apparatus according to claim 1, including spray means at the entrance to said chamber for the delivery of fluid in finely divided form into the gaseous stream entering said chamber.

4. Apparatus according to claim 1, including means for supplying cooling fluid to the interior spaces of said deflecting members.

5. Apparatus according to claim 1, including means for supplying cooling fluid to the interior spaces of said deflecting members, said means including a fluid chamber above said upper tube sheet and a fluid chamber above said hopper.

6. Apparatus according to claim 1, including spray means at the entrance to said chamber for the delivery of fluid in finely divided form into the gaseous stream entering said chamber, and means for supplying cooling fluid to the interior spaces of said deflecting members, said last means including a fluid chamber above said upper tube sheet and a fluid chamber above said hopper.

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