

[54] **GAS WASHING DEVICE WITH REVERSING SPRAY PATHS**  
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[52] U.S. Cl. .... **55/84, 55/220, 55/240, 55/257, 261/118**  
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[58] Field of Search .... **55/257, 258, 259-260, 55/436, 463, DIG. 14, 462, 240, 83, 84, 90, 261/118, DIG. 54, 116, 111, DIG. 16; 239/513**

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[57] **ABSTRACT**  
Gas washing apparatus including a gas duct and an axial spray nozzle adapted to produce a radial spray. The duct includes a ring having an annular recess shaped to receive and reverse the direction of the spray particles with a minimum loss in kinetic energy. The spray particles are reversed in direction a plurality of times to pass repeatedly through the gas stream until their kinetic energy becomes expended. The spray may or may not be used in conjunction with a venturi throat in the duct.

**10 Claims, 7 Drawing Figures**

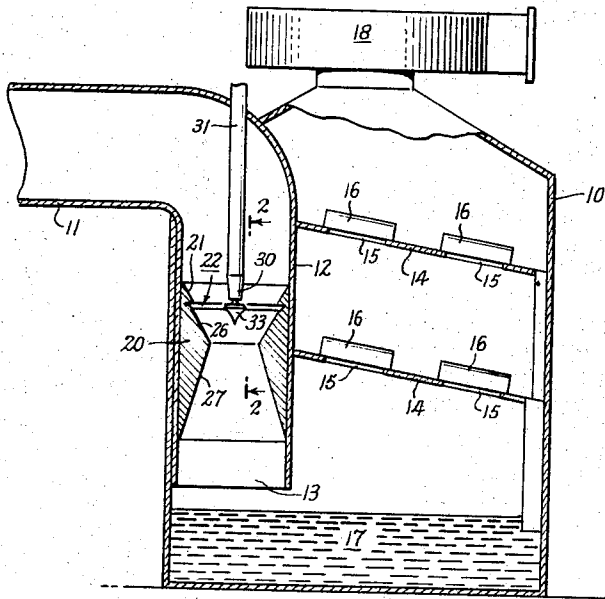


Fig 1

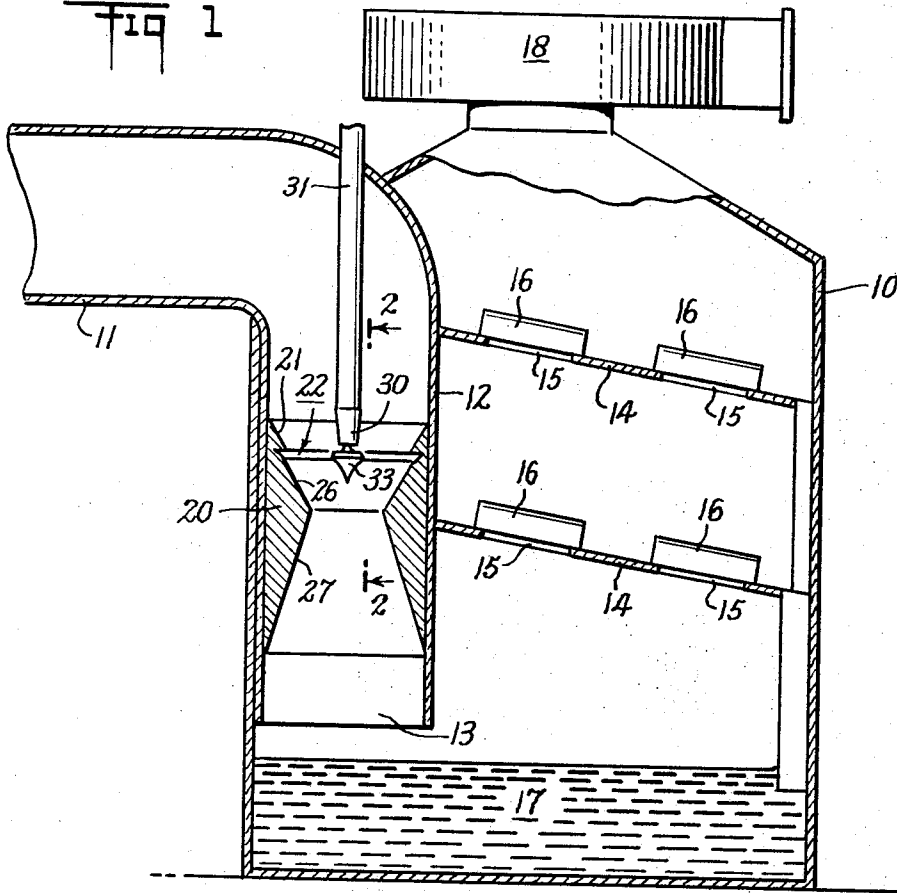
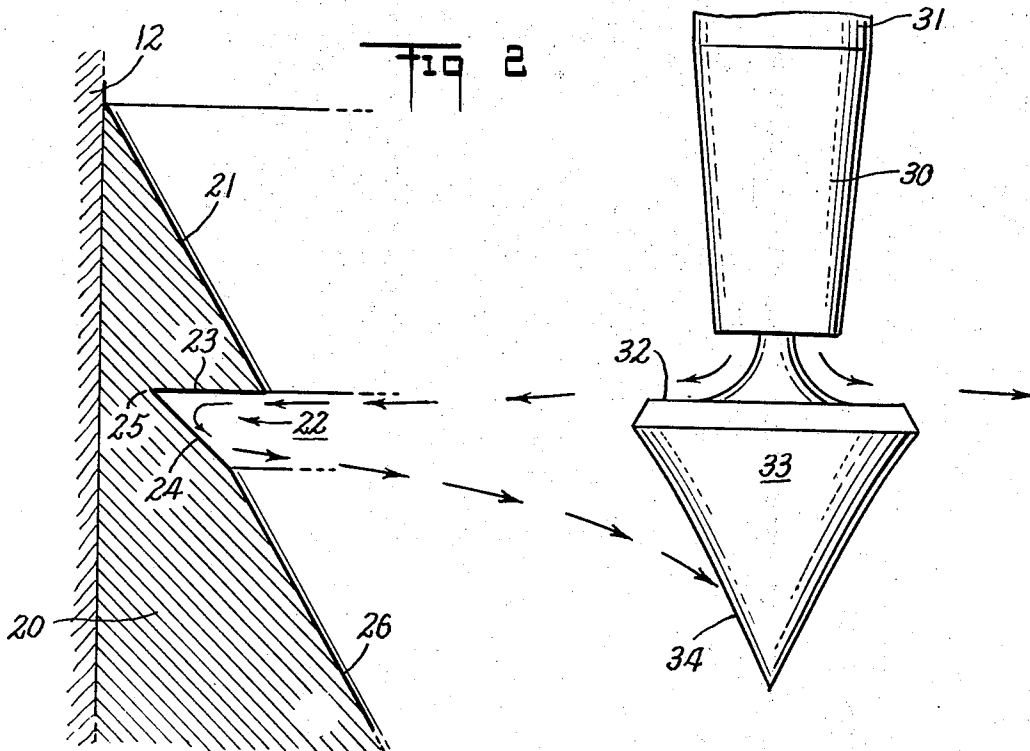


Fig 2



SHEET 2 OF 4

Fig 3

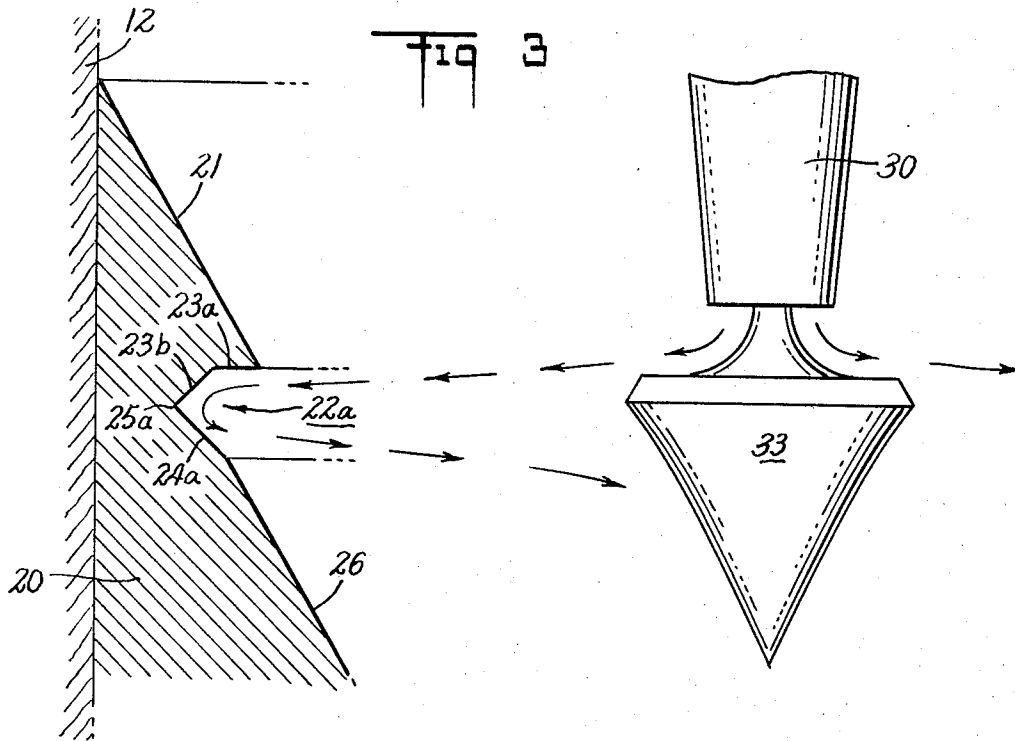
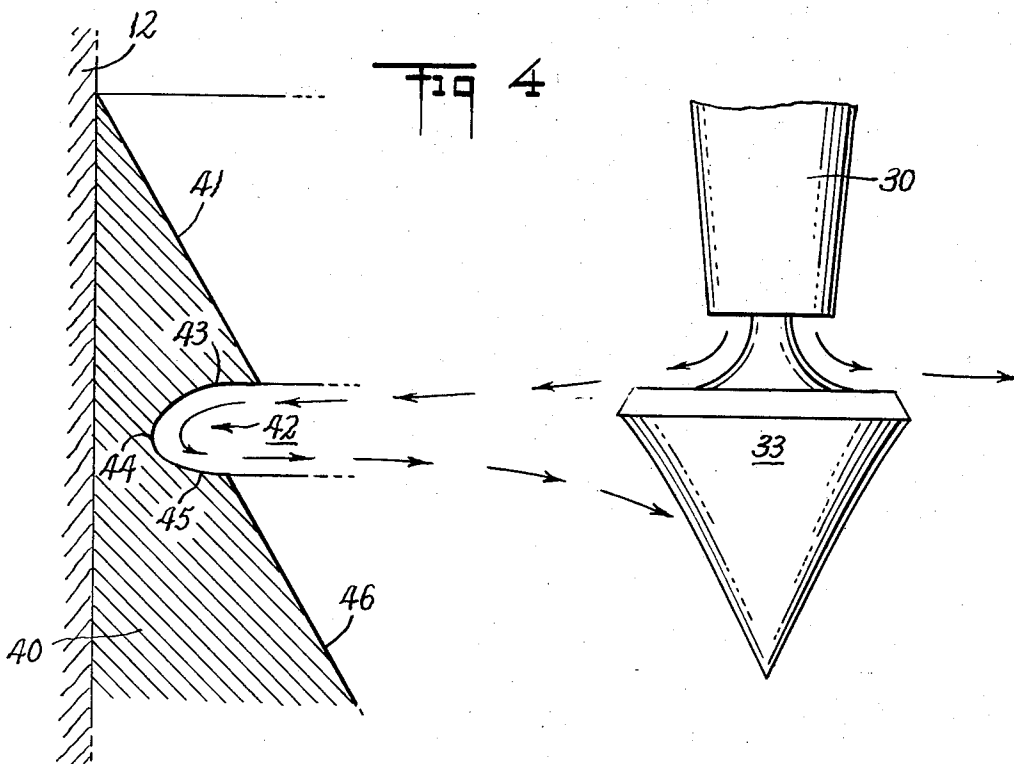


Fig 4



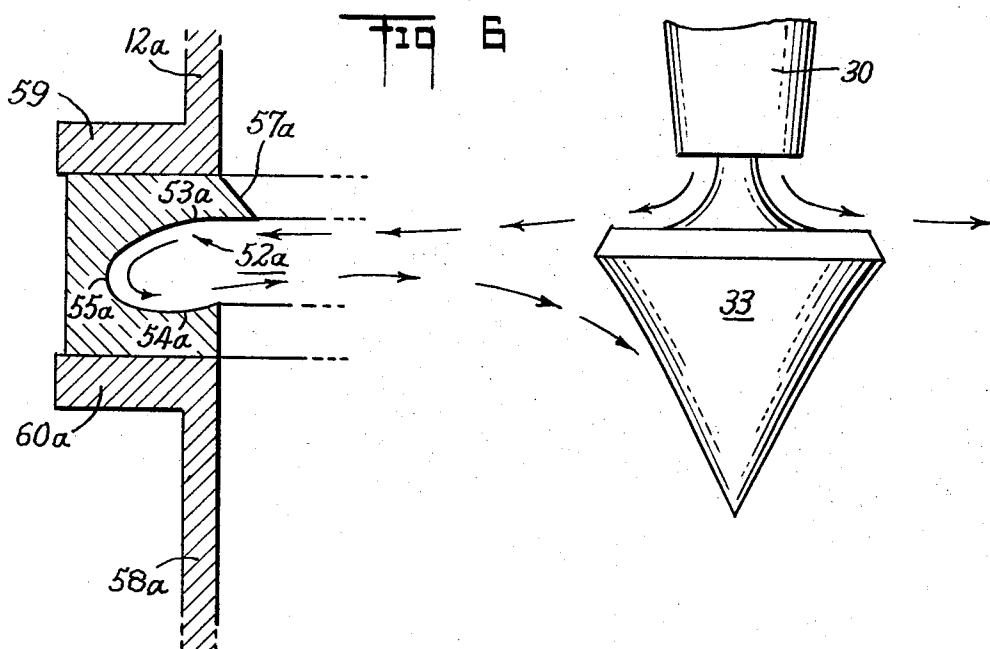
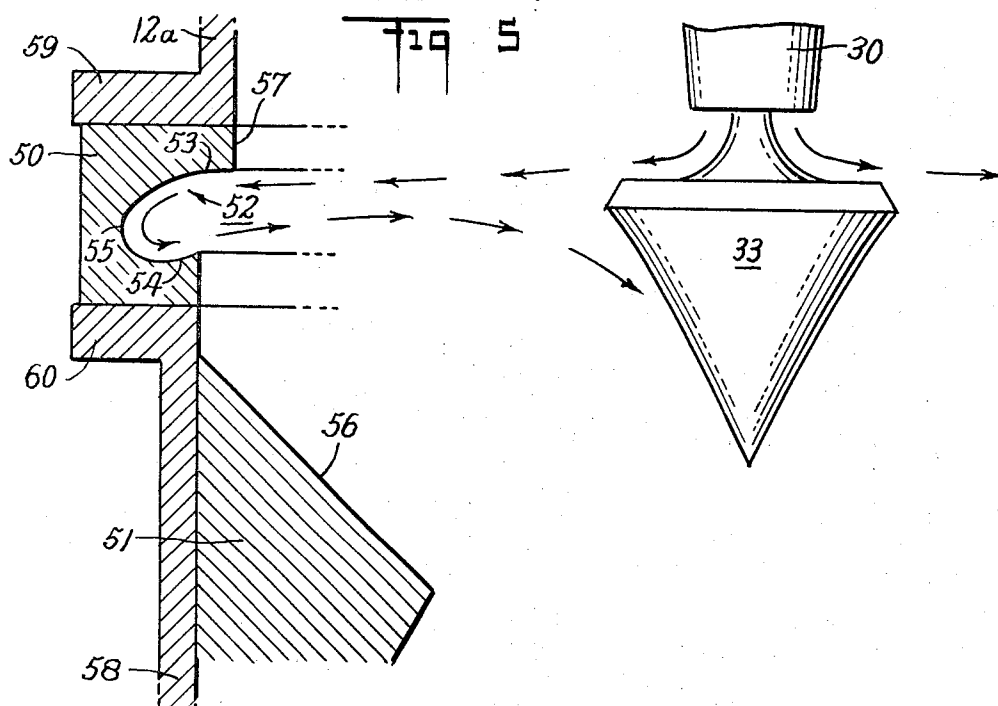
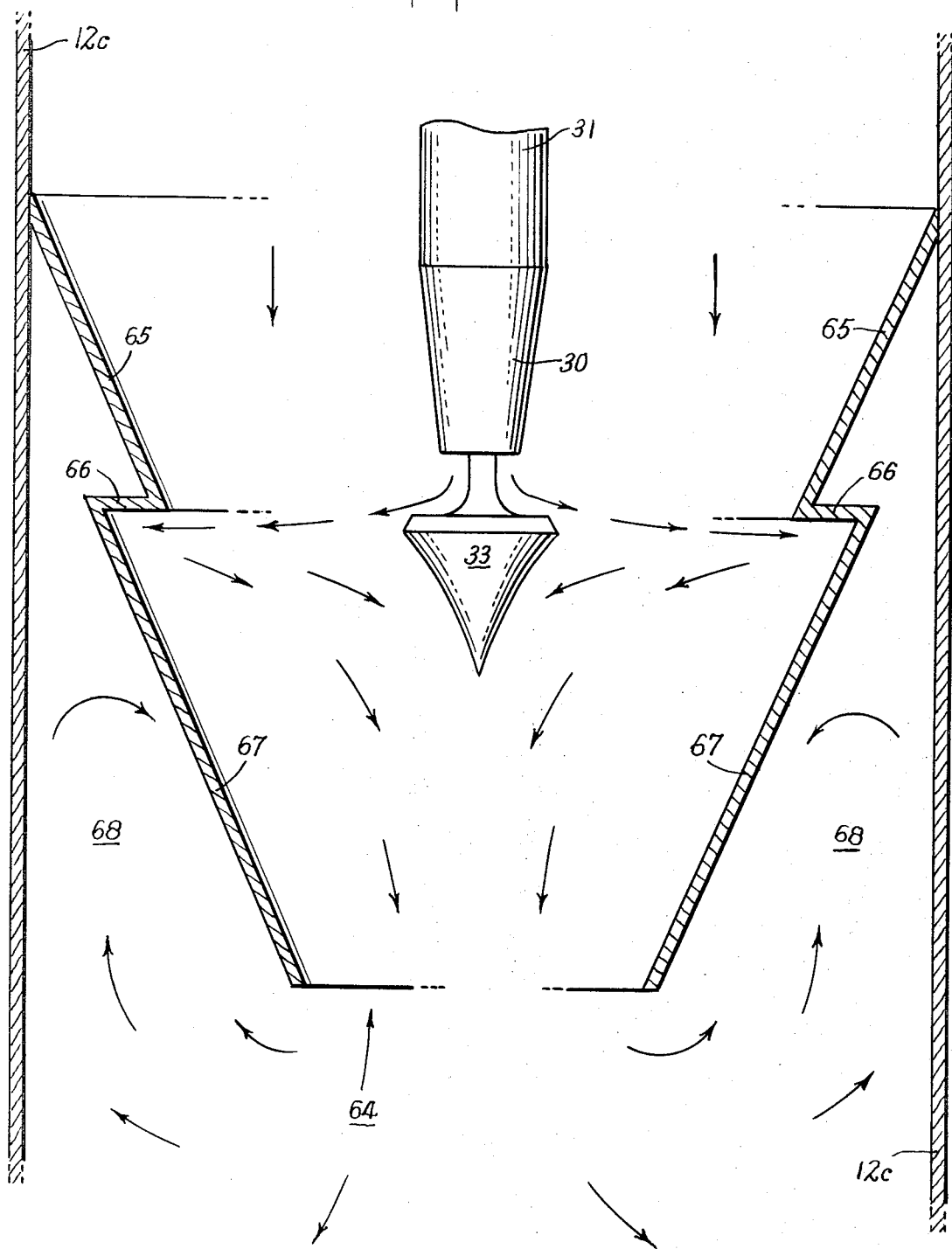


Fig 7



## GAS WASHING DEVICE WITH REVERSING SPRAY PATHS

This invention relates to gas cleaning apparatus and, more particularly, to apparatus for washing gases as they advance along a duct.

An object of the invention is to provide apparatus of the above type in which the liquid spray is caused to pass across the gas stream a plurality of times with a minimum loss of kinetic energy as the spray is reversed in direction by aligned surfaces.

A further object is to utilize efficiently the kinetic energy of the spray particles for removing suspended matter from the gas stream.

Another object is to provide a liquid spray zone in an annular passage through which gases are passed for cleaning, which is capable of producing a variable venturi effect due solely to the kinetic energy effect of the spray and without introducing any physical restriction in the passage.

A further object is to provide a system of the above type in which the venturi effect may be varied and controlled by varying the viscosity of the liquid spray and by varying the pressure and volume of the liquid.

A more specific object is to provide a system in which the venturi effect may be varied at will without making any physical variations of the area of the gas passage and without introducing any restriction in the walls of the passage.

In one embodiment the gas duct is provided with an inwardly sloping surface forming a venturi-like restriction and the axial spray strikes a deflector disc by which it is deflected outwardly to form a radial spray around its entire periphery. The radial spray is directed into an annular recess in the wall of the duct which is shaped to redirect the spray with a minimum loss of kinetic energy. The spray direction is reversed several times so that the spray liquid is caused to pass across the gas stream a plurality of times until its kinetic energy is expended.

It has been found that a controllable venturi effect is obtained due to the property of the spray itself. The kinetic energy of the spray particles and the volume taken up by the particles serves to reduce the effective cross sectional area of the passage and thus to vary the gas velocity in the passage. This is particularly effective due to the zigzag path taken by the spray particles as they pass two or more times through the annular gas stream in the passage. It has been found that by suitable variation of these properties a controlled variation in gas pressure drop, such for example as between 2 and 20 inches of water or more may be obtained. This drop may be adjusted by varying the pressure and volume of spray without altering the contour of the walls forming the annular passage and may thus be readily adjusted to conform to the requirements of any particular case. Of course, if the spray is atomized to aerosol form, an aerosol trap may be included in the drying portion of the apparatus.

The nature of the invention will be better understood from the following description, taken in connection with the accompanying drawings in which a specific embodiment has been set forth for purposes of illustration.

In the drawings:

FIG. 1 is a vertical section through a gas washing apparatus embodying the invention;

FIG. 2 is a partial section taken on the line 2—2 of FIG. 1 but on a larger scale to show the details of the washing zone and the annular recess for reversing the direction of the spray with a minimum loss of kinetic energy;

FIG. 3 is a detail section similar to FIG. 2 but showing a recess having a modified contour;

FIG. 4 is a similar section showing an annular recess without sharp angular portions;

FIG. 5 is a detail section similar to FIG. 2 showing a ring having a recess disposed above the venturi section of the inlet duct;

FIG. 6 is a section similar to FIG. 5 wherein the upper and lower portions of the inlet duct are of the same diameter; and

FIG. 7 is a partial vertical section showing the recessed ring in the form of a funnel.

Referring to the drawings more in detail, the apparatus is shown in FIGS. 1 and 2 as embodying a housing 10 forming a gas washing and drying vessel and having a gas inlet duct 11 entering the vessel from the side and having a downwardly extending portion 12 terminating in an open end 13. A plurality of baffle trays 14 are provided around the duct portion 12 and are formed with slots 15 and deflector plates 16 of known construction for removing droplets and suspended matter from the gases which pass upwardly therethrough. A reservoir 17 is provided at the bottom of the vessel to receive the spray liquid and suspended matter which is removed from the gases. The cleaned and dried gases are discharged by a fan or blower 18.

The inlet duct portion 12 carries a venturi ring 20 forming a venturi throat. In this embodiment the ring 20 has an upper sloping surface 21, an annular recess 22 which is adapted to reverse the direction of the spray particles with a minimum loss of kinetic energy. The recess is formed by an upper, substantially horizontal surface 23, and a lower sloping surface 24 forming with the upper surface 23 a sharp angle 25, and has a lower inclined surface 26 extending substantially parallel to the surface 21 but offset radially outwardly to be shielded from the gas stream in the duct portion 12 by the surface 21. The ring 20 terminates in a lower surface 27.

A spray nozzle 30, mounted on a supply pipe 31, is disposed axially of the duct portion 12 and carries a deflector disc 32 having a curved under surface preferably in the form of an archimedes spiral by which the jet of liquid from the nozzle 30 is deflected radially outwardly to form a radial spray of high kinetic energy around its entire periphery. The spray may be of the type disclosed more in detail in copending application Ser. No. 173,174, now U.S. Pat. No. 3,737,106. The nozzle 30 is disposed in alignment with the recess 22 of the venturi ring 20 so that the outwardly directed spray extends under the horizontal surface 23 and is reversed in direction by the surface 24 with a minimum loss of kinetic energy to pass inwardly through the gas stream in the duct portion 12.

The deflector disc 32 carries a downwardly extending conical member 33 having an inwardly sloping slightly curved peripheral surface 34 and so disposed that the inwardly directed spray impinges thereon and is again reversed in direction and passes outwardly through the gas stream. The spray thus passes repeatedly back and forth in a zigzag path between the venturi ring 20 and

the cone surface 34 until its kinetic energy is expended.

It will be noted that the surfaces 24 and 26 of the ring 20 are shielded from the gas stream by the inwardly extending portion of the surface 21 so that the spray particles impinge directly on these surfaces and are redirected thereby across the gas stream. The spray liquid and removed suspended matter fall into the reservoir 17 and the stripped gases pass upwardly through the slots 15 in the baffle trays 14 and the remaining droplets are removed by traps 16. The cleaned and dried gases are then discharged by blower 18.

In FIG. 3 the parts similar to FIG. 2 have been given the same reference numbers with the suffix *a*. The upper surface of the recess 22*a*, in this case, is divided into two portions. The inner portion 23*a* extends horizontally as in FIG. 2. The outer portion 23*b* of this surface extends downwardly at an angle of inclination of about 45° to join the downwardly sloping portion 24*a* at an angle of about 90°. The inner angle 25*a* is thus less sharp than in FIG. 2 and the downward sloping portion 23*b* assists in deflecting and reversing the spray liquid to the radially inward direction with a minimum loss of energy.

The embodiment of FIG. 4 is generally similar to that of FIG. 2, but in this case the venturi ring 40 is formed with an upper sloping surface 41 and an annular recess 42 formed by an upper arcuate outwardly extending surface 43, and a lower downwardly sloping surface 45 joined by a curved surface 44 to form a recess having a smooth contour.

The arrangement is such that the outwardly directed spray from the nozzle 30 enters this recess and is caused to flow around the various surfaces thereof to be directed inwardly through the gas stream with a minimum loss of energy.

In the embodiment of FIG. 5 a ring 50 is clamped between a flange 59 on the end of the duct portion 12*a* and a flange 60 on a duct 58 which forms a continuation of the duct portion 12*a* but is of somewhat larger diameter. The ring 50 is formed with an upper vertical surface 57 below which a recess 52 is formed. The recess 52 is formed by upper and lower surfaces 53 and 54 and a curved surface 55. The ring may be set into the wall of the duct portion 12 as an insert or the recess may be formed directly in such wall. The venturi ring 51 is of the usual form having an inwardly sloping surface 56.

In this embodiment the spray nozzle 30 is disposed in alignment with the recess 52 so that the spray is directed into this recess and is deflected and reversed in direction thereby with a minimum energy loss. The lower surface 54 may be arcuate in form and upwardly inclined at its inner end so as to impart an upward trajectory to the spray particles as they pass inwardly through the gas stream in the duct. The ring 50 of this embodiment may be used with or without the venturi ring 51.

The embodiment of FIG. 6 is similar to that of FIG. 5 except that the lower duct 58*a* is of the same diameter as the upper portion 12*a* and the upper inner surface 57*a* of the ring 50*a* slopes inwardly to form a shield for the lower surface of the recess 52*a*. The parts similar to those of FIG. 5 have been given the same reference numbers as in FIG. 2 or the sloping upper surface 57*a* may constitute a venturi section if required in any particular case.

In the form of FIG. 7 the ring 64 is generally funnel shaped and is secured to the inner surface of the inlet duct portion 12*c*. This ring 64 is formed with an inward sloping surface 65 terminating in a shoulder 66 and a lower sloping surface 67 which is parallel to the surface 65 but offset outwardly by the width of the shoulder 66. The space 68 between the ring 64 and the duct portion 12*c* is open to the gases in the duct and the turbulence produced thereby increases the contact of the spray with the contaminants in the gas stream and also aids in the removal of the coarser particles or droplets. The spray extends beneath the shoulder 66 and is deflected axially by the surface 67 as in previous forms.

Obviously the arrangement of the rings and the slopes of the various surfaces forming the annular recess may be varied as desired according to the requirements of a particular case. While the device has been shown in a gas supply duct, it is to be understood that this is representative of any vessel through which a gas stream is passed.

What is claimed is:

1. Gas washing apparatus comprising a duct adapted to carry a stream of said gas, liquid spray nozzle means disposed axially in said duct, axial deflector means proximate said nozzle means for deflecting liquid spray from said nozzle means radially outwardly, said deflector means including an axially downwardly extending deflector member, a ring concentrically disposed and in contact with said duct and defining on its innermost surface an annular recess disposed substantially in radial alignment with said nozzle means for receiving said radial spray, said recess being defined by an upper radially extending shoulder defining an upper surface and a lower radially extending surface, said recess shaped to redirect said spray radially inwardly against said deflector member with a minimum loss of kinetic energy, whereby, the spray is caused to pass repeatedly radially outwardly and inwardly through said gas stream with a minimum loss of kinetic energy as the latter advances along said duct.

2. Gas washing apparatus as set forth in claim 1, in which said innermost surface extends below said recess and is offset radially outwardly sufficiently to be shielded by said shoulder.

3. Gas washing apparatus as set forth in claim 1 in which said deflector means includes a disc adapted to deflect the liquid from said nozzle radially outwardly around its periphery and said axial deflector member comprises a cone carried by said disc and coaxial therewith and having an inwardly sloping slightly curved peripheral surface.

4. Apparatus for washing gases as set forth in claim 1 in which said ring is formed with sloping inner surface to provide a venturi throat.

5. Apparatus as set forth in claim 1 in which the recess in said ring is formed by upper and lower curved surfaces forming a smooth contour for deflecting and reversing the direction of the spray.

6. Apparatus as set forth in claim 1 in which said ring is formed with upper and lower inwardly sloping surfaces spaced by said shoulder beneath which the spray extends and is redirected.

7. Apparatus as set forth in claim 1 in which the lower surface of said recess is upwardly inclined to impart an upward trajectory to the inwardly deflected spray.

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8. Apparatus as set forth in claim 1 in which said ring is in the form of a cone, having a portion of its outer surface spaced inwardly from said duct to form an annular space for imparting turbulence to the gas in said stream.

9. Apparatus as set forth in claim 1 in which a venturi ring is disposed in said duct adjacent said ring.

10. The method of cleaning gases which comprises passing such gases in a stream through a duct and passing a radially directed liquid spray from an axial nozzle

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through the gas stream in said duct in a repeated zigzag path by deflecting the spray particles between an outer surface provided with an annular recess; said recess being defined by an upper radially extending shoulder defining an upper surface and a lower radially extending surface, said recess being positioned to receive and deflect said spray with a minimum loss of kinetic energy, and an inner surface spaced to form an annular passage for said gas stream.

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