United States Patent [19]

Reither

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[54] **WET SCRUBBER FOR AIR PURIFYING SYSTEMS**

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[52] **U.S. Cl.** **55/227**, 55/228, 55/233, 55/257, 55/274, 55/478, 55/482, 55/504, 261/98, 261/116, 261/117

[51] **Int. Cl.** **B01d 47/06**

[58] **Field of Search** 55/90–95, 220, 55/227, 228, 233, 230, 257, 258, 259, 260, 274, 478–482, 504; 261/115–118, 98, 111

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Primary Examiner—Bernard Nozick
Attorney, Agent, or Firm—Reising, Ethington & Perry

[57] **ABSTRACT**

A wet scrubber for an air purifying system comprising a housing having an inlet and an outlet for gas flow through the housing. The scrubber includes wetting means in the form of a plurality of jet banks mounted in the housing for wetting the gas flowing through the housing with a liquid purging agent. The jet banks are mounted in the housing for installation and removal transversely of the longitudinal axis of the housing. One or more packings are mounted in the housing and are retained therein in such a manner that the packings can be installed and removed in an axial or longitudinal direction with respect to the housing when the jet banks are moved.

36 Claims, 6 Drawing Figures

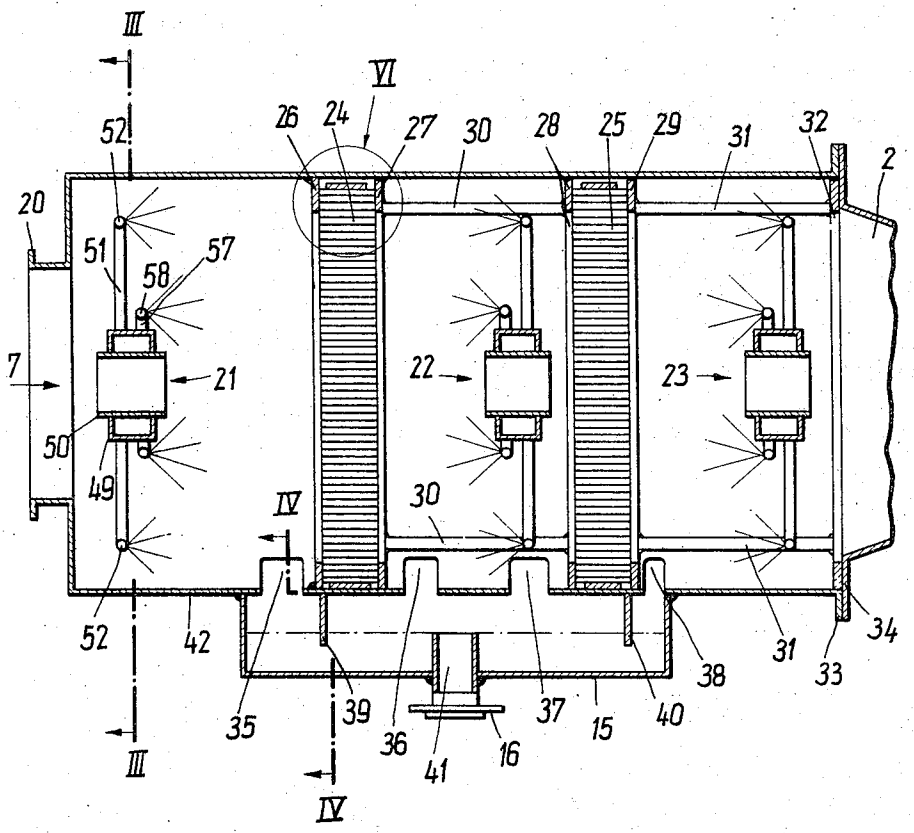

Fig. 1

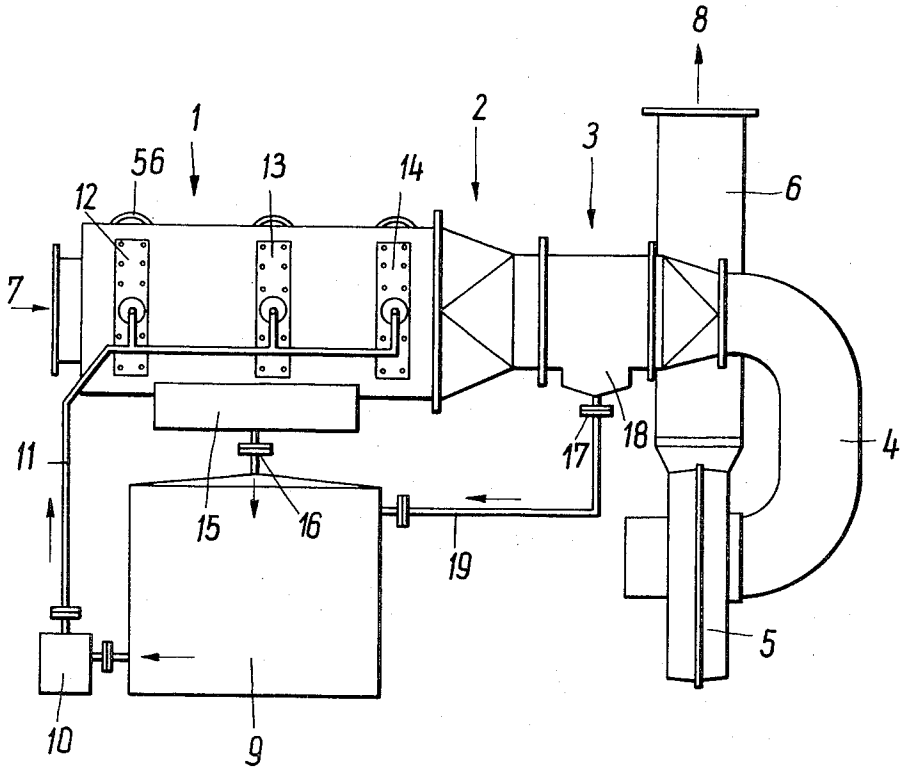

Fig. 2

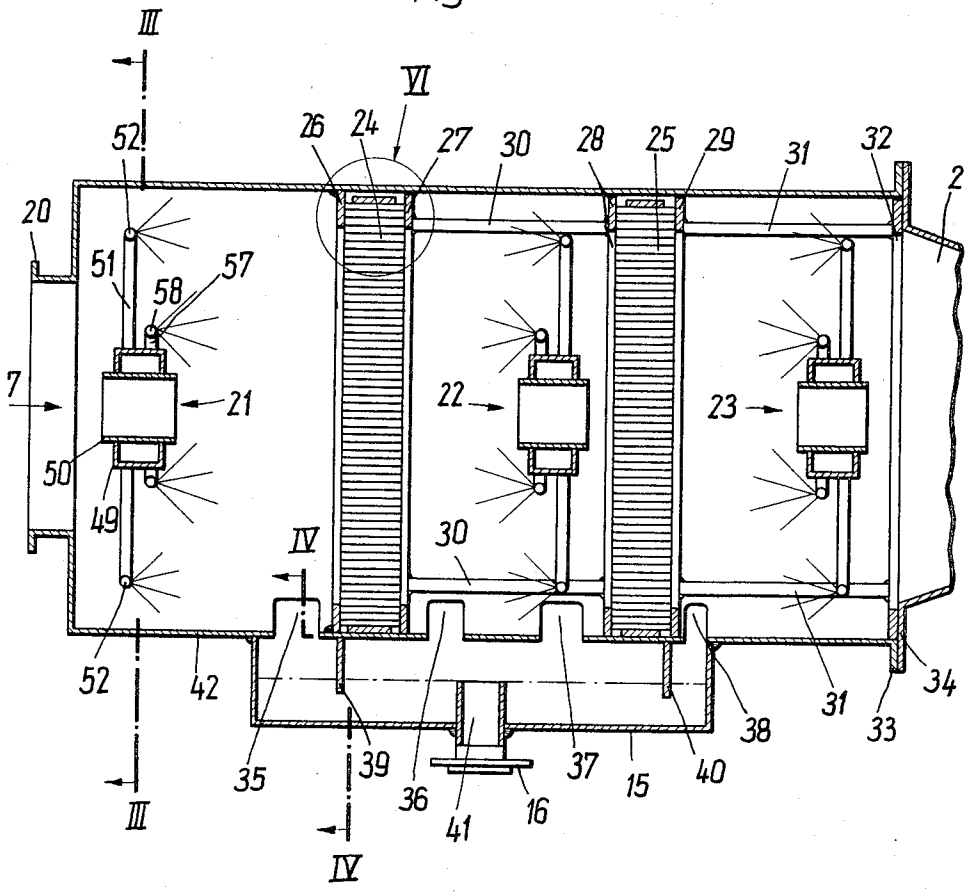
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Fig. 4

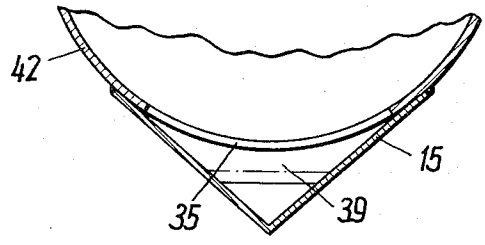
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Fig. 3

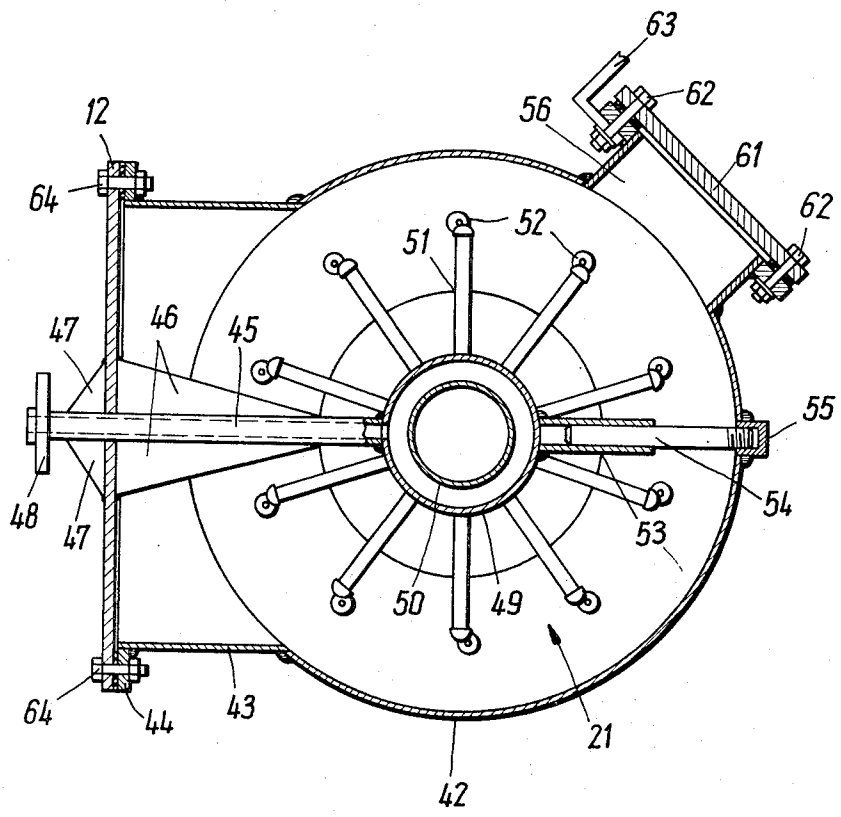

Fig. 5

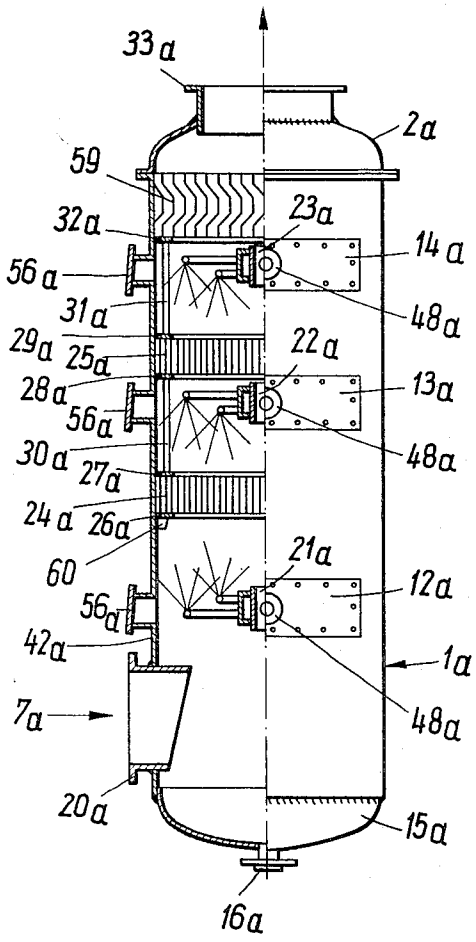
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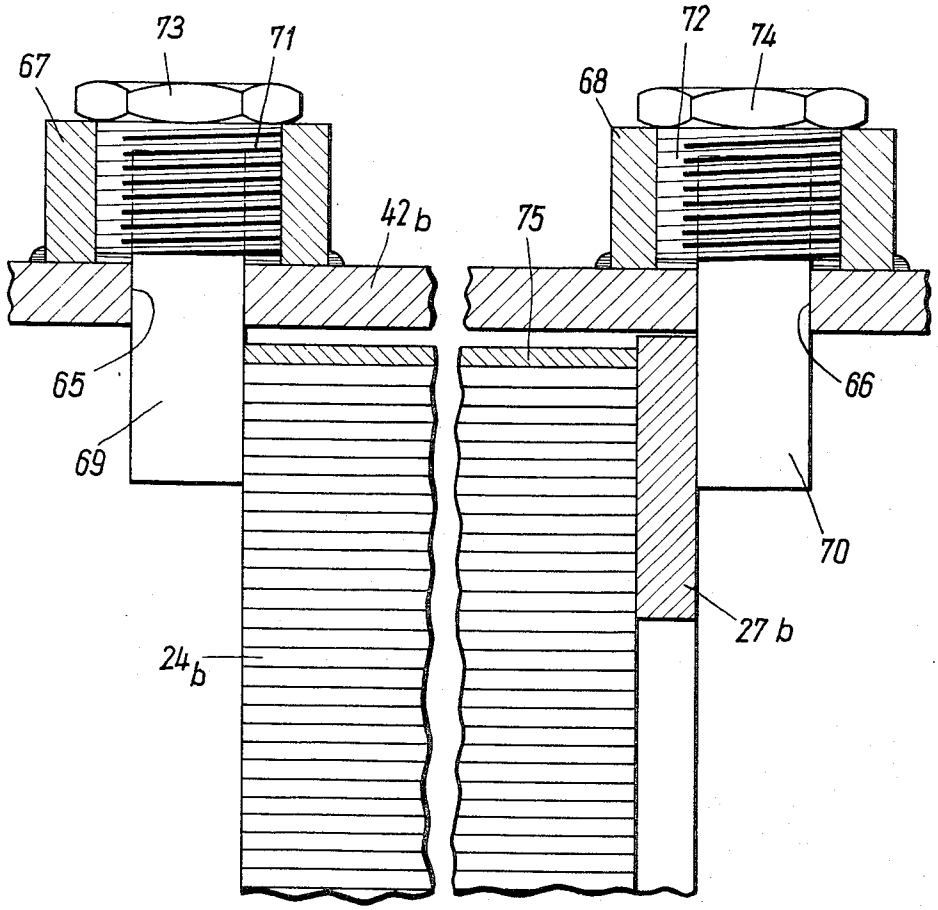
Fig. 6



WET SCRUBBER FOR AIR PURIFYING SYSTEMS

This invention relates generally to air or gas purifying systems, and is particularly concerned with the construction of wet scrubbers for use in such systems.

Wet scrubbers are used to remove contaminants from air, or other gases, by treating the gas with water or other liquid purging agents. The impurities are collected in the liquid purging agent and carried from the scrubber through a liquid discharge outlet, while the cleaned air or gas exits through a separate gas outlet.

In one type of wet scrubber, the gas flows through one or more packings, and contaminants or impurities are removed at the packings and carried away by the liquid purging agent. The cleaned gas exits from the scrubber downstream of the packings.

An object of this invention is to provide a wet scrubber constructed and arranged to provide a thorough wetting of the incoming, contaminant laden gas into the scrubber.

Another object is to provide a wet scrubber having one or more packings and a plurality of jet banks for spraying a liquid purging agent into the gas flowing through the scrubber wherein the various components can be installed and removed with ease as necessary for repair and replacement.

A further object is to provide a web scrubber having a plurality of jet banks for spraying liquid purging agent into the gas flowing through the scrubber with one or more packings arranged in series with the jet banks wherein each of the components can be installed and removed with relative ease for replacement and repair as necessary, and wherein the components can be easily inspected externally of the scrubber to determine if they are operating properly.

In carrying out the foregoing, and other objects, a wet scrubber according to the present invention may include a cylindrical housing having an inlet and an outlet permitting gas flow through the housing. Wetting means is provided in the housing for wetting the gas flowing through the housing with a liquid purging agent, and one or more liquid discharge openings are provided in the housing for conducting the liquid purging agent supplied by the wetting means from the housing.

The wetting means is in the form of a plurality of jet banks spaced from each other along the longitudinal axis of the housing, and the jet banks are mounted on the housing in such a manner that they can be installed and removed transversely of the longitudinal axis of the housing. A plurality of packings are positioned in the housing and are spaced from each other along the length thereof. Each packing is located between an adjacent pair of the jet banks, and is removably retained in the housing in such a manner that it can be removed and installed in a longitudinal direction with respect to the housing when some of the jet banks are removed.

In the preferred embodiment, the first jet bank adjacent to the inlet of the housing is arranged to spray the liquid purging agent in the direction of the gas flow, while the other jet banks, downstream of the first jet bank, are each arranged to spray the liquid purging agent in a direction opposite to the direction of gas flow.

In one embodiment of the invention, the packings are maintained in position by removable retaining rings located within the housing, and in another embodiment, the packings are held in position by removable retaining pins extending through the wall of the housing.

The scrubber may be connected in a system having a reducer connected with the outlet, and a droplet separator connected with the reducer for removing the residues of entrained liquid purging agent after the gas has passed through the reducer. The liquid purging agent can be recirculated through a container by a pump to maintain a steady supply of the liquid purging agent for the jet banks.

Other objects, advantages and features of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a diagrammatic illustration of an air purification system including a wet scrubber according to the invention;

FIG. 2 is an enlarged longitudinal sectional view of the wet scrubber of FIG. 1;

FIG. 3 is a slightly enlarged sectional view along lines III—III of FIG. 2;

FIG. 4 is an enlarged sectional detailed view along lines IV—IV of FIG. 2;

FIG. 5 is a front elevational view, partially in section, of a second form of wet scrubber according to the present invention; and

FIG. 6 is an enlarged detail of a modified construction, this construction being of that portion of the scrubber encompassed by circle VI in FIG. 2.

FIG. 1 illustrates an air purification system including a wet scrubber designated collectively by reference numeral 1 and having an inlet 7. Contaminant-laden air or other gas flows into the scrubber 1 at inlet 7. The gas flows from the scrubber 1 through a reducer 2 connected at the discharge end of the scrubber, a droplet separator 3 connected with the reducer 2 on the downstream side thereof, a tube or conduit 4 extending from the droplet separator 3 to a radial fan 5, and is discharged through the outlet 8 through the tube or conduit 6 connected with the fan 5.

The system shown in FIG. 1 also includes a container 9 for liquid purging agent, and a recirculation pump 10 for removing the liquid purging agent from the container 9 and discharging the liquid purging agent through a supply line 11 to wetting means supported in the wet scrubber by mounting plates 12, 13 and 14. As the gas moves through the scrubber, it is intermixed with the liquid purging agent from spray devices of the wetting means, and the liquid purging agent removes impurities from the gas and returns to the container 9 through a sump 15 connected with the container 9 through a connecting flange 16.

The cleaned gas passes through the reducer 2 into the droplet separator 3, wherein residues of the liquid purging agent entrained in the stream of gas are separated from the gas. The liquid removed by the droplet separator 3 is collected in a sump 18 and flows through a return line 19 connected thereto by a connecting flange 17 into the purging agent container 9. The cleaned gas then passes from the droplet separator 3 via the connecting tube 4 into the radial fan 5 and is discharged through the outlet 8 of the tube 6.

The construction of the wet scrubber is illustrated in detail in FIGS. 2 through 4.

FIGS. 2 through 4 illustrate wet scrubbing apparatus comprising a housing 42 having an inlet and an outlet permitting gas flow through the housing. The housing 42 is cylindrical, and the inelt 7 of the housing is defined by an inlet flange 20, and the outlet of the housing is defined by an outlet flange 33.

Wetting means is provided in the housing 42 for wetting the gas flowing through the housing with a liquid purging agent. The wetting means is in the form of three jet banks, each of which is indicated collectively by reference numerals 21, 22 and 23 in FIG. 2. The jet banks 21, 22 and 23 are each operable to spray liquid purging agent supplied thereto in a generally axial direction with respect to the longitudinal axis of the housing. As shown in FIG. 2, the first jet bank 21 sprays the liquid in the direction of the gas flow from the inlet 7 to the outlet defined by flange 33, while the two jet banks 22 and 23 each spray the liquid purging agent in a direction opposite to the gas flow, or in a direction toward the inlet 7. The liquid purging agent sprayed from the jet banks 21, 22 and 23 is conducted from the housing through liquid discharge openings 35, 36, 37 and 38 formed in the side wall of the housing. Mounting means to be described in detail herein-below removably mount the wetting means, or jet banks 21, 22 and 23, in the housing 42 in such a manner as to permit installation and removal of the jet banks transversely of the longitudinal axis of the housing.

The housing 42 is divided into three compartments by two packings 24 and 25 which are spaced axially from each other along the longitudinal axis of the housing 42. The packings 24 and 25 permit the passage of the gas flow without forming a significantly high resistance to the gas flow. However, as the gas flow with the liquid purging agent entrained therein flows through the packings 24 and 25, the liquid purging agent is collected by the packings and falls therefrom into the sump 15 through one of the openings 35, 36, 37 and 38. The specific construction of the packings 24 and 25 form no part of the present invention, any conventional form of such packings being suitable for use in the present invention.

As shown in FIG. 2, the sump 15 does not extend over the entire length of the housing 42 of the wet scrubber 1, the length being only that necessary to encompass the liquid discharge openings 35, 36, 37 and 38 in the wall of the housing. The sump 15 may be of substantially V-shaped cross-section as shown in FIG. 4. The sump 15 is mounted on the outer side wall of the housing and communicates with the liquid discharge openings 35, 36, 37 and 38. As shown in FIG. 2, a liquid discharge opening is located on each side of each of the packings. Mounted in the sump 15 is a drain tube 41 having an attachment flange 16 located externally of the sump 15. The upper end of the drain tube 41 is elevated above the bottom of the sump to provide a minimum liquid level in the sump, that is, the sump is always filled with the liquid purging agent to the height of the drain tube 41, the level indicated in phantom lines in FIG. 2.

Extending beneath each of the two packings 24 and 25 into the sump 15 are two separating walls 39 and 40. The walls 39 and 40 extend from the housing 42 into the sump 15 below the liquid level determined by the upper end of the drain tube 41. Since the separating walls 39 and 40 have their lower ends immersed in the liquid, the gas cannot bypass the packings 24 and 25 as it flows from the inlet of the housing 42 to the outlet thereof. Thus, the gas cannot flow from opening 35 through the sump to opening 36, or from the opening 37 through the sump to the opening 38. The amount of overlap of the top edge of the drain tube 41 with the bottom edges of the separating walls 39 and 40 can be varied depending on the pressure differential to be expected on both sides of each packing to insure that the gas cannot bypass the packings.

The packings 24 and 25 are supported in the housing by packing retaining means which removably retain the packings in the housing 42 for installation and removal along the longitudinal axis of the housing from the right-hand end of the housing 42 as viewed in FIG. 2, that is, the end adjacent flange 33.

The packing retaining means includes a fixed retaining ring 26 secured to the inner wall of the housing 42 by welding or other conventional means. The fixed retaining ring 26 is located generally in the first third of the housing between the openings 35 and 36. The fixed retaining ring 26 is engaged by one side of packing 24 near the periphery of the packing 24. The fixed retaining ring 26 extends in a radial direction only to the extent necessary to provide a reliable abutment for the packing 24 without significantly obstructing the gas flow through the packing 24.

The packing retaining means further includes a removable retaining ring 27 which is axially installable and removable in the housing for engagement by the other side of the packing 24 near the periphery of the packing 24. The packing 25 is held in position in the housing by removable retaining rings 28 and 29 located on each side of the packing 25. The removable retaining rings 27, 28 and 29 have substantially the same dimensions as the fixed retaining ring 26. A removable retaining ring 32 is located adjacent the outlet end of the housing and abuts the flange 34 of the reducer 2.

The packing retaining means further comprises a plurality of spacer rods 30, each having one end secured to the retaining ring 27 and its other end secured to the retaining ring 28. Similarly, the packing retaining means includes a plurality of spacer rods 31 extending between the removable retaining rings 29 and 32. The respective ends of the spacer rods 30 are firmly secured to the retaining rings 27 and 28, and similarly, the respective ends of the spacer rods 31 are firmly secured to the retaining rings 29 and 32. Consequently, the spacer rods 30 and retaining rings 27 and 28 are joined together into a unitary assembly, and the spacer rods 31 and retaining rings 29 and 32 are similarly joined to define a unitary assembly.

The two packings 24 and 25 are thus axially supported and located in the housing 42 between the stationary retaining ring 26 and the flange 34 of the reducer 2 by the assemblies of the spacer rods and removable retaining rings. When the reducer 2 is detached from the outlet end of the housing, and when the jet banks 22 and 23 are removed from the housing in the manner set forth below, the removable retaining rings 27, 28, 29 and 32 as well as the packings 24 and 25 can be withdrawn axially through the right-hand end of the housing as viewed in FIG. 2.

The constructions of the jet banks 21, 22 and 23 are identical in the illustrated embodiment, and consequently, only the jet bank 21 will be described in detail. With reference to FIGS. 2 and 3, the jet bank 21 com-

prises a central distributor body defined by an inner tubular member 50 open axially at both ends, and a larger tubular member 49 concentrically encompassing the tubular member 50. The tube member 49 is closed at both ends and is shorter than the inner tubular member 50 as shown in FIG. 2.

The jet bank 21 further includes jet spider means mounted on the distributor body 49, 50. The jet spider means includes a large spider and a small spider, the spiders being spaced axially from each other. Each of the spiders includes a plurality of jet tubes projecting radially from the distributor body 49, 50. The large spider has a plurality of individual jet tubes 51 each having a spray nozzle 52 on the outer end thereof, and the small spider has a plurality of short jet tubes 57, each of which is equipped with jets or spray nozzles 58. The tubes 51 and 57 radiate from the center of the tubular members 49 and 50. The construction of the jet bank 21 is illustrated clearly in FIG. 3, wherein, for the sake of simplicity, the section line III—III of FIG. 2 is taken in such a way that only the large diameter jet spider is shown.

As pointed out previously, mounting means is provided for removably mounting the jet banks in the housing in such a way that the jet banks can be installed and removed transversely of the longitudinal axis of the housing. As shown in FIG. 3, the mounting means for the jet bank 21 includes an opening in the side wall of the housing and a removable plate 12 covering the opening. The opening covered by the plate 12 is of sufficient size to permit installation and removal therethrough of the jet bank 21. An outwardly projecting collar 43 surrounds the opening, collar 43 having a closure flange 44 on its outer end. A suitable seal is disposed between the plate 12 and flange 44. The plate 12 is secured to the flange 44 by bolts 64.

The mounting means further includes a supply tube 45 extending radially outwardly from the jet bank 21 with its outer end projecting through the plate 12 for connection with a supply of liquid purging agent. The supply tube 45 extends through the large rectangular opening in the wall of the housing 42 which is surrounded by the collar 43.

The mounting means further includes gusset means extending between the supply tube 45 and plate 12. The gusset means includes a pair of inner gussets 46 extending between the supply tube 45 and the inner surface of the plate 12, and a pair of outer gussets 47 extending between the supply tube 45 and the outer side of plate 12. The reinforcement ribs or gussets 46 located inside the collar 43 are larger than the reinforcement ribs or gussets 47 on the outside of the collar 43 and the plate 12. At its outer end, the supply tube 45 carries a connecting flange 48 to which a supply line for the liquid purging agent may be connected.

In the illustrated embodiment, the housing 42, sump 15, collars 43, supply tubes 45, distributors 49, 50, and the jet tubes 51 and 57 may all be made of plastic, preferably polyvinyl chloride. The flange plates 12, 13 and 14 are preferably composed of a transparent plastic and are either welded or adhesively bonded to the supply tubes 45 and to the reinforcement ribs or gussets 46 and 47. The size of the openings and the respective collars 43 are sufficient to permit the associated jet banks 21, 22 or 23 to be respectively withdrawn transversely from the housing 42 after releasing the bolts 64. When the bolts 64 are released, the respective flange plate 12, supply tubes 45, distributor body 49, 50 and jet tubes 51, 57 can be removed as a unit from the housing 42.

The mounting means for the jet bank 21 further includes a retaining tube 53 extending radially from the outer shell 49 of the distributor body at a point diametrically opposite to the supply tube 45. A retaining pin 54 is received in the retaining tube 53. The retaining pin 54 extends radially inwardly from the wall of the housing 42 and is formed with male threads at the outer end which are engaged with the female threads of a retaining cap 55. Thus, the retaining cap 55 overlies a retaining pin opening in the wall of the housing 42, and the retaining pin 54 projects through the retaining pin in threaded engagement with the retaining cap 55. When the jet bank 21 is removed from the housing 42 by withdrawing it through the collar 43, the retaining pin 54 can be unscrewed from the cap 55 and removed.

As pointed out previously, the jet tubes 51 extend radially from the distributor body 49, 50 and each of the tubes 51 is provided with jet nozzles 52 of a conventional construction at the free ends. The jet nozzles 52 are arranged at the ends of the respective tubes 51 in such a manner that the cleaning liquid is sprayed axially and outwardly of the nozzles with respect to the longitudinal axis of the housing. The jet nozzles 52 and 58 of the jet bank 21 are disposed to spray the liquid in the direction of the gas flow as shown in FIG. 2, while the corresponding nozzles of the jet banks 22 and 23 are arranged to spray the liquid in a direction opposite to the direction of the gas flow, or toward the inlet 7.

In order to facilitate inspection of the jet banks in operation, an inspection socket, or sight socket 56 is provided in the housing 42 at the location of each of the jet banks 21, 22 and 23. Each inspection socket is closed by a transparent cover plate 61 by means of bolts 62. To facilitate inspection, a lamp holder 63 may be provided on each of the inspection sockets for carrying a lamp.

FIG. 5 illustrates a modified arrangement wherein the wet scrubber is disposed vertically. Parts of the scrubber of FIG. 5 corresponding to parts of the scrubber of FIG. 2 are indicated by the same reference numerals with the letter "*a*" appended thereto.

The wet scrubber 1*a* of FIG. 5 comprises a cylindrical housing 42*a* having an inlet 7*a* and an outlet defined at flange 33*a* at the upper end of the housing. The housing 42*a* is formed with a semi-spherical bottom 15*a* serving as a sump. Mounted in the bottom 15*a* is a short drain tube having a connecting flange 16*a*, the drain tube and flange 16*a* extending along the axis of the housing 42*a* and being located at the lowermost point of the semi-spherical bottom 15*a*.

The inlet for receiving the gas flow into the housing is defined by an inlet tube mounted in the side wall of the housing 42*a* near to the bottom 15*a*, the inlet tube having a flange 20*a*. The gas mixture to be purified enters the housing 42*a* in the direction of arrow 7*a* through the inlet tube.

The upper end of the housing 42*a* is closed by a cover 2*a* which at the same time serves as a reducer and terminates in a connecting flange 33*a* which defines the outlet for the cleaned gas.

As in the previously described embodiment, wetting means in the form of three jet banks 21*a*, 22*a* and 23*a* are disposed in alternating relationship with packings

24*a* and 25*a*. A droplet separator **59** of conventional construction is located above the uppermost jet bank **23***a*. The droplet separator **59** of FIG. **5** replaces the droplet separator indicated by reference numeral **3** downstream of the housing **42** in the embodiment of FIG. **1**.

In the FIG. **5** embodiment, the jet banks are connected by means of their respective supply tubes to flange plates **12***a*, **13***a* and **14***a* in a similar manner to the corresponding flange plates **12, 13** and **14** in the FIG. **1** and **2** construction. The jet banks **21***a*, **22***a* and **23***a* can thus be withdrawn from the housing in a transverse direction with respect to the longitudinal axis of the housing **42***a*. The flange plates **12***a*, **13***a* and **14***a* are preferably transparent as in the previously described embodiment. The embodiment of FIG. **5** also includes inspection or sight sockets **56***a* for each of the jet banks for inspecting the jet bank. As in the previously described embodiment, an inspection lamp can be mounted on the cover plate for each of the inspection sockets.

The packing **24***a* is supported on stationary abutment means **60** by means of a removable retaining ring **26***a*. Supported above the packing **24***a* is a removable retaining ring **27***a* connected by spacer rods **30***a* to a retaining ring **28***a*. The second packing **25***a* is supported on the retaining ring **28***a*, and a retaining ring **29***a* is supported on the upper side of the packing **25***a*. Spacer rods **31***a* secured to the packing **29***a* support at their upper ends a retaining ring **32***a* on which the droplet separator **59** is supported. Since the housing **42***a* is disposed vertically, a retaining ring above the droplet separator **59** is not required.

Thus, as in the previously described embodiment, FIG. **5** illustrates a wet scrubbing apparatus including a housing **42***a* having an inlet at **20***a* and an outlet at **33***a* permitting gas flow through the housing **42***a*; wetting means **21***a*, **22***a* and **23***a* in the housing **42***a* for wetting gas flowing through the housing with a liquid purging agent; a liquid discharge opening at **16***a* in the housing **42***a* for conducting liquid purging agent supplied by the wetting means from the housing; and mounting means removably mounting the wetting means **21***a*, **22***a* and **23***a* in the housing permitting installation and removal of the wetting means transversely of the longitudinal axis of the housing. Similarly, packings **24***a* and **25***a* are mounted in the housing by packing retaining means **60, 26***a*, **27***a*, **30***a*, **28***a*, **29***a*, **31***a* and **32***a* for removably retaining the packings **24***a* and **25***a* in the housing for installation and removal axially of the housing.

FIG. **6** illustrates a modified packing retaining means for retaining the packings in the wet scrubber housing, particularly the housing **42** of the FIG. **2** arrangement. In FIG. **6**, corresponding parts are identified by the same reference numerals as in the embodiment of FIGS. **1** to **3** with the letter "*b*" appended thereto.

In FIG. **6**, the packing retaining means comprises a plurality of circumferentially spaced retaining pin assemblies, each of which includes a retaining pin projecting radially inwardly from the side wall of the housing for engagement by the periphery of one of the packings. As shown in FIG. **6**, a plurality of circumferentially spaced retaining pins **69** extend radially inwardly through complementary holes **65** in the wall of the housing **42***b*, and provide an abutment for the packing **24***b* in an axial direction. The retaining pins **69** are provided with threaded plugs **71** at their ends which are positioned outside of the housing and which have a hexagonal head **73.** The threaded plugs **71** are screwed into sockets **67** which are provided with female threads. The female threads of the sockets **67** are positioned in alignment with a hole **65,** and the socket is welded to the outside of the housing **42.**

The shell **75** of the packing **24***b* has one end supported directly on the retaining pins **69** and its other end supported on a retaining ring **27***b* held in position by retaining pin **70** constructed identically to the retaining pin **69.** The retaining pins **70** extend through holes **66** in the housing **42***b* and are connected to threaded plugs **72** each having an hexagonal head **74.** The threaded plugs **72** are screwed into sockets **68** provided with female threads which in turn are secured to the housing **42***b* by welding.

Packing **25** may also be supported by two groups of retaining pins having a construction identical to the pins **69** and **70** on the associated plugs. The spacer rods **30** and **31** in the embodiment of FIGS. **1** through **3** are thus not required as the retaining pins serve to axially locate the removable retaining rings in position along the length of the housing. The retaining ring **32** of the embodiment of FIGS. **1** through **3** is also not required when the retaining pin assembly of FIG. **6** is utilized.

While specific embodiments of the invention have been disclosed in the accompanying drawings and described in the foregoing specification, it should be understood that the invention is not limited to the exact construction shown. Alterations in the construction and arrangement of parts, all falling within the scope and spirit of the invention, will be apparent to those skilled in the art.

I claim:

1. Wet scrubbing apparatus comprising: a housing having an inlet and an outlet permitting gas flow through said housing; wetting means in said housing between said inlet and outlet for wetting gas flowing through said housing with a liquid purging agent; at least one liquid discharge opening in said housing for conducting liquid purging agent supplied by said wetting means from said housing; and mounting means removably mounting said wetting means in said housing permitting installation and removal of the said wetting means transversely of the longitudinal axis of said housing; said wetting means comprising at least one jet bank, and said mounting means including an opening in the side wall of said housing and a removable plate covering said opening, said opening being of sufficient size to permit installation and removal therethrough of said jet bank; said mounting means further including a supply tube extending radially from said jet bank with its outer end projecting through said plate for connection with a supply of liquid purging agent; said mounting means further including gusset means extending between said supply tube and said plate; said gusset means including a pair of inner gussets extending between said supply tube and the inner surface of said plate, and a pair of outer gussets extending between said supply tube and the outer side of said plate; said mounting means further including a retaining tube projecting radially from said jet bank, and a retaining pin extending radially inwardly from the housing wall and received in said retaining tube.

2. Apparatus as claimed in claim **1** including a retaining pin opening in the wall of said housing, and a retain-

ing cap overlying said retaining pin opening, and wherein said retaining pin projects through said retaining pin opening into threaded engagement with said retaining cap.

3. Apparatus as claimed in claim 2 wherein said jet bank comprises: a central distributor body, and jet spider means mounted on said distributor body.

4. Apparatus as claimed in claim 3 wherein said jet spider means includes a large spider and a small spider, said spiders being spaced axially from each other.

5. Apparatus as claimed in claim 4 wherein each of said spiders includes a plurality of jet tubes projecting radially from said distributor body, the jet tubes of said large spider each having a greater length than the jet tubes of said small spider, each of said jet tubes having jet nozzles at their outer ends for spraying liquid purging agent in a generally longitudinal direction with respect to said housing.

6. Apparatus as claimed in claim 5 including an outwardly projecting collar surrounding said opening, said plate overlying the outer end of said collar.

7. Apparatus as claimed in claim 1 wherein said wetting means comprises a central distributor body, and jet spider means mounted on said distributor body.

8. Apparatus as claimed in claim 7 wherein said jet spider means includes a large spider and a small spider, said spiders being spaced axially from each other.

9. Apparatus as claimed in claim 8 wherein each of said spiders includes a plurality of jet tubes projecting radially from said distributor, the jet tubes of said large spider each having a greater length than the jet tubes of said small spider, each of said jet tubes having jet nozzles at their outer ends for spraying liquid purging agent in a generally longitudinal direction with respect to said housing.

10. Apparatus as claimed in claim 1 including at least one packing in said housing between said inlet and said outlet.

11. Apparatus as claimed in claim 10 including packing retaining means removably retaining said packing in said housing for installation and removal axially of said housing.

12. Apparatus as claimed in claim 11 wherein said packing retaining means comprises a fixed retaining ring secured to the inner wall of said housing for engagement by one side of said packing near the periphery thereof, and a removable retaining ring axially installable and removable in said housing for engagement by the other side of said packing near the periphery thereof.

13. Apparatus as claimed in claim 12 wherein said packing retaining means further comprises a plurality of spacer rods each having one end secured to said removable retaining ring and extending axially therefrom, and a second removable retaining ring secured to the other ends of said spacer rods.

14. Apparatus as claimed in claim 13 further including means providing an abutment for said second removable retaining ring.

15. Apparatus as claimed in claim 11 wherein said packing retaining means comprises a plurality of circumferentially spaced retaining pin assemblies each including a retaining pin projecting radially inwardly from the side wall of said housing for engagement by the periphery of said packing.

16. Apparatus as claimed in claim 11 wherein said wetting means comprises at least one jet bank, and said mounting means includes an opening in the side wall of said housing and a removable plate covering said opening, said opening being of sufficient size to permit installation and removal therethrough of said jet bank.

17. Apparatus as claimed in claim 16 wherein said mounting means further includes a supply tube extending radially from said jet bank with its outer end projecting through said plate for connection with a supply of liquid purging agent.

18. Apparatus as claimed in claim 1 including a sump mounted on the outer side wall of said housing communicating with said liquid discharge opening.

19. Apparatus as claimed in claim 18 including a liquid discharge opening on each side of each of said packings communicating with said sump, and a drain tube in said sump for conducting liquid from said sump.

20. Apparatus as claimed in claim 19 wherein the upper end of said drain tube is elevated above the bottom of said sump to provide a minimum liquid level in said sump.

21. Apparatus as claimed in claim 20 further including a plurality of separating walls extending from said housing into said sump to a depth below the upper end of said drain tube to prevent gas flowing through said housing from bypassing said packings.

22. Wet scrubbing apparatus comprising: a housing having an inlet and an outlet permitting gas flow through said housing; wetting means in said housing between said inlet and outlet for wetting gas flowing through said housing with a liquid purging agent; at least one liquid discharge opening in said housing for conducting liquid purging agent supplied by said wetting means from said housing; and mounting means removably mounting said wetting means in said housing permitting installation and removal of said wetting means transversely of the longitudinal axis of said housing; at least one packing in said housing between said inlet and said outlet; packing retaining means removably retaining said packing in said housing for installation and removal axially of said housing; said wetting means comprising at least one jet bank, and said mounting means includes an opening in the side wall of said housing and a removable plate covering said opening, said opening being of sufficient size to permit installation and removal therethrough of said jet bank; said mounting means further including a supply tube extending radially from said jet bank with its outer end projecting through said plate for connection with a supply of liquid purging agent; said mounting means further including a retaining tube projecting radially from each jet bank, and a retaining pin extending radially inwardly from the housing wall and received in said retaining tube.

23. Apparatus as claimed in claim 22 wherein said jet bank comprises: a central distributor body, and jet spider means mounted on said distributor body.

24. Wet scrubbing apparatus comprising: a housing having an inlet and an outlet permitting gas flow through said housing; wetting means in said housing between said inlet and outlet for wetting gas flowing through said housing with a liquid purging agent; at least one liquid discharge opening in said housing for conducting liquid purging agent supplied by said wetting means from said housing; and mounting means removably mounting said wetting means in said housing permitting installation and removal of said wetting

means transversely of the longitudinal axis of said housing; at least one packing in said housing between said inlet and said outlet; packing retaining means removably retaining said packing in said housing for installation and removal axially of said housing; said packing retaining means comprises a fixed retaining ring secured to the inner wall of said housing for engagement by one side of said packing near the periphery thereof, and a removable retaining ring axially installable and removable in said housing for engagement by the other side of said packing near the periphery thereof; said packing retaining means further comprising a plurality of spacer rods each having one end secured to said removable retaining ring and extending axially therefrom, and a second removable retaining ring secured to the other ends of said spacer rods; means providing an abutment for said second removable retaining ring.

25. Apparatus as claimed in claim **24** wherein said last named means includes a second packing supported in said housing.

26. Wet scrubbing apparatus comprising: a housing having an inlet and an outlet permitting gas flow through said housing; wetting means in said housing between said inlet and outlet for wetting gas flowing through said housing with a liquid purging agent; at least one liquid discharge opening in said housing for conducting liquid purging agent supplied by said wetting means from said housing; and mounting means removably mounting said wetting means in said housing permitting installation and removal of said wetting means transversely of the longitudinal axis if said housing; at least one packing in said housing between said inlet and said outlet; packing retaining means removably retaining said packing in said housing for installation and removal axially of said housing; said packing retaining means comprises a plurality of circumferentially spaced retaining pin assemblies each including a retaining pin projecting radially inwardly from the side wall of said housing for engagement by the periphery of said packing, said retaining pin assembly each includes a socket member mounted on the outer wall of the housing, and a co-axial retaining pin opening formed in the wall of said housing for receiving a respective retaining pin.

27. Apparatus as claimed in claim **26** wherein said retaining pin assembly further includes a plug threadedly mounted in said socket member, said plug having an internally threaded opening, the respective retaining pin being threadedly received therein.

28. Apparatus as claimed in claim **27** including one group of said retaining pin assemblies located on one side of said packing, a retaining ring engaging the other side of said packing at the periphery thereof, and a second group of said retaining pin assemblies engaging the side of said retaining ring opposite said packing.

29. Wet scrubbing apparatus comprising: a housing having an inlet and an outlet permitting gas flow through said housing; a plurality of jet banks mounted in said housing between said inlet and outlet and spaced from each other along the longitudinal axis of said housing for spraying liquid purging agent into said housing; each of said jet banks including a central distributor body located in said housing coaxial with the longitudinal axis of said housing and a pair of jet spiders mounted on said central distributor body in axially spaced relationship with respect to each other, each of said spiders including a plurality of jet tubes projecting radially from said central distributor body with a jet nozzle on the outer ends of each of said jet tubes for spraying liquid purging agent in a generally longitudinal direction with respect to said housing, the jet tubes of one of said spiders being of greater than the jet tubes of said other spider; a plurality of packings in said housing, each of said packings being located between an adjacent pair of said jet banks; at least one liquid discharge opening in said housing for conducting liquid purging agent from said housing; mounting means for mounting said jet banks in said housing for installation and removal in a direction transverse to the longitudinal axis of said housing; and packing retaining means for supporting said packings in said housing for installation and removal in the direction of the longitudinal axis of said housing.

30. Apparatus as claimed in claim **24** wherein the jet bank located nearest said inlet is disposed between said inlet and the packing located nearest said inlet, and is disposed to spray liquid purging agent in the direction of said outlet and hence toward the packing located nearest said inlet, and wherein the other jet banks are disposed to spray liquid purging agent in the direction of said inlet.

31. Apparatus as claimed in claim **29** including a droplet separator located downstream of the jet bank nearest said outlet.

32. Apparatus as claimed in claim **31** including a reducer secured to said outlet.

33. Apparatus as claimed in claim **32** wherein said reducer is located downstream of said droplet separator.

34. Apparatus as claimed in claim **32** wherein said droplet separator is located downstream of said reducer.

35. Apparatus as claimed in claim **33** wherein said housing is disposed vertically with said reducer mounted on the upper end thereof.

36. Apparatus as claimed in claim **35** including a semi-spherical bottom secured to the lower end of said housing and defining a sump for liquid purging agent, and a drain tube mounted in the lowermost point of said semi-spherical bottom.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,795,089 Dated March 5, 1974

Inventor(s) Karl Reither

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 8, line 45 before "said" delete "the". Column 12, line 28 "24" should be --29--.

Signed and sealed this 24th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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