

[54] **PARTICLE ACCUMULATOR WITH
PARTICLE EXTRACTOR AND STABILIZER**

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55/391, 55/394, 55/430, 55/458, 55/466,
73/28, 73/432, 356/103

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348, 261, 270, 274, 17, 391, 394, 466;
209/144; 210/512; 73/28, 23, 432; 356/103

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[57] **ABSTRACT**

A particle accumulator and display having a closed chamber with a plurality of injection nozzles to provide a vortex flow within the chamber. An ejection nozzle is centrally located within the chamber at the end adjacent the injection nozzles. A flow stabilizer is positioned between the injection nozzles and the ejection nozzle. A particle extractor and stabilizer is attached to one end of the closed chamber and has a stabilizer hub and rotating end wall driven by a motor. The particle extractor and stabilizer includes a flow impeller, which communicates with an annular channel between the stabilizer hub and rotating end wall to withdraw the accumulated column of particles from the chamber.

4 Claims, 11 Drawing Figures

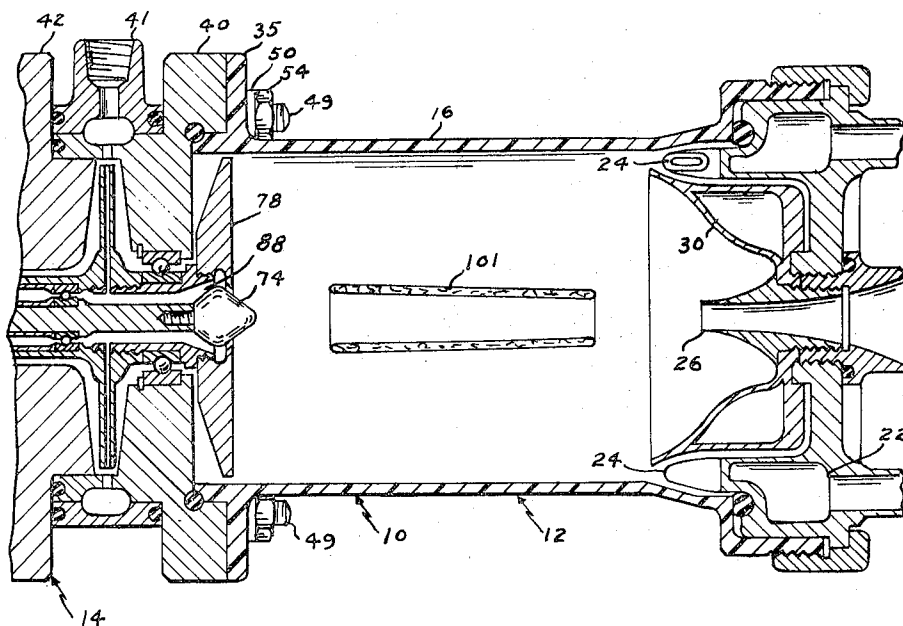


Fig-1

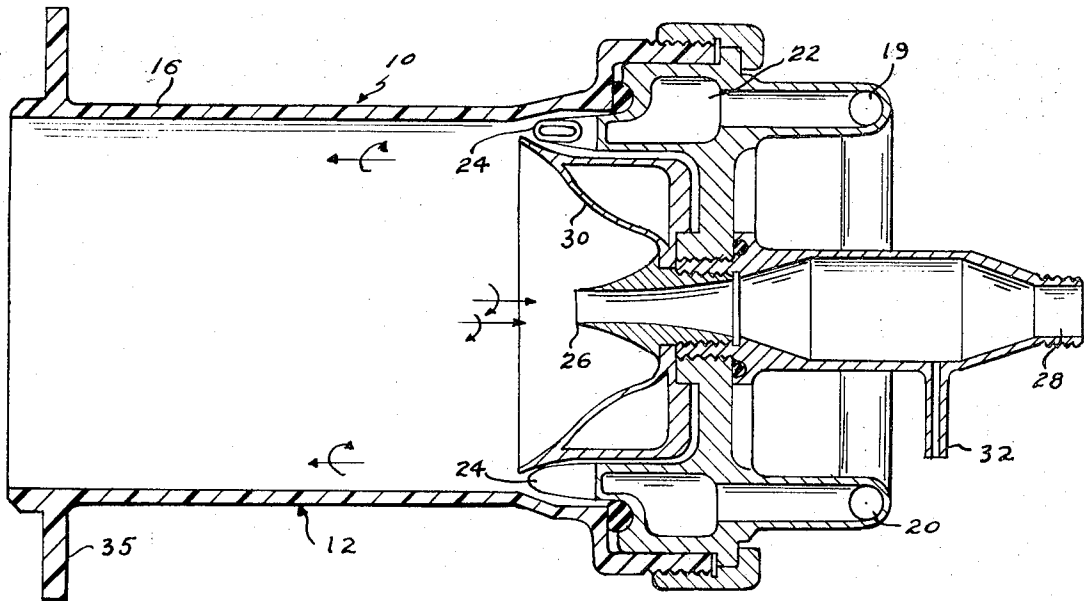
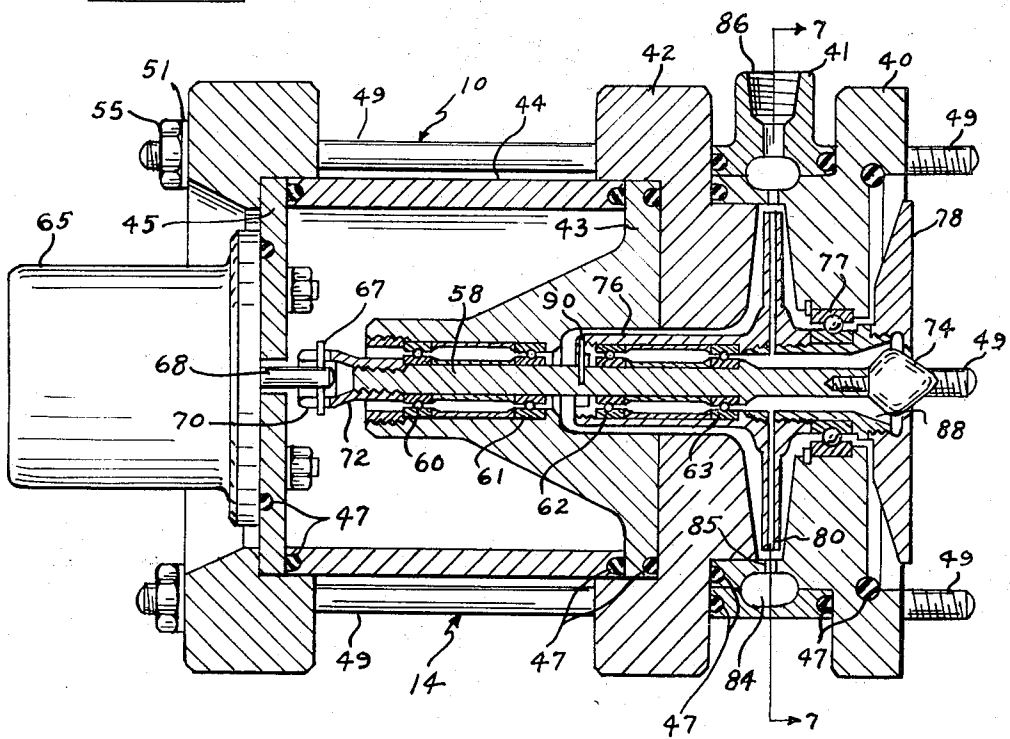


Fig-2



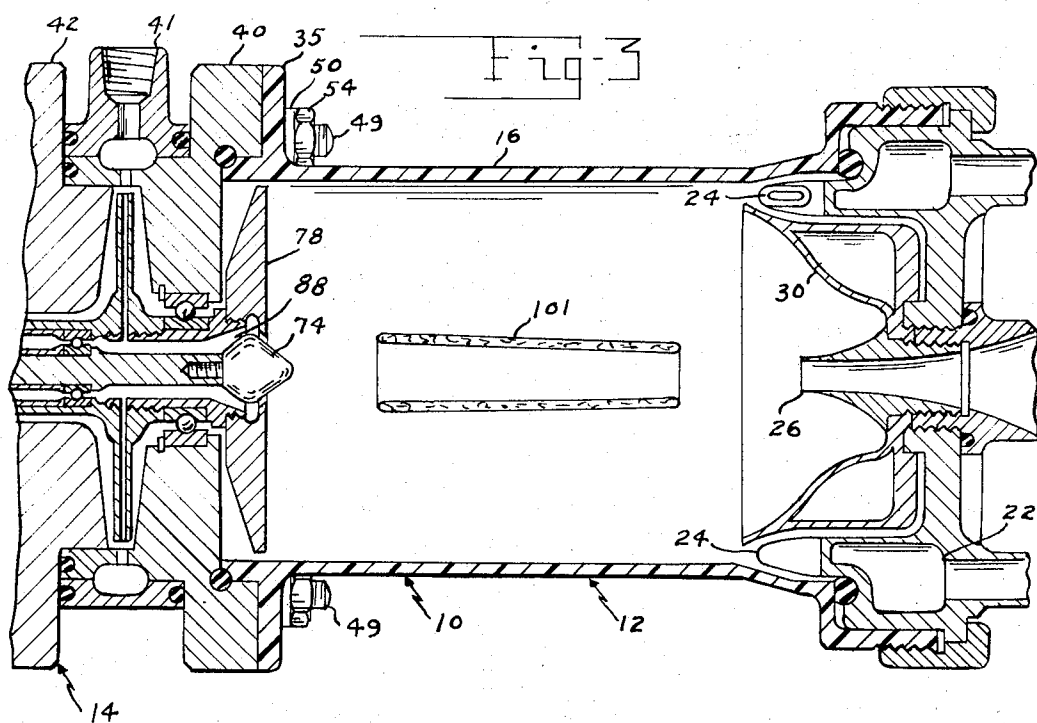


Fig. 4

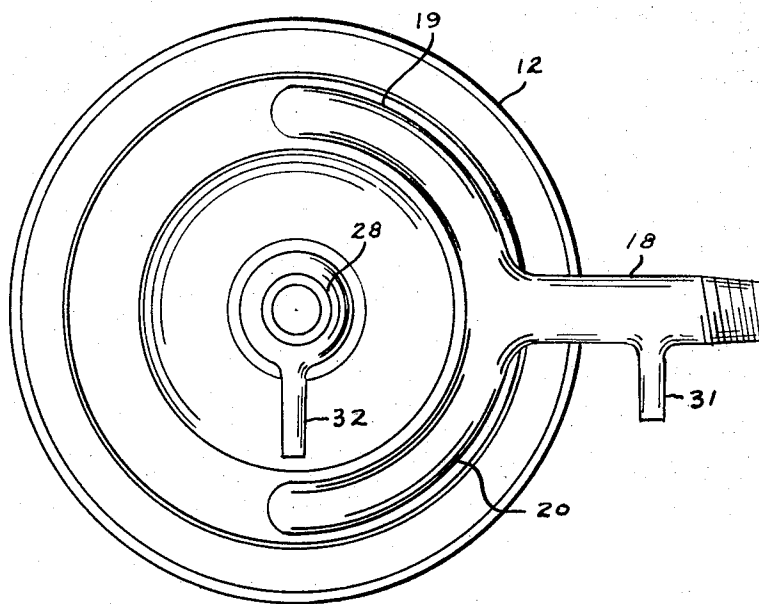


Fig-5

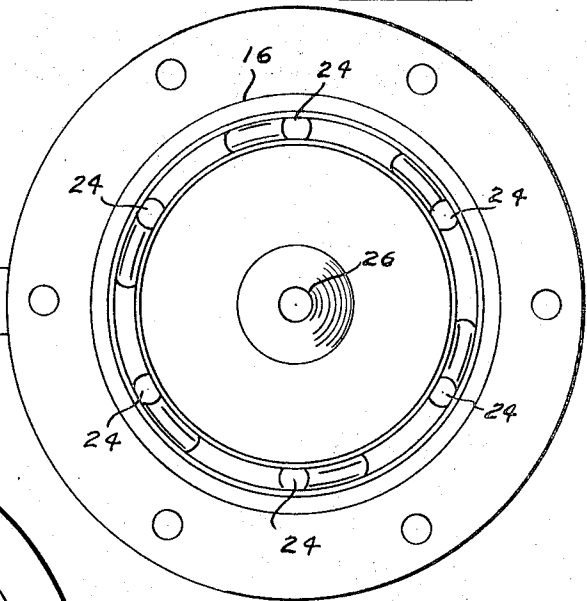


Fig-7

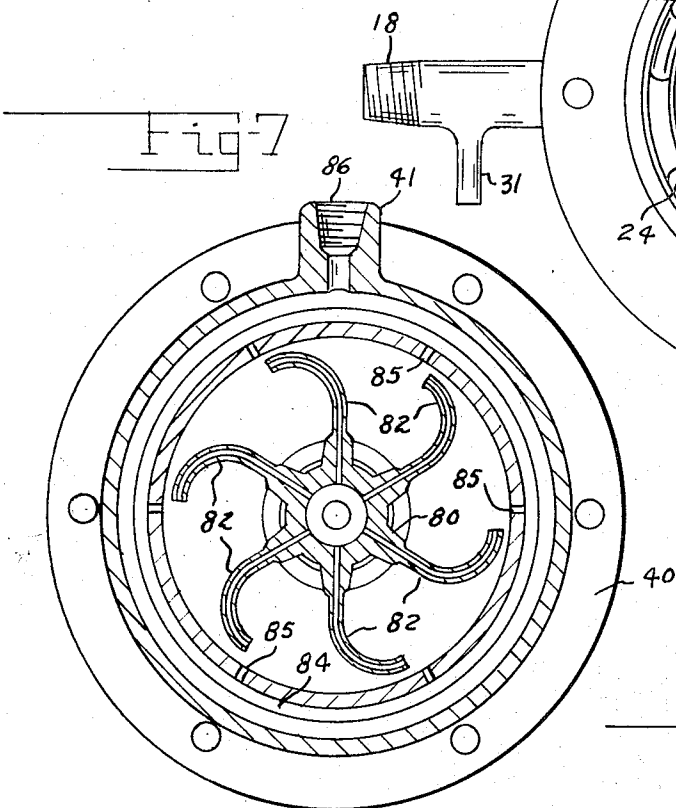


Fig-10

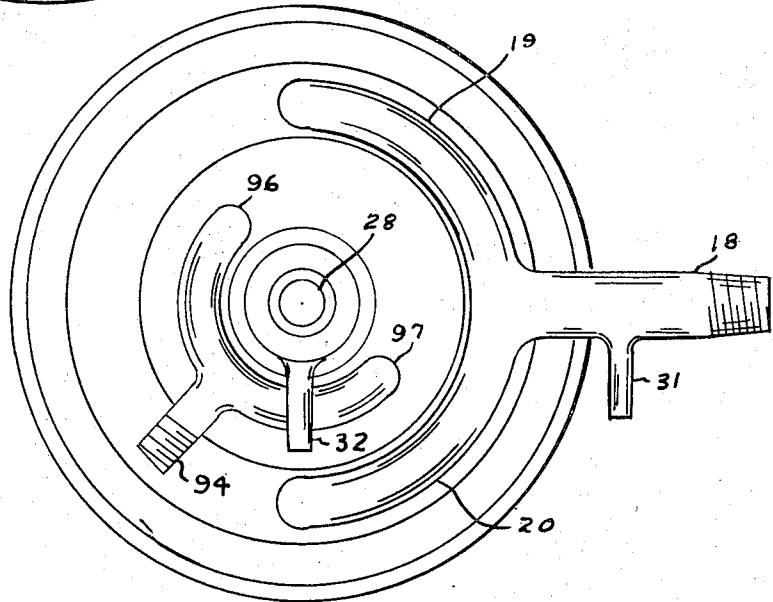
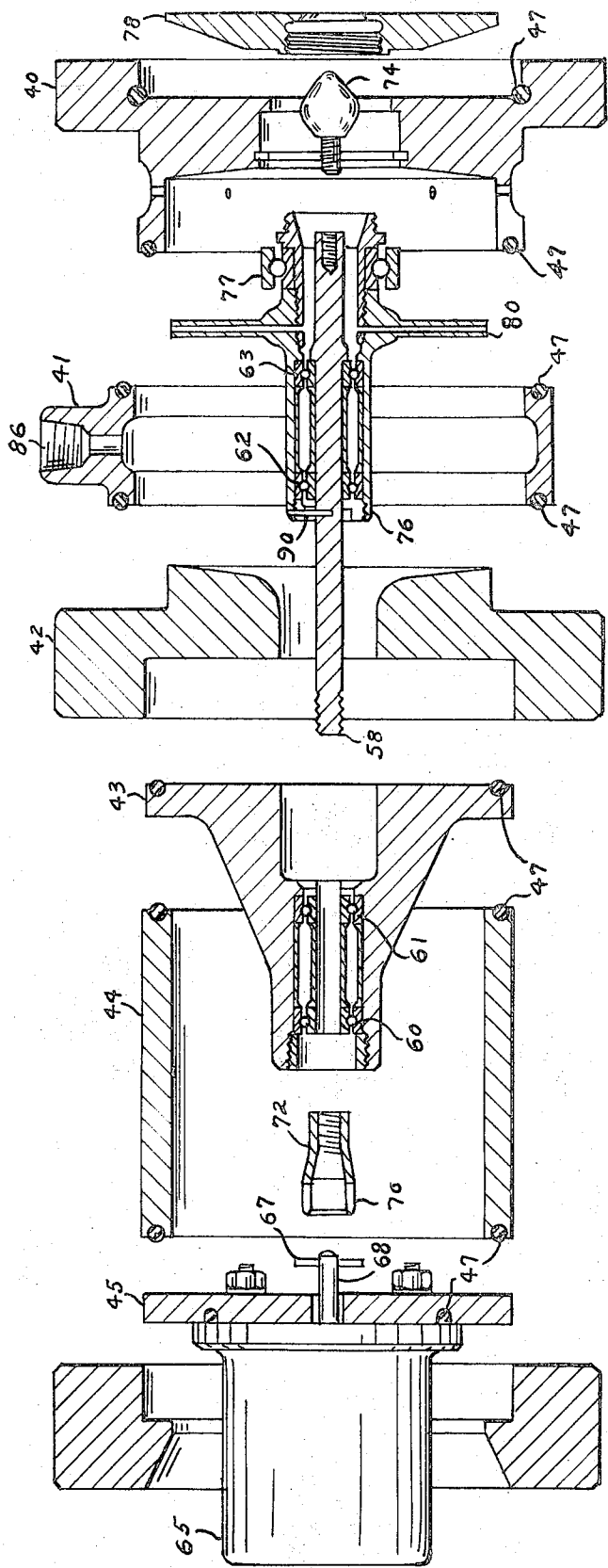
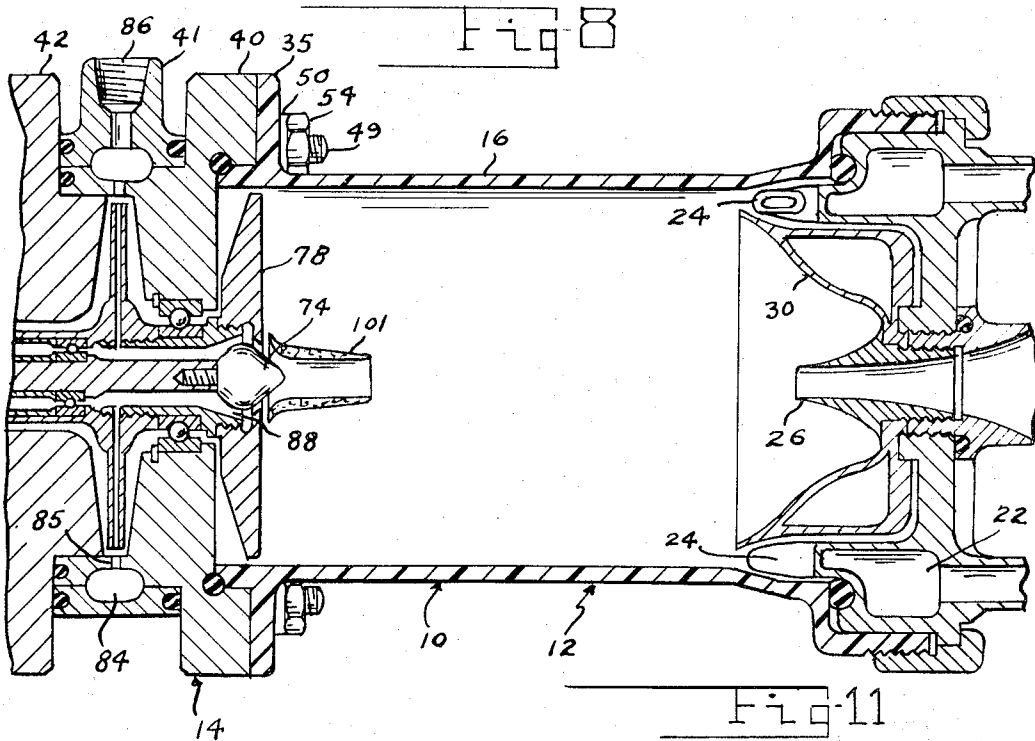
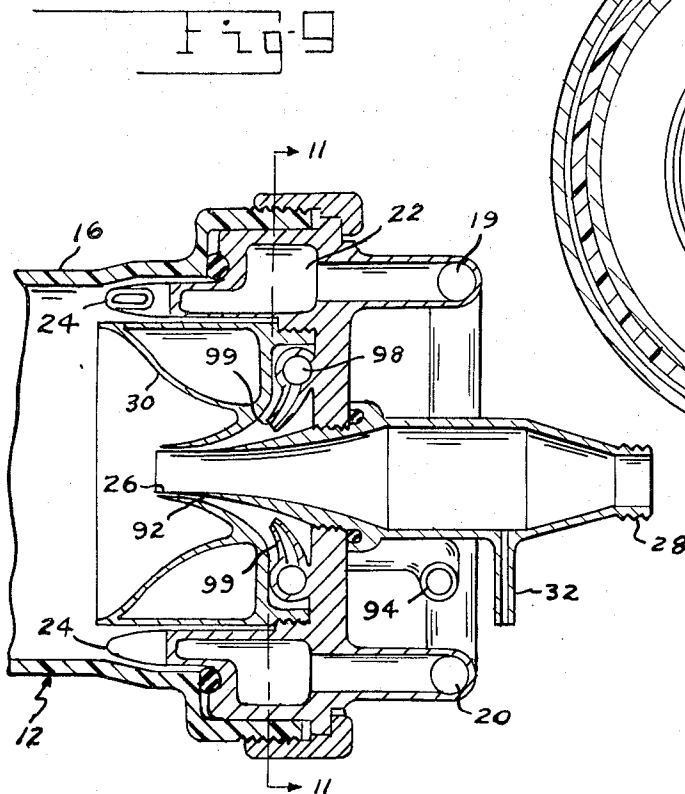
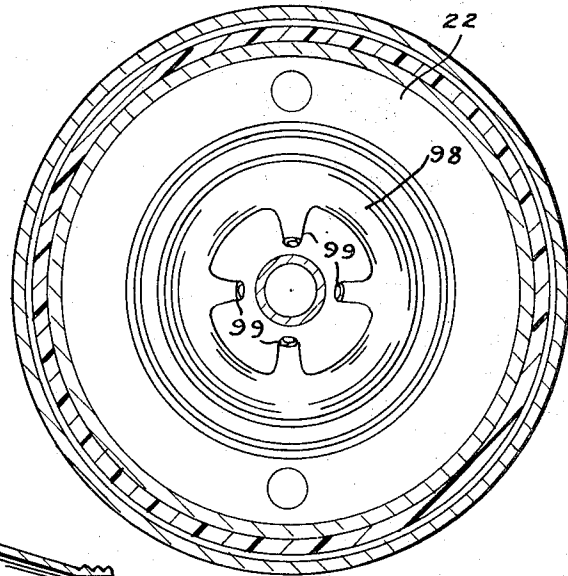


Fig. 6





PARTICLE ACCUMULATOR WITH PARTICLE EXTRACTOR AND STABILIZER

BACKGROUND OF THE INVENTION

In apparatus for accumulating and displaying fine particles, such as described in the inventor's copending application, "Apparatus for Accumulating and Displaying Fine Particles in a Gas," Ser. No. 157,136, now U.S. Pat. No. 3,677,650 it has been necessary to disassemble the apparatus to remove the collected particles after a test before the apparatus could be operated again to collect another sample. Some means is desirable for removing the column of collected particles without having to shut down the equipment and disassemble the apparatus.

BRIEF SUMMARY OF THE INVENTION

According to this invention, an apparatus with a motor driven particle extractor and stabilizer is attached at one end of the particle accumulator which provides an annular channel in the end wall, whereby the particle column can be drawn to one end of the accumulator where it can be removed while the accumulator is in operation. Also, a moving end wall and central hub are provided to reduce turbulence and boundary layer friction. By coordinating flow rate in the separation chamber with wall and hub speeds, the location of confinement area for the collected particle column in the annular transition region can be adjusted.

IN THE DRAWINGS

FIG. 1 is a sectional view of the separator and accumulator assembly of the invention.

FIG. 2 is a sectional view of the extractor and stabilizer assembly of the invention.

FIG. 3 is a sectional view showing the attachment of the accumulator assembly of FIG. 1 secured to the extractor and stabilizer assembly of FIG. 2.

FIG. 4 is a right hand end view of the device of FIG. 1.

FIG. 5 is a left hand end view of the device of FIG. 1.

FIG. 6 is an expanded view of the device of FIG. 2.

FIG. 7 is a sectional view of the device of FIG. 2 along the line 7-7.

FIG. 8 shows the device of FIG. 3 with the particle column drawn toward the stabilizer wall.

FIG. 9 shows a modified separator and accumulator assembly according to the invention.

FIG. 10 is a right hand end view of the device of FIG. 9.

FIG. 11 is a sectional view of the device of FIG. 9 along the line 11-11.

Reference is now made to FIGS. 1 and 2 of the drawing, which show a particle accumulator and separator 10 having a separator portion 12 and an extractor and stabilizer portion 14, which are normally connected together as shown in FIG. 3.

The separator portion 12 is similar to the apparatus shown and described in the copending application referenced above. The particle laden gas is supplied to chamber 16 through inlet 18, shown in FIG. 4. The gas passes through tubes 19 and 20 to an annular channel 22. Gas from the channel 22 enters the chamber 16 tangentially through a plurality of nozzles 24, shown in FIG. 5. The clean gas leaving the chamber passes out through ejection nozzle 26 to outlet 28. A flow stabi-

lizer 30 is provided between the inlet nozzles 24 and the ejection nozzle 26, as in the copending application referenced above. Pressure taps 31 and 32 are provided for measuring inlet and outlet pressures.

The particle extractor and stabilizer portion 14 of the particle separator, shown in FIG. 2, is shown in an exploded view in FIG. 6. The extractor and stabilizer has members 40, 41, 42, 43, 44 and 45 sealed with O-rings 47 and held together by threaded rods 49, which also pass through flange 35 of member 12, and are secured with washers 51, 52 and nuts 54, 55. A shaft 58, supported in bearings 60, 61, 62 and 63, is driven by a motor 65 which is secured to member 45. A pin 67 on motor shaft 68 engages a slot 70 in coupling member 72, which is secured to shaft 58. A hub member 74 is secured to the end of shaft 58 and acts to stabilize the flow within chamber 16. The bearings 62 and 63 support the shaft 58 within a hollow shaft 76, which in turn is supported within member 40 by a bearing 77. A flow stabilizer wall member 78 is threaded onto hollow shaft 76. The shaft 76 also includes a flow impeller 80 having six flow impeller tubes 82, as shown in FIG. 7. The impeller tube outlets lead to an annular channel 84 through orifices 85 and then to outlet port 86. An annular channel 88 is provided between shafts 58 and 76 which communicates with chamber 16 so that collected particles can be removed when desired. Normally the bearings used would be sealed bearings to keep particles in channel 88 from entering the bearing. However, if unsealed bearings were used, seals, not shown, would be provided. Shaft 76 would normally be driven through bearing friction in bearings 62 and 63. This, then, could provide some slip between the rotation of wall member 78 and hub member 74, which is useful for some applications. However, if it is desired to have shafts 58 and 76 run at the same speed, a pin member 90 may be provided to lock the shafts together. If it is desired to use the rotating end wall and hub during tests, the outlet port 86 could be closed to keep the flow impeller 80 from extracting the particles from chamber 16.

In the operation of the device, either particle laden gas is supplied under pressure to inlet 18, or a particle laden gas is supplied to inlet 18, with a vacuum source being connected to outlet 28. A vortex flow is established within chamber 16 to separate the particles and to provide an accumulated column of particles 101, shown in FIG. 3, in the manner described in applicant's application, Ser. No. 157,136. The motor 65 can be operating at a low speed to rotate hub 74, or the hub and wall 78 can be stationary. When it is desirable to extract the column, the motor 65 can be started or speeded up to cause hub 74, wall member 78 and the flow impeller 80 to rotate to draw the column 101 to the end of the chamber, as shown in FIG. 8, where it is drawn off through channel 88, impeller tubes 82, orifices 85, annular channel 84 and outlet port 86. The apparatus is then ready to accumulate additional columns of particles for test.

With the device thus far described, the particle accumulator portion of the apparatus is similar to that shown in the inventor's copending application, 157,136. However, the flow accumulator could be made similar to that shown in applicant's copending application, "Gas Particle Accumulator, Treating and Test Apparatus," Ser. No. 195,551, filed Nov. 4, 1971 as shown in FIGS. 9-11. This device is substantially the

3

same as the device shown in FIG. 1, except that an annular access channel 92 is provided around ejection nozzle 26. Material to be supplied to chamber 16 is fed to the channel 92 from inlet tube 94, shown in FIG. 10, which supplies the material through tubes 96 and 97 to an annular channel 98 to four nozzles 99. Thus, various tests may be performed on the column as described in copending application, "Gas Particle Accumulator, Treating and Test Apparatus."

All parts of the apparatus can be made of either plastic or metal or other materials, except that the bearings and motor would be made of the normal materials used in these devices and the seals would be made of a normal low pressure sealing material, such as rubber. The wall of chamber 16 must be made of a transparent material, such as glass or plastic, when it is desired to view the collected column. However, in some tests only pressure and temperature indications are made, in which case the wall could be made of an opaque material.

There is thus provided a particle separator and accumulator which provides apparatus for removing a column from the test chamber without disassembling the apparatus.

I claim:

1. A particle accumulator and test apparatus, comprising a closed chamber; means, including a plurality of input nozzles, for providing a vortex flow of a particle laden gas within the chamber; a gas ejection nozzle spaced from and centrally located at the end of the chamber adjacent the input nozzles; means, positioned between the input nozzles and the ejection nozzle, for stabilizing the flow within the chamber to permit at least one annular column of particles to accumulate within said chamber, means connected to the end of

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the chamber remote from input nozzles and the ejection nozzle for selectively withdrawing a collected column of particles from said chamber; said means for selectively withdrawing a collected column of particles from said chamber including means for providing a flow stabilizing rotating end wall for said chamber; means for providing a flow stabilizing rotating hub centrally located with respect to the rotating end wall; said means for selectively withdrawing a collected column of particles from said chamber including a particle outlet means; a flow channel between said rotating hub and said rotating end wall and a flow impeller for drawing collected particles from said chamber through said flow channel and for delivering them to the particle outlet means.

2. The device as recited in claim 1 including at least one annular channel adjacent the ejection nozzle for providing access to said chamber whereby treatment and test material may be inserted into said chamber and means, passing through the wall of the chamber, for providing access to the annular access channel.

3. The device as recited in claim 2 including a first shaft connected to said rotating end wall; a second shaft passing through the first shaft and connected to the rotating hub with the first shaft being at least partially supported, on bearings, on said second shaft; said first shaft being adapted to be driven through bearing friction by the second shaft and means for driving said second shaft; said flow impeller being formed as part of said first shaft.

4. The device as recited in claim 3 including a pin means for locking the first shaft and the second shaft against relative rotation.

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