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METHOD OF AND APPARATUS FOR MIXING FIBROUS MATERIAL AND POWDERED MATERIAL

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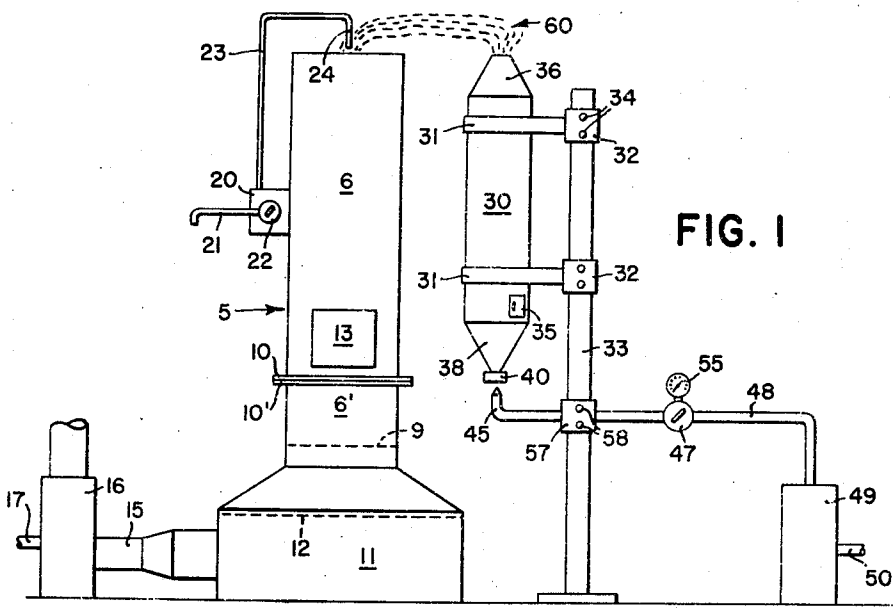


FIG. 1

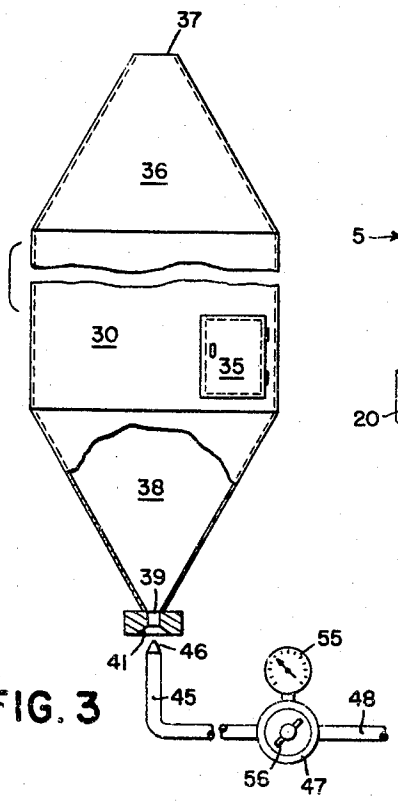


FIG. 3

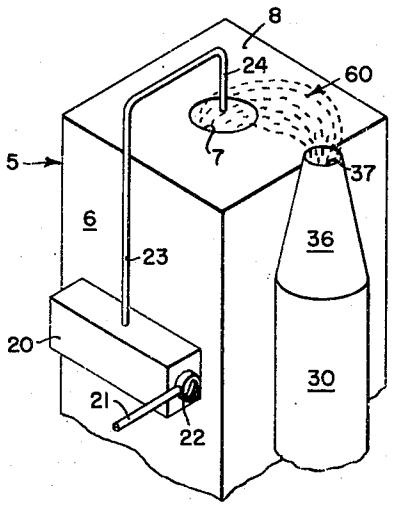


FIG. 2

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METHOD OF AND APPARATUS FOR MIXING FIBROUS MATERIAL AND POWDERED MATERIAL

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16 Claims. (Cl. 73—38)

The present invention relates generally to mixing fibrous material with powdered material, as best exemplified by a device for testing the efficiency of air filters wherein air laden with dust mixed with lint is drawn through an air filter. It has heretofore been conventional practice to mix the dust and lint together and then feed the mixture into the suction end of the filter compartment. However, it is well known to those skilled in the art that no more than about 3% lint can be mixed evenly with dust, because of the tendency of the lint to form rolls or balls rather than becoming evenly distributed through the dust.

Therefore, since it is sometimes desirable to test air filters with dust having considerably more than 3% lint mixed evenly therein, the principal object of my invention relates to a method of mixing dust and lint evenly together in any desired proportion.

A further object has to do with the provision of apparatus for mixing fine fibrous material and powdered material, such as, for example, dust and lint in any desired proportions.

Another object relates to the provision of apparatus for separating lighter particles of fibrous material, such as lint from a mass of such material in order to make it available for mixing. A related object has to do with the provision of control means for determining the size of particles separated from the mass.

These and other objects and advantages of my invention will be apparent to those skilled in the art after a consideration of the following description in which reference is had to the drawings appended hereto, in which—

Fig. 1 is an elevational view of an air filter test apparatus embodying the principles of the present invention;

Fig. 2 is a perspective view of the upper ends of the mixing compartment and lint chamber drawn to a larger scale; and

Fig. 3 is an elevational view of the lint chamber, drawn to a still larger scale with portions broken away.

Referring now to the drawings, the filter test unit is indicated in its entirety by reference numeral 5 and comprises a vertically disposed compartment 6 serving as a passageway for air or other gas and provided with an intake orifice 7 in the top wall 8 thereof and an observation window 13 in one side.

The air filter to be tested, as indicated by reference numeral 9, is disposed at the lower end of the compartment 6. The compartment is rectangular in cross-section and is so dimensioned that the filter unit 9 fits therein fairly snugly to insure that the air flow through the passageway 6 must all pass through the filter 9. The compartment is divided into separable portions 6, 6' having abutting flanges 10, 10', respectively.

The compartment portions 6, 6' rest upon and communicate with a lower compartment 11 of increased cross-section, in which is disposed an absolute filter 12 of a known high efficiency of greater than 99%. The lower compartment 11 communicates with an exhaust duct 15 which connects with the intake of a fan 16, the rotor

shaft 17 of which can be driven by any suitable means (not shown).

On one side of the compartment 6 is mounted a dust feeder 20. Air under pressure is supplied to the dust feeder 20 by a pipe 21 connected with any suitable source and there is a pressure regulator 22 in the supply line by means of which the pressure of the air can be adjusted to a value suitable for the feeder 20. A feeder pipe 23 extends upwardly over the top wall 8 and has a terminal end 24 directed downwardly toward the orifice 7 for feeding dust therein.

The air filter test apparatus so far described is the standard vertical test unit specified in detail by the Air Filter Institute in its "Code for Testing Air Cleaning Devices Used in General Ventilation. Section 1. Unit or Panel Type Air Filtering Devices," approved by the Air Filter Institute, January 1953. Inasmuch as this unit is known to those skilled in the art, the foregoing general description is deemed sufficient for present purposes.

A lint chamber 30 in the form of a cylindrical container is supported in a generally vertical position adjacent the test compartment 6 by means of a pair of arms 31 carried on clamps 32 which are slidable vertically on an upright post 33. The clamps are secured in vertically adjusted position on the post 33 by means of set screws 34. The chamber 30 is provided with an access door 35.

The upper end of the chamber terminates in a tapering or frusto-conical portion 36, the upper end of which terminates in a discharge opening 37. Similarly, the lower end portion 38 of the chamber tapers downwardly and has an air input opening 39 in the lower end thereof. The lower opening 39 is in a block 40 fixed to the lower end of the tapered portion 38. The lower end 41 of the opening 39 flares downwardly to serve as part of an injector by which air is forced into the bottom of the chamber, as will be described.

Below the input opening 39 is disposed an upwardly directed air blast pipe 45 on the upper end of which is a nozzle 46 provided with an orifice in the tip thereof, preferably in the order of .040 inch in diameter. The pipe 45 is connected through a pressure regulator 47 and pipe 48 to a compressor 49, the drive shaft 50 of which is connected to a suitable motor or source of power. A pressure gauge 55 indicates the air pressure in the pipe 45 as regulated by the regulator 47, which is adjustable by means of a control handle 56 in any conventional manner. The pipe 45 is supported on the post 33 by a clamp 57 secured in vertically adjustable position by set screws 58, by which the spacing between the nozzle 46 and flared opening 41 can be determined.

The pressure in the pipe 45 can be regulated according to the size and weight of the particles of lint or other material that is to be discharged from the chamber 30. A mass of cotton lint is inserted into the chamber 30 through the access door 35. The air pressure in the pipe 45 is then brought up to a value which I have found to be within a range of about 40 to 100 pounds per square inch. A fine blast of air is directed upwardly through the nozzle 46 into the flared opening 41 and penetrates into the mass of lint in the chamber. The action of the air blast entering the opening 41 is that of an injector, which causes a larger volume of air to be injected into the opening 39 around the blast. This volume of air rises through the chamber 30 and out through the discharge opening 37. The high velocity jet of air pierces the mass and tears the lint apart while the larger volume of air carries the linters up through the chamber and out through the discharge opening 37. The tapering upper end portion 36 causes the rising air to increase its velocity as it leaves the chamber.

I have found that with any given pressure maintained

in the pipe 45 the linters of a certain size and weight will be separated from the mass and carried out of the chamber until substantially all of that grade and lighter will be separated out of the mass, leaving the heavier linters in the chamber. The mass continually tumbles or rolls down toward the opening 39 but is forced upwardly by the air. When the flow of linters from the discharge opening stops, it is then known that the remaining linters are heavier and coarser.

The pressure in the pipe 45 as indicated by the gauge 55 can then be increased by turning the control handle 56, whereupon another stream of lint out of the opening 37 will occur until all of the linters that can be discharged by that jet pressure have passed out of the opening 37. In this manner the linters can be separated from the mass in any desired increments of coarseness. Adjusting the pipe 45 vertically relative to the opening 41 also varies the weight of linters separated.

The filter 9 to be tested is placed in the lower compartment 6' after the upper compartment 6 has been removed, then the latter is placed upon the flange 10' and the fan 16 is started, inducing a flow of air into the top orifice 7, down through the compartment 6, 6' and through the filter 9, then through the absolute filter 12 and out the exhaust duct 15. The test dust is fed by the feeder device 20 through the pipe 23 into the orifice 7 where it is drawn along with the air flow and is mixed therein by the air turbulence so that by the time the dust reaches the test filter 9 it is evenly distributed in the air.

The linters being discharged from the top opening 37 are caught by the air flow and carried into the orifice 7, as indicated by reference numeral 60. Since each linter is separate in the air flow and the same can be said about the particles of dust, the linters will mix evenly in the air flow without any tendency to form balls or rolls as they mix with the dust in the stream, regardless of the proportion of dust to lint. Thus, although it has always been considered that a maximum possible proportion of 3% lint to 97% dust was the limit in testing air filters, it is now possible by the method just described to mix the dust and lint half and half or even 97% lint and 3% dust, if desired. The dust and lint are both evenly distributed in the air stream and most of it is deposited on the test filter 9.

Any dust and lint that passes through the test filter 9 is caught by the absolute filter 12. Both filters can then be weighed and the efficiency calculated in a well known manner.

As specified in the above-mentioned code of the Air Filter Institute, the conventional method of mixing lint and dust is to stir it together in a container in the ratio of 3% lint, 72% dust and 25% carbon black.

It is now evident that the separating device can be used for separating other material linters, if desired. Any fibrous material can be separated and graded for different lengths of fibers and cleaned of dust, seeds and other material. Small grains can be separated from chaff and dust and other finely divided solid material can be graded for size.

I do not intend my invention to be limited to the particular details shown and described herein except as set forth in the following claims.

I claim:

1. The method of evenly blending fibrous material with finely divided solid material in any desired proportion, which comprises creating a flow of gas through a passageway and feeding said fibrous material and said finely divided material simultaneously but separately into said gas flow in said desired proportion.

2. The method set forth in claim 1, including the further step of passing the gas flow through a filter to separate the blended material from the gas.

3. The method of evenly mixing a very fine fibrous material with a powdered material in a gas, which comprises creating a flow of said gas through a passageway, feeding a stream of said fibrous material into said gas flow, and feeding a separate stream of said powdered material into said gas flow.

4. The method of evenly mixing a very fine fibrous material with a powdered material in a gas, which comprises inducing a flow of said gas through an orifice, feeding a stream of said fibrous material into said orifice, and simultaneonsly feeding a separate stream of said powdered material into said orifice.

5. The method of evenly mixing lint with dust in an air stream which comprises feeding a stream of lint into said air stream and simultaneously feeding a separate stream of dust into said air stream.

6. The method set forth in claim 5, which includes the further step of passing said air stream through a filter to separate the evenly mixed lint and dust from the air.

7. The method of evenly mixing lint with dust in air, which comprises inducing a flow of air through an orifice, feeding a stream of lint into said orifice, and simultaneously feeding a separate stream of dust into said orifice.

8. Apparatus for evenly mixing lint with dust in air, comprising in combination, a compartment having an orifice in a wall thereof, an exhaust duct connected with said compartment, means inducing a flow of air into said compartment through said orifice, means feeding a stream of lint into said orifice, and means simultaneously feeding a separate stream of dust into said orifice.

9. Apparatus for evenly mixing lint with dust comprising an air duct, means for inducing an air flow in said duct, means communicating with said duct for feeding a stream of lint into said air flow, and another feeding means communicating with said duct for simultaneously feeding a stream of dust into said air flow.

10. Apparatus as set forth in claim 9, including the further provision of a filter disposed in said duct for separating the mixture of lint and dust from the flow of air.

11. Apparatus for evenly mixing a very fine fibrous material with a powdered material, which comprises a duct, means connected with said duct for inducing a flow of gas in said duct, means communicating with said duct for feeding a stream of said fibrous material into said duct, and another feeding means communicating with said duct for simultaneously feeding said powdered material thereto.

12. Apparatus for evenly mixing lint with dust in air, comprising in combination, a compartment having an orifice in a wall thereof, an exhaust duct connected with said compartment, means inducing a flow of air into said compartment through said orifice, means feeding a stream of dust into said orifice and means simultaneously feeding a stream of lint into said orifice comprising a lint chamber having an air input opening at one end and a discharge opening at the opposite end, and means directing an air blast into said input opening, said discharge opening being disposed adjacent said compartment orifice to discharge lint into said flow of air into said orifice.

13. Apparatus of the class described, comprising in combination, a compartment having an orifice in a wall thereof, an exhaust duct connected with said compartment, a filter connected in series with said duct, an exhaust fan connected to said duct for inducing an air flow through said orifice, into said compartment, through said filter, and out through said exhaust duct, means feeding a stream of dust into said orifice and means simultaneously feeding a stream of lint into said orifice comprising a lint chamber disposed adjacent said compartment having an upper discharge opening in proximity to said compartment orifice and a lower air input opening, and means directing a fine blast of air at high velocity into said lower input opening, whereby air and lint are discharged from the upper discharge opening into the flow of air entering said orifice.

14. Apparatus of the class described, comprising a chamber having an air input opening in one end thereof and a discharge opening in the other end thereof, an air blast pipe having a nozzle supported in spaced relation to said input opening and provided with a fine orifice at the end thereof directed into said input opening for discharging a fine air blast under high pressure into said compartment to inject a comparatively lower velocity flow of air around said nozzle into said chamber, and means for controlling the pressure of air in said pipe.

15. Apparatus for separating lighter particles of material from a mass of fibrous material or the like, comprising a vertically disposed chamber adapted to receive the mass of material, the upper and lower ends of said chamber being tapered and having openings at their extremities, respectively, an air blast pipe disposed below said lower opening and having a nozzle supported in spaced relation to said lower opening and provided with a fine orifice directed into said lower opening to inject a comparatively lower velocity flow of air from the atmosphere around said nozzle into said chamber, and means

for controlling the air pressure in said pipe to determine the size of the particles of material that is driven out through the upper opening.

16. The apparatus claimed in claim 15, including the further provision of adjustable means for supporting said air blast pipe providing for adjustably securing the pipe with the nozzle disposed at various distances from said lower compartment opening.

References Cited in the file of this patent

UNITED STATES PATENTS

287,496	Baur	Oct. 30, 1883
1,947,852	Jewett	Feb. 20, 1934
2,326,438	Clarke	Aug. 10, 1943
2,389,701	Truesdale	Nov. 27, 1945
2,493,652	Bowersox	Jan. 3, 1950
2,561,396	Matheson	July 24, 1951
2,638,688	Hazelton	May 19, 1953
2,653,473	Simison	Sept. 29, 1953
2,683,685	Matheson	July 13, 1954