April 3, 1962 R. S. MUELLER 3,027,970

FLUID CLEANING APPARATUS

Filed Jan. 26, 1959 2 Sheets-Sheet 1

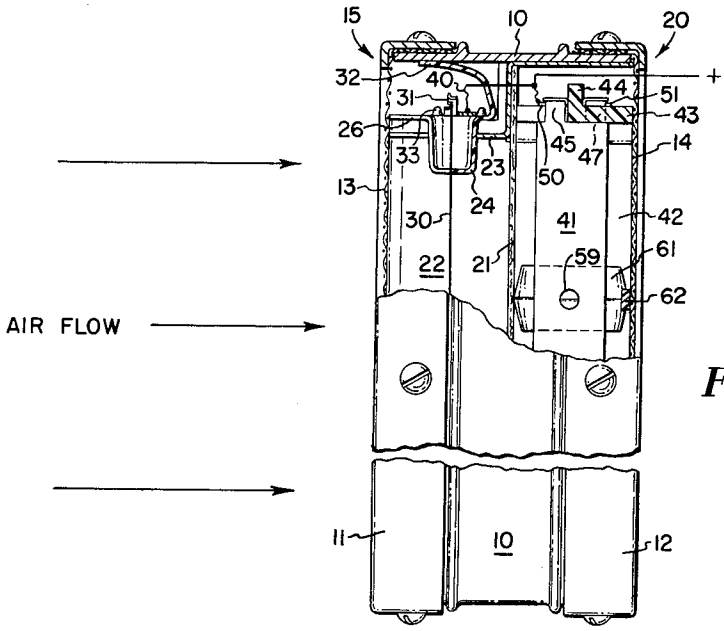


Fig. 1

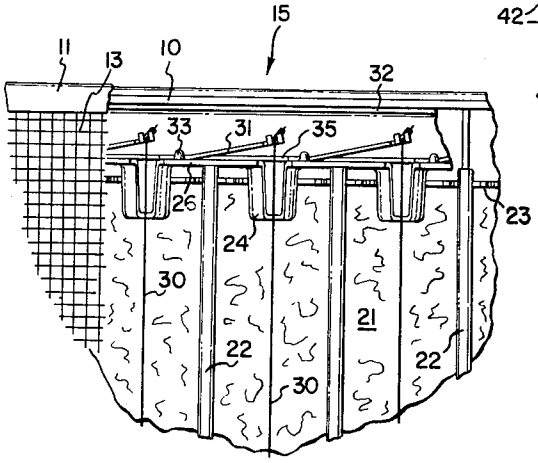


Fig. 2

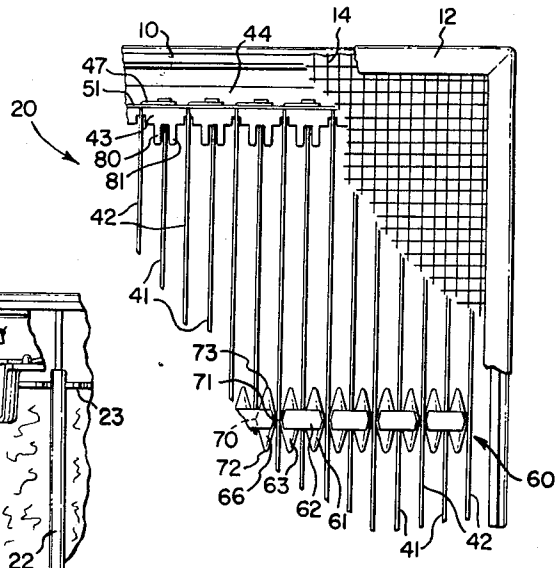


Fig. 3

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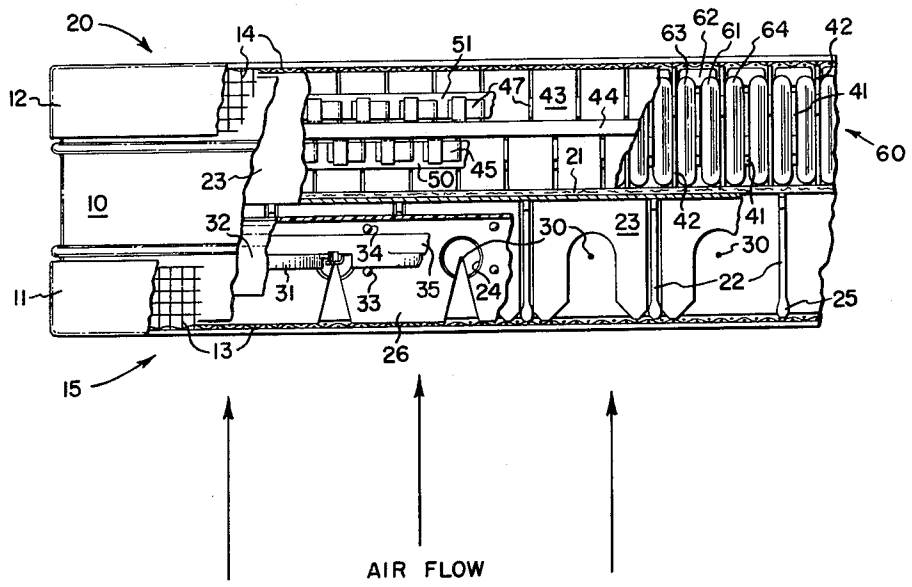


Fig. 4

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FLUID CLEANING APPARATUS

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The present invention is concerned with an improved spacer means for an electrostatic gas cleaning apparatus which has a relatively small dimension in the direction of gas flow. The size of the apparatus makes the unit readily adaptable to replace a conventional mechanical filter in both commercial and residential forced air conditioning installations.

Electrostatic gas cleaning apparatuses have been known and made use of for some time; however, such apparatuses have been quite expensive and not normally available as a replacement for the commonly used mechanical filters. As the desirablility of more efficient air cleaning increases, the need for a relatively inexpensive and yet efficient air cleaning unit to replace a conventional mechanical filter has increased.

The present invention provides an improved spacer means for an electrostatic air cleaning unit which has an ionization and collecting section. The spacer means facilitates in reducing the overall length of the unit in the direction of air flow, thus the unit is more adaptable as a replacement for mechanical filters.

An object of the present invention is to provide an improved electrostatic gas cleaning apparatus.

Another object of the present invention is to provide an improved electrostatic gas cleaning apparatus having an improved spacing means for use between parallel, oppositely charged plates.

These and other objects of the present invention will become apparent upon the study of the following specification and drawing of which:

FIGURE 1 is a side view of the present invention with a portion cut away.

FIGURE 2 is a front view of the apparatus of FIGURE 1 showing a portion of the ionization section.

FIGURE 3 is a rear view of the unit showing a portion of the collection section.

FIGURE 4 is a top view of the apparatus shown in FIGURE 1 with a portion cut away to show the ionization and collection sections.

Referring to FIGURE 1, a side view of the improved electrostatic gas or air cleaning apparatus is shown. A case 10 has a front cover frame 11 and a rear cover frame 12. When in position, frame 11 holds a wire mesh 13 across the front of the unit. A similar wire mesh 14 is held across the rear of the unit by frame 12. The forward portion of the unit is an ionization section 15. The rear part of the unit is a collection section 20. The ionization and collecting sections are separated by a thin layer of mechanical filter medium 21 to assist in the proper distribution of the gas flow in the unit. For explanation purposes, the size of the unit in the direction of gas flow may be considered to be approximately two inches.

Referring to FIGURE 2, the ionization section is shown in more detail. A plurality of thin metal parallel plates 22 are mounted in a parallel manner between two support members 23. The one support member is shown in FIGURE 2. Referring to FIGURE 4, the support member 23 is shown to have a plurality of notches for receiving plates 22 and a plurality of inner-disposed curved notches for receiving a cup-shaped insulator 24. Plates 22 have a thick leading edge 25 which provides a stiffness to the plates to prevent any quivering or bowing and possible noise due to the high velocity air flow.

Strung between adjacent plates 22 is an ionizing wire 30. The wire is held at its extremities in a notch in cup member 24 by connecting the wire to a spring 31.

Cup member 24 is made of an insulating material which is formed to form an angle like member having a plurality of cups 24 on one side 26 and a flexible side 32. When the member containing the cups 24 is inserted into a cavity between member 23 and the casing 12, portion 32 is deflected to resiliently force the cups 24 into the curved grooves of member 23. Member 26 is then biased against the ends of plates 22. A series of projections 33 and 34 on side 26 projecting in the opposite direction from cups 24 are stops to position a member 35 containing springs 31. When member 35 is laid in place, the ionizing wires 30 are connected to springs 31 to provide the necessary tension to keep the ionizing wires parallel to plates 22. By an appropriate connection 40, member 35 and thus all of the ionizing wires is connected to a positive source of power; so that, as air flows into the ionization section 15, any foreign particles receive an electrostatic charge.

The collecting section 20 is shown in detail in FIGURE 3. A first and a second set of thin metal parallel plates 41 and 42 are connected at their extremities to side members 43. Member 43 which is shown in cross section in FIGURE 1 has a center raised portion 44 separating two sets of notches on each side of member 43. The ends of the one set of plates 41 have tabs 45 which are inserted into one set of the notches in member 43. A buss or connecting member 50 receiving the tabs is slipped over the tabs to provide an electrical connection when the tabs are bent over. The second set of plates 42 also have tabs 47 which are inserted in the other set of notches to be connected by a similar buss member 51. Member 50 is connected by a suitable connection to the positive source of power, and member 51 is connected to the frame or ground.

When connected to the power source, every other plate of the collecting unit is of the opposite charge. The positive plates 41 are shorter in the direction of air flow than the ground plates 42, thus the forward and rear edges of the ground plates touch the filter medium 21 and the wire mesh 14, respectively. The positive plates 41 are insulated by the space between the plates and medium 21 and screen 14.

In between the extremities of the plates a plurality of insulators are used to maintain the parallel spacing of the plates. The insulator 60 is of a comb-like unit made of some plastic material or other insulating material. When the teeth of the comb-like member 60 are inserted between the parallel plates, the proper spacing is obtained. While only one set of insulators are shown in the collecting unit, the number of insulators between the extremities of the plates would vary depending on the length of the plates.

The insulator 60 has long teeth which extend the length in the direction of air flow of plate 42. The cross section of each of the teeth is of a diamond shape; so that, the insulator contacts the oppositely charged plates 41 and 42 on the opposite points of its diamond shape. At the point of contact of the insulators and the positive plates, a hole 59 is provided in positive plates 41. Before the comb-like insulator is placed in place, the teeth are dipped in a plastic cement which runs into holes 59 to help hold the insulator in place. The creepage distance across the insulator between the oppositely charged plates is elongated to prevent breakdown between the plates as the insulator becomes dirty. Referring to FIGURE 3, one tooth 61 of the comb-like insulator 60 is shown projecting between the oppositely charged plates 41 and 42. Tooth 61 is connected by a solid portion 62 to an adjacent tooth 63. Referring to FIGURE 4, the solid portion 62 is shown to

span across the positive plate 41; however, it does not extend to connect with the solid portion of the next insulator 64 on the other side of the negative plate 42. During assembly, the solid portions of each pair of insulators 61 and 62 might be connected by a common solid portion which is not shown. After all of the insulators were cemented in place, the common solid portion or main body could be severed before frame 12 and screen 14 were attached to the unit.

Referring specifically to the insulator 60 in FIGURE 3, the diamond shape cross section of tooth 66 has points 70 and 71 which engage the oppositely charged plates 42 and 41. The adjacent points 72 and 73 of the diamond shaped tooth provide the elongated creepage path between the plates 41 and 42. When voltage is applied to the collecting unit and the insulator becomes dirty, the current path across the insulator extends over either point 72 or 73. The elongated creepage path reduces the tendency of voltage breakdown in the collecting unit.

During assembly of the collection section 20, the parallel paths 41 and 42 are mounted between ends 43. The insulator 60 which is made up of the plurality of teeth 61 and a main body, which is not shown, attached to the portions 62 is dipped in a conventional cement or adhesive to cover the teeth. The teeth are then placed in position between the plates 41 and 42. Some of the cement will pass through hole 59 as shown in FIGURE 1 to fasten the insulator teeth to the positive plates 41. After the cement has dried, the main body of the insulator is broken off of portions 62 to reduce the length of the insulator in the direction of air flow. The cement holds insulator 60 in position. The cement on teeth also increases the insulation qualities of the insulator.

Member 43 has a construction as shown in FIGURE 3. Projections 80 and 81 on adjacent sides of plate 41 provide an elongated creepage path between the plate 41 and the adjacent plates 42 which are of the opposite charge. As member 43 becomes dirty, voltage breakdown across the member between adjacent plates is lessened by the elongated creepage path.

The cup shaped members 24 in the ionization section 15 as shown in FIGURE 2 provide an elongated creepage path between the plates 22 and the ionization wires 30 to prevent voltage breakdown in the ionization section.

Operation

With such a unit having a relatively short dimension in the direction of air flow, a conventional mechanical filter can be replaced by an improved electrostatic filter.

The unit would be slid into place in the suitable holding bracket and connected to a source of power. As air flows into the ionization section 15 of the unit, the particles of foreign material are charged either negatively or positively. The charged particles then continue to flow in the air stream into the collection section 20. The charged particles are then attracted to the plates 41 and 42 depending upon the polarity of the charged particles. When the charged particles touch the plates, the charge is removed, and the particles are collected.

When the unit becomes dirty as would be indicated by some appropriate signal device such as a pressure responsive device or current responsive device, the unit would be disconnected from the power supply and removed. The cleaning of the unit could be accomplished by submerging it in water or by some appropriate washing equipment. After the unit was washed and dryed, it could be slid into place and conected to the power source for normal operation.

While the invention has been described in some detail, the intention is to limit the invention only by the scope of the appended claim in which I claim:

In an electrostatic gas cleaning apparatus having a relatively small dimension in the direction of gas flow; an ionization section comprising a plurality of parallel plates spaced apart from one another and having charged wires strung therebetween so that foreign particles in the gas are charged as they pass through said section; and a particle collecting section comprising a plurality of oppositely charged parallel plates, and an insulating means for holding said plates in spaced relationship, said insulating means comprising a comb-like member having a plurality of teeth each tooth being a prism of rhomboidal cross-section attached to a main body, each of said teeth contacting substantially the whole width of said plates and inserted between adjacent plates of said collecting section, said teeth frictionally engaging said plates only at opposite corners of each tooth and the two other corners providing an elongated insulating surface between adjacent plates, said main body being dimensioned so that no part of said insulating means projects beyond the largest dimension collectively of said plates.

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