April 10, 1962 K. M. NODOLF 3,028,715

FLUID CLEANING APPARATUS

Filed Jan. 26, 1959 2 Sheets-Sheet 1

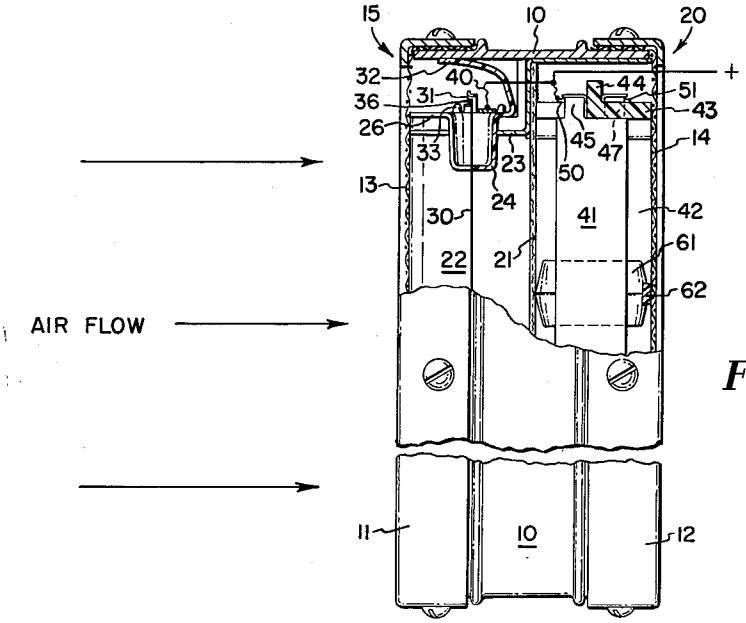



Fig. 1

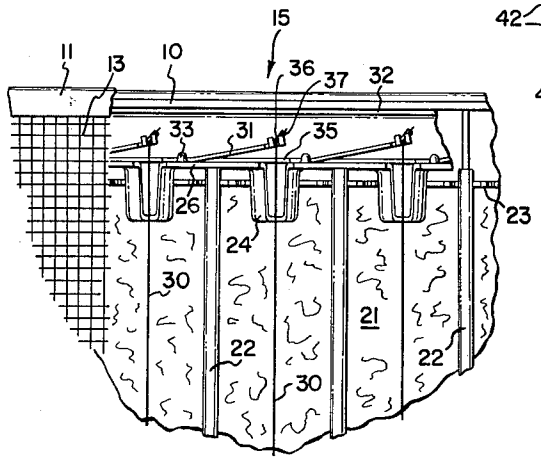


Fig. 2

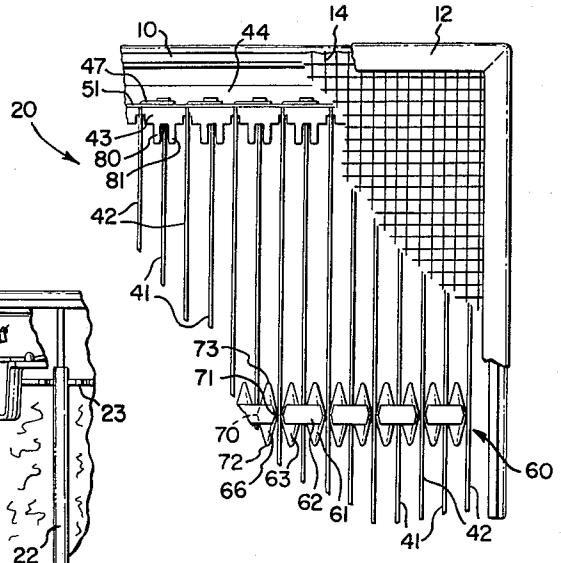


Fig. 3

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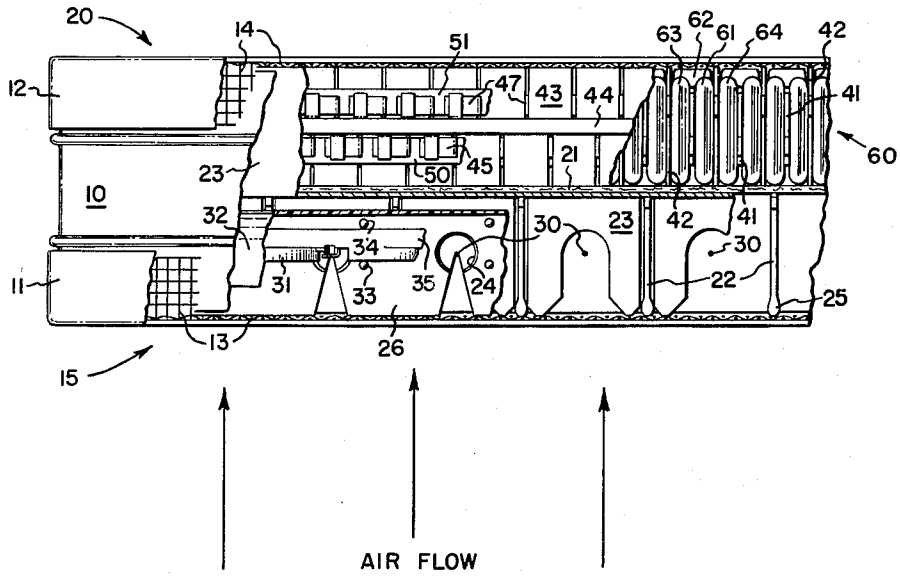



Fig. 4

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3,028,715

# FLUID CLEANING APPARATUS

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1 Claim. (Cl. 55—138)

The present invention is concerned with an improved electrostatic gas cleaning apparatus having a relatively small dimension in the direction of gas flow; so that, 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 apparatus have been known and made use of for some time; however, such apparatus have been quite expensive and not normally available as a replacement for the commonly used mechanical filters. As the desirability 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 is an electrostatic air cleaning unit with an ionization and collecting section. The unit has a short dimension in the direction of air flow; so that, the unit can be readily used in place of many types of mechanical filters. The improved unit is contained in a case; so that, the unit can be slipped into place and removed for cleaning with very little effort.

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 a relatively short dimension in the direction of air flow; so that, the unit can be used to replace a conventional mechanical filter.

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 10, 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 bus member 35 containing springs 31. When bus 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. Each spring 31 has a slot 36 at its extremity so an enlarged end portion 37 on each wire 30 can be held to maintain wires 30 under tension between the two bus members 35 on opposite sides of the ionization section. By an appropriate connection 40, bus member 35 and thus all of the ionizing wires are 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 bus 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 bus 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. 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 posi-

tive 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 inserted in place, the common solid portion could be broken off before frame 12 and screen 14 were attached to the unit.

Referring specifically to the insulator 60 in FIGURE 3, the diamond-shaped 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.

Member 43 has a similiar 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 or 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 connected 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 air cleaner apparatus having a relatively small dimension in the direction of gas flow as compared with the width and height dimension and being suitable for replacing a conventional mechanical filter, an ionization section for electrically charging foreign particles in the gas, a collecting section downstream from said ionization section for collecting the charged foreign particles, a source of power, said collecting section comprising a plurality of spaced parallel plates, said plates being connected to said source of power to be oppositely charged, and a housing for enclosing said ionization and said collecting sections, said ionization section comprising a pair of end insulating members each having cup shaped projections extending from a flat surface, said end members being mounted in spaced relationship with said cup projections extending towards each other, said cup projection having an open side integral with said flat surface, a plurality of parallel plates extending between said end members with a cup projection on each end member between adjacent plates, a pair of long, thin continuous bus members connected to said source of power, said bus members being mounted on said flat surfaces of respective end members to span said open sides of each of said cup projections, each of said bus members having a plurality of integral resilient portions bent away from said end members, said portions having slots at their extremities, and a plurality of ionization wires having enlarged portions at each end, said wires being mounted between said end members by placing said enlarged portions in said slots of respective resilient portions on each of said bus members so that each of said wires passes through said respective cup projections to extend between adjacent parallel plates from one end member to another end member.

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