United States Patent [19]

Jensen

[11] **3,813,856**

[45] **June 4, 1974**

[54] **AIR CLEANSING UNIT**

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[22] Filed: **Nov. 24, 1972**

[21] Appl. No.: **303,275**

[52] **U.S. Cl.** ..... **55/444,** 55/17, 55/446, 55/DIG. 36, 98/115 K

[51] **Int. Cl.** **B01d 45/06**

[58] **Field of Search** ... 55/1, 17, 344, 414, 418–419, 55/428, 462, 442–446, DIG. 36, DIG. 37; 98/115 K

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Primary Examiner—Frank W. Lutter
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[57] **ABSTRACT**

A unit which when disposed substantially transversely relative to the direction of flow of a current of air containing entrained fine particles removes the major portion of such particles as the current of air flows therethrough. The unit is not limited to but is particularly effective in removing grease particles from a current of air moving upwardly at a substantial velocity from a range, broiler or the like, prior to the air entering a duct system for discharge to the ambient air atmosphere.

In addition to serving the above functions, the unit also acts as a barrier to prevent a flame resulting from a flareup on the range or broiler initiating a fire in the duct system, which system may have a film of highly combustible material on the interior surface thereof.

The unit includes no moving parts, may easily be cleaned, and so operates that collected grease has no tendency to leak back to the cooking surface. The current of air flowing through the unit is subdivided into a number of pairs of air streams. The first and second air streams that define each pair are caused to travel through the unit at different velocities. By bringing the first and second air streams of each pair together prior to discharge from the unit, the entrained particles are subjected to a centrifugal force that flings them against the interior surfaces of the unit, and the major portions of the particles adhering thereto rather than being discharged outwardly from the unit to the ambient atmosphere.

When the air current is warm and contains grease particles, the collected grease particles will coalesce to define a liquid grease, which liquid grease as it forms tends to flow downwardly in the unit to a suitable trap if the unit is transversely disposed in the air current at a substantial angle. Due to this continuous removal of collected grease, the velocity of air flow through the unit is easily controlled, and the balance of the ventilation system maintained at a substantially constant value.

6 Claims, 5 Drawing Figures

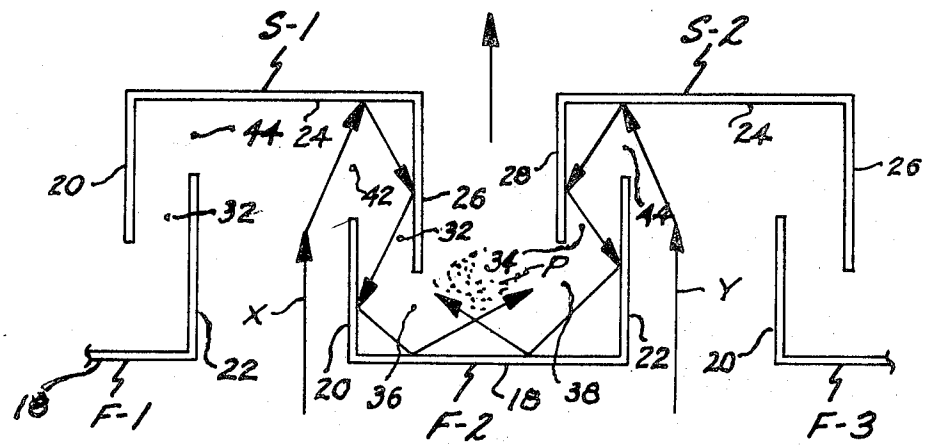


FIG. 1

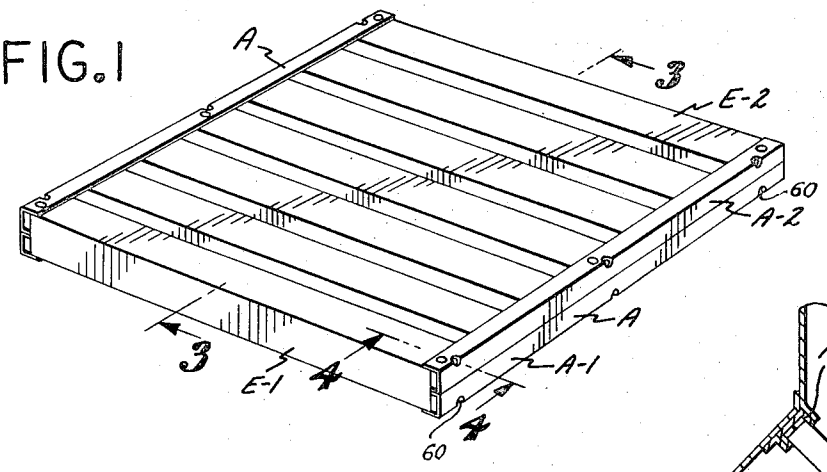


FIG. 2

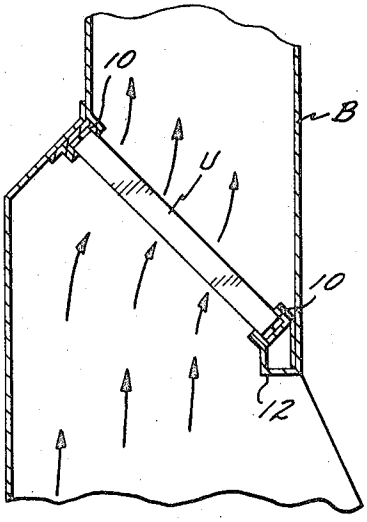


FIG. 4

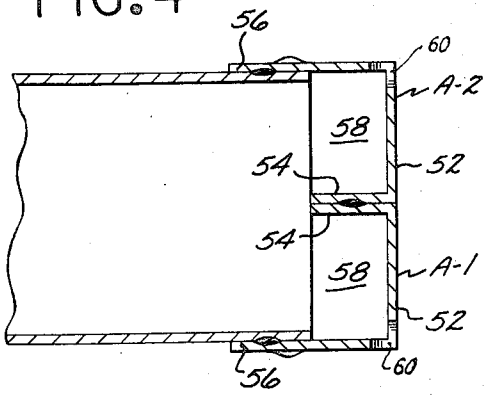


FIG. 3

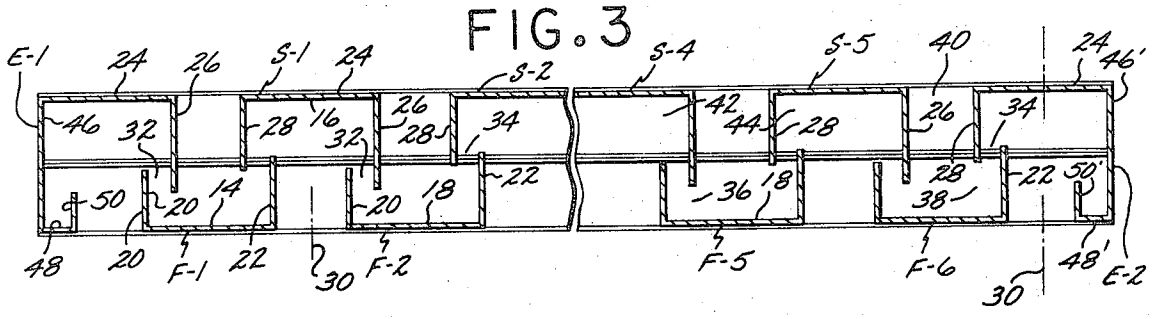
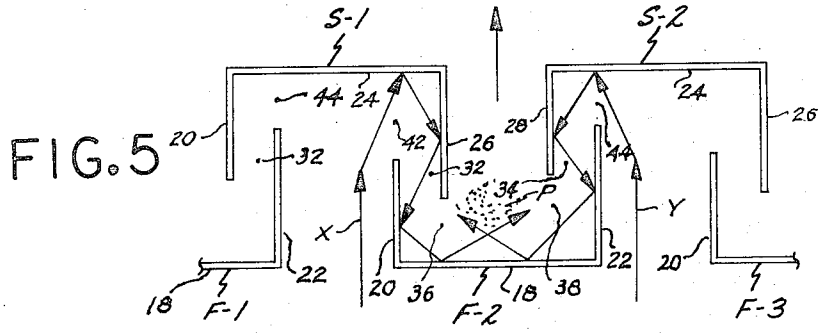


FIG. 5



AIR CLEANSING UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

Air cleansing unit and method of using same.

2. Description of the Prior Art

In the past, the removal of entrained particles from a current of air having substantial velocity has presented a difficult problem, and one to which there is no easy solution. A common prior art expedient to remove such entrained particles was to use filters that embodied a hydrated siliceous material or the like as the filtering medium. However, when the entrained particles are grease or of a fatty nature, such a filter rapidly becomes saturated from the grease material and must be removed for cleansing purposes at relatively short time periods. Also, when such a filter became saturated with grease, the grease would leak back to the hot cooking surface and create additional fumes. In an attempt to minimize the maintanance attention that such filters require, particle-extraction devices have been devised and used in which the current of air is caused to travel through a labyrinth defined by baffle members arranged in staggered relationship. The disadvantage of such a unit is that it is subject to corrosion, must frequently be renewed or replaced, and does not remove entrained particles, particularly grease particles, with a desired degree of efficiency.

The primary purpose in devising the present invention is to furnish an air cleansing unit that is particularly adapted for use in removing particles of grease from an air current that moves upwardly from a range or broiler at a substantial velocity, and the unit having a high degree of efficiency in removing such particles due to the air current being subjected to a centrifugal action prior to discharge from the unit. The centrifugal action causes the grease particles to be flung against the interior surfaces of the unit with sufficient force to cause them to tend to remain in adhering contact therewith, and the air current, if warm, causing the separated particles to subsequently coalesce into liquid grease, and the liquified grease then flowing to a suitable grease trap if the unit is angularly disposed in the air current.

Although the invention is illustrated and described in conjunction with a canopy or hood such as is conventionally used over ranges and broilers in restaurants, the unit is by no means limited to merely extracting grease particles from a current of air. The unit may be used to remove any entrained particles, irrespective of whether the material defining the particles is solid or liquid, from a moving current of air, so long as the current flows through the unit at a substantial velocity.

SUMMARY OF THE INVENTION

The air cleansing unit includes a rectangular frame defined by a pair of end pieces and side pieces, with the end pieces having a sequence of first and second laterally spaced channel-shaped members extending therebetween and arranged in first and second layers. The first and second channel-shaped members cooperate to define a number of labyrinth paths through which the air current containing entrained particles is caused to flow. As the current of air is caused to flow through this labyrinth the current is subdivided into a number of pairs of streams of air, with the first and second streams

defining each pair flowing at different velocities. The first and second streams of each pair that are flowing at different velocities are brought together prior to discharge from the unit, and at the junction of these first and second streams the air has a swirling motion imparted thereto.

This swirling motion subjects particles of entrained material in the first and second streams to a centrifugal action. This centrifugal action tends to fling the particles against the interior surfaces of the channel-shaped members where they tend to adhere thereto. If the entrained particles are grease, and the air current is warm, the particles, after being deposited on the interior surfaces of the unit, will tend to coalesce into liquid grease, which liquid grease will subsequently tend to flow to a suitable grease trap if the unit is both transversely and angularly positioned in the air current.

The labyrinth defined by the unit and through which the air current flows are of substantial transverse cross-sectional area so that during the particle extraction process a minimum backpressure is exerted on the air current.

The primary purpose in devising the present invention is to supply an air cleansing device that has no moving parts, may be fabricated from a standard, commercially available material such as stainless steel or the like that is not subject to corrosion, has a high efficiency in removing entrained material from a current of moving air, and even after being used for a prolonged period of time will not disturb the balance of the ventilation system in which it is installed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the unit that removes entrained particles from a current of air that flows therethrough at a substantial velocity;

FIG. 2 is a vertical cross-sectional view of the unit mounted in the entry portion of a duct system;

FIG. 3 is a transverse cross-sectional view of the unit shown in FIG. 1 taken on the line 3—3 thereof;

FIG. 4 is a fragmentary view of a corner portion of the unit; and

FIG. 5 is a diagrammatic view illustrating the paths followed by particles in moving through the unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The air cleaning unit U, as may be seen in FIG. 2 of the drawing, is illustrated as being positioned angularly in the entry into an upwardly extending duct B through which a current of air is drawn at a substantial velocity by means not shown. The duct B at the entry thereto is provided with conventional brackets **10**. The unit U, as shown in the drawing, is supported on the brackets **10** and in the event the unit is being used over a range or broiler (not shown) the lower end of the unit U supported on the lower brackets **10** is in communication with a conventional grease trap **12**.

The unit U, as may best be seen in FIG. **1**, includes two identical end pieces A, and two laterally spaced side pieces E–1 and E–2. The side pieces and end pieces are formed from a rigid sheet material, preferably stainless steel or like material, that will not tarnish or discolor appreciably when subjected to moisture, grease and the like.

The end pieces A, as may best be seen in FIGS. **1** and **3**, have a number of laterally spaced, upturned chan-

nel-shaped members F–1 through F–6 extending therebetween. The channel-shaped members F–1 through F–6 are secured to the lower portions A–1 of end pieces A, as will later be described in detail. Second longitudinally extending portions A–2 of end pieces A have a number of parallel, laterally spaced second downturned channel-shaped members S–1 through S–5 extending therebetween. The longitudinally extending centers 14 of the first channel-shaped members F–1 through F–6 are laterally offset from the longitudinally extending centers 16 of the second channel-shaped members S–1 through S–5. Each of the first channel-shaped members F–1 through F–6, as may be seen in FIG. 3, includes an elongate web 18 that has first and second flanges 20 and 22 extending upwardly from the longitudinal edges thereof. The second flange 22 is of substantially greater height than the first flange 20.

Each of the second channel-shaped members S–1 through S–5 includes an elongate second web 24 that has first and second legs 26 and 28 depending from the longitudinal edges thereof towards the first channel-shaped members F–1 through F–6. The first legs 26, as may best be seen in FIG. 3, are of substantially greater depth than the second legs 28. Each adjoining pair of the first channel-shaped members F–1 through F–6 has the first flange 20 and second flange 22 thereof cooperating to define a first opening 30 through which air containing entrained particles may flow upwardly when unit U is disposed as shown in FIG. 2.

In FIG. 3 it will be seen that the adjoining legs 26 and 28 of second channel-shaped members S–1 through S–5 extend downwardly into the confines of the first channel-shaped members F–1 through F–6 to cooperate with first and second flanges 20 and 22 to define first and second air passages 32 and 34, respectively. The free, longitudinally extending, lower end edges of the first and second legs 26 and 28 cooperate with the first webs 18 adjacent thereto to define first and second longitudinally extending ports 36 and 38.

The first and second ports 36 and 38 are in communication with a number of second openings 40 defined between each adjoining first leg 26 and second leg 28, as shown in FIG. 3. The first and second flanges 20 and 22 of each of the first channel-shaped members F–1 through F–6 cooperate with two adjoining second elongate webs 24 to define third and fourth openings 42 and 44 of different sizes that are in communication with two adjoining first openings 30 and first and second air passages 32 and 34, and serve to assure equal quantities of air containing entrained particles being delivered to the first and second ports 36 and 38 after such air has flowed into the confines of the unit U through the first openings 30. Air discharging into each of said second openings 40 through one of the first ports 36 is at a greater velocity than the stream of air discharging into the opening 40 through a second port 38, due to the fact that the first port is of substantially lesser transverse cross section than the second port.

In FIG. 5 the path of the two streams of air X and Y flowing through the first and second passages 32 and 34 and first and second ports 36 and 38 is indicated by arrows. Due to the two streams of air discharging through the first and second ports 36 and 38 at different velocities and towards one another, a swirling motion is imparted to the air in the second openings 40 that is of a turbulent character and imparts to entrained particles P in the air a centrifugal force that tends to fling the particles into forcible adhering contact with interior surfaces of the first channel-shaped members F–1 through F–6 and second channel-shaped members S–1 through S–5. If the current of air passing upwardly through the unit U, as shown in FIG. 2, is warm and the entrained particles are of grease or fat, the particles, after being deposited on the interior surfaces of the Unit U, will tend to coalesce, and due to the angular positioning of the unit will form liquid grease that drains by gravity into the grease trap 12. The side piece E–1, as shown in FIG. 3, includes an elongate member 46 that on one end develops into an outwardly extending tab 48 that has a short flange 50 extending upwardly therefrom that cooperates with a first flange 20 to define a first opening 30 through which air containing entrained particles may flow into a first air passage 32. The member 46 on the end thereof opposite that from which the tab 48 extends develops into a second web 24 that has a first leg 26 extending therefrom towards one of the first webs 18. Second side piece E–2, as may be seen in FIG. 3, includes an elongate member 46′ that also develops on one end into a tab 48′ that has a flange 50′ extending upwardly from the inner edge thereof and cooperates with a second flange 22 to define a first opening 30 through which air containing entrained material may enter the unit U to subsequently flow through a second air passage 34. The member 46′ has a second web 24 extending therefrom towards the second channel-shaped member S–5 and this second web 24 develops into a second leg 28, as may best be seen in FIG. 3, that cooperates with a first leg 26 to define a second opening 40.

The first and second portions A–1 and A–2 of each of the end pieces A, as may best be seen in FIG. 4, is defined by two elongate members of channel-shaped cross section that have webs 52 that lie in a common plane and develop on their adjoining ends into first flanges 54 that are tack-welded or otherwise rigidly secured to one another and on their outer ends develop into second flanges 56 of substantially greater length than the flanges 54. The flanges 54 have the ends of the first and second channel-shaped members F–1 through F–6 and S–1 through S-5 in abutting contact therewith, with the first and second webs of the first and second channel-shaped members being secured to the interior surfaces of the flanges 56 by conventional means.

Due to the ends of the first channel-shaped members F–1 through F–6 and second channel-shaped members S–1 through S–5 being spaced outwardly from the webs 52, spaces 58 are provided at the junction of the first channel-shaped members F–1 through F–6 and second channel-shaped members S–1 through S–5 into which liquified grease may drain when the unit U is angularly disposed as shown in FIG. 2.

The liquified grease drains by gravity through one or more weep holes 60, as shown in FIG. 4, in portion A–1 into the grease trap 12. The unit U when positioned as shown in FIG. 2 removes substantially all of the entrained particles of grease from the air current, and continuously delivers them in the form of melted grease to the trap 12. Thus, as there are a minimum of entrained particles of grease in the duct B above the unit, there is nothing to sustain a fire therein should there be a flame flareup from the cooking surface (not shown). Liquified grease in the trap 12 would not be contacted by such a flame flare-up, as it is to one side of the duct, and not in a path a flame would follow. It will be partic-

ularly noted that the unit U does not become clogged with grease as it is used, and as a result the possibility of grease that has been extracted dripping back onto the hot cooking surface is eliminated. A further advantage in continuously draining extracted grease to trap 12 is that the air flow characteristics of the unit U remain constant, and the possibility of the ventilation system of which it forms a part becoming unbalanced is eliminated.

Although unit U has been described and illustrated in an environment in which grease particles are removed from cooking fumes, it may also be used advantageously in other applications such as removing paint overspray from a current of air or the like.

The use and operation of the invention has been explained previously in detail and need not be repeated.

I claim:

1. A unit for removing finely divided particles entrained with a moving current of air as said current flows through said unit at a substantial velocity, said unit including:

a. a rigid frame defined by a pair of side pieces, and end pieces having first and second longitudinal portions, said side pieces and end pieces cooperating to define a space within the confines thereof through which said current may flow;

b. a plurality of parallel, laterally spaced, first channel-shaped members that extend between first portions of said end pieces, with each of said first members including an elongate first web that has first and second flanges projecting from longitudinal edges thereof in the same direction, said first flange being of a lesser depth than said second flange, and said first and second flanges of adjoining first members cooperating to define a plurality of elongate first openings through which said air current with entrained particles may flow; and

c. a plurality of parallel, laterally spaced, second channel-shaped members that extend between said second portions of said end pieces, with each of said second members including an elongate second web that has first and second legs projecting from longitudinal edges thereof in the same direction towards said first members, said second leg of each of said second members being of a lesser depth than said first leg thereof, said second members so disposed that first and second legs of two adjoining of said second members extend into one of said first members to cooperate with said first and second flanges thereof to define first and second passages of substantially equal transverse cross section, said first and second legs of each two of said adjoining second members cooperating to define an elongate second opening therebetween of substantially the same transverse area as one of said first openings, said first and second legs of each two of said adjoining second members cooperating with the first web of said first member into which they extend to define first and second elongate ports that are in communication with said first and second air passages, said first port of less area that said second port, said first and second flanges of each of said first members cooperating with said second webs of two adjoining of said second members to define third and fourth elongate openings that are in communication with two of said adjoining first openings to deliver air containing said entrained particles to said first and second passages in one of said first members, with air containing said entrained particles discharging from said first and second adjoining ports as first and second streams of air that are at first and second velocities and move towards one another to impact a swirling motion to air in said second opening prior to discharging therefrom, the major portion of said particles due to the centrifugal force to which they are subjected by said swirling motion being forcefully directed onto portions of said first and second members to which they adhere with said current substantially free of said particles discharging from said second openings, said first members have first ends that are outwardly spaced from an interior surface of said first portion of a first of said end pieces to cooperate therewith to provide a space into which said particles collected on said unit may flow when said unit is angularly disposed in said current of air with said space at the lower portion thereof.

2. A unit as defined in claim 1 in which said third and fourth openings are so selected as to size as to cooperate with said first and second ports with which they are operatively associated that substantially equal quantities of air containing said entrained particles flow through said first and second passages to discharge therefrom into said second openings as said first and second streams.

3. A unit as defined in claim 1 in which said first end piece has at least one weep hole therein in communication with said space and through which weep hole said fluid may flow.

4. A unit as defined in claim 1 in which said end pieces, side pieces and first and second members are formed from a rigid sheet material that does not appreciably corrode when subjected to moisture, grease and cooking fumes.

5. A unit as defined in claim 1 in which each of said end pieces has said first and second portions thereof defined by elongate first and second channel-shaped end members, each of said channel-shaped end members including a web from which first and second flanges project in the same direction, said first flanges of said channel-shaped end members in abutting contact and rigidly secured to one another, said webs of said channel-shaped end members lying in a common plane, and said second flanges of said channel-shaped end members overlying portions of the webs of said first and second channel-shaped members that extend between said end pieces and rigidly secured thereto.

6. A unit as defined in claim 1 in which said sheet material is stainless steel.

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