United States Patent

Doane

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[54] GREASE EXTRACTOR METHOD

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Related U.S. Application Data

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[52] **U.S. Cl.** **55/1**

[51] **Int. Cl.** **B01d 45/12**

[58] **Field of Search** ..... 98/115; 55/1 KH, 440–446

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[57] **ABSTRACT**

A flame proof grease extraction system for removing grease, oil and other condensable contaminants from a vaporous exhaust stream in a kitchen ventilating system. The grease extraction system comprises a housing with an entranceway for receiving the exhaust stream, an outlet for discharging the exhaust stream into a duct which contains a blower or fan for drawing the exhaust stream through the extraction system, and internal baffle means for guiding the exhaust stream along a predetermined path designed to provide the extracting action. The baffle arrangement includes an entrance baffle which extends rearwardly from the top of the entranceway for deflecting the entering exhaust stream rearwardly over the bottom wall of the extractor housing. A second baffle means then defects the exhaust stream upwardly from the bottom wall around the rearward edge of the entrance baffle means and forwardly over the top of the entrance baffle means toward the front wall. Third baffle means then defects the exhaust stream rearwardly from the front wall and down along the rear side of the second baffle means to the bottom wall, and then upwardly again between the rear side of the third baffle means and the rear wall of the housing. A drain means is provided in the bottom wall of the housing for receiving the extracted grease and oil which is deposited on the internal surfaces of the system, and which runs downwardly thereover due to the heating of the internal surfaces by the adjacent cooking surface.

5 Claims, 5 Drawing Figures

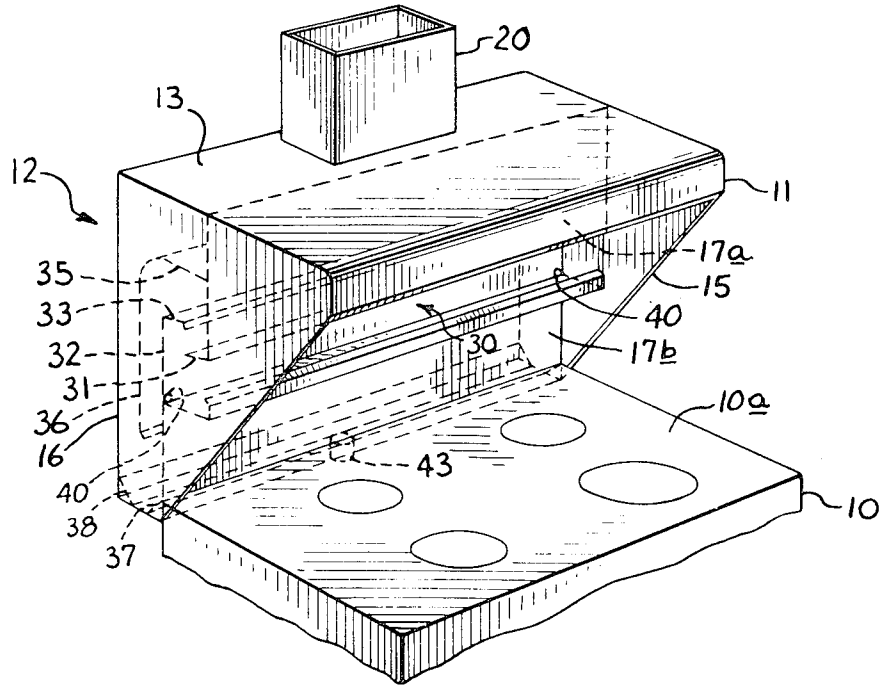


FIG. 1

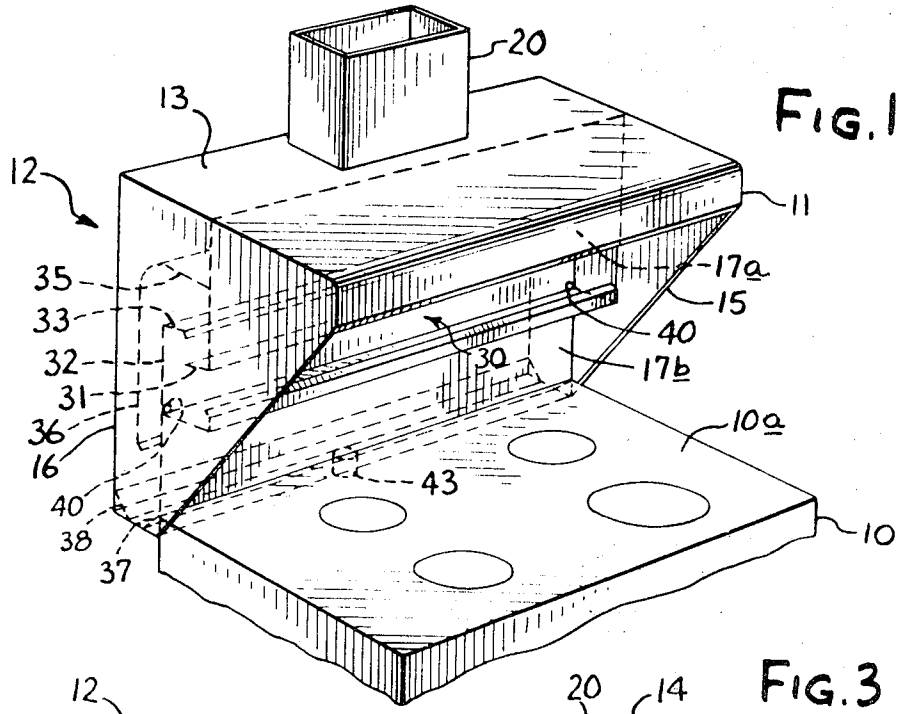


FIG. 3

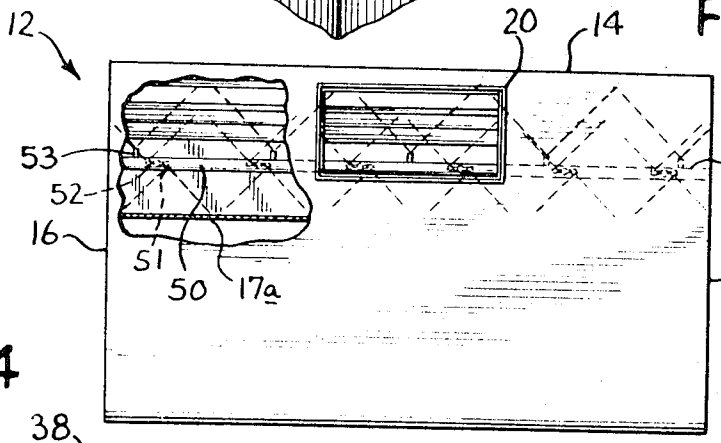
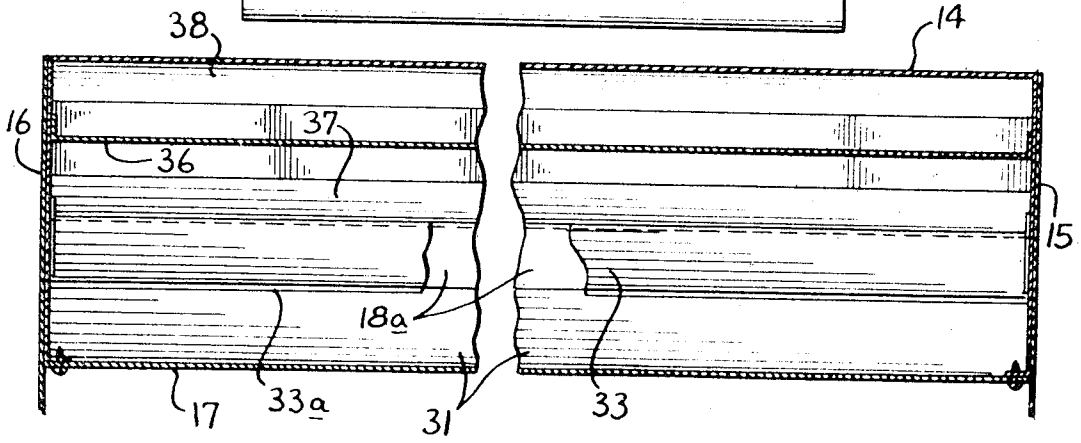


FIG. 4



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FIG. 5

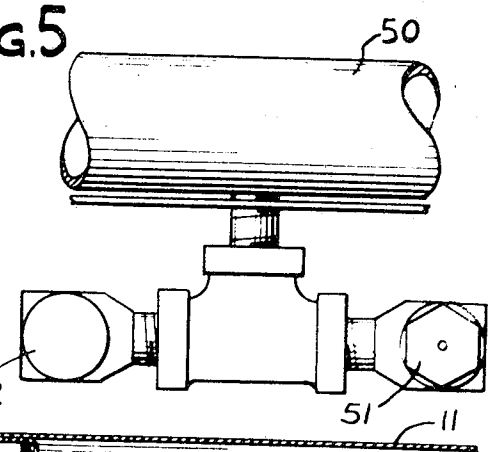


FIG. 2

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GREASE EXTRACTOR METHOD

This application is a division of copending application Ser. No. 672,314 filed Oct. 2, 1967 now U.S. Pat. No. 3,490,206 entitled "Grease Extractor For Kitchen Ventilating Systems."

The present invention relates generally to kitchen ventilating systems and, more particularly, to an improved grease extraction system for extracting condensable contaminants such as grease and oil from the vaporous exhaust stream in a kitchen ventilating system before the exhaust stream is discharged to the atmosphere.

It is the general aim of the present invention to provide an improved grease extraction system which provides significantly improved grease extraction combined with the ability to prevent the passage of flame through the extraction system. A more particular object is to provide such a grease extraction system which is capable of extracting over 99 percent of the condensable contaminants from a vaporous exhaust stream, while providing 100 percent efficiency in preventing the passage of flame through the extraction system. A related object is to provide an extraction system which combines such performance characteristics with a relatively low pressure drop between the inlet and outlet ends of the system, thereby minimizing the power requirements on the blower or other air-moving device.

It is another object of the present invention to provide an improved grease extraction system of the foregoing type which can be manufactured efficiently and economically from relatively few low cost parts. A related object is to provide such a grease extraction system in which all the parts can be formed by conventional cutting and stamping operations, and which requires no moving parts.

A further object of this invention is to provide an improved grease extraction system of the type described above which permits the efficient utilization of fluid washing and/or fire extinguishing systems with manual or automatic control. In this connection, it is another object of the invention to provide such a grease extraction system which can be completely flushed with washing or fire extinguishing fluid from a single internal distribution line.

Still another object of the present invention is to provide such an improved grease extraction system which is continuously self draining so as to prevent the accumulation of extracted grease and oil and other contaminants therein. Thus, a more particular object of the invention is to provide such a system which not only effectively extracts the condensable contaminants from a vaporous exhaust stream, but also transports the extracted materials rapidly and efficiently out of the path of fluid flow.

It is a still further object of the invention to provide such an improved grease extraction system which improves the longevity of the downstream portions of the ventilating system by extracting substantially all the condensable contaminants from the exhaust stream before it enters the main duct work, and by preventing the passage of flame into the duct. Yet another object of the invention is to provide such a grease extraction system which provides convenient access to the internal portions thereof for inspection purposes and the like.

Other objects and advantages of the invention will become apparent from the following detailed description and upon reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a conventional cooking range and its associated ventilating system including a grease extraction system embodying the present invention;

FIG. 2 is an enlarged vertical section of the grease extraction system shown in FIG. 1;

FIG. 3 is a top plan view of the grease extraction system of FIG. 1 with a fragment thereof broken away to show the internal structure;

FIG. 4 is a section taken along line 4—4 in FIG. 2; and

FIG. 5 is an enlarged front elevation of one of the lower nozzle assemblies connected to the fluid supply line shown in FIG. 1.

While the invention will be described in connection with certain preferred embodiments, it will be understood that it is not intended to limit the invention to these particular embodiments. On the contrary, it is intended to cover all alternatives, modifications, and equivalent arrangements as may be included within the spirit and scope of the invention as defined by the appended claims.

Turning now to the drawings, in FIG. 1 there is shown a cooking range **10** having a cooking surface **10***a* from which hot fumes laden with grease and oil vapors and other condensable contaminants rise upwardly toward a canopy or hood **11** which projects out over at least a portion of the cooking surface **10***a*. The hood **11** is mounted on a grease extraction housing **12** which includes a top wall **13**, a rear wall **14**, and a pair of side walls **15** and **16**. The front wall of the cabinet is stepped or indented at the bottom so as to form a protruding upper portion **17***a* and a recessed lower portion **17***b*. The bottom wall of the housing is correspondingly stepped to form a forward portion **18***a* extending between the two front wall portions **17***a*, **17***b*, and a rearward portion **18***b* extending between the rear wall **14** and the lower front wall portion **17***b*.

As the hot, grease-laden fumes rise upwardly beneath the hood **11**, they are drawn into the housing **12** and on through the grease extraction system therein by means of fan or blower **19** (FIG. 2) which is mounted within a flue or vent duct **20** connected to the outlet of the housing **12**. For the purpose of closing the duct **20** in the event of a fire in the ventilator system, a fire door **21** is pivotally mounted in the duct **20** and held open by a wire including fusible links adapted to fuse and thereby release the fire door **21** for movement to its closed position in response to a predetermined temperature. The rate at which the exhaust stream is drawn through the extraction system is determined by the blower **19**, a typical flow rate being 300 cubic feet per minute per lineal foot of ventilator (CFM). As the exhaust stream leaves the housing **12**, it is conducted via the duct **20** to an appropriate outlet for discharge to the atmosphere. It will be understood that the blower **19** represents only one example of a suitable device for drawing the exhaust stream through the grease extraction system, and that the invention is equally applicable to ventilating systems employing other air moving devices, such as power roof ventilators and the like.

In accordance with the present invention, the front wall of the housing **12** forms a vertically restricted, horizontally elongated entranceway for admitting the vaporous exhaust stream into an internal grease extraction system comprising an entrance baffle means extending rearwardly from the top of the entranceway for deflecting the entering exhaust stream rearwardly over the bottom wall of the housing, second baffle means for deflecting the exhaust stream upwardly from the bottom wall of the housing around the rear edge of the entrance baffle means and forwardly over the top of the entrance baffle means toward the front wall of the housing, and third baffle means for deflecting the exhaust stream rearwardly from the front wall of the housing and downwardly behind the second baffle means to the bottom wall of the housing, and then upwardly again between the rear side of the third baffle means and the rear wall of the housing. Thus, in the particular embodiment illustrated in the drawings, the hot grease-laden fumes are drawn into the housing through an entranceway **30** formed in the upper portion **17***a* of the front wall just slightly above the forward portion **18***a* of the bottom wall. The entranceway **30** is relatively narrow or restricted in the vertical direction, so as to increase the velocity of the exhaust stream as it enters the housing, but is elongated horizontally so as to extend continuously between the two side walls **15**, **16**, to insure the collection of vapors across the full width of the cooking surface.

As the hot exhaust stream enters the grease extraction system through the entranceway **30**, it is deflected rearwardly over the adjacent bottom wall **18***a* by means of an entrance baffle **31** formed as an integral part of the front wall **17***a*, and inclined downwardly toward the bottom wall **18***a* at an angle of 18° from the horizontal. The constriction formed by the entrance baffle **31** on the top, and the bottom wall **18***b*, and front

wall 17*a* on the bottom sharply reduces the cross-section of the exhaust stream, with a corresponding increase in the fluid velocity. As the velocious exhaust stream passes rearwardly over the bottom wall 18*a*, it is deflected upwardly past the rearward edge of the entrance baffle 31 by means of an upwardly projecting baffle 32 which is joined at its lower end to the bottom wall 18*a* and extends upwardly past the rear edge of the entrance baffle 31 and spaced therefrom. The upper end of the vertical baffle 32 terminates in a forwardly projecting baffle 33, which extends forwardly at least as far as the rearward edge of the entrance baffle 31, and spaced upwardly therefrom, for deflecting the exhaust stream forwardly over the top of the entrance baffle toward the front wall 17*a*.

It can be seen that the combination of the entrance baffle 31, the bottom wall 18*a*, and the baffles 32 and 33 effect a 180° reversal in the direction of flow of the exhaust stream. That is, the exhaust stream flows rearwardly beneath the entrance baffle 31 as it enters the housing, and is then quickly reversed so as to flow toward the front of the housing on the top of the entrance baffle 31. The centrifugal action resulting from this flow reversal causes a substantial portion of the condensable grease and oil entrained in the exhaust stream to be deposited or "plated out" on the surrounding walls, thereby providing an initial extraction stage. The extracting action in this initial stage is enhanced by an increase in the volume of the extraction chamber in which flow reversal is effected. More particularly, the volume of the chamber formed by the bottom wall 18*a* and the baffles 31, 32, 33 increases in the area adjacent the juncture of the bottom wall 18*a* and the vertical baffle 32, thereby causing the exhaust stream to expand simultaneously with the reversal in its direction of flow, with resultant condensation and agglomeration of the grease and oil vapors therein. A smaller secondary expansion chamber is formed in the area adjacent the junction of the baffles 32 and 33, with similar effect.

In order to insure that a maximum amount of grease and oil is removed in the initial extraction chamber, the forward end of the baffle 33 is bent transversely to the direction of fluid flow so as to form a small lip or trap 33*a* which collects a substantial portion of the grease and oil which is still entrained in the exhaust stream. Since the trap 33*a* is located at the outer periphery of the turning exhaust stream, it is in the area of the greatest concentration of remaining grease and oil particles for maximum efficiency.

As the exhaust stream moves forwardly above the entrance baffle 31, its direction of flow is reversed a second time by the deflecting action of the front housing wall 17*a* and a rearwardly projecting baffle 35 joined to the front wall and extending rearwardly therefrom a spaced distance above the forwardly projecting baffle 33. Moreover, a pair of expansion chambers are again provided in the course of this flow reversal, namely in the areas adjacent the junction of the entrance baffle 31 and the front wall 17*a*, and adjacent the juncture of the front wall 17*a* and the rearwardly projecting baffle 35. The resulting expansion of the velocious exhaust stream and the concurrent centrifugal action from the 180° turn in the fluid flow again produces a heavy deposition or "plating out" of the agglomerated grease and oil on the surrounding walls.

As the exhaust stream flows rearwardly between the baffles 35 and 33 and past the vertical baffle 32, it is deflected downwardly along the rear side of the baffle 32 by means of a downwardly projecting baffle 36 joined to the upper baffle 35 and extending downwardly past the rear edge of the baffle 33. In the illustrative embodiment, the baffle 36 extends downwardly past the entire length of the baffle 32 and terminates at a point below the forward portion 18*a* of the bottom wall of the housing, but above the rearward portion 18*b* of the bottom wall. Consequently, the exhaust stream flows downwardly through the conduit formed by the depending baffle 36 on the rear side, and the baffle 32 and the front wall 17*b* on the front side, until it reaches the bottom wall 18*b*. At the lower end of the baffle 36, the flow direction of the exhaust stream is again reversed by the combined action of the front wall 17*b*, the bottom wall 18*b*, and the rear wall 14. Another expansion chamber is also provided in the area between the bottom edge of the baffle 36 and the bottom wall 18*b*, which area is substantially wider (FIG. 2) than the area between the baffle 36 and the front wall 17*b*. To further restrict the exhaust stream just before it enters this expansion chamber, a forwardly projecting flange 36*b* is formed on the bottom edge of the baffle 36.

As the exhaust stream passes the flange 36*b* and is deflected rearwardly beneath the flange and then up along the rear side of the depending baffle 36, the combined centrifugal action and expansion once again deposits condensed grease and oil on the surrounding side walls. The remaining exhaust stream, which is composed primarily of noncondensable materials at this point, flows on up between the rear wall 14 and the depending baffle 36 into the region above the baffle 35 where it is discharged through an exit opening in the top wall 13 into the exhaust duct 20. The relatively large unrestricted area between the baffle 35 and the top wall 13 permits the exhaust stream to expand again just prior to its discharge from the extraction system, thereby cooling the stream before its entry into the duct 20 and minimizing the pressure drop along the rear wall 14.

In order to facilitate the flow reversal around the lower end of the depending baffle 36, with a minimum of turbulence, a pair of elongated deflector plates 37, 38 are mounted in the corners of the extraction chamber formed below the baffle 36. More particularly, a front deflector plate 37 is mounted at an angle of 45° across the corner formed by the front wall 17*b* and the bottom wall 18*b*, and a rear deflector plate 38 is mounted at the same angle across the corner formed by the rear wall 14 and the bottom wall 18*b*. These deflector plates 37, 38 guide the exhaust stream smoothly around the lower end of the baffle 36, so as to avoid the creation of turbulence in the front and rear corners beneath the deflector plates.

It has been found that the downward flow of the exhaust stream effected by the downwardly projecting baffle 36, following the initial double flow reversal, with the further abrupt flow reversal at the bottom of the downward travel, has the dual effect of (1) removing any remaining condensable or solid contaminants in the exhaust stream, and (2) preventing any flame that might leak through the initial extraction stages from continuing on through the extractor. While it is not intended to limit the present invention to any specific theory, it is believed that the improved extracting action of the final down-up stage is due to the combined effect of the concurrent expansion and centrifugal action described previously, and the impingement of the contaminants on the bottom wall of the extractor (including the deflector plates 37, 38) due to the gravitational forces acting on the contaminants during the downward leg of the flow pattern just prior to the final flow reversal. In actual tests of the illustrative system (to be described in more detail below), extraction efficiencies of over 99 percent have been obtained with reliable repeatability, and severe flame tests have demonstrated that it is virtually impossible for flame to penetrate beyond the final down-up extraction stage.

In order to minimize the pressure drop across the extraction system, thereby minimizing the power requirement on the blower or fan which draws the exhaust stream through the extraction system, it is preferred to have the extraction system gradually expand or "open up" between the inlet and outlet ends thereof, i.e., in the direction of fluid flow. Thus, in the illustrative embodiment, the restriction in the initial extraction stages are somewhat smaller than those in the final extraction stages. More particularly, the restrictions between the entrance baffle 31 and the flange 34 on the bottom, the baffle 32 on the rear, and the flange 33*a* on the top, are all alightly smaller than the restrictions between baffles 33 and 35, baffles 32 and 36, and baffle 36 and rear wall 14. With this particular arrangement, typical static pressures measured at points A, B, C, D, and E in FIG. 2 (such points being spaced along the path of fluid flow) are 0.48, 0.75, 0.84, 0.82. and 0.85 inches,

which indicates an extremely low pressure drop across the entire system. It has been found that static pressures as low as 0.8 inches can be attained at the outlet of the extraction system.

Since the grease extractor housing is located directly over or adjacent to the cooking surface **11**, the surfaces of the housing walls and the internal baffles on which the extracted grease and oil is deposited, are at a sufficiently high temperature to cause the deposited material to remain in a fluid condition and run down to the bottom of the housing. The grease which runs down the front wall **17***a*, the entrance baffle **31**, the underside of the baffle **33**, the front side of the baffle **32**, and the bottom wall **18***a* all collects at the juncture of the bottom wall **18***a* and the vertical baffle **32**, where a pair of drain openings **40** (FIGS. **1** and **2**) are formed at opposite ends of the bottom of the baffle **32** to conduct the grease therethrough. The bottom wall **18***a* preferably slopes downwardly from front to back, as illustrated in FIG. **2**, to insure that all the grease and oil deposited thereon runs rearwardly to the drain openings **40**, thereby avoiding any substantial accumulation of condensed materials on the bottom of the initial extraction chamber. As the extracted liquids drain through the openings **40**, they run downwardly along the inside of the front wall **17***b* onto the lower bottom wall **18***b*, where the extracted liquid is discharged from the housing through an opening **42** into a drain line **43** leading to an external receptacle. While experience has shown that the relatively small drain holes **40** do not permit any significant portion of the exhaust stream gases to pass directly through the baffle **32**, a drain line with a liquid trap may be connected to the drain holes **40** so that the liquid which collects in the trap serves as a vapor barrier to prevent any portion of the exhaust stream from passing directly through the baffle **32**. It will be appreciated from the foregoing description that the continuous drainage of the extracted liquids from the front side of the vertical baffle **32** into the region behind the baffle **32**, has the advantage of moving these materials into a zone of high extraction efficiency and fire safety. Consequently, any material that might become re-entrained in the exhaust stream is quickly extracted again in the final extraction stage below the downwardly projecting baffle **36**.

It can be seen from the foregoing description that the illustrative grease extraction system is continuously self draining, so that the extracted liquids are quickly removed from the interior of the extraction system to prevent or minimize re-entrainment thereof in the vaporous exhaust stream. No matter where the extracted grease and oil are deposited within the housing, they are free to run downwardly over smooth, uninterrupted surfaces to the drain openings provided for removing the extracted liquids to an external receptacle. Similarly, this continuous self draining construction also facilitates cleaning of the extraction system, since cleaning solutions can run freely through the extractor in the same manner as the extracted liquids, and over the same surfaces. The same is true of fire extinguishing liquids, in the event that it is desired to include a fire extinguishing system in the extractor.

In the particular embodiment illustrated, the drain openings **40** are shown as being located adjacent the side wall **15**, while the bottom drain opening **42** is located in the center of the bottom wall **18***b*. However, it will be appreciated that the locations of these drain openings may be changed without departing from the spirit and scope of this invention, since the extracted liquids will find their way to the drain openings regardless of where they are located along the length of their unit. Also, it may be desired to provide more than one upper and/or lower drain opening, or to vary the size thereof, for different applications. It has been found that it is not necessary to slope the bottom walls **18***a* and **18***b* in the transverse direction toward the drain openings **40** and **42**, respectively, but such slopes could be built into the system to enhance the draining action if desired.

In accordance with a further aspect of this invention, the grease extraction system is designed so that a single fluid supply line can be utilized to dispense fluid for cleaning and/or fire extinguishing purposes, into all the internal spaces of the extraction system. Thus, in the illustrative embodiment, a single fluid supply line **50** is mounted on top of the uppermost baffle **35**, and is provided with three series of of dispensing nozzles **51**, **52**, and **53**. The first series of nozzles **51** project slightly below the baffle **35** and are oriented to discharge fluid into the forward region of the extractor between the front wall **17***a* and the baffles **33** and **32**. The second series of nozzles **52** also project below the baffle **35**, and are oriented to discharge fluid into the intermediate region between the baffles **32** and **36**, while the third series of nozzles **53** project above the baffle **35** and are oriented to discharge fluid into the rear region between the rear wall **14** and the baffle **36**. Since the fluid is normally supplied under a substantial pressure, it tends to splash onto all the surfaces in these regions, and then runs downwardly over such surfaces to the drain openings **40** and **42** for removal from the extractor housing in the same manner described above in connection with the extracted materials.

It can be seen that the design of the extraction system enables a single strategically located fluid supply line to supply fluid to all the internal surfaces of the system. Thus, the interior of the extractor system can be periodically cleaned by feeding a cleaning solution into the supply line **50**, with the cleaning solution being distributed by the nozzles **51–53** onto all the internal surfaces of the various walls and baffles to prevent the undesirable accumulation of extracted materials thereon. Such cleaning may be initiated manually or automatically by simply providing an appropriate valve to control the supply of fluid to the supply line **50**. Moreover, the same system may be utilized to dispense a fire extinguishing fluid, in either liquid or gas form. As in the case of the cleaning solution, the fire extinguishing fluid is quickly and efficiently distributed from the single supply line throughout the entire interior of the extraction system so that any flame existing therein will be quickly smothered.

As an illustration of the superior performance characteristics of the extraction system provided by this invention, a typical installation was subjected to severe grease extraction and fire prevention tests. Thus, in a first grease extraction test, a system identical to that illustrated in the accompanying drawings was utilized. The extraction housing was 3 feet in length, with rear wall height of 2 feet. The width of the top wall, between the front and rear walls, was 1 foot, and the height of the upper portion of the front wall, between the bottom wall portion **18***a* and the top wall **13**, was about 14 inches. The proportions and relative sizes of all the other parts were as shown in the attached drawings. To determine the amount of grease extracted from the exhaust stream passed through the extraction system, a filter was mounted in the exhaust duct 10 inches above the top of the extractor housing, and was covered with cheesecloth to collect any grease not removed in the extraction system. The cloth was weighed before being placed over the filter. The extraction system was preheated with two 250-watt heat lamps for a period of 1 hour to simulate the heating which would normally be provided by the cooking surface. The ventilator system utilized in the test, including the blower in the exhaust duct, was set up to exhaust at a rate of 300 cubic feet per minute per lineal foot. In order to provide a heavily contaminated exhaust stream, SAE5 lubricating oil (345° F. flashpoint, 0.907 specific gravity) was sprayed continuously toward the entranceway of the extraction system from aerosol cans. Two aerosol oil cans were sprayed continuously for 9 minutes, and the total amount of oil injected during this period was 37.78 ounces, which is approximately the amount of grease and oil that is normally generated in a 2-week cooking period in a typical commercial installation. At the end of the test period, i.e., after the oil spraying was terminated, the ventilating system was shut off and the filters removed for the purpose of weighing the cloth thereon to determine the amount of oil passed through the extraction system. The weight of the cloth before the test was 0.9 ounces, and the weight after the test was 1.1 ounces, indicating that 0.2 ounce of oil passed through the extraction system.

Based on the 37.78 ounces of oil fed, the total extraction efficiency was 99.47 percent. The static pressure at the outlet of the extraction system was also measured during the test, and found to be 0.85 inch.

In a second grease extraction test, the grease extraction system utilized was similar to that described in the example above, except that the extraction housing was five feet in length, and the rear wall height was 57 inches. The reason for the increase in height was to permit floor mounting of the extraction system, so the entire height increase was in that portion of the unit below the forward bottom wall **18***a*. That is, the rear wall **14**, the lower front wall **17***b*, and the baffle **36** were simple made long enough to extend down behind the cooking range so that the rear bottom wall **18***b* could rest on the floor behind the cooking range. The proportions and relative sizes of all the other parts, i.e., above the forward bottom wall **18***a*, were the same as shown in the attached drawings. The test was conducted in the same manner described above, except that the blower was set to exhaust at a rate of 275 CFM, because of the larger size of the unit, and a total of 48.15 ounces of SAE5 lubricating oil were fed into the system over a 10.5-minute test period. Two aerosol oil cans were sprayed continuously for the first 9 minutes (total of 14 cans), after which one can was sprayed for 1.5 minutes. The weight of the filter cloth before the test was 1.73 ounces, and the weight after the test was 1.38 ounces, indicating the 0.35 ounce of oil passed through the extraction system. Based on the 48.15 ounces of oil fed, the total extraction efficiency was 99.39 percent. The static pressure at the outlet of the extraction system was also measured during the test and found to be 0.8 inch.

In order to test the fire-suppressing ability of the extraction system described above, it was subjected to two different types of tests, namely a "dry" fire test and a "wet" fire test. In the dry fire test, a pan 4 inches high, 30 inches long, and 9 inches wide was filled to a depth of 2 inches with a mixture of SAE20 motor oil and gasoline. This mixture was preburned for approximately 1 minute, and then placed slightly below the entranceway to the extraction system with the system operating at an exhaust rate of about 300CFM. In order to measure the internal temperatures of the extraction system during the fire test, thermocouples were mounted at four internal points spaced along the fluid flow path, as follows: (1) directly below the entrance baffle just inside the entranceway, (2) below the bottom edge of the baffle **36** at a point between the front wall **17***b* and a projection of the baffle **36** and about midway between the bottom of the baffle **36** and the bottom wall **18***b*, (3) midway between the baffle **36** and rear wall **14** at about the same elevation as the baffle **33**, and (4) just below the center of the outlet opening in the top wall of the housing. In addition, an inspection window of heat resistant glass was mounted in the front wall of the plenum or duct just above the top wall of the extraction housing to permit observation of the exhaust stream discharged from the extractor. The temperatures measured two minutes after the flaming pan was placed below the entranceway of the extraction system, with considerable flame penetrating into the entranceway, were as follows:

Location No. 1	700° F.
Location No. 2	500° F.
Location No. 3	500° F.
Location No. 4	460° F.

The fire was allowed to burn for approximately 5 minutes, and at no time during this test period was there any flame visible through the observation window, thereby indicating that the extraction system continuously suppressed the flame which entered the front portion of the system.

In the wet fire test, 16.05 ounces of SAE5 lubricating oil were sprayed from aerosol cans directly into the entranceway with the blower running at an exhaust rate of about 300 CFM. In addition, about 1 pint of SAE20 motor oil was then poured into the entranceway, and another pint of the same oil was poured down along the rear side of the downwardly projecting baffle **36**. Visual examination indicated that the entire interior of the extraction system was coated with either the lubricating oil or the motor oil, or both. The same pan described above was then filled to a depth of 2 inches with SAE20 motor oil, preburned for approximately 1 minute, and then placed under the entranceway to the extraction system, with the ventilating system operating at an exhaust rate of 300 CFM. The temperatures measured at the four points described above, again 2 minutes after the flaming pan was placed beneath the entranceway, with considerable flame entering the entranceway of the extractor were as follows:

Location No. 1	1000° F.
Location No. 2	650° F.
Location No. 3	600° F.
Location No. 4	640° F.

It could be seen that the flames drawn into the entranceway ignited the oil on the internal surfaces visible through the entranceway, but at no time could any flame be seen through the observation window, throughout the 5 minute period that the fire was allowed to burn. The fire was then extinguished, more oil added to the pan and poured into the entranceway, and the fire started again. As before, flames were drawn into the entranceway, but there was no flame visible through the observation window, thereby indicating that the flame could not travel through the baffle system.

In addition to the significantly improved performance characteristics, the extraction system provided by this invention can also be efficiently manufactured at a relatively low cost and at high production rates with excellent quality control. Thus, the entire system illustrated in the drawings can be fabricated from a total of seven parts, all of which are formed by simple cutting and stamping operations. No machining whatever is required. A first part forms the top wall **13**; a second part forms the rear wall **14** and the two side walls **15** and **16**; a third part forms the bottom wall **18***b*, the front wall **17***b*, the bottom wall **18***a*, and the flange **34**; a fourth part forms the top front wall **17***a*; a fifth part forms the baffles **32** and **33**; a sixth part forms the baffles **35** and **36**; and a seventh part forms the hood **11** including the depending side walls thereof. If it is desired to include the deflector plates **37** and **38**, of course, two additional parts are required. Moreover, these parts can be assembled as efficiently as they are formed, by a few simple welding operations.

Furthermore, by mounting the front panel **17***a* in a removable manner, such as by the use of removable screws **60** shown in the drawings (Figs. **2** and **4**), a major portion of the interior of the extraction system can be quickly and conveniently exposed, for inspection purposes for example, by simply removing the one front panel. Such inspection might be required, for example, by building codes or other requirements. The convenient access provided by the removable front panel also facilitates installation and maintenance of the internal fluid dispensing system for cleaning and/or fire extinguishing purposes, as described previously. Since the fluid supply line **50** is mounted just inside the front wall of the extractor housing, it is fully exposed as soon as the front panel has been removed.

As demonstrated by the two grease extraction tests described previously, the extraction system provided by this invention can be varied in length, to accommodate different types of mounting arrangements for example, by simply varying the length of the rear wall **14**, the lower front wall **17***b*, and the depending baffle **36**, without affecting the performance of the system. It will also be understood that the extraction system can be fabricated without the hood unit **11**, which is made from a single sheet of metal in the illustrative embodiment, to permit custom installation of the extraction system in different types of hoods and ventilator systems.

As can be seen from the foregoing detailed description, this invention provides an improved grease extraction system with significantly improved grease extraction characteristics com-

bined with the ability to prevent the passage of flame through the extraction system. As demonstrated by the above examples, the invention provides a grease extraction system which is capable of extracting over 99percent of the condensable contaminants from a vaporous exhaust stream, while providing 100 percent efficiency in preventing the passage of flame therethrough. Furthermore, these performance characteristics are achieved with only a minimal pressure drop across the extraction system, thereby minimizing the power requirements on the blower. This improved system can also be manufactured efficiently and economically from relatively few low cost parts, all of which can be formed by conventional stamping and cutting operations. Moreover, the improved extraction system permits the efficient utilization of fluid washing and/or fire extinguishing systems and, indeed, the entire internal structure of the extraction system can be completely flushed with washing or fire extinguishing fluid from a single internal distribution line. The system is also continuously self draining so as to prevent the accumulation of extracted grease and oil therein. Because of the high level of extraction efficiency, the system of this invention improves the longevity of the downstream portions of the ventilating system. The preferred structure has the further advantage of providing convenient access to the internal portion of the extraction system for inspection purposes and the like.

I claim as my invention:

1. A method of removing grease, oil, and other contaminants from a vaporous exhaust stream in a kitchen ventilating system, said method comprising providing a housing having top and bottom walls, front and rear walls, and a pair of side walls, drawing the vaporous exhaust stream through a restricted horizontally elongated entranceway formed by said front wall for receiving the vaporous exhaust stream, deflecting the entering exhaust stream rearwardly over said bottom wall by means of an entrance baffle extending rearwardly from the top of said entranceway, deflecting the exhaust stream upwardly from said bottom wall around the rearward edge of said entrance baffle means and forwardly over said entrance baffle toward said front wall by means of a second baffle connected to said bottom wall, deflecting the exhaust stream rearwardly from said front wall and downwardly along the rear side of said second baffle to said bottom wall by means of a third baffle, and then deflecting the exhaust stream upwardly again between the rear side of said third baffle means and said rear wall.

2. A method of removing grease, oil, and other contaminants from a vaporous exhaust stream in a kitchen ventilating system, said method comprising providing a housing having top and bottom walls, front and rear walls, and a pair of side walls, drawing the vaporous exhaust stream through a vertically restricted, horizontally elongated entranceway formed adjacent said bottom wall for receiving the vaporous exhaust stream, deflecting the incoming exhaust stream rearwardly over said bottom wall by means of an entrance baffle joined to said front wall and extending rearwardly from the top of said entranceway, deflecting the exhaust stream upwardly past the rearward edge of said entrance baffle by means of an upwardly projecting baffle joined to said bottom wall and extending upwardly past said entrance baffle and spaced from the rearward edge thereof, deflecting the exhaust stream forwardly over said entrance baffle and upwardly along said front wall by means of forwardly projecting baffle joined to said upwardly extending baffle and extending forwardly at least as far as the rearward edge of said entrance baffle and spaced from said front wall, deflecting the exhaust stream rearwardly over said forwardly projecting baffle by means of a rearwardly projecting baffle joined to said front wall and extending rearwardly beyond said forwardly projecting baffle and spaced above the upper surface of said forwardly projecting baffle, deflecting the exhaust stream downwardly behind said upwardly extending baffle to said bottom wall by means of downwardly projecting baffle joined to said rearwardly projecting baffle and extending downwardly past said forwardly projecting baffle and spaced from the rear side of said upwardly projecting baffle, said downwardly projecting baffle overlapping at least a major portion of said upwardly extending baffle, and deflecting the exhaust stream downwardly along the front side of said downwardly extending baffle, around the lower edge thereof and upwardly along the inside of said rear wall.

3. A method of removing grease, oil, and other contaminants from a vaporous exhaust stream in a kitchen ventilating system, said method comprising the steps of drawing the vaporous exhaust stream through a restricted opening into a chamber, therein deflecting the entering exhaust stream horizontally through the chamber adjacent the bottom thereof, thereafter redirecting the exhaust stream upwardly and outwardly of said chamber and into a second chamber disposed above said first chamber, and therein directing said stream horizontally and forwardly through said second chamber, subsequently causing said air stream to be deflected rearwardly into a third chamber, horizontally therethrough, subsequently changing the flow path of the air stream as it emerges from said third chamber to a vertically downward direction for a distance greater than the length of the flow paths through any of said first, second or third chambers, and finally reversing the flow path of the exhaust stream vertically upwardly and discharging same to atmosphere whereby during its passage through said chambers contaminants therein will be deposited in the respective chambers permitting discharge of contaminant free air to the atmosphere.

4. A method of removing contaminants such as grease and the like from air comprising the steps of imparting velocity to the contaminated air to create a vaporous exhaust stream, causing said stream to follow a complex flow path wherein said air is passed horizontally through a first chamber; thereafter reversing the direction of flow causing the air to flow in a horizontal path through a second chamber above the first chamber, again diverting the air stream to a horizontal path whereby it flows to and through a third chamber in a direction parallel and corresponding to its flow direction through the first chamber, thereafter directing the air stream into a further chamber for vertical passage therethrough in a downward direction and finally again reversing the direction of flow of the air stream into a last chamber wherein it flows in a vertically upward path to be discharged, free of contaminants, into the atmosphere.

5. A method of removing grease, oil, and other contaminants from a vaporous exhaust stream in a kitchen ventilating system, said method comprising increasing the velocity of the stream while directing the same along a first substantially horizontal flow path, directing said stream upwardly and reversing the direction of flow thereof to direct the same along a second substantially horizontal flow path, directing said stream upwardly and reversing the direction of flow thereof again to direct the same along a third substantially horizontal flow path, directing said stream downwardly along a first substantially vertical flow path, and reversing the direction of flow of said stream again and directing the same upwardly along a second substantially vertical flow path.

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