July 29, 1969 A. SWEET ETAL 3,457,850

AIR CURTAIN VENTILATOR

Filed Dec. 11, 1967

FIG. 1.

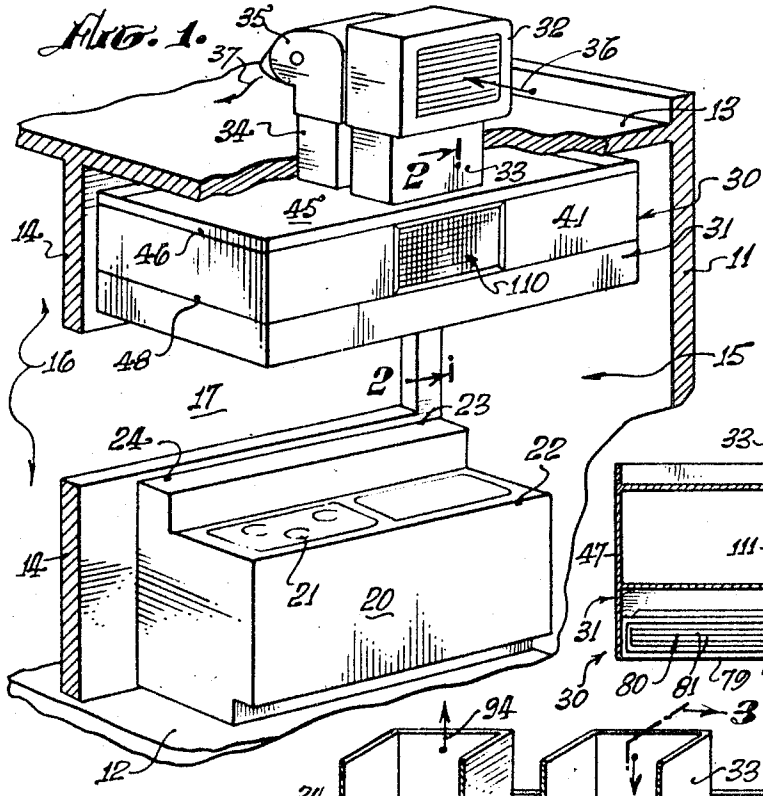


FIG. 3.

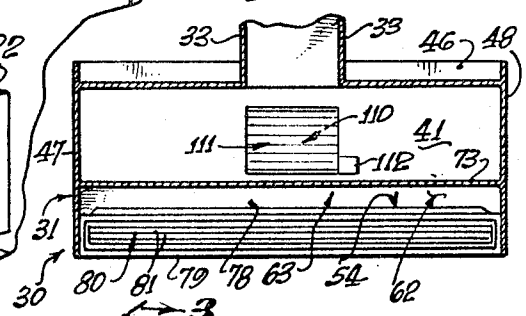


FIG. 2.

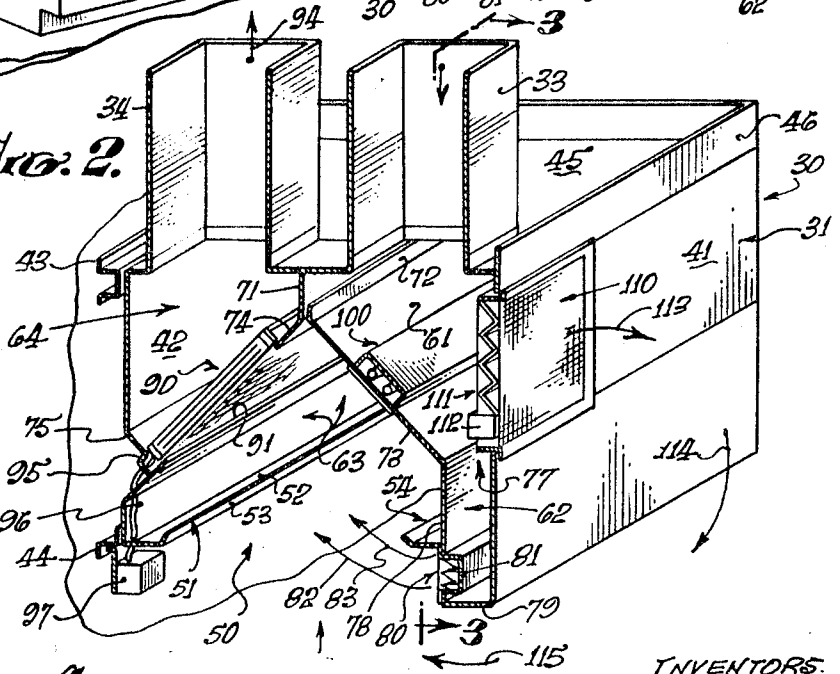
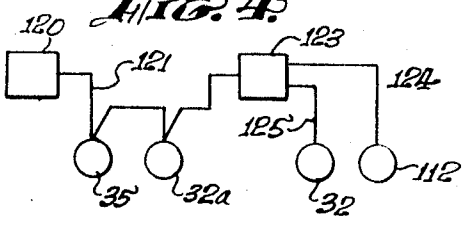


FIG. 4.



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AIR CURTAIN VENTILATOR

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U.S. Cl. 98—115 5 Claims

ABSTRACT OF THE DISCLOSURE

A ventilator hood for removing cooking vapors from above a cooking surface by means of a first curtain of outdoor air injected horizontally at overhead elevation, with the automatic addition of a second curtain of cooled outdoor air at a substantially lower elevation during periods of high outdoor air temperature.

This invention relates generally to ventilator hoods of the air curtain type, and more particularly to a ventilator in which a first curtain of outdoor air is injected substantially horizontally at an overhead elevation and along a line above the front or working edge of a cooking surface; a second curtain of cooled outdoor air is added at a lower elevation during period of high outdoor air temperature; and both curtains are exhausted to the outdoors through a grease filter exit disposed substantially parallel to said line of injection of said first air curtain, but at a higher elevation and along a line above the back edge of said cooking surface.

The present invention finds its greatest utility as a ventilator for a kitchen in an air-conditioned restaurant, and it will be described in connection with such an application. It will be understood, however, that the invention is not limited to the particular application for which it will probably find its best use, and it is conceivable that it might be used in a restaurant which had no air conditioning, or in a private home, or in some laboratory or manufacturing application resembling a restaurant kitchen in its requirements for vapor removal.

The typical stove for a large restaurant or institutional kitchen is substantially a long counter with heated cooking locations on its upper surface, hereinafter referred to as the cooking surface, and having a front edge at which cooks may stand, to carry on their cooking operations, and a back edge parallel to the front edge and spaced about an arm's length away, so as to be within convenient reach of the cooks working at the cooking surface. The cooking surface is typically long and narrow, being only 20 to 40 inches from front to back edges, but having a substantially greater horizontal longitudinal dimension at right angles to the front-to-back dimension.

It is conventional to overhang the cooking surface with a ventilator hood provided with an exhaust duct to the outdoors, and an exhaust fan in the exhaust duct for continuously removing cooking vapors which arise from the cooking surface. Cooking vapors is a term used in this specification to include all the air contaminants which it is customary and desirable to remove from a kitchen, including particularly vaporized grease, since the latter can condense and accumulate on the first cool surface it encounters.

In a typical large restaurant kitchen, adequate removal of cooking vapors requires the exhaust to the outdoors of several thousand cubic feet per minute of air. Even before the coming of air conditioning, the continuous removal of so much air made it necessary to build such systems with means for introducing make-up air from the outdoors into the locality of the cooking surface. This had the advantage that patrons and personnel in the restaurant, but not too close to the cooking surface would not be exposed to unpleasant drafts and air currents. In the older systems, however, the cook working at the cooking surface found himself exposed to a continuous chilling draft of make-up air passing from his back and up into the ventilator hood. In addition to and even more difficult of solution than the problem of eliminating drafts caused by adequately ventilating a restaurant kitchen is the problem of avoiding excessive heat loads on the heating or cooling systems employed to heat or cool the restaurant. Even before the coming of cooling and dehumidifying by air cnditioning, the cost of adequately heating a restaurant in a cold climate could be excessive if the kitchen ventilating system produced more than an absolute minimum required rate of removal of interior air. With the coming of air conditioning to modern restaurants, the cost of the additional heat load required solely because of the requirements of cooking vapor ventilation is a very substantial factor of cost, even in the best designed of systems.

The huge cost of kitchen ventilation heat load required in restaurants, particularly air-conditioned restaurants, has resulted in the employment by the design engineers of some form of "air curtain" system in most modern restaurant kitchen ventilation designs. In air curtain systems, the make-up air is introduced in the form of a relatively thin sheet or curtain coming from a long, make-up air slots disposed along one side of the location from which cooking vapors are to be removed. The exhaust opening is in the form of a mating opening slot parallel to the make-up air slot and spaced from it at the opposite side of the location of vapor removal. Typically, the curtain of make-up air enters the kitchen in the vicinity of the cooking surface in a moving sheet a few inches thick and having a width about the same length as that of the longitudinal dimension of the cooking surface. Moving rapidly, and increasing in thickness, while diminishng in velocity, it scavenges the cooking vapors and then makes an exit through an exhaust opening, usually at a higher elevation, which, typically, has the same longitudinal dimension as the entering air curtain, but with a transverse dimension several times the thickness of the curtain and the air curtain inlet.

Air curtain systems for kitchen ventilators have appeared and are currently in use in great variety. They are generally expensive systems with complex duct work, manifolds, special local heaters and local coolers, as well as a variety of grease filters and grease traps.

It has already been mentioned that effective cooking vapor removal requires the input and removal of makeup air from the outdoors. The establishment and maintenance of a suitable air curtain increases rather than diminishes the volume of air flow required. Moreover, the air curtain must be neither too hot or too cold if it is to achieve effective scavenging of the cooking vapors. For example, vaporized grease presents serious problems of fire hazard, as well as clealiness, if it condenses prematurely because of an excessively cool air curtain, or if it fails to condense at the grease collection gutters and grease filters provided by the designer for the purpose, and collects, instead, in the plenums and duct work down stream from the grease filter; the latter type of accumulation is a common cause of major restaurant fires.

Obviously, the most economical and practical air curtain system to install would be one which could be incorporated entirely into a single unitary hood structure suspended above the cooking surface. Such a system would have to make use of an overhead curtain of some type. Unfortunately, overhead air curtains heretofor known have been unable to cope with fluctuations in the temperature of the makeup outdoor air comprising the curtain. As a result, some of the most advanced air curtain

designs have abandoned the overhead air curtain entirely, and have resorted to extremely expensive constructions combining both stove and ventilating system, in an attempt to effectively scavage cooking vapors, while condensing greese at the desired location, with a minimum of heat load for the restaurant air conditioning system and that of the ventilator itself.

The present invention is a design which returns to the overhead air curtain, but in a new and novel form which eliminates the features of unsatisfactory performance which has characterized overhead air curtain systems in the past. Moreover, the design of the present invention achieves its advantages by means of a compact unitary hood structure which costs less to fabricate, operate, and maintain than any previously known restaurant kitchen ventilator having a comparably low heat load. For typical air-conditioned restaurants, a cost analysis reveals that the ventilator of the invention saves far more in heat load on the general restaurant air-conditioning system than its extra cost over the cheapest of ventilation hoods.

Since the ventilator of the invention is incorporated entirely in an overhead hood, standard restaurant stoves may be employed under it, and the great cost of specially designed combined stove and ventilator systems may be avoided.

The ventilator of the invention has built into it automatic adjustment to the most efficient operation regardless of winter or summer temperatures of outside air used for the air curtain. Incorporated in the ventilator design are a few simple adjustments so that it can be mass produced and then adjusted to the special characteristics of each location after delivery to the site. Usually, the only variable of any importance will be the length of hood and the size of blower and cooler needed for particular local climate, or the size and characteristics of a particular restaurant building.

When properly maintained and installed, the present invention practically eliminates the fire hazard problem of grease accumulation in an undesirable or inaccessible location.

The automatic system incorporated in the vental air of the present invention is not a sensitive one, since it is made to respond to the temperature of outdoor air and not to the temperature of air-conditioned air inside of the restaurant or its kitchen. Usually, temperature setting of the ventilator made at the time of its installation will remain unchanged for years of use; in extreme cases, a few seasonal changes may be required; but ordinarily, unless the building is moved to a new location or some radical alteration is made in its thermal conditions, temperature settings, as well as both manual and motorized damper settings may be set once and forgotten.

The foregoing and many other objects and advantages of the present invention are achieved by means of an overhead air curtain ventilator which relies on an air curtain of relatively high volume traveling a very short distance from its upstream entrance as makeup air to its downstream exhaust opening.

Like previously known overhead air curtain systems, the system of the present invention relies on the tendency of hot cooking vapors to rise vertically from the cooking surface, in a continuous vertically upward draft, and to be entrained in the relatively cooler air curtain and sent through a grease filter after being cooled sufficiently to condense substantially all of the grease before it can move any substantial distance downstream from the grease filter.

As with previously known air curtain systems, the present system provides an air curtain inlet register which has a manually adjustable damper so that the supply of makeup air can be balanced against the removal of exhaust air to achieve effective scavenging of cooking vapors with a minimum of disturbance to air conditioned air filling the restaurant and the restaurant kitchen.

As long as the outgoing air is sufficiently cool, that is at temperatures of about 70 degrees Fahrenheit, or lower, the ventilator of the present invention has only moderate superiority over previously known overhead air curtain ventilators, although the design of the invention appears to be novel even at low outdoor air temperatures because it utilizes the makeup air plenum and the makeup air distribution manifold in combination with the grease gutters to achieve the most effective form of air curtain flow, and grease condensing heat exchange through heat conductive wall surfaces.

The present invention begins to show its great superiority over previously known air curtain systems, as the outdoor air temperature rises. In previously known systems, an air curtain of hot outdoor air has simply failed to remove cooking vapors, since the continuous upward flow of cooking vapors could not be maintained when the overhead curtain temperature rose to a temperature substantially higher than that existing in the air-conditioned restaurant outside of the ventilator hood. Installing an air cooler in the inflowing makeup air has proved to be an extremely costly solution because of the very large volume of air which must continuously be cooled to supply the air curtain. It has proven extremely costly to cool many thousands of cubic feet per minute of makeup air which is continuously dumped to the outdoors through the exhaust system within a few seconds after being chilled.

It will be understood that the term air cooler used in this specification refers to any means for cooling the makeup air. In relatively dry climates, such means may be an evaporative cooler; the hot, incoming air passes through a water evaporation filter, to which water is continuously pumped. The makeup air is chilled a few degrees by the water evaporation and is sufficiently cool for cooking vapor scavenging purposes. In localities which have a hot and humid climate, the air cooler must use refrigerator coils, which are substantially more expensive type of cooler. Regardless of the type cooler used, each degree of temperature that the hot outdoor air must be cooled is reflected in a very substantial cost in original installation and operation, because of the very large volume of makeup air continuously being passed through the kitchen ventilator system.

The ventilator of the present invention does not entirely eliminate the cooler from the makeup air supply system. The cooler is employed, but it is much smaller than would otherwise be required, and much less temperature reduction in makeup air is required, because, in the present invention, the ventilator introduces a secondary air curtain of novel design at times of high outdoor air temperature.

In the present invention, a rise in outdoor air temperature above some suitable pre-determined level, 70 degrees Fahrenheit, for example, will result automatically in a division of the incoming makeup air into two streams. The greater portion of makeup air continues, as at lower temperatures, to pass through the ventilator hood structure in the air curtain flow which may be identified as the primary air curtain. However, at high outdoor air temperatures, a minor but substantial part of the incoming makeup air is diverted into a secondary air curtain; it is discharged external to the ventilator hood, near the kitchen ceiling above the location at which the cooks are working, and then sweeps down past the cooks at low elevation, and then up to the exhaust opening in the bottom of the ventilator hood, where it rejoins the makeup air of the primary air curtain and sweeps with it out through the grease filters and the exhaust system.

It may be objected that the secondary air curtain is a reversion to older systems which exposed the cooks to a draft. Admittedly, the cook does experience some movement of air when the secondary air curtain is flowing. Experience has unexpectedly shown that this is not objectionable, however, apparently because the secondary air curtain moves at relatively low velocity, and it moves

only when outdoor air is somewhat warmer than the air-conditioned interior of the restaurant.

The most unexpected and valuable feature of the secondary air curtain, however, is that its upward flow from a substantially lower level than that of the primary air curtain produces an upwardly flowing current of makeup air which is just as effective in scavaging the cooking vapors as if all of the makeup air in the primary air curtain had been subjected to substantial and very costly cooling. In short, the introduction of the secondary air curtain is sufficiently effective to greatly reduce the amount of makeup air cooling required.

The foregoing and many other objects and advantages of the invention will be understood from the following description of one preferred specific form of the invention, which should be read in conection with the accompanying drawings, in which:

FIGURE 1 is a perspective view of one corner of the restaurant kitchen, showing the stove and a ventilator system constructed according to the present invention;

FIGURE 2 is a perspective view of one-half of the ventilator hood of FIGURE 1, shown transversely sectioned at a central vertical plane indicated in FIGURE 1 by the arrow **2—2**;

FIGURE 3 is an elevational view through the ventilator hood of FIGURES 1 and 2, as seen at a longitudinal vertical plane looking in the direction indicated by the arrows **3—3** in FIGURE 2;

FIGURE 4 is schematic diagram of the automatic control system which makes certain changes in the operation of the ventilator of FIGURES 1 to 3 whenever the outdoor air temperature exceeds a pre-determined temperature level.

In the perspective view of FIGURE 1, a restaurant building, indicated generally by the numeral **10** is suggestably indicated by fragmentarily illustrated outerwall **11**, floor **12**, roof **13**, and an interior partition wall **14**, which separates the kitchen **15**, nearest the viewer, from the dining room **16** on the opposite side. Typically, a pass-through window **17** is provided so that trays of hot food may be passed directly from the kitchen **15** to serving personnel in the dining room **16**. Obviously, the presence of the pass-through window **17** complicates the problem of removing cooking vapors with a minimum of disturbance to the air-conditioning system of the dining room; if the size of the pass-through window **17** is reduced, or the pass-through window is entirely eliminated, cooking vapor scavaging is somewhat simplified; however, the ventilator of the present invention has proved to be extremely effective, even in the presence of a folding pass-through window **17**, as will be explained hereinafter.

A long restaurant stove **20** stands on floor **22**, immediately adjacent to partition **14**. It has a counter-height upper cooking surface **21**, which comprises cooking locations for cooking pans of various types as well as griddles and grills for frying and grilling all in a manner well known to those familiar with restaurant kitchen operation.

The cooking surface **21**, like the stove **20**, is much longer than the stove depth from front edge **22** to back back edge **23**. One or more cooks stand on floor **12**, adjacent to front edge **22**, which may also be designated the working side of stove **20**, and carry out their cooking operation on cooking surface **21**, passing dishes of cooked food to a serving top **24** for removal by serving personnel through the pass-through window **17**.

The ventilator hood of the invention is indicated generally by the numeral **30**, and is seen to be suspended from roof structure **13**, as well as walls **11** and **14**, over the cooking surface **21**. The ventilator hood **30** is seen to be comprised principally of a box-like hood structure **31**, a makeup air cooler **32**, makeup air ducts **33**, an exhaust air duct **34**, and an exhaust air fan **35**. Several thousand cubic feet per minute of outgoing air moves into the ventilator system **30** as indicated by the arrow **36**, and, within a few seconds, moves out of the system again as indicated by the arrow **37**, the outgoing stream having entrained and removed unwanted cooking vapors rising from cooking surface **21**.

As previously mentioned, air cooler **32** may be an evaporative cooler, cooled by water pumped to it, or a refrigerator coil type of cooler, or any suitable cooling means; the particular type of cooler is not a point of novelty of the present invention. Also, precise location of air cooler **32** is not a critical factor in the present invention as long as sufficient cooling is imparted to the makeup air. Similarly, the movement of air through the ventilator system **30** may be achieved by any of the air moving means conventional in the technology of air-conditioning engineers; exhaust fan **35** may be of any commercially available type suitable to the particular installation capable of moving the required number of thousands of cubic feet per minute of air, at the desired velocity, and may be located as shown, or elsewhere in the system as dictated by standard principals of air-conditioning engineering.

There will be irrelevant engineering details which have been omitted from the drawings, since they contribute nothing to the disclosure of the invention. For example, roof **13** would undoubtedly be comprised of a roof and ceiling separated by an intermediate air space. Also, various building codes require that the ventilator hood **31**, as well as ducts **33** and **34**, be constructed and mounted in the restaurant building **10** with dead air spaces between adjacent wall and ceiling surfaces, in order to reduce fire hazards. These building code requirements are only partly suggested by details of the illustrations FIGURES 1 and 2.

It is important to understand that the ventilator hood **31** is suspended with its bottom portion at an elevation very near or just above the head level of the cooks working at the working or front edge **22** of the cooking surface **21**. Such an elevation is common and conventional in restaurant kitchen hood construction of the past, but that elevation assumes a new and important function for both the primary and secondary air curtains used in the system of the present invention. If ventilator hood **31** were raised too far above cooking surface **21**, the primary and secondary air curtains of the invention would lose some of their effectiveness in performing their scavenging function.

In the combinations sectional and perspective view of FIGURE 2, the internal construction of ventilator hood **31** is clearly revealed. It should be noted that the entire ventilation system **30**, apart from mechanical devices, filters, and other special components, is a fabrication of sheet metal. Typically, exterior duct work **33** and **34** will be made of galvanized steel, but most parts of the hood **31**, particularly exposed parts, will be fabricated of stainless steel sheet.

The exterior of hood **31** is essentially a long rectangular box with a front wall **41** exposed to view in the interior of kitchen **15**, and a back wall **42** closely spaced from partition wall **14**. Space mounting may be achieved, as illustrated, by spacing girders **43** and **44**.

The top wall **45** is likewise spaced downwardly a few inches from the adjacent ceiling surface of roof **13**, as required by most building codes, the spacing being concealed behind a covering flange **46**.

As seen in the sectional elevation of FIGURE 3, the hood **31** is closed at each end by end walls **47** and **48**.

The sectional view of FIGURE 2 reveals that the under side of the ventilator hood **31** is almost entirely open, being provided with an exhaust opening designated by the arrow **50**, which is disposed in a substantially horizontal plane in the preferred embodiment illustrated, and is surrounded, around its entire periphery, by an inwardly projecting grease gutter **51**. For the special control of air flow peculiar to the present invention, grease gutter **51** is constructed with a horizontal bottom **52**, which terminates, around the entire periphery, in an obliquely upstanding

lip **53**. In a preferred form, grease gutter **51** passes entirely around exhaust opening **50**, but particularly important is the front grease gutter **54**, as will be described hereinafter, since it funtcions not only as a grease gutter but as an air curtain baffle.

In the preferred form of the invention, the interior of hood **31** is divided by longitudinal partitions into four different cavities or chambers which run its entire length. These cavities may be designated and identified as makeup plenum **61**, distributor manifold **62**, vapor collection chamber **63**, and exhaust plenum **64**. These four chambers are formed by the following partitions: a downwardly depending central partition wall **71** hangs internally from the longitudinal center line, approximately, of top wall **45** at a welded seam line **72**, a few inches below top wall **45**, as determined by design requirements, plenum volume and other dimensions of hood **31**, vertical partition **71** divides into two downwardly diverging walls **73** and **74**.

The upper back portion thus encloses a longitudinal space forming exhaust plenum **64**, which is closed at the bottom by a wall **75**.

The upper front portion of the interior of hood **31** thus enclosed by central wall **71** and downwardly diverging wall **73** provides the space which functions as makeup plenum **61**. Unlike exhaust plenum **64**, however, makeup plenum **61** is open along its entire bottom edge, as indicated at **77**, so that air from makeup plenum **61** decends without interruption into a downwardly dependent distribution manifold formed between front wall **41** and an inner manifold wall **78**. The manifold is closed at the bottom by bottom wall **79**. Thus, incoming makeup air, cooled if necessary by cooler **32**, passes down through makeup duct **33** into makeup plenum **61**, and from makeup plenum **61** downwardly into distributor manifold **62**.

Makeup air is discharged from distributor manifold **62** through a primary air curtain register **80**, which is vertically relatively narrow, but has a horizontal longitudinal dimension for substantially the entire length of hood **31** as may be seen from the interior as viewed in FIGURE 3. Primary register **80** is provided with suitable manually adjustable dampers **81**.

The primary air curtain is indicated by arrow **82** and **83**. It issues from primary air curtain register **80** as a vertically narrow stream having the same width, very nearly, as the length of hood **31**, and moves horizontally a short distance, being baffled by the underside of front grease gutter **54**. It then rises as it diverges transversely, increasing its thickness as a curtain and decelerating slightly. It moves upwardly and obliquely through exhaust opening **50** into the interior of vapor collection chamber **63**, entraining and carrying with it hot cooking vapors which have arisen from cooking surface **21** through exhaust opening **50** into vapor collection chamber **63**.

The primary air curtain **82–83** moves upwardly through a bank of grease filters **90**, which are disposed substantially normal to the direction of flow of the primary air curtain **82–83** in the obliquely disposed wall **74**. Since grease filters **90** extend the entire length of the hood **31**, and comprise substantially all of the plane of the wall **74**, it will be seen that wall **74** is little more than a frame around a grease filter opening **91**. Exhaust air, including the cooking vapors are carried upwardly from the exhaust plenum **64** through exhaust duct **34** as indicated by the arrow **94**.

One important part of the cooking vapors has been extracted from the exhaust air before it leaves the exhaust plenum **64**. Substantially all of the grease vapor has been condensed, first on the wall surfaces of vapor collection chamber **63**, and secondly on grease filter **90**. Grease droplets condensed on the wall surfaces of collection chamber **63** run down into the grease gutter **51**. Grease condensed on grease filter **90** runs down into a grease filter gutter **95**, through a conduit **96** to a grease collection cup **97**, which also receives drainings from the grease gutter **51**.

A convenient place to locate flourescent lighting for the stove **20** is inside the hood structure **31**, for example, in the oblique wall **73** as indicated for the flourescent lighting fixture **100**.

It is important to note that the primary air curtain **82–83** is injected substantially horizontally, and from inside of the front of ventilation hood **31**, so that it rises through exhaust opening **50** as it moves toward the back of ventilation hood **31**. It thus follows the most effective cooking vapor scavaging route for overhood air curtain, while it avoids any draft whatever on the food or the cooking personnel.

It is also important to note that the sheet metal walls **73** and **78** function as grease condensing heat exchanger surfaces, since relatively cool incoming makeup air is passing over the upper sides and front sides of these partitions. Even grease droplets which condense by encountering the incoming primary air curtain **82–83** immediately adjacent primary register **80**, are transported upward, since they encounter the air curtain at its point of highest velocity.

At this point in the description it is to be noted that the ventilator system **30** is designed to function very well with only a primary air curtain of outdoor air as long as the outdoor air is relatively cool. On hot days, however, there would be two adverse factors at work, as described in the introduction, since hot makeup air would raise the temperature in the vapor collection chamber **63** sufficiently above the interior restaurant temperature to halt or at least reduce the upflow of cooking vapors; and, further, the grease vapor, not being chilled enough to be condensed on the grease filter, would be carried upward into the exhaust plenum **64** and exhaust duct **34**, to be condensed and accumulate in an inaccessible location, where it would slowly become a fire hazard.

In the present invention, a secondary air curtain register **110** is located in the front wall **41** of ventilator hood **31**, preferably centrally and high up near the ceiling under surface of roof **13**. Secondary register **110** controls air passage by a damper system **111** which is controlled by motor **112**. When days are sufficiently cool, the damper system **111** is closed; but when the outdoor air temperature is too high for primary air curtain **82–83** to perform its function effectively, the damper system **111** is opened to permit diversion of part of the makeup air from the makeup air plenum **61**, into a secondary air curtain indicated by the arrows **113–114** and **115**. The secondary air curtain **113–115** loops downwardly past the location of the cooks, somewhat below head elevation, and then upwardly through horizontal exhaust opening **50**.

Secondary air curtain **113–115** is slower moving than the primary air curtain **82–83**, and it inevitably diffuses to some degree into the kitchen **15**, and it does impose some heat load on the restaurant air-conditioning system. However, as the outdoor air temperature rises above an intermediate range, which range is very nearly that of the air-conditioned air within the restaurant and kitchen, makeup air cooler **32** is automatically turned on. It will be understood that no attempt is made to cool the makeup air down to a temperature as low as that existing by virtue of the restaurant air-conditioning system within the kitchen **15**. Consequently, the cook experiences only a very slow moving and mild draft, and that is a draft of air which feels relatively warm.

FIGURE 4 illustrates a simple and basic wiring system. The main switch **120** supplies power at all times to exhaust fan **35**, and a makeup air blower **32***a*, which may conveniently be located in cooler **32** and operate regardless of whether cooling is in effect or not. Thus, scavenging air is both pushed and pulled through the ventilator system **30**. The power being supplied through the master switch **120** in line **121** then passes through a temperature sensing controller **123** which continuously senses outdoor temperature, and has at least 2 stages (although more may be employed as desired for stepwise or con-

tinuous increase in the cooling effect of secondary air curtain **113–115**). At about 70 degrees Fahrenheit, for example, in the outdoors, temperature sensing control **123** operates motor **112** to open dampers **111**, the power line being indicated in the diagram FIGURE 4 by **124**.

At some temperature several degrees higher, for the outdoor air, temperature sensing control **123** operates, through line **125** to start the operation of air cooler **32**.

It will be understood, of course, that the automatically operated devices, cooler **32** and motor **112**, may be controlled by any of the relay means well known in the electrical engineering art and suited to the particular application.

While we have described one specific embodiment of the invention, as is explained in the introductory remarks why the addition, at higher outdoor temperatures, of even a relatively slow moving and only slightly cool secondary air curtain, comprising only a minor portion of the incoming makeup air, suffices to lift cooking vapors from cooking surface **21** with great economy and effectiveness, while imposing only a minimum of additional heat load on the air-conditioning system of the restaurant **10**, it will be understood that the details are illustrative only.

We claim:

1. A ventilator for removing cooking vapors rising from a cooking surface located in a kitchen enclosure, said cooking surface having front and back edges disposed substantially in parallel along a horizontal longitudinal dimension, which ventilator includes:

a hollow hood structure overhanging said cooking surface with its lower wall surfaces at an elevation near the head level of cooks working at the front edge of said cooking surface, said hood structure having internal walls defining:

a vapor collection chamber in the bottom of said hood and overhanging substantially all of said cooking surface, said chamber being open at the bottom to permit the upward movement of cooking vapors into said chamber;

a makeup plenum in the upper front of said hood structure extending longitudinally through substantially the entire longitudinal dimension of said hood structure;

an exhaust plenum in the upper back of said hood structure extending longitudinally substantially the entire longitudinal dimension of said hood structure;

a distribution manifold extending longitudinally throughout substantially the entire longitudinal dimension of said hood structure in the lower front of said hood structure, said manifold being in open communication with said makeup plenum throughout its entire length, at its upper part, and said manifold extending downwardly below the bottom opening of said vapor collection chamber;

a primary air curtain register disposed in a substantially vertical plane in the lower part of said manifold, said register being narrow vertically relative to its length, and extending longitudinally for substantially the entire length of said manifold, and said register opening toward the back of said hood structure at an elevation just below said bottom opening of said vapor collection chamber;

walls between said vapor collection chamber and said exhaust plenum defining an exhaust opening extending substantially the entire longitudinal dimension of said hood structure and a grease filter mounted in said exhaust opening;

an exhaust system comprised of an exhaust duct leading from said exhaust plenum to the outdoors, and an exhaust blower for continuously exhausting air from said exhaust plenum to the outdoors;

a makeup system comprised of a makeup air duct permitting the inflow of outdoor air to said makeup plenum, and a makeup air cooler for cooling said makeup air on its way into said makeup plenum;

a secondary air curtain register in a front wall of said hood structure, said register providing a passage of the flow of air from said makeup plenum into said kitchen enclosure;

a motor-controlled damper on said secondary air curtain register; and

an automatic secondary air curtain control system which includes:

temperature sensing means for sensing the outdoor air temperature;

damper relay means controlled by said temperature sensing means for opening said motor control damper for outdoor temperatures above a pre-determined temperature; and

air cooler relay means controlled by said temperature sensing means for placing said makeup air cooler in operation when outdoor air temperature exceeds a pre-determined temperature.

2. A ventilator as described in claim **1** in which said bottom of said vapor collection chamber is surrounded at substantially its entire periphery by a grease gutter inwardly projecting from the sidewalls of said vapor collection chamber.

3. A ventilator as describer in claim **1** in which said hood structure includes a substantially horizontal baffle wall immediately above said primary air curtain register, and extending longitudinally for the length of said exhaust opening, and extending backwardly and then upwardly into said opening, to deflect the flow of said primary air curtain first horizontally and then obliquely upwardly toward the upper back of said vapor collection chamber; and an upper back wall of said vapor collection chamber overhangs said exhaust opening and is disposed in a plane rising obliquely and forwardly, and substantially transverse to said air curtain as it moves upward from the downstream edge of said baffle, said upper backwall containing said filter opening and said grease filters.

4. A ventilator as described in claim **1** in which said vapor collection chamber and said makeup plenum are separated from one another by a heat-conductive wall, and the undersurface of said wall is provided at its lower end with a grease gutter for the collection of grease condensed upon the surface of said wall.

5. A ventilator as described in claim **1** in which at least one of said relay controlled means is continuously changed over a range of outdoor temperatures to increase the cooling effect of said secondary air curtain as the outdoor temperature rises.

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