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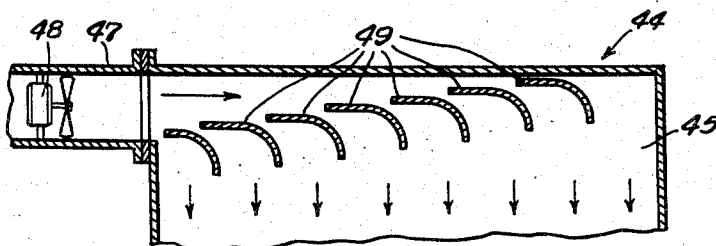
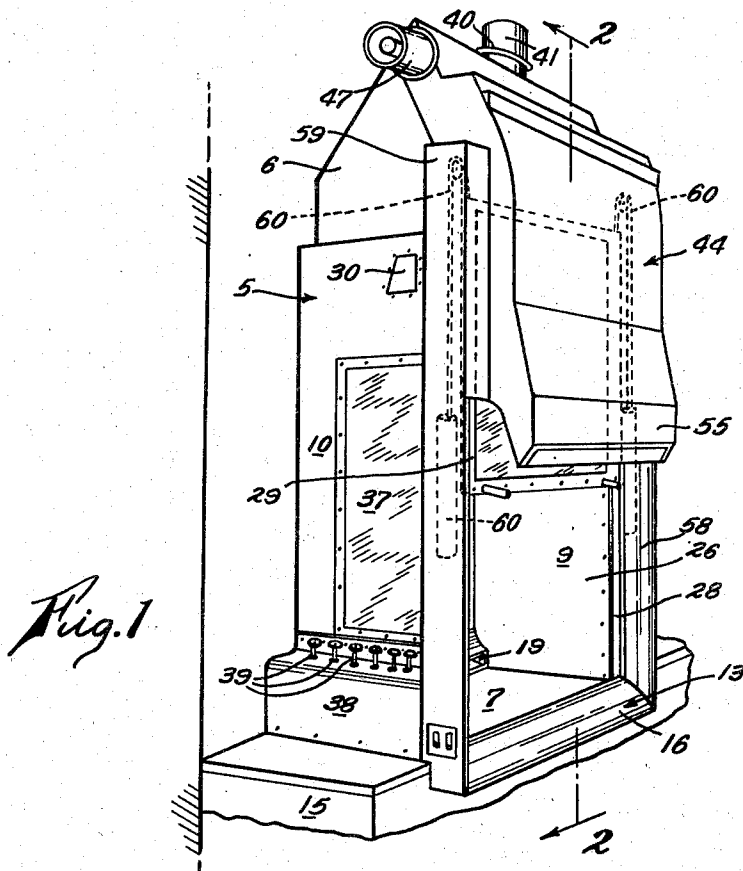
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LABORATORY FUME HOOD

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

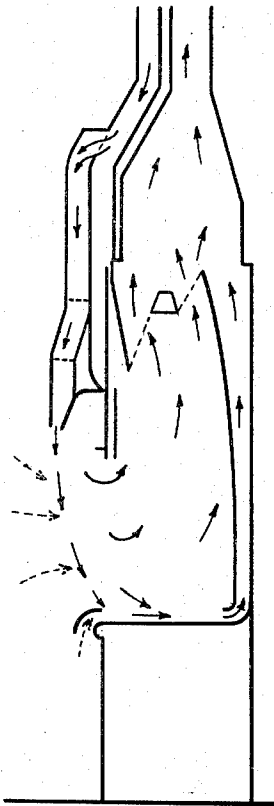


Fig. 4

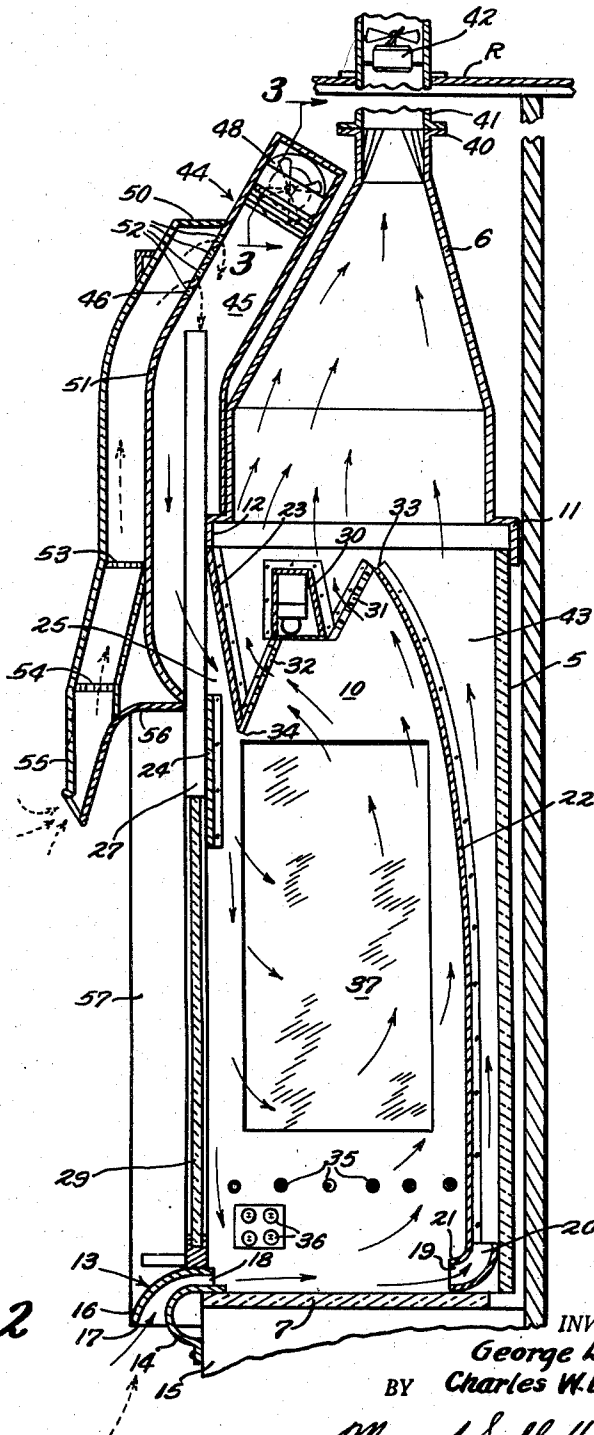


Fig. 2

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LABORATORY FUME HOOD

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The present invention relates to fume hoods for use particularly in air conditioned laboratories and generally in areas where it is desirable to keep the volume of air flowing through the hood at a minimum.

The use of fume hoods in air conditioned laboratories presents problems of several kinds affecting the users of the hoods and those responsible for the selection and operation of air conditioning apparatus that serves the laboratory. Efficient fume control becomes increasingly important as the cost of conditioned air exhausted from the laboratory through the hood becomes an important item of expense in operating such hoods. The previously attempted solution of the problems involved, as applied variously in heretofore available hoods, have been unsatisfactory. Economies in the loss of conditioned room air through the hood, if effected by reduction of the size of the access opening in the hood will considerably reduce the usefulness of the hood, whereas the employment of non-conditioned forced air with an accompanying requirement of regulations and adjustments in the hood to secure effective control of various light or heavy fumes, places added duties and responsibilities on the user as each experiment is undertaken. In the event of unexpected reaction in the work in the hood, or inadvertences in the regulation of the hood, unpleasant or dangerous fumes may escape from the hood and be circulated by the air conditioning system to all areas served thereby.

Important objects of the present invention include the provision of an arrangement of structure and apparatus that efficiently controls and removes fumes of all kinds regardless of whether the sash for the access opening of the hood is fully raised or completely lowered, and also completely eliminates all need for adjustments of baffles or dampers or regulation of motor driven fans.

Another object of the invention is to provide a structure of this kind wherein improved efficiency in fume control is attained with the exhaust of an appreciably reduced amount of air as a predetermined constant factor, and wherein the air entering the hood constantly and automatically balances said exhaust, and comprises equal amounts of room air and pressurized air respectively, this arrangement, when used in air conditioned laboratories, serving to effect a notable economy in the cost of conditioned air and to render the air conditioning apparatus subject to more reliable and economical control.

A further object of the invention is to provide a hood of this kind that may be constructed at moderate cost; that affords safety and enhanced convenience for the user; and is easily serviced and maintained.

Further objects and advantages of the invention will be noted in the following detailed description of the hood.

The general arrangement of the hood of the present invention includes a cabinet-like structure having an open top communicating with the open bottom of a plenum exhaust chamber, an uncontrolled room air entry slot at the bottom of an open cabinet front which also provides a full sized access opening and a port above the latter

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for admitting pressurized air, a vertically movable sash that fully uncovers the access opening only or said air port only depending on the position of the sash at its extreme raised or lowered position, and a pressure air manifold that constantly delivers a predetermined amount of pressure air as a descending air curtain in a plane parallel with the sash controlled access opening along the inner face of said sash when the latter is fully lowered, and in substantially parallel exteriorly disposed plane when the sash is fully raised. An individual air exhauster removes air and entrained fumes at a fixed and predetermined rate from the plenum exhaust chamber and a suitable fan or the like supplies air to the pressure air manifold at one-half the rate of said exhaust so that the amount of room air removed through the hood is also known and constant.

The interior of the cabinet is traversed by an imperforate fixed wall with its bottom edge spaced slightly from the bottom and rear wall of the cabinet and its top edge disposed substantially midway the front and rear of the cabinet where the open top of the cabinet and open bottom of said plenum chamber are connected. The fixed wall thus provides a separate rear channel, that is of increasing cross sectional area from bottom to top, through which an adequate portion of the total exhaust of the plenum chamber is drawn in order to efficiently exhaust all heavy fumes, while the remaining and greater portion of the total exhaust of said plenum chamber efficiently removes all lighter products from the top of the amply proportioned working zone in front of the said transverse wall.

A preferred form of the invention is hereinafter described and illustrated by way of example and not of limitation in the accompanying drawings, in which:

Fig. 1 is a perspective view of a fume hood of the invention with the sash for the access opening in a fully raised position.

Fig. 2 is a cross sectional view taken on line 2—2 of Fig. 1 but showing the sash in a fully lowered position.

Fig. 3 is a cross sectional view taken on line 3—3 of Fig. 2.

Fig. 4 is a diagrammatic view showing the direction of air flow into and through the hood when the sash is fully raised.

In the drawings a cabinet indicated generally at 5 is surmounted by a plenum exhaust chamber 6 which has an open bottom coextensive and in communication with the open top of the cabinet. For economy, durability and easy maintenance the work table 7 and rear wall 8 of the cabinet are of stone-like material resistant to acids and alkalis, while the remainder of the structure is principally of sheet metal construction with removably connected parts where replacement may be ultimately required. Those surfaces which are exposed to fumes have a durable coating of resistive material for example an epon phenolic coating (not shown) and other surfaces are suitably treated for easy cleaning and for decorative purposes as desired.

The parallel side walls 9 and 10 are connected at the bottom edges to work table 7 and at the rear vertical edges to rear wall 8. A rectangular frame 11 bounds the bottom edge of chamber 6 and has the tops of the walls 8, 9 and 10 connected to three of its sides and the remaining side member 12 of the frame defines the top of an open front for the cabinet.

At the bottom of the open front of the cabinet and disposed largely exteriorly thereof is a curved hollow air foil member indicated generally at 13 and comprising a member 14 of half-circular cross section with one edge secured on the forward top marginal portion of work table 7 and the remaining edge secured to the front of a laboratory bench 15, or the like, on which said work table or bottom 7 of the cabinet is supported at a con-

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venient level above the floor of the laboratory. The upper portion 16 of member 13 is of substantially quarter-circular cross section and forms an elongated downwardly opening mouth for a room air channel 17 and a discharge slot 18 therefrom at the level of the top of work table 7. At the rear of table 7 opposite slot 18 is an opposed slot 19 between a quarter-circular fillet strip 20 and the forwardly curved bottom edge 21 of a transverse divider wall 22 in the cabinet. Wall 22 extends upwardly in closely spaced relation to rear wall 8 for a distance and then curves arcuately forward so that the top edge thereof bisects the open top of the cabinet where it communicates with the open bottom of plenum chamber 6.

A fixedly mounted imperforate baffle 23 inclines inwardly and downwardly from member 12 at the top of the open front of the cabinet to a level intermediate the top and bottom edges of a strip 24 which divides the open front of the cabinet into an upper pressure air inlet port 25 and a lower access opening 26. Vertical guide channel members 27 and 28 extend upwardly from opposite ends of member 13 along the exterior side edges of the cabinet and across the outer face of strip 24 and terminate above the top exterior of the cabinet. A safety glass sash 29 has its vertical edges guidedly retained in the opposed channel members 27 and 28 and is suitably counterweighted so that it may be moved from a fully lowered position with the bottom thereof resting on member 13 and its top edge portion overlapping the lower exterior face portion of the strip 24 as shown in Fig. 2, for closing access opening 26 and uncovering the port 25 above the strip, to a fully raised position for fully uncovering the said access opening and closing said port 25.

A sealed fluorescent light housing 30 traverses the upper interior of the hood intermediate baffle 23 and the upper portion of divider wall 22. Perforated exhaust grilles 31 and 32 extend respectively from the top edge 33 of wall 22 downwardly to one bottom edge of the light fixture housing and from the bottom edge 34 of baffle 23 upwardly to the remaining bottom edge of said housing and these parts define a high ceiling for the working zone below which accommodates tall laboratory apparatus at a convenient level for the chemist in an easily visible position for even a taller than average man to comfortably observe from a position before the fully raised or fully lowered sash 29.

A plurality of utility pipes 35 pass through side wall 10 to render such media as hot and cold water, fuel gas, nitrogen, air etc. available inside the hood and an electric plug receptacle group 36 is conveniently located in the same wall. These utilities are located below a fixed safety glass window light 37 that renders the interior of the cabinet visible from the side of the hood, where a removable cover panel 38 permits the stems 39 of individual control valves (not shown) for these utility pipes 35 to be operated from the side of the hood while the window 37 permits identification of said stems 39 with their corresponding utility pipes 35.

The top of plenum chamber 6 has a suitable flange 40 to which is connected a pipe such as 41 that may pass through the roof R of the building to an outside stack (not shown) or, as will be readily understood without illustration or detailed description, an elbow pipe may be used in lieu of the straight pipe and directed at any convenient angle through the most convenient side wall and into a convenient outside stack. A power driven air exhauster schematically indicated at 42 serves to evacuate plenum exhaust chamber 6 at a predetermined fixed rate and serves only one individual hood and discharges through an independent outside stack in order to maintain the predetermined exhaust rate. This also eliminates danger, during fan shut down, of explosive fumes from one hood being ignited by flames in another

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hood on a common exhaust system. As indicated in Fig. 2 the exhauster 42 is located outside the building to insure a negative pressure on all ducts that may contain dangerous fumes.

Of the total predetermined volume of exhaust withdrawn from chamber 6, part thereof will be taken from the open top of rear channel 43 behind the wall 22 and the remainder will be withdrawn through the main exhaust grilles 31 and 32 in the top of the working zone. This affords adequate removal of any heavy fumes from the bottom of the cabinet via channel 43 separately from the lighter fumes and vapors that are released in the working zone. The two types of fumes are mixed, if both are present, when they reach the chamber 6 along with a sufficient air dilution to permit safe exhaust to the outside atmosphere.

In order to attain an improved efficiency of fume control that will permit of an unusually low rate of total exhaust, a novel air supply manifold indicated generally at 44 is disposed at the upper front exterior of cabinet 5. Manifold 44 is of a width corresponding to that of the open front of the cabinet and comprises two chambers 45 and 46, the first of which is disposed closely adjacent exhaust plenum chamber 6 at the top, and at the bottom it overhangs the front of cabinet 5 and communicates with the port 25 in the cabinet when sash 29 is lowered as shown in Fig. 2. When the sash 29 is fully raised, as shown schematically in Fig. 4, this chamber 45 is cut off from communication with the cabinet by way of said port 25. The chamber 46 is of predetermined smaller cross sectional area than chamber 45 and is in part in overlapped relation thereto. The upper end of chamber 45 projects above the corresponding end of the chamber 46 and has connected at one side, as clearly indicated in Figs. 1, 2 and 3, a pressure air supply pipe 47 arranged to deliver air by means of a suitable motor driven blower or fan 48 indicated schematically in the drawings. Blower 48 is selected to deliver air at the rate of 50% of the predetermined rate of exhaust from chamber 6. Arcuate pressure air distributors 49 are mounted in vertically and transversely spaced, staggered relation across the upper interior portion of chamber 45 opposite the end of pipe 47.

The chamber 46 has its top end wall 50 connected edgewise to the outer major wall 51 of chamber 45, and a portion of said wall 51, from the top 46 to the level of the top of port 25 in the cabinet, serves as a common wall for said two chambers 45 and 46. Just below its juncture with top wall 50, the common wall 51 has a transverse area with a multiplicity of closely spaced perforations 52 providing in aggregate an opening approximating 48% of the cross sectional area of chamber 46. A perforated air pressure distributor plate 53 extends completely across chamber 46 where said chamber extends forwardly and downwardly to another perforated pressure distributor plate 54, below which the major faces converge to form a wide nozzle 55 that terminates in forwardly spaced relation to the access opening 26 just above the top of said opening (see Fig. 1). A portion 56 of the rear wall of the nozzle 55 is extended rearwardly and connects with the extreme bottom edge of wall 51 to form a canopy between the front of the cabinet and said nozzle. Vertical air foil strips 57 and 58 connect at their tops with the canopy wall 56 and at their bottoms with the member 13 to frame the access opening 26. Behind air foil strips 57 and 58 and extending upwardly alongside the pressure manifold 44 are suitable hollow sheet metal columns 59 which house the counterweight mechanism 60 for the sash 29 and materially aid in rigidifying and stabilizing the mounting of manifold 44.

In use the hood has a predetermined and constant exhaust demand set up by its individual, properly selected exhauster 42. The fan 48 is selected and arranged to deliver pressure air through manifold 44 at a fixed rate which supplies one-half of the aforesaid exhaust demand.

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The remaining one-half of said demand is supplied by air from the laboratory and is a known constant factor. Due to the superior performance of the hood the exhaust demand is much lower than would ordinarily be required for heretofore known hoods of comparable size and equal access opening, hence the apparatus is useful generally in areas where it is desirable to keep the volume of air flowing into the hood at a minimum.

The fact that only one-half of this low total air flow is taken from the room and is moreover a known constant factor affords a further advantage when the apparatus is used in an air conditioned area and the room air lost through it thus becomes a known and small factor of considerable importance in maintaining proper control of air conditioning apparatus that serves the area and affords a considerable saving in the cost of conditioned air exhausted through the hood.

In the following description of the operation of the hood it may be understood, by way of example and not of limitation, that the hood is operated in an air conditioned room while the pressure air may be non-conditioned or partly conditioned air derived from any acceptable source.

In operating the hood with the sash fully raised, as shown in Fig. 1 and as shown schematically in Fig. 4, the total exhaust through plenum chamber 6 is taken, partly through the open top of channel 43, and the remainder through exhaust grilles 31—32 at the top of the working zone. The restricted inlet slot 19 and the lower end of channel 43 assures ample velocity flow of air rearwardly across the entire surface of work table 7 for effectively removing any and all heavy fumes. The uncontrolled hollow air foil channel 13 supplies some room air to this velocity flow and additional mixed room air and non-conditioned air, entering the access opening 26 immediately above member 13, sweeps across table 7 and into slot 19. The heavy fumes with adequate air dilution are thus separately removed. The light fumes and vapors are also separately carried to the top of the working zone in a smooth, non-turbulent flow pattern produced by a uniform velocity wall of air, developed exteriorly in front of access opening 26 and entered at uniform velocity toward and through opening 26 into the working zone in the hood where it entrains all light fume products and falls into a rearwardly and upwardly flow course sweeping along and parallel to the face of rear wall 22 and forwardly through exhaust grilles 31 and 32. The wall of air is developed and maintained by a downward curtain of pressure air from nozzle 55 which entrains some of the conditioned room air as it travels and is influenced to move bodily rearwardly in a non-turbulent manner between air foil strips 16, 57 and 58, through opening 26 as a wall with uniform face velocity at all points across the width and height of opening 26 and assumes the aforementioned directional flow in the working zone. The air curtain from nozzle 55 is not affected by cross drafts in the laboratory nor by the proximity of air conditioning grilles nearby. The presence of a person standing in front of the opening 26 has no adverse effect on the air curtain and the uniform velocity wall and they are not objectionable to such person. As indicated by the full line arrows in Fig. 4 the pressure air flows from the upper portion of chamber 45 through the perforations 52 into chamber 46 of the manifold and through the perforated pressure distributor plates 53 and 54 and leaves nozzle 55 as a uniform pressure curtain. The fully raised sash 29 during this action closes off any pressure flow from the bottom of chamber 45 through port 25.

When the sash 29 is fully lowered as shown in Fig. 2 the access opening is closed and the port 25 is fully open so that the flow of pressure air is to the bottom of chamber 45 and through port 25 against fixed baffle 23 which deflects the air as a descending curtain downwardly over the inside face of sash 29. A small amount

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of room air is induced to flow in a reverse direction into nozzle 55 through chamber 46 and through perforations 52 in the common wall 51 and is entrained with the velocity flow of the pressure air as it sweeps along said wall in chamber 45. Conditioned room air continues to enter at a now faster rate through the uncontrolled channel 17 for discharge through slot 18 across the work table and into the exhaust slot 19 to effectively remove heavy vapors and also aids in setting up substantially the same flow pattern of air in the working zone as took place when the sash was in raised position as previously described for effectively controlling all light fumes and vapors. The balance between the supplies of pressure air and room air remains unchanged and the efficient use thereof in a substantially unchanging directional flow pattern in the working zone under all conditions and without need for the adjustment of any baffles dampers or fan motor regulation, affords the chemist a previously unattained convenience and freedom from collateral duties and responsibilities in the pursuit of his work in the hood. The incidental added advantages and conveniences provided by the grouped external controls for the utilities 35 and 36, as well as his ability to observe the interior of the hood from the front and one side with complete and improved natural and artificial illumination will be readily appreciated.

What is claimed is:

1. In a fume hood the combination of a cabinet having bottom, rear and side walls and an open top and an open front, an imperforate divider positioned laterally across the full width of the cabinet and extending upwardly and forwardly to the mid-portion of the open top of the cabinet and having its bottom edge in closely spaced parallelism above the bottom wall and forwardly of the rear wall of the cabinet, a power driven exhauster means evacuating the open top of the cabinet at a fixed rate from both sides of the divider, an air foil member providing a narrow, room air entry port across the bottom of the open front of the cabinet on a level with the bottom wall, a strip extending across the upper end of said open front and defining the top of an access opening for the cabinet, an inwardly and downwardly inclined baffle spaced behind said strip and forming with the strip a pressure air inlet port across the front of the cabinet above and inside the access opening, a pressure air manifold comprising a first chamber and a second chamber having a common wall therebetween and each chamber being laterally coextensive with the open front of the cabinet, the first chamber mounted on the exterior front and top of the cabinet and communicating at its lower end with said pressure air inlet port for delivering pressure air from the first chamber downwardly across the inner side of the access opening, said first chamber having across its opposite upper end an air inlet and a pressure distributing and equalizer means, a foraminated zone formed through the common wall of the chambers and located therein below the pressure distributing and equalizer means in the first chamber and communicating with the interior of the upper end of the second chamber, a power driven means for delivering pressure air to said inlet at a fixed rate of substantially one-half the rate of evacuation of the aforesaid exhauster and for moving said air through the pressure distributing means and across the foraminated zone in said common wall, the second chamber having its lower end depending below the pressure air inlet port and terminating in a narrow, transverse nozzle located above the level of the top of the said access opening and spaced forwardly therefrom, and a sash adapted in its fully lowered position to close said access opening and movable upwardly into and across the lower portion of the first chamber, said sash in its fully raised position closing off communication between the upper end of the first chamber and the pres-

sure air inlet port and diverting the pressure air flow through the foraminated zone in the common wall into the second chamber for delivery through the nozzle as an air curtain for setting up a uniform velocity air wall movement into the access opening.

2. The combination as set forth in claim 1, characterized by the fact that the exhaustor means includes a plenum exhaust chamber mounted on top of the cabinet and having an open bottom coextensive with the open top of the cabinet.

3. The combination as set forth in claim 1, characterized by the fact that an exhaust grille means extends between and is connected to the top edge of the divider and the bottom edge of the fixed inclined baffle for inducing a transversely uniform flow of air in a non-turbulent pattern forwardly of the divider regardless of the position of the sash.

4. The combination as set forth in claim 1, characterized by the fact that the air foil member has upright air foil strips extending from its opposite ends along opposite side edges of the access opening for preventing edge turbulence of the uniform velocity air wall as it enters the access opening when the sash is in fully raised position.

5. The combination as set forth in claim 1, characterized by the fact that said second chamber of the air manifold contains pressure equalizer means intermediate its discharge nozzle and the foraminated zone in the common wall and that, in the fully lowered position of the sash, room air of a volume equal to that of the pressure air supply enters the cabinet in part through said air foil member and in part as an induced reverse flow, into the nozzle of the second chamber and through the foraminated zone in the common wall and into the first chamber, created by the pressure air flow along said common wall portion in said first chamber.

6. In a fume hood the combination of a cabinet having a bottom, an open front and an open top, a fixed imperforate divider extending upwardly from closely spaced relation to the rear bottom interior of the cabinet forwardly and upwardly to substantially bisect the open top of the cabinet, a plenum chamber having an open bottom in common with the open top of the cabinet, an exhaustor of known constant capacity for said chamber serving to evacuate air from opposite sides of the divider, an air foil member providing a narrow, room air entry port across the bottom portion of the open front of the cabinet, a strip extending across the upper end of said open front and defining with the air foil member an access opening for the cabinet, a deflector baffle fixed across the rear of said strip and spaced therefrom to define a pressure air inlet port for delivery of pressure air into said cabinet, exhaust grille means extending angularly upwardly and rearwardly from the bottom edge of said baffle to the top edge of the divider, a sash to close the access opening and vertically shiftable to an opposite limit to close the inlet port and open the access opening and vice versa, an exteriorly mounted pressure air manifold having laterally coextensive and adjacently positioned upright chambers with a common intermediate wall portion therebetween having a foraminated area, the first chamber being of greater cross sectional area than the second and having adjacent the bottom an opening registering with the pressure air port, the second chamber having an outwardly offset downwardly discharging nozzle at its bottom located for delivering a curtain of forced air from outside of, and in substantially parallelism with the access opening, and means to deliver pressure air into the side of the first chamber at a level

above said foraminated area and at a fixed rate of one-half the rate of evacuation of the plenum chamber by the exhaustor.

7. In a fume hood the combination of a cabinet having an open front, a power driven exhaustor means for evacuating the cabinet and remove fumes therefrom, a pressure air manifold comprising a first chamber and a second chamber, said first chamber being mounted on the exterior front and top of the cabinet and having its lower end terminating in a pressure air inlet port extending laterally across the upper end portion of the open front for delivery of pressure air into the cabinet, said first chamber having across its opposed upper end an air inlet and a pressure distributing and equalizer means, the second chamber having its lower end depending below the pressure air inlet port and terminating in a narrow transverse nozzle located above the level of the top of the access opening and outwardly therefrom, means establishing communication between the interior of the second chamber and that part of the first chamber subjacent the pressure distributor and equalizer means, and a sash adapted in its fully lowered position to close said access opening and vertically movable upwardly into and across the lower portion of the first chamber, said sash in its fully raised position closing off communication between the upper end of the first chamber and the pressure air inlet port thereby diverting the pressure air flow from said first chamber to the second chamber for delivery through the nozzle as an air curtain for setting up an air wall movement into the access opening.

8. In a fume hood the combination of a cabinet having an open front, a power driven exhaustor means for evacuating the cabinet and remove fumes therefrom at a fixed rate, an air foil member providing a narrow, room air entry port across the bottom of the open front of the cabinet, a pressure air manifold comprising a first chamber and a second chamber, said first chamber being mounted on the exterior front and top of the cabinet and having its lower end terminating in a pressure air inlet port extending laterally across the upper end portion of the open front for delivery of pressure air into the cabinet, said first chamber having across its opposed upper end an air inlet and a pressure distributing and equalizer means, a power driven means for delivering pressure air to said inlet at a fixed rate of substantially one-half the evacuation of the aforesaid exhaustor means, the second chamber having its lower end depending below the pressure air inlet port and terminating in a narrow transverse nozzle located above the level of the top of the access opening and outwardly therefrom, means establishing communication between the interior of the second chamber and that part of the first chamber subjacent the pressure distributor and equalizer means, and a sash adapted in its fully lowered position to close said access opening and vertically movable upwardly into and across the lower portion of the first chamber, said sash in its fully raised position closing off communication between the upper end of the first chamber and the pressure air inlet port thereby diverting the pressure air flow from said first chamber to the second chamber for delivery through the nozzle as an air curtain for setting up an air wall movement into the access opening.

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