March 29, 1955 V. L. HAYES, JR., ET AL 2,704,973

VENTILATING SYSTEM

Filed May 22, 1950

2 Sheets-Sheet 1

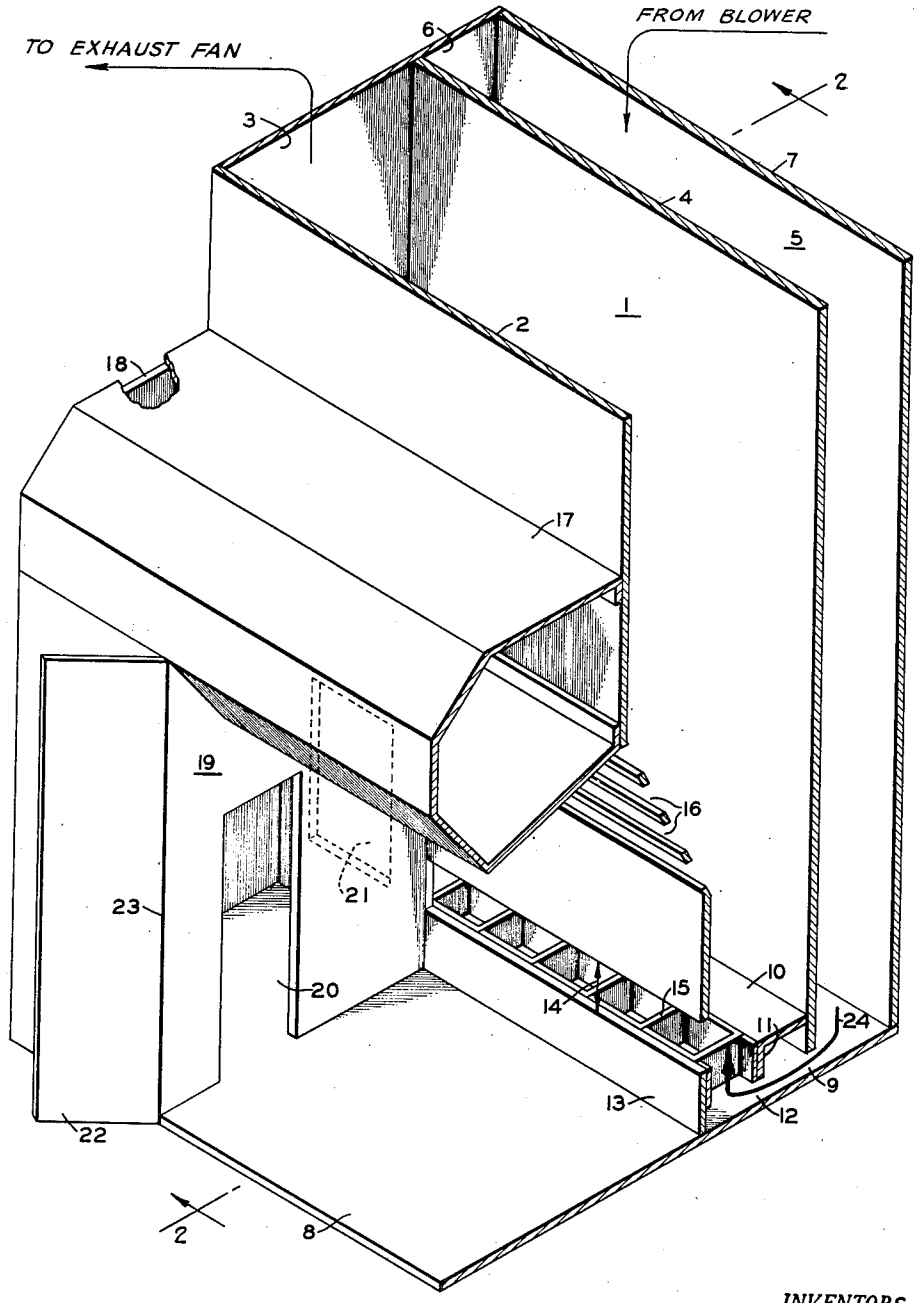


FIG. 1

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Filed May 22, 1950 2 Sheets-Sheet 2

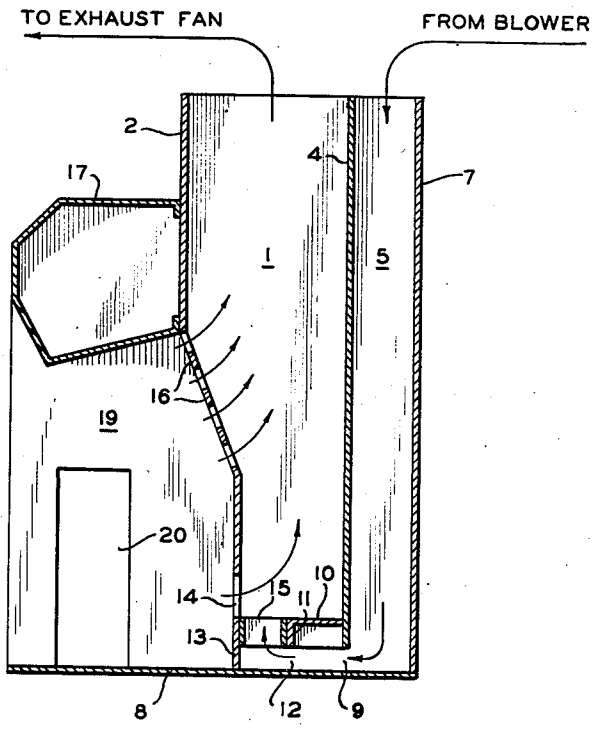


FIG. 2

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2,704,973

VENTILATING SYSTEM

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12 Claims. (Cl. 98—115)

This invention relates to a ventilating system. In one of its aspects, it relates to a ventilated fume hood. In another of its aspects, it relates to a means for ventilating a fume hood to thereby especially adapt it to be employed in an air conditioned space.

Fume hoods are employed to remove inflammable, noxious, toxic and other fumes, gases or vapors from a desired area. Ordinarily, such hoods are comprised of a hood-like enclosure, which may have a means for substantially enclosing the same, and an exhaust system such as a fan adapted to draw air from the surrounding area to thereby sweep any fumes or such from the hood. Fume hoods find particular usage in laboratories where personnel are employing various chemicals which yield toxic or noxious vapors dangerous or irritative to such personnel.

Conventionally designed fume hoods have several disadvantages. For example, in recent years there has been a widespread trend toward air conditioned buildings and the use of conventional fume hoods in such buildings results in excessive exhaustion of conditioned air from such buildings with the result that the cost of conditioning becomes comparatively high. Thus, conventional hoods employ a minimum face velocity, i. e. the velocity of the air entering the hood to purge the undesired gases therefrom, of 100 feet per minute and it is obvious that with such high face velocities, much conditioned air will be wasted in purging the fume hood.

Further, conventional hoods are subject to cross drafts induced by the air conditioning system or by passers-by. These cross drafts cause a rotational turbulence at the vertical side walls of the hood with the result that the rotating mass of air moves outwardly toward the cross draft until it merges therewith and contaminates the air of the surrounding area. This action persists even at high face velocities such as 250 feet per minute.

As stated, conventional hoods usually have a minimum face velocity of 100 feet per minute. On the other hand, extremely high face velocities, such as 250 feet per minute, create excessive turbulence in the hood and result in a negative or back flow at the hood face, particularly at the edges thereof where the vena contracta has been enlarged by the increased velocity of flow. In order to establish uniform flow through the hood and to avoid wasting of conditioned air, it is usually necessary to limit the area of the hood opening which also limits ease of access to the hood.

Also, conventional hoods, particularly those employing rather high face velocities, force the operator to stand back from the hood a considerable distance to avoid having fumes blown into his face. The flow of entrance air around the operator's body creates a low pressure area at his front into which contaminated air from the hood will pass, resulting in an actual clinging of contaminated air to his body and face.

It has now been found that a fume hood can be provided which will ordinarily employ a low face velocity and which will not be subject to cross drafts. The face velocity of the hood of this invention will ordinarily be only about one-half that of a conventional hood. According to this invention, the hood of the fume hood is provided not only with an air exhaust means but also with a pressurized plenum chamber from which air flows through a draft inducing means placed at the rear of the hood. The air flowing from the pressurized plenum chamber through the draft inducing means causes contaminated air to flow from the hood into the exhaust system thereby exhausting contaminated air from the hood. The exhaust system also acts to exhaust contaminated air from the hood. Thus, the contaminated air from the hood is exhausted partly by the exhaust system and partly by the draft inducing plenum chamber system. As a result, only a portion of the air necessary to purge the hood is drawn from the room surrounding the hood and conditioned air is not wasted. Further, the low face velocity employed with the fume hood of this invention prevents fumes from billing into the face of a nearby operator.

It has also been found that the cross draft induced rotating masses of air which tend to creep along the side walls of a fume hood to contaminate the air of a surrounding room can be eliminated by providing means along the side walls of a fume hood which will induce a draft in such a manner as to remove such rotating masses of air from the hood into the exhaust system. Such means can comprise a double-walled side wall having an opening in the inner wall through which air is drawn by an induced draft created by the pressurized plenum chamber system and exhaust system as explained above.

An object of this invention is to provide an improved fume hood.

Another object of this invention is to provide a fume hood especially adapted to be employed in an air conditioned space without removing excessive amounts of conditioned air from said space to purge the said hood.

Still another object of this invention is to provide a fume hood having in combination an exhaust system and a pressurized plenum chamber system whereby only a portion of the air necessary to purge the hood is drawn from the area in which it is situated and whereby an operator can work in close proximity to the hood without having contaminated air billow into his face.

Yet another object of this invention is to provide a fume hood having a side wall draft inducing means adapted to prevent escape of contaminated air from said hood when it is exposed to cross drafts.

Still yet another object of this invention is to provide a fume hood having an exhaust system and a draft inducing system adapted to purge said hood of contaminated air while withdrawing a minimum amount of air from the room surrounding said fume hood and while also preventing escape of contaminated air from said hood into said room.

Numerous other objects and advantages will be apparent to one skilled in the art upon reading the specification in conjunction with the annexed drawing wherein there is illustrated a preferred embodiment of a fume hood constructed according to the concept of this invention. Figure 1 is an isometric view of a fume hood with the right hand portion of the hood removed to better show the construction of the hood. It is to be understood that the remainder of the hood (not shown) will be a duplication and is symmetrical with that portion shown. Figure 2 is a cross-sectional view of the hood, taken on the line 2—2 of Figure 1.

In the drawings, an exhaust duct **1** having walls **2**, **3** and **4** can be situated at the immediate rear of the fume hood. An exhausting means, such as a fan (not shown) is situated at a suitable point and is adapted to suck contaminated air from duct **1** and discharge it into the atmosphere where it will do no harm. A plenum chamber **5** enclosed by walls **4**, **6** and **7** can extend down the rear of the fume hood to the bottom thereof. The plenum chamber is adapted to contain air under pressure, say from 0.05 to 10 inches of water, drawn from the surrounding atmosphere by a fan or blower (not shown) and discharged into said chamber under pressure. Wall **4** extends down the rear of the hood as shown but terminates before reaching the floor **8** of the hood to leave a space **9** between wall **4** and floor **8**. Extending from wall **4** is a sealing baffle **10** having a lip **11** extending downwardly therefrom but allowing a space **12** to exist between it and floor **8**. The rear of the fume hood working area is formed by a wall **13** which is common to the hood and duct **1** and which extends from floor **8** upwardly to join wall **2** of duct **1**. An opening which is preferably a horizontal slot **14** is provided in the lower

portion of wall 13 adjacent to an air directing means 15 which can comprise a grill work (as shown) adapted to direct air flowing therethrough upwardly along the inside of wall 13 in duct 1. Wall 13 can be bent inwardly near its upper end and an opening, preferably a plurality of slots 16 are provided therein to connect the working area of the fume hood with duct 1. An apron 17 is provided to extend over the working area of the fume hood from wall 2 of duct 1 and to join side walls 18 of the fume hood. An inner wall 19 having an opening such as vertical slot 20 therein is provided adjacent to outer wall 18 as shown. Slot 20 is preferably situated near the front portion of the inner wall. A second opening or slot 21 is provided in wall 13 to the rear of the compartment formed by outer wall 18 and inner wall 19. A flange 22 pivotable about edge 23 can be hung at each side of the fume hood as shown.

In operation, air in duct 1 is exhausted therefrom by a suitable means such as a fan or blower (not shown). Plenum chamber 5 is maintained under a suitable air pressure by a similar means also not shown. Air from plenum chamber 5 flows under the lower end of wall 4 and lip 11 in the direction shown by arrow 24 to pass upwardly through grill 15 along the inner side of wall 13 and thence into duct 1. As a result, the air flowing from grill 15 induces air to be drawn from the working area of the hood through slot 14 into duct 1. Additional air is caused to be withdrawn from the working area of the hood through slots 16 in wall 13 thereby properly ventilating the upper portion of such area.

In drawing contaminated air through slot 14, the air flowing upwardly from grill 15 will cause the lower portion of the working area of the fume hood to be properly purged. It has been found that proper purging of the working area of the fume hood can be obtained with an average face velocity of only about 50 feet per minute of air being drawn into the hood through the front opening thereof. In the absence of pressurized plenum chamber 5 and grill 15, the face velocity must be at least 100 feet per minute and, even then, the purging action is not as complete and efficient as that accomplished by the pressurized plenum chamber system.

Air passing downwardly through plenum chamber 5 in the direction of arrow 24 also induces a draft through slot 21 which in turn draws air through slot 20 from the immediate area of the hood around inner walls 19. In this manner, any rotating masses of contaminated air in the fume hood as induced by cross drafts will be drawn through slot 20 into duct 1. Accordingly, such masses of contaminated air cannot mingle with a cross draft to contaminate the air of the room surrounding the fume hood. Further, flanges 22, one at each end of the opening into the working area of the fume hood, help to prevent the cross drafts from sucking contaminated air from the fume hood. Preferably, such flanges will be located perpendicularly to the opening into the fume hood for bench models thereof and parallel to such opening for floor models thereof although the exact position will depend somewhat upon the direction of flow of the cross drafts.

It has been demonstrated that when a fume hood constructed in accordance with this invention is employed, the exhaustion of conditioned air from a surrounding room will be less than 50 percent of that of a conventional fume hood not employing the draft inducing plenum chamber. Also, it has been shown that the fume hood of this invention will not permit contaminated air from the hood to billow into the face of a worker even though he be standing immediately in front of it.

Although a particular type of grill 15 has been illustrated, it is to be understood that any type of means adapted to direct the flow of air from plenum chamber 5 upwardly along the inner face of wall 13 into duct 1 can be employed. Further, plenum chamber 5 need not necessarily be located adjacent and parallel to exhaust duct 1 although usually that is the most convenient location. It has been found, however, that plenum chamber 5 should have a width quite small with respect to its depth in order to achieve proper velocity of air upwardly through grill 15. For hoods of ordinary laboratory size, a plenum chamber width within the range of 1 to 5, preferably from 2 to 4, inches is satisfactory.

While the invention has been described in connection with a present, preferred embodiment thereof, it is to be understood that this description is illustrative only and is not intended to limit the invention, the scope of which is defined by the appended claims.

We claim:

1. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct having a common wall and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber having a small width relative to its depth and located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under positive air pressure, said rear wall of said hood having a horizontal slot near its lower end and having a plurality of horizontal slots near its upper end all opening into said duct, a grill situated in said duct immediately beneath said lower slot in said rear wall and adapted to direct a flow of air upwardly in said duct across said slots in said rear wall of said hood, said plenum chamber having a passageway therefrom to said grill whereby said air under pressure in said plenum chamber can flow upwardly through said grill and through said exhaust duct across said slots to draw contaminated air from said hood, an inner wall parallel to a side wall of said hood, a front wall connecting said inner wall and said side wall, said inner wall having a slot therein near the front of said hood and the portion of said rear wall between said side wall and said inner wall also having a slot therein whereby contaminated air tending to escape from said fume hood along a side wall thereof will be withdrawn through said slot in said inner wall by a draft induced by air discharged from said plenum chamber through said grill across said slot in said rear wall between said inner and side walls.

2. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct situated at and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under air pressure, said rear wall of said hood having a slot near its lower end and having a plurality of slots near its upper end all opening into said duct, a grill situated in said duct immediately beneath said lower slot in said rear wall and adapted to direct a flow of air upwardly in said duct across said slots in said rear wall of said hood, said plenum chamber having a passageway therefrom to said grill whereby said air under pressure in said plenum chamber can flow upwardly through said grill and through said exhaust duct across said slots to draw contaminated air from said hood.

3. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct situated at and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under air pressure, an inner wall parallel to a side wall of said hood, a front wall connecting said inner wall and said side wall, said inner wall having a slot therein and the portion of the rear wall of said hood between said side wall and said inner wall also having a slot therein, a grill having upwardly directed partitions situated in said duct beneath said slot in said rear wall adapted to direct a flow of air upwardly in said duct across said slot in said rear wall, said plenum chamber having a passageway therefrom to beneath said grill whereby said air under pressure in said plenum chamber can flow upwardly through said grill and through said exhaust duct across said slot in said rear wall to draw contaminated air from said hood through the slot in said inner wall, whereby contaminated air tending to escape from said fume hood along the side walls thereof will be withdrawn through said slot in said inner wall by a draft induced by air discharged from said plenum chamber through said grill across said slot in said rear wall between said inner and side walls.

4. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct situated at and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under air pressure, the rear wall of said hood having an opening therein connecting

said hood to said duct, means for directing air into said duct across said opening in said rear wall, said plenum chamber having a passageway therefrom to beneath said air directing means whereby air under pressure in said plenum chamber can flow through last said means and through said exhaust duct across said opening to draw contaminated air from said hood, an inner wall in said hood, a front wall connecting said inner wall to a side wall of said hood, said inner wall having an opening therein, and the portion of said rear wall between said inner wall and said hood also having an opening therein whereby contaminated air tending to escape from said fume hood along the side wall thereof will be withdrawn through said opening in said inner wall by a draft induced by air discharged from said plenum chamber through said air directing means across said opening in said rear wall.

5. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust means situated at and coextensive with the rear wall of said hood, a plenum chamber adjacent to said exhaust means, means for maintaining said plenum chamber under air pressure, the rear wall of said hood having an opening therein into said exhaust means, means for directing air into said exhaust means across said opening, said plenum chamber being connected to said air directing means, an inner wall in said hood, a front wall connecting said inner wall to a side wall of said hood, said inner wall having an opening therein and the compartment formed by said inner wall, said front wall, said side wall and said rear wall having an opening into said exhaust means, whereby contaminated air tending to escape from said hood along a wall thereof will be withdrawn through said opening in said inner wall by a draft induced by air discharged from said plenum chamber through said air directing means and across said opening in said compartment.

6. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an air exhausting means having a common wall with said hood, said common wall having an opening therein connecting said hood to said exhausting means, means for discharging air from an external source into said exhausting means, an inner wall in said hood, a front wall connecting said inner wall to a side wall of said hood, said inner wall having an opening therein and the compartment formed by said inner wall, said front wall, said side wall and said common wall having an opening into said exhausting means, and means for directing the flow of air discharged into said exhausting means across said openings in said common wall whereby contaminated air is purged from said hood at least in part by a draft induced by said air flowing across said openings.

7. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct having a common wall and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber having a small width relative to its depth and located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under positive air pressure, said rear wall of said hood having a horizontal slot near its lower end and having a plurality of horizontal slots near its upper end all opening into said duct, a grill situated in said duct immediately beneath said lower slot in said rear wall and adapted to direct a flow of air upwardly in said duct across said slots in said rear wall of said hood, said plenum chamber having a passageway therefrom to said grill whereby said air under pressure in said plenum chamber can flow upwardly through said grill and through said exhaust duct across said slots to draw contaminated air from said hood, an inner wall parallel to a side wall of said hood, a frontal wall connecting said inner wall and said side wall, said inner wall having a slot therein near the front of said hood, the portion of said rear wall between said side wall and said inner wall also having a slot therein whereby contaminated air tending to escape from said fume hood along a side wall thereof will be withdrawn through said slot in said inner wall by a draft induced by air discharged from said plenum chamber through said grill across said slot in said rear wall between said inner and side walls and a flange pivotally mounted at the side of said frontal opening of said hood.

8. A fume hood which comprises, in combination, a hood having a frontal opening, a top, side walls and a rear wall, an exhaust duct situated at and coextensive with the rear wall of said hood, means for exhausting air from said duct, a plenum chamber located adjacent to and coextensive with said duct, means for maintaining said plenum chamber under air pressure, the rear wall of said hood having an opening therein connecting said hood to said duct, means for directing air into said duct across said opening in said rear wall, said plenum chamber having a passageway therefrom to beneath said air directing means whereby air under pressure in said plenum chamber can flow through last said means and through said exhaust duct across said opening to draw contaminated air from said hood, an inner wall in said hood, a front wall connecting said inner wall to a side wall of said hood, said inner wall having an opening therein, the portion of said rear wall between said inner wall and said side wall also having an opening therein whereby contaminated air tending to escape from said fume hood along the side wall thereof will be withdrawn through said opening in said inner wall by a draft induced by air discharged from said plenum chamber through said air directing means across said opening in said rear wall, and a flange mounted at the side of the frontal opening into said hood.

9. A fume hood according to claim 1 characterized by the further fact that said inner wall has a flange connected to and pivotable about its outer edge.

10. A fume hood according to claim 3 characterized by the further fact that said inner wall has a flange connected to and pivotable about its outer edge.

11. A fume hood according to claim 6 characterized by the further fact that said inner wall has a flange connected to and pivotable about its outer edge.

12. A fume hood which comprises, in combination, a hood having a frontal opening, side walls and a rear wall, an exhaust means having a common wall with said hood, said common wall having an opening therein connecting said hood to said exhaust means, a plenum chamber located adjacent and coextensive with said exhaust means, means for maintaining said plenum chamber under air pressure, and means for directing air into said exhaust means across said opening, said plenum chamber being connected to said air directing means, whereby said air from said plenum chamber can flow through said air directing means and through said exhaust means across said opening to draw contaminated air from said hood.

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