May 9, 1967 A. K. BAKER 3,318,076

DUST-FREE BENCH

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FIG. 1

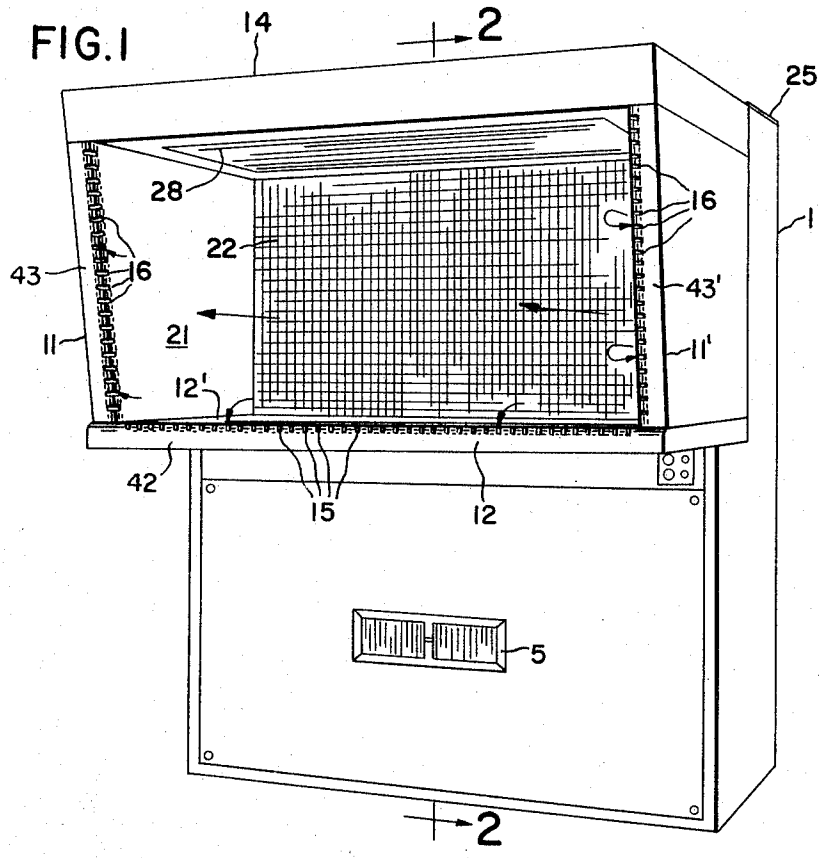
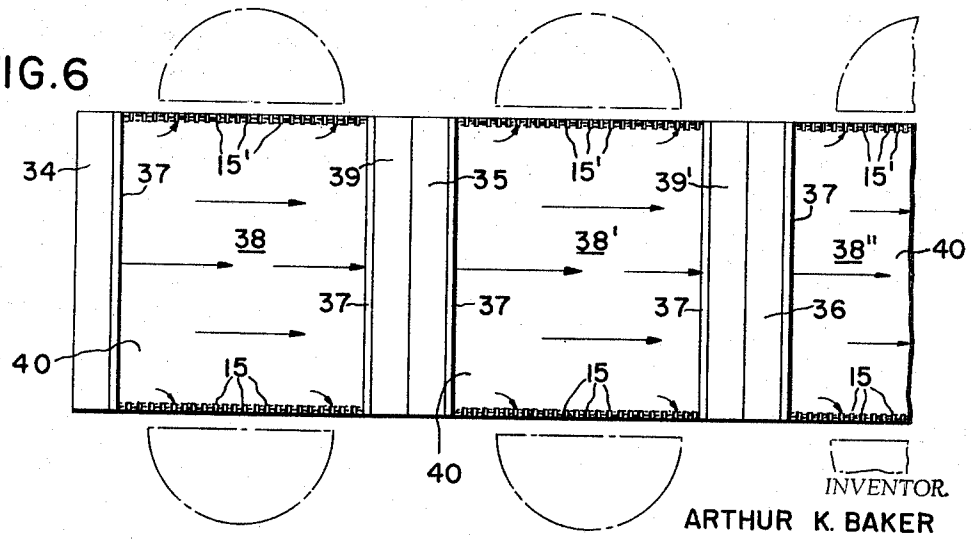


FIG. 6



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FIG.2

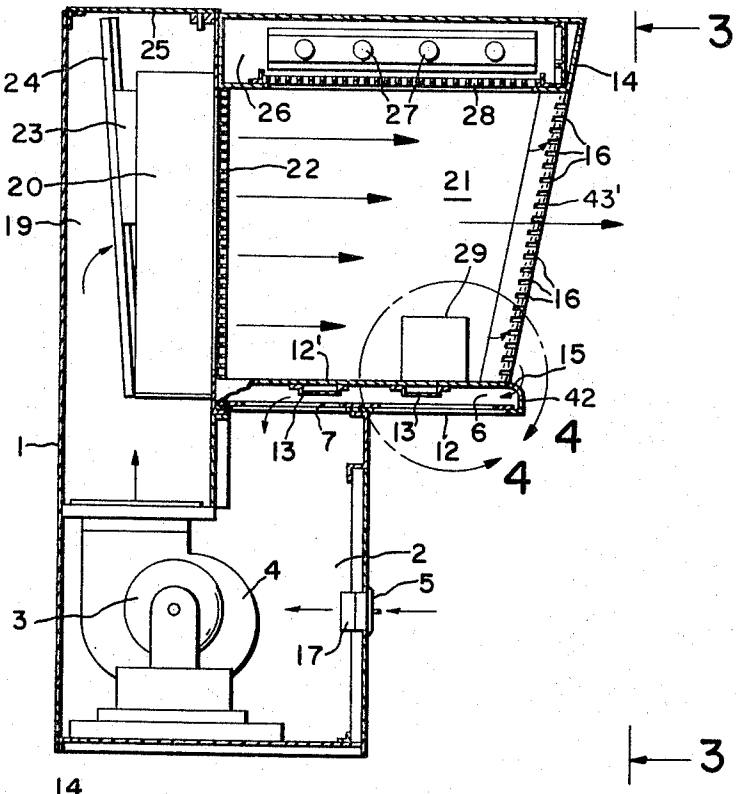
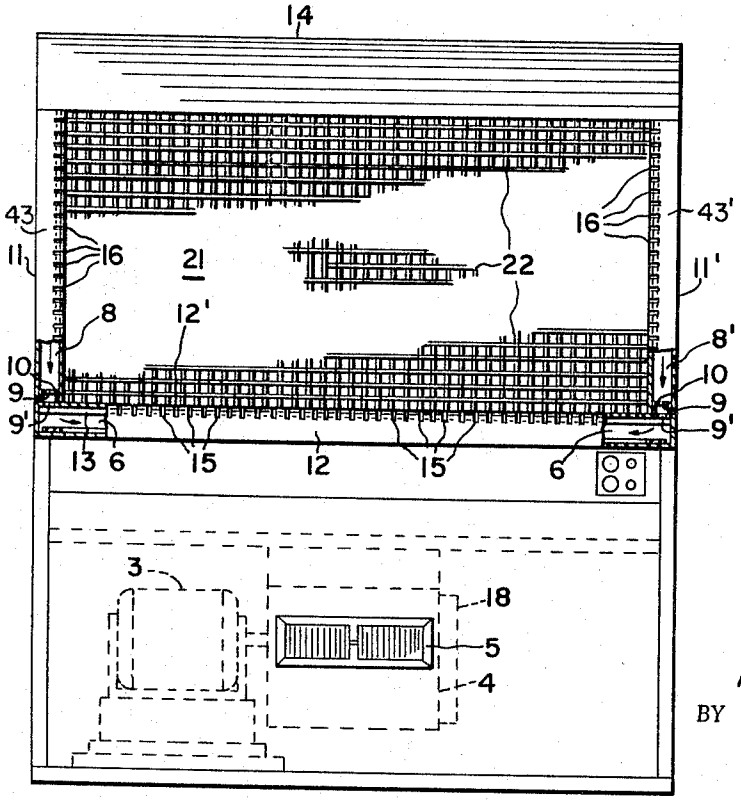


FIG.3



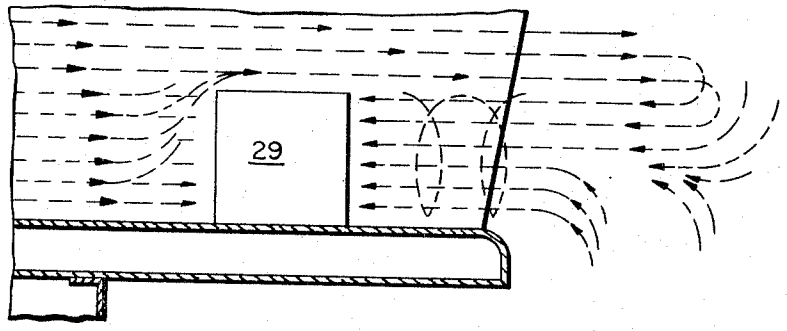
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FIG. 4A



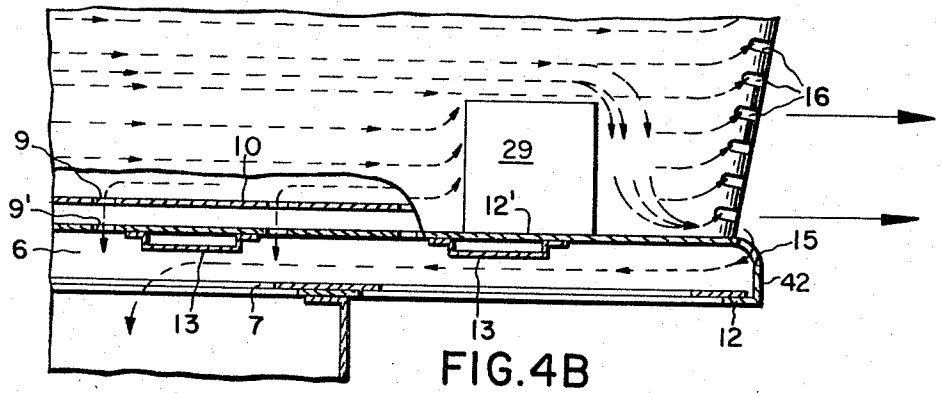


FIG. 4B

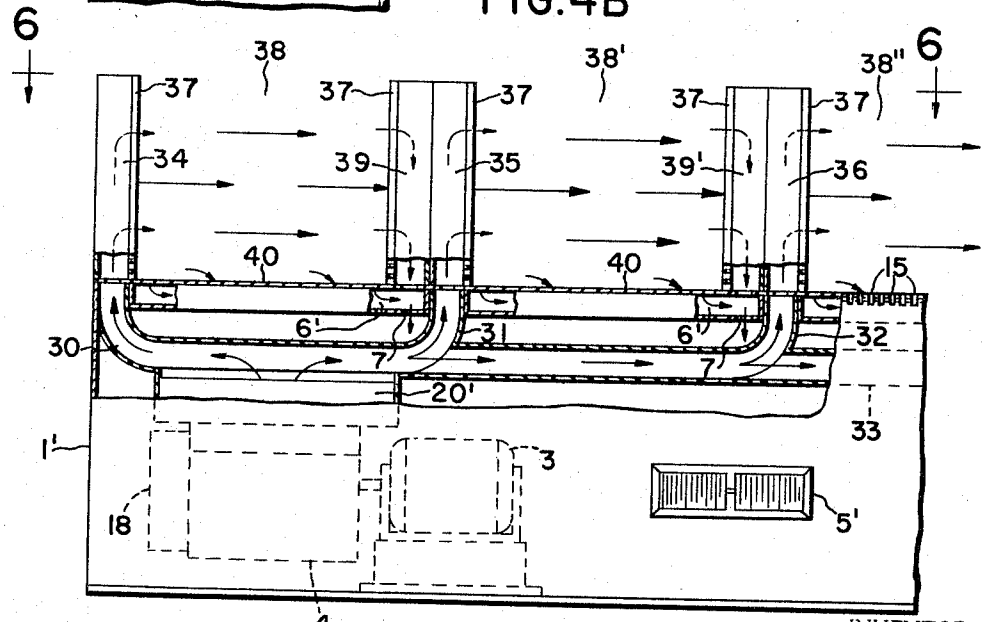


FIG. 5

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DUST-FREE BENCH

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4 Claims. (Cl. 55—350)

This invention relates generally to dust-free benches and has reference more particularly to a bench of this character having novel means for maintaining a dust-free upper working surface and a dust-free working space thereabove.

Duse-free benches as heretofore constructed generally provide for the movement of air substantially over the upper surface of the bench flowing as from the back thereof or from above, but such prior type benches do not prevent the lodging of dust on the bench surface, nor do they prevent dust from entering the open front of the bench, due to back flow of air currents produced by various causes such as eddy currents and backwash produced as by work lying upon the bench obstructing the normal flow of air, or by the worker, himself.

The principal object of the present invention is to provide a novel dust-free bench that is so constructed and arranged as to direct highly filtered air over the bench surface in smooth laminar or uniform flow, thereby maintaining a zone of dust-free air over the surface of the bench and throughout the working space above the same, the free edge or edges of the bench and the edges of the hood or dividing partitions adjacent to the bench working area having apertures, means being provided for drawing air inwardly through said apertures, whereby turbulent air due, for example to irregular flow over objects on the bench or the worker's movements and the eddy currents or backwash currents produced thereby are sucked in through the openings at the front of the bench and along the side edges of the hood or dividing partitions, thereby preventing external dust-laden air from entering the bench working area and depositing dirt thereon.

A feature of the present invention is to provide a novel, dust-free bench of the above character wherein an exceptionally clean environment over the bench and within the working space results in the recirculation of some of the same air over and over through the system, i.e., most of the air flowing only over the bench instead of flowing on into the room and becoming contaminated, being drawn back into the filter system of the bench through the openings in the hood or dividing partitions and in the bench top.

Another feature of the present invention is to provide a dust-free bench of the above character that eliminates operator discomfort, since most of the air flowing over the bench is sucked back into the bench interior and is not felt by the operator, the novel circulating method of the present invention enabling the use of a fully open front hood, for example, and hence easy access to the interior thereof without any danger of contamination, the hood top when used preferably overlying the forward edge of the bench to prevent dust or other particles from falling on the bench from above.

Still another feature of the present invention is to provide a novel bench of the above character wherein the velocity of the air passing outwardly of the hood toward the operator can be kept relatively low so as to eliminate operator discomfort while higher velocities exist over the bench working surface and still higher velocities are present in the air being drawn into the hood or dividing partition side edges and or into the bench free edge.

These and other features and advantages of the present invention will be more apparent after a perusal of the following specification taken in connection with the accompanying drawings, wherein:

FIG. 1 is a perspective view of one form of the novel dust-free bench of the present invention with arrows indicating the flow of the air over the bench within the hood and into the openings at the bench front and hood side edges;

FIG. 2 is a side view with parts broken away of the bench of FIG. 1 and also shows circulation of air throughout the bench and hood structure in use;

FIG. 3 is a front view taken of the bench of FIG. 2 with parts broken away;

FIG. 4A is a fragmentary schematic view illustrating the formation of eddy currents and the drawing of dust onto the bench top where the suction slots are not provided in the bench top and in the hood sides;

FIG. 4B is a view similar to FIG. 4A illustrating the air circulation when using the slots of this invention;

FIG. 5 shows a plurality of benches arranged in tandem for a plurality of workers; and

FIG. 6 is a plan view of the structures of FIG. 5.

Similar characters of reference are used in the above figures to designate corresponding parts.

Referring now to the drawings, the reference numeral **1** designates a bench housing or casing providing an interior lower chamber **2** having a motor **3** therewithin positioned for driving a blower **4** that sucks a controllable amount of external air in through an adjustable area grid or grille **5**, as of the type used in wood-burning or coal-burning stoves or in forced-air heating systems and well known to those skilled in the art, said grid being located at the front of the housing and also sucks air from a bench plenum chamber or duct **6** within a hollow horizontal bench **12** through openings **7** in the bench bottom wall communicating with the interior of housing lower chamber **2**. The bench is shown as having a hood **14** provided with side partitions or walls **11** and **11'** that are also hollow providing therewithin side wall plenum chambers or ducts **8** and **8'** provided with lower apertures **9** provided in inverted channel stiffening members **10** provided at the interior lower edges of the hollow hood side walls **11** and **11'**. The hollow bench **12** has spaced top and bottom walls providing the plenum chamber or duct **6** therebetween and is shown having its upper working surface **12'** interiorly reinforced by reinforcing members **13**.

The forward edge portion **42** of the hollow bench **12** and the forward edge portions **43**, **43'** of the hollow side walls **11** and **11'** are vented contiguous to the interior working area of the bench by being provided with a series of mutually spaced slots arranged in rows and designated **15** in the bench forward free edge and **16** in the partitions or hood sides **11** and **11'** so that air drawn in by the blower **4** not only passes in through grid **5** in controlled amounts depending upon the adjustment of this grid, but also flows in through the slots **16** at the inner sides of the partitions **11** and **11'** and through the hood plenum chambers **8** and **8'**, through apertures **9** and corresponding aperture **9'** in the upper surface **12'** of the bench, and into the bench plenum chamber or duct **6** and from thence to openings **7** into the lower chamber **2**. Likewise, air will flow in through slots **15** of the bench top through the plenum chamber **6**, through apertures **7**, and to the blower **4**. This air is then driven by the blower **4** through the bench circulatory system as will further appear.

The adjustable area grid **5** is shown provided with a primary or coarse filter **17**, and a similar filter is shown provided at **18** at the intake of the blower **4**. Actually, the coarse filter **17** may be eliminated, if desired. The blower **4** forces the air upward into the rear hood plenum chamber or duct **19** provided within casing **1**, whence this air flows through a fine or positive filter **20** that may be

a mechanical filter having a fine screen composed of cellulose glass material, for example. This filter is of rectangular shape and is made somewhat larger than the hood interior **21** so that there will be a uniform flow of air from the fine filter **20** and through a grille **22** into the interior of the hood chamber **21**, whereby there is no opportunity for eddy currents to be formed around the edges of the filter within the hood which would otherwise take place should the filter have a solid frame portion projecting into the confines of the hood interior **21**.

The multi-apertured grille **22** directs the air from the filter forward and parallel to the side and top interior walls of the hood **14** and also protects the filter **20** against physical damage, the air passing over the surface of the bench **12**, providing a uniform laminar flow of air forwardly through the hood in use.

The filter is removably retained within its position in the plenum chamber **19** by means of wedge members **23** or screws or other means and angle type guides **24** attached to the side interior walls of the casing **1**. When the filter is used up, it can be removed by opening the top hinged section **25**, whereupon the wedges **23** can be removed, allowing the filter to be replaced, the replacement of the wedges serving to hold the new filter in place so as to completely cover the grille **22**. The upper part of the hood **14** over the bench **12** is provided with a lighting chamber **26** containing fluorescent lights **27** which shine through a translucent plate **28** provided at the top of the hood chamber **21**.

All surfaces in the hood chamber are smooth and are arranged for smooth flow of air throughout the interior **21**. As the air moves forward within the chamber **21** it reaches the forward edges of the hood wall partition sides of the bench and a certain amount of this air is sucked into the slots **15** and **16** due to the suction of fan **4**, so that only a portion of the air leaving filter **20** moves forward and out of the hood **14**. The slots **15** and **16**, being subject to interior negative pressure, prevent the formation of any eddy currents at the front of the bench which might tend to draw dirt back onto the bench. For example, the work piece **29**, resting on top of the bench **12**, would ordinarily set up eddy currents due to the flow of air thereover, as illustrated in FIG. 4A, the eddy currents being in front of the work piece, and these currents whirling around would suck in contaminated air from the room surrounding the bench and from the operator's clothing and hands so that dust would be deposited upon the bench and upon the work, which is highly objectionable.

On the other hand, by using the slots **15** and **16**, the eddy currents are eliminated as shown by the circulation of air as indicated in FIG. 4B, for example. Actual tests have shown that where the slots **15** and **16** are not present, definite quantities of dirt will move onto the bench top and onto the work on the bench, but where these slots are used, no such dust can enter, because it will be sucked into the slots **15** and **16**, and thence through the blower to be eliminated from the circulating system.

FIG. 4A shows in detail the formation of eddy currents by a piece of work on the bench where the slots **15** and **16** are not employed, these eddy currents serving to draw in dust and deposit it upon the bench and upon the work. Since a lot of the air blown through the hood is sucked back into the circulating system, a much cleaner environment is provided within the work space than would otherwise be the case, and as a consequence of such recirculation, the life of the filter is greatly prolonged, since dust from the surrounding room is not drawn into the system except that passing through the adjustable grid **5**, the load on both coarse and fine filters is reduced greatly. The apertures **9** are so proportioned that ordinarily air is sucked into apertures **16** at the sides of the hood at a much higher velocity than the air moving forward from filler **20** through the work space. Also, the air moving backwardly through slots **15** at the front of the bench top flows at a higher velocity than the air moving from the filter **20** forwardly over the work space. In a typical instance, air may flow through filter **20** and through work space at a velocity of 100 feet a minute, whereas the velocity intake at the slots **16** at the sides of the hood may be as high as 2000 feet a minute. Since a large portion of the air moving forwardly through the work space is drawn back into the circulating system, the operator feels no uncomfortable draft from the operation of the bench.

Through the use of the vented slots **16** and **15** in the side partition walls **11** and **11'** of the hood and in the front of the bench, it is possible to have a fully open hood, or the hood may be eliminated entirely if desired, enabling easy access to the work on the bench top **12** without interference from any windows or panels. Also, higher velocities of air can be passed through the work space since much of it is withdrawn at the forward edges of the same.

In FIGS. 5 and 6 there is illustrated a continuous bench **40** adapted to provide a number of working spaces for a plurality of workers. In these figures filtered air from fine filter **20'** passes through ducts **30**, **31**, **32**, **33**, etc., to hollow side partition walls **34**, **35**, **36**, etc., and through grilles **37** transversely across the work spaces **38**, **38'**, **38''**, etc. and into plenum chambers **39**, **39'**, etc., from whence the air flows back to blower **4** through coarse filter **18**. A grid **5'** can be set to allow a desired amount of exterior air to enter the circulating system. In these figures the slots **15** are provided in the front edges of the hollow bench and if it is desired to have two workers in each working space slots **15'** are provided in the rear edge of the bench where the second row of workers sit, in which case the bench is made wider to accommodate the extra row of workers. Where only one row of workers is used the back wall of the bench can be closed, if desired, in which case the slots **15'** would not be essential. Slots **15** and **15'** are connected through the hollow bench plenum and apertures **7** to the interior of casing **1'** leading to blower **4**, whereby suction applied to slots **15** and **15'** prevents dust and dirt from moving onto the bench working spaces between the side partition walls **34**, **35**, **36**, etc.

Since many changes could be made in the above construction of the novel dust-free bench of this invention and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above descripion or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A dust-free bench structure comprising a bench housing, a hollow bench having a substantially impervious and horizontal upper working surface and a spaced lower surface, said surfaces terminating at the front of said bench in a forward edge portion, said bench being supported upon said housing and projecting forwardly thereof to provide knee-space therebelow, said hollow bench defining a duct therewithin and being provided with a series of mutually spaced apertures arranged in a tranverse row along the forward edge portion thereof communicating with said duct, the upper working surface of said bench being substantially horizontal for supporting work thereon and extending to said apertures at the forward edge portion thereof, said bench duct communicating with the interior of said bench housing, a blower within said housing having its input communicating through said housing and said bench duct with said apertures, a coarse filter at the intake of said blower for filtering air sucked in use through said bench forward apertures and through said duct and entering said housing, a fine filter positioned adjacent said hollow bench, a mulit-apertured grille adjoining said bench working surface and extending substantially perpendicularly to and substantially vertically above the same, and an output duct connecting the output of said blower to said multi-apertured grille and including

said fine filter for driving air through the latter and through said grille, said grille serving to direct the air over said bench working surface in substantially laminar flow, a portion of this air being sucked back in through said bench forward apertures and returned to said blower in use, thereby effecting recirculation of such air, thusly not only providing a cleaner environment above the work bench but also preventing the ingress of outside contaminated air resulting, in the the absence of said apertures, from the production of eddy currents over the forward upper surface of the bench due to the presence of work thereon or of the operator's hands, as well as reducing the velocity of air flow past the bench operator and improving his comfort.

2. A dust-free bench structure as defined in claim 1 wherein said housing has a front wall provided with an opening, a grid mounted in the opening of said housing front wall, said grid communicating through the interior of said housing with the intake of said blower and coarse filter, for permitting a controlled volume of outside air to enter said housing and mix with the returning air from said bench duct before entering said coarse filter at the intake of said blower, thus controlling the speed and volume of the air entering said bench forward apertures, to suit a desired environment, said bench forward row of apertures extending substantially completely across the front edge of said bench.

3. A dust-free bench structure as defined in claim 2 comprising a hood having a hollow top and side walls and open at its front overlying said bench and supported by said housing, said hood hollow side walls having ducts therewithin and being provided with a series of mutually spaced apertures along the forward edges only thereof communicating with said side wall ducts, said side wall ducts communicating at the lower edges of said side walls with the interior of said bench housing and through said housing interior to the input of said blower, said fine filter being positioned at the rear of said hood for directing filtered air therethrough and over said bench, said blower in use serving to suck air in through said hood side wall forward apertures, through said side wall ducts, into the interior of said bench housing, wherein

the same mixes with air entering said housing from said bench duct and from said grid, such mixed air then passing through said coarse filter, said blower and connected output duct to and through said fine filter.

4. A dust-free bench structure as defined in claim 3 wherein the forward mutually spaced apertures in each hood side wall extend in a row for substantially the full height of the interior of said hood, stiffening members within the hollow interior of said hood side walls and fixed thereto adjacent said bench upper working surface, and stiffening members within said hollow bench and fixed therewithin, said hood stiffening members and said bench upper working surface being apertured to enable air from said side wall ducts to enter said housing, said stiffening member and bench apertures being of sufficient size as to cause return air to enter said hood side apertures at a higher speed than that of the air flowing forwardly over said bench working surface.

References Cited by the Examiner

UNITED STATES PATENTS

1,194,527	8/1916	McNamara.	
2,150,252	3/1939	Shure	98—36 X
2,172,944	9/1939	Norris	98—40
2,291,220	7/1942	Germonprez.	
2,332,174	10/1943	Shreve	98—36 X
2,341,628	2/1944	Koweindl.	
2,999,448	9/1961	Abler et al.	
3,021,776	2/1962	Kennedy.	
3,123,988	3/1964	Richman	98—36 X
3,158,457	11/1964	Whitfield	55—473 X
3,229,611	1/1966	Berger.	

OTHER REFERENCES

Crane, V. G.: Design Techniques for Industrial Clean Rooms in Air Conditioning, Heating and Ventilating, pp. 58 to 63. December 1963.

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