

March 3, 1970

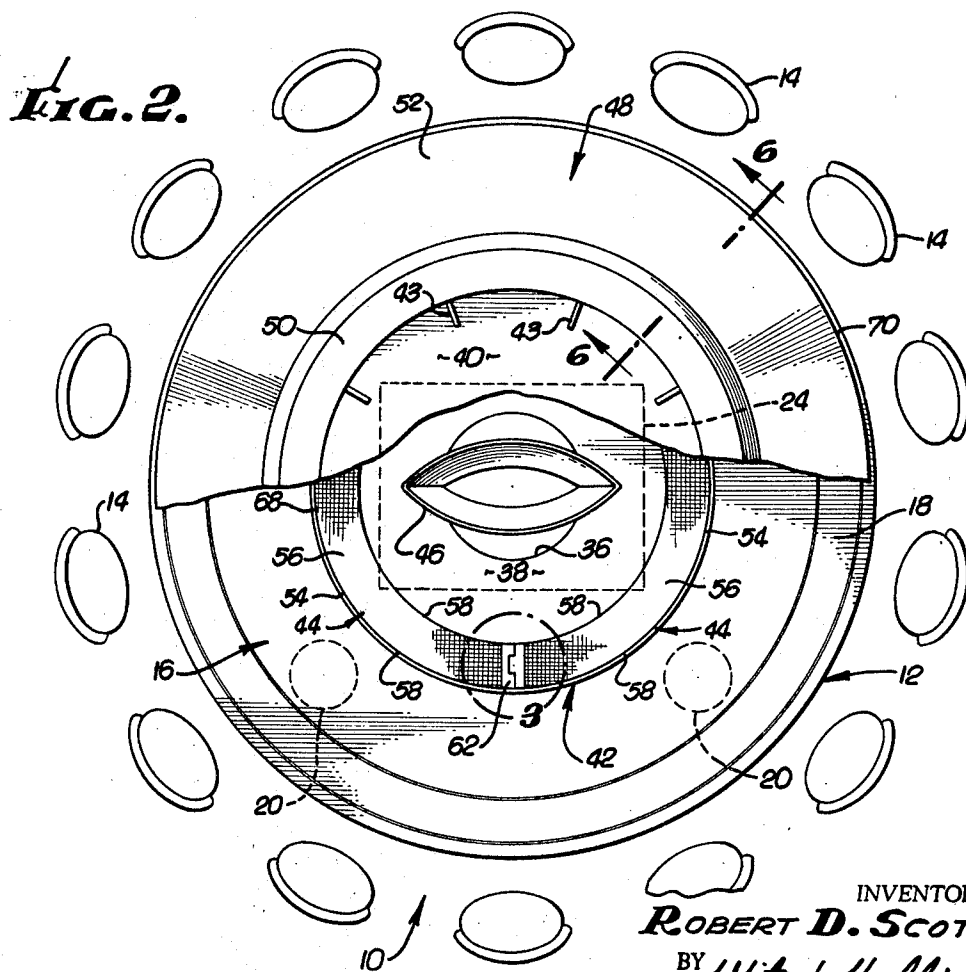
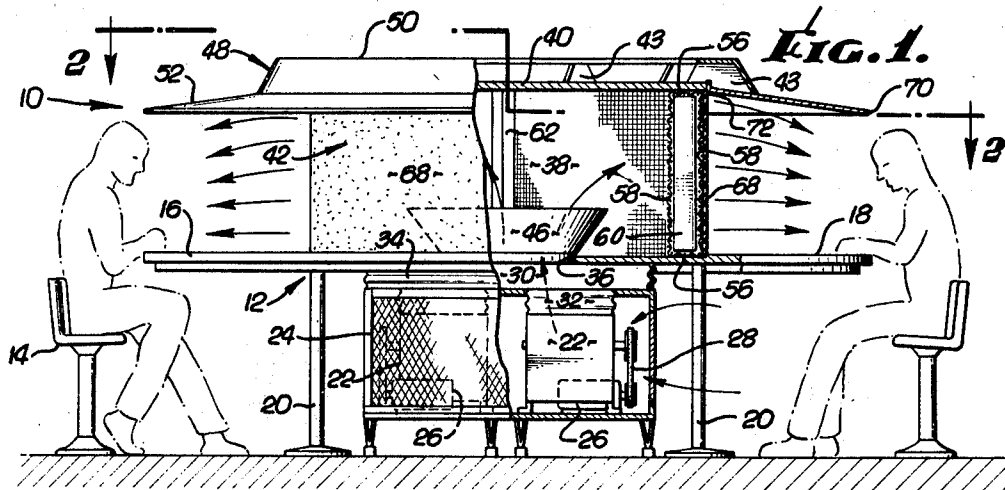
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3,498,032

HIGH CAPACITY LOW CONTAMINATION BENCH

Filed Aug. 31, 1967

2 Sheets-Sheet 1



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FIG. 3.

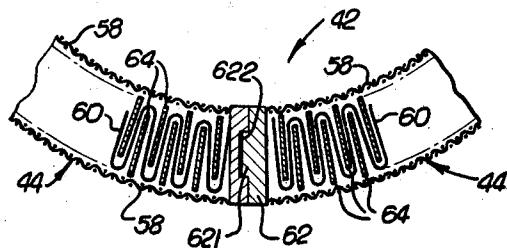


FIG. 4.

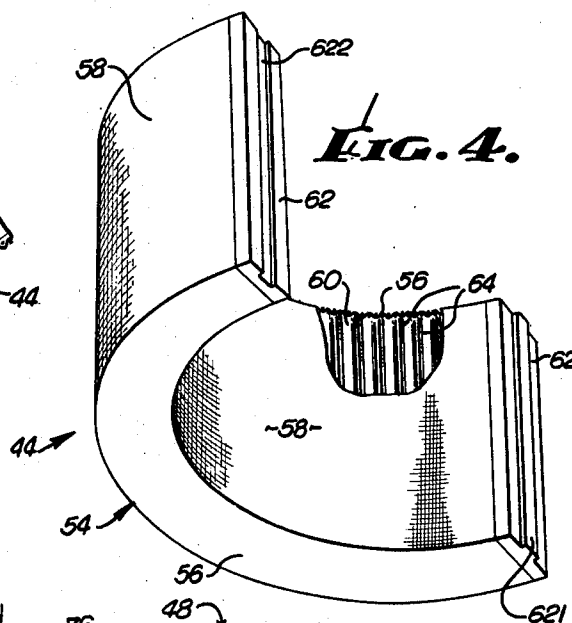


FIG. 5.

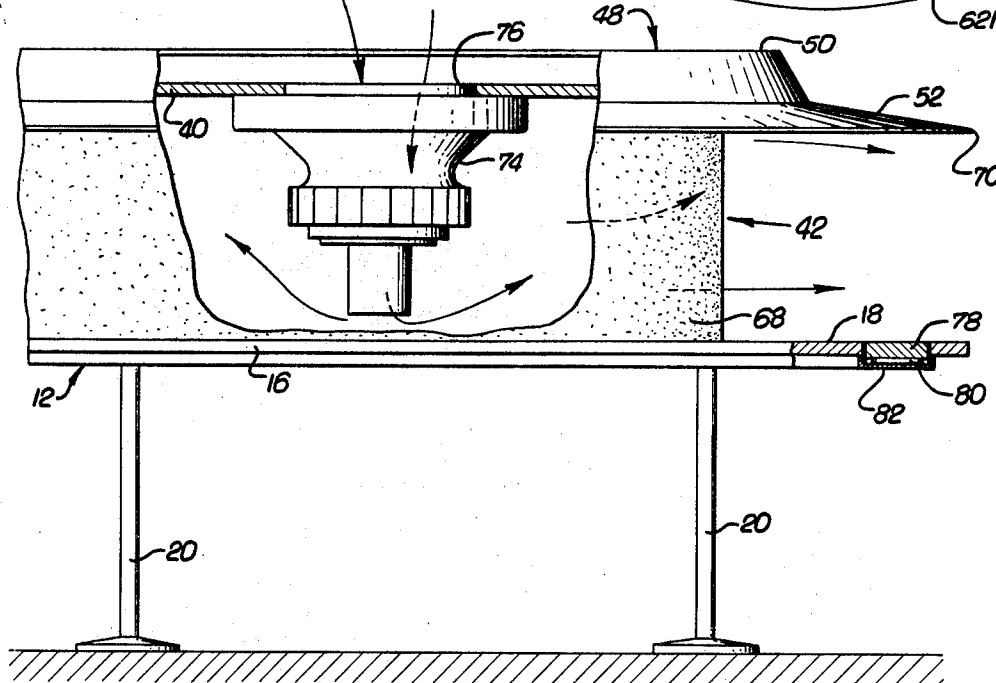
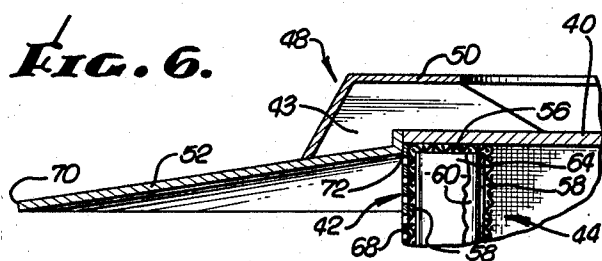


FIG. 6.



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HIGH CAPACITY LOW CONTAMINATION BENCH
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2 Claims

ABSTRACT OF THE DISCLOSURE

A clean bench having an increased number of work stations relative to previous benches with a given size submicron filter is provided. A wider work station area with a relatively smaller filter area is achieved with positive sweeping of all work surfaces by changing the profile of the air stream emanating from the filter to a lower, wider profile capable of filling the entire volume above the work surface.

BACKGROUND OF THE INVENTION

Field of the invention

This invention has to do with accomplishing work such as parts assembly under low contamination conditions. More specifically, the invention provides method and apparatus constituting an improvement over that presently known for working under so-called "clean" conditions.

The importance of clean rooms and clean benches is now well known. Originally because of demands of the electronics industry and the space program for zero defects in assembled parts, and now in major industries such as the automobile industry, contamination from dust and all manner airborne debris, a fertile source of component failure, is sought to be eliminated by accomplishing critical work tasks in a controlled "clean" environment. A clean environment is one in which particulate matter exceeding a micron or even a fraction of a micron in any dimension is filtered from the air in the environment. In practice, fresh, filtered air is continually blown through the clean area to constantly renew the low contamination condition. Occasionally entire rooms are maintained clean. Because many operations involve only small parts, however, it is often more convenient to employ a table or "bench" which provides the clean working surface. A submicron filter is positioned at the bench top to pass contamination-free air, supplied by a blower and filter across the working surface. Workers, of course, are themselves a source of contamination with their cosmetics and clothing dust, so the pressurized air stream is generally blown out across the bench top toward the worker, and thus the filter is placed at the inward edge of bench.

Prior art

Clean benches as just described are known. Heretofore, the number of work stations, places for workers to sit, has been limited by the virtual one-to-one ratio of work surface width and filter size. Because of the criticality of continually sweeping all portions of the working surface, it has been the practice in the past to employ a "piston" of air moving through the clean environment with an unchanging profile. The width of the air stream profile, is of course, fixed by the filter dimensions and, therefore, the width of the working surface must necessarily be limited to the filter width; thus the number of work stations is fixed by the filter dimensions. Increased size of filters has not been found to be practicable, because of stringent manufacturing requirements. Ideally, the working surface would be arcuate, even circular, with

a congruent filter to displace air radially outward from the locus of the arc. This arrangement provides the maximum number of work stations for a given filter width. In practice, however, the filtered air emerging from the available filter moves in a manner leaving spaces between adjacent streams, e.g. at junctions between filters.

SUMMARY OF THE INVENTION

It is a major objective of this invention to provide maximum work stations, and therefore, high work capacity in a low contamination or clean bench. This objective is realized by shaping the air stream from the filter in passage across the working surface from the dimensions of the filter to a lower, wider profile thereby to positively sweep all the working surface without voids or dead spots.

In particular, the invention provides a clean bench apparatus for low contamination work that includes a working surface, an air supply means such as a blower, and including a submicron filter, for sweeping the working surface with a contamination-free pressurized air stream. As in previous bench apparatus the air stream initially has the dimensions of the filter so that areas of the working surface exceeding the filter dimensions, e.g. width, are beyond the air stream and tend to increase in contamination level. Provision for sweeping these areas is made, however, novelly with the present invention, by shaping the air stream from its initial dimensions to dimensions which enable positive sweeping of all working surface areas, e.g. by use of a baffle means in vertically spaced relation with the working surface to lower and widen the air stream in its passage across the working surface. As in previously known clean benches, the filter may include an air passing filter shell and a submicron filter element within the shell capable of separating unwanted matter from the air passing through the filter. The filter may be fed air from a blower or other air supply means and will typically be at one side of the working surface and be arranged to direct the air stream in a generally parallel manner across the working surface to the opposite side thereof.

In certain highly preferred embodiments the working surface has an increasing horizontal extent (width) beyond the filter dimensions, outwardly from the filter as for example characterizes a convexly arcuate section, and has the filter at the inward side of the working surface to direct air radially across the surface in a generally parallel manner. In these embodiments, there is provided a baffle means in decreasing vertically spaced relation with the working surface outwardly from the filter to lower and widen the air streams passing over the surface. The working surface may be circular and be fed filtered air in all directions from the center thereof. In a highly specific form, the bench apparatus may comprise a table having multiple work stations and a top defining the working surface at these stations, and include a work supporting member movable in the plane of the top to carry work between work stations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation, partly in section of one embodiment of the present clean bench apparatus;

FIG. 2 is a view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view, greatly enlarged, showing in detail the junction of filter elements and is taken along line 3 of FIG. 2;

FIG. 4 is a perspective view, partly in section, of a filter element;

FIG. 5 is a view similar to FIG. 1 showing an alternate form of the present apparatus; and

FIG. 6 is a view taken along line 6—6 in FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings in detail, with reference first to FIGS. 1 and 2 a clean bench apparatus 10 is shown in the form of a circular table 12 having multiple work stations, one opposite each of chairs 14. The top 16 of table 12 defines a working surface 18 and is supported on legs 20 at a convenient height. An air supply to the working surface 18 is provided including a pair of blowers 22 each comprising an air pervious fan housing 24 and a motor 26 connected to a fan (not shown) by drive belt 28. Fan housing 24 opens upwardly to a header chamber 30 below and at the center of the table top 16. Connection from the fan housing to the header chamber 30 is by way of air tight flexible tubing 32. The vertical walls 34 of the header chamber 30 are typically and preferably non-rigid, e.g. formed of rubber or elastomeric plastic to isolate fan or motor produced vibration from the table 12. Pressurized air from the header chamber 30 passes upwardly through table top opening 36 into plenum chamber 38 formed between table top 16 as a base, a horizontal top wall 40 and a substantially continuous filter side wall 42 formed of joined semi-cylindrical filter elements 44, to be later described in detail. A generally elliptical upwardly and outwardly opening air distributing outlet 46 lies across the opening 36 in the table top 16 to outwardly and generally circumferentially direct the air passing into the plenum chamber 38 toward the filter side wall 42 supported by vertical ribs 43 along the top wall 40. There is provided a hood 48 including a central generally planar portion 50 and a peripheral, shallowly conical portion 52 of which more is to be said later. Suffice it now to be pointed out that the downward and outward thrust of hood portion 52 enables a baffle-like deflection of air streams passing from the filter across the working surface to decrease the vertical extent of such streams.

It will be noted from the drawings that the work surface 18 has an increasing horizontal extent or width outwardly from the filter wall 42. In the illustrated embodiment, the table 12 is fully circular but in other arrangements it may be a circle segment. The economy in filter requirement is easily seen in FIG. 2 where the greatly larger working surface 18 relative to filter wall 42 is best shown. Rather than a working surface only as wide as the filtered air source as in previous bench design, the working surface is increased beyond the filter dimension permitting additional work stations for the same linear extent of filter material.

Preferably the filter elements 44 are composed of arcuate shells 54 having an outward, or convex curvature symmetrical in relation to the working surface 18 and congruent with the perimeter of table top 16. The filter shells 54 extend vertically a convenient height, e.g. 36 inches so that overall the filter element is a cylinder segment and preferably, as illustrated, a semi-cylinder. While capable of construction in any of various specific forms, the filter shell 54 will be designed to generally contain a submicron filtering medium or membrane which may be of any known suitable commercially available types, as for example glass asbestos membrane known as an Absolute Filter and manufactured by Cambridge Filter Corporation of Syracuse, N.Y. For present purposes of disclosure these filters may be described as having intimately distributed pores capable of filtering from air passing through the pores, dust particles as small as submicron in size, thus to thoroughly cleanse the air to substantially completely eliminate dust particles that could contaminate the spaces adjacent the bench working surfaces. FIGS. 3 and 4 show an illustrative construction of filter elements 44 according to which filter shells 54 comprise air impervious top and bottom portions 56, air pervious side enclosures 58 on the convex and concave sides of the arcuate filter material 60 and end pieces 62. The end pieces 62 have mating surfaces in the form of tongue 621 and corresponding groove 622 to provide junction means between adjacent filter

elements 44 in the filter wall 42. Each of the filter elements 44 contains radially extending supports 64 projecting in staggered or offset relation from side enclosures 58. These supports typically are formed from cellular paperboard having sufficient strength and rigidity to support and position filter membrane 60. The latter being thin, flexible and of submicron porosity as previously indicated, is suitably secured at its sides to the element end pieces 62 and is extended reversely in essentially pleated or accordion shape between the supports 64 thus to provide adequately large surface area for the membrane to pass the necessary volume of air without excessive pressure drop.

Returning now to FIGS. 1 and 2, these filter elements 44 are shown in position to flow air from the plenum chamber 38 across the working surface 18 in a generally parallel manner, indicated by the arrows in FIG. 1, from the inner portion of the table top 16 to the outer portion thereof. The air flow is toward the worker at a work station in accordance with accepted practice to minimize personnel generated contamination on the work. In the embodiment shown in these figures a perforate screen 68 surrounds the filter elements 44 circumferentially to aid in obtaining initially circumferentially uniform flow outward from the filter wall 42 and to this end the screen extends around the wall and to the height of the wall.

From the foregoing description of the present apparatus it will be appreciated that the air streams emerging from the filter wall 42 will tend to pass outwardly across the working surface 18 with substantially the directional component conferred at the filter wall 42 or screen 68, if provided. As the air streams move thus, areas of the working surface lying between adjacent streams will not be positively swept if the stream direction is not modified. There may occur an induced air movement in these unswept areas in accordance with Venturi principles, but turbulence and eddy patterns will likely accompany such air movement and cause locally high contamination levels.

Positive sweeping excludes the generation of such conditions and is achieved in the present invention by shaping the air stream from its initial, filter, dimensions during sweeping movement across the working surface 18 to positively sweep all areas of the surface.

Hood 48 is used to so shape the air stream, specifically peripheral hood portion 52 which as indicated above is shallowly conical in configuration. With reference particularly to FIG. 6, the portion 52 of the hood projects outwardly from the filter wall 42 over the working surface 18 to be substantially coextensive with that surface (FIG. 1). The hood portion 52 also extends downwardly progressively with its outward extension. Thus, the perimeter 70 of the hood portion 52 is below the top 72 of the filter element 44 from which the hood portion extends. The construction of the hood portion 52 is of sheet material such as thin gauge metal or plastic, transparent if desired, so as to have a slight thickness, for effectively baffling air emanating in a pressurized condition from the filter wall 42. In a typical bench apparatus having a 36 inch vertical filter wall 42, the perimeter 70 of the hood portion 52 will be approximately 2 to 9 inches and preferably 3 inches below the top of the filter from which it extends so that approximately $\frac{1}{4}$ to $\frac{1}{3}$ of the vertical filter output will be diverted downward by the hood portion 52.

The effect of directing downward a fraction of the air stream is to lower and widen the profile of the air stream from its initial dimensions, determined by the filter, to a second set of dimensions, height determined by the perimeter 70 of the hood portion 52. In the substantial absence of lateral restraint the air stream widens as its vertical extent is decreased, filling the voids and unswept areas above the working surface 18 with a positive sweep of pressurized air, and thus all working surface areas are continually washed with contamination free air streams.

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In FIG. 5 where like numerals indicate like parts with FIGS. 1 and 2, the air supply is provided by a centrifugal fan 74 mounted centrally of the filter wall 42 and fed through aperture 76 in the plenum chamber top wall 40.

The circular design of the working surface made practical by the air stream control concept of the present invention enables incorporation of means facilitating handling of the work at the working surface, e.g. a complex multi-step parts assembly. Thus, there may be provided as depicted in FIG. 5, a work supporting member movable in the plane of the working surface to carry work between stations. In the form illustrated, an annular support 78 carried on rollers 80 in trough 82 extends circularly in the table top 16 and is movable in either direction horizontally so that when an operation is completed at one station the entire assembly may be carried to the next station for further assembling operations without being lifted from the work support.

While the invention has been described primarily in connection with a circular bench apparatus, it will be apparent that the principles are applicable to benches of other configurations such as, circular segments, oval or even rectangular where the working surface to be swept is wider than the filter being used.

I claim:

1. Clean bench apparatus for low contamination work that includes a circular horizontally disposed working surface, a horizontal top wall extending over the working surfaces, a circular filter extending between the top wall and the working surface, the top wall extending over the filter and outwardly therefrom in decreasing vertically spaced relation above and across the working surface, air supply means connected to and communicating with a central portion of the filter providing streams of filtered air from inner to peripheral portions of the working surface, said filter including a centrally disposed cylindrical submicron pleated filter extending vertically above the working surface and substantially coaxial therewith and the air supply means including a blower below the working surface having an outlet communicating with the filter to deliver air to and through the filter and radially outwardly from the filter across the working surface, said top wall deflecting downwardly air issuing from the uppermost portion of said cylindrical filter.

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2. Apparatus according to claim 1 including also air distributing means centrally within said cylindrical filter to distribute blower air outwardly toward the filter.

References Cited

UNITED STATES PATENTS

565,180	8/1896	Rucquoy	108—94
2,279,423	4/1942	Vokes	210—493
2,608,302	8/1952	Mattei	210—493
2,619,393	11/1952	Fires	108—94
2,627,217	2/1953	Hainke et al.	98—115
2,830,862	4/1958	Wright	108—104
3,169,844	2/1965	Young	55—510
3,229,611	1/1966	Berger	98—115
3,240,000	3/1966	Hayes et al.	55—498
3,251,177	5/1966	Baker	98—115
3,284,148	11/1966	Ramniceanu	98—115
3,084,609	4/1963	Onstad.	
3,308,610	3/1967	Springer et al.	55—498
3,301,167	1/1967	Howard et al.	55—467
3,336,855	8/1967	Messina	98—115
3,363,539	1/1968	Taylor et al.	98—115
3,426,512	2/1969	Nesher.	

FOREIGN PATENTS

1,130,844	10/1956	France.
1,448,873	7/1966	France.

OTHER REFERENCES

Bulletin ER658, Genie Air Vents, Inc., Frankfort, Kentucky, 1963, pp. 1-4.

Air Control Inc., 90° Converging Laminar Flow Work Station, pp. 1-2, Oct. 14, 1966.

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U.S. Cl. X.R.

55—473, 498, 521; 98—115; 108—104