

[54] VACUUM HOLD-DOWN APPARATUS

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[51] Int. Cl. **B26d 7/20**

[58] Field of Search **83/22, 451, 452, 83/374, 925 CC; 269/21**

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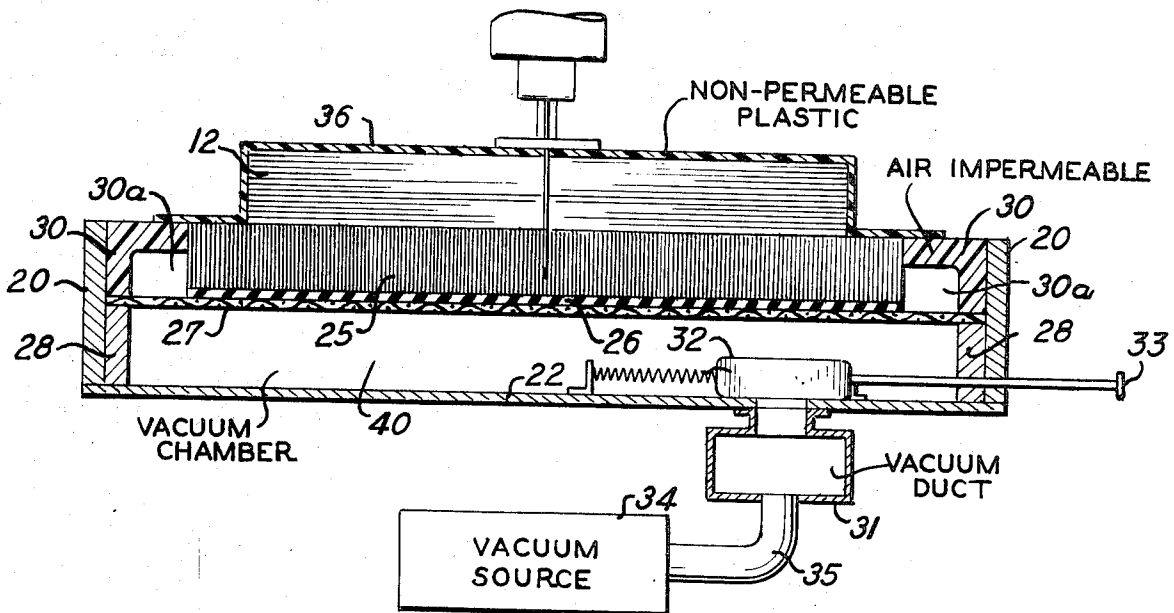
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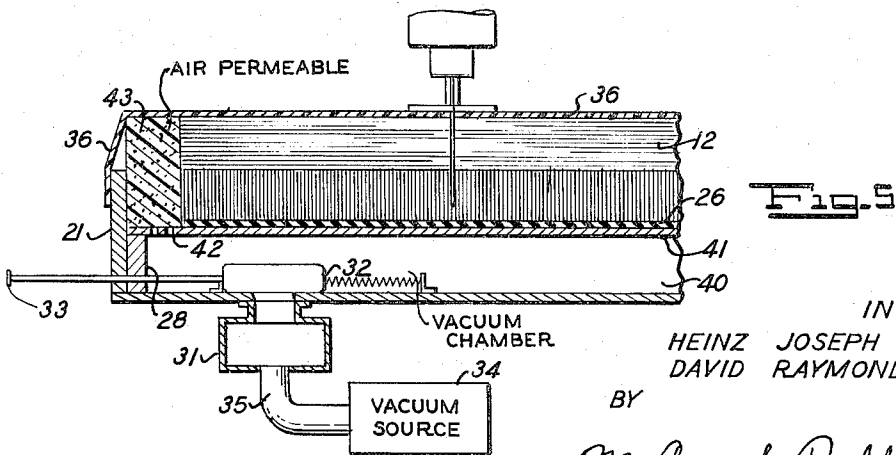
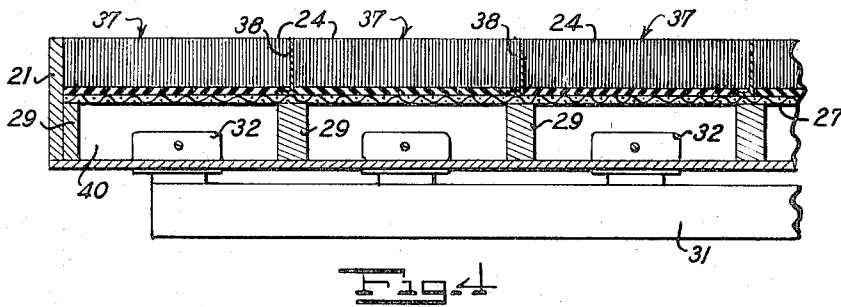
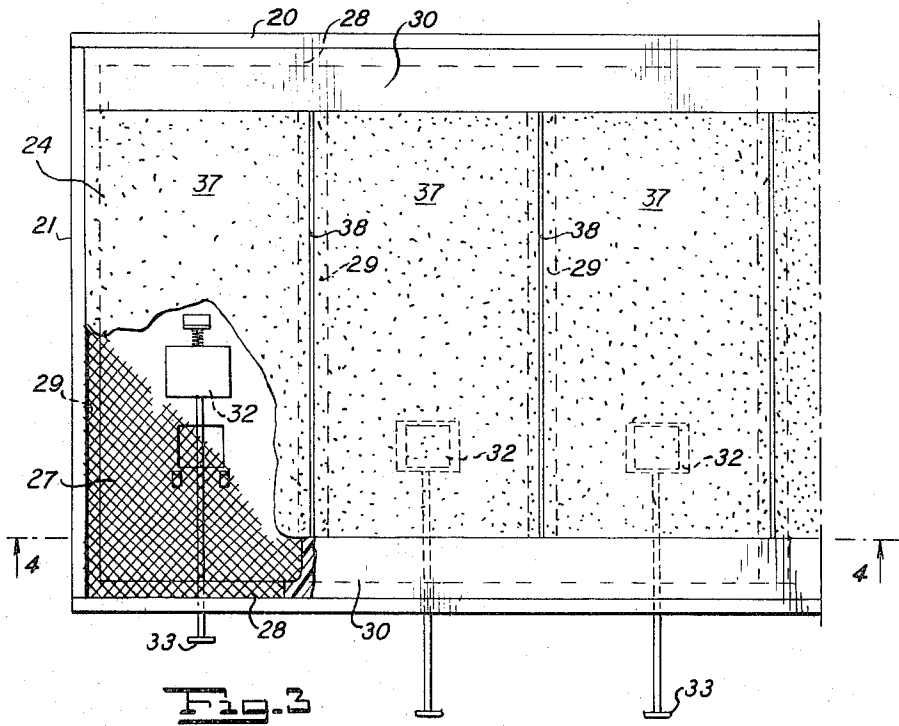
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[57] **ABSTRACT**

Vacuum hold-down apparatus is used for holding sheet material in place while it is being worked on by a tool. The apparatus comprises a means defining a generally horizontally disposed upwardly facing sheet material supporting surface. The supporting surface means includes a bed having a gas impermeable base portion and a gas permeable body portion disposed on the base portion. Means are provided for connecting a vacuum source to the gas permeable body portion of the bed to effect a vacuum within the body portion. A bed penetrable by a tool and a support means for the bed is disclosed as a combination in an apparatus for working on sheet material. The penetrable bed includes a gas impermeable base portion and a gas permeable body portion disposed on the base portion. A vacuum source is connected to the gas permeable body portion of the bed to hold the sheet material against a sheet material supporting surface while the sheet material is being worked on by the tool. Various specific embodiments of the vacuum hold-down apparatus are disclosed.

19 Claims, 7 Drawing Figures





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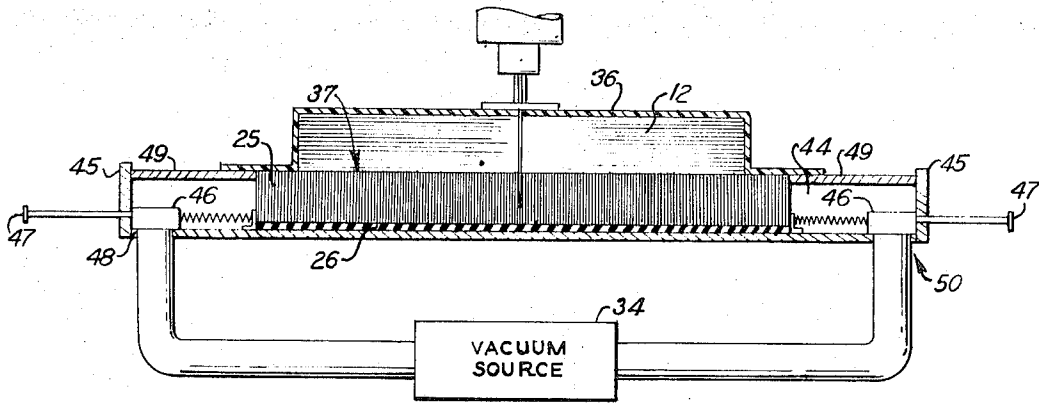


Fig. 6

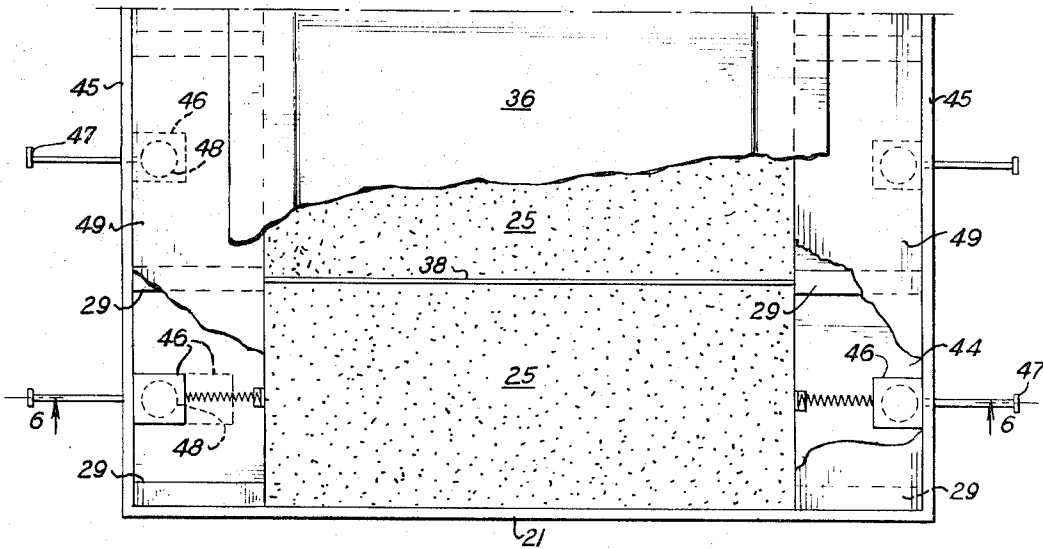


Fig. 7

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VACUUM HOLD-DOWN APPARATUS

RELATED SUBJECT MATTER

This application is related to the subject matter disclosed in the copending U.S. application Ser. No. 821,723, filed May 5, 1969, now U.S. Pat. No. 3,548,697, and U.S. Pat. No. 3,495,492, issued Feb. 17, 1970.

BACKGROUND OF THE INVENTION

An apparatus for holding sheet material in place with a vacuum while the sheet material is being worked on by a tool is generally known in the prior art. Such an apparatus is described in the applicants' U.S. Pat. No. 3,495,492. This apparatus comprises means defining a generally horizontally disposed upwardly facing sheet material supporting surface. A plurality of openings is distributed over the supporting surface which includes a longitudinal series of contiguous supporting zones. At least one of the openings is associated with each of the supporting zones. A tool is supported for movement relative to the sheet material supporting surface. A vacuum source is connected to the supporting surface for holding the sheet material thereon while the tool is moved relative thereto. Means responsive to the position of the tool relative to the supporting surface is provided for controllably connecting and disconnecting the vacuum source to and from the openings. Therefore, while the tool moves longitudinally of the supporting surface, the openings are connected to the vacuum source in zone wise succession with the zones involved being the contiguous supporting zones.

The vacuum hold-down apparatus of the prior art is particularly useful with a garment cutting implement. Garment components or the like are arranged either in a layer of sheets disposed in vertically stacked relationship or as a single sheet which is spread out in generally flat condition prior to the cutting operation.

Various types of material may be used in the construction of the beds used below the sheet supporting surface. Such materials as foamed polyethylene, bristle beds having a plurality of flexible bristles fixedly attached to a bottom base portion, granular materials such as sawdust, small balls of metal or plastic, granules of foamed or unfoamed plastic and superviscous liquids are well known in the prior art. The only type of bed material that is used in combination with a vacuum hold-down table, however, is one which is gas permeable. That is, the material itself is either porous enough to allow the passage of gas from the top through the bottom thereof or there is a plurality of passageways passing through the bed material for conducting vacuum from the vacuum source to the upper surface of the bed material which provides support for the material to be worked on.

While the general use of a penetrable bed composed of a plurality of flexible bristles fixedly connected to a base portion is known, its specific use in a vacuum hold-down apparatus is not known in the prior art. That is, a bed having a gas impermeable base portion and a gas permeable body portion disposed on the base portion in combination with a vacuum source is completely different from any prior art vacuum hold-down device and is deemed to be an improvement thereover.

PURPOSE OF THE INVENTION

The primary object of this invention is to provide a

vacuum hold-down apparatus used for maintaining sheet material in place while being worked on by a tool.

Another object of this invention is to provide a vacuum hold-down apparatus including a bed having a gas impermeable base portion and a gas permeable body portion disposed on the base portion.

It is another object of this invention to provide a vacuum hold-down apparatus having a bed of material penetrable by a cutting implement and comprised of a plurality of flexible bristles which are fixedly connected to a gas impermeable base portion and extend generally perpendicularly to a sheet material supporting surface.

A further object of this invention is to provide a vacuum hold-down apparatus wherein the dissipation of the vacuum is substantially prevented through the use of flexible and expendable divider means which define vacuum hold-down zones adjacent to a sheet material supporting surface.

It is a still further object of this invention to provide a vacuum hold-down apparatus for combination with a cloth cutting machine wherein the apparatus includes a penetrable bed composed of a plurality of bristles which are fixed to a gas impermeable base portion.

A still further object of this invention is to provide means for channeling vacuum along the longitudinal edge of a table on which a penetrable bed having a gas permeable body portion is in segments which are transversely disposed across said table.

SUMMARY OF THE INVENTION

The vacuum hold-down apparatus includes a means defining a generally horizontally disposed upwardly facing sheet material supporting surface. The apparatus is used for holding sheet material in place while it is being worked on by any type of tool. The supporting surface means includes a bed of material having a gas impermeable base portion and a gas permeable body portion disposed on the base portion. The vacuum source is connected to the gas permeable body portion of the bed to effect a vacuum within the body portion thereby holding the sheet material in place.

While the vacuum hold-down apparatus of this invention may be used with any type of working tool, a specific feature of this invention is the combination of the vacuum hold-down apparatus with a sheet material cutting device. Although any type of permeable and impermeable material may be used to form the body portion and base portion, respectively, a specific embodiment of this apparatus is directed to the use of a bristle bed. In such a bed, a plurality of flexible bristles is fixedly connected to a solid bottom backing or base portion. The bristles extend generally perpendicularly to the supporting surface for the sheet material.

When the vacuum source is connected to the bristle body portion of the bed, a vacuum is formed in the area located between the bristles. The use of such a bristle bed is found advantageous because a sufficient hold-down force can be effected by using a small area of vacuum suction along the edge of the gas permeable body portion. The bristle construction in and of itself helps to prevent dissipation of vacuum because of the circuitous path through the plurality of bristles or fibers. However, a specific feature of the invention incorporates the use of divider means which are used to define sheet material hold-down zones along the sheet material supporting surface. Separators composed of material that is flexible and expendable constitute the di-

vider means used in the hold-down apparatus of this invention. The separators used in combination with the cloth cutting apparatus are expendable in that they may be cut by the cutting implement during the course of the normal cutting operation. At the same time, however, the dissipation of vacuum along the supporting surface is prevented.

The most important function of the vacuum hold-down apparatus is that the sheet material is held firmly in place at the location where the work is being effected. The use of a bristle bed combines the advantages of the natural drag of the bristles together with the pull of the vacuum to enable the perfection of the work by a tool such as a cutting implement.

BRIEF DESCRIPTION OF DRAWINGS

Other objects of this invention will appear in the following description and appended claims, reference being made to the accompanying drawings forming a part of the specification wherein like reference characters designate corresponding parts in the several views.

FIG. 1 is a fragmentary perspective view of a vacuum hold-down apparatus made in accordance with this invention;

FIG. 2 is an enlarged sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional top plan view of an apparatus made in accordance with this invention;

FIG. 4 is a fragmentary sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary sectional view of an embodiment of a vacuum hold-down apparatus made in accordance with this invention;

FIG. 6 is a sectional view of another embodiment of a vacuum hold-down apparatus made in accordance with this invention; and

FIG. 7 is a fragmentary top plan view partially in section of the embodiment as shown in FIG. 6.

DESCRIPTION OF SPECIFIC EMBODIMENTS

More specifically, a vacuum hold-down apparatus, generally designated 11, is shown used in combination with a cloth cutting mechanism, generally designated 10. The vacuum hold-down apparatus or table 11 provides support for a fabric layup 12 comprising a plurality of fabric sheets arranged in vertically stacked relation. The cutting blade carriage 13 and main carriage 17 are adapted to move across the surface of the table 11 in the co-ordinate directions indicated by the arrows X and Y. A cutting mechanism 15 having a cutting blade 16 is mounted on the carriage 13 so that the cutting mechanism 15 can be driven to and from any predetermined point relative to the sheet material supporting surface 24. A blade 16 extends downwardly from the main body of the cutting mechanism 15 and is reciprocated vertically by a motor (not shown) in the cutter body. It may also be rotated 360° by another motor (not shown) in the cutter body.

The main carriage 17 is movably mounted on the racks 14 thereby providing movement for the cutting mechanism along the longitudinal direction of the table 11 or in the X co-ordinate direction. The cutter blade carriage 13 is movably mounted on a guide bar or tube 18 and a lead screw 19 of the main carriage 17 which extends transversely of the table 11. Movement of the carriage 13 along the guide bar 18, as driven with the lead screw 19, is in the Y co-ordinate direction.

The main carriage 17 includes a drive shaft (not shown) which extends transversely of table 11 and has pinions at its opposite end for engaging travel support racks 14. Movement of the main carriage 17 is effected in response to operation of a drive motor (not shown) which is connected to the main carriage drive shaft. The cutting mechanism carriage 13 moves transversely of the table 11 in response to the operation of another guide motor (not shown) which is operably connected to the lead screw 19.

The movement of the carriages 13 and 17 may be effected in response to positioning signals supplied through the cable 39 by an associated input means such as, for example, numerically controlled controller or a computer (not shown). The carriages 13 and 17 are capable of moving the blade 16 in cutting engagement with the layup 12 along any line which may be straight or curved as required in cutting a garment component or the like. The blade 16 has a reciprocating cutting stroke and is adapted for rotation about its own axis in a direction indicated by the arrow θ in response to signals from the input means. During at least a portion of its stroke, the blade 16 penetrates the upper supporting surface 24 of the table 11. The actual construction of the carriages 13 and 17, and means for supporting the carriages 13 and 17 relative to the table 11 may vary widely. The operation of a cutting apparatus 10 as described hereinabove is fully set forth in copending application Ser. No. 821,723, filed May 5, 1969, which is incorporated herewith.

The vacuum hold-down apparatus or table 11 of this specific embodiment includes a longitudinal series of contiguous vacuum chambers 40 between the longitudinal side members 20, end members 21 and longitudinally spaced transverse partitions 29 which extend between opposed side members. The hold-down apparatus 10 includes a generally horizontally disposed upwardly facing sheet material supporting surface 24. A bed of material penetrable by the cutting blade 16 includes a plurality of flexible bristles 25 which constitutes a gas permeable body portion and a solid bottom backing 26 which constitutes a gas impermeable base portion. When the vacuum source 34 is connected to the gas permeable body portion 25, the sheet material layup 12 is held firmly against the supporting surface 24 so that the normal cutting operation can be effected. The flexible bristles 25 are fixedly connected to the base portion 26 and extend generally perpendicularly to the supporting surface 24.

The penetrable bed in this specific embodiment includes a plurality of segments, generally designated 37, which extend transversely of the table 11 and are disposed longitudinally therealong. The bed segments 37 extend for a distance shorter than the distance between the longitudinally extending side members 20. Vacuum connecting means includes gas passage means shown as channel members or blocks 30 defining channels 30a located along at least one longitudinal side member 20 and disposed between the side member 20 and a respective edge of the bed segment 37. Divider means 38 are disposed between selected of the segments 37 to define a plurality of sheet material holding zones adjacent the supporting surface 24. The divider means or separators 38 are effective to prevent the longitudinal dissipation of vacuum from each of the sheet material holding zones. The separators 38 may be composed of any type of material that will prevent dissipation of the

vacuum and at the same time not interfere with the tool to work on the sheet material. For example, in the cloth cutting apparatus of this specific embodiment, the separators 38 may be composed of materials such as paper, rubber and the like. These materials are expendable in that they may be cut by a cutting implement during the normal cutting operation. While the separators 38 are shown disposed between each of the segments 37 in this specific embodiment, it is contemplated that different configurations of segments and separators may well be used in place of the segments 37 and separators 38 as disclosed in this specific embodiment.

The bed segments 37 are disposed transversely of the table 11 and are supported by the perforated supporting plate 27. The perforated plate 27 is preferably made from an expanded metal and spaced above the vacuum chamber 40 on spacers 28 and transverse partitions 29. The arrangement of the segments 37 and the dividers 38 form sheet material holding zones that are registered with the longitudinal series of contiguous chambers 40 adjacent the gas permeable body portion 25. Except for the specific use of a penetrable bed having a gas permeable body portion disposed on a gas impermeable base portion, the table 11 in this specific embodiment is constructed similarly to the applicants' apparatus as disclosed in U.S. Pat. No. 3,495,492 issued Feb. 17, 1970. In this former apparatus, the material used to form the bed was made of a foam pad consisting of Ethafoam having passageways or holes formed therein. In this particular prior art apparatus, it was necessary to develop a uniform drag or suction from the vacuum over the entire foam base. This necessitated a particular kind of structure and vacuum capacity which have become unnecessary due to the use of the type of bed disclosed in combination with a vacuum hold-down apparatus made in accordance with this invention.

A vacuum duct 31 extends the length of the table 11 and at least one opening is provided in each of the vacuum chambers 40. Valve blocks 32 are used to open and close the openings leading into the vacuum duct 31 when a vacuum drag is necessary to hold the sheet material 12. The valve actuators 33 are used to move the blocks 32 thereby connecting and disconnecting the vacuum source 34 to the chambers 40. The guide block members 30 constitute means for connecting the vacuum source in the chambers 40 to the gas permeable body portion 25. The blocks 30 in this specific embodiment are gas impermeable and include channels 30a through which the vacuum may be drawn within the flexible bristle body portion 25. It is noted herein that the penetrable bed forming the supporting surface 24 in this invention may be used in combination with the automatic valve control mechanism as disclosed in the applicants' prior U.S. Pat. No. 3,495,492 which is incorporated herewith.

In the embodiment as shown in FIG. 5, the bed supporting plate 41 includes openings 42 disposed along the longitudinal edge of the table 11. Air permeable guide blocks 43 are located along the longitudinal edge of the table and disposed adjacent the gas permeable body portion 25 and the layup 12. The air impermeable layer 36 is draped over the top of the layup 12 and over the side member 20. This structure specifically eliminates the need for perforations extending all the way across the width of the table 11 because the vacuum cannot

be drawn through the gas impermeable base portion 26. The basic operation of the valve 32 in conjunction with the vacuum source 34 and vacuum duct 31 remains the same as in the embodiment described hereinabove.

The specific embodiment as shown in FIGS. 6 and 7 is of particular importance because of the compactness and simplicity of construction when compared to the vacuum hold-down apparatus available heretofore. A sturdy perforated support is not required all the way across the table 11 because the vacuum is being pulled only from the edges of the bed along the gas permeable portion thereof. Vacuum chambers 44 are disposed along the longitudinal edges of the segments 37 and extend to the side members 45 of the vacuum hold-down apparatus. Each of the chambers 44 is formed between dividers 46 thereby forming a longitudinal series of contiguous chambers defining vacuum zones adjacent the gas permeable body portion 25. Valve blocks 46 are moved by actuators 47 to open and close the openings 48. The top cover 49 extends along the edge of the table 50 to form the top of the chambers 44. The top cover 49 may be hinged to the side members 45 or simply rest firmly along the edge of the table 50. It is important that appropriate sealing be effected between the top covers 49 and the side members 45 so that the vacuum will be directed only toward the bristle body portion 25.

While the embodiment as shown in FIG. 6 shows vacuum chambers 44 extending along either edge of the segments 37, it is within the contemplation of this invention that the vacuum chamber may be located along only one side thereof. The most important parameter is that the chamber capacity is effective enough to pull a suitable vacuum across the entire width of the gas permeable body portion 25. Factors such as width of the table, strength of the vacuum source 34, the specific materials used in the gas permeable body portion 25 and the sheet material being worked on must be considered when determining the structural relationships between the various elements in the vacuum hold-down apparatus of this disclosure.

Although not specifically shown in the drawings, it is noted that a substantially air impervious panel may be provided for overlaying at least an associated portion of the upper surface of sheet material received on the sheet material supporting surface. This setup for the cutting operation may be used in combination with the vacuum hold-down apparatus in the manner as described in U.S. Pat. No. 3,495,492.

While the vacuum hold-down apparatus has been shown and described in detail, it is obvious that this invention is not to be considered as being limited to the exact form disclosed, and that changes in detail and construction may be made therein within the scope of the invention, without departing from the spirit thereof.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A vacuum holddown apparatus for holding sheet material in place while being worked on by a tool comprising:

- a. means defining a generally horizontally disposed upwardly facing sheet material supporting surface,
- b. said supporting surface defining means including a bed of material adjacent said supporting surface,

- c. said bed including a gas impermeable base portion and a gas permeable body portion disposed above said base portion,
- d. means providing a vacuum source, and
- e. means for connecting said vacuum source to the gas permeable body portion of the bed at a station above the impermeable base portion and laterally adjacent at least one side edge of said body portion to effect a vacuum within said body portion.
2. An apparatus as defined in claim 1 wherein the gas permeable body portion includes a plurality of flexible bristles which are fixedly connected to the base portion and extend generally perpendicularly to the supporting surface.
3. An apparatus as defined in claim 1 wherein said supporting surface defining means includes an elongated table, said bed including a plurality of segments extending transversely of said table and being disposed longitudinally therealong, said bed having a plurality of transversely extending air impermeable divider means inserted between at least some of said segments of the bed to divide said supporting surface into a plurality of sheet material holding zones, said divider means being effective to prevent the longitudinal dissipation of vacuum from each of the holding zones, and said connecting means including means for selectively connecting said vacuum source to individual ones of said holding zones.
4. An apparatus as defined in claim 3 for holding sheet material in place while being worked on by a cutting tool wherein said body portion of said bed is penetrable by said tool; and each of said divider means is composed of a thin strip of material that may readily be cut by the tool.
5. An apparatus as defined in claim 3 wherein said table includes two longitudinally extending side members, said bed segments extend transversely of said table for a distance shorter than the distance between said side members, and said vacuum connecting means includes a first gas passage means located along one of said side members of the table and disposed between such one side member and the associated side edge of said bed.
6. An apparatus as defined in claim 5 wherein said vacuum connecting means includes a second gas passage means located along the other of said side members and disposed between said other side member and the associated side edge of said bed.
7. An apparatus as defined in claim 5 wherein: the first gas passage means in the vacuum connecting means comprises a channel member interposed between the one of said side members of the table and the associated side edge of the bed and defining a gas-transmitting channel communicating with the body portion.
8. An apparatus as defined in claim 5 wherein: the first gas passage means in the vacuum connecting means comprises an air permeable block extending laterally adjacent the one side edge of the body portion.
9. An apparatus as defined in claim 5 wherein: the first gas passage means in the vacuum connecting

means includes a vacuum chamber structure located along the one of said side members of the table and the associated side edge of the bed, the chamber structure forming a gas passageway between the vacuum source and the station laterally adjacent the body portion of the bed.

10. An apparatus as defined in claim 1 wherein said bed includes a plurality of transversely extending divider means disposed in said bed to divide it into a longitudinal series of contiguous sheet material holding zones,

said divider means being air impermeable to prevent the longitudinal dissipation of vacuum from each of the sheet material holding zones, and

said connecting means including means for selectively connecting said vacuum source to individual ones of said holding zones.

11. In an apparatus for working on sheet material, said apparatus having a generally horizontally disposed upwardly facing sheet material supporting surface, a tool, a bed of material penetrable by the tool and means for moving the tool and said bed of penetrable material with respect to each other, the combination comprising:

a. support means for said penetrable bed,

b. said penetrable bed including a gas impermeable base portion and a gas permeable body portion disposed on said base portion,

c. means providing a vacuum source, and

d. means for connecting said vacuum source to the gas permeable body portion of the bed laterally adjacent at least one side edge thereof for effecting a vacuum within said body portion.

12. In an apparatus as defined in claim 11, the combination wherein

said gas permeable body portion of said bed is comprised of a plurality of flexible bristles which are fixedly connected to said gas impermeable base portion and extend generally perpendicularly to the supporting surface.

13. In an apparatus as defined in claim 11, the combination wherein

said bed includes a plurality of transversely extending air impermeable separators disposed in said bed to divide it into a longitudinally extending series of contiguous sheet material holding zones,

said separators being effective to prevent the longitudinal dissipation of vacuum from each of the sheet material holding zones, and

said connecting means including means for selectively connecting said vacuum source to individual ones of said holding zones.

14. In an apparatus having a cutting tool as defined in claim 11, the combination wherein

said supporting surface means includes an elongated table having a longitudinal series of contiguous chambers defining vacuum zones adjacent at least one edge of said gas permeable body portion,

said penetrable bed including a plurality of segments disposed longitudinally along said table and extending transversely of said table,

said bed having air impermeable divider means capable of being cut by said cutting tool disposed between selected segments of the penetrable bed to define sheet material holding zones generally longitudinally aligned with said vacuum zones,

said connecting means including means for selectively connecting said vacuum source to selected ones of said contiguous chambers, and

said divider means being effective to prevent the longitudinal dissipation of vacuum from each of the sheet material holding zones.

15. A vacuum holddown apparatus for holding sheet material in place while being worked on by a tool comprising:

a. a bed of bristles projecting from one side of a non-permeable supporting base in the bed, the free ends of the bristles defining a supporting surface for supporting sheet material to be worked upon,

b. means providing a vacuum source, and

c. means for connecting said vacuum source to the region between the one side of the supporting base and the supporting surface defined by the free ends of the bristles so that air may flow through the bristles from said supporting surface to the vacuum source.

16. A vacuum holddown apparatus as defined in claim 15 further characterized by

said supporting base being a gas impermeable base, and

said means for connecting the vacuum source to the region between the one side of the base and the supporting surface including means extending along at least one lateral side edge of said bed for removing air from said region along said lateral side edge of the bed.

17. A vacuum holddown apparatus as defined in claim 16 further characterized by

said bed of bristles providing a plurality of contiguous holding zones arranged in a series extending longitudinally of said bed, and

said connecting means including means for selectively connecting said vacuum source to the region between the one side of the support base and the supporting surface within individual ones of said

holding zones.

18. A vacuum holddown apparatus as defined in claim 17 further characterized by

a plurality of transversely extending gas impermeable divider strips disposed in the region of said bed between the one side of the supporting base and the supporting surface and dividing said bed into said holding zones.

19. A vacuum holddown apparatus for holding sheet material in place while being worked on by a tool comprising:

a. a sheet material supporting bed including a gas impermeable base portion and a gas permeable body portion disposed on said base portion with said gas permeable body portion defining a sheet material supporting surface,

b. means providing a vacuum source,

c. means for connecting said vacuum source to said gas permeable body portion of said bed along at least one lateral side edge of said body portion above the impermeable base portion to effect a vacuum within said body portion,

d. said connecting means including means defining a plurality of vacuum chambers arranged in a series extending longitudinally of said bed and separated from one another by a plurality of partitions extending transversely of said bed,

e. said connecting means further including means for selectively connecting said vacuum source to individual ones of said vacuum chambers, and

f. a plurality of transversely extending divider means in said gas permeable body portion of said bed aligned with said partitions for dividing said body portion of said bed into a plurality of holding zones each associated with a respective one of said chambers and to prevent the longitudinal dissipation of vacuum from said holding zones.

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