April 17, 1951 H. A. SMYTH 2,549,254

VACUUM HOLD-DOWN FOR MACHINES OPERATING ON FLAT STOCK

Filed May 18, 1946 3 Sheets-Sheet 1

FIG. 1.

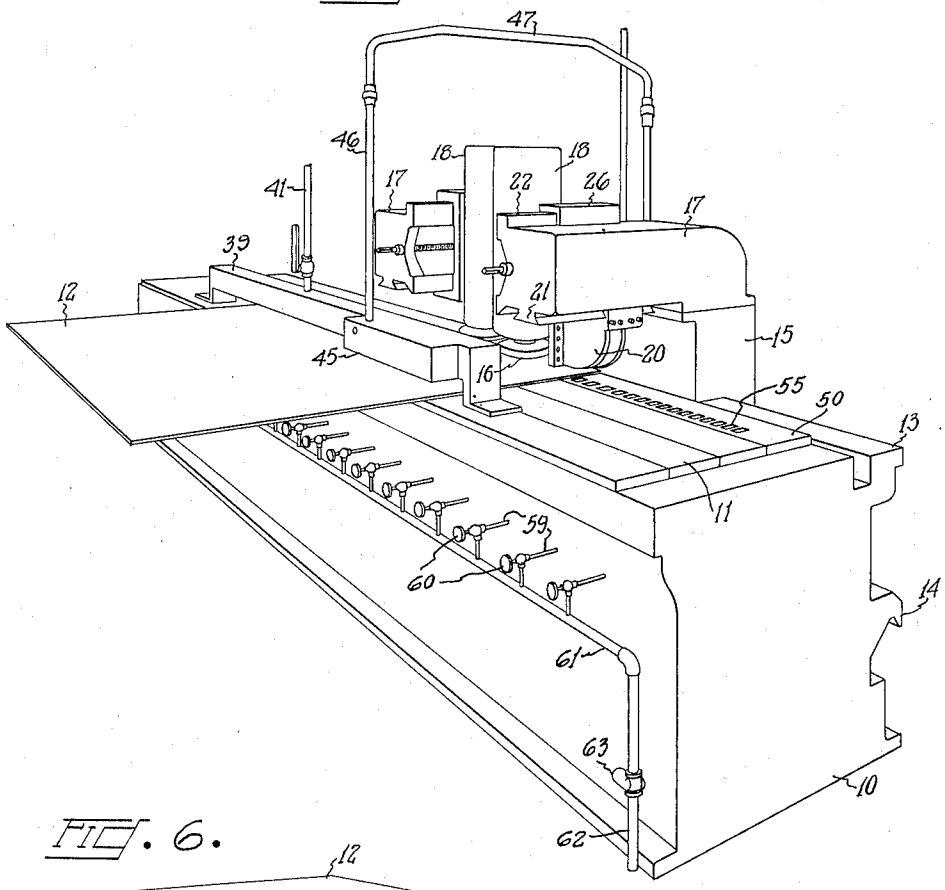


FIG. 6.

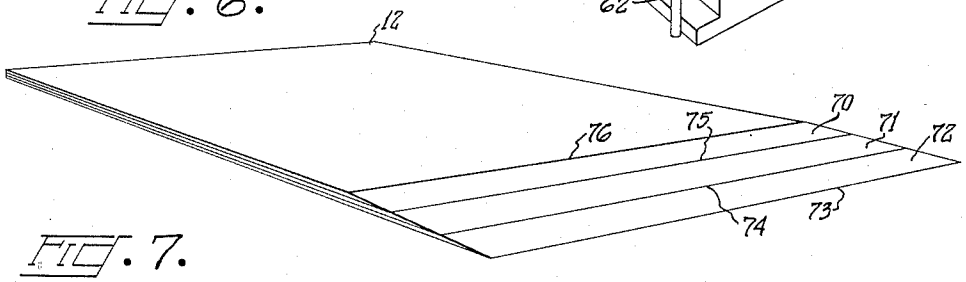


FIG. 7.



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VACUUM HOLD-DOWN FOR MACHINES OPERATING ON FLAT STOCK

Filed May 18, 1946 3 Sheets-Sheet 2

FIG. 2.

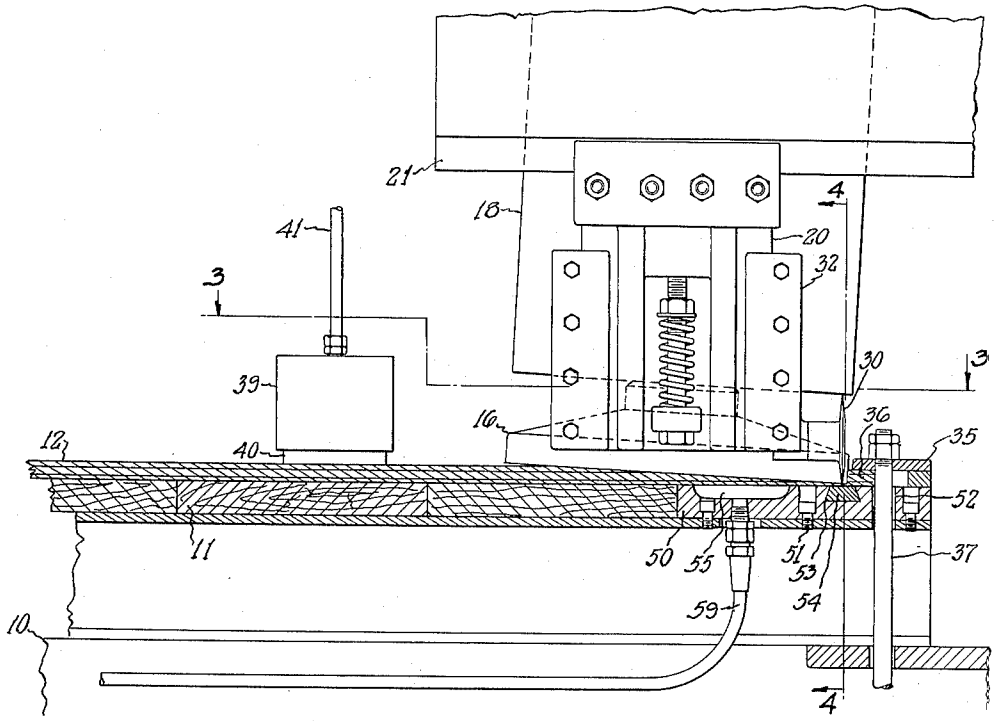
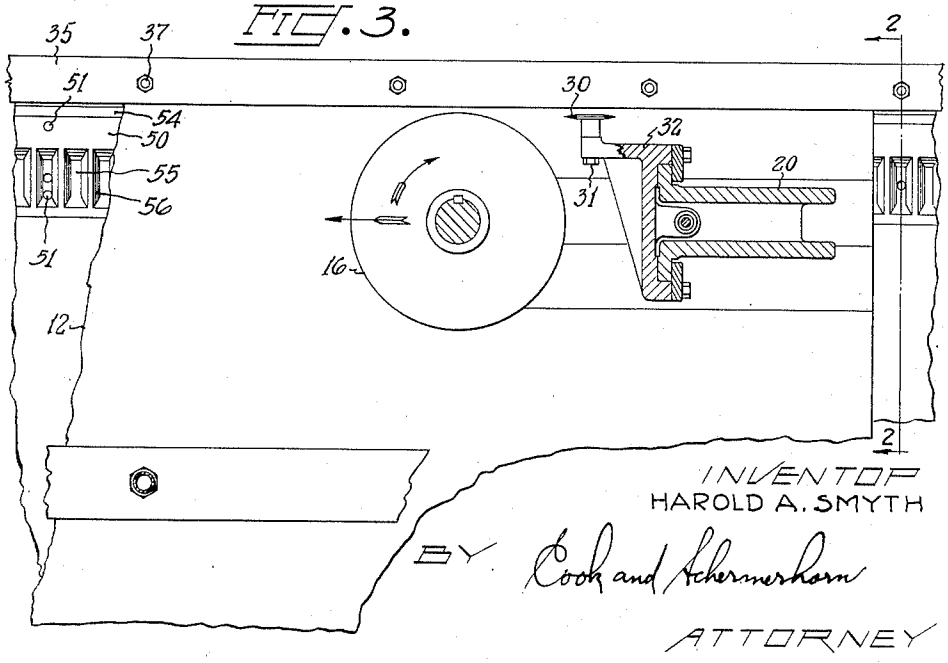


FIG. 3.



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Filed May 18, 1946 3 Sheets-Sheet 3

FIG. 4.

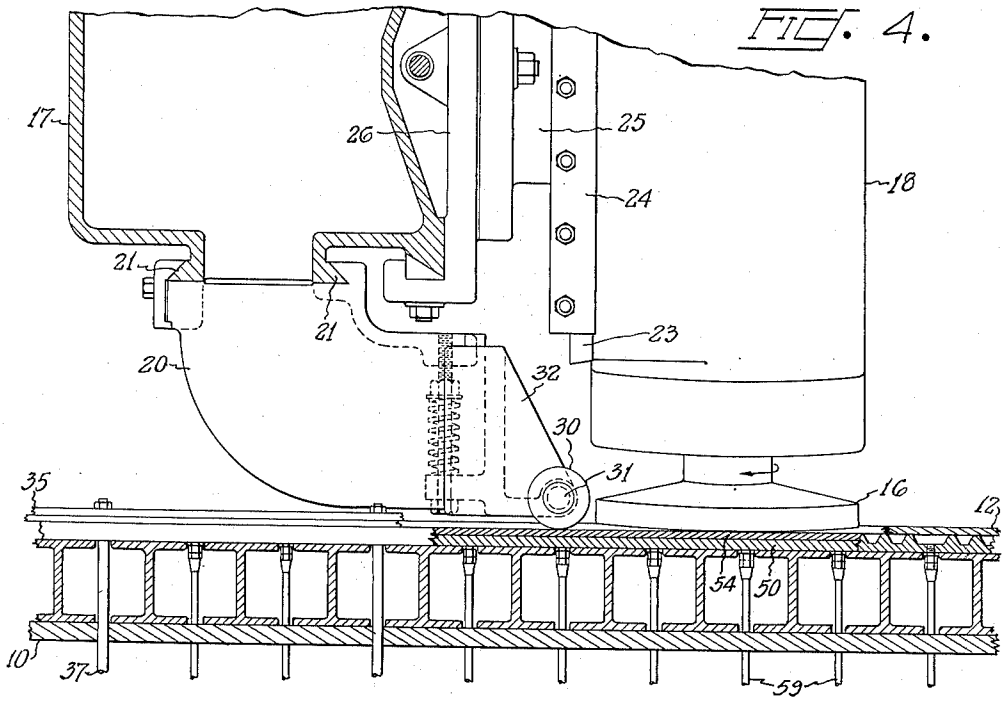


FIG. 5.

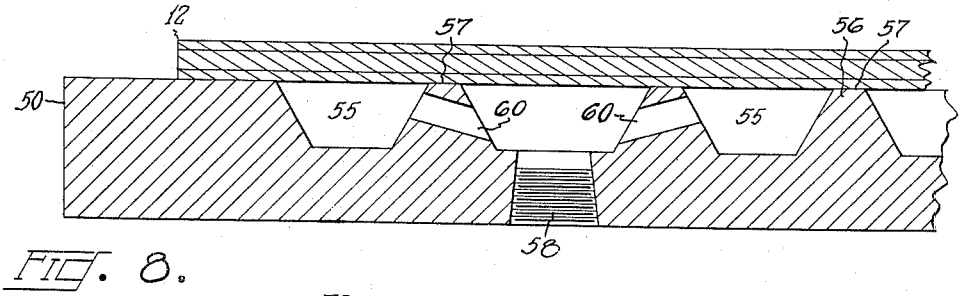
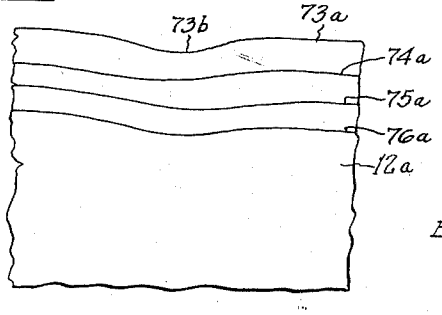


FIG. 8.



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UNITED STATES PATENT OFFICE

2,549,254

VACUUM HOLD-DOWN FOR MACHINES OPERATING ON FLAT STOCK

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Application May 18, 1946, Serial No. 670,717

2 Claims. (Cl. 144—278)

1

This invention relates to a novel vacuum hold down for holding flat stock and the like firmly against a table top or other supporting surface, the principles of the invention being illustrated with particular reference to a bevel milling machine, although it is to be understood that this application of the invention is referred to for purposes of illustration only, as the invention may be applied to advantage in other machines and equipment.

The invention will, therefore, be described in connection with a bevel milling machine for beveling the ends of wood veneer sheets and plywood panels. In the fabrication of large size plywood and veneer panels the expedient of scarf jointing of standard size sheets is utilized for making panels of sizes far beyond the capacity of conventional plywood and veneer manufacturing equipment. Machines have been developed for making scarf joints in production quantities, but the trade acceptance of such large panels depends to a considerable extent upon the quality of the joint. In order to make satisfactory scarf joints certain requirements must be met. A perfectly flat bevel is necessary to produce a scarf joint that will be adequately strong. Another requirement is that the toe or the tip of the scarf should be slightly blunt instead of thinning out to a ragged feather edge, so that the toe will ride slightly above the thick section of the scarf on the mating sheet when the two pieces are brought together. This is necessary in order to insure adequate pressure in the joint to obtain the close contact required for a successful bond between the bevel surfaces. The additional thickness thus provided in the joint compensates for the compression which occurs under the combined heat and pressure of the usual bonding process and prevents the formation of a depressed area at the joint.

In the beveling operation, flat panel stock is clamped on a flat supporting surface in a bevel milling machine. One or more end milling cutters are mounted on a movable carriage at the proper angle to form the desired bevel on the end of the sheet when the carriage is traversed thereacross. A high degree of precision in the machine elements is of little consequence if all parts of the stock in the path of the cutter are not held down firmly in a true plane on a rigid supporting surface, and considerable difficulty has been experienced in making the stock lie perfectly flat and true during the milling operation. When the stock is not held down flat under the bevel the wood has a tendency to spring up

2

toward the cutter head in certain regions causing an excessive depth of cut to be made in those parts. When this condition exists to a slight degree the toe or tip of the scarf is cut to a thin edge instead of a blunt edge, and when this condition is aggravated, the bevel surface is found to have a concave cut upon being flattened out in a scarf joint press which concavity results in an imperfect glue line wherein the two mating beveled surfaces do not come in contact with each other in such regions. When this condition is severe the contour of the cut causes the bevel surface to intersect the opposite face of the sheet to form a ragged edge instead of a straight, blunt toe line. Such bevels obviously produce a very poor quality of joint which is not acceptable to the trade.

The general objcet of the present invention is, therefore, to provide novel vacuum hold down means to hold flat panel stock and the like firmly against a supporting surface.

A further object is to provide a novel vacuum hold down means in the stock supporting table of a bevel milling machine, directly under the cutter heads.

Another object is to provide a plurality of suction cavities in a table top, having a novel arrangement of passages, valves and piping for applying suction to a certain number of said cavities in accordance with the size of the stock being handled.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings illustrating a preferred embodiment of the invention, it being clearly understood that the same are by way of illustration and example only, and are not to be taken as in any way limiting the spirit or scope of the invention. The spirit and scope of the invention are to be limited only by the terms of the appended claims.

In the drawings:

Figure 1 is a perspective view of a bevel milling machine incorporating a preferred embodiment of the novel vacuum hold down means forming the subject matter of the invention;

Figure 2 is a fragmentary cross sectional view through the machine shown in Figure 1 to illustrate the action of the cutter head in forming a bevel on the end of a plywood panel, this view being taken on the line 2—2 of Figure 3;

Figure 3 is a plan view showing certain parts in section on the line 3—3 of Figure 2;

Figure 4 is a sectional view taken on the line 4—4 of Figure 2;

Figure 5 is an enlarged sectional view showing the construction and arrangement of the vacuum cavities in the table;

Figure 6 shows a perfect bevel formed on a plywood panel by the machine illustrated in Figure 1;

Figure 7 illustrates a scarf joint uniting two panels beveled as shown in Figure 6; and

Figure 8 is a plan view of a panel having an imperfect bevel resulting from failure to hold the stock flat against the table under the cutter heads.

In carrying out the principles of the present invention the table upon which the stock is clamped is provided with a series of cavities adapted to be covered by the stock to form vacuum chambers directly beneath the cutter heads, so as to act upon the stock in the area over which the bevel is formed. These cavities are interconnected in groups by pipes leading to a suction line and valves are provided in these pipes for applying suction to those chambers which are covered by the stock. The suction line is connected through a control valve with a pump having sufficient capacity to quickly exhaust the air from those cavities which are covered by the stock so that atmospheric pressure is made effective over a considerable area of the panel directly on the surface to be beveled to make the panel lie true and flat against the table top. By reason of the large area which may be utilized in this manner an enormous force may be brought to bear upon the stock to counteract any tendency to warp out of a plane surface to cause the cutter head to make an uneven cut. The suction force is controlled coordinately with the clamps ordinarily employed to hold the stock so that the panel may be instantly released at the end of the cut by a simple valve manipulation.

Referring now to the several figures of the drawing, the numeral **10** in Figure 1 designates the bed of the machine which comprises preferably a massive and rigid iron casting. A hardwood table top **11** is bolted to the bed, and on this table top is shown a plywood panel **12** undergoing treatment by the machine. On the rear side of the machine bed are upper and lower carriage slides **13** and **14** respectively, to provide for traverse of a carriage **15** carrying two bevel milling cutters **16**. The upper slide **13** has a sliding surface in a horizontal plane to act as a support or track to bear all of the weight of the carriage assembly. The lower slide **14** has a sliding surface in a vertical plane to act as a support in maintaining the carriage assembly in its vertical position. These slides are machined to a high degree of precision, and the carriage base is provided with ways which are accurately machined and provided with adjustable gibs to insure precision movement of the carriage upon the bed in a straight line path of travel. Carriage travel is produced by an electric motor mounted on the carriage and operable through a variable speed drive and gear reduction assembly to effect driving engagement with a gear rack bolted to the machine bed.

The upper part of the carriage comprises a pair of rigid cast iron overarms **17**, each carrying a cutter motor assembly **18**. Each motor assembly **18** carrying a cutter head **16** is mounted vertically on a bracket **20** on which it may be raised and lowered with micrometer adjustment, and tilted toward either the front or back of the machine to produce the desired angle of bevel.

The bracket **20** has accurately machined ways with adjustable gibs riding on slides **21** and **22** for movement along the over-arms for proper positioning over the work. These motor assemblies and their manner of mounting on the two over-arms **17** are substantially identical except that the parts are reversed by reason of the fact that these assemblies are mounted to face each other between the over-arms.

Certain of these parts are shown in greater detail in Figure 4. In this view is shown a vertical slide **23** on the motor for vertical adjustment in the way **24**, which is in turn mounted on a rotatable plate **25** carried by a vertical portion **26** of the bracket **20**. It is this vertical portion **26** of the bracket **20** which engages and slides upon the previously mentioned slides **22**. By sliding the bracket **20** on the over-arm slides **21** and **22** the bevel may be cut at various distances from the end of the sheet. The angle of the bevel is controlled by the rotative position of the plate **25** on bracket member **26**, and the thickness of the toe end of the bevel is controlled by the vertical adjustment of the omtor assembly **18** in the way **24**.

In the present machine the direction of carriage traverse is from right to left as viewed in Figures 1 and 3, and from left to right in the rear view of Figure 4. The right over-arm is, therefore, in trailing position during traverse of the carriage, and the bracket **20** on this over-arm is provided with a disc cutter **30**, as shown in Figure 4 to sever the toe thickness of veneer left at the tip of the bevel. This cutter is necessary since for the reason previously mentioned it is desirable to have a blunt toe end rather than a feather edge on the bevel to form a good scarf joint. The cutter disc **30** is journaled on a horizontal pin **31** carried by a cutter bracket **32** mounted on the bracket **20**. Thus, the cutter disc **30** is in a trailing position with respect to the milling cutter heads **16** to sever the end of the sheet after the bevel has been formed.

Along the rear side of the table top between the cutter heads **16** and the carriage slide **13** is mounted a pneumatically operated clamping bar **35** for gripping a marginal portion **36** along the end of the stock or panel **12**. The bar **35** is attached to the upper ends of a plurality of vertical piston rods **37** associated with pneumatic operating means for exerting a substantial clamping effort upon the edge of the stock in response to valve control. The arrangement is preferably such that when the air pressure is released, the bar **35** will be raised by spring action to permit the removal of the severed end **36** after the traverse of the carriage, and to permit the easy insertion of the next panel. The piston rods **37** may function as stops against which the panel may be abutted to hold it square with the machine for a beveling operation, or wood stops may be provided closer to the cutter disc **30** to reduce waste. The milling heads **16** and the disc cutter **30** may be moved back quite close to the bar **35**, as shown in Figure 2, to make the severed end portion **36** relatively narrow to avoid waste.

Along the front side of the table top there is an elevated rail **39** carrying a plurality of pneumatically actuated clamping feet **40** to press the panel down on the front side of the cutter heads **16**. Air pressure for operation of the clamping feet **40** is supplied through a pipe **41** under control of a valve which also controls the action of clamping bar.

The motor switches and air valve required to

produce the above described operations may be actuated by push button controls on a control box 45 mounted on the rail 39 in front of the machine. Circuit connections are led from the control box through a stationary vertical conduit 46 and flexible conduit sections 47. However, to avoid traveling wires the cutter motors 18 may be controlled by manual switches directly on the motors, and the air valve may also be shifted manually, without remote control.

The machine elements thus far described constitute the basic structure of one particular type of conventional bevel milling machine, there being many different types in present day use. In these machines considerable difficulty has been experienced in obtaining a true and flat bevel to make high quality scarf joints between plywood panels. The present invention, therefore, relates to pneumatic hold down means to act in conjunction with the previously described clamps to maintain the stock absolutely true and flat against the table top under the bevel. When this is done the bevel will be true because the stock cannot warp or spring up into the milling cutters to produce an excessive depth of cut which will form concave areas when the sheets are flattened out in a scarf joint press. According to the present invention, the rear board of the table top 11 is replaced by a cast aluminum member 50 of the same thickness and width as the original board. Provision is made in this member for securing bolts or cap screws 51 (Figs. 2 and 3) at closely spaced intervals to hold the member true and flat on top of the bed of the machine with its upper surface exactly in the plane of the table top 11. Openings 52 are provided for the piston rods 37 associated with the clamping bar 35, and along the front edge of this clamping bar the member 50 carries a dovetail groove 53 filled with babbitt material 54 forming a base or track under the cutter wheel 30, as shown in Figure 2.

Most of the remainder of the top surface of the member 50, not covered by the clamping bar 35 and the babbitt track 54, is formed into a series of cavities 55 of generally rectangular shape and having upstanding partition walls 56 therebetween. The sides of the walls 56 are inclined to produce thick sections for strength and rigidity in the member 50, leaving relatively narrow horizontal bridge surfaces 57 in the plane of the table top.

When a piece of stock such as the plywood panel 12 is placed in position on the table top 11 it covers a certain number of these cavities to form closed chambers from which the air is evacuated by a suction pump. By reason of the narrowness of the bridges 57 the pressure differential thus established is caused to act over substantially the entire area across the sheet embraced by the continuous succession of cavities. The individual cavities are also relatively narrow to provide close spacing between the bridge surfaces to adequately support the stock under the weight of atmospheric pressure.

The cavities are interconnected in groups of three, as shown in Figure 5 so that suction may be applied along the length of the member 50 in accordance with the width of the stock being treated. The central cavity of each group is, therefore, tapped at 58 for connection with a suction pipe 59, and the walls of this cavity are apertured at 60 to evacuate the air from the adjacent cavities. The pipes 59 lead cut to the front of the machine to valves 60 by which they are connected with a suction mainfold 61, whereby the width of the table top to which suction is

applied may be controlled in three cavity increments. It will be noted in the drawings that the central cavity of each group of three is made wider than the flanking cavities, but these relative proportions and general pattern may be varied without departing from the spirit of the invention. A suction pump is connected through a pipe 62 with the manifold 61, this pump being of sufficient capacity to establish a relatively low pressure in the cavities which are covered by stock even if valves are opened to pipes connected with several end cavities which may be uncovered. The capacity of the suction pump, the size of manifold 61, and the size of pipes 59 may be chosen so that the uncovering of a few cavities will not materially affect the degree of vacuum produced in the cavities covered by stock.

The suction or hold down effect produced by the cavities 55 is controlled by a solenoid actuated valve 63 in the suction line 62 to operate simultaneously with the valves which control the air pressure supply for the clamping bar 35 and clamping feet 40. These valves are preferably all solenoid actuated valves operated by a single push button control on the control box 45, although of course manual valves may be used. With all of the valves 60 closed, which are connected with uncovered cavities, the suction limit of the pump is quickly established when the valve 63 is opened in the line 62. Thus, a hold down pressure which may attain a possible maximum of 14.7 pounds per square inch may be brought to bear over substantially the entire area of the bevel, making it impossible for the stock to rise into the cutter head to produce a concave bevel surface.

Suitable means, such as a pressure regulating valve, may be employed between the suction pump and the manifold 61 to reduce the degree of vacuum for holding more flexible stock. Where the cavities are large the degree of vacuum should be controlled to prevent the panel from being drawn into the cavities to form a concave surface instead of a flat surface on the top side. The deflection of the panels in this manner may be controlled both by varying the degree of vacuum and by varying the size of the cavities.

All bevel milling machines are not provided with clamping means for the extreme end of the panel and in such machines the present hold down device is especially advantageous.

Figure 6 shows the panel 12 after it has been properly beveled for a scarf joint. This happens to be a three-ply panel wherein the individual veneer sheets are exposed on the bevel surface at 70, 71 and 72. When the bevel is flat and true, the toe edge 73 is blunt, of uniform thickness, and forms a true straight line across the sheet. The glue lines 74 and 75 between the respective veneers are likewise true and straight, and parallel with the edge 73. The heel line 76 where the plane of the bevel intersects the top surface of the panel is also straight and parallel with the glue lines and the edge 73.

Figure 7 illustrates a scarf joint between two panels 12 and 12′ having beveled ends 77 overlapped and bonded together to form a long panel.

Figure 8 illustrates a poorly formed bevel which is frequently produced on the above described machine when the present vacuum hold down means is not employed. Here it will be observed that the clamping bar 35 and clamping feet 40 were ineffective to hold all parts of the panel 12a firmly and flatly against the table top. In spite of the clamps a portion of the sheet buckled up

slightly above the table top to cause the bevel milling cutter to take a deeper cut in that region. As a result the toe edge **73***a* is not straight and blunt, but runs into a feather edge at **73***b* where excessive material has been removed. Likewise, the glue lines **74***a* and **75***a* and the heel line **76***a* trace contour lines on the bevel surface indicative of the bulge in the panel at the time of milling. This bevel surface is, of course, flat and true when formed, but when placed in a scarf joint press with the bevel surface on another panel the panels will be flattened out leaving a cavity between the juxtaposed bevel surfaces in the joint. Such a cavity interrupts the continuity of the glue line so as to make an imperfect bond and produces an irregular surface on the panel. By the use of the present vacuum hold down means these difficulties are overcome, whereby uniform high quality scarf joints may be produced consistently.

Various changes may be made in the construction and arrangement of parts in the present improvement, and all such modifications within the scope of the appended claims are included in the invention.

Having now described my invention and in what manner the same may be used, what I claim as new and desire to protect by Letters Patent is:

1. In a wood working machine having a table top adapted to support stock thereon and having a wood treating mechanism mounted for traverse across said table top, a series of cavities in said table top extending throughout the length of said traverse and adapted to be covered by said stock to form closed chambers in a number of said cavities depending upon the width of said stock, a suction manifold, said cavities being arranged in a series of groups, the cavities in each group being communicatively connected with each other and out of communication with cavities in other groups, a pipe connecting each group of said cavities with said manifold, valves in said pipes to cut off the suction from those groups of cavities not covered by stock whereby the closed chambers under said stock may be evacuated to a relatively low pressure to hold stock of different widths firmly against said table top, and a valve for controlling the suction in said manifold.

2. In a wood working machine having a table top adapted to support stock thereon and having means for engaging two edges of said stock in clamped relation thereto and having a wood treating mechanism mounted for traverse across said table top intermediate said two edges, a series of cavities disposed in said table top extending in the path and throughout the length of said traverse and adapted to be covered by said stock to form closed chambers when covered by said stock, the number of said closed chambers depending upon the width of said stock, said cavities being arranged in a series of groups, the cavities in each group being communicatively connected with each other and out of communication with cavities in other groups, means communicatively connecting each group of cavities with a source of suction, valve means to cut off the suction from those groups of cavities which do not contain any closed chambers, whereby condition of low pressure may be created in those cavities closed by the stock to effectively hold stock of different widths firmly against said table top in the path of said wood treating mechanism.

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