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Porter et al.

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[54] VENEER MACHINE ROLLER PRESSURE BAR ASSEMBLY

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[51] **Int. Cl.** B27l 5/04

[58] **Field of Search** 144/209–213

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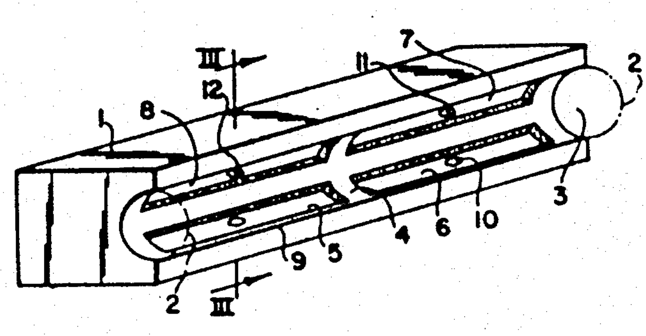
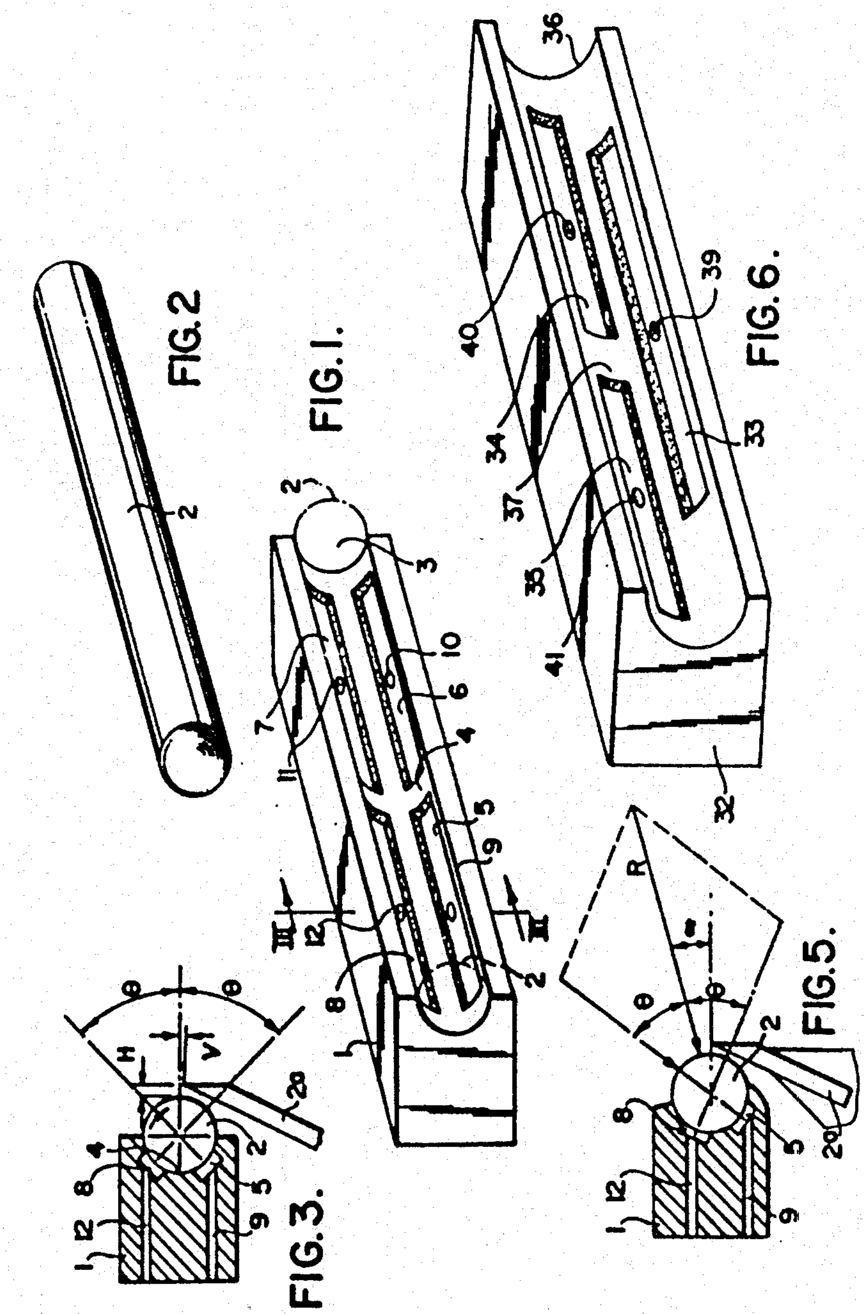
[57] **ABSTRACT**

A veneer pressure bar assembly is provided wherein the pressure bar or back-up rollers for the pressure bar are supported by hydrostatic lubrication in a housing. The lubricant which may be oil, water, oil and water, or air is fed to at least three slot shaped pockets extending along two paths along the housing (at least one slot along one path and at least two along the other path) on each side of the resultant force on the roller being lubricated. The slot or slots along each path occupy a major portion of that path.

7 Claims, 8 Drawing Figures





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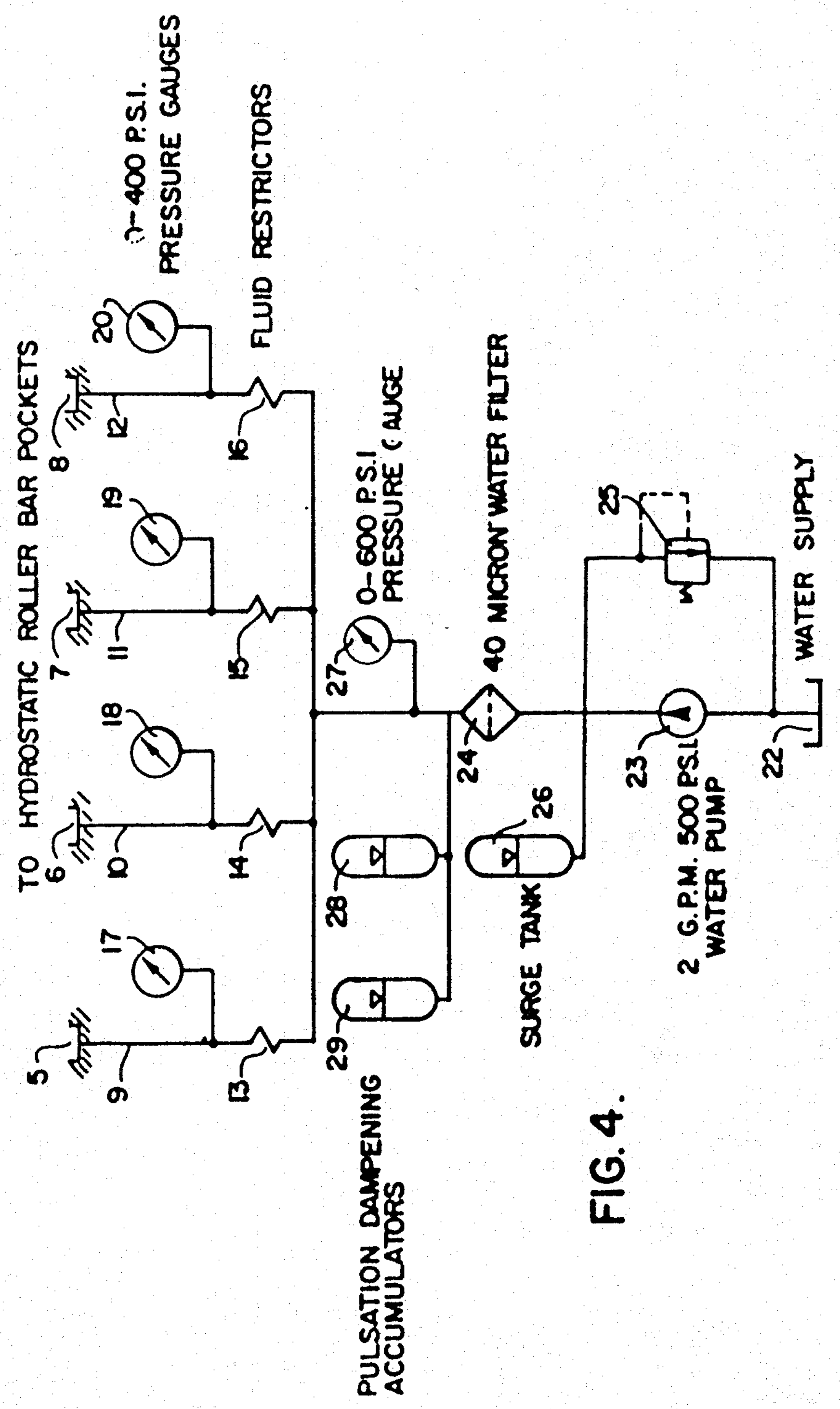

FIG. 4.

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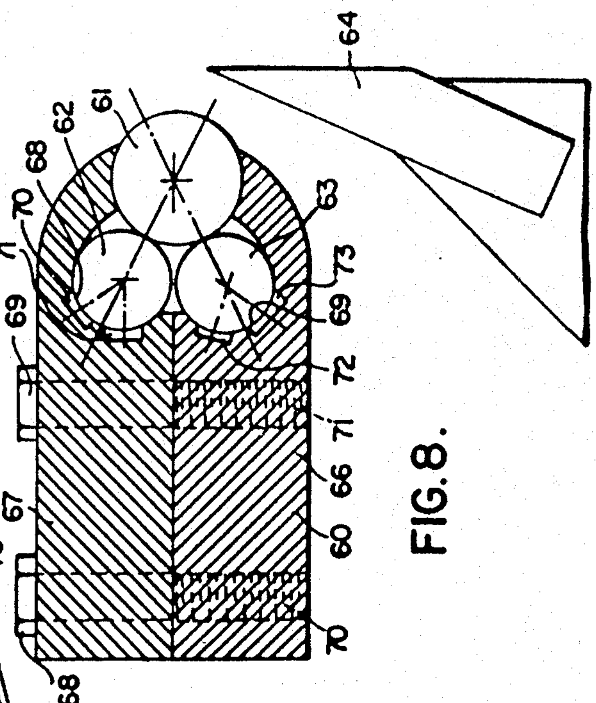

FIG. 8.

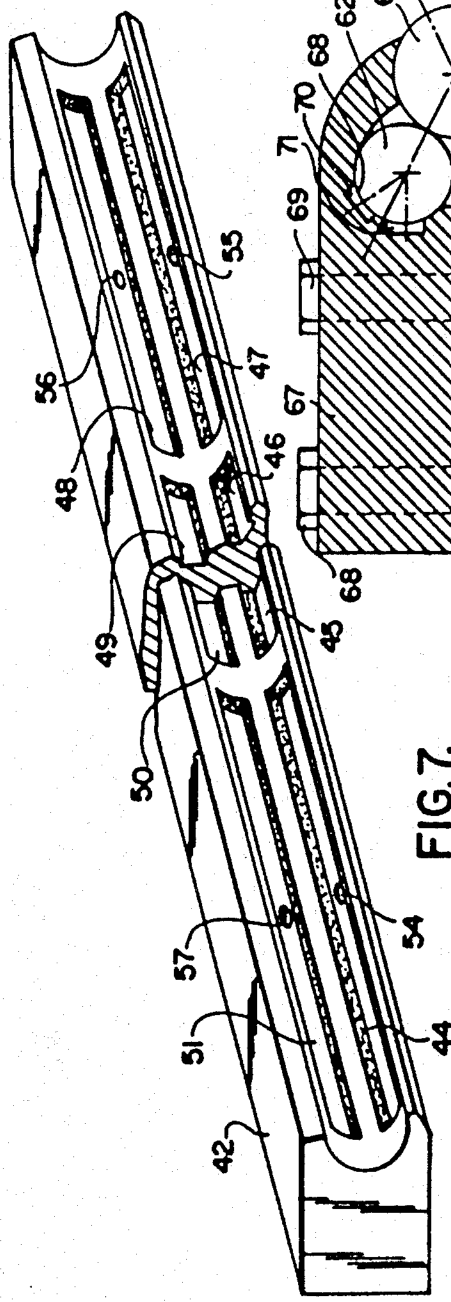

FIG. 7.

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VENEER MACHINE ROLLER PRESSURE BAR ASSEMBLY

This invention relates to a veneer machine roller pressure bar assembly.

The introduction of a wedge-shaped knife into a rotating log, as in veneer peeling results in a complex stress pattern in the wood which can lead to failure in the wood being peeled by either tension, compression or shear stresses therein. Each failure brings with it some machining defect, such as veneer lathe checks, thickness variation of the veneer, or torn grain in the veneer.

In veneer peeling, it has been found desirable to modify the stress pattern in the wood being peeled by introducing a pressure bar next to the knife edge. Experience has shown, however, that such a bar is subject to excessive wear, which results in high maintenance costs.

One type of pressure bar in use is known as a flat pressure bar, and this comprises a flat bar with the wood bearing surface inclined at an angle of approximately 14° to a tangent to the log. The inclined surface is arranged to receive and compress the wood as it approaches the knife. A modified form of the flat pressure bar, known as the double-surfaced nosebar, has the inclined surface cut away adjacent to the knife to form an inclined surface lying more or less along the face of the knife.

Flat pressure bars have a disadvantage in that slivers of wood tend to accumulate between the pressure bar and the log, which results in the veneer having a scoured surface or the veneer being over-compressed.

In order to overcome the disadvantages of flat pressure bars, roller pressure bar assemblies have been used, one form of roller pressure bar assembly comprises a single roller, which is rotatably held within a housing by two lips on the housing. Adjusting screws behind the roller pressure bar permit the distance between the lips to be adjusted, so that there is sufficient clearance between the roller pressure bar and the block for the roller pressure bar to be rotatable. Lubricant, which may be water or oil, or a mixture of both, is introduced at approximately two feet intervals along the length of the bar. Such a lubricating system has failed to prevent high frictional forces from being developed along the upper and lower lips. For this reason a driving mechanism has been used for rotating the roller pressure bar in approximate synchronism with the cutting speed of the veneer. Driving the roller pressure bar necessitates a driving gear on the end of the roller pressure bar, and this limits the minimum diameter of the log core remaining, after the veneer has been cut from it, to about 1.5 inches above the diameter of the log chucks, this is wasteful.

To reduce loss in veneer yield associated with a single roller pressure bar, another form of pressure bar assembly known as a double roller bar assembly has been used. In the double roller bar assembly a roller pressure bar is rotated by means of a driven back-up roller disposed in the block and behind the roller pressure bar. The back-up roller is driven through a gear and motor assembly and the roller pressure bar is driven by frictional contact with the back-up roller. To prevent galling, the roller pressure bar and back-up roller are made from dissimilar materials, usually phosphor bronze, silicon bronze or manganese bronze for the roller pressure bar, and steel for the back-up roller. Although the advantages of a back-up roller are well recognized, a major problem still exists in that, under normal West Coast mill conditions, the rate of wear of the roller pressure bar is still so great that the roller pressure bar should be replaced about every 2 weeks. This necessitates a considerable annual maintenance cost in labor and material.

It is an object of the invention to provide a veneer machine roller pressure bar assembly in which wear on the roller pressure bar is reduced and thus the annual maintenance cost in labor and material are also reduced.

It is a further object of this invention to provide a roller bar assembly in which the roller bar will rotate substantially in synchronization with the veneer being peeled.

Another object of the invention is to eliminate the drive system in a roller bar assembly, for rotating the roller bar and also to eliminate the means for synchronizing the roller bar surface speed with that of the veneer being produced.

According to the invention, there is provided a veneer machine roller pressure bar assembly, comprising a housing having a longitudinally extending roller retaining, generally arcuate shaped cavity providing a roller bar bearing surface with lubricating pockets, said lubricating pockets each being separately bounded by said bearing surface, a roller rotatably supported in said cavity for substantially the load bearing length of said roller and as a sliding fit with said bearing surface, fluid restrictor means connected to fluid inlets to said pockets, and means for delivering lubricant fluid via said fluid restrictor means to said pockets at approximately a constant pressure to maintain a film of escaping lubricant fluid between said bearing surface and said roller, for hydrostatic lubrication of said roller, and wherein said lubricating pockets are in the form of slots, at least one of said pockets extends along a first longitudinal path along said cavity, at least two of said pockets extend along a second longitudinal path of said cavity, said first and said second paths are parallel to and circumferentially spaced on either side of the resultant force on said roller when it is in operation, and the pocket lengths occupy a major portion of the length of the bearing surface.

The purpose of the fluid restrictor means is to provide the bearing with stiffness, so that it may accommodate changes in the applied load. The operating characteristics of the bearing depends on the manner of fluid restriction. Generally the order of increasing stiffness is as follows:

Capillaries and needle valves
Orifices
Constant flow valves
Pressure sensing valves

Furthermore, the stiffness of the bearing increases as the ratio of supply pressure to pocket pressure increases. Ideally this ratio is maintained greater than 1 and is suitably chosen as 2, although higher values are sometimes used if the pumping capacity is available.

In the accompanying drawings which illustrate, by way of example, embodiments of the invention,

FIG. 1 is a perspective view of a veneer machine roller pressure bar housing,

FIG. 2 is a perspective view of a roller pressure bar for the housing shown in FIG. 1,

FIG. 3 is a sectional end view III–III, FIG. 1 with the roller pressure bar shown in FIG. 2 in position,

FIG. 4 is a flow diagram for supplying water, as a lubricant, to the housing shown in FIG. 1,

FIG. 5 is a sectional end view similar to that shown in FIG. 3, but of a different roller pressure bar assembly thereto,

FIG. 6 is a perspective view of a different roller pressure bar housing to that shown in FIG. 1.

FIG. 7 is a perspective view of a further different roller pressure bar housing to that shown in FIG. 1, and

FIG. 8 is a sectional end view of a roller pressure bar assembly wherein the roller pressure bar is supported by two back-up rollers.

IN FIGS. 1 to 3 there is shown a housing 1, a roller pressure bar 2 of the same length as the housing, and a cutting blade 2*a*. The housing 1 has a longitudinally extending roller retaining, generally arcuate shaped cavity 3 providing a roller bar bearing surface 4. The roller bearing surface 4 has lubricating pockets 5 to 8 each separately bounded by the bearing surface 4.

As shown in FIG. 3, the roller 2 is rotatably mounted in the cavity 3 as a sliding fit with the bearing surface 4, with the pockets 5 to 8 each having a lubricant passage 9 to 12 respectively leading to them (see FIG. 4.) The pockets 5 to 8 are symetrically disposed at $\theta = 45°$ in this particular instance, although the angle θ may be within the range 10° to 70°.

In FIG. 4, each of the passages 9 to 12 have means for delivering lubricant to the pockets 5 to 8 at an approximately constant pressure, after first passing through fluid restrictors **13** to **16** respectively, and are connected to pressure gauges **17** to **20** respectively. The fluid restrictors may be orifices, capillaries, needles valves or pressure sensing valves. Water from a water supply **22** is delivered by a pump **23**, as a lubricant for the pockets **5** to **8**, via water filter **24**. A relief valve **25**, surge tank **26**, a pressure gauge **27**, and two pulsation dampening accumulators **28** and **29** are connected to the delivery from the water supply **22** to the needle valves **13** to **16**, which are used in this embodiment.

The apparatus shown in FIGS. **1** to **4** was arranged as shown in an experimental veneer lathe, which used a pressure roller bar 5 inches in length. This lathe is capable of peeling wood disks, 4 inches long and up to 16 inches in diameter, at an infinitely variable rate of speed of between 0 and 40 feet per minute. A 5 horse power hydraulic motor in conjunction with a 50:1 speed reducer is used in this lathe to rotate the wood disk and advance them into the stationary cutting blade **2*a***.

The pump **23** used was a two-cylinder piston type pump with a rated output of 2 G.P.M. at 500 psi. The pulsation dampening accumulators **28** and **29** were to reduce pressure pulsations from the pump **23**. The filter **24** was a 40μ water filter, and was used to prevent plugging of the restrictors **13** to **16**. For these tests, needle valves were used as restrictors **13** to **16**.

The four pressure gauges **17** to **20** were calibrated from 0 to 400 psi, and were used to monitor the pressures in the four pockets **5** to **8**.

The roller bar **2** (FIGS. **1** to **3**) used was 0.750 inches in diameter, constructed of mild steel, and rotated in a steel housing **1** having a 0.375 inch radius cavity **3**. The roller bar **2** and housing **1** were purposely made of the same material to accentuate any possible seizing which might occur. The land width was maintained constant at 0.165 inch, and tests were carried out with pockets **5** to **8** of depths of 1/16, ⅛ and ¼ inch each for a wide range of water supply pressures to the pockets **5** to **8** and water flow conditions.

The primary observation during the tests was to determine if seizing of the roller bar **2** occurred under relatively low water pressure and flow conditions. Measurements of the average water pressures in the pockets **5** to **8** were recorded, and the quality of the veneer was assessed by measuring the veneer roughness, the veneer thickness variation, and the average lathe-check depth.

A minimum of two wood disks was used to obtain data for any one set of conditions. Measurements were not taken until four complete cutting revolutions of the wood disk were completed to ensure that a dynamic cutting equilibrium had been obtained.

TABLE 1.—RESULTS OF TESTS ON HYDROSTATIC ROLLER BAR 1 WITH 1/16-INCH-DEEP POCKETS

Feed, in.	Lathe settings H, in.	Lathe settings V, in.	Supply pressure, p.s.i.	Flow per pocket, ml./sec.	Observed pocket pressures P_1, p.s.i.	P_2, p.s.i.	P_3, p.s.i.	P_4, p.s.i.	$t_{avg.}$ in.	$t_{std.dev.}$ $\times 10^{-2}$ in.	Roughness, 1 unit=.005 in.	Lathe-check depth, percent of thickness
1/16	.054	.094	200	5.0	30	60	60	30	.0607	.195	2	10
			200	10.0	60	100	100	60	.0633	.134	2	15
			300	10.0	75	100	100	75	.0616	.184	2	10
			400	5.0	30	85	85	30	.0629	.137	2	10
			400	10.0	70	110	100	70	.0623	.170	2	10
⅛	.106	.086	300	7.5	40	110	110	50	.1215	.435	2	30
¼	.231	.122	200	5.0	30	70	80	40	.2500	.052	2	60
			200	10.0	70	110	90	70	.2485	.190	2	70
			400	5.0	30	110	100	40	.2489	.166	2	70
			400	10.0	75	120	110	75	.2503	.195	2	80

NOTE.—Satisfactory operation, no wear occurred under test condition.

TABLE 2

[Results of tests on hydrostatic roller bar 2 with ⅛-inch-deep pockets]

Feed, in.	Lathe settings, in. H	V	Supply pressure, p.s.i.	Flow per pocket, ml./sec.	Observed pocket pressures, p.s.i. P_1	P_2	P_3	P_4	$t_{avg.}$ in.	$t_{std. dev.}$ $\times 10^{-2}$ in.	Roughness, 1 unit equals .005 in.	Lathe-check, depth, percent of thickness	Remarks
1/16	.054	.007	200	2.5	10	10	10	0	.0671	.401	1	10	Bar revolved intermittently.
			200	5.0	40	60	60	40	.0610	.275	2	15	Satisfactory operation, no wear.
			200	10.0	60	80	80	70	.0622	.554	3	15	Satisfactory operation, no wear.
			300	10.0	75	100	110	100	.0636	.671	2	15	Satisfactory operation, no wear.
			400	2.5	0	20	20	0	.0671	.886	2	15	Bar revolved intermittently.
			400	5.0	30	75	75	30	.0636	.173	2	20	Satisfactory operation, no wear.
			400	10.0	70	100	110	85	.0634	.776	2	15	Satisfactory operation, no wear.
⅛	.106	.086	300	7.5	60	120	120	60	.1274	.384	2	40	Satisfactory operation, no wear.
¼	.231	.122	200	5.0	40	80	80	50	.2486	.332	2	80	Satisfactory operation, no wear.
			200	10.5	60	105	120	70	.2480	.277	2	60	Satisfactory operation, no wear.
			400	5.0	40	105	120	30	.2409	.316	2	60	Satisfactory operation, no wear.
			400	10.0	50	100	110	40	.2496	.319	2	70	Satisfactory operation, no wear.

NOTE.—Satisfactory operation; wear occurred only with 2.5 ml./sec. flow rate, when bar revolved intermittently.

TABLE 3

[Results of tests on hydrostatic roller bar 3 with ¼-inch-deep pockets]

Feed, inches	Lathe settings, in. H	V	Pressure, p.s.i.	Flow per pocket, ml./sec.	Observed pocket pressures, p.s.i. P_1	P_2	P_3	P_4	$t_{avg.}$, in.	$t_{std.dev.}$, $\times 10^{-2}$ in.	Roughness, 1 unit equals .005 in.	Lathe-check depth, percent of thickness
1/16	.054	.094	200	5.0	5	20	20	25	.0618	.042	3	10
			200	10.0	20	50	50	40	.0635	.212	2	10
			300	10.0	40	60	60	70	.0629	.087	2	15
			400	5.0	10	35	40	30	.0641	.372	2	10
			400	10.0	30	70	70	70	.0655	.165	2	10
⅛	.106	.086	300	7.5	25	60	60	45	.1255	.085	2	10
¼	.231	.122	200	5.0	25	40	50	25	.2489	.285	2	80
			200	10.0	40	75	100	50	.2522	.498	2	90
			400	5.0	25	75	75	25	.2518	.355	2	80
			400	10.0	50	100	110	60	.2502	.193	2	80

NOTE.—Satisfactory operation, no wear occurred under test condition.

The results of the tests are set out in the following tables 1 to 3 where:

Feed is the forward advance of the disk into the knife per revolution of the disk.

H is the horizontal roller bar opening (see FIG. 3).

V is the vertical roller bar opening (see FIG. 3).

Supply pressure is the water pressure indicated by the gauge 27.

P_1, P_2, P_3 and P_4 are the water pressures in the pockets 5 to 8 respectively as indicated by the gauges 17 to 20 respectively.

t avg is the average thickness of the veneer produced.

t std. dev. is the standard deviation of the readings of veneer thickness.

Roughness is defined in terms of the reference standard maintained at the Vancouver Forest Products Laboratory, Vancouver, British Columbia. The scale of roughness is from 0 (smooth) to 9 (very rough) in units of 0.005 inch.

Lathe-Check depth is the percentage thickness of the veneer to which the majority of the lathe checks penetrate.

It will be seen that satisfactory operation of this short, 5-inch long pressure bar 1 was obtained with all of the tests except those where the water flow rate was 2.5 ml/sec. At this small flow rate, the thickness of the film of water between the roller pressure bar 2 and the bearing surface 4 was less than the surface roughness of the roller bar housing 1 and so intermittent abrasion occurred of the roller pressure bar 2. The test results show that when water flow rates of 5.0 ml/sec and greater are used, satisfactory operation of the roller pressure bar 2 was achieved at water supply pressures ranging between 200 and 400 psi. Thus the proper water flow rate for any given machine will be a compromise between a large film of water thickness between the roller pressure bar 2 and bearing surface 4, the available pump capacity of the pump 23, and the adequacy of drainage conditions around the veneer lathe.

The quality of the veneer was not affected by changes in the depth of the pockets 5 to 8, and it will be noted that in the tests the standard deviation of the thickness variation was generally less than 0.003 inch. It was observed during the tests that substantially perfect synchronization occurred between the veneer velocity and the roller pressure bar peripheral velocity. From this it would appear that shear stresses along the upper surface (that is the surface contacted by the roller pressure bar) will be less with the invention than with known types of roller pressure bar assemblies, and this should be reflected in an improvement in the quality of the veneer.

It will be observed from the tests that the water pressure in the two lower pockets 5 and 6 always exceeded that in the two upper pockets 7 and 8. In fact for the ¼ inch thick layer veneer the ratio of pressures in the two lower pockets 5 and 6 to those in the two upper pockets 7 and 8 was approximately 1.75 to 1.00. This can possibly be due to the resultant force R on the roller pressure bar 2 acting not horizontally but at an angle as shown in FIG. 5.

Referring now to FIG. 5, where parts similar to those shown in FIGS. 1 to 4 are given the same reference numerals, tests were carried out to determine whether equal water pressures in the four pockets could be achieved by symmetrically placing the pockets at an angle to the resultant force R acting on the pockets. The resultant, R, acts at an angle α with the horizontal. It was found that the water pressures in the four pockets were substantially equal when $\theta = 37°$ and $\alpha = 15°$, and from this can probably be assumed that the resultant force R on the roller pressure bar 2 was applied at this angle α. However, θ may be within the range 10° to 70° and α within the range 0° to 45°.

Although these tests were made on bars ¾ inch in diameter, other tests were made with 1¼ and 2 inch diameter roller bars. Again no evidence of wear was found and the bars rotated in what appeared to be perfect speed synchronization with the veneer being peeled.

In FIG. 6 there is shown a housing 32 having three pockets 33 to 35 disposed in an arcuate cavity 36 bounded by a bearing surface 37. The three pockets 33 to 35 have lubricating passages 39 to 41 respectively, which are connected to a similar lubricating system to that shown in FIG. 4.

A roller pressure bar of the type shown in FIG. 2 is fitted in the cavity 36 and the pressure bar assembly thus provided functions in the same manner as that described with reference to FIGS. 1 to 4.

In a different embodiment to that shown in FIG. 6 the positions of the pocket 33 and the pockets 34 and 35 are reversed, in other words the housing 32 may be used inverted from the position shown in FIG. 6. The pockets 33 to 35 may also be disposed symmetrically about and axis at an angle α as shown in FIG. 5.

FIG. 7 shows a roller pressure bar 60 inches long and ¾ inches in diameter which was successfully tested in the pressure bar housing 42 which flows of 3 G.P.M. at 500 psi using water as the lubricant. The housing 42 has eight pockets 44 to 51 which are equal in length. The pockets 45, 46, 49 and 50 are only partly shown because the housing is shown broken at the center. Each of the pockets 44 to 51 has a lubricating passage, four of which are shown and designated 54 to 57 for the pockets 44, 47, 48 and 51 respectively. These pockets are connected to a similar lubricating system as that shown in FIG. 4, except that the pump capacity was increased to 5 GPM.

The housing 42 with the roller pressure bar assembled therein functions in a similar manner to the assembly shown in FIG. 3.

If desired the pockets 44 to 51 may be disposed symmetrically about an axis at an angle α to the horizontal as shown in FIG. 5.

While needle valves 13 to 16 were used in the experiments, other types of fluid restrictors such as constant flow control valves, pressure sensing valves, orifices, or capillary tubes may also be used.

In FIG. 8 there is shown a housing 60, a roller pressure bar 61, two back-up rollers 62 and 63, and an outline of a cutting blade 64. The housing 60 is composed of two parts 66 and 67 held together by bolts 68 and 69 which are screwed into threaded holes 70 and 71 respectively, in part 66. The roller pressure bar 61 and back-up rollers 62 and 63 are rotatably held captive between the two parts 66 and 67. The arcuate shaped cavities 68 and 69 containing the rollers 62 and 63 respectively, are provided with pockets 70 to 73 which are similar to the pockets 5 to 8 (FIGS. 1 to 5). The pockets 70 and 71 are symetrically disposed about a centerline passing through the axis of rollers 61 and 62 at an angle B = 30°. The pockets 72 and 73 are symmetrically disposed at the same angle β° about a centerline passing through the axis of rollers 61 and 63. The angle B may be within the range 15° to 60°.

The assembly shown in cross-section in FIG. 8 may have the pockets 70 to 73 in any one of the configurations shown in FIGS. 1, 6 or 7 and they are connected to a hydraulic system similar to that shown in FIG. 4.

It will be appreciated that in any of the embodiments the pockets need not be of equal length.

Advantages of veneer pressure bar assemblies of the invention are:

1. There is a significant reduction in the wear of the roller or rollers during operation in comparison with known pressure bar assemblies.

2. The peripheral speed of the pressure bar roller is substantially the same as the speed of the veneer without the need of the complex and expensive electrical feedback loops with tachometer followers and d.c. motors of other pressure bar assemblies.

3. The drive system for rotating the roller bar is eliminated.

It will be noted that in FIGS. 1 to 7, the roller bars are supported for substantially their entire lengths by the bearing surfaces in the cavities. The load bearing lengths of the rollers, that is the length compressing the veneer bolt, in each of the embodiments described is nearly the total length of the roller, however, if the load bearing length was less than the total length of the roller, then substantially all of the load bearing length alone need be supported by the bearing surface.

It will be noted that the pocket lengths, that is the total length of the pockets or length of a pocket along any one path along the bearing surface in each of the embodiment is a major portion of the length of the bearing surface. For example, the sum of the lengths of pockets **34** and **35** (FIG. **6**), i.e. the pocket length along one path, is a major portion of the length of bearing surface **37**, similarly the length of pocket **33** i.e. the pocket length along another path is also a major portion of the lengths of the bearing surface **37**.

The lubricant may be any fluid, such as water, a water and oil mixture, or a gas, such as air. The lubricant pressures in the pockets may be at a pressure within the range 10 to 10,000 lbs/square inch.

In this specification "hydrostatic lubrication" is intended to have the generally accepted meaning, and is also intended to include lubrication in the same manner by a gas.

We claim:

1. A veneer machine roller pressure bar assembly, comprising a housing having a longitudinally extending roller retaining, generally arcuate shaped cavity providing a roller bar bearing surface with lubricating pockets, said lubricating pockets each being separately bounded by said bearing surface, a roller rotatably supported in said cavity for substantially the load bearing length of said roller and as a sliding fit with said bearing surface, fluid restrictor means connected to fluid inlets to said pockets, and means for delivering lubricant fluid via said fluid restrictor means to said pockets at approximately a constant pressure to maintain a film of escaping lubricant fluid between said bearing surface and said roller, for hydrostatic lubrication of said roller, and wherein said lubricating pockets are in the form of slots, at least one of said pockets extends along a first longitudinal path along said cavity at least two of said pockets extend along a second longitudinal path of said cavity, said first and said second paths are parallel to and circumferentially spaced on either side of the resultant force on said roller when it is in operation, and the pocket lengths occupy a major portion of the length of the bearing surface.

2. An assembly according to claim 1, wherein said pockets are symmetrically placed at an angle within the range 10° to 70° on either side of the resultant force on said roller of the applied forces on said roller when the assembly is in operation.

3. An assembly according to claim 2, wherein said upper pockets are placed at an angle of substantially 37° on either side of said resultant force.

4. An assembly according to claim 1, wherein there are an even number of said pockets disposed with one half of said number along one of said longitudinal paths, and the other half along the other said path.

5. An assembly according to claim 1, wherein said means for delivering lubricant delivers a lubricant selected from the group water, oil, a water and oil mixture and air.

6. An assembly according to claim 1, wherein said generally arcuate shaped cavity is one of two similar generally arcuate shaped cavities having said pockets, said roller is one of two similar rollers forming back-up rollers disposed side-by-side in said cavities, and said housing rotatably houses a pressure bar roller in contact with and supported by said back-up rollers.

7. An assembly according to claim 1, wherein said means for delivering lubricant to said pockets comprises a lubricant pump, and for each pocket the same type of fluid restrictor selected from the group comprising a needle valve, orifice, capillary, pressure sensing valve, a constant flow control valve connects the lubricant outlet from a lubricant pump to that pocket.

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