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(54) Waterproof joints between timbers

(57) A waterproof joint system between tongue and groove wood planks sawn to bisect the heart of the small log they were made from. These planks are then planed into Greenwood planks, which will have exposed hearts on one side. Greenwood planks with hearts exposed will warp or cup as they dry with the cupping being away from the heart side. The green planks are interlocked together to form a wall or roof panel so that the heart side of the planks alternate from one side of the panel to the other. They are tied together by a series of cross ties nailed to each plank. Held tightly together the tongues will be forcefully squeezed against the sides of the grooves as the planks cup, producing a watertight joint. If the planks or logs are laid horizontally like with a log cabin, the cross ties will prevent the logs from settling, or newly designed long wood screws can be used as cross ties, which will also prevent settling and, unlike the cross ties, will be hidden in the wall.

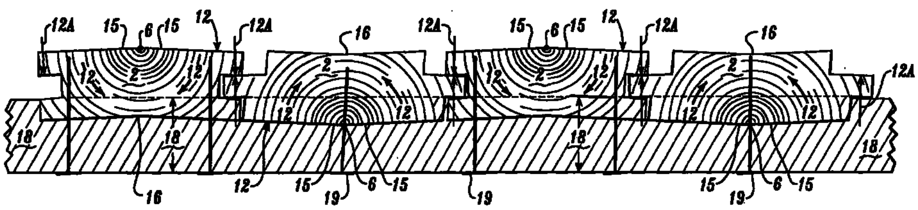

Fig. 10

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Description

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] My patent application 08/640,181 filed April 30, 1996 contained a broad application including various building panels that have waterproof joints where silicone caulking was projected. This application was divided into three divisions and was abandoned. Division I of '181 was filed September 28, 1998 and covers waterproof planks and waterproof panels of multiple planks that called for waterproof joints between the planks and between the panels without specifically stating how the waterproof joints were designed. This application follows many years of experimenting to solve the problem of waterproof joints including individual joints between planks in a panel and also a means to provide waterproof joints between panels.

[0002] In January 1978 I received a patent for metal covered planks and metal covered panels having multiple planks that had an effective waterproof folding sheet metal joint system. LINDAL #4,065,902.

[0003] In August 1978 I received patent #4,107,885 LINDAL, which covered single planks and multiple plank panels covered with wood shingles that had a waterproof joint system that called for a layer of shingles set in a waterproof configuration for single planks and multiple plank panels.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT - Not Applicable.

REFERENCE TO A "MICROFICHE APPENDIX" - Not Applicable

BACKGROUND OF THE INVENTION.

1. FIELD OF THE INVENTION

[0004] Prefabricated building panels and logs whose tongue and groove wood components are almost free of splits and checks and whose joints between the components are so tight that they are (virtually) waterproof.

2. DESCRIPTION OF RELATED ART

[0005] I made a wide search and had a Washington, D.C. professional search the records for any patents granted that would anticipate my invention. Nothing close to my invention was found and I reported none in my initial application listed. However, the examiner in his first action on this application listed and discussed several previously granted patents that had teaching in the field of my invention. I am responding on each of these inventions in respect to the examiner's discussions. But none of this art refers to using tangential shrinkage in wood to tighten joints between wood planks.

1. Johnson 4,443,990, April 24, 1984. By making shrinkage relief saw slits on each side of logs and close to being in line with the heart, Johnson teaches as I have done a means to avoid almost all chances of splits or checks forming from shrinkage known as tangential shrinkage. As this is a practice widely used in the art, I made no claim for invention here. However, Johnson does not refer to tangential shrinkage being used to seal joints between other logs, in fact a second or additional logs or planks are not mentioned.

2. Choiniere et al, 5,400,845, March 28, 1995. The inventors here teach a fastener that ties logs together that is unique and is now used widely in the field by log home builders who, like myself, buy these special screws from the assignee of this patent. However, these screws are not used in a manner so that setting is hindered, in fact, the use of a lubricant to aid setting is taught. If the screws extended to the 80% point in the thickness of the lower logs there would be a better chance that the threads of the screws would be locked into a fixed position in the lower logs as these logs shrink from radial shrinkage. Also, if the head of the screws were set tightly to the logs above the screw heads and the screw heads were wider, settling of the logs would be hindered as these screw heads would literally "hang up" the logs above them. Then, my main claim of tightened joints between logs from tangential shrinkage is not even addressed.

3. Fell, 3,863,409, February 4, 1975. Fell presents a joint sealing means that puts the weight of the log on two parallel pointed tongues extending along each side of the undersides of the logs. Also, the added weight of the logs above will tend to crush the points or crush the points into the surface of the logs below. The pointed tongues would work better, but all log houses use the weight of the log plus the weight of the logs above to seal joints between the logs. However, this does not always work, the surface of the logs are covered with knots or cuts off branches. These knots or branches do not shrink lengthwise as the logs shrink radially and branches between logs pop out and actually hang the logs up creating spaces on each side of the knots through which the wind whistles into the house. My sealing system differs entirely. Elongated tongue and grooves join the tiers of logs together. Tangential shrinkage forces the tongue of the lower log and the side of the groove of the upper log tightly (almost to the point of crushing the wood) together. Because my logs are hung up on the screw heads, they do not settle, but each log individually shrinks slightly radially but not enough to pull the tongues out of the

grooves so my wall remains airtight. Some of the radial shrinkage will be recovered as the logs swell more radially in wet weather, so inclement weather makes my wall airtight. My invention works on entirely different principals and is not anticipated by the fell invention.

4. Wrightman 5,020,289, June 4, 1991. Here a log wall is sealed against air or water infiltration between logs using a form of weather stripping that can be compressed 50% and recover. It has secondary seals referred to as a caulk, which can stand 25% compression. This is not a wood crushing against wood seal and though it is excellent and advanced log house art, it does not anticipate my invention.

5. Peter Sing 5,485,794, January 23, 1996. I personally know Mr. Sing and appreciate his continuing research and development in the field of cedar joinery. Mr. Sing has developed some very good joinery art, but this patent covers mostly pallet construction that requires no seals between components. A floor is shown with no connections between the flooring pieces such as ordinary tongue and grooves that are used with most floors. Walls are illustrated, but no claims are made on walls and no reference is made to sealed joints between wall siding components. Besides his patent does not apply to sealed joints between components. I personally know Mr. Sing's products and he does not try for sealed joints between components in his operations. This patent does not anticipate my invention.

6. Little 5,887,331, March 30, 1999. This is a system to tie down polymer plastic decking planks (not wood planks) to under framing using metal clips. No mention is made of sealing joints between planks and it appears that the planks are outside decking where it is preferable that rain can drain throughout the deck between the planks and not risk puddling. Plastic is free of shrinkage and warping problems and there is no way you can turn these otherwise undesirable features that wood has into useful purposes. This invention does not anticipate my invention and is dated after my patent was filed (March 30, 1999 vs. February 26, 1999)

7. Hubbard 5,577,356, November 26, 1996. Mr. John Hubbard is a neighbor and he and his buildings are well known to me. I should also mention that I know the building system covered in Mr. Hubbard's invention. I have viewed buildings under construction and I am continuing to examine buildings that have been standing for up to three years. I have recently and also two years ago, examined his operation from a view of purchasing his company. Mr. Hubbard has conveyed to me the various points of his R&D work including this patent, which he calls his "Phoenix" building. The invention states that the use of an adhesive between touching surfaces is preferred. The builders I saw building these houses were not using adhesives, however, there are signs that an adhesive has been used in a finished building I viewed, but the adhesive was dry and had cracked and, in one case, it had been supplemented by a caulking, which was also drying out. Horizontal tongue and groove joints can and do leak. The joints I have seen were not tight (not so tight that the planks have to be driven together with a 5 kg. mallet as do my plank walls). Weather and resultant alternate shrinkage and swelling had opened up the joints. Most of the horizontal timbers shown in his patent drawings have rounded edges presenting an open vee to the weather. Horizontal rain driven by strong winds force water into tongue and groove joints and a siphon action sucks the water up and over the tongues and into the buildings. Water stains on the inside of the timbers in one of the buildings I viewed clearly shoed the ingress of rain or melted snow.

The Phoenix building as introduced in this invention illustrates the use of laminated timbers and posts. Wood must be thoroughly kiln dried before glue lamination and it is correct to assume the wood is dry and would not be subject to the warping and cupping that is necessary for my very tight joint system to happen. Mr. Hubbard's invention relies on an adhesive or caulking to seal out water and does not mention any help from cupping or warping to keep out rain. This invention does not anticipate my invention.

BRIEF SUMMARY OF THE INVENTION

[0006] Very small logs only are used to make panels so that when the logs are sawn longitudinally into two, each half either has half the heart or one has the heart and the other is very close to the heart. Each half is made into a green tongue and groove plank being machined to a tight fit between planks. The planks are immediately made into building panels and left to slowly dry out. As they dry, the wood shrinks in such a way that the joints become tighter and tighter until the wood is almost crushed within the joints which becomes waterproof. This invention also applies to log homes or solid timber houses whose timbers encase the heart of the log they were sawn from.

[0007] To understand this phenomenon, one needs to study wood grain and how wood shrinks when it loses water from drying. There are two kinds of shrinkage. One is between the heart and the outer rim of the log. This is called radial shrinkage. The other is along the circular growth rings around the heart. This is called tangential shrinkage. Tangential shrinkage is three or more times as great as radial shrinkage, depending on species. In the round log the outside of the log being exposed also dries and shrinks faster than the interior of the log. Shrinkage means less wood on the circumference, which means it has to form splits around the log. If the round log is sawn longitudinally into two similar half logs, then it can shrink around its outer circumference without splitting. The resulting shape after drying has the line of the diameter bent out at the heart forming an obtuse angle. Tangential shrinkage is about 5% so the first 180° line of the half green log becomes approximately a 171° obtuse angle when the half log dries. A piece of tongue and groove lumber that is machined from the small green half log will use the flat edge of the half log as one side and will usually show the heart. When it dries, this tongue and groove plank will bend at the heart to have an angular side of up to 171°, the same as the half log. If a plurality of these green planks are attached together by edge tongue and grooves with all the hearts on one side, the combination, as they dry, will actually form a curved configuration like the side of a large wood barrel.

[0008] Alternatively, if a plurality of these green planks are attached together by edge tongue and grooves with the hearts being one side of the first planks and the other side of the second planks and continue with hearts alternating from one side to the other, when they dry will form a snake-like appearance as each planks will bend in the opposite direction to its adjoining planks.

[0009] Either way is unsatisfactory for a building surface, so it is necessary to nail stiff battens across the planks to keep the plurality of planks flat. Also because the thousands of narrow planks in a home would be costly to handle during construction, the manufacture of sections where enough narrow pieces are used to form a one-man load makes sense. The necessary cross battens to keep the section flat will also frame the section and provide resistance to shear forces. In order to give the section more resistance to this rack or shear, the cross ties are let into cross grooves cut out across the face of the planks. The cross ties are set into the grooves tightly and nailed or screwed firmly in place. The nailing should hit the center of each plank and there should be at least four cross ties in a 2.5 M high wall section. The individual planks will then be somewhat constrained from bowing and will hang on their nails. Shrinkage will occur and the tongues will need to be long enough and the grooves deep enough that the shrinkage on the edge of each plank will be about a fourth of the length of the tongues. If the plank is 60 mm wide the maximum shrinkage will only be about 2 mm which would call for 8 mm long tongues. In very damp weather the planks will expand some and there will always be movement in the grooves according to humidity. Though 2 mm is hardly perceptible, this movement can be disguised if the planks are grooved vertically with the shoulder of the outside tongue being set back 6 mm further than the inside shoulder, forming a permanent groove between planks. If the groove between planks is widened 2 mm more by shrinkage it can hardly be noticed.

[0010] Though the individual planks are restrained from acting collectively by the cross ties, they will still bow individually, forcing the tongues to want to eschew within the tight grooves making the joint even more air tight.

[0011] There are considerable economies in not kiln-drying nor air-drying the planks. Kilns represent a sizable capital investment and months of air drying costs interest on inventory investment. Then there is labor involved either way. The fact is that lower cost more air tight house sections evolve.

[0012] A greater economy is the use of only small logs (needed to include the heart or part of it on one side of every plank produced). These logs at today's market are at the price of pulp, only a fraction of the cost of saw logs. The price of pulp logs is substantially lower than logs that are large enough to produce lumber.

[0013] Ordinarily, the handling of small logs in a sawmill is more costly than handling larger logs. Imagine passing a 4" log four times past a head saw to square it. I have developed a machine that squares or shapes a log in one pass and another machine that cuts the cross notches (Four in a 2.5 M plank) as quick as a high powered planer can spit the planks out. A raw barked green small log freshly cut in the forest can be processed into wall, floor or roof sections within minutes and built into a nearby house within the hour.

[0014] Logs that have tops 75 mm or smaller (very, very small logs) cannot be made into two useful planks. However, they can be made into single planks with enough depth to be useful. Here it is necessary to cut two longitudinal shrinkage relief slits on opposite sides of the log and to a depth on each side of the log of one third of the log's diameter and close to being in line with the log's heart. Now the logs can dry out and shrink without splits and checks appearing on the surface. As the logs dry, the slits will become vee shaped when the circumference diminishes. The squares have their side slits cut by the same machine that saws them into squares and are planed so that there are tongue and grooves cut out into their edges above and below the slits. They are then cross-grooved and battens are nailed into the cross grooves making man-load sized sections. The upper and lower tongue and grooves will act the same way as the single tongues and grooves in the first example, they will cup outwardly away from the heart on each side of the saw slits, but there will be double the resistance to air or water passage through the doubled tongue and groove joints.

[0015] The square, center heart double-tongue and groove configuration has another good application. Juvenile, or young trees, can have soft pith centers. Some species such as Lodgepole Pine have black unsightly hearts and some logs will actually have dried out non-progressive rot in their hearts. The square configuration will encase these usually only pencil thick defects and there will be no loss of strength (being pipe-like). Even larger logs that should be split in half can be made useful this way if the defected logs show the defect at their ends and are sorted out to be milled as square, center heart shapes (not split lengthwise into two half planks). The 75 mm, topped logs can produce double tongue and groove planks that are approximately 60 mm square producing very sturdy wall, roof or floor sections. These sections can also be used to produce stand-alone partitions and ceiling panels. Studding can be set against outside wall sections which would allow for insulation and a drywall finish.

[0016] Many months of experiments have proved out this phenomenon and that it is consistent. Completely air-dried and kiln-dried sections have been examined. I found that it was impossible to separate the individual planks without breaking off the groove sides or the tongues. The planks were permanently stuck together as if they had been glued, but still can shrink or expand with humidity changes especially if used for open shed unheated situations.

[0017] An even greater saving can be realized if trees are plantation grown. Various universities working with pulp and paper companies have developed very low cost wood fiber that grows 3 meters high a year and adds about 25 mm of new wood in diameter per year at very low cost. It is possible to grow a small log in three years or four logs in five years. As new trees will sprout from the stumps, 100 hectares can produce 100 houses a year in perpetuity. The plantation can be planted close to the house factory saving in-freight costs. Using modern tree shearing equipment, the trees can be harvested like harvesting corn. The trick to make the most of this agricultural progress is to build my houses using only small, low-cost logs. A higher and better use than pulp.

[0018] It is essential to have the cross ties across planks whether the planks (or logs) are vertical, or horizontal as in a log wall. This hangs the planks (or logs) individually on the cross ties and the possible shrinkage of each plank (or log) will not accumulate causing settlement which is the bane of the log homes made from green or undried logs. Also, as noted before, the cross ties are essential to resist shear forces.

[0019] There are many applications such as ceiling beams or log walls where the component is exposed to view on both sides where let in cross ties with nail or screw heads showing are not acceptable. Here the purpose of the cross ties can be served by the use of the long nails or screws that cross two timbers being approximately half threaded and half smooth and are spaced to give the desired resistance to shear. In the case of horizontal members accumulated shrinkage or settlement can be avoided using screws that pass down through an upper log and down through 80% of a lower log. The lower log will shrink on the screw threads and maintain their respective relationships, but the crack between the logs will widen slightly. However, the two logs won't settle because they will be held up in place by the heads of screws fastening the two logs below them together. Such screws can take 700 kilograms of weight before the wood on the side of the screw threads is stripped and the point of the screw is forced deeper into the 20% of the lower log remaining. Second floor platforms, partitions and walls are supported by posts and beams along with the roof. The weight on the screw heads in a upper wall is negligible and the spacing of the screws for shear will govern though each building will need to have engineering calculations made to confirm the spacing of the screws particularly in the lower quarter of the log walls of each floor. In the case of the use of horizontal components that are attached to stud walls the studs will carry the weight of the floors, walls of second and third stories and roofs above.

[0020] Should building sections of lighter planks (not logs) be stored inside, out of the weather, the individual planks will start drying out and cupping, throwing their tongue and grooves askew as expected. However, the tongue and grooves at the edges of the sections will also go askew and the sections will be difficult to connect together at their edges. The cure I found for this is to use planks at the edges of the sections that are halved planks, which are known as quarter cut planks being both vertically and horizontally sawn at the heart or close to it. The grain at the midpoint at or close to the heart will be edge grain. Only radial shrinkage will apply here. Tongue and grooves made at this point will not go askew and the sections will connect easily. The tongue or groove at the other edge of the half plank will still go askew and lock to the next plank. However, if sections are planned to be used soon after manufacture, the half plank quarter cut side pieces will not be necessary.

[0021] Larger logs for log houses, or large timbers with encased hearts, will not adapt to sectionalizing because of weight. Here it will be necessary to peel the logs and cut the side shrinkage relief slits into them before storing under conditions where they will dry and shrink. Shrinkage will cause the slits to open up V-like. Planing the tongue and grooves into the logs or timbers should be delayed until the logs are about to be delivered to the building site. As logs take many months to dry they will (probably) continue to dry and shrink after the log house is built, skewing the tongue and grooves into tighter fits. Even if they are fully dried out when constructed into a log house they will pick up moisture from the air and expand skewing the tongue and grooves in a reverse way for tighter joints. We win either way.

ABSTRACT OF THE DISCLOSURE

[0022] A waterproof joint system between tongue and groove wood planks sawn to bisect the heart of the small log they were made from. These planks are then planed into Greenwood planks, which will have exposed

hearts on one side. Greenwood planks with hearts exposed will warp or cup as they dry with the cupping being away from the heart side. The green planks are interlocked together to form a wall or roof panel so that the heart side of the planks alternate from one side of the panel to the other. They are tied together by a series of cross ties nailed to each plank. Held tightly together the tongues will be forcefully squeezed against the sides of the grooves as the planks cup, producing a watertight joint. If the planks or logs are laid horizontally as with a log cabin, the cross ties will prevent the logs from settling, or newly designed long wood screws can be used as cross ties, which will also prevent settling and, unlike the cross ties, will be hidden in the wall.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0023]

Figure 1 shows a peeled raw green log having a 100 mm top.

Figure 2 illustrates a log that has been allowed to dry and resultant checking from radial shrinkage and the lessening of the size of the log from radial shrinkage.

Figure 3 shows a half raw green small log that has been sawn lengthwise through its heart.

Figure 4 shows how the half log shown in figure 3 dries and does not check and split, but is altered so that the former flat side becomes an obtuse angle (angle is somewhat exaggerated).

Figure 5 illustrates how a tongue and groove plank can be machined from a half green log.

Figure 6 illustrates how the plank cut from the green log (Figure 5) cups when it is dried (but does not check or split). Both surfaces form angles, the bottom side is an obtuse angle and the top angle is acute (angles again are exaggerated to show change).

Figure 7 illustrates a panel made from four green tongue and groove planks, with each having a heart showing at the center of each plank at the lower surface.

Figure 8 shows how the panel (Figure 7) will bow into a curved configuration when it dries (angle of bends in each planks are more realistic).

Figure 7A illustrates a panels made from four green planks with the first and third planks having hearts on one side and the second and fourth having hearts on the other side. Note that planks one and three have grooves on each side and planks two and four have tongues on each side

Figure 8A shows how the panel in 7A will twist into a snake like configuration when it dries (again angles are exaggerated for effect).

Figure 9 shows a panel of green planks that have been reinforced by having a cross batten let into grooves across the panel and nailed. The first and third planks have grooves on both edges with their hearts on the topside. The second and fourth planks have tongues on both edges and their hearts are on the underside. Note that the second and fourth plank have their top shoulders cut back to form grooves on the top surface.

Figure 10 shows how a panel fabricated as in Figure 9 behaves when the planks become completely dry.

Figure 11A shows how part of the panel in Figure 10 looks in double scale.

Figure 11B, also in double scale, shows the male and female side of jointing means in quarter cut wood between sections.

Figure 12 shows a raw green smaller log having a 75 mm top with an indication of how the log can be sawn to produce a maximum sized square green plank.

Figure 13 illustrates how a raw green log will split and check when it becomes dry. It also shows that a green plank sawn out of the log would also split and check.

Figure 14 shows a raw green log that has had two saw slits cut into its surface on opposite sides with the slits pointing at the log's center and each slit reaching to a point one third of the log's diameter from its surface.

Figure 15A is a very dry log as in Figure 14 and shows how the saw slits turn into V's and no splits or checks occur on the log's surface.

Figure 15B *shows how a 75 mm smaller log that has been split longitudinally in half behaves on drying similar to figure 4.*

Figure 16 shows how a plank having four tongues can be machined from a 75 mm green log. It also shows how saw slits as shown in Figure 14 are also cut into the sides of the (double) four tongue (and groove) plank in between the two sets of tongue (and grooves).

***Figure 16B** shows the configuration as figure 16A if the piece is sawn into two pieces at saw slits shown in 16A.*

Figure 17A illustrates what will happen to the green plank in Figure 16A after it becomes thoroughly dried out. Note that there are four tongues.

***Figure 17B** shows how the split off pieces shown in 16B behave when it is dried. Note the planks have grooves on both edges.*

Figure 18 illustrates how four green planks shaped as in Figures 17A and 17B are made into a special panel made up of solid pieces with tongues on both sides and on either side of the saw slits which are alternated with similar pieces that have been split in half and set into the panel so that the exposed hearts both face outward. The panel is assembled by inserting battens into grooves cut across the green planks and tightly nailing them together.

Figure 19 illustrates what will happen to a panel made from green planks as shown in Figure 18 when it becomes thoroughly dried out.

Figure 20 illustrates in double scale a part of the panel shown in Figure 19.

Figure 21 shows a log wall made up of "D" logs and half logs in alternate tiers. The Dee logs are approximately 150 mm by 140 mm and are green wood attached together with screws.

Figure 22 shows the log wall in figure 21 a year after construction, considerable shrinkage and distortion has happened but no settling.

Figure 23 shows an elevation view of a wall constructed out of the logs shown in figure 21. Included are floor platform, ceiling planks, top of the wall truss and roof platform. Also included in dotted lines is a post that supports the ceilings, the truss and roof. Openings for a door and a window are included. The drawing shows an x-ray view of the screws which are encased in the logs.

Figure 24 is a composite panel composed of green square planks and green Tee (T) shaped planks interlocked and tied together by internally nailed cross ties.

Figure 26A shows what happens to the panel in figure 24 when it dries.

Figure 26A and 26B in double scale show the effect of shrinking on two of the tongue and groove connections in figure 25.

Figure 27 illustrates Greenwood planks having a pyramid shape that have been machined out of half logs about 140 mm in diameter and formed into a panel of similar planks. Cross ties have been rabbeted into the tops and bases of alternately set planks which are locked together by tongue and grooves and firmly screwed into place.

Figure 28 shows the plank panel illustrated in figure 27 after six months of air-drying or twelve days in a kiln. The planks have shrunk radially in size and they have cupped from tangential shrinkage. The cupping action squeezes each tongue tightly to the side of a groove.

Figure 29 shows a panel made from green 100 mm logs. The two side logs are similar to figure 16A and are tied to cross ties as in figure 18. The center green 100 mm log has been split into two halves and instead of being formed into two planks with grooves on each end as in figure 17B hook like appendages have been machined out of the rounded side of the half logs so that the two half logs can be physically locked and nailed together in the panel instead of relying on the nails only as in figure 18.

Figure 30 is to figure 29 as figure 19 is to figure 18 except that the interlocking half logs in figure 30 makes for a stronger more solid panel. The logs in figure 30 are very dry.

DETAILED DESCRIPTION OF THE INVENTION

[0024]

Figure 1 - 1 indicates raw green untreated wood; 3 is a log having a 100 mm top which has its bark removed; 6 is the log's heart; 9 indicates an annular growth ring.

Figure 2 - Indicates a log similar to Figure 1 that has been thoroughly dried; 2 indicated dry wood; 4 covers the log itself; 5 is wood near the heart of the log which has dried more slowly being farther from the log's surface; 6 is the log's heart; 7 shows splits or checks that happen when a round log dries out; 8 indicates radial shrinkage; 9 are growth rings; 12 indicates tangential shrinkage. Logs should not be allowed to dry in the round. To avoid loss of product through splitting, logs should be sawn and dried or kept wet in a pond or by spraying with water.

Figure 3 - 10 is a raw green log that has been sawn longitudinally into a half length bisecting the log's

heart (6); 1 indicates raw green wood; 9 indicates growth rings.

Figure 4 - Shows that a half log when allowed to dry (11) does not split or check. Tangential shrinkage (12) lessens the circumference of the half log when green from 180° to about 171° when dry. 2 is dry wood; 5 is slower drying wood near the heart; 6 is the heart; 9 is growth rings and 15 illustrates how the flat sawn surface of the green half log becomes an obtuse angle.

Figure 5 - Shows how a tongue and groove plank (13) can be milled out of a green half log (1); 9 is a growth ring and 6 is the heart which is on one side of the plank. Small logs are used because, using only small logs, a maximum number of planks can be developed that have hearts on one side or near it.

Figure 6 - Shows how "cupping" of lumber occurs (16) when a green plank as in Figure 5 becomes dry. Tangential shrinkage (12) literally bends the plank at its heart (6) giving that side an obtuse angular (15) side, matching the cupped other side; 2 indicates dry wood; 9 are growth rings.

Figure 7 - Here a panel is made up out of four green (1) tongue and groove wood planks (13). Tight-fitting tongue and grooves (17) hold the panel together. Note that the hearts (6) are all on one side.

Figure 8 - Here the panel in Figure 7 is allowed to thoroughly dry (2). The individual planks (14) behave as shown in Figure 6 and the tight joints (17) become even tighter. This causes the panel to take on a curved configuration like the side of a large barrel. 2 indicates dry wood; 6 shows the hearts all on one side; 12 indicates tangential shrinkage; 15 indicates obtuse angles and 16 shows cupping on the other side.

Figure 7A is similar to figure 7 except that the hearts on the first and third planks are on one side of the assembly and the hearts of the second and fourth planks are on the opposite side, also the first and third planks have grooves on both edges and the second and fourth planks have tongues on both edges.

Figure 8A Here, instead of warping in a simple curve, the planks take on a snake-like configuration. The warpage is exaggerated for effect in the drawing.

Figure 9 - Shows a four plank panel made of green (1) planks (13) which are reinforced with cross battens (18) let into cross grooves across the planks to one third of the plank's thickness. The cross battens are thoroughly nailed (19) to each plank. The cross tie is dry (2); the hearts (6) are on alternative sides of the panel; 17 indicates tight tongue and groove joints. This is a very solid building panel. 22 are special grooves cut into the exposed face of the planks to disguise shrinkage. Like figure 7A, the hearts alternate from one side to the other and planks 1 & 3 have grooves on each side and 2 & 4 have tongues on each side.

Figure 10 - Shows what happens when the panel in Figure 9 is thoroughly dried out. Though constricted by the stiff cross battens (18) each individual plank (14) wants to behave as it did in Figure 6 and still cups (16) a little and bends (15) causing the tight tongue and grooves to be forced into opposing directions and bind very tightly together (see 55 and 12A in Figure 11) so that the wood in these tongue and grooves is almost crushed. In any case the section is stronger dry than green as in Figure 10 and is air-tight. 2 is dry wood; 6 are the hearts; 12 is tangential shrinkage; 14 are the planks dry; 15 shows obtuse angles based on the hearts and 16 represents cupping; 17 indicates the original tight joints; 18 indicates the cross ties and 19 is the nails. 22 are grooves that disguise shrinkage. The alternate configuration of heart side and tongue and groove proved to be, from tests, actually watertight not nearly watertight because the tongue engages the side of the groove for its whole length, not just at the corner of the tongue.

Figure 11A - Is a double scale drawing of part of the panel, Figure 10. This shows the crushing forces at 55 and 12A and gaps 29 and 30 between planks caused by both tangential and radial shrinkage. 22 is a special groove cut into the face of the planks at the joints. This gap disguises the small shrinkage and expansion which occurs on such narrow planks both during the originals shrinkage when the planks dry out and when there is lesser shrinkage and expansion of the planks due to changes in humidity. 30 are gaps formed between the tongue and grooves because of distortion caused by radial shrinkage.

Figure 11B shows a joint between two sections, 31 and 32. These are not subject to askew warping of the tongue and groove joint between sections because the wood, at the points of closure between the sections 34, is quarter cut and is all edge grain wood which is not subject to the warping action of tangential shrinkage. The interconnecting 33 tongue and grooves between sections will still be subject to radial compression or shrinkage across the grain, but this should be uniform enough to allow for the easy field joining of the section after manufacture months even years later.

Figures 12 to 20 - Illustrate the use of very, very small logs with diameters as narrow as 62 mm at the top of the logs. These drawings are based on logs with 75 mm tops. To get 2 planks from such small logs is not practical nor useful. But planks can be made using the whole log. Planks as thick as 60 mm are quite strong and such narrow widths are considered attractive, especially when shrinkage disguising grooves are used, which give accent to paneling.

Figure 12 - 3 is a green log without bark. Indicated also is the size of the plank (23) that could be made from this log; 1 is green wood; 6 is the log's heart; 23 indicates the square plank that can be made out of this log.

Figure 13 - Is a dry (2) very small log (4); 5 is the wetter heart area of the log; 6 is the log's heart; 7 are splits and checks caused by tangential shrinkage; 9 are growth rings. Again, a square plank (23) is indicated and it also has splits and checks, as does the dry log. 12 indicates tangential shrinkage. Again, it is stated that round logs should not be left to air dry and should not be kiln dried. Their wood would become almost useless.

Figure 14 - Shows how to prevent splits and checks by cutting longitudinal shrinkage relief saw slits on opposing sides of the log with the slits being in line or close to being in line with the heart. The slits are approximately one third of the log's diameter deep; 26 are the shrinkage relief slits; 6 is the log's heart. 1 indicates green wood.

Figure 15A - Is Figure 14 dried out (2). The log has no splits; the slits are now wide checks (27); 12 indicates tangential shrinkage; 6 is the heart; 2 is dry wood.

Figure 15B shows that a split log behaves the same as the log in 15A that has the shrinkage relief saw slits. 58 is the saw cut splitting the log. 12 Is the tangential shrinkage. 15 is the obtuse angle.

Figure 16A - shows how a four tongue plank (25) can be milled from the same small log. Note the saw slits (26) are included. The log is green (1); 6 is the heart.

Figure 16B shows how the four tongue piece in 16A can be slit into 25C two two-tongued pieces. 58 indicates saw cut. Planks are Greenwood.

Figure 17 - Shows how shrinkage can misshape the green plank shown in Figure 16A. However it still is a four tongue plank; 2 is dry wood; 25a is the dry plank itself; 12 shows tangential shrinkage away from 27 which now a has a wide split instead of being the slit shown in Figure 16A; 6 is the heart; 16 indicates cupping.

Figure 17B shows how the two half planks behave the same as the single planks in 17A. Note that planks with grooves on both edges are shown. 25D

Figure 18 - This is a panel of two-four tongue green (1) planks (25) (and two pairs of half planks with grooves at each side 25C) attached together by tight tongue and grooves (17) and further tied together by cross battens (18) which are set in grooves across the planks which are one half of the half plank's thickness in depth. The cross battens are securely nailed (19) to each plank. 2 is dry wood in the cross battens; 6 are the planks hearts; 26 are the saw slits; 28 is a soft pith heart or such a defect as black heart or even dry rot, which is solidly encased in wood; 17 indicates tight tongue and groove joints; 22 is a special groove designed to disguise shrinkage and expansion, 58 is the space between the two half planks.

Figure 19 - Is similar to Figure 18 and shows the panel after each plank has individually dried out and shrunk. The side slits have widened out to wide splits (27). The top and bottom sides of the plank have cupped (16) but not as much as in Figure 17A because of the restraint of the cross battens (18). However, the cupping action, on both sides of the hearts, has forced the tongue and grooves to be much tighter together and more air tight than in figure 18. 2 is dry wood; 6 are hearts; 9 are annular rings; 12 indicates tangential movement; 17 are tight joints, 19 are nails; 18 is the cross batten; 22 are the special decorative grooves that hide wood movement; 28 is a pencil sized soft pith heart, a black heart or even dry rot; 25a are the dried out planks; 29 are spaces now between the dry planks. 54 are small cavities in the wood at the end of the nails that happen when the cupping of planks 25D pull the nails out of the wood slightly. Note that this does not happen with nails through the heart of the wood. 12A indicates extreme pressure from tangential shrinkage. 55 indicates wood that is almost crushed by the extreme pressure forming waterproof joints.

Figure 20 - Is part of Figure 19 but in double scale to show the finer details of the air-tight joint system. 16 indicates cupping; 55 shows the pressure points where the tongue and grooves are almost crushed together stopping any possible passage of water or air through the joint; 29 shows spaces formed

between the individual planks when they shrink on their nails; 27 shows how the saw slits open up because of tangential movement; 25a are individual dry planks. They are individual because each is individually hung to the cross batten (18) and are free to expand with moisture and contract again in dry weather. The tongues will slide in the grooves at the pressure points 55 without losing the air-tight seal between the planks. When the planks expand or contract with moisture. 12 and 12A indicates the tangential movement of the wood as it dries and also shows opposing forces causing the tight joints.

Figure 21 This log wall system begins as a wall made from green logs except that every second tier is a split log with the hearts on the outside. The wall is stiffened against shear forces through the use of long screws which are only half threaded and can have drill like points that allow the screws to be power driven into the wood without the need to pre-drill holes. Though relatively new, the screws are broadly used. However, my invention introduces the use of the screws for the avoidance of the logs settling. My screws have wider heads then present screws to avoid crushing the wood above the screws. The threaded part of the screw is locked in place by shrinkage of the wood around the threaded portion so that it takes about 700 Kilograms of weight to push the screw further down once the wood starts shrinking. The screw heads virtually hold up the log above and all of the rest of the logs to the top of the wall. The "D" logs are approximately 140 X 150 mm 35. 1. Is Greenwood, 6 indicates log hearts, 9 are growth rings. 26 are splitting relief saw slits. 40 are the special long screws. 36 is the thread part of the screw. 41 are the screw heads that support the logs above. 37 is the flat side of the "D" logs and 38 is the rounded side. 42 are the tight fitting tongue and grooves between logs. 56 is the rounded half log with its hearts being on the rounded part, 57 is the square log half. 58 is the space between the pair of half logs.

Figure 22 This shows the log wall when it is dried out in about a year later than figure 21. The logs and half logs have shrunk but shrinkage has not accumulated to cause settlement of the logs. Each log is held up in its previous position perched on the top of the screw heads of the lag screws below it. The screws (40) have popped up, but the screw heads 41 are still in the same relation to the second log below that has locked onto the threaded part of the screw. Spaces have appeared between the logs 29 and caulking 43 is necessary to fill this space outside. Inside the special groove 22 disguises the extra shrinkage. In log house parlance the caulking may be called chinking. Tangential shrinkage forces the tongues very tightly to the side of the grooves to a point where the wood is nearly crushed making an air and watertight seal to what was already tight joints in the green wood. The extreme pressure points are indicated by 55. 27 also indicates tangential shrinkage changing the saw slits into deep V grooves. 37 indicates cupping on the flat side of the logs due to tangential shrinkage. The lag screws 40 give resistance to shear forces as well as limiting settlement and also tie the logs together. 12 indicates tangential shrinkage. 12A indicates how the different sides of the joint are crushed together by tangential shrinkage stopping all possible ingress of air or water.

Figure 23 This is an elevation view of a log wall plus the floor, ceiling and roof system including openings for a door and a window. The lag screws which are ordinarily buried out of view are shown in an ex-ray like situation. 44 is the floor platform on which the wall stands. 45 is an opening for a window and 46 is a door opening 35 are the "D" logs and 36 are the lag screws. 47 is the ceiling system. 48 is the truss which is supported by posts (53) and carries the roof and ceiling load. 49 is the roof construction. 50 shows how lag screws are set on each side of a splice joint between the ends of logs. 51 indicates double lag screws at the side of window and door openings. 52 and the logs above are effective door and window headers. There are no splices or joints in logs in the three courses of logs above openings. The drawing indicates more lag screws in the lower portion of the wall because these carry more weight whereas, for instance, the top log in any room carries practically no weight at all. The upper level here has a higher percentage of lag screws than is usual because of the splices. The post 53 carries the ceiling 47, truss 48 and roof 49 load so all that the screw heads and screw threads have to hold up are the logs above, there is no settling of the logs as the exact number of supporting screws are designed to carry the weight of the logs above so there are more screws designed for placement in the lower part of the wall than the upper each screw can carry 700 kgs.

Figures 24, 25, 26A and 26B cover a variation of a wood wall introduced in my patent application 08/640,181 filed April 30, 1996 and abandoned when it was divided into three divisional applications dated September 28, 1998. This is a more complicated wall system, but contains all the elements of tangential shrinkage made use of in my previous figures and each element has a heart of a log on one side. The elements are set so that heart sides of planks alternate from one plank to the other. This sets the tangential shrinkage of one plank in direct opposition to the tangential shrinkage of the next plank forming waterproof joints. This wall panel has a cross tie buried within it and all nails are internal and out of sight. 60 is a plank with a tongue on each edge similar to plank 25D in figure 18, except that 25D has a groove on each edge, but it also has its heart showing. 59 is a similar plank having a groove on each edge, but it has a hook like appendage machined out of the curved log material that is wasted in the manufacture of 60. This Tee shaped appendage is notched out to receive the cross ties 18, which are nailed internally and alternatively to the planks 59 and 60 on each side of 18. Figure 24 features Greenwood 1. Planks 60 with tongues on each side. Planks 59 with tongues on each edge and has the Tee shaped appendage. 42 indicates tight tongue and grooves between planks. 18 is the cross tie internally nailed to planks 59 and 60. 19 are internal nails, 6 are the hearts of logs. 2 indicates that the cross tie 18 is dry wood. 28 is a soft heart, which is turned inward and out of view.

Figure 25 is what figure 24 looks like when the planks are thoroughly dried out. Tangential shrinkage has forced the planks together and has caused the planks 50 to hook tightly together directly and internally tying one side of the panel to the other supplementing the nails 19. There is a three layer locking out of water and air. The tongue and grooves on each side and the hooking inside. The distortion is exaggerated and is actually hardly noticeable on a whole house wall, especially if the surfaces are rough finished. 26A and 26B are double enlargements of the tongue and groove joints on each side of the wall assembly. 12 indicate tangential shrinkage forcing the tongue of plank 60 against the inside of the groove of plank 59 so that the wood is almost crushed at 55.

Figure 27 is a pyramidal shaped roof plank system. The planks are formed out of small half logs so the hearts 6 are either exposed or are close to the base line of the pyramid shapes. The planks are fitted tightly together 42, and are Greenwood. One log shows a soft heart, which is on the inside of a wall or roof. The cross tie, 18, which is dry, 2, is very securely screwed 30 to the center of each pyramid plank. Each plank will shrink onto its screw, but the tongue and grooves are far too deep in relation to the plank width to shrink out of contact. A weep groove for roof construction is designed to drain away water that will get in between the planks as they separate on shrinking on their screws. The top surface of this roof surface is striated (with vee grooves) to help rain to only go downward and not be blown across the planks into spaces between planks. This watertight joint system between roof planks if used with my waterproof plank design 08/640,187, which also has to use planks with hearts encased or at or near the plank edge, a waterproof roof system involves, which needs no shingles, tile or other roofing and also saves the labor of applying the roof covering. Besides having a striated surface to keep rain away from joints between planks and a weep groove system to drain any water away that will get into the joints. Double tongue and grooves on each side of the planks are extremely tight fitting after the wood dries. Tangential shrinkage forces the tongues so tightly to a side of each groove to almost crush the wood. The joints become airtight and watertight. Tangential shrinkage is designated by the arrows, 12, that designate the direction of the tangential shrinkage. 55 indicates where wood is almost crushed forming the real moisture seal. No caulking compounds are needed to keep water out.

Figure 29 and 30 are an extension of figure 18 and 19. Here the two "floating" pieces 65 are physically locked together as also shown in figure 24. In figure 18, the two "floating" pieces 25D rely on nails to hold them in place so that the tongues of planks 25A can be forced by tangential shrinkage pressure to make a tight joint. This hold is more sure using the planks 65 shown in these illustrations. As in figure 24, the hooked appendage 65 in this drawing are like 59 in figure 24 in that they are machined out of the rounded part of the log that would otherwise be wasted. The main purpose of designs 18, 24 and 29 is to create a panel where the heart side of the components are alternated from one plank to the next so that tangential shrinkage will force the tongue and groove joints together, in a crushing action. Here again cross ties are used to anchor the components to the same bearing to aid the crushing action in the tongue and groove joints , serve to resist sheer forces and to act to prevent settling if the timbers are horizontal as in a log house. The individual planks will shrink onto their screws from radial shrinkage and the tongues will slide out of the grooves slightly but they are too deep to slide out of the grooves altogether. In figure 29, 25A are green timbers that have the heart of the logs they were machined from close to the center of the timber. At 26 there are saw slits cut to avoid checks and cracks from forming. Timber 25A is tied tightly to the cross tie 18 by wood screws 39. There are two interlocked planks 65, which for the purpose of this invention are set with their hearts out so that tangential shrinkage will force them against the tongues of the 25A planks on each side. 22 are grooves that help disguise shrinkage. 64 are voids formed between the round surface of one plank 65 and the flat surface of the interlocked plank 65. 39 are the connecting screws.

Figure 30 shows what happens to figure 29 when it is thoroughly dried out. Tangential shrinkage (arrows 12) open up the saw slits 26 in figure 29 to become open vees 27, in figure 30 forcing the tongues away from the vees 27 and crushing them against the side of the grooves in planks 65 at 55. Planks 65 have cupped away from their hearts as occurs with tangential shrinkage and are directly thrust against the tongues of the 25A planks. This crushing action is in collision so there is no possible space left between the tongues of planks 25A and the outside of the grooves of the planks 65 making a very waterproof and airtight joint. The screws 29 keep the planks 25A and 65 in relatively the same position as in figure 29 only the tongues and grooves move together. The crushing action is shown by arrows 12A and the crushed area is 55. 29 are spaces formed between the components caused by radial shrinkage - the components became smaller but as they are hung on screws 39 spaces open between them.

Claims

1. A method to produce airtight and waterproof tongue and groove joints between the edges of wood planks is described as follows:

   a) For ease of explanation standard planks are used and their length being the height of a standard wall;
   b) said planks are sawn from Greenwood logs so that the heart of the logs show on one side of the planks or the heart is close to one side;
   c) a batch of Greenwood planks is planed so that half have tongues on each edge and the other half have grooves on each edge, the size of the tongues and grooves is one third of the thickness of the planks in depth and in width;
   d) said Greenwood planks have four cross grooves cut across their faces two are spaced from each end of the planks and the other two cross grooves are spaced apart and from the other two cross grooves; the planks that have tongues on each edge have the cross qrooves cut on the side where the hearts are and the planks that have grooves on both their edges have the cross grooves cut across the opposite side of these planks;
   e) for ease of handling the Greenwood planks are fabricated into panels or sections which are limited in width to six planks being a two man load;
   f) sections are fabricated by laying six planks down on a jig table with their cross grooves facing up and in line; the Greenwood planks are clamped tightly together having tight fitting tongues and grooves and are rigidly held in place with dry wood cross ties set tightly in each of the four lines of grooves and the cross ties are firmly nailed to each plank at each cross point as close to the heart of the planks as is possible; fabricated this way the heart sides of the planks will alternate from one side of the section to the other;
   g) the Greenwood sections can be dried out in three ways, first they can be kiln dried, second they can be air-dried or third they can be built into a building and allowed to dry slowly in place;
   h) said green planks having hearts on one side will warp from tangential shrinkage as they dry and will cup away from the heart of the plank, this is a forceful action which always happens;
   i) with the said hearts being set alternatively from one side of the sections to the other, the edges of each plank will be forced against each other and being locked together in a tongue and groove configuration the grooves will be forcefully squeezed against the locked in tongues almost crushing the wood along the contact area, producing airtight waterproof joints;
   j) this procedure can be used with other sized planks and cross ties with all measurements being in proportion to planks chosen to illustrate this claim.

2. A watertight joint system as described in claim one where low cost small logs are used.

3. A variation of the method taught in claim one to produce waterproof tongue and groove joints between planks is described as follows:

   a) a wall system like the wall system described in claim one where every other plank is relatively square being the same width but twice the depth of the planks described in claim one and having its heart in its center area;
   b) said plank has saw slits on each side that reach to the one third point in the width of the plank and are close to being in line with the plank's heart;
   c) said saw slits divide the double thick plank into two planks attached at the heart, but are otherwise the same as the planks described in claim one that have tongues on both edges;
   d) alternating with the double thick planks are pairs of planks that have grooves at each edge and are exactly the same as the alternating planks described in claim one, which connect between double thick planks having their grooves locked over the tongues near the four corners of the double thick planks and having their heart sides facing outward;

e) as in claim one, cross ties are rabbetted into and across one side of this assembly with the depth of the cross grooves being half the thickness of the thinner planks;

f) this assembly is clamped together and nailed similar to claim one except the nails extend through the cross tie and through one of the thinner planks and to 80% of the thickness of the other thinner plank, also to 80% of the depth of the thicker planks;
g) the planks in this assembly are Greenwood and behave in the drying process exactly like the planks in claim one producing waterproof and airtight tongue and groove joints.

4. The planks in claim three can vary in size as in claim one, however, the double thick plank can be produced from logs having 75 mm diameter tops (3").

5. Planks with tongues on each edge, as described in claim one, have grooves showing on their exposed face that are formed by cutting back the exposed shoulders on each edge of their tongues making the face side of the tongues twice as wide as the opposite side of the tongues:

a) when two-tongue planks are assembled tightly with the two-groove planks they would ordinarily show uneven spaces between the planks as the planks shrink from radial shrinkage as they dry and when they shrink or expand according to moisture in their environment;
b) said new face grooves will widen and contract according to moisture conditions in their environment, but slightly widened grooves will disguise this movement from shrinkage and expansion as it would be hard to perceive the change;
c) such face grooves are cosmetic.

6. When planks or timbers are assembled, as in claim one, but are random length, and are built horizontally, the individual planks will hang on the vertical cross ties to which they are nailed and though the planks will shrink individually as they dry the shrinkage will be confined within the tongue and grooves between the planks and further disguised as taught in claim 5:

a) such an assembly will not settle as it dries, as is the case when ordinary green log walls are built;
b) often exposed cross ties would be considered unsightly especially if they are assembled like log walls where the same appearance is desired inside as the outside;

c) such log walls often use long screws such as are made by the Olympic company to tie the tiers of logs together with the screws extending through one tier and halfway into the tier below, giving resistance to shear forces;

d) modifications are made to the screws and to the method of building log walls that will arrest the settlement of log walls the same as plank walls and cross ties;
e) the screws are made with larger diameter heads about dime sized for small lighter logs and nickel sized for heavier logs, also the screws will have smooth shanks from the head down to the lower log and heavy threads 80% into the lower log;
f) the wood in the lower log will shrink as it dries and will lock onto the threads of the screw, which will keep the head of the screw at the same level in respect to the lower log; each tier of logs will hang-up on the logs two tiers down;
g) the log building is designed so that post and beams carry the load of ceilings, second floors, their walls and the roof and all that the screws carry is the logs above them to the ceiling level or below the second floor level;
h) the number of screws used to support the weight of the logs above will be less as the wall is built up closer to the ceiling or second floor level;
i) screws are designed to carry a load so screw spacing for each tier of logs is designed for each wall; excessive weight will shear the wood at the threads and drive the screws deeper into the logs causing settlement, log weight is calculated according to their expected moisture content at the time of construction, which usually means green logs.

7. Timber walls either square or rounded like logs or are so called "Dee logs" that are flat inside and round outside that have hearts encased near their centers that are tied together as in claim 6 with long screws to avoid settling and to resist sheer forces and are built into horizontal log or timber walls as follows:

a) as in claim 3, the walls are built out of alternate tiers of full timbers with the hearts of the logs encased and split timbers that are split at or close to the timber's heart, and which are set with the heart side of the split timbers turned outward and exposed on both sides of the wall;
b) as in claim 3, the full timbers have two tongues, top and bottom, and the split timbers each have a groove top and bottom, the tongue and grooves are twice as deep as the expected shrinkage of green log to hide shrinkage, and are tight fitting; shrinkage is further disguised

as taught in claim 5;

c) as in claim 3 the full timbers have saw slits, top and bottom lined close to being in line with the heart, which will allow cupping and avoid splits and checks when drying and shrinking;

d) the full and split components will cup against each other within the grooves, producing waterproof joints as described in claim 3.

8. A method of joining dry plank panels, as described in claim one, together, more easily than if the planks on each edge of the panel were dried out cupped planks like the rest of the panel which is accomplished as follows:

a) the 6th plank of a 6 plank panel which has a heart at or near one face split into two pieces with the split being made in line with the heart producing what would be referred to as "quarter cut" planks (at the heart edge); which are not subject to tangential shrinkage;

b) a groove is machined on the sawn edge of one half-plank and a tight fitting tongue is machined on the sawn edge of the other half-plank;

c) the sections are assembled as in claim 1, except that a half plank is placed at each edge of the section exposing the new tongue and grooves;

d) because the wood at the new tongue and groove edges, is edge grain, or also called "quarter cut" these tongue and grooves will not cup from tangential shrinkage and sections made this way will fit together more easily after drying than sections with planks at the edges that have cupped.

9. A wood panel or section of a wall or roof that is made from Greenwood small logs split in half with the split occurring as close to the heart as possible, as described in claim one, with the two halves each having double tongue and grooves opposed to each other when assembled and being pyramidal in shape making the maximum use of the wood in the round log; such as a panel is produced as follows:

a) small tree stems are cut to lengths being wall heights as in claim one;

b) the logs are split in half with the saw cut occurring so that it bisects the heart of the logs or is close to it;

c) the half logs are planed in the Greenwood state into planks that are pyramidal in shape and have two tongues and two grooves on each side cut into a double shiplap configuration;

d) as in claim one the planks have four cross grooves cut across them, half with the groove being on the broad side of the pyramid shape and the other half cut across the narrower or top side of the pyramid shape and having a depth to the one quarter point of the height of the pyramid shape;

e) further as in claim one the pyramidal shape planks are assembled so that alternate planks have their hearts facing up and down, the double tongues and grooves are locked tightly together and the tight assembly is held together by four dry tight fitting cross ties that because the panels can be self supporting roof panels with snow loads the cross ties are twice as deep and are fastened with heavy screws at each cross point and close to the heart of the planks;

f) as a roof panel the green individual planks will dry and shrink radially opening up spaces between the planks in the roof surfaces, so vee grooves are planed into the outside surfaces of the planks to feed rainwater downward and to prevent it from flowing sideways into the spaces between planks and for rain that does get into the grooves, weep grooves are planed into the top side of the top tongues of the wide base planks to drain water away;

g) tangential shrinkage as in claim one, will force the two pairs of tongues on each side of each plank against each other with great pressure producing doubly waterproof joints.

10. A panel assembly that is very similar to the panel in claim three except that the single thickness planks whose hearts face outward have hooked shaped appendages milled out of the rounded portion of the small logs which in claim three, was wasted; said hooks lock the planks together in assembly and with the use of the thicker cross ties and screws makes a stronger panel that has a triple interlocking means.

11. A double layer Greenwood panel, which consists of two layers of panels built as described in claim one, but the alternate planks that have exposed hearts have hooks similar to planks described in claim 10 that hook onto similar hooks in the second layer of planks, however this double layer panel has more applications:

a) the hooks are two way, giving greater versatility to the design;

b) half logs from small juvenile trees can have soft hearts showing that should not be used to make planks with hearts on the outer sides, here they can be faced inward and not be seen or exposed;

c) in this configuration the cross ties are hidden internally being notched through the hooked appendages and nailed internally alternatively to one side and then the other from the cross ties so that nail heads and hammer marks are also hidden internally;

d) this is a panel that is attractive on both sides and can be used as a stand alone wall or partition or for a door: being a double panel it would be twice as airtight as the single layer panel described in claim one.

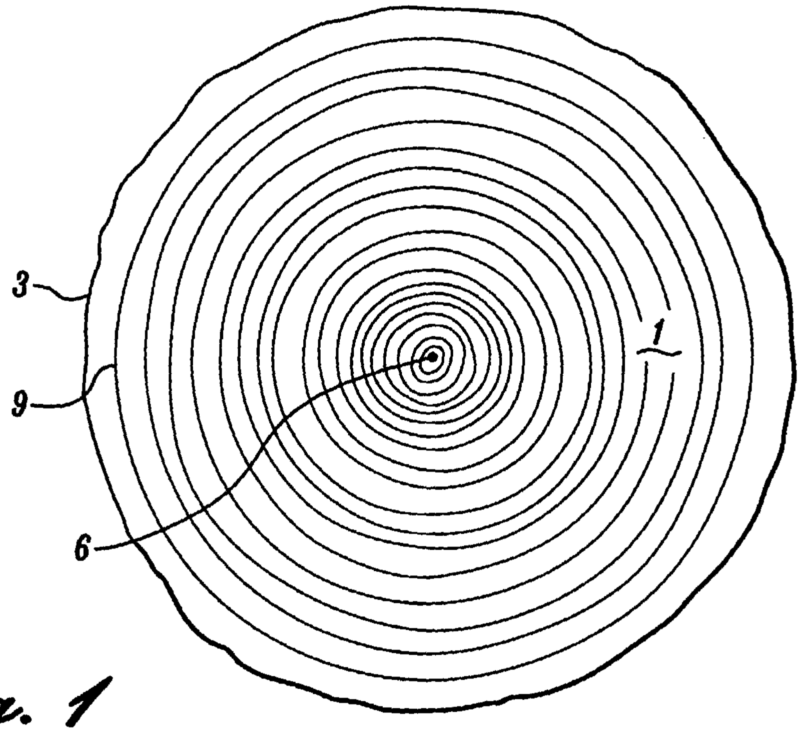

Fig. 1

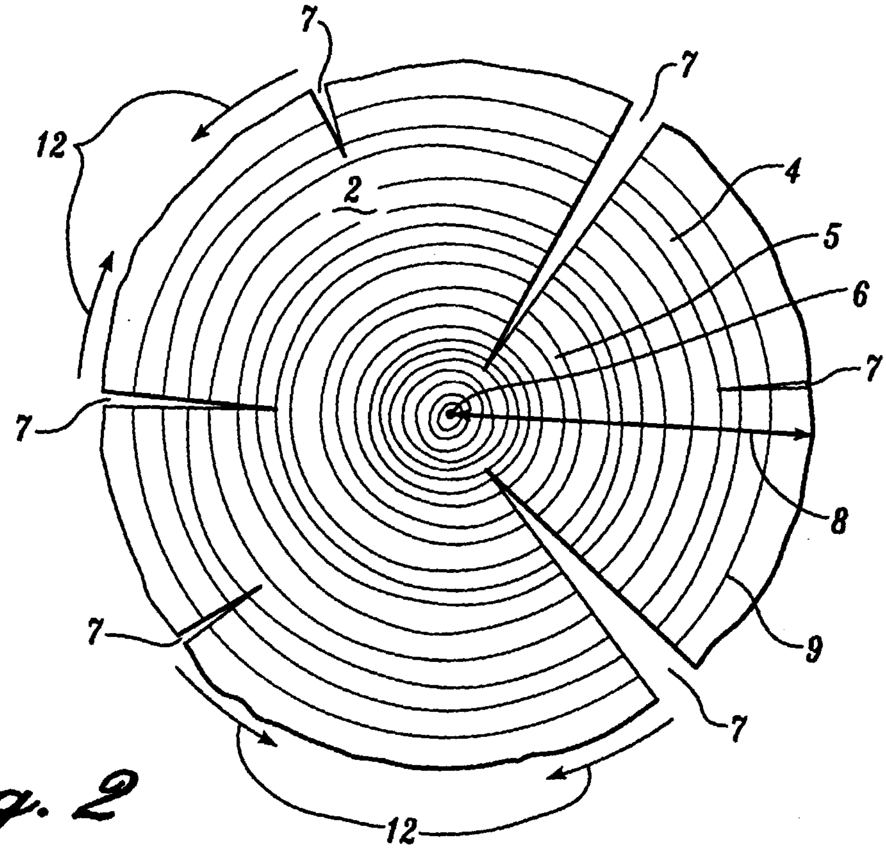

Fig. 2

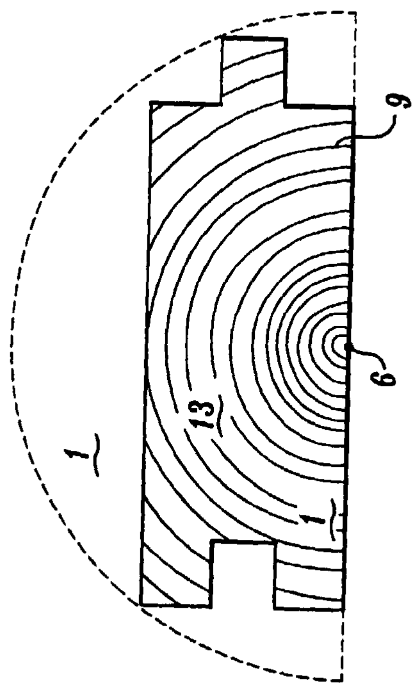

Fig. 5

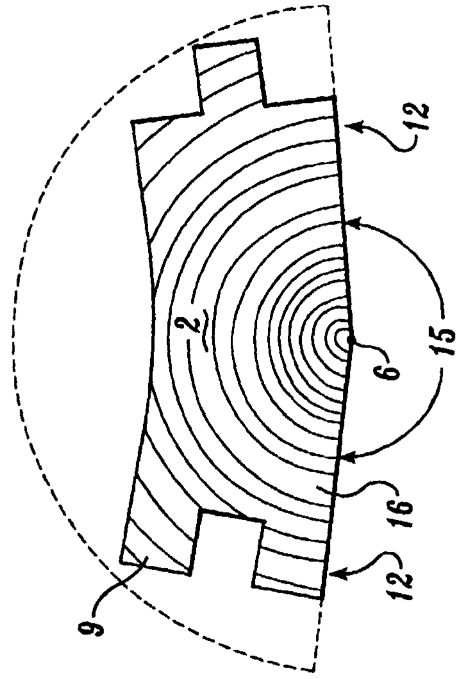

Fig. 6

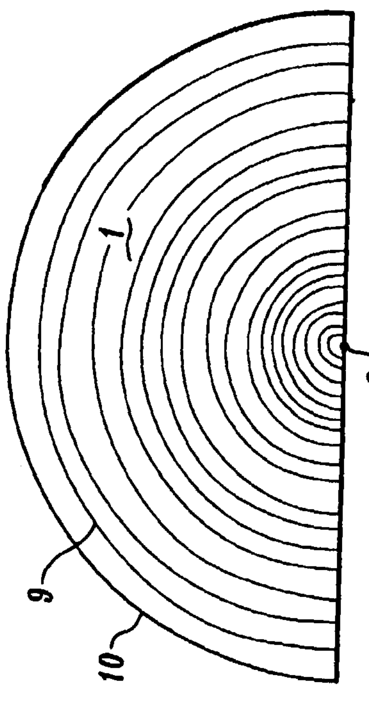

Fig. 3

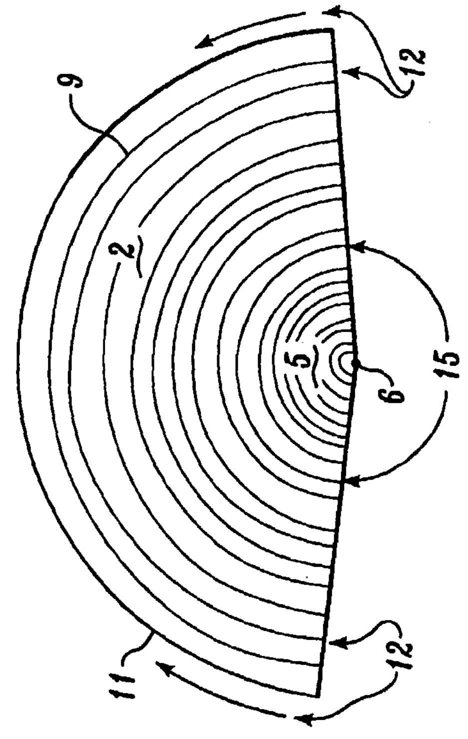

Fig. 4

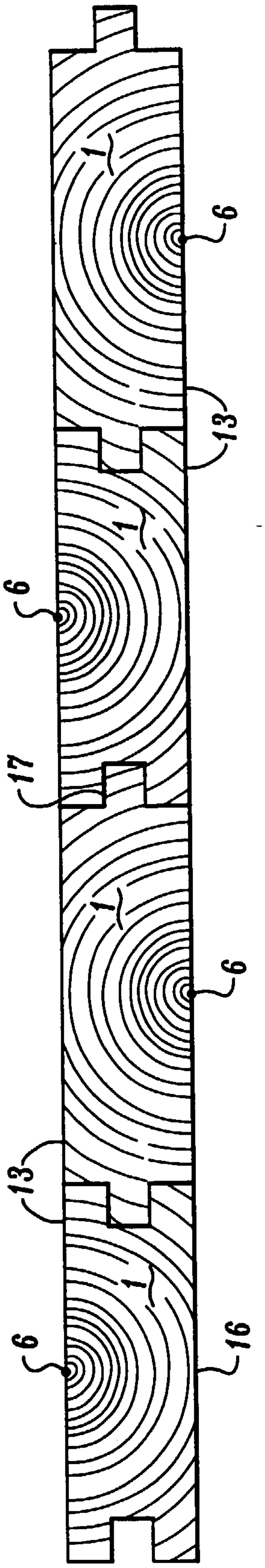

Fig. 7A

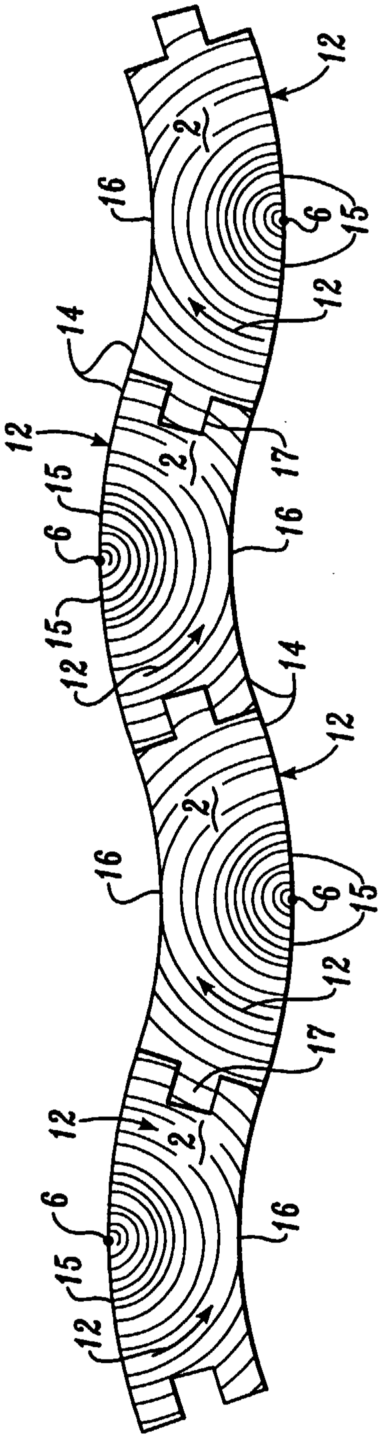

Fig. 8A

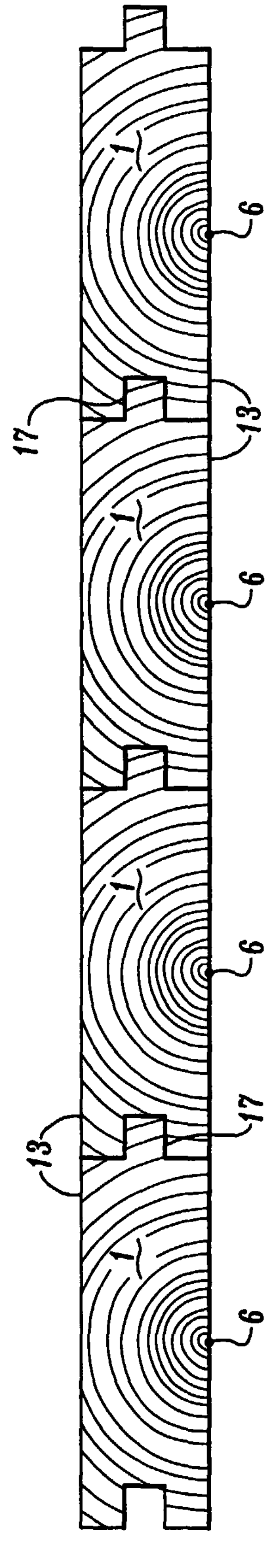

Fig. 7

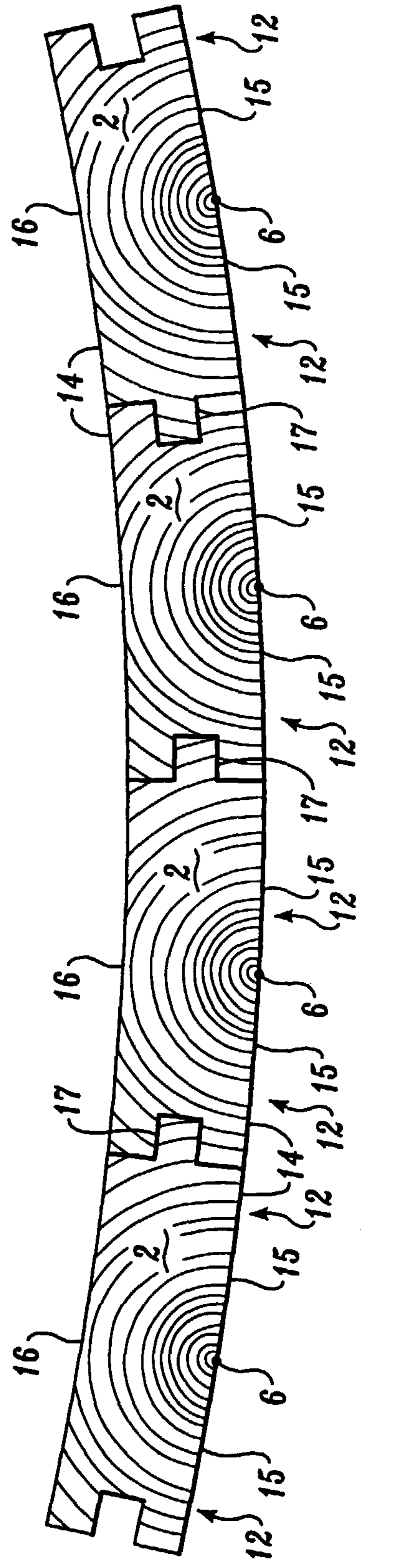

Fig. 8

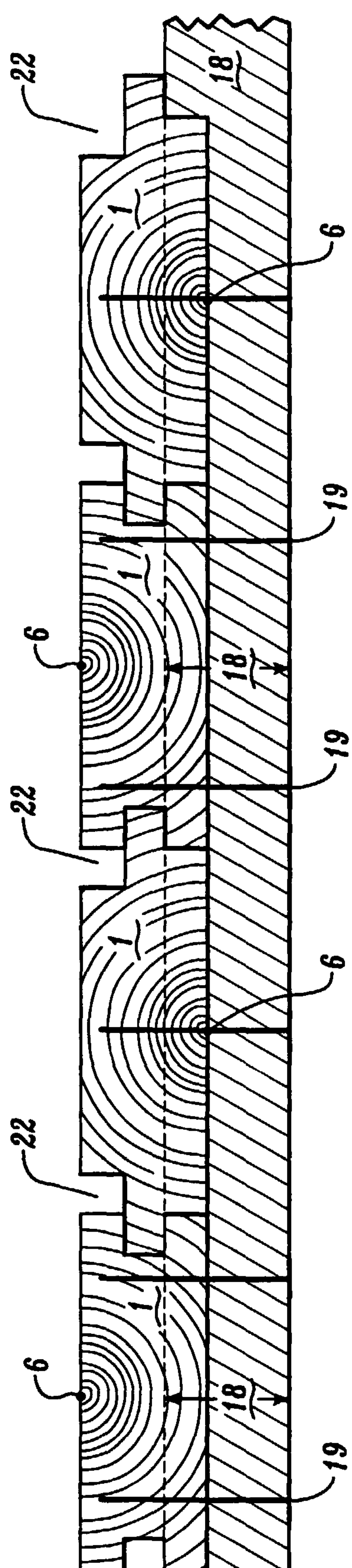
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Fig. 9

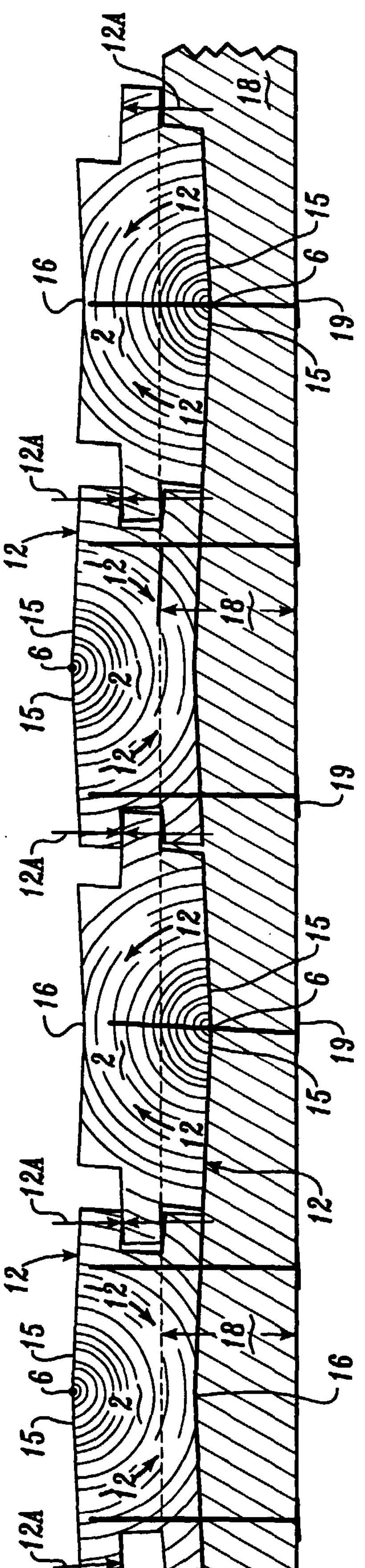
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Fig. 10

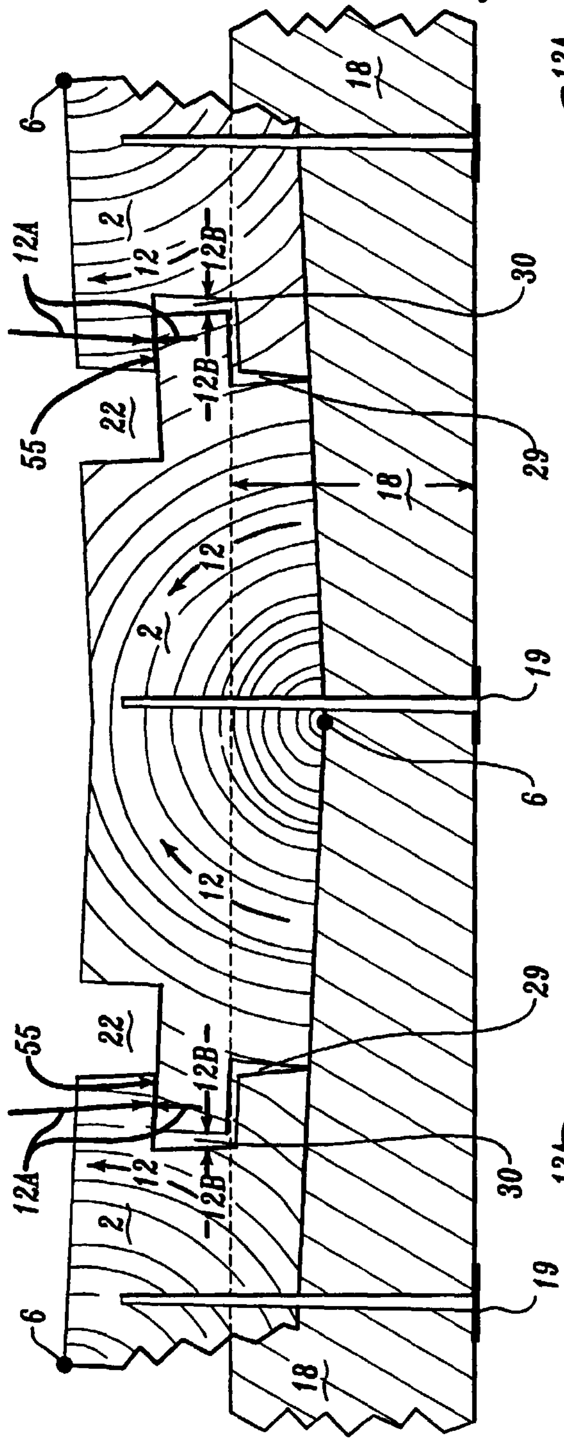

Fig. 11A

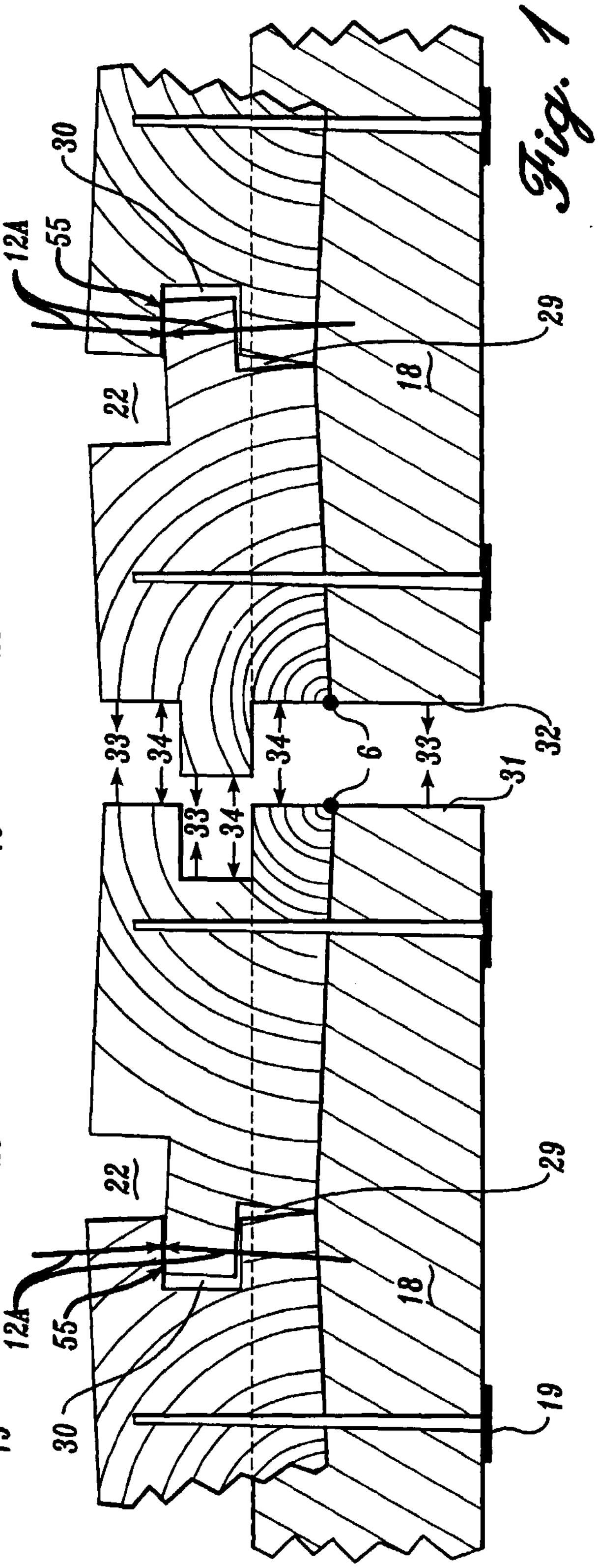

Fig. 11B

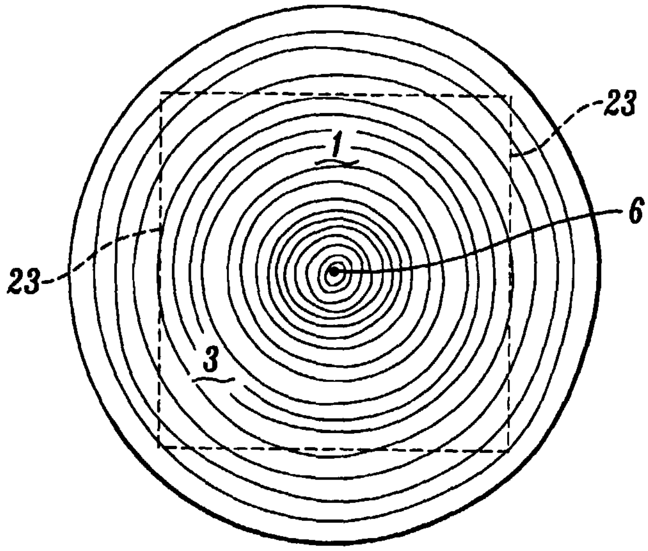

Fig. 12

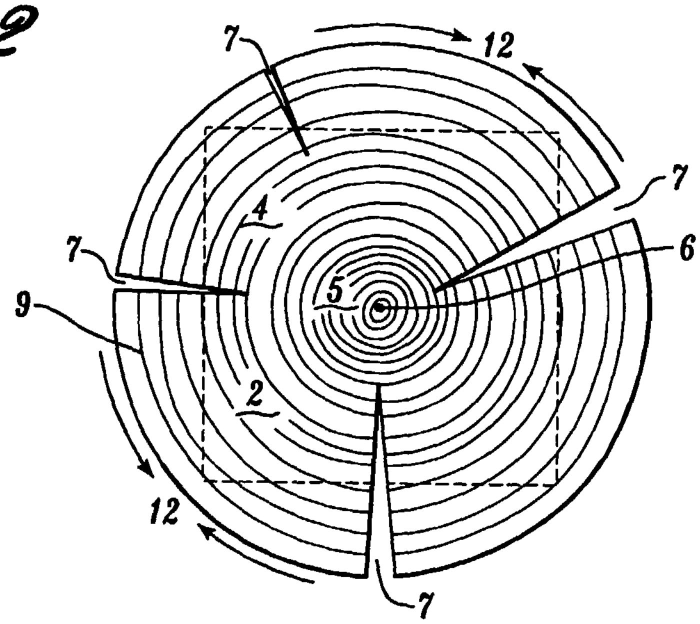

Fig. 13

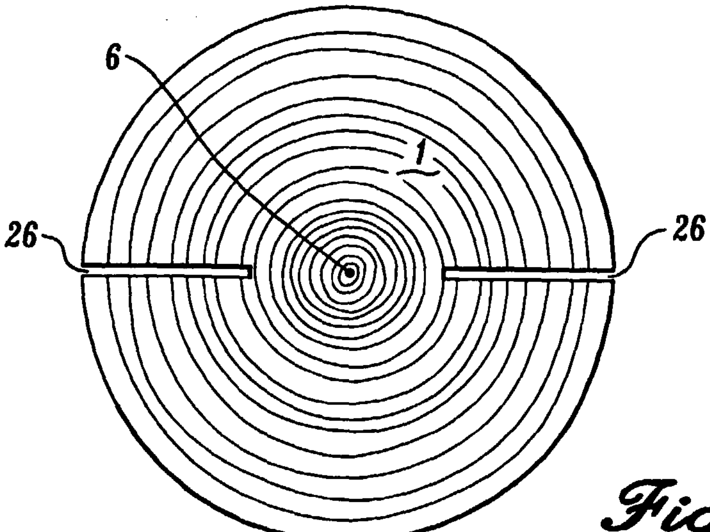

Fig. 14

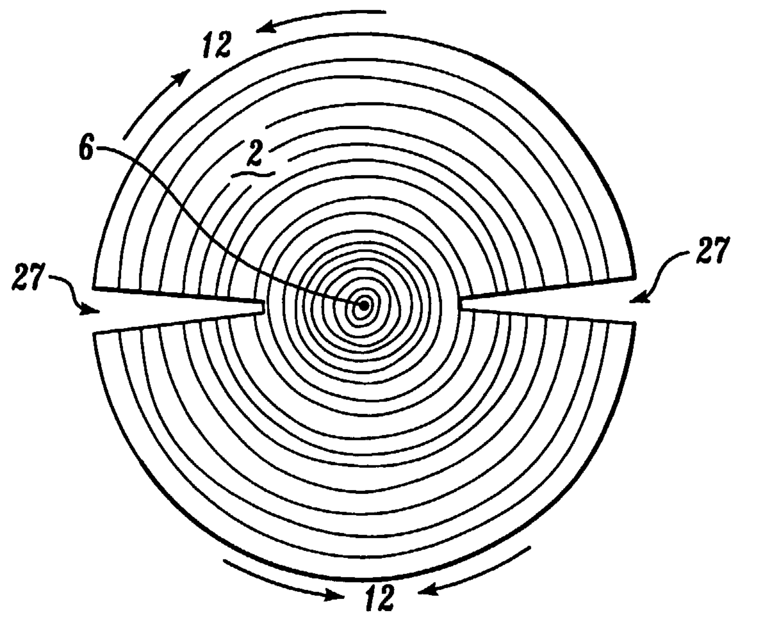

Fig. 15A

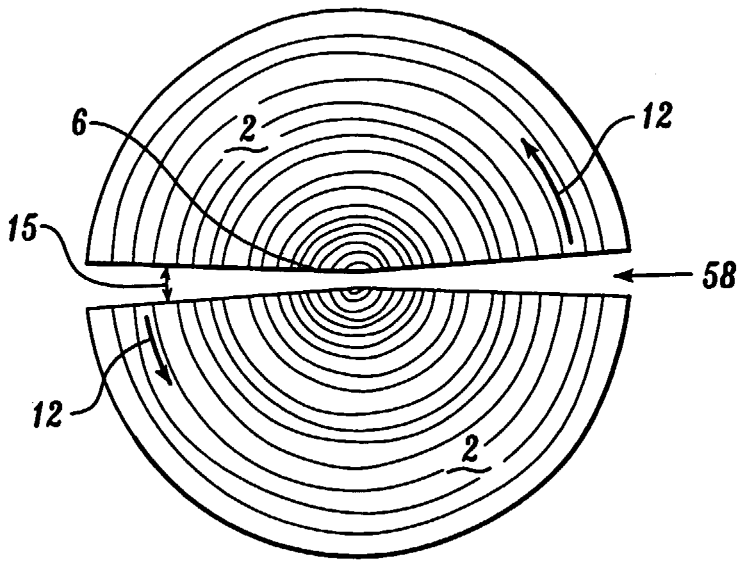

Fig. 15B

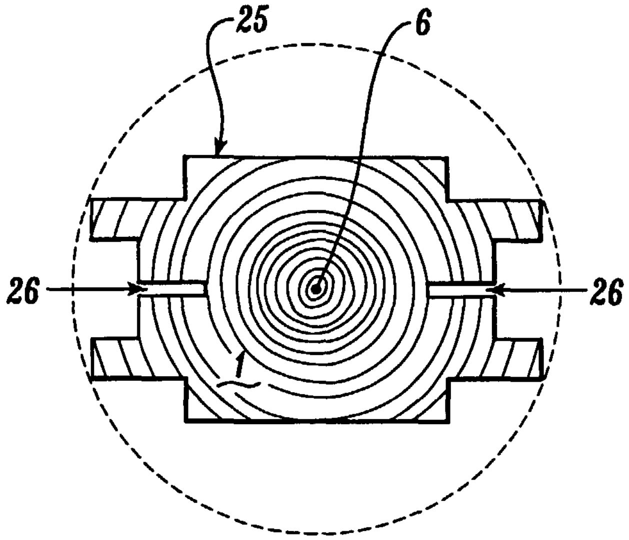

Fig. 16A

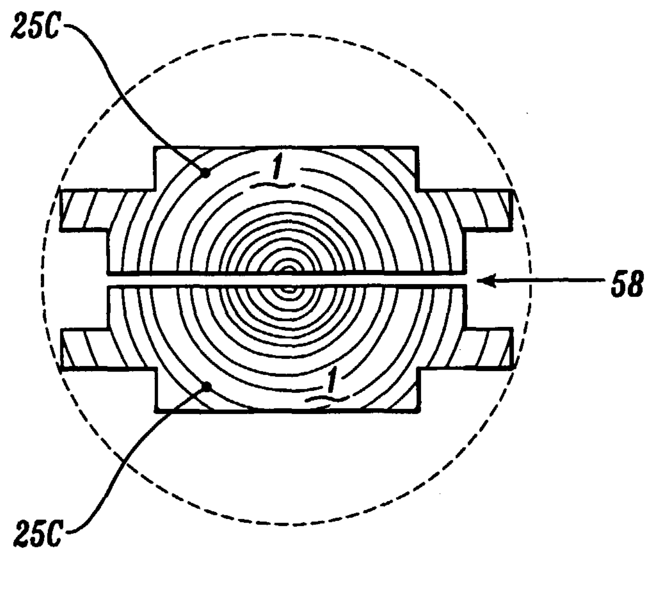

Fig. 16B

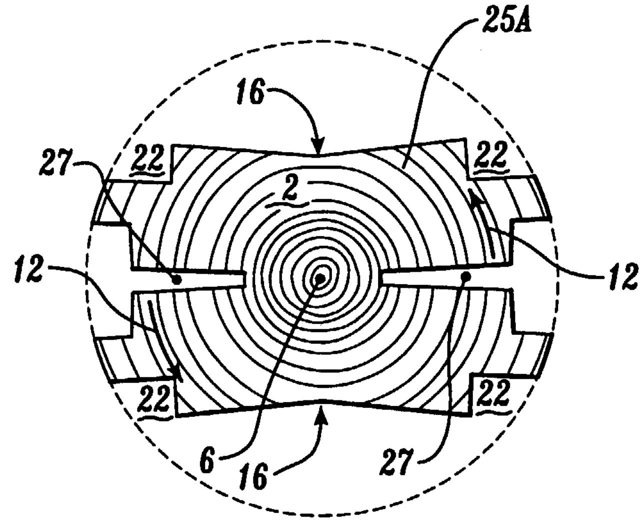

Fig. 17A

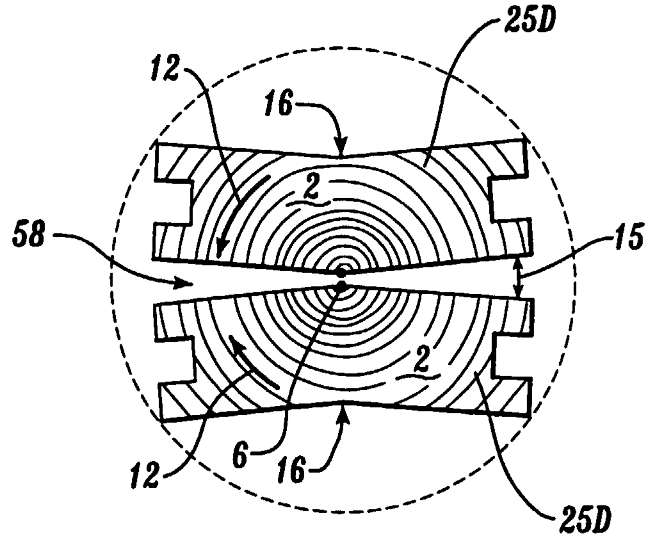

Fig. 17B

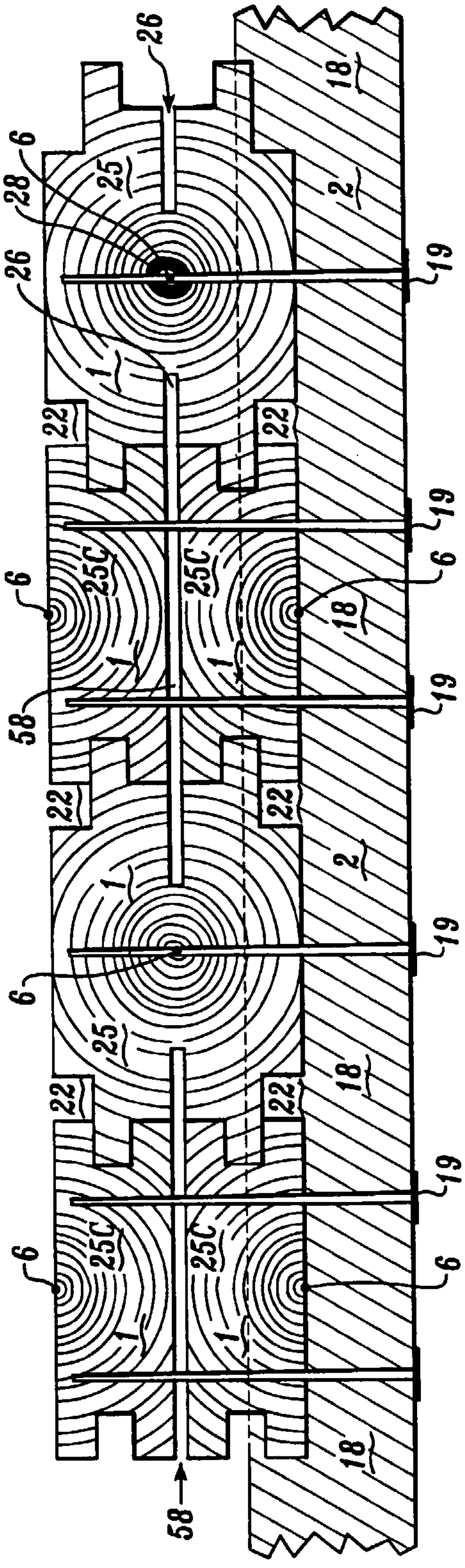
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Fig. 18

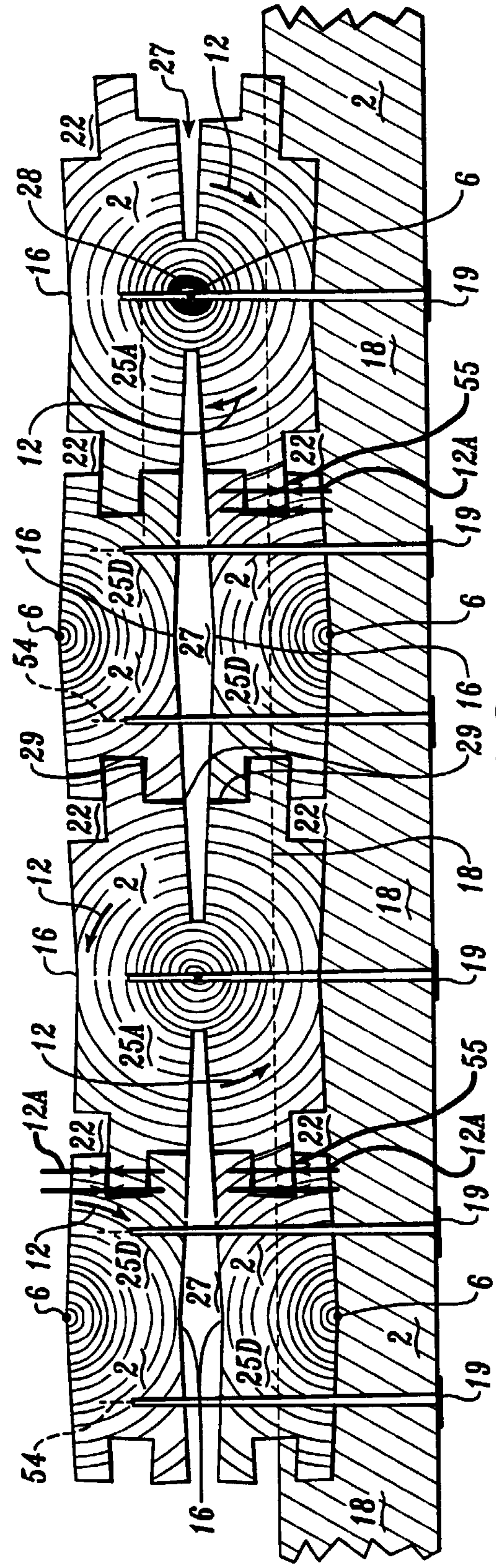
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Fig. 19

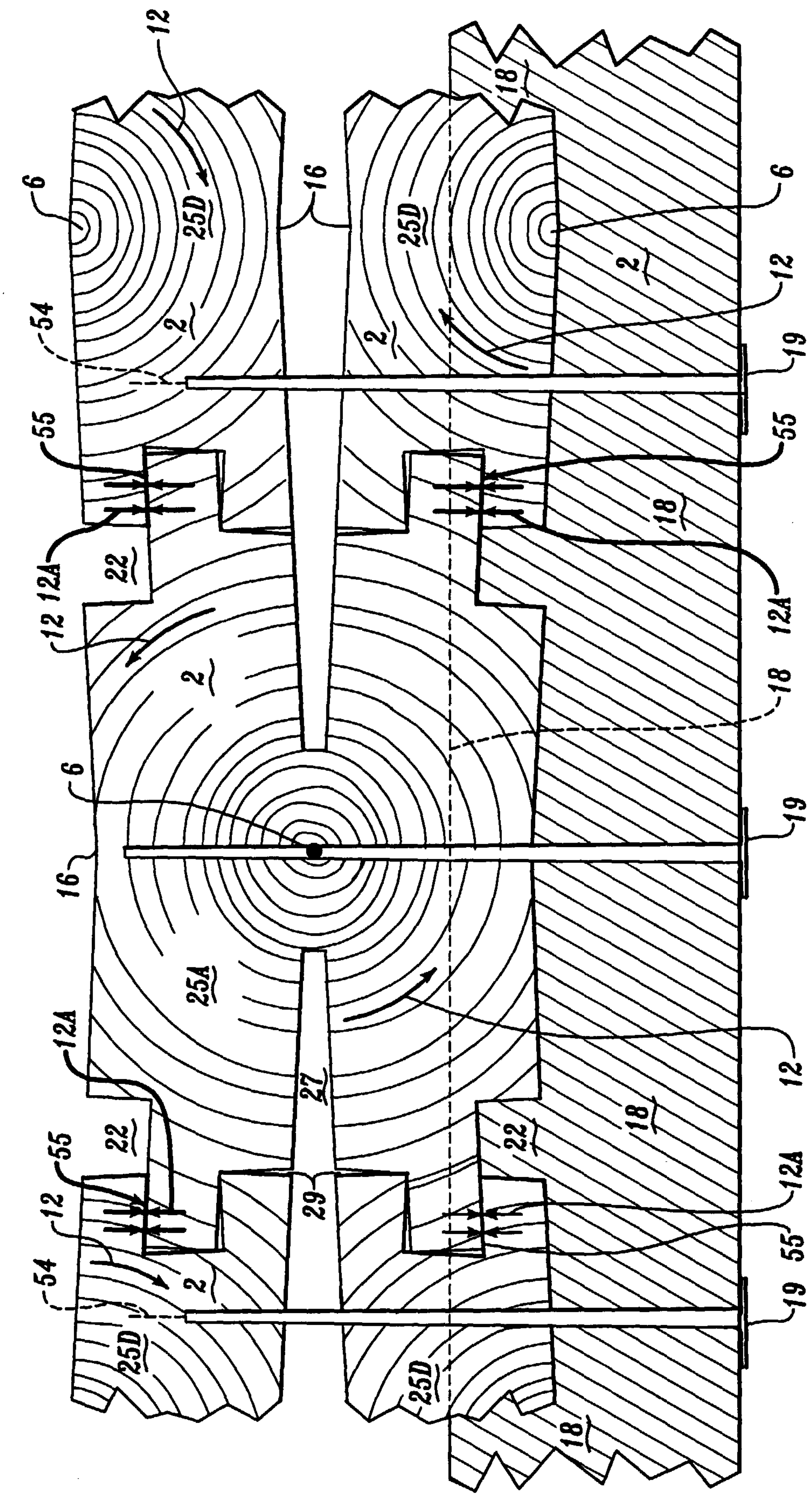

Fig. 20

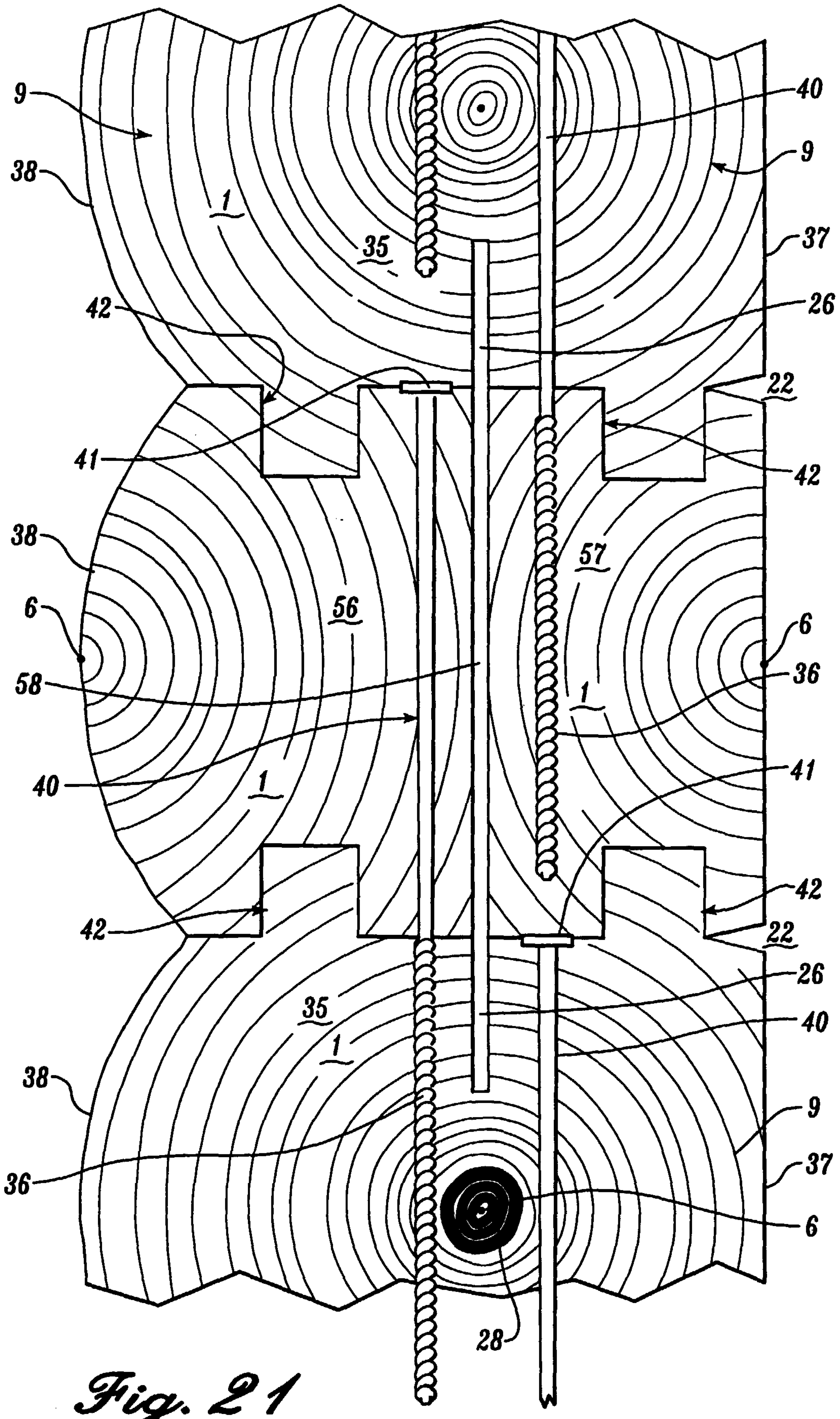
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Fig. 21

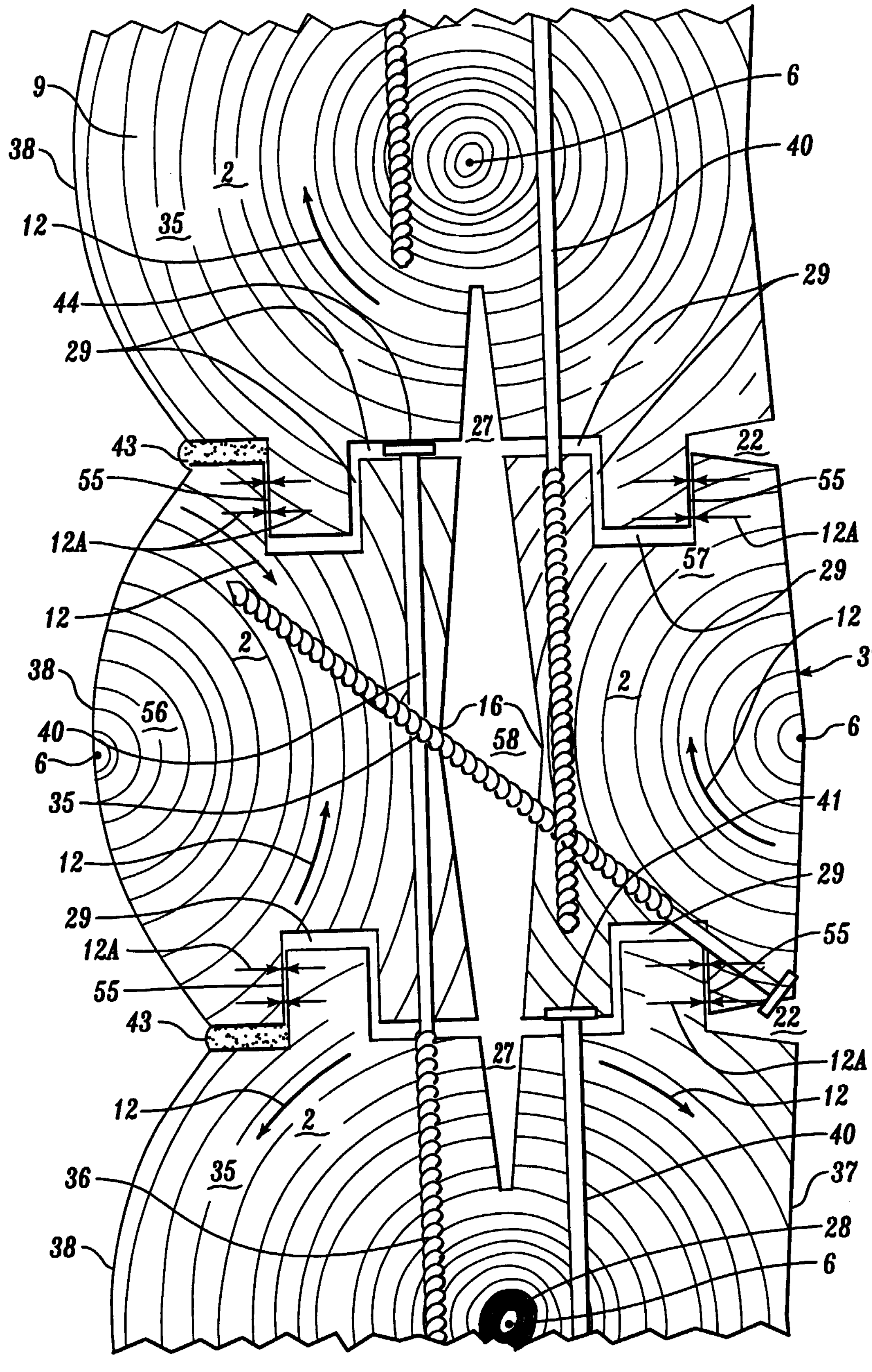
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Fig. 22

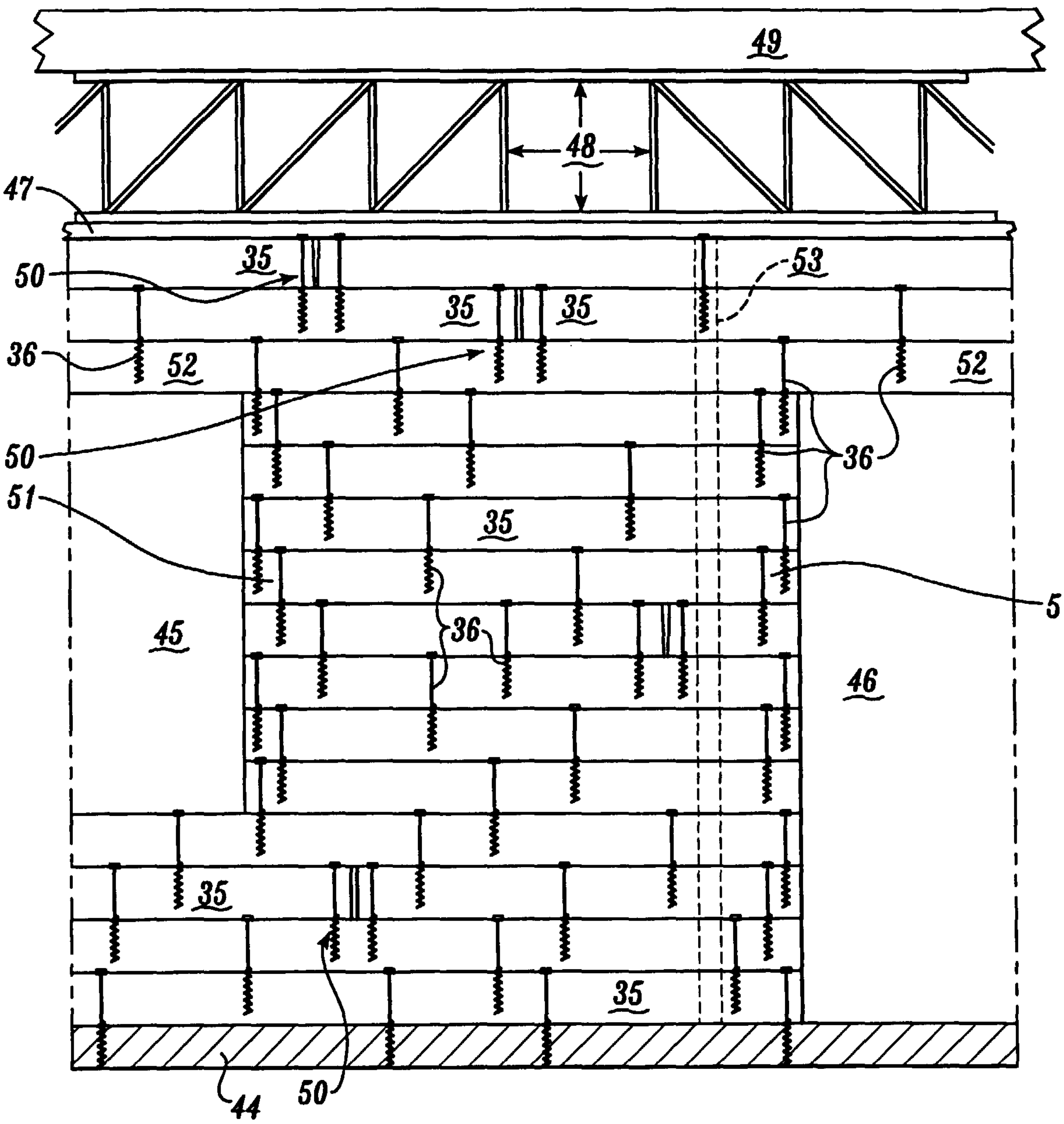

Fig. 23

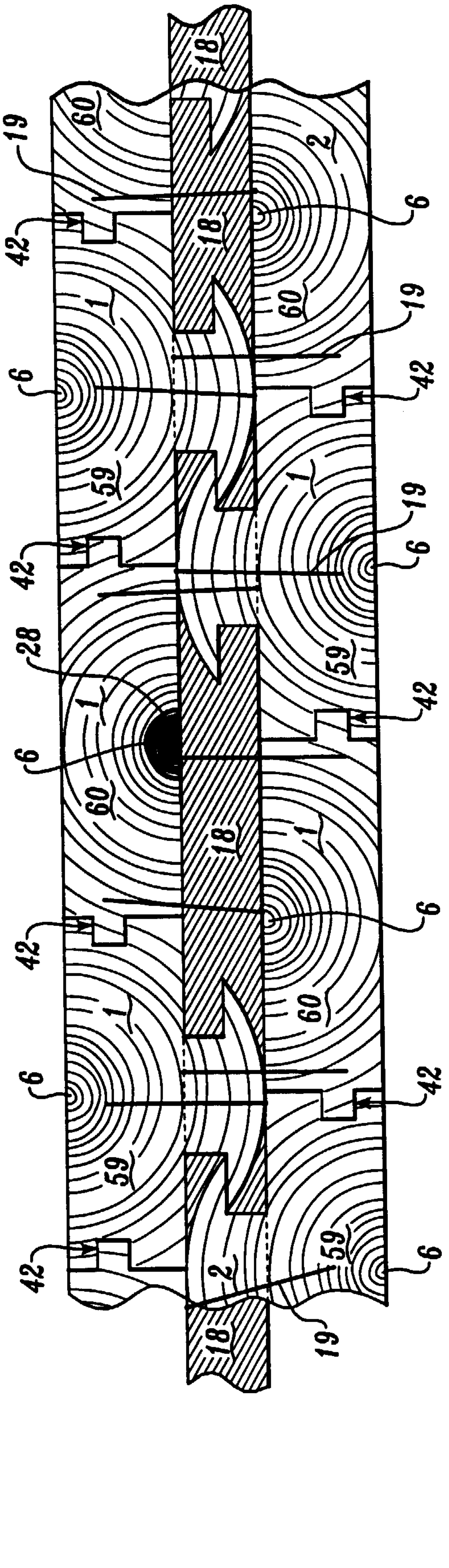

Fig. 24

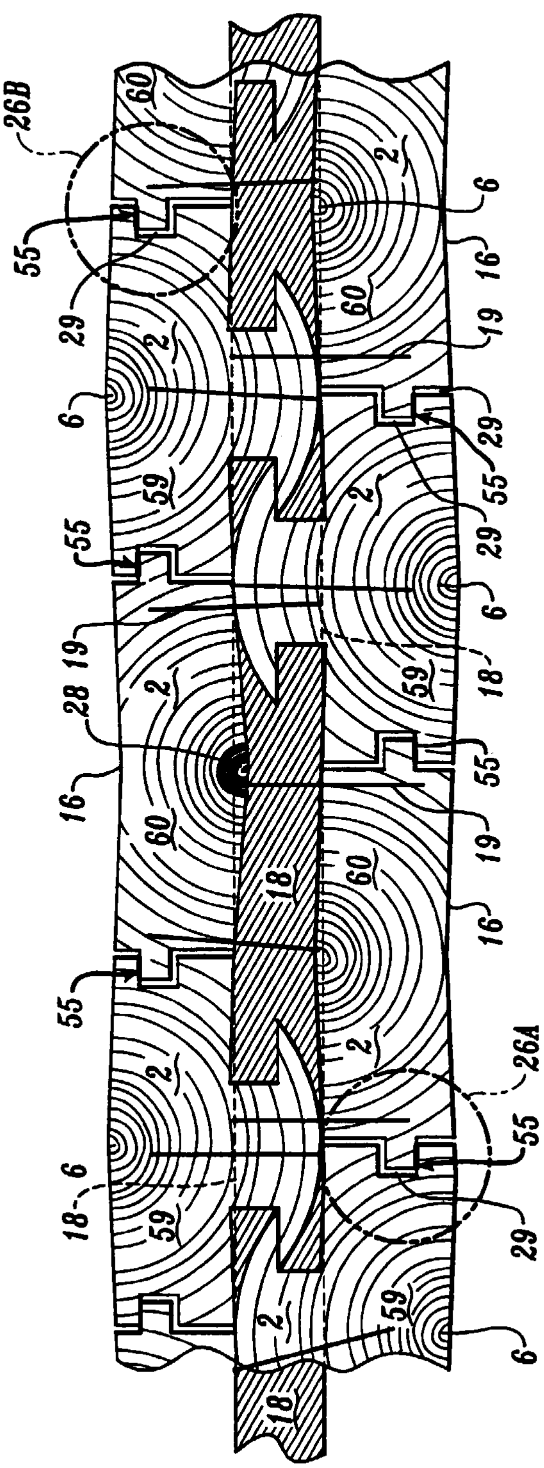

Fig. 25

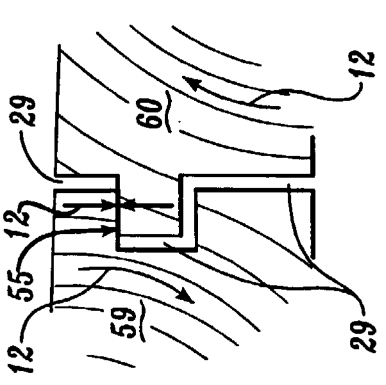

Fig. 26B

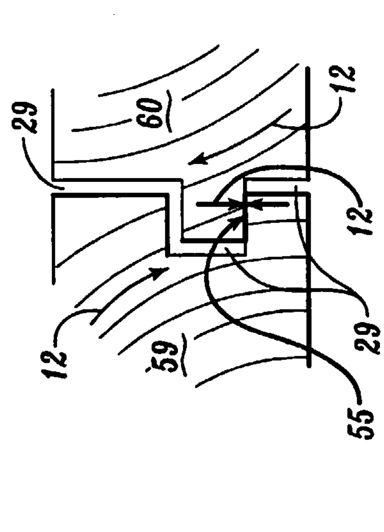

Fig. 26A

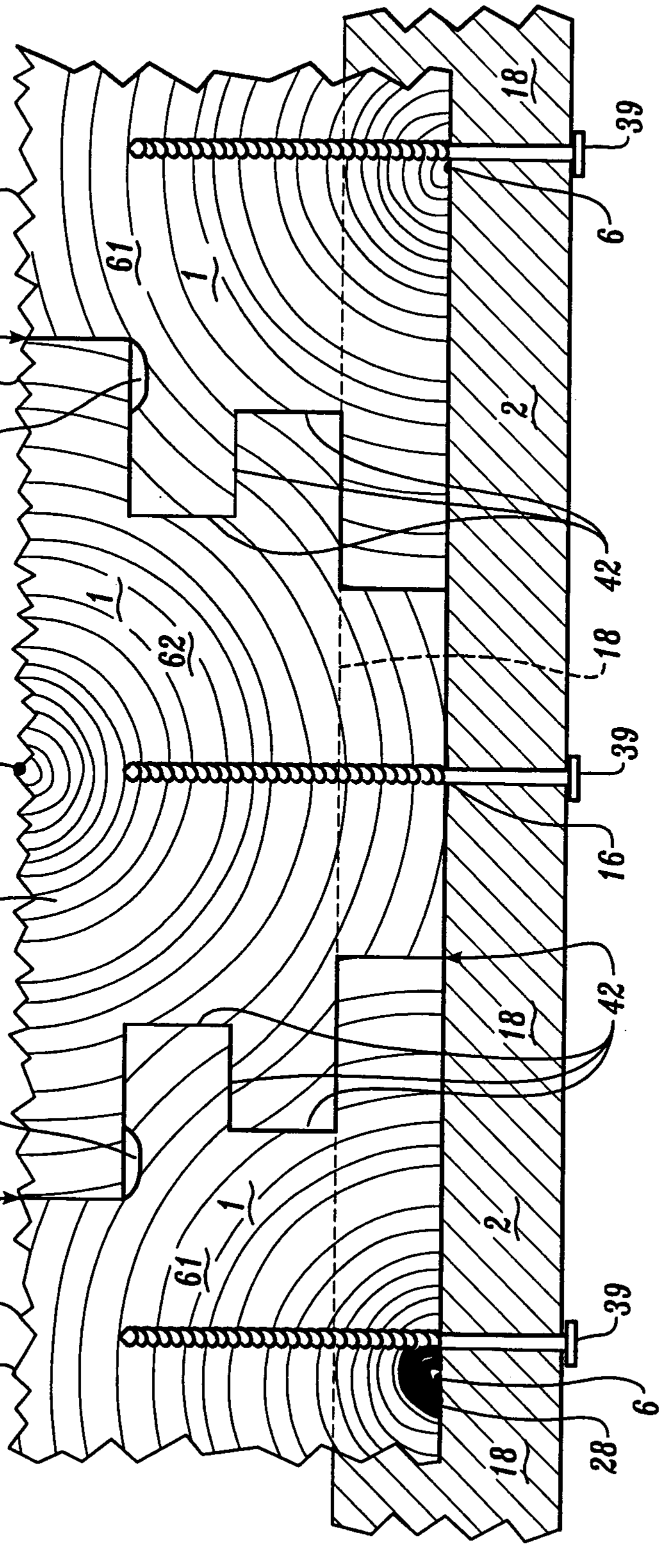

Fig. 27

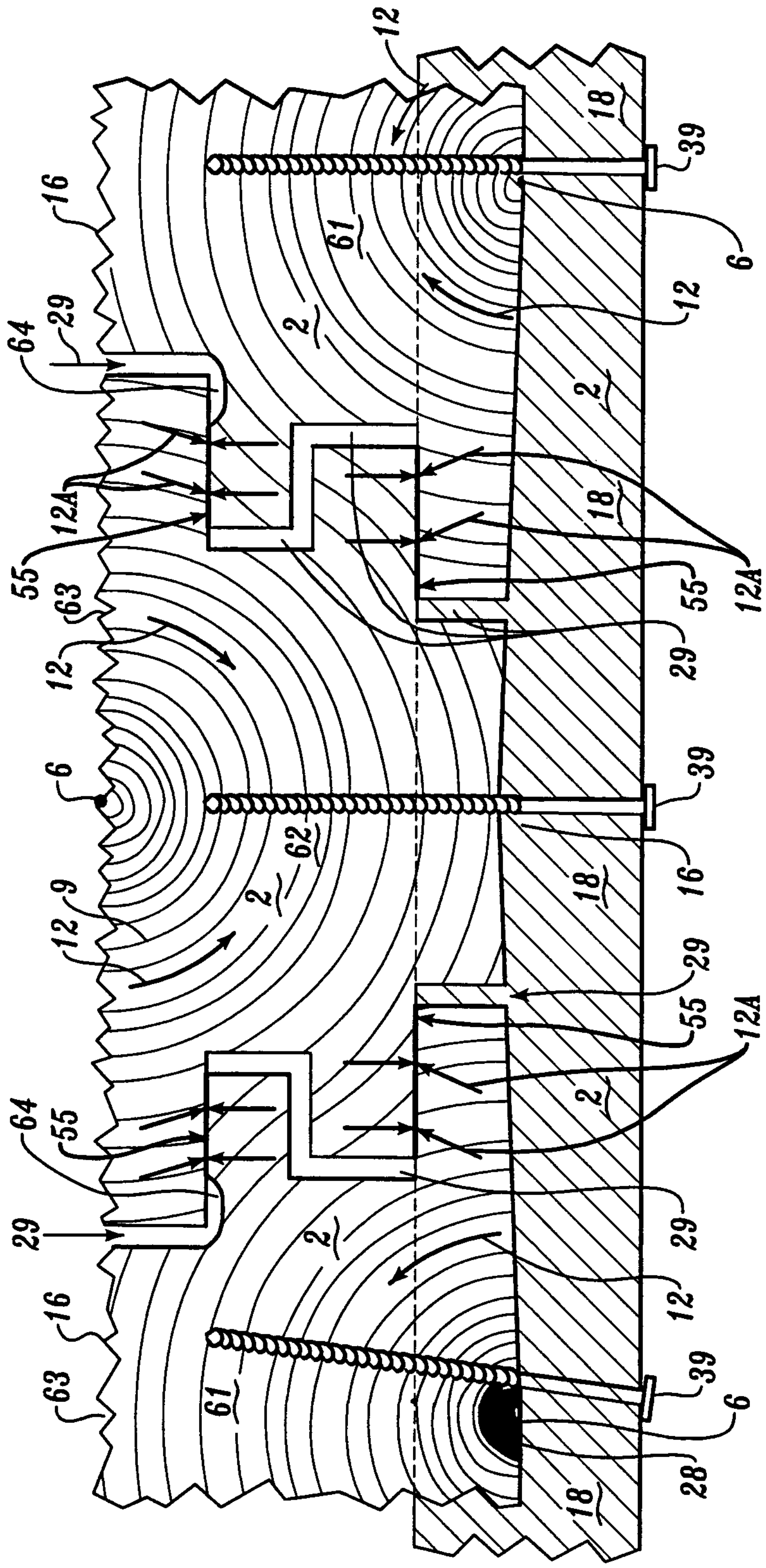

Fig. 28

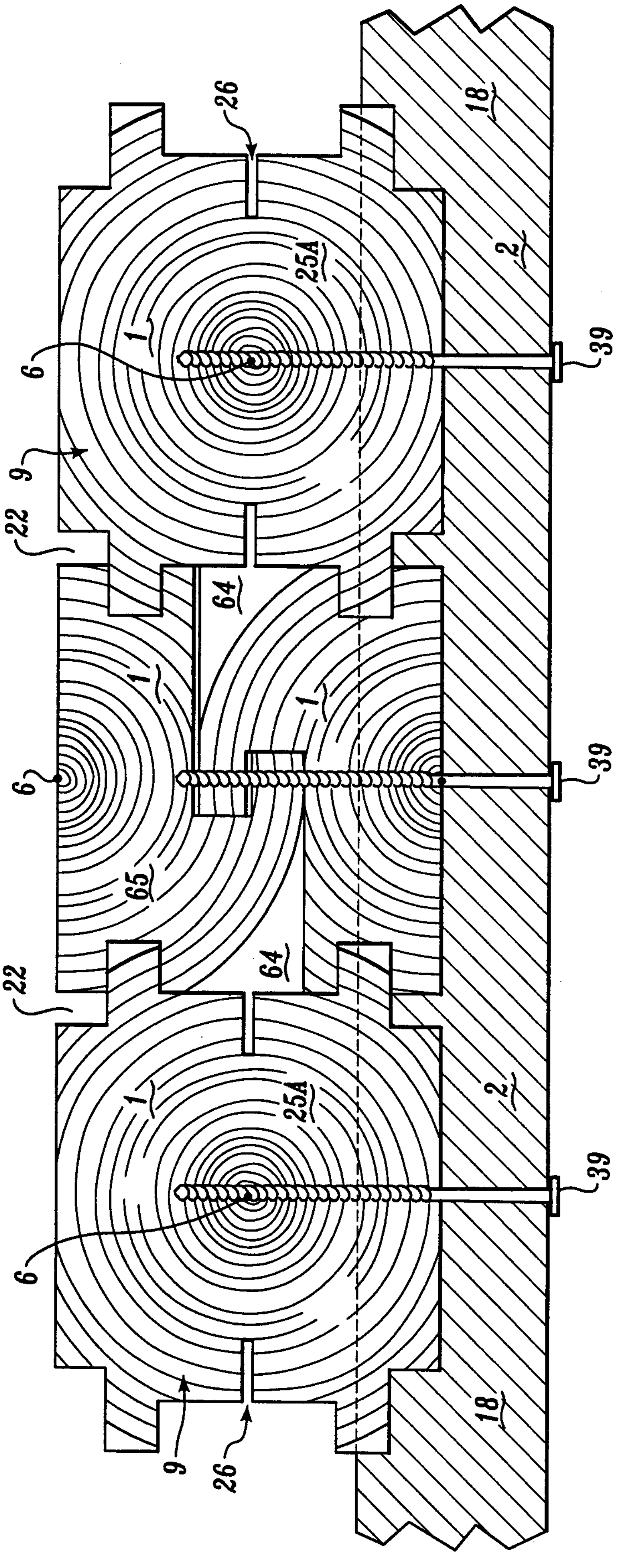

Fig. 29

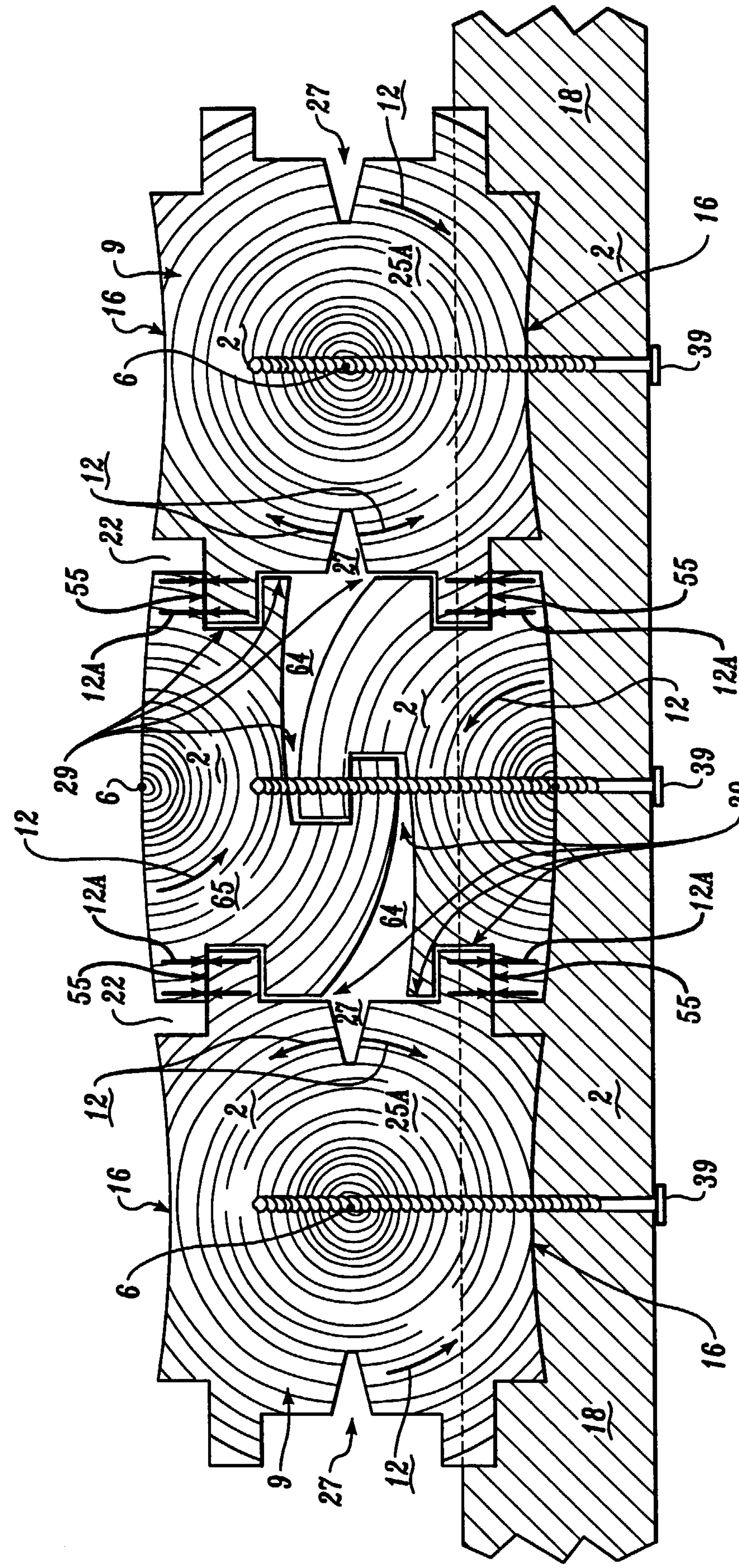

Fig. 30