(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 939 174 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.09.1999 Bulletin 1999/35

(51) Int. Cl.[6]: **E04B 2/70**, E04B 7/02

(21) Application number: 99301442.2

(22) Date of filing: 26.02.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 26.02.1998 GB 9804138

(71) Applicant: Lindal, Sir, Walter
Seattle, Washington 98101 (US)

(72) Inventor: Lindal, Sir, Walter
Seattle, Washington 98101 (US)

(74) Representative:
Tribe, Thomas Geoffrey et al
fJ Cleveland
40-43 Chancery Lane
London WC2A 1JQ (GB)

(54) Wooden frame building construction

(57) A building material kit for constructing buildings comprises a plurality of T-shaped sections (31;31a), L-shaped sections (166,167), d-shaped sections (37), cross-section shaped sections (11,30;32), h-shaped sections (33;110,111) and hh-shaped sections (34) manufactured directly from logs. The various sections may be formed into outside walls, partitions, floors, ceilings, roof and outside decking by nailing cross ties (113) using nails (116) to each section in cross grooves (133) with nails (116), all nailing be accomplished without visible nails showing in the finished building.

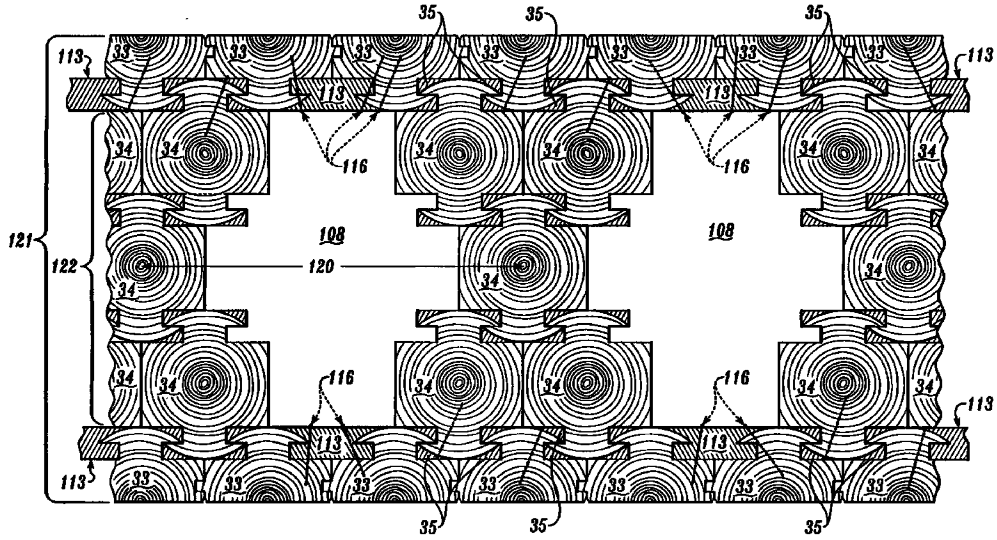


Fig. 54.

EP 0 939 174 A2

Description

Field of the Invention

DETAILS ON MY NEW HOUSE KIT COMPONENTS AND THE HISTORY OF THEIR DEVELOPMENT

[0001] Presently, we have a situation where there is actual deflation in the cost of most commodities, but the price of wood fiber for lumber and paper products is increasing substantially and there appears to be no end to this price escalation. Environmentalists and governments are making less timber available to harvest and what is left is being consumed faster than it replenishes itself.

[0002] However, there is a segment of our forest timber that is being trashed and wasted during the harvesting of sawlogs to make lumber. Included in this waste are small trees and tree tops of the species harvested and also, so-called "junk" trees that don't grow to sawlog sizes, or don't grow in sufficient quantities to be economically harvested, such as alder, aspen, willow, cherry, and in the tropics, bamboo. Small logs are defined as logs that come from tree stems 8 meters long with 150 mm butts and 75 mm tops.

[0003] Governmental forest departments such as in British Columbia encourage the harvesting of small trees and junk trees. Stumpage charges on sawlog harvesting runs from $30 to $80 per M^3. The charges for small trees and junk trees are as low as .25 cents M^3 and such wood fiber is not charged against quotas that limit harvesting. Until recently, small trees have been more costly to log and small logs have been more expensive to manufacture into lumber than regular saw logs and thus the apathy about harvesting small trees. New tree shear equipment has reduced harvesting costs of small logs and new saw milling machinery have reduced the house manufacturing costs to costs lower than lumber production from saw logs.

[0004] There is an area of tens of thousands of square kilometers stretching from Idaho, through British Columbia and into the Yukon that contains many millions of small Lodgepole Pine trees. This tree is not self thinning, and they grow so close together that 80 year-old trees reach 45M high and only have 150 mm butts. A high percentage are over mature and dying. Right now they only make pulpwood, firewood and fence posts, but if handled differently would make excellent material for homes.

[0005] Perhaps most important of all is that various university and governmental forest departments have developed very fast-growing hybrid trees that grow a now useable small tree in three to five years that produce wood fiber at less than a third of the cost of harvesting regular sawlogs. Now a home manufacturer can grow his own small trees nearby his factory, supply all his lumber needs, control his costs and be independent of the volatile timber market and have a substantial cut in in-freight costs. Imagine Chicago, London or Calcutta growing their own houses in nearby tree farms.

[0006] We have all the wood we need in the form of small trees and we have the equipment to economically use the wood to make houses. But who has ever heard of a house made entirely from the wood of small trees? My invention teaches how to manufacture houses using only wood from small tree stems. No lumber as we know it is produced, no floor joists, no studs, no rafters, no decking, no plywood and no shingles. My houses are built out of new timber shapes that are sawn directly from the small tree logs in a one-pass operation. The shapes in cross section are Tees (T), Ells (L), Crosses (+), Ees (E), Dees (D), Ayches (H) and Double Ayches (HH). Costs are further lowered by using almost 100% of the small logs to make these special shapes. More than twice as much of the wood in a log is utilized as compared to the wood recovered from the same sized logs when standard lumber sizes are manufactured. The cost of a house is further reduced by the use of new components that serve two or three purposes. A cross-shaped roof plank that serves as a rafter, roof sheathing and weatherproof shingles. An inverted tee shape that serves as a ceiling liner and a ceiling joist. An ell shaped molding that serves as a door or window jamb and also as casing or trim. As done in Scandinavia, wood from small trees is used to make doors and windows reducing wood cost by 90%. My invention covers a new jointing system in assembly where special shaped house parts can be joined together so that most nailing is eliminated, and where nails are used, they are not visible.

[0007] This invention covers a new method and plant to manufacture houses that can initiate a whole new industry. Ordinary saw mills cannot handle small logs in an efficient manner. A new type of mill with special equipment is necessary to produce my special house components. We have chosen to call it a "House Factory" because its end product is a complete house package. A house factory like a high production saw mill will cost from four to six million U.S. dollars. Also, an investment of about a million dollars will be needed for the latest state-of-the-art log harvesting equipment to keep the house factory going. Automated manufacture of house sections will be part of the house factory set up. This machinery substantially lowers field labor costs in the actual construction of the homes.

[0008] For over forty-five years, I have been trying to produce wood planks that are waterproof and remain waterproof, thus eliminating the need for shingles, tile or any other roofing and the labor for the application of roofing materials.

[0009] Back in 1951 a cedar 38mm x 150mm plank with tight or integral knots appeared to me to be quite impervious to water. All that seemed necessary were waterproof joints between the planks if they were laid vertically to the slope of the roof, not horizontally. Experiments taught me that tight tongue-and-groove joints were waterproof for roof slopes

5 in 12, or steeper. For flatter roofs, I found it was necessary to use a joint sealant, because even thoroughly kiln-dried planks swell in humid conditions and shrink in very dry weather. I had a lot of trouble here, because some sealants dried out in hot, dry weather and became ineffective, and even everelastic sealants like silicone got squeezed out altogether when the wood expanded in wet weather. I learned to leave space at the end of the tongue in the groove to hold enough sealant to block the joint from water entry when the wood planks shrank apart from long periods of dry weather. Once I had a truly waterproof joint system, I built a series of small sheds using 38mm x 150mm cedar planks laid vertically for roof covering, and no shingles. One roof was 2 to 12 in slope, one was 4 to 12 and a third was 6 to 12 in slope. The sheds had weatherproof walls and flooring. The floors were covered with a sensitive paper that changed color permanently from the tiniest drop of water. A full year of all kinds of weather, rain, snow and ice produced not a single drop of leaked water. I decided to demonstrate our waterproof roof plank system to the world and entered the Canadian National Exhibition in Toronto, Canada (which had three million in attendance) in the late summer of 1954. I built a small summer home and all there was between the inside and the sky were 38mm thick planks, no shingles. Heavy rains during construction and on the first day of the show produced no leaks. Then, we had 10 days of hot, sunny weather followed with a drenching thunder shower. The roof leaked in several places. Embarrassed, I snuck in overnight and installed shingles. What happened? The wood knots shrank more than the wood around them and either split, star checked or crescents opened up around the knots and the water streamed through for up to a half hour, when the wood expansion from the moisture closed up the checks and crescents. Unfortunately, our test sheds were built on the north side of our plant, always out of the sun, and were kept moist, even in dry weather, from morning dews dripping from the plant roof and were thoroughly soaked even from small showers from water off the roof.

[0010] I went on to work on roof planks made from clear lumber, free of knots. This proved to be only marginally successful, because very often the cost of clear wood was so much more than common lumber with knots that it was cheaper to use shingles with common lumber. Also, flat grained clear lumber checked and split due to tangential shrinkage, so more expensive edge grain clear lumber had to be used.

[0011] Then, in 1968, I came up with a species of pine whose knots did not shrink faster than the wood around them. However, sometimes the wood around the knots shrank so much that it split right through at the knots producing leaks just as the knots did in the show house fiasco.

[0012] Then, in the spring of 1994 I happened to notice an outside deck on one of our homes which was being partly used as dry storage for firewood. The decking planks were covered with checks and split knots. I asked the owner if the deck really kept the firewood dry. He said that it was very dry on one side, but leaked too much on the other side where he had no firewood stored. Puzzled, I examined the deck carefully. I discovered that the ends of each of the planks on the dry side showed the heart of the log it was sawn from. There were checks through the knots on the wet side, and some of the wet side planks had splits in the clear wood right through them. Here I had a solution to my waterproof, common grade, plank problem. Branches start as tiny specks at the heart of a tree and show up as knots on the face of lumber sawn from the tree's logs. If the knots check or split, the split cannot go through the plank if the plank encases the heart of the tree the plank was sawn from. The shrinkage of wood around the face of a log is called tangential shrinkage. The shrinkage between the heart of a log and its surface is called radial shrinkage. It is an axiom that tangential shrinkage is three times as great as radial shrinkage. Also, the exposed outside of a log will dry faster. Such checks and splits point to the heart, but do not reach it. Even when the round log is sawn into square planks, tangential shrinkage is still greater than radical shrinkage. Faster tangential drying causes the checks and splits. The circumference becomes less from shrinkage, but the inside does not shrink correspondingly, so the outside lumber is forced to split or check as its circumference becomes smaller, and the check lines radiate down toward the wetter center, but stop when they reach the wetter corewood. My observations during very considerable research was whereas planks that do not encase the heart of the tree they are sawn from can, and often do split right through, no small planks with their tree hearts encased split right through. So small planks that contain hearts do not split through and are waterproof, even if their surfaces contain many knots and checks. I had waterproof, common planks at last, as long as they have encased hearts and are small. We can use low-cost common lumber to keep rain out of houses and even water out of the hulls of house boats and barges which otherwise now use expensive clear edgegrain lumber. Edgegrain lumber has radial shrinkage across the planks and tangential shrinkage across the thickness of the planks and there is no checking because the different shrinkages are not in conflict. A flat grain plank has both radial and tangential shrinkage across the plank and can spilt where the two types of shrinkage are in conflict. Planks that encase the heart of logs have edgegrain wood on either side of the heart so the wood is free of checks and splits.

[0013] Over the past three years, I have run experiments with small sheds again, but this time the sheds are out in full sunshine. After prolonged periods of hot, dry weather, the roof planks (especially the pine samples) were covered with small shallow checks and every knot was star checked or split and some had shallow open crescents on a side of them. No leaks have developed. The pine is now black and the cedar is silver gray. Paint improves the appearance and stops most of the checking. A sample garage roof nearby is painted a light green and clearly shows that there are no shingles. (The garage roof hasn't leaked in 3 years.) Besides opening up a new vista in the exterior decoration, painting a roof gives it extra insulation against heat absorption. A white painted roof reflects 35 times as much heat as a black asphalt shingle roof, and 25 times as much heat as a white shingle sloped roof or a silver flat roof. These statistics are from a well-known journal on cooling.

[0014] In any run of sawn lumber there will be a certain percentage of common lumber with the tree hearts encased. But naturally, if the logs are small there will be a much higher percentage, so lumber with encased hearts would not call for a price premium. On the other hand, lumber sawn to the specification "free-of-heart-center" costs extra. However, if the logs are very small, with tops 100mm or less, 100% of the planks produced will include hearts. The cost of small logs is substantially less than for larger logs.

[0015] Experimenting has improved the quality and usefulness of say, 38mm x 80mm T&G roof planks out of 87mm logs, producing both the planks (with enclosed hearts), and the pulp chips by making cross shaped roof components out of the same logs. The horizontal segment was made into a T&G roof plank and the vertical part of the cross became and effective roof rafter, greatly increasing the span capability of the roof plank alone. Also, cutting the four right angle notches at 90º around the log stopped the tangential shrinkage that produce checks. The 90º angles became larger and the vertical and horizontal planks acquired thinner ends as the crosses dried out.

[0016] I went further, I made the right angle notches sharper angled at 60º, producing a shape similar to Maltese cross which, having more wood, became stronger and enables the interlocking of successive long shingle-like roof planks. This roof was painted white and being so unusually shaped is truly stunningly different and, of course, waterproof.

[0017] The Maltese cross shape actually enhances the performance of the roof plank. It is cheaper if we can avoid having to use everelastic sealants in the T&G joints between the crosses. The exposed surface is sloped away from the joints between the crosses so that only a direct hit of a rain drop on the joint has any chance of working through the joint. Also true to the Maltese cross configuration, the top of the rafter part is veed downward to stop water that hits the top of the widened cross from spilling over to the joint area. With the top configuration of the Maltese cross being the same shape as its bottom, a second tier of roof planks can have its bottom area end tucked into the top area of the first tier, locking it to the first layer without the need for nails, making the joint between layers more waterproof. The bottom of the second layer of planks will cover the nails necessary to nail the top of the first layer to the cross bearer beam. Of course, the roof planks can be attached to their bearing cross beams using the key-lock principal taught in my US Patent #5,475,960, December 19, 1995, where attachment is possible without the need of visible nails.

[0018] Cross-shaped components can also make excellent free-standing walls or partitions for homes and other buildings. Here the vertical member of the plank will become a stud instead of a rafter, providing extra stability and strength to the wall. A cross made from a 100mm log would produce enough stability for a 5M high wall based on the 1 to 50 rule and there would be no need for nails showing.

[0019] If the top of the square angled cross were to be milled off leaving a "T"(tee) shaped component and leaving the heart encased, a waterproof component for an outside porch, patio or deck would be produced. This, with the bottom of the cross still attached, would produce a much stronger tee shaped deck plank, with a sort of built-in joist, able to span wider spaced bearing beams and having less bounce. This component shape could produce a partition or wall with enough stability to stand 4 meters tall and there would be attractive "studs" showing on one side of the wall and could allow the attachment of drywall on the stud side of the wall, if desired.

[0020] The cross shaped configuration could be modified differently to produce two tees by splitting the horizontal cross members horizontally. It would still be waterproof if the split occurred right on the heart, but it would not need to be if the tee shapes were used for inside flooring or upside down for ceiling liner or for partitions. It would go twice as far and would approach the cost of drywall, when you consider the expensive decorating cost of drywall and the cost of such low-cost small logs. 63mm or 75mm logs could be used, which are only good for firewood. Also, components that are used inside only, can be made from junk trees such as willow and alder.

[0021] This patent application also covers a wood wall system that consists of two or more layers of unusually shaped plank components which can be employed vertically or horizontally. These planks are interlocked in each layer by simple tongue-and-groove joints and are held together with cross ties nailed across the face of the planks. The individual layers are interlocked together using tee shaped projections cut out of the planks that project from the middle of facing planks. The planks are offset so that they can hook on to each other. The resulting shape is an Ayche (H) shaped plank which has a smaller side of the Ayche shorter by a third than the tongue-and-groove side to make room for the cross bars of the Ayches when they are offset and hooked together. In this two layer wall, the cross ties are set in grooves cut across the interlocking Ayches which cut through the smaller side of the Ayches plus the cross bar of the Ayches. The cross ties are nailed alternatively from one side to the other as each Ayche piece is added on each side until a section is formed that is a one man load, or about 26 kg. Cross ties may be spaced 800mm to 1200mm, say, with 3 in an 2.5M high wall panel. To produce multiple interlocked layers a new shape is introduced, as a second layer instead of Ayche pieces, which can be described as a double Ayche because it is the same shape as if two above noted Ayche pieces have been joined back to back with the larger part, the tongue-and-groove part being fastened together. Then a third layer can be hooked on which is composed of the same Ayches as the first layer. A second series of cross ties would be cut through the short sides of the third layer and the double Ayche middle layer. The three layer section would be assembled one piece at a time and individually nailed in place. First, the first layer plank, and then the double Ayche layer plank, and then the third layer plank. A wall section can consist of four layers or even five or more layers with all internal layers being double Ayche layers hooked together lengthwise and fastened together cross ways with cross ties nailed each way between each layer. A .75M wide section 2.5M high with five layers would be a two-man load depending on the size of the individual components. A multi-layered section need not be solid. Voids can be left in the assembly and still have a very strong wall, The voids can be filled with insulation producing a lighter and warmer wall. Cross ties can also be limited to the outside layers reducing the labor to produce the section. Walls can be composed of different species. The outside layer could be cedar or redwood to withstand bad weather. Center layers can be lower cost but stronger wood to carry weight and the home's inside layer could be choice paneling for a rich interior.

[0022] The development of my layered wood wall has taken many years. It started with a plain log wall that needed chinking and went on to a machined log wall with tongue-and-grooves between the logs. That sounds easy, but it is difficult to tongue-and-groove tapered logs together. Log walls are subject to substantial uneven shrinkage and settlement. I tried to hold back the wall settlement by nailing 38mm x 80mm studs at800mm spacing to the inside of the walls and covering them with half log siding inside. The log shrinkage meant open gaps between some logs that were held from settling by the studs. The log siding inside gave way to a second layer of full logs held in place by in between studs nailed alternatively to an inside log and the next outside log. Face nailing to the logs was not satisfactory as there was no resistance to sheer and the logs were uneven in shape so I cut grooves into the logs and let the studs into the logs at each side. This was a big improvement but the sheer weight of the logs tended to pull the two layers of logs apart. Then I developed the tee shaped notched joint between the logs. This double interlocking and vertical nailed on studs made a firm wall that did not settle and though there still was shrinkage, the tongue-and-grooves masked that, and logs shrunk individually on the studs and shrinkage did not accumulate into substantial settlement . The logs shrank and hung on their nails.

[0023] There was a demand for "D" logs so I sawed the inside log in half and had a smooth wall finish inside. Recently, I did this on the outside or, in effect, used two half logs with the inside half log being a better grade. I now had the basis for my current Ayche Wall System. I went to small logs to reduce the cost of walls when we learned from our roof plank studies that small logs were much lower cost. We still see a use for double full log walls. It was the use of full logs that led to my idea of the double Ayche interlocking components and the multi-layered wall. With the very small logs being a fraction of the cost of the same weight in large logs it made more sense to use multi-layered small logs. Though I thoroughly study the present and past art in wood wall construction, there is nothing in presently known art that led to my development of the layered Ayche wall system. Right now we favor a vertical half log system rather than a horizontal log house type of wall. Vertical planks lend themselves better to section manufacture. Except where large logs are used, it does not make sense to try to fabricate horizontal small Ayche pieces and small double Ayche pieces in the field. It would be like trying to sort out different length straws from a haystack. An average house would take 10,000 small sticks, section manufacture in a plant is the only way to go.

[0024] This patent application also covers a new so called "key-lock" system for joining cladding to framing or simply just joining various shapes of wood together. This was also developed by me over many years of experimenting not directly from the use of currently established art. In my January 3, 1978 invention U.S. Patent #4,065,902 I taught a system of making waterproof planks by using metal covered planks that had special waterproof joint means. However, the planks could not be face nailed through their metal covering and remain waterproof. I had to rely on nails that were on the edges of the planks and covered by the jointing system. Though these nails could hold the planks down, they could not produce enough resistance to shear forces (from winds) to pass very minimal tests. My next step was to cut dado grooves across the planks to fit over their bearing beams. This gave considerable improvement, but tests proved unsatisfactory as pressure would cause the roof planks to twist out of the grooves. The next step was a simple dovetail joint locked over the bearers. This passed the most severe tests, but in practice I found that it was impractical to have to slide the roof plank from the end of its bearer to the desired position. With further experimentation, I developed the key-lock joint which used a male bearing edge that had a slit sawn into it which could be compressed together to allow a roof plank to be forced over it forming a locked joint. This system was patented December 19, 1995 U.S. Patent #5,475,960. The first problem was that builders either did not caulk the open slits in the bearing timbers between planks in spaced outside decking or they did a poor job of it. Also, though the hold down of the new joint seemed to work well, it did not pass satisfactorily in formal shear tests. What happened was that the gaps produced in the male nobs of the joints that were squeezed together by a mallet blow to make assembly faster also were squeezed together by the heavy test equipment and accumulatively across a test panel produced enough "give" to produce poor tests.

[0025] I tried to put the slits into the cladding close to the cross groove. It appeared to work fine and water could not get into the saw slits, however, the wood between the cross groove and the slit too often sheared off when the plank was forced over the nob. The grain of the wood assisted the shear. Next I tried bending the planks upward to open up the undercut cross groove enough to pass over the nobbed edge of the bearing joist. This worked OK with some tough and very green wood. Slits to the side of the groove did not help so I tried small slits right in the cross groove. This worked and this application is for a patent for this joint system. Shear tests were comparable to true dovetail joints. The harder the test equipment pushes the cladding against the stud or joist, the more firmly it is locked in place. the slits in the groove are not affected.

[0026] My Patent #5,475,960 joint system can still be used to hold components together that are too thick to be bent to open the cross groove and is very useful to hold assemblies together until glue hardens or cures.

[0027] The wood of small logs is better than from most saw logs because the branches of small trees are small and so are the knots in the lumber they produce, also, it is generally accepted that heartwood is stronger and more resistant to decay than the rest of the tree. In Scandinavia, wood from small logs is used in the manufacture of windows and doors. Only clear lumber is used in North America, despite the fact that Scandinavian millwork is of perfect quality, and once painted will look the same as clear wood.

[0028] Probably the cheapest wood on earth is bamboo. This basically hollow wood is very hard and strong. Bamboo is part of the grass family having nodes at varying intervals where there are diaphragms across the stems. Compared to trees, bamboo stems are quite small. A 80mm bamboo log is a large log for bamboo. To make a wall or weatherproof roof out of it, the stems would be cut to 2.5M wall lengths and then sawn vertically in half. Key-lock grooves would be machined across the exposed edges of the halves, similar to the key grooves covered in my Patent #5,475,960, December 19, 1995, except they could be designed to accept an oval shaped cross tie. A plurality of bamboo half pieces could be set tightly together with their rounded sides down and say, three cross ties in an 2.5M wall could be snapped in to place, tying the vertical half logs together, and then a series of similarly sized and milled half pieces could be snapped on the open side of the wall and onto the same cross pieces, but offset so that the upper pieces cover the left half of one bottom piece and the right half at the next bottom piece to the left of the first piece, making a clean bamboo wall on both sides. If the bamboo is used for a roof, the inside node diaphragms of the bottom pieces would have to be grooved on center down to the outside shell (to drain water that can get in between the halves) on center of the half diaphragms and to the depth of the cross grooves, and also to accept the lips of the opposing half logs and hold them tightly together.

[0029] Putting all this together, components for a complete home can be produced, giving the world solid, lower cost homes made from trees that are now only good for wood pulp, fence posts or firewood, and which are very abundant. Many species of trees do not grow to sawlog sizes and some, such as logepole pine and bamboo, grow so thickly that they mature before reaching sawlog sizes. Also, thinnings from plantation timber can be used, and also the cores from plywood peeler logs can be used. They are waste wood, but high quality, not cull wood, and always have encased hearts. Now they become pulp or firewood.

[0030] Manufacturing my homes using only logs from small trees opens up the concept that such a house factory can have its own nearby tree plantation that can grow trees that can produce a 8M tree stem with a 75mm top in three to five years, depending on species. Such a factory could in many locations have its plant and plantations close to large city market areas and be independent of distant timber barons and the freight involved. The Christmas tree industry and now the pulp paper industry are doing this. Fluctuating timber prices have severely hurt home manufacturers in the past few years. It would be great to be independent. Small logs from plantation trees can reduce the cost of regular sawlogs by 66%.

[0031] Summarizing the home components from small trees that together can produce a complete low-cost house:

1. Wood planks containing integral hearts for waterproof planks, eliminating the need for shingles or other roofing materials.

2. Cross shaped planks that are both waterproof roof planks and rafters containing hearts.

3. Cross shaped components and tee shaped components that can be outside walls for a tropical home or stand alone inside partitions.

4. Tee shaped flooring that can span between beams, eliminating the need for floor joists.

5. Inverted tee shaped ceiling liner that can span across beams without ceiling joists.

6. Tee shaped vertical partition components.

7. Waterproof outside decking planks that have encased hearts.

8. Tee shaped outside decking that can span between beams and not need joists.

9. Sash and door components made from the wood of very small trees that only have tiny knots, which would be about a tenth of the cost of clear wood usually used. (Not new, but enables the production of a whole house from small wood.)

10. Interlocking Ayche shaped half log wall components with rounded sides turned inward and the flat sides forming flat wall surfaces on both sides. This wall solves the proverbial problem of squaring the circle. Round logs are made into square walls and over 90% of the log is used as a compared to less than 50% when stock lumber is sawn from small logs.

11. Interlocking Ayche shaped wall components can be formed into a thicker wall by inserting a double Ayche log having similar interlocking hooks on both sides which locks to the two layers of outside and inside half logs. Adding similar layers of double sided logs could make even thicker solid wood wall assemblies. Five layers would make a wall approximately 450mm thick.

12. Horizontally applied tee shaped siding resawn from cross shaped components at a cant to produce interlocking bevel siding.

13. Small squared logs that can be built up to form stair treads and stringers and also handrails and balustrades. (Not new.)

14. Small wood components which can be remanufactured into low-cost kitchen cabinets and vanities. (Not new.)

15. Small wood components that can be laminated to form low-cost closet shelving and single small logs that can be turned to become clothes rods in closets.

16. Turned very small logs that can be cut into quarters to form a quarter-round base trim.

17. Tee shapes can be formed to make wood doors with cross bars and diagonal braces, which would be let into notchings of the bases of the tees. A superior door can be like the solid walls, using Ayche shaped half logs with notched-in cross ties and diagonal braces hidden inside the doors.

18. Roof beams made from the new wall components that are both interlocked with nails and glue laminated together.

19. Ell (L) shapes that make special corner molds and combination jamb and trim components.

20. Dee (D) shapes that are not finished like the Tee shapes and can serve as a stronger floor or ceiling provided that the unfinished round sides face unused space below the floor or unused attic space above the ceiling.

[0032] This house will come directly from small trees and will eliminate the use of plywood, solid or glue laminated beams, floor joists, ceiling joists, rafters, trusses, wood or asphalt shingles, inside and outside doors as we know them, windows and cabinets, and can eliminate the need or use of drywall finish. A whole house can be produced from low-cost small logs.

[0033] Single layer waterproof roof planks or crosses, and single layer wall tees can produce quality low-cost buildings for many uses where insulation against heat or cold is not a factor: (1) garages of all sizes; (2) three-season room additions and screen porches for homes; (3) back yard offices, pool houses, play houses and party cabins; (4) seasonally used second homes of all sizes; (5) stables, cow barns, implement sheds, chicken houses, storage sheds, all kinds of farm buildings that are usually made from galvanized sheet iron and wood framing; (6) many types of commercial warehouses or storage buildings that are not insulated and which would cost less than conventional, sheet metal covered wood framed buildings and look better.

[0034] A garage building or a three-season room addition at half price would be so much more affordable, that tens of thousands of extra sales of these small buildings could result each year. The wood used could mainly come from the junk small trees in our bushes and cut over forests and of course from small tree plantations.

[0035] A summer home built of these low-cost cross, tee, Ayche and double Ayche components would be a mansion in many tropical third-world countries. In time, their people could be taught to use their bamboo and other junk wood trees from their bushland to build good homes.

REFERENCES EXAMINED

[0036]

U.S. PATENTS		
Patant Number	**Date**	**Name**
148,016	07-1873	Winans
168,672	03-1875	Reed
479,054	02-1891	Briggs
502,289	08-1893	Feldmann
1,344,181	05-1920	Mason
1,943,033	07-1932	Midby
2,463,612	09-1946	Grudda
4,043,090	08-1977	Viapiano et al.
4,065,902	01-1978	Lindal
4,356,676	11-1982	Hauptman
4,700,524	10-1987	Addison
4,896,999	01-1990	Ruckstuhl
5,020,289	06-1991	Wrightman
PCT/US92/01748	03-1992	Lindal

PATENTS - OTHER COUNTRIES			
Patent Number	**Date**	**Country**	**Name**
390,245	02-1924	Germany	von Ausfachungen
3,408,608	09-1985	Germany	Pfister
25,284	09-1951	Finland	Alanko & Stenlund
529,215	12-1982	Australia	Amling

DESCRIPTION OF DRAWINGS

[0037]

Figure 1 is a green board with a tight knot.

Figure 2 is a very dry board with three knots that have shrunk more than the wood around them.

Figure 3 is the end of a round green log that has been de-barked.

Figure 4 is a clear plank that has been sawn from the log.

Figure 5 is a knotted plank containing the log's heart.

Figure 6 is a plank with a knot that passes through it.

Figure 7 is the end view of a thoroughly dry log.

Figure 8 is a badly split, very dry, plank end view, split through and open to water admission.

Figure 9 is a plank containing the heart of the log it was sawn from and which has no openings for the passage of water through it.

Figure 10 is a cross section of a plank containing a knot that is split right through and which will allow water to pass through it.

Figure 11 illustrates a waterproof joint between waterproof roof or outside decking planks under normal weather conditions. A weep groove is used to drain away water that might get into the joint.

Figure 12 shows how extremely dry weather can cause the planks to shrink and come apart, opening up the joints between the planks.

Figure 13 illustrates the use of a sealant or caulking that is everelastic that seals the joints between waterproof planks and stretches when the planks separate.

Figure 14 illustrates how a sealant acts to stop the passage of water should the joints between the planks open up in very dry weather.

Figure 15 illustrates the production of an ordinary tongue-and-groove plank from a log having a 80mm top which leaves a lot of waste.

Figure 16 shows the view of the top of a log and how a cross shaped or a plus sign shaped reinforced tongue-and-groove plank can be milled directly form the same log with a 80mm top, leaving much less wasted wood.

Figure 17 illustrates how two pieces of reinforced 25mm x 75mm tongue-and-groove flooring can be produced from the same 80mm top log.

Figure 18 illustrates how a tongue-and-grooved wood shape that looks on end like a Maltese Cross can be milled from the same 80mm log.

Figure 19 shows the Dee (D) shape which are stronger than the Tee (T) shapes. They can only be used where the rounded side is hidden from view.

Figure 20 illustrates two "H" (Ayche) shaped building components that have been milled out of a small log.

Figure 21 illustrates a double "H" shaped wall component (HH - double Ayche) milled from a small log having a 80mm top and a 106mm butt.

Figure 38 illustrates a cross section of an inside floor and beam assembly.

Figure 39 illustrates a cross section of an outside waterproof deck and beam assembly.

Figure 40 illustration is the same as Figure 39, except the decking is not tongue-and-grooved, it is spaced 6.5mm and is open for rain to pass through between the planks.

Figure 41 is a cross section across the joist, 90º to Figure 40. It shows that there is no slot in the top of the knob of the top of the joist that can take in water from the space between the decking planks.

Figure 42 shows the application of the decking over the knob on top of the joist assembly.

Figure 43 illustrates a cross section of a ceiling panel.

Figure 44 is a small scale cross section of a ceiling panel.

Figure 45 is a cross section of an inside partition panel or a panel suitable for a garage or other out-building wall.

Figure 46 is a cross section of the wall panel shown in Figure 45 in small scale.

Figure 47 is a cross section of a wall panel for a house partition or an unheated building outside wall

Figure 48 is a cross section in full scale of a partition wall for a home or an outside wall for an unheated building.

Figure 49 shows a wall made up of (Ayche) "H" shaped components interlocked and bound cross ways by 25mm x 75mm cross ties rabetted into the shorter sides of the Ayche components.

Figure 50 is a cross detail of two "H" components cut from the same 80mm log. One component is thicker than the other and the combination, as shown in Figure 52, produces a solid wall that has a board and batten appearance.

Figure 51 shows the top of a 80mm log that has been milled to produce two tee shaped components, but in this case the log has been resawn at a cant to the base of the tee, producing bevel siding.

Figure 52 shows a wall averaging 140mm thickness. It is the wall shown in Figure 49 with 80mm posts (Figure 21) inserted inside and locked into place.

Figure 53 shows an outside wall, the same as Figure 52, except that another tier of posts has been added making the wall 70mm wider.

Figure 54 shows a post and liner wall combination that has a third tier of posts added. The drawing is half-scale.

Figure 59 shows two layers of Maltese Cross roof planks interlocked over a beam assembly.

Figure 60 is a cross section of Figure 59 showing Maltese Cross roof planks interlocking over beams.

Figure 61 illustrates a waterproof roof system using cross shaped components taken out of logs having 80mm tops.

Figure 63 shows horizontal cross sections of roof and wall panels made from bamboo.

Figure 64 illustrates a vertical cross section at the joint between roof or wall panels shown in Figure 63.

Figure 65 is similar to Figure 64 except that it shows how the upper half log is slightly bent upwards which causes the saw slots to open up enough to allow the top half to snap over the key-lock strip, locking the top half log to the lower half log.

Figure 66 shows a wall or a partition horizontal cross section. This wall differs from the previous wall shown, in that is uses small solid logs instead of hollow bamboo logs, but is built similarly to the bamboo wall shown in Figures 63, 64 & 65 using floating cross ties that lock the two sides of the wall together without nails.

Figure 67 is the vertical section of the wall shown in Figure 66. It clearly shows the floating cross tie.

Figure 68 is a cross section of part of Figure 70. It basically shows the design of the stud assembly end, for a wall using the cross tie locking principle.

Figure 69 shows a vertical cross section of Figure 70 at the junction of the siding tee planks with the stud assembly and the cross tie.

Figure 70 is a conventionally looking outside wall, finished in vertical V-joint siding on the outside. The wall is tied together with a rounded cornered cross ties that are nailed to the stud assembly.

Figures 71, 72 and 73 are presented to show how two logs each 100mm in diameter can be manufactured into useful house components but the one in Figure 72 produces more than twice as much useful building material as the log in Figure 71. Figure 73 shows how the two components shown in Figure 72 which we have referred to as Ayche pieces (Figure 20, part 33) can be built into being part of a wall section (see Figure 49).

Figure 74 indicates a glued up roof beam assembly made up from Ayche pieces (Part 33, Figure 20) and double Ayche pieces (Part 34, Figure 21) and a new shape, part 161 which we refer to as "E" pieces which are used to square out the beam and which are made up by splitting double Ayche pieces in half horizontally.

Figure 75 shows how a log can be quartered and made into Ell pieces (L) which can be used as shown for corner trim and combination door jambs and door trim.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0038] My presentation of the drawings begins with a series of Figures 1 to 10 on the effect of shrinkage in wood on the wood itself and on live knots in the wood.

Figure 1 illustrates a green board (1) and knot (2) that is part of a live branch and is integral with the wood.

Figure 2 is a very dry board which shows the wood (3) itself which has suffered a check (10) due to tangential shrinkage. Tangential shrinkage is in the direction across the surface of a log, differing from radial shrinkage, which is from the heart of the log to its outer circumference. Tangential shrinkage is three times as much as radial shrinkage and it is this difference that causes splits in the clear part of the wood. (4) (5) and (6) are three knots that have shrunk more than the wood around them causing holes in the board. Knot (4) has shrunk so that it has become smaller than the hole in the wood that it formerly occupied, and a crescent shaped opening has occurred (7). Knot (5) has simply split into two pieces opening up a hole (8) through the board. Knot (6) has "star checked" opening up a hole (9) in the board. Knots in a green board contain more moisture than the wood surrounding them and thus shrink more. Even a sound dead knot which is dry causes problems when a board shrinks, the board itself will split slightly at the knot when it shrinks and the knot does not.

Figure 3 shows a cross section of a de-barked log that is green right out of the forest. Growth rings as shown as well as a knot that was a live branch (2) which starts as a fine point at the heart and spreads, forming a cone shape as it progresses from the center to the surface of the log. (1) is green wood, (2) is the knot and (11) is the heart of the log. Figures 4, 5 and 6 show cross sections of boards cut from the log in Figure 3, Figure 3 also shows the parts of the log the boards have been sawn from. These three boards as shown are waterproof. In these four Figures, 1 is green wood, 2 is a knot and 11 is the heart of the log.

Figures 7, 8, 9 and *10* show what happens when the log itself (7) and the boards sawn from the log (8), (9) and (10) shrink. The logs check or split (10) the knot splits (8), and the log itself and the boards take on a smaller dimensions. The knot does not shrink lengthwise, so it is left protruding from the log and boards (15). Radial shrinkage is shown as 12 and tangential shrinkage is shown as 13. Boards Figure 8 and Figure 10 are no longer waterproof as they have holes right through them but board Figure 9, which encases the heart of the log it came from, is still waterproof as neither the knot nor the splits pass from the circumference of the log through the heart of the log. The splits are caused because the circumference of the log shrinks more than the radius of the log, and something has to go. The lesson is that to have a waterproof plank the plank must encase the heart of the log it came from. 3 is dry wood, 5 is a knot with a split in it, 8 is the split in the knot, 10 are splits in the wood, 11 is the heart of the log, 12 shows radial shrinkage and 13 shows tangential shrinkage. (There is no 14.)

Figures 11 and *12* show how water that gets into the joint between two waterproof planks can be drained away using what is commonly called a weep groove. The planks are thoroughly dried and preshrunk before being installed and are machined so that when the planks are driven tightly together, the vertical top joint (18) will be very snug, aided by slightly open spaces (19) that assures all the force exerted to close the joint will apply to the vertical joint (18). The horizontal joints (18) are also very tight. Then, Figure 12 illustrates a condition that can happen in extremely dry conditions, the planks shrink and separate, opening up a gap on the surface (21) and further widening gap 19 to become 22. Water that may get into the opening (21) say from a sudden shower, will drain away in the weep groove (20) and will not get past the tight horizontal joint surfaces (18). Moisture from the shower will soon cause the planks to expand again, and should the shower become more than a half hour long, the opening (21) will close up. Though the use of a weep groove can not now be Claimed as a new invention, this illustration is included to show how planks that are waterproof can have waterproof connections. 11 is the heart of the log the plank was sawn from, 16 is the tongue side of the first plank, 17 is the groove side of the second plank, 18 are very tight joints, 19 are loose open joints, 20 is the weep groove, 22 shows how the space (19) will open up in extreme dry conditions, 21 shows how vertical joint (18) can open up slightly in very dry conditions, and 25 indicates shrinkage in the very dry planks.

Figures 13 and *14* illustrate how silicone caulking can be used to waterproof a joint. An extra space (23) is created in the bottom of the groove to receive the sealant and which is designed so that the sealant will not squeeze out of the joint in severely wet conditions, which might be the condition if sealant were placed elsewhere in the joint system. The silicone (24 and 26) shows how the thickness of the sealant can be made thinner if it is stretched (like chewing gum stretched between the fingers). 11 is the heart of a log, 17 is the groove side of the 2nd plank and 16 is the tongue side of the first plank, 18 are very tight joints, 19 are loose open joints, 21 is the vertical joint 18 after shrinking, 22 is the loose joint 19 after shrinkage, 23 is the special groove to contain sealant, 24 is the sealant and 25 indicates shrinkage. Again, the use of silicone is not a new invention but is shown how waterproof planks can have a jointing system that is also waterproof. A doubly sure waterproof joint can be made by combining the weep groove system with the silicone sealant system in a single joint.

Figure 15 shows a 38mm x 75mm tongue-and-groove plank that is waterproof because it encases the heart of the 80mm log it was sawn from. 27 indicates the 80mm log, 29 is the 38mm x 75mm waterproof plank, 11 is the heart of the log and 28 indicates wood that is wasted in the milling and sawing process.

Figure 16 illustrates a similar 38mm x 75mm waterproof plank that has been expanded to become a cross shaped component which uses up much of the wasted wood shown in Figure 15 to produce reinforcing ribs that turn the component into a combination waterproof plank and a rafter which can span greater distances between supports than the 38mm x 75mm can alone. Wasted wood (28) becomes much less than in Figure 15. This cross shape can also be used for a wall with the vertical part becoming a stud, producing a pleasingly decorated wall. 30 is the new cross shaped component, 11 is the heart of the 80mm log 27 that the cross shape is made from, and 28 is waste wood lost in the manufacturing process.

Figure 17 illustrates how the cross shaped component 30 in Figure 16 can be ripped into two tee shaped pieces (31). These are individually machined to have their own tongue-and-groove connection ability. Because it is likely that only one of the pieces will encase the heart of the log, this tee shape will not be used as waterproof components. However, it can be used for inside flooring, or upside down as a ceiling, or vertical as a wall. In each case, the reinforcing rib will act like a joist or stud and reinforce the strength of the component by spanning greater distances as joists or stabilize a higher wall as a stud. 11 is the heart of the log, 27 is the 80mm log, 31 is the tee component and 28 is the wasted wood.

Figure 18 is a variation of the cross shaped waterproof roof plank shown in Figure 16. It is made from a 80mm log 27, and encase the heart (11). This component has been called a Maltese Cross because it resembles one. Its main function is to make the component more waterproof by channeling rain away from the joints and funneling it downward in the vee grooves. Only a direct hit of a raindrop on the joint will challenge the integrity of the joint. The component is reversible, that is, the bottom half is the same shape exactly as the top half of the cross so it can be spun 180º and be the same. 32. is the Maltese Cross component. 32a are the reversible joints, 27 is the 80mm log, 11 is the heart, 28 is waste wood and 28a indicates how the reversible top and bottom points are equilateral triangles, enabling them to be interlocked during construction, that is, the top half of one log will slide into the vee spaces of the bottom half of another similar log (see also Figure 59).

Figure 19 shows a Dee (D) component (37) which can be used the same way the finished Tee components are used for flooring, ceiling planks and partition planks provided that the unfinished rounded side faces unoccupied space like under a floor or in an unused attic space. In the case of partitions, the Dee components can have their unfinished rounded side covered with drywall. Sections made from Dee components are stronger than sections made from Tees. 28 is waste wood, 11 is the log's heart.

Figure 20 shows the top of a 80mm dry log, (27) and it also shows 36, which is the bottom of the same log and is larger from 13mm to 25mm in diameter on an 2.5m log, depending on species and growing conditions. The log is sawn exactly into two similar half logs 33, which are called Ayche (H) components as they have a vague Ayche shape with one side of the Ayche being shorter and smaller. The Ayche is formed as the tee shape was formed in Figure 17 except that instead of having a 90º notch cut from the half log on each side, the notch is a slot cut parallel to the base and to the top of the tee. With a 80mm log the net base of the Ayche is 75mm. The slots are then 25mm deep on each side leaving the cross bar of the Ayche to be also 25mm, a third of the width of the base deep. The width of the notches is about 20% of the net height of the Ayche piece or 10mm and the thickness of the small side of the Ayche is slightly less than 10mm, assuring a tight fit when the small side of an Ayche is slid into the notch of another Ayche piece that has been inverted. The taper of the half log can be taken advantage of to the extent that the small side of the Ayche will get stronger closer to the bottom of the half log, the improvement is shown as 35. As the placement of the log's heart is not sure, the Ayche piece is not considered to be waterproof. 11 is the log heart, 27 is the 80mm circumference of the top of a dry log, 36 is the circumference of the base of the same log, 28 is waste wood which is minimal, 33 is the new Ayche shape and 35 is the extra wood gained by the use of taper.

Figure 21 resembles Figure 20 because it is in fact 2 Ayche pieces in one. The Ayche pieces can be finished and glued or otherwise be attached to form the new shape called a double Ayche (HH) or a single double Ayche can be machined directly from the original 80mm topped log. The only good reason for attaching two Ayche pieces together to form a double Ayche is that the half log piece dries more than twice as fast as a whole log and gluing half logs together from different trees inhibits twist and warp. It should be noted that the tongue-and-grooves have been omitted in Figure 21. This is also optional. The double Ayche is used as a post or a stud in the inside of a wall and most often stands alone, making the tongue-and-grooves useless. In the case of a layered solid wall, tongue-and-grooves on the double Ayche pieces would resist air infiltration.

Figures 49, 52, 53 and 54 are taken out of numerical sequence because they apply to the Ayche component Figure 20 and the double ache component Figure 21. Figure 49 is a wall, a floor or a roof panel made up of two layers of Ayche pieces (33), with their finished sides facing outward on each side of the panel and their other slightly rounded sides solidly interlocked together. The panel has three types of interlocking; first, the tongue-and-grooves at the heavy side of the Ayches, and then the interlocking smaller Ayche sides, and then the cross ties, (113) three for an 2.5M high wall. The three cross ties are set firmly into notches across each Ayche piece, the notches extend through the smaller Ayche sides and also through the cross bars of the Ayches. The three cross ties about 19mm by 65mm are firmly nailed to each Ayche piece, first on one side of the section, and then the other as each piece is slid into place and the nail heads are hidden inside the section (116). Sections are limited in width to a one man load of about 25 kg. The shaded areas (35) in the drawing indicate wood that is picked up from the log's taper. 33 is an Ayche section, 35 is a wood taper, 109 indicates the thickness of the section which for 80mm topped logs is 70mm, 113 is a wood cross tie buried in the section, 116 is nails.

Figure 52 is similar to Figure 49 except that the section is thicker which is affected by the insertion of a double Ayche post locked to the two opposing panels like the inner and outer halves of the panel in Figure 49, with the difference that there are now two layers of cross ties (113) which are nailed from the inside to each individual Ayche piece and to the double Ayche posts (34). Assembly will be from one side to the other the same as the assembly for the section (Figure 49). Another difference is that to illustrate the use of the components, (110) and (111) (to be described later) on one side of the wall instead of regular Ayche pieces (33). The use of these special Ayche pieces Ayche pieces (33). The use of these special Ayche pieces produces a wall that is styled as a board on board outside siding. The cavity space in the panels (108) can contain insulation. In this case the double Ayche pieces (34) are spaced one double Ayche piece width apart, they could be spaced 630mm or even 800mm apart depending on the use of the panel, wall, floor or (roof with shingles). If they are used as a solid wall, the double Ayche pieces could be connected sideways by tongue-and-grooves shown in the original double Ayche drawing (Figure 21). 33 is an Ayche piece, 34 is a double Ayche piece, 35 indicates log taper, 108 are cavities in the sections, 113 are cross ties, 116 are nails, 110 and 111 are a pair of Ayche pieces machined to an in and out pattern. 114 and 115 indicates the width of the wall which is approximately 185mm.

Figure 53 is the same as Figure 52 but another layer of double Ayche posts have been added producing a section that is 210mm wide (117). It is necessary for stability to add two more posts at each juncture. Spacing here is indicated by 119, which as explained in the description of 52 can vary. 118 indicated the width of the cavity, which is 115mm.

Figure 54 is drawn in half the scale of Figures 52 and 53. Here, a third layer of double Ayche posts have been added, making a section that is 11 inches wide (121) and has a 190mm deep cavity for insulation (122 and 108). Here the five piece post assemblies are 230mm on center (120). Sections this heavy would be made for two man loads about 58 kg. Note that each of these cavity sections have only two layers of cross ties.

Figure 50 is a variation of an Ayche component (33) designed to give an in and out appearance also called board on board (see Figure 52). This is a more weather tight wall system but usually is face nailed. My new Ayche type system shown in Figure 52 avoids face nailing and is stronger than board on board. Component 110 is thicker than component 111, however, when they are locked into an opposing panel of Ayche pieces similar to Figure 52, their round sides are on the same level which allows the shiplap-like tongues of 111 to exactly fit in the grooves of the (110) components when assembled into a section. The tongue-and-grooves are larger and stronger and more weather tight than the tongues-and-grooves of the regular Ayche pieces (33). 11 is the heart of the log, 27 is the 80mm circumference of the log, 28 indicates very limited waste wood, 110 is the heavier part of the pair (from the same log) and 111 is the smaller part.

Figure 51 is another variation of the Ayche piece, but is shown as a variation of a tee piece because it is designed for horizontal use and could be locked to a series of studs using my key-lock joint later described in this application. In this case, the two pieces (112) are exactly the same being sawn from a log at a cant. The shiplap like tongues and also the grooves are the same size as shown in parts 110 and 111 respectfully, but each beveled piece has a shiplap like tongue on one edge and a groove in the thicker edge. When a plurality of these (Figure 112) components are locked onto a series of studs with the tongue edges up, and into the grooved edges, these bevel siding components (112) will lock together forming a bevel siding wall.

Figure 38 shows a series of tee pieces (31) that have been formed into a floor fitted together using tongue-and-grooves like most floors. They are locked onto the top of a floor joist assembly (56). The locking system is my key-lock system taught in my U.S. Patent #5,495,960. 86 is the nob at the top of the joist that extends down to a shoulder in the joist shape (87) and extends to the underside of the flooring (88).

Figure 39 shows a waterproof outside deck with each deck plank (30a) encasing the heart of the log it was sawn from. The waterproof joint system used is illustrated in Figure 13. The joist and key-lock system (56, 86, 87 and 88) are the same as in Figure 38, 30a is like the cross shape 30 except it does not have a rib on the top surface.

Figures 40 and 41 are two views of a spaced deck that does not need waterproof planks even though many may encase hearts as they are made from small logs. Spaced decking is thicker than flooring, so it is hard to get two pieces from a small log. Here my new key-lock joint is used to connect the decking to the joist assembly. My key-lock joint (patent 5,495.960) has saw slits in the top of the nob (86 in Figures 38 and 39). The slits are further illustrated in the key-lock joint between 59 and 56b (in Figure 41). With water pouring through the spaces between the deck planks (30b), water would get into the slits and cause rot. Nob 86a does not have a slit in it , so rot is avoided. 59 is a part of the joist assembly even though what is shown is not new, and it is not Claimed as patentable. 56b is a joist component that has a nob (86a) that does not have a slit in it, 86a is the nob without the slit, 87 is the shoulder of the joist component 56b, 88 is the top of the nob and is also the underside of the decking, 30b is the spaced decking which has no tongue-and-grooves, 130 shows that the nob is exposed, 116 shows nails that are used to stop the decking from sliding along the nob 86a, 131 shows two saw slits across the decking in the cross groove. These weaken the decking so it may be bent upwards once to open up the cross groove to snap over the nob 86a.

Figure 42 is an action view of Figure 41 that shows a decking plank (30b) being bent back at its cross groove (133) so as to open up the under cut cross groove so that it will snap over the nob of 56b. This action is aided by saw slits (131) that open up (132) to allow a one time only bending of the deck plank (30b) without breaking it. Usually it is enough for the carpenter to put his knee at point 133 and lift up the plank with his right hand, however, the use of the hard rubber mallet (134) may be necessary to hammer down the plank at point 133. 59 is a joist component, 56 is a modified joist component, 30b is the deck plank, 88 is the line of the underside of the decking, 131 are the saw slits, 132 indicates that the saw slits have opened up, 133 is the bending point of the decking and 134 is a hard rubber mallet.

Figures 43 and 44 (44 is a smaller scale than 43) show two views of a ceiling section which is a simple series of tee (31) components tied together by two cross ties (89). Though rectangular 19mm x 38mm cross ties could be used, illustrated here are shaped cross ties that have ess (s) shaped lips that fit into an under cut groove in the tee planks that has the same pattern. In the groove are small slits (100) that aid bending the ceiling planks to open up the grooves to snap over the cross ties similar to the action in Figure 42. The cross bars (89) are further held in place with nails(90) that further fasten the cross ties to each plank. 31 are the ceiling planks, 89 is the cross ties, 90 are nails, 100 is saw slits and 96 is the width of the ceiling sections.

Figures 45 and 46 are two views of a partition section (46 is smaller scale). The section is composed of tees (31) that are interlocked by their tongue-and-grooves and tied together by top and bottom plates that are nailed to the ends of the tees. The width of the plates is the same as the height of the tees. The tees all face the same way giving a smooth vee joint surface to the partition on one side and an attractive fluted appearance on the other side. 31 are the tees, 91 is the top plate, 93 is the bottom plate, 92 are the nails that tie the plates to each of the wall planks (31), 94 is the nails that tie the bottom plate to the floor and the top plate to the ceiling, 95 is the height of the wall often 2.5m, 97 is the floor line, 98 is the ceiling line and 99 is the quarter round trim.

Figure 47 is a partition panel or section that is similar to Figure 46 except that the base of the tees have been alternatively turned in and out so that the partition is fluted on both sides with the flutes being wider spaced than in Figure 46. The top plate (101) and the bottom plate (102) are wider. This partition is more stable having a width (103) of 70mm instead of 45mm in Figure 46. 31 are tee planks, 101 is the top plate, 102 is the bottom plate, 92 are top plate nails, 94 is bottom plate nails and 103 is the depth of the partition.

Figure 48 is Figure 45 with drywall liner applied to its fluted side making a thicker wall section which (107) is 56mm thick instead of 45mm. The new top plate (106) and the new bottom plate (106a) are similarly wider. The drywall is attached by drywall nails (109). Otherwise, 31 are tee planks, 92 and 94 are nails.

Figure 57 is included to only show how the beveled tee planks (112) look when they are applied to a stud wall. The nails (116) are used only to stop the planks (112) from sliding along the nob (58).

Figure 59 illustrates how two layers of Maltese Cross roof planks can be interlocked together for a joint between two roof sections over a roof beam. The bottom layer of the Maltese Cross planks (32b) are notched over a built up beam (59, 56 and 86 using the key-lock system of my patent 5,495.960). The second layer of interconnected Maltese roof planks (32a) are interlocked because the lower points and angles fit in-between the points of the first or lower layer. Nails are not needed to fasten the top layer 32a's to the lower layer. 32a and 32b are respectively the upper and lower layers of Maltese Cross planks, 59 and 56 are roof beam components, 86 is the nobbed top of 56 and has a slit in it, 11 is the heart of the logs the planks were cut from, 88 is the line of the top of the nob 86, 108 is void spaces and 87 is the shoulder line of beam component 56.

Figure 60 is a cross section of overlapping Maltese Cross roof section over a built up beam combination. 130 is the overlap area between two sections, 129 is the cleat, or cross tie, forming the roof sections, 116 are nails, 59 and 56 are roof beam components, 58 is the locking nob with a slit showing in it, 32 is a Maltese Cross plank, 32a is an upper portion of a 32 at a junction, 32b is a lower portion and 133 indicates the pitch of the roof which is 4/12.

Figure 61 shows how cross shaped roof planks can also form a roof system. These planks are doubly protected against leaks at their joints, 20 shows weep grooves and 23 shows silicone sealants. 59, 56, 58, 87 and 88 together indicate a supporting beam assembly that key-locks the roof planks (30) to the beam assembly. 11 is the heart, of the logs the roof planks were made from.

Figures 63, 64 and 65 show the manufacture of roof and wall sections using half bamboo logs. Both roof and wall sections are the same except that the lower layer of the roof sections need to have the diaphragms cut down to their shells to allow water that might get in between the upper roof halves to drain away. Bamboo is hollow with cross diaphragms occurring at the nodes. The shell is very hard, so much so that the use of bamboo for posts is better than any other wood (pound for pound) and is comparable to steel. The bottom half section (134a) is tied together using cross ties (89) that are oval shaped. These are forced into grooves across the open half logs one log at a time the grooves are undercut so that the cross ties cannot be forced into them unless the half logs are bent back as previously described. The bending back is aided by saw slits (100) that open up when the logs are bent up. Then the upper half logs (134) are similarly bent up and are snapped over the same oval cross ties (89) one at a time, the oval strips are also nailed (116) to the half bamboo logs to prevent sliding and solidify the assembly, but before they are set the bottom layer of half logs (134a) are nailed to supporting beams using large nails (142). Figure 63 is a cross section, Figure 64 is a side view and Figure 65 is a side view showing a half log (134) being bent upward so that the grooves open up to snap over the oval cross tie (89). 134 are the top logs of a roof section or the half logs for each side of a wall section, 134a is the lower half log of a roof section, 135 is a bamboo node, 138 is the diaphragm that occurs at nodes. The notch in the diaphragm 137 is for drainage purposes, the diaphragm must also be cut down to allow for the cross tie if it occurs where the cross tie cuts across, 89 is the cross tie, 100 is the saw slits, 134b is the inside of the bamboo log shell, 108 is void space that can be filled with insulation, 136 indicates a break in the cross strips (89) between sections, 139 indicates the cross section of Figures 64 and 65, 140 indicates where the sides of the individual half logs are planed so that they fit tightly together which means shaving down the nodes (135), 141 is the edge of a log that has passed over the cross tie, 143 indicates the line of the top edge of the lower log.

Figures 66 and 67 show how a section similar to the basic Ayche section explained in Figure 49 can be made using tee shapes instead of Ayche shapes by introducing the floating oval shaped cross tie used in the bamboo sections Figures 63, 64 and 65. Here the tees (31) and (31a) have oval cross grooves cut into them at the intended level of the cross ties (89) in the section. These grooves exactly match the oval cross ties but need to be opened up by bending the tee shapes back so that the cross ties snap over the cross ties. For a firm section the cross bars need to be also nailed to each tee piece on each side because the tees can still be slid along the cross ties. The opening up action is aided by saw slits (100) cut across the tee pieces in the grooves across the tee sections. The wall section an also be assembled by framing the bottom layer of tees (31a) by snapping over the tees (31a) over the cross tie. Then the upper tees (31) are snapped over the cross ties (89) one at a time and locked by its tongue-and-grooves to an adjacent tee piece (31). This system does not allow the upper layer of tees (31) to be nailed to the tee piece and rely on their stability by being set between the lower level of the tee pieces (31a) however there has to be some slack between the bases of the tees of both sides to allow the tongue-and-grooves to slide into a locked position. The method of assembly where a (31) tee and a (31a) tee are locked onto the oval shaped cross bar alternatively one at a time is better because then every tee piece can be nailed to each cross tie. 31 is a tee component in the upper layer of the section, 31a is a tee piece in the lower layer of the section, 89 is the oval shaped cross tie, 100 is the saw slits in the bottom of the cross grooves, 144 is the space between two adjacent tees in the lower level, 145 is the width of the base of a tee in the upper level, 146 is the thickness of the section which with 80mm topped dry logs would be 65mm, 47 is the space between two cross ties (89) indicating the junction of two sections.

Figures 70, 68 and 69 show how tee components (31) can be locked onto a stud assembly made from small logs using the oval shaped cross ties previously referred to forming a house wall. Components 62, 59 and 149 form a small log stud assembly which is not sought to be patented in this application because its main principle is the interlocking key-lock (47) joints that are already patented. However, 149 has its top end modified so that it is the same shape and size of the tees (31) used in the wall. The wall would have at least three cross ties (89) which are fitted tightly into square cross notches in the stud ends (149) and firmly nailed into place. The wall pieces or tees (31) are snapped over the oval cross pieces and can have the cross pieces nailed to them, from the inside wall, between stud assemblies to further firm up the construction. 31 is a tee wall component, 62, 59 and 149 is a stud assembly, 47 is a key-locked joint, 89 is the oval shaped cross tie, 151 are heavy nails that fasten 89 to the stud assembly, 109, 125, 108, 153, 152, 35, 126 and 124 are other parts of the wall illustrated that are not germane to the explanation of this joint system.

Figures 71 and 72 show identical sized logs each (155) are 100mm in diameter. The log in Figure 71 has been manufactured so as to produce the maximum sized piece of stock sized lumber that a 100mm diameter log can produce a 2x4 (160) scantling which is actually only 1 ½" x 3 ½" or in a metric measure 38mm x 90mm (157 x 156) which amounts to 3420mm^2. Figure 72 has been manufactured into two (33) Ayche pieces which fill out the entire 100mm circle, with practically no waste (28) as compared to considerably more waste (28) in Figure 71.

Figures 73 illustrates how the two "H" pieces (33) in Figure 72 can be combined with other similar "H" pieces to form a very useful wall panel similar to the wall already shown in Figure 49. To illustrate and to calculate the amount of useful building material produced out of log Figure 72, one "H" piece has been designated as ("A") and the other piece in Figures 72 has been designated as two pieces (B) and (C). Figure 73 shows how these pieces A, B, and C can be rearranged to form a square which is 95.25mm (158) by 76.2mm (159) totaling 7,258.05mm^2, which is more than twice the useful wood produced (3,420mm^2) in Figure 71 through standard lumber production procedures.

Figure 74 is a roof beam made up of Ayche (33) and Double Ayche (34) pieces similar to the wall section shown in Figure 52, except that it is solid wood and the horizontal joints are held together with glue (162). The three vertical layers are interlocked as in the wall section. A new shape (161) is introduced which I have called an "E" piece which is made from a Double Ayche piece split horizontally into two similar pieces. This produces a square beam and adds strength to the beam. Vertical stiffeners are used as in the wall part 113 which holds the component parts together until the glue sets and will give sheer strength to the beam should there be any glue failure. (116) are nails. 163 indicates the top of the beam with (113) slightly protruding. 164 is the bottom of the beam which does not have part 113 protruding, giving a more finished appearance.

Figure 75 introduces the Ell (L) shaped piece (166 and 167). These are made out of quarter cut log pieces (165) sawn from the quarter pieces in regular quarter cut sawing procedures. The corner of the Ell pieces are sawn as close to the heart of the log (165) as possible. This produces edge grained trim and makes the splitting of the Ell molds at their corners more difficult than if the Ells were sawn from other parts of the log. Part 166 is designed to be corner trim. Part 167 is designed to be a combination door or window jamb with its trim or casings attached. 168 designates a partition wall. 170 is stock door stop and 169 is a door. 171 indicates whole quarters of log 165 which can be used to make more Ell shaped trim. 172 indicates wood that needs not be wasted and can be made into other trim moldings.

[0039] Thus, one particular form of the invention comprises a building materials kit from which lower cost homes and other buildings can be constructed with the savings coming from the use of very low cost small logs and certain so-called "junk trees", both of which are wasted and are left behind in logging operations; further savings are realised by using up to 90% of the waste lost in saw milling operations and by making dual use of certain components, for example, roof planks that are waterproof and also serve as shingles and ceiling planks that have built-in ceiling joists supporting them which are formed from otherwise wasted material which happens when a log is made into regular ceiling planks, said kit does not include lumber as we know it, having no studs, rafters, floor joists, ceiling joists, roof trusses nor plywood sheathing, said kit introduces new shapes that on end look like tees (T), Ells (L), Ees (E), Dees (D), Crosses (+), Ayches (H) and Double Ayches (HH) that are manufactured directly from logs and not from lumber and together form a new type of housing kit, that includes outside walls, partitions, floors, ceilings, roof and outside decking, said individual components are formed into sections by nailing cross ties to each component in cross grooves in each piece, all nailing is accomplished without visible nails showing in the finished house or building, said kit also includes bamboo logs.

Claims

1. A building materials kit from which low cost homes and other buildings can be constructed comprising low cost small logs and wood from small tree stems, said kit including shaped sections made from said logs and tree stems and adapted to be connected together to form components of the building.

2. A kit according to Claim 1 comprising a roof plank that is tongue-and-grooved and in itself is waterproof and which encases the heart of the log it is sawn from and which when combined with other like planks having tongue-and-groove joints between them that are also waterproof forms a waterproof roof surface.

3. A kit according to Claim 1 or Claim 2 including a tongue-and-grooved roof plank made from a small log that is shaped like a cross so that a vertical member is formed from otherwise waste wood and which acts like a rafter, said cross shape also encasing the heart of the log it was made from.

4. A kit according to any preceding claim including a cross shaped roof plank which has the top surface of its tongue-and-groove cross bar sloped 60° inward from the tongue-and-groove joints down to the vertical rafter like part of the cross to drain rain water away from the joints on either side so that only a direct hit on the joint by a raindrop can challenge the waterproof joint, said cross shaped roof plank encasing the heart of the log it was made from, said cross shape being further modified by sloping the sides of its vertical members outward from its base so that there are 60° angles between the vertical and horizontal members which results in a wider top to the vertical member which in turn has a vee cut into it forming a 120° vee channel between its top corners which further sheds water from challenging the joints, said cross being modified so that it resembles a Maltese Cross by shaping the bottom half of the cross to the same shape as the top half.

5. A kit according to any preceding claim in which said shaped sections are cross shapes formed by sawing them into two tee shapes by cutting the crosses through the centre of the horizontal bar of the cross shapes then separately tongue-and-grooving the ends of the tops of the tees so formed so that a plurality of such tees can form a floor, a ceiling or a wall with the vertical parts of the tees acting like floor joists, ceiling joists or studs.

6. A kit according to any preceding claim in which said shaped sections are tees made by cutting them directly from half logs instead of making crosses first and then splitting them, said half logs being left unfinished on the rounded side (not made into finished tee shapes) and used like the tees except the unfinished rounded side is hidden from view and having the rounded side slightly flattened to correspond to the flattened top of the tee shape.

7. A kit according to any preceding claim including an ayche shaped component which is formed by a slot being cut into each side of the half log parallel to the base of the tee and the top of the tee, said base in the case of a 80mm topped log being substantially 75mm and the depth of the slots are a third of the base width being substantially 25 mm leaving the thickness of the cross bar of the ayche to be also substantially 25 mm, said notches being 10mm wide and the thickness of the small side of the ayche being slightly less than 10mm assuring a tight fit when the small side of an ayche is slid into the notch of another ayche piece that has been inverted, said small side of the

ayche being strengthened towards the base of the half log it is formed from so that it will take advantage of the log's taper.

8. A kit according to any preceding claim including a double ayche component that is two ayche pieces fastened together back to back at their wider sides or the double ayche is formed directly in one piece from a round log, said double ayche pieces also being formed without centred tongue-and-grooves.

9. A kit according to any preceding claim comprising ayche components that have cross grooves cut across their shorter faces that reach to the inside edge of the wider sides of the ayche components and have a width about double their depth, said cross grooves being located about a component width from the tops and bottoms of the ayche planks and in between these grooves at spacing averaging 1300mm with a 2.5m wall having one groove midway between the top and bottom grooves and a 5m component having three cross grooves between its top and bottom grooves.

10. Wall, partition, roof or floor sections that are fabricated from a plurality of ayche pieces having cross grooves according to Claim 9 which consist of two layers of ayche pieces interlocked together and tied together by cross ties set in the cross grooves with the process of assembly into substantially 2.5m wall sections by the following steps, the first 2.5m ayche component is laid down with its narrower notched side facing up, with the groove side to the right and the tongue side to the left, three cross ties are set tightly into the cross grooves and nailed in place and another 2.5m ayche piece is placed on the other side of the cross ties and is locked snugly onto the cross ties and slid tightly into the notch of the first piece so that the short sides of the ayches interlock for their entire length, the assembly is then turned over and the cross ties are nailed to the second piece, then a third piece is locked over the cross ties and slid so that its tongue fits tightly into the groove of the first piece and its shorter ayche side interlocks firmly to the shorter ayche side of the second piece, the assembly is then flipped over again and the cross ties are firmly nailed to the third piece, then a fourth piece is set tightly to the cross ties slid over to interlock doubly with the second and third pieces and the assembly is flipped again to securely nail the fourth piece in place; said process is continued until a section of desired width is fabricated which is a one man load of approximately 28 kg.

11. Wall, partition, roof or floor sections according to Claim 10 where a third layer is introduced between said two layers which is a layer of double ayche components plus a second set of three cross ties with the double ayche pieces being interlocked to ayche pieces with the order being first a single ayche piece then three cross ties then a double ayche piece then three more cross ties and then a single ayche piece with the process continuing until a 28 kg section is fabricated, said wall being further thickened by the addition of second, third or even fourth layers of double ayche pieces without additional sets of cross ties producing sections that are approximately 57 kg or a two-man load.

12. Wall, partition or roof sections according to Claim 11 where voids are left in the walls, making them lighter and providing space for insulation with single double ayche components being set 625mm apart in a three layer wall pyramid of three double ayches being set 625mm apart in a four layer wall, and five double ayche pieces being set in a 2-1-2 configuration for a five layer wall, and seven double ayche pieces set in a 2-2-1-2 configuration for a six layer wall.

13. Partition wall sections made up from a kit according to Claim 1 with a plurality of tee components with their tee bases or studs all facing the same way which are held tightly together by 25mm thick top and bottom plates firmly nailed to each tee piece and are the same width as the overall thickness of the wall, said sections are about 20 kg in weight, being limited more by size than weight for ease of handling.

14. Partition wall sections according to Claim 13 which are set together so that their tongue-and-groove tee bases face alternatively from one side to the other, making an effectively thicker wall than when the components all face the same way and are also about 20 kg in weight.

15. A kit according to any of Claims 1 to 9 comprising a pair of ayche components that have been made from the same small log which is split, off centre enough so that the heavier side of the ayches so produced have a relation where one is 50% thicker than the other with the smaller side of the ayches so produced being exactly the same size and shape, said thicker side has a groove cut into each edge on the centre of the edges that is approximately one third of the thickness of the thicker side in thickness and having a depth that is about as deep as it is wide, said smaller thickness ayche component has a shiplap type of tongue at its wider side at each corner which snugly fits into either of the grooves of the heavier ayche, so that should the two sizes of ayches be fitted together with their similar sized

smaller ayche parts on the same plane, the shiplap tongue of the smaller ayche fit into the groove of the heavier ayche and a plurality of such pairs will produce an in and out appearance usually referred to as a board on board appearance.

16. A kit according to Claim 15 where the log has been cut into two similar tee shapes differing from other tees in that the saw cut splitting the log in two is at a cant to the base of the tees producing tees that have the same size of grooved end on one side and the same size of shiplapped edge on the other side as the two ayches in accordance with Claim 15 with the bases of the tees being exactly the same as each other, so that when the two bevelled pieces are set on the same plane, the shiplap corner of one piece can fit snugly into the groove of the other plank forming, when a plurality of pairs are set together in the same plane, the appearance of bevelled siding.

17. A kit, according to any of Claims 1 to 9 or Claims 15 or 16 that has waterproof planks that have a water resistant tongue-and-groove joint system made by having a rounded weep groove planed into the top of the tongue at the shoulder of the tongue, being approximately one quarter of the thickness of the tongue wide and of the same depth, also to ensure a tight top joint the length of the tongue being less than the depth of the groove and the bottom of the joint being milled to leave a similar sized space between the bottom of the planks, as there is between the end of the tongue of one plank and the bottom of the groove of the next plank.

18. A kit according to Claim 17 in which said waterproof planks that have water resistant tongue-and-groove connecting joints which have very tight fitting top joints and similar spaced bottom joints, the space left between the end of the tongue of one plank and the bottom of the groove of the next plank being as wide as a third of the thickness of tile tongue and into which an everlastic sealant can be inserted, like silicone, filling the space.

19. A kit according to any of Claims 1 to 9, or 15 to 18 which has a dove tail like joint system to firmly lock cladding components such as outside siding, roof planks, decking, inside flooring, ceiling liner and wall liner to framing members eliminating direct nailed connections, said joint being effected between say, two 38mm and 155mm planks, one referred to as a female plank and the other as a male plank with the male plank having a nobbed edge made by cutting rounded grooves 1.6mm deep and 6.5mm wide on each face of the male plank 6.5mm from one of the planks edges and rounding the quarter inch spaces between the grooves and the corner of the plank to match the rounded grooves, and forming a narrow "s" like combination on one side and a reverse "s" on the other side, said female plank having a 13mm deep groove cut across it which exactly matches the nobbed edge of the male plank by under-cutting the sides of the female groove to fit the nob edge of the male plank said female plank being bent so as to open up its cross groove wide enough to snap over the nobbed edge of the male plank making a very solid joint, for species of wood where the female plank is too stiff for workmen to bend it back by cutting two saw slits in the groove and across the plank with each saw slit being close to each side of the main groove and being deep enough to enable a workman to bend the female plank once only to snap it over the nobbed edge of the male plank without breaking the female plank at the groove, helped where necessary by using a hard rubber mallet to pound the plank across the groove, said dovetail locking joint system being also used where the planks concerned may be smaller or larger than a 38mm x 155mm with all other mentioned dimensions being in proportion to the dimensions of other sized planks compared to a 38mm x 155mm.

20. A kit according to Claim 19 where the species of wood concerned and the dimension concerned do not require the two saw slits and an ordinary workman can bend the female plank enough to snap over the nob of the male plank once without breaking the female plank at its cross groove.

21. A kit according to Claim 20 that includes the use of a small nail that connects the two planks together but is only meant to stop the female plank from sliding along the nob of the male plank and is hidden from sight by being on the edge of the female plank.

22. A kit according to any of Claims 1 to 9, or Claims 15 to 21 which contains wall and roof panels made from similar length half bamboo logs which, when laid closely together side by side with their half round surfaces down, are connected together with a plurality of oval shaped cross ties that are forced into similar sized oval shaped grooves notched out of the edges of the half bamboo logs having openings that are too small to ordinarily admit the oval cross ties, but which can be made to open up enough to do so by bending back the bamboo which bending is aided by saw slits in the cross grooves that weaken the bamboo half logs enough to enable them to be bent back once, without breaking and admit the cross ties which are tapped into place using a rubber mallet, said panels being doubled up by forcing another similar course of half bamboo logs having their rounded sides upward with similar edge cross grooves, one at a time, onto the inside of the first panel and locking the edges of the second layer of half logs onto the same oval shaped cross ties by bending each half log upward enough to let it snap over the cross ties, said second layer of half logs each being centred over the junction of the half logs below, said half bamboo logs having diaphragms at their nodes that are cut down the thickness of the cross tie if they occur at the cross tie or at an opposing diaphragm and are notched at their centre to receive the edges of the opposing half logs and in the case of the lower half of the roof panels are slotted at centre to the shell to drain away rain water that can come in between the upper half logs, otherwise the cavity in the bamboo closed panel is filled with foam insulation that would also help hold the half logs in place and together, said double layer panels are limited in width to keep their weight to about 28 kg and are attached to beams and other bearing with lag screws.

23. A two layer wall panel formed from a kit according to any of Claims 1 to 9, or 15 to 21 comprising tee shapes made from ordinary half logs, said tees being connected at the top of the tees by a tongue-and-groove joint system and being formed into a panel by at least three oval shaped cross ties, one near the top, one near the bottom and one across the middle of the panel, said cross ties being tightly set into square notches cut into the base of the tees right to the top members of the tees and being firmly nailed to each tee, then individual tee pieces that have similarly spaced notches that are oval shaped to match the oval cross ties in the other half section and having openings that cannot fit onto the oval cross ties unless they are opened up by bending back half logs so that they can snap over the oval cross ties one at a time, said tees one at a time having their tops joined together by tongue-and-grooves as in the first layer with the base of each single tee being set between two tee bases of the first layer limiting their sideways movement and again the double layer panels are limited in width to about 28 kg weight.

24. Ceiling panels formed from a kit according to any of Claims 1 to 9 or 15 to 21 comprising tee shapes made from ordinary half logs, said tees being connected at the top of the tees by a tongue-and-groove joint system and being formed into a panel by at least three oval shaped cross ties, one near the top, one near the bottom and one across the middle of the panel, said cross ties being tightly set into square notches cut into the base of the tees right to the top members of the tees and are firmly nailed to each tee, then individual tee pieces that have similarly spaced notches that are oval shaped to match the oval cross ties in the other half section and have openings that cannot fit onto the oval cross ties unless they are opened up by bending back half logs so that they can snap over the oval cross ties one at a time, said tees one at a time having their tops joined together by tongue-and-grooves as in the first layer with the base of each single tee being set between two tee bases of the first layer limiting their sideways movement and again the double layer panels are limited in width to about 28 kg weight, said panels being placed with the tee bases upward and across ceiling beams and are nailed from above onto supporting beams with nails that are not in view, said panels being limited in width so that the panel will not weigh over 20 kg, however, their cross ties not being oval shaped and are made to match the grooves and serve to hold the sections of tee shapes together.

25. A roof beam formed from a kit according to Claim 9 and in the form of a three-layer wall system according to Claim 1 except that the joints that are horizontal to the mass of the beam are glued joints and the ends of the beam unlike the wall are capped top and bottom with an Ee (E) shaped component which is produced by horizontally splitting a double ayche component similar to the centre ply of the beam into two similar pieces and which exactly cap the beam both top and bottom.

26. A building materials kit according to Claim 1 which comprises Ell (L) shaped components that are sawn from quartered logs that have been sawn so that the cuts cross at or close to the heart of the log with the Ell (L) shapes being cut from the quartered log pieces at the 90° corners of the pieces of log.

27. A building materials kit for the construction or buildings or parts thereof comprising a plurality of sections for forming a building or part thereof, said sections being connectable to each other, a plurality of cross ties for location in grooves formed between adjacent sections in use, said cross ties being securable to each section with a plurality of securement means, said securement means being substantially hidden from view on assembly of the building material kit.

28. A method of manufacturing houses or other buildings by use of a kit or panels according to any preceding claim.

29. A method of manufacturing houses or other buildings by use of wood planks incorporating encased tree or log hearts.

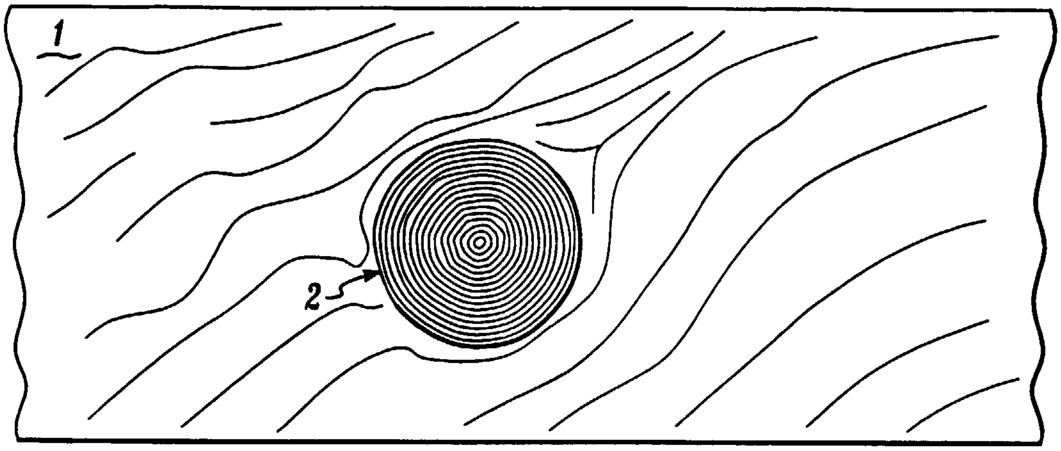


Fig. 1.

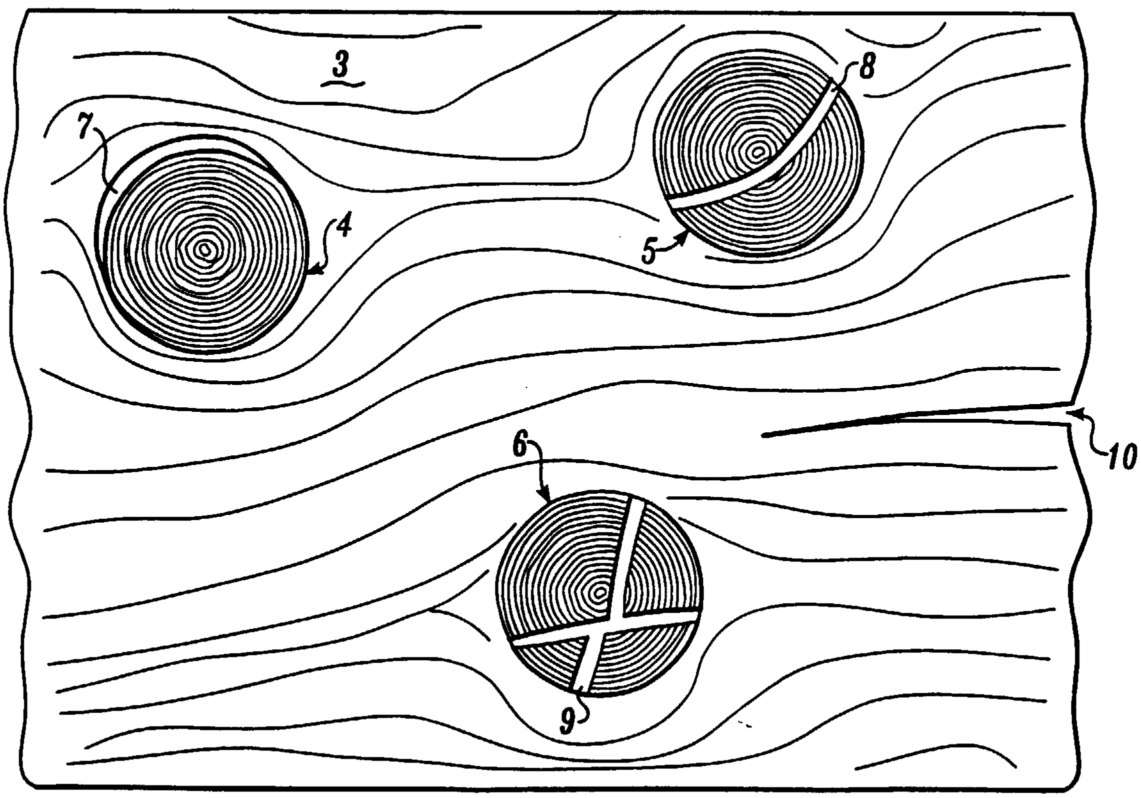


Fig. 2.

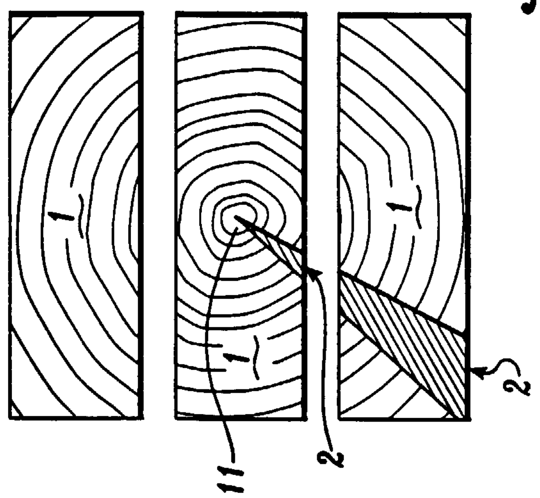


Fig. 4.

Fig. 5.

Fig. 6.

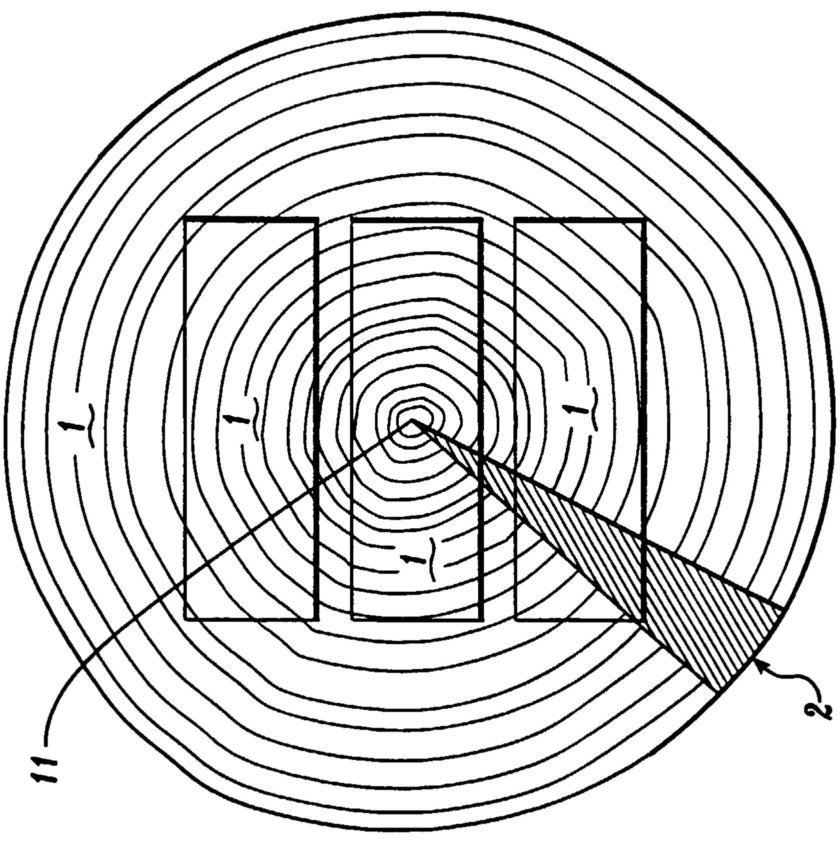


Fig. 3.

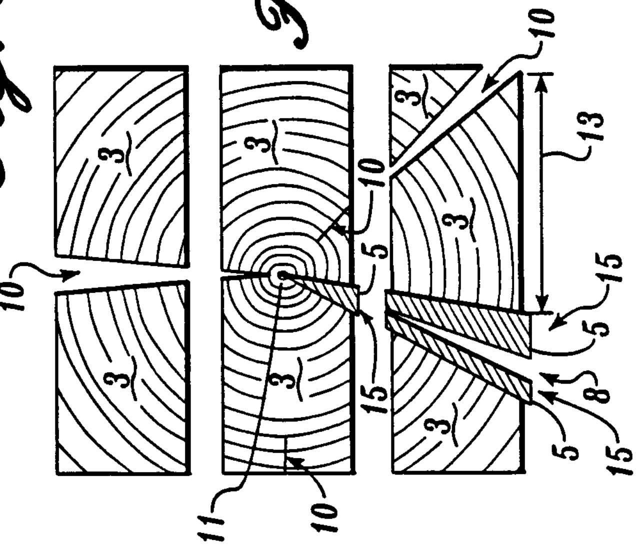


Fig. 8.

Fig. 9.

Fig. 10.

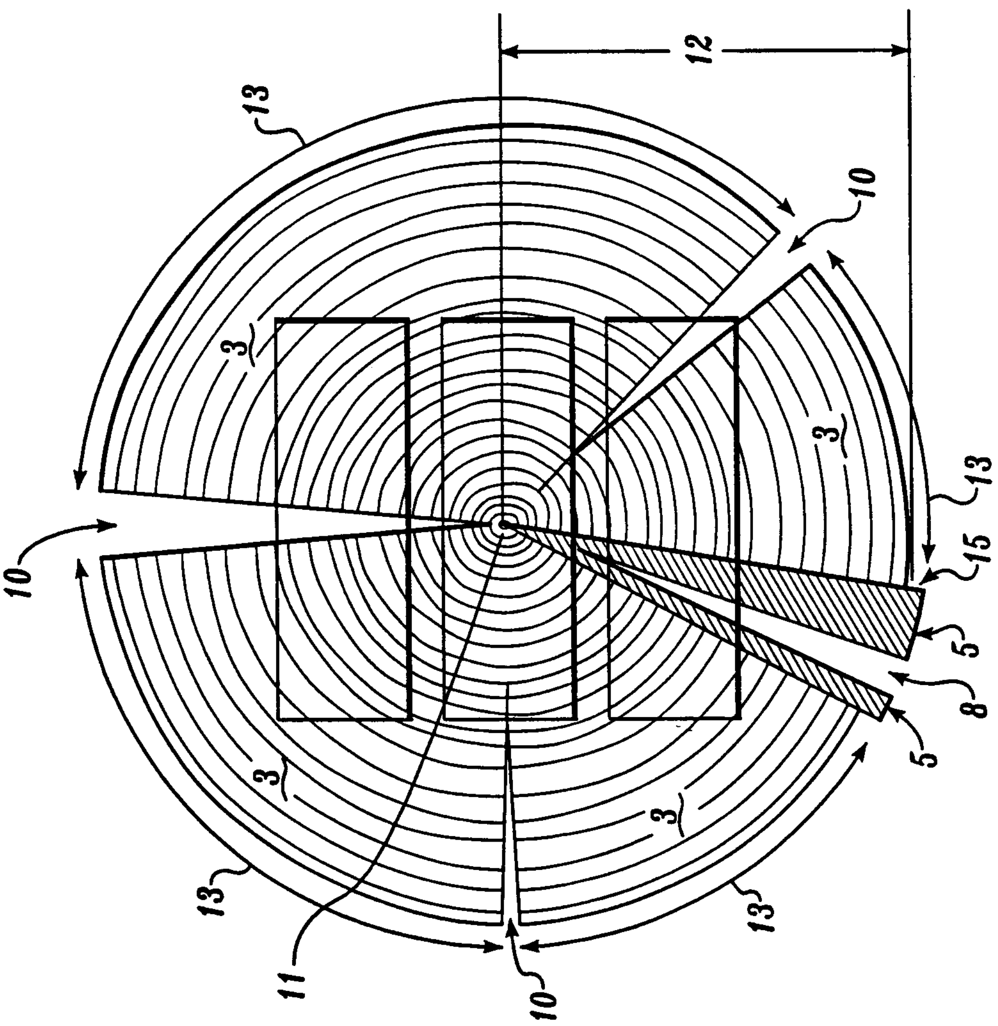


Fig. 7.

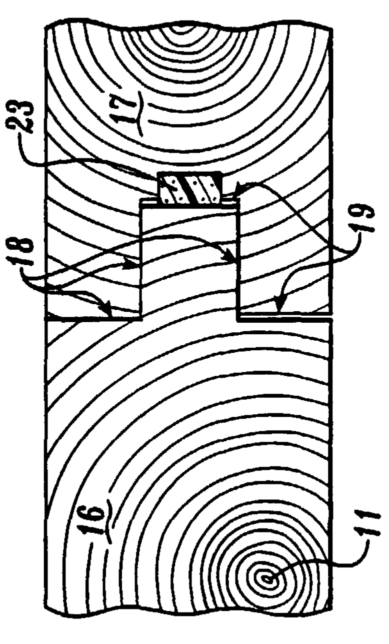


Fig. 13.

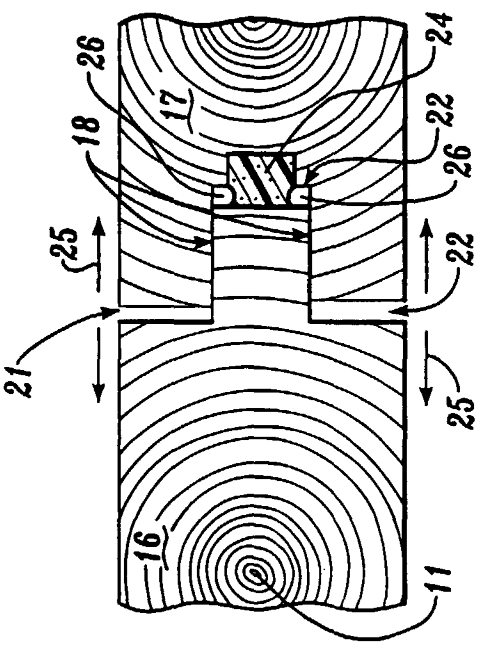


Fig. 14.

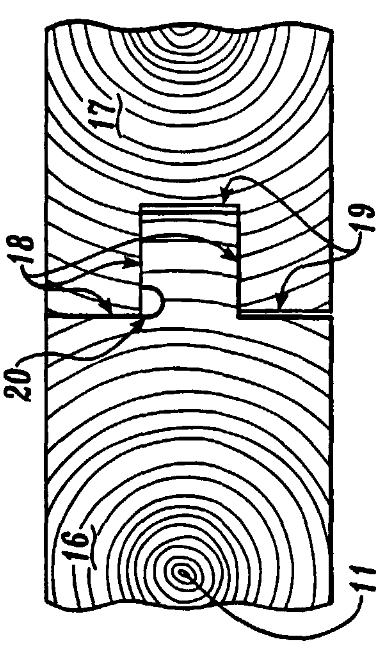


Fig. 11.

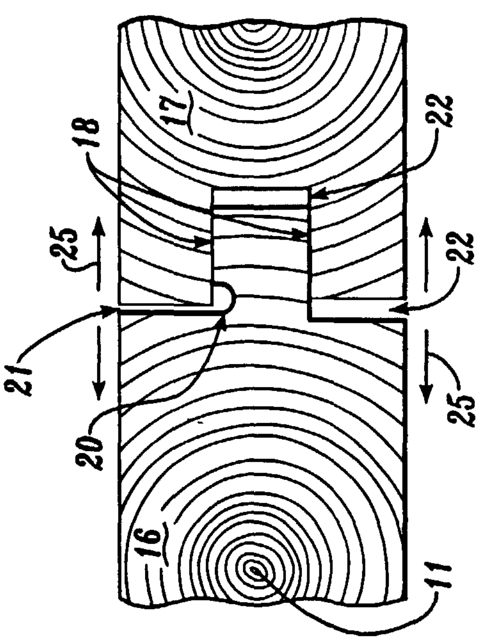


Fig. 12.

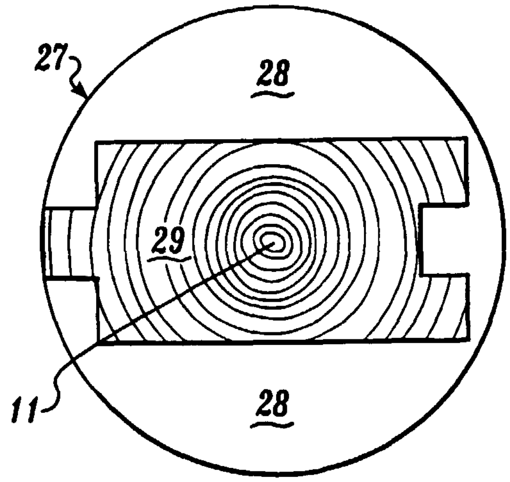


Fig. 15.

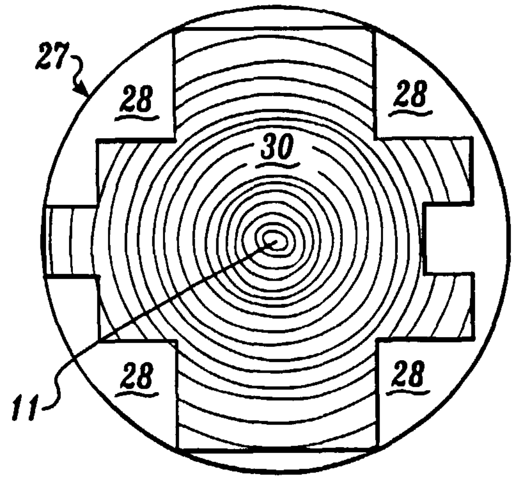


Fig. 16.

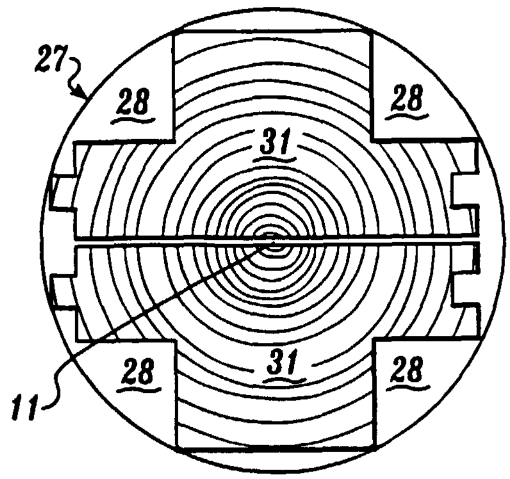


Fig. 17.

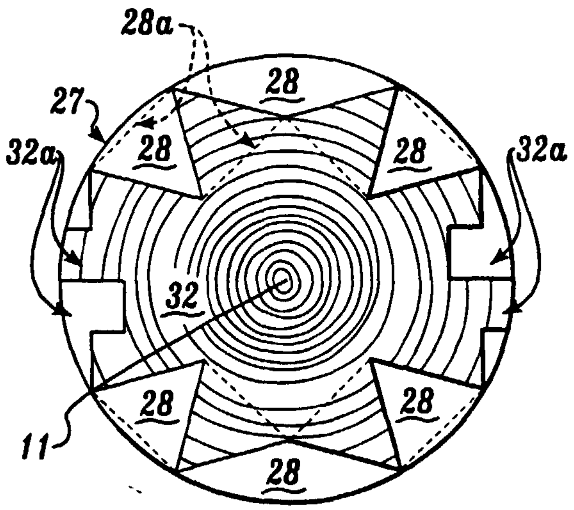


Fig. 18.

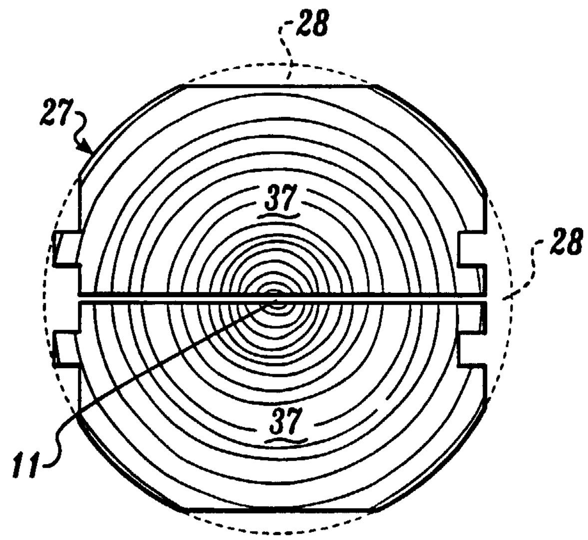


Fig. 19.

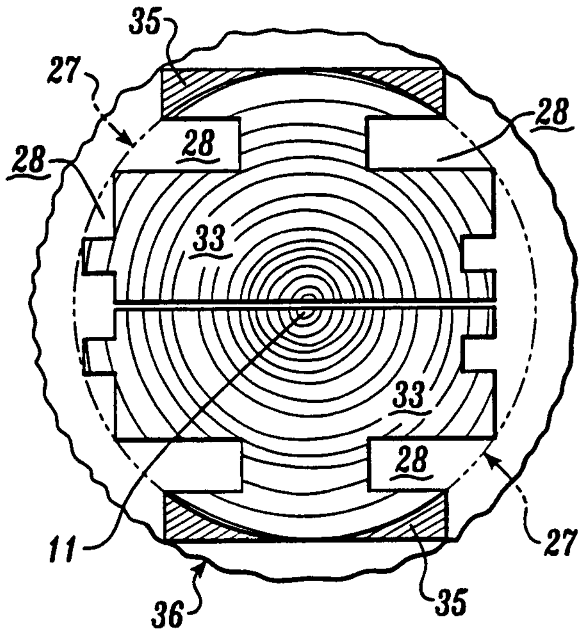


Fig. 20.

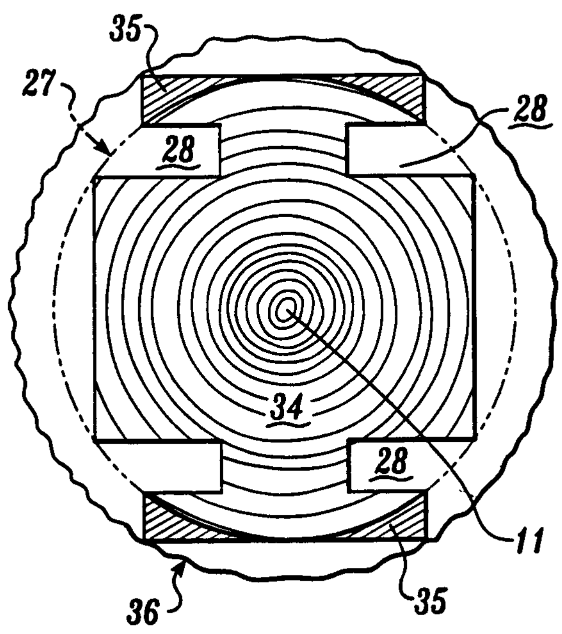


Fig. 21.

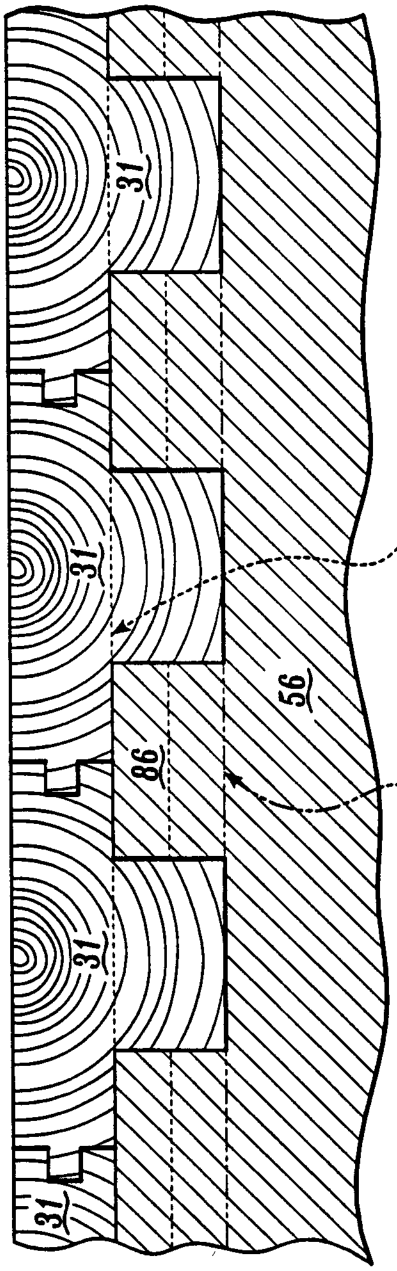


Fig. 38.

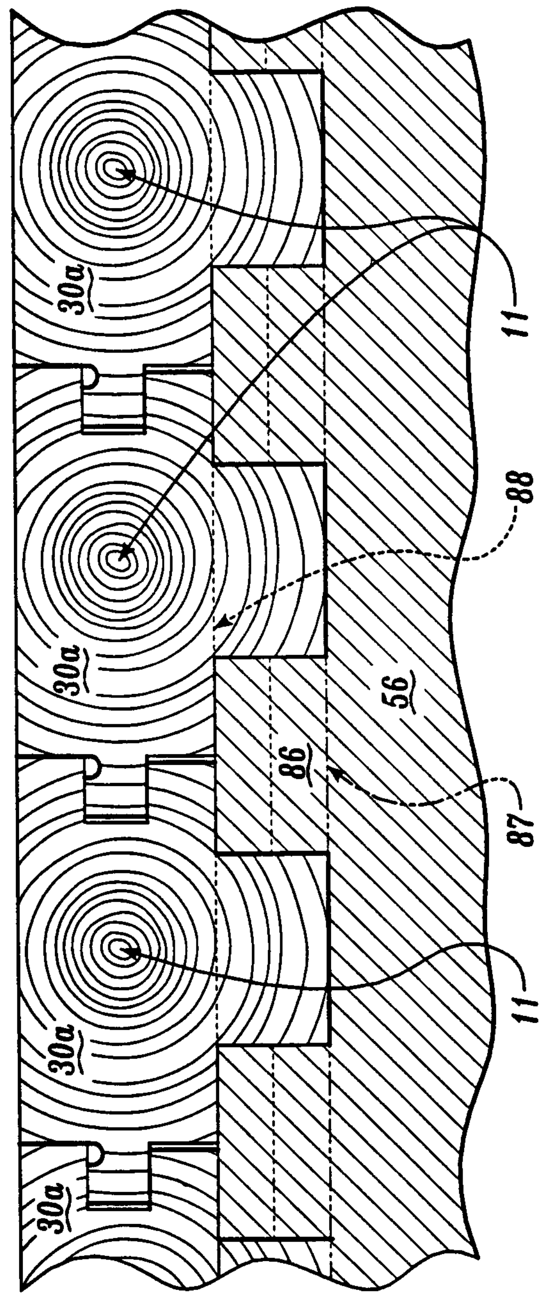


Fig. 39.

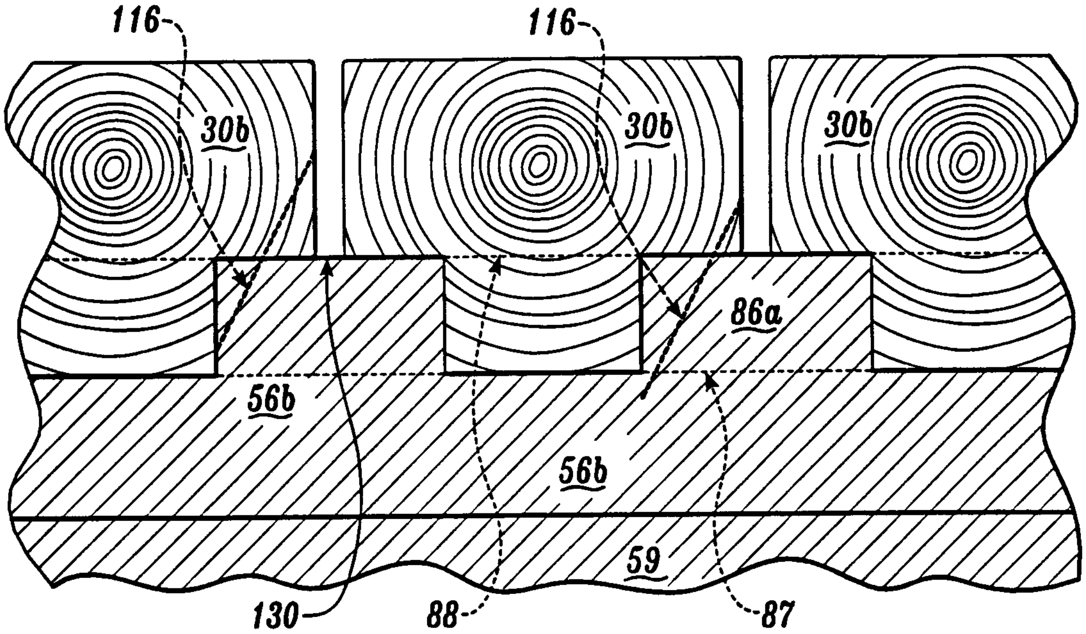

116
116
30b
30b
30b
86a
56b
56b
59
130
88
87

Fig. 40.

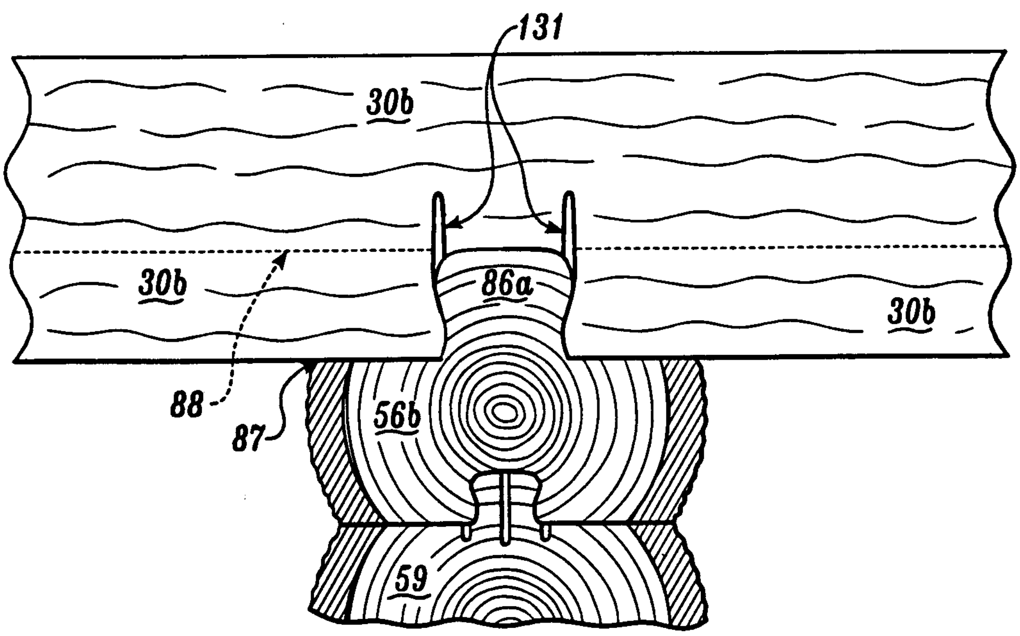

131
30b
30b
86a
30b
88
87
56b
59

Fig. 41.

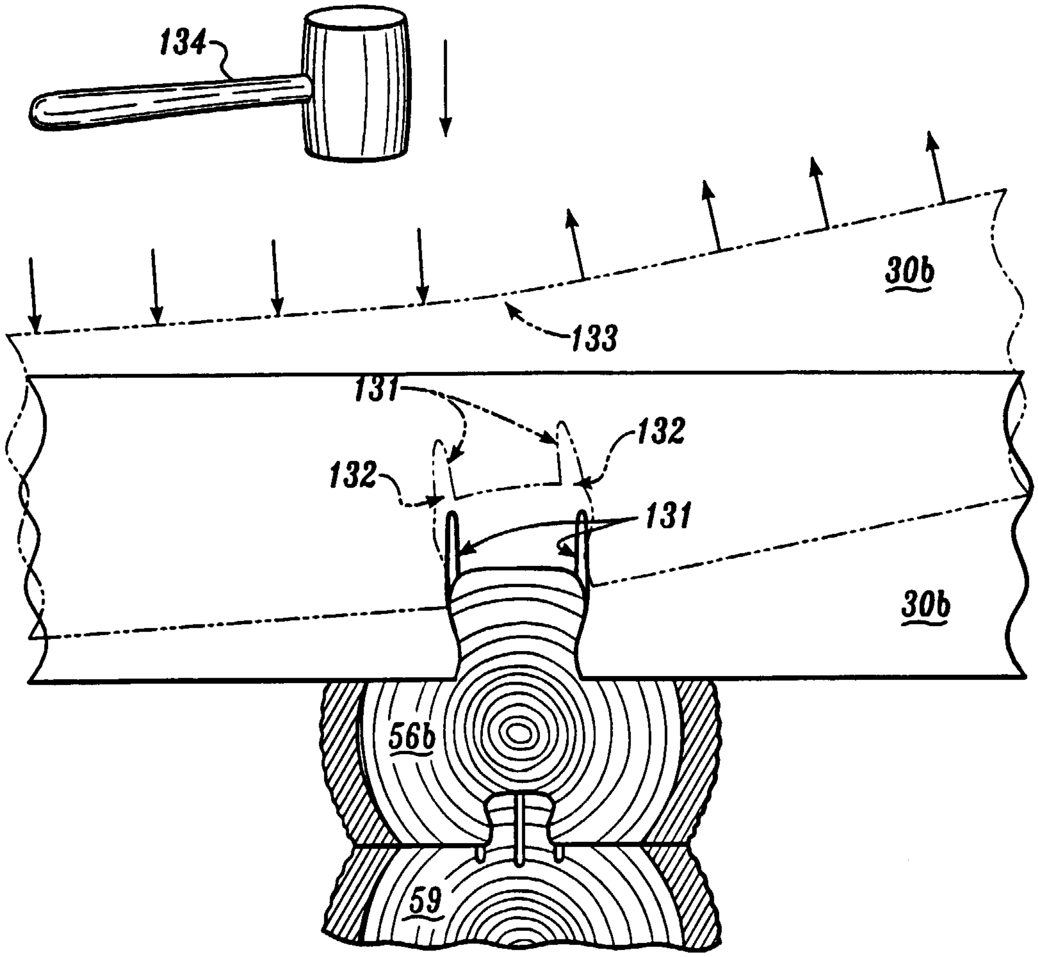


Fig. 42.

Fig. 43.

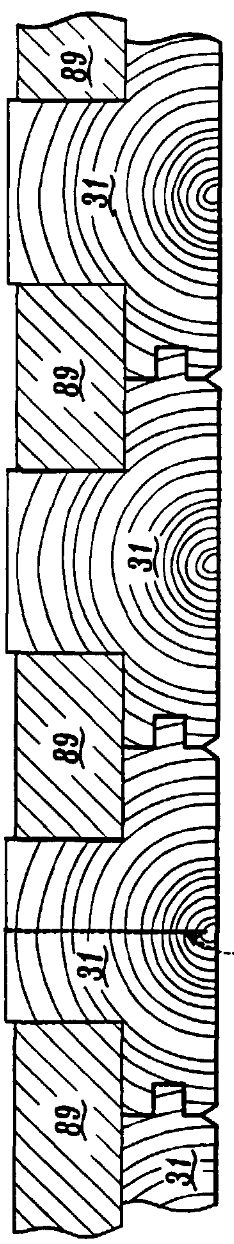


Fig. 44.

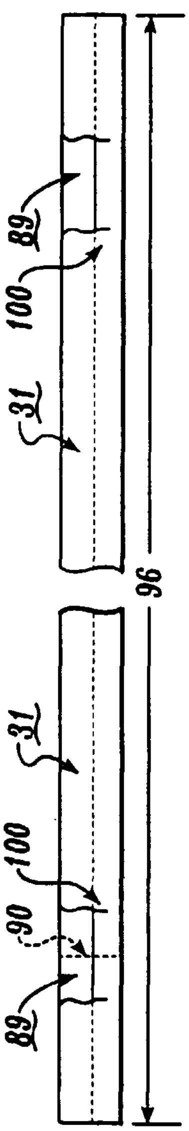


Fig. 45.

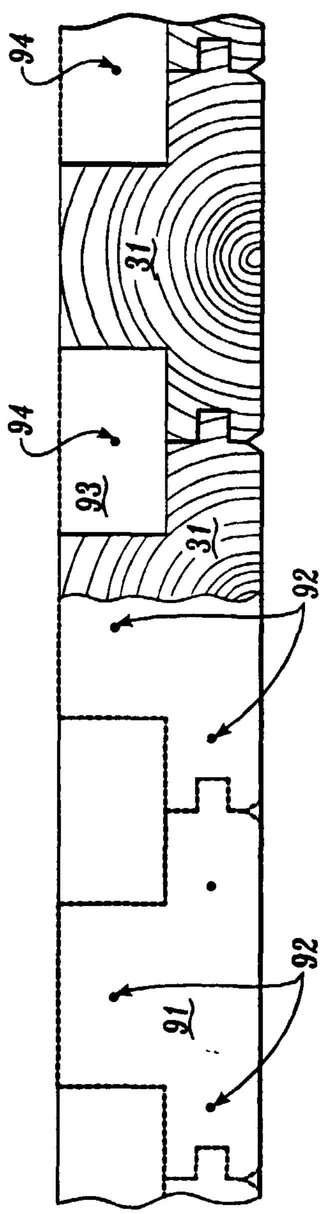


Fig. 46.

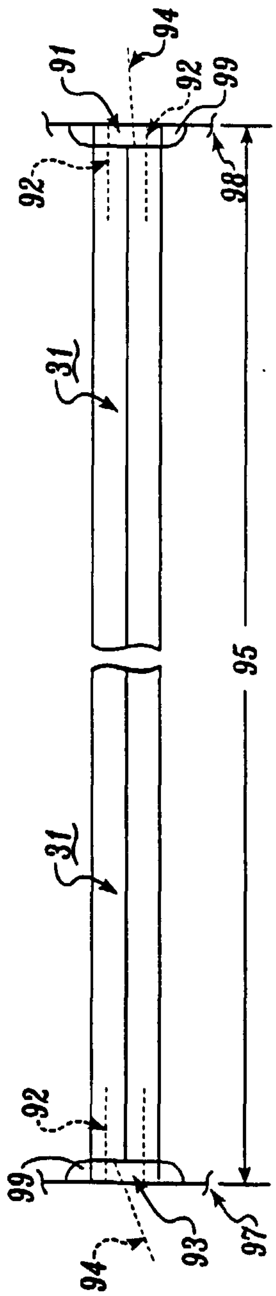


Fig. 47.

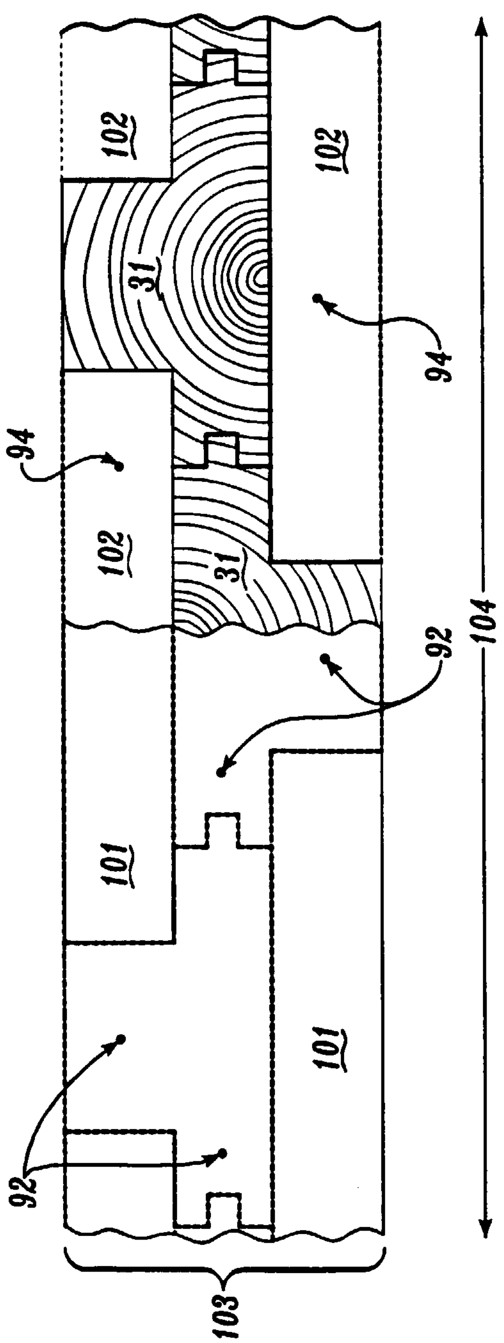
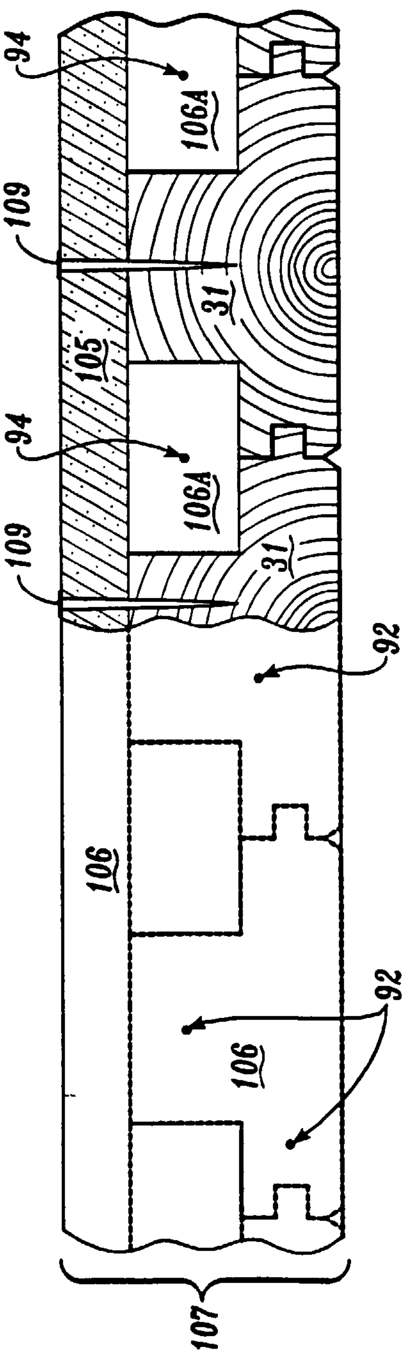

102
102
31
94
94
102
31
92
92
101
92
101
104
103

Fig. 48.


94
106A
109
105
31
94
106A
109
31
92
106
92
106
107

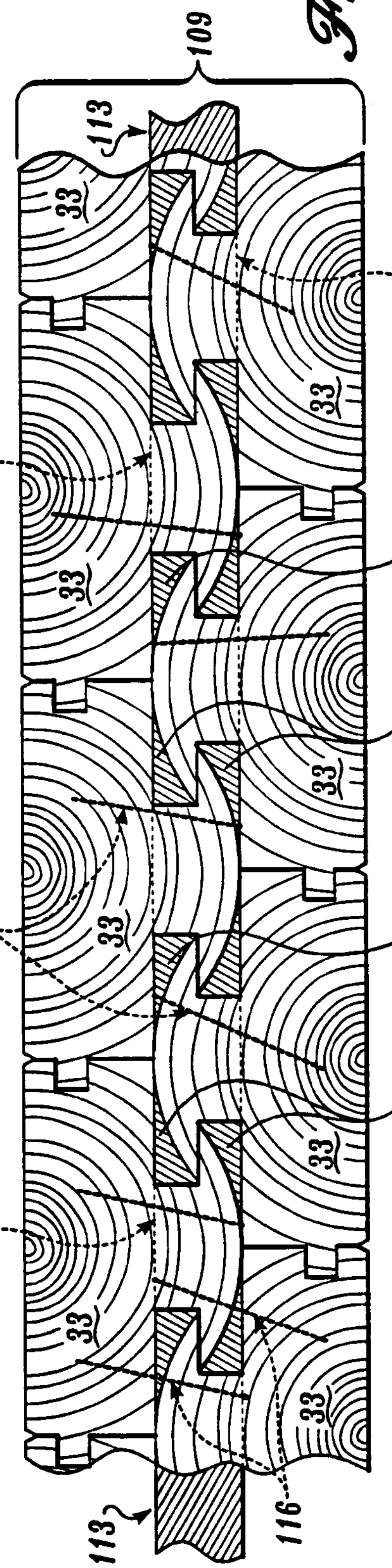


Fig. 49.

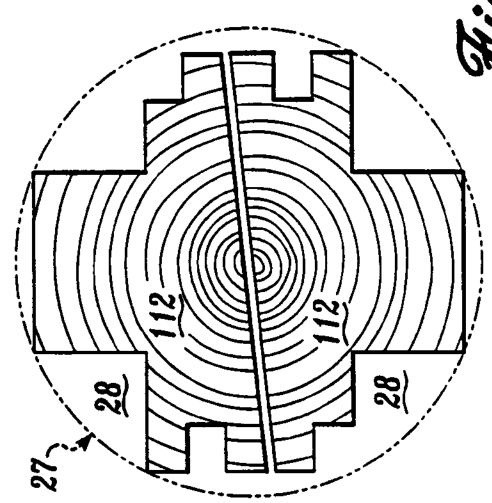


Fig. 51.

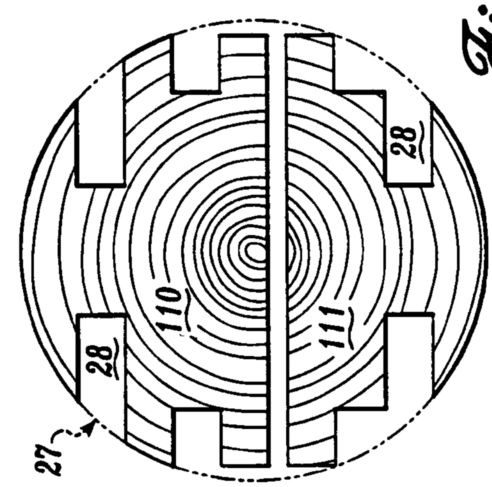


Fig. 50.

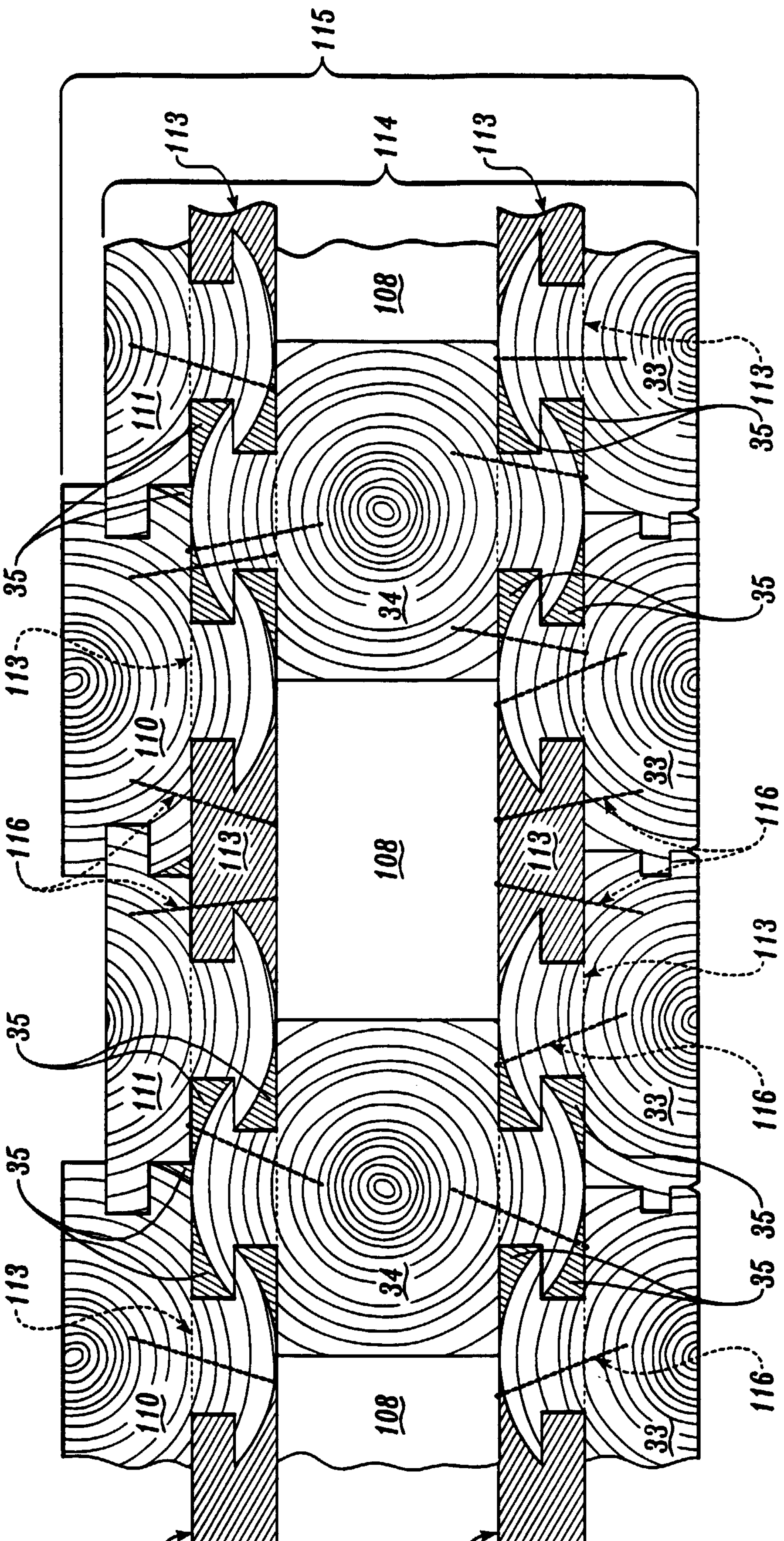


Fig. 52.

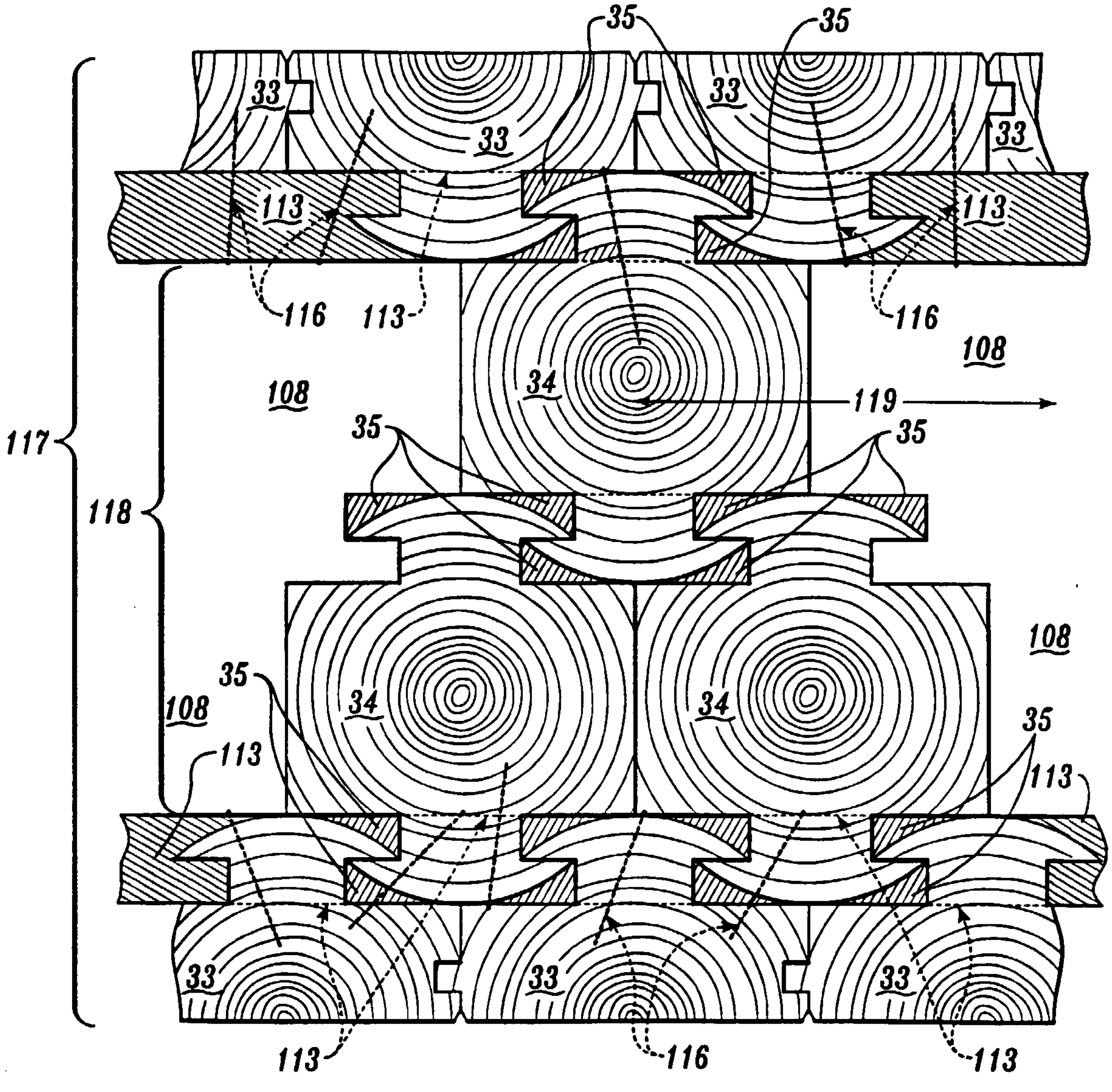

35
35
33
33
33
33
113
113
116
113
116
108
34
119
108
35
35
117
118
34
34
108
35
108
113
35
113
33
33
33
113
116
113

Fig. 53.

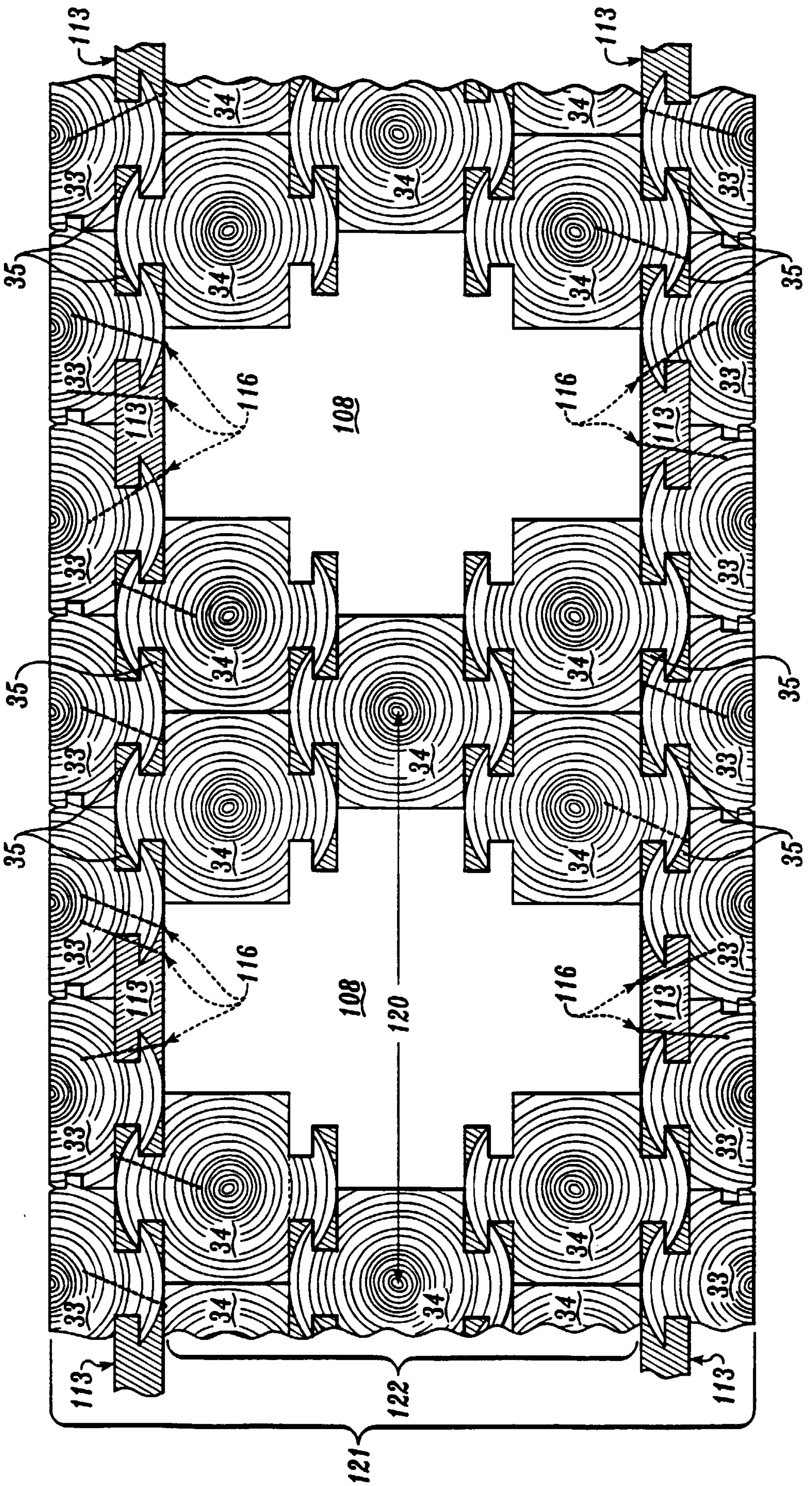


Fig. 54.

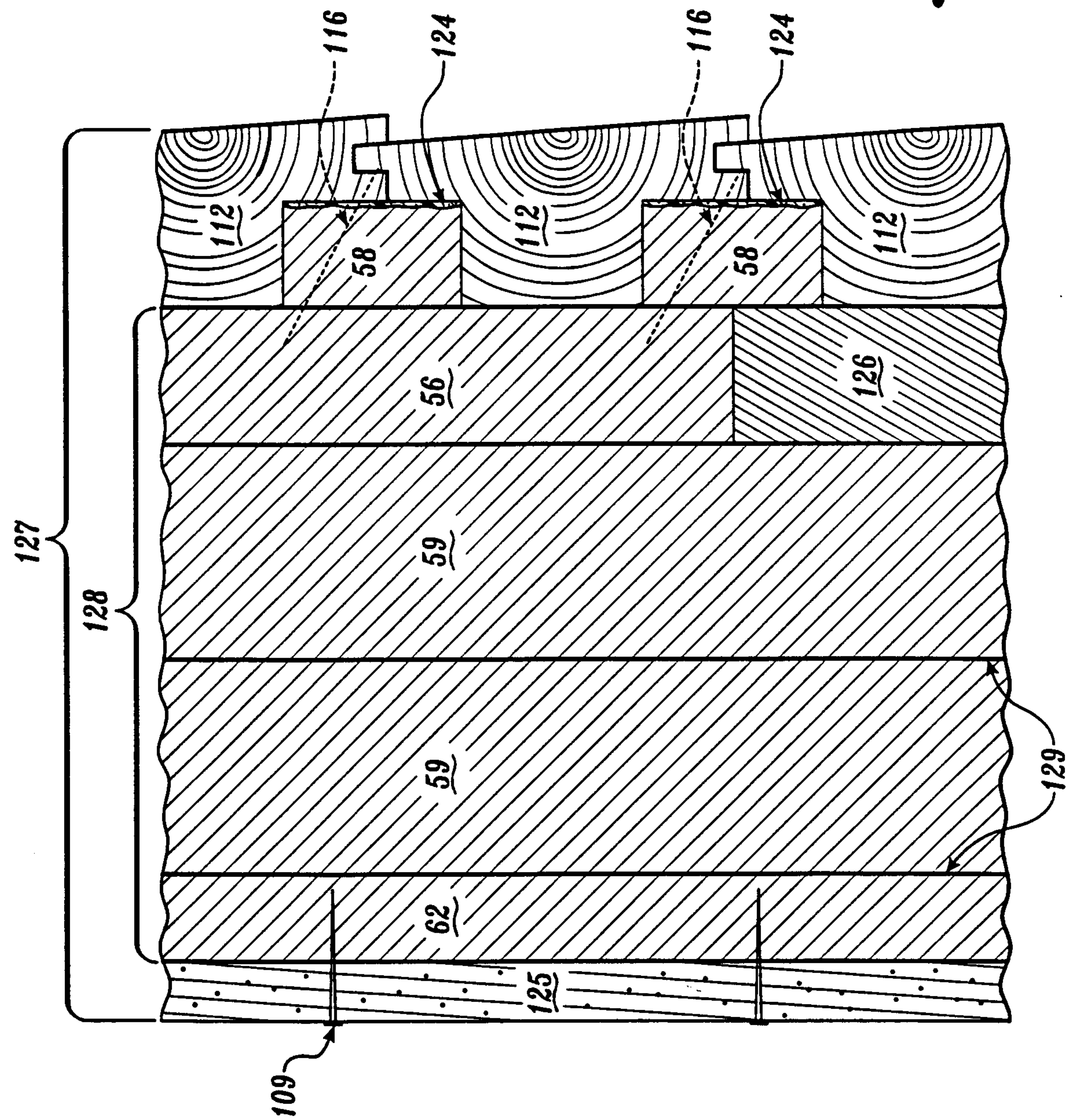

116
124
116
124
112
112
112
58
58
56
126
59
59
62
125
127
128
129
109

Fig. 57.

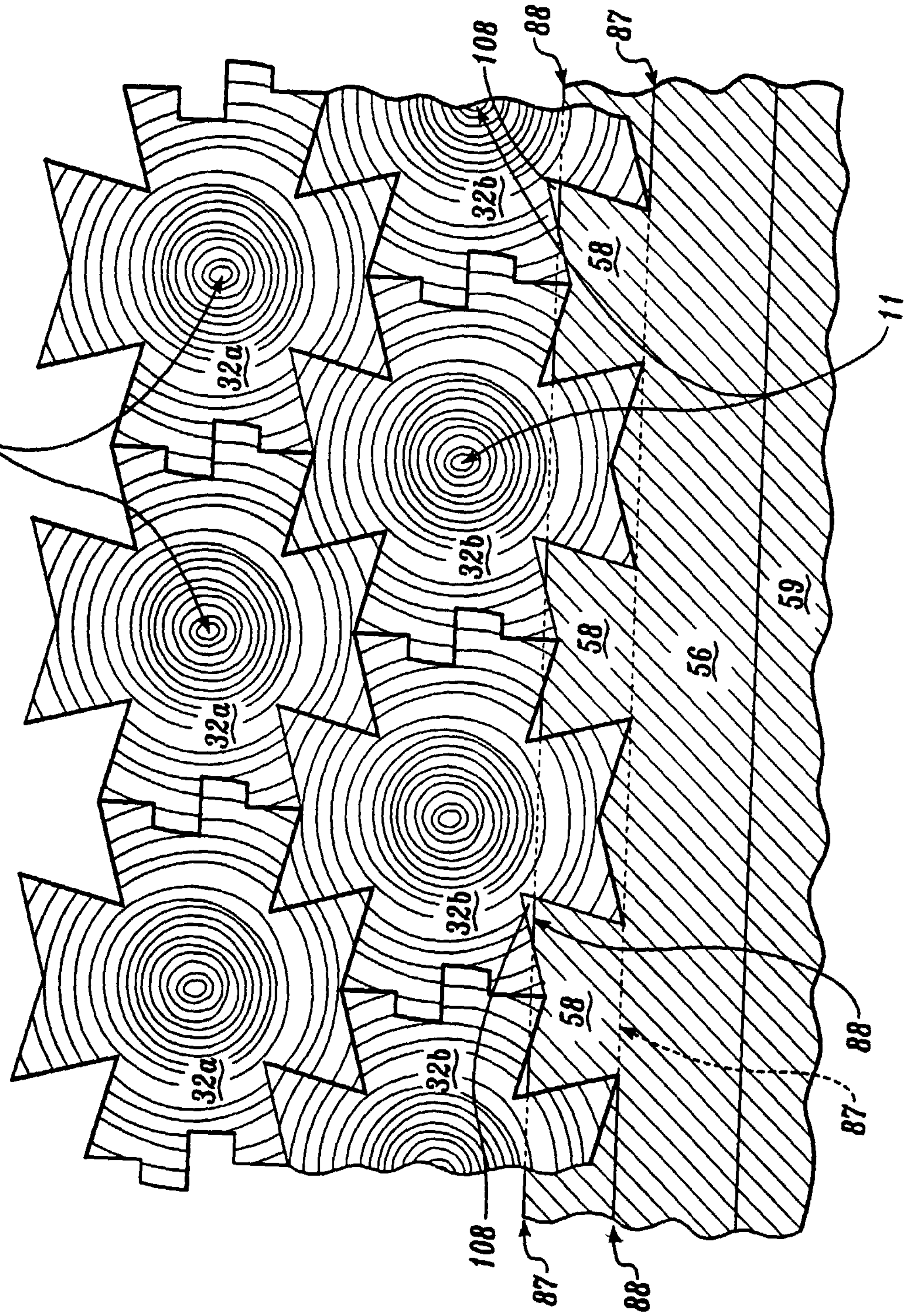


Fig. 59.

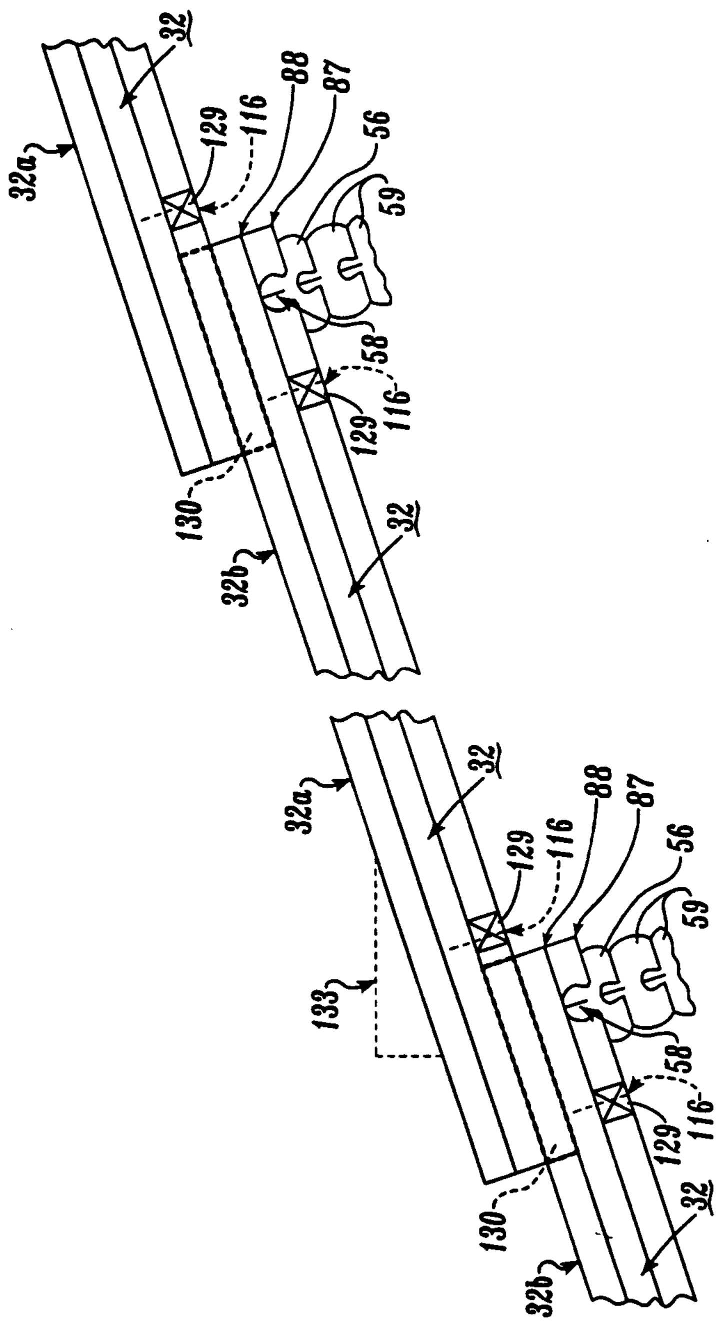

32a
32
129
116
88
87
56
59
58
129
116
130
32b
32
32a
32
133
129
116
88
87
56
59
58
129
116
130
32b
32

Fig. 60.

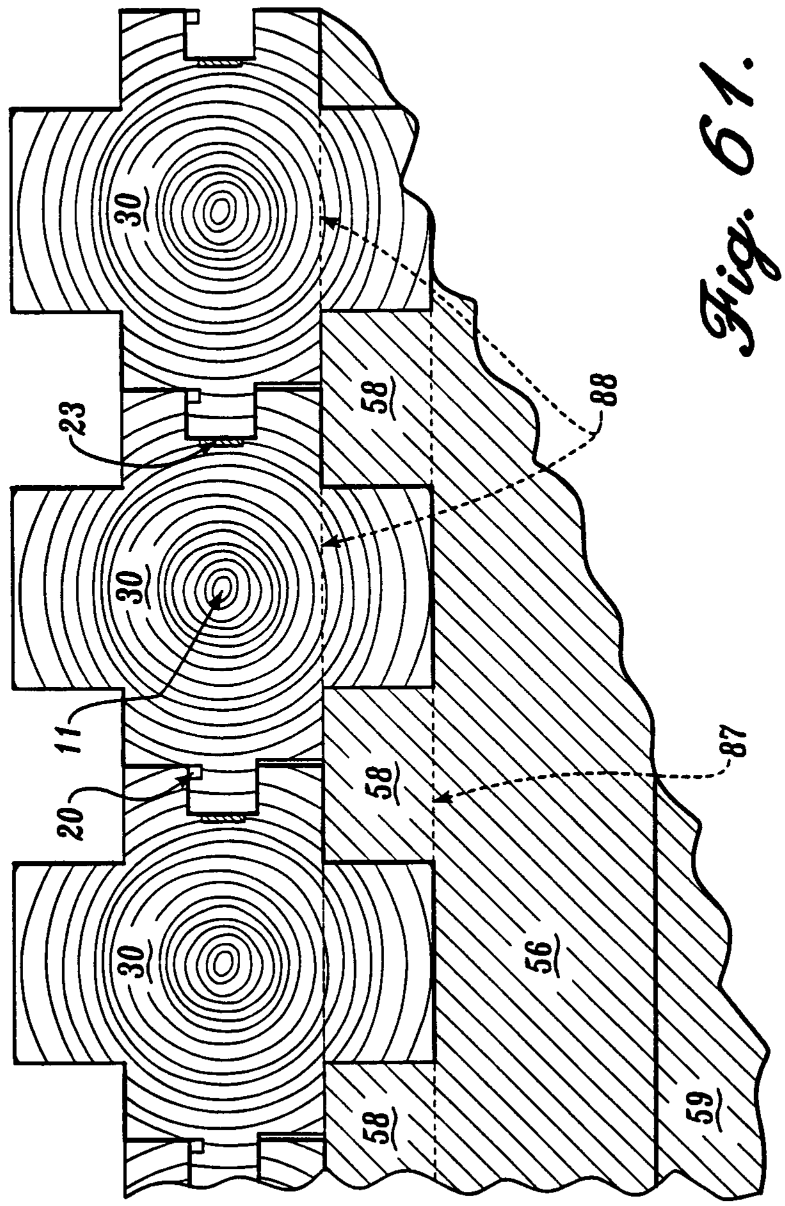


Fig. 61.

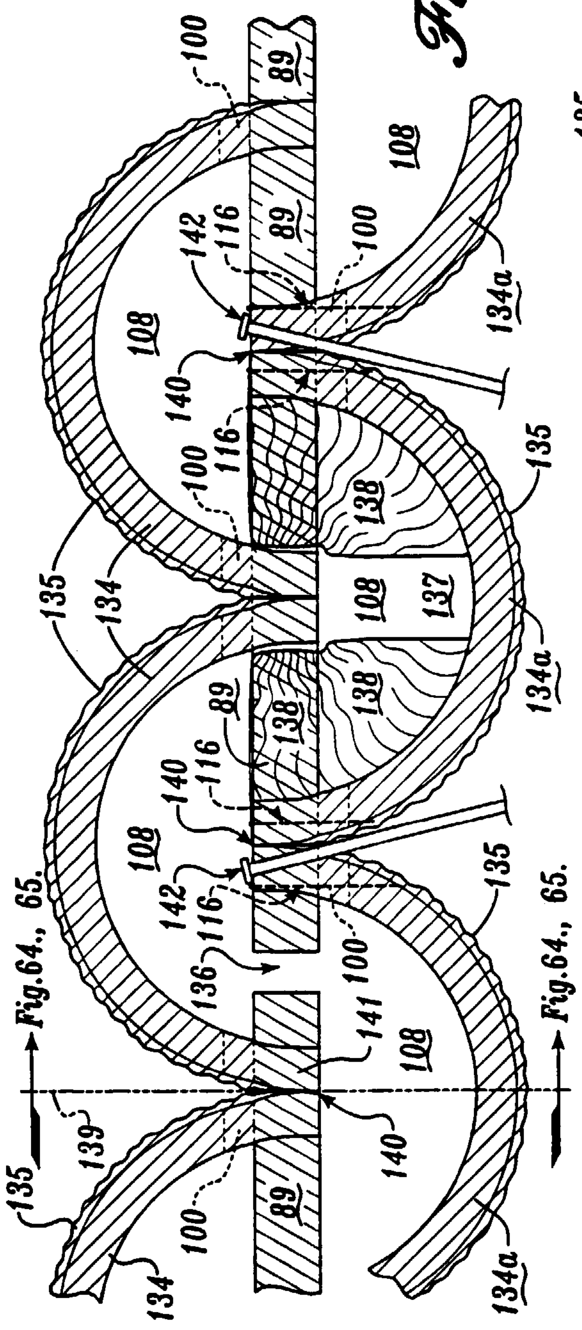


Fig. 63.

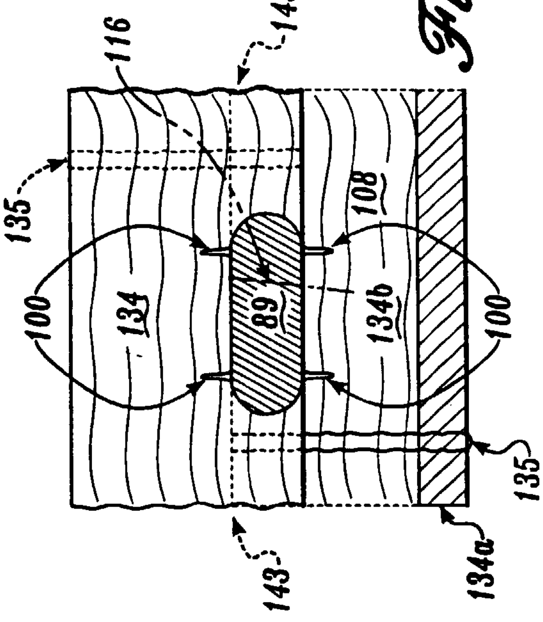


Fig. 64.

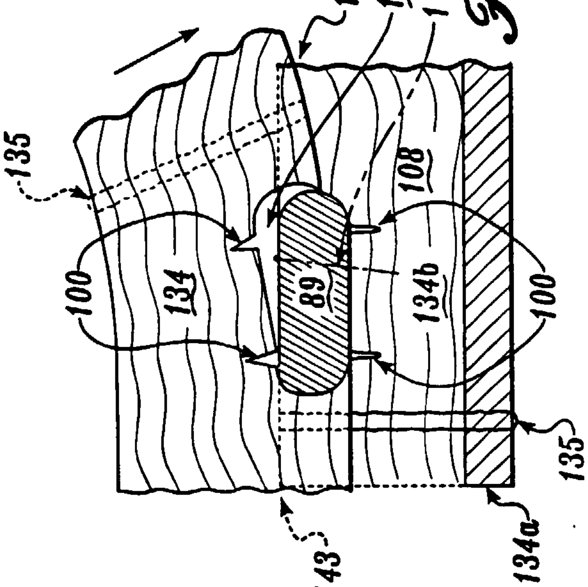


Fig. 65.

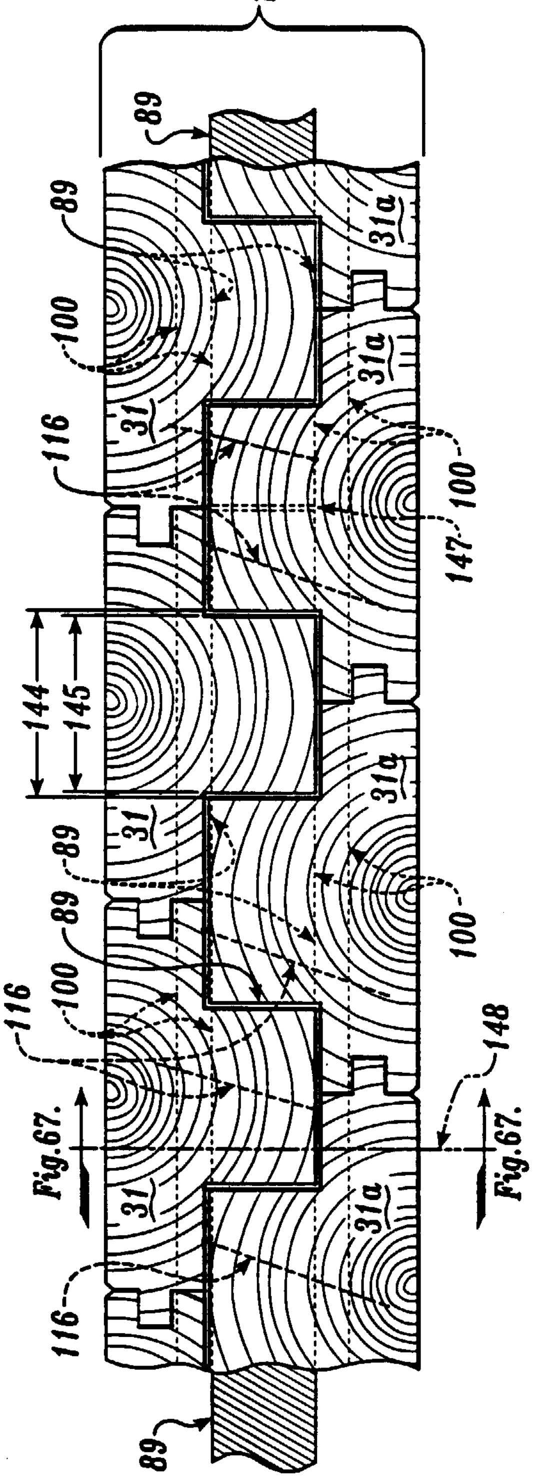

146
89
89
100
31a
31a
31
116
100
147
144
145
31
31a
89
89
100
100
116
Fig.67.
Fig.67.
148
31
31a
116
89

Fig. 66.

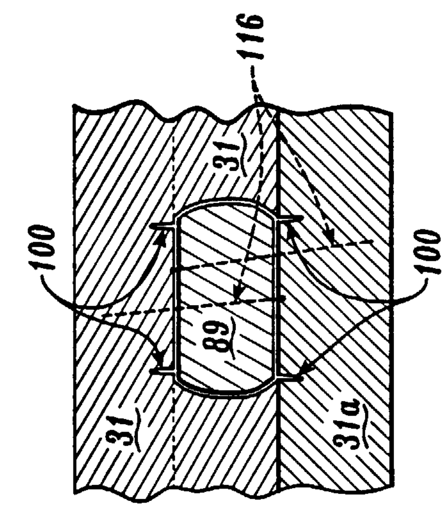

116
31
100
100
89
31
31a

Fig. 67.

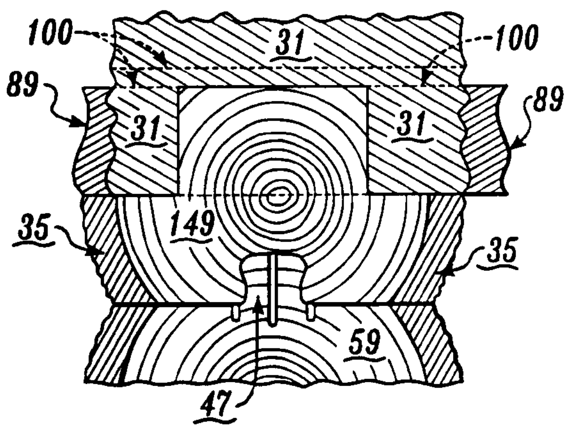


Fig. 68.

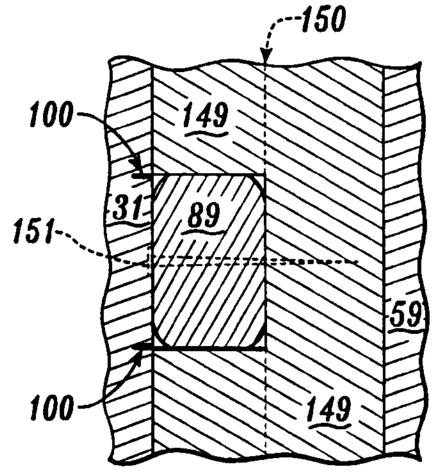


Fig. 69.

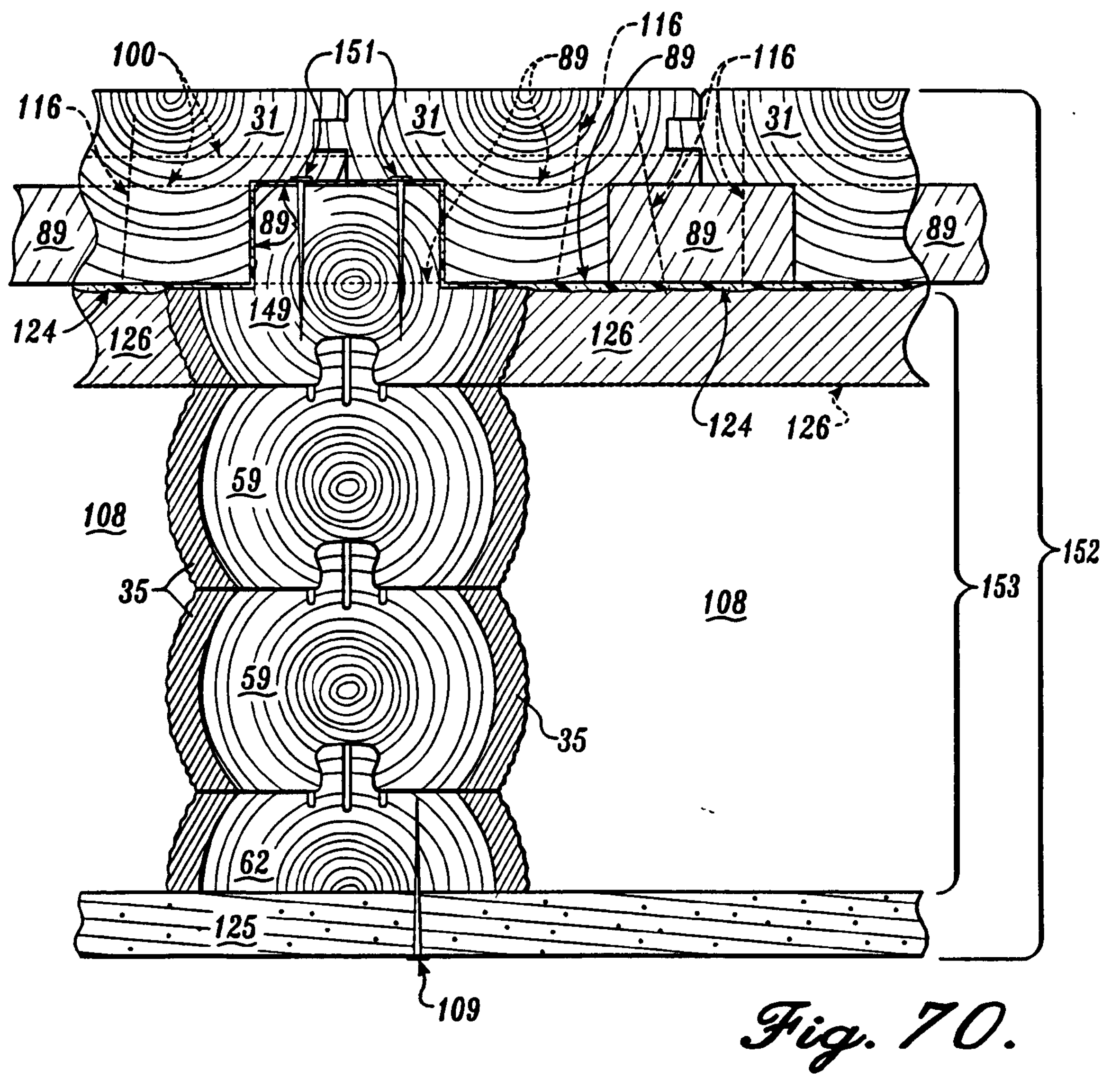


Fig. 70.

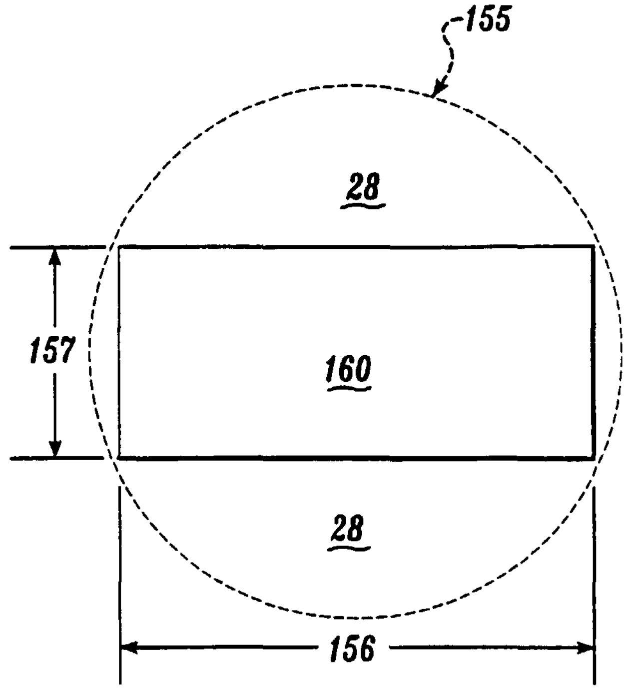


Fig. 71.

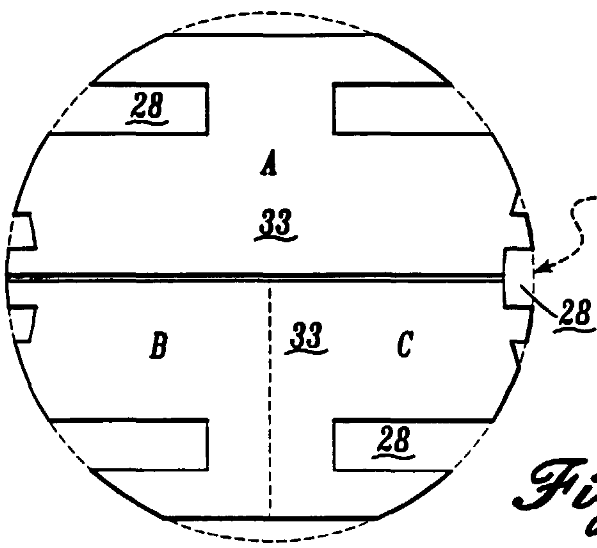


Fig. 72.

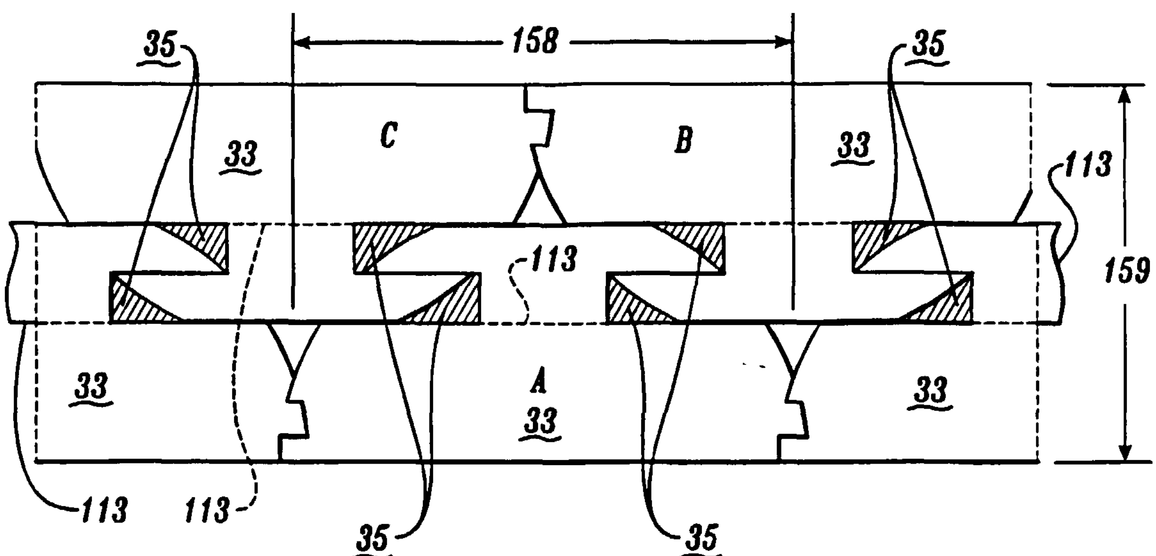


Fig. 73.

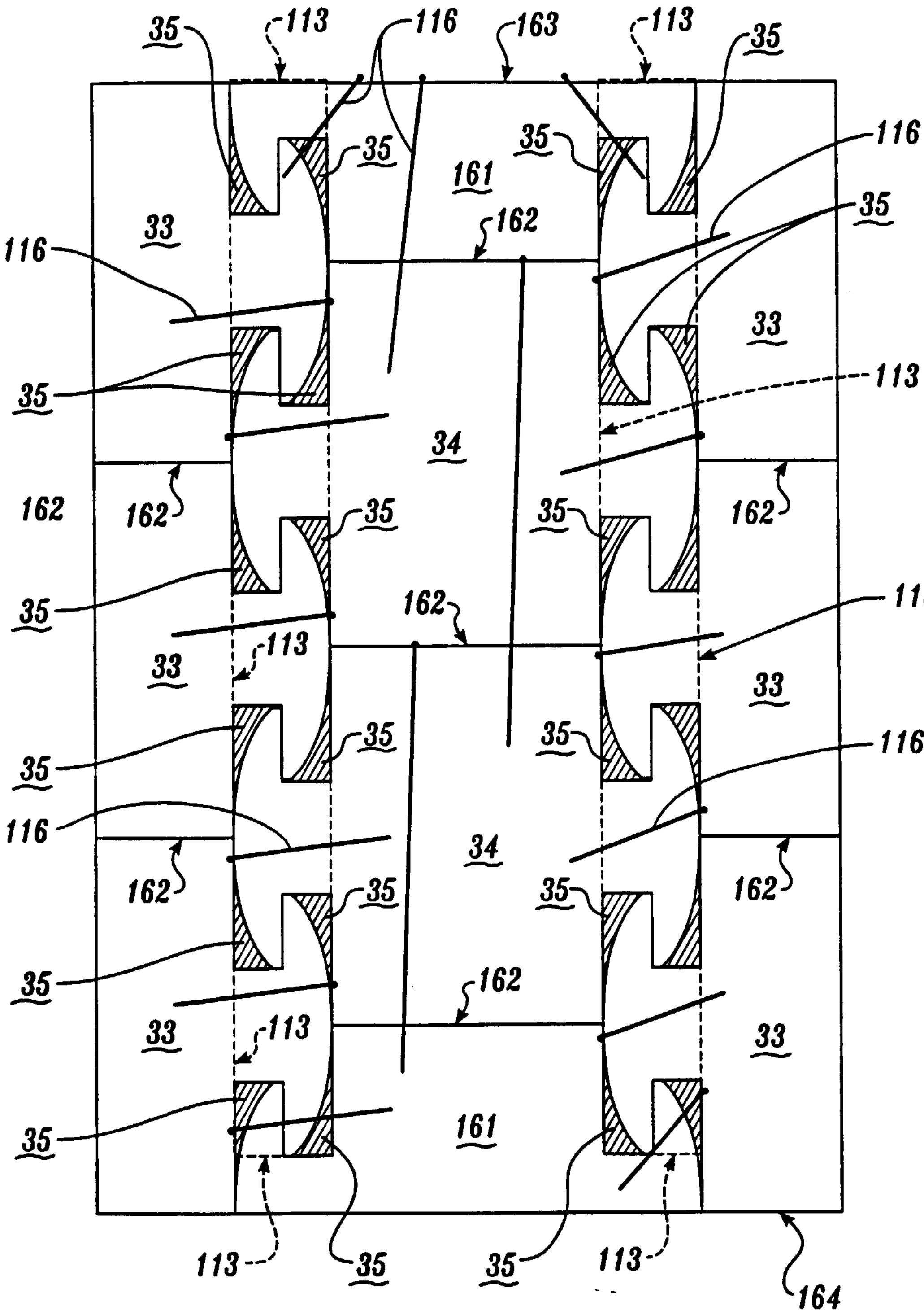

35
113
116
163
113
35
35
161
35
116
33
162
35
116
33
35
113
34
162
162
162
35
35
162
35
162
113
33
113
33
35
35
35
116
34
116
162
35
35
162
35
162
33
113
33
35
161
113
35
35
113
164

Fig. 74.

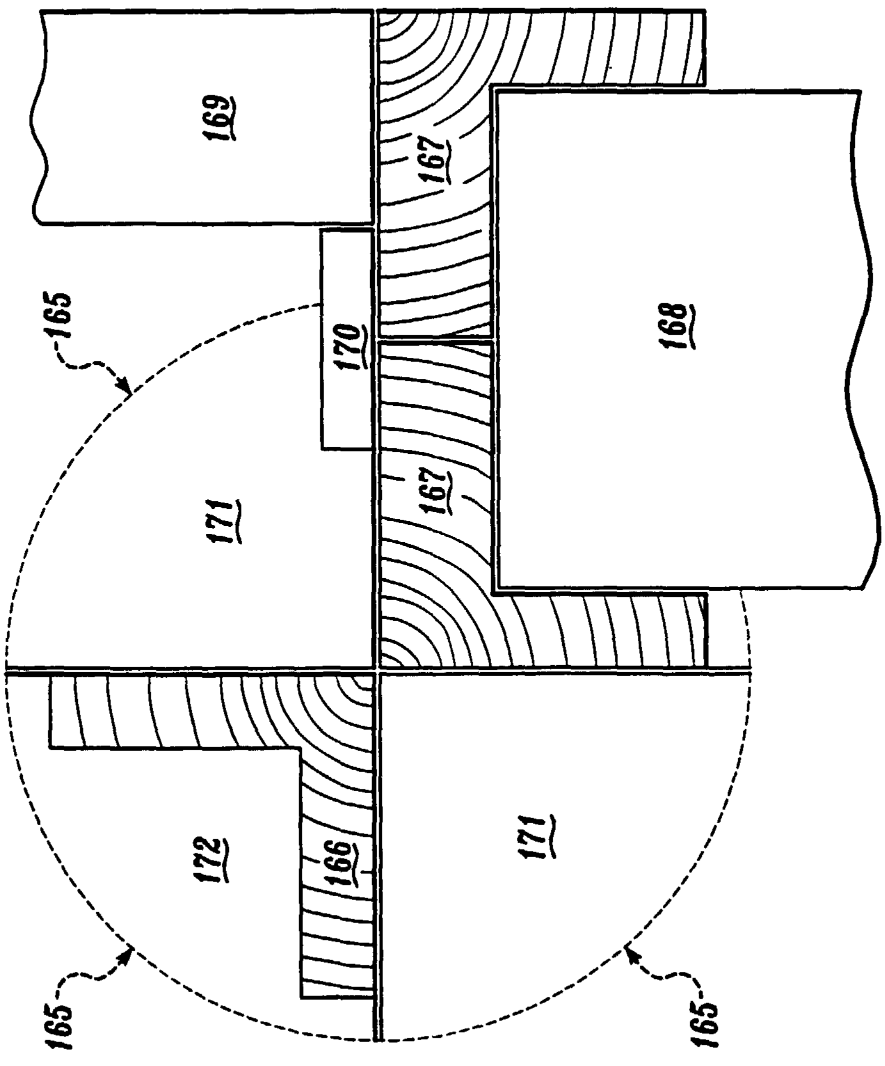


Fig. 75.