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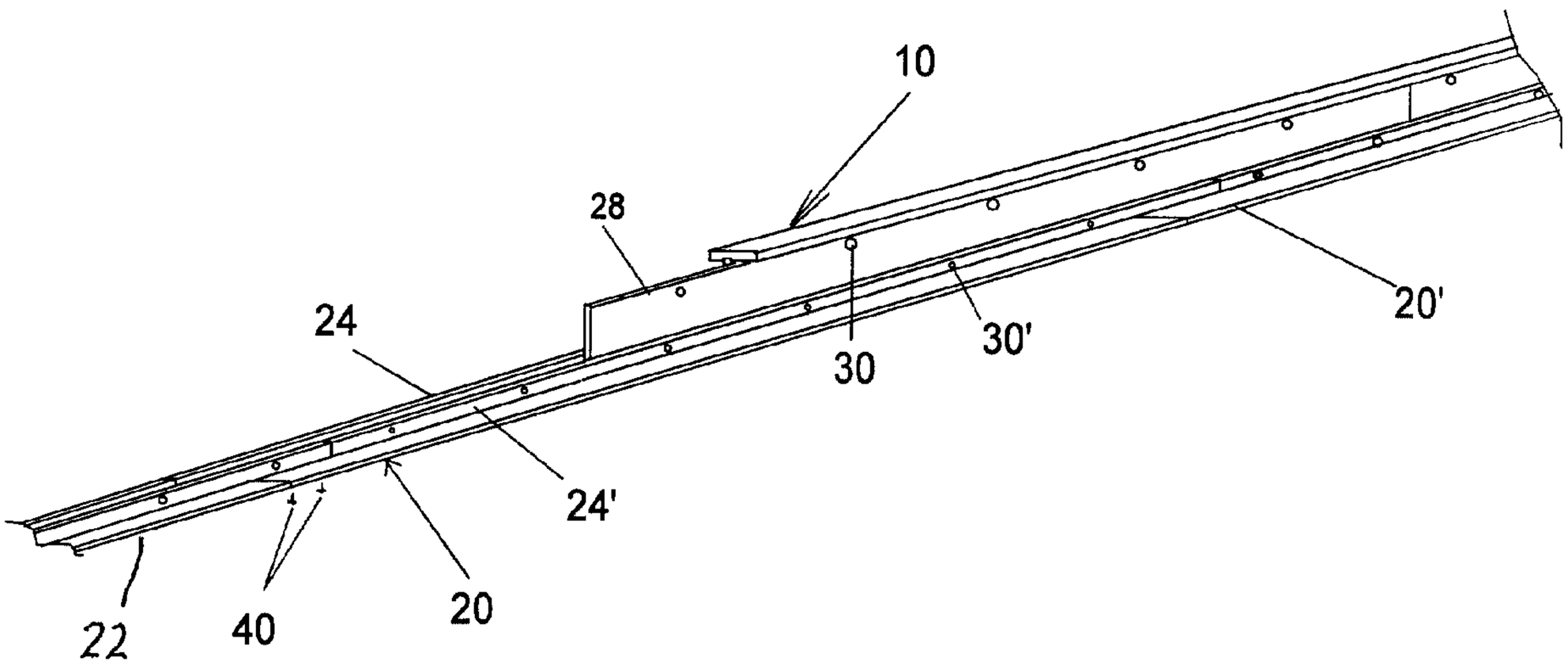
(54) Titre : POUTRE DE BOIS COMPOSITE
(54) Title: COMPOSITE WOODEN BEAM



(57) Abrégé/Abstract:
A wooden I beam comprising upper and lower wooden members each member having an outer longitudinal flange secured by glue at a right angle to at least one elongated web, upper members of the beam being connected at end joints which are staggered relative to end joints between lower members of the beam, the webs of all members being inwardly projecting and connected together by means including mechanical fastening means which secure together the webs and/or web connecting members, with both said fastening means and web connecting members serving to connect said webs without the use of glue. Each lower member has a pair of the webs spaced apart and parallel to each other and which receive between them an upper member web or one of the web connecting members. Ends of the webs may be staggered relative to ends of the flanges.

Abstract of the Disclosure.

A wooden I beam comprising upper and lower wooden members each member having an outer longitudinal flange secured by glue at a right angle to at least one elongated web, upper members of the beam being connected at end joints which are staggered relative to end joints between lower members of the beam, the webs of all members being inwardly projecting and connected together by means including mechanical fastening means which secure together the webs and/or web connecting members, with both said fastening means and web connecting members serving to connect said webs without the use of glue. Each lower member has a pair of the webs spaced apart and parallel to each other and which receive between them an upper member web or one of the web connecting members. Ends of the webs may be staggered relative to ends of the flanges.

Title: Composite wooden beam

Background of the Invention.

1.Field of the Invention

The present invention relates to composite beams or similar members, e.g. posts, formed from wooden members, and especially composite I beams. The present invention represents improvements in the beam described in my pending Canadian Patent Application No.2,298,292 filed Feb.4, 2000.

2.Prior Art

In recent years the increasing scarcity and cost of large trees suitable for wooden joists or beams has lead to the use of composite beams, such as I beams, in which the upper and lower flanges of the beams, and the web member, are formed as separate pieces and then joined together. While in the past such beams were sometimes made of wooden pieces held together with bolts, in modern composite beams the flanges are nearly always joined to the web members by adhesive. Prior art composite beams using adhesive are referred to in my copending application aforesaid.

The term "beam" as used herein will be understood to refer not only to members used horizontally under floors or roofs, but also to members which may be used vertically, in the manner of posts or as vertical strengthening members used in walls.

The method of described in my copending application can make use of T-shaped members used for forming building panels of the type described in my earlier pending Canadian Patent Application No.2,245,299, filed Aug.19,1998 (corresponding to

issued U.S.Patent No.5,901,524, issued May 11, 1999). This earlier application describes several designs of T-shaped members formed from strips of material such as OSB (oriented strand board) material having flanges and webs with specially designed notches which allow the members to be readily assembled into building panels by unskilled labor. Normally, such members are 8 feet in length, and produce 8 foot square panels. The right angle joints between the webs and flanges of these members are dado joints which are strongly glued using suitable presses in factories where the notches are also cut. My copending '292 application allows the T-shaped members which are the same or similar to those described in my earlier application to be assembled into composite I beams which are quite light and easy to handle, and which can be used to support floor panels. Where stresses are low, the T-shaped members can be identical to the notched members of my pending application, but for higher loads it is preferred to use members which are closely similar to those of my pending application but which do not have the notches.

My copending '292 application was based on the realization that the wastage involved in present production of composite I beams can largely be eliminated by producing the beams at a place of assembly or workshop near to a building site, in a manner which allows a continuous length of beam to be produced by continually adding pieces, including T-shaped members, to one end, while the required beam lengths are cut off from the other end. To avoid the problems with making satisfactory glued joints on site, the only such joints are the factory made joints between the flanges and the webs of the T-shaped members, and these members and any other pieces of the beams are connected together with mechanical connecting means, preferably non-metallic fastening means such as wooden pegs or

bolts. The term "mechanical connecting means" is intended to exclude glue. While non-metallic connecting means have the advantage that they can be sawn through without difficulty, metallic means such as nails or screws may be used if these are such as to be removable before sawing, or if the location of such metallic parts are noted and avoided in sawing. Alternatively, beams can be made up on site to particular lengths after the upper and lower members have been cut to suitable lengths.

The reference to "upper" and "lower" members will be understood in relation to the normal orientation of these parts in a horizontal beam as produced, and does not imply that the process needs to be done in any particular orientation. The reference to the ends of the members abutting does not preclude the possibility that these ends may be separated for example by shims inserted to avoid looseness at these joints.

The beams produced in accordance with the '292 application comprise upper and lower wooden members each member having an outer longitudinal flange secured by glue at a right angle to at least one elongated web, upper members of the beam being connected at end joints which are staggered relative to end joints between lower members of the beam, the webs of all members being inwardly projecting and connected together by means including mechanical fastening means which secure together said webs or which secure said webs to web connecting members without the use of glue.

Thus, my copending '292 application describes both the possibility of directly connecting opposed webs of the upper and lower members with mechanical fasteners such as pegs or bolts, and the possibility of connecting the opposed webs by

the use of web connecting members, usually flat planks of wood, having an upper edge portion connected to the web of an upper member and a lower edge portion connected to the web of the lower member.

Summary of the Invention

The present invention relates to improvements in the beams described in my copending '292 application. These improvements are principally directed to achieving greater strength at the critical joints in the beam which are those connecting the ends of the lower members which tend to be pulled apart when heavy loads are placed on the beams. While the joints between the upper members, which are normally in compression, are less in need to strengthening, nevertheless in many cases it will be convenient to use similar configurations for both the upper member and lower member joints.

Specifically, the lower member joints are strengthened by providing that:

1. The lower members, instead of each having a single web, each have a pair of spaced apart webs which receive between them either the lower edge of the web of an upper member, or the lower edge of a web connecting member which is attached to the upper member web; and/or

2. Each lower member has web ends which are staggered relative to the ends of its flange, whereby a web end portion of a lower member overlaps with an adjacent end portion of a lower member flange. The web end portion may be connected to the overlapped flange by screw means inserted through the flange end portion.

The staggering of webs and flanges may be used along with

the pair of webs, so that each lower member has two spaced webs including a first web which projects beyond an adjacent end of the lower member flange, and a second web which has an end set back from the same end of the flange.

The mechanical connecting means between the webs may be pegs or like means, such as bolts, inserted through the adjacent webs of the upper and lower members to directly connect the webs.

Where web connecting members are used, these may be planks lying in face-to face relationship with the webs of both the upper and lower members and connected thereto by pegs or like means, the end joints between the web connecting members being staggered between the joints of the upper and lower members.

My copending '292 application describes wooden pegs which may be used. These may each have a front end portion terminating in a rearwardly facing abutment surface, and a rear end portion which is wider than the diameter of the aligned bores in the web and/or web connecting members. The rear end portion may terminate in a forwardly facing abutment surface, the two abutment surfaces of the peg locating against the sides of parts held by the peg. Alternatively, the peg may have rearwardly and outwardly diverging side surfaces, and the rear end portion may be merely a wide and diverging end portion of the peg which is capable of firmly pressing against the outer side of one of the connected members, so that each member is held between the wide rear end of a peg and its rearwardly facing abutment surface. Wooden or plastic pegs are preferred, and allow the beams to be produced without metallic parts so that they can be cut by saws without danger of damage to the saw blades.

Where bolts are used, these are also preferably non-metallic; suitable bolts may be formed by cutting threads on 3/4 inch diameter wooden dowels. Wooden nuts for such bolts may be made from OSB material.

While non-metallic fastening means have the advantage that the beams can be cut through at any location to provide suitable lengths, it is also quite practical to produce these beams at a building site where the lengths of needed beams are already known, and to cut the necessary upper and lower members to suitable lengths before they are assembled into beams. In this case it is quite safe for the parts of the beam, including upper and lower members and web connecting members, to be connected together by metal screws, since there is no need for subsequent cutting of the beam.

Brief Description of the drawings.

Preferred embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which;

Fig.1 is a perspective view of a T-shaped member similar to those described in the afore-mentioned patent applications which can be used, mainly as an upper member, for forming I beams in accordance with this invention;

Fig.2 is an end view of a simple form of beam made in accordance with this invention;

Fig.3 is a perspective view of an end portion of the beam of Fig.2 being formed by the method of this invention;

Fig.4 is an enlarged cross-sectional view through parts joined by a wooden peg;

Fig.5 is an enlarged sectioned view of an alternative peg used in the lower part of the Fig.2 construction to connect

three layers of material;

Fig.6 shows an end view of a further form of beam;

Fig.7 shows an enlarged view of a bolt used in the Fig.6 construction;

Fig.8 shows how upper and lower members of the beam can be packaged prior to assembly;

Fig.9 shows an alternative form of joint between a lower member and a thin web connecting member;

Fig.10 shows an alternative joint used between a web connecting member and a T-shaped member;

Fig.11 shows how parts used in the Fig.10 construction can be packaged together, and

Fig.12, which appears on the first drawing sheet, shows a beam in which the web connecting means are interrupted by spaces.

Detailed Description.

Fig.1 shows a T-shaped member 10 similar to one of the members of my aforesaid copending application. This member is approximately 8 feet in length, and is preferably made from OSB of 3/4 inch thickness. It has an upper flange 12 of 4 inches width connected by a dado joint to a web 14 which projects 3 1/4 inches from bottom of the flange giving the member an overall height of 4 inches. The dado joint is a strong factory glued joint, as described above.

As shown, the member lacks any of the notches which are shown in the members of my copending applications; this makes the member stronger and more suitable for use in the beam of this invention. However, where it is desired that a house be built with a minimum number of different pieces, the notched members of my copending application can be used to make beams

in accordance with the present invention provided that the building design takes account of the weakening effect of the notches.

The member also differs from that of my copending applications in that an end portion 14a of the web 14 projects beyond an adjacent end of the flange 12, and the other end of the web is set back from the other end of the flange.

Figs.2 and 3 show one form of beam in accordance with this invention, made up from primary members similar to member 10, and secondary members 20 which are similar to members 10, having the same flanges 22, but having a pair of spaced webs 24, 24' instead of the single web 14. These latter webs define a gap of about 5/8 inch width which can snugly receive the lower margin of a web connecting member such as shown at 28, or web 14 if this is of 5/8 thickness.

Fig.2 shows the upper margins of the web connecting members 28 which are overlapped with the webs 14 and joined to these webs by wooden pegs 30, discussed below with reference to Figs.4. The lower margins of web connecting members 28 are inserted between the webs 24, 24' and connected to these by pegs 30' described below with reference to Fig.5. In the example shown, the web connecting members 28 each have a thickness of 5/8 inch, a length of 8 feet, and a width of about 12 to 15 inches. As described in my copending application, the webs 14 and 24 are not placed centrally on the flanges, but each has one side which is at the centerline of the flange; this arrangement allows these webs and connecting members 28 to meet at the vertical center of the beam. The joints between the ends of the members 10, 20 and 28 are staggered, as will be explained below with reference to Fig.3.

The strength of the beam shown in Figs.2 and 3 can be materially improved by the addition of plain wood (OSB) planks indicated by broken lines 31, these also being 8 feet in length, and being butted end to end and held, as by further pegs 30 (not shown), to the bottom of the flange 22, the joints between the planks 31 being staggered between those connecting the ends of adjacent members 20. This is especially valuable if the flange 22 is notched, but such additional members also help to prevent separation of the joints between the flanges of adjacent members 20.

Fig.3 illustrates the method of the invention being used in the production of the basic Fig.2 beams (i.e. without the planks 31), and illustrates the overlapping relationship of the beam components. The left hand end portion of the composite beam being produced has an upper member 10, a web connecting member 28 overlapped to project about 32 inches from the end of the flange of member 10, and a lower member 20 overlapped so that its nearside web 24' projects about 32 inches from the end of member 28, while its flange 22 projects another 8 inches beyond that, and the far side web 24 projects 8 inches more. Each member is 8 feet in length, so this arrangement means that about 32 inches separates all of the major joints of the beam. The members are held together by pegs 30 and 30' as shown in Fig.3 at about 12 inch centers, the pegs also being staggered as between top and bottom. To further extend the beam, additional members 10, 28 and 20 are continually added to the left hand end of the beam portion shown, the inner end of each member being butted up against the end of the preceding similar member, each added member being secured in place at points where the members overlap. This is a procedure which can easily be done manually, or with simple tools such as a hydraulic press to push the pegs into place, to produce a beam of

indefinite length. The final beams have adequate strength by reason of the overlapping nature of the joints and by reason of the strong glued joints between the flanges and webs.

The use of wooden pegs 30 and 30' minimizes the presence of metal in the beam. A beam without metal can be sawn through at any location without danger of damaging the saw. Pegs of plastic material could be used with the same advantage. However, metal screws, such as indicated at 40 in Fig.3, are usually considered advantageous to secure the end portions of flanges to projecting web portions such as 14a which they overlap, the screws being inserted through the flange end portion. The presence of steel connecting means such as screws and bolts is acceptable especially where the beam is produced at the building site, since the members 10 and 20 can then be cut to suitable lengths before the beam is made.

Figs.4 and 5 show details of the wooden pegs 30 and 30' as used in the constructions of Figs.2 and 3. As shown in Fig.4, pegs 30 have a generally cylindrical body with a front end portion 30a which, in use, passes completely through the aligned bores of the overlapped parts, a rear end portion 30b which remains projecting when the peg is in place, and an intermediate portion 30c which is enclosed within the aligned bores when the peg is in place. To ease the entry of the peg into aligned bores, which are preferably slightly smaller in diameter than the diameter of the cylindrical portions of the peg, the front end portion 30a has a rounded nose, and a transverse slit 35 extends across and along the length of the front end portion and into the intermediate portion; this allows compression of this front end portion during insertion.

The rear of the front end portion 30a is defined by a

rearwardly facing, generally radial abutment surface 32a formed, as by a saw cut, in a top portion of the peg, while the front of the rear end portion 30b is defined by a similar forwardly facing abutment surface 32b. The intermediate portion 30c of the peg is defined by a continuation of the cylindrical sides of the body, and by upper and lower flat sloping surfaces 34a and 34b. Specifically, the upper surface 34a slopes radially inwardly from a cylindrical upper surface of the rear portion 30b down to meet an inner extremity or base of the first abutment 32a, and the lower surface 34b slopes radially inwardly from a cylindrical lower surface of the front portion 30a to meet an inner extremity or base of the second abutment 32b, the upper and lower surfaces 34a and 34b being parallel.

Fig.4 shows how the peg 30 fits into two aligned bores in overlapping members 14 and 28, into which it has been driven by a mallet or hydraulic press. The aligned bores are 5/8 inch diameter, slightly smaller than the 3/4 diameter dowel stock from which the peg is made. The nose portion has been pushed through the aligned bores, being compressed as allowed by the slit 35, and the peg has been stopped in its movement when the abutment 32b strikes the outer surface of the member 28, at which stage the nose portion has expanded as the abutment 32a reached the outer surface of member 14. The members 14 and 28 are thus held in contact between the two abutments 32a and 32b.

The fact that the basic diameter of the cylindrical portion of the peg is slightly larger, by say 1/8 inch, than the diameter of the bores, ensures a very tight fit. This is possible without splitting the wood because the members 14, 24 and 28 are of OSB or similar material, having randomly oriented strands, which is highly resistant to splitting.

Fig.5 illustrates a modified form of peg which can be used to connect together three layers of material, as is required in the lower part of the beam.

As shown in Fig.5, the peg 30' has a front end portion 30a' similar to that of the peg 30, having a rounded front end with a transverse slit 35 allowing it to be compressed for entry into the aligned bores of webs 24 and 24' and connecting members 28, which bores are the same diameter before being expanded by having the peg driven in. To the immediate rear of the front end portion the diameter of the peg is substantially the same as, or just slightly smaller than, the aligned bores, and from here the peg diverges gradually towards its rear end. For aligned bores initially of 5/8 inch, the divergence is such that the rear end has a diameter of 3/4 inch. This characteristic of the peg is useful in allowing it to be used both for holding together only two thicknesses of wooden members, as well as when holding three thicknesses together as shown in Fig.2 and 5. The aligned bores are all initially 5/8 inch, but when the peg is being driven in the bores in the members 28 and 24', especially the latter, expand to accommodate the peg. Provided OSB or similar material is used, this does not cause substantial splitting.

The bores for the pegs 30 and 30' may be pre-drilled at suitable spacing, e.g. 12 inches spacing. However, there may be difficulty with obtaining sufficiently accurate alignment with pre-drilled holes, so it is preferred to drill the holes through the overlapping members during the assembly. The preferred arrangement is to provide, in the webs 24, small (for example 1/8 inch diameter) holes, which may be only partially drilled (i.e. blind holes), and to use these as guides to drill the actual large holes for the pegs through both the webs 24

and the web connecting members 28, while keeping the parts clamped so that the edges of the web connecting members are maintained in firm contact with the flanges 22.

The beam portion may be continually extended by addition of further members at the left hand end in accordance with the need for lengths of the beam which are cut off, by a saw, from the right hand end. Preferably, the cuts are made between the pegs, but the use of wooden pegs means that a saw will not be harmed by cutting through such pegs. If necessary, additional pegs, or screws, may be added at the cutting stage, to ensure that the members are properly connected near to the cut off ends. When operating on site, it may be more convenient to cut all the members to the required lengths before they are joined.

Thus, composite beams can be produced by this method in a simple workshop near to a building site, without special equipment, in a large variety of lengths, with practically no wastage or unusable pieces.

Figs.6-11 show various other forms of beam which can be made in accordance with this invention, all making use of primary and/or secondary members similar to those described above.

Fig.6 shows a joist formed of two secondary members 20 and 20', each having a pair of spaced webs 24 and 24', and a connecting member 28 having its edge portions inserted between the webs of the members. The joints between these members are staggered as before, and overlapping portions of the members are held together in this case by wooden bolts 130, shown in detail in Fig.7.

As shown in Fig.7 the bolt 130 is provided with two wooden nuts 132 for holding together the webs 24 and 24′ onto outer margins of the web connecting members 28. The bolt may be formed by cutting screw threads in a 3/4 inch dowel, while the nuts 132 may be formed from a 1 1/2 inch square piece of OSB material. A characteristic of this material is that it tends to swell slightly with time, and with moisture, effectively tightening the bolt.

Fig.8 shows how the upper and lower beams 20 and 20′ nest together into a square package which occupies little space. Here, the webs 24 are 3/4 inch thick, and webs 24′ are thinner, specifically 5/8 inch thickness, and the gap between these webs fits snugly the edges of the 5/8 inch thick web connecting member 28. When nested as in Fig.8, the gaps are occupied by the thicker web 24. The overlapping webs shown in Fig.8 can also be connected together by bolts to form a post.

Fig.9 shows how similar webs, which normally define a gap of 5/8 inch, can be used to connect onto the margin of a thin web connecting member 28 which is 1/2 in width. The webs are bent inwards into contact with the sides of the web connecting member by screws 40.

Fig.10 shows the lower portion of a beam which has an upper portion which has equivalent parts. Fig.10 shows how a joint between a lower member 20′ having flange 22′ and webs 24 and 24′, and the lower margin of a web connecting member 28, can be reinforced by a further plank piece 42 held against the outer side of web 24′ by screws 40. This plank piece is arranged to overlap the other joints between the ends of flanges 22′, webs 24, 24′, and web connecting member 28.

Fig.11 shows how the pieces of the beam, of which part is shown in Fig.10, can be packaged for transport. The webs 24 and 24' are nested together in a manner similar to that shown in Fig.8, and the sides of the package are filled by the planks 42. Again, this package can be converted into a post by connecting the planks 42 and webs together with screws, bolts, etc.

Fig.12 shows yet another variation, in which the web connecting member 228 is interrupted by spaces S which allow ducts to pass through the beam. For example, 2 foot lengths of web connecting member 228 may have their ends separated by 2 foot long spaces. I have found that a beam made in this way has almost the same strength as a beam with a continuous series of web connecting members.

It will be evident that beams of widely varying depth can be produced from a series of the upper and lower members 10 and 20 and 20', along with web connecting members 28, 28' of varying width which can readily be cut on site depending on the depth of beam required. Accordingly a preferred process of the invention includes the on-site cutting of strips from sheet material to form the web connecting members 28 or 28', so as to readily produce beams not only of varying lengths but also of varying depths and strengths.

Reference may be made to my copending Canadian Patent Application No.2,298,292 for other variations which are possible, including the use of nails for connecting the members together.

I claim:

1. A wooden I beam comprising upper and lower wooden members each member having an outer longitudinal flange secured by glue at a right angle to at least one elongated web, upper members of the beam being connected at end joints which are staggered relative to end joints between lower members of the beam, the webs of all members being inwardly projecting and connected together by means including mechanical fastening means which secure together said webs and/or web connecting members, both said fastening means and web connecting members serving to connect said webs without the use of glue, and wherein each said lower member has a pair of said webs spaced apart and parallel to each other and which receive between them a said upper member web or one of said web connecting members.

2. A beam according to claim 1, wherein both said upper and lower members have a spaced apart pair of said webs, and wherein said webs are joined by web connecting members which have edge portions which fit between the web pairs of the upper and lower members.

3. A beam according to claim 2, wherein one web of each upper member is capable of fitting between a web pair of each lower member and vice versa, whereby, before said beam is assembled, a said upper and a said lower member can be nested together with each web pair accommodating an opposed web.

4. A beam according to claim 3, wherein each of the upper and lower members has one web with a side aligned with the longitudinal center of the flange to which it is connected, whereby, before said beam is assembled, a said upper and a said lower member can be nested together with the edges of their

flanges aligned.

5. A beam according to claim 1, wherein each said lower member has ends of webs of said pair which are staggered relative to ends of its flange, whereby a web end portion of a lower member overlaps with an adjacent end portion of a lower member flange.

6. A beam according to claim 6, wherein said web end portion is connected to the overlapped flange end portion by screw means inserted through the overlapped flange end portion.

7. A beam according to claim 5, wherein the webs of said lower member include a first web which projects beyond an adjacent end of the lower member flange, and a second web which has an end set back from said adjacent end of the flange.

8. A wooden I beam comprising upper and lower wooden members each member having an outer longitudinal flange secured by glue at a right angle to at least one elongated web, upper members of the beam being connected at end joints which are staggered relative to end joints between lower members of the beam, the webs of all members being inwardly projecting and connected together by means including mechanical fastening means which secure together said webs and/or web connecting members, both said fastening means and web connecting members serving to connect said webs without the use of glue, and wherein each said lower member has at one end a web which projects beyond an the adjacent end of its flange and is secured to the adjacent flange end portion, said web having its other end set back from the other end of the flange.

9. A beam according to claim 8, wherein said web end portion is connected to the overlapped flange end portion by screw means

inserted through the overlapped flange end portion.

10. A beam according to claim 1 or 8, wherein said webs are joined together indirectly by web connecting members, said fastening means joining the said webs of the upper and lower members to outer margins of the web connecting members, and wherein the web connecting members are interrupted by spaces which allow the passage of ducts or the like through the beam.

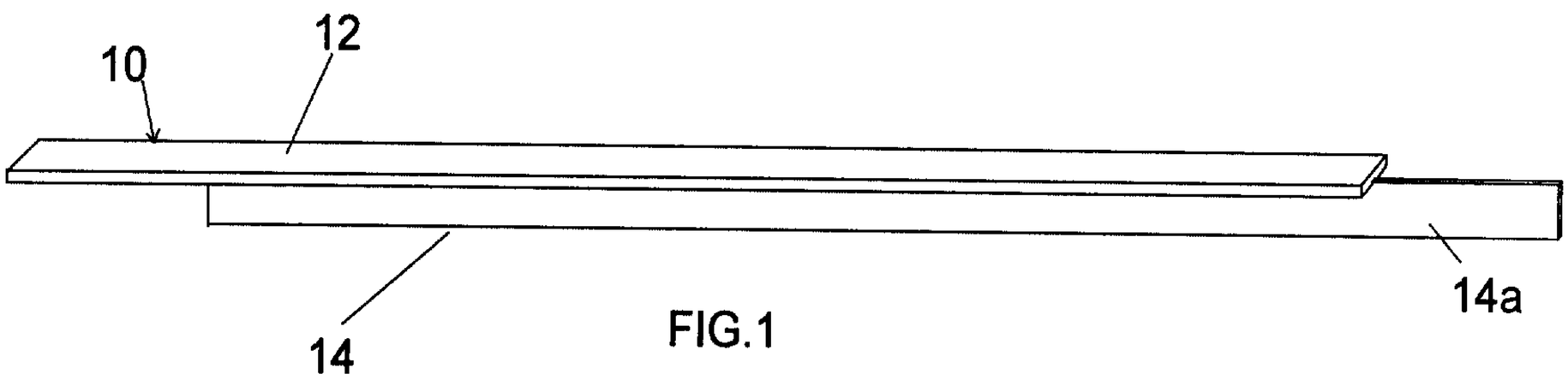
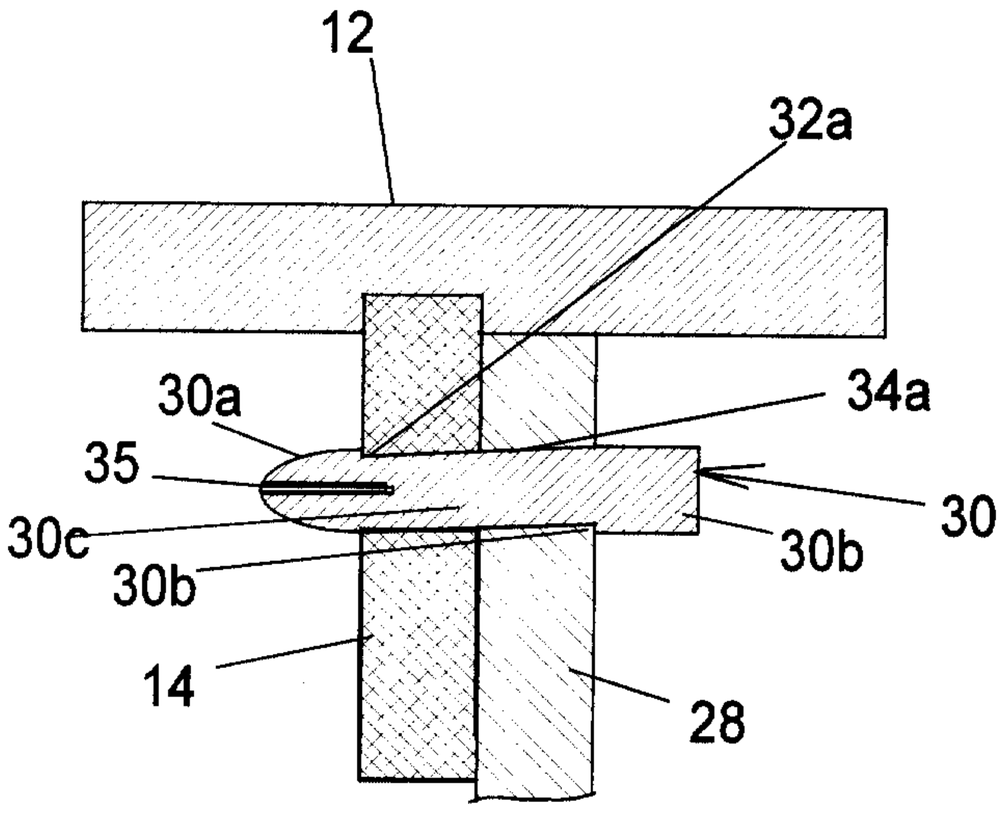


FIG.1



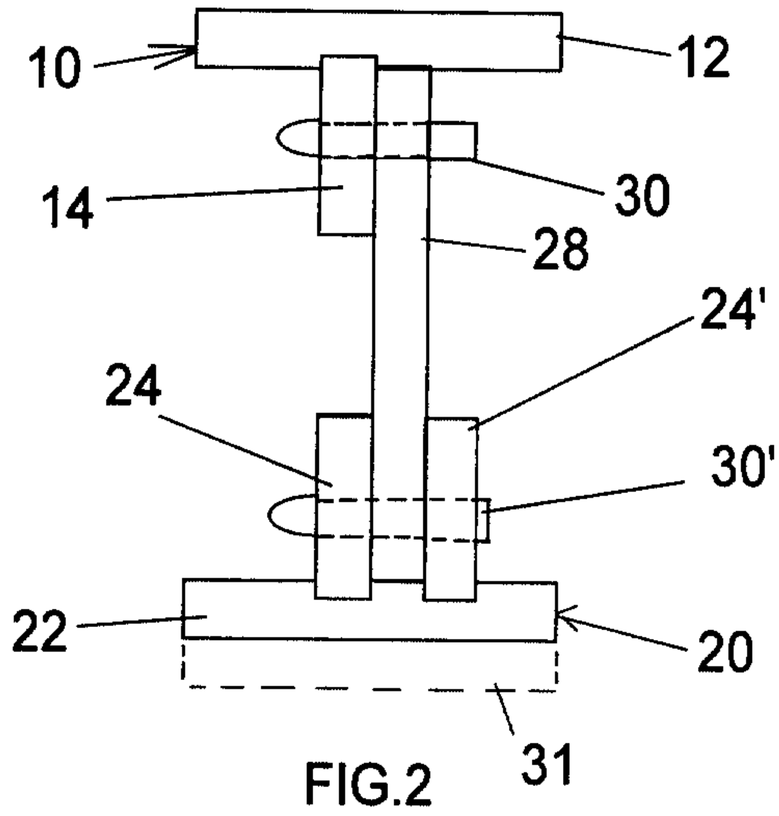


FIG.2

FIG.4

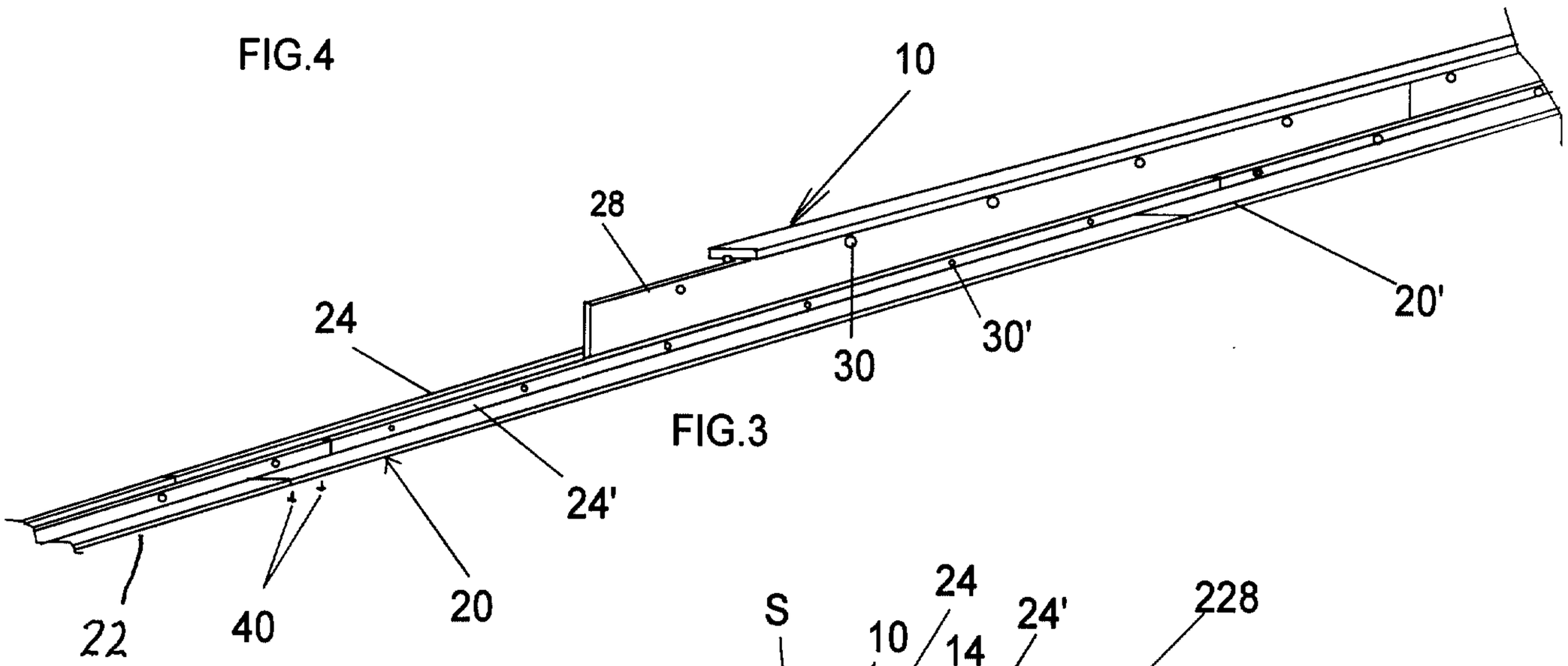


FIG.3

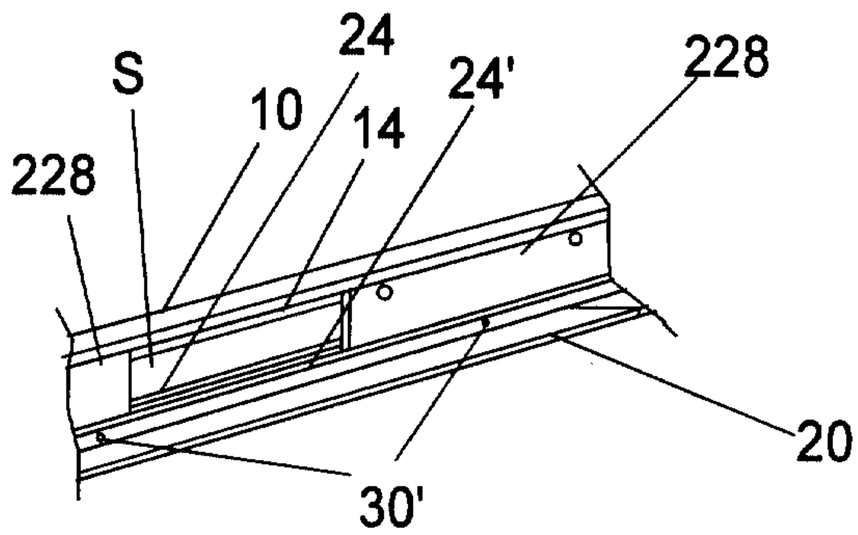


FIG.12

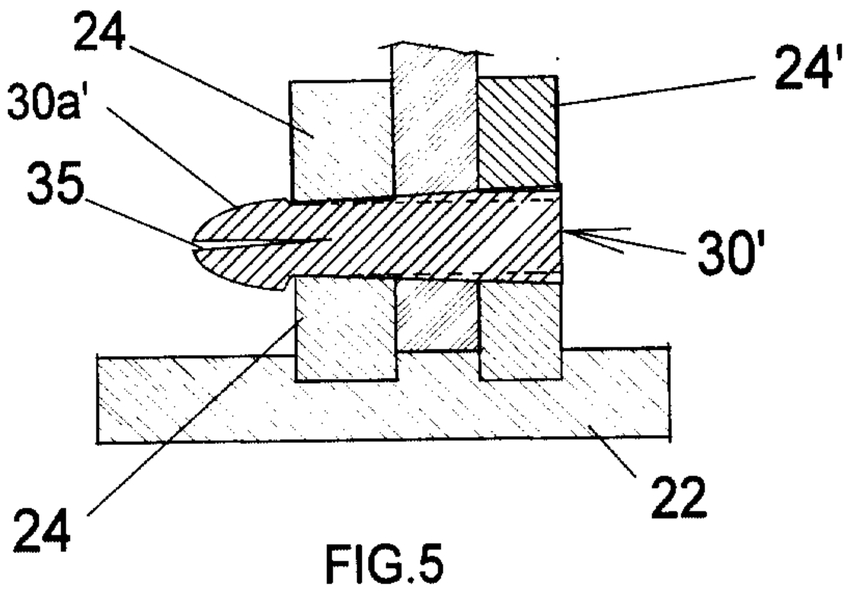


FIG.5

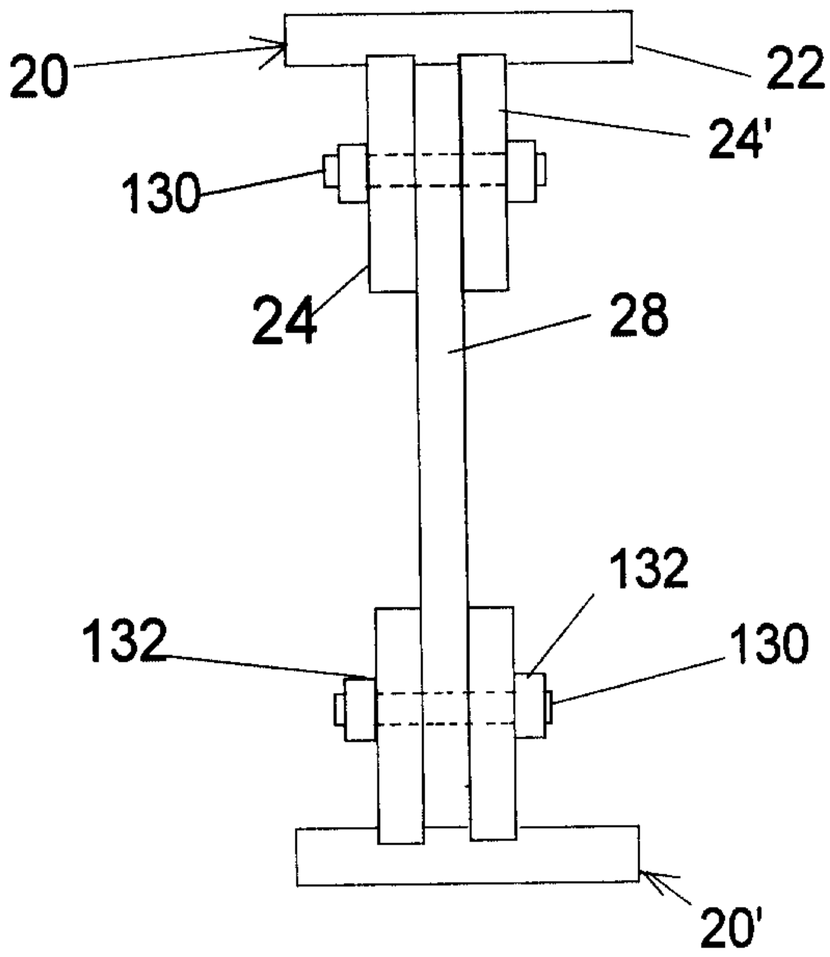


FIG.6

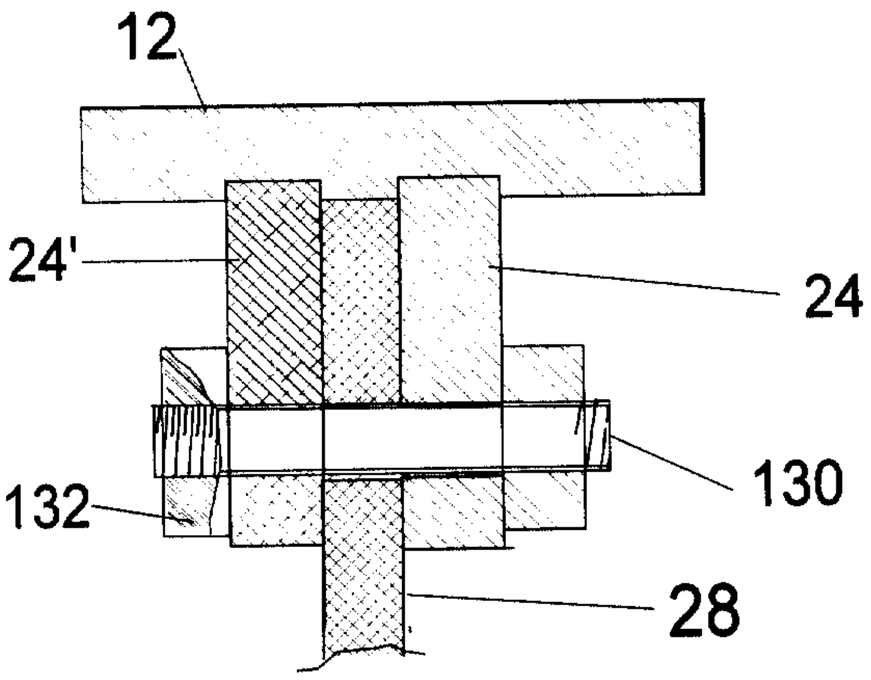


FIG.7

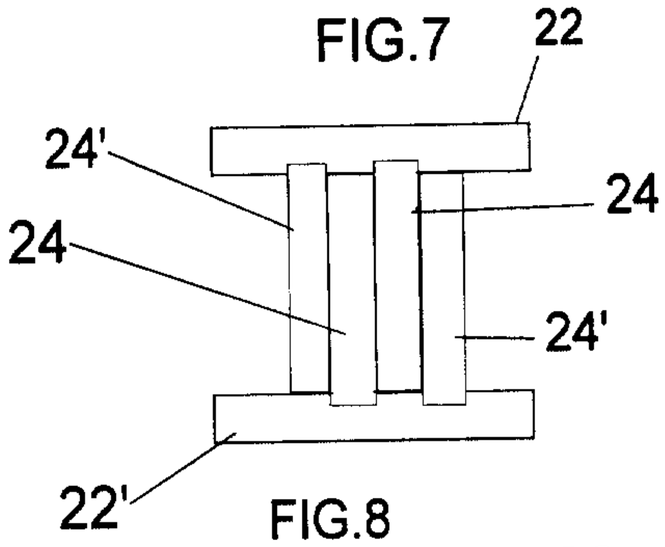


FIG.8

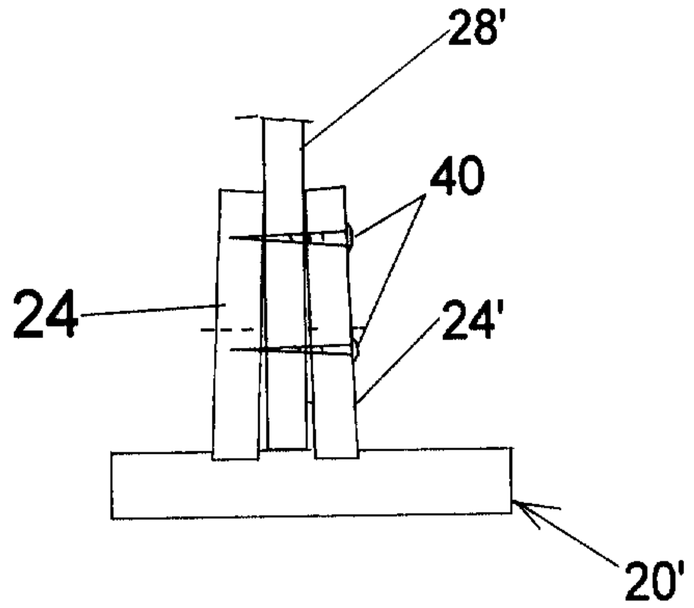


FIG.9

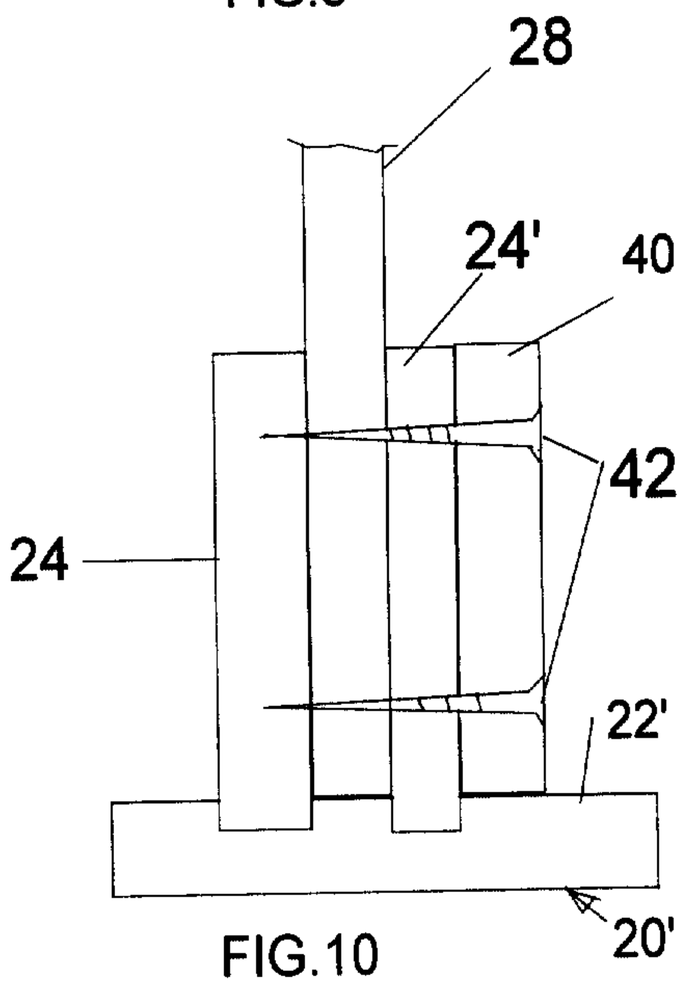


FIG.10

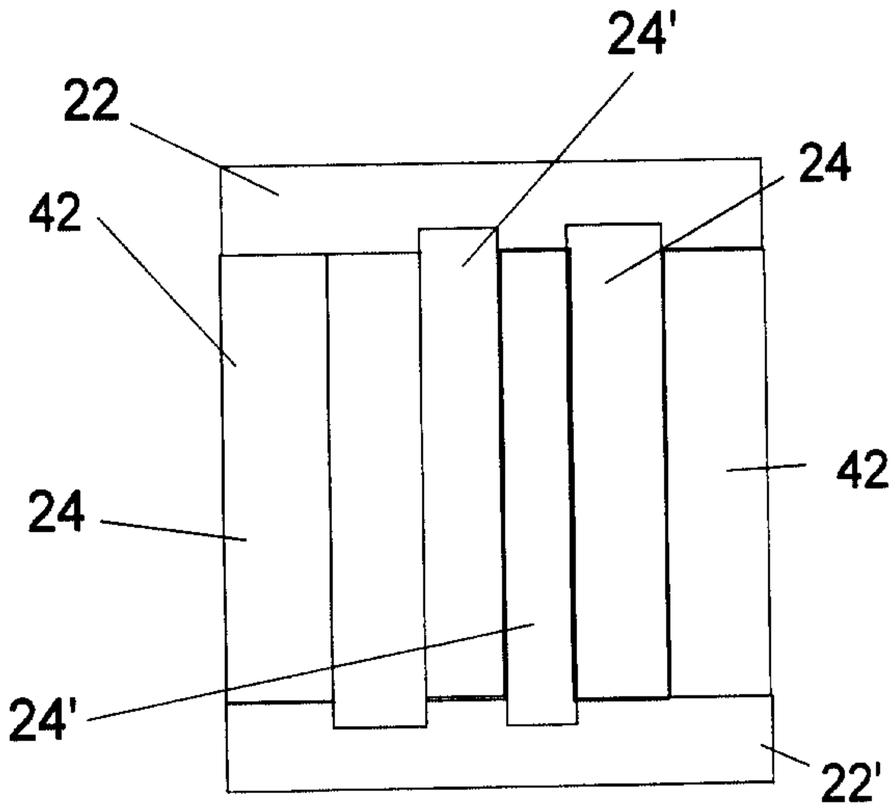
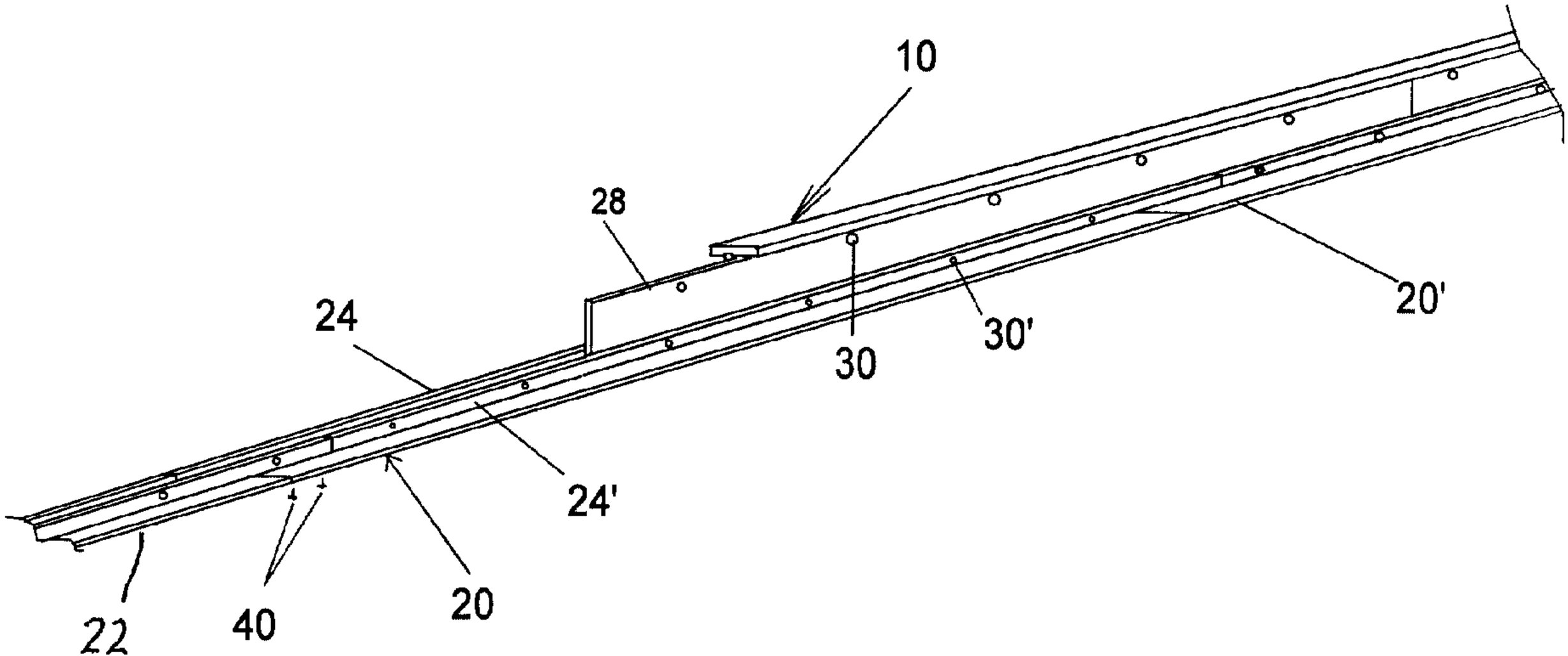


FIG.11


10
28
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