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(54) Method for the composition of panels for the on-site erection of formworks.

(57) The method for the composition of panels for the on-site erection of formworks foresees the use of boards (1, 2) although they have different measurements in the length, of spacing elements (10) separating the horizontal rows of boards, of vertical posts (30) connecting the boards and the spacing elements.

The formation of the panel occurs by assembling the boards vertically spaced at an equal distance from one another, by the spacing elements (10) arranged horizontally and parallel to each other, which are provided with tongues (12) which engage themselves with the boards, and with connecting elements (13) protruding from said spacing elements and engaging themselves on vertical posts (30) by means of a junction through a wedge, a bolt or equivalent means.

The junction between the posts (30) and the connecting elements (13) lends rigidity and compactness to the structure of the panel. The panel thus formed can easily be moved and employed for subsequent uses.

Several panels are united to form a formwork and are placed side-by-side, aligned and fastened to one another by means of vices (100, 148, 171) each presenting two hooks (102, 109; 162, 169) which act on flat bars (126, 128) arranged at an inclined position and welded on the spacing elements of the panels and having pins contrasting against the panel.

When the panels are united to form a corner, the vice takes on a tube-shaped, right-angle form (148, 171) and it is also provided with hooks and with spacing pins.

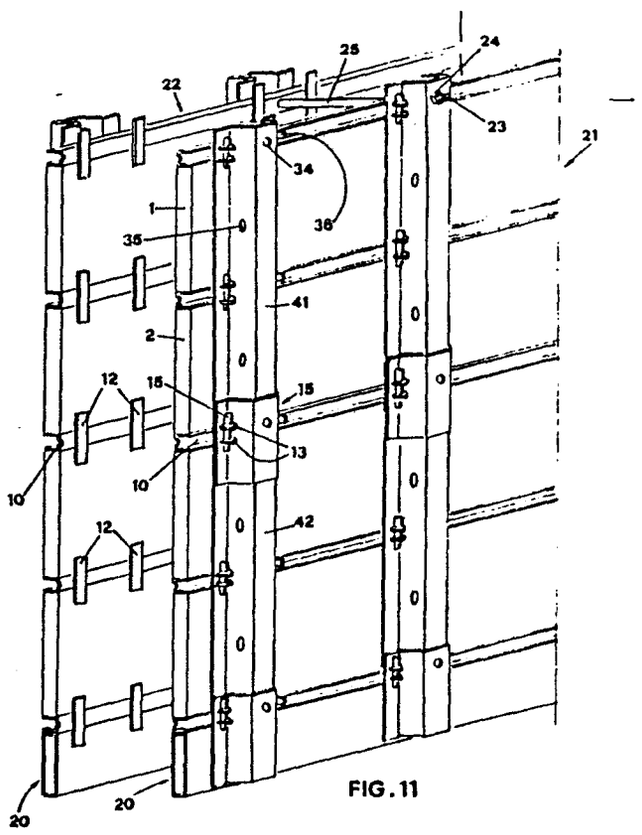

FIG. 11

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"METHOD FOR THE COMPOSITION OF PANELS FOR THE ON-SITE ERECTION OF FORMWORKS"

DESCRIPTION

The invention concerns a method for the composition of panels for the on-site erection of wooden formworks to be used in the formation of reinforced concrete layers.

In the following description the term "wooden board" or "board" will be used to indicate those special wooden manufacts which are used in the building trade for the construction of formworks and which are boards consisting of glued wooden layers having standard measurements. Besides, the term "panel" will be used to indicate a manufact consisting of several "wooden boards" and constituting a basic element in the erection of formworks.

In the building trade the use of formworks consisting of special wooden boards for the casting of reinforced concrete works is well known. One of the simplest and most widely employed methods consists in the on-site erection of formworks, using special wooden boards having standard measurements and being joined together by means of mounts, which act as posts and which engage themselves by means of wedges with tie-rods in the shape of tongues protruding from the area of junction between the boards. An obvious limitation showing the lack of practicality of this method consists in the fact that the formworks can not be re-used for different castings, unless they are completely taken apart and re-assembled elsewhere.

Another method of formwork construction consists in joining together several wooden boards, so as to form large-surface panels: in this case the boards are screwed or nailed to vertical supporting beams and to transversal connecting beams. Afterwards holes are drilled in the boards, in order to allow the passage of the joining tie rods of the formwork. Although this method is more evolved than the preceding one, since it allows the re-use of the panel in subsequent employments, it is convenient not to vary the dimensions of the panel for obvious reasons of practicality.

Yet more industrilized methods foresee the use of iron frames on which the boards are mounted.

These frames have standard measurements and are used particularly in large construction projects, but they offer a limited flexibility of employment, so that the pre-formed frames can not be conveniently used in those construction projects which do not foresee repetitive modules.

It is observed that at a European and especially at an Italian level, the most widely spread method followed in the erection of formworks foresees the use of boards having standard measurements, with height: 0.5 m. and a length variable from 1 to 3 m., each variation being of 0.5 m.

One of the purposes of the present invention is that of obtaining a method for the construction of formworks for the building trade, by efficiently and easily re-using the above-mentioned wooden boards, which are already found on the market and widely used by the construction companies.

Another purpose is that of obtaining with the proposed method panels for formworks, having large dimensions and being easily movable and, therefore, re-usable for several castings, without the need of disassembling and re-assembling the pre-formed panels.

Yet another purpose is that the method used for the composition of large panels unite together wooden boards having different sizes, without making it necessary to fasten said boards to the supporting structure by means of nails or bolts and to drill holes in the boards.

Yet another purpose proposed by the present invention is that of avoiding each and any difficulty in aligning and connecting the panels. The purpose, in fact, is that of obtaining that the means used to connect one panel with another not only guarantee the junction between the panels, but also that they exert, even during the fastening operation, the action of placing next to each other and aligning said panels.

Another purpose that the invention proposes to reach is that of obtaining a method of connecting together the aligned panels and the corners of the formworks, which can easily be applied and can be performed with simply built and simply usable tools, so as not to require an in-depth training of the personnel in charge of erecting the formworks.

Yet another purpose is that of obtaining that the method of composition of the panels utilize only a few basic components, so as to be easily assembled and, therefore, economical and convenient.

The above-listed purposes and others, which will be better illustrated hereafter, are reached by the method of composition of panels for the erection of formworks, using wooden boards having standard measurements, which can, however, be different in lenghts, which, in accordance with the claims, is characterized by the fact that said boards are assembled vertically at an equal distance between each other, said distance being determined by spacing elements being placed horizontally and parallel to each other, said spacing elements being foreseen with holes suited for the passage of the braces of the formwork, with tongues which engage themselves vertically, leaning against the surface of the wooden board which is inside the formwork, and with protruding connecting elements, which receive vertical posts, further characterized in that said vertical posts join together the spacing elements and the wooden boards by means of connecting elements, being rigidly connected to the spacing elements and the tongues, so as to form a unit, usable as a formwork element, which can be connected with other elements and can be moved as a whole, further characterized by the fact that the actions of placing next to each other the adjoining panels or other equivalent means, of aligning and fastening them, are obtained by the combined action of vices, or equivalent means, and of flat bars being welded at an inclined position on the spacing elements of the panels, said vices or equivalent means presenting hooks which engage themselves

in said flat bars, and spacing pins contrasting with the panel.
According to the invention, the basic elements for the composition of the panels are advantageously the spacing element and the vertical post.

The spacing element performs two essential functions for the construction of the panel; it has the function of spacing the rows of wooden boards and that of tying together said boards, so as to form the panel. In fact, it is necessary that the rows of boards be spaced the one from the other, in order to allow the passage of the junction braces of the formworks through holes being present on said spacing elements, in order to avoid the drilling of the boards.

The junction between boards constituting a single panel is obtained by means of the inter-action between the spacing element and the vertical post, which acts on the spacing element by means of the connecting element.

In fact, the spacing element is not only provided with holes for the passage of the framework braces, but also with tongues and connecting elements. Said connecting elements are inserted into corresponding slots in the post and are stressed so that the tongues stretch and go to contrast against the board walls which are inside the formwork. Should the connecting elements of the spacing element be threaded braces, these will be stressed by tightening nuts against the supporting wall of the post. If, on the other hand, the connecting elements of the spacing element are flat elements provided with slots, their stressing will be carried out by inserting wedges which contrast against the slots and the walls of the post. Thus, that is, by stressing the tongues, which the connecting element is provided with, by tightening the wedge-shaped elements or the nuts on the post, the rigid connection between boards constituting the panel is obtained. Thus a rigid structure, which can easily be moved and, therefore, placed repeatedly in different places, according to need, is obtained. It is also easily disassembled and

simply re-assembled according to different modules, by re-using all the previously used components.

The aligning and tightening of adjoining elements is obtained by means of vices which engage themselves on flat bars being present on the spacing elements of the panels.

In the same way the vices are also used to join two aligned but adjoining panels having between them a plate for the adjustment of the formwork length.

Analogously, vices are present both in the inside and the outside corners of the formwork. In this case they have the shape of a bracket.

The tightening by means of vices is also used to an advantage in the closing of the casting end of the formwork. Other construction details and advantages will be better explained in the description of a preferred form of execution according to the invention, which is given by way of example only, but is not meant to limit the scope of the invention, and which is illustrated in the enclosed tables of drawing, where:

- Fig. 1 shows a perspective view of a spacing element to be mounted between two boards,
- Fig. 2 is a cross-section of the mounted spacing element,
- Fig. 3 and 4 are a sketchy representation of the composition of the spacing elements of Fig. 1, having a length of 1 m. and 1.5 m respectively,
- Fig. 5 shows a perspective view of the special shape of the spacing section resting on the ground,
- Fig. 6 is a cross-section of Fig. 5,
- Fig. 7 shows a perspective view of the post made with an omega-shaped section being placed on top of the upper end of yet another post,
- Fig. 8 is a cross-section of Fig. 7 along the VIII-VIII-line,
- Fig. 9 is a lengthwise section of a post of Fig. 7,
- Fig. 10 shows a schematic view of the arrangement of the spacing elements and of the wooden boards in a panel being put together,

- Fig. 11 shows a perspective view of an erected formwork with two panels facing each other and being formed according to the method of the invention,
- Fig. 12 shows a perspective view of the vice suited to the connect and tighten two adjoining panels,
- Fig. 13 shows a front view of two panels about to be connected by means of the vice of Fig 12,
- Fig. 14 is a cross-section of Fig. 13 along the XIII-XIII- line,
- Fig. 15 shows a front view of the junction between two panels, having interposed between them a flat bar for the extension of the castings to sizes not corresponding to the standard measurements,
- Fig. 16 is a cross-section of Fig. 15 along the XV-XV-lines of Fig. 15,
- Fig. 17 shows a perspective view of the vice used to close the external corners of the formwork,
- Fig. 18 shows a perspective view of the vice used to close the internal corners of the formwork,
- Fig. 19 shows a perspective view of a variation of the vice suited to close the end of the casting
- Fig. 20 shows a cross-section of a complete corner of the formwork.

With reference to Fig. 1, a spacing element 10 is represented, which has the task of vertically spacing from each other two adjoining rows of horizontal boards. Said element consists of a U-shaped channel 11, on which pairs of pre-bent metal tongues 12 are welded at regular intervals, said tongues being made, in the example under examination, of harmonic steel, so as to insure a certain degree of flexibility and elasticity.

In correspondence with each tongue 12 there is a spacing element 13, also in the shape of a U-channel and being permanently fixed to the U-shaped channel 11. On each of the protruding parts of element 13 there is a slot suited to receive a wedge, which, as will be seen hereafter, and as can be observed in Fig. 2, by acting on the surface of boards 1 and 2, causes said boards to be compressed between the wedge

and tongue 12.

All spacing elements are provided with holes being regularly spaced and in relation to the vertical surface comprised between the two lateral parallel surfaces of the U-shaped channel. More precisely in the exampli-fied form of execution, each spacing element presents holes 16 with a distance of 500 mm between the centers of each pair of holes, beginning from the ends, where there is a semi-hole 17.

The braces connecting the panels which form the formwork go through the holes 16.

In the example of the preferred form of execution being the object of the invention, two different sizes are foreseen for the spacing elements, one being 1 m long and being schematically represented in Fig. 3, the other being one meter and a half and schematically represented in Fig.4.

As can be observed in said figures, each hole 16 of the spacing ele-ment is always in the middle between two connecting elements 13, which are always arranged in pairs at the same distance from each other, while in the terminal part of the spacing element ending with a semi-hole 17, there is, on the same side, a pair of elements 13, presenting the cha-racteristic that the connecting element 13 being closer to the semi-hole 17 is placed at a distance from this one corresponding to half the distance between two connecting elements 13 forming a pair and being placed at the side of a whole hole 16.

Thus, when two spacing elements having any length are placed side by side, it will ensue that two semi-holes 17 join together to form a new whole hole and that the two connecting elements 13 which were closer to the semi-holes, are now at the sides of the whole hole at a distan-ce from each other which is equal to the distance of the other elements 13 being present at the sides of the holes 16. Further on it will be seen how said pairs of elements are employed to join together the boards of the panel during its construction.

Another detail characterizing each spacing element is represented by two flat bars welded at an inclined position, indicated with 36 and 40, which are positioned inside the U-shaped channel forming the spacing

element 10. Said flat bars are placed near the pair of connecting elements 13 being closer to the semi-hole 17, as can be observed in the Figs. 3 and 4. The purpose of these flat bars is that of serving as an anchoring element for the vice hooks, which engage themselves on said flat bars and which tightly hold two adjoining panels, as will be better described hereafter.

It is now necessary to point out that the construction of a panel requires the use of several spacing elements and of several wooden boards. Besides, during the erection of the panel it is necessary to foresee a series of basic spacing elements, that is of elements resting on the ground when the panel is in the upright position.

Thus, the element indicated as a whole with 20 in Figs. 5 and 6 shows said basic element. As can be noticed in the above-mentioned figures, element 20 is nothing but another spacing element 10 having welded to its bottom a tube-shaped section 3, which takes the place of the last wooden board, and this because of obvious reasons of resistance to wear and tear during subsequent on-site erections.

Fig. 10 shows an example of the first phase of formation of a panel of the invention presenting the details described so far, that is,spacing section of type 10, basic sections of type 20 and wooden boards having different sizes.

As can be seen in Fig. 10, in the row of basic spacing elements, indicated with 4, spacing elements of type 20, each measuring one meter in length, are placed side by side; in the next row, indicated with 5, there are three spacing elements of type 10, one being one meter in length, while the other two measure 1.5 meters.

In the row indicated with 6, the spacing element measuring one meter is comprised between two spacing elements measuring 1.5 meters, and thus, in the rows indicated with 7 and 8, the arrangement and the measurements of the spacing elements change. The used boards, which are comprised between rows of spacing elements are also of the most varied sizes, as can be observed. For instance, in Fig. 10, board 1 is 2.5 meters long, while board 2 measures 3 meters. All this indicates that no bond is set by the composition method according to the invention, for the

formation of the panel. In fact the arrangement of the long and short aligned spacing elements can be made in any way, and so can the distribution of the boards, with the single warning, which, however, is not binding, but is an improvement on the formed panel, that two edges of boards mounted on opposite sides of the same spacing element are not resting on the same vertical straight line, and this to insure more stiffness in the structure.

After the pre-formation stage of the panel has been reached, such as it appears in Fig. 10, the use of the posts 10, shown in the Figs. 7, 8 and 9, which join with the connecting elements 13, makes it possible for the panel to acquire its desired stable and rigid shape.

As can be observed in the Figs. 7 and 9, post 10 shown in the example is an omega-shaped section presenting on its supporting surfaces 31 and 32 pairs of slots 33, which receive the connecting elements 13. In the symmetry surface of the omega being in the middle in relation to the pairs of holes 33, there is a hole 34, suited to the passage of the braces connecting the formwork panels facing each other and passing thorugh the holes 16 of the spacing elements. While the holes 33, which receive the connecting elements 13 are arranged in relation to each row of spacing elements, the holes 34 for the passage of the braces are arranged at a double distance, that is in relation with every other row of spacing elements. In section 30 there are also other transversal holes 35 on the lateral walls, which , as will be explained further on, are meant for the passage of braces, which are used especially for the junction of the various elements of the formwork and also for the application of service accessories.

It can also be noticed that the cross-section of the lower part 37 of post 30 is larger in relation to the cross section 38, belonging to the remaining upper part, as can be observed in Fig. 8, so that two adjoining posts 30 and 39 can be joined one on top of the other, for a certain stretch, so that the holes 33 and 34 coincide, thereby

creating a continuity through the connecting elements 13 which pass through the holes of both superimposed posts.

In Fig. 11 it can be observed how two panels 21 and 22 are mounted facing each other and are connected together, so as to form a formwork. More particularly, it can be observed that each post consists of two posts of type 30, now indicated with 41 and 42, joined together. Said posts are connected with each other by means of wedge pair 15, each wedge being mounted on opposite sides of the post, only one of them being visible in Fig. 11. In fact, said wedges are inserted into the holes of the connecting elements 13 belonging to the spacing element 10. In essence, the connection between the wedges 15 and the connecting elements 13 insures a double effect, that is, the effect of uniting with each other the posts 41 and 42 and the effect of connecting also said posts with the spacing elements 10. On this subject, it is necessary to point out that, should the post be over the joining area of two spacing elements, the connecting elements 13 would be grouped by four units, as can also be seen in the assembly scheme of Fig. 10. In this case, the connecting elements 13, which are used for the junction with the post, will be the two middle ones, each belonging to a different spacing element, which also insures the connection between the two elements 10 placed next to each other. Thus the rigidity and the compactness of the panel are insured.

In fact, it is clear that the insertion of the wedges 15 causes all the tongues 12 of the spacing elements 10 to be under stress and to exert their pressure on the wooden boards, which are, therefore, compressed between the tongues and the supporting surfaces of the post.

In Fig. 11 it can be observed that at the bottom of the panels 21 and 22 there are the basic elements 20, which prevent the wooden boards constituting the panels, from resting directly on the ground.

In order to form a certain stretch of formwork, it is necessary for the panels 21 and 22 to be placed facing each other and to be connected together by means of braces. First of all then it must be possible to move the panels by lifting them from the ground by using lifting means, the hooks of which can find a support in the holes 34 or 35 of the posts 30.

As far as the connection through braces is concerned, a single connection brace 23 is represented in the drawing of Fig. 11 for simplicity sake. It can be observed that said brace goes through the holes of the spacing elements 10 and exits through the holes 34 of the posts, where it is fastened by the nuts 24. In the space comprised between the two panels 21 and 22, that is inside the formwork, the brace is protected by a plastic tube 25 which acts as a spacing element and also protects the brace from being held by the setting concrete after the casting, so that, after the setting of the concrete, the braces can be removed and the panels 21 and 22 can be recovered.

It is important to notice that the holes for the passage of the braces only interest the spacing elements 10 and the posts, while leaving untouched the wooden boards placed between the spacing elements. Thus a new and different re-assembly of the panels is possible, for instance, the wooden boards can be arranged differently as compared to the arrangement represented in Fig. 10, and that without any need for the wooden boards to undergo any deterioration. On that subject it will be pointed out that the most widely spread systems for the erection of formworks foresee the fastening of the boards by means of nails and, sometimes, also the drilling of the boards for the passage of the braces.

It will also be pointed out that the panels 21 and 22 represented in Fig. 11, can acquire any length and width, the dimensions being limited exclusively by the necessity of handling the panels, said handling depending on the overall dimensions and the weight.

During the erection stage it is recommendable to have panels with the desidered height and to join together in the length several panels being equally high.

It is pointed out that at the ends of each panel, thanks to the presence, at the ends of the spacing elements, of two connecting elements 13, posts 30 are applied, which constitute the terminal ribs of the panel and fulfil the function of connecting two panels placed side by side and the accessories used in the formwork.

Hereafter some application characteristics are described which further show the extreme flexibility of the panels built with the method according to the invention.

Connection between two adjoining panels.

First of all, the connecting means and method between two adjoining panels are described, said connection being necessary for the formation of a formwork, no matter what its dimensions.

As it has been mentioned before, the actions of putting two adjoining panels side by side, of aligning and tightening them are obtained by tightening the vices which engage themselves on flat bars welded at an inclined position inside the U-shaped channels of the spacing elements type 10.

With reference to Fig. 12, it can be observed that the vice, indicated as a whole with 100, consists essentially of a shaped tube having a square or rectangular cross section 101, on a surface of which a hook 102 and a spacing pin 103 are welded. In approximately the central position of tube 101 there is a through hole 104 and a reinforcement 105 consisting of a metal strip which sheathes tube 101 at the sides of the hole.

The other element of the vice is tube 106 having a larger cross-section in relation to the first element, and being such that it can easily receive in its interior a part of tube 101. Both tube 101 and tube 106 have their terminal walls, indicated with 107 and 108 respectively, closed. Tube 106 is also provided with a hook 109

and with a spacing pin 110. A threaded tie rod 112 is welded on the end wall 107 of tube 101, while it goes through hole 114 drilled on the end wall of the other tube 106. Thus, when the hooks 102 and 109 of vice 100 thus formed contrast against their suitable counterparts, it is sufficient to tighten bolt 115 against surface 108 of tube 106, in order for the vice to be stressed and to perform its tightening function.

The practical application of vice 100 occurs when two panels are joined together in order to create one of the two front sides of the formwork. So, as can be observed in Fig. 13, the panels 116 and 117 are placed side by side before they are joined together.

Said panels have their spacing elements equipped with flat bars welded at an inclined position, as can be observed in 125, 126, 127 and 128.

In Fig. 13, it can be observed that vice 100 is positioned at the lower part of the two panels 116 and 117, and in Fig. 14 it can be seen how the hooks 102 and 109 of vice 100 engage themselves respectively on the inclined surfaces of the flat bars 126 and 128, belonging to the spacing element 119 of panel 116 and to the spacing element 129 of panel 117.

Since the action of vice 100 is applied on the flat bars 126 and 128 which are inclined, the reaction forces which develop during the tightening of nut 115 of vice 100, can be distributed according to a horizontal component parallel to the surfaces of the panels and according to a component perpendicular to the other component. The consequence of this is a nearing effect of one panel to the other and also an aligning effect; the perfect alignment is determined by the action of the spacing pins 103 and 110 which lean respectively against the spacing elements 119 and 129, vice 100 resting against the posts 123 and 124.

Of course, one single vice 100 is not sufficient in order to obtain the side-by-side positioning and the alignment of the two panels 116 and 117. It is convenient to limit the use of the 100-type vices

to the areas where one foresees the passage of the junction tie-rods between two panels facing each other, so that vice 100, being provided with a central hole, allows the passage and the stressing of brace 130, thereby performing also the function of an element reacting against the terminal posts 123 and 124 during the casting of the concrete.

The following description will emphasize how the 100-type vice, adequately modified according to the specific uses, is employed in all the various forms of connection between the elements forming the formwork.

Fig. 15 represents the case where two neighboring panels must be spaced the one from the other by means of a compensation plate, in order to obtain a formwork having a length which differers from the length obtainable with the modular repetition of the panels. More precisely, and also with the help of Fig.16, it can be observed that plate 133 is employed as a spacing element of the formwork to be obtained. In this case, the vice of the invention keeps its shape and function unaltered, with the difference that it presents two mobile parts 113, analogous to those already described with No. 106 in Fig. 12. In fact it can be observed that vice 135 also engages itself on the flat inclined bars 134 and 136 belonging to the panels 131 and 132 respectively, but in the specific case, the tightening of the vice does not bring the two panels 131 and 132 in touch with each other, but it simply nears them to one another and aligns them. The two panels 131 and 132 will approach each other until their end posts go to rest against the locking nuts 137 and 138 placed on the threaded spacing element 139. Of course, during this nearing procedure the threaded spacing element 139 is only locked by the nuts 140 and 141 on the shaped section 142 belonging to the spacing plate 133, while the nuts 137 and 138 are placed at the desired distance, and the terminal nuts 143 and 144 are not inserted. These last nuts will only be tightened after the nearing procedure by means of the vice has been completed. As can be observed in Fig. 15, the threaded

spacing element 139 is not mounted where the vice is, but it is inserted into the transversal holes of the posts in an intermediate position in relation to the area where the wedges connecting the posts and the spacing elements operate. Fig. 16 shows how, in this case also, brace 145 finds its seat in the middle hole of vice 135, which during the casting also acts as a reaction element for brace 145 against the terminal posts of the two panels placed at the sides of plate 133.

In the case under examination, what has been previously said concerning the fact that with vice 135 acting on the flat bars 134 and 136 and with the combined action of the spacing pins 146 and 147 belonging to the vice, is valid, i.e. both the nearing of the panels 131 and 132 and their alignment are obtained, besides the locking of plate 133.

The construction of the corners

In the following description it will be pointed out how the vice according to the invention, which now is no longer straight but presents a right-angle shape and is, nonetheless, provided with the hooks peculiar to the vice, is suited to connect with each other the corner panels and to place them perpendicularly to one another.

In order to be able to create the corners of the formwork, it is necessary to employ a box-shaped element, such as, for instance, a tube with a square cross-section, exactly where the corner is going to be, and a series of compensating elements, also having a square or rectangular shape, placed between the box-shaped element and the panel to be connected. The number of compensating elements will be varied according to the desired thickness of the wall which one wants to obtain inside the formwork.

Both for the inside and the outside corners, the compensating elements are united with the box-shaped corner element by means of braces, which go through the transversal holes of the panel posts. Figs. 17 and 20 show the closing of the external corner obtained by

means of vice 148. As can be observed in Fig. 20, the corner panels 149 and 150 are directly in touch with each other, but they present, first of all, the box-shaped element 151 at their edge, and then a series of spacing elements 152. The box-shaped element 151 carries, welded in its interior, the nuts 153 and 154 into which the braces 155 and 156 are screwed. Through the locking of nut 157 on the post of panel 149, brace 155 brings panel 149 near the box-shaped element of corner 151.

In the same way, with the locking of nut 158 on the post of panel 150, brace 156 unites the spacing elements 152 and brings panel 150 close to said compensating elements. The final locking and the perpendicularity between panel 149 and the compensating elements 152 and panel 150 is, however, guaranteed solely by the tightening of vice 148.

Said tightening occurs by tightening the nuts 167 and 168 of the two braces 159 and 163 which are contained within the arms of the vice. It can be observed that brace 159 is welded on the mobile tube-shaped element 161 having a larger cross-section than the section of the arms 160 of the vice; said tube-shaped element 161 carries hook 162 and the spacing pin 170 and it slides on one of the arms 160 of the vice. In the same way, brace 163 is welded on the mobile tube-shaped element 165, which carries hook 166 and the spacing pin 169; said element 165 slides on the other arm of the vice. Thus, when tightening the external nuts 167 and 168, the hooks 166 and 162 are stressed and they engage themselves leaning against the flat inclined bars 172 and 173 of the panels 149 and 150 respectively. In this way, the final tightening between the panels and the spacing elements, as well as the adjustment of the perpendicularity between panels 149 and 150 together with the spacing elements 152 , is reached. It will be pointed out that in this case too, the spacing pins 169 and 170, placed near the hooks 166 and 162 respectively, insure the

perpendicularity by acting as an arresting element during the tightning action performed by the hooks with the closing of the nuts 167 and 168 on the braces.

The same considerations made for the formation of the external corner of the formwork are valid also for the formation of the internal corner In fact, the right-angle vice 172 functions as vice 148, with the difference that, in the case under examination, the tightening nuts of the braces inside the vice are placed at the ends of the arms of the vice itself and not at the edge, as in the case of the vice for the external corner.

The formation of the inside corner of the formwork, in relation to the corner panels 174 and 175 is achieved equally by interposing the compensating elements 176 and 177 between the panels themselves and the corner box-shaped element 178. As previously explained, the braces 179 and 180 operate a first binding by tightening, while the final binding and the achievement of the perpendicularity is left to the tightening of vice 171 by tightening the nuts 181 and 182 on the braces 193 and 194 of the vice.

Said braces on the side of the edge of the vice are screwed on the internal nuts being present in the compensating elements 117, adjoining the corner element 178.

A special stress is put on the fact that the inside corner element 178 is exactly identical to and interchangeable with the outside corner element 151, in the same way as the elements 176 are identical to the compensating elements 152 and the elements 177 are interchangeable with said elements 152.

In actuality, by having available the corner element 178, being equal to 151, and the compensating elements 176, being equal to 152, and 177, it is possible to form indifferently both the internal and the external corners of the formwork. Therefore, by appropriately combining said compensating elements either inside or outside, it will be possible to obtain in the corners the desired thicknesses of the concrete walls.

The junction between the inside corner and the outside one occurs by means of the connecting braces 183 and 184. Said braces pass from the outside to the inside through the second post of each panel counting from the edge and, viewed from the inside, beside the last compensating element. The locking nuts of these spacing braces 183 and 181 rest directly against the arms of the inside and outside vices , which, therefore, in this case too, act as reaction elements.

Another special execution form of the vice being the object of the invention is used for the closing of the terminal end of the casting formwork.

In this case, a board or a plate for the restraint of the concrete at the end of the casting space is placed between the two walls constituted by the panels. This board must be held vertically by means of rafters which lean against the board itself.

In Fig. 19 the metal bar 185 which acts as a rafter, is connected tc vice 186 by means of a clamp 187 which allows the length adjustment. The threaded brace 188 is fixed inside vice 186, so that the sliding part 189 of the vice, which also carries hook 191 and the spacing pin 195, can go to contrast against nut 191 which, when screwed, stresses the vice and, as a consequence, pushes the rafter 185 against the board restraining the castin g. In this case too, hook 190 goes to lean against the flat bar 192 being present on the spacing element of the last panel of the formwork and the spacing pin 195 guarantees the rigidity of the system.

Of course, during the phase of execution of the invention, the method of composition of the panels can undergo some construction variations, which will still be contained within the scope of the inventive idea described above.

As an explication, it will be observed that the boards can be connected with the spacing elements not only by means of the tongues 12, but also by means of protrusions being present on the horizontal ribs of said elements, where said protrusions can acquire the shape of

pointed projections penetrating the boards, or of aligned segments which penetrate into the central groove being foreseen on the rib of each board.

Another example of execution of the spacing element diferring from the one already described, but with the same interacting elements, can be represented by the fact that the spacing element can be made with two shaped sections, one placed inside the other, both being rigidly connected with each other by means of a permanent deformation. In this case, the first shaped section presents a U-shape and it is formed in such a way as to form with its structure, the connecting elements 113 as well.

Another U-shaped section presents some slots in its vertical part, which can receive the terminal ends of the tongues 12, shaped accordingly. The insertion of the first shaped section into the just described second shaped section, and its locking by means of a deformation of the protruding edges of the second shaped section, constitute the spacing element 10 of the invention. This construction presents the obvious advantage that the spacing element is made without welding and it can, therefore, be moulded and assembled relatively easily and at a lower cost.

CLAIMS

1) A method for the composition of panels for the on-site erection of formworks employing wooden boards having different sizes in the length, spacing elements (10) separating the horizontal rows of the boards, and vertical posts (30) connecting the boards and the spacing elements, characterized by the fact that the rigid connection between the posts (30) and the spacing elements (10) creates a panel having a rigid structure, which can be used as a formwork element, being horizontally and/or vertically connectable with other similar panels, although they may have different sizes, and being mobile as a whole for subsequent use.

2) A panel according to the method claimed under claim 1), characterized by the fact that the spacing element (10) presents some holes for the passage of braces connecting the panels facing each other in the formwork, that it has elastic and practically vertical tongues which contrast against the boards on the vertical inside wall of the formwork, and that it is provided with connecting elements (13), which join themselves with the vertical posts and that it presents at least two flat bars (36, 40) placed at an inclined position on the spacing element near its terminal ends and suitable to react with the connecting elements of adjoining panels.

3) A panel according to claim 2), characterized by the fact that the junction and the locking between the spacing element (10) and the post (30) is achieved with the use of slots and wedges, or with threaded rods and nuts, or similar mechanical means.

4) A spacing element for a panel, according to claim 2), characterized by the fact that each hole (16) of said spacing element is in the middle between two connecting elements (13) said connecting elements always being arranged in pairs, the components of which are always at the same distance from one another, further characterized by the fact that the parts of said spacing element end each with a semi-hole (17) at the side of which there is a

pair of connecting elements, the nearer one of which is placed at a distance from the terminal end which corresponds to half the distance between the connecting elements forming a pair, the distance between the axes of two holes and the distance between the semi-holes and the holes always being constant.

5) A spacing element according to claim 4), characterized by the fact that it has the shape of a U-shaped section, on the terminal wall of said section metal tongues (12) are joined externally, while, inside the section and in correspondence with the tongues there are, united with the spacing element, U-shaped connecting elements (13), protruding from the spacing element and presenting, on the protruding part, slots (14), said slots being suited to the insertion of locking wedges, and the tongues and the connecting elements preferably being arranged at regular intervals and being spaced at the same distance from one another.

6) A panel according to part of claim 1), characterized by the fact that the vertical posts which make it up have a cross-section presenting approximately an omega shape, and that they are provided with openings (33) for the passage of the connecting elements (13), with holes (34) for the passage of the connecting braces of the formwork, with transversal holes (35) for the passage of the connecting braces between the panel and another neared panel or between the panel and the accessories of the formwork, said posts being connectable to one another, so as to insure the composition of the panel in its height.

7) A panel according to claim 6) characterized by the fact that the post (30) presents in its lower (or upper) terminal part a cross-section (37) suitable to receive the upper (or lower) terminal part of another post, so that the holes (33) for the passage of the connecting elements and the holes (34) for the passage of the bracing for the junction of the formwork are aligned and coinciding between one one upper and one lower posts and are such that, the union between two posts can be achieved by means of connecting

elements inserted therein.

8) A panel according to the method claimed under claim 1), characterized by the fact that said panel rests on the ground by means of basic spacing elements (20) including spacing elements (10) being welded to or, at any rate, connected with tube-shaped sections (3), such as to prevent the wooden boards from resting directly on the ground.

9) A method for the composition of panels according to claim 1), characterized by the fact that the action of placing two adjoining panels side by side and aligning them or of bringing together and aligning two panels forming a corner, is obtained by the combined action between vices (100) or similar means, and flat bars (126, 128) arranged at an inclined position and welded on the spacing elements of the panels, said vices or equivalent means presenting hooks (102, 109; 162, 166) which engage themselves on said flat bars, and spacing pins (103, 110; 169, 170) contrasting against the spacing elements of the panel.

10) A vice for the locking of the panel according to the method described under claim 9), characterized by the fact that said vice, which holds two adjoining panels, consists of two tube-shaped sections (101, 106) having a square or rectangular cross-section, one section being inserted into and sliding within the other, each of the tubes presenting a hook (102, 109) and a spacing pin (103, 110), further characterized by the fact that it has at least one threaded tie-rod (112) being fixed within the inner tube, on which a nut (115) is tightened, said nut contrasting against the outer tube, the tie-rod locking the vice, further characterized by the fact that it presents practically in its middle a hole (104) which receives the tie-rod uniting two panels facing each other.

11) A vice according to claim 10), characterized by the fact that the vice (148) which closes the external corners of the formwork consists of a right-angle element (160) and of two terminal tube-shaped elements (161, 165) inserted into and sliding on said element,

some threaded pins (159, 163) being fastened to said elements, the pins being stressed by the tightening of the nuts (167, 168) at the edge of the vice, both the hooks (162, 166) and the spacing pins (169, 170) being welded to the tube-shaped ends of the vice.

12) A vice according to claim 10), characterized by the fact that the vice,which closes the internal corners of the formwork, consists of a right-angle, tube-shaped element (171) and of two mobile tube-shaped elements inserted into and sliding on the terminal ends of said element, two threaded, right-angle pins, the one perpendicular to the other going through said element and being attached to the compensating elements (177) being placed beside the corner element (178) and goind through holes drilled in the mobile, tube-shaped elements, said threaded pins being stressed by the tightening of nuts (181, 182) which contrast against the mobile, tube-shaped elements, wherein said mobile, tube-shaped elements present the welded hooks and the spacing pins of the vice.

13) A method according to claim 1) or 9), characterized by the fact that the corner element (178) and the compensating elements (176, 177) which form the inner corner are interchangeable respectively with the corner element (151) and the compensating elements (152) forming the outer corner and vice-versa.

14) A method for the composition of the panels according to claim 1), characterized by the fact that the board closing the formwork between two panels facing each other, is supported by at least one rafter (185) being put under stress by a right-angle vice (186) presenting two perpendicular arms, on one of which a clamp (187) locking the rafter (185) is fixed, while the other arm receives the mobile part (189) of the vice carrying a hook (190) and a spacing pin, said vice being stressed by the tightening of a nut (191) which is screwed on the brace (188) being fastened in the inner, right-angle part of the vice.

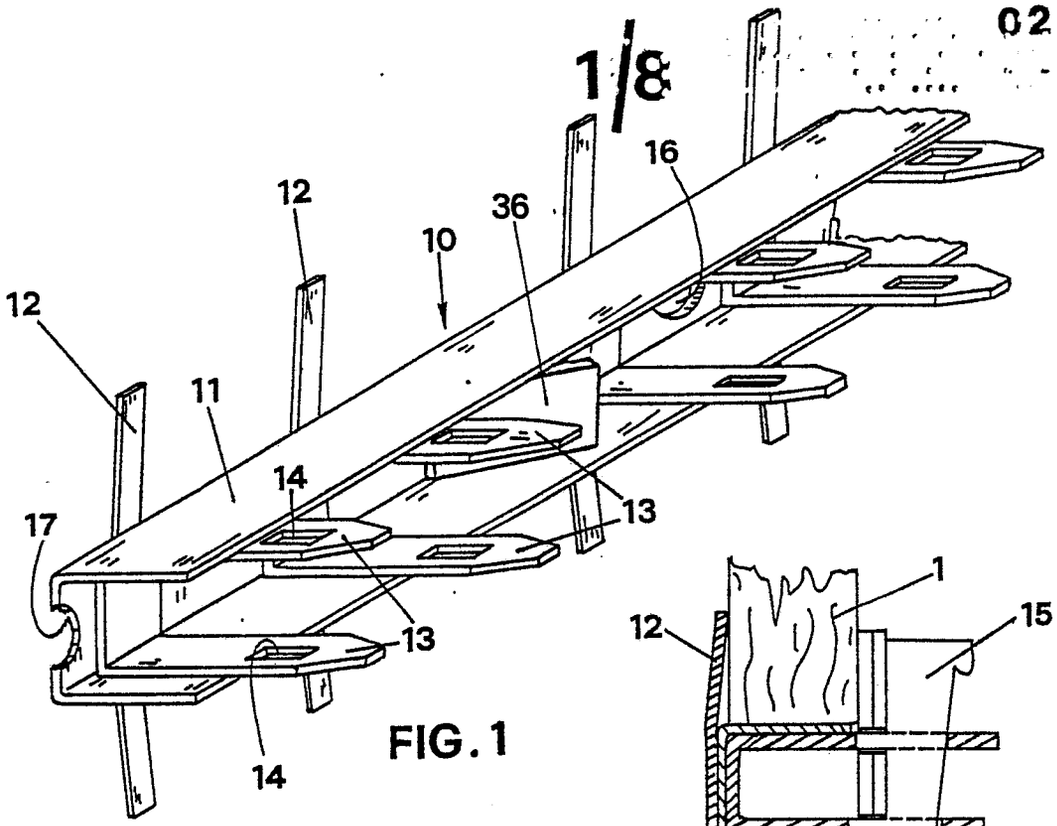

FIG. 1

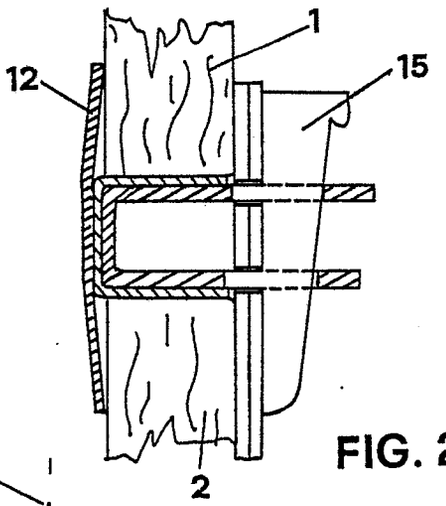

FIG. 2

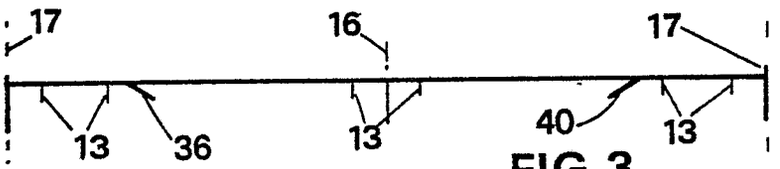

FIG. 3

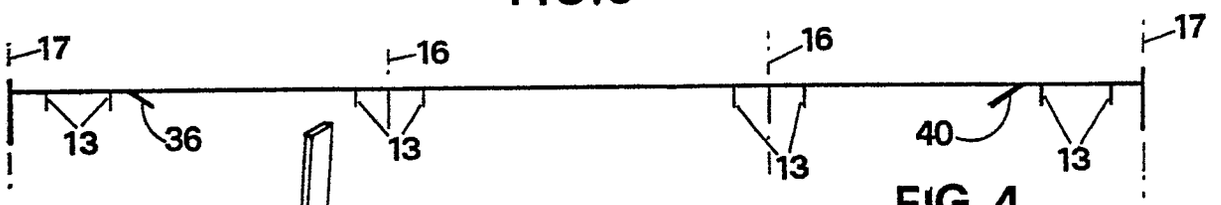

FIG. 4

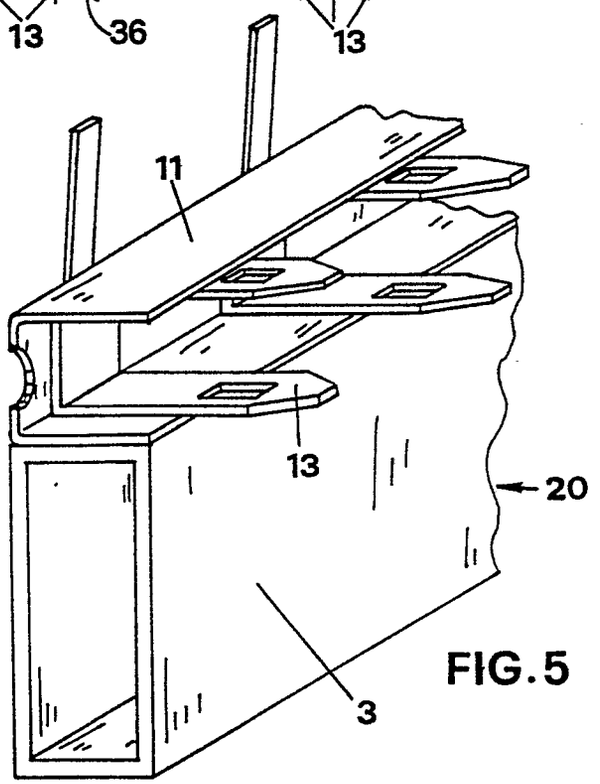

FIG. 5

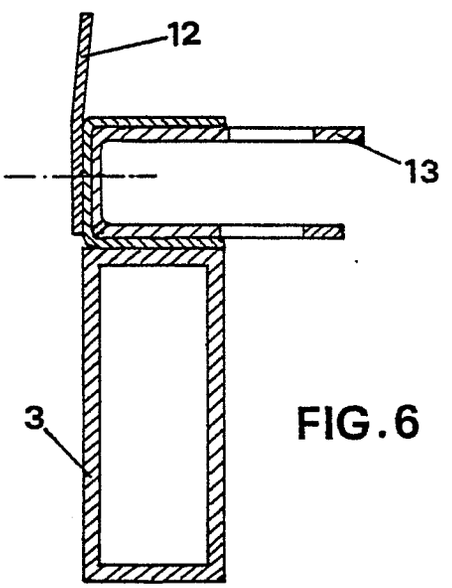

FIG. 6

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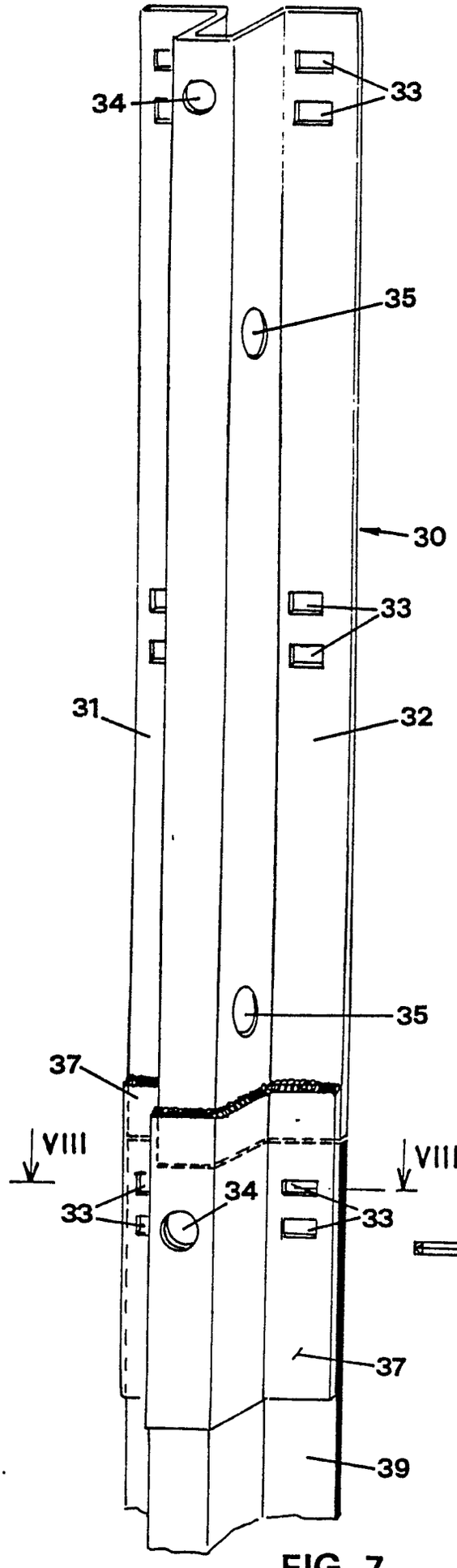

FIG. 7

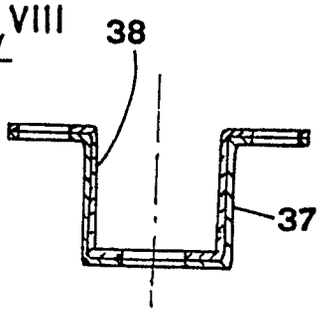

FIG. 8

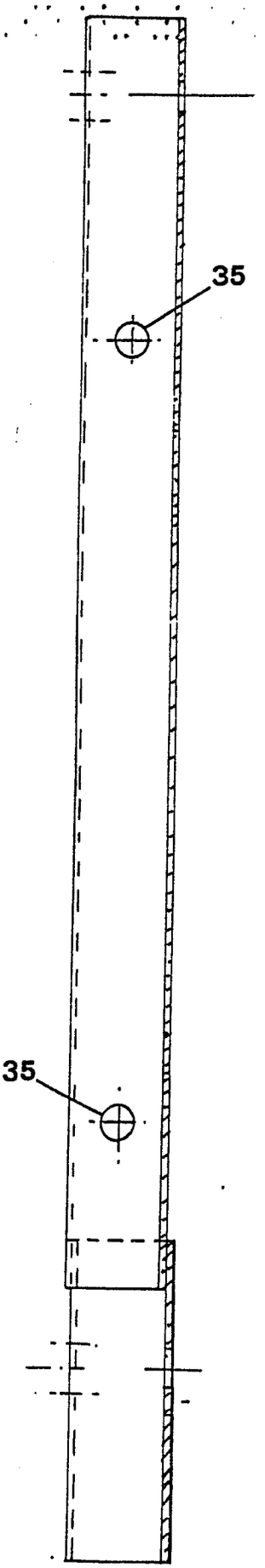

FIG. 9

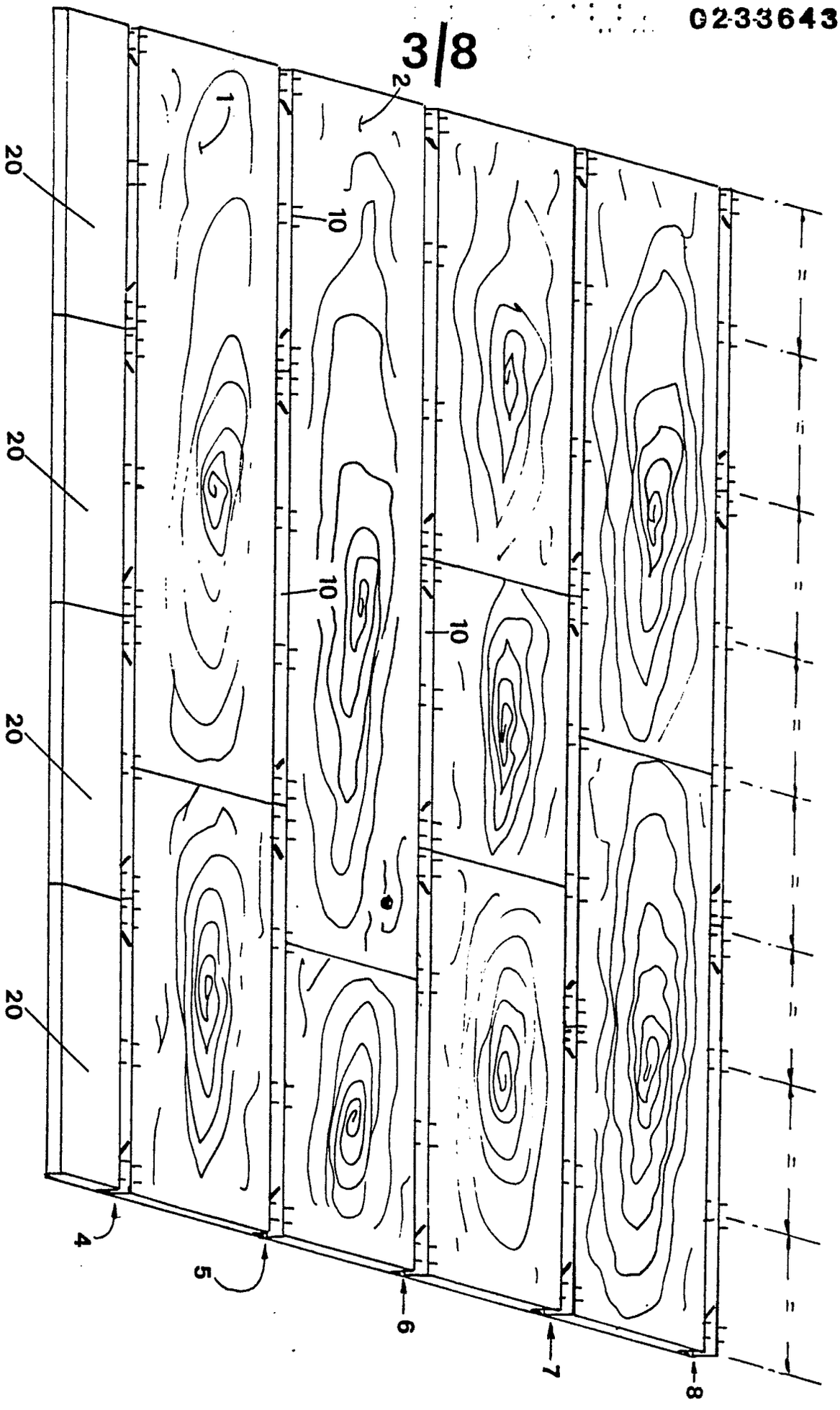

FIG. 10

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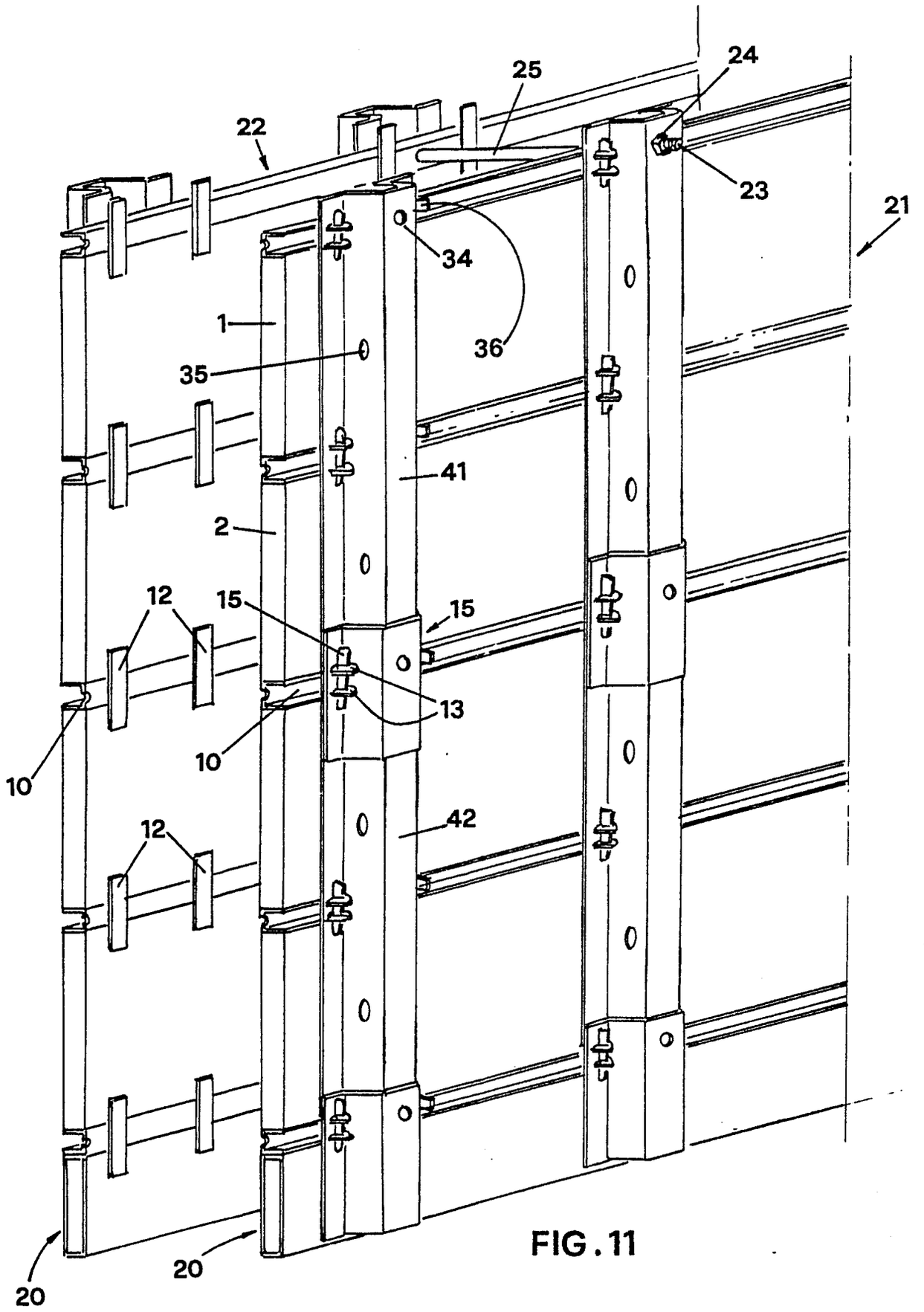

FIG. 11

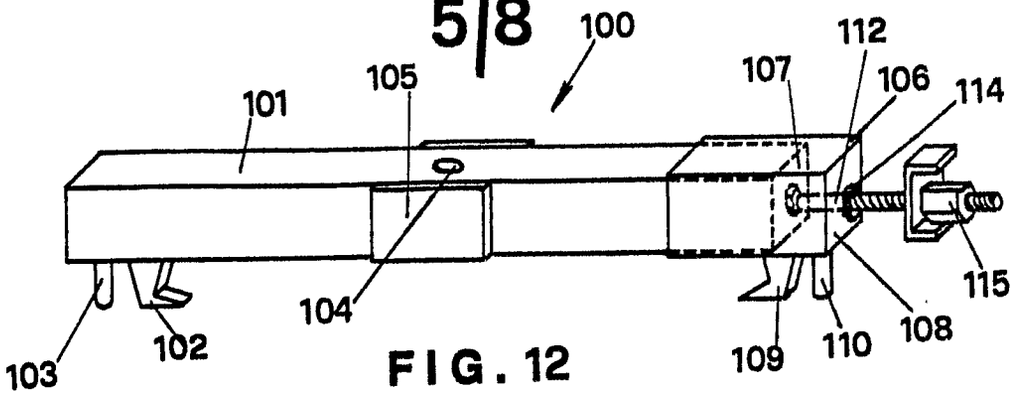

FIG. 12

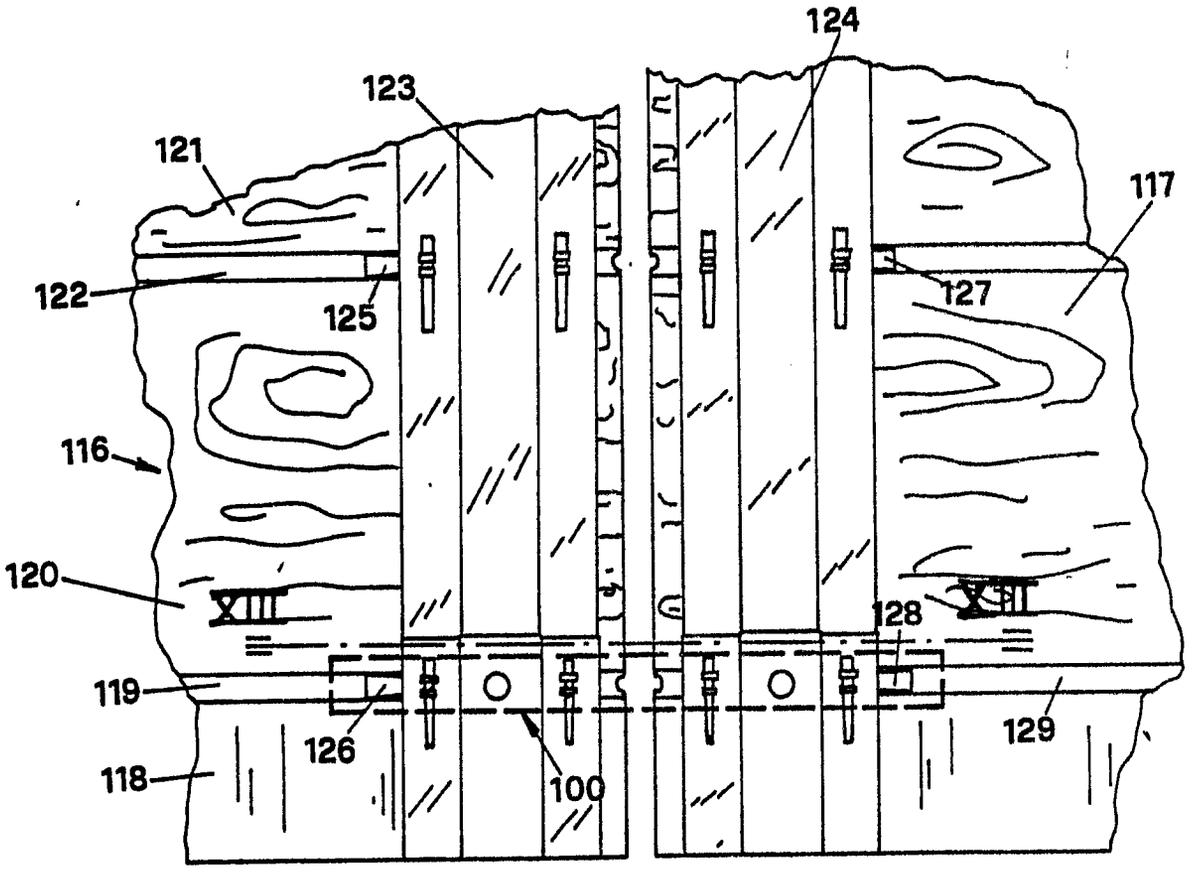

FIG. 13

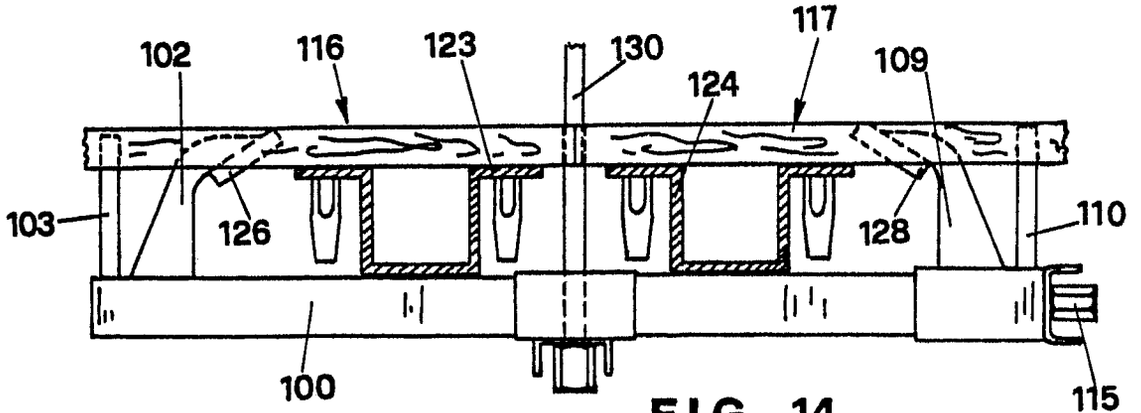

FIG. 14

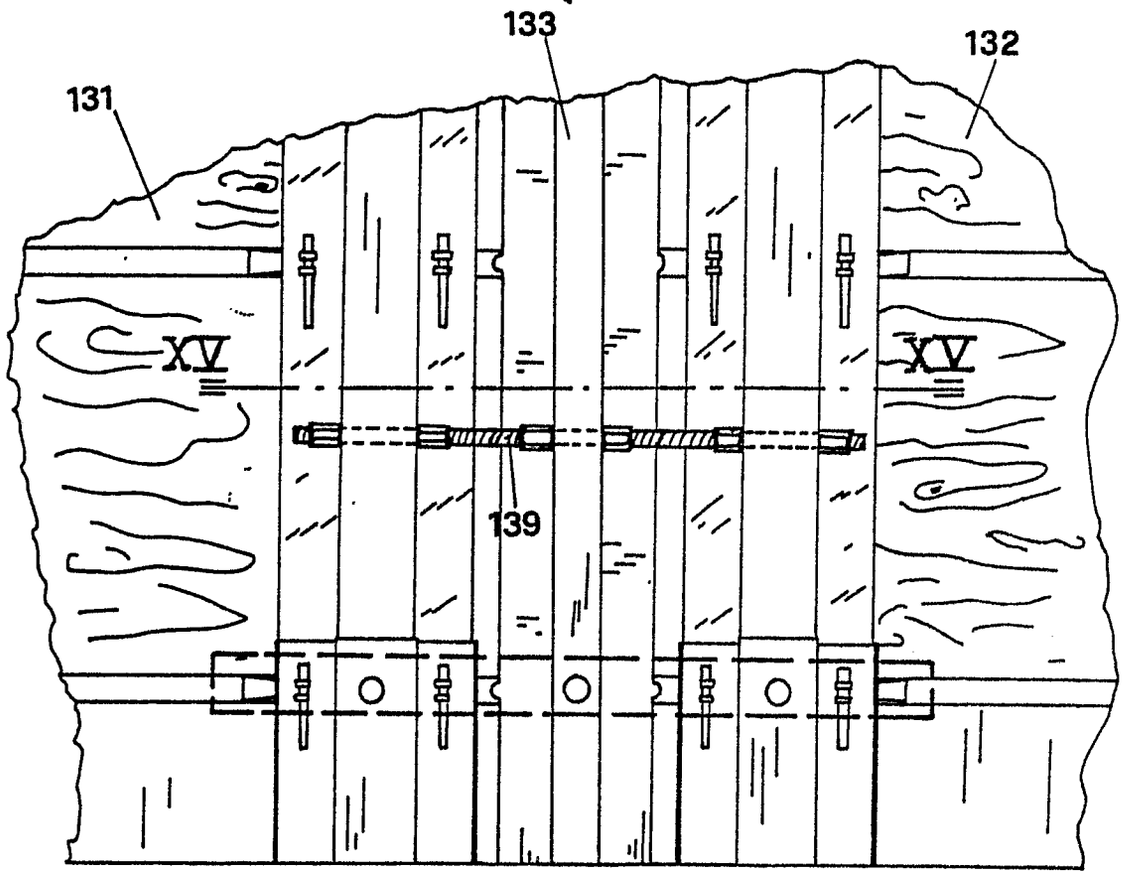
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FIG. 15

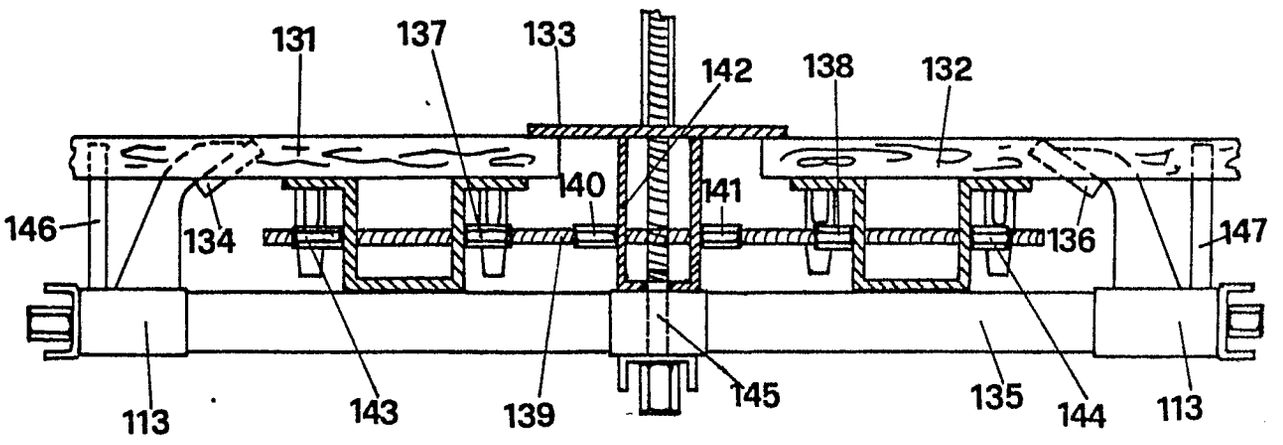
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FIG. 16

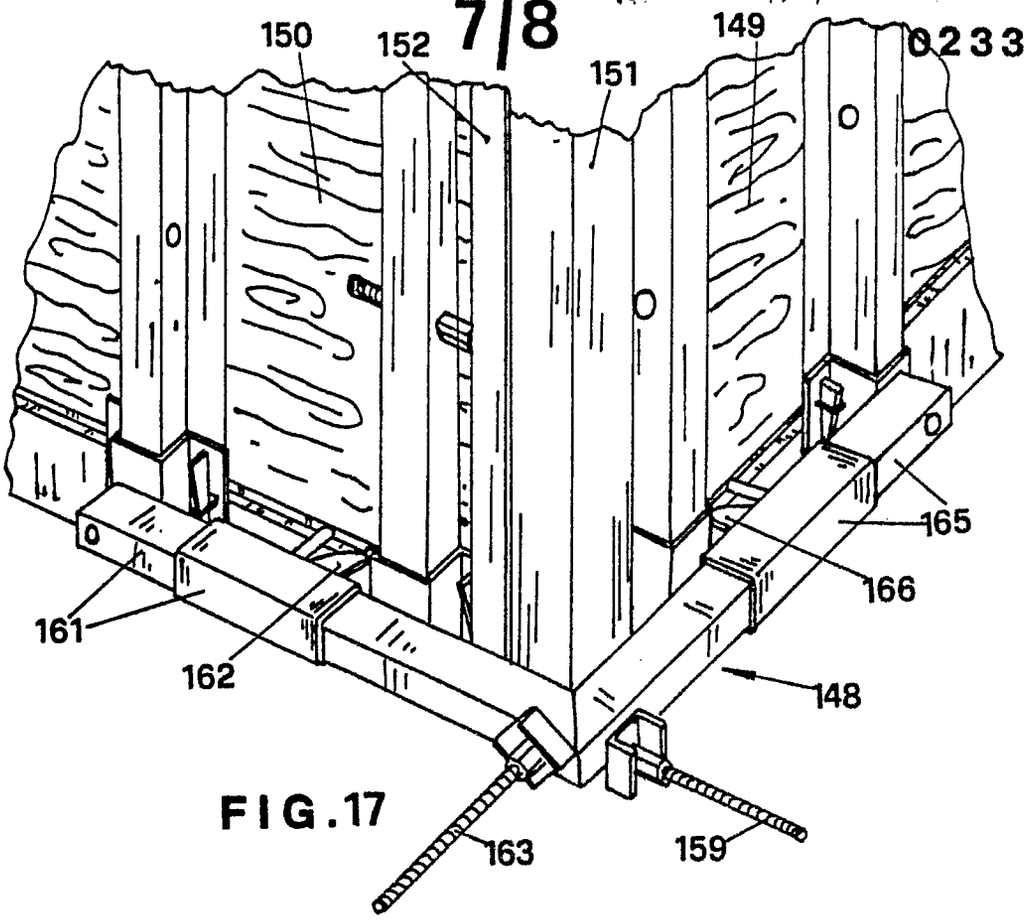

FIG.17

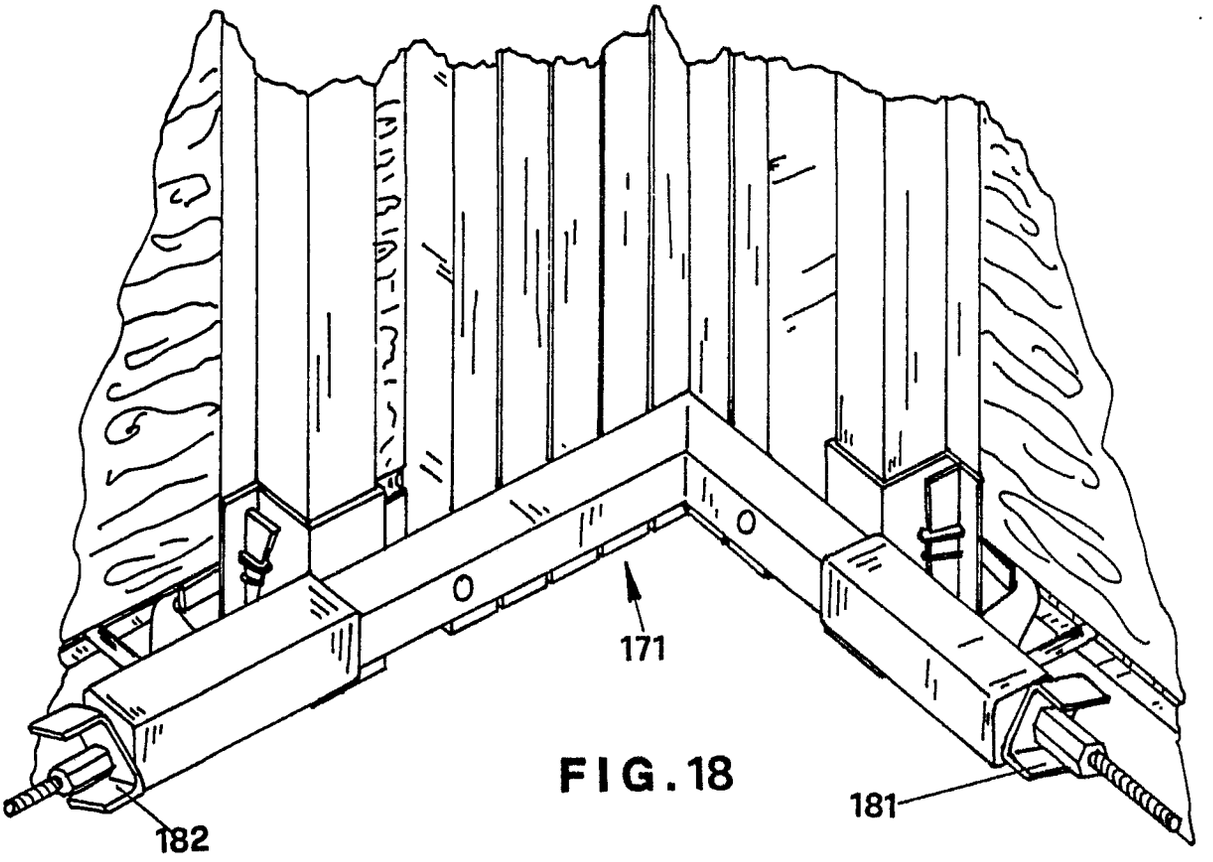

FIG.18

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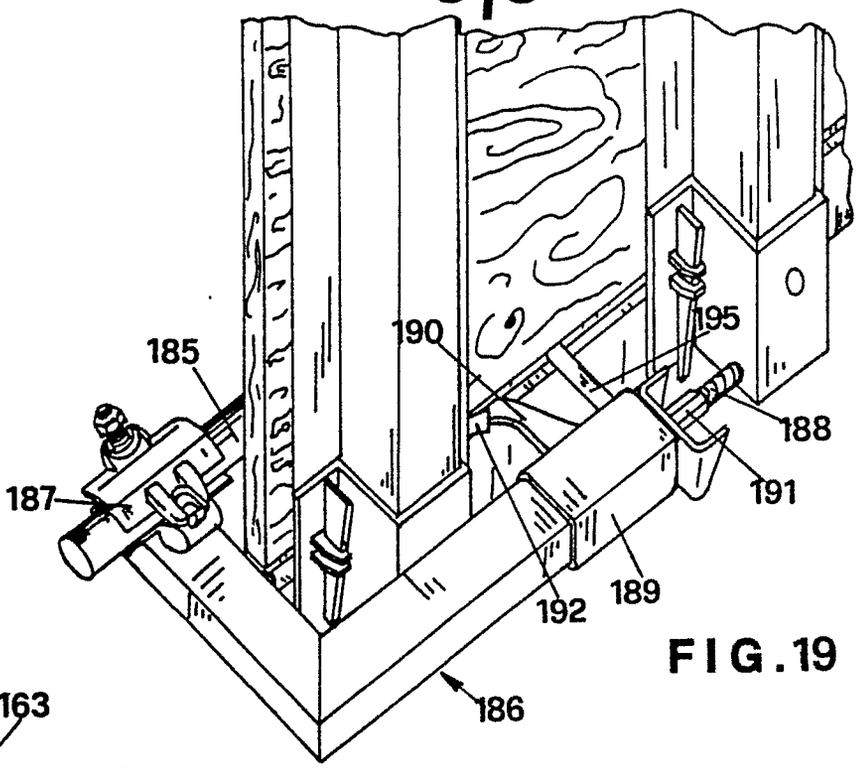

FIG.19

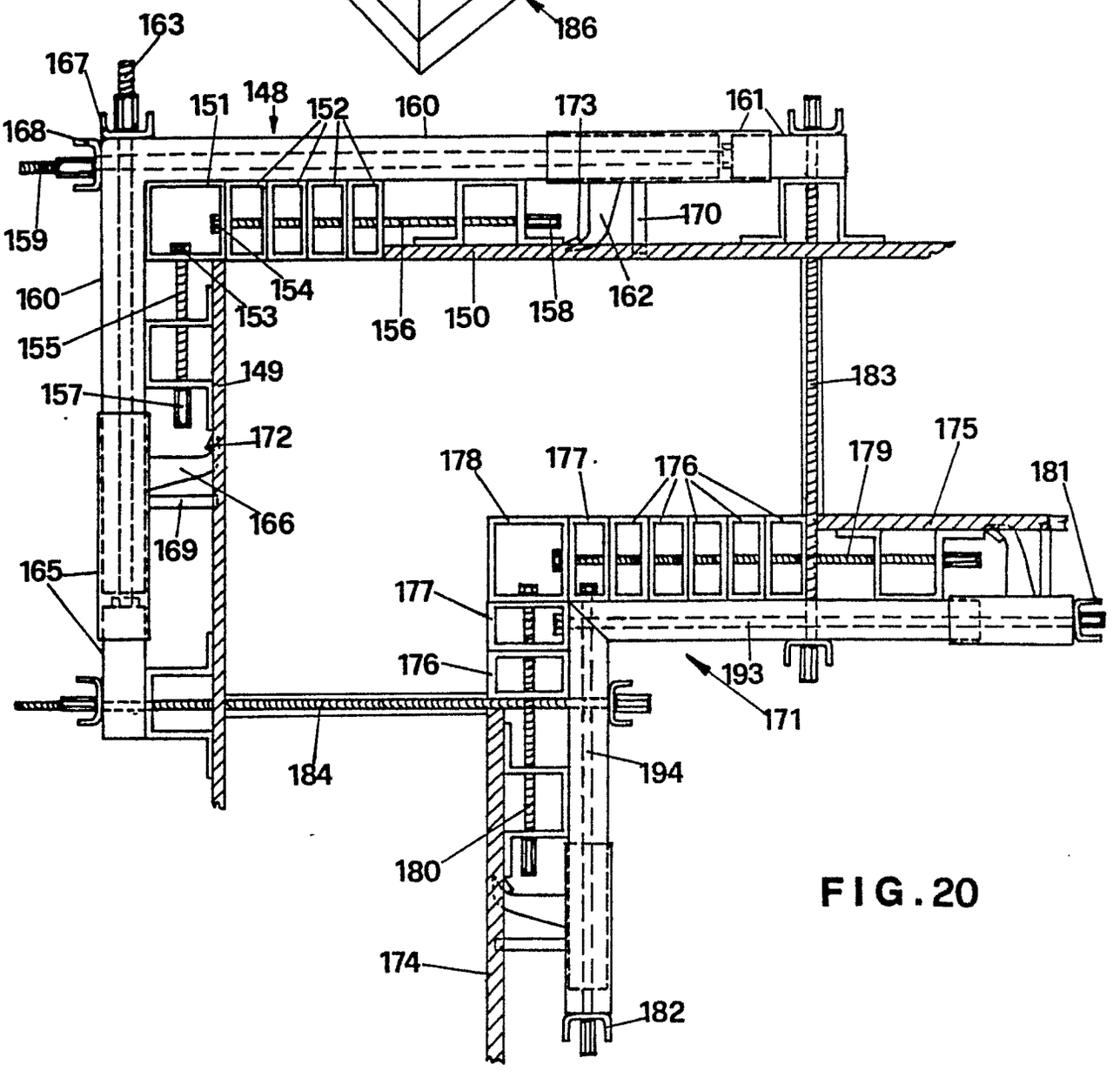

FIG.20