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W. SAHLBERG
WOODEN FRAME TRUSSES
Filed Oct. 19, 1938

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235,842
6 Sheets-Sheet 1

Fig. 2

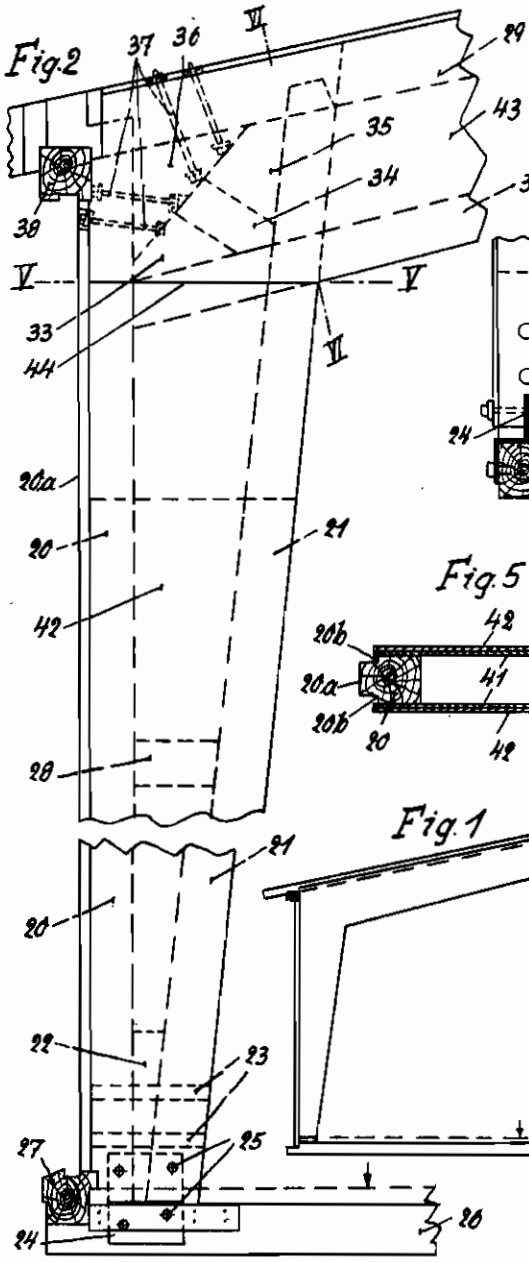


Fig. 3

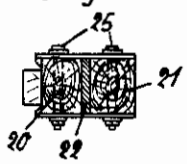


Fig. 4

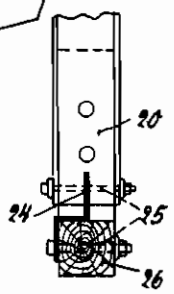


Fig. 6

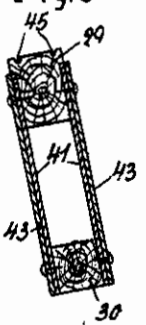


Fig. 5

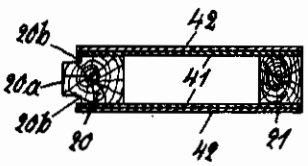
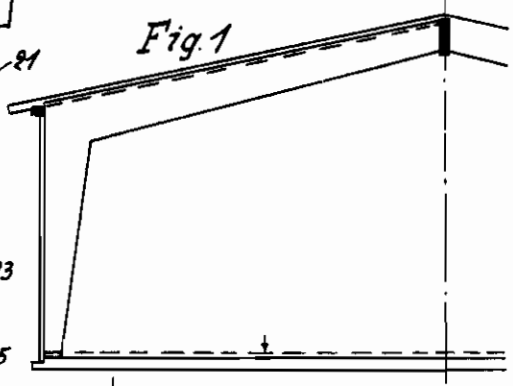


Fig. 1



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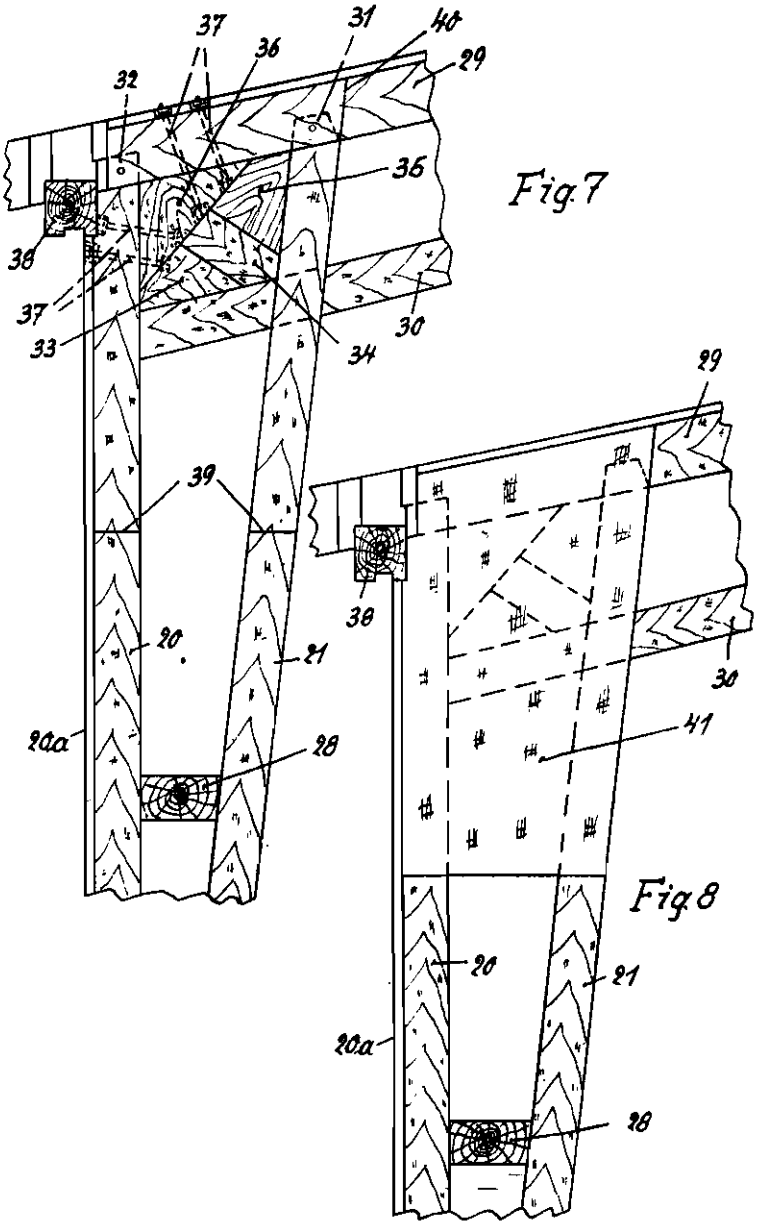

Fig. 7

Fig. 8

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Fig. 11

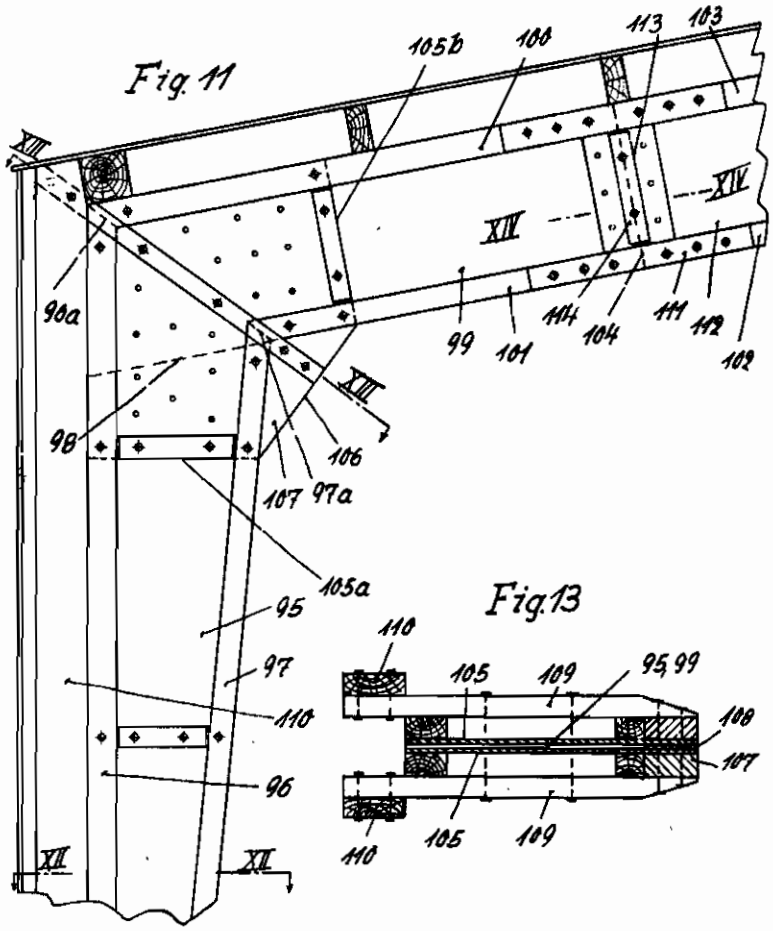

Fig. 13

Fig. 12

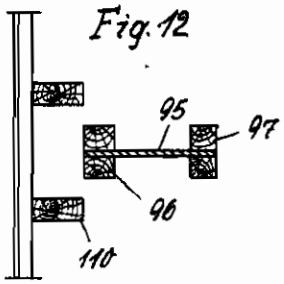

Fig. 14

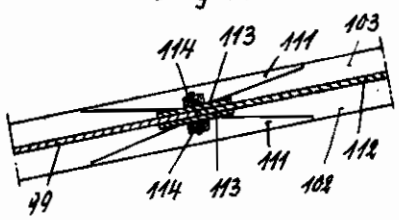

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Fig. 15

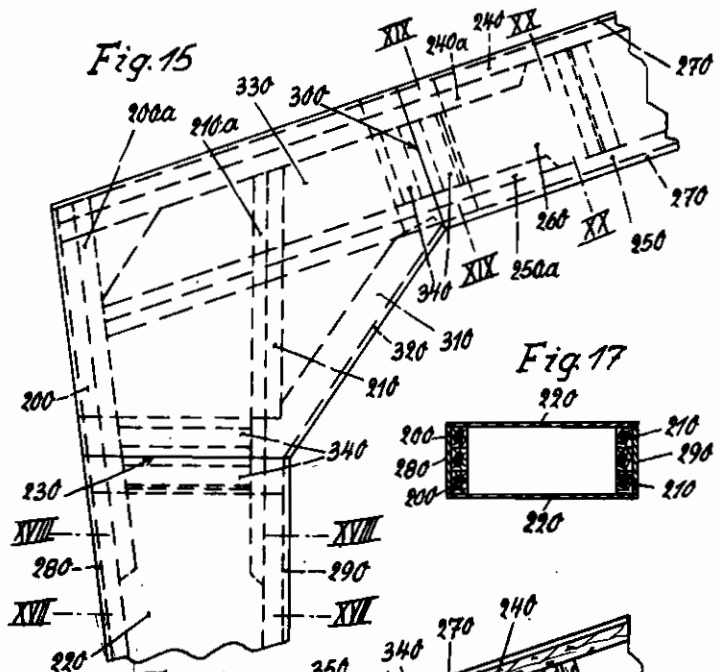

Fig. 17

Fig. 16

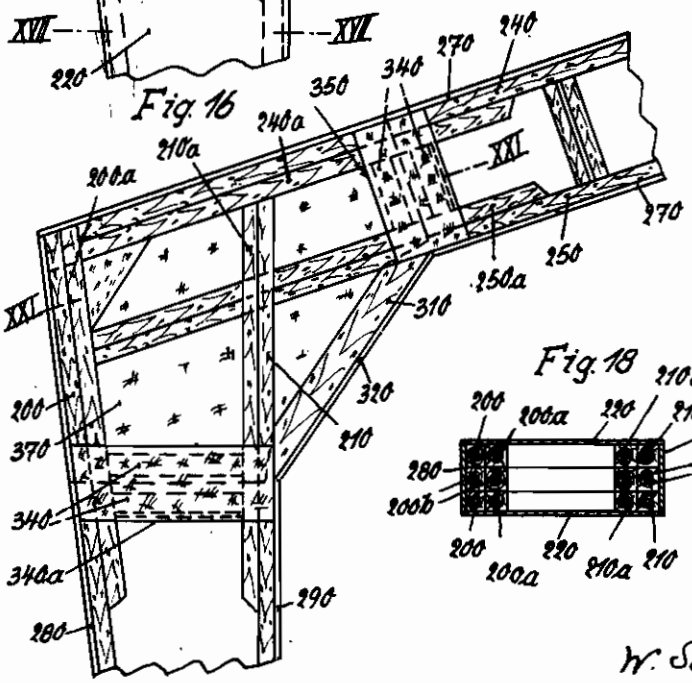

Fig. 18

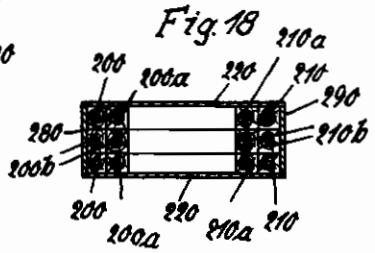

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Fig. 19

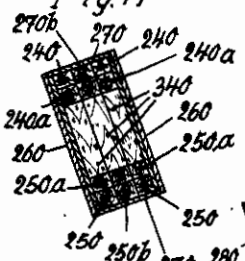

Fig. 21

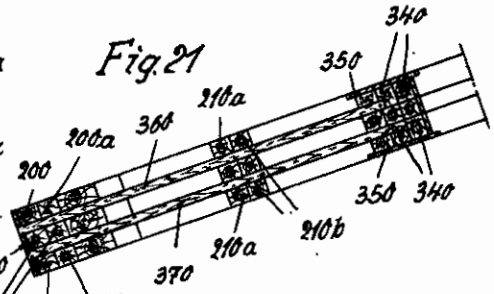

Fig. 20

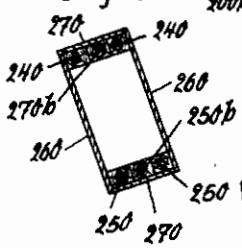

Fig. 22

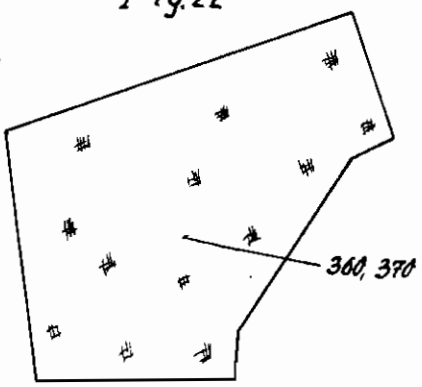

Fig. 23

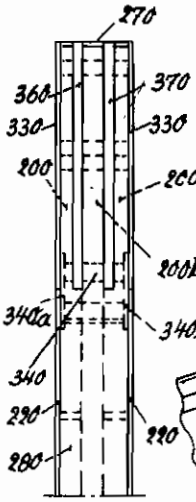

Fig. 24

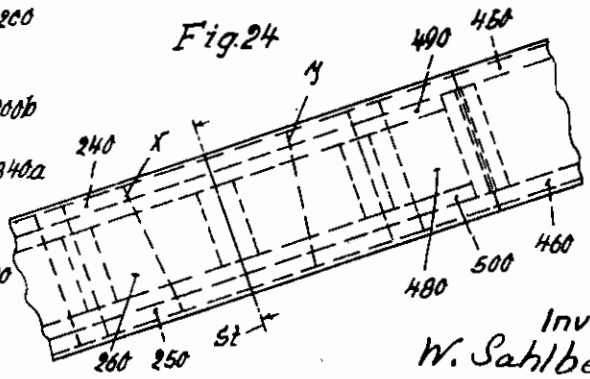

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Fig. 25

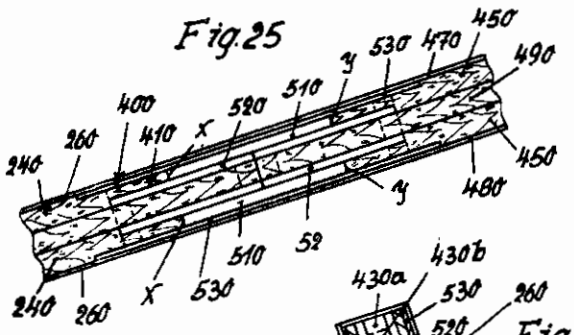


Fig. 26

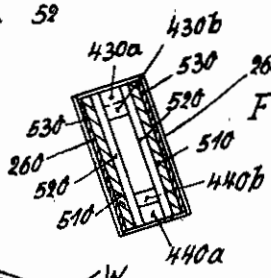


Fig. 27

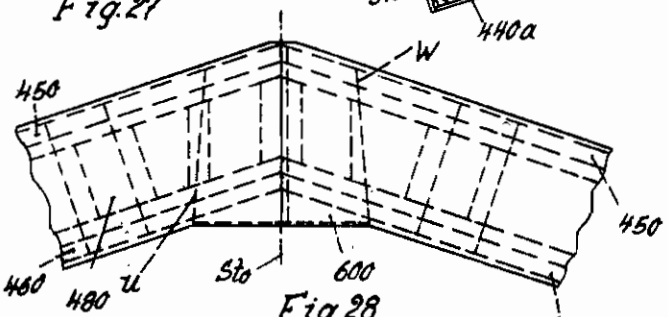


Fig. 28

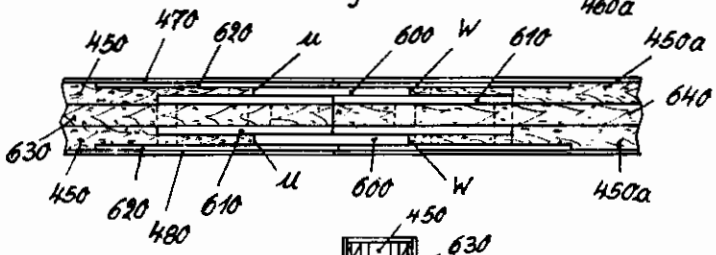
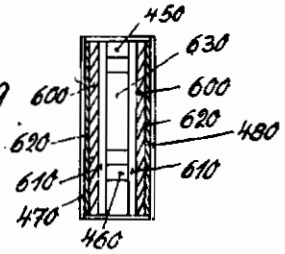


Fig. 29



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ALIEN PROPERTY CUSTODIAN

WOODEN FRAME TRUSSES

Wilhelm Sahlberg, Niesky (Oberlausitz), Germany; vested in the Alien Property Custodian

Application filed October 19, 1938

This invention relates to frame trusses of box or I-cross-section in which the webs consist of plywood and the flanges of rectangular timber, all the parts being secured together by means of artificial resin glue. It thus relates to wooden solid wall frame trusses which are extremely well adapted to the nature of the material.

The invention deals with the problem of satisfactorily transmitting by simple means the forces arising at the structural and assembly junctions. According to the invention this problem is solved by a joint covering plate having the full height of the girder being glued in at each corner of the frame in a suitable depression in the rectangular timber flange. This joint covering plate transmits not only the forces in the web but also the forces in the flanges. The said plate can be adapted to the contour of the upper end of the truss upright. In frame trusses of I-cross-section however the joint covering plate or each of the plates arranged on both sides of the web is preferably so constructed as to project over the inner corner of the frame. At this projecting part of the plate by means of lining pieces the checks of stiffening tongues are secured which extend over the outer side of the flanges and so far over the outer frame corner that the ends of the cheeks projecting beyond the outer frame corner can be connected with the wall uprights of the construction.

In frame trusses of I-cross-section in which the cross member is carried through to the outer edge of the frame and rests upon the upper end of the truss upright the joint covering plate is so arranged that it bears upon the outer flange of the upright and extends downwardly from the upper edge of the cross member. The plate in this case has the same breadth as the outer flange of the upright. The bearing formed by the lower side of the lower flange and the lower edge of the web of the cross member is in this case glued to the end surface of the upright which carries it. It is advisable to insert on each side a plywood plate in the corner enclosed by the flanges of the upright and the flanges of the cross member and to glue it to the web plate of the cross member. The abutting ends of the flanges according to a further feature of the invention are sharpened towards the truss web and the spaces formed in this way are filled by wooden wedges glued in.

The invention makes possible the construction of frame trusses of box or I-cross-section, the continuous webs of which consist of plywood while the flanges consist of rectangular timber, all parts being secured together by glueing. The frame trusses constructed according to the invention have a very great strength and are suitable for large spans. The external appearance of these trusses is exactly the same as that of the known welded steel frame trusses.

Some constructional examples of the invention are illustrated in the accompanying drawings.

Fig. 1 shows diagrammatically the profile of a continuous wall frame truss.

Fig. 2 shows on a larger scale the left-hand truss upright and the jointing part of the cross member. The frame corner is fitted with the joint covering plate according to the invention.

Fig. 3 is an elevation from below of the foot of the truss.

Fig. 4 is a side elevation of the truss foot according to Fig. 3.

Fig. 5 is a plan view of the truss upright in section on line V—V.

Fig. 6 is an end elevation of the cross member in section on the line VI—VI of Fig. 2.

Fig. 7 shows the truss corner before the application of the plywood plates on the same scale as in Fig. 2.

Fig. 8 shows the same frame corner as in Fig. 7 after the application of the joint covering plate.

Fig. 9 shows in elevation the truss upright and the parts of the cross member belonging to the frame corner of a frame truss according to the invention with I-cross-section.

Fig. 10 is a side elevation in section on the line X—X in Fig. 9.

In Figs. 11 to 14 a second constructional form of the truss with I-cross-section according to the invention is illustrated.

Fig. 11 is an elevation of the truss corner,

Fig. 12 is a section through the upright on the line XII—XII in Fig. 11.

Fig. 13 is a section on the line XIII—XIII of Fig. 11.

Fig. 14 a section on the line XIV—XIV in Fig. 11 and

Figs. 15 to 23 show another constructional form of the frame corner according to the invention.

Fig. 15 shows the corner of the truss in elevation.

Fig. 16 shows the same corner but without web plates.

Figs. 17 to 20 are cross-sections on the correspondingly numbered section lines in Fig. 15.

Fig. 21 is a cross-section on the line XXI—XXI of Fig. 16.

Fig. 22 shows one of the additional power transmitting plates which are provided in the frame corner according to Fig. 15.

Fig. 23 is an outside elevation of the upper end of the truss upright.

Fig. 24 shows in elevation the assembly junction of the truss cross member.

Fig. 25 is a plan of the assembly junction shown in Fig. 24 without the upper flange plate.

Fig. 26 is a cross-section through the joint of the assembly junction according to Fig. 24.

Fig. 27 shows in elevation an assembly junction for connecting the two halves of the truss cross member.

Fig. 28 is a plan of the assembly junction shown in Fig. 27 without the upper flange plate.

Fig. 29 is a section through the joint in the assembly junction according to Fig. 27.

The truss upright consists of the two rectangular timber flanges **20** and **21** which at their foot ends are connected together by means of a glued in wooden wedge piece **22** and hard wood dowel **23**. The foot covering consists of a Z-shaped metal member **24** which is secured in the foot by means of screw bolts **25**. By means of the covering **24** the foot of the truss upright rests upon the bearing timber **26** as shown in Fig. 4. **27** is the longitudinal sill which rests on the heads of the bearing timbers. About halfway up between the rectangular timbers **20** and **21** a rectangular timber member **28** is inserted. This member **28** is firmly secured to the two flanges both by glueing and by nailing. **29** and **30** are the flanges of the truss cross member which also consists of rectangular timber. The flange **21** of the upright is extended beyond the flange **30** of the cross member and is tenon jointed to the upper member **29** (reference numeral **31**). At the point of intersection the flanges **21** and **30** are interleaved with one another. The flange **30** is extended up to the inner side of the flange **20** of the truss web while the upper end of the flange **20** is tenon jointed to the left-hand end of the flange **29** at **32**. The space in the corner enclosed by the flanges **20**, **21**, **29** and **30** is completely filled by means of three pieces of rectangular timber **33**, **34** and **35** and a hard wood cleat **36**. The pieces of rectangular timber are glued together and to the flanges. The bolts **37** serve for connecting the hard wood cleat with the flanges **29** and **29** during the assembly of the truss. When left in the truss they increase the strength and stiffness of the corner. **38** is a wall frame which together with the bearing sill serves for securing the wall plates which are not illustrated. Fig. 7 shows the arrangement described before glueing on the plywood plates. The flanges **20** and **21** are provided on each side with a recess which begins at the point **39** and extends to the upper edge of the flange **29**. The flange **20** is also provided with a corresponding recess, the right-hand end of which is indicated by the line **40**. In this recess on each side of the truss there is inserted firstly a joint covering plate **41** of plywood as shown in Fig. 8. This plate is secured to the surface of the rectangular timbers which it touches by means of glue, preferably artificial resin glue. It serves for transmitting the forces from the truss upright to the cross member and vice versa and bridges over the joint at the corner of the plywood web plates **42** and **43**. This joint is indicated in Fig. 2 by the reference **44**; at this point the abutting plywood plates **42** and **43** are glued together. The flanges **20** and **21** are also covered by means of the plywood plates **42**. Since the plywood plate **42** is secured to these rectangular timbers by glueing on all surfaces where it touches the flanges there is obtained a girder of box form cross-section consisting entirely of wood. The same applies to the truss upright which consists of a girder with box form cross-section, the web being formed by the two plywood plates **43** and the flanges by the two rectangular timbers **29** and **30**. As is clear from Fig. 6 the arrangement is made such that a part of the flange **29** projects over the upper edge of the plywood web **43**. The upper side of the flange **29** is provided with two longitudinal grooves **45** running in the same direction which are used in securing the plates employed for covering the roof. Fig. 5 shows that the flange **20** of the upright is also provided with a part **20***a* projecting over the outer edge of the web **42** which also has two grooves or channels **20***b* running in the same direction. In the vicinity of the joint covering plate **41** the outer wall of each groove **20***b* is formed from the correspondingly projecting edge of the plate **41**. This arrangement is made for securing the wall plates which are not illustrated.

The constructional example illustrated in Figs. 9 and 10 relates to a continuous wall truss of I-cross-section. The upright consists of a plywood web **75** which extends from the line **76** up to the lower side of the flange of the cross member. Parallel to the right and left edges of the web **75** the flanges made of rectangular timber **77** and **78** are glued on at each side of the web. These flanges extend from the line **76** up to the lower side of the upper flanges of the cross member consisting of rectangular timbers **79** and at the places where they intersect the lower flanges of the cross member consisting of rectangular timbers **80** are interleaved therewith. Each of the two flanges **78** is provided at its upper end with a recess beginning at the line **81** and extending up to the end of the flange. A wooden plate **82** is glued into this recess by means of artificial resin glue which plate bridges over the joint at the inner corner of the frame. **83**, **84** and **85** are rectangular timbers which are glued into the space formed between the opposite surfaces of the flanges **77** and **78** and the web **75** for the purpose of stiffening. The stiffening **85** is moreover interleaved with the flanges **77** and **76**. Moreover in the space bounded by the flanges **77**, **78**, **79** and **80** on each side of the plywood web **86** of the cross member a plywood plate **87** is inserted and is secured to the surfaces which it touches by glueing.

The joint covering plate in this construction of the truss according to the invention is arranged on the outside. It consists of a plywood plate **86** which is placed and glued in a recess in the flanges **77**. The plate **88** extends from the upper corner of the truss up to the point **89**; it may however be shorter.

At the lower end of the truss upright a foot in the form of a sheet iron plate **90** bent into a U-shape is secured by means of screw bolts **91**. By means of this foot **90** the upright is secured to the concrete foundation **92**.

Figs. 11 to 14 show another constructional form for a truss of I-cross-section. The foot consists of the plywood web **95** and the flanges each made of two glued-on rectangular timbers **96**, **97**. The web **95** extends from the foot which is not illustrated up to the joint **98** while the flanges **96** and **97** end at the points **96***a*, **97***a*. At these points suitable rectangular timber members **100**, **101** are

applied and glued on, which extend in the direction of the flanges 102, 103 of the cross member. The members 100, 101 are glued on to a plywood web 99 in exactly the same way as flanges 96 and 97 and like this web end at the line 104. This line is the joint between the upright and the cross member. The plywood web 99 extends from the line 104 up to the left-hand edge of the flange 96. At the line 98 the lower end of the plywood plate 99 abuts against the upper edge of the plate 95. The joint is effected by means of artificial resin glue and is bridged over by a joint covering plate 105 also consisting of plywood. Such a joint covering plate as shown in Fig. 13 is arranged on each side of the plywood web 95, 99 of the upright. Each joint covering plate 105 extends from the line 105*a* to the line 105*b*. The inner edge of the joint covering plate however does not follow the line of the inner edges of the flanges 97 and 101 but extends beyond the inner corner of the truss. The inner corner of each joint covering plate 105 thus does not follow the line 106. On the parts of the joint covering plate projecting over the inner corner of the frame rectangular lining members 107 are glued; moreover the space between the two projecting parts of the two joint covering plates is filled by an inserted triangular plate 108. All the parts are connected together by means of artificial resin glue. The timbers 96, 97, 100 and 101 are provided with suitable recesses where they meet the joint covering plates. The frame corner is stiffened by means of nippers the cheeks of which consist of wooden plates 109. The wooden plates are bolted to linings 107 and the ends of the two joint covering plates which project over the inner frame corner and extend beyond the outer side of the flanges. They extend beyond the outer corner of the frame and are bolted to the wall uprights 110. At the joints 104 the rectangular timbers 100, 101, 102 and 103 are sharpened as shown in Fig. 12. Fig. 12 shows a plan view in section on the line XIV—XIV of Fig. 11. On account of this sharpening of the timbers wedge-shaped spaces are formed in which suitable wooden wedges 111 are inserted. The wedges 111 project over the joints and are bolted to the flanges. The joints between the plywood web plate 112 of the cross member and the plywood plate 99 is bridged over by a wooden plate 113, such a plate being provided on each side of the joint. Moreover wooden plates 114 are provided which are bolted together.

All the connections between the individual components are effected by glue joints with artificial resin glue or an equivalent glue with the exception of those which are specifically stated to be bolted joints.

The construction illustrated in Figs. 15 to 23 relates to a frame truss of box cross-section in which the webs consist of plywood and the flanges of rectangular timber each frame corner being provided with a joint covering plate which transmits not only the forces in the webs but also the forces which arise in the flanges. In addition to the two joint covering plates arranged on the outside of the frame corner in this constructional example a number of plywood plates (or only one plywood plate) are arranged in the interior of the box girder which also take part in the transmission of force. This has the result that the tension is more uniformly distributed over the whole cross-section of the girder so that it is possible to make the span of such trusses very great. The upright like the cross member is constructed as a box girder. Each girder consists of four flanges, two webs and two plates made preferably of surfaces of the flanges which extend transversely to the webs.

In Figs. 15 to 23 200 are the outer flanges of the upright and 210 are the two inner flanges of the upright. 220 are the web plates of plywood glued on to the outside of the said flanges which are extended up to the line 230 indicated in Fig. 15. The flanges 200 and 210 of the upright extend higher up and are interleaved with the corresponding flanges of the cross member. The cross-member consists of the two upper flanges 240, the two lower flanges 250 and the two web plates 260 of plywood. On the outer surfaces of the flanges 240 and 250 extending transversely to the web plates 260 these plates 270 are glued which consist preferably of strengthened wood. Also the upright is provided with such plates (references 280 and 290). The outer plate 280 of the upright is likewise continued upwardly beyond the line 230 while the upper plate 270 of the cross member runs through to the left-hand frame corner. The lower plate 270 of the cross-member extends only up to the joint 300 while the inner plate 290 of the upright ends at the line 230. The upper flanges 240 of the cross member are carried through to the left-hand frame corner and are there interleaved with the upper ends of the outer flanges 200 of the upright. The lower flanges 250 of the cross member fit over the upper ends of the inner flanges 210 of the upright and abut against members 200*a* which are glued on to the inner surfaces of the outer flanges 200 of the upright extending transversely to the web surfaces. The members 200*a* extend from the left-hand upper frame corner downwardly a certain distance beyond the joint 230. In the vicinity of the members 200*a* intermediate rectangular timbers 200*b* are glued in between the outer flanges 200 (Fig. 18). Also the inner flanges 210 of the upright are provided with members 210*a* which extend downwardly exactly as far as the members 250*a*. In the vicinity of the members 250*a* intermediate timbers 210*b* are glued in between the inner flanges 210. The same arrangement is provided for the cross member. As shown by Figs. 15, 16 and 19 members 240*a* are glued on to the lower side of the ends near to the frame corner of the upper flanges 240 while the lower flanges 250 are provided with members 250. 250*b* and 270*b* are glued in intermediate timbers. Between the inner flanges 210 of the upright and the lower flanges 250 of the cross member inclined supporting flanges 310 are provided, on the outer side of which a suitable plate 320 is glued. The left-hand end of the two web plates 260 of the upright is broadened corresponding to the outline of the frame corner. The two web plates 360 end at the line 300. Between the ends 230 and 300 of the web plates 220 and 260 on each side a plywood web plate 330 is glued on to the outside of the flanges of the upright and cross member. Near to the joint 230 and the joint 300 the space between the flanges is completely filled by glued in short timbers 340. The wood body obtained in this way in the vicinity of the joints 230 and 300 is recessed on the right and left sides and in the recess a joint covering plate 340*a* or 350 is glued.

In the vicinity of the frame corner two plates 360, 370 having the shape shown in Fig. 22 are arranged in the interior of the box girder. The plates 360 and 370 are glued into corresponding recesses in the inner surfaces of the rectangular

timbers 200, 200*a*, 200*b*, 210, 210*a*, 210*b*, 240, 240*a*, 250, 250*a*, 250*b*, 270*b*. These plates are carried through upwardly and to the left up to the outside of the frame. The plates 270, 200 glued on to the outsides of the flanges 200 and on to the upper sides of the flanges 240 are suitably recessed as illustrated in Fig. 23 for the plate 280. Also the plates 280 and 270 may be extended from the outer edges of the intermediate corner plates 360 and 370 in which case the corner plates 360 and 370 become correspondingly narrower and lower. The corner plates 360 and 370 form an additional force transmission whereby a uniform distribution of the stress from the whole girder cross-section is obtained. In this way it is possible considerably to increase the span of frame girders composed of rectangular timber flanges and plywood webs secured together with artificial resin glue.

According to the invention much additional force transmitting plates are arranged in the interior of the box girder also at other places in the frame girder. The upright illustrated in Figs. 15 to 23 is made complete in the workshop. Its assembly with the corresponding halves of the cross member is effected on the building site. In Figs. 24 to 29 the assembly joint is illustrated which is made on the building site when assembling the upright with the corresponding half of the cross member.

The plywood plates 260 of the upright extend to the line *St* which represents the joint. The flanges 240 and 250 of the upright are somewhat shorter than the web plates 260; they end at the line *x*. Each of the two timbers 240 and 250 is provided with an outer recess 400 and an inner recess 410. Between the two upper flanges 240 and the two lower flanges 250 is glued in each case an intermediate member consisting of two superposed rectangular timbers 430*a*, 430*b* or 440*a*, 440*b* which extends up to the joint *St*.

The end of the cross member lying near to the joint *St* is constructed in exactly the same manner. The cross member consists of the two upper flanges 450 and the two lower flanges 460 and the two web plates 470 and 480. Between the upper flanges 450 is glued an intermediate member consisting of two superposed timbers 490. Between the two lower flanges 460 is glued an intermediate member consisting of two superposed timbers 500. *y* indicates the line up to which the flanges 450 and 460 of the cross member extend. As shown in Fig. 22 these lines are not parallel to the joint *St* but form an acute angle therewith. In this way between the ends of the flanges of the upright and the ends of the flanges of the cross member spaces are formed which are somewhat tapered downwardly. Wedge plates 510 are inserted and glued into these spaces. In the inner recesses 410 of the flanges of the upright and the corresponding inner recesses of the flanges of the cross member additional force transmitting plates 520 are glued. The joints *x* and *y* are moreover covered by thin joint covering plates 530 which are placed in the above mentioned outer recesses 400 of the flanges.

In Figs. 27 to 29 the assembly joint is illustrated which is constructed on the building site for connecting the upper ends of the two halves of the cross member. The upper flanges 450 of the lower flanges 460 of the left-hand half of the cross member extend up to the line *u* while the upper flanges 450*a* of the lower flanges 460*a* of the right-hand half of the cross member extend up to the line *w*. These two lines with the joint *Sto* form an upwardly directed acute angle. In this way between the opposite ends of the flanges of the two halves of the cross member a hollow space is formed which is narrowed towards the top. This hollow space is filled up by means of the joint covering plates 600. The flanges 450, 460, 450*a* and 460*a* are provided with inner recesses which receive the additional force transmitting plates 610. Moreover the said flanges have outer recesses in which are inserted thin plates 620 formed of two pieces. Each of these plates serves for covering the joint *u* while the other half of the plate 620 covers the joint *w*. Between the flanges 450 and 450*a* or 460 and 460*a* intermediate timbers 630 or 640 are inserted which extend up to the joint *Sto*. All these parts are glued together using artificial resin glue. As shown in Fig. 27 the outline of the wedge plate 600 is made such that the lower edge of the plate 600 bridges over the inner corner of the upright.

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