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**GB - A - 593 422**
**US - A - 2 688 167**

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# Roof-truss comprising a tension member

## Technical field

The present invention relates to the construction art. More particularly, the invention relates to a roof-truss comprising a tension member between the two rafters of the roof-truss.

## Background art

In the construction art, in order to roof large spans, a construction is often used formed as a three-jount frame or arch, where the horizontal component of the bearing reaction is taken up by one or more tension members. This construction is usual with frame members both of steel and of glued laminated timber but in its original form it cannot take up upwardly directed loads.

The British Patent Specification No. 593 422 discloses a triangulated frame or truss comprising three completely separate members held or braced together solely by a bolt in tension between the apex and the base or transverse member. The side members are provided with pins or other abutments engaging the transverse member to prevent lateral separation of the side members from the transverse member when the bolt is tightened up. The object of this previous invention is to provide a simple, strong and robust triangular frame or truss which may be simply and quickly assembled and dismantled but it does not solve the significant problems involved particularly in roofing large spans. Another construction in this art is disclosed in US Patent Specification 2 688 167, according to which a pair of identical cheek plates are engaged under the ridge of the roof and secured to the rafters by means of bolts. As is the case in the British Patent Specification No. 593 422 also the US Patent Specification 2 688 167 aims to provide a frame structure the component parts of which may be standardised and which can be easily and quickly erected on the building site but does not aim at solving the significant problems involved in roofing large spans.

## Disclosure of invention

The object of the invention is to offer a ridge jointing which permits moment-rigid junction at the building site. According to the invention, a ridge jointing bridges the ridge join between the two rafters by means of a transverse ridge beam which has a length amounting to 5 to 20% of the span of the roof truss and which is connected to the ridge by a substantially vertical tie, which comprises separate members which individually or in groups tie the ridge beam to the ridge at each side of a vertical plane through the ridge line.

The ridge beam, which may appropriately have a length of up to 5—20%, preferably 10—15% of the span of the roof-truss, normally abut against the rafters without a statically effective connection in the unloaded state. As a result, the ridge jointing gives the roof-truss substantially a rigidity corresponding to that which would have been obtained with a continuous frame construction. With a downwardly directed roof loading, which, with a rigid ridge jointing normally results in negative moment in the ridge, according to the invention the moment forces are transferred in said case to the ridge beam. The joint function is thus eliminated in this case of loading. Negative moments are thus transferred to the ridge beam and from there, via the abutment of the ridge beam against the rafters, to the rafters, as a result of which the positive field moment in the rafters is reduced. With upwardly directed forces, negative moments are also obtained in the ridge beam, according to the invention, that is to say the same effect as with downwardly directed loading. The favourable result of this feature is that, inter alia, there is only a minor horizontal component on the wall columns and that compressive forces can be transferred into the roof-truss as a result of which the building can be stabilized as a result of the fact that only the columns at one side need to be braced.

It is also conceivable not to have full abutment between ridge beam and rafter, a case which may be of interest when the stress from snow loading determines the dimensions of the ridge beam.

The opposite case is also conceivable, prestressed ridge jointing, which is of interest primarily when upwardly directed wind forces determine the dimensions of the construction and it is desired to use a ridge jointing, which is over-strong for downwardly directed loads, to further reduce the dimensions or deformations of the rafters.

Further aspects and characteristics of and advantages with the invention are apparent from the following description of a preferred form of embodiment.

## Brief description of drawings

In the following description of a preferred form of embodiment, reference is made to the accompanying figures of the drawing, in which

Fig. 1 shows a cross-section through a hall building in which the roof-truss comprising a tension member according to the invention is utilized.

Fig. 2 shows, in more detail, a ridge joining included in a roof-truss of Fig. 1.

Fig. 3 constitutes a section on III—III in Fig. 1.

Fig. 4 shows, through a side view, the anchoring of one end of the tension member in the foot portion of one of the rafters of the roof-truss.

Fig. 5 constitutes a view on V—V in Fig. 4.

Description of preferred embodiment

The building section shown in Fig. 1 may, for example, consist of a section in a sports stadium, warehouse or industrial building or the like. Similar constructions may be considered, however, for smaller buildings and for other building work than house buildings. The roof-truss according to the invention is designated to general in Fig. 1 by the numeral 1. As can be seen from the Figure, it has a low profile. According to the form of embodiment, the incline of the roof is 14°.

The main parts of the roof-truss 1 consist of a pair of rafters 2, 3 which form the frame or arch of the construction, a tension member 4, and a ridge jointing generally designated by 5. The rafters 2, 3 consist of glued laminated timber beams. The tension member 4 hangs from the rafters 2, 3 from wires 6. Transversely to the incline of the roof there are laid battens 7 which, in conventional manner, connect the roof-trusses of the building while at the same time they constitute a support for the roof covering 8. The ends of the rafters 2, 3 rest against wall columns 9, 10 and are secured against lifting forces in the vertical direction and against horizontal forces in the lateral direction by plates 11, Fig. 4. A supporting beam 12 for a stand is shown in Fig. 1 to illustrate the use of the roof-truss for example for sports stadiums where the supporting beam 12 stabilizes the whole building via the column 9 and roof-truss 1. The ground level is designated by 13.

The tension member 4 consists of four steel bars 4a—d arranged as the corners in a rectangle, Fig. 3. The bars 4a—d are surrounded by a bracket, the ends of which are united to the supporting wire 6. A bolt to support the upper steel bars passes through the bracket. The tension bars 4a—d extend, at the ends, past the foot portions of the two rafters 2, 3 and through an end plate 15 which is disposed at each end and which bears against the short end of the respective rafter 2, 3. The ends of the tension bars 4a—d are threaded and nuts 16 complete the bolting.

The ridge jointing 5 shown in detail in Fig. 2 comprises a horizontal ridge beam 17 which is very short in comparison with the span of the roof-truss 1. According to the form of embodiment, the length of the ridge beam 17 is only 12% of the span of the roof-truss 1. The two upper edges of the ridge beam 17 are bevelled so that contact surfaces 18 are obtained which abut against the under side of the rafters 2, 3. In order to facilitate the assembly of the roof-truss 1, mounting aids are provided in form of long bolts 19 which extend through each end portion of the ridge beam 17 at right angles to the contact surfaces 18 and up through the rafters 2 or 3 respectively. The parts can be screwed together by means of nuts 20. In order that the bolts 19 and laminated members 2, 3 and 17 may not be damaged if the rafters move slightly in relation to the ridge beam 17, the through holes through the ridge beam for the rods 19 are widened out close to the contact surfaces 18. This is indicated by the numeral 21. A loose steel pin 22 in the ridge portion also has a temporary purpose in connection with the assembly. The pin 22 is disposed loosely in horizontal holes 23 which extend into each rafter in the region in front of the contact surface 24 of the rafter in the ridge. The end surface of one rafter 3 is recessed at 25 below and above the contact surface 24.

The ridge jointing 5 is further held together mainly by a vertical tie 26 close to the ridge line of the roof-truss. More specifically, the tie 26 consists, according to the form of embodiment, of a bolt connection consisting of six ridge bolts 26a—f with associated nuts 27 as well as one lower 28 and two upper horizontal washer plates 29, 30. The last two ones are associated with the rafters 2 and 3 respectively and can be displaced in relation to one another. The ridge bolts 26a—f extend through vertical holes through the ridge beam 17 disposed symmetrically in relation to a vertical plane through the ridge line. The left-hand ridge bolts 26a—c extend further through vertical through holes in the left-hand rafter 2 adjacent to the end surface of said left rafter 2 facing the end surface of the right-hand rafter 3 and further through the left-hand upper washer plate 29. The three right-hand ridge bolts 26d—f extend in a corresponding manner through the right-hand rafter 3 and the right-hand washer plate 30.

According to the form of embodiment, a ridge support 31 is also provided as a spacing element between the under side of the roof ridge and the ridge bolt 17. The ridge support 31 has the form of a symmetrical prism with a plane under side and an angled upper side with angles of inclination coinciding with the incline of the roof. The two centre ridge bolts 26c—d extend through vertical holes in the ridge support 31. The holes 32 are so wide that they permit movements of the ridge bolts 26c, 26d as a result of minor angular movements in the ridge members.

Briefly, the roof-truss 1 thus described works in the following manner. The rafters 2, 3 abut without any effective connection against the ends of the ridge beam 17 which is held firmly by the ridge bolts 26a—f secured to the ridge. In the case of downwardly directed loading through the weight of the roof itself and for example through possible snow loading, the moment forces are taken up by the ridge beam 17 via the vertical ridge bolts 26a—f and the contact surfaces 18. This eliminates the joint function in the ridge. As a result of the fact that negative moments are introduced into the ridge beam 17, which moments are transferred to the rafters 2, 3, the positive field moments in the rafters are reduced, which renders possible a more slender construction.

With upwardly directed wind forces, the ten-

sion member 4 can be ignored, as it does not cooperate in the system in this case. On the other hand, the ridge joining 5 again acts so that negative moments are introduced into the ridge beam 17. Thus a load condition is achieved similar to the one with a freely mounted boomerang beam with upwardly directed loading, which means, inter alia, that the horizontal component of force on the lateral uprights 9, 10 is very small.

With an asymmetrical loading condition, which may often occur as a result of wind forces and with uneven snow loading, the ridge support 31 serves the purpose of transmitting transverse forces into the system. It thus replaces the ridge securing means previously necessary to take up transverse forces.

The roof-truss comprising a tension member according to the invention can be varied within the scope of the idea of the invention as defined in the following claims. Thus the ridge jointing 5 need not necessarily consist of a horizontal ridge beam of glued laminated timber in combination with vertical ridge bolts through the ridge which press the ridge beam against the rafters, and a spacing element in between forming the ridge support. Thus it is easily conceivable that these parts may be replaced, for example, by a welded construction in which the bolts, if desired, may remain as in the illustrated form of embodiment or, for example, be replaced by rod- or plate-members embracing the rafters at each side of the ridge line or are secured by other means, for example by transverse horizontal bolts through the rafters near the end surfaces in the region of the ridge starting from vertical iron members between the ridge beam and the ridge at the outside of the ridge beam and rafters. In a simple form of embodiment, it is also conceivable to replace the ridge bolts by vertical plank members or the like which are screwed or nailed firmly into the outsides of the ridge beam and rafters at each side of the vertical plane through the ridge line. Thus the possible variations within the scope of the idea of the invention are very numerous. Naturally, the invention is not restricted either to the proposed form of tension member, or to the selection of simple, completely straight glued laminated timber beams for the rafters. Thus arched rafters are in principle conceivable to use with the construction according to the invention. In the description of the invention, the embodiment has been mentioned in which the ridge beam, in the unloaded state, does not abut entirely against the rafters, as well as the embodiment in which the ridge jointing is prestressed.

In the form of embodiment shown, the frame and the roof-truss 1 are symmetrical. It is also conceivable that one rafter may be longer than the other. In this case, the ridge beam can be disposed inclined whereas in the symmetrical case it may appropriately be horizontal.

## Claims

1. A roof-truss having a tension member between the two rafters of the roof-truss, with a join in the ridge portion between the two rafters (2, 3) and a ridge jointing (5) consisting essentially of a transverse ridge beam (17), which has a length amounting to 5 to 20% of the span of the roof truss, and a substantially vertical tie (26) between the ridge and the ridge beam, characterized in that the vertical tie (26) comprises separate members (26a—c and 26d—f respectively) which individually or in groups tie the ridge beam to the ridge at each side of a vertical plane through the ridge line.

2. A roof-truss as claimed in claim 1, characterized in that the ridge beam is secured to the rafters by means of said vertical tie which is prestressed.

3. A roof-truss as claimed in claim 1, characterized in that a bevelled contact surface (18) at each end of the ridge beam abuts the rafters in the unloaded state.

4. A roof-truss as claimed in claim 1, characterized by a certain spacing between the rafters and a bevelled surface (18) at each side of the ridge beam in the unloaded state, so that the rafter members will not abut against the ridge beam until after a minor alteration of the angle in the joint caused by a downwardly directed loading on the roof-truss, and that the jointing in the ridge, after said angle alteration, is subjected to elastic deformation as a result of said loading.

5. A roof-truss as claimed in one of the claims 1—4, characterized by a ridge support (31) in the form of a spacing member between the ridge beam and the rafters in the ridge line.

6. A roof-truss as claimed in one of the claims 1—5, characterized in that the roof-truss has an inclination corresponding to an incline of the roof between 10° and 20°.

7. A roof-truss as claimed in one of the claims 1—6, characterized in that the ridge beam has a length amounting to 10—15% of the span of the roof-truss.

## Patentansprüche

1. Dachstuhl mit einem Zugglied zwischen zwei Sparren des Dachstuhls, mit einer Fuge im Firstteil zwischen den beiden Sparren (2, 3) und mit einer Firstverbindung (5), die im wesentlichen aus einem Firstquerbalken (17) einer 5 bis 20% der Spannweite des Dachstuhls betragenden Länge und einem im wesentlichen senkrechten Bindeglied (26) zwischen dem First und dem Firstbalken besteht, dadurch gekennzeichnet, dass das senkrechte Bindeglied (26) getrennte Glieder (26a—c bzw. 26d—f) umfasst, die einzeln oder gruppenweise den Firstbalken zu beiden Seiten einer zur Firstlinie senkrechten Ebene an den First binden.

2. Dachstuhl nach Anspruch 1, dadurch

gekennzeichnet, dass der Firstbalken an den Sparren mittels dieses senkrechten Bindeglieds, das vorgespannt ist, befesitgt ist.

3. Dachstuhl nach Anspruch 1, dadurch gekennzeichnet, dass eine abgeschrägte Berührungsfläche (18) an beiden Enden des Firstbalkens im unbelasteten Zusatand an den Sparren anliegt.

4. Dachstuhl nach Anspruch 1, gekennzeichnet durch einen bestimmten Abstand zwischen den Sparren und einer abgeschrägten Fläche (18) auf beiden Seiten des Firstbalkens im unbelasteten Zustand, so dass die Sparrenglieder erst nach einer kleinen, durch eine abwärts gerichtete Belastung des Dachstuhls verursachte Aenderung des Winkels in der Verbindung am Firstbalken anliegen, und dass die Verbindung im First nach dieser Winkeländerung als Ergebnis dieser Belastung einer elastischen Verformung unterliegt.

5. Dachstuhl nach einem der Ansprüche 1—4, gekennzeichnet durch eine Firststütze (31) in Form eines Abstandsglieds zwischen dem Firstbalken und den Sparren in der Firstlinie.

6. Dachstuhl nach einem der Ansprüche 1—5, dadurch gekennzeichnet, dass die Schräge des Dachstuhls einer Dachneigung zwischen 10° und 20° entspricht.

7. Dachstuhl nach einem der Ansprüche 1—6, dadurch gekennzeichnet, dass die Länge des Firstbalkens 10—15% der Spannweite des Dachstuhls beträgt.

**Revendications**

1. Ferme comportant un tirant entre ses deux chevrons (2, 3) qui se rejoignent au niveau de la partie faîtière et une jonction de faîte (5) comprenant essentiellement une poutre de faîte transversale (17) d'une longueur égale à 5 à 20% de la portée de la ferme et un dispositif d'assemblage en substance vertical (26) entre le faîte et la poutre de faîte, caractérisée en ce que le dispositif d'assemblage vertical (26) comprend des organes séparés (26a—c et 26d—f, respectivement) qui, individuellement ou en groupe, relient la poutre de faîte au faîte de part et d'autre d'un plan vertical passant par la ligne de faîte.

2. Ferme suivant la revendication 1, caractérisée en ce que la poutre de faîte est fixée aux chevrons au moyen du dispositif d'assemblage vertical qui est précontraint.

3. Ferme suivant la revendication 1, caractérisée en ce qu'une surface de contact biseautée (18) à chaque extrémité de la poutre de faîte vient en contact avec les chevrons dans l'état non en charge.

4. Ferme suivant la revendication 1, caractérisée par un certain espacement entre les chevrons et une surface biseautée (18) de part et d'autre de la poutre de faîte dans l'état non en charge, de sorte que les chevrons ne viennent s'appliquer contre la poutre de faître qu'après une modification mineure de l'angle de la jonction causée par une charge exercée vers le bas sur la ferme, et la jonction de faîte, après cette modification angulaire, est soumise à une déformation élastique à la suite de la charge.

5. Ferme suivant l'une quelconque des revendications 1 à 4, caractérisée par un support de faître (31) ayant la forme d'un élément d'entretoisement entre la poutre de faître et les chevrons dans la ligne de faître.

6. Ferme suivant l'une quelconque des revendications 1 à 5, caractérisée en ce qu'elle présente une inclinaison correspondant à une pente du toit de 10 à 20°.

7. Ferme suivant l'une quelconque des revendications 1 à 6, caractérisée en ce que la poutre de faître a une longueur de 10 à 15% de la portée de la ferme.

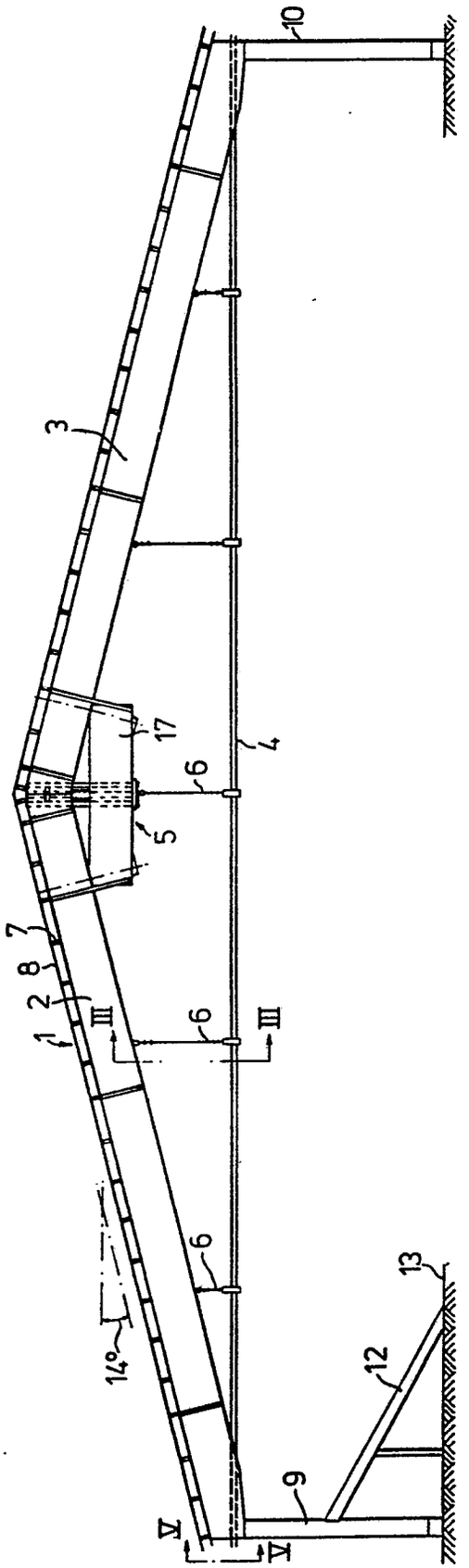



Fig.1.

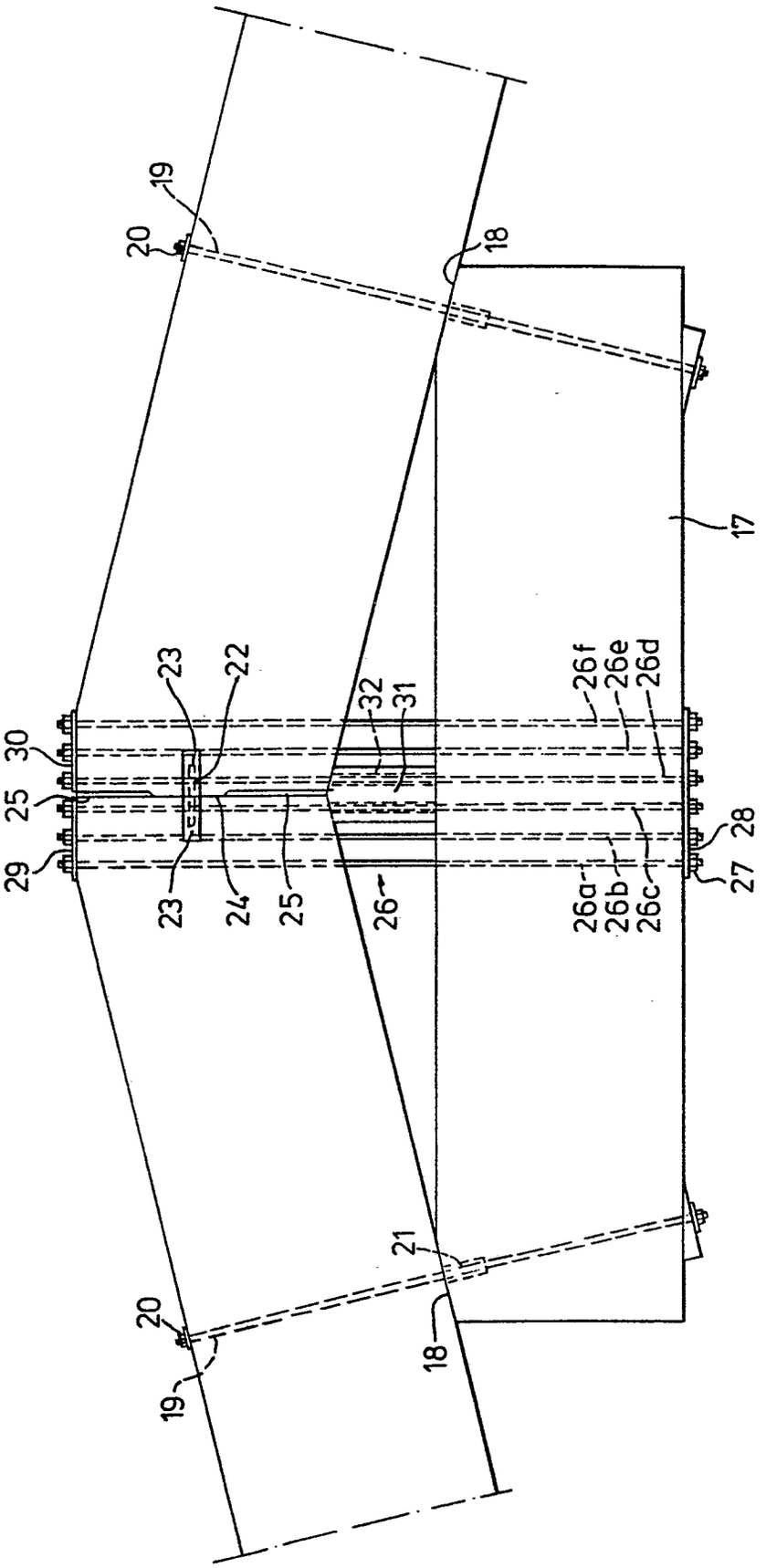

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Fig.2.

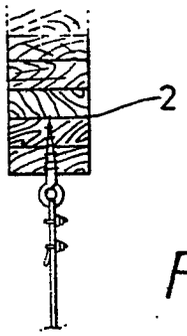
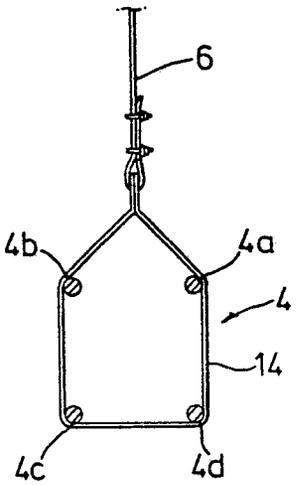



Fig.3.



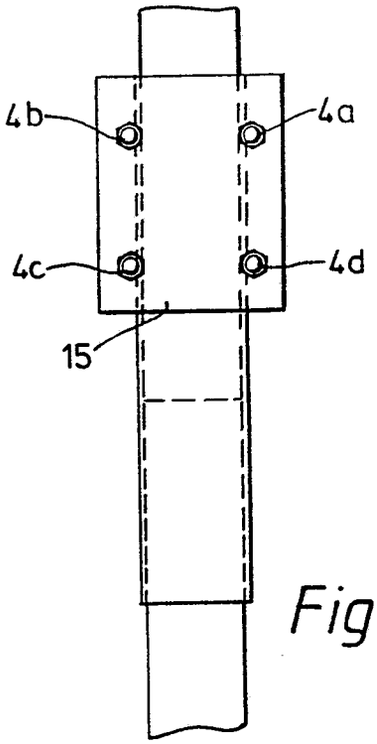




Fig.5.

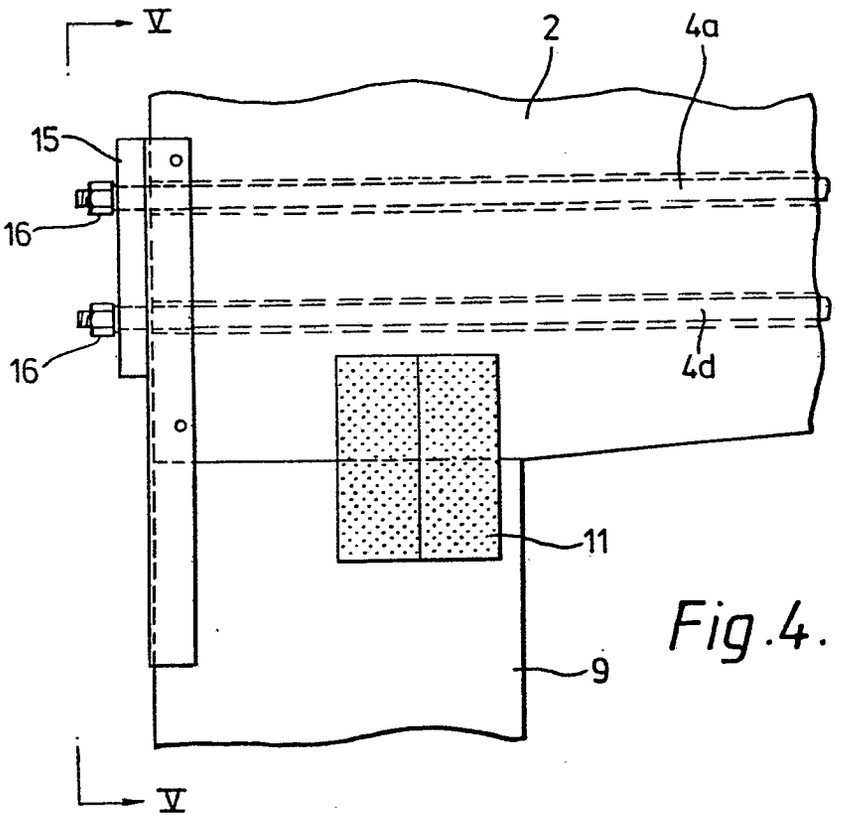



Fig.4.