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(54) **A STRUCTURAL SUPPORT SYSTEM AND A METHOD FOR PROVIDING A NODE SECTION FOR USE IN A STRUCTURAL SUPPORT SYSTEM**

STRUKTURTRÄGERSYSTEM UND VERFAHREN ZUR BEREITSTELLUNG EINES KNOTENABSCHNITTS ZUR VERWENDUNG IN EINEM STRUKTURTRÄGERSYSTEM

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**Description***Technical Field of the Invention*

- 5 **[0001]** The present invention relates to a structural support system, according to claim 1, comprising vertical and horizontal poles, called herein verticals and horizontals respectively, connected at standard node points arranged spaced apart on the vertical.

*Background for the Invention*

- 10 **[0002]** Structural support systems such as scaffolding and falsework are used in several applications, to support and provide safe access related to constructions and maintenance of these. It is a temporary structure, which is assembled at construction site and dismantled upon completion. It is a modular system of metal components, where the components are reusable - assembled and dismantled from site to site. In conventional scaffolding, the components within the system  
15 usually comprise poles for vertical and horizontal purposes, where the vertical and horizontal poles are connected together with couplings usually pre-assembled at the vertical poles, and where the components are of metal, usually galvanized steel.

**[0003]** Ringlock™, Allround™, Kwikstage™ and CUPLOK™ are well known scaffolding systems.

- [0004]** The CUPLOK™ system is described in GB 1 463 867 and is consisting of a bottom cup permanently and rigidly  
20 connected to a vertical pole at given intervals along the pole, with a loose and movable top cup above each bottom cup to engage a horizontal pole's end configuration for connecting the horizontal pole to the vertical pole by means of the bottom and top cups. Welding is used in order to lock components such as bottom cup, wedges and mechanical stoppers of the system permanently to the vertical pole and to make a permanent connection between the horizontal pole and the blade end configuration of the horizontal pole.

- 25 **[0005]** CN 105421757 discloses a bowl fastener connector for a bowl-holding scaffold. The bowl fastener connector comprises a vertical rod, an upper bowl fastener, a cross rod-limiting module, a lower bowl fastener and a cross rod connector, wherein the upper bowl fastener, a limiting pin, the cross rod-limiting module and the lower bowl fastener are installed on the outer wall of the vertical rod from top to bottom in sequence. According to the bowl fastener connector, a cross rod is fixed through the upper bowl fastener and the lower bowl fastener, installation and detachment are both  
30 possible, the cross rod is clamped and fixed to the upper bowl fastener and the lower bowl fastener through the upper end and lower end of the cross rod connector respectively, and scaffold installation stability can be effectively guaranteed through a saw tooth groove formed in the bottom of the cross rod connector and a cross rod-limiting stand column arranged on the inner wall of the cross rod connector. The upper end and the lower end of the bowl fastener connector are clamped and stressed, so that the stability of the scaffold is not to be affected i.e. if the bowl fastener connector rusts.

- 35 **[0006]** CN 200978854 relates to a detachable tightening connecting device comprising a connector equipped on a pillar of a scaffold or a ceiling rack, wherein the outer side wall is equipped with an equipping structure, and a wedge lining jacket is equipped between the connector and the pillar, and a locating locking device used to prevent the generating of comparative movement between the wedge lining and the pillar is equipped between the wedge lining jacket and the pillar. The utility model adopts a structure of adding the locating locking device between the pillar and the wedge lining, the  
40 connection between the wedge lining and the pillar can realize that the wedge lining and the pillar become a detachable structure through the detachable locating locking device structure, avoiding deficits brought by the glue sticking or welding to connect the wedge lining and the pillar, and also making the detaching and equipping of the connecting device and the maintenance possible.

- 45 **[0007]** FR 2298720 discloses a junction piece consisting of a metal cup drilled with a number of holes which are normal to the surface of the cup. The tubular struts are each fitted with a tapped plug insert. The outside of the cup may be reinforced by a ring which fits between the cup and the tubes. The tubes and cup are joined by means of screws or bolts. Horizontal tubes are fixed in any direction by the screw holes and a central vertical tube by the fixing hole. Angular tubes may also be fitted.

- 50 **[0008]** CN 102817890 discloses a fastener, which belongs to the technical field of machinery. The fastener comprises two butt-jointed half ring-shaped bodies, and is characterized in that a stud pin and a stud pin hole matched with the stud pin are respectively formed on the two end surfaces of the half ring-shaped bodies; the two half ring-shaped bodies are clamped and in butt joint with each other by the stud pin and the stud pin hole; and reinforcing ribs are arranged on the inner side walls of the half ring-shaped bodies. The fastener may be assembled and disassembled, and can be applied to connection of scaffolds or stud bodies.

- 55 **[0009]** CN 2003034788 discloses a flexible scaffold capable of being assembled and detached. The scaffold is formed by a vertical rod, a cross rod, a plug pin and a locking plate and is characterized in that the vertical rod is provided with the locking plate which is provided with a lock hole; the plug pin is arranged in the lock hole; the cross rod is connected with the plug pin; a lock sleeve and a lock ring are connected into a whole to form into the locking plate; the lateral side of the locking

plate is provided with a screw hole; one side of the upper end of the plug pin is provided with a connecting hole; the other side of the upper end of the plug pin is provided with a pushing block; the lower end of the plug pin is provided with a pin; the end portion of the pushing block is provided with an arc opening which is matched with the vertical rod; and an angle from 70 to 80 degrees is formed between an outer lateral edge of the pin and the horizontal direction of the lock hole.

**[0010]** CN 102704670 discloses a lower bowl-type coupler for a bowl-type coupler scaffolding, which includes a bowl-type coupler body, wherein a sleeve is arranged on the bowl-type coupler body; a recess is arranged on a vertical upright; both the bowl-type coupler body and the sleeve are arranged on the vertical upright; a protrusion is arranged on the inner wall of the sleeve, and extends to the inside of the recess to be tightly matched with the recess. The invention further includes a mounting method for the lower bowl-type coupler for the bowl-type coupler scaffolding, which includes the following steps: firstly, the bowl-type coupler body and the sleeve are arranged on the vertical upright; and secondly, the sleeve is clamped through a clamping device, and a radial clamping force is exerted to the protrusion through the clamping device, so that the protrusion extends into the vertical upright, and the recess is formed on the vertical upright, the protrusion extends to the inside of the recess to be tightly matched with the recess, as a result, the lower bowl-type coupler is installed on the vertical upright. The lower bowl-type coupler for the bowl-type coupler scaffolding can be connected with the vertical upright.

**[0011]** CN 205935627 discloses a cup connection type scaffold comprising a vertical rod and a cross rod wherein an upper cup and a lower cup are arranged on the vertical rod. The two ends of the cross rod are provided with inserting pieces. A plurality of screw holes are arranged at the outer circular surface of the vertical rod. The bottom of the lower cup is fixed to the vertical rod through a first bolt screwed with one of the screw holes providing a horizontal pressure as the lower cup is being clamped or pressed towards the vertical rod. A second bolt used for limiting is arranged at the top of the upper cup.

**[0012]** CN 205046830 discloses a cup type steel pipe scaffold, the scaffold being composed of an upper cup, a lower cup, a transfer rod, a cross rod joint and a fastening bolt. The fastening bolt is arranged in the middle of the lower cup providing a horizontal clamping force of the lower cup towards a vertical.

**[0013]** The current state of the art is reflected in use of tubes and fittings made in steel. This makes the components of the structural support system in many cases unnecessary heavy. There is also a health, environment and safety (HES) aspect due to weight of components and allowed lifting weight. Therefore, there is a need for reducing weight of components and increased system flexibility in order to obtain of a structural support system, which meets the HES requirements without reducing the capacity or integrity of the structural support system.

**[0014]** There is a need for a system wherein the vertical and the cups can be made of aluminium or where the cups may also be made of a tougher and more solid material, such as steel. It is also a need for a system that is simple to assemble and erect, and where the nodes are solid and strong, meeting the structural and HES criteria.

### Summary of the Invention

**[0015]** In the following throughout the specification, when referring to structural support system, this includes, but is not limited to, scaffolding, falsework, beams, bridges, staging, ski jumps and slopes and such, unless clearly specified otherwise. Moreover, in the following, the following terms mean:

The noun term "horizontal" refers to elongated tube elements intended to be arranged in horizontal direction. In the industry of structural support systems, "elongated tubes", "horizontal ledger", "transom", "ledger", "runner" etc. are also well-known expressions.

The noun term "diagonal" refers to elongated tube elements intended to be arranged diagonally in a structural support system.

**[0016]** The noun term "vertical" refers to the elongated tube element intended to be arranged in vertical direction. Expressions like "standard upright", "standards", "posts", "poles" etc. are also known in the industry.

**[0017]** The present invention is in principle functioning as a CUPLOK™ system, but with improved solutions for attaching its couplers or cups to a pole with vertical standing purposes. The key point of the present invention is the ability to held and/or permanently fix the bottom cup to the vertical without using welding or components which compromises the pole's inside hollow section, hence being compatible and may be used interchangeably with the existing prior art CUPLOK™ system. The present invention opens for the possibility of using materials for the vertical and the node section, which are either undesirable to weld, or non-weldable altogether, but possesses other desirable features such as for instance being lightweight and/or environmentally friendly. A lightweight structural support system will ease both transport and handling, will provide working capacity and reduce the environmental impact of transportation, in addition to open up new areas where the structural support system may be utilized.

**[0018]** The main object of the present invention is to provide new methods for joining components of a structural support system together and being able to choose materials for reduced weight of the structural support systems.

**[0019]** Another object of the present invention is to provide a backward compatibility to existing CUPLOK™ systems.

**[0020]** Another object of the invention is to provide a bottom cup which may be rigidly fixed to the vertical in a removable and/or replaceable manner without influencing the integrity of the new joint or the vertical.

**[0021]** Another object of the invention is to provide a new system where the vertical, the elements forming the joint and possibly also the horizontals may be made of aluminium without being dependent on welding operations.

**[0022]** Yet another object of the invention is to provide a cup assembly allowing removal of a bottom cup for substitution with a new or a modified bottom cup or a cup with a different shape, adapted to a differently shaped ends of the horizontals.

**[0023]** A still further object of the invention is to allow change of position of the node along the length of the vertical and/or the locking surface of the node, adapted to a differently shaped end of a horizontal.

**[0024]** Another object of the invention is to retain the full tensile strength of the vertical and/or full working capacity, i.e. for example the aluminium tubular sections, and/or the node.

**[0025]** Yet a further object of the invention is to enable provision of a node and a fixture to a vertical, for example being made up of two different material, that cannot easily be welded together and without being dependent on welding operations.

**[0026]** Yet another object of the invention is to provide a solution where a lower and upper cup also may be used in connection with a traditional vertical made of steel.

**[0027]** Another object of the invention is to provide a system wherein the bottom cup may be made of aluminium and may being fixed to a vertical of steel or aluminium in a non-welded manner without reducing the bearing capacity.

**[0028]** Another object of the invention is to provide a solution where the fixing of the lower cup is not dependent on a rigid fixing to a vertical.

**[0029]** An object of the invention is to provide a new cup that is compatible to existing system.

**[0030]** The objects are achieved by a structural support system and method as further defined by the independent claims, while embodiments, options and variants are defined by the dependent claims.

**[0031]** In a first aspect, the present invention relates to a structural support system, according to claim 1.

**[0032]** According to an embodiment, the bottom cup may comprise a lower part preferably of cylindrical form, an intermediate part, preferably inclined upwardly and outwardly, an upper part preferably of cylindrical form.

**[0033]** The bottom cup further comprises at least one hole for fastening means preferably at the circumference of the lower part or the bottom cup, the diameter of the hole being larger than the diameter of a part of the fastening means, e.g. a bolt, intended to be in contact with the bottom cup. Moreover, the hole(s) in the bottom cup may optimally be without threads.

**[0034]** According to an option, the bottom cup further comprises at least one drainage recess in the lower part of the bottom cup.

**[0035]** Moreover, the system may further comprise a bottom cup guard in order to protect the bottom cup and the fastening means, e.g. the bolts, from mechanical impact and environmental elements causing material degradation.

**[0036]** According to another embodiment, the bottom cup guard comprises a lower part, preferably of cylindrical form, and an upper part, preferably inclined upwardly and outwardly.

**[0037]** In an embodiment, the bottom cup guard further comprises at least one drainage recess at least in the lower part of the bottom cup guard, and with same height as the drainage recess of the bottom cup.

**[0038]** In an embodiment, the bottom cup guard further comprises a flange at the free end of the lower part of the bottom cup guard, pointing inwards the bottom cup guard having a diameter with a tolerance in order to approximately face the vertical.

**[0039]** The parts of the structural support system, according to an embodiment that is not part of the present invention, may also be intended to be permanently fixed to the verticals by using fastening means, being one or more dowel pins, and corresponding hole(s) in the parts and the verticals, the dowel pin(s) being rigidly fixed using a bonding agent or by press fit.

**[0040]** Dowel pins are fixed on face to face permanent connections where dowel pins are put into pre-machined holes in the verticals and in the opposite face of connecting part in combination with a bonding agent, such as glue.

**[0041]** The face-to-face dowel pin surfaces may be provided with bonding agents, such as glue, in order to fully make a strong and firm connection.

**[0042]** The bottom cup may have machined recesses at the bottom end matching dowel pins projecting out from the vertical and bonded by a bonding agent or by press fit in holes pre-machined around the vertical's periphery at the same level as described above, where the bottom cup is to be lowered and simultaneously adjusted to mate the recesses with the dowel pins and being permanently connected to the dowel pins with a bonding agent and/or spot welds between dowel pins and bottom cup.

**[0043]** Alternatively, according to an embodiment not covered by the present invention, the bottom cups may be fixed using at least two wedges for the bottom cup and by pushing the bottom cup onto the wedges in a permanent connection is made and where the wedges are connected to the vertical using a bonding agent and/or welds.

**[0044]** The bottom cup may comprise two identical but mirrored halves with pre-machined holes for dowel pins in surfaces facing the two halves and in surfaces facing the verticals, where the bottom cup halves and the verticals are

connected as described above.

**[0045]** The horizontal may comprise an elongated tube and a blade end with fins, which fits with an engaging tube, where the engaging tube and blade end are permanently connected to the elongated tube by applying glue to the connecting surfaces, where the connecting surfaces are the inner surface of the elongated tube and the outer surface of the engaging tube.

**[0046]** The elongated tube, preferably semi-cylindrically shaped may be thread onto the engaging tube, preferably semi-cylindrically shaped but might also be conical shaped, chamfered shaped or it might even be threaded for a threading connection between engaging tube and elongated tube.

**[0047]** The installed bottom cup may be covered with a bottom cup guard in order to protect the bottom cup, dowel pins and bonding agent from mechanical impacts and environmental elements causing material degradation.

**[0048]** Material used in the bottom cup guard may be of a polymer, such as plastic or rubber.

**[0049]** The horizontals may be supported with an extra support bracket in order to transfer forces between horizontals and the verticals, where the support bracket comprises two identical but mirrored shaped steel or aluminium plates. These plates are placed together in order to be able to grip around the horizontals and the verticals where the two plates are loosely connected with bolts, washers and nuts to be screwed together and tighten around the horizontals and verticals.

**[0050]** In a second aspect, the present invention relates to a method for mounting a node section on a vertical for use in a structural support system, according to claim 14. A bottom cup guard threaded onto the vertical may be raised towards the bottom cup until the free end of the lower part of the bottom cup guard aligns a free end of the lower part of the bottom cup, or until a surface of the flange of the bottom cup guard pointing in direction of the bottom cup is mating against the free end of the lower part of the bottom cup.

**[0051]** The method further providing the bottom cup guard being adjusted in position, where drainage recesses in the bottom cup guard is being aligned with drainage recesses in the bottom cup.

**[0052]** Alternatively, according to an embodiment not covered by the present invention, the surface of each hole is being treated with a bonding agent and introducing a dowel pin of steel into each of the holes, lowering the bottom cup down onto the dowel pin(s) and welding the dowel pin(s) and the lower surface of the bottom cup together in a permanent fixture to the vertical using a bonding agent.

**[0053]** The method may further provide the lower surface of the bottom cup with downwardly open holes or recesses, positioned to be complimentary to the position of the dowel pin(s) and moving the bottom cup vertically downwards and possibly rotating the bottom cup so as to allow the dowel pin(s) to enter into corresponding hole(s) or recess(es) at the bottom surface of the bottom cup.

**[0054]** Structural support system, such as scaffolding or falsework, comprises verticals and horizontals connected together with coupling agents at the verticals placed with intervals along the verticals. The coupling agents comprises lower and upper coupling parts, where the lower coupling part is being permanently connected and rigidly fixed to the vertical, and the upper coupling part is in a loose and movable connection with the vertical. The horizontals comprise elongated tubes with flanged ends at each end of the elongated tube fitting into the coupling parts. The flanged end is lifted into the lower coupling parts, the upper coupling parts are being rotated and in order to lock the upper coupling, a helical surface at the upper coupling part is wedged against a lug permanently connected to the vertical. Stoppers are preferably installed on the vertical in order to prevent the last upper coupling part to fall off the vertical.

**[0055]** A structural support system is traditionally predominated by welded steel structures. Using light material, such as aluminium is of great interest in order to gain easier handling of elements without, or with reduced need for lifting equipment. As a result of being a non-welded structure, one can retain a full tensile strength of the aluminium tubular sections. The system of the present invention is a fully non-welded element, resulting in that the aluminium elements retains full working capacities.

**[0056]** In one embodiment, the bottom cup is fixed to an aluminium vertical by using bolts. The bolts do not fix the cup against the vertical tube in the traditional sense, but act as a support for the lower cup to rest on. The bolt is fixed horizontally to the vertical via the holes within the lower part of the bottom cup, providing compressive vertical load capacity of the lower cup via the bolt head as opposed to a tightening of the bolt between the lower cup and the vertical tube. Holes in the vertical is predrilled and preferably threaded. Since the bolt do not press or fix the bottom cup to the vertical, the bolt goes straight through the cup and the cup simply rests on the bolt head. Bolts are used as a vertical restraint as opposed to a clamping function. The bolts may come in varying sizes. Since the bottom cup rests on a head of the bolt, this is allowing a higher force to be applied through the head of the bolt and back into the vertical due to larger surface area between the bolt head and the surface of the vertical.

**[0057]** The bottom cup is designed to be compatible with current steel systems on the market. The system of the present invention will provide all the same connectivity features as current system with the only difference being the vertical capacity being reduced due to the working tensile capacity of the aluminium vs. steel. The system is bi-directionally compatible with other similar systems.

**[0058]** The bottom cup is preferably formed out of a forged aluminium billet. By forging the bottom cup, the material changes occurring through the forging process causing the tensile capacities of the cup to increase, providing an

aluminium product with comparable tensile properties as steel.

**[0059]** Gluing is a well-known method for joining metal parts together and opens up the potential to use new materials or combination of different materials where use of traditionally joining methods is inconvenient. Using high strength material such as steel on load bearing or impact exposed parts and being able to choose lighter materials, such as aluminium or fibre reinforced plastics, on joining parts, may be of great interest in relation to, for example, easier handling of the elements without, or with reduced need for lifting equipment. Gluing in combination with dowel pins, or local welding of high strength material, such as steel, gives a structural reinforcement of the connection for load bearing components transferring and distributing loads to connecting components.

**[0060]** In an embodiment not covered by the invention, the bottom cup is rigidly fixed to the vertical by means of dowel pins of steel inserted and glued in pre-machined holes filled with glue in the vertical, preferably made of aluminium. A bottom cup of the coupling agent, threaded onto the vertical is provided with pre-machined recesses arranged on its lower circumferential edge, matching the size and position of the configuration of the dowel pins, the bottom cup is then lowered down onto the matching dowel pins in the vertical. Spot welding between the dowel pins and the recesses of the bottom cup, where both dowel pins and bottom cup are of the same weldable material, preferably steel, provide a firm, rigid and permanent connection of the bottom cup to the vertical. Gluing the matching surfaces of the dowel pins and recesses in the bottom cup may be an alternative or addition to the welding.

**[0061]** Another embodiment, not covered by the invention, of joining the bottom cup together with the pole is with the use of wedges. The bottom cup wedges being of a high strength material such as steel, are distributed around the circumference of the pole, where the bottom cup is being fastened to the pole by wedges. The wedges are fixed to the pole using dowel pins with glue in holes of both the pole, as indicated above, and the wedges. Additionally extra glue may be added in the interfacing mating surfaces of the pole and the wedge. Alternatively, or in addition, a welding seam between the lower end surface of the bottom cup and the wedge may be used. Other components, such as a wedge lug for the top cup and mechanical stoppers, preferably being of a high strength material such as steel, which might be dowel pins, are also connected through dowel pins and gluing, or alternatively or additionally by welding.

**[0062]** In yet another embodiment, not covered by the invention, of the bottom cup, the cup preferably being of a high strength material such as steel, the cup comprises two cup halves with holes for dowel pins. The halves are joined together, embracing a pole with dowel pins between the joining surfaces of the two halves and between the inner surfaces of the cups and the pole, and further fixed together either by welding or gluing of the joining surfaces. The inner surface of the bowl-shaped halves has curved faces complementary to the side of the vertical with holes for dowel pins and with corresponding holes for dowel pins on the vertical. When the halves are brought together around the vertical, dowel pins are also placed between the halves and the vertical before welding or gluing both the two halves together, but also the welded or glued cup formed by the two halves together with the vertical.

**[0063]** A structural support system of the present invention is a flexible system able to take all kind of shapes, from right angled to complex curves. In heavy constructions with scaffolding elements, extra support of the structure is required. The structural support system is able to also take poles arranged diagonally as a framework construction, alternatively or supplementary support brackets can be used in the corners or junction points between verticals and horizontals. Such support brackets easily grip and lock around the poles by loosening and fastening of bolts and nuts.

**[0064]** The present invention is backward compatible with the CUPLOK™ system, since the bottom cups of the present invention are designed to fit existing equipment utilizing the CUPLOK™ system. This is beneficial for the customer being able to easily adapt their existing equipment and save potentially high investment cost.

#### *Brief Description of the Drawings*

**[0065]** Embodiments of the present invention will now be described in further detail by way of example only, with reference to the following diagrams wherein:

Figure 1 shows schematically a perspective of a locking system of prior art;

Figure 2 shows schematically and in perspective a section of a typical scaffold built up with embodiments according to the present invention;

Figure 3 shows schematically and in perspective a section of a heavy-duty support structure, e.g. falsework, used for supporting heavy duty steel girders or beams for formwork, used for supporting formwork for construction of bridges, or the like;

Figure 4 shows schematically and in perspective a view of a bottom cup of one embodiment of the present invention;

Figure 5 shows schematically and in perspective a view of a bottom cup guard used to protect the bottom cup and fastening means from mechanical impacts and environmental elements causing material degradation;

Figure 6a shows a vertical with preinstalled pairs of bottom cups and a top cups arranged at different levels and spaced along the vertical. Figure 6b shows a detail A from figure 6a of the lower part of the vertical, showing one pair of a bottom cup and a top cup;

Figure 7a shows schematically an exploded view, while Figure 7b shows an assembled view of an embodiment of an assembly of the bottom cup, the top cup, as well as the bottom cup guard of the present invention;

Figure 8a shows schematically and in perspective an exploded view of an embodiment of the bottom cup of a node using the dowel fastening method according to an embodiment not covered by the present invention, while Figure 8b shows schematically and in perspective an assembled view of the embodiment shown in Figure 8a;

Figure 9a shows schematically and in perspective an exploded view of another embodiment not covered by the present invention of the bottom cup using the dowel fastening method, while Figure 9b shows schematically and in perspective an assembled view of the embodiment shown in Figure 9b;

Figure 10a shows schematically and in perspective an exploded view of yet another embodiment not covered by the present invention of the bottom cup using the dowel pins and wedges, while Figure 10b shows schematically and in perspective an assembled view of the embodiment shown in Figure 10a;

Figure 11a shows schematically and in perspective an exploded view of yet another embodiment of the bottom cup not covered by the present invention, where the bottom cup comprises two identical but mirrored halves joined together, while Figure 11b shows schematically and in perspective an assembled view of the embodiment shown in Figure 11a;

Figure 12a shows schematically and in perspective an exploded view of an embodiment not covered by the present invention for fixing a lug used for locking the top cup of the coupling system against upwards movement to the vertical; while Figure 12b shows schematically and in perspective the embodiment shown in Figure 12a, the unit being in an assembled state;

Figure 13a shows schematically and in perspective an end of a horizontal and its end configuration in an exploded view, while Figure 13b shows the horizontal end in an assembled state;

Figure 14 shows in perspective an assembled node on a vertical, with one horizontal supported the support bracket, extending between the vertical below a node and a horizontal, the support bracket forming an angle with the horizontal and the vertical;

Figure 15a shows schematically and in perspective an embodiment of the support bracket in an exploded state, while Figure 15b shows the embodiment shown in Figure 15a in an assembled state; and

Figure 16a shows schematically and in perspective an exploded view of an embodiment, not covered by the present invention, of the bottom cup including a bottom cup guard, while Figure 16b shows schematically and in perspective an assembled view of the embodiment shown in Figure 16a.

#### *Detailed Description of embodiment disclosed in the Drawings*

**[0066]** The following description of the exemplary embodiments refers to the accompanying drawings. The drawings illustrate exemplary embodiments configured to be integrated in a structural support system such as a scaffolding or a falsework system. The exemplary embodiments disclosed in the drawings should not be understood as a limitation to the scope of protection of the invention.

**[0067]** The same reference numbers in different drawings identify the same or similar elements. The following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

**[0068]** Reference throughout the specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases "in one embodiment" or "in an embodiment" in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

**[0069]** In general, the verticals are made of aluminium, and the elements forming the node or the wedges or the lugs of the embodiments described below, i.e. top and bottom cup and the dowels may be made either of forged aluminium or steel, unless otherwise specifically defined. In this manner, if bottom cup is made of steel, steel dowel pins and bottom cup may be welded together, or the dowel pins used may be glued, or press fitted with corresponding elements. In addition, or as an alternative, interconnected surfaces may also be glued.

**[0070]** Figure 1 shows schematically a perspective of a prior art node section 120 used for locking horizontals or the like in a prior art scaffolding system. The system is made of steel. Only a single node section 120 is shown. It should be noted, however that each vertical 10, which is delivered in standard lengths, are provided with node sections 120 shown in Figure 1, preferably equally spaced apart in tube longitudinal direction. The system consists of a vertical 10 provided with a bottom cup 20, welded to the vertical 10. The bottom cup 20 defines an annular channel 21 (not shown in Figure 1) around it, such annular channel 21 being open at its upper end. The lower part 22 of the wall of the bottom cup 20 is inclined upwardly and outwardly from the vertical 10 and terminates in a short upper part 24 of cylindrical form.

**[0071]** The node section 120 also consist at its upper end of a top cup 30 which is slidably and rotatably mounted on the vertical 10 and also defines an annular channel (not shown in Figure 1) around it, the annular channel being open at its lower end, the wall of the top cup 30 having a cylindrical upper part which fits loosely around the vertical 10 and a downwardly inclined lower part. At one side, the top cup 30 has a bulge 31, in which there is formed adjacent to the vertical

10, a vertical slot 32. The top face of the top cup 30 may be inclined upwardly from either side of the bulge 31 or continuously for a full 360° from one side, thus forming a wedge-shaped surface.

**[0072]** The vertical 10 has on one side thereof a lug 12, which is of such size that it can pass through the vertical slot 32 in the bulge 31 of the top cup 30. Thus, if the top cup 30 is turned to bring the lug 12 into line with the vertical slot 32, the top cup 30 can be moved up and down the vertical 10 past the lug 12.

**[0073]** A horizontal 40 is at each end provided with a blade end 41 provided with two diametrically opposed fins 42 (not shown). The fins 42 on each end of the horizontal 40 are pointing in the same direction. The end surface of the blade end 41 is curved, i.e. given a shape that is complimentary to the corresponding shape of the vertical 10.

**[0074]** For assembling a vertical 10 and a horizontal 40, the top cup 30 is in a position above the lug 12 on the vertical 10. A flanged coupling end (the horizontal's 40 blade end 41) is brought into position with one fin 42 positioned inside the open ended annular channel 21 in the bottom cup 20, also bringing the horizontal 40 into a position where it is perpendicular to the vertical 10. The top cup 30 is then lowered by bringing the vertical slot 32 in the top cup 30 in aligned position with the lug 12, whereupon the top cup 30 is lowered down past the lug 12 and around the upper fin 42. In this position, the inclined upper surface of the top cup 30 is positioned below the lower end of the lug 12. In order to lock the position of the horizontal 40, the top cup 30 is rotated in a clockwise direction. Due to the inclining surface of the top cup 30, when the top cup 30 is rotated in this position, the top cup 30 will act as a wedge against the lug 12, forcing the top cup 30 in the downwards direction, thus providing a secure locking engagement between the top cup 30, the blade end 41 and the vertical 10. In order to achieve rotational movement of the top cup 30, the top cup 30 is fitted with top cup lugs 33, spaced apart around the top cup 30, said top cup lugs 33 being intended to be hit by a hammer or a sledge in order to force the top cup 30 into a locking engagement. It should be noted that the blade ends 41, which are made of steel, are welded to the end of the horizontal 40.

**[0075]** Figure 2 shows schematically and in perspective a view of a typical scaffold built up with embodiments according to the present invention. The scaffold may comprise of a number of verticals 10 arranged in spaced relation and interconnected by a number of horizontals 40. As indicated in the Figure 2, the verticals 10 and the horizontals 40 are locked together by means of node sections 120. The node sections 120 disclosed are of a type that shall be described in more detail below. It should be noted that the scaffold may also be provided with accessories, such as bracings with brace ledge ends, brackets, base jacks, all adapted to form an integrated part of the node system described below. As indicated in Figure 2, the horizontals 40 are assembled in a node section 120, i.e. two horizontals 40 being aligned arranged with an angle of 180° there between, while the third horizontal 40 is arranged orthogonally with the two aligned horizontals 40. It should be noted that other angles and another number of horizontals 40 adjoining in a node section 120 on a vertical 10 is also possible.

**[0076]** Figure 3 shows schematically, principally and in perspective a view of a heavy-duty falsework support structure, for example usable for supporting heavy duty steel girders or beams for formwork, for example for supporting formwork for construction of bridges, or the like. As shown in Figure 3, the falsework is made up of nine verticals 10 and a large number of horizontals 40, adjoined to the respective verticals 10. Dependent on type and size of falsework and the structure to be supported, the falsework may be made up of numerous verticals 10 and horizontals 40. In this respect, a typical joint may be made up of four adjoining horizontals 40, forming an angle of 90° between each. Again, the built-up of each node section 120, the method for fabricating the verticals and the method for assembling the system shall be described in further details below.

**[0077]** Figure 4 shows schematically and in perspective a view of a bottom cup 20 of one embodiment of the present invention. The bottom cup is made of metal material, preferably of aluminium, but may also be made of steel. A lower part 22 of the wall of the bottom cup 20 preferably forms a lower part 22 of a cylindrical form. An intermediate part 23 of the bottom cup 20 is preferably inclined upwardly and outwardly, while an upper part 24 of the bottom cup 20 preferably forms an upper part 24 of cylindrical form. Cut-outs in lower end of the bottom cup 20 are drainage recesses 26 for draining purposes, preventing accumulation of water, ice, etc. in the bottom cup 20. In order to fix the bottom cup 20 to a vertical 10 (not shown), at least one hole 25 for fastening means 50 (not shown), preferably at the lower part 22 of the bottom cup 20, are furnished at the bottom cup 20. Corresponding hole(s) 11 is furnished at the vertical 10. The holes 11 at the vertical are preferably susceptible to receive threaded fastening means 50.

**[0078]** Figure 5 shows schematically and in perspective a view of a bottom cup guard 110 used to protect the bottom cup 20 (not shown) and fastening means 50 (not shown) from mechanical impacts and environmental elements causing material degradation. A lower part 111 of the bottom cup guard 110 forms a lower part 111 of preferably a cylindrical form. An upper part 112 of the bottom cup guard 110 forms an upper part 112 preferably inclined upwardly and outwardly. A free end of the lower part 111 of the bottom cup guard 110 preferably has a flange 113 orthogonal to the cylindrical form of the lower part 111 directed towards an axial axes of the bottom cup guard 110, having a diameter with a tolerance in order to approximately face the outer surface of the vertical 10 (not shown). Further the bottom cup guard 110 may be furnished with cut-outs in the lower end of the bottom cup guard 110 being drainage recesses 114 corresponding the recesses 26 of the bottom cup 20 (not shown). The recesses 114 of the bottom cup guard 110, also serving as draining purposes as those recesses 26 of the bottom cup 20 (not shown), preventing accumulation of water, ice etc. in the bottom cup 20 (not shown).



The bottom cup guard 110 can be of for example a polymer, such as plastic or rubber. The bottom cup guard 110 can also serve as a marketing object, sporting for instance company logo or product name, and/or being in bright colour. The bottom cup guard 110 is made up of a single unit and may be applied an adhesive and attached to the bottom cup 20, thus providing permanent joining of the bottom cup guard 110 and the bottom cup 20.

**[0079]** Figure 6a shows a vertical 10 with preinstalled pairs of bottom cups 20 and a top cups 30 arranged at different levels and spaced along the vertical 10, ready to be installed in a falsework, scaffold or the like and ready to receive bladed ends of horizontals 40 comprising in a falsework, scaffold or the like. The top cup 30 is made of metal material, preferably aluminium. The vertical 10 shows six pairs of bottom cups 20 and top cups 30, there may be fewer and there may be more, but each vertical 10 shall preferably comprise at least one pair of one bottom cup 20 and one top cup 30. At each end of the vertical 10 there are bolts going straight through the vertical with an accompanying nuts. These bolts and nuts are for connection to internal spigots used when stacking one vertical 10 on top of another when the structural support system moves vertically/grows upwards. Figure 6b shows a detail A from figure 6a of the lower part of the vertical 10, showing one pair of a bottom cup 20 and a top cup 30. A bottom cup guard 110 (not shown) may also be preinstalled below each pair of bottom cups 20 and top cups 30 arranged at the vertical 10. A lug 12 is shown on the vertical 10 arranged above a pair of bottom cups 20 and top cups 30. An inclined helical surface 34 at the upper part of the top cup 30. In order to lock the horizontal 40 (not shown), the top cup 30 is rotated in order for top cup 30 to slide it's helical surface 34 towards the lug 12 forcing the top cup 30 in an downward direction. The lug 12 and the helical surface 34 acting as a wedge, providing a secure locking engagement.

**[0080]** Figure 7a shows schematically an exploded view, while Figure 7b shows an assembled view of an assembly of the bottom cup 20 and the top cup 30 of the present invention. At its upper end, the bottom cup 20 is configured to form an annular channel 21 around the vertical 10 when assembled and fixed to the vertical 10. The annular channel 21 is formed by the room between the vertical 10 and surface facing inwards and towards the vertical 10 of the intermediate part 23 and the upper part 24 of the bottom cup 20 as described above in the description of Figure 4. In Figure 7a is shown holes 11 in the vertical 10, there should be at least one hole 11, preferably two holes 11, and more preferably three holes 11. These holes 11 in the vertical 10 corresponds to the at least one hole 25 of the bottom cup 20. When the bottom cup 20 is lowered or raised in order for the at least one hole 25 in the bottom cup 20 to be at the level of the at least one hole 11 in the vertical 10, the bottom cup 20 should be adjusted to align the axis of the at least one hole 25 in the bottom cup 20 with the axis of the at least one hole in the vertical 10. Thus, when at least two holes 25 in the bottom cup 20, those holes should be distributed around it's circumferences with the same distribution/angle as the at least two holes 11 in the vertical 10 distributed around it's circumferences, the at least two holes 11 being in a common plane approximately orthogonal to a longitudinal axis of the vertical 10. When the holes 11, 25 in the vertical 10 and the bottom cup 20 respectively, are aligned, at least one fastening means 50 may be threaded through the at least one hole 11, 25 of the vertical 10 and the bottom cup 20. The fastening means 50 may preferably be a cap-head socket bolt, but may also be any other suitable threaded or unthreaded bolts, with or without heads, or even pins or wedges. The fastening means 50 not fixing the bottom cup 20 to the vertical 10, rather serving as support for the bottom cup 20 to rest on. The fixing of the at least one bolt 50 to the vertical 10 via the holes 25 in the bottom cup 20 provides a compressive vertical load capacity of the lower cup via the fastening means as opposed to a tightening of the fastening means between the bottom cup 20 and the vertical 10.

**[0081]** A bottom cup guard 110 position on the vertical below the bottom cup 20 will be raised towards the bottom cup 20 until the free end of the lower part 111 of the bottom cup guard 110 aligns a free end of the lower part 22 of the bottom cup 20, or until an surface of the flange 113 of the bottom cup guard 110 pointing in direction of the bottom cup 20 is mating against the free end of the lower part 22 of the bottom cup 20. The recesses drainage 114 of the bottom cup guard 110 being positioned to align with the drainage recesses 26 of the bottom cup 20 and thereby the draining purposes, preventing accumulation of water, ice, etc. in the bottom cup 20 being fulfilled and protecting the bottom cup 20 and fastening means 50 from mechanical impacts and environmental elements causing material degradation.

**[0082]** The top cup 30 is arranged above the bottom cup 20, the vertical 10 being in an upraised vertical position. A lug 12, preferably a cap-head socket bolt, but may also be any other suitable threaded or unthreaded bolts, with or without head, or even pins or wedges being arranged in a hole 13, threaded or unthreaded, in the vertical 10 preventing the top cup 30 for further movement upwards the vertical 10. When the bottom cup 20 is installed and the top cup 30 is installed and at it's uppermost position, preventing any further movement by means of the lug 12, the bottom cup 20 and top cup 30 is now ready to receive the bladed ends 41 of the horizontals 40 (not shown) comprising in the falsework, scaffold or the like. When the lower part of the bladed ends 41 of the horizontals 40 (not shown) is received by the bottom cup 20, the top cup 30 will thereafter be lowered towards the bottom cup 20 and rotated onto the upper part of the blade end 41, by rotating the top cup 30 comprising a helical surface 34 at its upper part against the lug 12, and thereby locking the horizontals 20 to the vertical 10 in a firm locking, but releasable, engagement. In order to achieve the rotational movement of the top cup 30, the top cup 30 is fitted with top cup lugs 33, spaced apart around the top cup 30, said top cup lugs 33 being intended to be hit by a hammer or a sledge in order to force the top cup 30 into the locking engagement.

**[0083]** Figure 8a shows schematically an exploded view while Figure 8b shows an assembled view of another embodiment of the bottom cup 20 made of steel, fixed to the vertical 10. At its upper end, the bottom cup 20 is configured

to form an annular channel 21 around the vertical 10 when assembled and fixed to the vertical 10 in aluminium. The annular channel 21 is open at its upper end. The lower part 22 of the wall of the bottom cup 20 is inclined upwardly and outwardly, while the upper part 24 of the bottom cup 20 forms an upper part 24 of steel with a cylindrical form.

**[0084]** In order to fix the bottom cup 20 to the vertical 10, holes 11 for fastening means 50, are pre-machined in the vertical 10 around its periphery at the same level, into which fastening means 50, preferably dowel pins of steel are fixed, protruding radially out of the vertical 10. The holes 11 in the verticals 10 are preferably pre-glued in order to permanently fix the dowel pins 50 to the vertical 10. The dowel pins 50 are evenly positioned around the entire circumference of the vertical 10, positioned at the same level. At its lower end surface, the bottom cup 20 is provided with a corresponding number of machined recesses 28 in bottom cup 20 to match the number of dowel pins 50 arranged around the circumference of the vertical 10.

**[0085]** It should be noted that the bottom cup 20 may be machined as a single, integrated unit, thread on to the vertical 10 for appropriate fixing, or the bottom cup 20 may be machined or formed as separate units and subsequently assembled around the vertical. The latter way of assembling will be described below.

**[0086]** When lowering bottom cup 20 down onto the dowel pins 50, the orientation of the bottom cup 20 is adjusted so as to enable recesses 28 in bottom cup 20 on the lower surface of the bottom cup 20 to rest on the corresponding dowel pins 50. If the vertical 10 is in an upright position, the bottom cup 20 is now resting on the dowel pins 50. The bottom cup 20 is permanently connected to the dowel pins 50, and thereby to the vertical 10, preferably through spot welds between bottom cup 20 and each dowel pin 50 and/or by applying glue to either dowel pins 50 and/or the machined recesses 28 in bottom cup 20, thus gluing the bottom cup 20 to the dowel pins 50. Cutouts in lower end of bottom cup 20 are drainage recesses 26 for draining purposes, preventing accumulation of water or ice in the bottom cup 20.

**[0087]** Figure 9a and 9b shows yet another embodiment of the bottom cup 20 of the view shown in Figure 8, the only major difference being the height of the cylindrical part 15 of the bottom cup 20.

**[0088]** Figure 10a shows schematically an exploded view of yet another embodiment, while Figure 10b shows an assembled view of the same embodiment of a bottom cup 20. Apart for the differences described below, the shape, configuration, and function of the bottom cup 20 disclosed correspond to the shape, configuration and functions disclosed above in relation to Figure 8 and 9. According to this embodiment, upwards and inwards inclined wedges 70 are used for locking the bottom cup 20 to the vertical 10. Holes 11 for dowel pins 50 are pre-machined in the vertical 10 around its periphery, in which dowel pins 50 are placed and fixed, protruding out from the outer surface of the vertical 10. The holes 11 in the vertical 10 are preferably pre-glued, in order to permanently fix the dowel pins 50 to the vertical 10. Glue is applied to the dowel pins 50 protruding out of the outer surface of the vertical 10 and the wedges 70 provided with corresponding machined holes (not shown) to match the dowel pins 50, fixing the wedges 70 to the dowel pins 50 for a permanent fixture on the vertical 10. Correspondingly, the inner surface at the lower end of the bottom cup 20 is provided with complementary shaped recesses (not shown), configured to receive the wedges 70 and securing the correct position of the bottom cup 20 on the vertical 10. Alternatively, or supplementary, the mating surfaces of the wedges 70 against the vertical 10 might be applied with glue. The bottom cup 20 thereafter slides down onto to the wedges 70 for a stiff and firm connection. After the bottom cup 20 is placed onto the wedges 70, welding may be applied between the bottom cup 20 and the wedges 70 in order to insure a fixed connection.

**[0089]** Figure 11a shows schematically an exploded view of a yet another embodiment of the bottom cup, while Figure 11b shows an assembled view of the same embodiment of the bottom cup 20. The bottom cup 20 comprises two identical, but mirrored, bottom cup halves 27, 27'. Dowel pins 60 are used to connect both the two bottom cup halves 27, 27' together, and dowel pins 50 are at the same time connecting the two bottom cup halves 27, 27' together with the vertical 10. Pre-machined holes 29 in the mating surfaces of the two bottom cup halves 27, 27' and pre-machined holes 11 in the mating surfaces of the two bottom cup halves 27, 27' and the vertical 10 is applied with glue before dowel pins 29, 50 are inserted protruding out of the vertical 10 and one half 27, 27' of the bottom cup 20. Glue is filled in the remaining holes 11, 29. The bottom cup halves 27, 27' are then joined together with each other and at the same time with the vertical 10 for a permanent connection.

**[0090]** Figure 8-10 shows cups in one piece, it is not restricted to be manufactured in one piece; it might in all embodiments as shown in figure 8-10 be manufactured in two pieces, joined together as described in figure 11, with or without dowel pins in combination with gluing and/or welding on joining surfaces, prior to being thread onto the vertical.

**[0091]** Figure 12a shows schematically an exploded view of an embodiment of a lug 12 for locking of the top cup 30, while Figure 12b shows the unit in an assembled state. Holes 13 are pre-machined in the vertical 10 in which dowel pins 130 are placed protruding out of the vertical 10, the holes 13 are preferably pre-glued, in order to permanently fix the dowel pins 130 to the vertical 10. Glue is applied to the dowel pins 130 and the face of lug 12, which shall be mated with the vertical 10, before the lug 12, with pre-machined holes to match the dowel pins 130 in the vertical 10, is placed onto the dowel pins 130 for a permanent connection. Stoppers 100, which might be dowel pins, shown at the top of the vertical 10 are mechanical stoppers preventing loose objects, such as the top cup 30, from falling off. The stoppers 100 are placed in pre-machined holes in the vertical 10 filled with glue.

**[0092]** Figure 13a and 13b shows an exploded and assembled view of an embodiment of the end piece of a horizontal 40

with an end piece on each end of an elongated tube 80 of the horizontal 40. The long elongated tube 80 of the horizontal 40 being of a light material, such as aluminium, is to be permanently connected to a connecting end piece comprising a blade end 41 with an engaging tube 81, being of a stronger material such as steel.

**[0093]** The blade end 41 of the end piece fits the shape of the vertical 10, the bottom cup 20 and top cup 30. The end piece's engaging tube 81 has a shape to fit within the elongated tube 80 of the horizontal 40. The outer surface of the engaging tube 81 of the connecting end piece being applied with glue before being treaded into the elongated tube 80 of the horizontal 40 for a permanent connection. The engaging tube 81 is preferably of a semi-cylindrical shape, but it might also take a conical shape, chamfered shape or it might be threaded for a threaded connection between engaging tube 81 and elongated tube 80.

**[0094]** Figure 14 shows schematically an embodiment of an assembly of the coupling system of the present invention. Showing two horizontals 40, only end part shown, to be connected to the vertical 10 through first lowering one side of the blade end 41 into the preinstalled, permanent bottom cup 20 as described in Figure 7, 8, 9, 10 and 11. A top cup 30 is thereafter lowered and rotated onto the other side of the blade end 41, by rotating the top cup 30 comprising a helical upper part against the lug 12 described in Figure 12, and thereby locking the horizontals 40 to the vertical 10 in a firm but releasable connection. A support bracket 90 may be assembled between the vertical 10 and horizontal 40 in order to aid the transfer of loads between the horizontal 40 and the vertical 10 creating a stronger and more rigid connection between the horizontal 40 and the vertical 10. The support bracket 90 is configured to be securely fixed to the vertical 10 below the node section 120 and the horizontal 40 at a distance from the node section 120, thereby forming a strut or a brace. The support bracket 90 will be described in further details below, referring to Figure 15a and 15b.

**[0095]** Figure 15a and 15b shows an exploded and assembled view of an embodiment of the support bracket 90 mentioned in Figure 14 comprising two identical but mirrored support bracket plates 91, 91', being shaped steel or aluminium plates, able to grip around both the horizontal 40 and the vertical 10. The two support bracket plates 91, 91' are loosely connected with bolts 93, washers 95 and nuts 96 before assembled in order to be fastened together and tightened around the horizontal 40 and the vertical 10. The bolts 93, which may be carriage bolts used with corresponding squared holes 94 in the support bracket plates 91, 91' in order to keep the bolts 93 in place while screwing the nuts 96 and tightening the parts together or loosening the parts, thereby eliminating the need of an extra holding-on tool while tightening or loosening of the parts.

**[0096]** Figure 16a and 16b shows an exploded and assembled view of an embodiment of a bottom cup guard 110 used to protect the bottom cup 20, dowel pins 50 and joining adhesive from mechanical impacts and environmental elements causing material degradation. The bottom cup guard 110 can be for instance of a polymer material such as plastic or rubber. The bottom cup guard 110 can also serve as a marketing object, sporting for instance company logo or product name, and/or being in bright colour. The bottom cup guard 110 is made up of a single unit and is applied an adhesive and attached to the bottom cup 20, thus providing permanent joining of the bottom cup guard 110 and the bottom cup 20.

Table 1

10	Vertical
11	Holes in the vertical
12	Lug on vertical
13	Hole for lug on vertical
20	Bottom cup
21	Annual channel
22	Lower part of the wall of the bottom cup
23	Intermediate part of the wall of the bottom cup
24	Upper part of the wall of the bottom cup
25	Hole in bottom cup
26	Drainage recess in bottom cup
27, 27'	Bottom cup halves
28	Machined recesses in bottom cup
29	Holes in the mating surfaces of the bottom cup halves
30	Top cup
31	Top cup bulge

(continued)

32	Vertical slot
33	Top cup lug
34	Helical surface
40	Horizontal
41	Blade end
42	Fins
50	Fastening means
60	Dowel pins for bottom cup halves
70	Wedges
80	Elongate tube
81	Inner tube
90	Support bracket
91, 91'	Support bracket plate
92, 92'	Clamping portion
93	Bolt
94	Squared hole
95	Washer
96	Nut
100	Stopper
110	Bottom cup guard
111	Lower part of the bottom cup guard
112	Upper part of the bottom cup guard
113	Flange of the bottom cup guard
114	Drainage recess in bottom cup guard
120	Node section
130	Dowel pins for lugs in vertical

## Claims

1. A structural support system, such as, but not limited to, a scaffolding or a falsework comprising verticals (10), horizontals (40) and/or diagonals connected at node sections (120) at the verticals (10), where each node section (120) comprises a locking device for joining horizontals (40) and/or diagonals with bladed ends arranged at ends of the horizontals (40) and/or diagonals and the vertical (10), where the locking device is a cup pair comprising a bottom cup (20) held at a position on the verticals (10) and a top cup (30) moveably arranged on the verticals (10), where bladed ends of the horizontals (40) and/or diagonals are configured to be locked by bottom cup (20) part and top cup (30) part, providing a rigid connection,

the bottom cup (20) comprises at least one hole (25), preferably at the circumference of a lower part (22) of the bottom cup (20),

the bottom cups (20) to be held at a position on the verticals (10) are held by using at least one fastening means (50) and corresponding hole(s) (11, 25) in the bottom cups (20) and the verticals (10), the fastening means (50) being a headed bolt rigidly fixed by screwing the headed bolt into the vertical (10),

**characterized in that** the diameter of the hole (25)

of said bottom cup (20) being larger than the diameter of the head of the headed bolt, such that the hole (25) of the bottom cup (20) rests on the head of the headed bolt, providing a compressive

load capacity in  
vertical and/or horizontal direction of the bottom cup (20) via the bolt.

- 5     **2.** Structural support system according to claim 1, where the bottom cup (20) comprises the lower part (22), preferably of cylindrical form, an intermediate part (23), preferably inclined upwardly and outwardly, an upper part (24) preferably of cylindrical form.
- 3.** Structural support system according to claim 1 or 2, wherein the hole(s) (25) in the bottom cup is without threads.
- 10    **4.** Structural support system according to one of the claims 1-3, where the bottom cup (20) further comprises at least one drainage recess (26) in the lower part (22) of the bottom cup (20).
- 5.** Structural support system according to one of the claims 1-4, where the system further comprises a bottom cup guard (110).
- 15    **6.** Structural support system according to claim 5, where the bottom cup guard (110) comprises a lower part (111), preferably of cylindrical form, and an upper part (112), preferably inclined upwardly and outwardly.
- 7.** Structural support system according to claim 6, where the bottom cup guard (110) further comprises at least one drainage recess (114) at least in the lower part (111) of the bottom cup guard (110), preferably with the same height and width as the drainage recess (26) of the bottom cup (20).
- 20    **8.** Structural support system according to claim 5 or 6, where the bottom cup guard (110) further comprises a flange (113) at the free end of the lower part (111) of the bottom cup guard (110), pointing inwards the bottom cup guard (110) having a diameter with a tolerance in order to approximately face outer surface of the vertical (10).
- 25    **9.** Structural support system according to any of the preceding claims, where the horizontal (40) comprises an elongated tube (80) and a blade end (41) with fins (42) with an engaging tube (81), where the engaging tube (81) and blade end (41) are permanently connected and further being permanently connected to the elongated tube (80) by applying glue to the connecting surfaces, where connecting surfaces is inner surface of the elongated tube (80) and the outer surface of the engaging tube (81).
- 30    **10.** Structural support system according to claim 9, where the elongated tube (80), preferably semi-cylindrically shaped is thread onto the engaging tube (81), preferably semi-cylindrically shaped but might also be conical shaped, chamfered shaped or it might even be threaded for a threading connection between engaging tube (81) and elongated tube (80).
- 35    **11.** Structural support system according to any of the claims 1-10, where the installed bottom cup (20) is covered with a bottom cup guard (110) in order to protect the bottom cup (20), fastening means (50) and bonding agent from mechanical impacts and environmental elements causing material degradation.
- 40    **12.** Structural support system according to claim 11, where material used in the bottom cup guard (110) is of a polymer, such as plastic or rubber.
- 13.** Structural support system to any of the claims 1-12, where the horizontals (40) are supported with extra support bracket (90) in order to transfer forces between horizontals (40) and the verticals (10), where the support bracket (90) comprises two identical but mirrored shaped steel or aluminium plates (91, 91') in order to be able to grip around the horizontals (40) and the verticals (10) where the two plates (91, 91') are loosely connected with bolts (93), washers (95) and nuts (96) to be screwed together and tighten around the horizontals (40) and verticals (10).
- 45    **14.** A method for mounting a node section (120) on a vertical (10) for use in a structural support system, according to any of the claims 1-13, where each node section (120) is a locking device for connecting horizontals and/or diagonals with bladed ends arranged at ends of the horizontals (40) and/or diagonals with verticals (10), where the locking device is a cup comprising a bottom cup (20) of metal material, preferably aluminium or steel held at a predetermined position on the verticals (10) and a top cup (30) of metal material, preferably aluminium, moveably connected to the verticals (10),  
50    **characterized in that** forming the vertical (10) from extruded aluminium tubes, forming one or more radially orientated holes (11) in the outer surface of the vertical (10) surface, the surface of each hole (11) preferably being threaded, positioning the holes (25) in the bottom cup (20) with the holes (11) in the vertical (10) and introducing a fastening means(50) of steel into each of the holes (11) via the holes (25) in the bottom cup (20).  
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15. Method according to claim 14, wherein a bottom cup guard (110) threaded onto the vertical (10) being raised towards the bottom cup (20) until the free end of the lower part (111) of the bottom cup guard (110) aligns a free end of the lower part (22) of the bottom cup (20), or until a surface of the flange (113) of the bottom cup guard (110) pointing in direction of the bottom cup (20) is mating against the free end of the lower part (22) of the bottom cup (20).
16. Method according to claim 15, wherein the bottom cup guard (110) is being adjusted in position where drainage recesses (114) in the bottom cup guard (110) is being aligned with drainage recesses (26) in the bottom cup (20).

## Patentansprüche

1. Strukturstützsystem, wie beispielsweise, aber nicht beschränkt auf ein Gerüst oder ein Lehrgerüst, umfassend Vertikale (10), Horizontale (40) und/oder Diagonale, die an Knotenabschnitten (120) an den Vertikalen (10) verbunden sind, wobei jeder Knotenabschnitt (120) eine Verriegelungsvorrichtung zum Verbinden von Horizontalen (40) und/oder Diagonalen mit an den Enden der Horizontalen (40) und/oder Diagonalen und der Vertikalen (10) angeordneten beschauelte Enden umfasst, wobei die Verriegelungsvorrichtung ein Becherpaar ist, umfassend einen unteren Becher (20), der an einer Position an den Vertikalen (10) gehalten wird, und einen oberen Becher (30), der beweglich an den Vertikalen (10) angeordnet ist, wobei beschauelte Enden der Horizontalen (40) und/oder Diagonalen dazu konfiguriert sind, durch den unteren Becherteil (20) und den oberen Becherteil (30) verriegelt zu werden, um eine starre Verbindung bereitzustellen,

der untere Becher (20) mindestens ein Loch (25) umfasst, vorzugsweise an dem Umfang eines unteren Teils (22) des unteren Bechers (20),

die unteren Becher (20) an einer Position an den Vertikalen (10) unter Verwendung von mindestens einem Befestigungsmittel (50) und entsprechenden Löchern (11, 25) in den unteren Bechern (20) und den Vertikalen (10) gehalten werden, wobei das Befestigungsmittel (50) eine Kopfschraube ist, die durch Einschrauben der Kopfschraube in die Vertikale (10) starr befestigt wird,

**dadurch gekennzeichnet, dass** der Durchmesser des Lochs (25) des unteren Bechers (20) größer ist als der Durchmesser des Kopfes der Kopfschraube, sodass das Loch (25) des unteren Bechers (20) auf dem Kopf der Kopfschraube aufliegt und eine Druckbelastbarkeit in vertikaler und/oder horizontaler Richtung des unteren Bechers (20) über die Schraube bereitstellt.

2. Strukturstützsystem nach Anspruch 1, wobei der untere Becher (20) den unteren Teil (22), vorzugsweise in zylindrischer Form, einen Zwischenteil (23), vorzugsweise nach oben und außen geneigt, und einen oberen Teil (24), vorzugsweise in zylindrischer Form, umfasst.
3. Strukturstützsystem nach Anspruch 1 oder 2, wobei das Loch/die Löcher (25) in dem unteren Becher ohne Gewinde ist/sind.
4. Strukturstützsystem nach einem der Ansprüche 1 bis 3, wobei der untere Becher (20) ferner mindestens eine Entwässerungsaussparung (26) in dem unteren Teil (22) des unteren Bechers (20) umfasst.
5. Strukturstützsystem nach einem der Ansprüche 1 bis 4, wobei das System ferner einen unteren Becherschutz (110) umfasst.
6. Strukturstützsystem nach Anspruch 5, wobei der untere Becherschutz (110) einen unteren Teil (111), vorzugsweise in zylindrischer Form, und einen oberen Teil (112), vorzugsweise nach oben und außen geneigt, umfasst.
7. Strukturstützsystem nach Anspruch 6, wobei der untere Becherschutz (110) ferner mindestens eine Entwässerungsaussparung (114) mindestens in dem unteren Teil (111) des unteren Becherschutzes (110) umfasst, vorzugsweise mit derselben Höhe und Breite wie die Entwässerungsaussparung (26) des unteren Bechers (20).
8. Strukturstützsystem nach Anspruch 5 oder 6, wobei der untere Becherschutz (110) ferner einen Flansch (113) an dem freien Ende des unteren Teils (111) des unteren Becherschutzes (110) umfasst, der nach innen zeigt, wobei der untere Becherschutz (110) einen Durchmesser mit einer Toleranz aufweist, um ungefähr der Außenfläche der Vertikalen (10) zugewandt zu sein.
9. Strukturstützsystem nach einem der vorstehenden Ansprüche, wobei die Horizontale (40) ein längliches Rohr (80)

und ein Schaufelende (41) mit Rippen (42) mit einem Eingriffsrohr (81) umfasst, wobei das Eingriffsrohr (81) und das Schaufelende (41) dauerhaft verbunden sind und ferner dauerhaft mit dem länglichen Rohr (80) durch Auftragen von Klebstoff auf die Verbindungsflächen verbunden sind, wobei die Verbindungsflächen die Innenfläche des länglichen Rohrs (80) und die Außenfläche des Eingriffsrohrs (81) sind.

- 5 10. Strukturstützsystem nach Anspruch 9, wobei das längliche Rohr (80), das vorzugsweise halbzyklindrisch geformt ist, auf das Eingriffsrohr (81) geschraubt ist, das vorzugsweise halbzyklindrisch geformt ist, aber auch konisch geformt, abgeschrägt oder sogar mit einem Gewinde für eine Gewindeverbindung zwischen dem Eingriffsrohr (81) und dem länglichen Rohr (80) versehen sein kann.
- 10 11. Strukturstützsystem nach einem der Ansprüche 1 bis 10, wobei der installierte untere Becher (20) mit einem unteren Becherschutz (110) abgedeckt ist, um den unteren Becher (20), die Befestigungsmittel (50) und das Bindemittel vor mechanischen Einwirkungen und Umwelteinflüssen zu schützen, die eine Materialverschlechterung verursachen.
- 15 12. Strukturstützsystem nach Anspruch 11, wobei das für den unteren Becherschutz (110) verwendete Material aus einem Polymer, wie Kunststoff oder Gummi, besteht.
- 20 13. Strukturstützsystem nach einem der Ansprüche 1 bis 12, wobei die Horizontalen (40) mit einer zusätzlichen Stützhalterung (90) gestützt werden, um Kräfte zwischen den Horizontalen (40) und den Vertikalen (10) zu übertragen, wobei die Stützhalterung (90) zwei identische, aber spiegelbildlich geformte Stahl- oder Aluminiumplatten (91, 91') umfasst, um in der Lage zu sein, um die Horizontalen (40) und die Vertikalen (10) herum zu greifen, wobei die beiden Platten (91, 91') lose mit Schrauben (93), Unterlegscheiben (95) und Muttern (96) verbunden sind, um miteinander verschraubt und um die Horizontalen (40) und Vertikalen (10) herum festgezogen zu werden.
- 25 14. Verfahren zum Montieren eines Knotenabschnitts (120) an einer Vertikalen (10) zur Verwendung in einem Strukturstützsystem nach einem der Ansprüche 1 bis 13, wobei jeder Knotenabschnitt (120) eine Verriegelungsvorrichtung zum Verbinden von Horizontalen und/oder Diagonalen mit beschauelten Enden ist, die an Enden der Horizontalen (40) und/oder Diagonalen mit Vertikalen (10) angeordnet sind, wobei die Verriegelungsvorrichtung ein Becher ist, umfassend einen unteren Becher (20) aus Metallmaterial, vorzugsweise Aluminium oder Stahl, der an einer vorbestimmten Position an den Vertikalen (10) gehalten wird, und einen oberen Becher (30) aus Metallmaterial, vorzugsweise Aluminium, der beweglich mit den Vertikalen (10) verbunden ist,  
30 **dadurch gekennzeichnet, dass** die Vertikale (10) aus stranggepressten Aluminiumrohren geformt ist, ein oder mehrere radial ausgerichtete Löcher (11) in die Außenfläche der Vertikalen (10) geformt sind, die Oberfläche jedes Lochs (11) vorzugsweise mit einem Gewinde versehen ist, die Löcher (25) in dem unteren Becher (20) mit den Löchern (11) in der Vertikalen (10) positioniert werden und ein Befestigungsmittel (50) aus Stahl in jedes der Löcher (11) über die Löcher (25) in dem unteren Becher (20) eingeführt wird.
- 35 15. Verfahren nach Anspruch 14, wobei ein auf die Vertikale (10) aufgeschraubter unterer Becherschutz (110) in Richtung des unteren Bechers (20) angehoben wird, bis das freie Ende des unteren Teils (111) des unteren Becherschutzes (110) mit einem freien Ende des unteren Teils (22) des unteren Bechers (20) ausgerichtet ist, oder bis eine Fläche des Flansches (113) des unteren Becherschutzes (110), die in Richtung des unteren Bechers (20) zeigt, gegen das freie Ende des unteren Teils (22) des unteren Bechers (20) passt.
- 40 16. Verfahren nach Anspruch 15, wobei der untere Becherschutz (110) in Position eingestellt wird, wobei Entwässerungsaussparungen (114) in dem unteren Becherschutz (110) mit Entwässerungsaussparungen (26) in dem unteren Becher (20) ausgerichtet sind.
- 45

## Revendications

- 50 1. Système de support structurel, tel que, mais sans s'y limiter, un échafaudage ou un coffrage comprenant des éléments verticaux (10), horizontaux (40) et/ou diagonaux reliés au niveau de sections de nœud (120) au niveau des éléments verticaux (10), où chaque section de nœud (120) comprend un dispositif de verrouillage pour relier des éléments horizontaux (40) et/ou diagonaux avec des extrémités à pales disposées au niveau d'extrémités des éléments horizontaux (40) et/ou diagonaux et de l'élément vertical (10), où le dispositif de verrouillage est une paire de coupelles comprenant une coupelle inférieure (20) maintenue au niveau d'une position sur les éléments verticaux (10) et une coupelle supérieure (30) disposée de manière mobile sur les éléments verticaux (10), où les extrémités à pales des éléments horizontaux (40) et/ou des éléments diagonaux sont configurées pour être verrouillées par la partie de  
55

coupelle inférieure (20) et la partie de coupelle supérieure (30), fournissant une connexion rigide,

la coupelle inférieure (20) comprend au moins un trou (25), de préférence au niveau de la circonférence d'une partie inférieure (22) de la coupelle inférieure (20),

les coupelles inférieures (20) à maintenir en une position sur les éléments verticaux (10) sont maintenues en utilisant au moins un moyen de fixation (50) et le(s) trou(s) correspondant(s) (11, 25) dans les coupelles inférieures (20) et les éléments verticaux (10), le moyen de fixation (50) étant un boulon à tête fixé rigidement en vissant le boulon à tête dans l'élément vertical (10),

**caractérisé en ce que** le diamètre du trou (25) de ladite coupelle inférieure (20) est supérieur au diamètre de la tête du boulon à tête, de sorte que le trou (25) de la coupelle inférieure (20) repose sur la tête du boulon à tête, fournissant une capacité de charge de compression dans la direction verticale et/ou horizontale de la coupelle inférieure (20) par l'intermédiaire du boulon.

2. Système de support structurel selon la revendication 1, où la coupelle inférieure (20) comprend la partie inférieure (22), de préférence de forme cylindrique, une partie intermédiaire (23), de préférence inclinée vers le haut et vers l'extérieur, une partie supérieure (24) de préférence de forme cylindrique.

3. Système de support structurel selon la revendication 1 ou 2, dans lequel le(s) trou(s) (25) dans la coupelle inférieure sont sans filets.

4. Système de support structurel selon l'une des revendications 1 à 3, dans lequel la coupelle inférieure (20) comprend en outre au moins un évidement de drainage (26) dans la partie inférieure (22) de la coupelle inférieure (20).

5. Système de support structurel selon l'une des revendications 1 à 4, où le système comprend en outre une protection de coupelle inférieure (110).

6. Système de support structurel selon la revendication 5, où la protection de coupelle inférieure (110) comprend une partie inférieure (111), de préférence de forme cylindrique, et une partie supérieure (112), de préférence inclinée vers le haut et vers l'extérieur.

7. Système de support structurel selon la revendication 6, où la protection de coupelle inférieure (110) comprend en outre au moins un évidement de drainage (114) au moins dans la partie inférieure (111) de la protection de coupelle inférieure (110), de préférence avec la même hauteur et la même largeur que l'évidement de drainage (26) de la coupelle inférieure (20).

8. Système de support structurel selon la revendication 5 ou 6, où la protection de coupelle inférieure (110) comprend en outre une bride (113) au niveau de l'extrémité libre de la partie inférieure (111) de la protection de coupelle inférieure (110), pointant vers l'intérieur de la protection de coupelle inférieure (110) ayant un diamètre avec une tolérance afin de faire approximativement face à la surface extérieure de l'élément vertical (10).

9. Système de support structurel selon l'une quelconque des revendications précédentes, dans lequel l'élément horizontal (40) comprend un tube allongé (80) et une extrémité de pale (41) avec des ailettes (42) avec un tube d'engagement (81), où le tube d'engagement (81) et l'extrémité de pale (41) sont reliés de manière permanente et sont en outre reliés de manière permanente au tube allongé (80) en appliquant de la colle sur les surfaces de connexion, où les surfaces de connexion sont la surface intérieure du tube allongé (80) et la surface extérieure du tube d'engagement (81).

10. Système de support structurel selon la revendication 9, où le tube allongé (80), de préférence de forme semi-cylindrique, est fileté sur le tube d'engagement (81), de préférence de forme semi-cylindrique, mais pourrait également être de forme conique, de forme chanfreinée ou pourrait même être fileté pour une connexion de filetage entre le tube d'engagement (81) et le tube allongé (80).

11. Système de support structurel selon l'une quelconque des revendications 1 à 10, dans lequel la coupelle inférieure installée (20) est recouverte d'une protection de coupelle inférieure (110) afin de protéger la coupelle inférieure (20), les moyens de fixation (50) et l'agent de liaison contre les impacts mécaniques et les éléments environnementaux provoquant une dégradation des matériaux.

12. Système de support structurel selon la revendication 11, où le matériau utilisé dans la protection de coupelle inférieure



(110) est un polymère, tel que du plastique ou du caoutchouc.

13. Système de support structurel selon l'une quelconque des revendications 1 à 12, dans lequel les éléments horizontaux (40) sont supportés par une patte de support supplémentaire (90) afin de transférer des forces entre les éléments horizontaux (40) et les éléments verticaux (10), où la patte de support (90) comprend deux plaques d'acier ou d'aluminium (91, 91') identiques mais en forme de miroir afin de pouvoir serrer autour des éléments horizontaux (40) et verticaux (10) où les deux plaques (91, 91') sont reliées de manière lâche à des boulons (93), des rondelles (95) et des écrous (96) à visser ensemble et à serrer autour des éléments horizontaux (40) et verticaux (10).

14. Procédé de montage d'une section de nœud (120) sur un élément vertical (10) destiné à être utilisé dans un système de support structurel, selon l'une quelconque des revendications 1 à 13, où chaque section de nœud (120) est un dispositif de verrouillage pour connecter des éléments horizontaux et/ou diagonaux avec des extrémités à pales disposées au niveau d'extrémités des éléments horizontaux (40) et/ou diagonaux avec des éléments verticaux (10), où le dispositif de verrouillage est une coupelle comprenant une coupelle inférieure (20) de matériau métallique, de préférence en aluminium ou en acier, maintenue au niveau d'une position prédéterminée sur les éléments verticaux (10) et une coupelle supérieure (30) de matériau métallique, de préférence en aluminium, reliée de manière mobile aux éléments verticaux (10),

**caractérisé en ce que** la formation de l'élément vertical (10) à partir de tubes en aluminium extrudés, la formation d'un ou plusieurs trous orientés radialement (11) dans la surface extérieure de la surface d'élément vertical (10), la surface de chaque trou (11) étant de préférence fileté, le positionnement des trous (25) dans la coupelle inférieure (20) avec les trous (11) dans l'élément vertical (10) et l'introduction de moyens de fixation (50) en acier dans chacun des trous (11) par l'intermédiaire des trous (25) dans la coupelle inférieure (20).

15. Procédé selon la revendication 14, dans lequel une protection de coupelle inférieure (110) vissée sur l'élément vertical (10) est soulevée vers la coupelle inférieure (20) jusqu'à ce que l'extrémité libre de la partie inférieure (111) de la protection de coupelle inférieure (110) aligne une extrémité libre de la partie inférieure (22) de la coupelle inférieure (20), ou jusqu'à ce qu'une surface de la bride (113) de la protection de coupelle inférieure (110) dirigée dans la direction de la coupelle inférieure (20) s'adapte contre l'extrémité libre de la partie inférieure (22) de la coupelle inférieure (20).

16. Procédé selon la revendication 15, dans lequel la protection de coupelle inférieure (110) est ajustée en position où les évidements de drainage (114) dans la protection de coupelle inférieure (110) sont alignés avec les évidements de drainage (26) dans la coupelle inférieure (20).

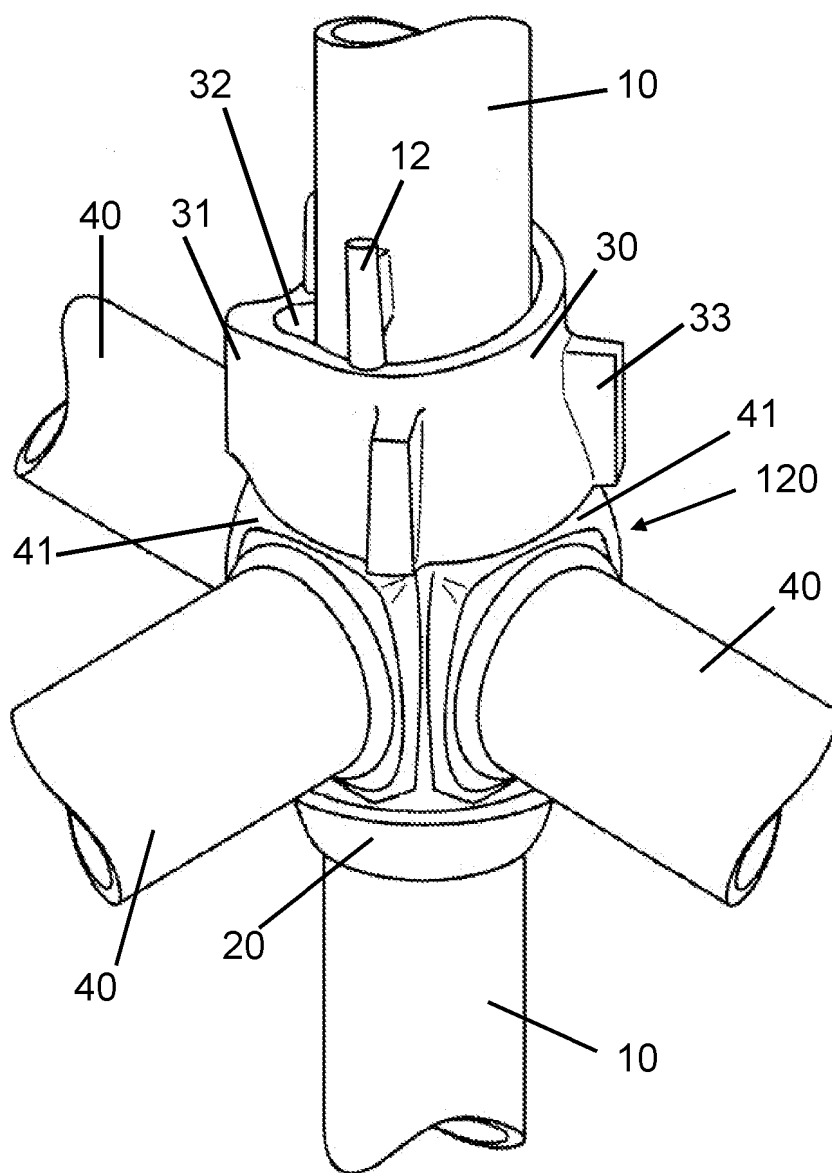


Fig. 1 (Prior Art)

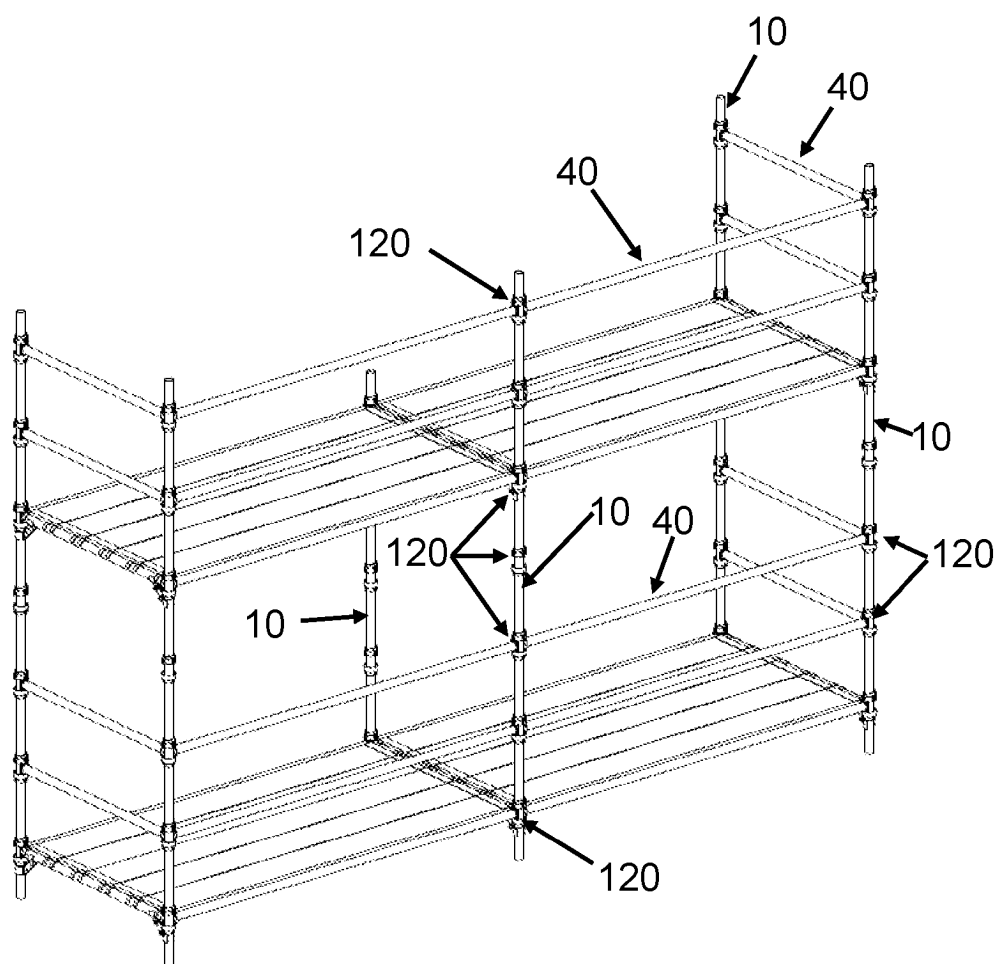


Fig. 2

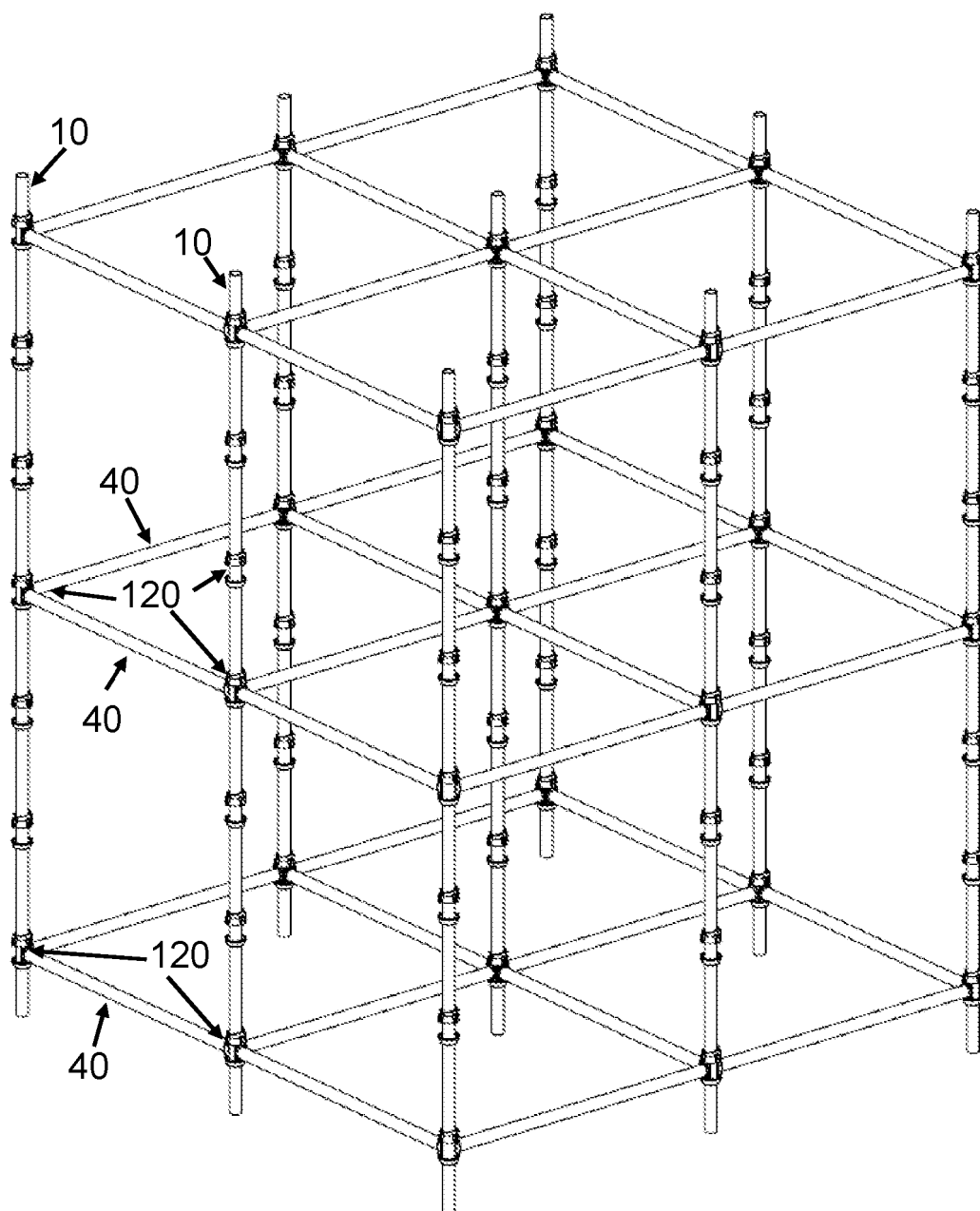


Fig. 3

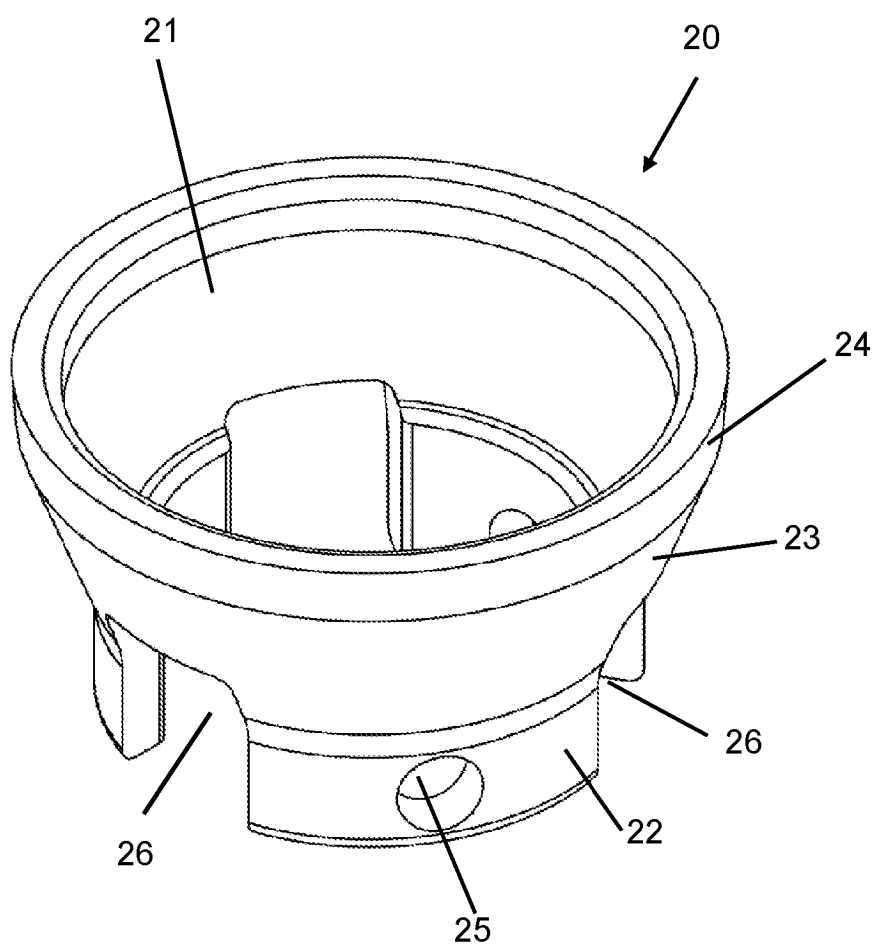


Fig. 4

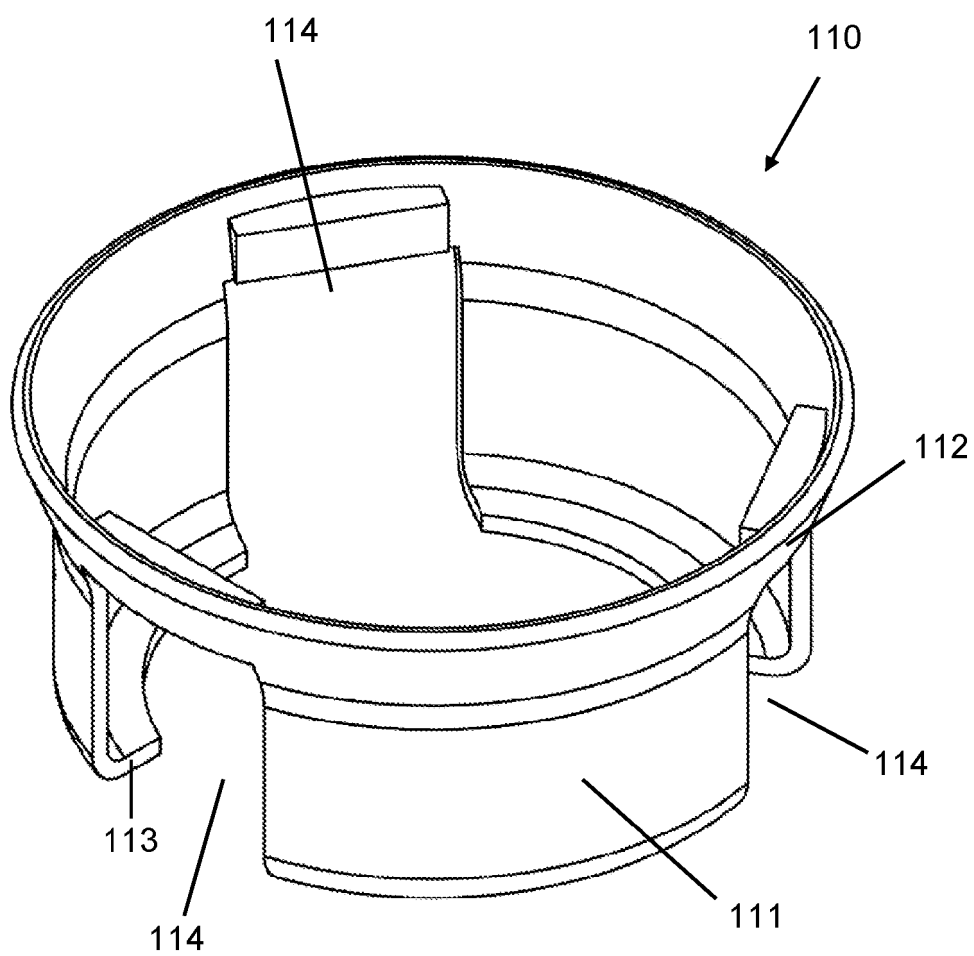
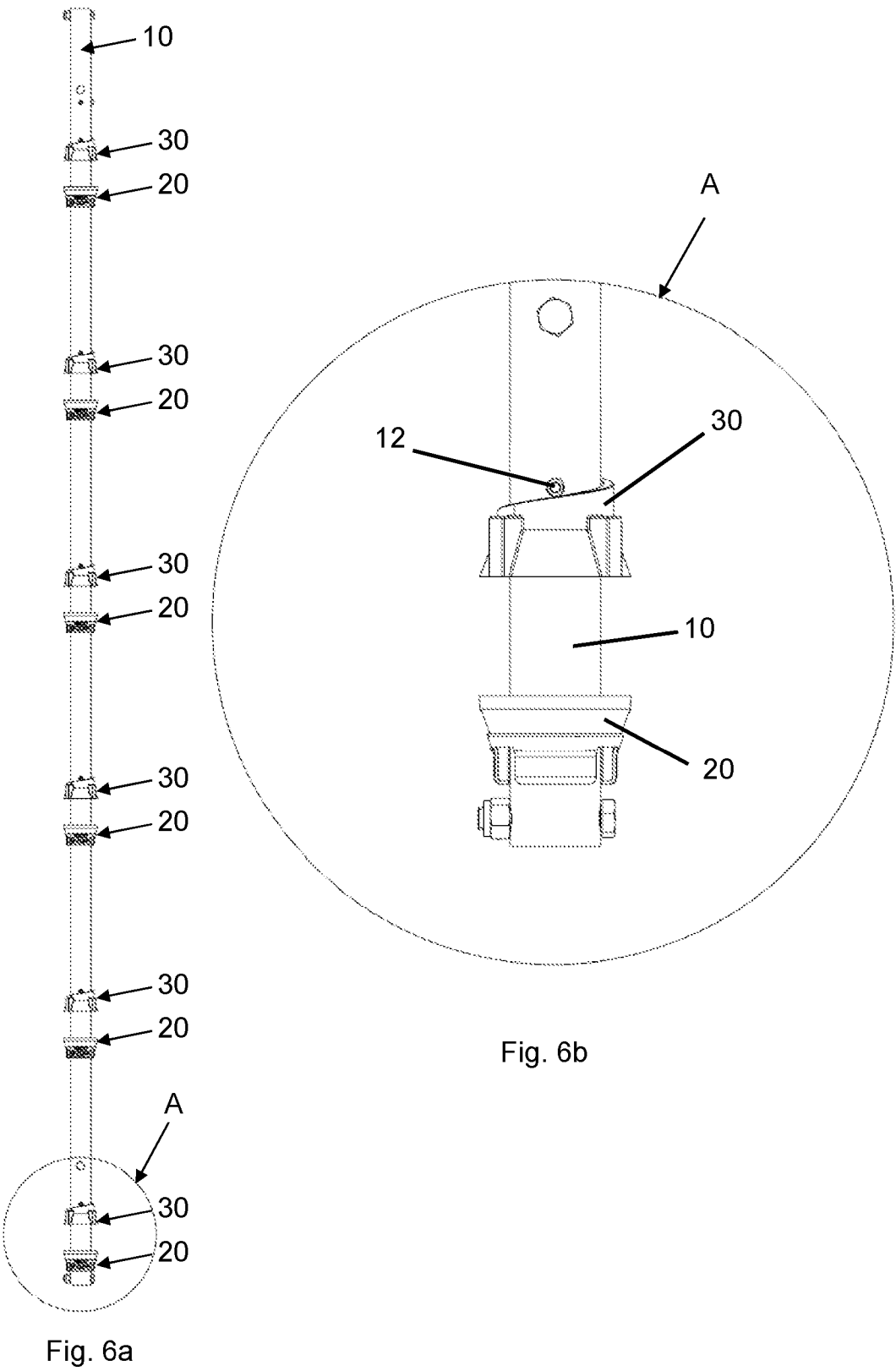


Fig. 5



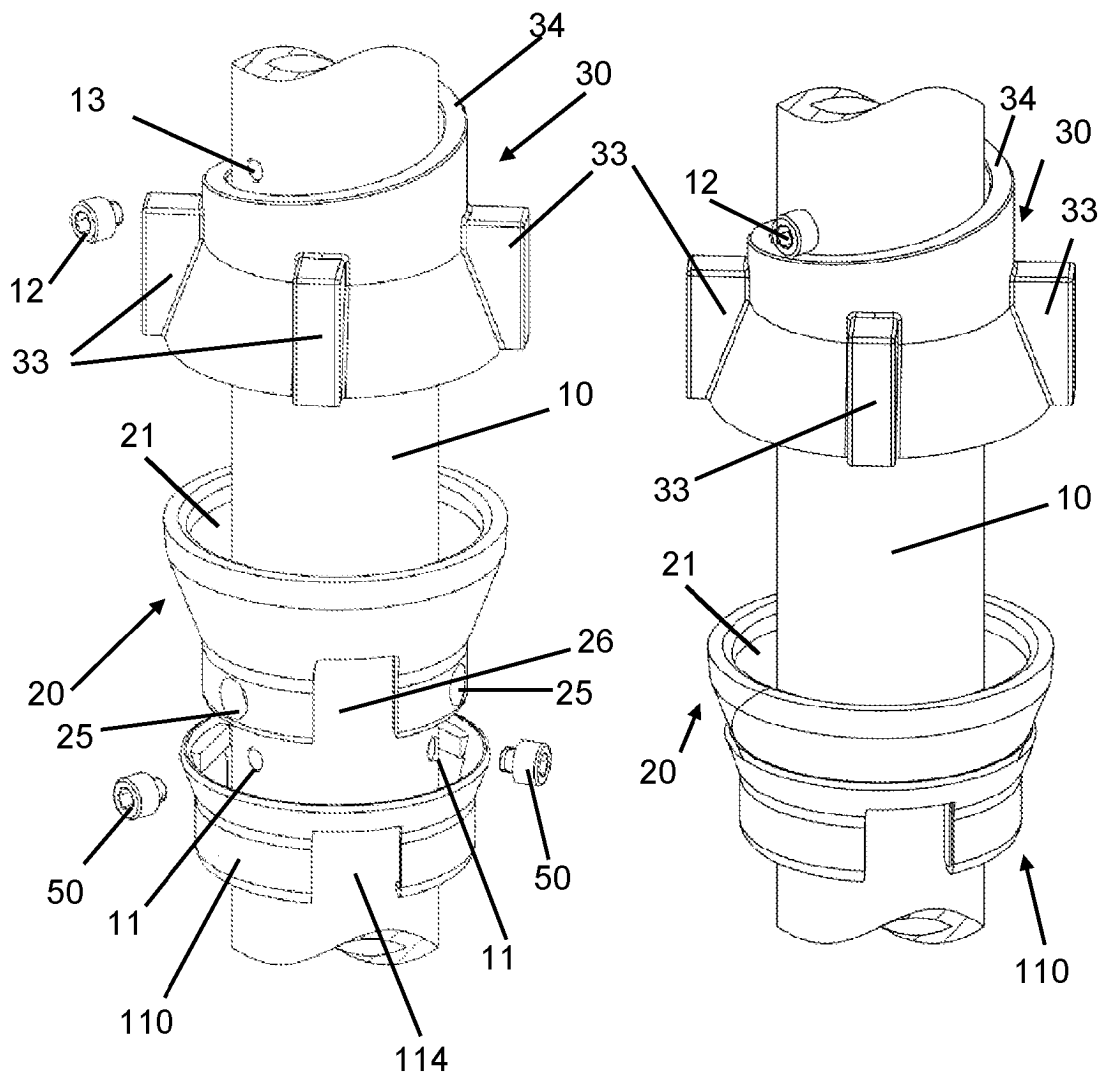


Fig. 7a

Fig. 7b



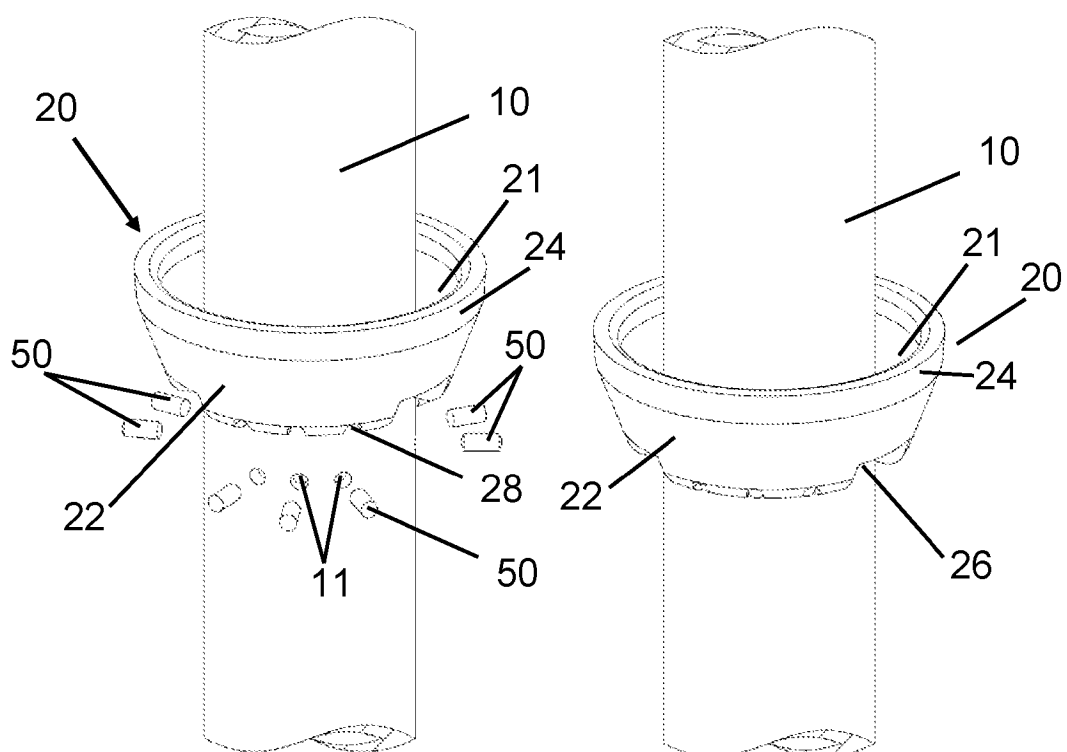


Fig. 8a

Fig. 8b

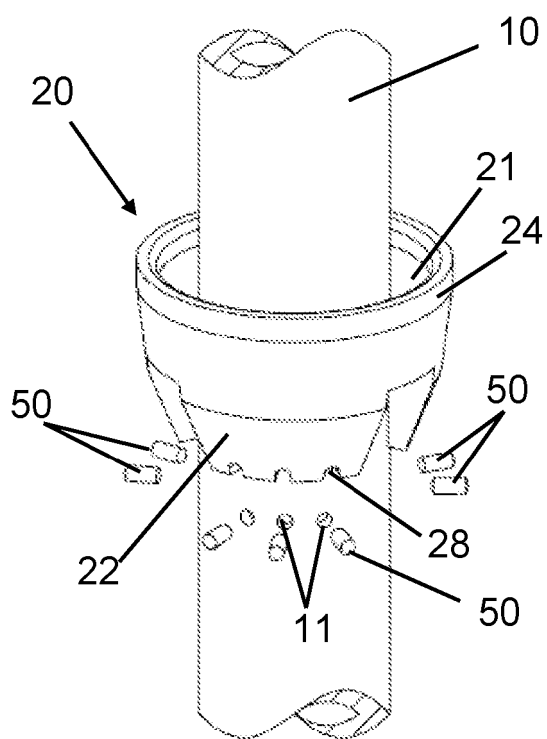


Fig. 9a

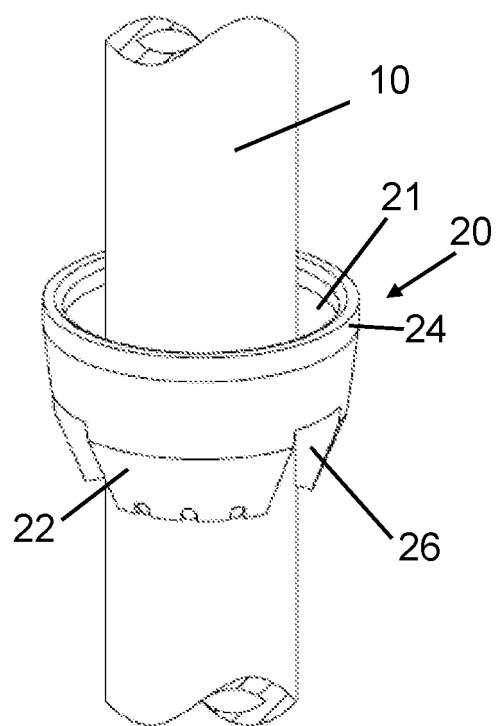


Fig. 9b

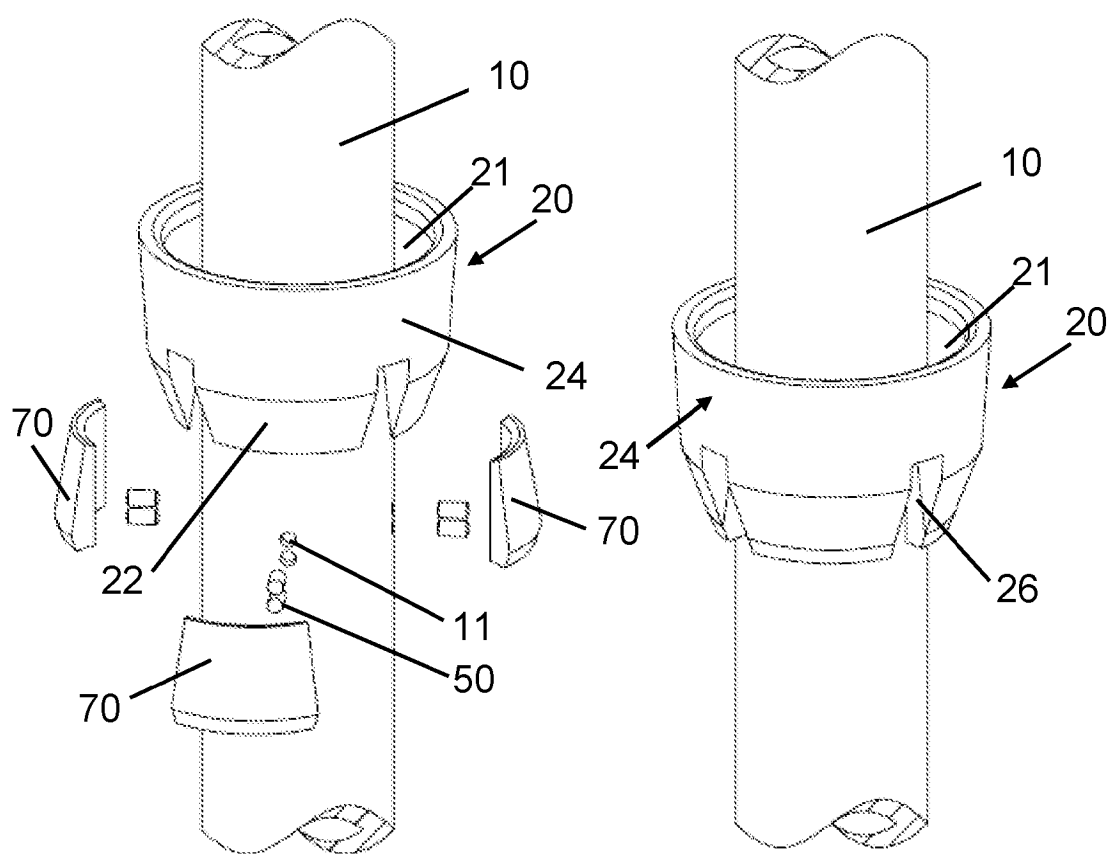


Fig. 10a

Fig. 10b

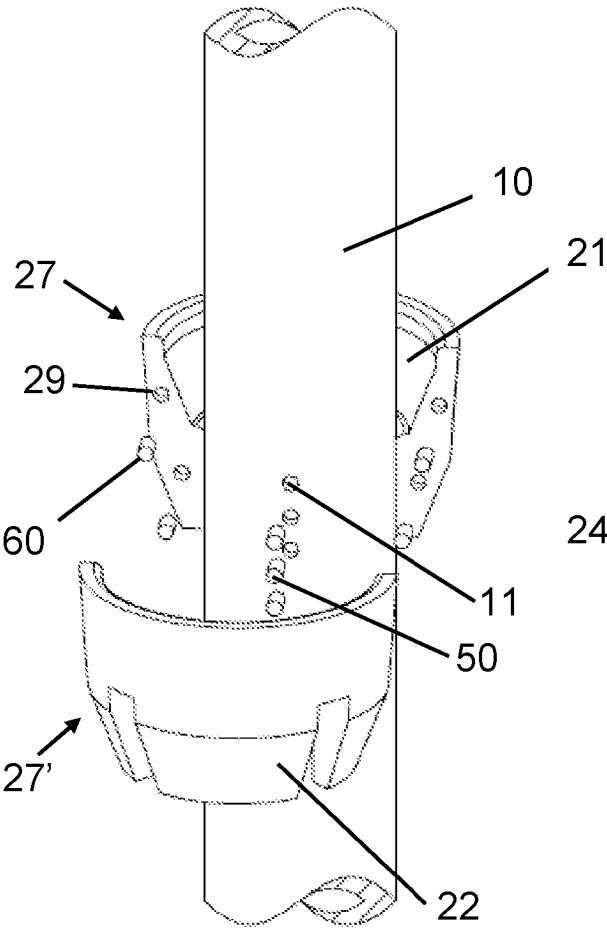


Fig. 11a

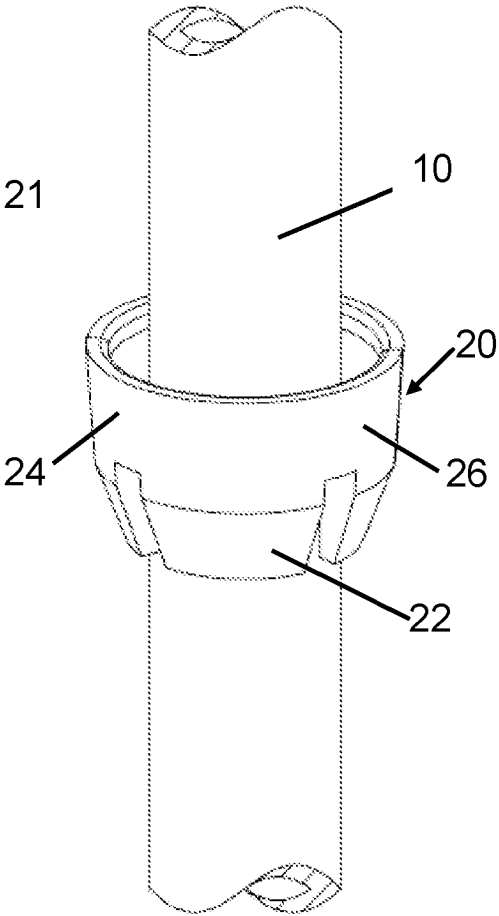


Fig. 11b

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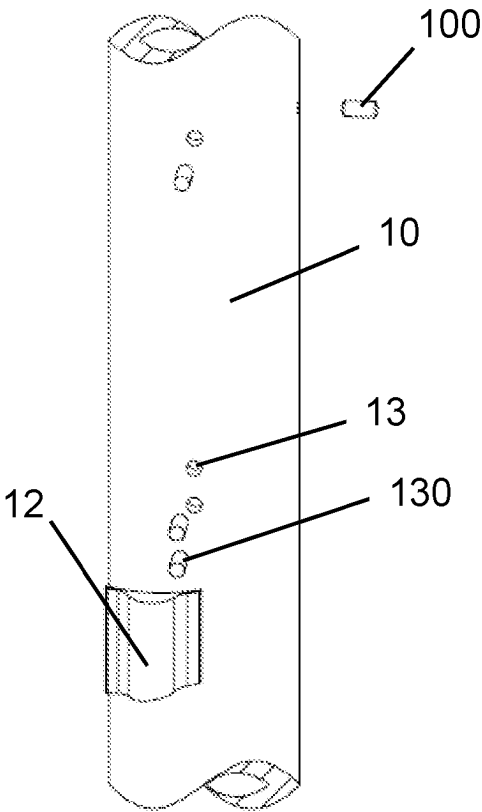


Fig. 12a

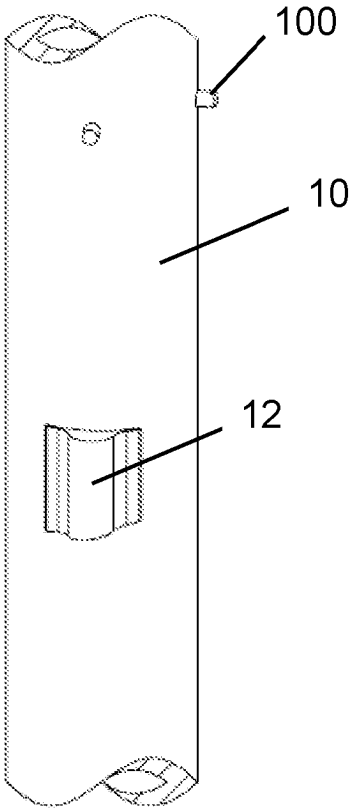


Fig. 12b

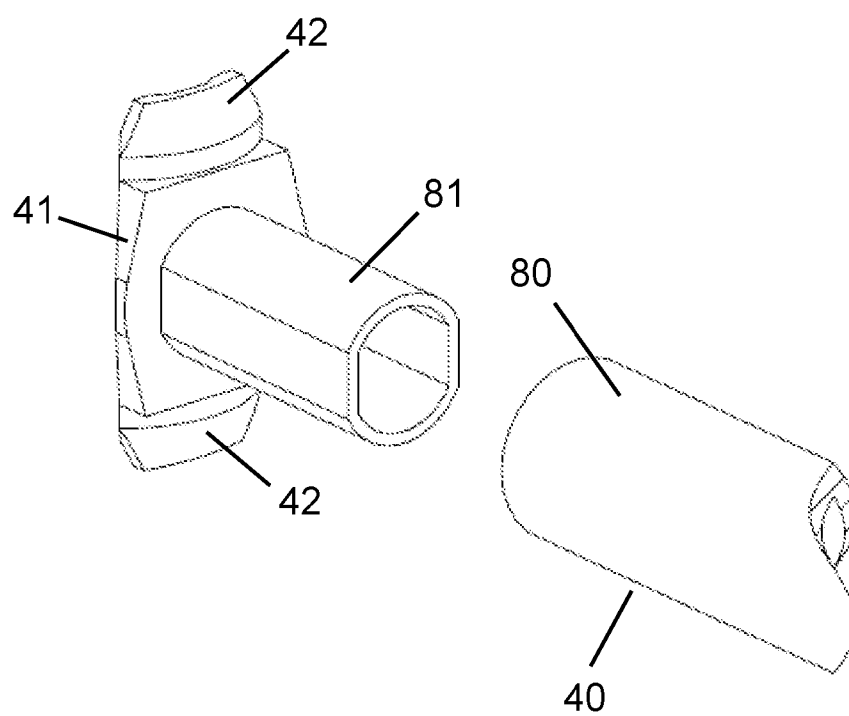


Fig. 13a

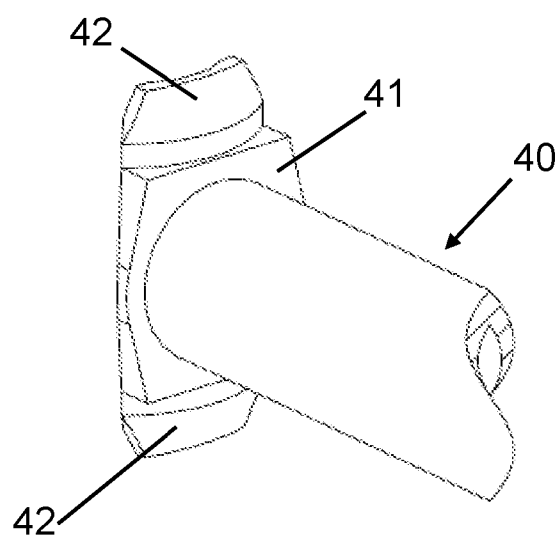


Fig. 13b

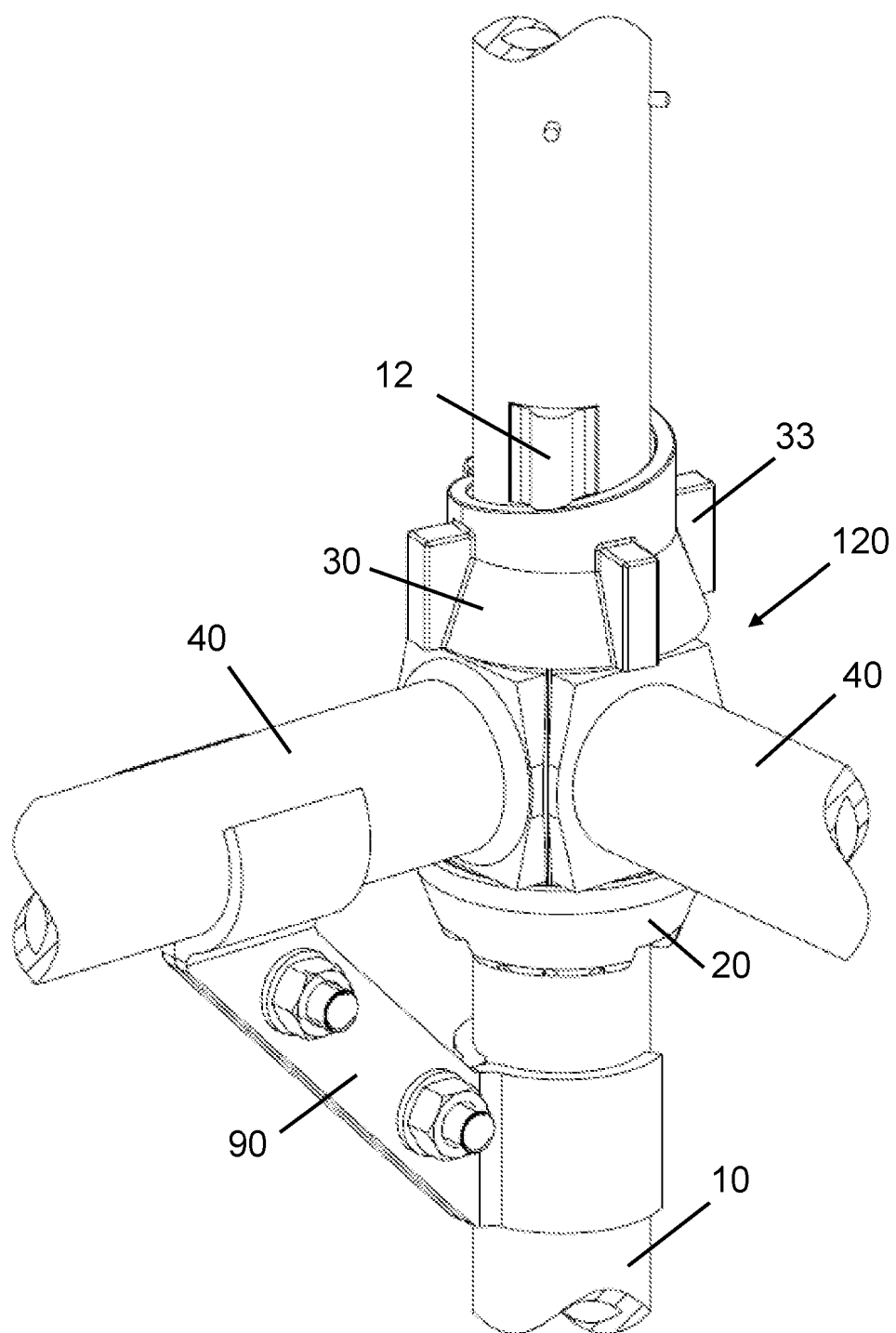


Fig. 14

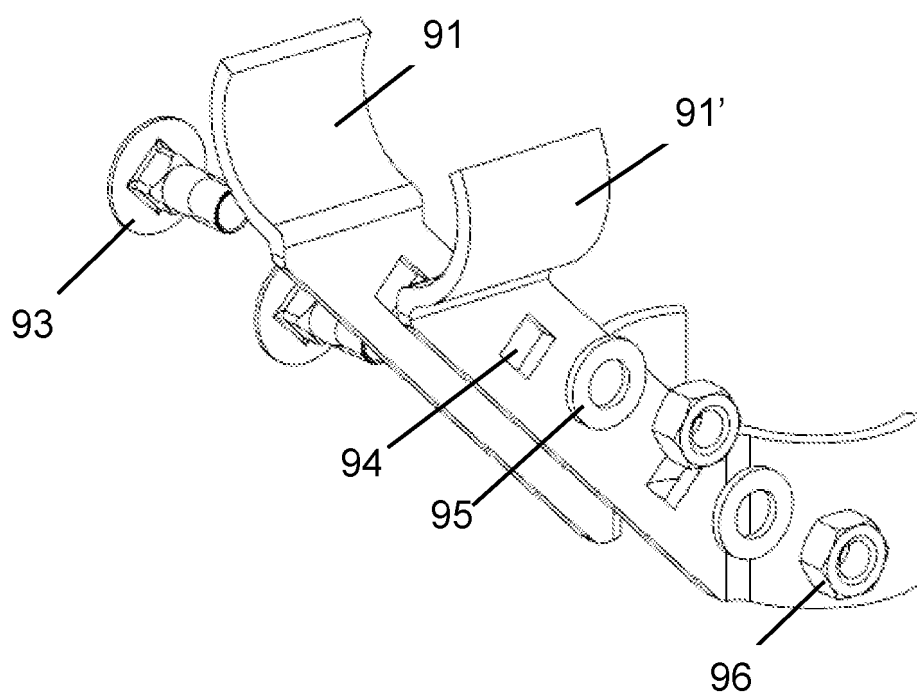


Fig. 15a

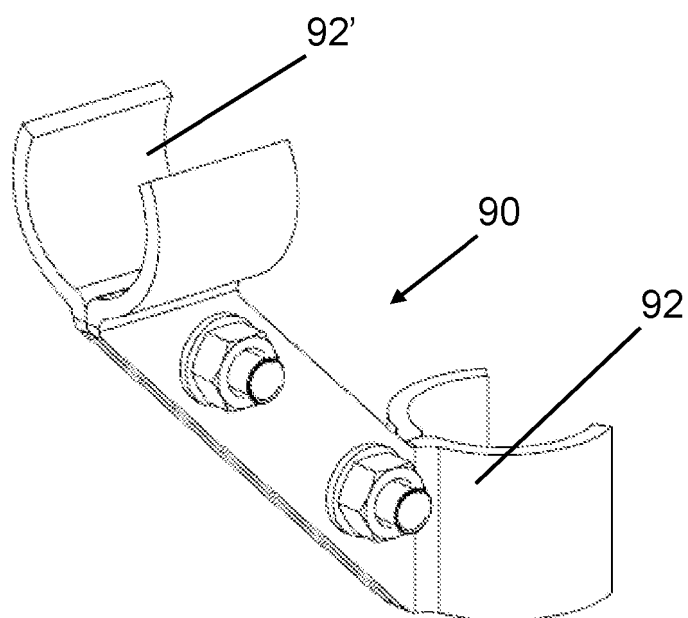


Fig. 15b



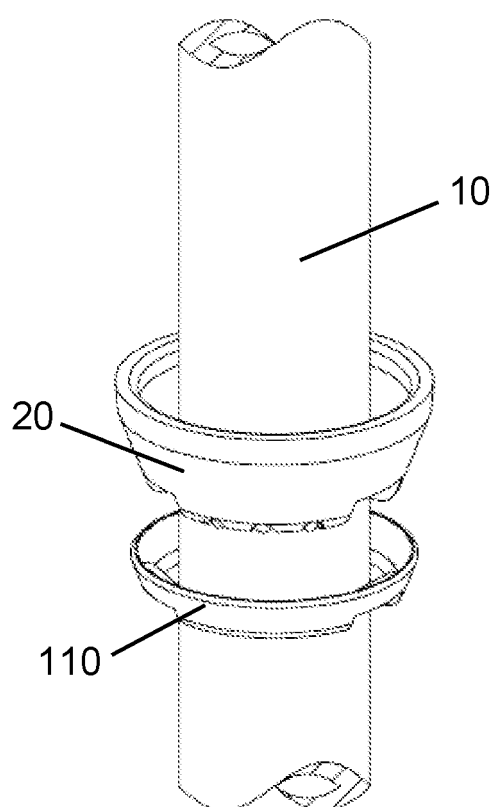


Fig. 16a

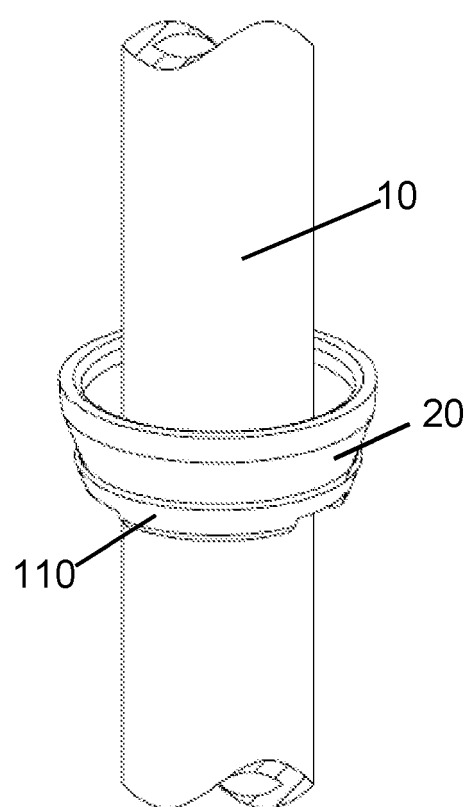


Fig. 16b

**REFERENCES CITED IN THE DESCRIPTION**

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