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(54) **An assembly of elements for modular joints connecting the struts of suspended structures**

Elementenzusammenbau für Verbindungsknoten für Stangen von selbsttragenden Gerüsten

Assemblage d'éléments pour les noeuds de connection des barres de structures autoportantes

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Description

The present invention relates to an assembly of elements making up a modular joint by means of which to interconnect the struts of suspended structures, comprising

- two multiple coupling elements for interconnecting a plurality of struts affording relative mating surfaces, at least one of the multiple coupling elements having a plurality of sockets and corresponding slots each communicating with one of the sockets, said slots being of a smaller width than the sockets;
- a plurality of longitudinal coupling elements interposed between the multiple coupling elements, each longitudinal coupling element comprising an axialsymmetrical body, having a first end constrained to a struts and a second and opposite end bearing a tip connected to the body by an intermediate shank, said tip and said shank being respectively shaped to match the sockets and the corresponding slots of the multiple coupling element such as to be insertable therein while enabling the tip to interfere geometrically with a corresponding slot, removably constraining the longitudinal coupling element to the multiple coupling element;
- fastening means by which the multiple coupling elements are secured one to another when their respective mating surfaces are placed in contact and pressed according to an axis orthogonal to the mating surfaces, wherein, in said assembly, each one of the multiple coupling elements has a plurality of profiled sockets, and each one of the mating surfaces incorporates said profiled sockets.

In the art field embracing the prefabrication of temporary structures, in particular those designed to support lightweight roofing erected as shelter over normally open spaces in public or private use, the systems most widely adopted are typified by a plurality of structural joints at which the struts of the supporting framework are interconnected by means of specially designed coupling assemblies.

Given the extreme variation in shape and dimensions of possible roof layouts, the angles at which the component struts meet in space will differ notably from one roofing plan to another. This diversity is accentuated further, given the dissimilarity of the essential geometries adopted in the design of such roofing structures, in terms both of function and of appearance.

In order to accommodate the specific constructional requirements which arise out of such diversity, several different solutions are known:
a first solution (GB-A-2150998), outlined as in the preamble to claim 1 considers that the longitudinal elements provided for the coupling for the multiple coupling element are equipped with spherical tips rotatably associable with the cavities of the multiple coupling elements themselves.

Whilst this hinged type of articulation affords some degree of versatility in erection of the roof, or whatever construction, it also betrays the serious structural drawback of increased stress on the struts deriving from the hinged joints; the strut must therefore be designed with more generous transverse dimensions to ensure sufficient strength, and is heavier than a strut associated with a rigid socket type connector.

Moreover, a structure erected utilizing this hinged type of arrangement undoubtedly lacks the general stability of a structure with rigid connectors. A second type of construction technique, described in document (FR-A-864668), designed to overcome such drawbacks employs structural joints of prefabricated and positively coupled design, in which the joints are coupled by means of which the struts are connected with their axes disposed along directions predetermined by the embodiment of the coupling elements themselves.

This type of solution is certainly able to remedy the stress problem, though without affording any modular advantages whatever; in effect, the diverse constructional requirements encountered in practice have to be met by customizing connectors to suit individual installations, unless the decision is taken to manufacture extensive ranges of ready-made assemblies and therefore to shoulder the associated high investment and inventory costs.

A further drawback of the above solution is represented by the fact that it provides structural joints wherein the fixing efficiency is secured not by a special geometrical conformation, but by the intensity of the locking forces applied on it. A third known solution, demonstrated in FR-A-2591251, discloses a multiple coupling element equipped with shaped slots in which the tips of the longitudinal elements can slide along the slots, therein constrained transversally to the sliding direction.

Since the slots of the coupling element are throughholes, the device includes means for blocking the sliding of the longitudinal elements associable to the coupling elements.

Also in this solution the interconnecting device presents the drawback of not affording a perfect joint since there will inevitably be residual sliding play between the shaped tips of the longitudinal elements and the slots receiving them.

The object of the present invention is to overcome the drawbacks described above.

The stated object is realized in an assembly of elements as characterized in the appended claims, which comprises at least one multiple coupling element affording a plurality of profiled sockets, and an interlocking longitudinal element of which one end affords a profiled tip accommodated to a matching fit and positively retained by a relative socket, and the remaining end is connected stably to a respective strut. The interlocking geometry of the socket and the tip of the longitudinal element is polyhedric and associable to the concavities of the mul-

tiple coupling joints and is such as to stay fixed in combination with the coupling elements of the longitudinal elements and the struts associated to them in the joint.

Finally the assembly according to the invention enables a stable connection of the struts to a structural joint of modular embodiment in which the component parts are positively coupled and yet removable one from another.

The tip profile exhibits faces convergent in a longitudinal plane containing both the axis of symmetry of the tip itself and the mutually parallel axes of the longitudinal element and the connected strut. In a preferred embodiment, the axis of the tip is angled away from the axis of the longitudinal element to a degree whereby the convergent faces are disposed in planes respectively parallel with and angled in relation to the axis of the strut, in such a way as allows of altering the angle between the axis of the strut and the plane in which the parallel or angled face of the tip is offered to the surface of a relative socket afforded by the multiple coupling element.

This advantageous feature, in conjunction with the fact that the multiple coupling element affords a plurality of sockets set apart one from the next at given angular distance, brings the added advantage that different longitudinal elements can be paired selectively with one multiple coupling element to create a modular system of joints offering a wide range of geometrical options.

A further advantage of the invention is that the modular joint can be pre-assembled conveniently on the ground, according to erection requirements, and the assembly then fitted into the structure.

Thus, with an assembly of elements according to the present invention, it becomes possible not only to embody positively coupled joints affording greater economies from the structural standpoint, but also, utilizing a greatly streamlined range of versatile and easily assembled components, to obtain notable economies in manufacture and stock control of the assembly, as well as in the erection of structures incorporating the assembly.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- fig 1 shows the assembly of elements according to the invention in its entirety, exploded and partly in section;
- figs 2a and 2b are further illustrations of one of the elements in fig 1, viewed in plan from above and from beneath, respectively;
- fig 3 is a detail of one of the elements of the assembly, seen in section through III-III, fig 1;
- figs 4 and 5 are further illustrations of one of the elements of fig 1, seen in plan from beneath and from above, respectively;
- figs 6 and 7, are further illustrations of one of the elements of fig 1, seen in plan from above and from beneath, respectively;
- figs 8, 9 and 10 show details of structures such as might be erected using an assembly of elements according to the invention, by way of example.

In fig 1 of the accompanying drawings, 1 denotes an assembly of modular elements serving to join the struts 2 of a temporary roof structure, comprising two multiple coupling elements 3 matched one to the other by way of relative mating surfaces 4a and 4b and secured thus with fastening means 7, by means of which to interconnect a plurality of struts 2; the assembly 1 further comprises a plurality of longitudinal coupling elements 8, each associated axially with one end of a relative strut 2, which are insertable between and retained positively by the two multiple coupling elements 3.

Each multiple coupling element 3 is of symmetrical embodiment in relation to a centre axis (figs 4, 5, 6 and 7), and each mating surface 4a and 4b affords a respective plurality of profiled sockets 5a and 5b merging with corresponding slots 6 of which the transverse dimensions are smaller than those of the sockets 5a and 5b.

In the preferred embodiment of figs 4 and 6, the sockets 5a-5b are eight in number and distributed uniformly about a given circumference

The single longitudinal coupling element 8 exhibits a body 9 of which one end 9a is connected to the relative strut 2 and the remaining end 9b affords a profiled tip 10 shaped to match the sockets 5a-5b of the multiple coupling elements 3. More exactly, the tip 10 is carried by a shank 20 of rectangular section extending from the body 9 and of shape such as to occupy the corresponding sockets 5a-5b of the two multiple coupling elements 3 with the shank 20 longitudinally disposed in the relative slot 6.

The width of the profiled tip 10 is greater than that of the single slots 6 of the multiple coupling elements 3, such that with geometrical interference occasioned between the tip and the elements 3 in a direction coinciding with the axis 91 of the body 9 of the longitudinal element 8, an interlocking fit is established whereby the longitudinal element 8 remains positively retained and yet removable from between the multiple coupling elements 3.

The shaped tip 10 of the longitudinal element 8 is polyhedral in shape, exhibiting a first pair of opposite angled faces 12 and 13 converging on a point forward of the body 9 and coinciding with the longitudinal axis 10a of the polyhedron, hence of the tip; in a preferred embodiment, the two faces 12 and 13 will be set at identical angles on each side of the tip axis 10a.

As discernible from fig 1 in particular, the tip 10 of the preferred longitudinal coupling element 8 is also angled away from the axis 91 of the body 9, advantageously to a degree matching the convergence between either of the first faces 12 and 13 and the tip axis 10a. Accordingly, as shown in fig 1, one face 12 of the first pair is disposed parallel with the longitudinal axis 91 of the

body 9, hence with the axis of the associated strut 2, whereas the angle between the opposite face 13 and the same axis 91 is equal to the sum of the angles compassed by the two convergent faces 12 and 13 and the tip axis 10a.

It follows therefore, that if the longitudinal element 8 is offered to a socket of the multiple coupling elements 3 with the face denoted 12 flush against the bottom face 14 of the socket 5a, then the axis 91 of the body 9, hence the strut 2 also, will lie parallel to this same bottom face 14 as in fig 1, whereas if the opposite face 13 is offered to the bottom face 14 of the socket 5a, the strut 2 will be displaced from the position of fig 1, with the axis 91 of the body 9 rotated through an angle equal to the sum of the angles compassed by the convergent faces 12 and 13 and the tip axis 10a.

In a preferred embodiment, the angles of the first pair of faces 12 and 13 in relation to the axis 10a of the tip 10 will be identical, and advantageously 225° or 15°, in such a manner that the struts 2 can be disposed parallel to the bottom face 14 of the sockets 5a, and angled away at 45° or 30°. 15 and 16 denote second pairs of faces afforded by the profiled tip 10, which are angled in relation to a longitudinal plane containing both the tip axis 10a and the axis 91 of symmetry of the body 9, and of shape such as to wedge to an exact fit in a corresponding socket 5a-5b of the multiple coupling elements 3 when the mating surfaces 4a and 4b are brought together and the fastening means 7 located and tightened; in the preferred embodiment of fig 1 such means 7 consist in a screw 17 of which the axis is disposed normal to the mating surfaces 4a and 4b.

Figs 8, 9 and 10 show just three examples of joints that might be fashioned for a suspended structure utilizing the assembly 1 of elements according to the invention, in which the longitudinal elements 8 are connected to the multiple coupling elements 3 in a variety of ways so as to alter the angle of the struts 2 in space to suit different erection requirements.

In one alternative and simplified embodiment of the invention, the profiled tip 10 might be disposed in alignment with the shank 20 and the body 9 of the longitudinal element 8, rather than angled; such a solution permits clearly of fashioning structural joints in which the struts 2 can be disposed at one angle only in relation to the multiple connector. It will be observed, moreover, that in a preferred embodiment of the assembly of elements as shown in the drawings, the two multiple coupling elements 3 of the assembly are dissimilar one from the other, the one affording a sleeve 50 enabling connection to a vertical strut 2 beneath, the other with the slots 6 extended to accommodate the maximum height of the shank 20. Nonetheless, it will be clear that the two elements 3 might be identical in embodiment without prejudice to the spirit of the invention.

Claims

1. An assembly of elements for modular joints serving to connect struts (2) of suspended structures, comprising:

   - two multiple coupling elements (3) for interconnecting a plurality of struts (2) affording relative mating surfaces (4a,4b), at least one of the multiple coupling elements (3) having a plurality of sockets (5) and corresponding slots (6) each communicating with one of the sockets (5), said slots (6) being of a smaller width than the sockets (5);
   - a plurality of longitudinal coupling elements (8) interposed between the multiple coupling elements (3), each longitudinal coupling element (8) comprising an axialsymmetrical body (9), having a first end (9a) constrained to a strut (2) and a second and opposite end (9b) bearing a tip (10) connected to the body (9) by an intermediate shank (20), said tip (10) and said shank (20) being respectively shaped to match the sockets (5) and the corresponding slots (6) of the multiple coupling element (3) such as to be insertable therein while enabling the tip (10) to interfere geometrically with a corresponding slot (6), removably constraining the longitudinal coupling element (8) to the multiple coupling element (3);
   - fastening means (7) by which the multiple coupling elements (3) are secured one to another when their respective mating surfaces (4a,4b) are placed in contact and pressed according to an axis (17) orthogonal to the mating surfaces (4a, 4b), wherein, in said assembly, each one of the multiple coupling elements (3) has a plurality of profiled sockets (5), and each one of the mating surfaces (4a,4b) incorporates said profiled sockets (5), said assembly being characterized in that the tip (10) of the longitudinal coupling elements (8) has a polyhedric shape having a longitudinal axis of symmetry (10a) and is limited by flat faces (12, 13, 15, 16) arranged about the longitudinal axis of symmetry (10a) of the tip (10), a first pair of said faces (12,13) converging on said axis (10a) in an opposite direction to the body (9) of the longitudinal coupling element (8), at least a second pair of faces (15,16) converging on a plane containing the axis (91) of the body (9) and the axis (17) of the fastening means (17).

2. An assembly as in claim 1, wherein the axis (10a) of the tip (10) is angled in relation to the axis (91) of symmetry of the body (9) of the longitudinal coupling element (8) in order to permit of orienting the longitudinal coupling element (8) in various posi-

tions in relation to the multiple coupling element (3).

3. An assembly as in claim 2, wherein the axis (10a) of the tip (10) is angled by 15 degrees with respect to the axis (91) of symmetry of the body (9) of the longitudinal coupling element (8).

4. An assembly as in claim 2, wherein the axis (10a) of the tip (10) is angled by 22.5 degrees with respect to the axis (91) of symmetry of the body (9) of the longitudinal coupling element (8).

Patentansprüche

1. Elementenzusammenbau für Verbindungsknoten für Stangen (2) von selbsttragenden Gerüsten, enthaltend:

   - zwei Mehrfachverbindungselemente (3) zur gegenseitigen Verbindung einer Mehrzahl von Stangen (2), jeweilige Flächenpaare (4a, 4b) bereitstellend, wobei wenigstens eines der Mehrfachverbindungselemente (3) eine Mehrzahl von Anschlüssen (5) und entsprechende Nuten (6) aufweist, von denen jede mit einem der Anschlüsse (5) in Verbindung steht, wobei die besagten Nuten (6) eine kleinere Weite als die Anschlüsse (5) aufweisen;
   - eine Mehrzahl von Längsverbindungselementen (8), die zwischen den Mehrfachverbindungselementen (3) angeordnet sind, wobei jedes Längsverbindungselement (8) einen axialsymmetrischen Körper (9) enthält, der ein erstes Ende (9a) aufweist, das an einer Stange (2) befestigt ist, und ein zweites und gegenüberliegendes Ende (9b) aufweist, das eine über einen Zwischenschaft (20) mit dem Körper (9) verbundene Spitze (10) trägt, wobei die besagte Spitze (10) und der besagte Schaft (20) jeweils geeignet ausgebildet sind, um sich mit den Anschlüssen (5) und den entsprechenden Nuten (6) desMehrfachverbindungselementes (3) derart zusammenzufügen, daß sie darin einfügbar sind, während die Spitze (10) in den Stand versetzt wird, geometrisch in eine entsprechende Nut (6) einzugreifen, trennbar das Längsverbindungselement (8) mit dem Mehrfachverbindungselement (3) verbindend;
   - Befestigungsmittel (7), durch welche die Mehrfachverbindungselemente (3) gegeneinander befestigt sind, wenn deren jeweiligen Flächenpaare (4a, 4b) in Kontakt gebracht und zusammengedrückt sind entsprechend einer Achse (17), die senkrecht zu den Flächenpaaren (4a, 4b) verläuft, wobei in dem besagten Zusammenbau jedes der Mehrfachverbindungselemente (3) eine Mehrzahl von profilierten Anschlüssen (5) aufweist, und jedes der Flächenpaare (4a, 4b) die besagten profilierten Anschlüsse (5) einverleibt, dadurch gekennzeichnet, daß die Spitze (10) der Längsverbindungselemente (8) eine polyedrische Gestalt aufweist, mit einer Symmetrielängsachse (10a), und durch um die Symmetrielängsachse (10a) der Spitze (10) angeordnete, flache Stirnflächen (12, 13, 15, 16) begrenzt wird, und ein erstes Paar der besagten Stirnflächen (12, 13) auf der besagten Achse (10a) in eine zum Körper (9) des Längsverbindungselements (8) gegenüberliegende Richtung konvergiert, und wenigstens ein zweites Paar derStirnflächen (15, 16) auf einer Ebene konvergiert, die die Achse (91) des Körpers (9) und die Achse (17) des Befestigungsmittels (17) enthält.

2. Elementenzusammenbau, nach Anspruch 1, wobei die Achse (10a) der Spitze (10) in einem Winkel bezüglich der Symmetrieachse (91) des Körpers (9) des Längsverbindungselements (8) steht, um die Ausrichtung des Längsverbindungselements (8) in verschiedenen Positionen bezüglich des Mehrfachverbindungselements (3) zu erlauben.

3. Elementenzusammenbau, nach Anspruch 2, wobei die Achse (10a) der Spitze (10) in einem Winkel von 15 Grad bezüglich der Symmetrieachse (91) des Körpers (9) des Längsverbindungselements (8) steht.

4. Elementenzusammenbau, nach Anspruch 2, wobei die Achse (10a) der Spitze (10) in einem Winkel von 22.5 Grad bezüglich der Symmetrieachse (91) des Körpers (9) des Längsverbindungselements (8) steht.

Revendications

1. Un assemblage d'éléments pour des articulations modulaires servant à raccorder des entretoises (2) de structures suspendues, comprenant :

   - deux éléments de couplage multiple (3) pour raccorder entre elles une pluralité d'entretoises (2) présentant des surfaces de couplage respectives (4a, 4b), l'un au moins des éléments de couplage multiple (3) ayant une pluralité de logements (5) et de rainures correspondantes (6) communiquant chacune avec l'un des logements (5), lesdites rainures (6) étant moins larges que les logements (5) ;
   - une pluralité d'éléments de couplage longitudinaux (8) interposés entre les éléments de couplage multiple (3), chaque élément de couplage longitudinal (8) comprenant un corps symétri-

que par rapport à son axe (9), ayant une première extrémité (9a) mise en contrainte contre une entretoise (2) et une deuxième extrémité opposée (9b) supportant un embout (10) relié au corps (9) par un manche intermédiaire (20), ledit embout (10) et ledit manche (20) étant respectivement conformés pour s'associer avec les logements (5) et les rainures correspondantes (6) de l'élément de couplage multiple (3) de façon à pouvoir s'y insérer tout en permettant à l'embout (10) d'interférer géométriquement avec une rainure correspondante (6), mettant en contrainte par déplacement l'élément de couplage longitudinal (8) contre l'élément de couplage multiple (3) ;

- des moyens de fixation (7) par lesquels les éléments de couplage multiple (3) sont fixés les uns aux autres lorsque leurs surfaces de couplage respectives (4a, 4b) sont placées en contact et pressées suivant un axe (17) orthogonal aux surfaces de couplage (4a, 4b), en quoi, dans ledit assemblage, chacun des éléments de couplage multiple (3) a une pluralité de logements profilés (5), et chacune des surfaces de couplage (4a, 4b) contient lesdits logements profilés (5), ledit assemblage étant caractérisé en ce que l'embout (10) des éléments de couplage longitudinaux (8) a une forme polyédriqueayant un axe de symétrie longitudinal (10a) et est limité par des faces plates (12, 13, 15, 16) disposées sur l'axe de symétrie longitudinal (10a) de l'embout (10), une première paire de ces faces (12, 13) convergeant sur l'axe (10a) en question dans une direction opposée à celle du corps (9) de l'élément de couplage longitudinal (8), au moins une deuxième paire de faces (15, 16) convergeant sur un plan contenant l'axe (91) du corps (9) et l'axe (17) des moyens de fixation (17).

2. Un assemblage selon la revendication 1, en quoi l'axe (10a) de l'embout (10) forme un angle par rapport à l'axe de symétrie (91) du corps (9) de l'élément de couplage longitudinal (8) de façon à pouvoir orienter l'élément de couplage longitudinal (8) dans différentes positions par rapport à l'élément de couplage multiple (3).

3. Un assemblage selon la revendication 2, en quoi l'axe (10a) de l'embout (10) forme un angle de 15 degréspar rapport à l'axe de symétrie (91) du corps (9) de l'élément de couplage longitudinal (8).

4. Un assemblage selon la revendication 2, en quoi l'axe (10a) de l'embout (10) forme un angle de 22,5 degrés par rapport à l'axe de symétrie (91) du corps (9) de l'élément de couplage longitudinal (8).

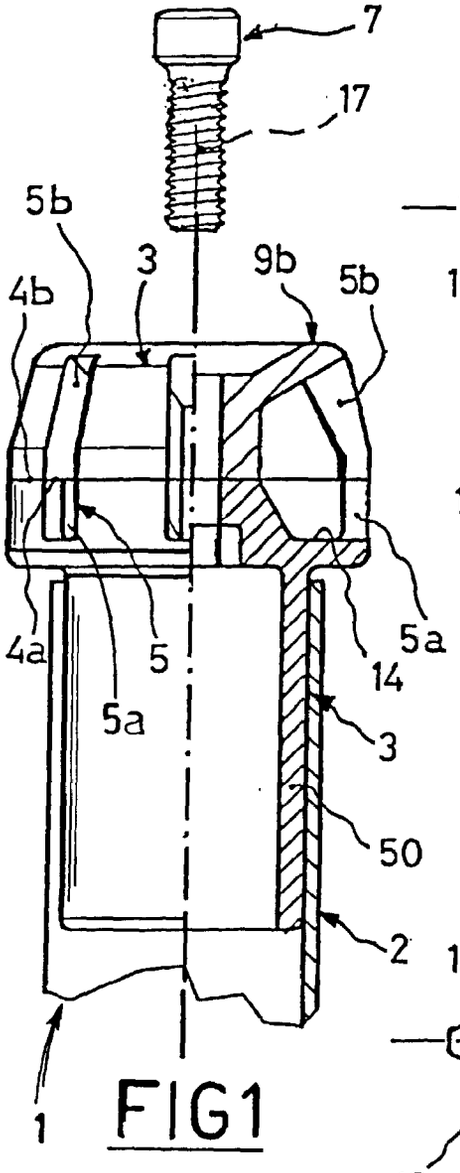


FIG1

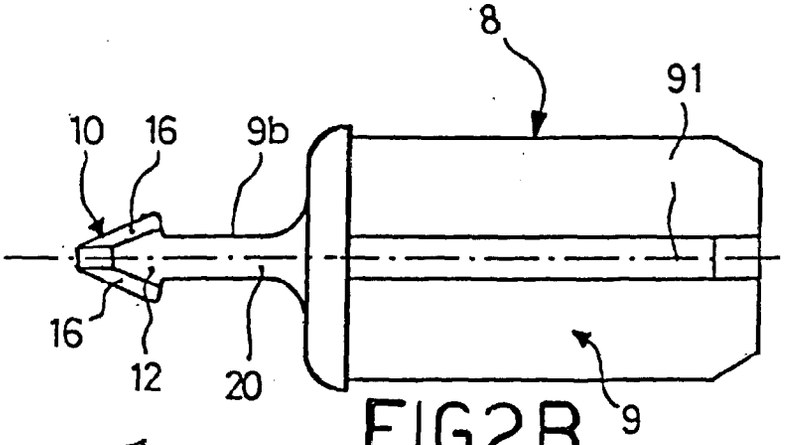
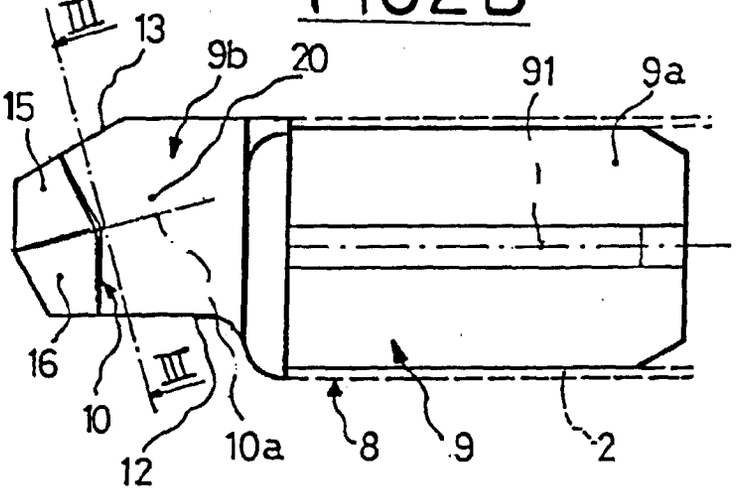


FIG2B



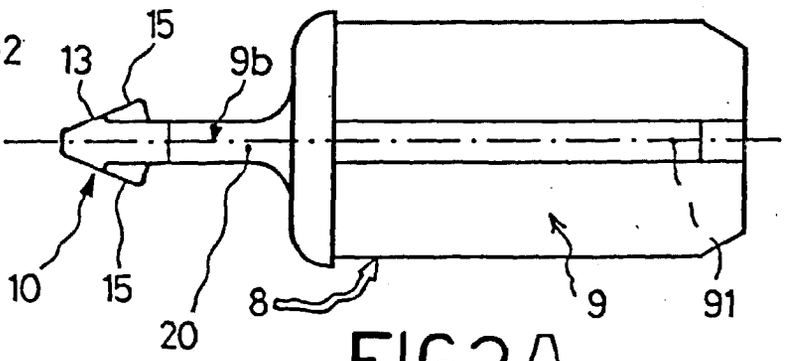


FIG2A

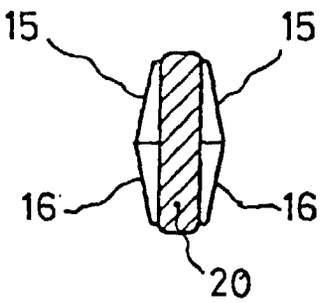


FIG3

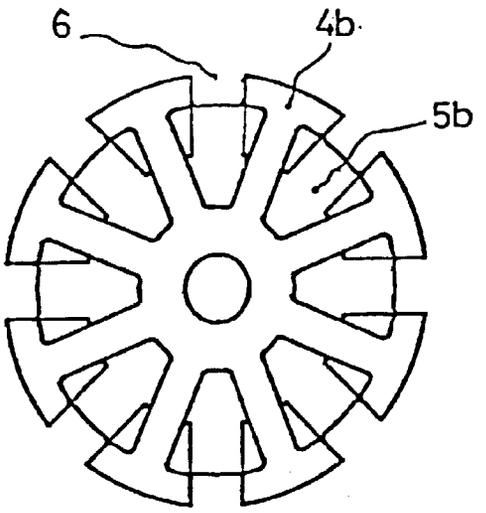


FIG4

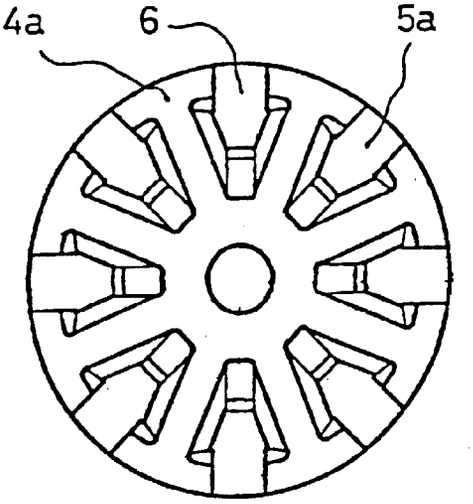


FIG6

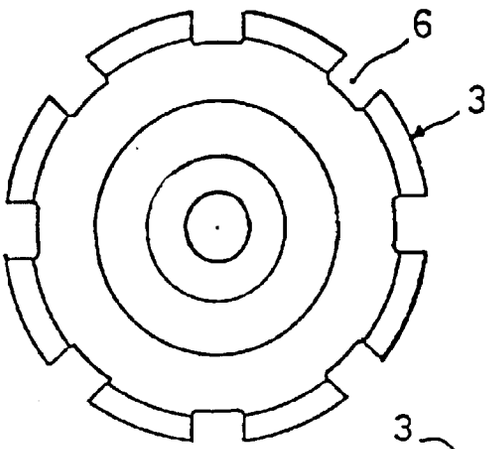


FIG5

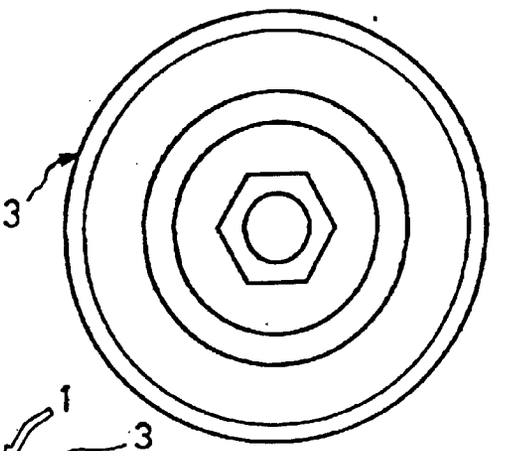


FIG7

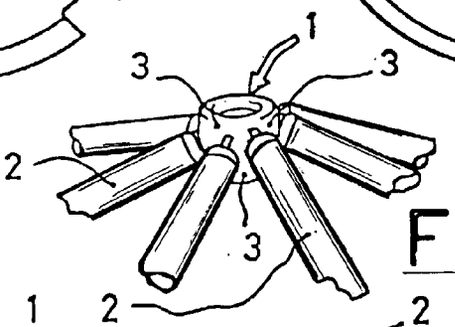


FIG8

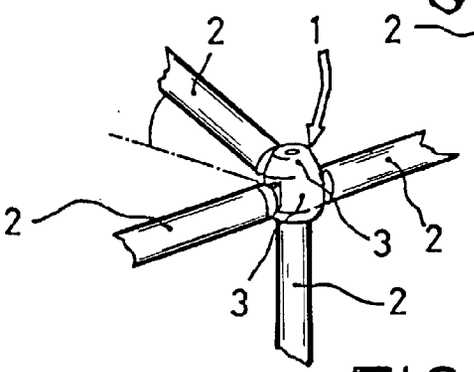


FIG10

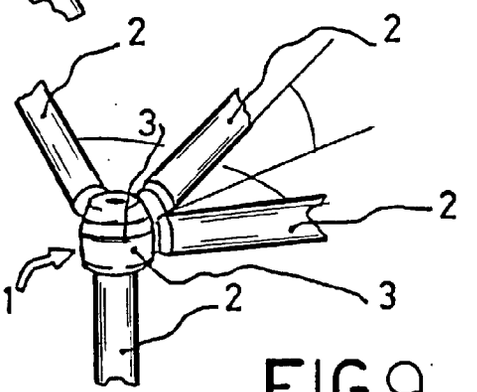


FIG9