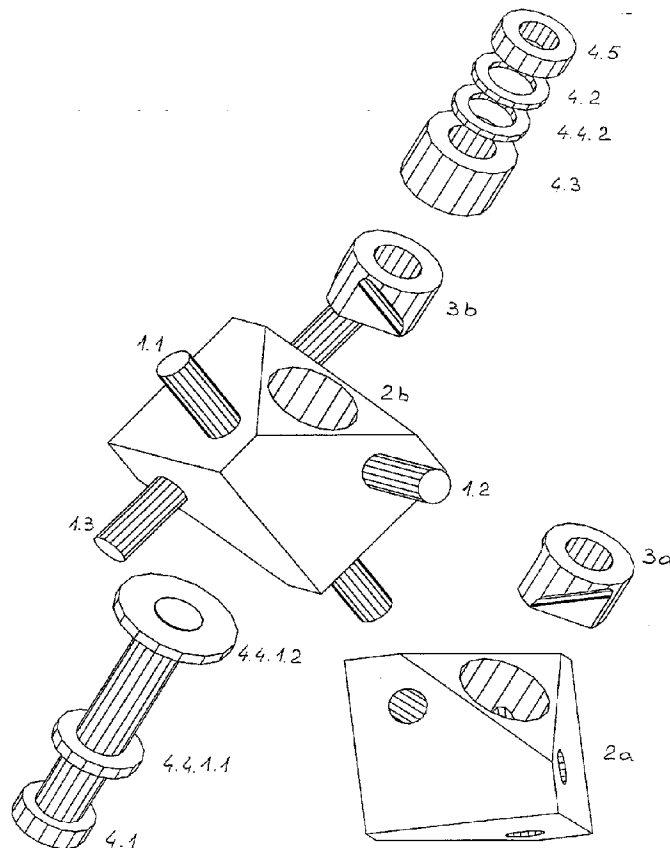




(72) CALIC, Bruno, HR
(71) CALIC, Bruno, HR
(51) Int.Cl.⁶ F16B 7/04
(30) 1996/04/05 (P960160A) HR
(54) **ASSEMBLAGE TRIDIMENSIONNEL**
(54) **SPACE JOINT**



(57) L'invention concerne un assemblage tridimensionnel avec serrage central (1) par tiges intérieures (1.1 à 1.3), qui comprend un corps (2) (en position 2a ou 2b), un corps de serrage (3.1a ou 3.1b respectivement; ou 3.2; ou 3.3 ou une position similaire), une vis (4.1), une rondelle (4.4.1.1), un corps additionnel (4.3.1), une rondelle (4.4.1.2), une rondelle (4.4.2.2), un corps additionnel (4.3.2), une rondelle (4.4.2.1), une fixation (4.2.1) et un écrou (4.5). La configuration générale du corps (2) de l'assemblage est décrite dans le brevet P 950575 A: le corps (2) de l'assemblage

(57) Referring to the figure, a space joint with central inner rods tightening 1 (1.1 - 1.3) comprises a body 2a or 2b, a tightening body 3.1a or 3.1b respectively; or 3.2; or 3.3; or similar, a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1, and a nut 4.5. General geometry of the joint body (2) is described in P 950575 a, so that the joint body 2 (Pos. 2a, or Pos. 2b) is cut with two planes that are perpendicular to a space diagonal of the joint body 2 (Pos. 2a or Pos. 2b) that passes through two joint body



(21) (A1) **2,223,631**
(86) 1997/04/03
(87) 1997/10/16

(en position 2a ou 2b) est coupé en deux plans qui sont perpendiculaires à une diagonale tridimensionnelle du corps (2) (en position 2a ou 2b) de l'assemblage, qui passe à travers deux points supérieurs du corps de l'assemblage équidistants à ces deux plans, de sorte qu'il existe autour de la diagonale tridimensionnelle un trou qui traverse en diagonale tout le corps de l'assemblage. Ainsi, la surface du trou de la diagonale tridimensionnelle entrecroise partiellement les surfaces des trous latéraux. Une pièce rapportée (3) de serrage est utilisée pour que les tiges (1) (en position 1.1 à 1.3) serrent le corps (2) (en position 2a ou 2b) de l'assemblage de l'intérieur en appliquant une force de serrage: a) lorsque le corps de serrage (3) est en fonctionnement (en position 3.1a et 3.1b respectivement; ou en position 3.2; ou 3.3 ou une position similaire), à l'aide d'une vis (4.1), d'une rondelle (4.4.1.1), d'un corps additionnel (4.3.1), d'une rondelle (4.4.1.2), d'une rondelle (4.4.1.1), d'un corps additionnel (4.3.2), d'une rondelle (4.4.2.1), d'une fixation (4.2.1) et d'un écrou (4.5), afin de garantir sur un côté du système de serrage une entrée libre pour tous les éléments dans le trou du corps de l'assemblage, alors que de l'autre côté une rondelle correspondante (4.4) (4.4.1.1; 4.4.1.2; 4.4.2.1 ou 4.4.2.2) sert de support au corps de l'assemblage; b) dans le même cas qu'en a), de sorte que le trou de la diagonale tridimensionnelle est dirigé vers l'un des points supérieurs de la diagonale dont une section transversale est plus petite, et en principe adapté à la taille de la vis (4.1); c) dans le même cas qu'en b), de sorte que le trou de la diagonale de section transversale plus petite est conçu pour y visser la vis (4.1), de façon que pour serrer cette vis (4.1), la fixation (4.2.1), la rondelle (4.4.1.1), le corps additionnel (4.3.29) et la rondelle (4.4.2.2) puissent être utilisés.

top points that are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of the side holes. A tightening insert (3) is used for the rods 1 (1.1 - 1.3) tightening to joint body 2 (Pos. 2a or 2b) from inside, so that a tightening force of tightening bush (3) is obtained: a) in use of tightening body 3 (Pos. 3.1a and 3.1b respectively; or Pos. 3.2, or 3.3 or similar) by using a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5, so that on one side of the tightening system has to be secured free entering of all elements in the joint body hole, while from the other side a corresponding washer 4.4 (4.4.1; 4.4.1.2; 4.4.2.1 or 4.4.2.2) ensures supporting of the joint body; b) same as in a), so that the space diagonal hole is towards one of diagonal top point of smaller cross section, and in principle adopted to the screw 4.1 dimension; c) same as in b), so that in the diagonal hole of smaller cross section thread is performed in which the screw 4.1 is screwed, so that for tightening the screw 4.1, the securing 4.2.1, the washer 4.4.1.1, the additional body 4.3.2 and the washer 4.4.2.2 can be used.



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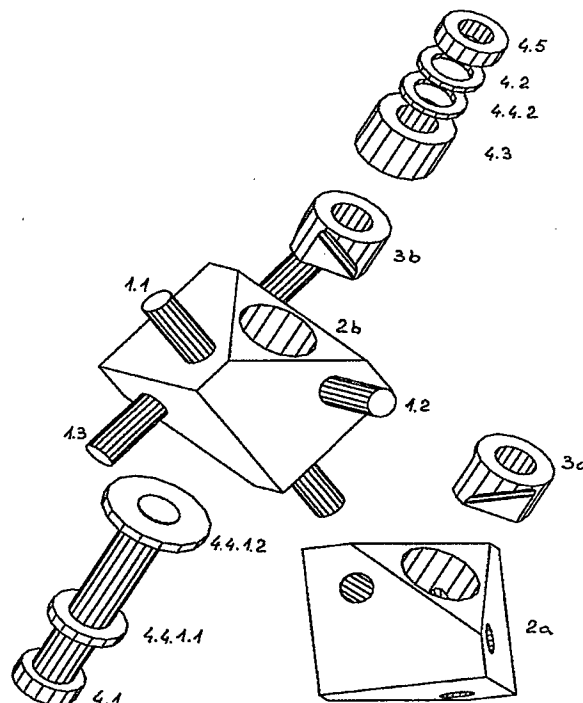
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F16B 7/04	A1	(11) International Publication Number: WO 97/38229 (43) International Publication Date: 16 October 1997 (16.10.97)
(21) International Application Number: PCT/GB97/00944 (22) International Filing Date: 3 April 1997 (03.04.97) (30) Priority Data: P960160A 5 April 1996 (05.04.96) HR (71) Applicant (for all designated States except US): JONES, Graham, Henry [GB/GB]; 77 Beaconsfield Road, Blackheath, London SE3 7LG (GB). (71)(72) Applicant and Inventor: CALIC, Bruno [HR/HR]; Ivana Luppisa 15/142, 51000 Rijeka (HR). (74) Agent: JONES, Graham, Henry; Graham Jones & Company, 77 Beaconsfield Road, Blackheath, London SE3 7LG (GB).	(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.	

(54) Title: SPACE JOINT

(57) Abstract

Referring to the figure, a space joint with central inner rods tightening 1 (1.1 - 1.3) comprises a body 2a or 2b, a tightening body 3.1a or 3.1b respectively; or 3.2; or 3.3; or similar, a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1, and a nut 4.5. General geometry of the joint body (2) is described in P 950575 a, so that the joint body 2 (Pos. 2a, or Pos. 2b) is cut with two planes that are perpendicular to a space diagonal of the joint body 2 (Pos. 2a or Pos. 2b) that passes through two joint body top points that are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of the side holes. A tightening insert (3) is used for the rods 1 (1.1 - 1.3) tightening to joint body 2 (Pos. 2a or 2b) from inside, so that a tightening force of tightening bush (3) is obtained: a) in use of tightening body 3 (Pos. 3.1a and 3.1b respectively; or Pos. 3.2, or 3.3 or similar) by using a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5, so that on one side of the tightening system has to be secured free entering of all elements in the joint body hole, while from the other side a corresponding washer 4.4 (4.4.1; 4.4.1.2; 4.4.2.1 or 4.4.2.2) ensures supporting of the joint body; b) same as in a), so that the space diagonal hole is towards one of diagonal top point of smaller cross section, and in principle adopted to the screw 4.1 dimension; c) same as in b), so that in the diagonal hole of smaller cross section thread is performed in which the screw 4.1 is screwed, so that for tightening the screw 4.1, the securing 4.2.1, the washer 4.4.1.1, the additional body 4.3.2 and the washer 4.4.2.2 can be used.



SPACE JOINT

Technical Field

This invention relates to a joint for construction elements in mechanical engineering, shipbuilding, civil engineering, as well as in building generally. More specifically, this invention relates to a space joint for rods joining primarily in grid structure's nodes.

Technical Background

In cases of space joining of crossover joint elements (rods) in three-dimensional nodes, the problem of quick, sustainable, cheap, synchronous, central joint tightening or yielding has been noticed, so that, if necessary, the following could be done in addition:

- a) whole joint protected from slipping by dynamic forces;
- b) joint separately insured from slipping of one or more than one rod which is very high forced;
- c) separate rods protected from dangers while joining and yielding of space joint;
- d) joint protected from decay while in aggressive environmental condition;
- e) very high carrying capacity enabled, if necessary;
- f) joint "warmth" and suitable design for chosen application field insured;
- g) usage of joint and rods from almost all metals (steel, procron, aluminum, brass, etc.), and nonmetals (wood, plastics, armored concrete, rubber, polyurethane, etc.) enabled;
- h) joint maintenance reduced to minimum, or quite excluded;
- I) on already existing construction to enable, with minimum exertion, easy way of extension, and/or additional partitioning, and/or adaptation;
- j) education to be enabled through space joint usage in play by toys and furniture assembling, etc.;
- k) if necessary, space joint usage for joining sheeting, panels, or similar, could be enabled;
- l) so, if necessary, axes of one or more than one hole or bearing surfaces is not a straight line, or axes do not exist at all;
- m) with relatively small number of standard space joint body dimensions, coverage of a wide field of rod dimensions and rod shapes is enabled;

- n) joint body to be used and as a bearing surface for rods, and so making tightening and loosening of space joints easier;
- o) length of space joint body side holes, or bearing surfaces on space joint body and tightening bodies represent bearings with sufficient carrying capacity for compressive loads, and herewith enlarge buckling stiffness.

The above mentioned technical problem has been noticed in numerous technical fields, where joining of more rods or other joining elements in nodes, is realized, as for instance:

- Maritime (surface and sub-sea) grid structures, as for instance: bridges, pontoons, gates, tourist platforms, foundations, etc.;
- Grid structures on land, as for instance: bridges, prefabricated shops, prefabricated houses, prefabricated roofs, partitioning systems, eaves, snow protective structures, power line grid structures, etc.;
- Partitioning systems, as for instance: in stores and cargo stores (holds) on land, in air, water and on space vehicles, and similar;
- Furniture, as for instance: diving room furniture, wardrobes, chairs, beds, shelves, and similar;
- Toys, as for instance: folding toys, toys in function of education and furniture, etc.;
- Equipment of theaters and circuses, as for instance: stages, scenarios, bearable grid structures, etc.;
- Equipment of children's recreation places, as for instance: toboggans, swings, bridges, ladders, etc.;
- Space grid structures, as for instance: space modules, foundations, grid carriers, etc.;
- Ornamental (decorative) objects, as for instance: appendages on small chains, appendages for keys, etc.

Technical Background

Patent application P 950575 A, partially solves some of mentioned problems, but rods have to be singly tightened and loosed. Although this gives the possibility of additional rebuilding,

partitioning, or adopting of existing construction, separate intervention on every node is necessary.

JP, 05248420 A does not satisfy the following requirements b), e), g), i), k), m), n), and o), and only partially satisfies requirements d), j), l), while requirements a), c), f), and o) are mainly satisfied.

JP, 03113106 A solves the joining of rods whose axes are bisected at one point, but a crossover node joint is not dealt with.

A wide variety of space joints are known. However, they are not predicted for joining of crossover rods, or joining of crossover rods is solved by minimum of two space joints, or solutions are much worse than in JP 05248420 A.

Description

The present invention aims to solve the mentioned technical problem with space joints, by achieving the following:

- a) enabling the solution of the technical problem through usage of "multipurpose" space joint types ensuring as much as possible wider range of application;
- b) enabling the solutions of the technical problem by quick, sustainable, cheap, synchronous, central tightening or loosening of rods;
- c) enabling the solution of the technical problem by synchronous, central tightening of rods from internal of space joint, in such mode to retreat rods into corresponding space joint body holes;
- d) enabling the solution of the technical problem by synchronous, central tightening of rods from external of space joint, in such mode to retreat rods into corresponding space joints body holes, while rods' tightening or loosening is executed through tightening bodies (covers);
- e) enabling the solution of the technical problem by synchronous, central tightening of rods from "heart" external of space joint, in such mode as space joint represent the joint upon

which the rods are lean against from the external side, and rod tightening is solved through external tightening bodies ("grips");

- f) enabling the solution of the technical problem by synchronous, central tightening of rods in such mode that rods' tightening is performed by tightening body "separated part" of space joint;
- g) enabling the solution of the technical problem in such mode as the space joint if necessary become nondisconnected, of more difficult type to disconnect, as to assure higher joint load capacity, and in that way of whole construction, as to avoid the need for additional problem solving of dynamic loads of constructions, as well as space joints;
- h) enabling the solution of the technical problem in such mode as the space joint if necessary become non-disconnected, of easier type to disconnect, as to assure higher joint load capacity, and in that way of whole construction, as to avoid the need for additional problem solving of dynamic loads of constructions, as well as space joints, so that the joint could be easy disconnected, if necessary, and so without bigger joint parts destruction; and
- i) enabling the solution of the technical problem in such mode that space joint internal become isolated of surrounding fluid, if necessary, so to prevent joint parts deterioration due to surrounding fluid aggressive influence.

Innovation Preview Summary

The technical problem of synchronous, central tightening or loosening of rods by space joints is enabled by usage of space joint type solutions based upon following principals: friction, blocking; final hard joint (easier or harder to disconnect). Basic space joint type solutions are pointed out, as follows:

A) SOLUTIONS ON FRICTION PRINCIPLE

TYPE I Tightening of rods 1 in a space joint body 2 is performed from the internal side (from inner side) of space joint body through tightening bodies (inserts) 3 placed in space diagonal hole of space joint body and by system for tightening of tightening bodies (inserts), so that the rods must be drawn into corresponding space joint body holes before final rods tightening. Friction

force among tightening bodies, rods and space joint bodies is realized by axial moving-of tightening bodies along space diagonal hole of space joint body.

TYPE II Tightening of rods 1 in a space joint body 2 is performed from the external side (from outer side) of space joint body through tightening bodies (covers) 3 placed outside of space joint body 2 and system for tightening of tightening bodies, so that the rods must be drawn into corresponding space joint body 2 holes before final rods tightening. Friction force among tightening bodies, rods and space joint bodies is realised by axial moving of tightening bodies along space diagonal hole of space joint body. Tightening is enabled by moving of tightening bodies towards space joint body, from space joint body, or combined.

TYPE III Tightening of rods 1 in a space joint body 2 is performed from the external side (from outer side) of space joint body through tightening bodies (grips) 3 placed outside of space joint body and system for tightening of tightening bodies, in such way that the rods lean against at corresponding grooves or plane surfaces of bearing part of space joint body "heart" 2, before final tightening.

Friction force among tightening bodies, rods and space joint body is realised by axial moving of tightening bodies along space diagonal hole of space joint body, in such way that friction force is realized: a) among rods, tightening bodies and space joint body,
b) among rods and tightening bodies only.

TYPE IV Tightening of rods 1 in a space joint body is performed from the external side (from outer side) of space joint body through separated tightening body 3 which in principle represent part of the space joint body 2, and system for tightening of tightening body, placed around the space diagonal hole axes of space joint, in such way that the rods must be drawn into corresponding holes of bearing part of space joint, before final rods tightening. Friction force among tightening bodies, rods and space joint body is realized by axial moving of tightening body along space diagonal hole of space joint body.

B) Solutions on Blocking principle

TYPE V Rods blocking is obtained from a space joint body 2 internal (inner) side (in principle

based on TYPE I) by means of blocking bodies 3 situated in space diagonal hole of space joint body. Blocking is obtained by mutual adaptation of the geometry of blocking bodies and rods in ways of blocking, such as:

- a) by adaptation of rods geometry, only,
- b) by adaptation of both rods and blocking bodies geometry.

TYPE VI Rods blocking 1 is obtained from a space joint body 2 external (outer) side (in principle based on TYPE II to IV) by means of tightening bodies 3 situated outside the space joint body. Blocking is obtained by mutual adaptation of the geometry of tightening bodies and the rods in ways of blocking.

C) Solutions on Principle of Easier or Harder Separating Joint

TYPE VII Easier or harder separable joint (in principle based on TYPE I to VI) is obtained by rods 1 sticking with:

- a) space joint body 2,
- b) space joint body 2 and tightening (blocking) body 3,
- c) tightening (blocking) body 3.

TYPE VIII Easier or harder separable joint (in principle based on TYPE I to VI) is obtained by rods 1 welding with:

- a) space joint body 2,
- b) space joint body 2 and tightening (blocking) body 3,
- c) tightening (blocking) body 3.

TYPE IX Easier or harder separable joint (in principle based on TYPE I to VI) is obtained by rods 1 soldering with:

- a) space joint body 2,
- b) space joint body 2 and tightening (blocking) body 3,
- c) tightening (blocking) body 3.

TYPE X Easier or harder separable joint (in principle based on TYPE I to VI) is obtained by one of mutual combination of rods 1: sticking, welding, soldering with:

- a) space joint body 2,
- b) space joint body 2 and tightening (blocking) body 3,
- c) tightening (blocking) body 3.

TIGHTENING SYSTEM OVERVIEW

In all cases where rods tightening is obtained through tightening bodies (inserts-covers-grips), tightening of bodies themselves is realized in some of following ways:

- by screwing joint; - by keying; - by hydraulics; - by pneumatics; - by electromagnetic, or combined.

BLOCKING BODIES ASSURANCE SYSTEMS OVERVIEW

In all cases of blocking, blocking bodies are assured from falling out by using of some of well-known engineering solutions: split pin; cotter; wedge; nut; elastic full bodied inserts, etc.

DRAWING SHORT DESCRIPTION

Embodiments of the invention will now be described solely by way of example and with reference to the accompanying drawings in which:

- Fig. 1.1 Space joint - Space joint body with circular cylindrical space diagonal hole which intersects side holes: a) Right handedness; b) Left handedness;
- Fig. 1.2 Space joint - Space joint body with circular conical space diagonal hole that intersects side holes: a) Right handedness; b) Left handedness;
- Fig. 1.3 Space joint - Space joint body with circular cylindrical space diagonal hole which does not intersect side holes: a) Right handedness; b) Left handedness;
- Fig. 1.4 Space joint - Space joint body with partially circular cylindrical space diagonal hole: a) Right handedness; b) Left handedness;

- Fig. 1.5 Space joint - Space joint body with stepped circular cylindrical space diagonal hole:
a) Right handedness; b) Left handedness;
- Fig. 1.6 Space joint - Space joint body with space circular cylindrical diagonal hole with six side holes: Right and Left handedness;
- Fig. 1.7 Space joint - Space joint body with partially circular cylindrical space diagonal hole and with nine side holes: Right and Left handedness;
- Fig. 1.8 Space joint - Space joint body consisting from outer part and filling - fastening from inside;
- Fig. 1.9 Space joint - Space joint body consisting from outer part and filling - fastening from outside;
- Fig. 2.1 Space joint with inner rods tightening, with one tightening body (insert) and with hole in tightening body - TYPE Ia;
- Fig. 2.2 Space joint with inner rods tightening, with at least two tightening bodies and with hole through tightening body - TYPE Ib;
- Fig. 2.3 Space joint with inner rods tightening, with one tightening body (insert), without hole in tightening body - TYPE Ic;
- Fig. 2.4 Space joint with inner rods tightening, with at least two tightening bodies (inserts), without hole in tightening body - TYPE Id;
- Fig. 3.1 Space joint with outer rods tightening towards or off space diagonal with one or two tightening bodies - TYPE IIa;
- Fig. 3.2 Space joint with outer rods tightening off space diagonal with one or two tightening bodies - TYPE IIb;
- Fig. 4.1 Space joint with outer rods tightening on space joint body "space body heart" (rods are not passing through space joint body) by means of one or two tightening bodies: basic space joint body shape is regular trilateral prism - TYPE IIIa;
- Fig. 4.2 Space joint with outer rods tightening on space joint body "space body heart" (rods are not passing through space joint body) by means of one or two tightening bodies: basic space joint body shape is circular cylinder - TYPE IIIb;
- Fig. 5.1 Space joint with tightening body as part of space joint body - small tightening surfaces - TYPE IVa;
- Fig. 5.2 Space joint with tightening body as part of space joint body - enlarged tightening surfaces, without tightening subsystem presentation - TYPE IVb;

- Fig. 6.1 Space joint with central internal blocking body for three rods synchronous blocking - TYPE Va;
- Fig. 6.2 Space joint with central internal blocking body for six rods synchronous blocking - TYPE Vb;
- Fig. 6.3 Space joint with central internal blocking body for three non-circular rods synchronous blocking - TYPE Vc;
- Fig. 7.1 Space joint with adapted bodies for rods of circular and non-circular transversal section - TYPE VI;
- Fig. 8.1 Application example of space joint with subsystem for tightening or blocking of tightening or blocking body from inside;
- Fig. 8.2 Application example of space joint with subsystem for tightening or blocking of tightening or blocking body from inside, with marks for sticking, welding and soldering.; and
- Fig. 8.3 shows an example of a space joint with a subsystem for tightening or blocking of tightening or blocking body from outside;

Preview of drawing reference numbers:

Name of space joint element	Reference No.
Rods	1
Space joint body	2
Tightening body	3
Tightening system for tightening body	4
Securing system for blocking body	5
Stick	6
Weld	7
Sold	8
Adaptable bearing insert	9
Sheathing (panels)	10

For easy of description and understanding, on all drawings, the same reference numbers for the same type of joint element are used. On some drawings there is a surplus, and on some drawings a lack of positions, and on some of them a surplus and lack of positions in series. Additional marks "a" describe space joint parts of right handedness, and additional marks "b" describe space joint parts of mirror symmetry realization, as well as left handedness. A space joint element is treated as having right handedness if side holds looking in direction of space diagonal (one which intersects side holes) is placed on the right side of a space joint's body outer surface diagonal.

DESCRIPTION

Description of space joint body (Fig. 1.1 to 1.9)

For ease of following particular types of space joints in Fig. 1.1 to 1.9, space joint bodies with side holes as well as space diagonal hole are shown. Basic geometric body shape is a cube. By reshaping, space joint functionality and design are obtained. As can be seen from Fig. 1.1 to 1.9 all joint bodies are solid, excluded holes, while joint bodies shown in Fig. 1.8 and 1.9 are of a composite type.

Fig 1.1 shows a space joint body 2 (2a - right handedness and 2b left handedness) of cubical shape with three side holes of circular cross section, with a space diagonal hole which is also of circular cross section and which intersects side holes, and two mutually perpendicular cross sections P1 (P1a and P1b) and P2 (P2a and P2b) by which the space joint body is divided (if holes are excluded) in two geometrically mutually identical body parts. The joint body 2 is only partly of modified cubical shape, which is obtained by intersection of body 2 with planes perpendicular to space diagonal. Rods 1 (1.1 - 1.3) are shown which are fastened by a space joint.

Fig. 1.2 shows space joint body 2 (2a - right handedness and 2b - left handedness) of cubical shape with three side holes of circular cross section, with conical space diagonal hole of circular cross section which intersects side holes, and cross section P1 (P1a and P1b).

Fig 1.3 shows a space joint body 2 (2a - right handedness and 2b left handedness) of cubical shape with three side holes of circular cross section, with a space diagonal hole also of circular cross section which does not intersect side holes, and with cross sections P1 (Pa and Pub) which are obtained by intersection of the joint body with a plane perpendicular to one side hole, and

parallel with other side holes. The joint body 2 is only partly of modified cubical shape, which is obtained by the intersection of the body 2 with planes perpendicular to a space diagonal. Rods 1 (1.1 to 1.3) are shown, which are fastened by a space joint.

Fig 1.4 shows a space joint body 2 (2a - right handedness and 2b left handedness) of cubical shape with three side holes of circular cross section, with a partial space diagonal hole also of circular cross section which does not intersect side holes, and with cross sections P1 (P1a and P1b) which are obtained by intersection of the joint body with a plane which passes through space diagonal and through two plane diagonals of the joint body. The joint body 2 is only partly of modified cubical shape, which is obtained by the intersection of the body 2 with planes perpendicular to a space diagonal. Rods 1 (1.1 to 1.3) are shown, which are fastened by a space joint.

Fig 1.5 shows space joint body 2 (2a - right handedness and 2b left handedness) of cubical shape with three side holes of circular cross section, with a discontinued space diagonal hole also of circular cross section which does not intersect side holes, and with cross sections P1 (P1a and P1b) and P2 (P2a and P2b) which are obtained by intersection of a joint body with a plane which passes through a space diagonal and through two plane diagonals of the joint body, and by a plane perpendicular on that plane and space diagonal respectively. The joint body 2 is only partly of modified cubical shape, which is obtained by intersection of the body 2 with planes perpendicular to the space diagonal. Rods 1 (1.1 to 1.3) are shown, which are fastened by a space joint.

Fig 1.6 shows a space joint body 2 of cubical shape with six side holes of circular cross section, with a space diagonal hole which is also of circular cross section and which does not intersect side holes, and with cross sections P1 and P2 which are obtained by intersection of the joint body with a plane which passes through the space diagonal and through two plane diagonals of the joint body, and by a plane perpendicular on that plane and space diagonal. The joint body 2 is only partly of modified cubical shape, which is obtained by the intersection of body 2 with planes perpendicular to the space diagonal.

Fig 1.7 shows a space joint body 2 of cubical shape with nine side holes of circular cross section, with a space diagonal hole which is also of circular cross section and which does not intersect side holes, and with cross sections P1 and P2 which are obtained by intersection of the joint body with a plane which passes through the space diagonal and through two plane diagonals of the joint body, and by a plane perpendicular on that plane and space diagonal. The joint body

2 is only partly of modified cubical shape, which is obtained by the intersection of the body 2 with planes perpendicular to the space diagonal.

Fig. 1.8 shows a space joint body 2 of cubical shape with three side holes of circular cross section, and a space diagonal hole which is also of circular cross section and which intersects the side holes. The joint body 2 consists of an outer part (shell) (2.1a and 2.1b respectively) and an inner part (fulfillment) (2.2a and 2.2b respectively). The outer shape is only partly of modified cubical shape that is obtained by intersection of the body 2 with planes perpendicular to the space diagonal. The outer body space joint part consists of plane parts and tubular parts which join together to represent a shell casing of the space joint body. Tubular parts of the shell casing are shaped so that the space joint fastening is performed from inside (tightening or blocking or etc.).

Fulfillment shape is such as to fulfill space inside the shell casing.

Fig. 1.9 shows a space joint body 2 of cubical shape with three side holes of circular cross section, and a space diagonal hole which is also of circular cross section and which intersects the side holes. The joint body 2 consists of an outer part (shell) (2.1a and 2.1b respectively) and an inner part (fulfillment) (2.2a and 2.2b respectively). The outer shape is only partly of modified cubical shape that is obtained by cutting of the body 2 with planes perpendicular to the space diagonal. The outer body space joint part consists of plane parts and tubular parts which join together to represent a shell casing of the space joint body. On tubular parts of the joint body there is no special geometrical preparation because, rod fastening by the joint is performed from outside or separately in a side hole.

Fulfillment shape is such as to fulfill space inside the shell casing.

DESCRIPTION OF SPACE JOINT TYPES

SOLUTIONS ON FRICTION PRINCIPLE (TYPE I TO IV)

TYPE Ia SPACE JOINT WITH INNER RODS TIGHTENING, WITH ONE TIGHTENING BODY, WITH HOLE IN BODY

Referring to Fig. 2.1, a space joint with central inner rods tightening 1 (1.1 - 1.3) comprises a body 2a or 2b, a tightening body 3.1a or 3.1b respectively; or 3.2; or 3.3; or similar, a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body

4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (Pos. 2a, or Pos. 2b) is cut with two planes that are perpendicular to a space diagonal of the joint body 2 (Pos. 2a or Pos. 2b) that passes through two joint body top points that are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of the side holes.

A tightening insert 3 is used for the rods 1 (1.1 -1.3) tightening to joint body 2 (Pos. 2a or 2b) from inside, so that a tightening force of tightening bush 3 is obtained:

- a) In use of tightening body 3 (Pos. 3.1a and 3.1b respectively; or Pos. 3.2, or 3.3 or similar) by using a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5, so that on one side of the tightening system has to be secured free entering of all elements in the joint body hole, while from the other side a corresponding washer 4.4 (4.4.1.1; 4.4.1.2; 4.4.2.1 or 4.4.2.2) ensures supporting of the joint body.
- b) Same as in a), so that the space diagonal hole is towards one of diagonal top point of smaller cross section, and in principle adopted to the screw 4.1 dimension.
- c) Same as in b), so that in the diagonal hole of smaller cross section thread is performed in which the screw 4.1 is screwed, so that for tightening the screw 4.1, the securing 4.2.1, the washer 4.4.1.1, the additional body 4.3.2 and the washer 4.4.2.2 can be used.

In use of the tightening bush 3 (3.1a or 3.1b) the tightening body must be positioned in the diagonal hole before the rods 1 (1.1 - 1.3) are drawn in. In this case, surface performance against the rods 1 (1.1 - 1.3) geometry is enabled so that an unmachined tightening insert is inserted in space hole, tightened with tightening systems from both sides of the diagonal hole, normally while the rods are not drawn in. Machining of the tightening bush surface is now performed through side holes of the joint body 2 (2a or 2b). It is also possible to simultaneously drill holes in the joint body and so, at the same time to get side holes and adapt tightening bush geometry.

In case of use of the tightening bush 3 (3.2; or 3.3; or similar), the tightening bushes are performed from more soft elastic material (rubber or similar), the tightening bushes need not be additionally shaped because they are drawn in into the diagonal hole under the relevant load before they are drawn in or after the rods are drawn into the side holes.

If a non-uniform tightening force is requested or friction force on rods respectively, this is obtained by corresponding shaping of the tightening bush 3 and the washers (4.4.1.2 and /or 4.4.2.2).

To ensure tightening with rods 1 (1.1 - 1.3) of smaller diameter than the diameter of side holes in the body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles and similar), the space between rods circular side hole surfaces is filled with relevant inserts.

TYPE Ib SPACE JOINT WITH INNER RODS TIGHTENING, WITH TWO TIGHTENING BODIES, WITH HOLE IN BODIES

Referring to Fig. 2.2, a space joint with central inner rods tightening 1 (1.1 - 1.3), comprises a body 2a or 2b, a tightening body 3.1a or 3.2a; or 3.1b and 3.2b; or 3.2; or 3.3 respectively, or similar, a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to a space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of the side holes.

The tightening body 3 is used for the rods 1 (1.1 - 1.3) tightening to joint body 2 (2a or 2b) from inside, so that a tightening force of the tightening bush 3 is obtained:

- a) In use of the tightening body 3 (3.1a and 3.1b respectively; or Pos. 3.2, or 3.3 or similar) by using a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5, so that on both sides of the tightening system have to be secured free entering of all elements in the joint body hole.
- b) Same as in a), so that the space diagonal hole is towards one of diagonal top point of smaller cross section, and in principle adapted to the screw 4.1 dimension.
- c) Same as in b), so that in the diagonal hole of smaller cross section thread is made in which the screw 4.1 is screwed, so that for tightening the screw 4.1, the securing 4.2.1, the washer 4.4.1.1, the additional body 4.3.2 and the washer 4.4.2.2 can be used, so that then just one tightening body is used.

In use of the tightening body 3 (3.1a and 3.1b or 3.1b and 3.2b respectively), the tightening bodies need not be positioned in diagonal hole before the rods 1 (1.1 - 1.3) are drawn in. In this case, surface performance against the rods 1 (1.1 - 1.3) geometry is enabled so that an unmachined tightening body is inserted in the space hole, tightened with tightening systems from both sides of the diagonal hole, normally while the rods are not drawn in. Machining of the tightening bush surface is now performed through side holes of the joint body 2 (2a or 2b). It is also possible to simultaneously drill holes in the joint body and so at the same time to get side holes and adapt tightening bush geometry. After tightening the body is drawn out of the hole in the space joint body and the same is transversally cut by such cut thickness that enables sufficient clearance while mutually rods fastening. The tightening bodies can be made in a range of ways, by for example casting, injection, milling, and cutting and similar.

In case of use of tightening bush 3 (3.2; or 3.3; or similar), the tightening bushes are made from more soft elastic material (rubber or similar). The tightening bushes need not be additionally shaped because they are drawn into the diagonal hole under the relevant load before they are drawn in or after the rods are drawn into the side holes.

If a non-uniform tightening force is requested or friction force on rods respectively, it is obtained by corresponding shaping of the tightening bush 3 and the washers (4.4.1.2 and /or 4.4.2.2).

To ensure tightening with rods 1 (1.1 - 1.3) of smaller diameter than the diameter of side holes in the body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles and similar), the space between rods circular side hole surfaces are filled with relevant inserts.

TYPE Ic -SPACE JOINT WITH INNER RODS TIGHTENING, WITH ONE TIGHTENING BODY, WITHOUT HOLE IN BODY

Referring to Fig. 2.3, a space joint with central inner rods tightening 1 (1.1 - 1.3), comprises a body 2a or 2b, a tightening body 3.1a or 3.1b; or 3.2; or 3.3, or similar, a securing 4.2.1, an additional element 4.3.1, a washer 4.4.1, a washer 4.4.2, an additional element 4.3.2, a washer 4.2.2, and a screw 4.1.2. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally

through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of side holes, so that in the space diagonal hole the thread is threaded from the side of new formed diagonal surfaces (thread can be extended and across whole surface of space diagonal hole).

The tightening body 3 is used for the rods 1 (1.1 - 1.3) tightening to joint body 2 (2a or 2b) from inside, so that a tightening force of tightening bush 3 is obtained.

- a) In use of tightening body 3 (3.1a or 3.1b) by using a screw 4.1.1, a securing 4.2.1, an additional element 4.3.1, and a washer 4.4.1, or by a screw 4.1.2, a securing 4.2.2, an additional element 4.3.2, and a washer 4.4.2, so that one of two corresponding tightening systems of the tightening bush must be released before. One of two tightening systems does not need to exist at all.
- b) When using tightening body 3 (3.2 or 3.3 or similar) by using a screw 4.1.1, a securing 4.2.1, an additional element 4.3.1 and a washer 4.4.1 and /or by a screw 4.1.2, a securing 4.2.2, an additional element 4.3.2 and a washer 4.4.2.
- c) Same as in a), so that the space diagonal hole does not pass entirely through joint body 2 (2a or 2b).
- d) Same as in b), so that the space diagonal hole does not pass entirely through joint body 2 (2a or 2b).
- e) Same as in c) and d), so that in continuation of the space diagonal hole in the non-holed joint body part, a passage is drilled and the passage serves for to drive out the tightening body, compensation passage for the case when the space joint is used in unpressurised fluid, or similar.
- f) Same as in e), so that in a continuation of space diagonal hole in the non-holed joint body part, a passage is drilled and a thread is threaded in it, and the passage with thread serve for to drive out of the tightening body, compensation passage for the case when space joint is used sunken in unpressurised fluid, or similar.

In use of the tightening body 3 (3.1a or 3.1b), the tightening bodies must be positioned in the diagonal hole before the rods 1 (1.1 - 1.3) are drawn in. In this case, surface performance against the rods 1 (1.1 - 1.3) geometry is enabled so that an unmachined tightening body is inserted in the space hole, tightened with tightening systems from both sides of the diagonal hole, normally while the rods are not drawn in. Machining of the tightening bush surface is now performed

through side holes of the joint body 2 (2a or 2b). It is also possible to simultaneously drill holes in the joint body and so at the same time to get side holes and adapt tightening bush geometry.

In case of use of the tightening bush 3 (3.2; or 3.3; or similar), tightening bushes are performed from more soft elastic material (rubber or similar), the tightening bushes need not be additionally shaped because they are drawn in into the diagonal hole under the relevant load before they are drawn in or after the rods are drawn into the side holes.

If a non-uniform tightening force is requested or friction force on rods respectively, this is obtained by corresponding shaping of the tightening bush 3 and the washers (4.4.1 and /or 4.4.2).

To ensure tightening with rods 1 (1.1 - 1.3) of smaller diameter than the diameter of side holes in the body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles and similar), the space between rods circular side hole surfaces are filled with relevant inserts.

TYPE Id SPACE JOINT WITH INNER RODS TIGHTENING, WITH TWO TIGHTENING BODIES, WITHOUT HOLE IN BODY

Referring to Fig. 2.4, a space joint with central inner rods tightening 1 (1.1 - 1.3) comprises a body 2a or 2b, a tightening body 3.1.1a or 3.1.2a; or 3.1.1b and 3.1.2b; or 3.2; or 3.3 respectively, or similar, a securing 4.2.1, an additional element 4.3.1, a washer 4.4.1, a washer 4.4.2, an additional element 4.3.2, a washer 4.2.2, and a screw 4.1.2. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to space diagonal of joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of the space diagonal hole partly intersects surfaces of the side holes, so that in space diagonal hole, the thread is threaded from the side of the new formed diagonal surfaces (thread can be extended and across the whole surface of the space diagonal hole).

The tightening inserts 3 (3.1a and 3.2a or 3.1b and 3.2b respectively) are used for the rods 1 (1.1 - 1.3) tightening to the joint body 2 (2a or 2b) from inside, so that a tightening force of the tightening bush 3 is obtained:

- a) In using of the tightening body 3 (3.1a or 3.2a or 3.1b and 3.2b respectively) by using a screw 4.1.1, 4.2.1, an additional element 4.3.1, and a washer 4.4.1, or by a screw 4.1.2, a securing 4.2.2, an additional element 4.3.2, and a washer 4.4.2. One of two tightening systems, such as neither

one of tightening bodies need not be used if high tightening forces are not required. For smaller requested tightening forces, it is sufficient to equip the space joint only with one-sided tightening system, with tightening body included.

- b) When using the tightening body 3 (3.2 or 3.3 or similar) by using a screw 4.1.1, a securing 4.2.1, an additional element 4.3.1 and a washer 4.4.1 and /or by a screw 4.1.2, an securing 4.2.2, an additional element 4.3.2 and a washer 4.4.2. In this case, the space joint must be equipped with both tightening systems, so that one of them need not to be tightened for smaller requested tightening forces.
- c) Same as in a), so that the space diagonal hole does not pass entirely through the joint body 2 (2a or 2b), so that in this case the space joint is equipped only with one tightening system and with one tightening element.
- d) Same as in b), so that the space diagonal hole does not pass entirely through the joint body 2 (2a or 2b).
- e) Same as in c) and d), so that in continuation of the space diagonal hole in the non-holed joint body part, the passage is drilled and the passage serves to drive out tightening body, compensation passage for the case when the space joint is used sunken in unpressurised fluid, or similar.
- f) Same as in e), so that in continuation of the space diagonal hole in the non-holed joint body part, the passage is drilled and the thread is threaded in it, and the passage with thread serves to drive out of tightening body, compensation passage for the case when the space joint is used sunken in unpressurised fluid, or similar.

In use of the tightening body 3 (3.1.1a and 3.1.2a or 3.1.1b and 3.1.2b), the tightening bodies need not be positioned in diagonal hole before the rods 1 (1.1 - 1.3) are drawn in. In this case, surface performance against the rods 1 (1.1 - 1.3) geometry is enabled so that an unmachined tightening insert (cylindrical piece) is inserted in the space hole, tightened with tightening systems from both sides of the diagonal hole. Normally while in the body the rods are not drawn in. Machining of the tightening body surface is now performed through the side holes of the joint body 2 (2a or 2b). It is possible to simultaneously drill holes in the joint body and so at the same time to get side holes and adapt the tightening body geometry. After the machined bush is drawn out from the joint body, the same is transversally cut by such cutting thickness that enable

sufficient clearance while tightening the rods from both sides. Normally tightening bodies can be made in a range, for example by casting, injection, milling and cutting, and similar.

In use of the tightening body 3 (3.2; or 3.3; or similar), the tightening bushes are made from more soft elastic material (rubber or similar). The tightening bushes need not be additionally shaped because they are drawn into the diagonal hole under the relevant load before they are drawn in or after the rods are drawn into the side holes.

If a non-uniform tightening force is requested or friction force on rods respectively, this is obtained by corresponding shaping of the tightening body 3 and washers (4.4.1 and /or 4.4.2).

To ensure tightening with the rods 1 (1.1 - 1.3) of smaller diameter than the diameter of side holes in the body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles and similar), the space between rods circular side hole surfaces are filled with relevant inserts.

TYPE IIa SPACE JOINT WITH OUTER RODS TIGHTENING, FROM OR TOWARDS THE SPACE DIAGONAL WITH ONE OR TWO TIGHTENING BODIES

Referring to Fig. 3.1, a space joint with central inner rods tightening 1 (1.1 - 1.3), comprises a body 2a or 2b, a tightening body 3.1a and 3.2a; respectively 3.1b and 3.2b, a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2 and a nut 4.5. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body. In axes of symmetry of joint bodies, there is a hole for passing through parts of tightening systems.

The tightening body can be made in several ways, for example by casting, injection, welding, by combined procedures, or in some other manner. Hole beginning on the tightening body can be made with a spherical recess, for easier use of the joint.

For joint body construction, different materials can be used, for example metals (steel, procron, brass, aluminum, duraluminum, bronze, etc.), and nonmetals (GRP, acrylic, wood, polyurethane, etc.), armored concrete, etc.

Additional body is described separately for all types of space joints.

The washers 4.4.1.1 and 4.4.1.2 are after need for adaptable joint made in a rounded version because of adaptation.

The tightening body 3 (3.1a and 3.2a respectively 3.1b and 3.2b) is used for the rods 1 (1.1 -1.3) tightening to the joint body 2 (2a or 2b) from outside of joint body geometry, so that tightening force of the tightening body 3 is obtained:

- a) By a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2, and a nut 4.5, the screw 4.1 is used simultaneously for tightening both the tightening bodies 3 (3.1a and 3.2a respectively 3.1b and 3.2b).
- b) In case that in space diagonal hole of tightening body of joint body 2 (2a respectively 2b) left or right thread is threaded along whole length of hole, Fig. 4.3 in general case of tightening , by using a screw 4.1, a securing 4.2.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.2 and a screw 4.1.2.
- c) Same as in b), except that screws with heads are not used, and studs and nuts are used instead.
- d) Same as in a), b) and c), except that only one tightening body is used. It is applied for cases when smaller tightening forces are required.
- e) Same as in a), b),c) and d), except that particular elements of the tightening system are not used: additional bodies (4.3.1 and (or) 4.3.2), some washers.

To ensure tightening also when the rods 1 (1.1 - 1.3) are of smaller radius than the radius of side holes on body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles, and similar), hollow space between the rods and side circular hole surfaces is filled with corresponding inserts (for example Fig. 7.1).

An advantage of this tightening node is that in the side holes of the tightening bodies corresponding bushes are easily inserted, and also those holes can be made with changeable cross section so to enable adaptation of holes themselves to rods, respectively to bushes.

A disadvantage of tightening bodies is in that, those bodies can not be positioned afterwards, that is after the rods are pulled through the side holes.

**TYPE IIb SPACE JOINT WITH OUTER RODS TIGHTENING, FROM THE SPACE
DIAGONAL, WITH ONE OR TWO TIGHTENING BODIES**

This type of space joint differs in relation to space joint TYPE IIIa, only in tightening body 3 (3.1a and 3.2a respectively 3.1b and 3.2b). As can be seen from Fig. 3.2 the tightening body 3 is made so that rods 1 (1.1 - 1.3) can be tightened only from the diagonal axes of the joint body. The advantage of this method of tightening is that tightening bodies can be positioned after the rods are pulled through the side holes in the joint space body. This is advantageous in that tightening is achieved only from space diagonal axes.

TYPE IIIa and IIIb SPACE JOINT WITH OUTER RODS TIGHTENING, TO OPEN JOINT BODY "HEART" WITH ONE OR TWO TIGHTENING BODIES

Referring to Fig. 4.1-4.3, a space joint with outer rods tightening 1 (1.1 - 1.3) to joint body "heart", comprises a joint body 2, tightening bodies 3 (3.1a and 3.2a respectively 3.1b and 3.2b), a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2 and a nut 4.5. General geometry of the body 2 (2a or 2b) is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that the surface of space diagonal hole does not intersect the side hole surfaces. Thus a final joint body 2 (2a or 2b) geometry, as per Fig. 3.1 is obtained in such a manner that from body 2 (2a or 2b) particular outer parts are cut by planes perpendicular to orthogonal joint body 2 (2a or 2b) surfaces. Those surfaces are perpendicular to corresponding diagonals of orthogonal surfaces or respectively parallel to space diagonal. The cut body 2 (2a or 2b) parts, intersect corresponding side holes through the middle or slightly over hole axes, respectively as per Fig. 3.2 and the same as per Fig. 3.1. From joint body 2 (2a or 2b) "heart" additionally joint body parts are removed yet from outside of cylindrical surface whose axes represent space diagonal of joint body, and radius is such that cylindrical surface is tanging planes by whom in precedence the joint body had been cut. General inside geometry of the tightening bodies follows the geometry of the joint body 2 (2a or 2b) "heart", and represents basically the form of regular trilateral prism, Fig. 3.1 or the form of circular cylinder, Fig. 3.2, so to ensure corresponding clearance between tightening bodies 3.1a and 3.2a respectively 3.1b and 3.2.b and joint body 2a respectively 2b, and due to

necessity of rods 1 (1.1 - 1.3) tightening to the joint body 2 (2a or 2b). In axes of symmetry of the tightening bodies there is a hole for passing of tightening system parts.

The tightening body can be made in, for example by casting, injection, welding, etc. The beginning of the hole on the tightening body can be made with a spherical recess, because of easier joint adaptation.

To produce joint body, different materials can be used, for example metals (steel, procron, brass, aluminum, duraluminum, bronze, etc.), and nonmetals (GRP, acrylic, wood, polyurethane, etc.), armored concrete, etc.

Additional body is described separately for all types of space joints.

Washers 4.4.1.1 and 4.4.1.2 are after need for adaptable joint made in rounded version because of adaptation.

The tightening bodies 3 (3.1a and/or 3.2a respectively 3.1b and/or 3.2b) are used for the rods 1 (1.1 - 1.3) tightening to the joint body 2 (2a or 2b) from outside, so that tightening force of the tightening bodies 3 is obtained:

- a) In using of one or both the tightening bodies 3 (3.1a and/or 3.2a respectively 3.1b and/or 3.2b) in general case of tightening, by using a screw 4.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a nut 4.5.
- b) If in space diagonal hole of joint body 2 (2a respectively 2b) left or right thread is threaded along whole hole length, in general case of tightening, by a screw 4.1.1, a securing 4.2.1, a washer 4.4.1.1, an additional body 4.3.1, a washer 4.4.1.2, a washer 4.4.2.2, an additional body 4.3.2, a washer 4.4.2.1, a securing 4.2.1 and a screw 4.1.2.
- c) Same as in b), so that as the tightening body is used the tightening body 3 (3.1a and 3.2a respectively 3.1b and 3.2b) as per Fig. 4.2, and the tightening is obtained by re-screwing of the screws 4.1.1 and 4.1.2, Fig. 3.3.
- d) Same as in b), except that screws with heads are not used and studs and nuts are used instead.
- e) Same as in a), b) and c), except that only one tightening body is used. It is applied in cases when smaller tightening forces are requested.
- f) Same as in a), b) c), and d), except that particular element of tightening system are not used: additional bodies (4.3.1 and/or 4.3.2), some washers.

To ensure tightening and in case when the rods 1 (1.1 - 1.3) of smaller diameter from diameter of side holes on body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles, and similar), hollows space between the rods and circular side hole surfaces is filled with corresponding inserts.

On Fig. 4.3 joint TYPE IIIa with two screws for tightening 4.1 (4.1.1 and 4.1.2) is shown.

TYPE IVa SPACE JOINT WITH TIGHTENING BODY AS PART OF JOINT BODY, WITH SMALL BEARING TIGHTENING SURFACES

Space joint TYPE Ia with (with smaller bearing tightening surfaces) Fig. 5.1 which serves for rods 1.1, 1.2 and 1.3 tightening, comprises a body 2 (2a or 2b), a tightening body 3 (3a or 3a) and system for tightening of the tightening body which in general case can be formed of following parts: a screw 4.1, a washer 4.2, an insert 4.3, a washer 4.4, a washer 4.5, an insert 4.6, a washer 4.7, a securing 4.8, a nut 4.9. General geometry of the joint body 2 (2a or 2b) is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole which passes diagonally through the whole joint body, so that surface of the space diagonal hole does not intersect the side hole surfaces. From such obtained joint body by suitable intersection of the body 2 with three planes, of which each one is perpendicular to one surface of body 2 which is neighbouring to surface where there is a diagonal hole and passes through diagonal of that surface so that the body part among those three planes towards one cut top point of body 2 where there a diagonal hole, the body 3 is obtained, and the remaining part of the body 2 represents the tightening body 3. The tightening body 3 serves for tightening the rods 1 (1.1 - 1.3), so that a tightening force is obtained by tightenings system 4. To ensure tightening also when the rods 1 (1.1 -1.3) are of smaller diameter then diameter of side holes of body 2, or rods are not of circular cross section (elipse, angled profiles, and similar), the hollow space between the rods and the surfaces of the circular side holes are filled with corresponding inserts and also hollow space between rods and tightening surfaces on tightening element.

The body of such joint can be easy produced from metals and nonmetals, for example steel, procron, aluminum, brass, duraluminum, wood, GRP, polyurethane, acrylic, etc. The joint body can be obtained in different ways, for example by cutting from quadrilateral rods, by casting, by

forging, or by injection. The body holes can be produced during casting, injection, or afterwards, which depending upon material, series, dimensions, technology on disposition, requested quality of performance, and similar. The tightening body can be produced in similar way to the joint body, even and from joint body itself, if it is performed in geometry which includes also tightening body geometry.

The threads in the bodies can be made in performed in various ways, for example by casting, injection, subsequent threading, etc.

The rods can be rods of shapes such for example as circular, elliptical, angled profiles, bulb profiles, Holland profiles, etc. They can be tubes, of such cross section that can be pulled through the side holes, so that eventual bigger clearances are solved with additional inserts.

The rods 1 (1.1 - 1.3) tightening system by means of the tightening body 3 to joint body 2 enables following options of tightening:

- a) If the space diagonal holes in the joint body 2 and the tightening body are smooth (without threads), than tightening of the tightening body 3 is obtained by the screw 4.1, the washers 4.2 and 4.7, the securing 4.8 and the nut 4.9.
- b) If in the space diagonal hole of the joint body 2 right or left thread is threaded, it is also used as a nut, than tightening of the tightening body 3 is obtained by the screw 4.1, the securing 4.8 and the washer 4.2.
- c) If in the space diagonal hole of the tightening body 3 right or left thread is threaded, it is also used as a nut, than the tightening of the tightening body 3 is obtained by the screw 4.1, the securing 4.8 and the washer 4.2.
- d) If in the space diagonal hole of the joint body 2 and/or in the space diagonal hole of the tightening body right or left thread is threaded, but it is not used, but already only is used free passage inside threaded thread(s), than the tightening of the tightening body 3 is obtained by the screw 4.1, the washers 4.2 and 4.7, the securing 4.8 and the nut 4.9.
- e) Same as in b), except that the hole in the space diagonal of the joint body 2 is not transitory along the whole length of the joint body.
- f) Same as in c), except that the hole in the space diagonal of the tightening body 3 is not transitory along the whole length of tightening body.

The washers 4.4 or respectively 4.5 are rounded towards the tightening body or respectively the joint body because of adaptation to eventual inaccuracies of the joint, to ensure equal tightening of the joint. It can be combined also with mutual rounding of bodies and washers.

TYPE IVb SPACE JOINT WITH TIGHTENING BODY AS PART OF JOINT BODY, WITH ENLARGED BEARING TIGHTENING SURFACES

Space joint TYPE IVb (with bigger bearing tightening surfaces) Fig. 5.2 differs from space joint TYPE IVa substantially only in joint body 2 geometry and tightening body 3 geometry, so that tightening body 3 geometry is obtained in such a way that the joint body 2 is cut partially with three planes which are perpendicular to planes in which there are neighboring surfaces of one diagonal top point and which pass through diagonals of those surfaces up to the middle of the joint body 2, and partially cut with three planes perpendicular to surfaces before mentioned which are also perpendicular to the side holes, so they reach up to the middle of the side holes and reach up to the middle joint body.

Advantage of joint Type IVb in relation to joint Type IVa is in enlarged bearing surfaces of the tightening body to the rods 1 (1.1 - 1.3), which can be very useful on some separable joints where bigger tightening forces are required, and by that also bigger friction forces respectively specific loads of tightening surfaces and also is requested that for frequent joint adaptations are minimally damaging smooth rods surfaces.

SOLUTIONS ON JOINT BLOCKING PRINCIPLE (TYPE V and VI)

TYPE Va SPACE JOINT WITH CENTRAL INNER BLOCKING BODY FOR SIMULTANEOUS BLOCKING OF THREE RODS

Referring to Fig. 6.1, a space joint with central inner rods tightening 1 (1.1 - 1.3), comprises a body 2a or 2b and a blocking body 3. General geometry of the joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exists the hole that passes

diagonally through the whole joint body, so that the space diagonal hole surface partially cuts side hole surfaces.

Rods preparation because of blocking body appliance:

- a) Rods are drawn in relevant side holes in the joint body and temporarily prevent moving and twisting. Then through the space diagonal hole, machining of rods is performed so that after the machining of rods space diagonal hole geometry for blocking body passing is ensured.
- b) Preparation (machining) of rods is performed outside joint body on an automatic machine or similar machine by which machining of recess and cutting is enabled.

Preparation of the blocking body is extremely simple as such body has a cylindrical cross section. Preventing the blocking body from moving along space diagonal axes of the joint body is enabled by series of common known ways: a) by special head on blocking body; b) cotters; c) split pins; d) by a recess in the space diagonal hole and a thread on part of the blocking body; e) by producing shorter blocking body and applying screw; f) by incorporating a cylindrical seal to recess at the blocking body, and in other ways.

The blocking body 3 serves for contemporary blocking of all the rods 1 (1.1 - 1.3) in the joint body 2 (2a or 2b) from inside, so that blocking is obtained by:

- a) Inserting of the blocking body to space diagonal hole after the rods are drawn into the joint body at right positions and correspondingly twist, the blocking body is secured in hole from axial movement by some of before mentioned ways.
- b) Same as in a), so at least one rod is not drawn in.

An advantage of this space joint is in that it is an extremely simple blocking system, and contemporary is securing the joint from axial movement and from rotation. An additional advantage is that the joint blocking system practically does not need maintenance. An especial advantage is that the joint strength is constant and with extremely easy separating. A disadvantage of this system is in that on rods smaller but permanent recesses have to be milled.

To ensure blocking also in case when rods 1 (1.1 - 1.3) of smaller diameter then diameter of side holes on joint body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles, and similar), hollow space between rods and circular side hole surfaces is filled with relevant inserts, so that on those inserts there are appendages of profiles the same as that on rods, by which double blocking is ensured, of insert with rod and of blocking body with inserts.

One of possible ways of usage of blocking system is when the rods in the form of angled profiles as shown in Fig. 6.3.

The tightening body can be made in several manners, for example by casting, by injection, by welding, by combined procedures and in other ways. Hole beginning on tightening body can be performed with spherical recess, due to easier adaptation of joint.

For joint body construction different materials can be used, for example metals (steel, procron, brass, aluminum, duraluminum, bronze, etc.), nonmetals (GRP, acrylic, wood, polyurethane, etc.), armored concrete, etc.

Additional body is described separately for all types of space joints.

Washers 4.4.1.1 and 4.4.1.2 are after need for adaptable joint performed in rounded version because of adaptation.

The tightening body 3 (3.1a and 3.2a respectively 3.1b and 3.2b) is used for the rods 1 (1.1 - 1.3) tightening to joint body 2 (2a or 2b) from outside of joint body geometry, so that tightening force of tightening body 3 is obtained:

- a) By the screw 4.1, the washer 4.4.1.1, the additional body 4.3.1, the washer 4.4.1.2, the washer 4.4.2.2, the additional body 4.3.2, the washer 4.4.2.1, the securing 4.2, and the nut 4.5, so that screw 4.1 is used simultaneously for tightening both tightening bodies 3 (3.1a and 3.2a respectively 3.1b and 3.2b).
- b) If in space diagonal hole of tightening body of joint body 2 (2a respectively 2b) left or right thread is threaded along whole length of hole, Fig. 4.3 in general case of tightening, by using screw 4.1, securing 4.2.1, washer 4.4.1.1, additional body 4.3.1, washer 4.4.1.2, washer 4.4.2.2, additional body 4.3.2, washer 4.4.2.1, securing 4.2.2 and screw 4.1.2.
- c) Same as in b), except that screws with heads are not used, and studs and nuts are used instead.
- d) Same as in a), b) and c), except that only one tightening body is used. It is applied for cases when smaller tightening forces are requested.
- e) Same as in a), b), c) and d), except that particular elements of tightening system are not used: additional bodies (4.3.1 and (or) 4.3.2), some washers.

To ensure tightening also in case when the rods 1 (1.1 - 1.3) are of smaller radius then the radius of the side holes on the body 2 (2a or 2b) or rods are not of circular cross section (ellipse,

angled profiles, and similar), the hollow space between rods and the side circular hole surfaces is filled with corresponding inserts, see for example Fig. 7.1.

An advantage of this tightening mode is the possibility that, in side holes of tightening bodies, corresponding bushes are easily inserted, and also those holes can be made with changeable cross section so to enable adaptation of holes themselves to rods, respectively to bushes.

A disadvantage of the tightening bodies is that those bodies can not be positioned afterwards, that is after the rods are pulled through the side holes.

TYPE Vb SPACE JOINT WITH CENTRAL INNER BLOCKING BODY FOR SIMULTANEOUS BLOCKING OF SIX RODS

Referring now to Fig. 6.2, a space joint with central inner rods tightening 1 (1.1 - 1.6), comprises a body 2a or 2b and blocking body 3. General geometry of joint body 2 is described in P 950575 A, so that the joint body 2 (2a, or 2b) is cut with two planes which are perpendicular to the space diagonal of the joint body 2 (2a or 2b) which passes through two joint body top points which are equidistant from them, so that around the space diagonal exist the hole which passes diagonally through the whole joint body, so that the space diagonal the hole surface partially cuts side hole surfaces.

The rods preparation because of blocking body appliance on all six rods simultaneously need something more complex procedure from that of joint TYPE Va. Machining of the rods is performed outside of the joint body by an automatic machine or similar machine by which machining of recesses and inclined cutting of rods is enabled. Inclined cutting of rods is predicted only because of space rationalization in the joint body.

The preparation of blocking body is something more complex than with joint TYPE Va. The basic form of the blocking body is a cylindrical rod from which by corresponding machining geometry suitable to rods recesses is obtained. Prevention against moving of the blocking body along space diagonal axes of the joint body is enabled by several known ways: a) by transversal holes and split pins; by special head on the blocking body; b) cotters; c) by thread in space diagonal hole and thread on part of the blocking body; d) by producing shorter blocking body and using screw; e) by incorporating cylindrical seal in recess on the blocking body, and in other ways.

The blocking body 3 serves for simultaneous blocking of all the rods 1 (1.1 - 1.3) in the joint body 2 (2a or 2b) from inside so that blocking is obtained as follows:

- a) By inserting the blocking body in the space diagonal hole after the rods are drawn in the joint body on right positions and correspondingly twist, the blocking body is secured in the hole from axial movement by some of before mentioned ways.
- b) Same as in a), except that at least one rod is not drawn in.

An advantage of this space joint in relation to that described in joint TYPE Va is in that it is extremely simple system for blocking of more than three rods, by which with system of such joints is enabled easy enlargement of space system configuration relating to width, high and length.

A disadvantage of this blocking system in relation to preceding TYPE Va is in that the preparation of rods is slightly more complex.

To ensure blocking also in case when all rods 1 (1.1 - 1.3) of smaller diameter from diameter of side holes of joint body 2 (2a or 2b) or rods are not of circular cross section (ellipse, angled profiles, and similar), the hollow space between the rods and the circular side hole surfaces is filled with relevant inserts, so that on this inserts there are profile appendages same as that on the rods by which double blocking is ensured: of insert with the rod and of the blocking body with the inserts.

Additional options of rods 1 (1.1 - 1.3) fastenings exist as follows:

- a) Tightening (fixing) of the rods 6.1 - 6.3, after they are temporarily tightening, is performed by sticking through the space diagonal hole. Separation of the joint is enabled by the action of increased forces on the rods, and in case of a more strengthened joint by corresponding chemical.
- b) Tightening (fixing) of the rods 6.1 - 6.3, after they have been temporarily tightened, is performed by welding through the space diagonal hole. Separation of the joint is enabled by partial drilling of a weld through the space diagonal hole, so that the rods and the body 2 are partially damaged.

TYPE VI SPACE JOINT WITH CENTRAL OUTER BLOCKING BODY FOR SIMULTANEOUS BLOCKING OF AT LEAST THREE RODS

There are no substantial differences from joint TYPE V, where the rods blocking in the space joint is obtained from inside. For this type of joint same option of rods and/or tightening bodies adaptation are relevant.

C) SOLUTIONS BASED ON EASIER OR HARDER SEPARABLE JOINT PRINCIPLE
(TYPE VII, VIII, IX AND X)

**TYPE VII SPACE JOINT WITH STICKED RODS - EASIER OR HARDER
SEPARABLE JOINT**

By rods sticking bigger joint rigidity is achieved, and so bigger reliability, especially under dynamic loads. The necessary force for producing a quality stuck joint is achieved by using of the tightening bodies, respectively by their tightening. The same or a similar result is obtained by the blocking bodies if those are performed in option with possibility of additional tightening. In appliance of some materials for joint parts and rods, and by using corresponding adhesion additionally, can be ensured also easy separating of a priviously stuck joint by applying of some chemicals, or other.

In the case of rods only stuck to tightening bodies and/or blocking bodies, repeated separating of joint is obtained by forced realizing of tightening and/or blocking bodies.

Additional fastening of the space joint by sticking can be realized only on those rods for which additional joint safety is required, or for which is not predicted more frequent need for joint adaptation.

Sticking can be realized in several phases, for example firstly rods parts are stuck in panel constructions in body or at joint body (force is obtained by means of tightening and/or blocking subsystems), and after temporarily complex space modules, sticking among tightening and/or blocking bodies and rods is performed.

**TYPE VIII SPACE JOINT WITH WELDED RODS - EASIER OR HARDER
SEPARABLE JOINT**

Within the welded option of creating additional joint strength, several different combinations of welding are possible, for example welding only one single rod, welding of the rods to the joint

from outside. welding within inside of the joint body, welding of tightening and/or blocking bodies, etc.

A disadvantage of such way of additional fastening of the space joint is in harder separable joint, causes bigger damage of joint parts with forced separating. If it deals only with welding in space diagonal hole, damage appears at the very hole and rod parts in way of weld. An advantage of such possibility of additional fastening of space joint is in that it is firstly a separable joint, and than if necessary is inseparable, and finally a "quasi" - separable joint. This advantage of the joint can be multiple - used when performing various assembling activities on spot, where lots of things have to be adapted before final joint fixing.

TYPE IX SPACE JOINT WITH SOLDERED RODS - EASIER OR HARDER SEPARABLE JOINT

This situation is similar like the welding one, except that instead of welding procedures, soldering procedures are used.

This type of space joint is very interesting for the use of technologically different materials.

TYPE X SPACE JOINT WITH COMBINED ADDITIONALLY FASTENED RODS - EASIER OR HARDER SEPARABLE JOINT

For joints where combined procedure of additional fastening of space joint is used, it is primarily used for parts usage and additional elements of joints and rods from various materials.

DESCRIPTION OF ADAPTIVE BEARING BUSHES (Fig. 7.1)

Adaptive bearing bushes are intended for fitting hollow spaces in side holes in space joint body and rods which are fastened in one of predicted ways. Fig. 7.1 shows some options of adaptation for circular and uncircular rods forms. By using bearing bushes, it is possible to join (fasten, block, stick, weld, sold, or similar) rods of various geometrical forms, independently of standardized holes in the joint body.

A special advantage is that the rods can be chosen regarding load (form, dimensions, material). Furthermore, by using a bush, fastening of the bush to the joint body can be solved differently from the fastening of a bush and a rod.

EXAMPLES OF APPLICATION OF SPACE JOINTS (Fig. 8.1 to 8.3)

Fig. 8.1 shows the application of space joints with complete side holes in the joint body.

Fig. 8.2 shows the application of space joints in the construction of, for example furniture, where besides joints, rods and panels are used. The panels 10 can be from various materials, for example paper, cardboard, aluminum, plastics, steel, etc., depending of application, load, environment, and similar. Sometimes rods can be used instead of panels.

Fig. 8.3 shows the application of a space joint without side holes (rods are reposed on adapted bearing places of joint body before tightening).

In particular there is mentioned the possibility of joint applications of specially adapted body and hole form, and after special technical requirements, such as:

- a) At least one of the holes (side, space diagonal) is not of circular cross section;
- b) At least one of the holes has geometrical form of rotational body;
- c) At least one of the holes does not have own symmetry axes;
- d) At least one of the holes does not pass through whole joint body;
- e) At least one of the holes is not of constant cross section;
- f) That exists at least one additional side hole;
- g) That at least two side holes are inclined under angle different from 90 degrees;
- h) There exists in at least one of the holes a thread and:
 - * that thread extends along the entire hole length,
 - * that thread extends along only part of hole length;
- i) That at least one joint body surface is not parallel relating to surface which is on opposite side of joint body skirt;
- j) That at least one joint body surface is rounded, and in special cases the joint body becomes of cylinder form, sphere, ellipsoid, or similar;
- k) That at least one of joint top point is rounded, or skewed, or skewed and rounded.

MULTILAYERS (HYBRID) SPACE JOINTS

As shown in Fig. 1.8 and 1.9, the joint body consists of outer shell and inner part - fulfillment 2.2. Various materials can be used depending upon requirements such for example isest load, environment, temperature, pressure, and similar. The joint bodies can be used as bodies for all mentioned space joints types, while some of them due to specifically geometry and price are seldom used in practice.

OTHER GEOMETRICAL FORMS OF SPACE JOINT BODIES

Space joint body for three or more rods can be made, upon special request in various known standard or non - standard geometrical forms:

- a) regular trilateral prism;
- b) regular trilateral pyramid;
- c) regular trilateral truncated pyramid;
- d) regular quadrilateral pyramid;
- e) regular quadrilateral truncated pyramid;
- f) some other application suitable form.

APPLICATION OF SPACE JOINT IN COMPLEX AND STRONGLY LOADED GRID CONSTRUCTIONS

Because of modularized construction possibilities of such objects, the assembling speed of module themselves and module reciprocally, possibilities of geometry adaptation to field conditions and possibility of easy transformation of separable space joints in entirely or partly in separable joints, same can very successfully be used on length (carrying grid constructions of various applications: bridges, crossings, supports, etc.), at and in sea (pontoons, bridges, platforms, brake - waters, etc.).

Space joint can be used and for rods connecting by which are additionally stiffened plane and space grids, so that special additions for the joint body are used, and also space diagonal hole is used for separable and/or inseparable fastening.

APPLICATION OF SPACE JOINTS IN LIGHT GRID CONSTRUCTIONS

Space joints in different performance options can be used also in space where it is necessary in short term to assemble new construction or already existing one to partition or adapt to new needs.

SOME OTHER APPLICATION POSSIBILITIES

Due to joint separability and the possibility of simultaneous application of materials with various characteristics which are reciprocally connected, the space joint can very successfully be used in various application conditions and with joints also to ensure an ecological component.

The space joint can be also successfully used for various children toys, including toys that are educational. The space joint can also be a useful element of furniture, and similar.

The space joint has application in the formation of decorative objects from various materials (wood, various metals, nonmetals, etc.), also including precious materials like gold, platinum, etc.

Also within welded option of creating additional joint strength, several different combinations of welding are possible, from welding only single rod, welding of rods to joint from outside, welding within inside of joint body, welding of tightening and/or blocking bodies, etc.

A disadvantage of such way of additional fastening of space joint is in harder separable joint, resulting in bigger damages of joint parts under forced separation. If it deals only with welding in space diagonal hole, damages appear at the hole and rod parts in the way of the weld. An advantage of the possibility of additional fastening of the space joint is in that it is firstly a separable joint, and than if necessary an inseparable, and finally a "quasi" - separable joint. This advantage of the joint can be multiple - used when performing various assembling activities on spot, where lots of things have to be adapted before final joint fixing.

Also within welded option of creating additional joint strength, several different combinations of welding are possible, from welding only single rod, welding of rods to joint from outside, welding within inside of joint body, welding of tightening and/or blocking bodies, etc.

A disadvantage of such way of additional fastening of space joint is in harder separable joint, respectively in bigger damages of joint parts while forced separating. If it deals only with welding in space diagonal hole, damages appear at the hole and rod parts in the way of the weld. An advantage of the possibility of additional fastening of space joint is in that it is firstly a separable joint, and than if necessary an inseparable, and finally a "quasi" - separable joint. This advantage

of the joint can be multiple - used when performing various assembling activities on spot, where lot of things have to be adapted before final joint fixing.

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CLAIMS

1. A space joint with a body formed in a cubical shape, the joint body having three side holes on itself with constant circular cross section of equal radius, which lay on cross over straight lines, from which each one is perpendicular to single pair of mutually parallel cube surfaces, that hole surfaces mutually do not intersect, **characterised in**, that the joint body has one more hole of constant circular cross section which axes of symmetry is placed in that space diagonal which passes through body top points near by there is not neither one of side holes but these holes are placed nearer to other top points of joint body, that in space hole of joint body is placed a subsystem for tightening of a tightening body or a subsystem for securing of a blocking body, for rods fastening in space joint and that rods joint with space joint is disassembling.
2. A space joint according to claim 1, **characterised in**, that the rods fastening is realized by a tightening system.
3. A space joint according to claim 1, **characterised in**, that the rods fastening is realized by a blocking system.
4. A space joint according to claim 1, **characterised in**, that the rods fastening is realized by a sticking system.
5. A space joint according to claim 1, **characterised in**, that the rods fastening is realized by a welding system.
6. A space joint according to claim 1, **characterised in**, that the rods fastening is realized by a combination of procedures from claims 2 to 5.
7. A space joint according to claims 1 and 2, **characterised in**, that tightening system comprises a tightening body and a subsystem for tightening the tightening body.
8. A space joint according to claim 7, **characterised in**, that the tightening is realized from inside, while space diagonal hole intersects side holes.
9. A space joint according to claim 8, **characterised in**, that the tightening body is hollow cylinder shaped.
10. A space joint according to claim 8, **characterised in**, that the tightening body is sphere shaped with a cylindrical hole.
11. A space joint according to claim 8, **characterised in**, that the tightening body is of a voluntarily geometric shape with a cylindrical hole.

12. A space joint according to claim 8, **characterised in**, that the tightening body is of a hollow cylinder shaped with recesses on outer shell.
13. A space joint according to claim 8, **characterised in**, that the tightening body consists of two parts each of which are of a hollow cylindrical shape.
14. A space joint according to any one of claims 9 to 13, **characterised in**, that the tightening bodies do not have a hole in themselves i.e. they represent solid bodies.
15. A space joint according to any one of claims 9 to 14, **characterised in**, that the tightening subsystem of the tightening body comprises one or more additional bodies, one or more suitable shaped, adaptable washers, one or more nuts, elements for nuts securing, one bolt, which on both ends has keyway, and corresponding keys, or bolts with thread at one of its ends, and correspondent key, or one screw, or two screws.
16. A space joint according to claim 15, **characterised in**, that additional body has the role of filling of space in between and/or of forces transferring.
17. A space joint according to claim 16, **characterised in**, that the additional body is realized in the form of a solid or hollow distance.
18. A space joint according to claim 15, **characterised in**, that by an additional body tightening force maintaining is ensured within required range of joint reliability, under changeable usage conditions.
19. A space joint according to claim 18, **characterised in**, that the additional body is realized in form of an amortizing system.
20. A space joint according to claim 15, **characterised in**, that an additional body tightening force is realized.
21. A space joint according to claim 20, **characterised in**, that the additional body is a system with compressed air.
22. A space joint according to claim 20, **characterised in**, that the additional body is a hydraulic system.
23. A space joint according to claim 20, **characterised in**, that the additional body is an electromagnetic system.
24. A space joint according to claims 7 and 15 and one or more of claims 16 to 23, **characterised in**, that tightening is from outside.

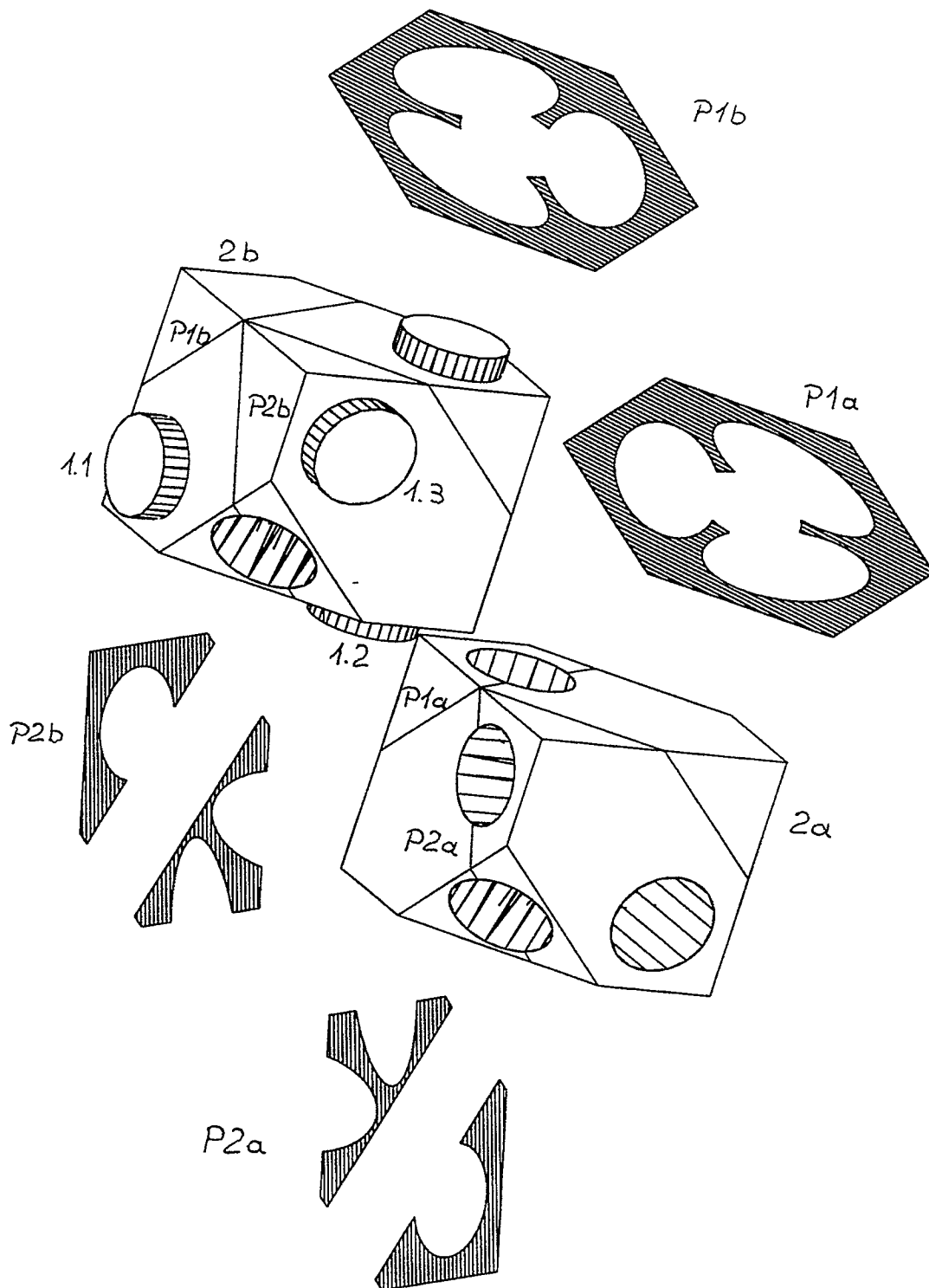
25. A space joint according to claim 24, **characterised in**, that the tightening of the tightening body is in a direction towards or from the joint body, respectively towards the joint body.
26. A space joint according to claim 25, **characterised in**, that the tightening body is shaped, while the inner tightening body surface is adapted to outer joint body geometry and rod shape in tightening zone.
27. A space joint according to claim 24, **characterised in**, that the tightening of the tightening body is in a direction towards joint body or its opposite direction.
28. A space joint according to claim 1, **characterised in**, that the joint body is shaped like remaining part of joint body that should appear by removing some parts of the joint body.
29. A space joint according to claim 28, **characterised in**, that the joint body is geometrically shaped with three intersection planes of that each one is perpendicular to two parallel joint body surfaces and two relevant surface diagonals, while this planes passes:
 - a) through accesses of relevant side holes, or
 - b) closer of axes of A space diagonal hole, or
 - c) more distant of axes of A space diagonal hole.
30. A space joint according to claim 28, **characterised in**, that the joint body is cut with circular cylindrical surface whose axis is coaxial with axis of A space diagonal hole while:
 - a) its radius is such that it is tanging axes of A space holes, or
 - b) its radius is smaller then radius of tanging of A space holes, or
 - c) its radius is bigger than radius of tanging of A space holes.
31. A space joint according to claims 24,29 and 30, **characterised in**, that inner surfaces of the tightening body are adapted to outer joint body geometry and rods form in way of tightening.
32. A space joint according to claims 1 and 24, **characterised in**, that geometrical joint body form is obtained by geometrical separation of part of joint body shown produced by suitable cutting with relevant number of surfaces, and that separated part represents tightening body.
33. A space joint according to claim 32, **characterised in**, that by geometrical cutting of joint body is performed by three planes of which each one is perpendicular to one joint body surface, and that neighbouring top point where space diagonal hole is placed and is passing through the relevant surface diagonal and reaches the axes of space diagonal hole.

34. A space joint according to claim 33, **characterised in**, that geometrical forms of A space joint body produce by additional intersection of body with another three mutually perpendicular planes.
35. A space joint according to claim 32, **characterised in**, that geometrical form of A space joint body, is produced by intersection of body with sphere skirt.
36. A space joint according to claims 1 and 3, **characterised in**, that the blocking system comprises a blocking body, and a subsystem for securing the blocking body.
37. A space joint according to claim 36, **characterised in**, that rods blocking is obtained from inside, while space diagonal hole intersects side holes.
38. A space joint according to claim 37, **characterised in**, that for rods blocking with blocking body rods geometrical shape in way of blocking is adapted to geometrical shape of blocking body, or
that for rods blocking with blocking body, geometrical shape of blocking body is adapted to geometrical shape of rods in way of blocking.
39. A space joint according to claim 38, **characterised in**, that the blocking body is of cylinder form, or some other regular geometrical shape, or
that blocking body is of regular geometrical shape to whom parts are geometrically extracted in such manner that the shape of its skirt is adapted to rods shape in way of blocking.
40. A space joint according to claim 39, **characterised in**, that the blocking body comprises more parts.
41. A space joint according to claim 36, **characterised in**, that the rods blocking is obtained from outside.
42. A space joint according to at least one of claims 26, 27, 31, 33 to 35 and 41, **characterised in**, that blocking body represents additionally adapted tightening body.
43. A space joint according to claim 1, **characterised in**, that at least one of the holes (side and/or space diagonal) is not of circular cross section.
44. A space joint according to claim 1, **characterised in**, that at least one of the holes has geometrical shape of rotational body.

45. A space joint according to claim 1, **characterised in**, that at least one of the holes has not its own axes of symmetry.
46. A space joint according to claim 1, **characterised in**, that at least one of the holes does not pass through the whole joint body.
47. A space joint according to claim 1, **characterised in**, that at least one of the holes is not of constant cross section.
48. A space joint according to claim 1, **characterised in**, that there is at least one additional side hole.
49. A space joint according to claim 1, **characterised in**, that there are at least two side holes of an angle different from 90 degrees.
50. A space joint according to claim 1, **characterised in**, that there is a thread at least in one hole and:
 - a) that thread spreads over the quite hole length, or
 - b) that thread spreads only over part of hole length.
51. A space joint according to claim 1, **characterised in**, that at least one joint body surface is not parallel in relation to surface that is placed at the opposite side of joint body shell.
52. A space joint according to claim 1, **characterised in**, that at least one joint body surface is rounded.
53. A space joint according to claim 1, **characterised in**, that at least one of joint body top points is:
 - a) rounded, or
 - b) inclined, or
 - c) inclined and rounded.
54. A space joint according to at least one of claims 9 to 13, 16 to 19, 21 to 23, 26, 27, 31, 33 to 35, 39, 40 and 42, **characterised in**, that the joint body make as a skirt of the space joint and is filled inside the skirt.

55. A space joint according to at least one of claims 9 to 13, 16 to 19, 21 to 23, 26, 27, 31, 33 to 35, 39, 40 and 42, **characterised in**, that inseparability of A space joint is obtained in such manner that one or more bearing surfaces on tightening body or blocking body, rods and/or in joint body are stuck:
- a) before tightening or blocking of rods in A space joint body, or
 - b) after tightening or blocking of rods in A space joint body, or
 - c) before and after body make skirt of space joint and fulfillment inside the skirt.
56. A space joint according to at least one of claims 9 to 13, 16 to 19, 21 to 23, 26, 27, 31, 33 to 35, 39, 40 and 42, **characterised in**, that inseparability of A space joint is obtained in such manner that after tightening of rods with tightening body or blocking of rods with blocking body A space joint is additionally fastened:
- a) by welding of one or more rods to A space joint body at outer and/or inner joint body surfaces,
 - b) such as a), and additionally to weld tightening body or blocking body to one or more rods and/or to A space joint body.
57. A space joint according to at least one of claims 1, 9 to 13, 16 to 19, 21 to 23, 26, 27, 31, 33 to 35, 39, 40, 42, 55 and 56 **characterised in**, that its geometrical forms includes and mirror symmetry performance of joint body, and tightening and blocking bodies.
58. A space joint whose context is realized fastening of three or more rods according to at least one of claims 9 to 13, 16 to 19, 21 to 23, 26, 27, 31, 33 to 35, 39, 40, 42, 55, 56 and 57 **characterised in**, that the joint body is in the form of a:
- a) regular trilateral prism, or
 - b) regular trilateral pyramid, or
 - c) regular trilateral truncated pyramid, or
 - d) regular quadrilateral pyramid, or
 - e) regular quadrilateral truncated pyramid, or
 - f) some other purpose suitable form.

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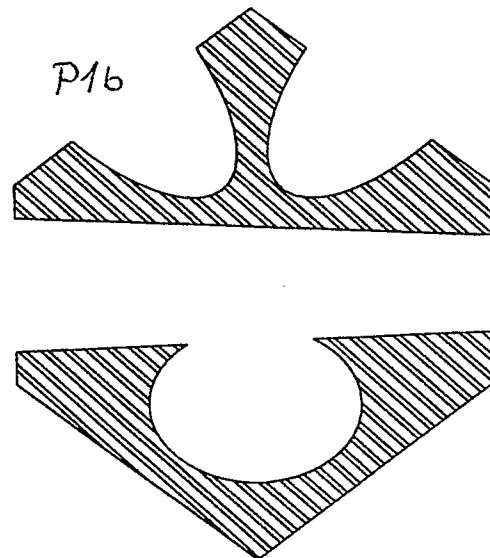
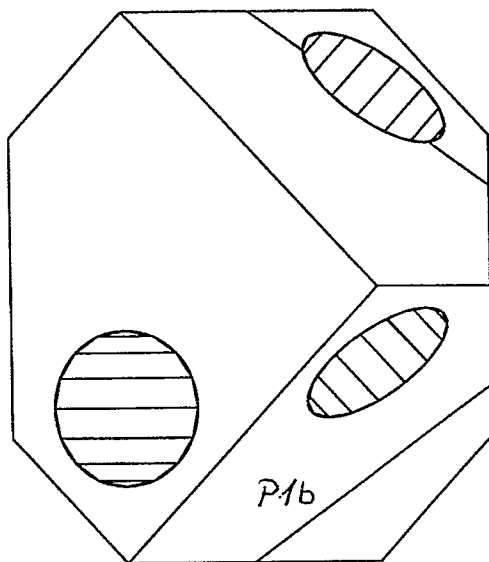
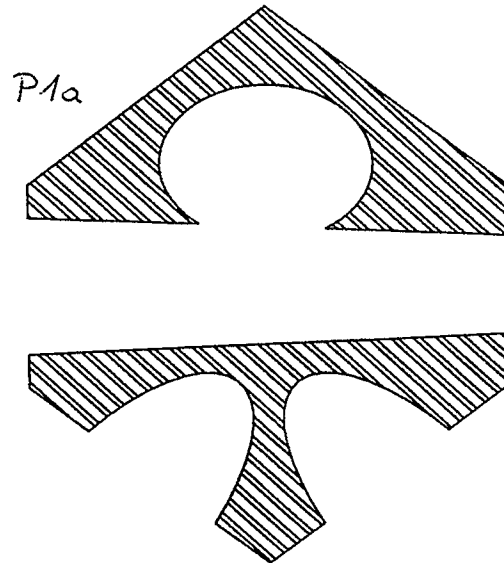
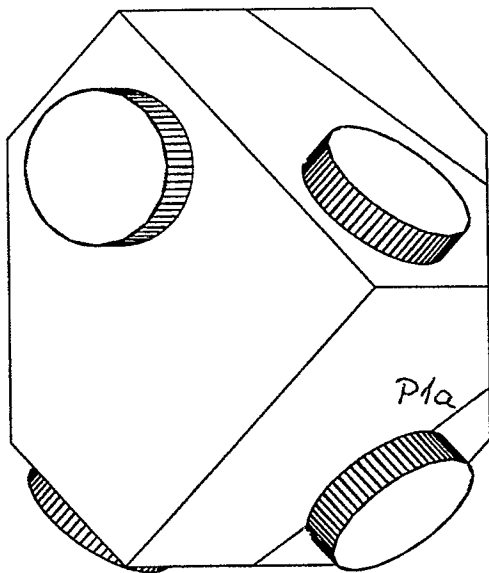


Fig. 1.2

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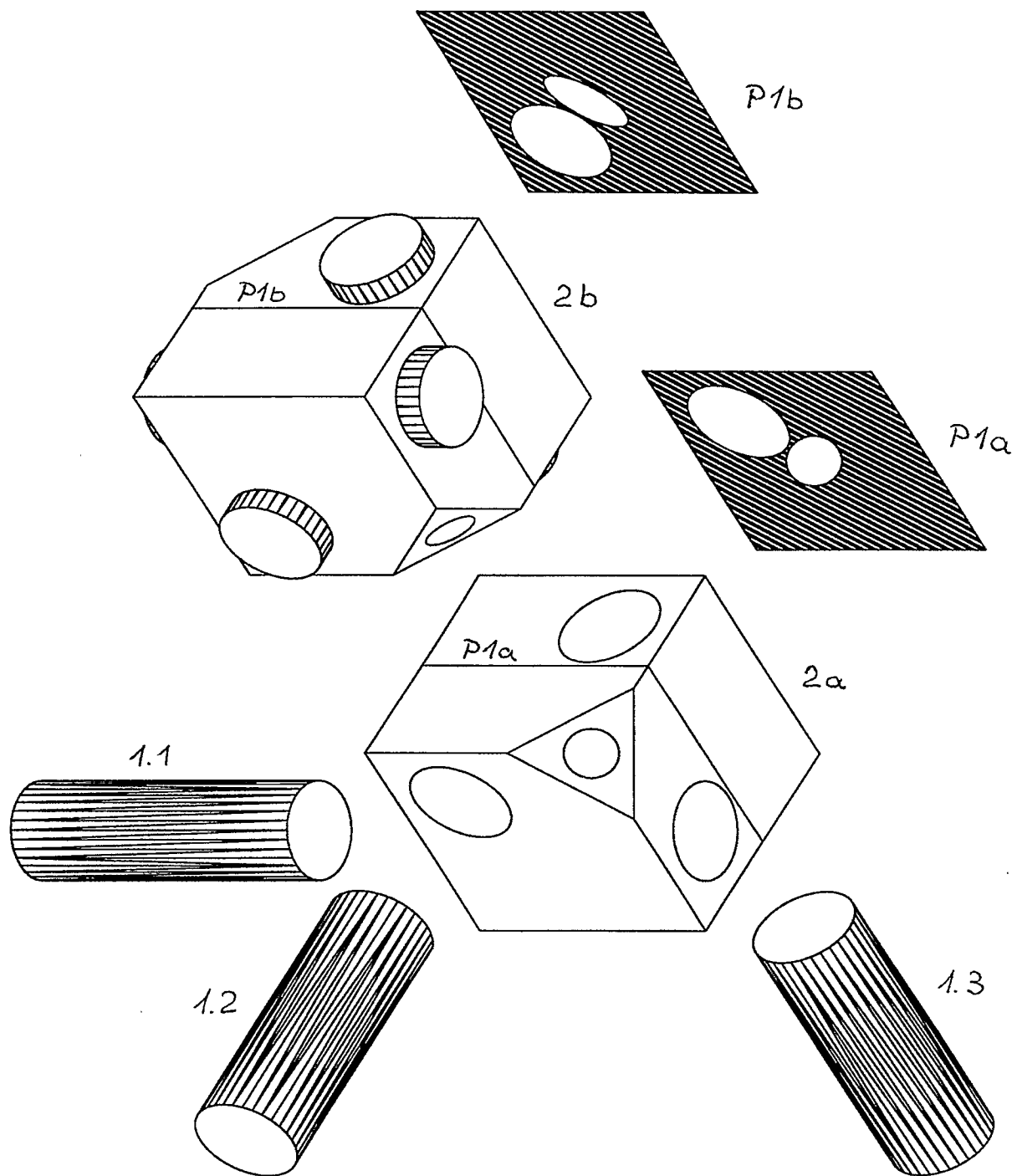


Fig. 1.3

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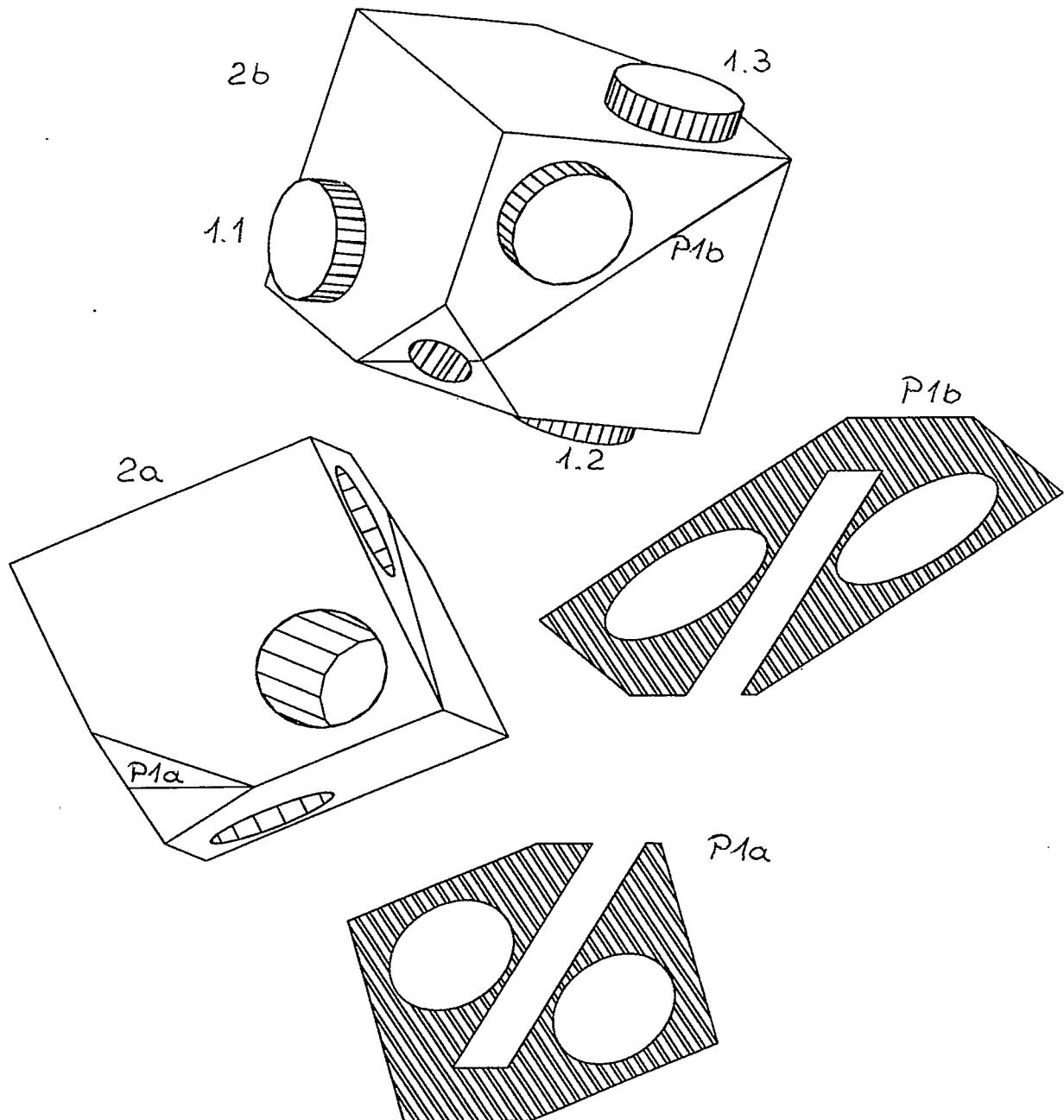


Fig. 1.4

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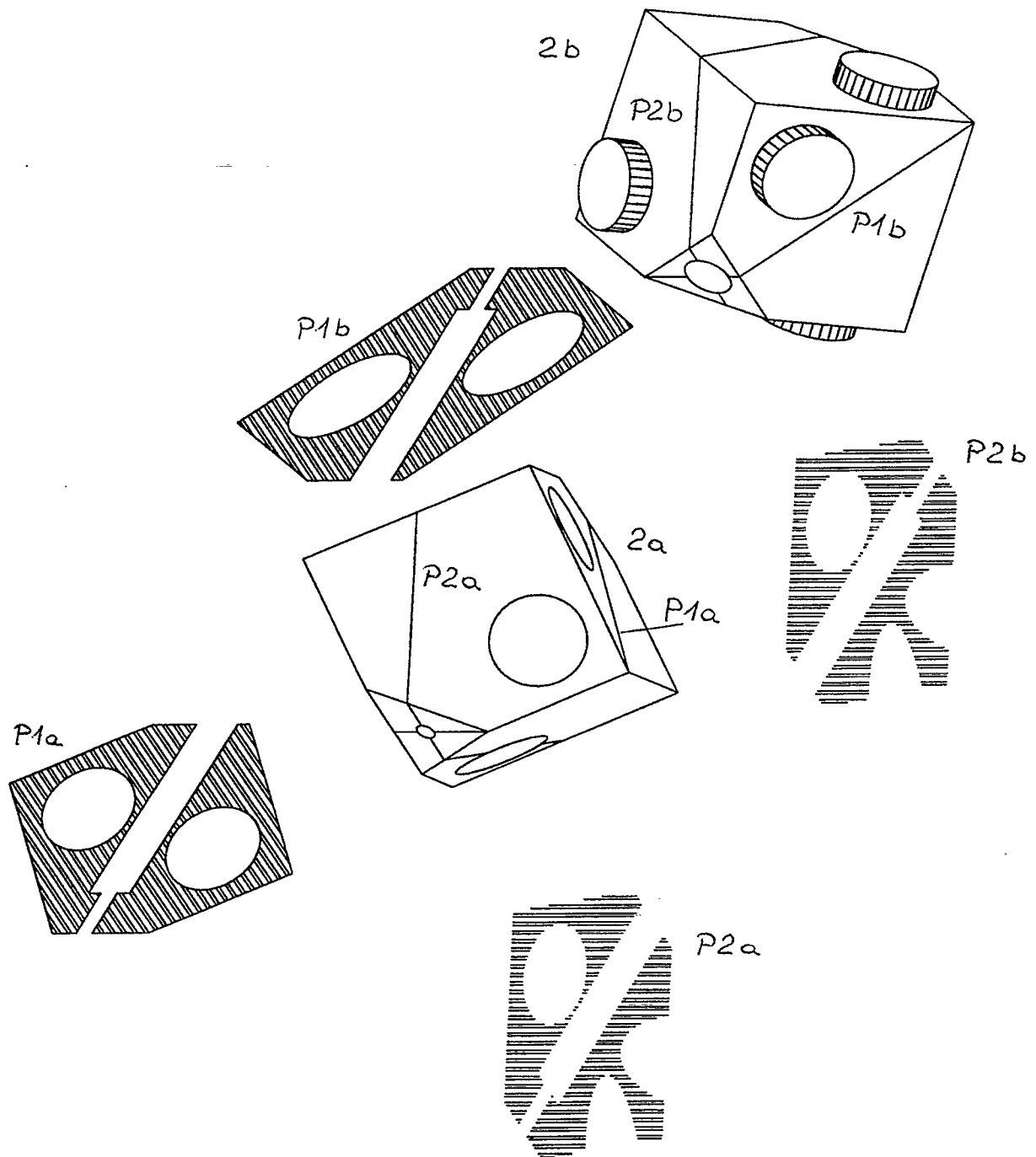


Fig. 1.5

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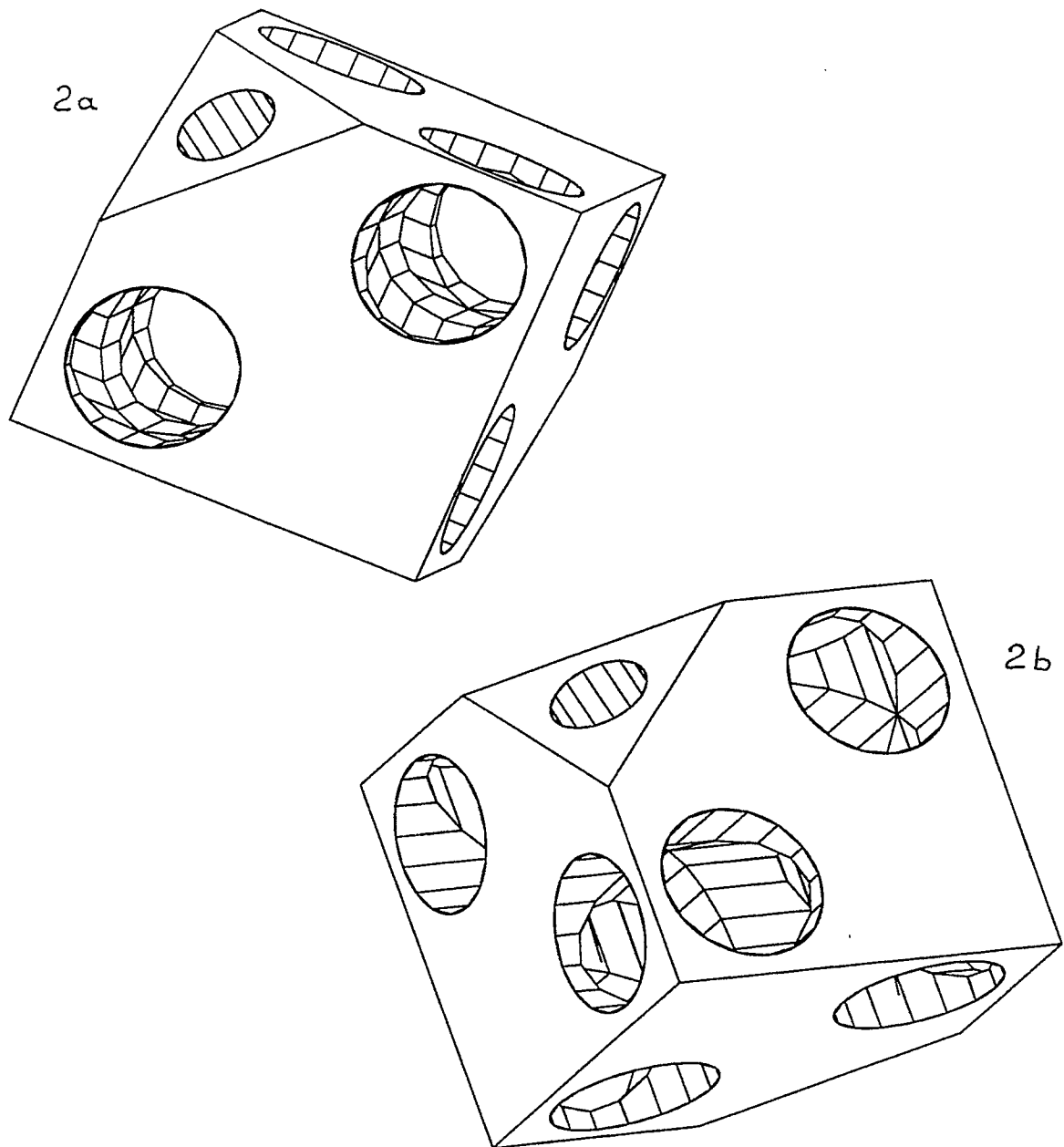


Fig. 1.6

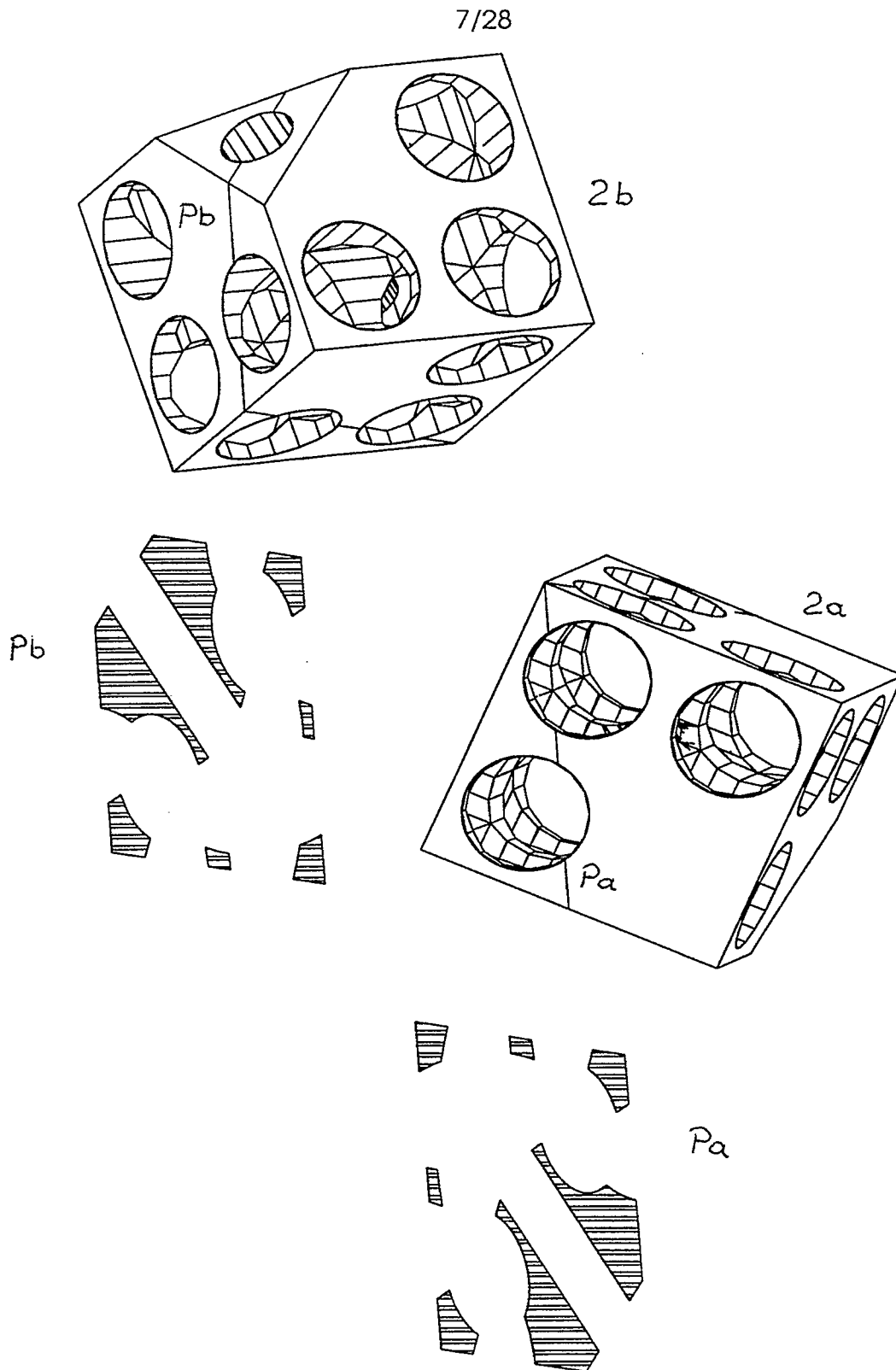


Fig. 1.7

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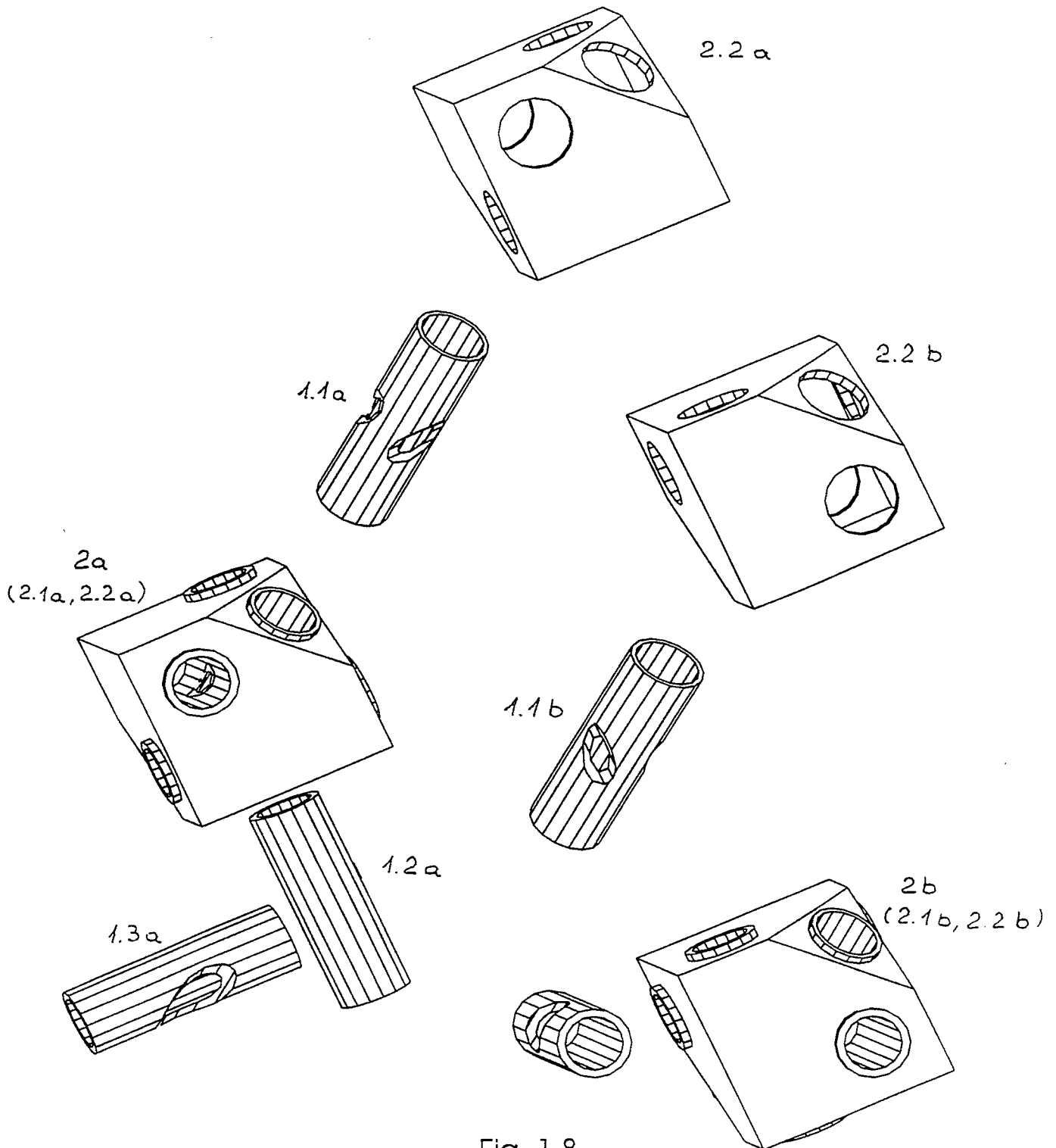


Fig. 1.8

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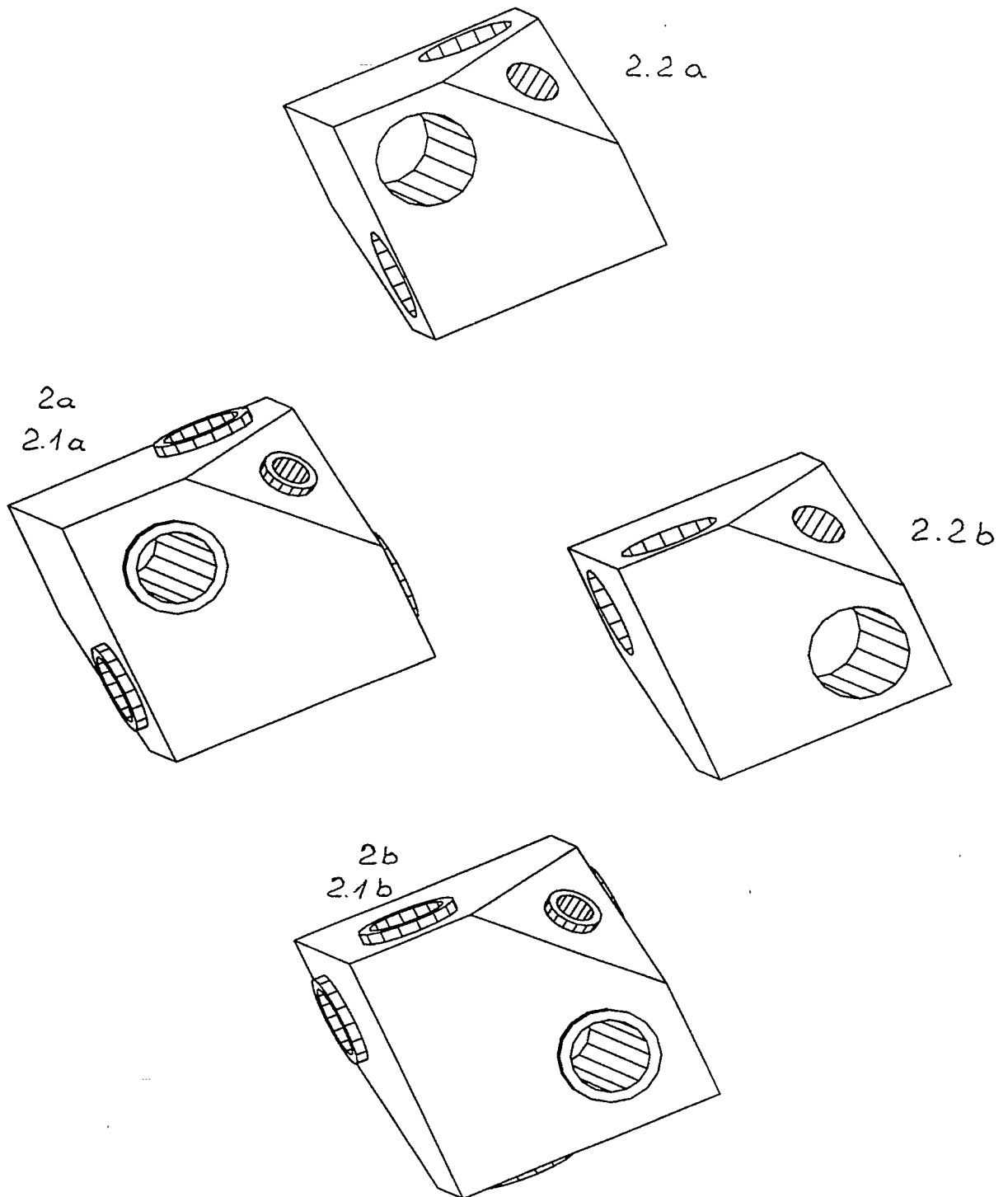


Fig. 1.9

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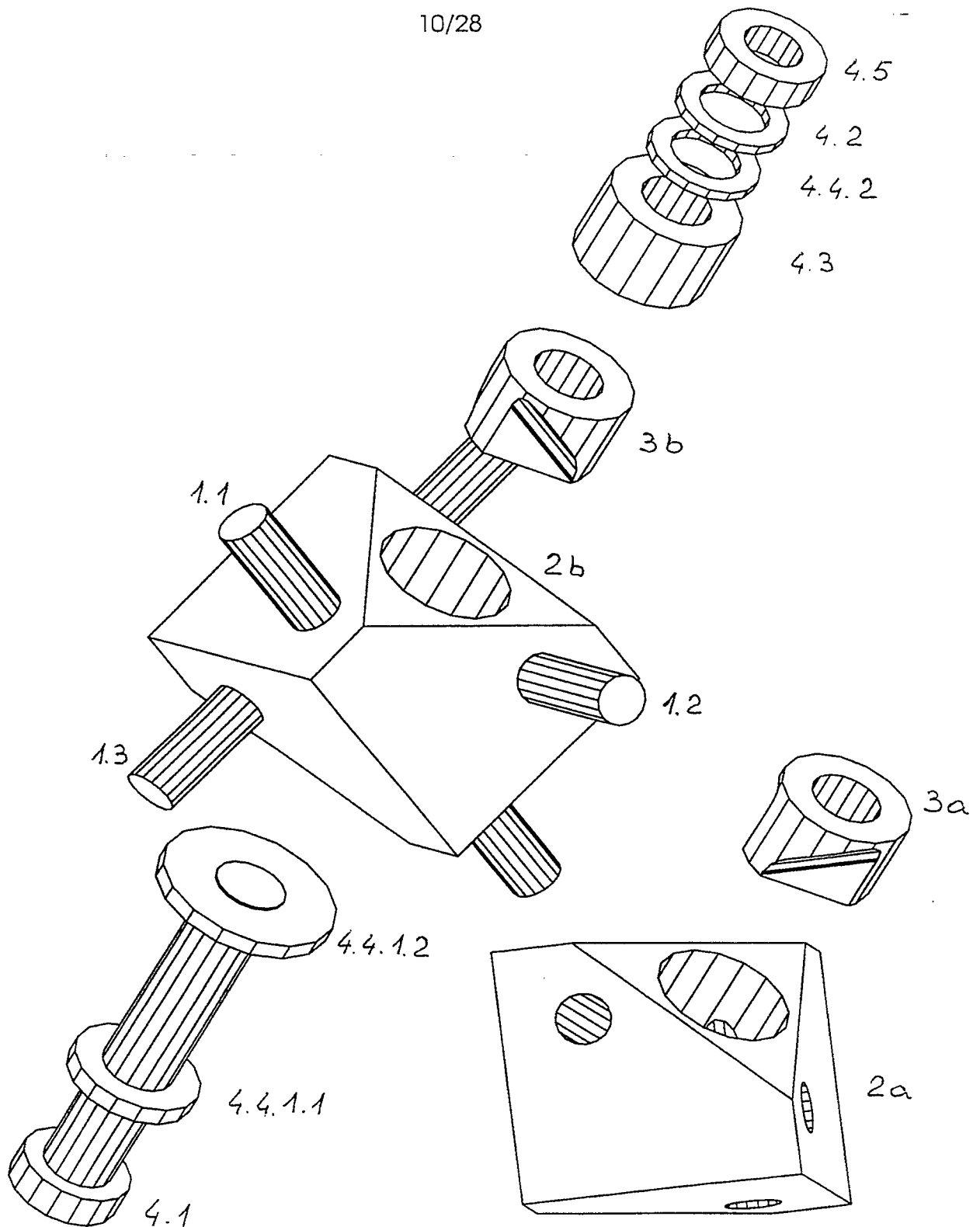


Fig. 2.1

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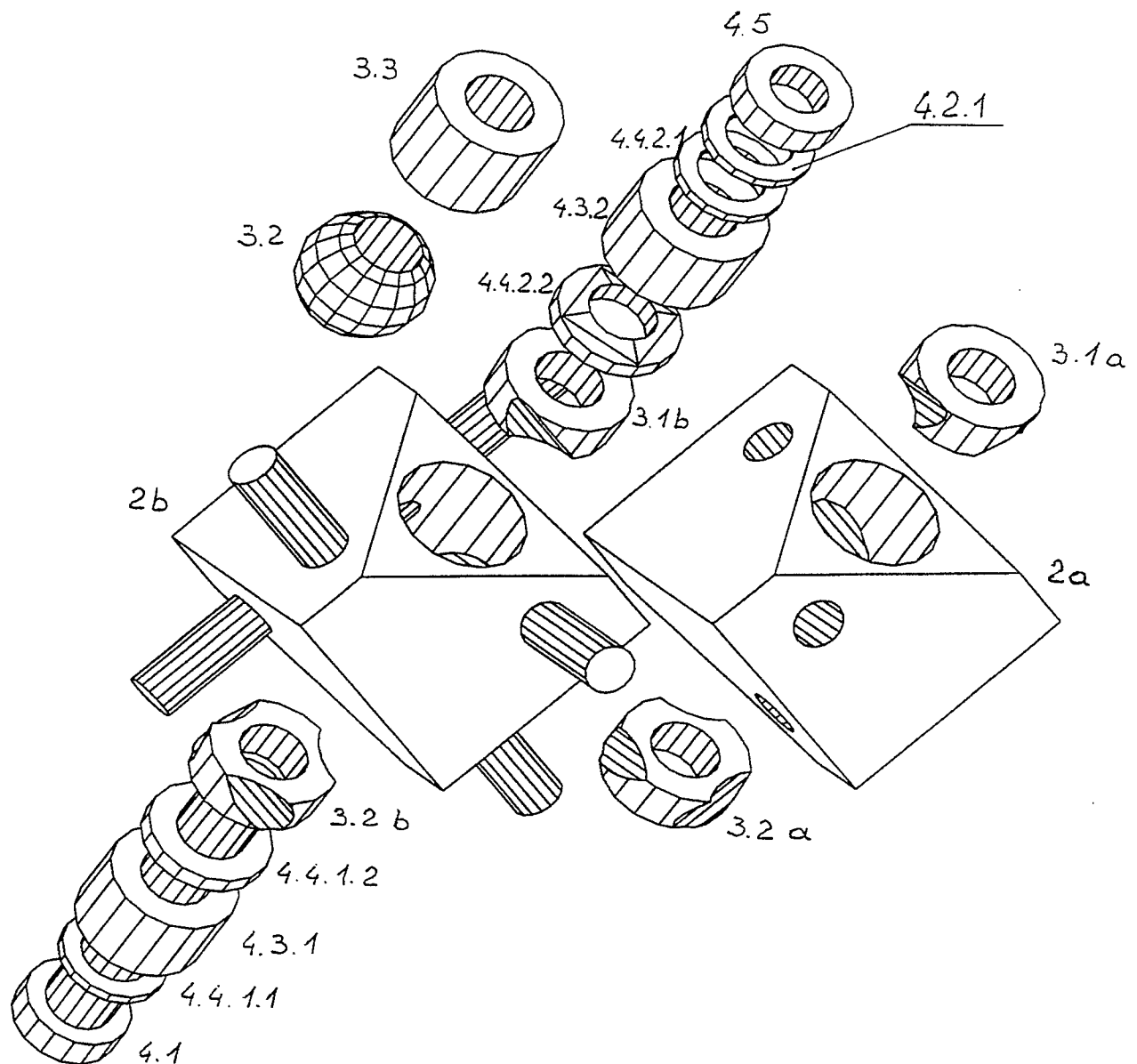
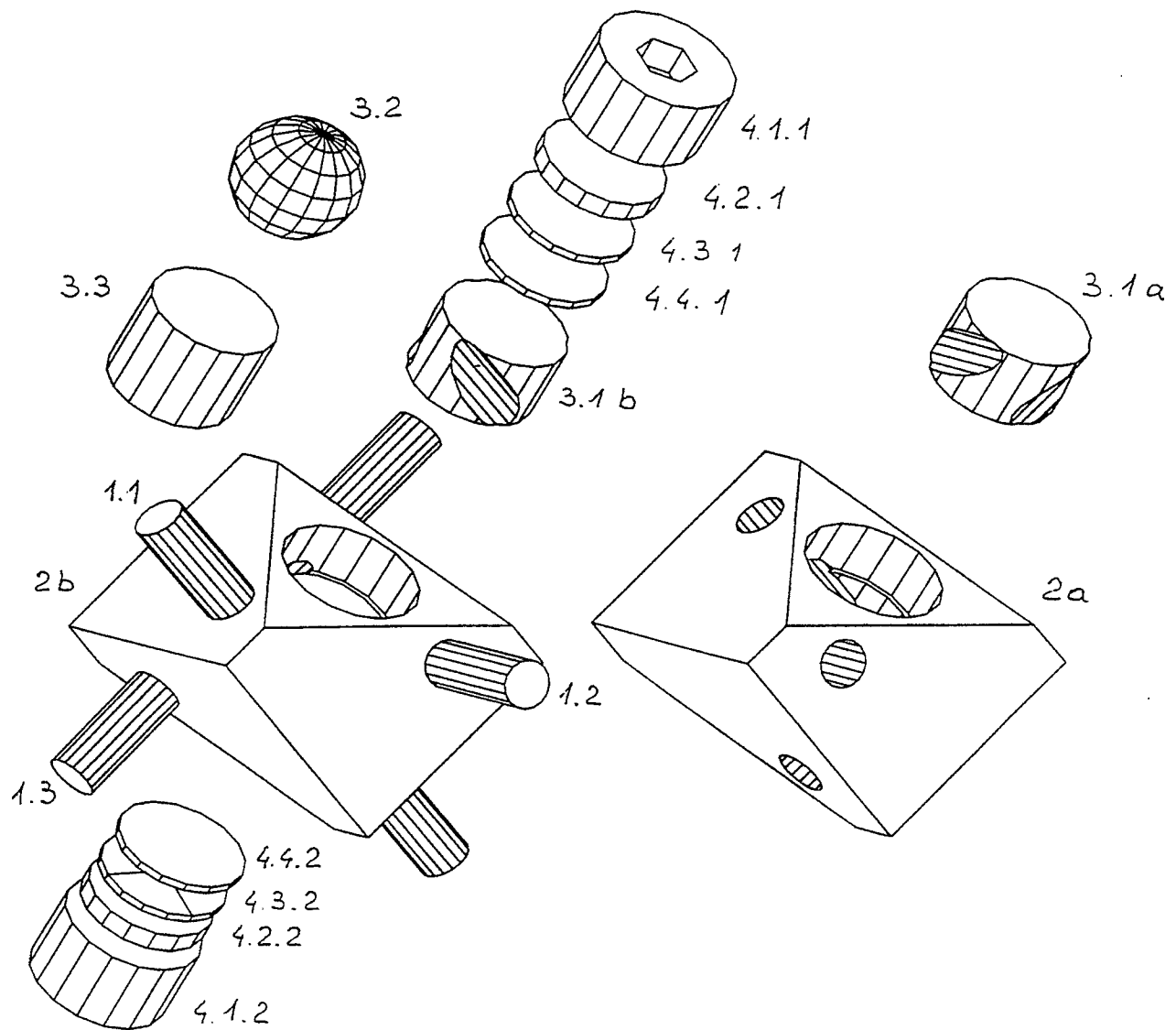


Fig. 2.2
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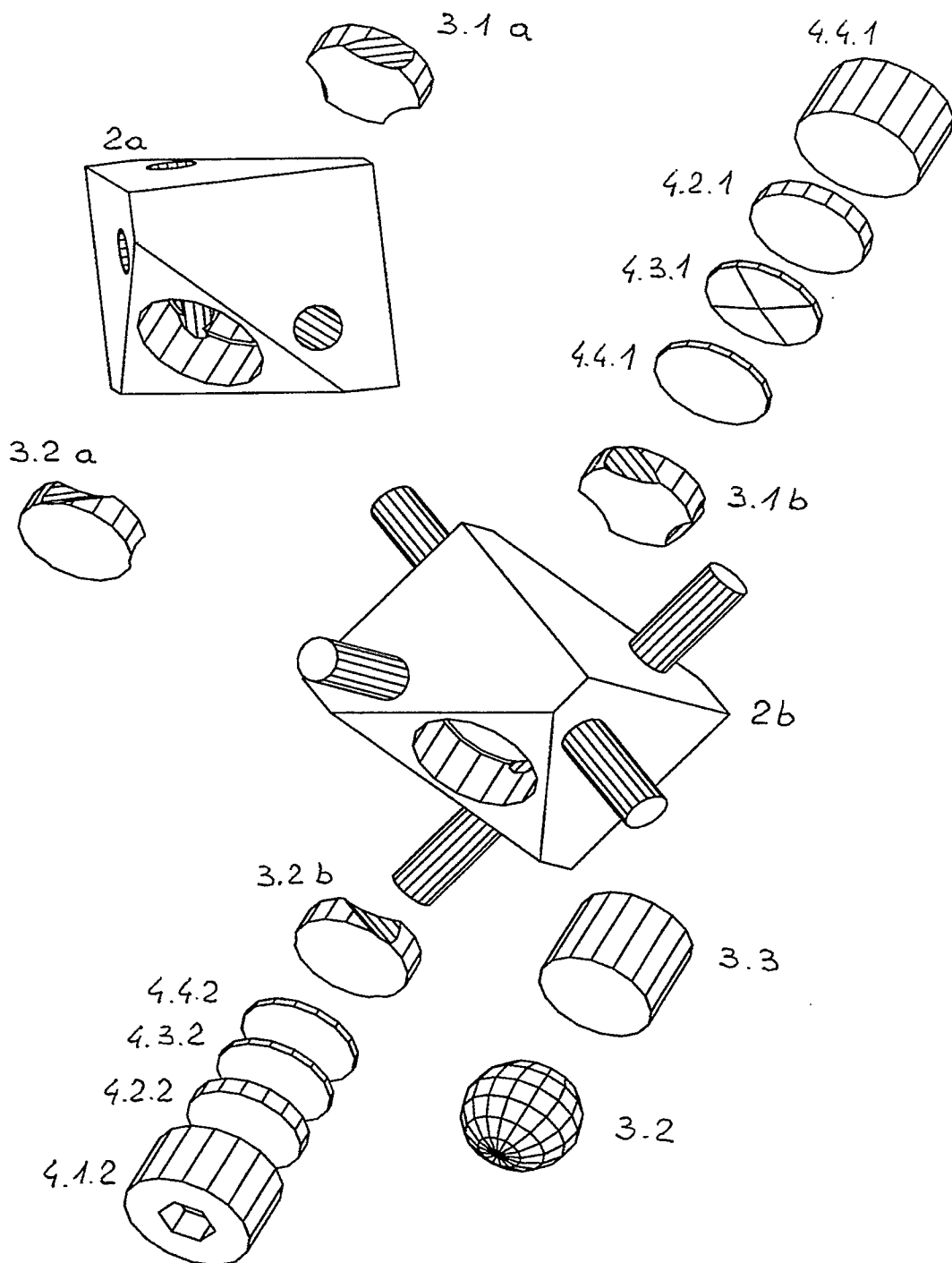


Fig. 2.4

SUBSTITUTE SHEET (RULE 26)

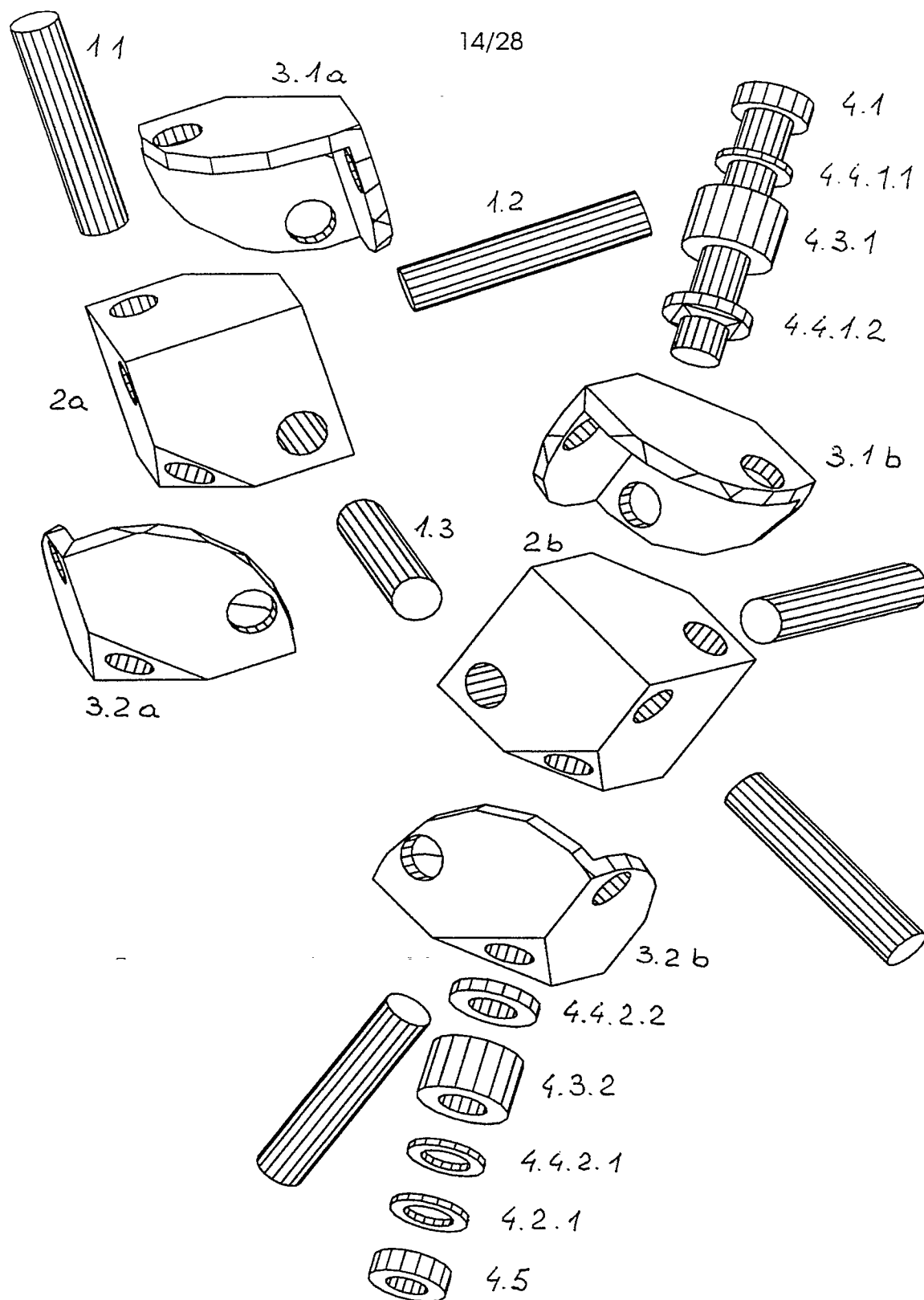


Fig. 3.1

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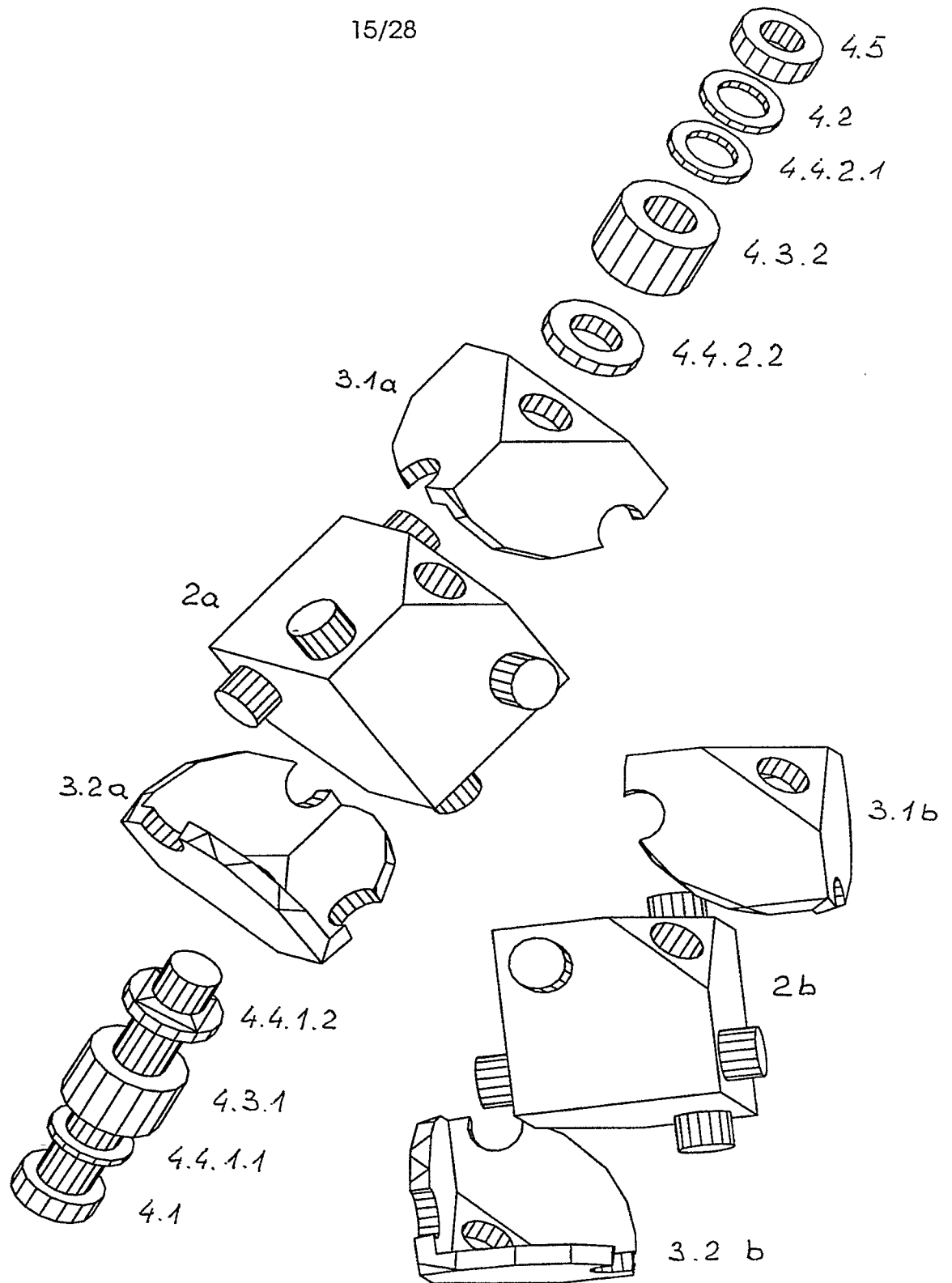


Fig. 3.2

SUBSTITUTE SHEET (RULE 26)

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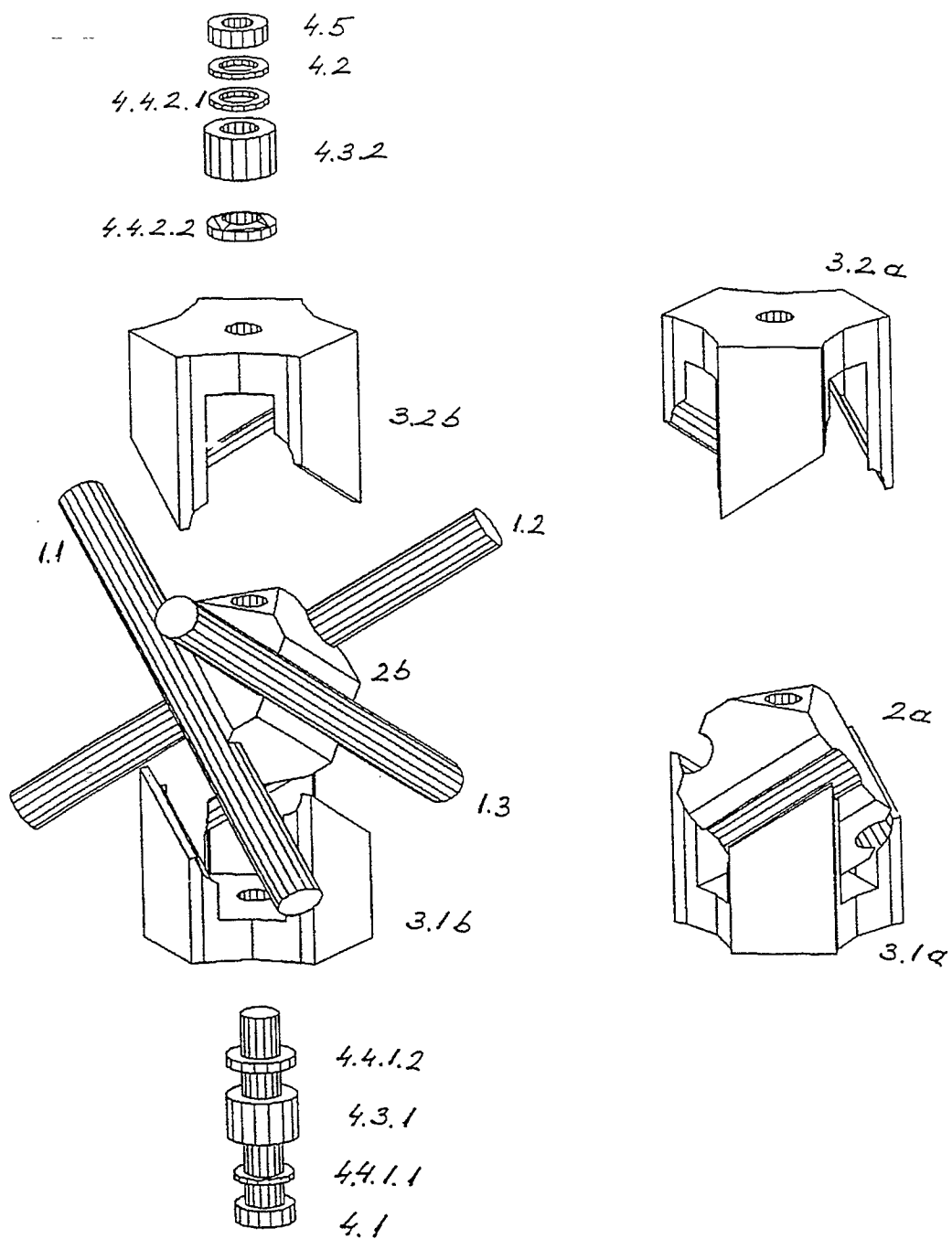


Fig. 4.1

SUBSTITUTE SHEET (RULE 26)

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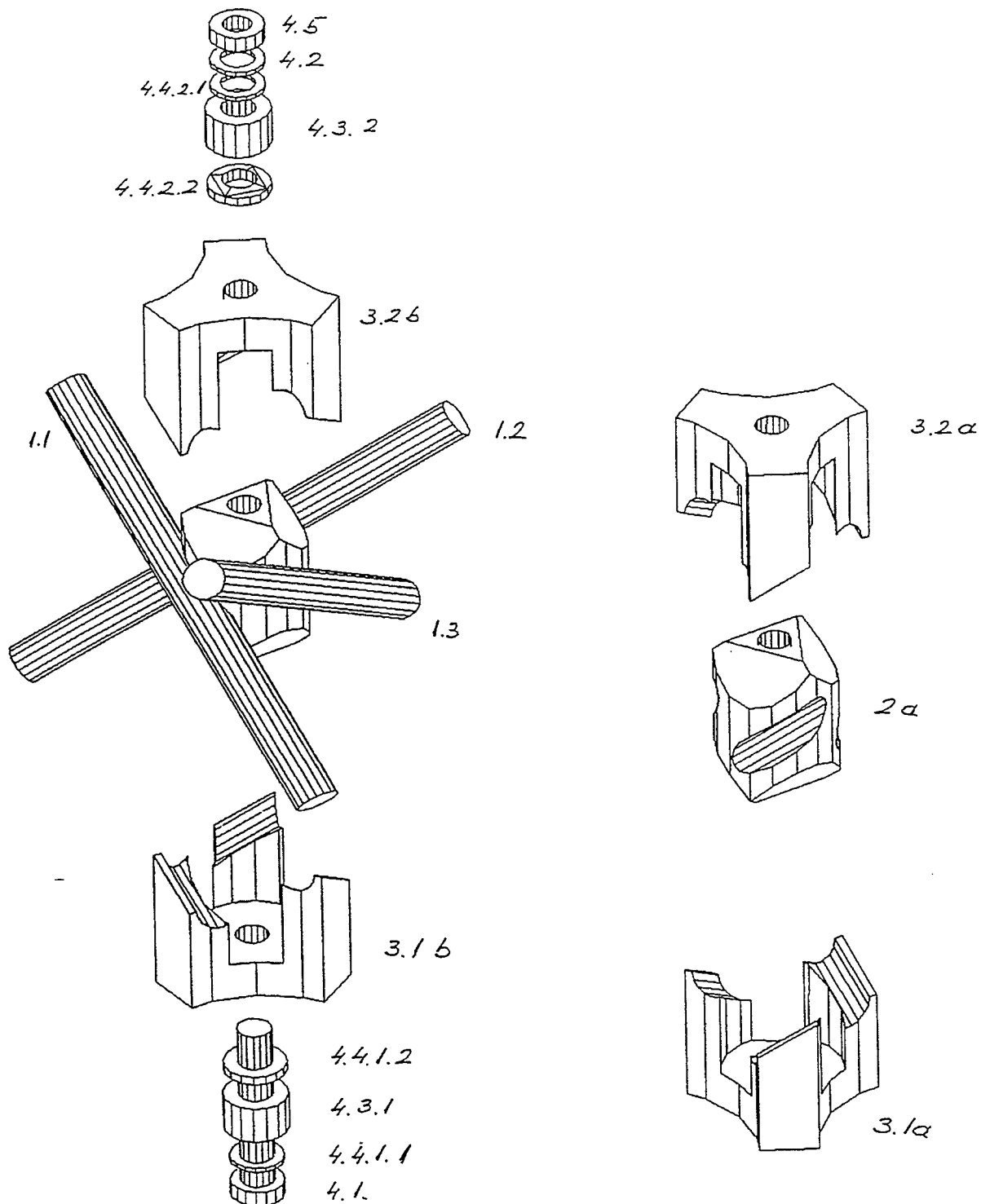


Fig. 4.2

SUBSTITUTE SHEET (RULE 26)

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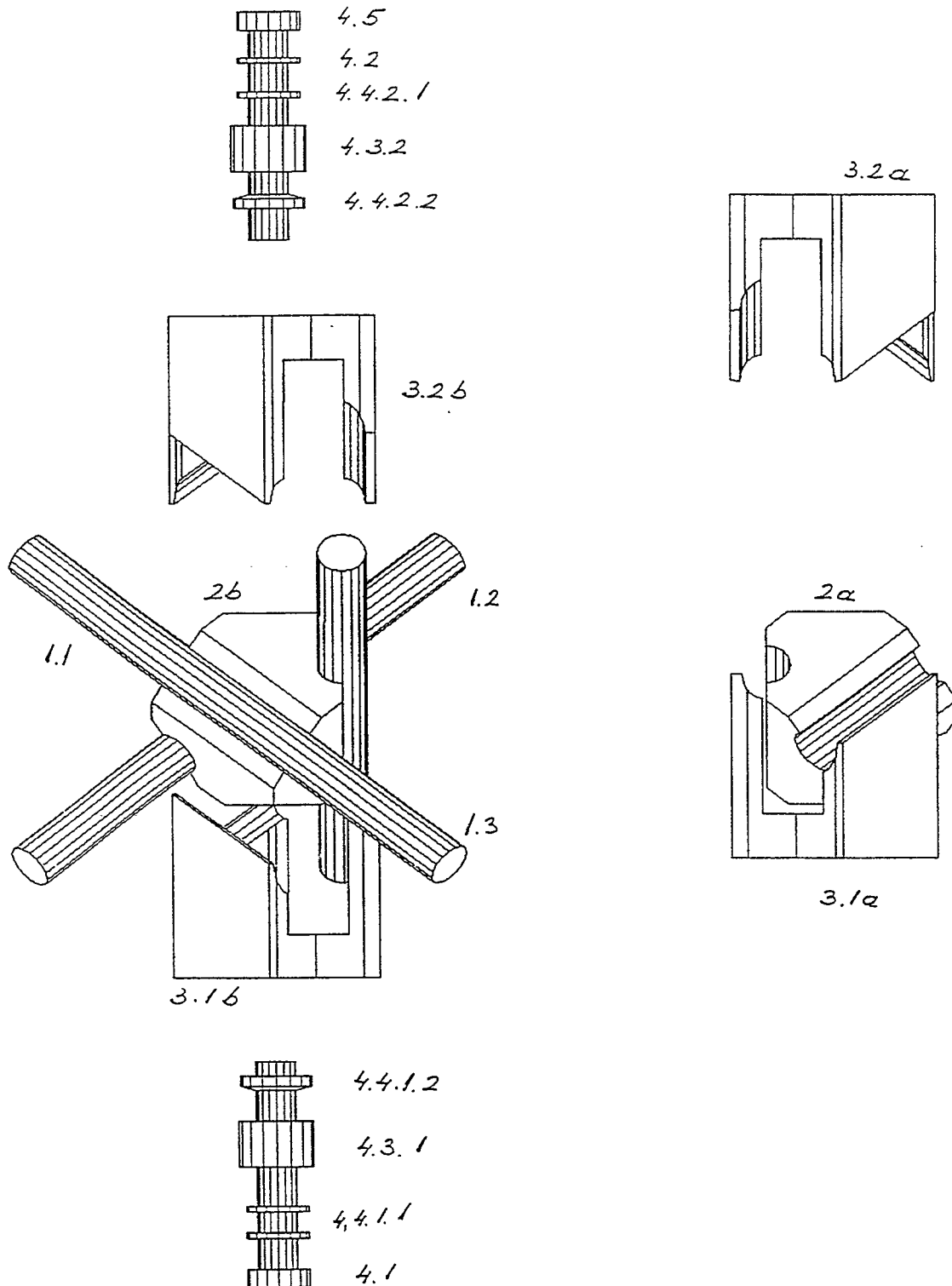


Fig. 4.3

SUBSTITUTE SHEET (RULE 26)

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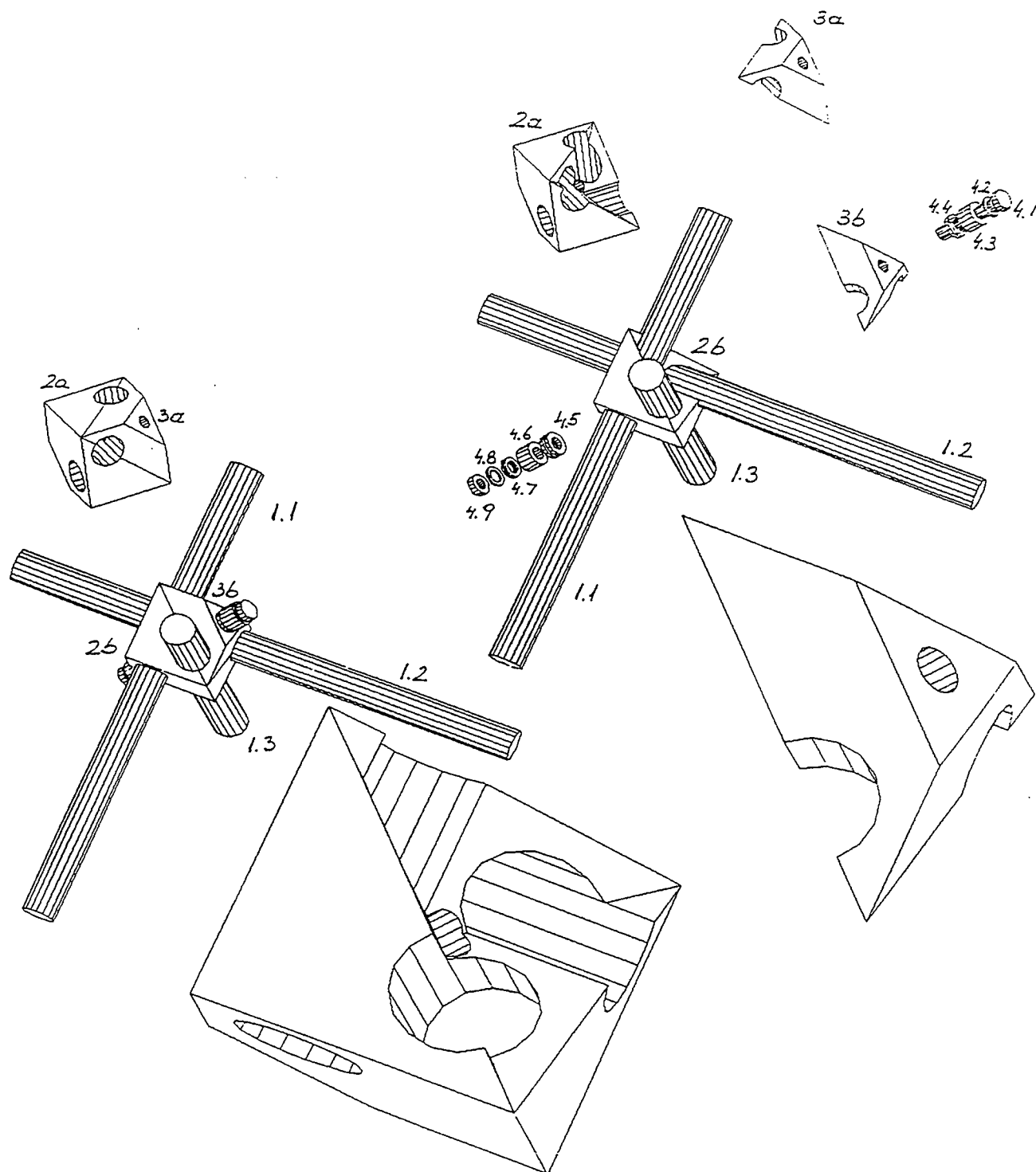


Fig. 5.1

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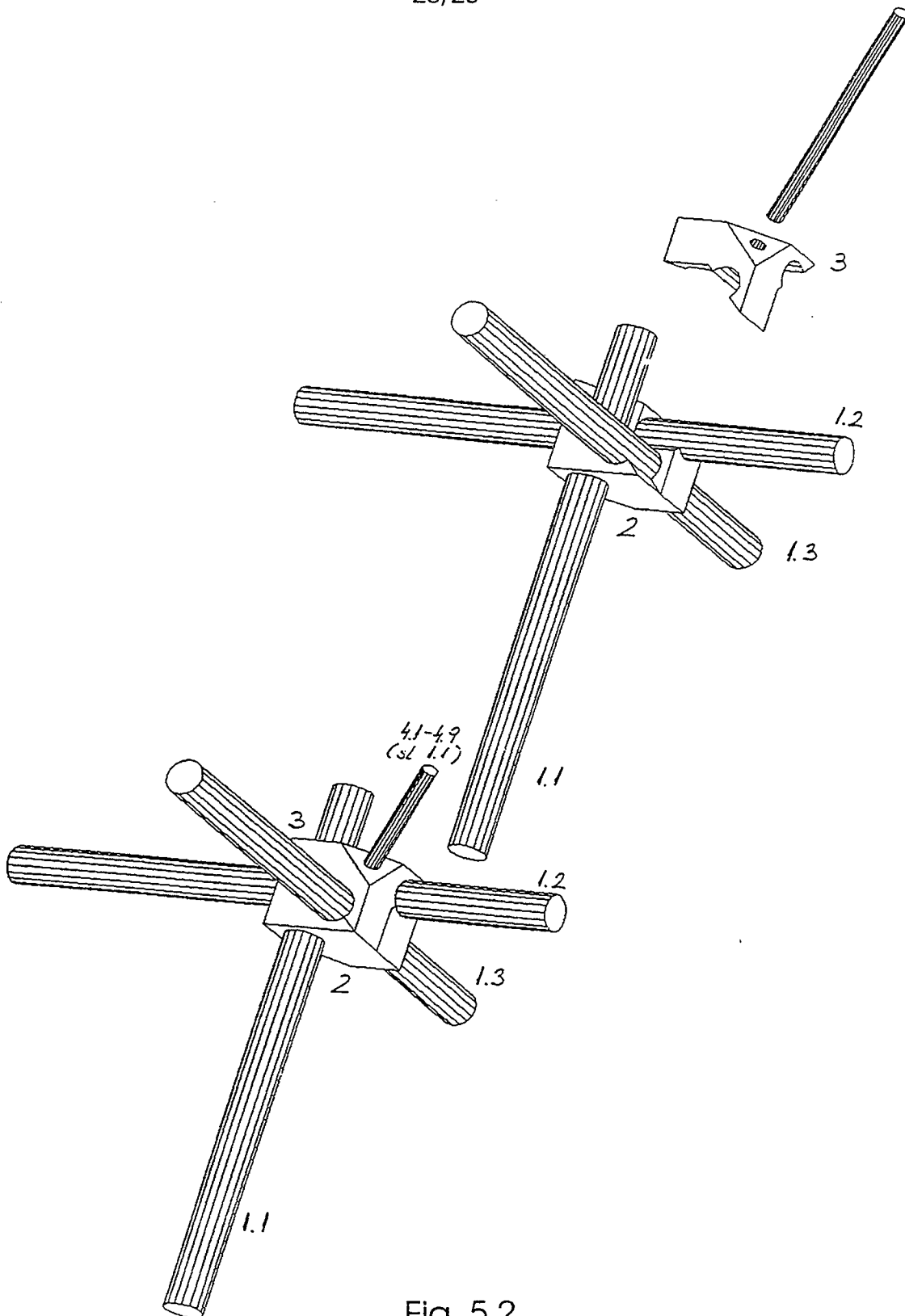


Fig. 5.2

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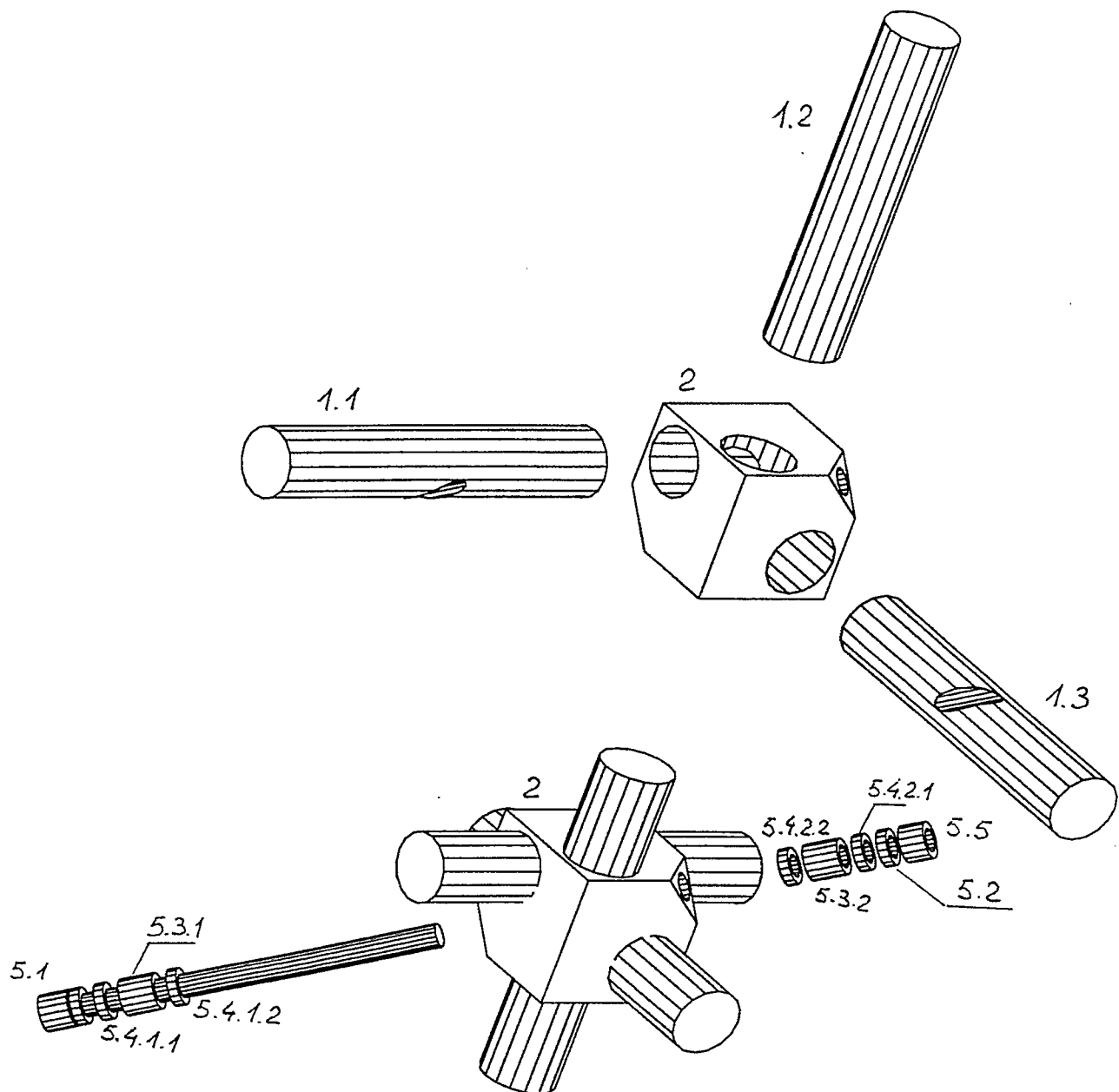


Fig. 6.1

SUBSTITUTE SHEET (RULE 26)

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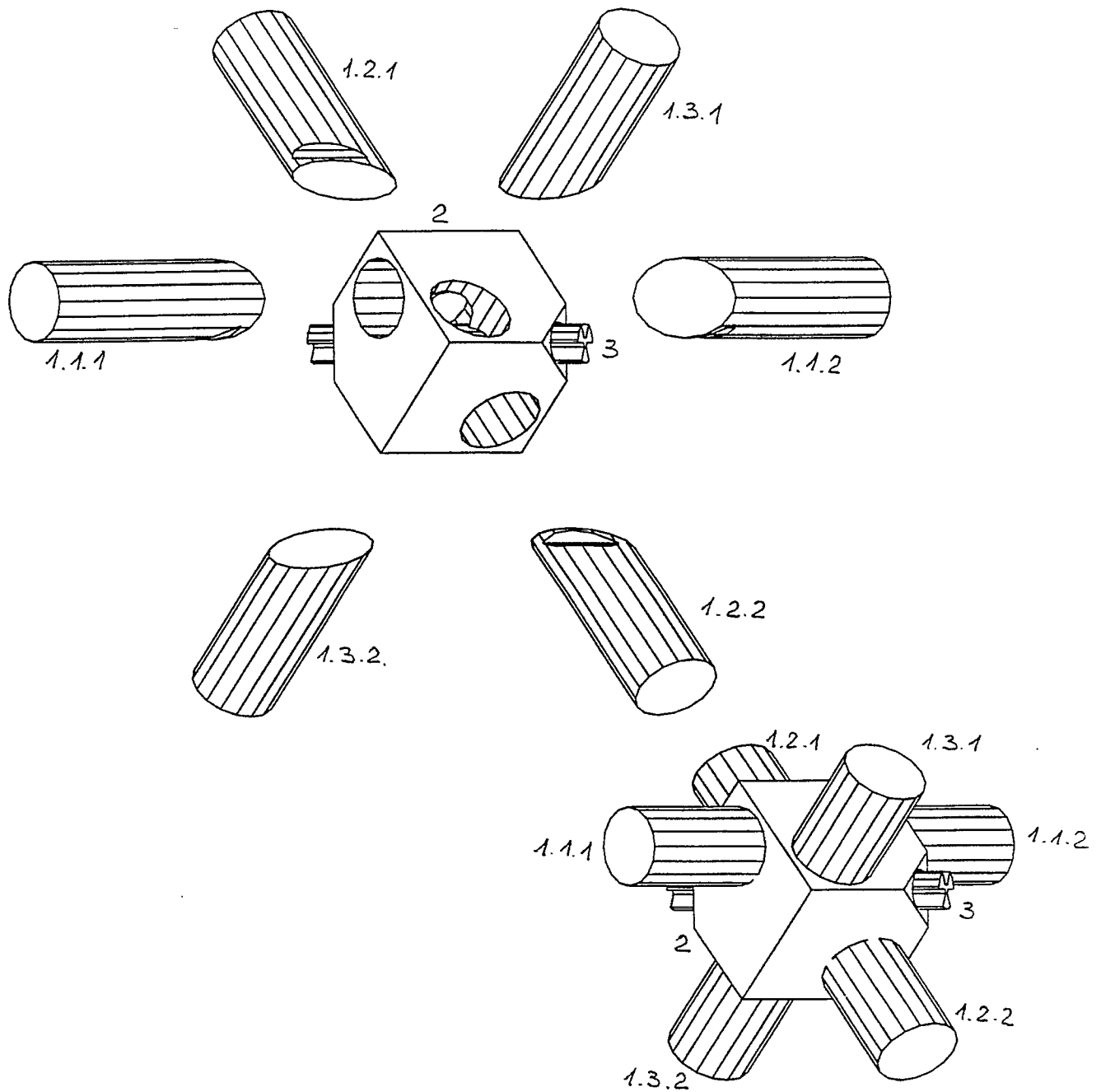


Fig. 6.2

SUBSTITUTE SHEET (RULE 26)

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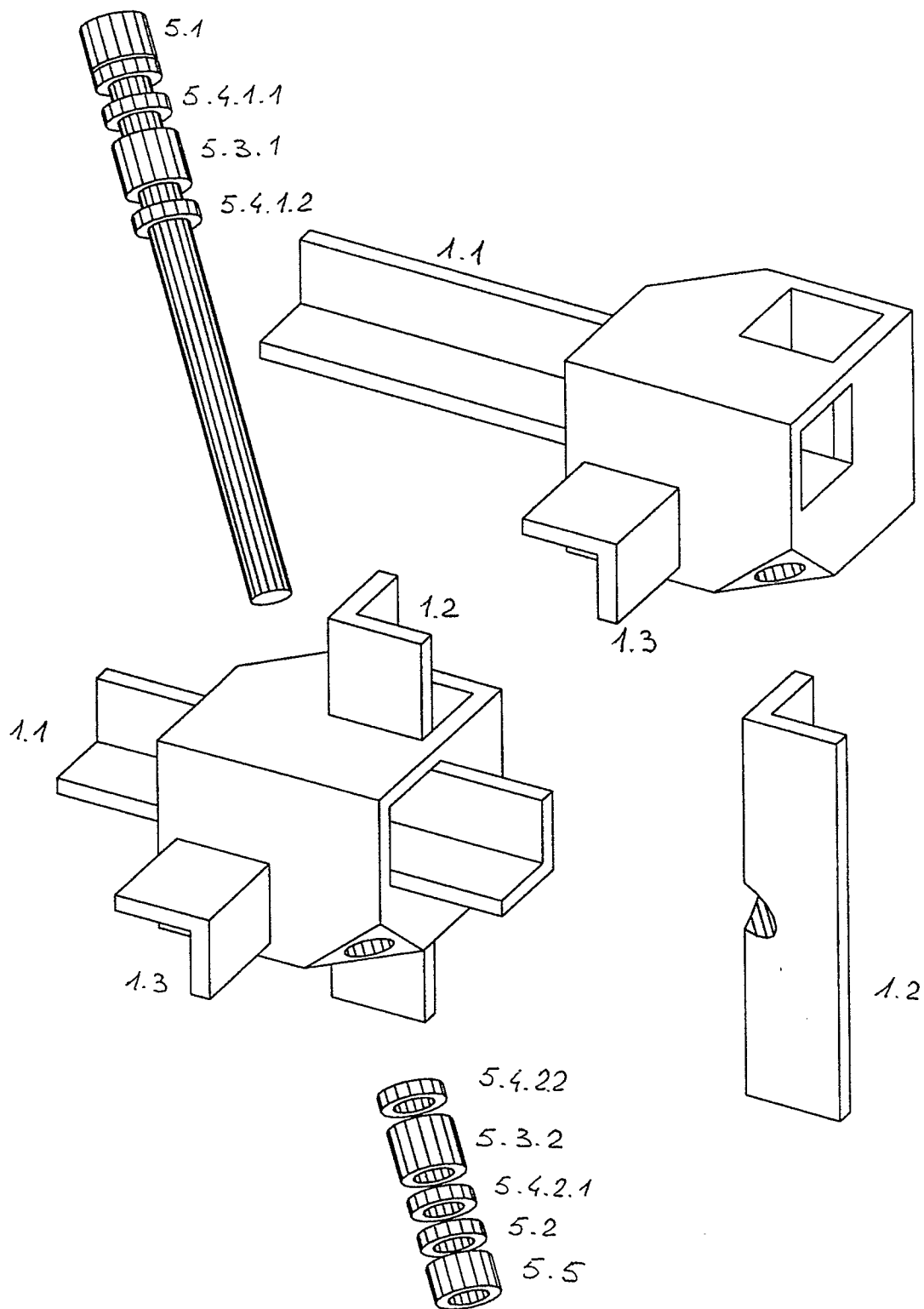


Fig. 6.3

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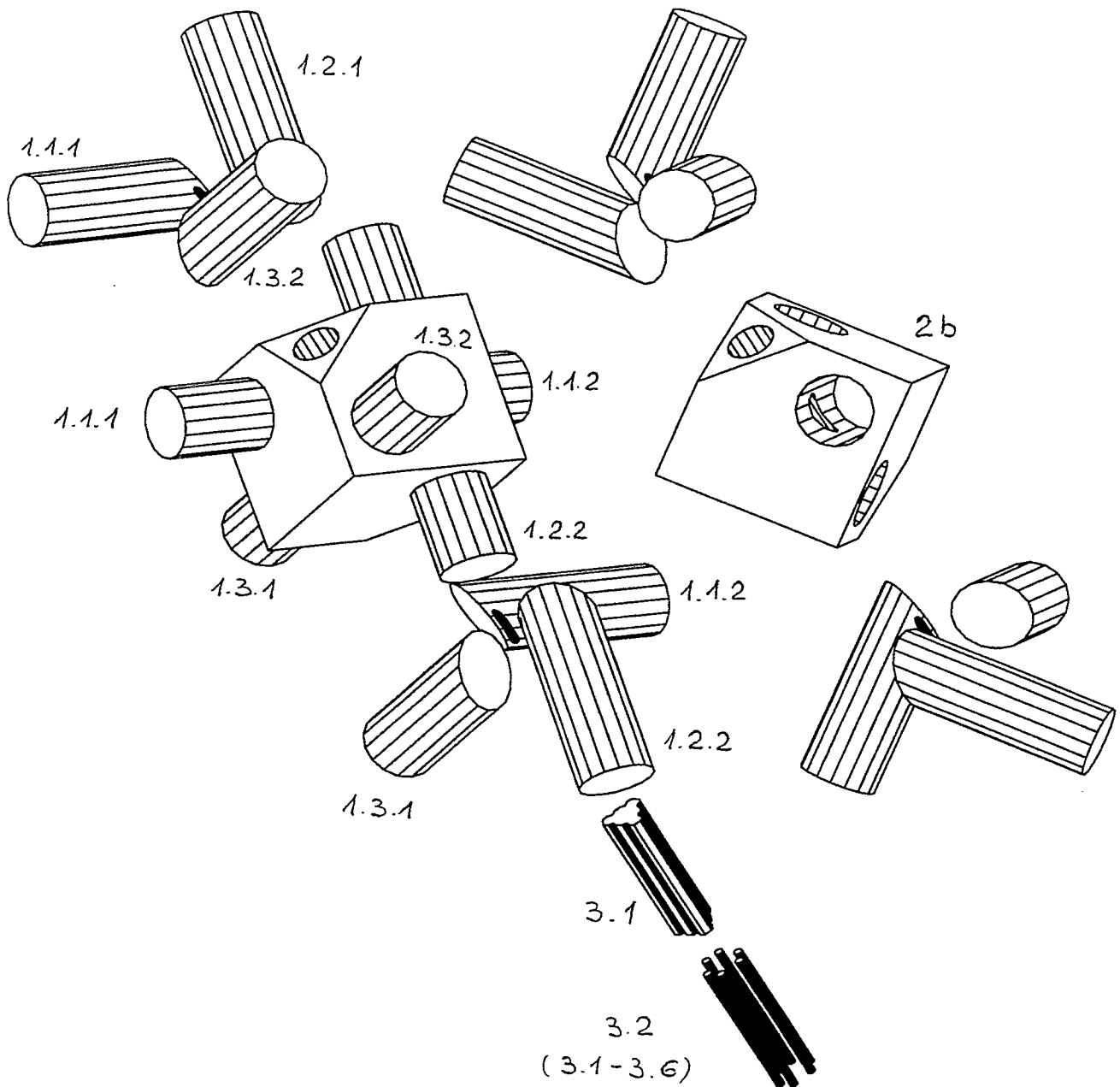


Fig. 6.4

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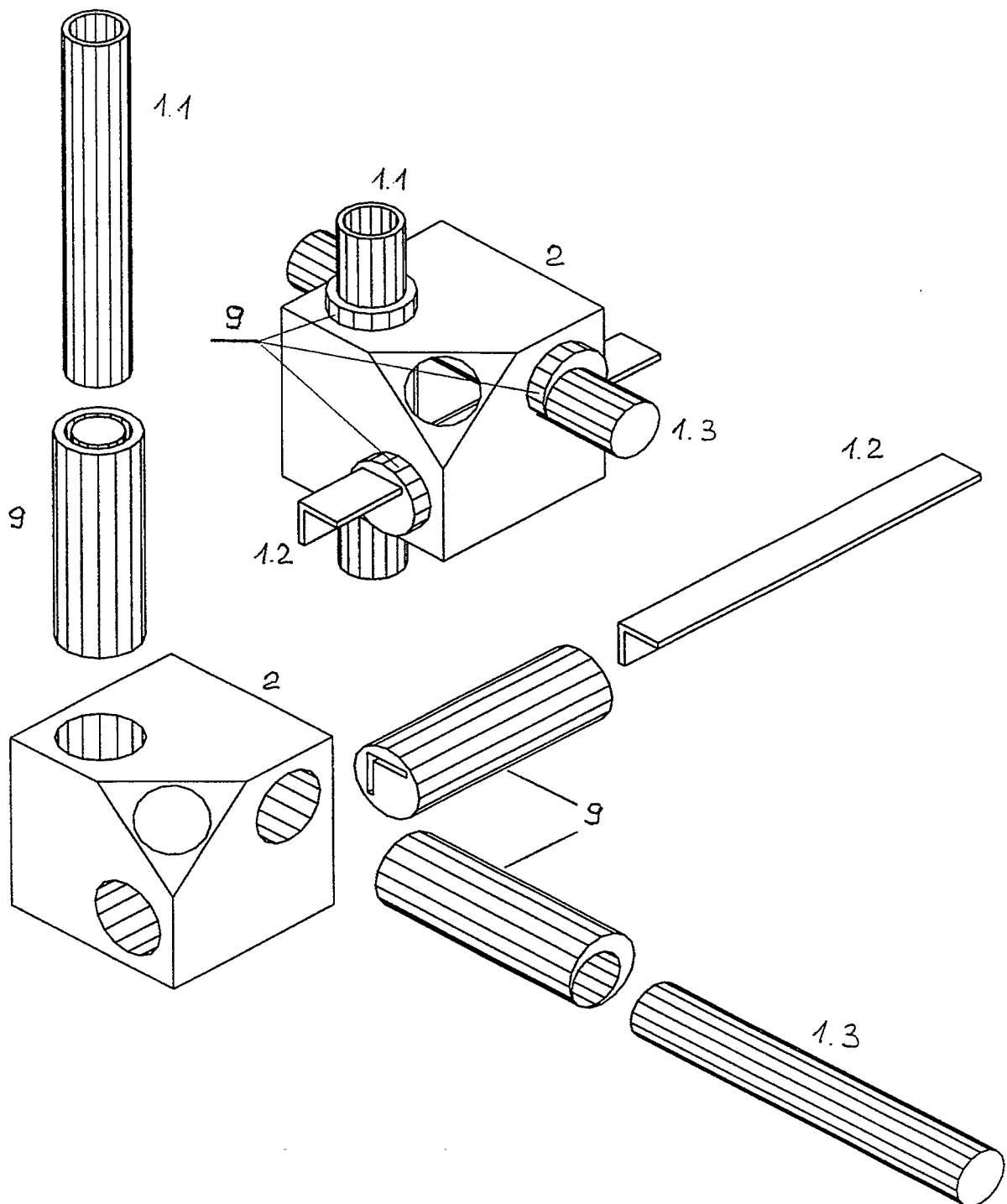


Fig. 7.1

SUBSTITUTE SHEET (RULE 26)

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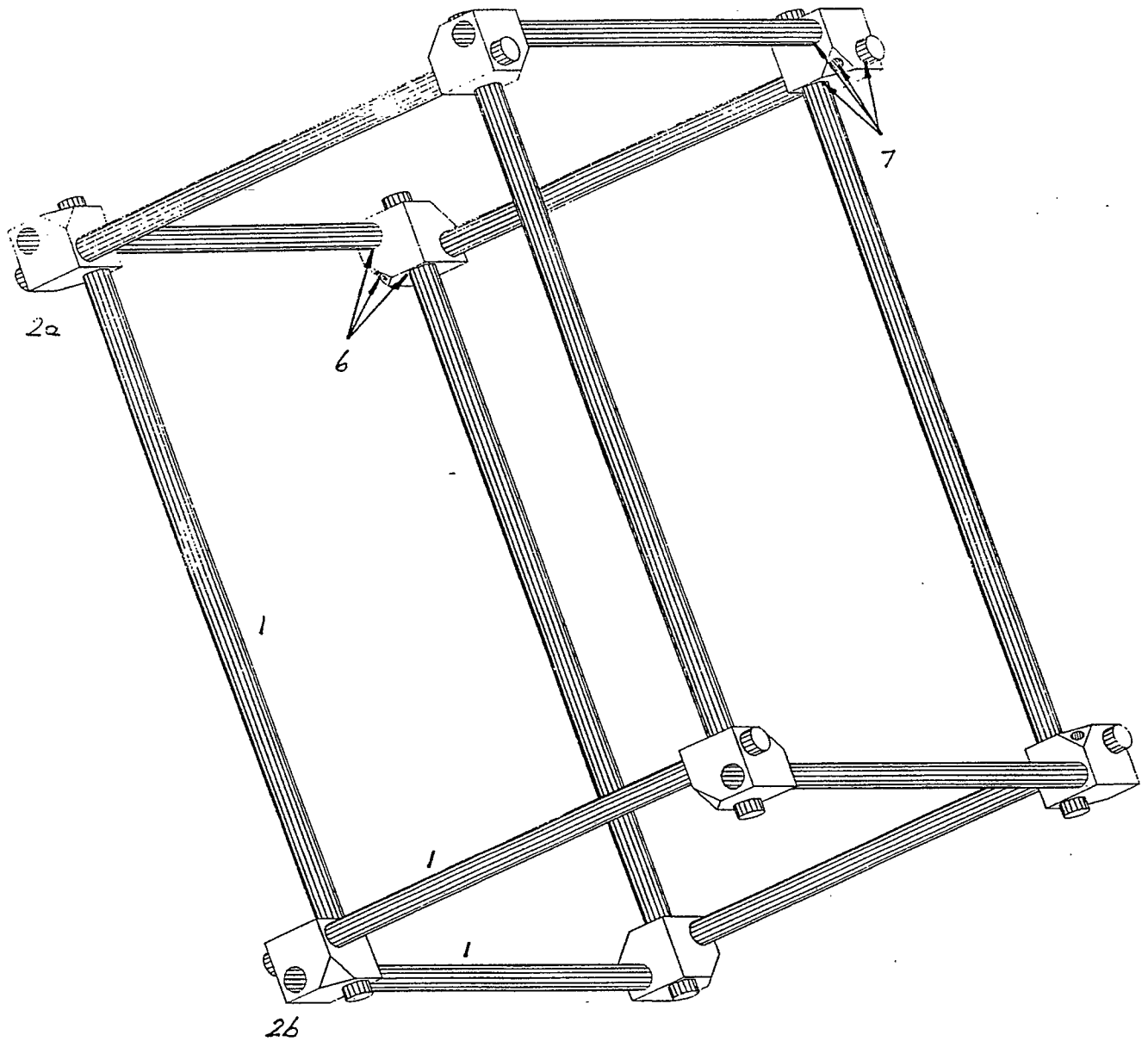


Fig. 8.1

SUBSTITUTE SHEET (RULE 26)

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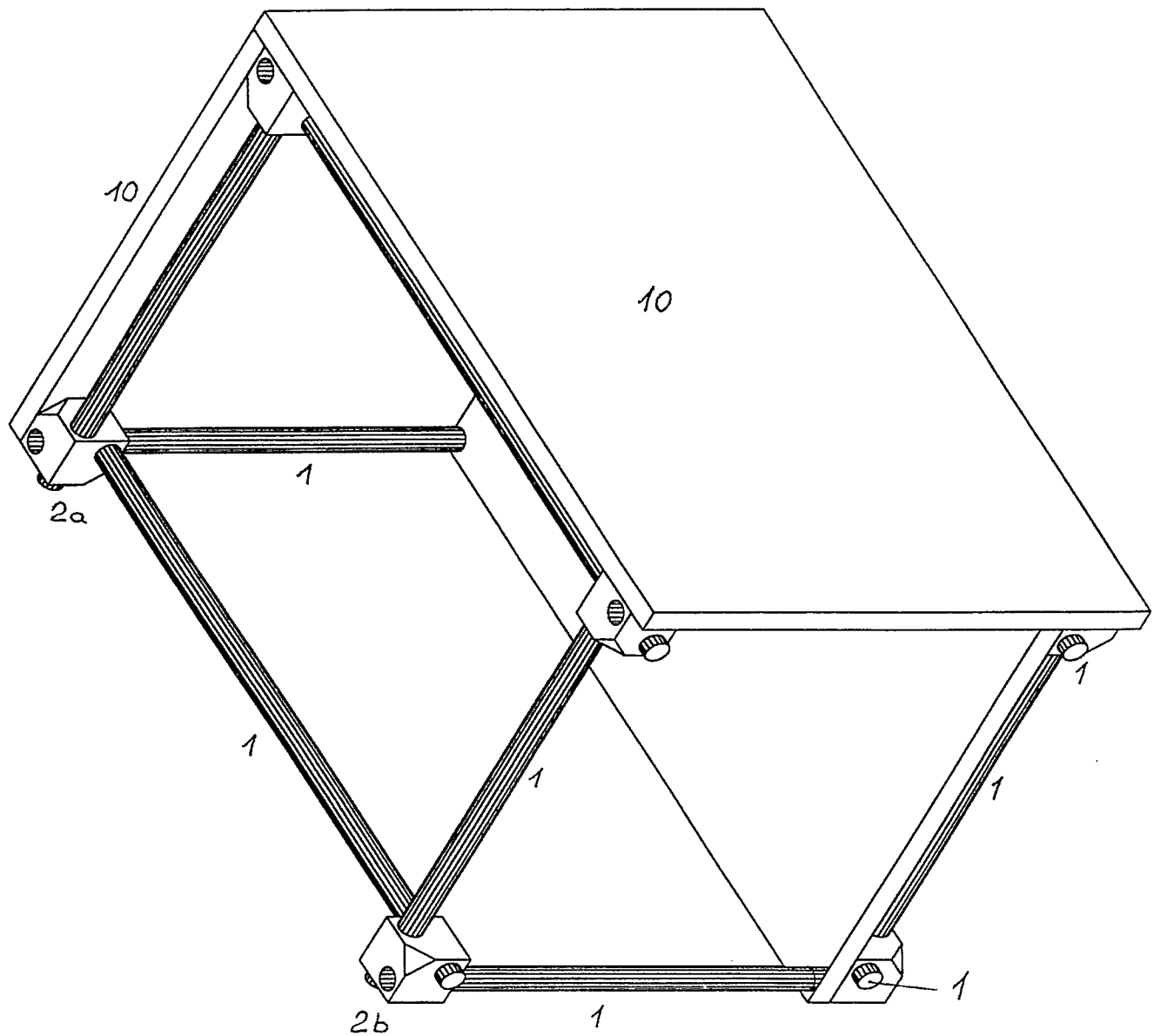


Fig. 8.2

SUBSTITUTE SHEET (RULE 26)

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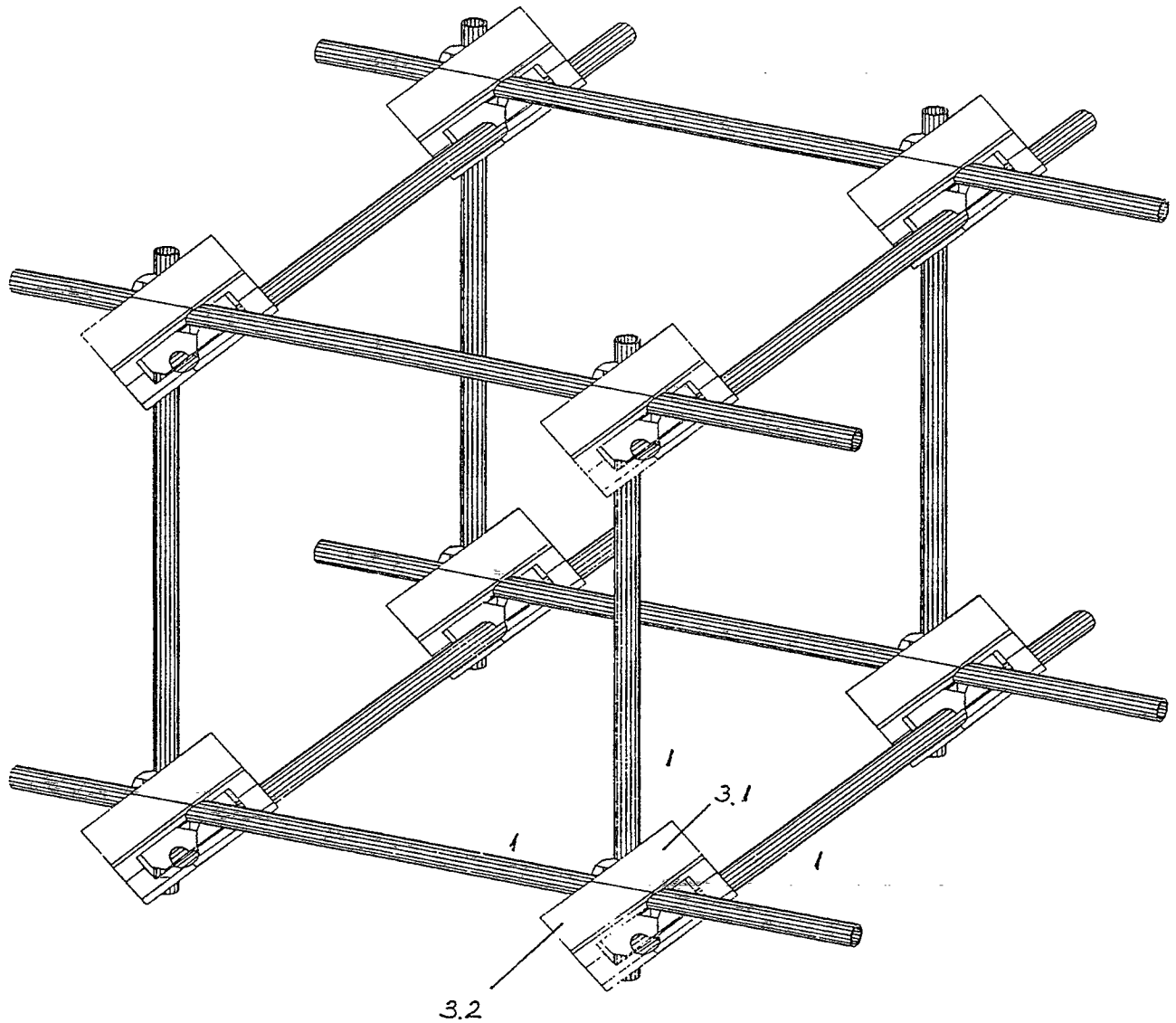


Fig. 8.3

SUBSTITUTE SHEET (RULE 26)

