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(54) TOY CONSTRUCTION SET

(57) A toy construction set comprising blocks (10) with through-bores (18), connector elements (12) and shaft elements (14). The cross-sections (20, 24) of the through-bores are shaped such that the connector elements (12) can be inserted by a predetermined distance (22) creating a strong, but easily reversible, frictional connection between the connector elements (12) and the blocks (10), and such that the shaft elements (14) can be inserted into and pushed through the through-bores (18), being able to rotate around their elongated axis, when inside the through-bores. Embodiments of this versatile toy construction set allow constructing in all three dimensions and can be cost-efficiently fabricated in non-plastic materials like wood.

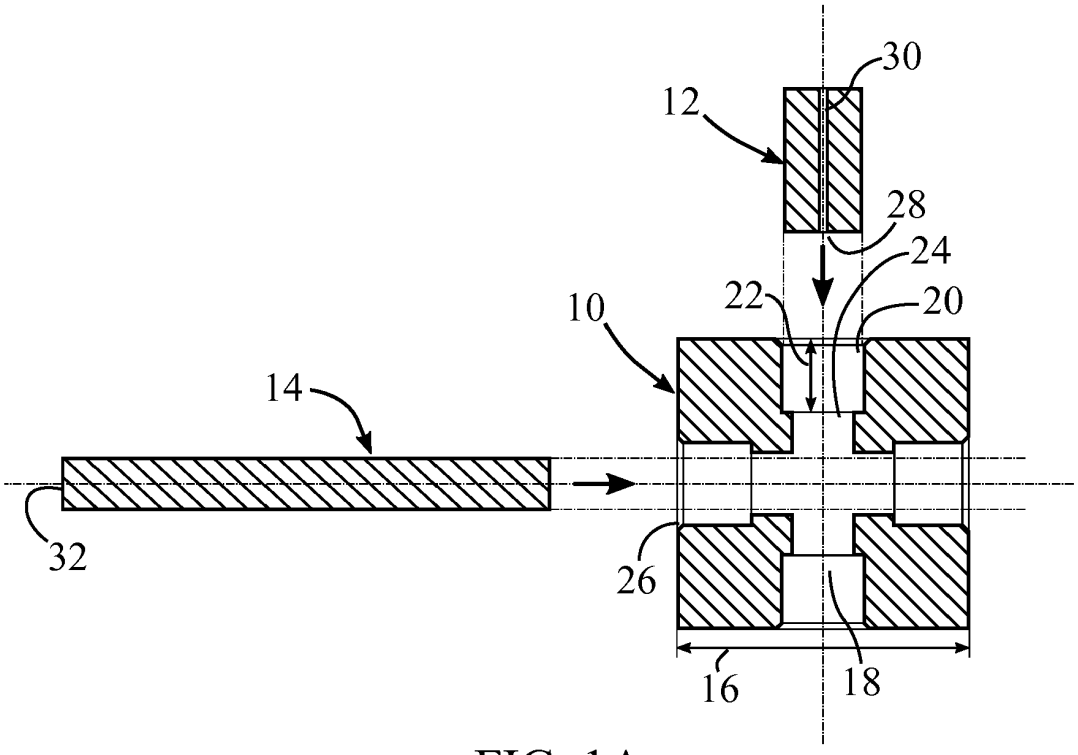

FIG. 1A

EP 3 135 360 A1

Description

FIELD OF INVENTION

[0001] Embodiments of the present invention relate to toy construction sets for children and adults.

BACKGROUND OF THE INVENTION

[0002] Toy construction sets are very popular, because they foster creativity, three-dimensional thinking, haptic learning, and social skills.

[0003] Sets of only few, versatile construction elements allow assembling a large variety of objects. The possibility to construct in all three dimensions and to integrate moving shafts, for example to construct vehicles, significantly enhances the possibilities for play.

[0004] It is important that users, particularly children, can assemble and dissemble the construction elements easily. It is also important that the connections between the assembled elements are sufficiently strong to keep the assembled object together, when moved or used in play.

[0005] Designing few, very versatile construction elements, which can be produced in high quantities, reduces manufacturing costs. Adapting the design of the construction elements to the manufacturing technology and material further reduces costs.

[0006] Today, most toy construction sets are made of injection-molded plastic like ABS. Wood is a natural and renewable material. It has a warmth and tactile response that is not attainable with injection-molded plastic. However, the lower manufacturing precision of wood and its expansion with humidity make manufacturing complex construction elements and controlling the connection strength between assembled construction elements more challenging than with injection-molded plastic.

[0007] Different solutions have been proposed to design toy construction sets suitable for manufacturing from non-plastic materials such as wood:

[0008] One solution proposes blocks with through-bores. Connection rods are inserted into the through-bores to assemble the blocks. As the entry depth and thereby the friction surface area of the rod in the through-bore is not controlled, the connection strength can vary significantly. Assembly and disassembly of the blocks can become very difficult, when the rods enter deep into the bores. This can lead to frustration, particularly when used by children.

[0009] Another solution proposes blocks with blind bores for insertion of connection rods. The blind bores do not allow inserting shafts that can move along or rotate around their axis. For this purpose, a different block design with through-bores is proposed, reducing the versatility of the individual blocks and the opportunities for play. The user needs a larger number of blocks with different block designs to compensate for the lower versatility of the individual blocks.

[0010] Another solution proposes blocks with through-bores and cylindrical connector elements. The entry depth of the connector elements into the through-bores is controlled by a flange around the central section of the cylindrical connector elements. These connector elements are difficult to fabricate in non-plastic materials such as wood. Therefore, this solution is commercialized with connector elements made of plastic.

[0011] None of the described solutions satisfies the need for a toy construction set with versatile construction elements that allows constructing in all three dimensions, precisely controlling the connection strength, integrating moving shafts, and cost-efficient manufacturing all construction elements from non-plastic materials like wood.

SUMMARY OF THE INVENTION

[0012] In accordance with one embodiment the presented toy construction set comprises blocks with at least one through-bore, connector elements, and shaft elements, which are elongated elements.

[0013] The through-bores have a first cross-section at least at one opening of the through-bores, and a second cross-section as of a distance from this opening along the respective through-bore. The cross-section area of the first cross-section is larger than the cross-section area of the second cross-section. The through-bores are adapted, such that the connector elements can be inserted into the opening of the through-bores with the first cross-section at most by the distance from the opening to the beginning of the second cross-section, creating a frictional connection between the respective connector element and the respective block. The through-bores are also adapted, such that the shaft elements can be inserted into the openings of the through-bores with the first or the second cross-section and can be pushed through the through-bores, being able to rotate around their elongated axis when inside the through-bores.

[0014] The advantages of one or more of the embodiments of this toy construction set are the following:

- The blocks allow constructing in all three dimensions.
- The same through-bores can serve as host for connector elements or shaft elements, making the blocks more versatile.
- The connection strength can be precisely controlled via the geometric structure of the through-bores enabling easy assembly and disassembly, and strong connections between assembled blocks at the same time.
- The blocks, connector elements, and shaft elements can be manufactured cost-efficiently in non-plastic materials like wood.
- Stuck connector elements or other items that may accidentally clutter the through-bore can be easily pushed out using a shaft element. In rare cases, when two connector elements are stuck in both

openings of a through-bore, a block of wrench-like shape can be used to pull out the stuck connector elements.

BRIEF DESCRIPTION OF THE DRAWINGS

Drawings - Figures:

[0015]

Fig. 1	shows a block, a connector element, and a shaft element in accordance with one embodiment.
Fig. 1A	shows a sectional view of the block, the connector element, and the shaft element of Fig. 1.
Fig. 2	shows a block, a connector element, and a shaft element in accordance with one embodiment. The shaft element is used to push out the connector element from the through-bore of the block.
Fig. 3	shows a block, a connector element, and a block of wrench-like shape in accordance with one embodiment. The block of wrench-like shape is used to pull out the connector element from the through-bore of the block.
Figs. 4 to 10	show alternative blocks in accordance with one or more embodiments.
Figs. 11 to 13	show alternative connector elements in accordance with one or more embodiments.
Fig. 14	shows an alternative shaft element in accordance with one embodiment.

Drawings - Reference Numerals:

[0016]

10	block
12	connector element
14	shaft element
16	side length of block
18	through-bore in block
20	first cross-section at opening of through-bore
22	distance from opening of through-bore to beginning of second cross-section
24	second cross-section at distance from opening of through-bore
26	recess at opening of through-bore with first cross-section
28	cross-section of connector element
30	groove of connector element
32	cross-section of shaft element
34	block of wrench-like shape

DETAILED DESCRIPTION OF THE INVENTION

[0017] The features and the advantages of the present invention will be more readily understood upon a thoughtful deliberation of the following detailed description of one embodiment of the present invention with references to the accompanying drawings.

[0018] One embodiment of the invention is illustrated in Fig. 1 (isometric view of block 10, connector element 12, and shaft element 14) and Fig. 1A (sectional view of block 10, connector element 12, and shaft element 14).

[0019] Figs. 1 and 1A show a suitable block 10 that has a cubic form with a side length 16 of few centimeters. In the center of each face of the cubic block 10 is an opening of a through-bore 18. Each of the through-bores 18 has a first circular cross-section 20 close to the opening. The diameter of the first cross-section 20 is around one quarter of the side length of the block 16. Each through-bore 18 maintains this diameter until a certain distance 22 from the opening along the through-bore 18. The distance 22 is one quarter of the side length of the block 16. As of the distance 22 from the opening, the through-bore 18 has a second circular cross-section 24 with an area smaller than the area of the first cross-section 20. The diameter of the second cross-section 24 is one fifth of the side length of the block 16. The three through-bores 18 are perpendicular to each other and intersect in the central region of the block 10. The through-bore openings with the first cross-section 20 widen close to the surface of the block forming a recess 26.

[0020] Figs. 1 and 1A also show a suitable connector element 12, which has a circular cross-section 28. The diameter of the cross-section of the connector element 28 is about the same as the diameter of the first circular cross-section 20.

[0021] Inserting the connector element 12 into one of the through-bores 18 connects the connector element and the block by means of friction. The strength of the connection can be controlled and adjusted during design and manufacturing by a.) changing the relative diameters of the cross-section 28 and of the first cross-section 20 and by b.) changing the distance 22 that limits the entry depth of the connector element 12 into the block 10. A larger diameter of the cross-section of the connector element 28 compared to the diameter of the first cross-section 20 makes the connection between assembled blocks stronger, but also tougher to assemble and dissemble. A longer distance 22 makes the connection stronger, but also tougher to assemble and dissemble. The distance 22 has geometric constraints, because the through-bores 18 must only intersect at sections with the second cross-section 24.

[0022] The connector element 12 has a length of two times the distance 22, which is one half of the side length of the blocks 16. This length of the connector element allows connecting two blocks such that their faces touch. Alternative embodiments may comprise longer connector elements, which allow connecting two distant blocks,

such that their faces do not touch when assembled.

[0023] The connector element 12 has a groove 30 along its full length with a depth slightly beyond the center of the cross-section 28 giving some radial elasticity to the connector element. This elasticity facilitates insertion of the connector elements into the through-bores of the blocks. It also offers flexibility offsetting the impact of humidity on the shape of wood and the connection strength. The radial elasticity of the connector element can be increased by deepening the groove 30 further beyond the center of the cross-section 28.

[0024] Figs. 1 and 1A also show a suitable shaft element 14, which is an elongated element with a circular cross-section 32. The diameter of the cross-section 32 is smaller than the diameter of the second cross-section 24. In this embodiment, the diameter is slightly smaller than one fifth of the side length of the block 16. This diameter allows the shaft element 14 to freely rotate around its elongation axis when inside the through-bore 18. The length of the shaft element is longer than the side length of the block 16, such that further block-like elements serving, for example, as wheels can be connected to each end of the shaft element 14 that is inside a block 10. The shaft element 14 can also move along its elongation axis inside the through-bore 18, which offers further functional features to assembled objects.

[0025] The above description shows that this embodiment of the toy construction set is highly versatile. The three through-bores in this block are perpendicular to each other, enabling constructing in all three dimensions. The through-bores can serve as a host for connector elements or shaft elements, further enhancing versatility and the possibilities for play.

[0026] To assemble a desired object, the user inserts, without the use of any tools, both ends of a connector element into the openings of the through-bores of two different blocks, thereby creating a firm connection between the two blocks. More blocks can be added to this first pair of assembled blocks using additional connector elements. Shaft elements can be inserted into the through-bore of one or several aligned blocks - as long as no connector element is already inserted into these through-bores. To dissemble or to alter an assembled object, the user simply pulls two assembled blocks apart. This will leave the connector element in the through-bore of one of the blocks. The connector element can then be pulled out of the block or left there for assembly with another block.

[0027] Fig. 2 shows how a shaft element 14 can be used to push out the connector element 12 of the through-bore 18 in the case where the connector element 12 is stuck. For this, the user inserts the shaft element 14 into the opening of the through-bore 18 opposite to the opening where the connector element 12 is stuck. Pushing the shaft element 14 against the connector element 12 will push the connector element 12 out of the through-bore 18. Other items that may accidentally clutter the through-bore 18 can also be pushed out using the shaft element 14 in the same way.

[0028] Fig. 3 shows a block of wrench-like shape 34 that allows using this block not only as a construction element, but also as a tool to pull stuck connector elements 12 from other blocks 10. This tool is helpful in the rare case where two connector elements 12 are stuck in both openings of a through-bore and using a shaft element to push out the stuck connector elements 12 is not possible.

[0029] Although the description above contains many specificities, these should not be construed as limiting the scope of the embodiments, but as merely providing illustration of some of many embodiments.

[0030] Figs. 4 to 14 give some examples of alternative embodiments of a block 10, a connector element 12, and a shaft element 14.

[0031] Fig. 4 shows a block 10 with a non-cubic, partially rounded shape; Fig. 5 shows a block 10 with a rectangular first cross-section 20 at the opening of the through-bores 18 and a quadratic second cross-section 24 at the distance 22 from the opening of the through-bores; Fig. 6 shows a block 10 with several through-bores 18 on the same face of the block; Fig. 7 shows a block 10 with through-bores 18 only on some of its faces; Fig. 8 shows a block 10 with through-bores 18 at a 30 degree angle to the faces of the block with the through-bore openings; Fig. 9 shows a block 10 with through-bores 18, which have a first cross-section 20 with a larger cross-section area only at one opening and a sec-ond cross-section 24 with a smaller cross-section area at the other opening; Fig. 10 shows a block 10 with some through-bores 18, which have a first cross-section 20 at both openings, and some through-bores 18, which have a first cross-section 20 at one opening and a second cross-section 24 at the opposite opening.

[0032] When playing with blocks that have through-bore openings with the first cross-section 20 and through-bore openings with the second cross-section 24, the user can insert connector elements only into the openings with the first cross-section 20. A recess 26 at the through-bore openings with the first cross-section 20 indicates that a connector element 12 can be introduced - as opposed to the through-bore openings with the second cross-section 24 and no recesses - and facilitates inserting the connector element 12.

[0033] Fig. 11 shows a connector element 12 with slots across the full diameter at both ends instead of a groove along its full length; Fig. 12 shows a long connector element 12, which allows connecting two distant blocks; Fig. 13 shows a connector element 12 with a rectangular cross-section 28 adapted to be inserted into the through-bores of an embodiment of the block as shown in Fig. 5; Fig. 14 shows a shaft element 14 with a quadratic cross-section 32.

[0034] The alternative embodiments of the blocks, the connector elements, and the shaft elements described above can further enhance the possibilities for play particularly when used in combination.

[0035] The blocks, the connector elements, and the shaft elements of these embodiments can be cost-efficiently fabricated from plastic materials, but more importantly from non-plastic materials such as wood. This is made possible by defining the insertion depth of the connector elements via the geometric structure of the through-bore (distance from the opening of the through-bore to the beginning of the second cross-section) and not via the structure of the connector element as proposed in prior art (flanges around the central section of the cylindrical connector elements), which significantly reduces the complexity of fabricating the connector elements in non-plastic materials such as wood.

[0036] It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances, which fall within the scope of the appended claims.

Claims

1. A toy construction set comprising a plurality of blocks (10) with at least one through-bore (18), a plurality of connector elements (12), and a plurality of shaft elements (14) being elongated elements with an elongation axis, **characterized in that**
   the through-bores (18) have
   a first cross-section (20) with a cross-section area at least at one opening of the through-bores (18), and a second cross-section (24) with a cross-section area as of a distance (22) from this opening along the respective through-bore,
   the cross-section area of the first cross-section (20) being larger than the cross-section area of the second cross-section (24),
   adapted such that the connector elements (12) can be inserted into the openings of the through-bores (18) with the first cross-section (20) at most by the distance (22) from the opening to the beginning of the second cross-section, creating a frictional connection between the respective connector element (12) and the respective block (10), and
   adapted such that the shaft elements (14) can be inserted into the openings of the through-bores (18) with the first cross-section (20) or the second cross-section (24) and can be pushed through the through-bores (18), being able to rotate around their elongation axis when inside the through-bores (18).

2. The toy construction set in accordance with claim 1 **characterized in that** the through-bores (18) in one block (10) are either parallel or perpendicular to each other.

3. The toy construction set in accordance with claim 1 **characterized in that** the first cross-section (20) and the second cross-section (24) of the through-bores (18) are circular.

4. The toy construction set in accordance with claim 3 **characterized in that** the first cross-section (20) of the through-bores (18) has a diameter that is at most double the distance (22) from the opening of the through-bore to the beginning of the second cross-section.

5. The toy construction set in accordance with claim 1 **characterized in that** the blocks (10) have side lengths (16), which are equal or a multiple of the distance (22) from the opening of the through-bore to the beginning of the second cross-section.

6. The toy construction set in accordance with claim 1, **characterized in that** the section of the through-bores (18) with the first cross-section (20) widens close to and in direction to the opening of the through-bores (18) forming a recess (26).

7. The toy construction set in accordance with claim 1 **characterized in that** the connector elements (12) have a length, which is two times or a bigger multiple of the distance (22) from the opening of the through-bore to the beginning of the second cross-section.

8. The toy construction set in accordance with claim 1, **characterized in that** the toy construction set comprises at least one block of wrench-like shape (34), elongated along an elongation direction having
   at least one through-bore, adapted to engage with the connector elements (12), such that when the through-bore is pressed upon one of the connector elements (12) a frictional connection is established, and
   a slit from the through-bore along the elongation direction separating a part of the block of wrench-like shape (34) into two legs that can be bent towards each other and thereby increase the frictional connection strength with the connector element (12).

9. The toy construction set in accordance with claims 1 - 8 **characterized in that** the toy construction set is machined from solid materials.

10. The toy construction set in accordance with claims 1 - 8 **characterized in that** the toy construction set is made of wood.

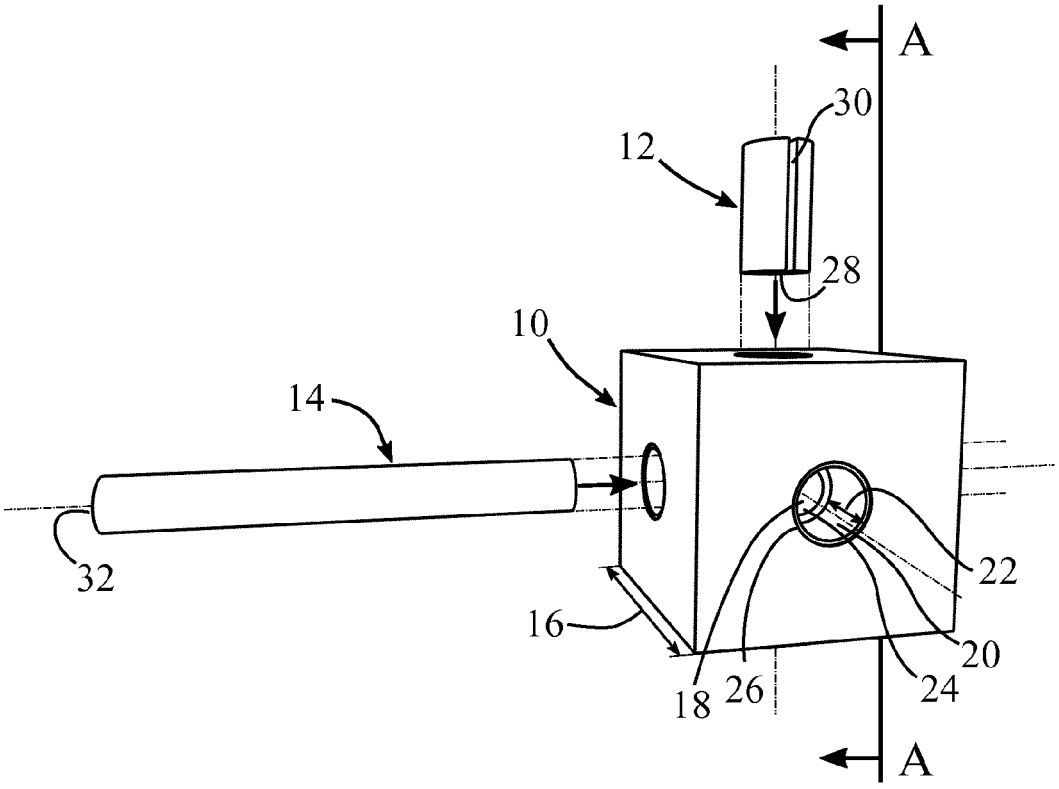
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FIG. 1

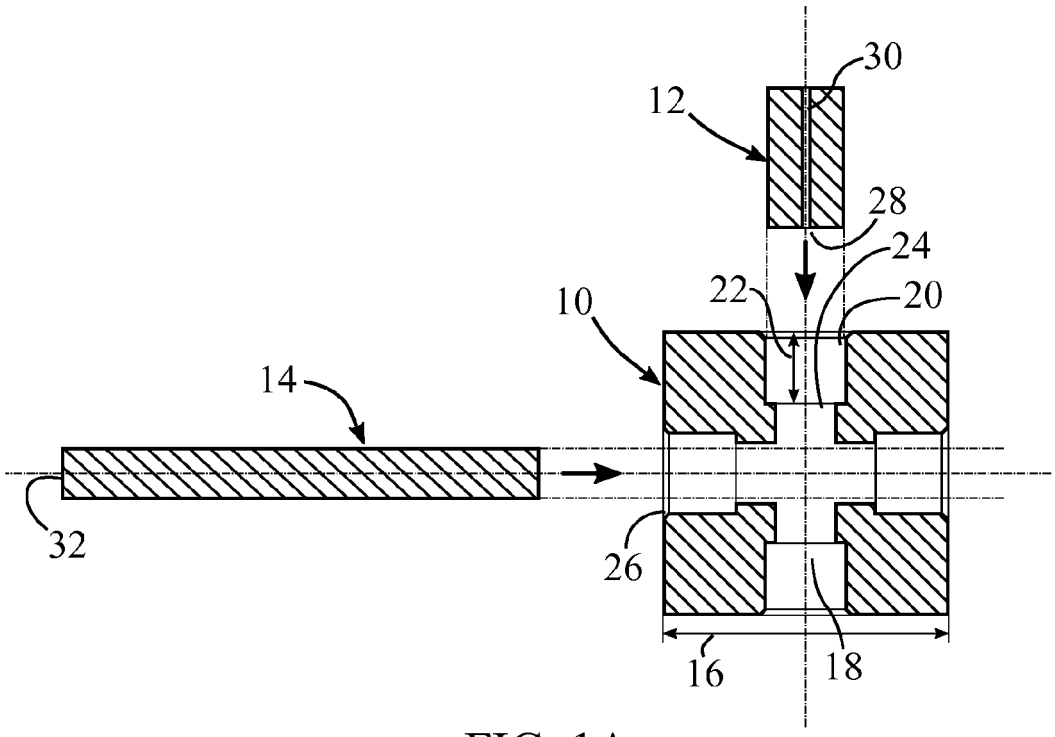
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FIG. 1A

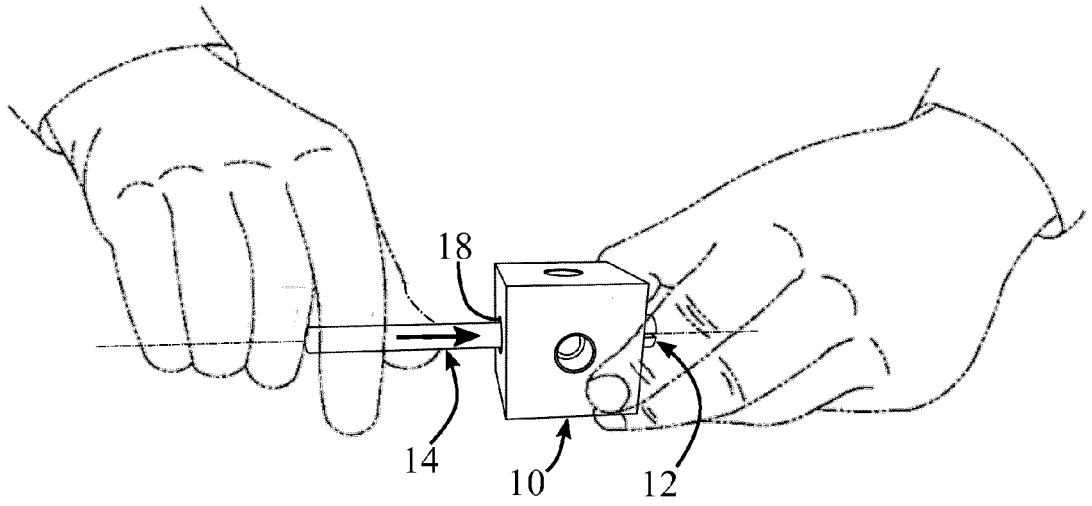

FIG. 2

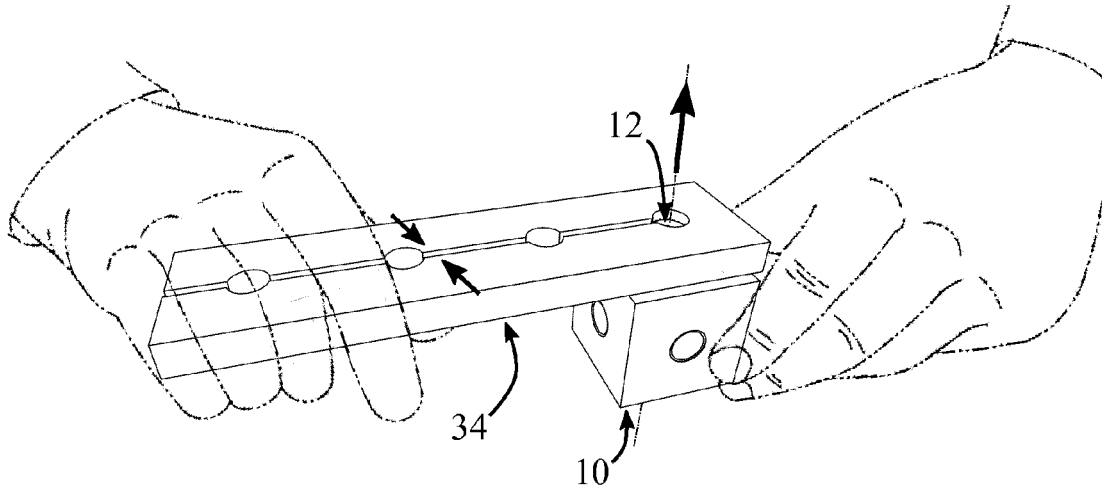

FIG. 3

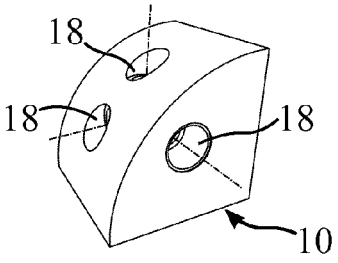

FIG. 4

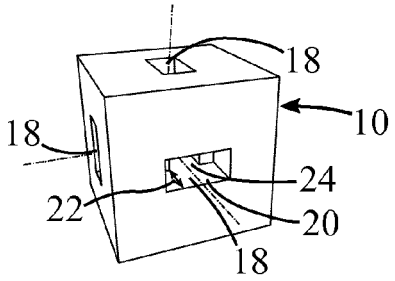

FIG. 5

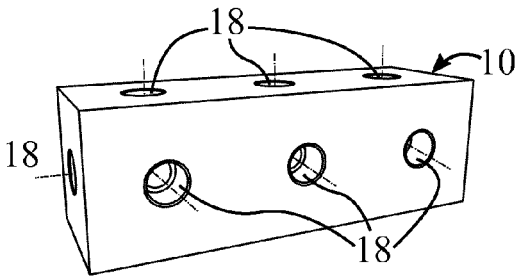

FIG. 6

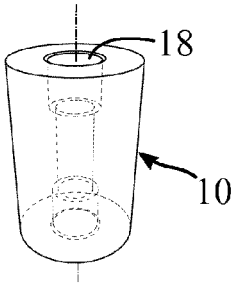

FIG. 7

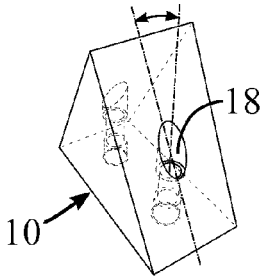

FIG. 8

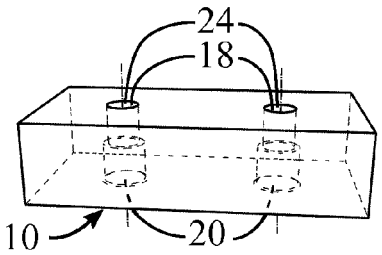

FIG. 9

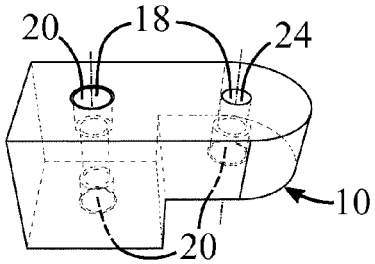

FIG. 10

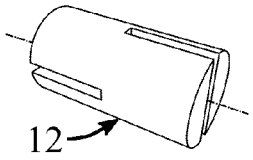

FIG. 11

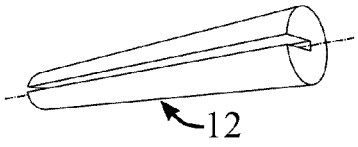

FIG. 12

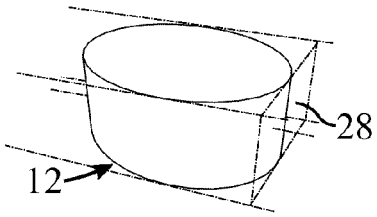

FIG. 13

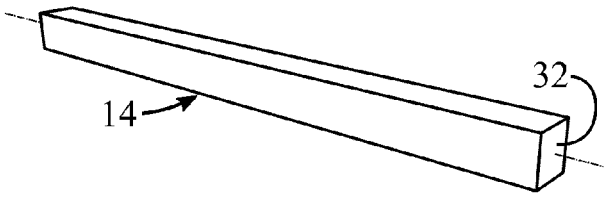

FIG. 14

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EUROPEAN SEARCH REPORT

Application Number
EP 15 02 0146

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 911 070 A2 (HAPPY CLOWN GMBH [CH]) 28 April 1999 (1999-04-28) * paragraph [0031] - paragraph [0033]; figures *	1-10	INV. A63H33/10
A	DE 28 23 440 A1 (SCHMIDT TROSCHKE GEB TROSCHKE) 13 December 1979 (1979-12-13) * page 8, line 9 - page 10, line 29; figures *	1-10	
A	US 1 915 835 A (HAMILTON PAJEAU CHARLES) 27 June 1933 (1933-06-27) * page 2, line 33 - page 4, line 90; figures *	1-10	
A	CA 933 360 A (HOEWE A [DE]) 11 September 1973 (1973-09-11) * page 7, line 18 - page 15, line 23; figures *	1-10	
A	US 2007/173095 A1 (BIN-NUN RIFAEL [US] ET AL) 26 July 2007 (2007-07-26) * paragraph [0022] - paragraph [0036]; figures *	1-10	TECHNICAL FIELDS SEARCHED (IPC) A63H
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 February 2016	Lucas, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 02 0146

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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10-02-2016

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82