



- (51) **International Patent Classification:**
A61C 7/10 (2006.01)
- (21) **International Application Number:**
PCT/IB2012/051047
- (22) **International Filing Date:**
6 March 2012 (06.03.2012)
- (25) **Filing Language:** Italian
- (26) **Publication Language:** English
- (30) **Priority Data:**
MI2011A000355 7 March 2011 (07.03.2011) IT
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- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) **Title:** RAPID PALATAL EXPANDER IN A SIMPLIFIED MANNER

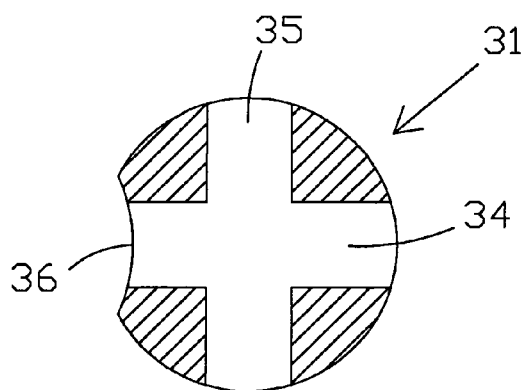


FIG. 4

(57) **Abstract:** A rapid palatal expander comprises a double-screw jack having a cylindrical head with two diametrical holes intersecting at 90°, for receiving a driving key. Two screws having oppositely directed threads extend from the two bases of the head, and engage in two respective nut blocks connected by palatal arms to metal rings, which are cemented to the molars of the upper hemi-arches. Therefore, the nut blocks can be located proximate to the palatal mucosa on each side of the palatal suture. Two pins extend through the blocks on each side of the double screw to guide the blocks in opposite directions during rotation of the jack. The head exerts a pressure against the guide pins to prevent any undesired rotation that might reduce the current expansion degree. A longitudinal recess in the jack head intersects the entry of a hole, for introduction of a guide pin at a time in its seat with no interference by the head.



Rapid palatal expander in a simplified manner.*Field of the invention*

The present invention is directed to the field of orthodontic appliances, namely to a rapid palatal expander having a simplified assembly.

5 *Background art*

Rapid Palatal Expansion (RPE) is an orthodontic treatment to correct malocclusion due to inadequate transverse growth of the upper jaw. This treatment is performed by temporary application of an orthopedic device known as "rapid palatal expander" in the mouth, to cause the palatine suture to open and the palate to expand,
10 thereby creating more room between teeth and allowing proper closure of the mouth. The RPE is usually used in early infancy, when the palatine suture is not ossified yet. However, in case of complete synostosis, surgical assistance is required for RPE.

Figure 1 shows a prior art rapid palatal expander 1 fixed to the upper arch of a patient. The expander is supported by two metal rings 2 and 3, known as molar bands,
15 which are fitted on opposite molar teeth of the two hemi-arches and fastened thereto by cement, e.g. glass ionomer cement.

The two molar bands 2 and 3 are bonded to one end of two respective curved bars 4, 5, 6 and 7, known as palatal arms, which have the other end laterally connected to two respective nut blocks 8 and 9 of a double-screw jack. The pairs of arms 4, 5 and 6, 7
20 are designed to locate the nut blocks 8, 9 proximate to the palatal mucosa, on each side of the palatine suture. The double-screw jack 10 comprises a cylindrical head 11 having two cylindrical bars 12 and 13 of the same length extending from its bases, which bars are integral with the head 11, have oppositely directed threads and are engaged in the two nut blocks 8 and 9 respectively at each end. The head 11 has two diametrical holes
25 25 and 26 which intersect at 90° to allow introduction of a key for rotating the head 11 by a quarter turn each time.

The ends of two cylindrical pins 14 and 15 project out of respective holes 21 and 22 (outlined by dashed lines) in the nut blocks 8 and 9, and are formed on each side of a central threaded hole 20 (outlined by dashed lines) allowing the threaded bars 12 and 13 to be screwed therein. The pins 14 and 15 guide the translational motion of the nut
5 blocks 8 and 9 as the head 11 of the jack 10 rotates. Upon actuation of the jack 10 to open the nut blocks 8 and 9 apart (in the direction of the arrows on the blocks), the palatal arms 4, 5 and 6, 7 exert a pressure against their respective arches, thereby opening the palatine suture and causing transverse expansion of the upper jaw.

The pins 14 and 15 have devices (not shown) at their ends for locking the
10 maximum opening position, thereby preventing disassembly of the palatal expander during activation.

Instead of being bonded to metal rings 2 and 3, the palatal arms 4, 5 and 6, 7 may be connected to bands (not shown), which extend from such rings 2 and 3, to lie on the palatal surface of the enamel of the teeth adjacent to them 2 and 3.

15 The blocks 8 and 9 may be embedded in two respective resin shields (not shown), which gently touch the palatine mucosa to improve the conformation of the palatal vault during the period in which the expander 1 is in place.

By way of example, each of the above mentioned elements of the palatal expander 1 is made of stainless steel ISO 5832-9, which has superior mechanical properties, due
20 to the presence of nitrogen and manganese. Alternatively, other biomedical steels may be used, such as ISO 5832-1D and ISO 5832-1E, which have poorer mechanical properties, but also a lower cost than ISO 5832-9. The palatal expander may be also made of titanium, a material that combines high biocompatibility and the advantage of not causing allergies and not altering the taste of food.

25 Prior art rapid palatal expanders are formed in such a manner that the guide pins

of the nut blocks contact the cylindrical head of the jack, which exerts there against a sufficient pressure to prevent the pins from coming out of their seats, as well as expansion from being loosened due to chewing stresses.

Figure 1a is an enlarged view of a detail of Figure 1, which highlights the interference between the cylindrical head 11 and the guide pins 14 and 15. The figure accentuates the curve formed by the pins 14 and 15 due to the pressure exerted by the head 11 there against.

Figure 1b is a schematic view showing that the cylindrical head 11 and the guide pins 14 and 15 are not simply in mutual contact, but are pressed together due to the partial overlapped arrangement of the head and the pins. Due to the pressure between the cylindrical head and the guide pins, during assembly of the expander the pins have to be forced into their seats in the nut blocks. This occurs both before application of the expander in the patient's mouth and also thereafter, each time the jack reaches its maximum elongation prior to completion of the desired expansion.

Particularly, a problem arises in that dentists find it difficult to perform reassembly of the rapid palatal expander on site, after replacing the pins and the double screw with longer parts.

Therefore, they must completely remove the palatal expander and apply a new one. This requires a new impression of the upper jaw of the patient to be taken, for new modeling of the molar bands and the palatal arms of the new expander, resulting in an increase of treatment times and costs.

A rapid palatal expander is disclosed in the Italian patent application No. MI2010A001788, filed by the Applicant hereof. The expander described therein solves both problems of the jack being loosened and the pins coming out of their seats: the former is solved by the provision of a circumferential tooth projecting out of the

cylindrical surface of the jack head to exert a pressure against the pin walls; the latter is solved by the provision of two rectangular recesses at the center of the guide pins in which the jack head is partially inserted with its circumferential tooth in contact with the recess wall.

5 Nevertheless, the above mentioned problem is not solved by the palatal expander disclosed by the reference document, because assembly of the expander requires the two pins to be forced into their respective seats until the head may be introduced into the two recesses.

Objects of the invention

10 Therefore, the object of the invention is to overcome the above drawbacks and provide an easy-assembly rapid palatal expander.

Summary of the Invention

In view of fulfilling these objects, the present invention relates to a rapid palatal expander comprising:

15 - a jack having a cylindrical head with two bars, integral with the head, and having oppositely directed threads, the two bars extending from its bases;

 - two nut blocks engaged by respective threaded bars and driven in opposite directions during rotation of the head;

 - two pins engaged in respective holes of the nut blocks, said pins extending on
20 each side of the holes that engage the threaded bars to guide the nut blocks in said opposite directions, the head of the jack exerting a pressure against at least one of said pins, to oppose inadvertent rotation of the jack;

 - palatal arms integral with said nut blocks, connecting them to anchor rings for fixation to respective upper hemi-arches; said arms being designed to allow the jack to
25 be placed in the proximity of the palatal mucosa, substantially at the center of the palate,

for the rotation of the head of the jack in a predetermined direction to cause the two nut blocks to move away from each other and hence the palate to expand;

wherein, according to the invention, the head of the jack is lacking of lateral portion longitudinally extending between the bases, the head has a deep enough to
5 release the pressure exerted against said at least one pin, as claimed in claim 1.

Further features of the present invention, that are deemed to be innovative, are defined in the dependent claims.

In one aspect of the invention, the omitted portion leaves a recess along the head of the jack.

10 In a further aspect of the invention, the head of the jack has two diametrical holes that intersect at 90° , to receive a key for rotating the head by a quarter turn each time, and the wall of the head left by the omitted portion includes the entry section of one of said diametrical holes.

In another aspect of the invention, an end section of each threaded bar is lacking
15 of thread, to prevent the nut blocks from further moving away from each other, when the expander has reached its maximum opening state.

Yet another object of the invention is a jack for use in a rapid palatal expander, said jack having a cylindrical head with two respective bars, integral with the head and with oppositely directed threads, the two bars extending from its bases to engage two
20 respective nut blocks guided in opposite directions by a pair of pins during rotation of the head, the head of the jack exerting a pressure against at least one of said pins, to oppose inadvertent rotation of the jack, wherein according to the invention the head of the jack is lacking to a lateral portion longitudinally extending from a base to the other, of deep enough to release the pressure exerted against the said at least one pin, as
25 described in the relevant independent claim.

A further object of the invention is a method of assembling the rapid palatal expander as defined in claim 1, which includes the steps of:

a) screwing the threaded arms of the jack into the nut blocks until the cylindrical head;

5 b) introducing one end of a first guide pin into a first hole of a nut block until the head of the jack;

c) rotating the head of the jack until the area thereof with the omission of said portion is opposed to the partially introduced pin;

d) completing the introduction of the pin into a first hole of the other nut block;

10 e) repeating the steps b) to d) with a second guide pin, as described in the method claim.

Advantages of the invention

The simpler assembly of the expander allows such assembly to be performed on site, and allows further and simpler extension of the expander's length. As a result, each
15 time that the jack reaches its maximum elongation and treatment has to be continued, the dentists can reuse the molar bands, the palatal arms and the blocks of the palatal expander to be replaced, and assemble by themselves a new palatal expander, with apparently reduced treatment times and costs.

The provision of an unthreaded end section at each threaded bar prevents
20 disassembly of the palatal expander during activation, without requiring the use of lock devices on the expander.

Brief description of the figures

Further objects and advantages of the present invention will be more apparent from the following detailed description of an exemplary embodiment thereof and from
25 the accompanying drawings, which are given by way of example and without limitation,

in which:

- Figure 1 is a bottom perspective view of a prior art rapid palatal expander fixed to the upper arch of a patient;

5 - Figures 1a and 1b schematically show the interference between certain elements of Figure 1;

- Figure 2 shows a top view of a jack of a rapid palatal expander of the present invention;

- Figure 3 is a top view of the central body of the jack of Figure 2;

- Figure 4 is a central cross section of the driving head of the jack of Figure 2;

10 - Figure 5 is a cross section taken along the plane A-A of Figure 2;

- Figure 6 is a cross section taken along the plane A-A of Figure 2 after 45° counterclockwise rotation of the central body of the jack;

- Figure 7 is a central cross section of a variant embodiment of the jack of Figure 2;

15 - Figure 8 is a central cross section of another variant embodiment of the jack of Figure 2.

Detailed description of a few preferred embodiments of the invention

In the description that follows, like parts in different figures may be designated by like references. The description of a figure may designate parts that are not expressly shown in that figure, but in previous figures. The scale and proportions of the various parts do not necessarily correspond to the reality.

Figure 2 shows a double-screw jack 30 of a rapid palatal expander, which comprises a cylindrical head 31 having two cylindrical bars 32 and 33 of the same length extending from its bases 31a and 31b, which bars are integral with the head 31 and have oppositely directed threads and are engaged in the two nut blocks 8 and 9,

identical to those of the rapid palatal expander 1 as shown in Figure 1, respectively at each end. The diameter of the head 31 is obviously larger than that of the partially threaded bars 32 and 33. The jack 30 also comprises two cylindrical guide pins 14 and 15, identical to those of the expander 1, which project out of respective holes 21 and 22 (outlined by dashed lines) in the nut blocks 8 and 9, and are formed on each side of the central threaded hole 20 (outlined by dashed lines) allowing the threaded bars 32 and 33 to be screwed therein. The double screw of the jack 30 consists of the cylindrical head 31, with the bars 32 and 33 aligned from each base of the head. The pins 14 and 15 are parallel to the double screw, which is at the same distance from both, and has its axis coplanar to the axis of both. The head 31 comprises two holes 34 and 35 for receiving a key (not shown), which is designed to rotate the head 31. The latter has a lateral recess 36 longitudinally extending from one base 31a to the other 31b. The entry section of the hole 34 is in the wall of the recess 36.

The jack 30 is close to a maximum elongation state.

In this configuration, the ends of the pins 14 and 15 project a short distance out of the holes 21 and 22 of the blocks 8 and 9, and the ends of the bars 32 and 33 also project a short distance out of the threaded holes 20. The head 31 contacts the guide pins 14 and 15 external to the recess 36, with both holes 34 and 35 being accessible. The pins 14 and 15 are at such a distance that the head 31 exerts a pressure there against.

Figure 3 shows the head 31 of the jack 30 with the threaded bars 32 and 33 extending from both bases 31a and 31b thereof. The two bars 32 and 33 have respective unthreaded sections 32a and 33a extending from their free ends, whose length is approximately equal to the length of the threaded holes 20 of the blocks 8 and 9. The entry section of the hole 34 is wholly contained in the recess 36, at the center thereof. The head 31 and the bars 32 and 33 are formed from one piece, by turning and the

recess 36 is formed by milling.

Figure 4 is a central cross section of the head 31 of the jack 30, showing that the holes 34 and 35 have a diametrical , orthogonal arrangement. As the activation key is introduced into these holes 34, 35, it can be levered up to rotate the head 31 by a quarter turn at a time in the desired direction. The cross section of the head 31 is curved at the recess 36. By way of example, the width of the recess 36 is approximately equal to the radius of the head 31 and the ratio of the depth of the recess 36 to the radius of the head 31 is about 1/8.

In operation, from a configuration in which the blocks 8 and 9 are at their minimum distance from the head 31, the rapid palatal expander is activated once a day, by rotating the head 31 a quarter turn using the special key. The direction of activation, i.e. the one that causes the nut blocks 8 and 9 to move away from each other, is given by the arrows on the blocks 8 and 9 in Figure 1. When the head 31 is rotated to the position as shown in Figure 2, the friction created between the head 31 and the guide pins 14 and 15 prevents both the pins from translating out of their seats 21 and 22, and the thrust exerted by the jack 30 against the upper arches from being loosened due to the continuous stresses that act upon the rapid palatal expander, especially during chewing.

Figure 5 shows a cross section of the head 31 and the pins 14 and 15 of Figure 2, taken along the plane A-A passing through the axes of the diametrical holes 34 and 35. The figure shows that, at each step of palatal expansion, the head 31 must rotate a quarter turn so that, when rotation is completed, a new hole of the head 31 may be accessed for the next activation. Therefore, during operation, there will always be a pressure between the head 31 and the guide pins 14 and 15, whereas the recess 36 does not oppose the guide pins 14 and 15.

Figure 6 shows a cross section of the head 31 and the pins 14 and 15 of Figure 2,

taken along the plane A-A after a 45° counterclockwise rotation of the head 31 of the jack 30. In this configuration, the recess 36 opposes the cylindrical pin 14 and the presence of such recess prevents any contact between the head 31 and the pin 14. Therefore, the latter is free to slide in the holes 21 of the nut blocks 8 and 9, which is advantageous during assembly of the device, both in the beginning, before application of the device in the patient's mouth, and when the palatal expander has reached its maximum expansion and the treatment should be continued. In this event, the dentist will entirely remove the palatal expander, disassemble it and separate the molar bands, the palatal arms and the blocks; then he/she will use a central body like the one of Figure 3, with longer threaded arms 32 and 33 as compared with the central body that has just been removed, and a pair of guides 14 and 15 of appropriate length, and can thus assemble the new expander, through the steps of:

- a) screwing the threaded arms 32 and 33 of the jack into the nut blocks 8 and 9 until the cylindrical head 31;
- b) introducing one end of the guide pin 14 into the hole 21 of the nut block 8 until the head 31 of the jack 30;
- c) rotating the head 31 of the jack 30 until the recess 36 is opposed to the pin 14;
- d) completing the introduction of the pin 14 into the hole 21 of the nut block 9;
- e) rotating the head 31 of the jack through 180°;
- f) introducing the guide pin 15 into the holes 22 of the nut blocks 8 and 9;
- g) rotating the head 31 of the jack using the activation key of the expander in a direction opposite to that indicated by the arrows on the blocks, for moving the latter away from each other until the molar bands can be fitted again on the patient's teeth.

Unlike the prior art palatal expander 1, due to the provision of the recess in the head 11 of the jack 30, the palatal expander of the invention can be assembled by

dentists, without using any special equipment.

The lack of contact between the head 31 and the pins 14 and 15 can be also obtained by reducing the curvature of the head 31 at a longitudinal band of the lateral surface extending all along the head, as shown in Figures 7 and 8. The curvature of a
5 curve at one point is intended as the reciprocal inverse of the radius of the circumference tangent to the curve at that point, which approximates the curve to the second order.

Figure 7 shows the cross section of a head 40 of a jack similar to that of Figure 2. The head 40 differs from the cylindrical head in that its cross section, and hence its side
10 wall, has a smaller curvature at a longitudinal band 41 than along the rest of the circumference.

Figure 8 shows the cross section of a head 42 of a jack similar to that of Figure 2. The head 40 differs from the cylindrical shape in that in correspondence of a longitudinal band 43 its cross section, and hence its side wall, is rectilinear.

15 While the above disclosure is given with reference to a preferred embodiment, changes may be made thereto by the skilled person without departure from the scope of the invention, as defined in the following claims.

CLAIMS

1. A rapid palatal expander comprising:

- a jack (30) having a cylindrical head (31) having two bars (32, 33) integral with the head (31) and with oppositely directed threads, the two bars extending from its bases
5 (31a, 31b);

- two nut blocks (8, 9) engaged by respective threaded bars (32, 33) and driven in opposite directions during rotation of the head (31);

- two pins (14, 15) engaged in respective holes (21, 22) of the nut blocks (8, 9), said pins (14, 15) extending on each side of holes (20) that engage said threaded bars
10 (32, 33) to guide the nut blocks (8, 9) in said opposite directions, the head (31) of the jack (30) exerting a pressure against at least one of said pins (14, 15), to oppose inadvertent rotation of the jack (30);

- palatal arms (4, 5, 6, 7) integral with said nut blocks (8, 9), connecting them to anchor rings for fixation to respective upper hemi-arches; said arms (4, 5, 6, 7) being
15 designed to allow the jack (30) to be placed in the proximity of the palatal mucosa, substantially at the center of the palate, for the rotation of the head (31) of the jack (30) in a predetermined direction to cause the two nut blocks (8, 9) to move away from each other and hence the palate to expand;

characterized in that the head (31) of the jack (30) is lacking of lateral portion
20 longitudinally extending from one base (31a) to the other (31b), the head has a deep enough to release the pressure exerted against said at least one pin (14, 15).

2. The rapid palatal expander of claim 1, characterized in that the head (31) of the jack (30) exerts said pressure against both pins (14, 15).

3. The rapid palatal expander of claim 1, characterized in that said omitted portion
25 leaves a recess (36) along the head (31) of the jack (30).

4. The rapid palatal expander of claim 1, characterized in that the head (31) of the jack (30) has two diametrical holes (34, 35) that intersect at 90°, to receive a key for rotating the head (31) by a quarter turn each time, and the wall of the head left by the omitted portion includes the entry section of one (34) of said diametrical holes.

5 5. The rapid palatal expander of claim 1, characterized in that an end section (32a, 33a) of each threaded bar (32, 33) is lacking of thread, to prevent the nut blocks (8, 9) from further moving away from each other, when the expander has reached its maximum opening state.

10 6. The rapid palatal expander of claim 1, characterized in that said omitted portion leaves a longitudinal band (41) along the head (40) of the jack, whose cross section has a smaller curvature than the rest of the circumference of the section of the head (40).

7. The rapid palatal expander of claim 1, characterized in that said omitted portion leaves a longitudinal band (43) along the head (42) of the jack, whose cross section is rectilinear.

15 8. A jack (30) for use in a rapid palatal expander, said jack having a cylindrical head (31) with two respective bars (32, 33), integral with the head (31) and with oppositely directed threads, extending from its bases (31a, 31b), to engage two respective nut blocks (8, 9) guided in opposite directions by a pair of pins (14, 15) during rotation of said head (31), the head (31) of the jack (30) exerting a pressure
20 against at least one of said pins (14, 15), to oppose inadvertent rotation of the jack (30), **characterized in that** the head (31) of the jack (30) is lacking of lateral portion longitudinally extending from one base (31a) to the other (31b), the head has a deep enough to release the pressure exerted against said at least one pin (14, 15).

25 9. A method of assembling the rapid palatal expander of claim 1, including the steps of:

a) screwing the threaded arms (32, 33) of the jack (30) into the nut blocks (8, 9) until the cylindrical head (31);

b) introducing one end of a first guide pin (14) into a first hole (21) of a nut block (8) until the head (31) of the jack (30);

5 c) rotating the head (31) of the jack (30) until the area (36) of the head (31) with the omission of said portion is opposed to the partially introduced pin (14);

d) completing the introduction of the pin (14) into a first hole (21) of the other nut block (9);

e) repeating the steps b) to d) with a second guide pin (15).

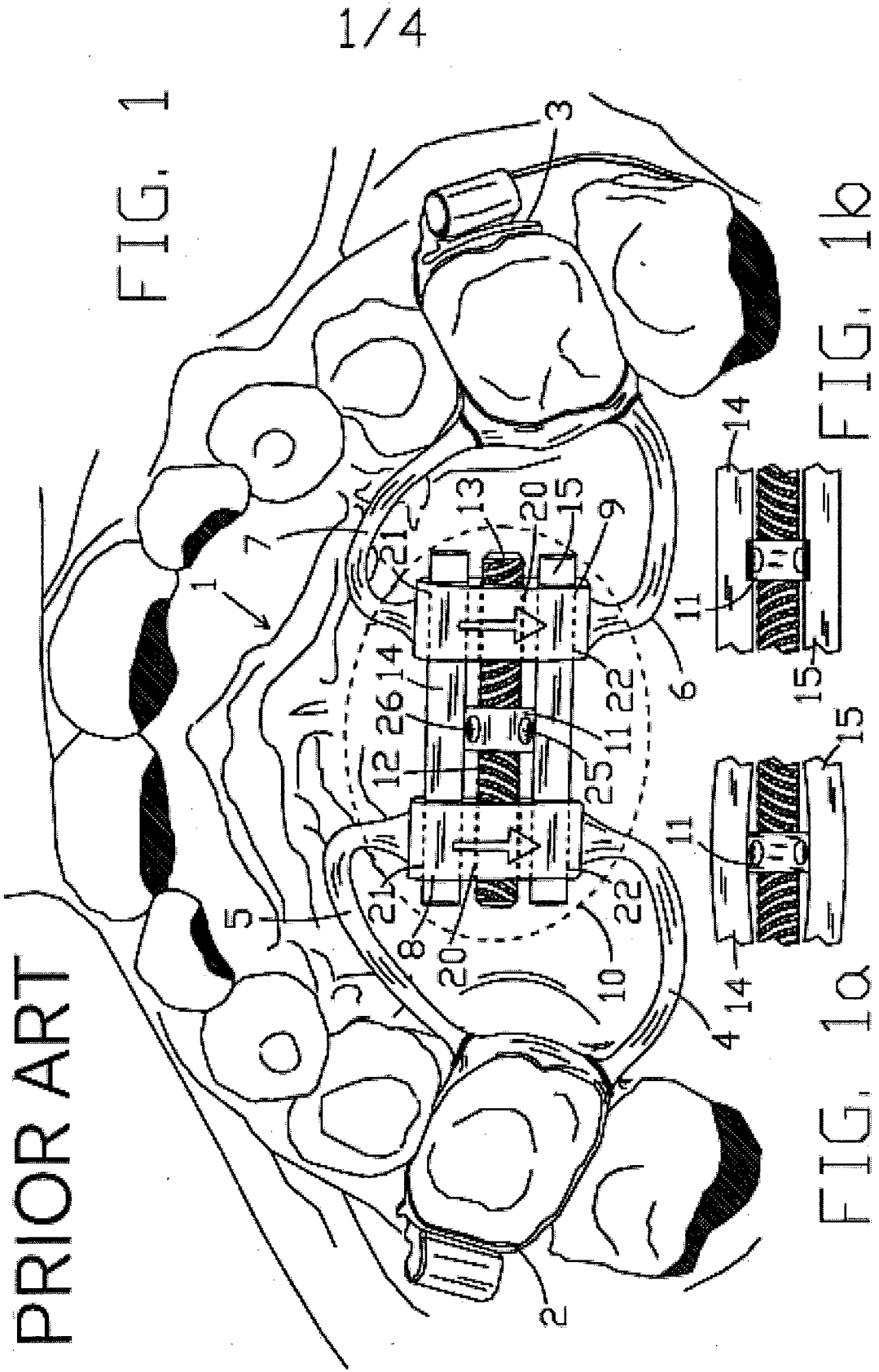
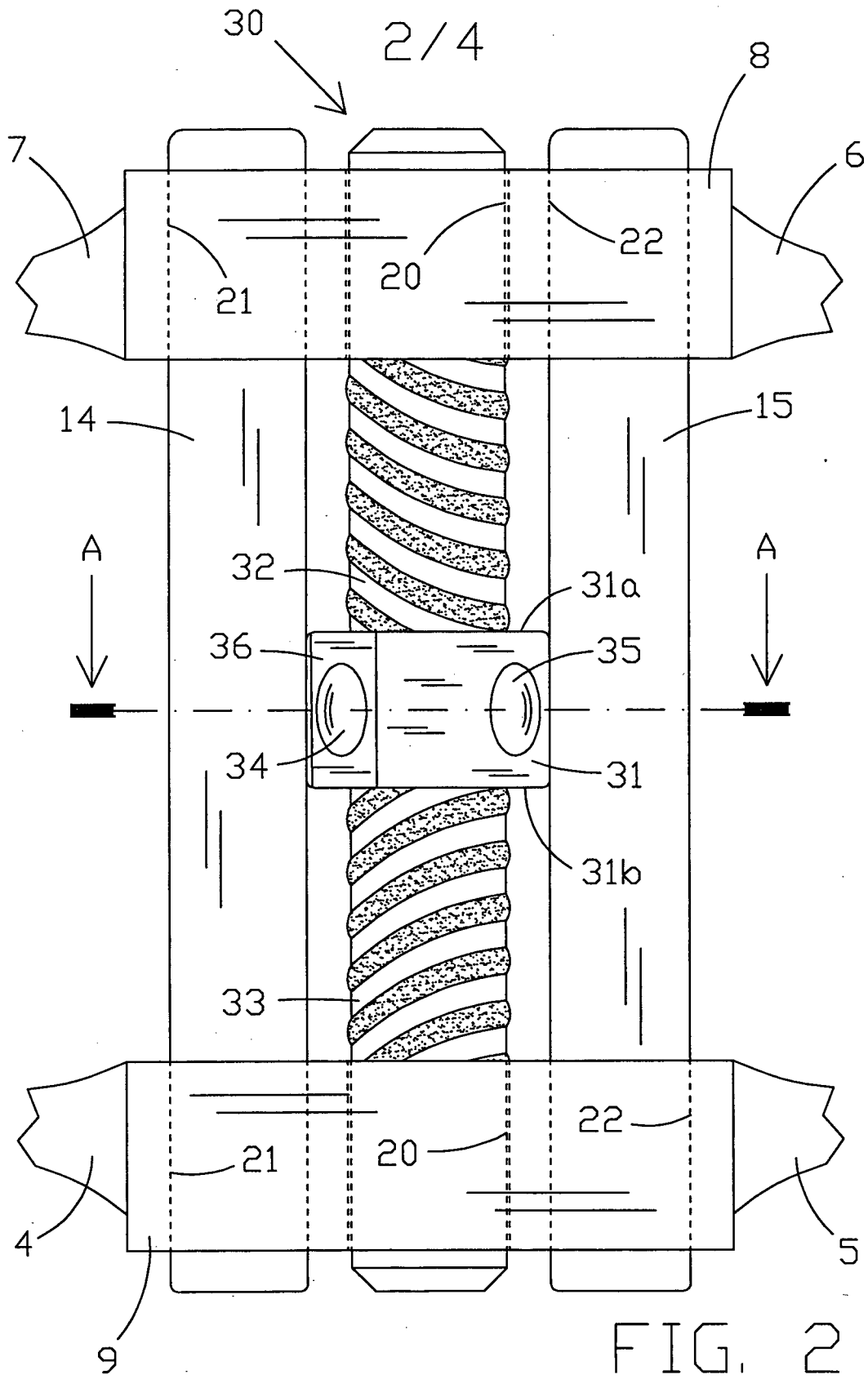


FIG. 1b

FIG. 1c



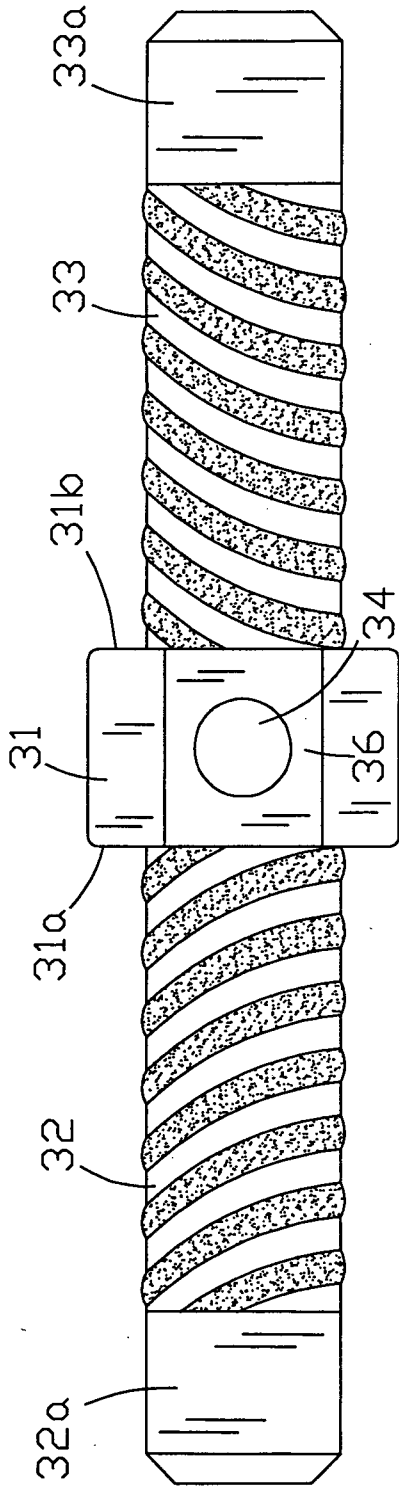


FIG. 3

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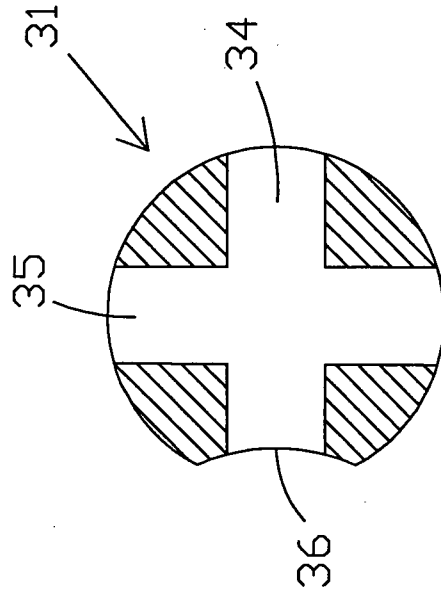
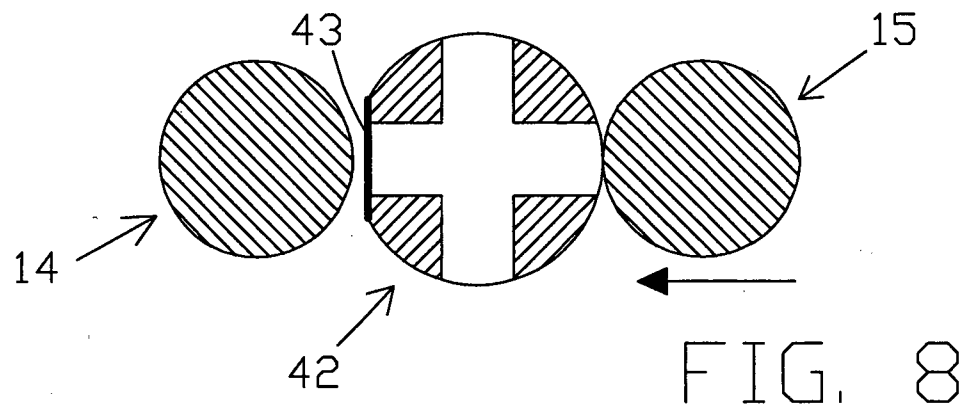
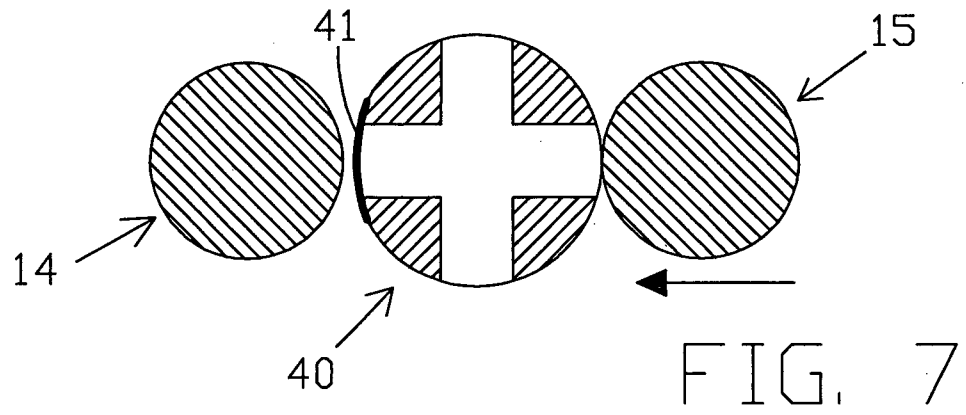
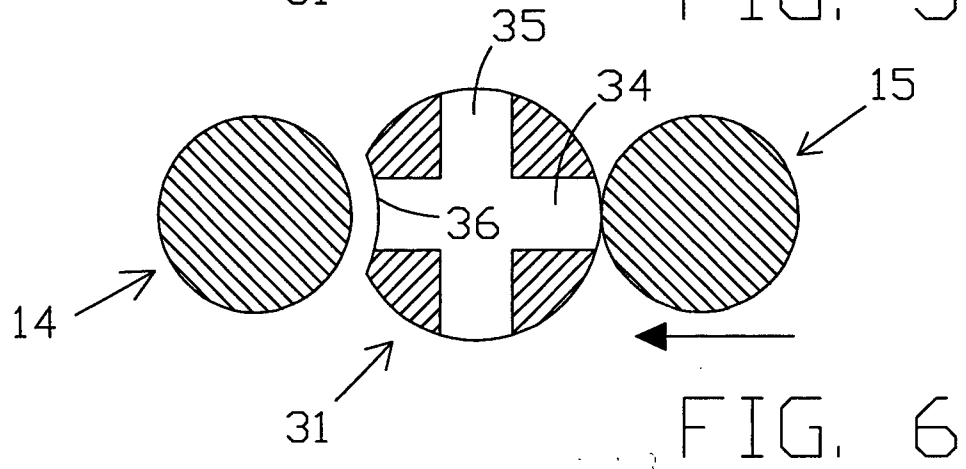
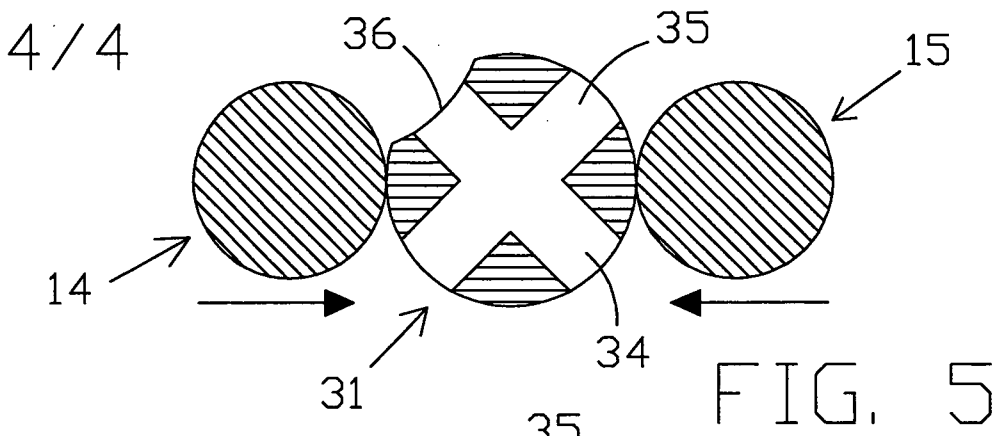


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No PCT/IB2012/051047
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A. CLASSIFICATION OF SUBJECT MATTER INV. A61C7/10 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A61C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/218416 A1 (KELES AHMET O [US] KELES AHMET OZLEM [US]) 20 September 2007 (2007-09-20) paragraphs [0024], [0057]; figures 1, 5 -----	1-9
X	WO 03/071976 A1 (SPECIALTY APPLIANCES WORKS INC [US]) 4 September 2003 (2003-09-04) page 20, lines 4-19 figure 7 -----	8
X	US 2007/275341 A1 (HANKS STEPHEN D [US]) 29 November 2007 (2007-11-29) -----	8
A	figure 3 -----	4
A	DE 296 15 820 U1 (FOERSTER BERNHARD GMBH [DE]) 31 October 1996 (1996-10-31) figures 6-10 -----	1,8,9
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International application No
PCT/IB2012/051047

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