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(58) Field of Search:
INT CL **A61C**
Other: **WPI, EPODOC, Patent Fulltext**

(54) Title of the Invention: **An archwire**
Abstract Title: **AN ARCHWIRE WITH A NON-RECTANGULAR CROSS-SECTION COMPRISING OPPOSING RIGHT-ANGLED EDGES**

(57) An archwire 10 comprises a non-rectangular cross-section 16 comprising two opposite pairs of substantially right-angled edges 18 connected by respective connecting edges 20. The non-rectangular cross-section may comprise an irregular hexagon. The respective connecting edges may be straight or curved, and may comprise a series of two or more sub-edges (Figure 15). The archwire may also be hollow, and may have a constant cross-section along its entire length.

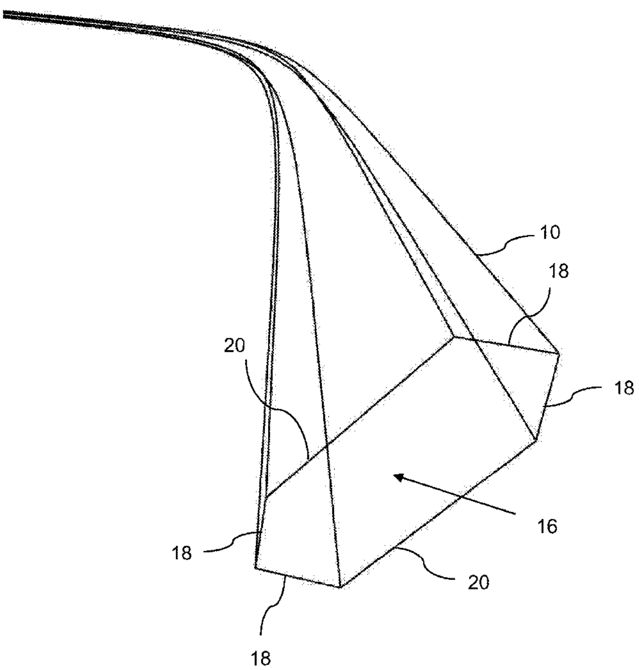

Fig. 9

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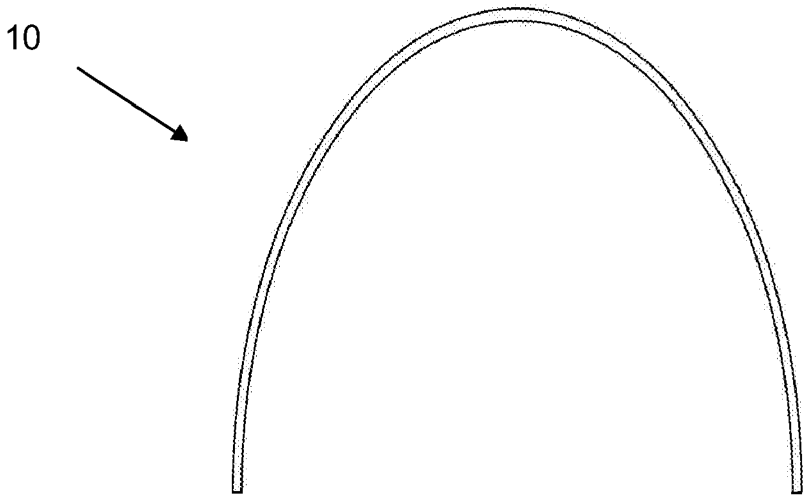

Fig. 1

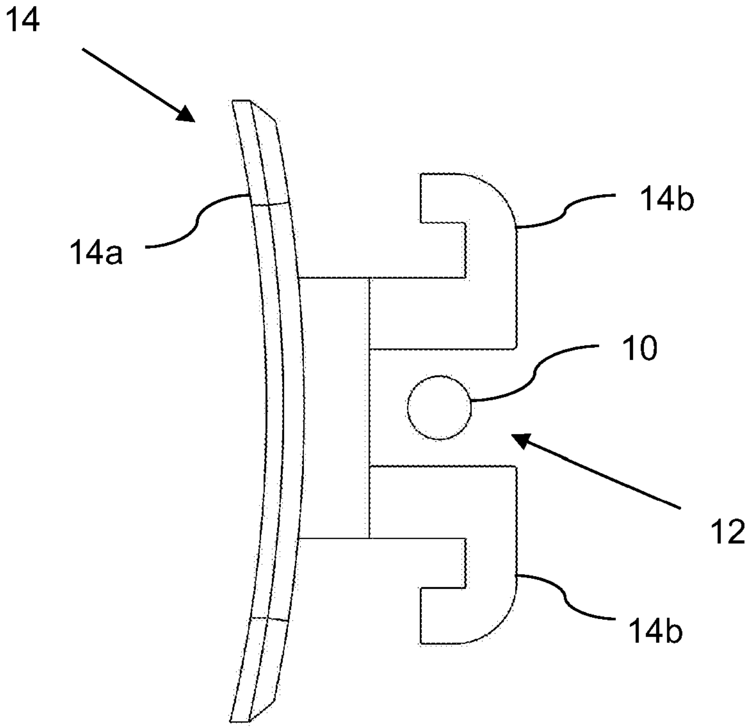

Fig. 2

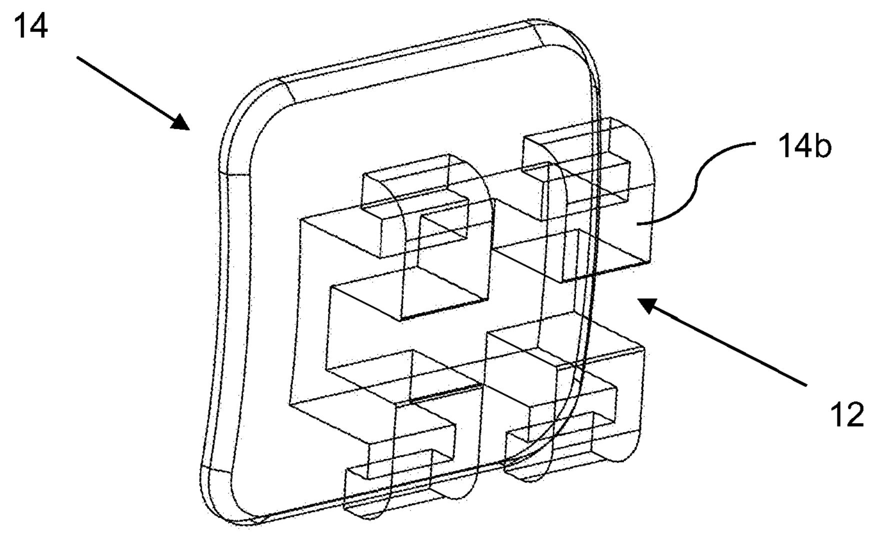

Fig. 3

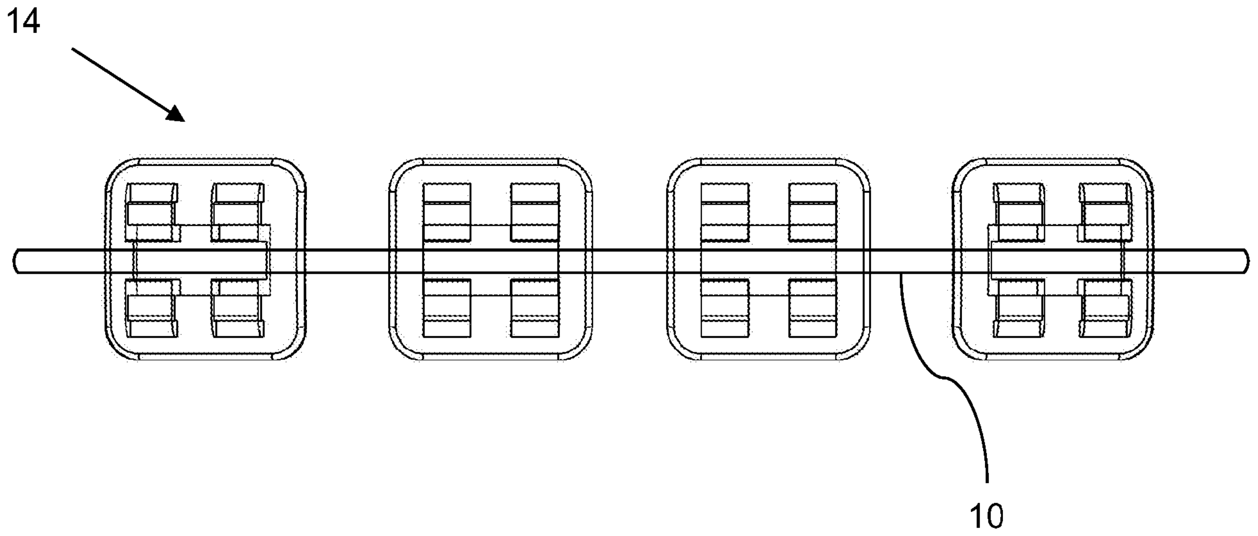

Fig. 4

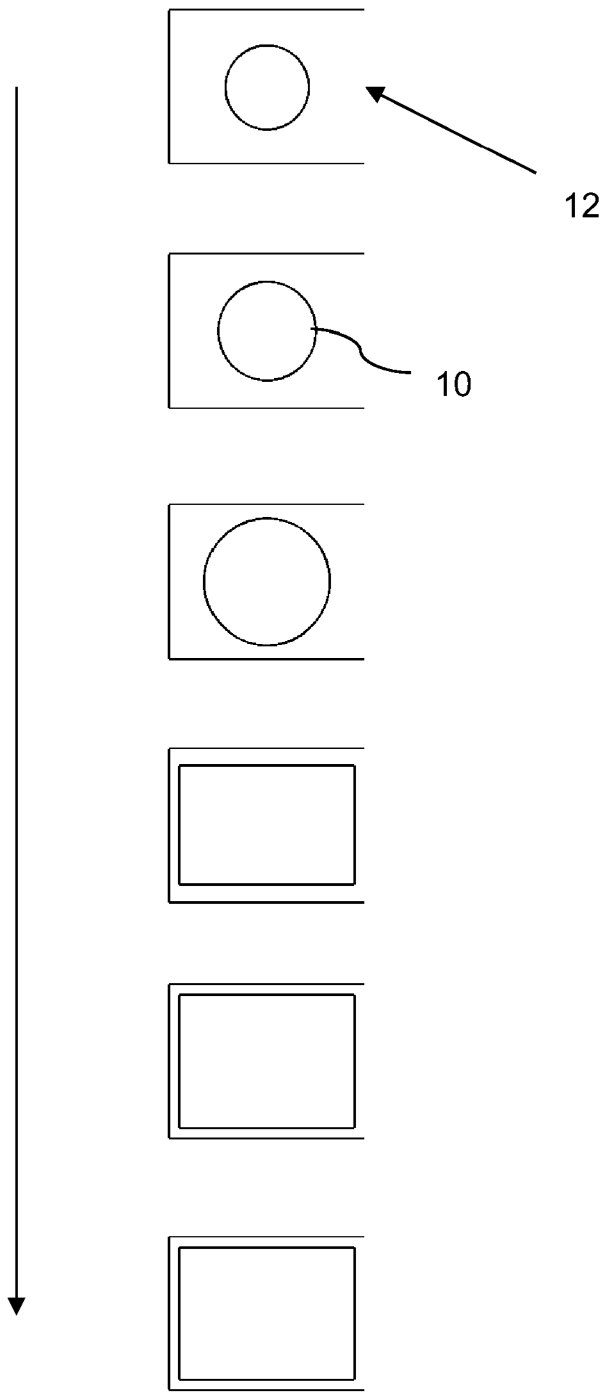

Fig. 5

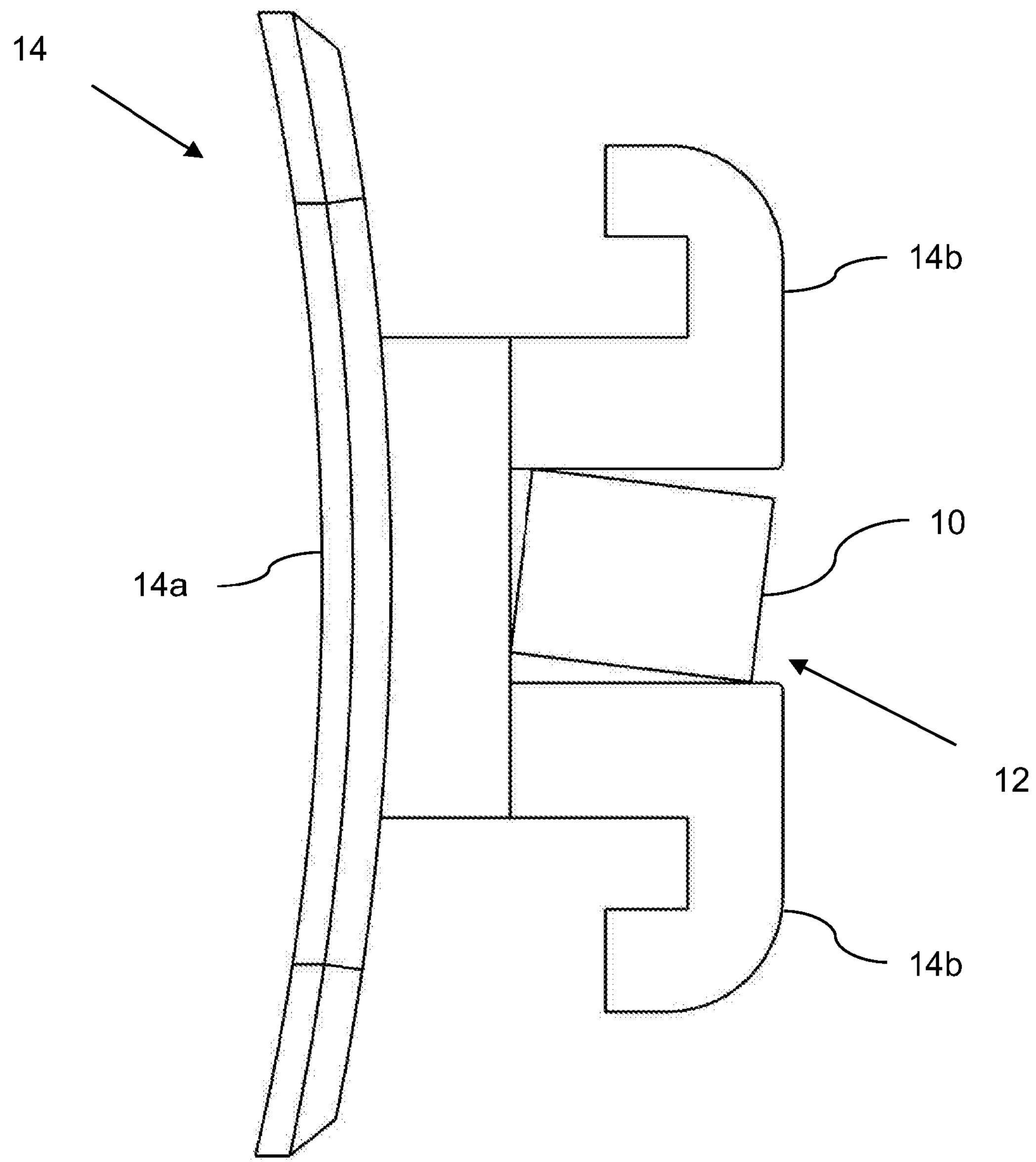

Fig. 6

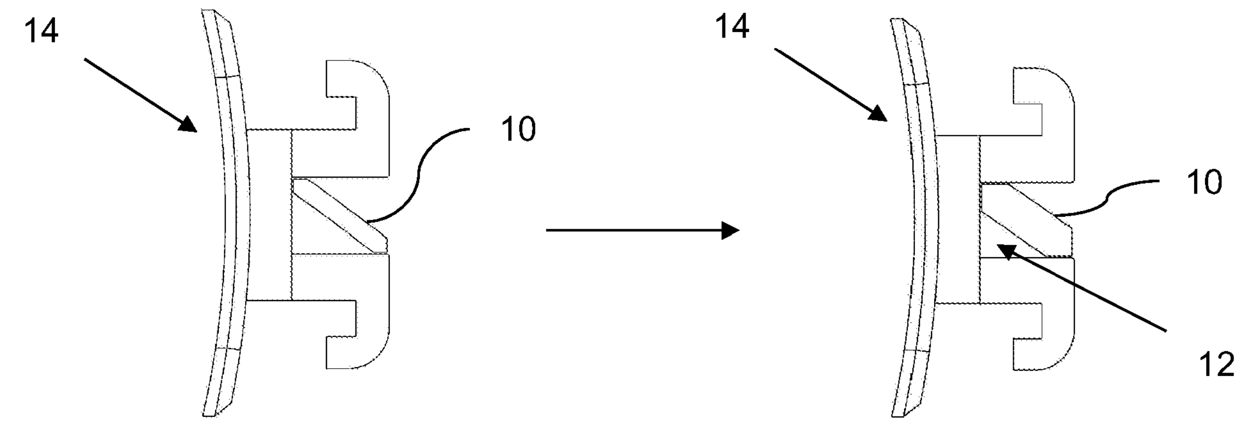

Fig. 7

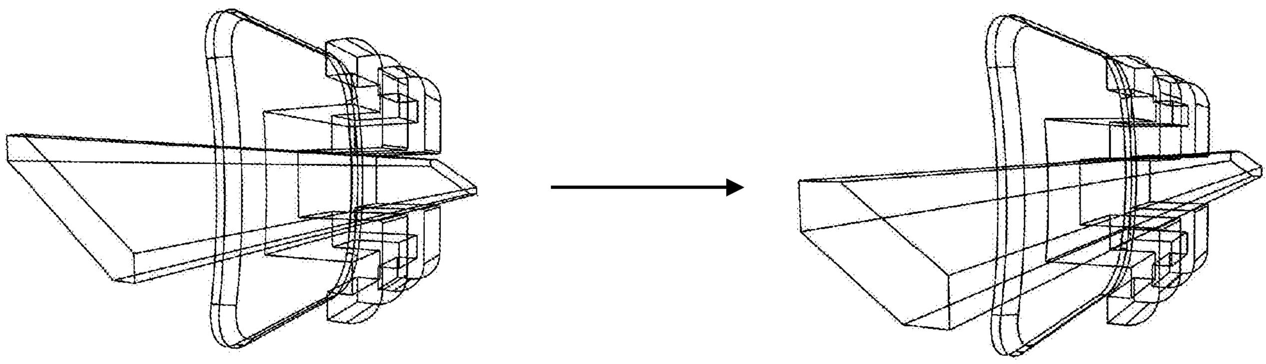

Fig. 8

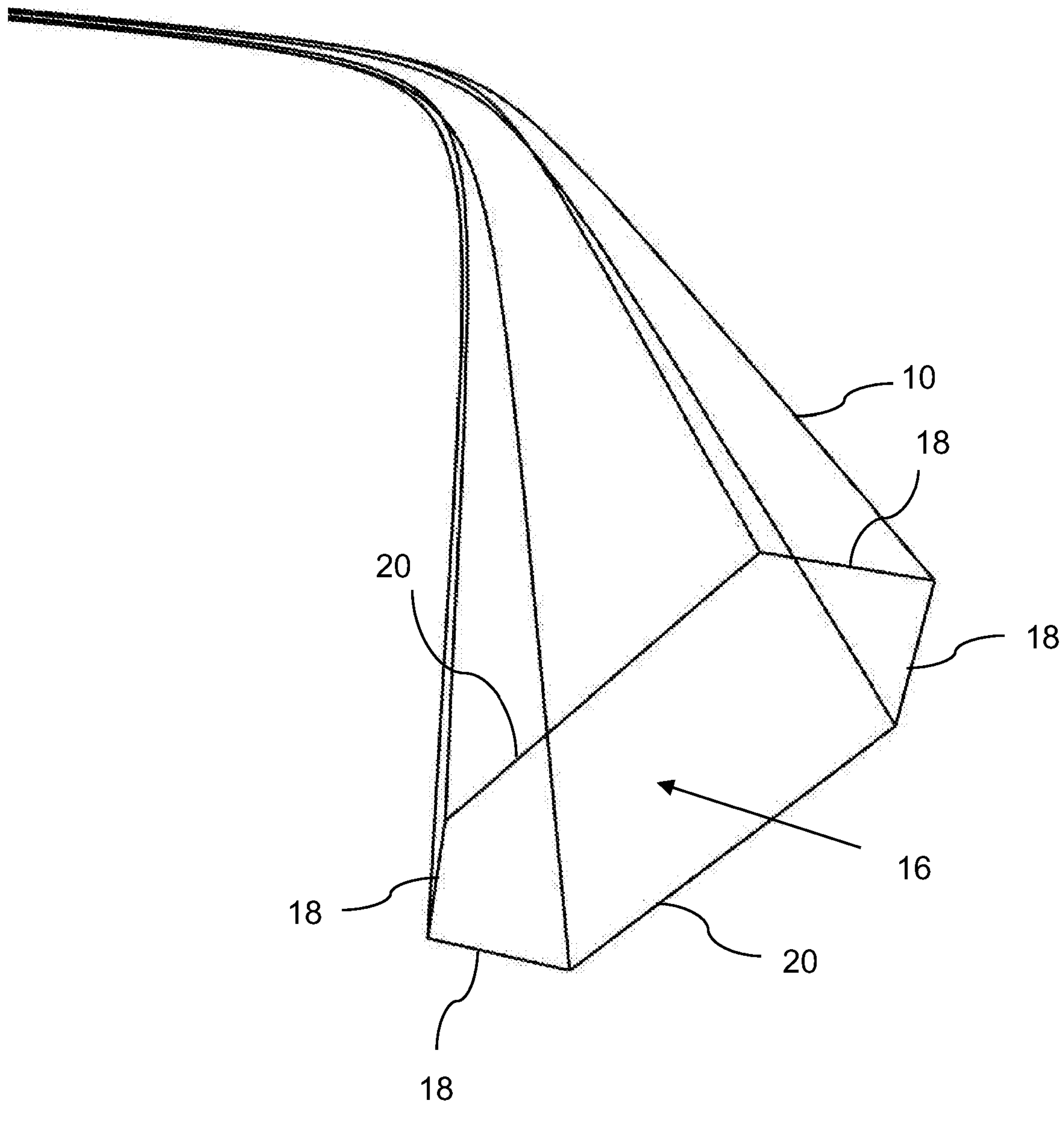

Fig. 9

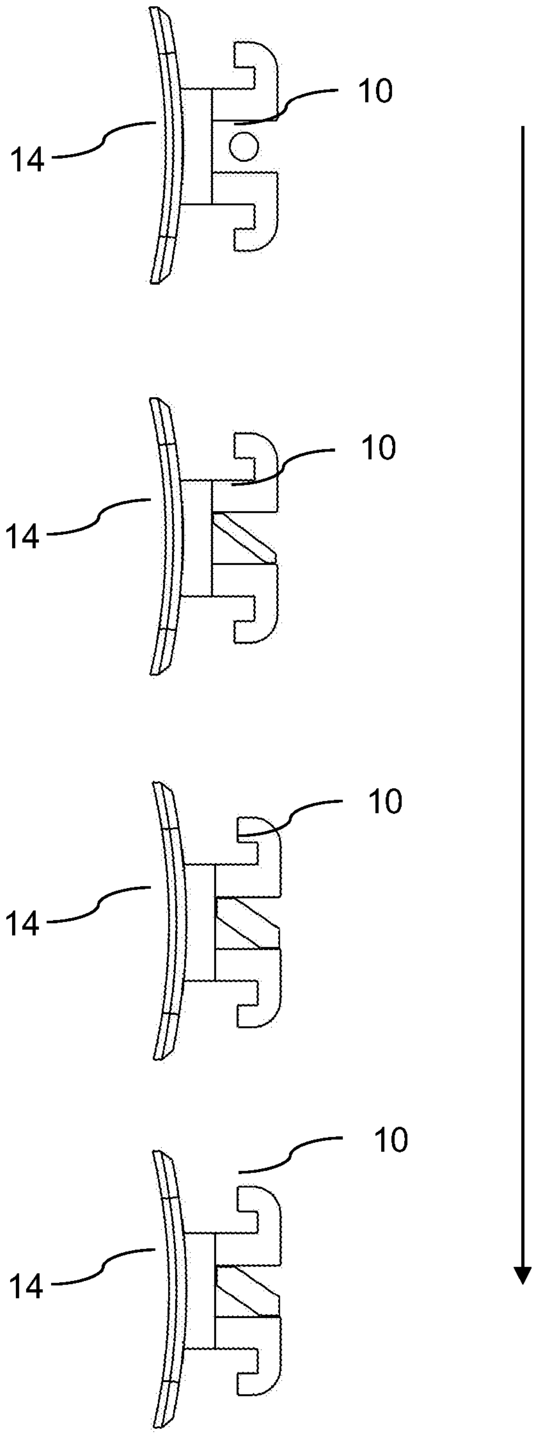

Fig. 10

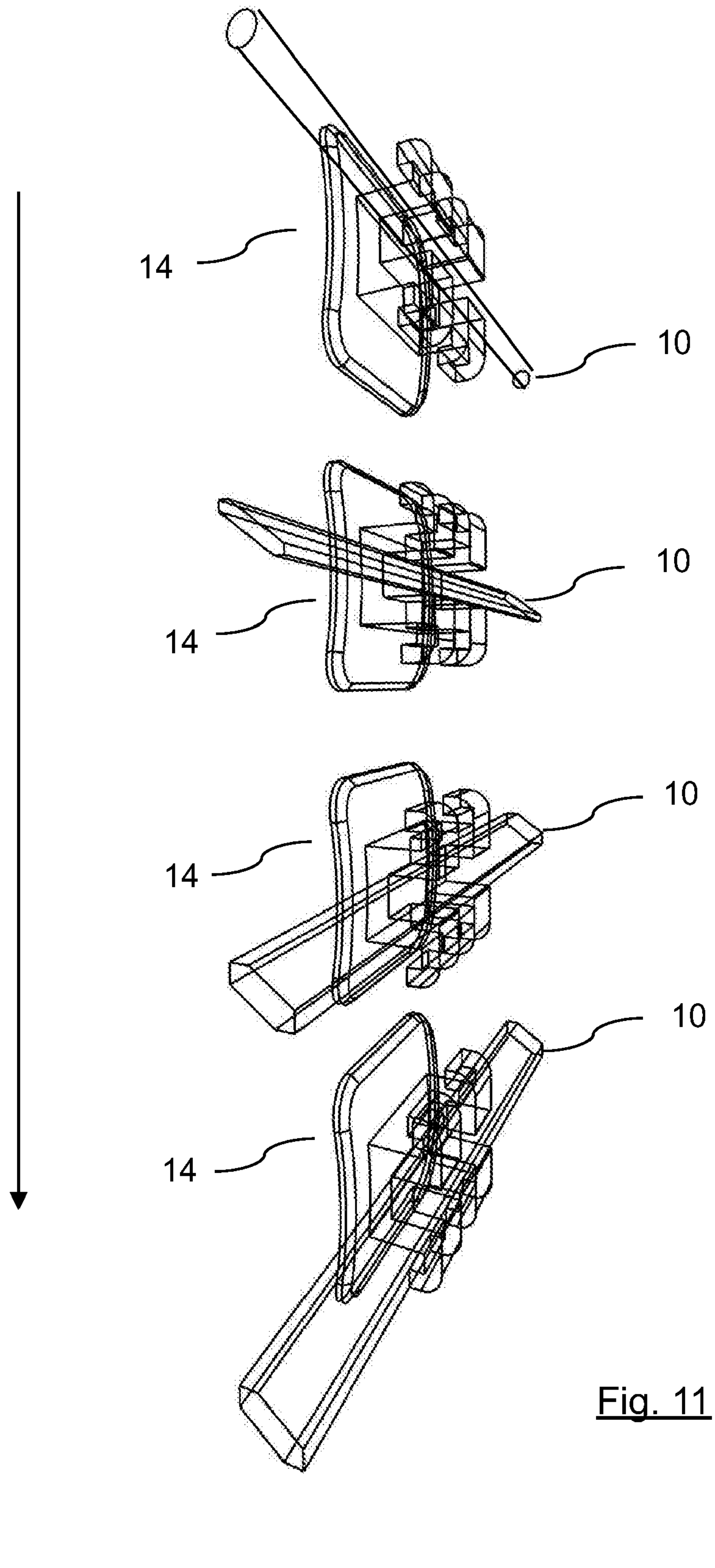

Fig. 11

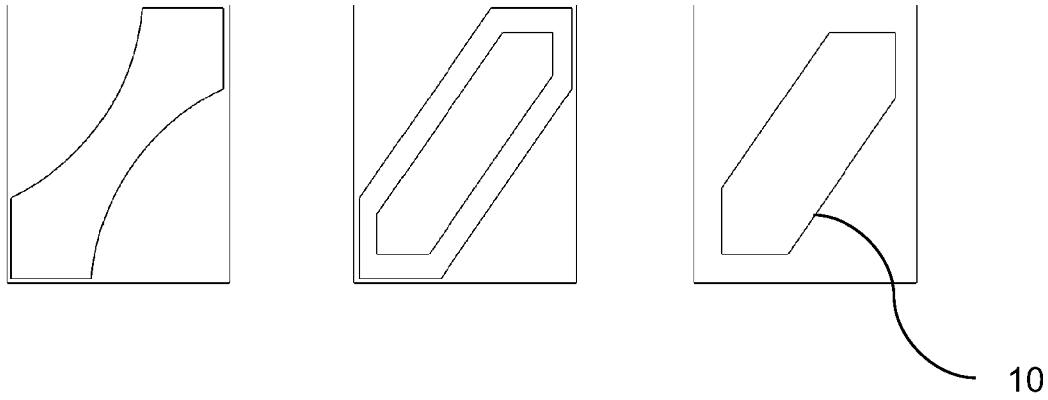

Fig. 12

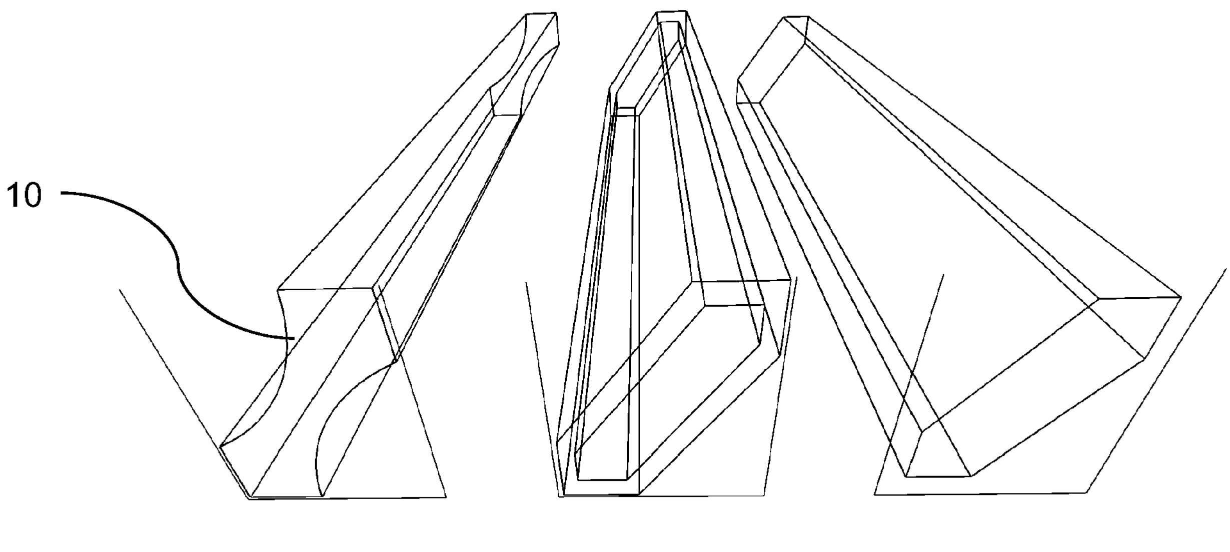

Fig. 13

Fig. 14

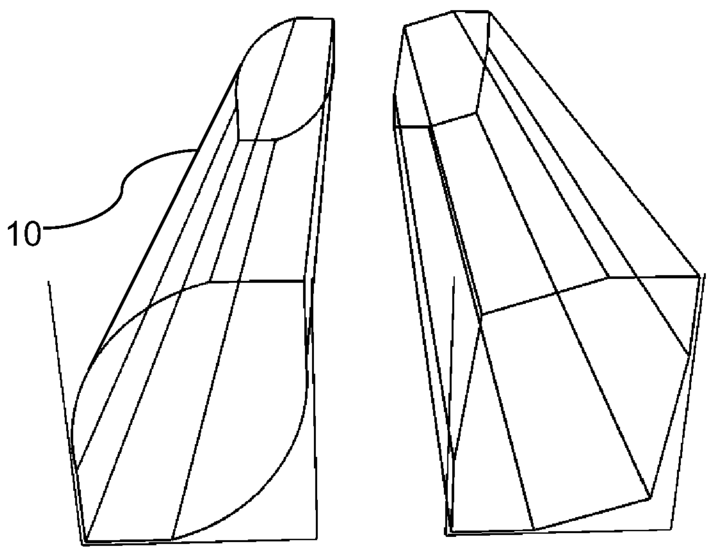

Fig. 15

DESCRIPTION

AN ARCHWIRE

This invention relates to an archwire for use in orthodontic devices.

The origins of the orthodontic archwire were in Dr P. Fauchard's Bandeau, from 1746, which used a curved ribbon arch made of gold or silver wrapped around the buccal (outside surfaces) of the maxillary (upper) or mandibular (lower) dental arches. The Bandeau was perforated with holes through which gold thread was threaded in order to apply traction to teeth when tension was applied, which tipped tooth crowns towards the metal ribbon arch. Subsequently, the metal ribbon, was developed into metal arch-shaped wires which were round and rectangular in cross section, by Dr E. Angle, which aligned the crowns of teeth and torqued the roots respectively. The orthodontist spent a great deal of time bending wires with Dr Angle's appliances.

Dr Andrews made a significant development by programming the three-dimensional control of each bracket/tube (and therefore each tooth) into the dimensions of the bracket and slot design. This obviated the need for most wire bends as each bracket/tube now had a built-in geometric prescription when the archwire was inserted bringing each tooth to its ideal position (based on an average of 120 'ideal' occlusions subjectively assessed by Dr Andrews). The most popular contemporary fixed appliances in the United Kingdom are still based on a modification of Andrews Straight-wire appliance, both bracket and wire.

Subsequent bracket designs have centred on slot prescription and bracket slot ligation. There have been a large number of bracket prescriptions and designs manufactured since Andrews' original prescription according to the innovator's philosophy of ideal tooth position (for ideal function, ideal aesthetics, long term stability and dental, periodontal & condylar health) and treatment mechanics. Arguably the most significant of which is the prescription by Dr R. McLaughlin, Dr J. Bennett & Dr H. Trevisi (MBT prescription) which sought to overcome some of the mechanical issues that orthodontists had been experiencing with the original Andrews straight-wire appliance and bracket slot prescription, including torque delivery. The two main types of bracket design are conventionally ligated (with elastomeric modules – small elastic band ties over then bracket securing the wire into the bracket slot and changed at each visit) or ‘self-ligating’ which use an integrated sliding gate mechanism to close. These can be further subdivided into active, which have gate mechanisms that push the wire into the bracket slot or passive, which do not.

The Andrews straight wire appliance originally used wires made of stainless steel throughout treatment but the introduction of nickel titanium archwires meant that contact point alignment and torque application became simpler and required fewer archwire bends due to the shape memory and superelastic properties of nickel titanium. A number of archwire forms are available, however the cross sections of wire available are limited to either round, square, rectangular or braided. In the United Kingdom, the bracket slot dimensions the wire engages into are typically 0.022 (height) x 0.028” (depth). In the United States, the wire and corresponding bracket slot sizes used are typically smaller; finishing on a 0.017 x 0.025”; the slot dimensions are 0.018” x 0.028”.

Modern treatment normally commences with the use of a light, flexible, round in cross section, nickel titanium (NiTi) archwire, which has shape memory and superelastic properties to align the dental contact points, typically starting with 0.012” or 0.014” cross sectional dimension round wires, with the dimension progressively increasing, increasing tooth control gradually. After cross sectionally round wires are used, rectangular nickel titanium arch wires are used which deliver torque. The typical final archwire is a 0.019 x 0.025” stainless steel wire on which final torque delivery, space closure, arch levelling, arch co-ordination and correction of the overjet occurs.

An example typical archwire sequence is shown in the table below. Conventional brackets are bonded to incisors, canines and premolars. Tubes are bonded or banded to molar teeth. Table 1:

WIRE DIMENSIONS	WIRE MATERIAL	MECHANICS	APPOINTMENT INTERVAL
+/- 0.012“	Nickel titanium	Initial contact point alignment for arches with very displaced teeth	6-8 weeks
0.014“	Nickel titanium	Initial contact point alignment	6-8 weeks
0.018“	Nickel titanium	Continuing contact point alignment	6-8 weeks
0.017 X 0.025”	Nickel titanium	Initial torque delivery	6-8 weeks
0.019 X 0.025“	Nickel titanium	Continuing torque delivery	6-8 weeks
0.019 X 0.025“	Stainless steel	Final torque delivery	6-8 weeks
		Space closure, arch levelling, overjet correction and arch coordination	Varies

There is a significant shortcoming in the typical design of modern orthodontic fixed appliances, which are based on Andrews Straight-wire appliance, in that there are still issues in torque delivery. This means the intended prescribed inclination of a tooth, relative to other teeth is not achieved and this has potential aesthetic, functional and stability consequences if not corrected. Typically, incorrect inclinations are corrected at the end of treatment manually by the orthodontist using torquing archwire bends, which then lengthens treatment time, needs significant operator skill to deliver the correct degree of wire bend to correct tooth inclination and is often imprecise.

The main reason for this shortcoming in torque delivery is due to a significant physical gap between the wire and bracket slot, principally due to either bracket manufacturers setting manufacturing tolerances so that on average bracket slots are oversized, so that wires are unlikely not to fit or an expected physical gap between the bracket slot and the wire caused by the difference in the dimensions of the wire and bracket slot, for example 0.019 x 0.025" for the archwire versus 0.022 x 0.028" for the slot.

This torque issue is illustrated in Figure 6, which shows a side view of a 0.019 x 0.025" archwire in a 0.022 x 0.028" slot of a bracket. This is the final archwire used at the end of orthodontic treatment (the final row of table 1 above). The slop inherent in the system, which translates to poor torque control clinically can be seen in the gaps between the bracket slot and the archwire.

A number of non-wire bending techniques have so far been derived to try to overcome torque issues to date. Firstly, there exist high or low torque brackets. The most common technique is to select a high or low torque bracket version of the normal bracket torque prescription for teeth which at the start of treatment are notably displaced from the line of the arch. A number of manufacturers now produce these high / low torque brackets. However, this increases stock inventory, needs to be remembered by the orthodontist or orthodontic therapist at bond up of the appliance or if it needs to be replaced during treatment and may still not fully correct the tooth inclination to that slot prescription's intended value.

Secondly there are active gate brackets. A bracket design with an active gate has been devised that pushes the rectangular (torque delivering) wire into the opposing corner of the bracket slot however the wire gate is more expensive to produce, may become broken during treatment and is bulky, which can lead to chipping of the opposing dentition. In addition the active gate pushes larger wires into the bracket slot which increases friction between the wire and the bracket slot.

Thirdly there are brackets with Computer Numeric Controlled (CNC) bracket slots. Traditionally brackets have been cast or injection moulded which have been shown to be oversized, however it is now possible to machine mill brackets using computer numeric controlled (CNC) milling, thus increasing precision of the bracket slot, however this process is significantly more expensive than brackets produced through injection moulding and is not commonplace.

Fourthly it is possibly to use a bracket with a rhomboid shaped slot. More recently, a bracket has been designed by Dr D. Damon in the US, that has a rhomboid slot, engaging round and then rectangular wires in order to overcome the issue, however this still means additional stock inventory is required, the operator must use the Damon appliance, slot prescription and system, the use of the rhomboid shaped slot bracket needs to be remembered by the orthodontist or orthodontic therapist at bond up of the appliance or if it needs to be replaced during treatment. The Damon brackets are also expensive relative to the cost of other brackets.

Finally there is the 0.021 x 0.025” rectangular stainless steel archwire. This archwire is not popularly used by orthodontists, and it is likely that this is because orthodontists feel the forces applied by this rigid wire are too high. The finishing archwire for the 0.022 x 0.028” bracket slot in teaching and in clinical practice is the 0.019 x 0.025” stainless steel wire. If the 0.021 x 0.025” archwire is used after the 0.019 x 0.025” archwire this increases treatment time

Despite the availability of these techniques, inadequately delivered torque is still commonplace and a simple, cost-effective solution is required.

It is therefore an object of the invention to improve upon the known art.

According to the present invention, there is provided an archwire for locating in a slot of an orthodontic bracket, wherein the archwire has a non-rectangular cross-section comprising two opposite pairs of substantially right-angled edges connected together by respective connecting edges.

Owing to the invention, it is possible to provide an archwire for use in an orthodontic device that does not have the problems of existing archwires in delivering the necessary torque forces to the bracket(s) to which the archwire is connected. The archwire can be used with existing brackets without requiring any modification of those brackets. The primary advantages of the improved archwire are to simultaneously overcome inadequately delivered torque and to reduce overall treatment time by commencing torque delivery earlier in treatment. The secondary advantages of the improved archwire are to be cost efficient, easy to use and keep stock inventory to a minimum.

Preferably, the non-rectangular cross-section comprises a non-regular hexagon. The simplest and most efficient cross-section that can be used in the improved archwire is a non-regular hexagon. This provides the necessary improved torque functionality while being straightforward to manufacture and relatively easy for the orthodontist to handle. The six sides of the hexagon are formed from the two pairs of opposite edges (which are preferably at a right-angle to each other) and the two connecting edges (which are preferably straight but could be curved).

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a top plan view of an archwire,

Figure 2 is a cross-section of a bracket with an archwire,

Figure 3 is a perspective view of the bracket,

Figure 4 is a perspective view of three brackets with an archwire,

Figure 5 is a set of cross-sections through a bracket slot and archwires,

Figure 6 is a further cross-section of the bracket and an archwire,

Figure 7 is a pair of cross-sections of a bracket and an improved archwires,

Figure 8 is a perspective view of the brackets and archwires of Figure 7,

Figure 9 is a further perspective view of the improved archwire,

Figure 10 is a set of cross-sections through a bracket and improved archwires,

Figure 11 is a set of perspective views of the brackets and archwires of Figure 10,

Figure 12 is a set of cross-sections of further embodiments of the improved archwire,

Figure 13 is a set of perspective views of the further embodiments of the improved archwire of Figure 12,

Figure 14 is a set of cross-sections of further embodiments of the improved archwire, and

Figure 15 is a set of perspective views of the further embodiments of the improved archwire of Figure 14.

Figures 1 to 6 show the prior art arrangement of an archwire 10 that is located in a slot 12 of an orthodontic bracket 14. Figure 1 shows the archwire 10 from above and Figure 2 shows a cross sectional view of conventionally ligated bracket 14 with 0.012" round wire 10 inserted into the bracket slot 12. The bracket 14 has a bracket base 14a, which is adhered to a tooth surface (when in use) and is provided with bracket wings 14b that extend from the base 14a and form sides of the slot 12. The archwires 10 come in a number of different forms (selected largely depending on orthodontist philosophy) but on average have approximately the shape shown in Figure 1.

Figure 3 shows perspective view of the bracket 14 with no archwire inserted into the slot 12. There are normally four tie wings 14b on a bracket 14 which can be seen in the Figure and around which a circular elastomeric tie is placed to secure the archwire 10 into the bracket slot 12. Alternatively, a narrow-gauge wire can be tied to secure the archwire 10 in place. Figure 4 shows a perspective view of a series of three conventionally ligated brackets in series after they have been aligned with 0.012" round archwire 10 inserted into the bracket slot 12. The archwire 10 would be tied into each bracket 14 around the tie-wings 14b using elastomeric or wire ligatures.

Figure 5 shows a conventional progression through the archwires 10 in cross section, (similar to that described above in table 1), which would normally be used over the course of a defined orthodontic treatment program. Nickel titanium (NiTi) wires are flexible, which helps engage the archwire 10 in the slot 12 and exhibit shape memory (they return to their original shape after deformation, within limits). NiTi wires also have superelastic properties (within a certain range) which means a range of wire deflections (when ligated into the brackets 14) will all lead to the same consistent force being delivered between appointments.

There are a number of ways that an orthodontist can secure a bracket or tube indirectly to a tooth. Stainless steel wires are relatively rigid and in stainless steel brackets 14 allow sliding of the brackets 14 along the archwire 10 with low friction. In conventional brackets 14 the (cheek facing) wall is open and the archwire 10 is inserted into the slot 12 in this direction. The archwire 10 is secured into place using a circular elastic tie around each bracket 14, which are changed at each wire change visit. In tubes (on molar teeth) this wall is closed and the archwire 10 has to be inserted into one end of the tube. In self-ligating brackets 14, this wall is initially open and after the archwire 10 is inserted (as for conventional brackets 14) the gate is slid shut.

Figure 6 shows a cross-section through the bracket 14, with a rectangular cross-section archwire 10 located in the slot 12. The “slop” torque issue is illustrated which shows a side view of a 0.019 x 0.025” archwire in a 0.022 x 0.028” slot of a bracket (representing the dimensional differences between the bracket and the wire). This is the final archwire 10 used at the end of orthodontic treatment as shown in the program of Figure 5. The slop inherent in the system, which translates to poor torque control clinically, can be seen in the gaps between the bracket slot 12 and the archwire 10. The rectangular cross-section archwire 10 does not sit cleanly in the slot 12 of the bracket 14 and this causes an incomplete application of the forces required from the archwire 10 on the tooth to which the bracket 14 is connected.

Figures 7 and 8 shows two embodiments of the present invention in use. The improved archwire 10 is for locating in a slot 12 of an orthodontic bracket 14 and the archwire 10 has a non-rectangular cross-section 16. The cross-section comprises two opposite pairs of substantially right-angled edges connected together by respective connecting edges. Figure 7 shows two different sizes of the archwire 10 that can be used in conventional brackets 14. Figure 8 shows the same two archwires 10 in perspective form in the brackets

14. Figure 9 shows the archwire 10 on its own in perspective. This Figure shows the cross-section 16 of the archwire 10. the cross-section 16 of the archwire 10 is constant along the whole length of the archwire 10. The cross-section 16 comprises two opposite pairs of substantially right-angled edges 18 that are connected together by respective connecting edges 20. The archwire 10 can be designed so that the cross-section 16 of the archwire 10 varies along its length, with thicker parts being used on teeth that require more force to move them.

The archwire 10 allows the use of a sequence of orthodontic archwires for use with fixed orthodontic appliances (braces) that uses preferably hexagonally shaped archwires (in cross-section) of any clinically appropriate material and archform and which progressively engage the opposing bracket slot corners from the start or early on in treatment. Examples of this archwire design are shown in Figures 7 to 9.

The primary aims of the improved archwire 10 are to simultaneously overcome inadequately delivered torque and to reduce overall treatment time, by commencing torque delivery earlier in treatment. The secondary aims of the improved archwire 10 are to be cost efficient, easy to use and keep stock inventory to a minimum. Since Angle’s Edgewise appliance, orthodontic archwire cross-sectional design has consisted of round or rectangular archwires (and more recently square, braided or multi-stranded).

The improved archwire 10 uses flexible shape memory or stainless steel wire (or any other clinically appropriate material and archform shape) that is preferably hexagonal in cross-section, and which when used as a sequence of wires, progressively aims to contact opposing corners of the bracket slot 12; which can be used in conventional brackets 14, self-ligating brackets 14 or tubes. There are a number of significant benefits of this approach which are described below, apart from obviating the need for any alternative approach previously discussed with their incumbent disadvantages.

Using the non-rectangular (preferably hexagonal) cross sectional shaped archwire 10 from the start or near the start of treatment allows the archwire 10 to be flexible enough to be inserted into brackets 14 and tubes at or near the start of treatment and simultaneously begin to apply torque early in treatment and potentially leading to treatment finishing earlier. By deploying torque earlier and over the duration of treatment, torque forces to move the roots can potentially be kept lighter and this may result in less root resorption (on average roots shorten (predominantly at the apex of the tooth after fixed appliance treatment) by approximately 1-1.5mm) and this may not be the case or may be reduced using this system.

Predictable torque control will be achieved within clinically acceptable limits without fully filling the bracket slot 12 in all dimensions (the final cross-sectional hexagonal archwire 10 will have a similar degree of torque control to a theoretical 0.021 x 0.027" archwire), retaining some wire flexibility throughout treatment and therefore not rigidly splinting teeth together which is felt not to be physiological and avoids the concern of excessive force being placed on teeth with an equivalent rectangular archwire of for example 0.021 x 0.025" stainless steel.

Reducing the final wires' overall surface area that contacts the walls of the bracket slot 12 is beneficial in the sliding mechanics phase of treatment as it reduces friction between the archwire 10 and the bracket slot 12, whilst still maintaining good three-dimensional control of the tooth positions, despite less space between the archwire 10 and the slot walls in the opposing contacting corners. The archwire can be inverted without any expected significant difference in clinical effects which makes things simple for the operator and/or it may be mechanically beneficial to invert the orientation of the wire at alternate wire changes. Using these wires in sequence reduces inventory and keeps expensive bracket and wire bending inventory to a minimum.

An example wire sequence for fixed appliance treatment using the new archwires is presented in table 2 below and illustrated in Figures 10 and 11, where the new archwires 10 are referred to as Hex^{1}, Hex ^{2} and Hex ^{3}. Table 2:

WIRE DIMENSIONS	WIRE MATERIAL	MECHANICS	APPOINTMENT INTERVAL (approximate)
+/- 0.012"	Nickel titanium	Initial contact point alignment for arches with very displaced teeth	6-8 weeks
Hex[1]	Nickel titanium	Initial contact point alignment & torque delivery	6-8 weeks
Hex[2]	Nickel titanium	Progressive contact point alignment & torque delivery	6-8 weeks
Hex[3]	Stainless steel or Nickel Titanium	Space closure, arch levelling, overjet correction and arch coordination	Varies

Figure 10 shows a sequence of archwires 10 that can be used in a conventional bracket 14. It is expected, more often than not, the need for an 0.012" NiTi round cross-section archwire 10 (the top archwire 10 shown) will not be needed. Here the orthodontist is provided with three new archwires 10 (Hex[1], Hex[2] and Hex[3]) that all have the same non-rectangular cross-section, but with different sizes. Each cross-section of the new archwires 10 has two opposite substantially right-angled edges that are connected together by respective connecting edges. Here the connecting edges are straight edges and the resulting cross-section of each of the new archwires 10 is a non-regular hexagon.

In the preferred embodiment of the archwire 10, the two edges that are at the opposite corners of the cross-section are at 90 degrees angle to each other (a precise right-angle) but some flexibility in this angle is possible, for example up to 5 degrees either way to create a still functioning archwire 10. Preferably, if the angle is precisely 90 degrees, then the cross-section of the archwire 10 is sized to exactly match the size of the slot 12 into which the archwire 10 is to be located. This provides the closest and tightest fit of the archwire 10 in the slot 12 of the bracket 14 and provides the best way of providing the necessary torque effect on the bracket 14 from the archwire 10.

A number of modifications to Hex^1 may be useful to maximise the flexibility of archwire 10 and these are discussed below. Conversely it may be useful to increase the rigidity of the final hexagonal archwire and similarly a number of modifications may be useful, these are also discussed below. For patient comfort the wire edges may need to be slightly bevelled.

As can be seen in Figure 10, the improved archwires 10 are designed to be used in sequence by the orthodontist, however may be used individually. The three archwires 10 (Hex1, Hex^2 and Hex^3) are used in stages by the orthodontist to carry out the necessary tasks in moving a patient’s teeth. The cross-sections of the three archwires 10 are all of the same shape (as described above) but are of different sizes. The three archwires 10 form a set of archwires 10 that are to be used by the orthodontist. Figure 11 shows the set of archwires 10 in perspective, located in the slot 12 of respective brackets 14.

Figures 12 and 13 show different embodiments of archwire 10 modified in order to increase the flexibility of the archwire 10. They are shown in Figure 12 in cross-section and in Figure 13 in perspective. All of the different archwires 10 still have the same structure of the cross-section, with two pairs of edges 18 at right-angle that are joined together by connecting edges 20. The connecting edges 20 can be straight edges, curved edges or comprise a series of two or more sub-edges. The second archwire 10 shown in Figure 12 is hollow. The designs shown in these two Figures are all designed to provide increased flexibility while also maintaining the opposing corner control, when the archwire 10 is located in the slot 12 of a bracket 14.

Figures 14 and 15 show yet further embodiments of the archwire 10, here modified in order to increase the rigidity of the archwire 10. They are shown in Figure 14 in cross-section and in Figure 15 in perspective. As before, all of the different archwires 10 still have the same structure of the cross-section, with two pairs of edges 18 at right-angle that are joined together by connecting edges 20. The archwires 10 shown in these two Figures provide increased rigidity, while still maintaining a reduced slot wall contact. The second archwire 10 shown in Figure 14 is lemon shaped, but still has the two pairs of edges 18 at right-angles to each other. Similarly the third archwire 10 show in Figure 14 has the two pairs of edges 18 each joined by two sub-edges 20.

In the embodiments of the archwire 10 in Figures 12 and 13 the non-rectangular cross-section 16 is elongate. In the embodiments of the archwire 10 in Figures 14 and 15 the non-rectangular cross-section 16 is not elongate. Removing material from the archwire cross-section increases the flexibility of the archwire 10 and adding material to the archwire cross-section increases the rigidity of the archwire 10. All of the different embodiments of the archwire 10 have the same features of the cross-section, which is that the cross-section is non-rectangular and comprises two opposite pairs of substantially right-angled edges 18 that are connected together by respective connecting edges 20. The connecting edges 20 can be straight lines, curved lines, or made up of a number of individual sub-edges formed at an angle to each other.

In the preferred embodiment of the archwire 10, the cross-section is symmetrical and the archwire 10 can be fitted into the slot 12 of a bracket 14 either way round, as the edges 18 are the same on both sides.

CLAIMS

1. An archwire (10) for locating in a slot (12) of an orthodontic bracket (14), wherein the archwire (10) has a non-rectangular cross-section (16) comprising two opposite pairs of substantially right-angled edges (18) connected together by respective connecting edges (20).

2. An archwire according to claim 1, wherein the connecting edges (20) are straight edges (20).

3. An archwire according to claim 1 or 2, wherein the non-rectangular cross-section (16) comprises a non-regular hexagon.

4. An archwire according to claim 1, wherein the connecting edges (20) are curved edges (20).

5. An archwire according to any preceding claim, wherein the archwire (10) is hollow.

6. An archwire according to any preceding claim, wherein the non-rectangular cross-section (16) is elongate.

7. An archwire according to any one of claims 1 to 5, wherein the non-rectangular cross-section (16) is not elongate.

8. An archwire according to any preceding claim, wherein each connecting edge (20) comprises a series of two or more sub-edges (20).

9. An archwire according to any preceding claim, wherein the cross-section (16) of the archwire (10) is constant along the whole length of the archwire (10).

10. A set of archwires (10), wherein each archwire (10) is according to any preceding claim, wherein the set comprises archwires (10) with different sized cross-sections (16) from each other.

Intellectual Property Office

Application No:	GB2201780.0	**Examiner:**	Mr Henry You
Claims searched:	1-10	**Date of search:**	12 July 2022

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3, 6, 7, 9 and 10	WO 2019/210798 A1 (GUANGZHOU OO MEDICAL SCIENTIFIC LIMITED), see Figures 2c, 5, 6, 13 and 14 and paragraph 97

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A61C

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC, Patent Fulltext

International Classification:

Subclass	**Subgroup**	**Valid From**
A61C	0007/20	01/01/2006
A61C	0007/28	01/01/2006