United States Patent [19]

Schudy

[11] **3,916,526**

[45] **Nov. 4, 1975**

[54] **METHOD AND APPARATUS FOR ORTHODONTIC TREATMENT**

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[22] Filed: **May 10, 1973**

[21] Appl. No.: **358,972**

[52] **U.S. Cl.** ..... **32/14 A;** 32/14 A

[51] **Int. Cl.**[2] **A61C 7/00**

[58] **Field of Search** 32/14

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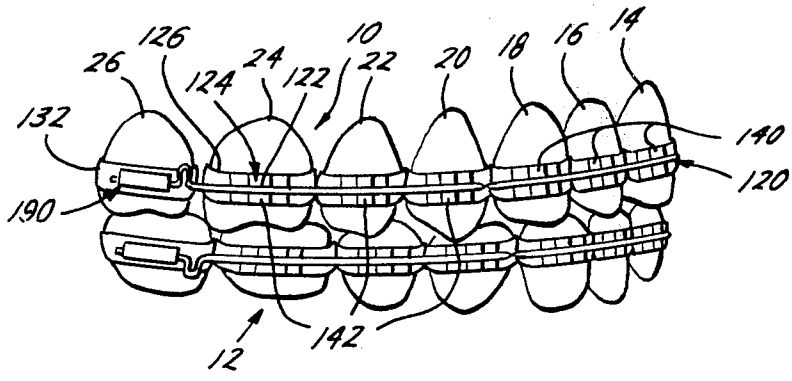
Attorney, Agent, or Firm—Murray Robinson; Ned L. Conley; David Alan Rose

[57] **ABSTRACT**

The apparatus for the orthodontic treatment of teeth which form a dental arch includes a 0.016 inch by 0.022 inch rectangular arch wire, labial brackets having a 0.016 inch slot, buccal brackets having a 0.022 inch slot, and two-way buccal tubes. The two-way buccal tubes have a two-way slot for anchoring the arch wire regardless of whether the 0.016 or the 0.022 dimension is in the vertical position. The arch wire, therefore, can initially be secured to the dental arch with its 0.016 inch dimension being vertical. Then the arch wire may be twisted 90° at the junctures of the anterior and posterior teeth and be secured to the dental arch by inserting the vertical 0.016 dimension of the arch wire into the 0.016 slot of the labial brackets and by inserting the vertical 0.022 dimension of the arch wire into the 0.022 slot of the buccal brackets. In both instances the two-way tube can anchor the arch wire.

The apparatus further includes a locking mechanism to lockingly engage the headgear hook of a headgear to the arch wire. Also an anti-friction spring is used to prevent friction between a bracket and the arch wire through the application of a counter moment to a tooth. This allows the tooth to slide along the arch wire when an elastic force is applied to the tooth.

20 Claims, 17 Drawing Figures



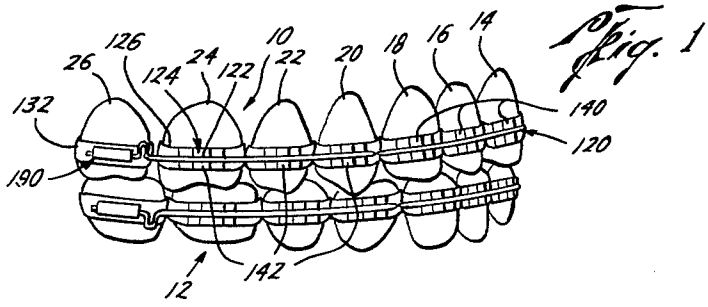


Fig. 1

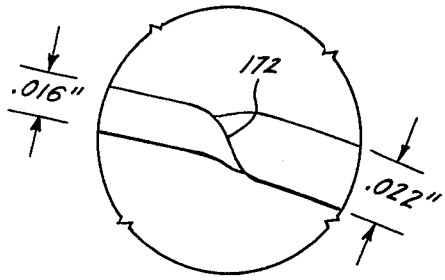


Fig. 9

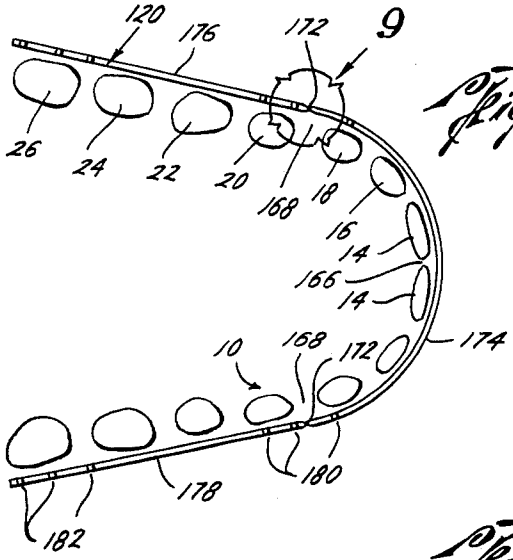


Fig. 8

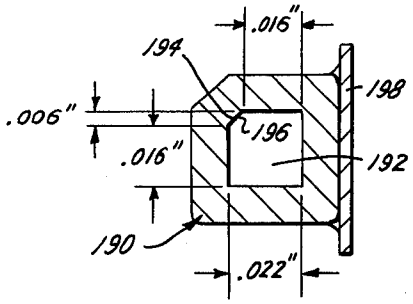
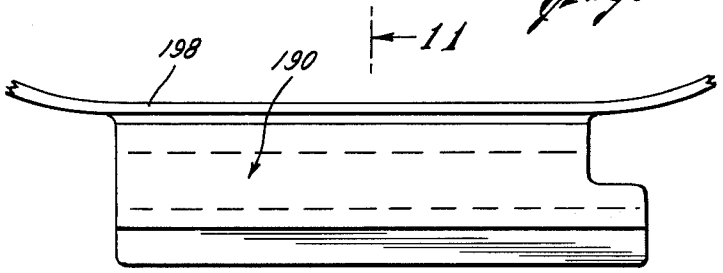


Fig. 11

Fig. 10



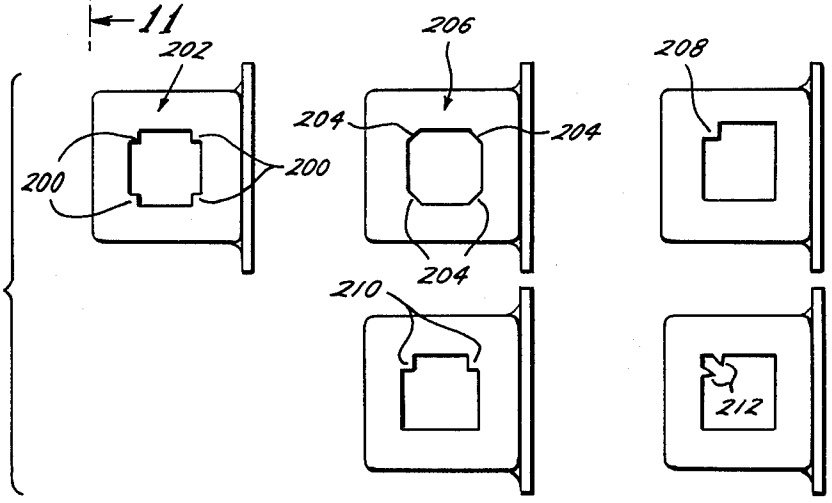


Fig. 12

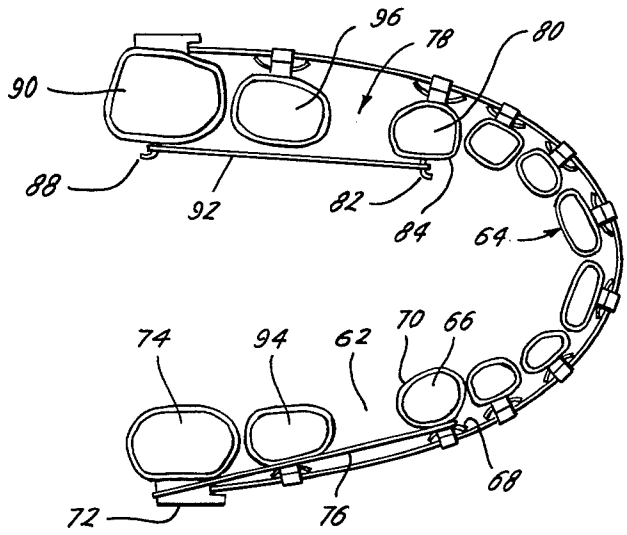


Fig. 2
PRIOR ART

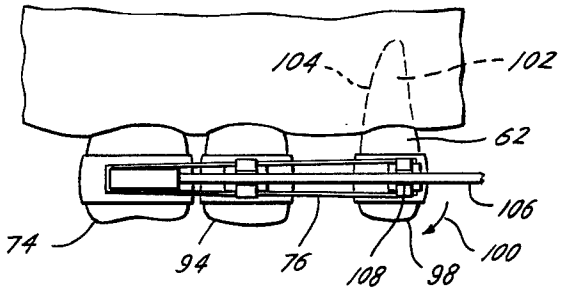


Fig. 3
PRIOR ART

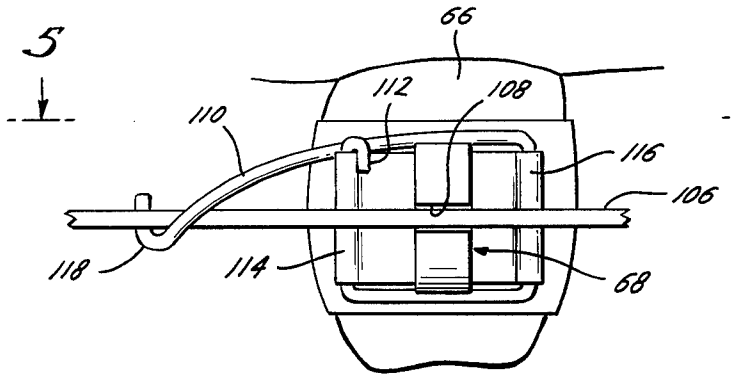


Fig. 4

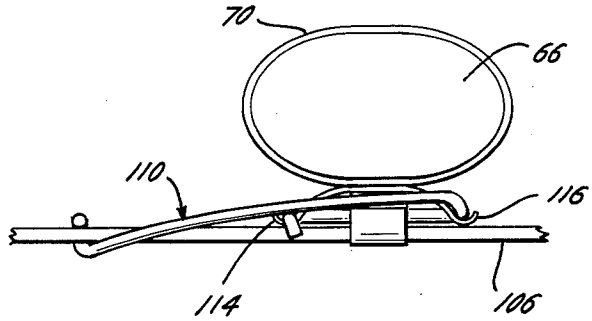


Fig. 5

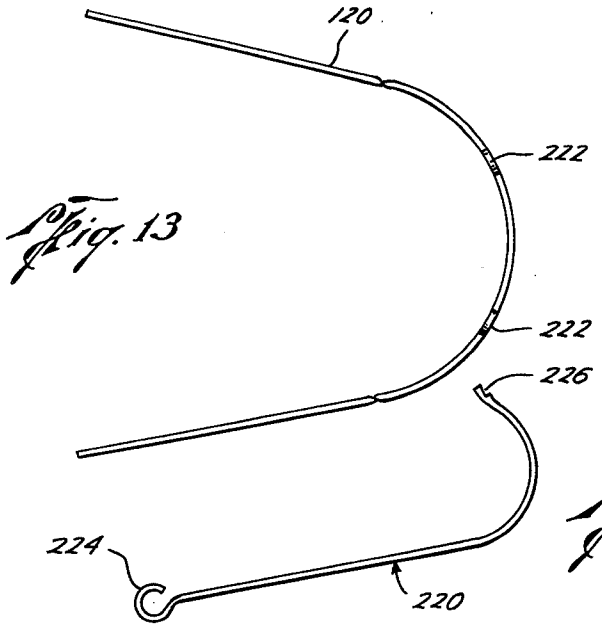


Fig. 13

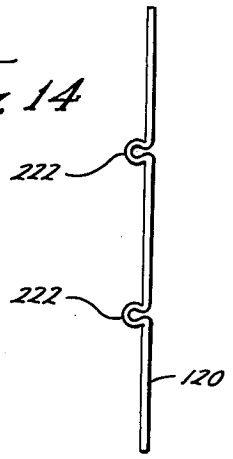


Fig. 14

Fig. 15

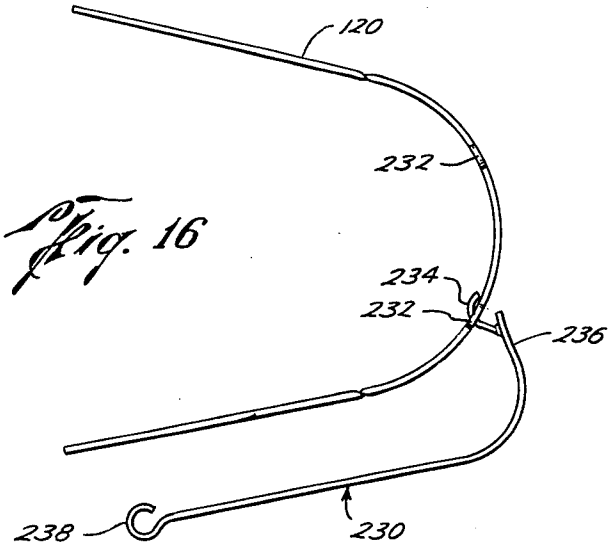


Fig. 16

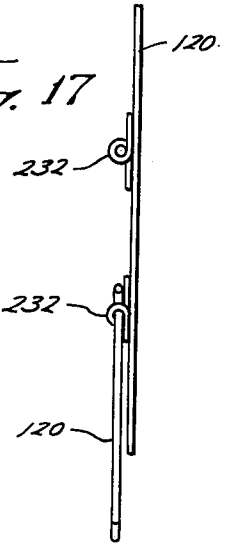


Fig. 17

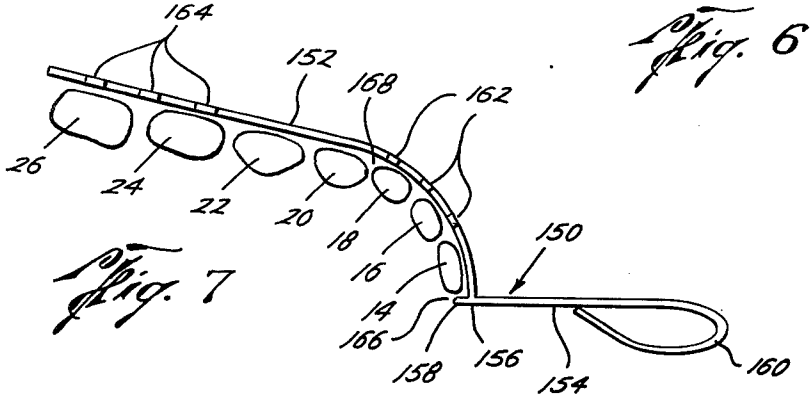


Fig. 7

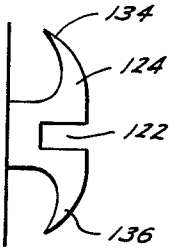


Fig. 6

METHOD AND APPARATUS FOR OTHODONTIC TREATMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to orthodontic treatment and more particularly relates to a method and apparatus for the utilization of an arch wire.

2. Description of the Prior Art

The art of orthodontics is the correction of irregularities of the teeth. Typical orthodontic mechanotherapy during orthodontic treatment are the rotating of the teeth into proper position, the shifting of a tooth to close a void caused by the extraction of a tooth, the uprighting of the teeth in the dental arch, the aligning of the teeth in a proper arch form, and the coordinating of the lower dental arch with the upper dental arch. To achieve this mechotherapy certain orthodontic apparatus and appliances have been constructed. Such appliances include arch wires, brackets, buccal tubes, various springs, elastic bands, and headgear, to name a few.

The arch wire is a wire or band which is positioned around the outer periphery of the dental arch extending from the posterior teeth on one side of the arch to the posterior teeth on the other side of the arch. Similar arrangements are employed on both the upper and lower dental arches. The arch wire is secured to the teeth by brackets attached to each tooth by a metal band. The arch wire is anchored to one of the posterior teeth, generally the second molars, by means of a buccal tube which is likewise secured to the anchor tooth by a metal band.

In certain cases the dental arch is too small to accommodate all of the teeth whereby it is desirable to extract certain teeth to allow space for the alignment of the others. Appliances are then used to shift the teeth to close the void caused by the extraction of a tooth. Generally, an elastic band or thread is attached to the tooth to be shifted and to one or more anchor teeth. The elastic band causes the tooth to move towards the anchor teeth. However, under existing methods the bracket secured to the tooth to be shifted must slide on the arch wire since the arch wire is disposed in a horizontal slot in the bracket. Problems arise because the crown of the tooth will tend to tip due to resistance of the bone and gums around the root of the tooth. As the tooth tips the arch wire engages the edges of the slot in the bracket and tends to bind so as to cause friction between the arch wire and the bracket. Such friction retards the movement of the tooth.

One solution to this problem is to lengthen or widen the longitudinal length of the slot of the brackets to resist the binding tendency of the bracket and arch wire. However, the wider bracker reduces the distance between brackets leaving no space for hooks, loops, joints, and the like. The orthodontist has no working room which tends to increase work time not to mention the tension and frustration created for the patient and orthodontist. Greater force is required to seat the arch wire and more arch wires are required since the size of the wires have to be increased slowly to permit the threading of the wires through all the slots of the brackets due to the sharp bends required. The flexibility from one bracket to another is also decreased. Needless to say all operations have to be more exact due to the reduction of space.

A variety of sizes and shapes of arch wires are used during orthodontic treatment under present methods. Generally a series of round arch wires, having much resiliency, are used initially and their size is increased from **0.014** to **0.020** inches until the dental arch is sufficiently formed to use a square or rectangular arch wire having greater strength and rigidity to close voids and to level the dental arch. Likewise several different square or rectangular wires are used to increase the strength of the arch wire to stabilize the teeth in their new positions and to coordinate the upper dental arch with the lower dental arch.

Rectangular arch wires have a range of sizes. The rectangular wire size most often used is that of **0.018** × 0.025 as described in U.S. Pat. No. **3,076,265.** Other rectangular arch wires are described generally in U.S. Pat. Nos. **2,566,414; 3,043,007; 3,052,028; 3,076,265; 3,091,857; 3,464,112;** and **3,578,744.** It should be noted that much resiliency in the arch wire is lost when the round arch wire is replaced for the **0.018** × 0.025 rectangular arch wire.

The rectangular arch wire is generally formed by hand and then installed. Methods of forming arch wires are described in U.S. Pat. Nos. **2,566,414** and **3,578,744.** Often forming the arch wire by hand is time consuming due to inadequate means of measurement. Much time would be saved by accurate measuring means and preformed arch wires.

As described previously and in U.S. Pat. No. **3,494,034,** the arch wire is anchored at each end to buccal tubes generally secured to the second molars. Such buccal tubes, previously used, limit the snug fit of the rectangular arch wire to one cross-sectional direction. To use the other cross-sectional direction or wires of another size, a loose fit could only be maintained within the tube. Heretofore all tubes and brackets only provided a precision fit where the longer cross-sectional dimension was in the horizontal position.

Various brackets, some of which are described in U.S. Pat. Nos. **1,280,628; 1,584,501; 1,890,487; 2,971,258; 3,043,007; 3,052,028; 3,076,265; 3,091,857; 3,128,553;** and **3,302,288,** are used to secure the different sized arch wires to the teeth. Generally such brackets have a slot which retains the arch wire. The arch wire is then secured to the bracket by a wire engaging device. Existing arch wire engaging devices or brackets are of three types. The first is a ligating bracket which requires the use of soft wire to tie the arch wire to the bracket. The second is a non-ligating bracket with a removable cover which may be secured to the bracket for holding the arch wire. The third type is a non-ligating bracket with an attached cover which secures the arch wire to the bracket.

In using a rectangular arch wire to level the posterior teeth, it is necessary to have a clearance between the rectangular arch wire and the inner surface of the slots in the buccal brackets to permit the teeth to slide on the arch wire as the posterior teeth shift into position. The arch wire cannot be permitted to completely fill the slots or to fit snugly therein since friction will occur between the brackets and the arch wire limiting the movement of the tooth. However, since the labial brackets on the anterior teeth have the same sized slots as the buccal brackets, there will be a gap between the wire and the labial brackets which is undesirable because the orthodontist then loses control of the anterior teeth. Therefore the anterior teeth begin to lose some

of the proper alignment previously achieved while the orthodontist is attempting to level the posterior teeth.

To exert some pressure on the appliance to either move teeth posteriorly and/or prevent their movement anteriorly, a headgear is connected to the arch wire. The headgear generally includes an orthodontic headgear hook attached to the arch wire and an elastic band attached to the ends of the headgear hook for the application of pressure to the arch wire. A face bow is shown in U.S. Pat. No. **3,492,044.** The prior art headgear have a hook attached to the arch wire and a loop on the headgear hook creating various disadvantages. Often the headgear comes disconnected from the arch wire during the night.

SUMMARY OF THE INVENTION

The apparatus for the orthodontic treatment of teeth includes an anti-friction spring which hooks to the rotating levers of the bracket secured to a tooth to be shifted into a void. The spring is affixed to the arch wire at various distances from the bracket. The spring provides a moment on the crown countering the moment on the root due to the gums and bone.

The apparatus also includes a **0.016** by **0.022** inch rectangular arch wire, labial brackets having a **0.016** vertical slot, buccal brackets having a **0.022** vertical slot, and two-way buccal tubes. This permits the orthodontist to level the posterior teeth while still maintaining control of the anterior teeth since the **0.016** vertical dimension of the arch wire fills the slots of the labial brackets but still permits a **0.006** inch gap in the slots of the buccal brackets to prevent any friction between the buccal brackets and arch wire.

The arch wire may be twisted **90°** at the junctures of the anterior and posterior teeth whereby the **0.016** arch wire dimension fills the labial brackets and the **0.022** arch wire dimension fills the buccal brackets. This permits the orthodontist to control the anterior teeth and the posterior teeth at the same time; but yet the twisted arch wire will have its **0.016** dimension vertical when adjacent to the anterior teeth for added resiliency and will have its **0.022** dimension vertical when adjacent to the posterior teeth where more strength and rigidity are required.

The **90°** twist makes maximum use of the strength of the arch wire and permits fewer removals and replacements of arch wires. Further the treatment is much easier on the patient and requires less time.

Another advantage is the use of one arch wire to take the place of two arch wires of different sizes.

Further the reduction of the size of the slots of the labial brackets from **0.018** to **0.016** increases the torquing capability and produces a lighter force.

The arch wire in the present invention is coded whereby a unique arch caliper is used to measure the length of the dental arch comprising the anterior teeth, and the length of the arch wire required. The caliper is applied to the dental arch to mark the location of the **90°** twists and to indicate the length of the arch wire required. A calibrated preformed arch wire is then selected which has the proper dimensions. Such a device eliminates haphazard measurement and permits the use of preformed arch wires.

The present invention further includes two-way buccal tubes permitting the rectangular arch wire to be secured with either dimension in the vertical position.

The present invention further describes an orthodontic headgear hook and connector which elimnates an accidental removal of the headgear from the arch wire.

The method of orthodontic treatment comprises the steps of securing the arch wire in the untwisted position with the **0.016** dimension in the vertical direction to the labial brackets, buccal brackets, and two-way tubes; removing the arch wire; locating the junctures of the anterior and posterior teeth; twisting the arch wire **90°** at these junctures; securing the twisted arch wire to the labial brackets by inserting the **0.016** dimension of the twisted arch wire being vertical into the **0.016** slot; securing the twisted arch wire to the buccal brackets by inserting the **0.022** dimension of the twisted arch wire being vertical into the **0.022** slot; and anchoring the twisted arch wire in the two-way tubes with the **0.022** arch wire dimension being vertical.

Another object of the present invention is to streamline orthodontic appliances by eliminating various removable auxillary attachments to rotate, torque, and upright teeth. The present invention permits the use of the edgewise technique in its simplest form.

Other objects and advantages of the invention will appear from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

For a detailed description of a preferred embodiment of the invention, reference will now be made to the accompanying drawings wherein:

FIG. **1** is a side view of two arch wires secured and anchored to a set of teeth;

FIG. **2** is a plan view of a dental arch having two voids;

FIG. **3** is a side view of the dental arch shown in FIG. **2**;

FIG. **4** is a front view of an anti-friction spring mounted on a tooth;

FIG. **5** is a view of the spring as indicated in plane **5—5** in FIG. **4**;

FIG. **6** is a side view of one of the brackets shown in the environmental view of FIG. **1**;

FIG. **7** is a plan view of an arch caliper;

FIG. **8** is a plan view of an arch wire having two **90°** twists;

FIG. **9** is an enlarged view of one of the **90°** twists in the arch wire shown in FIG. **8**;

FIG. **10** is a plan view of a buccal tube and a portion of a band;

FIG. **11** is an end view of the buccal tube as indicated in FIG. **10**;

FIG. **12** illustrates the end view of a variety of buccal tubes lettered A through E;

FIG. **13** is a plan view of a calibrated arch wire;

FIG. **14** is an end view of the calibrated arch wire of FIG. **13** showing the connectors for a face bow;

FIG. **15** is a plan view of a headgear hook for engagement with the connectors and arch wire of FIGS. **13** and **14**;

FIG. **16** is a plan view showing a headgear hook attached to an arch wire; and

FIG. **17** is an end view of the headgear hook and arch wire of FIG. **16.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

A variety of appliances are utilized in orthodontics. In FIG. **1** there is shown an environmental view of a set

of appliances. Those appliances include an arch wire **120**, brackets **124**, and a buccal tube **190** installed on an upper dental arch **10** and a lower dental arch **12**. Referring now to the upper dental arch **10**, arch **10** includes central incisors **14**, lateral incisors **16**, cuspids **18**, first bicuspids **20**, second bicuspids **22**, first molars **24**, and second molars **26**. Of course a corresponding set of those teeth is located on the other side of dental arch **10**. The central incisors **14**, lateral incisors **16**, and the cuspids **18** can be generally defined as the anterior teeth or front teeth, and the first bicuspids **20**, second bicuspids **22**, first molars **24**, and second molars **26** can be generally defined as the posterior teeth or back teeth. A similar arrangement is found in the lower dental arch. An exception to the above will occur if one of those teeth has been extracted.

The hereinafter described appliances are utilized for orthodontic mechanotherapy to rotate and shift the teeth to achieve proper alignment. As shown in FIG. **1** brackets **124** are secured to the teeth and buccal tubes **190** are affixed to an anchor tooth such as the second molars. Then an arch wire is attached to the brackets **124** and anchored to buccal tubes **190** to provide a source of pressure and leverage for aligning the teeth.

Referring again to FIG. **1** a variety of arch wires have been used in the past during treatment which are of all sizes and shapes. Initially a series of preliminary arch wires are used which are round and have much resiliency. The preliminary round arch wires generally range from **0.014** to **0.020** inches in diameter. Later in the treatment rectangular wires are used which have greater strength and rigidity. In the present invention only two different arch wires are required, barring exceptional circumstances, first a preliminary round arch wire and then a rectangular arch wire.

In FIG. **1** it is seen that the arch wire **120** is inserted into a rectangular slot **122** in brackets **124**, best illustrated in FIG. **6**, which are secured to the teeth by metal bands **126** or may be by adhesive. Brackets **124** could be any of three types for securing arch wire **120**. The first is a ligating bracket which requires the use of soft wire to tie the arch wire to the bracket. The second is a non-ligating bracket with a removable cover which may be secured to the bracket for holding the arch wire. The third type is a non-ligating bracket with an attached cover which secures the arch wire to the bracket **124**. Any of these types may be used. However, FIG. **6** illustrates the first type which is preferred.

Buccal tubes **190** anchor the arch wire **120** and are generally secured to the two molars **26** by means such as metal bands **132** or possibly by adhesive.

The preliminary round arch wire (not shown) is formed and then installed on dental arch **10** shown in FIG. **1**. The round arch wire is inserted into slots **122** of brackets **124** and a soft wire (not shown) is wrapped around bracket wings **134, 136** and the round arch wire to secure the round arch wire to brackets **124**. The ends of the round arch wire are anchored by insertion within buccal tubes **190**.

The preliminary round wire is used principally to rotate the irregular teeth into position and to place the teeth in general alignment for the application of the arch wire **120** shown in FIG. **1**. After the removal of the preliminary round arch wire, arch wire **120** is installed to close any voids, to level the teeth and to produce fair arch form.

Where a tooth has been extracted, as for making room for the other teeth, a non-friction spring is illustrated in FIGS. **4** and **5**. Referring now to FIGS. **2** and **3** a space **62** is shown in dental arch **64**. To shift tooth **66** into space **62** an elastic band **76** is engaged to bracket **68** secured to tooth **66** by metal band **70** and is also engaged to buccal tube **72** on molar **74**. Elastic band **76** may be an elastic thread or a rubber band. Elastic thread **76** is wrapped around bracket **68** and tube **72** and is then tied. A rubber band may merely be slipped over bracket **68** and tube **72**.

Another method of closing a space is also shown in FIG. **2**. To close space **78** by moving tooth **80**, a hook **82** has been soldered or otherwise secured to the lingual side of metal band **84** on tooth **80**. Another hook **88** is secured to the lingual side of metal band on molar **90**. An elastic band **92** similar to band **76** is secured to hooks **82, 88**.

During this treatment the molars **74** and **90** together with teeth **94, 96** respectively are an anchor by which a distal force is placed on teeth **66, 80** to move them into spaces **62, 78**.

Referring specifically to the movement of tooth **66** since a similar movement is made of tooth **80**, there is shown in FIG. **3** a tendency for the crown **98** of tooth **62** to tip in a clockwise direction **100** due to the resistance of the distal movement of the root **102** of tooth **62** by gum and bone at **104**. This tipping causes arch wire **106** to bind within slot **108** of bracket **68**. The binding increases the friction between bracket **68** and arch wire **106** because the edges of slot **108** bite into arch wire **106**. The narrower the slot in bracket **68** the greater the increase in binding and friction.

Referring now to FIGS. **4** and **5** there is shown anti-friction spring **110**. Spring **110** has a hook **112** on one end which engages the upper portion of rotating lever **114** on bracket **68**. Spring **110** then bends around the lower side of bracket **68** and up under rotating lever **116** and arch wire **106**. It then arches over arch wire **106** and is attached to arch wire **106** by means of hook **118** on the other end of spring **110** at a point on arch wire **106** some distance from tooth **68** in the distal direction. Spring **110** is thereby coiled around bracket **68** and attached to arch wire **106** causing a counterclockwise moment on tooth **66** to counteract the clockwise moment caused by bone and gums at **104**. Spring **110** maintains tooth **68** in a substantially vertical plane as tooth **66** moves into space **62** thereby eliminating the binding and friction between bracket **68** and arch wire **106**.

Referring now to FIG. **8**, arch wire **120** is a filamentary member which may be a wire or a band which is formed around the outer periphery of the patient's dental arch **10** extending from the posterior teeth **20, 22**, 24, 26 around anterior teeth **14, 16, 18** and to the other side of arch **10**. Arch wire **120** is a strong resilient noncorrodible wire made of a metal such as stainless steel. Although prior arch wire designs had a variety of cross sectional configurations such as circular, square, and rectangular, arch wire **120** has an elongated cross-section, preferably rectangular but it could be elliptical, polygonal, trapezoidal, rhomboidal or the like, with the longest axis being defined as the longitudinal axis of the cross-section. Further wire **120** is preferred to have the cross-sectional dimensions of **0.016** inches by **0.022** inches as shown in FIG. **9**.

To secure arch wire **120** to arch **10**, brackets **124** shown in FIG. **1** include labial brackets **140** having a vertical slot dimension of **0.016** inches and buccal brackets **142** having a vertical slot dimension of **0.022** inches. Arch wire **120** is anchored by two-way buccal tubes **190**, hereinafter described in detail, having a vertical and a horizontal slot dimension of **0.016** inches (see FIG. **11**).

Arch wire **120** is installed on dental arch **10** with the **0.016** inch dimension in the vertical position (occlusal-gingival) and the **0.022** inch dimension in the horizontal position (labial-lingual) around the anterior teeth and the posterior teeth. Since the **0.016** dimension is vertical, the 0.016 inch slot **122** of labial brackets **140** will be completely filled providing a precision fit between labial brackets **140** and arch wire **120**. There will be a **0.006** inch gap or clearance in the **0.022** inch slot **122** of buccal brackets **142**. Arch wire **120** will also fit snugly within the **0.016** inch slot of two-way tube **190**.

The gap in buccal brackets **142** permits arch wire **120** to slide freely within the bracket as the posterior teeth shift into position during the leveling process. However, no control over the anterior teeth is lost since there is a precision fit between arch wire **120** and labial brackets **140**. Further arch wire **120** is also well anchored to tubes **190** since there are no gaps. The fits between arch wire **120** and labial brackets **140** and tubes **190** prevent a rotation relative thereto.

Traditionally brackets have had either the dimensions **0.018** inches or **0.022** inches. By decreasing the width of the slot of the labial brackets **140** to **0.016** inches, greater torque may be placed on an individual tooth and a lighter force is required providing obvious advantages. Therefor by decreasing the size of slot **122** of labial brackets **140** the orthodontist can obtain a maximum torquing capability not before attained. This means a minimum number of arch wires used with a minimum number of removals.

To obtain parallel roots and to coordinate the lower dental arch with the upper dental arch, arch wire **120** is removed and is either reformed as hereinafter described or replaced by a preformed arch wire as hereinafter described. It is preferred that a preformed arch wire be used because of the convenience and because of the time saved. There is shown in FIG. **7** a new and unique arch caliper **150** permitting the use of preformed arch wires. Caliper **150** includes an arcuate bow **152** and a pin **154**. Bow **152** and pin **154** are made of a slender non-corrodible metal or plastic wire-like member. Bow **152** attaches to pin **154** at **156** near one end of pin **154** leaving a projection **158** at that end. On the other end of pin **154** a handle **160** may be formed, such as a loop or the like, to operate caliper **150**. A series of anatomical markings **162** and a series of size markings **164** are provided on arcuate bow **152**. Identical markings **180, 182** respectively are placed on the preformed arch wire **120** shown in FIG. **8** as hereinafter discussed. Anatomical markings **162** include colored rings on bow **152** to determine the length of the arch from the juncture **166** of central incisors **14** to the juncture **168** of cuspid **18** and first bicuspid **20** shown in FIGS. **7** and **8**. From this measurement the length of the anterior arch of the anterior teeth may be determined. Size markings **164** are provided to measure the length of dental arch **10** by determining the distance from juncture **166** between central incisors **14** to the second molar **26**. Markings **162, 164** are merely calibrations or indicia which may be numerical or not. They may be scored onto caliper **150** and arch wire **120** or may be colored rings as shown in FIGS. **7** and **8**. No actual numerical measurements are required since by knowing the color markings **162, 164**, a proper preformed arch wire having the same markings may be selected.

In operation caliper **150** is inserted into the patient's mouth so as to partially circumscribe the dental arch to be fitted. Projection **158** is positioned at juncture **166** between central incisors **14** while arcuate bow **152** extends around one side of the dental arch **10**. The position of the anatomical markings **162** and size markings **164** with reference to juncture **168** and second molar **26** respectively are thereby indicated. Obviously these measurements are quite easy to make using caliper **150** and such a task can easily be delegated by the orthodontist.

Having the sizes of the dental arch **10**, a proper preformed arch wire may be selected having the same markings thereby having the proper lengths. Arch wire **120** may be either reformed by hand by the orthodontist or the orthodontist can be provided with an array of preformed arch wires from which to choose. In the present invention, the orthodontist may have the convenience of selecting a preformed arch wire.

In the reformed arch wire **120** twists **172** are made in wire **120** at the junctures **168** between the cuspids **18** and first bicuspids **20**. Twist **172** is illustrated in the enlarged view of FIG. **9**. As wire **120** is formed into an arch for positioning around dental arch **10**, an arcuate portion **174** and two linear portions **176, 178** are formed. This formation and twists **172** form arch wire **120** so that the longitudinal axis of the cross-section of wire **120** is substantially perpendicular to the occlusal plane, i.e., the plane of dental arch **10** along the arcuate portion **174** and will be juxtaposed with the anterior teeth when installed. Further the longitudinal axis will be substantially parallel to the occlusal plane along linear portions **176, 178** and will be juxtaposed with the posterior teeth when installed.

In essence this method combines two arch wires into one because the arcuate portion **54** will have the longitudinal axis of wire **120** in the horizontal position thereby being very resilient for the anterior teeth and the linear portions **176, 178** will have the longitudinal axis of wire **120** in the vertical position thereby emphasizing the strength and rigidity of wire **120** for the posterior teeth.

Preferably the twist **172** in wire **120** will be a **90°** rotation of wire **120** at the determined location. However, it must be understood that the twist need not be exactly **90°** but may be for example approximately an **83°** twist or approximately a **97°** twist depending upon the mechanotherapy required. Often the labial and buccal sides of the anterior and posterior teeth are not vertical within the month thereby requiring a twist **172** to be slightly greater or smaller than **90°**.

By utilizing caliper **150** arch wire **120** may be preformed. The anterior arch measurement, by means of anatomical markings **162**, will determine the location of twists **172**, and the dental arch measurement, by means of size markings **164**, will set the length of wire **120**. To further simplify the selection of the proper preformed arch wire, calibrations have been disposed on wire **120** at **180** for the anatomical reading and at **182** for the size reading thereby corresponding to markings **162, 164**.

FIGS. 10 and 11 illustrate the preferred buccal tube 190 for anchoring reformed arch wire 120. Tube 190 is a two-way tube which may be made of stainless steel, plastic, or an alloy of gold, platinum and irridium. Tube 190 has a longitudinal bore 192 extending mesial-distally and also has a generally square cross-section with dimensions of 0.022 inches. However, a stop 194 of a generally isosceles triangular cross-section having a side of 0.006 inches, the difference between the dimensions of arch wire 120, is milled, molded or in like-wise fashion secured in the occlusal-buccal corner 196 of tube 190. Stop 194 permits arch wire 120 to be secured from rotation within tube 190 regardless of whether the 0.016 inch or the 0.022 dimension is edgewise or in the ginguval-occlusal axis and to provide a precision fit of wire 120 within tube 190. The 0.006 inch dimension permits a 0.006 inch clearance on the buccal side of the tube 190 if the 0.022 inch dimension is vertical and also permits a 0.006 inch clearance on the occlusal side of the tube 190 if the 0.016 inch dimension is vertical. However, in both cases, stop 194 arch wire 120 in position and prevents rotation. Buccal tube 190 may either be secured, as by brazing, to a metal band 198 extending around the anchor tooth or be secured by an adhesive.

Referring now to FIG. 12 there is shown five other embodiments of tube 190. Embodiment A comprises four stops 200 which has the advantage of holding arch wire 120 from rotation at four locations. In essence embodiment A includes two rectangular bores through tube 202 each having the same dimensions as wire 120 and are perpendicular to each other with a common mesialdistal axis. Embodiment B also has four stops 204 of the form of stop 194 in FIG. 16 except that a stop has been located in each longitudinal corner of tube 206. Embodiments C and D provide square shouldered stops 208 and 210 respectively. Embodiment E has two projections 212, each providing a positive stop to the rotation of wire 120 depending upon the dimension which is vertical.

As the preformed arch wire 120 is installed on arch 10, the .016 dimension of arch wire 120 will face the anterior teeth and will completely fill the 0.016 slots of labial brackets 140 thus providing a precision fit between wire 120 and brackets 140. The 0.022 dimension of arch wire 120 will face the posterior teeth due to twists 172 and will also completely fill the 0.022 slots of buccal brackets 142 thereby also providing a precision fit between wire 120 and brackets 142. Two-way buccal tubes 190 will also hold wire 120 securely and prevent rotation relative thereto. Thus the orthodontist has resiliency for the anterior teeth and strength and rigidity for the posterior teeth and yet has complete control of all the teeth.

FIGS. 13-17 describe a new headgear hook 220 for use with a headgear (not shown) to apply pressure to arch wire 120. FIGS. 13-14 illustrate the preferred embodiment. Eyes or loops 222 are formed in the front portion of arch wire 120 and comprise circular or omega-shaped loops made in wire 120.

FIG. 15 illustrates headgear hook 220. Hook 220 is generally in the form of a large hook which extends from loops 222 on wire 120 out of the mouth and around the cheek where the end 224 of hook 220 is attached to an elastic band (not shown). End 224 may be in the form of a circular loop for attachment to the elastic band. A notch or groove 226 is ground into the other end of hook 220 for engagement with loop 222 having approximately the same diameter as the diameter of arch wire 120. Groove 226 acts as a lock preventing disengagement once inserted into and engaged with loop 222. The closer that end 224 is brought to the cheek the better the locking engagement.

FIGS. 16 and 17 illustrate a second embodiment of the headgear hook 230. As shown in FIG. 17 eyes 232 are made into a small semi-circle or into a complete loop as illustrated in FIG. 17 and soldered or brazed to arch wire 120. Headgear hook 230 has a small hook 234 secured to one end 236 which engages eye 232 as illustrated in FIG. 16. Hook 234 has an arcuate diameter the same size as the diameter of arch wire 120. Again as end 238 moves towards the patient's cheek, the headgear hook 230 becomes locked into engagement with eye 232. It must be understood that headgear hooks 220 and 230 may be made of either metal or plastic.

In the method of orthodontic treatment labial brackets 140 having a 0.016 slot are secured to the anterior teeth and buccal brackets 142 having a 0.022 slot are secured to the posterior teeth. Two-way buccal tubes 190 are anchored to the second molars 26. The preliminary round arch wire is installed on dental arch 10 by means of brackets 140, 142 and tubes 190 to rotate the irregular teeth into position and to place the teeth in general alignment for the application of rectangular arch wire 120. The round arch wire must be removed prior to installation of the rectangular arch wire 120.

A 0.016 by 0.022 rectangular arch wire 120 is then installed to close any voids, to level the teeth, and to produce good arch form. The rectangular arch 120 has its 0.016 side vertical thereby filling the slots of the labial brackets 140 and leaving a gap in the slots of the buccal brackets 142. Wire 120 is anchored to two-way buccal tubes 190 and prevented from rotation relative thereto. In closing the voids the antifriction spring 110 is used to maintain the tooth to be shifted substantially vertically during its movement. The rectangular wire 120 is then removed.

Caliper 150 is used to measure the dental arch for a preformed arch wire 120. By virtue of these measurements, two 90° twists 172 have been placed in wire 120 at the juncture 168 of the anterior and posterior teeth. The preformed arch wire 120 is then installed with its 0.016 side facing the anterior teeth filling the 0.016 slots of labial brackets 140 and with its 0.022 side facing the posterior teeth filling the slots of buccal brackets 142 due to 90° twists 172. Two-way buccal tube 190 again secures preformed arch wire 120 and prevents relative rotation therewith.

Each time after the rectangular arch wire 120 and the preformed rectangular arch wire 120 is installed, headgear hook 220 is lockingly engaged to the wires to apply pressure to move teeth posteriorly and/or prevent their movement anteriorly.

While a preferred embodiment of the invention has been shown and described, modifications thereof can be made by one skilled in the art without departing from the spirit of the invention.

I claim:

1. An orthodontic apparatus for the treatment of the anterior and posterior teeth of a dental arch comprising:

an arch wire having a rectangular cross section with a large dimensioned side and a small dimensioned

side; said arch wire having two approximately 90° twists located at the juxtapositions of the anterior and posterior teeth on each side of the dental arch;

labial brackets secured to the anterior teeth and each having a slot slightly larger than the dimension of the small dimensioned side of the arch wire;

buccal brackets secured to the posterior teeth and each having a slot slightly larger than the dimension of the large dimensioned side of the arch wire; and

said small dimensioned side of said arch wire being slidingly received within the slot of said labial brackets and said larger dimensioned side of said arch wire being slidingly received within the slot of said buccal brackets.

2. An orthodontic apparatus as defined in claim **1** further including buccal tubes attached to two posterior teeth for anchoring said arch wire, said buccal tubes having a bore with a square cross-section of a dimension slightly larger than the large dimensioned side of the arch wire and means disposed within said bore to limit the rotation of said arch wire when said arch wire is inserted within said bore with the large dimensioned side vertical or horizontal.

3. An orthodontic appliance as defined in claim **1** wherein one of the dimensions of said rectangular cross-section is **.016** inches.

4. An orthodontic appliance as defined in claim **1** further including calibrations on said arch wire for sizing said arch wire element with the dental arch.

5. An orthodontic appliance as defined in claim **1** further including locking means disposed on said arch wire adapted for locking engagement with a headgear to hold said arch wire element in position.

6. A buccal tube for securing an arch wire having a rectangular cross-section with a large dimensioned side and a small dimensional side to a tooth comprising:

a tube affixed to a tooth and having a longitudinal bore therethrough, said bore having a square cross-section with a dimension slightly greater than the length of the large dimensioned side of the arch wire; and

means disposed longitudinally within said bore causing a vertical portion and a horizontal portion of said bore to have a dimension smaller than the large dimensioned side of the arch wire whereby the arch wire may pass through said bore with its larger dimensioned side vertical or horizontal within said bore and said means preventing rotation of the arch wire within said bore.

7. A buccal tube as defined in claim **6** wherein said means includes at least one square cross-sectioned stop member disposed in one or more longitudinal corner of said bore; said stop member having a dimension slightly smaller than the difference between the dimension of the large dimensioned side and the small dimensioned side of the arch wire.

8. An orthodontic apparatus as defined in claim **1** further including means for shifting a tooth along said arch wire substantially without friction between one of said brackets and said arch wire comprising:

elastic means for applying a horizontal force on the tooth causing a first moment due to the resistance of the mouth to the movement of the tooth; and

spring means for placing a second moment on the tooth which negatives said first moment.

9. An orthodontic apparatus as defined in claim **8** wherein

said one of said brackets has a first rotating lever and a second rotating lever; and

said spring means includes a spring engaging said first rotating lever, extending under said second rotating lever and engaging said arch wire.

10. An orthodontic apparatus for the treatment of a dental arch composed of anterior teeth and posterior teeth comprising:

an arch wire having an elongate cross-section, the longitudinal axis of said cross-section being substantially perpendicular to the plane of the dental arch at the juxtaposition of said arch wire and the posterior teeth and being substantially parallel to the plane of the dental arch at the juxtaposition of said arch wire and the anterior teeth;

anterior and posterior brackets for securing said arch wire to the teeth regardless of whether said longitudinal axis is perpendicular or parallel to the plane of the dental arch;

spring means for preventing friction between said arch wire and said brackets;

calibrated means for positioning said longitudinal axis with respect to the anterior and posterior teeth; and

lock means for applying pressure to said arch wire whereby said apparatus allows said anterior brackets to be filled by the smaller dimension of said arch wire and said posterior brackets to be filled by the larger dimension of said arch wire thus permitting complete control over the movement of the teeth.

11. An orthodontic appliance for receiving and securing the terminal ends of a rectangular cross-sectioned arch wire to a tooth, comprising:

a tube banded to the tooth and having a longitudinal bore having a horizontal and vertical dimension slightly larger than the larger dimension of the arch wire whereby said tube will receive the arch wire with either dimension in the vertical or horizontal position, said bore having at least one corner invaginated therein whereby after the arch wire is inserted into said tube, the smaller dimension of the arch wire is confined by said corner thereby preventing the arch wire from rotating regardless of which dimension of the arch wire is horizontal or vertical.

12. An orthodontic appliance comprising:

a rectangular arch wire having two anterior loops disposed on an anterior portion of said arch wire, and two posterior loops disposed near the terminal ends of said arch wire;

buccal tubes on two posterior teeth for anchoring said arch wire regardless of whether the larger dimensioned side of said arch wire is vertical or horizontal, said posterior loops securing said arch wire to said buccal tubes;

anterior brackets secured to the anterior teeth and having a slot slightly larger than the smaller dimension of said arch wire;

posterior brackets secured to the posterior teeth and having a slot slightly larger than the larger dimension of said arch wire;

whereby said arch wire will fill the slots of said anterior and posterior brackets upon twisting said arch wire approximately 90° at the juxtapositions of the

anterior and posterior teeth when precise control of all the teeth is desired and said arch wire will fill only the slots of said anterior brackets when said arch wire is not so twisted when such precise control is not desired; and

a headgear wire having a hook on one end for insertion into one of said anterior loops of said arch wire whereby as the other end of said headgear wire is moved toward said arch wire, said headgear wire becomes locked with said arch wire.

13. An orthodontic appliance as defined in claim **12** wherein said anterior loops have an opening slightly larger than the diameter of said hook and said hook includes a groove.

14. An orthodontic appliance as defined in claim **13** wherein said anterior loops have an opening slightly larger than the diameter of the said hook and said hook has an arcuate diameter slightly smaller than the diameter of said anterior loops in said arch wire.

15. An appliance for straightening teeth comprising:

labial brackets affixed to the central incisors, lateral incisors and cuspids, said labial brackets having a slot with a vertical dimension slightly larger than **0.016** inches;

buccal brackets affixed to the first bicuspids, second bicuspids and first molars, said buccal brackets having a slot with a vertical dimension slightly larger than **0.022** inches;

buccal tubes affixed to the second molars, said buccal tubes having a generally square bore with a dimension slightly larger than **0.022** inches and at least one stop in one corner of said bore having the dimensions **0.006** by **0.006** inches;

a rectangular archwire having a **0.016** inch dimensioned side and a **0.022** inch dimensioned side, and two approximate **90°** twists located at the juxtaposition of the cuspids and first bicuspids whereby the **0.016** inch side of the archwire is vertical and inserted into the **0.016** inch slot of the labial brackets, and the **0.022** inch side of the archwire is vertical and inserted into the **0.022** inch slot of the buccal brackets and into the **0.022** inch bore of the buccal tube.

16. A buccal tube for anchoring a rectangular archwire having the dimensions **0.016** inches by **0.022** inches comprising:

a tube mounted on a band adapted for attachment to a molar;

said tube having a longitudinal bore with a generally square cross-section with dimensions slightly larger than **0.022** inches by **0.022** inches;

said tube further having at least one longitudinal stop running the length of the bore dimensioned **0.006** inches by **0.006** inches whereby said archwire may be inserted two ways, one where the **0.016** inch side of the archwire is vertical and a second where the **0.022** inch side of the archwire is vertical, the stop preventing the archwire from rotating within the bore of the buccal tube regardless of which side of the archwire is vertical.

17. An orthodontic apparatus for the treatment of a dental arch composed of anterior teeth and posterior teeth comprising:

a filamentary member having an elongate cross-section, the longitudinal axis of said cross-section being substantially perpendicular to the plane of the dental arch at the juxtaposition of said member and the posterior teeth and being substantially parallel to the plane of the dental arch at the juxtaposition of said member and the anterior teeth;

securement means for securing said member to the teeth regardless of whether said longitudinal axis is perpendicular or parallel to the dental arch;

spring means for preventing friction between said filamentary member and said securement means;

calibrated means for positioning said longitudinal axis with respect to the anterior and posterior teeth; and

lock means for applying pressure to said member.

18. An orthodontic appliance comprising:

an arch wire having a loop disposed on said arch wire; and

a headgear wire having a hook on one end for insertion into said loop whereby as the other end of said headgear wire is moved toward said arch wire, said headgear wire becomes locked with said arch wire.

19. An orthodontic appliance as defined in claim **18** wherein said loop has a opening slightly larger than the diameter of the arch wire and said hook includes an arcuate groove.

20. An orthodonic appliance as defined in claim **18** wherein said loop has an opening slightly larger than the diameter of the arch wire and said hook has an arcuate diameter equal to the diameter of said arch wire.

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